FASTR Documentation

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Fastr contributors

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CONTENTS

1 FASTR Documentation **3**

1.1 Introduction . . . 3
1.1.1 Philosophy . . . 3
1.1.2 System overview . . . 3
1.2 Quick start guide . . . 5
1.2.1 Installation . . . 5
1.2.2 Configuration . . . 6
1.2.3 Creating a simple network . . . 6
1.2.4 Running a Network . . . 9
1.3 User Manual . . . 10
1.3.1 Tools . . . 10
1.3.2 Network . . . 13
1.3.3 Data Flow . . . 15
1.3.4 DataTypes . . . 20
1.3.5 Execution . . . 21
1.3.6 IOPlugins . . . 22
1.3.7 Secrets . . . 22
1.3.8 Debugging . . . 22
1.3.9 Naming Convention . . . 28
1.3.10 Provenance . . . 28
1.4 Command Line Tools . . . 29
1.4.1 fastr cat . . . 29
1.4.2 fastr dump . . . 30
1.4.3 fastr execute . . . 30
1.4.4 fastr extract_argparse . . . 30
1.4.5 fastr provenance . . . 31
1.4.6 fastr pylint . . . 31
1.4.7 fastr report . . . 31
1.4.8 fastr run . . . 32
1.4.9 fastr sink . . . 32
1.4.10 fastr source . . . 32
1.4.11 fastr test . . . 33
1.4.12 fastr trace . . . 34
1.4.13 fastr upgrade . . . 35
1.4.14 fastr verify . . . 35
1.5 Resource File Formats . . . 35
1.5.1 Config file . . . 35
1.5.2 `Tool` description . . . 39
1.6 Plugin Reference . . . 40
1.6.1 CollectorPlugin Reference . . . 40

1.6.2 ExecutionPlugin Reference . . . 42
1.6.3 FlowPlugin Reference . . . 44
1.6.4 IOPlugin Reference . . . 44
1.6.5 Interface Reference . . . 50
1.6.6 ReportingPlugin Reference . . . 52
1.6.7 Target Reference . . . 53
1.7 Development and Design Documentation . . . 55
1.7.1 Sample flow in Fastr . . . 56
1.7.2 Network Execution . . . 58
1.7.3 Secrets . . . 61
1.8 Changelog . . . 62
1.8.1 3.2.0 - 2020-06-19 . . . 62
1.8.2 3.1.4 - 2020-06-10 . . . 62
1.8.3 3.1.3 - 2019-11-28 . . . 63
1.8.4 3.1.2 - 2019-06-18 . . . 63
1.8.5 3.1.1 - 2019-05-02 . . . 63
1.8.6 3.1.0 - 2019-05-02 . . . 63
1.8.7 3.0.1 - 2019-03-28 . . . 64
1.8.8 3.0.0 - 2019-03-05 . . . 64
1.8.9 2.1.2 - 2018-10-24 . . . 65
1.8.10 2.1.1 - 2018-06-29 . . . 65
1.8.11 2.1.0 - 2018-04-13 . . . 66
1.8.12 2.0.1 - 2017-10-19 . . . 66
1.8.13 2.0.0 - 2017-09-28 . . . 66
1.8.14 1.2.2 - 2017-08-24 . . . 67
1.8.15 1.2.1 - 2017-04-04 . . . 68
1.8.16 1.2.0 - 2017-03-15 . . . 68
1.8.17 1.1.2 - 2016-12-22 . . . 69
1.8.18 1.1.1 - 2016-12-22 . . . 69
1.8.19 1.1.0 - 2016-12-08 . . . 69

2 FASTR User reference **71**
2.1 Fastr User Reference . . . 71

3 FASTR Developer Module reference **79**
3.1 fastr Package . . . 79
3.1.1 `fastr` Package . . . 79
3.1.2 `exceptions` Module . . . 80
3.1.3 `version` Module . . . 88
3.1.4 Subpackages . . . 88

4 Indices and tables **251**

Python Module Index **253**

Index **255**

FASTR is a framework that helps creating workflows of different tools. The workflows created in FASTR are automatically enhanced with flexible data input/output, execution options (local, cluster, etc) and solid provenance.

We chose to create tools by creating wrappers around executables and connecting everything with Python.

Fastr is open-source (licensed under the Apache 2.0 license) and hosted on gitlab at https://gitlab.com/radiology/infrastructure/fastr

For support, go to https://groups.google.com/d/forum/fastr-users

To get yourself a copy, see the *Installation*

The official documentation can be found at fastr.readthedocs.io

The Fastr workflow system is presented in the following article:

> Hakim Achterberg, Marcel Koek, and Wiro Niessen. "Fastr: a workflow engine for advanced data flows in medical image analysis." Frontiers in ICT 3 (2016): 15.

Fastr is made possible by contributions from the following people: Hakim Achterberg, Marcel Koek, Adriaan Versteeg, Thomas Phil, Mattias Hansson, Baldur van Lew, Marcel Zwiers, and Coert Metz

CHAPTER

ONE

FASTR DOCUMENTATION

1.1 Introduction

Fastr is a system for creating workflows for automated processing of large scale data. A processing workflow might also be called a processing pipeline, however we feel that a pipeline suggests a linear flow of data. Fastr is designed to handle complex flows of data, so we prefer to use the term network. We see the workflow as a network of processing tools, through which the data will flow.

The original authors work in a medical image analysis group at Erasmus MC. They often had to run analysis that used multiple programs written in different languages. Every time a experiment was set up, the programs had to be glued together by scripts (often in bash or python).

At some point the authors got fed up by doing these things again and again, and so decided to create a flexible, powerful scripting base to easily create these scripts. The idea evolved to a framework in which the building blocks could be defined in XML and the networks could be constructed in very simple scripts (similar to creating a GUI).

1.1.1 Philosophy

Researchers spend a lot of time processing data. In image analysis, this often includes using multiple tools in succession and feeding the output of one tool to the next. A significant amount of time is spent either executing these tools by hand or writing scripts to automate this process. This process is time consuming and error-prone. Considering all these tasks are very similar, we wanted to write one elaborate framework that makes it easy to create pipelines, reduces the risk of errors, generates extensive logs, and guarantees reproducibility.

The Fastr framework is applicable to multiple levels of usage: from a single researcher who wants to design a processing pipeline and needs to get reproducible results for publishing; to applying a consolidated image processing pipeline to a large population imaging study. On all levels of application the pipeline provenance and managed execution of the pipeline enables you to get reliable results.

1.1.2 System overview

There are a few key requirements for the design of the system:

- Any tool that your computer can run using the command line (without user interaction) should be usable by the system without modifying the tool.
- The creation of a workflow should be simple, conceptual and require no real programming.
- Networks, once created, should be usable by anyone like a simple program. All processing should be done automatically.
- All processing of the network should be logged extensively, allowing for complete reproducibility of the system (guaranteeing data provenance).

Using these requirements we define a few key elements in our system:

- A `fastr.Tool` is a definition of any program that can be used as part of a pipeline (e.g. a segmentation tool)
- A `fastr.Node` is a single operational step in the workflow. This represents the execution of a `fastr.Tool`.
- A `fastr.Link` indicates how the data flows between nodes.
- A `fastr.Network` is an object containing a collection of `fastr.Node` and `fastr.Link` that form a workflow.

With these building blocks, the creation of a pipeline will boil down to just specifying the steps in the pipeline and the flow of the data between them. For example a simple neuro-imaging pipeline could look like:

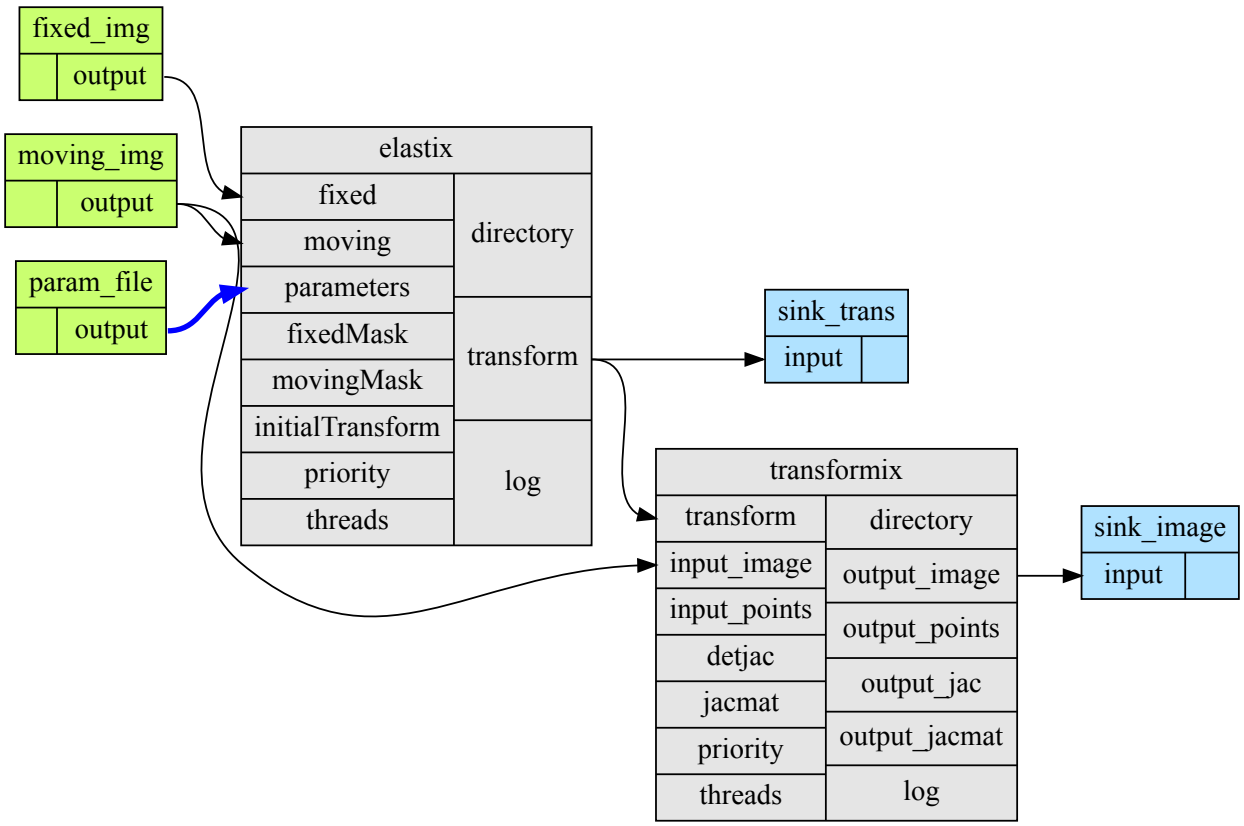


Fig. 1.1: A simple workflow that registers two images and uses the resulting transform to resample the moving image.

In Fastr this translates to:

- Create a `fastr.Network` for your pipeline
- Create a `fastr.SourceNode` for the fixed image
- Create a `fastr.SourceNode` for the moving image
- Create a `fastr.SourceNode` for the registration parameters
- Create a `fastr.Node` for the registration (in this case elastix)
- Create a `fastr.Node` for the resampling of the image (in this case transformix)
- Create a `fastr.SinkNode` to save the transformations
- Create a `fastr.SinkNode` to save the transformed images

- `fastr.Link` the output of the fixed image source node to the fixed image input of the registration node
- `fastr.Link` the output of the moving image source node to the moving image input of the registration node
- `fastr.Link` the output of the registration parameters source node to the registration parameters input of the registration node
- `fastr.Link` the output transform of the registration node to the transform input of the resampling node
- `fastr.Link` the output transform of the registration node to the input of transformation SinkNode
- `fastr.Link` the output image of the resampling node to the input of image SinkNode
- Run the `fastr.Network` for subjects X

This might seem like a lot of work for a registration, but the Fastr framework manages all other things, executes the pipeline and builds a complete paper trail of all executed operations. The execution can be on any of the supported execution environments (local, cluster, etc). The data can be imported from and exported to any of the supported data connections (file, XNAT, etc). It is also important to keep in mind that this is a simple example, but for more complex pipelines, managing the workflow with Fastr will be easier and less error-prone than writing your own scripts.

1.2 Quick start guide

This manual will show users how to install Fastr, configure Fastr, construct and run simple networks, and add tool definitions.

1.2.1 Installation

You can install Fastr either using pip, or from the source code.

Installing via pip

You can simply install fastr using `pip`:

```
pip install fastr
```

Note: You might want to consider installing `fastr` in a virtualenv

Installing from source code

To install from source code, use Mercurial via the command-line:

```
git clone https://gitlab.com/radiology/infrastructure/fastr.git  # for http
git clone git@gitlab.com:radiology/infrastructure/fastr.git # for ssh
```

If you prefer a GUI you can try TortoiseGIT (Windows, Linux and Mac OS X) or SourceTree (Windows and Mac OS X). The address of the repository is (given for both http and ssh):

```
https://gitlab.com/radiology/infrastructure/fastr.git
git@gitlab.com:radiology/infrastructure/fastr.git
```

To install to your current Python environment, run:

```
cd fastr/
pip install .
```

This installs the scripts and packages in the default system folders. For windows this is the python `site-packages` directory for the fastr python library and `Scripts` directory for the executable scripts. For Ubuntu this is in the `/usr/local/lib/python3.x/dist-packages/` and `/usr/local/bin/` respectively.

Note: If you want to develop fastr, you might want to use `pip install -e .` to get an editable install

Note: You might want to consider installing `fastr` in a virtualenv

Note:

- On windows `python` and the `Scripts` directory are not on the system PATH by default. You can add these by going to `System -> Advanced Options -> Environment variables`.
- On mac you need the Xcode Command Line Tools. These can be installed using the command `xcode-select --install`.

1.2.2 Configuration

Fastr has defaults for all settings so it can be run out of the box to test the examples. However, when you want to create your own Networks, use your own data, or use your own Tools, it is required to edit your config file.

Fastr will search for a config file named `config.py` in the `$FASTRHOME` directory (which defaults to `~/.fastr/` if it is not set). So if `$FASTRHOME` is set the `~/.fastr/` will be ignored.

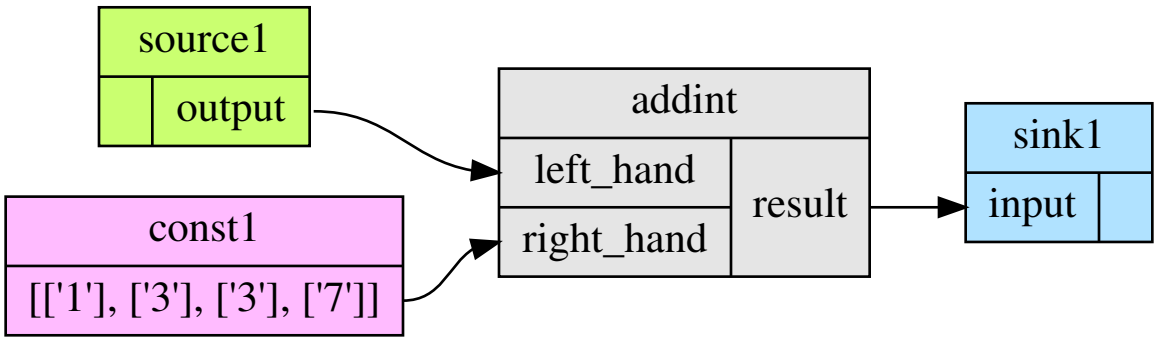
For a sample configuration file and a complete overview of the options in `config.py` see the *Config file* section.

1.2.3 Creating a simple network

If Fastr is properly installed and configured, we can start creating networks. Creating a network is very simple:

```
>>> import fastr
>>> network = fastr.create_network(id='example', version='1.0')
```

Now we have an empty network, the next step is to create some nodes and links. Imagine we want to create the following network:



Creating nodes

We will create the nodes and add them to the network. This is done via the network `create_` methods. Let's create two source nodes, one normal node, and one sink:

```
>>> source1 = network.create_source('Int', id='source1')
>>> sink1 = network.create_sink('Int', id='sink1')
>>> addint = network.create_node('fastr/math/AddInt:1.0', tool_version='1.0', id=
↪'addint')
```

The functions `Network.create_source`, `Network.create_sink` and `Network.create_node` create the desired node and add it into the Network.

A SourceNode and SinkNode only require the datatype to be specified. A Node requires a Tool to be instantiated from. The `id` option is optional for all four, but makes it easier to identify the nodes and read the logs. The tool is defined by a namespace, the id and the version of the command. Many packages have multiple version which are available. The `tool_version` argument reflects the version of the Fastr wrapper which describes how the command can be called. For reproducibility also these are checked as they might be updated as well.

There is an easy way to add a constant to an input, by using a shortcut method. If you assign a `list` or `tuple` to an item in the input list, it will automatically create a ConstantNode and a *`Link`* between the ContantNode and the given Input:

```
>>> [1, 3, 3, 7] >> addint.inputs['right_hand']
Link link_0 (network: example):
   fastr:///networks/example/1.0/nodelist/const__addint__right_hand/outputs/output ==>
↪ fastr:///networks/example/1.0/nodelist/addint/inputs/right_hand/0
```

The created constant would have the id `const_addint__right_hand_0` as it automatically names the new constant `const_$nodeid__$inputid_$number`.

Note: The use of the >>, <<, and = operators for linking is discussed bellow in section *Creating links*.

In an interactive python session we can simply look at the basic layout of the node using the `repr` function. Just type the name of the variable holding the node and it will print a human readable representation:

```
>>> source1
SourceNode source1 (tool: Source:1.0 v1.0)
      Inputs          |        Outputs
------------------------------------------
                      |  output    (Int)
>>> addint
Node addint (tool: AddInt:1.0 v1.0)
       Inputs           |        Outputs
-------------------------------------------
left_hand  (Int)        |  result    (Int)
right_hand (Int)        |
```

This tool has inputs of type Int, so the sources and sinks need to have a matching datatype.

The tools and datatypes available are stored in *`fastr.tools`* and *`fastr.types`*. These variables are created when `fastr` is imported for the first time. They contain all the datatype and tools specified by the yaml, json or xml files in the search paths. To get an overview of the tools and datatypes loaded by fastr:

```
>>> fastr.tools
ToolManager
```

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```
...
fastr/math/Add:1.0       1.0 :  .../fastr/resources/tools/fastr/math/1.0/add.yaml
fastr/math/AddInt:1.0    1.0 :  .../fastr/resources/tools/fastr/math/1.0/addint.yaml
...

>>> fastr.types
DataTypeManager
...
Directory                    :  <URLType: Directory>
...
Float                        :  <ValueType: Float>
...
Int                          :  <ValueType: Int>
...
String                       :  <ValueType: String>
...
```

The `fastr.tools` variable contains all tools that Fastr could find during initalization. Tools can be chosen in two tways:

- `tools[id]` which returns the newest version of the tool
- `tools[id, version]` which returns the specified version of the tool

Creating links

So now we have a network with 4 nodes defined, however there is no relation between the nodes yet. For this we have to create some links.

```
>>> link1 = source1.output >> addint.inputs['left_hand']
>>> link2 = sink1.inputs['input'] <<  addint.outputs['result']
```

This asks the network to create links and immediately store them inside the network. A link always points from an Output to an Input (note that SubOutput or SubInputs are also valid). A SourceNode has only 1 output which is fixed, so it is easy to find. However, addImage has two inputs and one output, this requires us to specify which output we need. A normal node has a mapping with Inputs and one with Outputs. They can be indexed with the appropriate id's. The function returns the links, but you only need that if you are planning to change the properties of a link.

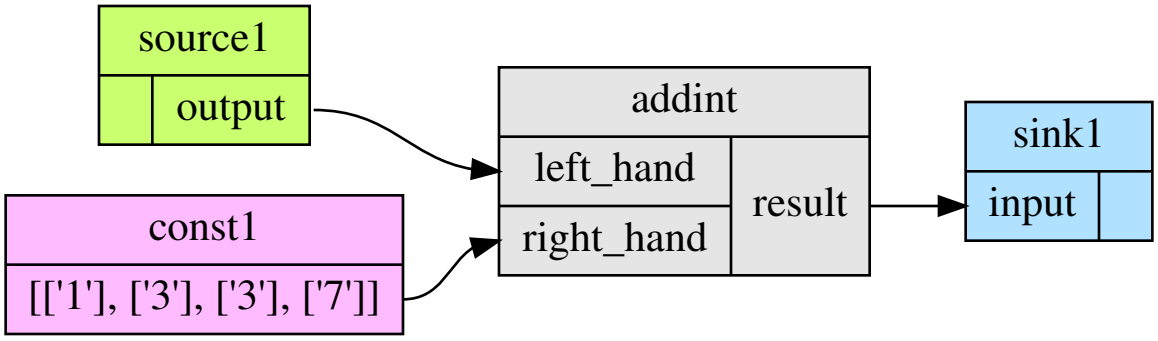
The operators with >> and << clearly indicate the direction of the desired data flow. Also they return the created link, which is easy if you want to change the flow in a link later on. The last short hand uses the assignment, but it cannot return the created link and changing the link later on is more difficult.

Create an image of the Network

For checking your Network it is very useful to have a graphical representation of the network. This can be achieved using the *`Network.draw`* method.

```
>>> network.draw()
'example.svg'
```

This will create a figure in the path returned by the function that looks like:



Note: for this to work you need to have graphviz installed

1.2.4 Running a Network

Running a network locally is almost as simple as calling the *Network.execute* method:

```
>>> source_data = {'source1': {'s1': 4, 's2': 5, 's3': 6, 's4': 7}}
>>> sink_data = {'sink1': 'vfs://tmp/fastr_result_{sample_id}.txt'}
>>> run = network.execute(source_data, sink_data)
>>> # Lots output will appear on the stdout while running
>>> run.result  # Show if the run was successful or if errors were encountered
True
```

As you can see the execute method needs data for the sources and sinks. This has to be supplied in two `dict` that have keys matching every source/sink `id` in the network. Not supplying data for every source and sink will result in an error, although it is possible to pass an empty `list` to a source.

Note: The values of the source data have to be simple values or urls and values of the sink data have to be url templates. To see what url schemes are available and how they work see *IOPlugin Reference*. For the sink url templates see `SinkeNode.set_data`

For source nodes you can supply a `list` or a `dict` with values. If you supply a `dict` the keys will be interpreted as sample ids and the values as the corresponding values. If you supply a `list`, keys will be generated in the form of `id_{N}` where N will be index of the value in the list.

Warning: As a `dict` does not have a fixed order, when a `dict` is supplied the samples are ordered by key to get a fixed order! For a `list` the original order is retained.

For the sink data, an url template has to be supplied that governs how the data is stored. The mini-lanuage (the replacement fields) are described in the `SinkNode.set_data` method.

To rerun a stopped/crashed pipeline check the user manual on *Continuing a Network*

1.3 User Manual

In this chapter we will discuss the parts of Fastr in more detail. We will give a more complete overview of the system and describe the more advanced features.

1.3.1 Tools

The Tool in Fastr are the building blocks of each workflow. A tool represents a program/script/binary that can be called by Fastr and can be seens as a template. A *Node* can be created based on a Tool. A Node will be one processing step in a workflow, and the tool defines what the step does.

On the import of Fastr, all available Tools will be loaded in a default ToolManager that can be accessed via `fastr.tools`. To get an overview of the tools in the system, just print the `repr()` of the ToolManager:

```
>>> import fastr
>>> fastr.tools
ToolManager
...
fastr.math.Add          v0.1 :  .../fastr/resources/tools/fastr/math/0.1/add.xml
fastr.math.AddInt       v0.1 :  .../fastr/resources/tools/fastr/math/0.1/addint.xml
...
```

As you can see it gives the tool id, version and the file from which it was loaded for each tool in the system. To view the layout of a tool, just print the `repr()` of the Tool itself.

```
>>> fastr.tools['AddInt']
Tool AddInt v0.1 (Add two integers)
       Inputs           |        Outputs
------------------------------------------------
left_hand  (Int)        |  result    (Int)
right_hand (Int)        |
```

To add a Tool to the system a file should be added to one of the path in `fastr.config.tools_path`. The structure of a tool file is described in *Tool description*

Create your own tool

There are 4 steps in creating a tool:

1. **Create folders.** We will call the tool ThrowDie. Create the folder throw_die in the folder fastr-tools. In this folder create another folder called bin.
2. **Place executable in correct place.** In this example we will use a snippet of executable python code:

```
#!/usr/bin/env python
import sys
import random
import json

if (len(sys.argv) > 1):
    sides = int(sys.argv[1])
else:
    sides = 6
result = [int(random.randint(1, sides ))]

print('RESULT={}'.format(json.dumps(result)))
```

Save this text in a file called `throw_die.py`

Place the executable python script in the folder `throw_die/bin`

3. **Create and edit xml file for tool.** See *tool definition reference* for all the fields that can be defined in a tool.

   Put the following text in file called `throw_die.xml`.

```
<tool id="ThrowDie" description="Simulates a throw of a die. Number of sides of␣
↪the die is provided by user"
      name="throw_die" version="1.0">
  <authors>
    <author name="John Doe" />
  </authors>
  <command version="1.0" >
    <authors>
      <author name="John Doe" url="http://a.b/c" />
    </authors>
    <targets>
      <target arch="*" bin="throw_die.py" interpreter="python" os="*" paths='bin/
↪'/>
    </targets>
    <description>
       throw_die.py number_of_sides
       output = simulated die throw
    </description>
  </command>
  <interface>
    <inputs>
      <input cardinality="1" datatype="Int" description="Number of die sides" id=
↪"die_sides" name="die sides" nospace="False" order="0" required="True"/>
     </inputs>
    <outputs>
      <output id="output" name="output value" datatype="Int" automatic="True"␣
↪cardinality="1" method="json" location="^RESULT=(.*)$" />
    </outputs>
  </interface>
</tool>
```

   Put throw_die.xml in the folder example_tool. All Attributes in the example above are required. For a complete overview of the xml Attributes that can be used to define a tool, check the *Tool description*. The most important Attributes in this xml are:

```
id      : The id is used in in FASTR to create an instance of your tool, this␣
↪name will appear in the tools when you type fastr.tools.
targets : This defines where the executables are located and on which platform␣
↪they are available.
inputs  : This defines the inputs that you want to be used in FASTR, how FASTR␣
↪should use them and what data is allowed to be put in there.
```

   More xml examples can be found in the fastr-tools folder.

4) **Edit configuration file.** Append the line `[PATH TO LOCATION OF FASTR-TOOLS]/fastr-tools/throw_die/` to the the `config.py` (located in ~/.fastr/ directory) to the `tools_path`. See *Config file* for more information on configuration.

   You should now have a working tool. To test that everything is ok do the following in python:

```
>>> import fastr
>>> fastr.tools
...
```

Now a list of available tools should be produced, including the tool ThrowDie

To test the tool create the script test_throwdie.py:

```
import fastr

# Create network
network = fastr.create_network('ThrowDie')

# Create nodes
source1 = network.create_source('Int', id='source1')
sink1 = network.create_sink('Int', id='sink1')
throwdie = network.create_node('ThrowDie', id='throwdie')

# Create links
link1 = source1.output >> throwdie.inputs['die_sides']
link2 = throwdie.outputs['output'] >> sink1.inputs['input']

# Draw and execute
source_data = {'source1': {'s1': 4, 's2': 5, 's3': 6, 's4': 7}}
sink_data = {'sink1': 'vfs://tmp/fastr_result_{sample_id}.txt'}
network.draw()
network.execute(source_data, sink_data)
```

Call the script from commandline by

```
$ python test_throwdie.py
```

An image of the network will be created in the current directory and result files will be put in the tmp directory. The result files are called `fastr_result_s1.txt`, `fastr_result_s2.txt`, `fastr_result_s3.txt`, and `fastr_result_s4.txt`

Note: If you have code which is operating system depend you will have to edit the xml file. The following gives and example of how the elastix tool does this:

```
<targets>
      <target os="windows" arch="*" bin="elastix.exe">
        <paths>
          <path type="bin" value="vfs://apps/elastix/4.7/install/" />
          <path type="lib" value="vfs://apps/elastix/4.7/install/lib" />
        </paths>
      </target>
      <target os="linux" arch="*" modules="elastix/4.7" bin="elastix">
        <paths>
          <path type="bin" value="vfs://apps/elastix/4.7/install/" />
          <path type="lib" value="vfs://apps/elastix/4.7/install/lib" />
        </paths>
      </target>
      <target os="darwin" arch="*" modules="elastix/4.7" bin="elastix">
        <paths>
          <path type="bin" value="vfs://apps/elastix/4.7/install/" />
          <path type="lib" value="vfs://apps/elastix/4.7/install/lib" />
        </paths>
```

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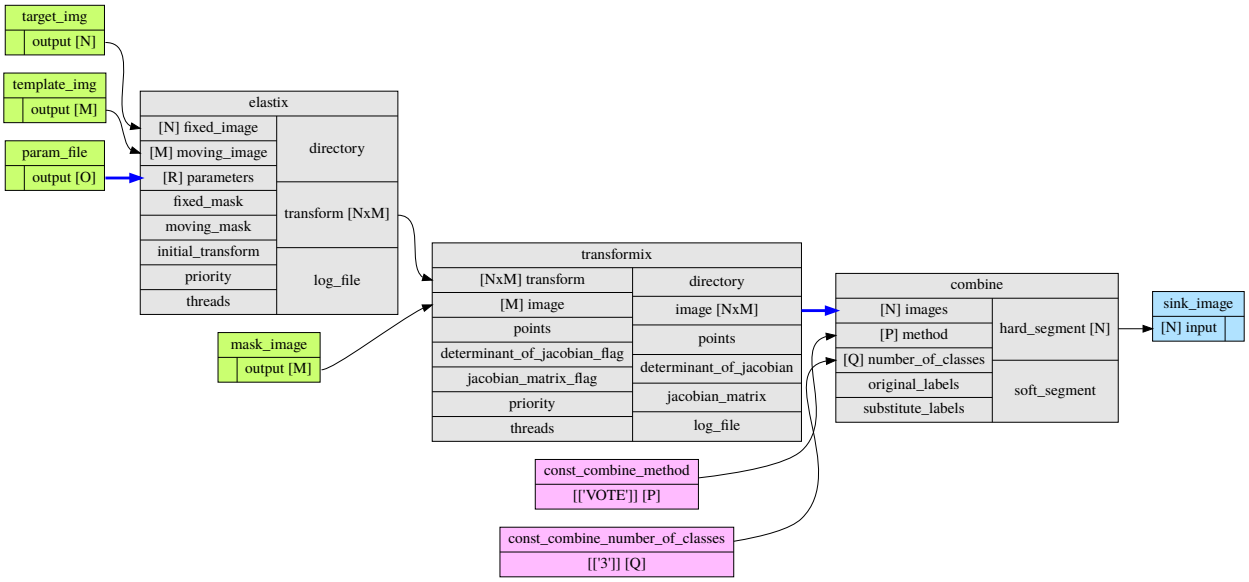
```
    </target>
  </targets>
```

vfs is the virtual file system path, more information can be found at *VirtualFileSystem*.

1.3.2 Network

A *Network* represented an entire workflow. It hold all *Nodes*, *Links* and other information required to execute the workflow. Networks can be visualized as a number of building blocks (the Nodes) and links between them:



An empty network is easy to create, all you need is to name it:

```
>>> network = fastr.create_network(id="network_name")
```

the *network* is the main interface to fastr, from it you can create all elements to create a workflow. in the following sections the different elements of a *network* will be described in more detail.

Node

Nodes are the point in the *Network* where the processing happens. A *Node* takes the input data and executes jobs as specified by the underlying Tool. A *Nodes* can be created easily:

```
>>> node2 = network.create_node(tool, id='node1', step_id='step1')
```

We tell the Network to create a Node using the *create_node* method. Optionally you can add define a step_id for the node which is a logical grouping of Nodes that is mostly used for visualization.

Note: For a Node, the tool can be given both as the Tool class or the id of the tool. This id can be just the id or a tuple with the id and version.

A *Node* contains *Inputs* and *Outputs*. To see the layout of the *Node* one can simply look at the repr().

```
>>> addint = network.create_node('AddInt', id='addint')
>>> addint
Node addint (tool: AddInt v1.0)
       Inputs           |       Outputs
-----------------------------------------
left_hand  (Int)        |  result   (Int)
right_hand (Int)        |
```

The inputs and outputs are located in mappings with the same name:

```
>>> addint.inputs
<Input map, items: ['left_hand', 'right_hand']>

>>> addint.outputs
<Output map, items: ['result']>
```

The InputMap and OutputMap are classes that behave like mappings. The InputMap also facilitates the linking shorthand. By assigning an *Output* to an existing key, the InputMap will create a *Link* between the Input and Output.

SourceNode

A SourceNode is a special kind of node that is the start of a workflow. The SourceNodes are given data at run-time that fetched via IOPlugins. On create, only the datatype of the data that the SourceNode supplied needs to be known. Creating a SourceNode is very similar to an ordinary node:

```
>>> source1 = network.create_source('Int', id='source1', step_id='step1', node_group=
↪'subject')
```

The first argument is the type of data the source supplies. The other optional arguments are for naming and grouping of the nodes. A SourceNode only has a single output which has a short-cut access via `source.output`.

Note: For a source or constant node, the datatype can be given both as the *BaseDataType* class or the id of the datatype.

ConstantNode

A ConstantNode is another special node. It is a subclass of the SourceNode and has a similar function. However, instead of setting the data at run-time, the data of a constant is given at creation and saved in the object. Creating a ConstantNode is similar as creating a source, but with supplying data:

```
>>> constant1 = network.create_constant('Int', [42], id='constant1', step_id='step1',␣
↪node_group='subject)
```

The first argument is the datatype the node supplies, similar to a SourceNode. The second argument is the data that is contained in the ConstantNode. Often, when a ConstantNode is created, it is created specifically for one input and will not be reused. In this case there is a shorthand to create and link a constant to an input:

```
>>> link = addint.inputs['value1'] << [42]
>>> link = [42] >> addint.inputs['value1']
>>> addint.inputs['value1'] = [42]
```

are three methods that will create a constant node with the value 42 and create a link between the output and input `addint.value1`.

SinkNode

The SinkNode is the counter-part of the source node. Instead of get data into the workflow, it saves the data resulting from the workflow. For this a rule has to be given at run-time that determines where to store the data. The information about how to create such a rule is described at `SinkNode.set_data`. At creation time, only the datatype has to be specified:

```
>>> sink2 = network.create_sink('Int', id='sink2', step_id='step1', node_group=
↪'subject')
```

Link

Links indicate how the data flows between *Nodes*. Links can be created explicitly using on of the following:

```
>>> link = network.create_link(node1.outputs['image'], node2.inputs['image'])
```

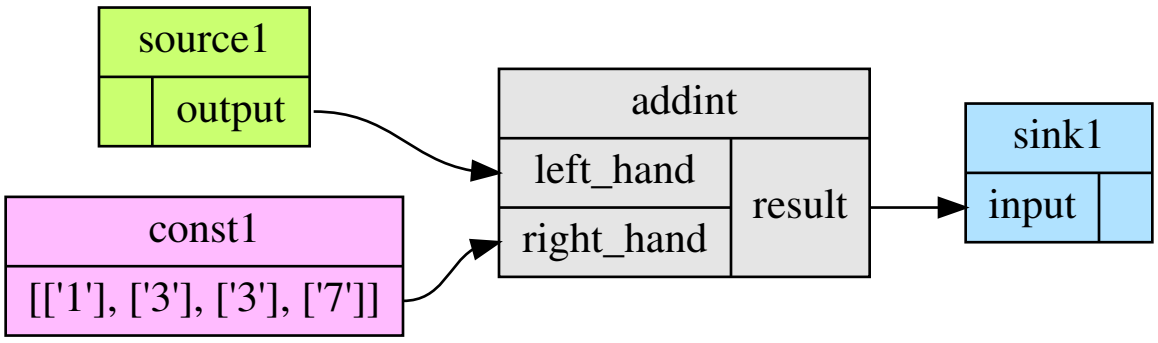
or can be create implicitly by a short hand (there are three options):

```
# This style of assignment will create a Link similar to above
>>> link = node1.outputs['image'] >> node2.inputs['image']
>>> link = node2.inputs['image'] << node1.outputs['image']
>>> node2.inputs['image'] = node1.outputs['image']
```

Note that a *Link* is also create automatically when using the short-hand for the ConstantNode <fastr.planning.node.ConstantNode>`.

1.3.3 Data Flow

The data enters the Network via SourceNodes flows via other Node and leaves the Network via SinkNodes.The flow between Nodes goes from an Output via a Link to an Input. In the following image it is simple to track the data from the SourceNodes at the left to the SinkNodes at right side:



Note that the data in Fastr is stored in the Output and the Link and Input just give access to it (possible while transforming the data).

Data flow inside a Node

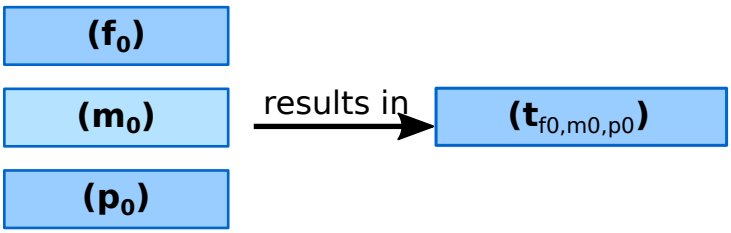
In a Node all data from the Inputs will be combined and the jobs will be generated. There are strict rules to how this combination is performed. In the default case all inputs will be used pair-wise, and if there is only a single value for an input, it it will be considered as a constant.

To illustrate this we will consider the following Tool (note this is a simplified version of the real tool):

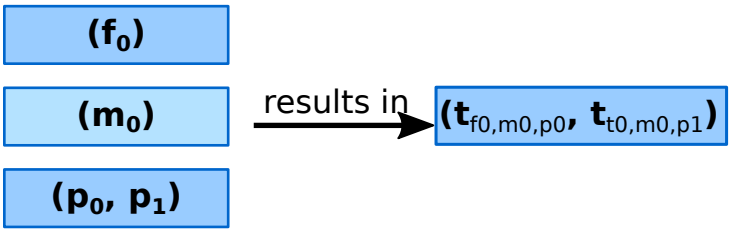
```
>>> fastr.tools['Elastix']
Tool Elastix v4.8 (Elastix Registration)
                          Inputs                                    |              Outputs
------------------------------------------------------------------------------------------
↪--------
fixed_image         (ITKImageFile)                                  |  transform␣
↪(ElastixTransformFile)
moving_image        (ITKImageFile)                                  |
parameters          (ElastixParameterFile)                          |
```

Also it is important to know that for this tool (by definition) the cardinality of the `transform` Output will match the cardinality of the `parameters` Input.

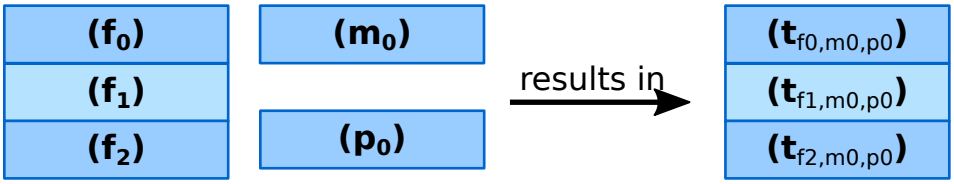
If we supply a Node based on this Tool with a single sample on each Input there will be one single matching Output sample created:



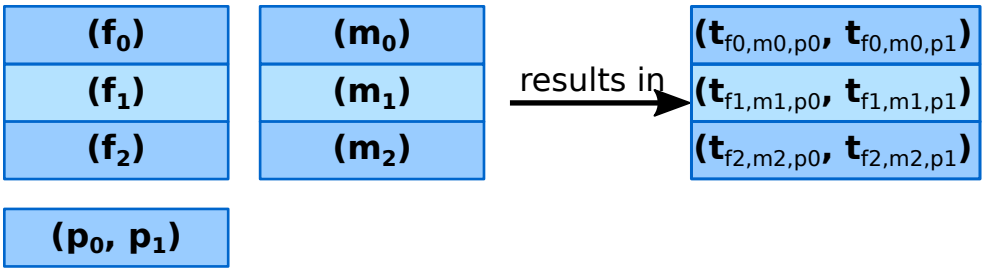
If the cardinality of the `parameters` sample would be increased to 2, the resulting `transform` sample would also become 2:



Now if the number of samples on `fixed_image` would be increased to 3, the `moving_image` and `parameters` will be considered constant and be repeated, resulting in 3 `transform` samples.



Then if the amount of samples for `moving_image` is also increased to 3, the `moving_image` and `fixed_image` will be used pairwise and the `parameters` will be constant.

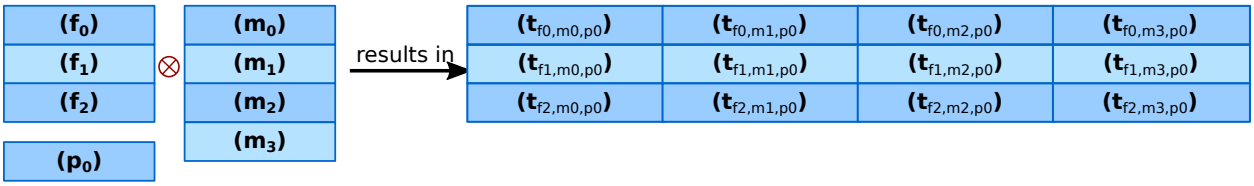


Advanced flows in a Node

Sometimes the default pairwise behaviour is not desirable. For example if you want to test all combinations of certain input samples. To achieve this we can change the *input_group* of *Inputs* to set them apart from the rest. By default all Inputs are assigned to the `default` input group. Now let us change that:

```
>>> node = network.create_node('Elastix', id='elastix')
>>> node.inputs['moving_image'].input_group = 'moving'
```

This will result in `moving_image` to be put in a different input group. Now if we would supply `fixed_image` with 3 samples and `moving_image` with 4 samples, instead of an error we would get the following result:

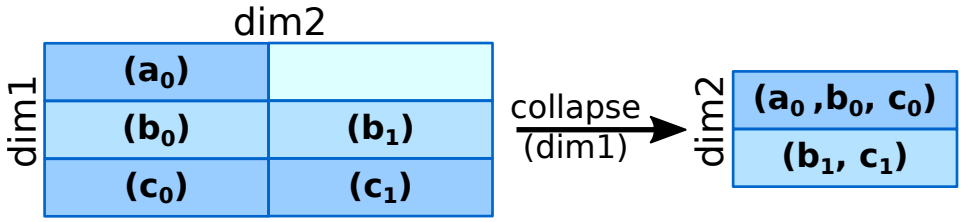


Warning: TODO: Expand this section with the merging dimensions

Data flows in a Link

As mentioned before the data flows from an Output to an Input through a Link. By default the Link passed the data as is, however there are two special directives that change the shape of the data:

1. Collapsing flow, this collapses certain dimensions from the sample array into the cardinality. As a user you have to specify the dimension or tuple of dimensions you want to collapse.

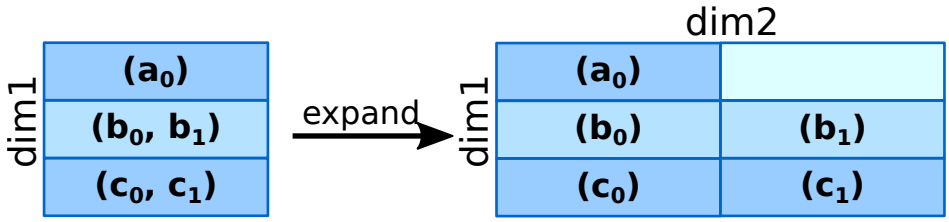


   This is useful in situation where you want to use a tool that aggregates over a number of samples (e.g. take a mean or sum).

   To achieve this you can set the *collapse* property of the *Link* as follows:

```
>>> link.collapse = 'dim1'
>>> link.collapse = ('dim1', 'dim2')  # In case you want to collapse multiple␣
↪dimensions
```

2. Expanding flow, this turns the cardinality into a new dimension. The new dimension will be named after the *Output* from which the link originates. It will be in the form of `{nodeid}__{outputid}`

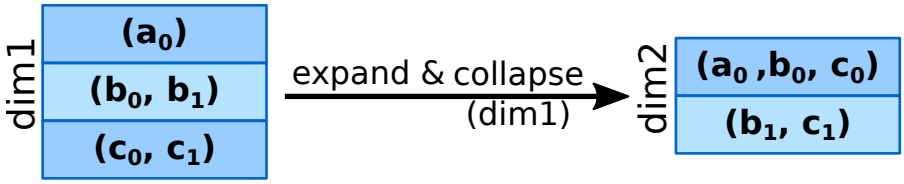


This flow directive is useful if you want to split a large sample in multiple smaller samples. This could be because processing the whole sample is not feasible because of resource constraints. An example would be splitting a 3D image into slices to process separately to avoid high memory use or to achieve parallelism.

To achieve this you can set the *expand* property of the *Link* to `True`:

```
>>> link.expand = True
```

Note: both collapsing and expanding can be used on the same link, it will executes similar to a expand-collapse sequence, but the newly created expand dimension is ignored in the collapse.




```
>>> link.collapse = 'dim1'
>>> link.expand = True
```

Data flows in an Input

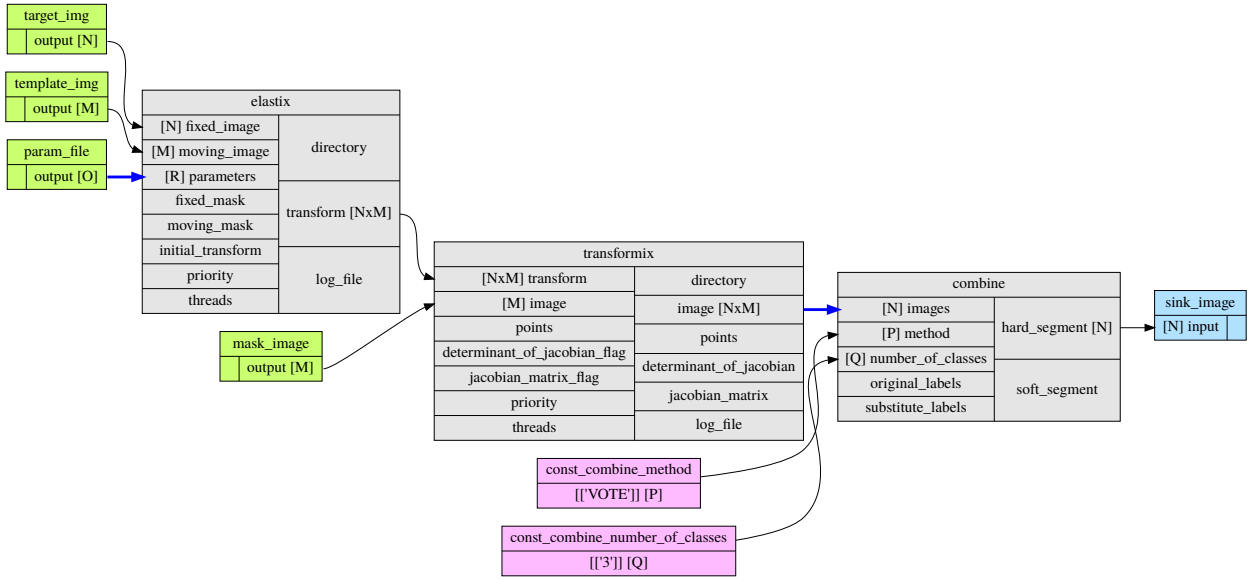
If an Input has multiple Links attached to it, the data will be combined by concatenating the values for each corresponding sample in the cardinality.

Broadcasting (matching data of different dimensions)

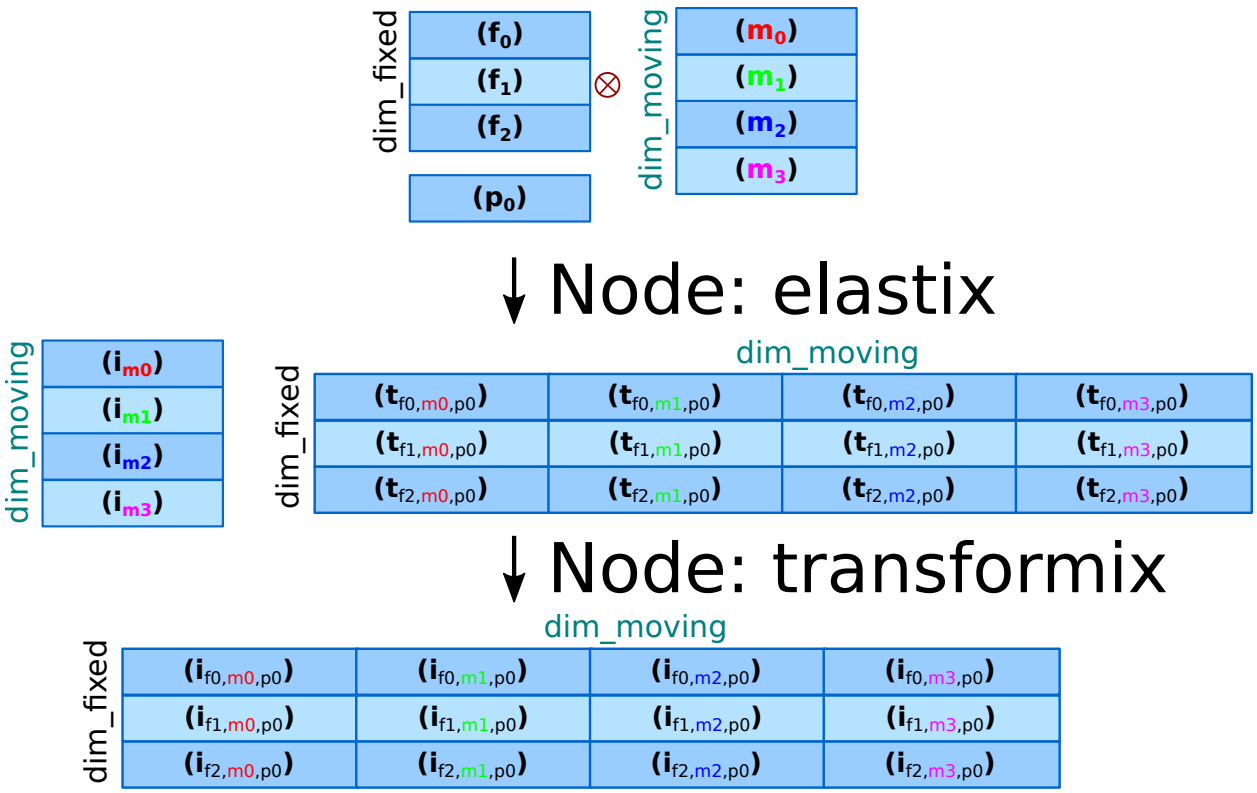
Sometimes you might want to combine data that does not have the same number of dimensions. As long as all dimensions of the lower dimensional datasets match a dimension in the higher dimensional dataset, this can be achieved using *broadcasting*. The term *broadcasting* is borrowed from NumPy and described as:

> "The term broadcasting describes how numpy treats arrays with different shapes during arithmetic operations. Subject to certain constraints, the smaller array is "broadcast" across the larger array so that they have compatible shapes."
>
> —NumPy manual on broadcasting

In fastr it works similar, but to combined different Inputs in an InputGroup. To illustrate broadcasting it is best to use an example, the following network uses broadcasting in the `transformix` Node:



As you can see this visualization prints the dimensions for each Input and Output (e.g. the `elastix.fixed_image` Input has dimensions `[N]`). To explain what happens in more detail, we present an image illustrating the details for the samples in `elastix` and `transformix`:



In the figure the `moving_image` (and references to it) are identified with different colors, so they are easy to track across the different steps.

At the top the Inputs for the `elastix` Node are illustrated. Because the input groups a set differently, output samples are generated for all combinations of `fixed_image` and `moving_image` (see *Advanced flows in a Node* for details).

In the `transformix` Node, we want to combine a list of samples that is related to the `moving_image` (it has the same dimension name and sizes) with the resulting `transform` samples from the `elastix` Node. As you can see the sizes of the sample collections do not match (`[N]` vs `[N x M]`). This is where *broadcasting* comes into play, it allows the system to match these related sample collections. Because all the dimensions in `[N]` are known in `[N x M]`, it is possible to match them uniquely. This is done automatically and the result is a new `[N xM]` sample collection. To create a matching sample collections, the samples in the `transformix.image` Input are reused as indicated by the colors.

Warning: Note that this might fail when there are data-blocks with non-unique dimension names, as it will be not be clear which of the dimensions with identical names should be matched!

1.3.4 DataTypes

In Fastr all data is contained in object of a specific type. The types in Fastr are represented by classes that subclass *`BaseDataType`*. There are a few different other classes under *`BaseDataType`* that are each a base class for a family of types:

- *`DataType`* – The base class for all types that hold data
  - *`ValueType`* – The base class for types that contain simple data (e.g. Int, String) that can be represented as a str
  - *`EnumType`* – The base class for all types that are a choice from a `set` of options
  - *`URLType`* – The base class for all types that have their data stored in files (which are referenced by URL)
- *`TypeGroup`* – The base class for all types that actually represent a group of types

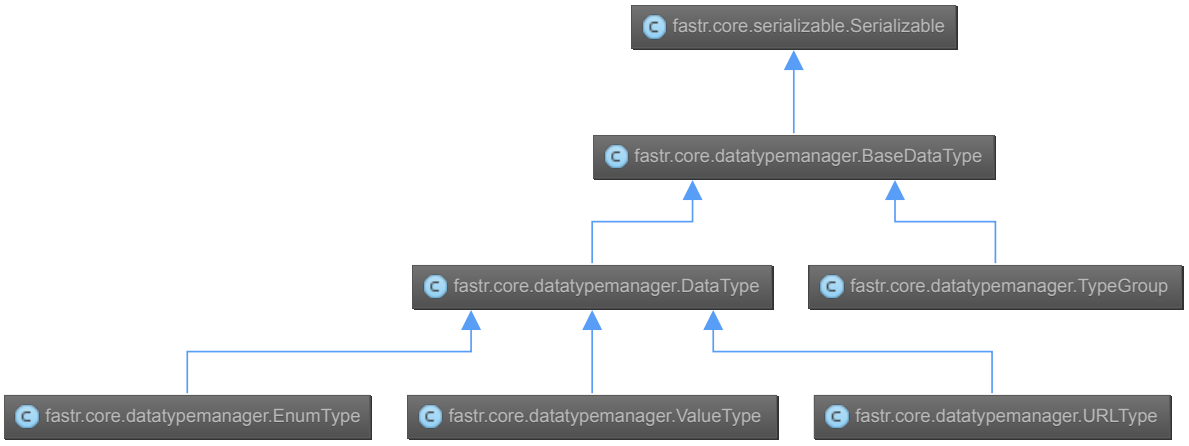


Fig. 1.2: The relation between the different DataType classes

The types are defined in xml files and created by the `DataTypeManager`. The `DataTypeManager` acts as a container containing all Fastr types. It is automatically instantiated as `fastr.types`. In fastr the created DataTypes classes are also automatically place in the *`fastr.datatypes`* module once created.

Resolving Datatypes

Outputs in fastr can have a *TypeGroup* or a number of *DataTypes* associated with them. The final *DataType* used will depend on the linked *Inputs*. The *DataType* resolving works as a two-step procedure.

1. All possible *DataTypes* are determined and considered as *options*.
2. The best possible *DataType* from *options* is selected for non-automatic Outputs

The *options* are defined as the intersection of the set of possible values for the *Output* and each separate *Input* connected to the *Output*. Given the resulting *options* there are three scenarios:

- If there are no valid *DataTypes* (*options* is empty) the result will be None.
- If there is a single valid *DataType*, then this is automatically the result (even if it is not a preferred *DataType*).
- If there are multiple valid *DataTypes*, then the preferred *DataTypes* are used to resolve conflicts.

There are a number of places where the preferred *DataTypes* can be set, these are used in the order as given:

1. The *preferred* keyword argument to `match_types`
2. The preferred types specified in the *fastr.config*

1.3.5 Execution

Executing a Network is very simple:

```
>>> source_data = {'source_id1': ['val1', 'val2'],
                   'source_id2': {'id3': 'val3', 'id4': 'val4'}}
>>> sink_data = {'sink_id1': 'vfs://some_output_location/{sample_id}/file.txt'}
>>> network.execute(source_data, sink_data)
```

The *Network.execute* method takes a `dict` of source data and a `dict` sink data as arguments. The dictionaries should have a key for each SourceNode or SinkNode.

The execution of a Network uses a layered model:

- *Network.execute* will analyze the Network and call all Nodes.
- `Node.execute` will create jobs and fill their payload
- *execute_job* will execute the job on the execute machine and resolve any deferred values (`val://` urls).
- *Tool.execute* will find the correct target and call the interface and if required resolve `vfs://` urls
- *Interface.execute* will actually run the required command(s)

The `ExecutionPlugin` will call call the *executionscript.py* for each job, passing the job as a gzipped pickle file. The *executionscript.py* will resolve deferred values and then call *Tool.execute* which analyses the required target and executes the underlying *Interface*. The Interface actually executes the job and collect the results. The result is returned (via the Tool) to the *executionscript.py*. There we save the result, provenance and profiling in a new gzipped pickle file. The execution system will use a callback to load the data back into the Network.

The selection and settings of the `ExecutionPlugin` are defined in the *fastr config*.

Continuing a Network

Normally a random temporary directory is created for each run. To continue a previously stopped/crashed network, you should call the *Network.execute* method using the same temporary directory(tmp dir). You can set the temporary directory to a fixed value using the following code:

```
>>> tmpdir = '/tmp/example_network_rerun'
>>> network.execute(source_data, sink_data, tmpdir=tmpdir)
```

Warning: Be aware that at this moment, Fastr will rerun only the jobs where not all output files are present or if the job/tool parameters have been changed. It will not rerun if the input data of the node has changed or the actual tools have been adjusted. In these cases you should remove the output files of these nodes, to force a rerun.

1.3.6 IOPlugins

Sources and sink are used to get data in and out of a *Network* during execution. To make the data retrieval and storage easier, a plugin system was created that selects different plugins based on the URL scheme used. So for example, a url starting with `vfs://` will be handles by the *VirtualFileSystem plugin*. A list of all the *IOPlugins* known by the system and their use can be found at *IOPlugin Reference*.

1.3.7 Secrets

Fastr uses a secrets system for storing and retrieving login credentials. Currently the following keyrings are supported:

- Python keyring and keyrings.alt lib: - Mac OS X Keychain - Freedesktop Secret Service (requires secretstorage) - KWallet (requires dbus) - Windows Credential Vault - Gnome Keyring - Google Keyring (stores keyring on Google Docs) - Windows Crypto API (File-based keyring secured by Windows Crypto API) - Windows Registry Keyring (registry-based keyring secured by Windows Crypto API) - PyCrypto File Keyring - Plaintext File Keyring (not recommended)
- Netrc (not recommended)

When a password is retrieved trough the fastr SecretService it loops trough all of the available SecretProviders (currently keyring and netrc) until a match is found.

The Python keyring library automatically picks the best available keyring backend. If you wish to choose your own python keyring backend it is possible to do so by make a keyring configuration file according to the keyring library documentation. The python keyring library connects to one keyring. Currently it cannot loop trough all available keyrings until a match is found.

1.3.8 Debugging

This section is about debugging Fastr tools wrappers, Fastr Networks (when building a Network) and Fastr Network Runs.

Debugging a Fastr tool

When wrapping a Tool in Fastr sometimes it will not work as expected or not load properly. Fastr is shipped with a command that helps checking Tools. The *fastr verify* command can try to load a Tool in steps to make it more easy to understand where the loading went wrong.

The `fastr verify` command will use the following steps:

- Try to load the tool with and without compression
- Try to find the correct serializer and make sure the format is correct
- Try to validate the Tool content against the json_schema of a proper Tool
- Try to create a Tool object
- If available, execute the tool test

An example of the use of `fastr verify`:

```
$ fastr verify tool fastr/resources/tools/fastr/math/0.1/add.xml
[INFO]    verify:0020 >> Trying to read file with compression OFF
[INFO]    verify:0036 >> Read data from file successfully
[INFO]    verify:0040 >> Trying to load file using serializer "xml"
[INFO]    verify:0070 >> Validating data against Tool schema
[INFO]    verify:0080 >> Instantiating Tool object
[INFO]    verify:0088 >> Loaded tool <Tool: Add version: 1.0> successfully
[INFO]    verify:0090 >> Testing tool...
```

If your Tool is loading but not functioning as expected you might want to easily test your Tool without building an entire Network around it that can obscure errors. It is possible to run a tool from the Python prompt directly using *tool.execute*:

```
>>> tool.execute(left_hand=40, right_hand=2)
[INFO] localbinarytarget:0090 >> Changing ./bin
[INFO]      tool:0311 >> Target is <Plugin: LocalBinaryTarget>
[INFO]      tool:0318 >> Using payload: {'inputs': {'right_hand': (2,), 'left_hand':␣
↪(40,)}, 'outputs': {}}
[INFO] localbinarytarget:0135 >> Adding extra PATH: ['/home/hachterberg/dev/fastr-
↪develop/fastr/fastr/resources/tools/fastr/math/0.1/bin']
[INFO] fastrinterface:0393 >> Execution payload: {'inputs': {'right_hand': (2,),
↪'left_hand': (40,)}, 'outputs': {}}
[INFO] fastrinterface:0496 >> Adding (40,) to argument list based on <fastrinterface.
↪InputParameterDescription object at 0x7fc950fa8850>
[INFO] fastrinterface:0496 >> Adding (2,) to argument list based on <fastrinterface.
↪InputParameterDescription object at 0x7fc950fa87d0>
[INFO] localbinarytarget:0287 >> Options: ['/home/hachterberg/dev/fastr-develop/fastr/
↪fastr/resources/tools/fastr/math/0.1/bin']
[INFO] localbinarytarget:0201 >> Calling command arguments: ['python', '/home/
↪hachterberg/dev/fastr-develop/fastr/fastr/resources/tools/fastr/math/0.1/bin/addint.
↪py', '--in1', '40', '--in2', '2']
[INFO] localbinarytarget:0205 >> Calling command: "'python' '/home/hachterberg/dev/
↪fastr-develop/fastr/fastr/resources/tools/fastr/math/0.1/bin/addint.py' '--in1' '40
↪' '--in2' '2'"
[INFO] fastrinterface:0400 >> Collecting results
[INFO] executionpluginmanager:0467 >> Callback processing thread ended!
[INFO] executionpluginmanager:0467 >> Callback processing thread ended!
[INFO] executionpluginmanager:0467 >> Callback processing thread ended!
[INFO] jsoncollector:0076 >> Setting data for result with [42]
<fastr.core.interface.InterfaceResult at 0x7fc9661ccfd0>
```

In this case an AddInt was ran from the python shell. As you can see it shows the payload it created based on the call, followed by the options for the directories that contain the binary. Then the command that is called is given both as a list and string (for easy copying to the prompt yourself). Finally the collected results is displayed.

Note: You can give input and outputs as keyword arguments for execute. If an input and output have the same name, you can disambiguate them by prefixing them with `in_` or `out_` (e.g. `in_image` and `out_image`)

Debugging an invalid Network

The simplest command to check if your Network is considered valid is to use the *`Network.is_valid`* method. It will simply check if the Network is valid:

```
>>> network.is_valid()
True
```

It will return a boolean that only indicates the validity of the Network, but it will print any errors it found to the console/log with the ERROR log level, for example when datatypes on a link do not match:

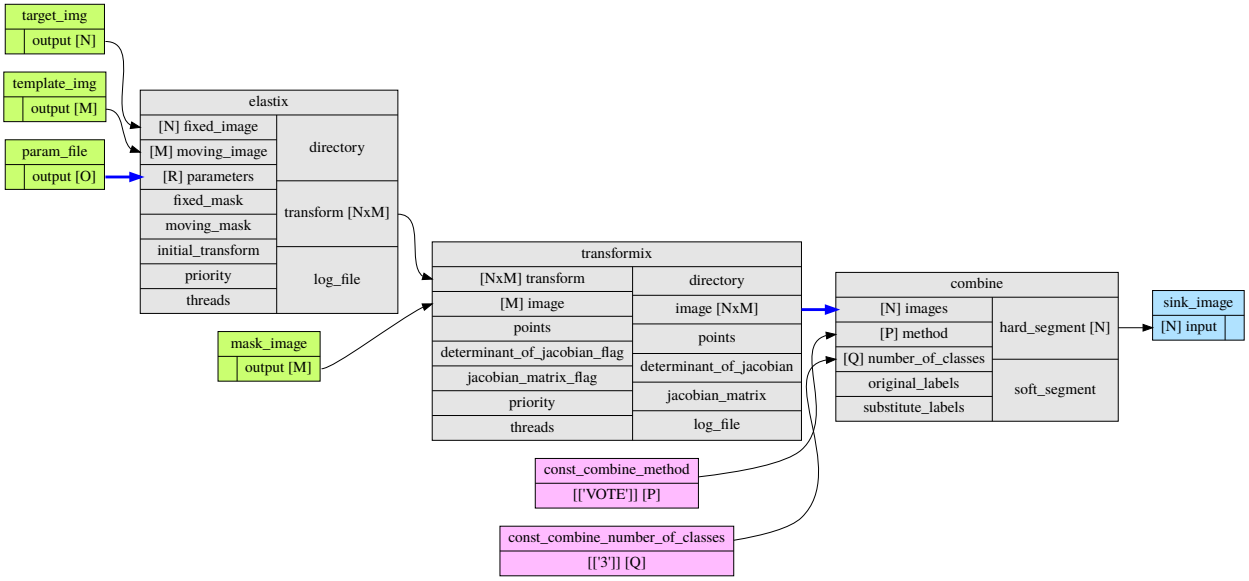
```
>>> invalid_network.is_valid()
[WARNING] datatypemanager:0388 >> No matching DataType available (args (<ValueType:␣
↪Float class [Loaded]>, <ValueType: Int class [Loaded]>))
[WARNING]      link:0546 >> Cannot match datatypes <ValueType: Float class [Loaded]>␣
↪and <ValueType: Int class [Loaded]> or not preferred datatype is set! Abort linking␣
↪fastr:///networks/add_ints/0.0/nodelist/source/outputs/output to fastr:///networks/
↪add_ints/0.0/nodelist/add/inputs/left_hand!
[WARNING] datatypemanager:0388 >> No matching DataType available (args (<ValueType:␣
↪Float class [Loaded]>, <ValueType: Int class [Loaded]>))
[ERROR]   network:0571 >> [add] Input left_hand is not valid: SubInput fastr:///
↪networks/add_ints/0.0/nodelist/add/inputs/left_hand/0 is not valid: SubInput source␣
↪(link_0) is not valid
[ERROR]   network:0571 >> [add] Input left_hand is not valid: SubInput fastr:///
↪networks/add_ints/0.0/nodelist/add/inputs/left_hand/0 is not valid: [link_0] source␣
↪and target have non-matching datatypes: source Float and Int
[ERROR]   network:0571 >> [link_0] source and target have non-matching datatypes:␣
↪source Float and Int
False
```

Because the messages might not always be enough to understand errors in the more complex Networks, we would advice you to create a plot of the network using the *`network.draw_network`* method:

```
>>> network.draw_network(network.id, draw_dimensions=True, expand_macro=True)
'add_ints.svg'
```

The value returned is the path of the output image generated (it will be placed in the current working directory. The `draw_dimensions=True` will make the drawing add indications about the sample dimensions in each Input and Output, whereas `expand_macro=True` causes the draw to expand MacroNodes and draw the content of them. If you have many nested MacroNodes, you can set `expand_macro` to an integer and that is the depth until which the MacroNodes will be draw in detail.

An example of a simple multi-atlas segmentation Network nicely shows the use of drawing the dimensions, the dimensions vary in certain Nodes due to the use of input_groups and a collapsing link (drawn in blue):



Debugging a Network run with errors

If a Network run did finish but there were errors detected, Fastr will report those at the end of the execution. We included an example of a Network that has failing samples in `fastr/examples/failing_network.py` which can be used to test debugging. An example of the output of a Network run with failures:

```
[INFO] networkrun:0604 >> ####################################
[INFO] networkrun:0605 >> #    network execution FINISHED    #
[INFO] networkrun:0606 >> ####################################
[INFO] networkrun:0618 >> ===== RESULTS =====
[INFO] networkrun:0627 >> sink_1: 2 success / 2 failed
[INFO] networkrun:0627 >> sink_2: 2 success / 2 failed
[INFO] networkrun:0627 >> sink_3: 1 success / 3 failed
[INFO] networkrun:0627 >> sink_4: 1 success / 3 failed
[INFO] networkrun:0627 >> sink_5: 1 success / 3 failed
[INFO] networkrun:0628 >> ====================
[WARNING] networkrun:0651 >> There were failed samples in the run, to start debugging␣
↪you can run:

    fastr trace $RUNDIR/__sink_data__.json --sinks

see the debug section in the manual at https://fastr.readthedocs.io/en/default/static/
↪user_manual.html#debugging for more information.
```

As you can see, there were failed samples in every sink. Also you already get the suggestion to use *fastr trace*. This command helps you inspect the staging directory of the Network run and pinpoint the errors.

The suggested command will print a similar summary as given by the network execution:

```
$ fastr trace $RUNDIR/__sink_data__.json --sinks
sink_1 -- 2 failed -- 2 succeeded
sink_2 -- 2 failed -- 2 succeeded
sink_3 -- 3 failed -- 1 succeeded
sink_4 -- 3 failed -- 1 succeeded
sink_5 -- 3 failed -- 1 succeeded
```

Since this is not given us new information we can add the `-v` flag for more output and limit the output to one sink, in this case `sink_5`:

```
$ fastr trace $RUNDIR/__sink_data__.json --sinks sink_5
sink_5 -- 3 failed -- 1 succeeded
  sample_1_1: Encountered error: [FastrOutputValidationError] Could not find result␣
↪for output out_2 (/home/hachterberg/dev/fastr-develop/fastr/fastr/execution/job.
↪py:970)
  sample_1_2: Encountered error: [FastrOutputValidationError] Could not find result␣
↪for output out_1 (/home/hachterberg/dev/fastr-develop/fastr/fastr/execution/job.
↪py:970)
  sample_1_3: Encountered error: [FastrOutputValidationError] Could not find result␣
↪for output out_1 (/home/hachterberg/dev/fastr-develop/fastr/fastr/execution/job.
↪py:970)
  sample_1_3: Encountered error: [FastrOutputValidationError] Could not find result␣
↪for output out_2 (/home/hachterberg/dev/fastr-develop/fastr/fastr/execution/job.
↪py:970)
```

Now we are given one error per sample, but this does not yet give us that much information. To get a very detailed report we have to specify one sink and one sample. This will make the `fastr trace` command print a complete error report for that sample:

```
$ fastr trace $RUNDIR/__sink_data__.json --sinks sink_5 --sample sample_1_1 -v
Tracing errors for sample sample_1_1 from sink sink_5
Located result pickle: /home/hachterberg/FastrTemp/fastr_failing_network_2017-09-
↪04T10-44-58_uMWeMV/step_1/sample_1_1/__fastr_result__.pickle.gz


===== JOB failing_network___step_1___sample_1_1 =====
Network: failing_network
Run: failing_network_2017-09-04T10-44-58
Node: step_1
Sample index: (1)
Sample id: sample_1_1
Status: JobState.execution_failed
Timestamp: 2017-09-04 08:45:19.238192
Job file: /home/hachterberg/FastrTemp/fastr_failing_network_2017-09-04T10-44-58_
↪uMWeMV/step_1/sample_1_1/__fastr_result__.pickle.gz

Command:
List representation: [u'python', u'/home/hachterberg/dev/fastr-develop/fastr/fastr/
↪resources/tools/fastr/util/0.1/bin/fail.py', u'--in_1', u'1', u'--in_2', u'1', u'--
↪fail_2']
String representation: 'python' '/home/hachterberg/dev/fastr-develop/fastr/fastr/
↪resources/tools/fastr/util/0.1/bin/fail.py' '--in_1' '1' '--in_2' '1' '--fail_2'

Output data:
{'out_1': [<Int: 2>]}

Status history:
2017-09-04 08:45:19.238212: JobState.created
2017-09-04 08:45:21.537417: JobState.running
2017-09-04 08:45:31.578864: JobState.execution_failed

----- ERRORS -----
- FastrOutputValidationError: Could not find result for output out_2 (/home/
↪hachterberg/dev/fastr-develop/fastr/fastr/execution/job.py:970)
- FastrValueError: [failing_network___step_1___sample_1_1] Output values are not␣
↪valid! (/home/hachterberg/dev/fastr-develop/fastr/fastr/execution/job.py:1473)
```

(continues on next page)

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```
------------------

----- STDOUT -----
Namespace(fail_1=False, fail_2=True, in_1=1, in_2=1)
in 1  : 1
in 2  : 1
fail_1: False
fail_2: True
RESULT_1=[2]

------------------

----- STDERR -----

------------------
```

As shown above, it finds the result files of the failed job(s) and prints the most important information. The first paragraph shows the information about the Job that was involved. The second paragraph shows the command used both as a list (which is clearer and internally used in Python) and as a string (which you can copy/paste to the shell to test the command). Then there is the output data as determined by Fastr. The next section shows the status history of the Job which can give an indication about wait and run times. Then there are the errors that Fastr encounted during the execution of the Job. In this case it could not find the output for the Tool. Finally the stdout and stderr of the subprocess are printed. In this case we can see that RESULT_2=[...] was not in the stdout, and so the result could not be located.

Note: Sometimes there are no Job results in a directory, this usually means the process got killed before the Job could finished. On cluster environments, this often means that the process was killed due to memory constraints.

Asking for help with debugging

If you would like help with debugging, you can contact us via the fastr-users google group. To enable us to track the errors please include the following:

- The entire log of the fastr run (can be copied from console or from the end of `~/.fastr/logs/info.log`.
- A dump of the network run, which can be created that by using the *fastr dump* command like:

  ```
  $ fastr dump $RUNDIR fastr_run_dump.zip
  ```

  This will create a zip file including all the job files, logs, etc but not the actual data files.

These should be enough information to trace most errors. In some cases we might need to ask for additional information (e.g. tool files, datatype files) or actions from your side.

1.3.9 Naming Convention

For the naming convention of the tools we tried to stay close to the Python **PEP 8** coding style. In short, we defined toolnames as classes so they should be UpperCamelCased. The inputs and outputs of a tool we considered as functions or method arguments, these should we named lower_case_with_underscores.

An overview of the mapping of Fastr to **PEP 8**:

Fastr construct	Python **PEP8** equivalent	Examples
Network.id	**module**	brain_tissue_segmentation
Tool.id	**class**	BrainExtractionTool, ThresholdImage
Node.id	**variable name**	brain_extraction, threshold_mask
Input/Output.id	**method**	image, number_of_classes, probability_image

Furthermore there are some small guidelines:

- No input or output in the input or output names. This is already specified when setting or getting the data.
- Add the type of the output that is named. i.e. enum, string, flag, image,
  - No File in the input/output name (Passing files around is what Fastr was developed for).
  - No type necessary where type is implied i.e. lower_threshold, number_of_levels, max_threads.
- Where possible/useful use the fullname instead of an abbreviation.

1.3.10 Provenance

For every data derived data object, Fastr records the Provenance. The *SinkNode* write provenance records next to every data object it writes out. The records contain information on what operations were performed to obtain the resulting data object.

W3C Prov

The provenance is recorded using the W3C Prov Data Model (PROV-DM). Behind the scences we are using the python prov implementation.

The PROV-DM defines 3 Starting Point Classes and and their relating properties. See Fig. 1.3 for a graphic representation of the classes and the relations.

Fig. 1.3: The three Starting Point classes and the properties that relate them. The diagrams in this document depict Entities as yellow ovals, Activities as blue rectangles, and Agents as orange pentagons. The responsibility properties are shown in pink.*[0]

*

[0] This picture and caption is taken from http://www.w3.org/TR/prov-o/ . "Copyright © 2011-2013 World Wide Web Consortium, (MIT, ERCIM, Keio, Beihang). http://www.w3.org/Consortium/Legal/2015/doc-license"

Implementation

In the workflow document the provenance classes map to fastr concepts in the following way:

Agent Fastr, *Networks*, *Tools*, *Nodes*

Activity *Jobs*

Entities Data

Usage

The provenance is stored in ProvDocument objects in pickles. The convenience command line tool `fastr prov` can be used to extract the provenance in the PROV-N notation and can be serialized to PROV-JSON and PROV-XML. The provenance document can also be vizualized using the `fastr prov` command line tool.

1.4 Command Line Tools

Fastr is shipped with a number of command line tools to perform common tasks and greatly simplify things such as debugging. The list of command line tools that is included in Fastr:

command	description
cat	Print information from a job file
dump	Dump the contents of a network run tempdir into a zip for remote assistance
execute	Execute a fastr job file
extract_argparse	Create a stub for a Tool based on a python script using argparse
provenance	Get PROV information from the result pickle.
pylint	Tiny wrapper in pylint so the output can be saved to a file (for test automation)
report	Print report of a job result (__fastr_result__.pickle.gz) file
run	Run a Network from the commandline
sink	Command line access to the IOPlugin sink
source	Command line access to the IOPlugin source
test	Run the tests of a tool to verify the proper function
trace	Trace samples/sinks from a run
upgrade	Upgrade a fastr 2.x python file to fastr 3.x syntax
verify	Verify fastr resources, at the moment only tool definitions are supported.

1.4.1 fastr cat

Extract selected information from the extra job info. The path is the selection of the data to retrieve. Every parts of the path (separated by a /) is seen as the index for the previous object. So for example to get the stdout of a job, you could use 'fastr cat __fastr_extra_job_info__.json process/stdout'.

```
usage: fastr cat [-h] __fastr_extra_job_info__.json path
```

Positional Arguments

__fastr_extra_job_info__.json result file to cat

path path of the data to print

1.4.2 fastr dump

Create a dump of a network run directory that contains the most important information for debugging. This includes a serialization of the network, all the job command and result files, the extra job information files and the provenance files. No data files will be included, but note that if jobs get sensitive information passed via the command line this will be included in the job files.

```
usage: fastr dump [-h] RUNDIR DUMP.zip
```

Positional Arguments

RUNDIR The run directory to dump

DUMP.zip The file to place the dump in

1.4.3 fastr execute

Execute a job from commandline.

```
usage: fastr execute [-h] [JOBFILE]
```

Positional Arguments

JOBFILE File of the job to execute (default ./__fastr_command__.yaml)

1.4.4 fastr extract_argparse

Extract basic information from argparse.

```
usage: fastr extract_argparse [-h] SCRIPT.py TOOL.xml
```

Positional Arguments

SCRIPT.py Python script to inspect

TOOL.xml created Tool stub

1.4.5 fastr provenance

Export the provenance information from JSON to other formats or plot the provenance data as a graph.

```
usage: fastr provenance [-h] [-so SYNTAX_OUT_FILE] [-sf SYNTAX_FORMAT]
                        [-i INDENT] [-vo VISUALIZE_OUT_FILE]
                        [RESULTFILE]
```

Positional Arguments

RESULTFILE File of the job to execute (default ./__fastr_prov__.json)

Named Arguments

-so, --syntax-out-file Write the syntax to file.

-sf, --syntax-format Choices are: [json], provn or xml

Default: "json"

-i, --indent Indent size of the serialized documents.

Default: 2

-vo, --visualize-out-file Visualize the provenance. The most preferred format is svg. You can specify any format pydot supports. Specify the format by postfixing the filename with an extension.

1.4.6 fastr pylint

Run pylint in such a way that the output is written to a file

```
usage: fastr pylint [-h] --output_file PYLINT.OUT
```

Named Arguments

--output_file The file to result in

1.4.7 fastr report

Print a report of a job result file.

```
usage: fastr report [-h] [-v] [JOBFILE]
```

Positional Arguments

JOBFILE File of the job to execute (default ./__fastr_result__.yaml)

Named Arguments

-v, --verbose More verbose (e.g. add fastr job stdout and stderr)

Default: False

1.4.8 fastr run

Execute a job or network from commandline.

```
usage: fastr run [-h] NETWORKFILE
```

Positional Arguments

NETWORKFILE File of the network to execute

1.4.9 fastr sink

executes an ioplugin

```
usage: fastr sink [-h] -i INPUT [INPUT ...] -o OUTPUT [OUTPUT ...]
                  [-d DATATYPE [DATATYPE ...]]
```

Named Arguments

-i, --input The url to process (can also be a list)

-o, --output The output urls in vfs scheme (can also be a list and should be the same size as –inurl)

-d, --datatype The datatype of the source/sink data to handle

1.4.10 fastr source

Executes an source command

```
usage: fastr source [-h] -i INPUT [INPUT ...] -o OUTPUT [-d DATATYPE]
                    [-s SAMPLE_ID]
```

Named Arguments

-i, --input	The url to process (can also be a list)
-o, --output	The output url in vfs scheme
-d, --datatype	The datatype of the source/sink data to handle
-s, --sample_id	The sample_id of the source/sink data to handle

1.4.11 fastr test

Run a tests for a fastr resource.

```
usage: fastr test [-h] {tool,tools,network,networks} ...
```

Sub-commands:

tool

Test a single tool

```
fastr test tool [-h] TOOL
```

Positional Arguments

TOOL	Tool to test or directory with tool reference data

tools

Test all tools known to fastr

```
fastr test tools [-h]
```

network

Test a single network

```
fastr test network [-h] NETWORK
```

Positional Arguments

NETWORK The reference data to test the Network

networks

Test all network references inside subdirectories

```
fastr test networks [-h] [--result RESULT.json] REFERENCE
```

Positional Arguments

REFERENCE path of the directory containing subdirectories with reference data

Named Arguments

--result Write the results of the test to a JSON file

1.4.12 fastr trace

Fastr trace helps you inspect the staging directory of the Network run and pinpoint the errors.

```
usage: fastr trace [-h] [--verbose] [--sinks [SINKS [SINKS ...]]]
                   [--samples [SAMPLES [SAMPLES ...]]]
                   [__sink_data__.json]
```

Positional Arguments

__sink_data__.json result file to cat

Default: "/home/docs/checkouts/readthedocs.org/user_builds/fastr/checkouts/3.2.0/fastr/doc/__sink_data_

Named Arguments

--verbose, -v set verbose output for more details

Default: False

--sinks list results for specified sinks

--samples list result for all samples

1.4.13 fastr upgrade

Upgrades a python file that creates a Network to the new fastr 3.x syntax. The file will be parsed and the full syntax tree will be transformed to fit the new syntax.

Note: Solves most common problems, but cannot always solve 100% of the issues

```
usage: fastr upgrade [-h] [--type TYPE] NETWORK.py NEW.py
```

Positional Arguments

NETWORK.py	Network creation file (in python) to upgrade
NEW.py	location of the result file

Named Arguments

--type	tool of resource to upgrade, one of: network, tool

1.4.14 fastr verify

Verify fastr resources, at the moment only tool definitionsare supported.

```
usage: fastr verify [-h] TYPE path
```

Positional Arguments

TYPE	Possible choices: tool Type of resource to verify (e.g. tool)
path	path of the resource to verify

1.5 Resource File Formats

This chapter describes the various files fastr uses. The function and format of the files is described allowing the user to configure fastr and add DataTypes and Tools.

1.5.1 Config file

Fastr reads the config files from `$FASTRHOME/config.py` by default. If the `$FASTRHOME` environment variable is not set it will default to `~/.fastr`. As a result it read:

- `$FASTRHOME/config.py` (if environment variable set)
- `~/.fastr/config.py` (otherwise)

Reading a new config file change or override settings, making the last config file read have the highest priority. All settings have a default value, making config files and all settings within optional.

Note: To verify which config files have been read you can see `fastr.config.read_config_files` which contains a list of the read config files (in read order).

Note: If `$FASTRHOME` is set, `$FASTRHOME/tools` is automatically added as a tool directory if it exists and `$FASTRHOME/datatypes` is automatically added as a type directory if it exists.

Splitting up config files

Sometimes it is nice to have config files split in multiple smaller files. Next to the `config.py` you can also created a directory `config.d` and all `.py` files in this directory will be sourced in alphabetical order.

Given the following layout of the `$FASTRHOME` directory:

```
./config.d/a.py
./config.d/b.txt
./config.d/c.py
./config.py
```

The following files will be read in order:

1. `./config.py`
2. `./config.d/a.py`
3. `./config.d/c.py`

Example config file

Here is a minimal config file:

```
# Enable debugging output
debug = False

# Define the path to the tool definitions
tools_path = ['/path/to/tools',
              '/path/to/other/tools'] + tools_path
types_path = ['/path/to/datatypes',
              '/path/to/other/datatypes'] + types_path


# Specify what your preferred output types are.
preferred_types += ["NiftiImageFileCompressed",
                    "NiftiImageFile"]

# Set the tmp mount
mounts['tmp'] = '/path/to/tmpdir'
```

Format

The config file is actually a python source file. The next syntax applies to setting configuration values:

```
# Simple values
float_value = 1.0
int_value = 1
str_value = "Some value"
other_str_value = 'name'.capitalize()

# List-like values
list_value = ['over', 'ride', 'values']
other_list_value.prepend('first')
other_list_value.append('list')

# Dict-like values
dict_value = {'this': 1, 'is': 2, 'fixed': 3}
other_dict_value['added'] = 'this key'
```

Note: Dictionaries and list always have a default, so you can always append or assign elements to them and do not have to create them in a config file. Best practice is to only edit them unless you really want to block out the earliers config files.

Most operations will be assigning values, but for list and dict values a special wrapper object is used that allows manipulations from the default. This limits the operations allowed.

List values in the `config.py` have the following supported operators/methods:

- +, `__add__` and `__radd__`
- += or `__iadd__`
- `append`
- `prepend`
- `extend`

Mapping (dict-like) values in the `config.py` have the following supported operators/methods:

- `update`
- `[]` or `__getitem__`, `__setitem__` and `__delitem__`

Configuration fields

This is a table the known config fields on the system:

name	type	description	default
debug	bool	Flag to enable/disable debugging	False
examples-dir	str	Directory containing the fastr examples	$systemdir/examples
execution_plugin	str	The default execution plugin to use	'ProcessPoolExecution'
execution-script	str	Execution script location	$systemdir/execution/executionscript.py
extra_config_dirs	list	Extra configuration directories to read	['']
filesynchelper_url	str	Redis url e.g. redis://localhost:6379	''
job_cleanup_level	str	The level of cleanup required, options: all, no_cleanup, non_failed	no_cleanup
log_to_file	bool	Indicate if default logging settings should log to files or not	False
logdir	str	Directory where the fastr logs will be placed	$userdir/logs
logging_config	dict	Python logger config	{}
loglevel	int	The log level to use (as int), INFO is 20, WARNING is 30, etc	20
logtype	str	Type of logging to use	'default'
mounts	dict	A dictionary containing all mount points in the VFS system	{'tmp': '$TMPDIR', 'example_data': '$systemdir/examples/data', 'home': '~/'}
networks_path	list	Directories to scan for networks	['$userdir/networks', '$resourcedir/networks']
plugins_path	list	Directories to scan for plugins	['$userdir/plugins', '$resourcedir/plugins']
preferred_types	list	A list indicating the order of the preferred types to use. First item is most preferred.	[]
protected_modules	list	A list of modules in the environmnet modules that are protected against unloading	[]
queue_report_interval	int	Interval in which to report the number of queued jobs (default is 0, no reporting)	0
reporting_plugins	list	The reporting plugins to use, is a list of all plugins to be activated	['SimpleReport']
resources-dir	str	Directory containing the fastr system resources	$systemdir/resources
schemadir	str	Directory containing the fastr data schemas	$systemdir/schemas
source_job_limit	int	The number of source jobs allowed to run concurrently	0
systemdir	str	Fastr installation directory	Directory of the top-level fastr package
tools_path	list	Directories to scan for tools	['$userdir/tools', '$resourcedir/tools']
types_path	list	Directories to scan for datatypes	['$userdir/datatypes', '$resourcedir/datatypes']
userdir	str	Fastr user configuration directory	$FASTRHOME or ~/.fastr
warn_develop	bool	Warning users on import if this is not a production version of fastr	True
web_hostname	str	The hostname to expose the web app for	'localhost'

Note: This tables only includes the fastr default config fields, but not the fields added by plugins. For information

look at the appropriate plugin reference. For the built-in fastr plugins they can be found at the *plugin reference*

1.5.2 `Tool` description

`Tools` are the building blocks in the fastr network. To add new *`Tools`* to fastr, XML/json files containing a *`Tool`* definition can be added. These files have the following layout:

Attribute			Description
`id`			The id of this Tool (used internally in fastr)
`name`			The name of the Tool, for human readability
`version`			The version of the Tool wrapper (not the binary)
`url`			The url of the Tool wrapper
`authors[]`			List of authors of the Tools wrapper
	`name`		Name of the author
	`email`		Email address of the author
	`url`		URL of the website of the author
`tags`	`tag[]`		List of tags describing the Tool
`command`			Description of the underlying command
	`version`		Version of the tool that is wrapped
	`url`		Website where the tools that is wrapped can be obtained
	`targets[]`		Description of the target binaries/script of this Tool
		`os`	OS targeted (windows, linux, macos or * (for any)
		`arch`	Architecture targeted 32, 64 or * (for any)
		`...`	Extra variables based on the target used, see *Targets*
	`description`		Description of the Tool
	`license`		License of the Tool, either full license or a clear name (e.g. LGPL, GPL v2)
	`authors[]`		List of authors of the Tool (not the wrapper!)
		`name`	Name of the authors
		`email`	Email address of the author
		`url`	URL of the website of the author
`interface`			The interface definition see *Interfaces*
`help`			Help text explaining the use of the Tool
`cite`			Bibtext of the Citation(s) to reference when using this Tool for a publication

1.6 Plugin Reference

In this chapter we describe the different plugins bundled with Fastr (e.g. IOPlugins, ExecutionPlugins). The reference is build automatically from code, so after installing a new plugin the documentation has to be rebuild for it to be included in the docs.

1.6.1 CollectorPlugin Reference

`CollectorPlugins` are used for finding and collecting the output data of outputs part of a `FastrInterface`

scheme	`CollectorPlugin`
JsonCollector	*JsonCollector*
PathCollector	*PathCollector*
StdoutCollector	*StdoutCollector*

JsonCollector

The JsonCollector plugin allows a program to print out the result in a pre-defined JSON format. It is then used as values for fastr.

The working is as follows:

1. The location of the output is taken
2. If the location is `None`, go to step 5
3. The substitutions are performed on the location field (see below)
4. The location is used as a regular expression and matched to the stdout line by line
5. The matched string (or entire stdout if location is `None`) is `loaded as a json`
6. The data is parsed by `set_result`

The structure of the JSON has to follow the a predefined format. For normal `Nodes` the format is in the form:

```
[value1, value2, value3]
```

where the multiple values represent the cardinality.

For a `FlowNodes` the format is the form:

```
{
  'sample_id1': [value1, value2, value3],
  'sample_id2': [value4, value5, value6]
}
```

This allows the tool to create multiple output samples in a single run.

PathCollector

The PathCollector plugin for the FastrInterface. This plugin uses the location fields to find data on the filesystem. To use this plugin the method of the output has to be set to `path`

The general working is as follows:

1. The location field is taken from the output
2. The substitutions are performed on the location field (see below)
3. The updated location field will be used as a regular expression filter
4. The filesystem is scanned for all matching files/directory

The special substitutions performed on the location use the Format Specification Mini-Language Format Specification Mini-Language. The predefined fields that can be used are:

- `inputs`, an objet with the input values (use like `{inputs.image[0]}`) The input contains the following attributes that you can access:
  - `.directory` for the directory name (use like `input.image[0].directory`) The directory is the same as the result of `os.path.dirname`
  - `.filename` is the result of `os.path.basename` on the path
  - `.basename` for the basename name (use like `input.image[0].basename`) The basename is the same as the result of `os.path.basename` and the extension stripped. The extension is considered to be everything after the first dot in the filename.
  - `.extension` for the extension name (use like `input.image[0].extension`)
- `output`, an object with the output values (use like `{outputs.result[0]}`) It contains the same attributes as the input
  - `special.cardinality`, the index of the current cardinality
  - `special.extension`, is the extension for the output DataType

Example use:

```
<output ... method="path" location="{output.directory[0]}/TransformParameters.
↪{special.cardinality}.{special.extension}"/>
```

Given the output directory `./nodeid/sampleid/result`, the second sample in the output and filetype with a `txt` extension, this would be translated into:

```
<output ... method="path" location="./nodeid/sampleid/result/TransformParameters.1.
↪txt>
```

StdoutCollector

The StdoutCollector can collect data from the stdout stream of a program. It filters the `stdout` line by line matching a predefined regular expression.

The general working is as follows:

1. The location field is taken from the output
2. The substitutions are performed on the location field (see below)
3. The updated location field will be used as a regular expression filter

4. The `stdout` is scanned line by line and the regular expression filter is applied

The special substitutions performed on the location use the Format Specification Mini-Language Format Specification Mini-Language. The predefined fields that can be used are:

- `inputs`, an objet with the input values (use like `{inputs.image[0]}`)
- `outputs`, an object with the output values (use like `{outputs.result[0]}`)
- `special` which has two subfields:
  - `special.cardinality`, the index of the current cardinality
  - `special.extension`, is the extension for the output DataType

Note: because the plugin scans line by line, it is impossible to catch multi-line output into a single value

1.6.2 ExecutionPlugin Reference

This class is the base for all Plugins to execute jobs somewhere. There are many methods already in place for taking care of stuff.

There are fall-backs for certain features, but if a system already implements those it is usually preferred to skip the fall-back and let the external system handle it. There are a few flags to enable disable these features:

- `cls.SUPPORTS_CANCEL` indicates that the plugin can cancel queued jobs
- `cls.SUPPORTS_HOLD_RELEASE` indicates that the plugin can queue jobs in a hold state and can release them again (if not, the base plugin will create a hidden queue for held jobs). The plugin should respect the `Job.status == JobState.hold` when queueing jobs.
- `cls.SUPPORTS_DEPENDENCY` indicate that the plugin can manage job dependencies, if not the base plugin job dependency system will be used and jobs with only be submitted when all dependencies are met.
- `cls.CANCELS_DEPENDENCIES` indicates that if a job is cancelled it will automatically cancel all jobs depending on that job. If not the plugin traverse the dependency graph and kill each job manual.

  Note: If a plugin supports dependencies it is assumed that when a job gets cancelled, the depending job also get cancelled automatically!

Most plugins should only need to redefine a few abstract methods:

- `__init__` the constructor
- `cleanup` a clean up function that frees resources, closes connections, etc
- `_queue_job` the method that queues the job for execution

Optionally an extra job finished callback could be added:

- `_job_finished` extra callback for when a job finishes

If `SUPPORTS_CANCEL` is set to True, the plugin should also implement:

- `_cancel_job` cancels a previously queued job

If `SUPPORTS_HOLD_RELEASE` is set to True, the plugin should also implement:

- `_hold_job` hold_job a job that is currently held
- `_release_job` releases a job that is currently held

If `SUPPORTED_DEPENDENCY` is set to True, the plugin should:

- Make sure to use the `Job.hold_jobs` as a list of its dependencies

Not all of the functions need to actually do anything for a plugin. There are examples of plugins that do not really need a `cleanup`, but for safety you need to implement it. Just using a `pass` for the method could be fine in such a case.

Warning: When overwriting other functions, extreme care must be taken not to break the plugins working, as there is a lot of bookkeeping that can go wrong.

scheme	`ExecutionPlugin`
BlockingExecution	*BlockingExecution*
DRMAAExecution	*DRMAAExecution*
LinearExecution	*LinearExecution*
ProcessPoolExecution	*ProcessPoolExecution*

BlockingExecution

The blocking execution plugin is a special plugin which is meant for debug purposes. It will not queue jobs but immediately execute them inline, effectively blocking fastr until the Job is finished. It is the simplest execution plugin and can be used as a template for new plugins or for testing purposes.

DRMAAExecution

A DRMAA execution plugin to execute Jobs on a Grid Engine cluster. It uses a configuration option for selecting the queue to submit to. It uses the python `drmaa` package.

Note: To use this plugin, make sure the `drmaa` package is installed and that the execution is started on an SGE submit host with DRMAA libraries installed.

Note: This plugin is at the moment tailored to SGE, but it should be fairly easy to make different subclasses for different DRMAA supporting systems.

Configuration fields

The following configuration fields are added to the fastr config:

name	type	description	default
drmaa_queue	str	The default queue to use for jobs send to the scheduler	'week'
drmaa_max_jobs	int	The maximum jobs that can be send to the scheduler at the same time (0 for no limit)	0
drmaa_engine	str	The engine to use (options: grid_engine, torque	'grid_engine'
drmaa_job_check_interval	int	The interval in which the job checker will start to check for stale jobs	900
drmaa_num_undetermined_to_fail	int	Number of consecutive times a job state has be undetermined to be considered to have failed	3

LinearExecution

An execution engine that has a background thread that executes the jobs in order. The queue is a simple FIFO queue and there is one worker thread that operates in the background. This plugin is meant as a fallback when other plugins do not function properly. It does not multi-processing so it is safe to use in environments that do no support that.

ProcessPoolExecution

A local execution plugin that uses multiprocessing to create a pool of worker processes. This allows fastr to execute jobs in parallel with true concurrency. The number of workers can be specified in the fastr configuration, but the default amount is the `number of cores - 1` with a minimum of `1`.

Warning: The ProcessPoolExecution does not check memory requirements of jobs and running many workers might lead to memory starvation and thus an unresponsive system.

Configuration fields

The following configuration fields are added to the fastr config:

name	type	description	default
process_pool_worker_number	int	Number of workers to use in a process pool	1

1.6.3 FlowPlugin Reference

Plugin that can manage an advanced data flow. The plugins override the execution of node. The execution receives all data of a node in one go, so not split per sample combination, but all data on all inputs in one large payload. The flow plugin can then re-order the data and create resulting samples as it sees fits. This can be used for all kinds of specialized data flows, e.g. cross validation.

To create a new FlowPlugin there is only one method that needs to be implemented: `execute`.

scheme	`FlowPlugin`
CrossValidation	*CrossValidation*

CrossValidation

Advanced flow plugin that generated a cross-validation data flow. The node need an input with data and an input number of folds. Based on that the outputs test and train will be supplied with a number of data sets.

1.6.4 IOPlugin Reference

`IOPlugins` are used for data import and export for the sources and sinks. The main use of the *`IOPlugins`* is during execution (see *Execution*). The *`IOPlugins`* can be accessed via `fastr.ioplugins`, but generally there should be no need for direct interaction with these objects. The use of is mainly via the URL used to specify source and sink data.

scheme	`IOPlugin`
CommaSeperatedValueFile	*CommaSeperatedValueFile*
FileSystem	*FileSystem*
HTTPPlugin	*HTTPPlugin*
Null	*Null*
Reference	*Reference*
S3Filesystem	*S3Filesystem*
VirtualFileSystem	*VirtualFileSystem*
VirtualFileSystemRegularExpression	*VirtualFileSystemRegularExpression*
VirtualFileSystemValueList	*VirtualFileSystemValueList*
XNATStorage	*XNATStorage*

CommaSeperatedValueFile

The CommaSeperatedValueFile an expand-only type of IOPlugin. No URLs can actually be fetched, but it can expand a single URL into a larger amount of URLs.

The `csv://` URL is a `vfs://` URL with a number of query variables available. The URL mount and path should point to a valid CSV file. The query variable then specify what column(s) of the file should be used.

The following variable can be set in the query:

variable	usage
value	the column containing the value of interest, can be int for index or string for key
id	the column containing the sample id (optional)
header	indicates if the first row is considered the header, can be `true` or `false` (optional)
delimiter	the delimiter used in the csv file (optional)
quote	the quote character used in the csv file (optional)
reformat	a reformatting string so that `value = reformat.format(value)` (used before relative_path)
relative_path	indicates the entries are relative paths (for files), can be `true` or `false` (optional)

The header is by default `false` if the neither the `value` and `id` are set as a string. If either of these are a string, the header is required to define the column names and it automatically is assumed `true`

The delimiter and quota characters of the file should be detected automatically using the `Sniffer`, but can be forced by setting them in the URL.

Example of valid `csv` URLs:

```
# Use the first column in the file (no header row assumed)
csv://mount/some/dir/file.csv?value=0

# Use the images column in the file (first row is assumed header row)
csv://mount/some/dir/file.csv?value=images

# Use the segmentations column in the file (first row is assumed header row)
# and use the id column as the sample id
csv://mount/some/dir/file.csv?value=segmentations&id=id

# Use the first column as the id and the second column as the value
# and skip the first row (considered the header)
csv://mount/some/dir/file.csv?value=1&id=0&header=true
```

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```
# Use the first column and force the delimiter to be a comma
csv://mount/some/dir/file.csv?value=0&delimiter=,
```

FileSystem

The FileSystem plugin is create to handle `file://` type or URLs. This is generally not a good practice, as this is not portable over between machines. However, for test purposes it might be useful.

The URL scheme is rather simple: `file://host/path` (see wikipedia for details)

We do not make use of the `host` part and at the moment only support localhost (just leave the host empty) leading to `file:///` URLs.

Warning: This plugin ignores the hostname in the URL and does only accept driver letters on Windows in the form `c:/`

HTTPPlugin

Warning: This Plugin is still under development and has not been tested at all. example url: https://server.io/path/to/resource

Null

The Null plugin is create to handle `null://` type or URLs. These URLs are indicating the sink should not do anything. The data is not written to anywhere. Besides the scheme, the rest of the URL is ignored.

Reference

The Reference plugin is create to handle `ref://` type or URLs. These URLs are to make the sink just write a simple reference file to the data. The reference file contains the DataType and the value so the result can be reconstructed. It for files just leaves the data on disk by reference. This plugin is not useful for production, but is used for testing purposes.

S3Filesystem

Warning: As this IOPlugin is under development, it has not been thoroughly tested.

example url: s3://bucket.server/path/to/resource

VirtualFileSystem

The virtual file system class. This is an IOPlugin, but also heavily used internally in fastr for working with directories. The VirtualFileSystem uses the `vfs://` url scheme.

A typical virtual filesystem url is formatted as `vfs://mountpoint/relative/dir/from/mount.ext`

Where the `mountpoint` is defined in the *Config file*. A list of the currently known mountpoints can be found in the `fastr.config` object

```
>>> fastr.config.mounts
{'example_data': '/home/username/fastr-feature-documentation/fastr/fastr/examples/data
↪',
 'home': '/home/username/',
 'tmp': '/home/username/FastrTemp'}
```

This shows that a url with the mount `home` such as `vfs://home/tempdir/testfile.txt` would be translated into `/home/username/tempdir/testfile.txt`.

There are a few default mount points defined by Fastr (that can be changed via the config file).

mountpoint	default location
home	the users home directory (`expanduser('~/')`)
tmp	the fastr temprorary dir, defaults to `tempfile.gettempdir()`
example_data	the fastr example data directory, defaults `$FASTRDIR/example/data`

VirtualFileSystemRegularExpression

The VirtualFileSystemValueList an expand-only type of IOPlugin. No URLs can actually be fetched, but it can expand a single URL into a larger amount of URLs.

A `vfsregex://` URL is a vfs URL that can contain regular expressions on every level of the path. The regular expressions follow the `re module` definitions.

An example of a valid URLs would be:

```
vfsregex://tmp/network_dir/.*/.*/__fastr_result__.pickle.gz
vfsregex://tmp/network_dir/nodeX/(?P<id>.*)/__fastr_result__.pickle.gz
```

The first URL would result in all the `__fastr_result__.pickle.gz` in the working directory of a Network. The second URL would only result in the file for a specific node (nodeX), but by adding the named group `id` using `(?P<id>.*)` the sample id of the data is automatically set to that group (see Regular Expression Syntax under the special characters for more info on named groups in regular expression).

Concretely if we would have a directory `vfs://mount/somedir` containing:

```
image_1/Image.nii
image_2/image.nii
image_3/anotherimage.nii
image_5/inconsistentnamingftw.nii
```

we could match these files using `vfsregex://mount/somedir/(?P<id>image_\d+)/.*\.nii` which would result in the following source data after expanding the URL:

```
{'image_1': 'vfs://mount/somedir/image_1/Image.nii',
 'image_2': 'vfs://mount/somedir/image_2/image.nii',
 'image_3': 'vfs://mount/somedir/image_3/anotherimage.nii',
 'image_5': 'vfs://mount/somedir/image_5/inconsistentnamingftw.nii'}
```

Showing the power of this regular expression filtering. Also it shows how the ID group from the URL can be used to have sensible sample ids.

Warning: due to the nature of regexp on multiple levels, this method can be slow when having many matches on the lower level of the path (because the tree of potential matches grows) or when directories that are parts of the path are very large.

VirtualFileSystemValueList

The VirtualFileSystemValueList an expand-only type of IOPlugin. No URLs can actually be fetched, but it can expand a single URL into a larger amount of URLs. A `vfslist://` URL basically is a url that points to a file using vfs. This file then contains a number lines each containing another URL.

If the contents of a file `vfs://mount/some/path/contents` would be:

```
vfs://mount/some/path/file1.txt
vfs://mount/some/path/file2.txt
vfs://mount/some/path/file3.txt
vfs://mount/some/path/file4.txt
```

Then using the URL `vfslist://mount/some/path/contents` as source data would result in the four files being pulled.

Note: The URLs in a vfslist file do not have to use the `vfs` scheme, but can use any scheme known to the Fastr system.

XNATStorage

Warning: As this IOPlugin is under development, it has not been thoroughly tested.

The XNATStorage plugin is an IOPlugin that can download data from and upload data to an XNAT server. It uses its own `xnat://` URL scheme. This is a scheme specific for this plugin and though it looks somewhat like the XNAT rest interface, a different type or URL.

Data resources can be access directly by a data url:

```
xnat://xnat.example.com/data/archive/projects/sandbox/subjects/subject001/experiments/
↪experiment001/scans/T1/resources/DICOM
xnat://xnat.example.com/data/archive/projects/sandbox/subjects/subject001/experiments/
↪*_BRAIN/scans/T1/resources/DICOM
```

In the second URL you can see a wildcard being used. This is possible at long as it resolves to exactly one item.

The `id` query element will change the field from the default experiment to subject and the `label` query element sets the use of the label as the fastr id (instead of the XNAT id) to `True` (the default is `False`)

To disable `https` transport and use `http` instead the query string can be modified to add `insecure=true`. This will make the plugin send requests over `http`:

```
xnat://xnat.example.com/data/archive/projects/sandbox/subjects/subject001/experiments/
↪*_BRAIN/scans/T1/resources/DICOM?insecure=true
```

For sinks it is import to know where to save the data. Sometimes you want to save data in a new assessor/resource and it needs to be created. To allow the Fastr sink to create an object in XNAT, you have to supply the type as a query parameter:

```
xnat://xnat.bmia.nl/data/archive/projects/sandbox/subjects/S01/experiments/_BRAIN/
↪assessors/test_assessor/resources/IMAGE/files/image.nii.gz?resource_
↪type=xnat:resourceCatalog&assessor_type=xnat:qcAssessmentData
```

Valid options are: subject_type, experiment_type, assessor_type, scan_type, and resource_type.

If you want to do a search where multiple resources are returned, it is possible to use a search url:

```
xnat://xnat.example.com/search?projects=sandbox&subjects=subject[0-9][0-9][0-9]&
↪experiments=*_BRAIN&scans=T1&resources=DICOM
```

This will return all DICOMs for the T1 scans for experiments that end with _BRAIN that belong to a subjectXXX where XXX is a 3 digit number. By default the ID for the samples will be the experiment XNAT ID (e.g. XNAT_E00123). The wildcards that can be the used are the same UNIX shell-style wildcards as provided by the module `fnmatch`.

It is possible to change the id to a different fields id or label. Valid fields are project, subject, experiment, scan, and resource:

```
xnat://xnat.example.com/search?projects=sandbox&subjects=subject[0-9][0-9][0-9]&
↪experiments=*_BRAIN&scans=T1&resources=DICOM&id=subject&label=true
```

The following variables can be set in the search query:

variable	default	usage
projects	`*`	The project(s) to select, can contain wildcards (see `fnmatch`)
subjects	`*`	The subject(s) to select, can contain wildcards (see `fnmatch`)
experiments	`*`	The experiment(s) to select, can contain wildcards (see `fnmatch`)
scans	`*`	The scan(s) to select, can contain wildcards (see `fnmatch`)
resources	`*`	The resource(s) to select, can contain wildcards (see `fnmatch`)
id	`experiment`	What field to use a the id, can be: project, subject, experiment, scan, or resource
label	`false`	Indicate the XNAT label should be used as fastr id, options `true` or `false`
insecure	`false`	Change the url scheme to be used to http instead of https
verify	`true`	(Dis)able the verification of SSL certificates
regex	`false`	Change search to use regex `re.match()` instead of fnmatch for matching
overwrite	`false`	Tell XNAT to overwrite existing files if a file with the name is already present

For storing credentials the `.netrc` file can be used. This is a common way to store credentials on UNIX systems. It is required that the file is only accessible by the owner only or a `NetrcParseError` will be raised. A netrc file is really easy to create, as its entries look like:

```
machine xnat.example.com
        login username
        password secret123
```

See the `netrc module` or the GNU inet utils website for more information about the `.netrc` file.

Note: On windows the location of the netrc file is assumed to be `os.path.expanduser('~/_netrc')`. The leading underscore is because windows does not like filename starting with a dot.

Note: For scan the label will be the scan type (this is initially the same as the series description, but can be updated manually or the XNAT scan type cleanup).

Warning: labels in XNAT are not guaranteed to be unique, so be careful when using them as the sample ID.

For background on XNAT, see the XNAT API DIRECTORY for the REST API of XNAT.

1.6.5 Interface Reference

Abstract base class of all Interfaces. Defines the minimal requirements for all Interface implementations.

scheme	`Interface`
FastrInterface	*FastrInterface*
FlowInterface	*FlowInterface*
NipypeInterface	*NipypeInterface*

FastrInterface

The default Interface for fastr. For the command-line Tools as used by fastr. It build a commandline call based on the input/output specification.

The fields that can be set in the interface:

Attribute		Description
`id`		The id of this Tool (used internally in fastr)
`inputs[]`		List of Inputs that can are accepted by the Tool
	`id`	ID of the Input
	`name`	Longer name of the Input (more human readable)
	`datatype`	The ID of the DataType of the Input[1]
	`enum[]`	List of possible values for an EnumType (created on the fly by fastr)[1]
	`prefix`	Commandline prefix of the Input (e.g. –in, -i)
	`cardinality`	Cardinality of the Input
	`repeat_prefix`	Flag indicating if for every value of the Input the prefix is repeated
	`required`	Flag indicating if the input is required
	`nospace`	Flag indicating if there is no space between prefix and value (e.g. –in=val)
	`format`	For DataTypes that have multiple representations, indicate which one to use

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Table 1.1 – continued from previous page

Attribute		Description
	`default`	Default value for the Input
	`description`	Long description for an input
`outputs[]`		List of Outputs that are generated by the Tool (and accessible to fastr)
	`id`	ID of the Output
	`name`	Longer name of the Output (more human readable)
	`datatype`	The ID of the DataType of the Output[1]
	`enum[]`	List of possible values for an EnumType (created on the fly by fastr)[1]
	`prefix`	Commandline prefix of the Output (e.g. –out, -o)
	`cardinality`	Cardinality of the Output
	`repeat_prefix`	Flag indicating if for every value of the Output the prefix is repeated
	`required`	Flag indicating if the input is required
	`nospace`	Flag indicating if there is no space between prefix and value (e.g. –out=val)
	`format`	For DataTypes that have multiple representations, indicate which one to use
	`description`	Long description for an input
	`action`	Special action (defined per DataType) that needs to be performed before creating output value (e.g. 'ensure' will make sure an output directory exists)
	`automatic`	Indicate that output doesn't require commandline argument, but is created automatically by a Tool[2]
	`method`	The collector plugin to use for the gathering automatic output, see the *Collector plugins*
	`location`	Definition where to an automatically, usage depends on the `method`[2]

[1] `datatype` and `enum` are conflicting entries, if both specified `datatype` has presedence
[2] More details on defining automatica output are given in [TODO]

FlowInterface

The Interface use for AdvancedFlowNodes to create the advanced data flows that are not implemented in the fastr. This allows nodes to implement new data flows using the plugin system.

The definition of `FlowInterfaces` are very similar to the default `FastrInterfaces`.

Note: A flow interface should be using a specific FlowPlugin

NipypeInterface

Experimental interfaces to using `nipype` interfaces directly in fastr tools, only using a simple reference.

To create a tool using a nipype interface just create an interface with the correct type and set the `nipype` argument to the correct class. For example in an xml tool this would become:

```
<interface class="NipypeInterface">
  <nipype_class>nipype.interfaces.elastix.Registration</nipype_class>
</interface>
```

Note: To use these interfaces `nipype` should be installed on the system.

Warning: This interface plugin is basically functional, but highly experimental!

1.6.6 ReportingPlugin Reference

Base class for all reporting plugins. The plugin has a number of methods that can be implemented that will be called on certain events. On these events the plugin can inspect the presented data and take reporting actions.

scheme	`ReportingPlugin`
ElasticsearchReporter	*ElasticsearchReporter*
PimReporter	*PimReporter*
SimpleReport	*SimpleReport*

ElasticsearchReporter

NOT DOCUMENTED!

Configuration fields

The following configuration fields are added to the fastr config:

name	type	description	default
elasticsearch_host	str	The elasticsearch host to report to	''
elasticsearch_index	str	The elasticsearch index to store data in	'fastr'
elasticsearch_debug	bool	Setup elasticsearch debug mode to send stdout stderr on job succes	False

PimReporter

NOT DOCUMENTED!

Configuration fields

The following configuration fields are added to the fastr config:

name	type	description	default
pim_host	str	The PIM host to report to	''
pim_username	str	Username to send to PIM	Username of the currently logged in user
pim_update_interval	float	The interval in which to send jobs to PIM	2.5
pim_batch_size	int	Maximum number of jobs that can be send to PIM in a single interval	100
pim_debug	bool	Setup PIM debug mode to send stdout stderr on job success	False
pim_finished_timeout	int	Maximum number of seconds after the network finished in which PIM tries to synchronize all remaining jobs	10

SimpleReport

NOT DOCUMENTED!

1.6.7 Target Reference

The abstract base class for all targets. Execution with a target should follow the following pattern:

```
>>> with Target() as target:
...     target.run_commmand(['sleep', '10'])
```

The Target context operator will set the correct paths/initialization. Within the context command can be ran and when leaving the context the target reverts the state before.

scheme	`Target`
DockerTarget	*DockerTarget*
LocalBinaryTarget	*LocalBinaryTarget*
MacroTarget	*MacroTarget*
SingularityTarget	*SingularityTarget*

DockerTarget

A tool target that is located in a Docker images. Can be run using docker-py. A docker target only need two variables: the binary to call within the docker container, and the docker container to use.

```
{
  "arch": "*",
  "os": "*",
  "binary": "bin/test.py",
  "docker_image": "fastr/test"
}
```

```
<target os="*" arch="*" binary="bin/test.py" docker_image="fastr/test">
```

LocalBinaryTarget

A tool target that is a local binary on the system. Can be found using environmentmodules or a path on the executing machine. A local binary target has a number of fields that can be supplied:

- `binary (required)`: the name of the binary/script to call, can also be called `bin` for backwards compatibility.
- `modules`: list of modules to load, this can be environmentmodules or lmod modules. If modules are given, the `paths`, `environment_variables` and `initscripts` are ignored.
- `paths`: a list of paths to add following the structure `{"value": "/path/to/dir", "type": "bin"}`. The types can be `bin` if the it should be added to $PATH or `lib` if it should be added to te library path (e.g. $LD_LIBRARY_PATH for linux).
- `environment_variables`: a dictionary of environment variables to set.
- `initscript`: a list of script to run before running the main tool
- `interpreter`: the interpreter to use to call the binary e.g. `python`

The LocalBinaryTarget will first check if there are modules given and the module subsystem is loaded. If that is the case it will simply unload all current modules and load the given modules. If not it will try to set up the environment itself by using the following steps:

1. Prepend the bin paths to $PATH
2. Prepend the lib paths to the correct environment variable
3. Setting the other environment variables given ($PATH and the system library path are ignored and cannot be set that way)
4. Call the initscripts one by one

The definition of the target in JSON is very straightforward:

```
{
  "binary": "bin/test.py",
  "interpreter": "python",
  "paths": [
    {
      "type": "bin",
      "value": "vfs://apps/test/bin"
    },
    {
      "type": "lib",
      "value": "./lib"
    }
  ],
  "environment_variables": {
    "othervar": 42,
    "short_var": 1,
    "testvar": "value1"
  },
  "initscripts": [
    "bin/init.sh"
  ],
```

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```
  "modules": ["elastix/4.8"]
}
```

In XML the definition would be in the form of:

```
<target os="linux" arch="*" modules="elastix/4.8" bin="bin/test.py" interpreter=
↪"python">
  <paths>
    <path type="bin" value="vfs://apps/test/bin" />
    <path type="lib" value="./lib" />
  </paths>
  <environment_variables short_var="1">
    <testvar>value1</testvar>
    <othervar>42</othervar>
  </environment_variables>
  <initscripts>
    <initscript>bin/init.sh</initscript>
  </initscripts>
</target>
```

MacroTarget

A target for MacroNodes. This target cannot be executed as the MacroNode handles execution differently. But this contains the information for the MacroNode to find the internal Network.

SingularityTarget

A tool target that is run using a singularity container, see the singulary website

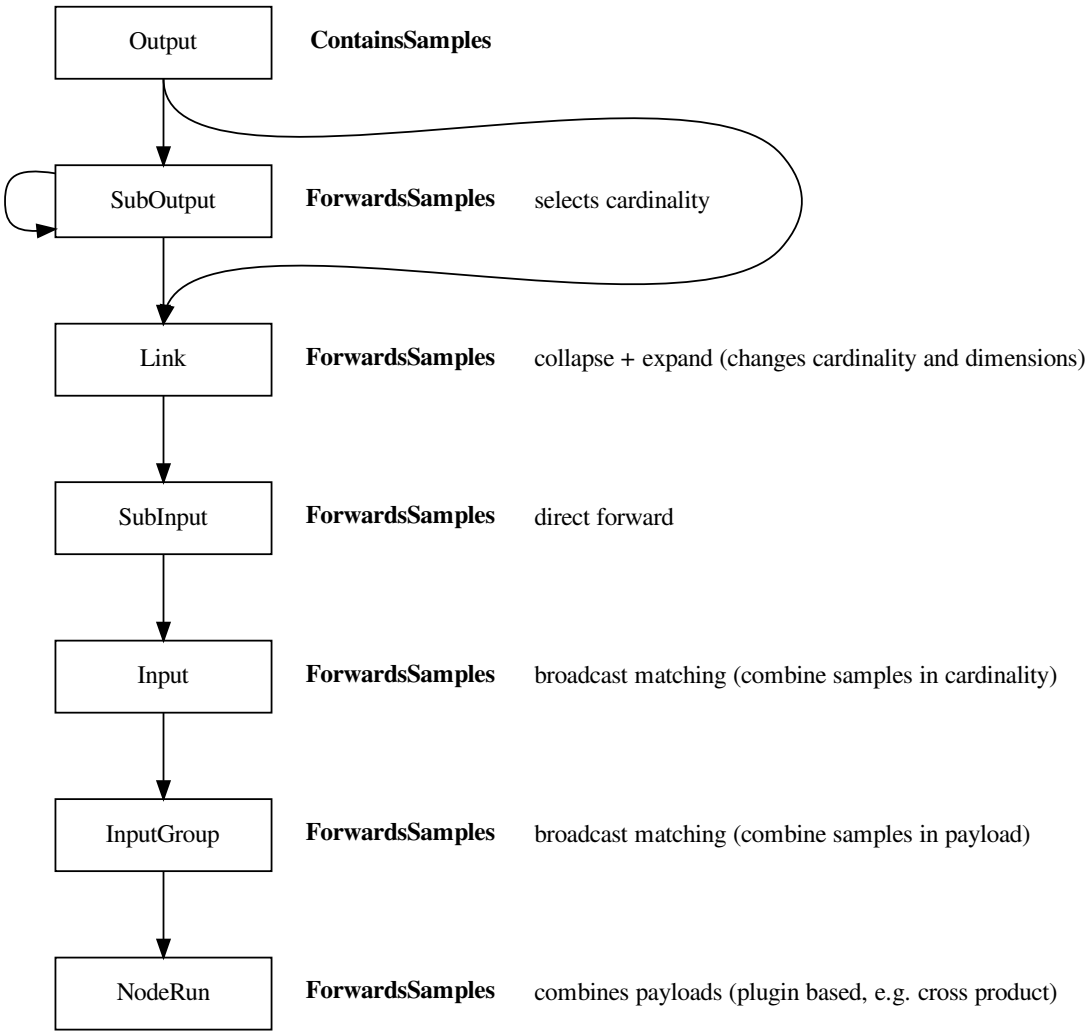
- `binary (required)`: the name of the binary/script to call, can also be called `bin` for backwards compatibility.
- **`container (required)`: the singularity container to run, this can be in url form for singularity** pull or as a path to a local container
- `interpreter`: the interpreter to use to call the binary e.g. `python`

1.7 Development and Design Documentation

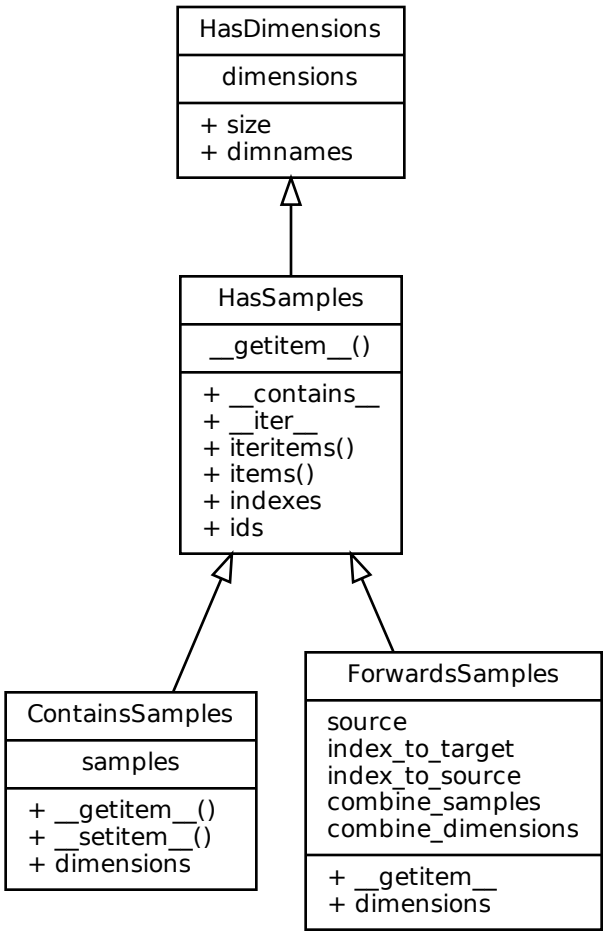
In this chapter we will discuss the design of Fastr in more detail. We give pointers for development and add the design documents as we currently envision Fastr. This is both for people who are interested in the Fastr develop and for current developers to have an archive of the design decision agreed upon.

1.7.1 Sample flow in Fastr

The current Sample flow is the following:



The idea is that we make a common interface for all classes that are related to the flow of Samples. For this we propose the following mixin classes that provide the interface and allow for better code sharing. The basic structure of the classes is given in the following diagram:



The abstract and mixin methods are as follows:

ABC	Inherits from	Abstract Methods	Mixin methods
`HasDimensions`		`dimensions`	`size` `dimnames`

`HasSamples`	`HasDimensions`	`__getitem__`	`__contains__`
			`__iter__`
			`iteritems`
			`items`
			`indexes`
			`ids`

`ContainsSamples`	`HasSamples`	`samples`	`__getitem__`
			`__setitem__`
			`dimensions`

`ForwardsSamples`	`HasSamples`	`source`
		`index_to_target`
		`index_to_source`
		`combine_samples`
		`combine_dimensions`
			`__getitem__`
			`dimensions`

Note: Though the flow is currently working like this, the mixins are not yet created.

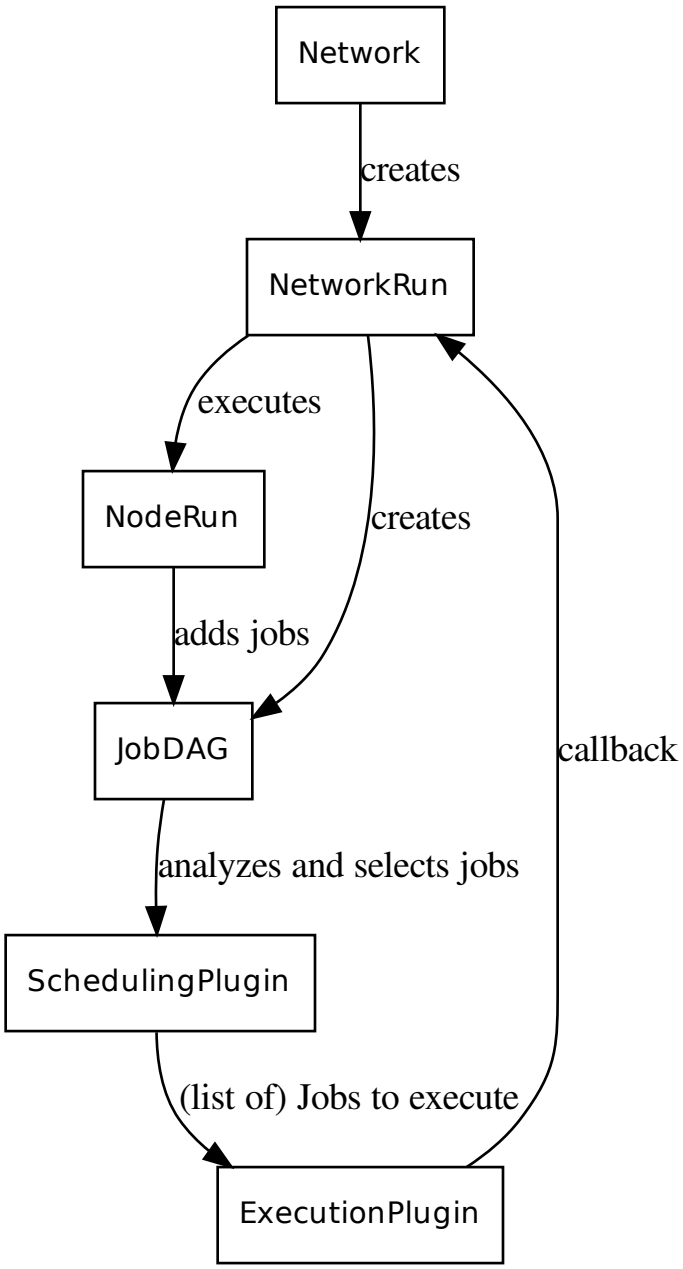
1.7.2 Network Execution

The network execution should contain a number of steps:

- `Network`
  - Creates a `NetworkRun` based on the current layout
- `NetworkRun`
  - Transform the `Network` (possibly joining Nodes of certain interface into a combined NodeRun etc)
  - Start generation of the Job Direct Acyclic Graph (DAG)
- `SchedulingPlugin`
  - Prioritize Jobs based on some predefined rules
  - Combine certain `Jobs` to improve efficiency (e.g. minimize i/o on a grid)
- `ExecutionPlugin`

- Run a (list of) `Jobs`. If there is more than one jobs, run them sequentially on same execution host using a local temp for intermediate files.
- On finished callback: Updated DAG with newly ready jobs, or remove cancelled jobs

This could be visualized as the following loop:



The callback of the `ExecutionPlugin` to the `NetworkRun` would trigger the execution of the relevant `NodeRuns` and the addition of more `Jobs` to the `JobDAG`.

Note: The Job DAG should be thread-safe as it could be both read and extended at the same time.

Note: If a list of jobs is send to the `ExecutionPlugin` to be run as on Job on an external execution platform, the resources should be combined as follows: memory=max, cores=max, runtime=sum

Note: If there are execution hosts that have mutliple cores the `ExecutionPlugin` should manage this (for example by using pilot jobs). The `SchedulingPlugin` creates units that should be run sequentially on the resources noted and will not attempt parallelization

A `NetworkRun` would be contain similar information as the `Network` but not have functionality for editting/changing it. It would contain the functionality to execute the Network and track the status and samples. This would allow `Network.execute` to create multiple concurent runs that operate indepent of each other. Also editting a `Network` after the run started would have no effect on that run.

Note: This is a plan, not yet implemented

Note: For this to work, it would be important for a Jobs to have forward and backward dependency links.

SchedulingPlugins

The idea of the plugin is that it would give a priority on Jobs created by a `Network`. This could be done based on different strategies:

- Based on (sorted) sample id's, so that one sample is always prioritized over others. The idea is that samples are process as much as possible in order, finishing the first sample first. Only processing other samples if there is left-over capacity.
- Based on distance to a (particular) `Sink`. This is to generate specific results as quick as possible. It would not focus on specific samples, but give priority to whatever sample is closest to being finished.
- Based on the distance to from a `Souce`. Based on the sign of the weight it would either keep all samples on the same stage as much as possible, only progressing to a new `NodeRun` when all samples are done with the previous `NodeRun`, or it would push samples with accelerated rates.

Additionally it will group `Jobs` to be executed on a single host. This could reduce i/o and limited the number of jobs an external scheduler has to track.

Note: The interface for such a plugin has not yet been established.

1.7.3 Secrets

"Something that is kept or meant to be kept unknown or unseen by others."

Using secrets

Fastr IOPlugins that need authentication data should use the Fastr SecretService for retrieving such data. The SecretService can be used as follows.

```
from fastr.utils.secrets import SecretService
from fastr.utils.secrets.exceptions import CouldNotRetrieveCredentials

secret_service = SecretService()

try:
  password = secret_service.find_password_for_user('testserver.lan:9000', 'john-doe')
except CouldNotRetrieveCredentials:
  # the password was not found
  pass
```

Implementing a SecretProvider

A SecretProvider is implemented as follows:

1. Create a file in fastr/utils/secrets/providers/<yourprovidername>.py
2. Use the template below to write your SecretProvider
3. Add the secret provider to fastr/utils/secrets/providers/__init__.py
4. Add the secret provider to fastr/utils/secrets/secretservice.py: import it and add it to the array in function _init_providers

```
from fastr.utils.secrets.secretprovider import SecretProvider
from fastr.utils.secrets.exceptions import CouldNotRetrieveCredentials,␣
↪CouldNotSetCredentials, CouldNotDeleteCredentials, NotImplemented


try:
  # this is where libraries can be imported
  # we don't want fastr to crash if a specific
  # library is unavailable
  # import my-libary
except (ImportError, ValueError) as e:
  pass

class KeyringProvider(SecretProvider):
  def __init__(self):
    # if libraries are imported in the code above
    # we need to check if import was succesfull
    # if it was not, raise a RuntimeError
    # so that FASTR ignores this SecretProvider
    # if 'my-library' not in globals():
    #   raise RuntimeError("my-library module required")
    pass
```

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```
  def get_password_for_user(self, machine, username):
    # This function should return the password as a string
    # or raise a CouldNotRetrieveCredentials error if the password
    # is not found.
    # In the event that this function is unsupported a
    # NotImplemented exception should be thrown
    raise NotImplemented()

  def set_password_for_user(self, machine, username, password):
    # This function should set the password for a specified
    # machine + user. If anything goes wrong while setting
    # the password a CouldNotSetCredentials error should be raised.
    # In the event that this function is unsupported a
    # NotImplemented exception should be thrown
    raise NotImplemented()

  def del_password_for_user(self, machine, username):
    # This function should delete the password for a specified
    # machine + user. If anything goes wrong while setting
    # the password a CouldNotDeleteCredentials error should be raised.
    # In the event that this function is unsupported a
    # NotImplemented exception should be thrown
    raise NotImplemented()
```

1.8 Changelog

All notable changes to this project will be documented in this file.

The format is based on Keep a Changelog and this project adheres to Semantic Versioning

1.8.1 3.2.0 - 2020-06-19

Changed

- Changed serialization in Fastr. Networks and Jobs have a better format and are serialized to yaml by default. This makes the job files human readable.

1.8.2 3.1.4 - 2020-06-10

Added

- Added functionality to be able to use the cardinality of one of the items in an ordereddict input or output.
- Added dependency list function to the Network API.

1.8.3 3.1.3 - 2019-11-28

Added

- Support for FASTR_CONFIG_DIRS to add extra configuration directories (they will be loaded in order after the config.d directory has been loaded).

Improved

- The DRMAA execution plugin is more robust and less likely to encounter errors that will cause the execution to become stuck.

Fixed

- Bugs in file:// IOPlugin

1.8.4 3.1.2 - 2019-06-18

Improved

- Avoid execution plugins calling cleanup multiple times
- Tools can now set an input to environment variables using the environ attribute. The parameter will NOT be put command-line anymore and instead be dispatched via an environment variable given by the environ argument value

Fixed

- Bug in XNATStorage plugin where files with a path within the resource could not be correctly located
- Add timeout when waiting to send to PIM
- Fix problem with non-requested outputs being able to invalidate a job execution

1.8.5 3.1.1 - 2019-05-02

Fixed

- Packaging problem in release (old file left in build folder)

1.8.6 3.1.0 - 2019-05-02

Added

- Added support for tools in YAML
- `fastr upgrade` can also upgrade tools from XML to YAML
- `fastr report` command to print an overview report of a job result

Fixed

- Re-added support for named sub-inputs

Improved

- Fixes in `fastr upgrade` to handle more exotic whitespace and arguments
- Small documentation fixes (especially in configuration section)
- Better windows support (tested by users)

Changed

- In ResourceLimits the default time of jobs is now None (no limit) instead of 1 hour.
- By default do not log to files (we noticed fastr logs are not very often read by users and they could cause some issues with log rotation, by default logging to files is turned off, switching it back on can be done by setting `log_to_file = True` in the fastr.config

1.8.7 3.0.1 - 2019-03-28

Fixed

- Improved implementation of `fastr upgrade` to handle newlines in the `create_node` function properly. Also can handle old-fashioned use of fastr.toollist[...] in create_node.

1.8.8 3.0.0 - 2019-03-05

Changed

- Now ported to Python 3.6+ (Python 2 is no longer supported!)
- New public API which is not fully compatible with fastr 2.x, the changes are small. The new API will be guaranteed in next minor version upgrades and is considered to be stable.
- Clear way of defining resource limits for Nodes in a Network using the ResourceLimit class.
- The datatype and cardinality of inputs of a tool are now checked before the tool is to be executed as an extra safety.
- Dimensions are drawn by default in network.draw
- The api now accepts types other than Output, list, tuple when creating a link. When a single value is given it is assumedly a constant from the network definition.
- Drawing a network will not create temporary .dot files anymore
- Sinkdata can be a string, it that case it will be the same string for all sink nodes so a {node} substitution should be used in the template
- Make the xnat ioplugin use xnat+http:// and xnat+https:// url schemes in favour of xnat:// with ?insecure=... (old behaviour will also work for now)
- Complete rewrite of PIM plugin (PIMReporter) making use of the new Reporter plugin infrastructure. It also caches all communication with PIM to be resilient against connection interruptions.

Added

- `fastr upgrade` command to automatically upgrade a network creation file from fastr 2.x to fastr 3.x API.
- http(s) IOPlugin for downloading files via http(s)
- network.draw now has a flag to hide the unconnected inputs and output of a node. The unconnected inputs/outputs are hidden by default.
- Reporting plugins, Fastr now exposes a number of message hooks which can be listened to by Reporter plugins.

Fixed

- Fixed some bugs with drmaa communication (more safeties added)
- Fixed a bug in the MacroNode update function which could cause networks with MacroNodes to be invalid
- The margins and font size of the network.draw graph rendering are set a bit wider and smaller (resp.) to avoid excessive text overflow.
- Fixed bug in provenance which did not properly chain the provenance of subsequent jobs.

1.8.9 2.1.2 - 2018-10-24

Added

- Allow overriding the timestamp of the network execution

Changed

- Updated PIM publisher to support the new PIM API v2
- Updated XNAT IOPlugin to not crash when creating a resource failed because another process already did that (race condition)
- Make default resource limits for DRMAA configurable
- Add stack trace to FastrExceptions

1.8.10 2.1.1 - 2018-06-29

Fixed

- Fixed some issues with the type estimation of outputs of Jobs and update validation functions of NIFTI files

1.8.11 2.1.0 - 2018-04-13

Added

- SLURM execution plugin based on `sbatch`, `scancel`, `scontrol` and `squeue`. The plugin supports job dependencies and cancellation.
- Support for running tools in Docker containers using a DockerTarget
- Support for running tools in Singularity containers using a SingularityTarget
- Support for datatypes with multiple extensions (e.g. .tif and .tiff) by setting the extension to a tuple of options. The first extension is leading for deciding filenames in a sink.

Changed

- Source jobs now also validate the output (and do not only rely on the stderr of the tool)
- Added preferred_types attribute to TypeGroups that gives the order of preference of members, alternatively the order of _members is used (this should be given as tuple or list to be meaningful)
- In the config.py you can now access the USER_DIR and SYSTEM_DIR variables for use in setting other variables. These are only read and changing them will only change subsequent config reads but not the main config values.
- checksum for nii.gz now takes the md5 checksum of the decompressed data
- Serialization of MacroNodes now should function properly

Fixed

- BUG in XNAT plugin that made it impossible to download data from scans without an empty type string
- BUG where the order of OrderedDict in a source was not preserved
- BUG where newer Werkzeug version requires the web port to be an integer

1.8.12 2.0.1 - 2017-10-19

- Fix a bug in the validation of FilePrefix datatypes

1.8.13 2.0.0 - 2017-09-28

Added

- The default python logger can now be configured from the fastr config file under key logging_config
- Support for MacroNodes, a Network can be used as a Node inside of another Network. There is should be no limitation on the internal Network used, but currently the MacroNode ignores input_groups on its inputs.
- A sync helper was added to assist in slow file synchronisation over NFS
- Source and Sink can now handle S3 URL's
- FastrInterface can now forward errors from a subprocess if they are dumped to stdout or stderr in a json identified by `__FASTR_ERRORS__ = []`.

- A `specials.workdir` field in the location field of automatic outputs that gives the current working directory (e.g. job directory)
- Added support for Torque (using pbs-drmaa library) to DRMAAExecution
- Added option to set a limit for number of jobs submitted at same time be the DRMAAExecution
- Use of the ~/.fastr/config.d directory for adding additional config files. Any `.py` file in there will be parsed in alphabetical order.
- XNATStorage IOPlugin now has a retry scheme for uploads, if an uploaded file could not be found on the server, it is retried up to 3 times.
- Added `fastr dump` command to create a zip containing all important debugging information.

Changed

- FilePrefix type does not have an extension anymore (avoids ugly dot in middle of filename)
- Allow expanding of link where samples have a non-uniform cardinality. This will not result in a sparse array.
- The default for `required` for the automatic outputs is now `False`
- Removed `testtool` commandline subcommand in favour of the `test` subcommand which can test both Tools and Networks
- Moved nodegroup specification into the Node for speedup

Fixed

- Stop Jobs from failing when a non-required, non-requested output is invalid
- Bug in boolean value parsing in the Boolean datatype
- Bug in target that caused paths not to be expanded properly in some cases
- Made sure failed sources also create a sample so the failure becomes visible and traceable.
- Bug in XNAT IOPlugin that made download from XNAT seem to fail (while getting the correct data).

Removed

- `fastr.current_network` has been removed as it was deemed to "magical" and could change things out of the sight of the user.

1.8.14 1.2.2 - 2017-08-24

Fixed

- Fixed a bug breaking the XNAT IOPlugin due to an xnatpy version update.

1.8.15 1.2.1 - 2017-04-04

Added

- A FastrInterface can now specify a `negate` flag on an automatic output that also has a prefix, which will negate the flag. This is useful for flag the suppress the creation of an output (e.g. no_mask). An example is given in the Tool `fastr.util.AutoPrefixNegateTest`.

Changed

- The provenance and extra information of a Job now is not serialized in the Job, but exported to separate files next to the job file __fastr_prov__.json and __fastr_extra_job_info__.json which makes the information more accessible and reduces the memory footprint of the main process hugely as it will not read this information back anymore.
- Most execution plugin will not overwrite the executionscript stdout and stderr but rather append it. This is only relevant when continuing a run in the an existing temporary directory, but avoids loss of information.

Fixed

- Bug that stopped the `Link.append` function from returning the newly created link
- Bugs that caused some cardinality computations of the output to fail during execution
- Bug in the job.tmpurl that caused double slashes somewhere. Some tools chocked on this when it was used for parameters.

1.8.16 1.2.0 - 2017-03-15

Added

- Failed sample annotation: when a job fails, the result is annotated and forwarded until a SinkNode, where we can determine the status and possibly point of failure of the Sample.
- Commandline tool `fastr trace` that can inspect a workflow run and help trace errors and print debug information
- Supported for Lmod modules environment next to the old environmentmodules
- BaseDataType descendants are now (un)picklable (including EnumTypes)
- Option to use `{extension}` field in sink_data, which differs from `{ext}` in that it doesn't include a leading dot.
- Support for Docker targets. A Docker target will execute a command inside of a specified docker container, allowing Tools to use Docker for distribution
- Using the right and left shift operator (<< and >>) for creating links to `Inputs` using `input << output` or `output >> input`.
- In the FastrInterfaces, automatic outputs can have a prefix for a flag that should be set for the output to be actually generated.
- Fastr is now able to limit the amount of SourceJobs that are allowed to run concurrently.
- Ability to report progress to PIM (use the pim_host field in the config)

Changed

- Version can now also accept a format based on a date (e.g. 2017-02-17_bananas) which will be parsed the same way as 2017.02.17_bananas
- Work on the ExecutionPlugin and the corresponding API. Has better fall-backs and a mechanism to advertise plugin capabilities.
- The collector plugins have the `input` and `input_parts` fields merged, and the `output` and `output_parts` fields merged.

Fixed

- In some cases the log directory was not created properly, causing an handled exception
- A bug making the handling of Booleans incorrect for the FastrInterface, when a Boolean was given a flag would also appear when it was False
- Serialization of the namespace of a Network was not correct
- Check version of Fastr that creates and executes a Job against each other
- load_gpickle helper can handle data with Enums that use to cause an AttributeError
- Output validation of Jobs did not work correctly for automatic outputs

1.8.17 1.1.2 - 2016-12-22

Fixed

- The example network in resources/networks/add_ints.json was using an old serialization format making it non-functions. Replaced by a new network file.

1.8.18 1.1.1 - 2016-12-22

Fixed

- Network runs called from an interpreter (and not file) caused a crash because the network tried to report the file used. Better handling of these situations.

1.8.19 1.1.0 - 2016-12-08

Added

- Namespaces for resources (tools and networks)
- Network manager located at `fastr.networklist`
- RQExecution plugin. This plugin uses python-rq to manage a job queue.
- LinearExecution plugin. This plugin uses a background thread for execution.
- BlockingExecution plugin. This plugin executes jobs in a blocking fashion.
- Automatic generation of documentation for all plugins, the configuration fields and all commandline tools.

Changed

- Provenance is updated with a network dump and used tool definitions.
- New configuration system that uses python files
- New plugin system that integrates with the new configuration system and enables automatic importing of plugins
- The fastr command line tools now use an entrypoint which is located in `fastr.utils.cmd`. This code also dispatches the sub commands.

Removed

- fastr.config file. This is replaced by the config.py file. Go to the docs!

Fixed

- Adds explicit tool namespace and version to the provenance document.

CHAPTER

TWO

FASTR USER REFERENCE

2.1 Fastr User Reference

`fastr.tools`
A ToolManager containing all versions of all Tools loaded into the FASTR environment. The ToolManager can be indexed using the Tool id string or a tool id string and a version. For example if you have two versions (4.5 and 4.8) of a tool called *Elastix*:

```
>>> fastr.tools['elastix.Elastix']
Tool Elastix v4.8 (Elastix Registration)
                          Inputs                                    |            ␣
↪Outputs
------------------------------------------------------------------------------------
↪----------------
fixed_image        (ITKImageFile)                                   |  directory␣
↪(Directory)
moving_image       (ITKImageFile)                                   |  transform␣
↪(ElastixTransformFile)
parameters         (ElastixParameterFile)                           |  log_file ␣
↪(ElastixLogFile)
fixed_mask         (ITKImageFile)                                   |
moving_mask        (ITKImageFile)                                   |
initial_transform  (ElastixTransformFile)                           |
priority           (__Elastix_4.8_interface__priority__Enum__)      |
threads            (Int)                                            |

>>> fastr.tools['elastix.Elastix', '4.5']
Tool Elastix v4.5 (Elastix Registration)
                          Inputs                                    |            ␣
↪Outputs
------------------------------------------------------------------------------------
↪----------------
fixed_image        (ITKImageFile)                                   |  directory␣
↪(Directory)
moving_image       (ITKImageFile)                                   |  transform␣
↪(ElastixTransformFile)
parameters         (ElastixParameterFile)                           |  log_file ␣
↪(ElastixLogFile)
fixed_mask         (ITKImageFile)                                   |
moving_mask        (ITKImageFile)                                   |
initial_transform  (ElastixTransformFile)                           |
priority           (__Elastix_4.5_interface__priority__Enum__)      |
threads            (Int)                                            |
```

fastr.**types**
A dictionary containing all types loaded into the FASTR environment. The keys are the typenames and the values are the classes.

fastr.**networks**
A dictionary containing all networks loaded in fastr

fastr.api.**create_network**(*version=None*)
Create a new Network object

Parameters

- **id** (str) – id of the network
- **version** (Union[*Version*, str, None]) – version of the network

Return type *Network*

Returns

fastr.api.**create_network_copy**()
Create a network based on another Network state. The network state can be a Network or the state gotten from a Network with __getstate__.

Parameters **network_state** (Union[*Network*, *Network*, dict]) – Network (state) to create a copy of

Return type *Network*

Returns The rebuilt network

class fastr.api.**Network**(*id*, *version=None*)
Representation of a Network for the creating and adapting Networks

create_constant(*datatype*, *data*, *id=None*, *step_id=None*, *resources=None*, *node_group=None*)
Create a ConstantNode in this Network. The Node will be automatically added to the Network.

Parameters

- **datatype** (Union[*BaseDataType*, str]) – The DataType of the constant node
- **data** (Dict[str, Union[List[Union[str, Tuple[str, ...]]], Dict[str, Union[str, Tuple[str, ...]]]]]) – The data to hold in the constant node
- **id** (Optional[str]) – The id of the constant node to be created
- **step_id** (Optional[str]) – The step to add the created constant node to
- **resources** (Optional[*ResourceLimit*]) – The resources required to run this node
- **node_group** (Optional[str]) – The group the node belongs to, this can be important for FlowNodes and such, as they will have matching dimension names.

Return type *Node*

Returns the newly created constant node

create_link(*source*, *target*, *id=None*, *collapse=None*, *expand=False*)
Create a link between two Nodes and add it to the current Network.

Parameters

- **source** (Union[*Input*, *BaseInput*]) – the output that is the source of the link
- **target** (Union[*Output*, *BaseOutput*]) – the input that is the target of the link
- **id** (Optional[str]) – the id of the link

- **collapse** (Optional[Tuple[Union[int, str], ...]]) – The dimensions to collapse in this link.
- **expand** (bool) – Flag to expand cardinality into a new dimension

Return type *Link*

Returns the created link

create_macro(*network*, *id=None*)

Create macro node (a node which actually contains a network used as node inside another network).

Parameters

- **network** (Union[*Network*, *Network*, dict, *Tool*, str]) – The network to use, this can be a network (state), a macro tool, or the path to a python file that contains a function create_network which returns the desired network.
- **id** (Optional[str]) – The id of the node to be created

Return type *Node*

Returns the newly created node

create_node(*tool*, *tool_version*, *id=None*, *step_id=None*, *resources=None*, *node_group=None*)

Create a Node in this Network. The Node will be automatically added to the Network.

Parameters

- **tool** (Union[*Tool*, str]) – The Tool to base the Node on in the form: `name/space/toolname:version`
- **tool_version** (str) – The version of the tool wrapper to use
- **id** (Optional[str]) – The id of the node to be created
- **step_id** (Optional[str]) – The step to add the created node to
- **resources** (Optional[*ResourceLimit*]) – The resources required to run this node
- **node_group** (Optional[str]) – The group the node belongs to, this can be important for FlowNodes and such, as they will have matching dimension names.

Return type *Node*

Returns the newly created node

create_sink(*datatype*, *id=None*, *step_id=None*, *resources=None*, *node_group=None*)

Create a SinkNode in this Network. The Node will be automatically added to the Network.

Parameters

- **datatype** (Union[*BaseDataType*, str]) – The DataType of the sink node
- **id** (Optional[str]) – The id of the sink node to be created
- **step_id** (Optional[str]) – The step to add the created sink node to
- **resources** (Optional[*ResourceLimit*]) – The resources required to run this node
- **node_group** (*str*) – The group the node belongs to, this can be important for FlowNodes and such, as they will have matching dimension names.

Return type *Node*

Returns the newly created sink node

create_source(*datatype*, *id=None*, *step_id=None*, *resources=None*, *node_group=None*)
Create a SourceNode in this Network. The Node will be automatically added to the Network.

Parameters

- **datatype** (BaseDataType) – The DataType of the source source_node
- **id** (*str*) – The id of the source source_node to be created
- **step_id** (*str*) – The step to add the created source source_node to
- **resources** (Optional[*ResourceLimit*]) – The resources required to run this node
- **node_group** (*str*) – The group the node belongs to, this can be important for FlowNodes and such, as they will have matching dimension names.

Returns the newly created source source_node

Return type SourceNode

draw(*file_path=None*, *draw_dimensions=True*, *hide_unconnected=True*, *expand_macros=1*, *font_size=14*)
Draw a graphical representation of the Network

Parameters

- **file_path** (*str*) – The path of the file to create, the extension will control the image type
- **draw_dimensions** (*bool*) – Flag to control if the dimension sizes should be drawn in the figure, default is true
- **expand_macros** (*bool*) – Flag to control if and how macro nodes should be expanded, by default 1 level is expanded

Return type Optional[str]

Returns path of the image created or None if failed

execute(*source_data*, *sink_data*, *tmpdir=None*, *timestamp=None*, *blocking=True*, *execution_plugin=None*)
Execute the network with the given source and sink data.

Parameters

- **source_data** (Dict[str, Union[List[Union[str, Tuple[str, ...]]], Dict[str, Union[str, Tuple[str, ...]]]]]) – Source data to use as an input
- **sink_data** (Union[str, Dict[str, str]]) – Sink rules to use for determining the outputs
- **tmpdir** (Optional[str]) – The scratch directory to use for this network run, if an existing directory is given, fastr will try to resume a network run (see *Continuing a Network*)
- **timestamp** (Union[datetime, str, None]) – The timestamp of the network run (useful for retrying or continuing previous runs)
- **blocking** (bool) – Flag to indicate if the execution should be blocking or launched in a background thread
- **execution_plugin** (Optional[str]) – The execution plugin to use for this run

Return type *NetworkRun*

Returns The network run object for the started execution

property id
The unique id describing this resource

Return type str

classmethod load(*filename*)
Load Network froma file

Parameters **filename** (*str*) –

Returns loaded network

Return type *Network*

save(*filename*, *indent=2*)
Save the Network to a JSON file

Parameters

- **filename** (str) – Path of the file to save to
- **indent** (int) – Indentation to use (None for no indentation)

property version
Version of the Network (so users can keep track of their version)

Return type *Version*

class fastr.api.**Link**(*parent*)
Representation of a link for editing the Network

property collapse
The dimensions which the link will collapse into the cardinality

Return type Tuple[Union[int, str], ...]

property expand
Flag that indicates if the Link will expand the cardinality into a new dimension.

Return type bool

property id
The unique id describing this resource

Return type str

class fastr.api.**Node**(*parent*)
Representation of Node for editing the Network

property id
The unique id describing this resource

Return type str

property input
In case there is only a single Inputs in a Node, this can be used as a short hand. In that case it is basically the same as `list(node.inputs.values()[0])`.

Return type *Input*

property inputs
Mapping object containing all Inputs of a Node

Return type InputMap

property output
In case there is only a single Outputs in a Node, this can be used as a short hand. In that case it is basically the same as `list(node.outputs.values()[0])`.

Return type *Output*

property outputs
Mapping object containing all Outputs of a Node

Return type SubObjectMap[*Output*]

class fastr.api.**Input**(*parent*)
Representation of an Input of a Node

__lshift__(*other*)
This operator allows the easy creation of Links to this Input using the << operator. Creating links can be done by:

```
# Generic form
>> link = input << output
>> link = input << ['some', 'data']  # Create a constant node

# Examples
>> link1 = addint.inputs['left_hand'] << source1.input
>> link2 = addint.inputs['right_hand'] << [1, 2, 3]

# Mutliple links
>> links = addints.inputs['left_hand'] << (source1.output, source2.output,␣
↪source3.output)
```

The last example would return a tuple with three links.

Parameters **other** (Union[*Output*, *BaseOutput*, list, dict, tuple]) – the target to create the link from, this can be an Output, a tuple of Outputs, or a data structure that can be used as the data for a ConstantNode

Return type Union[*Link*, Tuple[*Link*, ...]]

Returns Newly created link(s)

__rrshift__(*other*)
This operator allows to use the >> operator as alternative to using the << operator. See the *__lshift__ operator* for details.

Parameters **other** (Union[*Output*, *BaseOutput*, list, dict, tuple]) – the target to create the link from

Return type Union[*Link*, Tuple[*Link*, ...]]

Returns Newly created link(s)

append(*value*)
Create a link from give resource to a new SubInput.

Parameters **value** (Union[*Output*, *BaseOutput*, list, dict, tuple]) – The source for the link to be created

Return type *Link*

Returns The newly created link

property id
The unique id describing this resource

Return type str

property input_group
The input group of this Input. This property can be read and changed. Changing the input group of an Input will influence the data flow in a Node (see *Advanced flows in a Node* for details).

Return type str

class fastr.api.**Output**(*parent*)
Representation of an Output of a Node

__getitem__(*item*)
Get a SubOuput of this Ouput. The SubOutput selects some data from the parent Output based on an index or slice of the cardinalty.

Parameters **key** – the key of the requested item, can be an index or slice

Return type *Output*

Returns the requested SubOutput with a view of the data in this Output

property id
The unique id describing this resource

Return type str

CHAPTER

THREE

FASTR DEVELOPER MODULE REFERENCE

3.1 fastr Package

3.1.1 `fastr` Package

Initialize self. See help(type(self)) for accurate signature.

`fastr.__init__.__dir__()` → list
default dir() implementation

`fastr.__init__.__format__()`
default object formatter

`fastr.__init__.__init_subclass__()`
This method is called when a class is subclassed.

The default implementation does nothing. It may be overridden to extend subclasses.

`fastr.__init__.__new__(*args, **kwargs)`
Create and return a new object. See help(type) for accurate signature.

`fastr.__init__.__reduce__()`
helper for pickle

`fastr.__init__.__reduce_ex__()`
helper for pickle

`fastr.__init__.__sizeof__()` → int
size of object in memory, in bytes

`fastr.__init__.__subclasshook__()`
Abstract classes can override this to customize issubclass().

This is invoked early on by abc.ABCMeta.__subclasscheck__(). It should return True, False or NotImplemented. If it returns NotImplemented, the normal algorithm is used. Otherwise, it overrides the normal algorithm (and the outcome is cached).

3.1.2 exceptions Module

This module contains all Fastr-related Exceptions

exception fastr.exceptions.**FastrAttributeError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*, AttributeError

AttributeError in the fastr system

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrCannotChangeAttributeError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

Attempting to change an attribute of an object that can be set only once.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrCardinalityError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

The description of the cardinality is not valid.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrCollectorError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

Cannot collect the results from a Job because of an error

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrDataTypeFileNotReadable**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

Could not read the datatype file.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrDataTypeMismatchError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

When using a DataType as the key for the DataTypeManager, the DataTypeManager found another DataType with the same name already in the DataTypeManager. The means fastr has two version of the same DataType in the system, which should never happen!

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrDataTypeNotAvailableError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

The DataType requested is not found by the fastr system. Typically this means that no matching DataType is found in the DataTypeManager.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrDataTypeNotInstantiableError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

The base classes for DataTypes cannot be instantiated and should always be sub-classed.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrDataTypeValueError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

This value in fastr did not pass the validation specificied for its DataType, typically means that the data is missing or corrupt.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrError**(**args*, ***kwargs*)
Bases: Exception

This is the base class for all fastr related exceptions. Catching this class of exceptions should ensure a proper execution of fastr.

__init__(**args*, ***kwargs*)
Constructor for all exceptions. Saves the caller object fullid (if found) and the file, function and line number where the object was created.

__module__ = 'fastr.exceptions'

__repr__()
String representation of the error

Returns error representation

Return type str

__str__()
String value of the error

Returns error string

Return type str

__weakref__
list of weak references to the object (if defined)

excerpt()
Return a excerpt of the Error as a tuple.

exception fastr.exceptions.**FastrErrorInSubprocess**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrExecutionError*

Encountered an error in the subprocess started by the execution script

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrExecutableNotFoundError**(*executable=None*, **args*, ***kwargs*)
Bases: *fastr.exceptions.FastrExecutionError*

The executable could not be found!

__init__(*executable=None*, **args*, ***kwargs*)
Constructor for all exceptions. Saves the caller object fullid (if found) and the file, function and line number where the object was created.

__module__ = 'fastr.exceptions'

__str__()
String representation of the error

exception fastr.exceptions.**FastrExecutionError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

Base class for all fastr execution related errors

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrFileNotFound**(*filepath*, *message=None*)
Bases: *fastr.exceptions.FastrError*

Could not find an expected file

__init__(*filepath*, *message=None*)
Constructor for all exceptions. Saves the caller object fullid (if found) and the file, function and line number where the object was created.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrIOError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*, OSError

IOError in the fastr system

__module__ = 'fastr.exceptions'

__weakref__
list of weak references to the object (if defined)

exception fastr.exceptions.**FastrImportError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*, ImportError

ImportError in the fastr system

__module__ = 'fastr.exceptions'

__weakref__
list of weak references to the object (if defined)

exception fastr.exceptions.**FastrIndexError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*, IndexError

IndexError in the fastr system

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrIndexNonexistent**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrIndexError*

This is an IndexError for samples requested from a sparse data array. The sample is not there but is probably not there because of sparseness rather than being a missing sample (e.g. out of bounds).

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrKeyError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*, KeyError

KeyError in the fastr system

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrLockNotAcquired**(*directory*, *message=None*)
Bases: *fastr.exceptions.FastrError*

Could not lock a directory

__init__(*directory*, *message=None*)
Constructor for all exceptions. Saves the caller object fullid (if found) and the file, function and line number where the object was created.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrLookupError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

Could not find specified object in the fastr environment.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrMountUnknownError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrKeyError*

Trying to access an undefined mount

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrNetworkMismatchError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

Two interacting objects belong to different fastr network.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrNetworkUnknownError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrKeyError*

Reference to a Tool that is not recognised by the fastr system. This typically means the specific id/version combination of the requested tool has not been loaded by the ToolManager.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrNoValidTargetError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrKeyError*

Cannot find a valid target for the tool

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrNodeAreadyPreparedError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrStateError*

A attempt is made at preparing a NodeRun for the second time. This is not allowed as it would wipe the current execution data and cause data-loss.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrNodeNotPreparedError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrStateError*

When trying to access executation data of a NodeRun, the NodeRun must be prepare. The NodeRun has not been prepared by the execution, so the data is not available!

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrNodeNotValidError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrStateError*

A NodeRun is not in a valid state where it should be, typically an invalid NodeRun is passed to the executor causing trouble.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrNotExecutableError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrExecutionError*

The command invoked by subprocess is not executable on the system

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrNotImplementedError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*, NotImplementedError

This function/method has not been implemented on purpose (e.g. should be overwritten in a sub-class)

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrOSError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*, OSError

OSError in the fastr system

__module__ = 'fastr.exceptions'

__weakref__
list of weak references to the object (if defined)

exception fastr.exceptions.**FastrObjectUnknownError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrKeyError*

Reference to a Tool that is not recognised by the fastr system. This typically means the specific id/version combination of the requested tool has not been loaded by the ToolManager.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrOptionalModuleNotAvailableError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrNotImplementedError*

A optional modules for Fastr is needed for this function, but is not available on the current python installation.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrOutputValidationError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrExecutionError*

An output of a Job does not pass validation

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrParentMismatchError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

Two interactive objects have different parent where they should be the same

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrPluginCapabilityNotImplemented**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrNotImplementedError*

A plugin did not implement a capability that it advertised.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrPluginNotAvailable**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrKeyError*

Indicates that a requested Plugin was not found on the system.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrPluginNotLoaded**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrStateError*

The plugin was not successfully loaded. This means the plugin class cannot be instantiated.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrResultFileNotFound**(*filepath*, *message=None*)
Bases: *fastr.exceptions.FastrFileNotFound*, *fastr.exceptions.FastrExecutionError*

Could not found the result file of job that finished. This means the executionscript process was killed during interruption. Generally this means a scheduler killed it because of resource shortage.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrScriptNotFoundError**(*interpreter=None*, *script=None*, *paths=None*, **args*, ***kwargs*)
Bases: *fastr.exceptions.FastrExecutionError*

Script could not be found

__init__(*interpreter=None*, *script=None*, *paths=None*, **args*, ***kwargs*)
Constructor for all exceptions. Saves the caller object fullid (if found) and the file, function and line number where the object was created.

__module__ = 'fastr.exceptions'

__str__()
String value of the error

Returns error string

Return type str

exception fastr.exceptions.**FastrSerializationError**(*message*, *serializer*, *original_exception=None*)
Bases: *fastr.exceptions.FastrError*

The serialization encountered a serious problem

__init__(*message*, *serializer*, *original_exception=None*)
Constructor for all exceptions. Saves the caller object fullid (if found) and the file, function and line number where the object was created.

__module__ = 'fastr.exceptions'

__repr__()
Simple string representation of the exception

__str__()
Advanced string representation of the exception including the data about where in the schema things went wrong.

exception fastr.exceptions.**FastrSerializationIgnoreDefaultError**(*message*, *serializer*, *original_exception=None*)
Bases: *fastr.exceptions.FastrSerializationError*

The value and default are both None, so the value should not be serialized.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrSerializationInvalidDataError**(*message*, *serializer*, *original_exception=None*)
Bases: *fastr.exceptions.FastrSerializationError*

Encountered data to serialize that is invalid given the serialization schema.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrSerializationMethodError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrKeyError*

The desired serialization method does not exist.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrSinkDataUnavailableError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrKeyError*

Could not find the Sink data for the desire sink.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrSizeInvalidError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

The given size cannot be valid.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrSizeMismatchError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

The size of two object in fastr is not matching where it should.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrSizeUnknownError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

The size of object is not (yet) known and only a theoretical estimate is available at the moment.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrSourceDataUnavailableError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrKeyError*

Could not find the Source data for the desire source.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrStateError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

An object is in an invalid/unexpected state.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrSubprocessNotFinished**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrExecutionError*

Encountered an error before the subprocess call by the execution script was properly finished.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrToolNotAvailableError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

The tool used is not available on the current platform (OS and architecture combination) and cannot be used.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrToolTargetNotFound**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

Could not determine the location of the tools target binary/script. The tool cannot be used.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrToolUnknownError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrKeyError*

Reference to a Tool that is not recognised by the fastr system. This typically means the specific id/version combination of the requested tool has not been loaded by the ToolManager.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrToolVersionError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*

Version mismatch, usually the installed tool version and version requested by the network mismatch.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrTypeError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*, TypeError

TypeError in the fastr system

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrUnknownURLSchemeError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrKeyError*

Fastr encountered a data URL with a scheme that was not recognised by the IOPlugin manager.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrValueError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrError*, ValueError

ValueError in the fastr system

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrVersionInvalidError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrValueError*

The string representation of the version is malformatted.

__module__ = 'fastr.exceptions'

exception fastr.exceptions.**FastrVersionMismatchError**(**args*, ***kwargs*)
Bases: *fastr.exceptions.FastrValueError*

There is a mismatch between different parts of the Fastr environment and integrity is compromised.

__module__ = 'fastr.exceptions'

fastr.exceptions.**get_message**(*exception*)
Extract the message from an exception is a safe manner

Parameters **exception** (*BaseException*) – exception to extract from

Returns message string

Return type str

3.1.3 `version` Module

This module keeps track of the version of the currently used Fastr framework. It can check its version from mercurial or a saved file

`fastr.version.`**`clear_version`**`()`
Remove the cached version info

`fastr.version.`**`get_base_version`**`()`
Get the version from the top-level version file

Return type `Optional`[`str`]

Returns the version

Rtype str

`fastr.version.`**`get_hg_info`**`()`
Read information about the current mercurial branch and revision

Return type `Tuple`[`Optional`[`str`], `Optional`[`str`]]

Returns tuple containing head revision and branch

`fastr.version.`**`get_saved_version`**`()`
Get cached version from file

Return type `Tuple`[`Optional`[`str`], `Optional`[`str`], `Optional`[`str`]]

Returns tuple with version, head revision and branch

`fastr.version.`**`save_version`**(*current_version*, *current_hg_head*, *current_hg_branch*)
Cache the version information (useful for when installing)

Parameters

- **`current_version`** (*`str`*) – version
- **`current_hg_head`** (*`str`*) – mercurial head revision
- **`current_hg_branch`** (*`str`*) – mercurial branch

Returns

3.1.4 Subpackages

api Package

`api` Package

This module provides the API for fastr that users should use. This API will be considered stable between major versions. If users only interact via this API (and refrain from operating on `parent` attributes), their code should be compatible within major version of fastr.

`class` `fastr.api.`**`ResourceLimit`**(*cores=1*, *memory='2G'*, *time=None*)
Bases: `object`

`__eq__`(*other*)
Check if two resource limits are equal

Parameters **`other`** – resource limit to test against

Return type `bool`

__getstate__()

Return type dict

__hash__ = None

__init__(*cores=1*, *memory='2G'*, *time=None*)
An object describing resource requirements/limits for a node

Parameters

- **cores** (Optional[int]) – number of cores
- **memory** (Union[str, int, None]) – memory specification, can be int with number of megabytes or a string with numbers ending on M, G, T, P for megabytes, gigabytes, terrabytes or petabytes. Note that the number has to be an integer, e.g. 1500M would work, whereas 1.5G would be invalid
- **time** (Union[str, int, None]) – run time specification, this can be an int with the number of seconds or a string in the HH:MM:SS, MM:SS, or SS format. Where HH, MM, and SS are integers representing the number of hours, minutes and seconds.

__module__ = 'fastr.core.resourcelimit'

__ne__(*other*)
Check if two resource limits are not equal

Parameters **other** – resource limit to test against

Return type bool

__setstate__(*state*)

__slots__ = ('_cores', '_memory', '_time')

copy()
Return a copy of current resource limit object

Return type *ResourceLimit*

property cores
The required number of gpus

Return type int

property memory
The required memory in megabytes

Return type int

property time
The required time in seconds

Return type int

fastr.api.**create_network**(*id*, *version=None*)
Create a new Network object

Parameters

- **id** (str) – id of the network
- **version** (Union[*Version*, str, None]) – version of the network

Return type *Network*

Returns

fastr.api.**create_network_copy**(*network_state*)
Create a network based on another Network state. The network state can be a Network or the state gotten from a Network with __getstate__.

Parameters **network_state** (Union[*Network*, *Network*, dict]) – Network (state) to create a copy of

Return type *Network*

Returns The rebuilt network

core Package

core Package

This module contains all of the core components of fastr. It has the classes to create networks and work with them.

cardinality Module

class fastr.core.cardinality.**AnyCardinalitySpec**(*parent*)
Bases: *fastr.core.cardinality.CardinalitySpec*

__eq__(*other*)
Test for equality

__hash__ = None

__module__ = 'fastr.core.cardinality'

__str__()
String version of the cardinality spec, should be parseable by create_cardinality

Return type str

validate(*payload*, *cardinality*)
Validate cardinality given a payload and cardinality

Parameters

- **payload** (dict) – Payload of the corresponding job
- **cardinality** (int) – Cardinality to validate

Return type bool

Returns Validity of the cardinality given the spec and payload

class fastr.core.cardinality.**AsCardinalitySpec**(*parent*, *target*)
Bases: *fastr.core.cardinality.CardinalitySpec*

__eq__(*other*)
Test for equality

__hash__ = None

__init__(*parent*, *target*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.core.cardinality'

__str__()
String version of the cardinality spec, should be parseable by create_cardinality

Return type str

calculate_execution_cardinality(*key=None*)
Calculate the cardinality given the node and spec, during execution this should be available and not give unknowns once the data is present and the key is given.

Parameters **key** – Key for which the cardinality is calculated

Return type Optional[int]

Returns calculated cardinality

calculate_job_cardinality(*payload*)
Calculate the actually cardinality when a job needs to know how many arguments to create for a non-automatic output.

Return type Optional[int]

calculate_planning_cardinality()
Calculate the cardinality given the node and spec, for cardinalities that only have validation and not a pre-calculable value, this return None.

Parameters **node** – Node for which the cardinality is calculated

Return type Optional[int]

Returns calculated cardinality

get_ordereddict_cardinality()

get_target()

Return type str

property node

property predefined
Indicate whether the cardinality is predefined or can only be calculated after execution

class fastr.core.cardinality.**CardinalitySpec**(*parent*)
Bases: object

__dict__ = mappingproxy({'__module__': 'fastr.core.cardinality', '__init__': <functi

abstract __eq__(*other*)
Test for equality

__hash__ = None

__init__(*parent*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.core.cardinality'

__ne__(*other*)
Return self!=value.

__repr__()
Console representation of the cardinality spec

Return type str

abstract __str__()
String version of the cardinality spec, should be parseable by create_cardinality

Return type str

__weakref__
list of weak references to the object (if defined)

calculate_execution_cardinality(*key=None*)
Calculate the cardinality given the node and spec, during execution this should be available and not give unknowns once the data is present and the key is given.

Parameters **key** – Key for which the cardinality is calculated

Return type Optional[int]

Returns calculated cardinality

calculate_job_cardinality(*payload*)
Calculate the actually cardinality when a job needs to know how many arguments to create for a non-automatic output.

Return type Optional[int]

calculate_planning_cardinality()
Calculate the cardinality given the node and spec, for cardinalities that only have validation and not a pre-calculable value, this return None.

Parameters **node** – Node for which the cardinality is calculated

Return type Optional[int]

Returns calculated cardinality

property predefined
Indicate whether the cardinality is predefined or can only be calculated after execution

validate(*payload*, *cardinality*, *planning=True*)
Validate cardinality given a payload and cardinality

Parameters

- **payload** (Optional[dict]) – Payload of the corresponding job
- **cardinality** (int) – Cardinality to validate

Return type bool

Returns Validity of the cardinality given the spec and payload

class fastr.core.cardinality.**ChoiceCardinalitySpec**(*parent*, *options*)
Bases: *fastr.core.cardinality.CardinalitySpec*

__eq__(*other*)
Test for equality

__hash__ = None

__init__(*parent*, *options*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.core.cardinality'

__str__()
String version of the cardinality spec, should be parseable by create_cardinality

Return type str

class fastr.core.cardinality.**IntCardinalitySpec**(*parent*, *value*)
Bases: *fastr.core.cardinality.CardinalitySpec*

__eq__(*other*)
Test for equality

__hash__ = None

__init__(*parent*, *value*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.core.cardinality'

__str__()
String version of the cardinality spec, should be parseable by create_cardinality

Return type str

calculate_execution_cardinality(*node*)
Calculate the cardinality given the node and spec, during execution this should be available and not give unknowns once the data is present and the key is given.

Parameters **key** – Key for which the cardinality is calculated

Return type int

Returns calculated cardinality

calculate_job_cardinality(*payload*)
Calculate the actually cardinality when a job needs to know how many arguments to create for a non-automatic output.

Return type Optional[int]

calculate_planning_cardinality()
Calculate the cardinality given the node and spec, for cardinalities that only have validation and not a pre-calculable value, this return None.

Parameters **node** – Node for which the cardinality is calculated

Return type int

Returns calculated cardinality

property predefined
Indicate whether the cardinality is predefined or can only be calculated after execution

class fastr.core.cardinality.**MaxCardinalitySpec**(*parent*, *value*)
Bases: *fastr.core.cardinality.CardinalitySpec*

__eq__(*other*)
Test for equality

__hash__ = None

__init__(*parent*, *value*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.core.cardinality'

__str__()
String version of the cardinality spec, should be parseable by create_cardinality

Return type str

class fastr.core.cardinality.**MinCardinalitySpec**(*parent*, *value*)
Bases: *fastr.core.cardinality.CardinalitySpec*

__eq__(*other*)
Test for equality

__hash__ = None

__init__(*parent*, *value*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.core.cardinality'

__str__()
String version of the cardinality spec, should be parseable by create_cardinality

Return type str

class fastr.core.cardinality.**RangeCardinalitySpec**(*parent*, *min*, *max*)
Bases: *fastr.core.cardinality.CardinalitySpec*

__eq__(*other*)
Test for equality

__hash__ = None

__init__(*parent*, *min*, *max*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.core.cardinality'

__str__()
String version of the cardinality spec, should be parseable by create_cardinality

Return type str

class fastr.core.cardinality.**ValueCardinalitySpec**(*parent*, *target*)
Bases: *fastr.core.cardinality.CardinalitySpec*

__eq__(*other*)
Test for equality

__hash__ = None

__init__(*parent*, *target*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.core.cardinality'

__str__()
String version of the cardinality spec, should be parseable by create_cardinality

Return type str

calculate_execution_cardinality(*key=None*)
Calculate the cardinality given the node and spec, during execution this should be available and not give unknowns once the data is present and the key is given.

Parameters **key** – Key for which the cardinality is calculated

Return type Optional[int]

Returns calculated cardinality

calculate_job_cardinality(*payload*)
Calculate the actually cardinality when a job needs to know how many arguments to create for a non-automatic output.

Return type Optional[int]

property node

fastr.core.cardinality.**create_cardinality**(*desc*, *parent*)

Create simplified description of the cardinality. This changes the string representation to a tuple that is easier to check at a later time.

Parameters **desc** (str) – the string version of the cardinality

Parent the parent input or output to which this cardinality spec belongs

Return type *CardinalitySpec*

Returns the simplified cardinality description

Raises ***FastrCardinalityError*** – if the Input/Output has an incorrect cardinality description.

The translation works with the following table:

cardinality string	cardinality spec	description
"*", any	``('any',)	Any cardinality is allowed
"N"	('int', N)	A cardinality of N is required
"N-M"	('range', N, M)	A cardinality between N and M is required
"*-M"	('max', M)	A cardinality of maximal M is required
"N-*"	('min', N)	A cardinality of minimal N is required
"[M,N,...,O,P]"	('choice', [M,N,...,O,P])	The cardinality should one of the given options
"as:input_id"	('as', 'input_id')	The cardinality should match the cardinality of the given Input
"val:input_id"	('val', 'input_id')	The cardinliaty should match the value of the given Input

Note: The maximumu, minimum and range are inclusive

dimension Module

class fastr.core.dimension.**Dimension**(*name*, *size*)

Bases: object

A class representing a dimension. It contains the name and size of the dimension.

__eq__(*other*)

Dimension is the same if the name and size are the same

__hash__ = None

__init__(*name*, *size*)

The constructor for the dimension.

Parameters

- **name** (*str*) – Name of the dimension
- **size** (*int or Symbol*) – Size fo the dimension

__module__ = 'fastr.core.dimension'

__ne__(*other*)

The not equal test is simply the inverse of the equal test

__repr__()
String representation of a Dimension

__slots__ = ('_name', '_size')

copy()
Get a copy object of a Dimension

property name

property size

update_size(*value*)

class fastr.core.dimension.**ForwardsDimensions**
Bases: *fastr.core.dimension.HasDimensions*

Class of objects that have dimensions not because they contain data with dimensions but forward them (optionally with changes via combine_dimensions)

__abstractmethods__ = frozenset({'combine_dimensions', 'source'})

__module__ = 'fastr.core.dimension'

abstract combine_dimensions(*dimensions*)
Method to combine/manipulate the dimensions

Parameters **dimensions** – the input dimensions from the source

Returns dimensions manipulated for this object

Return type tuple of dimensions

property dimensions
The dimensions of the object based on the forwarding

abstract property source
The source object from which the dimensions are forwarded

Returns the object from which the dimensions are forwarded

Return type *HasDimensions*

class fastr.core.dimension.**HasDimensions**
Bases: object

A Mixin class for any object that has a notion of dimensions and size. It uses the dimension property to expose the dimension name and size.

__abstractmethods__ = frozenset({'dimensions'})

__dict__ = mappingproxy({'__module__': 'fastr.core.dimension', '__doc__': '\n A Mixi

__module__ = 'fastr.core.dimension'

__weakref__
list of weak references to the object (if defined)

abstract property dimensions
The dimensions has to be implemented by any subclass. It has to provide a tuple of Dimensions.

Returns dimensions

Return type tuple

property dimnames
A tuple containing the dimension names of this object. All items of the tuple are of type str.

property ndims
The number of dimensions in this object

property size
A tuple containing the size of this object. All items of the tuple are of type int or Symbol.

interface Module

A module that describes the interface of a Tool. It specifies how a set of input values will be translated to commands to be executed. This creates a generic interface to different ways of executing underlying software.

class fastr.core.interface.**InputSpec**(*id_*, *cardinality*, *datatype*, *required=False*, *description=''*, *default=None*, *hidden=False*)
Bases: *fastr.core.interface.InputSpec*

Class containing the information about an Input Specification, this is essentially a data class (but

__dict__ = mappingproxy({'__module__': 'fastr.core.interface', '__doc__': '\n Class

__module__ = 'fastr.core.interface'

static __new__(*cls*, *id_*, *cardinality*, *datatype*, *required=False*, *description=''*, *default=None*, *hidden=False*)
Create new instance of InputSpec(id, cardinality, datatype, required, description, default, hidden)

asdict()

fastr.core.interface.**InputSpecBase**
alias of *fastr.core.interface.InputSpec*

class fastr.core.interface.**Interface**
Bases: fastr.abc.baseplugin.Plugin, fastr.abc.serializable.Serializable

Abstract base class of all Interfaces. Defines the minimal requirements for all Interface implementations.

__abstractmethods__ = frozenset({'__getstate__', '__setstate__', 'execute', 'expanding

abstract __getstate__()
Retrieve the state of the Interface

Returns the state of the object

Rtype dict

__module__ = 'fastr.core.interface'

abstract __setstate__(*state*)
Set the state of the Interface

abstract execute(*target*, *payload*)
Execute the interface given the a target and payload. The payload should have the form:

```
{
  'input': {
    'input_id_a': (value, value),
    'input_id_b': (value, value)
  },
  'output': {
    'output_id_a': (value, value),
    'output_id_b': (value, value)
  }
}
```

Parameters

- **target** – the target to call
- **payload** – the payload to use

Returns the result of the execution

Return type (tuple of) *InterfaceResult*

abstract property expanding
Indicates whether or not this Interface will result in multiple samples per run. If the flow is unaffected, this will be zero, if it is nonzero it means that number of dimension will be added to the sample array.

abstract property inputs
OrderedDict of Inputs connected to the Interface. The format should be {input_id: InputSpec}.

abstract property outputs
OrderedDict of Output connected to the Interface. The format should be {output_id: OutputSpec}.

classmethod test()
Test the plugin, interfaces do not need to be tested on import

class fastr.core.interface.**InterfaceResult**(*result_data*, *target_result*, *payload*, *sample_index=None*, *sample_id=None*, *errors=None*)
Bases: object

The class in which Interfaces should wrap their results to be picked up by fastr

__dict__ = mappingproxy({'__module__': 'fastr.core.interface', '__doc__': '\n The cl

__init__(*result_data*, *target_result*, *payload*, *sample_index=None*, *sample_id=None*, *errors=None*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.core.interface'

__weakref__
list of weak references to the object (if defined)

class fastr.core.interface.**OutputSpec**(*id_*, *cardinality*, *datatype*, *automatic=True*, *required=False*, *description=''*, *hidden=False*)
Bases: *fastr.core.interface.OutputSpec*

Class containing the information about an Output Specification, this is essentially a data class (but

__dict__ = mappingproxy({'__module__': 'fastr.core.interface', '__doc__': '\n Class

__module__ = 'fastr.core.interface'

static __new__(*cls*, *id_*, *cardinality*, *datatype*, *automatic=True*, *required=False*, *description=''*, *hidden=False*)
Create new instance of OutputSpec(id, cardinality, datatype, automatic, required, description, hidden)

asdict()

fastr.core.interface.**OutputSpecBase**
alias of *fastr.core.interface.OutputSpec*

ioplugin Module

This module contains the manager class for IOPlugins and the base class for all IOPlugins

class fastr.core.ioplugin.**IOPlugin**
Bases: fastr.abc.baseplugin.Plugin

IOPlugins are used for data import and export for the sources and sinks. The main use of the *IOPlugins* is during execution (see *Execution*). The *IOPlugins* can be accessed via `fastr.ioplugins`, but generally there should be no need for direct interaction with these objects. The use of is mainly via the URL used to specify source and sink data.

__abstractmethods__ = frozenset({'scheme'})

__init__()
Initialization for the IOPlugin

Returns newly created IOPlugin

__module__ = 'fastr.core.ioplugin'

cleanup()
(abstract) Clean up the IOPlugin. This is to do things like closing files or connections. Will be called when the plugin is no longer required.

expand_url(*url*)
(abstract) Expand an URL. This allows a source to collect multiple samples from a single url. The URL will have a wildcard or point to something with info and multiple urls will be returned.

Parameters **url** (*str*) – url to expand

Returns the resulting url(s), a tuple if multiple, otherwise a str

Return type str or tuple of str

fetch_url(*inurl*, *outfile*)
(abstract) Fetch a file from an external data source.

Parameters

- **inurl** – url to the item in the data store
- **outpath** – path where to store the fetch data locally

fetch_value(*inurl*)
(abstract) Fetch a value from an external data source.

Parameters **inurl** – the url of the value to retrieve

Returns the fetched value

static isurl(*string*)
Test if given string is an url.

Parameters **string** (*str*) – string to test

Returns `True` if the string is an url, `False` otherwise

Return type bool

path_to_url(*path*, *mountpoint=None*)
(abstract) Construct an url from a given mount point and a relative path to the mount point.

Parameters

- **path** (*str*) – the path to determine the url for

- **mountpoint** (*str or None*) – the mount point to use, will be automatically detected if None is given

Returns url matching the path

Return type str

static print_result(*result*)
Print the result of the IOPlugin to stdout to be picked up by the tool

Parameters **result** – value to print as a result

Returns None

pull_source_data(*inurl*, *outdir*, *sample_id*, *datatype=None*)
Transfer the source data from inurl to be available in outdir.

Parameters

- **inurl** (*str*) – the input url to fetch data from
- **outdir** (*str*) – the directory to write the data to
- **datatype** (DataType) – the datatype of the data, used for determining the total contents of the transfer

Returns None

push_sink_data(*inpath*, *outurl*, *datatype=None*)
Write out the sink data from the inpath to the outurl.

Parameters

- **inpath** (*str*) – the path of the data to be pushed
- **outurl** (*str*) – the url to write the data to
- **datatype** (DataType) – the datatype of the data, used for determining the total contents of the transfer

Returns None

put_url(*inpath*, *outurl*)
(abstract) Put the files to the external data store.

Parameters

- **inpath** – path to the local data
- **outurl** – url to where to store the data in the external data store.

put_value(*value*, *outurl*)
(abstract) Put the files to the external data store.

Parameters

- **value** – the value to store
- **outurl** – url to where to store the data in the external data store.

abstract property scheme
(abstract) This abstract property is to be overwritten by a subclass to indicate the url scheme associated with the IOPlugin.

setup(**args*, ***kwargs*)
(abstract) Setup before data transfer. This can be any function that needs to be used to prepare the plugin for data transfer.

url_to_path(*url*)
(abstract) Get the path to a file from a url.

Parameters **url** (*str*) – the url to retrieve the path for

Returns the corresponding path

Return type str

provenance Module

class fastr.core.provenance.**Provenance**(*host=None*)
Bases: object

The Provenance object keeps track of everything that happens to a data object.

__dict__ = mappingproxy({'__module__': 'fastr.core.provenance', '__doc__': '\n The P

__init__(*host=None*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.core.provenance'

__weakref__
list of weak references to the object (if defined)

activity(*identifier*, *start_time=None*, *end_time=None*, *other_attributes=None*)

agent(*identifier*, *other_attributes=None*)

collect_input_argument_provenance(*input_argument*)

collect_provenance(*job*, *advanced_flow=False*)
Collect the provenance for this job

static data_uri(*value*, *job*)

entity(*identifier*, *other_attributes=None*)

static get_parent_provenance(*value*)
Find the provenance of the parent job

Parameters **value** (*str*) – url for the value for which to find the job

Returns the provenance of the job that created the value

Raises

- ***FastrKeyError*** – if the deferred is not available (yet)
- ***FastrValueError*** – if the value is not a valid deferred url

init_provenance(*job*)
Create initial provenance document

serialize(*filename*, *format*)

resourcelimit Module

Module for the management of resource limits of compute resources

class fastr.core.resourcelimit.**ResourceLimit**(*cores=1*, *memory='2G'*, *time=None*)

Bases: object

__eq__(*other*)

Check if two resource limits are equal

Parameters **other** – resource limit to test against

Return type bool

__getstate__()

Return type dict

__hash__ = None

__init__(*cores=1*, *memory='2G'*, *time=None*)

An object describing resource requirements/limits for a node

Parameters

- **cores** (Optional[int]) – number of cores
- **memory** (Union[str, int, None]) – memory specification, can be int with number of megabytes or a string with numbers ending on M, G, T, P for megabytes, gigabytes, terrabytes or petabytes. Note that the number has to be an integer, e.g. 1500M would work, whereas 1.5G would be invalid
- **time** (Union[str, int, None]) – run time specification, this can be an int with the number of seconds or a string in the HH:MM:SS, MM:SS, or SS format. Where HH, MM, and SS are integers representing the number of hours, minutes and seconds.

__module__ = 'fastr.core.resourcelimit'

__ne__(*other*)

Check if two resource limits are not equal

Parameters **other** – resource limit to test against

Return type bool

__setstate__(*state*)

__slots__ = ('_cores', '_memory', '_time')

copy()

Return a copy of current resource limit object

Return type *ResourceLimit*

property cores

The required number of gpus

Return type int

property memory

The required memory in megabytes

Return type int

property time

The required time in seconds

Return type int

samples Module

This package holds the classes for working with samples.

class fastr.core.samples.**ContainsSamples**
Bases: *fastr.core.samples.HasSamples*

__abstractmethods__ = frozenset({'samples'})

__getitem__(*item*)

__module__ = 'fastr.core.samples'

__setitem__(*key*, *value*)

property dimensions
The dimensions has to be implemented by any subclass. It has to provide a tuple of Dimensions.

Returns dimensions

Return type tuple

abstract property samples

class fastr.core.samples.**HasSamples**
Bases: *fastr.core.dimension.HasDimensions*

Base class for all classes that supply samples. This base class allows to only define __getitem__ and size and get all other basic functions mixed in so that the object behaves similar to a Mapping.

__abstractmethods__ = frozenset({'__getitem__', 'dimensions'})

__contains__(*item*)

abstract __getitem__(*item*)

__iter__()

__module__ = 'fastr.core.samples'

ids()

indexes()

items()

iteritems()

class fastr.core.samples.**SampleBaseId**(**args*)
Bases: tuple

This class represents a sample id. A sample id is a multi-dimensional id that has a simple, consistent string representation.

__add__(*other*)
Add another SampleId, this allows to add parts to the SampleId in a convenient way.

__dict__ = mappingproxy({'__module__': 'fastr.core.samples', '__doc__': '\n This cla

__getnewargs__()
Get new args gives the arguments to use to re-create this object, This is used for serialization.

__module__ = 'fastr.core.samples'

static __new__(*cls*, **args*)
Create a new SampleId

Parameters **args** (*iterator/iterable of element type or element type*) – the strings to make sample id for

__radd__(*other*)
Add another SampleId, this allows to add parts to the SampleId in a convenient way. This is the right-hand version of the operator.

__repr__()
Get a string representation for the SampleBaseId

Returns the string representation

Return type str

__str__()
Get a string version for the SampleId, joins the SampleId with __ to create a single string version.

Returns the string version

Return type str

class fastr.core.samples.**SampleCollection**(*dimnames*, *parent*)
Bases: collections.abc.MutableMapping, *fastr.core.dimension.HasDimensions*

The SampleCollections is a class that contains the data including a form of ordering. Each sample is reachable both by its SampleId and a SampleIndex. The object is sparse, so not all SampleId have to be defined allowing for non-rectangular data shapes.

Note: This object is meant to replace both the SampleIdList and the ValueStorage.

__abstractmethods__ = frozenset({})

__contains__(*item*)
Check if an item is in the SampleCollection. The item can be a SampleId or SampleIndex. If the item is a slicing SampleIndex, then check if it would return any data (True) or no data (False)

Parameters **item** (SampleId, SampleIndex) – the item to check for

Returns flag indicating item is in the collections

Return type bool

__delitem__(*key*)
Remove an item from the SampleCollection

Parameters **key** (SampleId, SampleIndex, *tuple of both, or* SampleItem) – the key of the item to remove

__dict__ = mappingproxy({'__module__': 'fastr.core.samples', '__doc__': '\n The Samp

__getitem__(*item*)
Retrieve (a) SampleItem(s) from the SampleCollection using the SampleId or SampleIndex. If the item is a tuple, it should be valid tuple for constructing either a SampleId or SampleIndex.

Parameters **item** (SampleId, SampleIndex, *or tuple*) – the identifier of the item to retrieve

Returns the requested item

Return type *SampleItem*

Raises

- ***FastrTypeError*** – if the item parameter is of incorrect type
- **KeyError** – if the item is not found

__init__(*dimnames*, *parent*)
Createa a new SampleCollection

__iter__()
Iterate over the indices

__len__()
Get the number of samples in the SampleCollections.

__module__ = 'fastr.core.samples'

__repr__()
Return repr(self).

__setitem__(*key*, *value*)
Set an item to the SampleCollection. The key can be a SampleId, SampleIndex or a tuple containing a SampleId and SampleIndex. The value can be a SampleItem (with the SampleId and SampleIndex matching), a tuple with values (assuming no depending jobs), or a with a list of values and a set of depending jobs.

Parameters

- **key** (SampleId, SampleIndex, *tuple of both, or* SampleItem) – the key of the item to store
- **value** (SampleItem, *tuple of values, or tuple of tuple of values and set of depending jobs*) – the value of the SampleItem to store

Raises

- ***FastrTypeError*** – if the key or value types are incorrect
- ***FastrValueError*** – if the id or values are incorrectly formed

__weakref__
list of weak references to the object (if defined)

property dimensions
The dimensions has to be implemented by any subclass. It has to provide a tuple of Dimensions.

Returns dimensions

Return type tuple

property fullid
The full defining ID for the SampleIdList

property ndims
The number of dimensions in this SampleCollection

property parent
The parent object holding the SampleCollection

class fastr.core.samples.**SampleId**(**args*)
Bases: *fastr.core.samples.SampleBaseId*

SampleId is an identifier for data using human readable strings

__module__ = 'fastr.core.samples'

class fastr.core.samples.**SampleIndex**(**args*)
Bases: *fastr.core.samples.SampleBaseId*

SampleId is an identifier for data using the location in the N-d data structure.

__module__ = 'fastr.core.samples'

__repr__()
Get a string representation for the SampleIndex

Returns the string representation

Return type str

__str__()
Get a string version for the SampleId, joins the SampleId with __ to create a single string version.

Returns the string version

Return type str

expand(*size*)
Function expanding a slice SampleIndex into a list of non-slice SampleIndex objects

Parameters **size** – the size of the collection to slice

property isslice
Flag indicating that the SampleIndex is a slice (as opposed to a simple single index).

class fastr.core.samples.**SampleItem**(*index*, *id*, *data*, *jobs=None*, *failed_annotations=None*)
Bases: *fastr.core.samples.SampleItemBase*

__module__ = 'fastr.core.samples'

static __new__(*cls*, *index*, *id*, *data*, *jobs=None*, *failed_annotations=None*)
Create a SampleItem. Data should be an OrderedDict of tuples.

Parameters

- **index** (*tuple, slice*) – the sample index
- **id** (SampleId) – the sample id
- **data** (SampleValue, *Mapping*) – the data values
- **jobs** (*set*) – set of jobs on which this SampleItems data depends.
- **failed_annotations** (*set*) – set of tuples. The tuple is contructed like follows: (job_id, reason).

class fastr.core.samples.**SampleItemBase**(*index*, *id*, *data*, *jobs=None*, *failed_annotations=None*)
Bases: tuple

This class represents a sample item, a combination of a SampleIndex, SampleID, value and required jobs. The SampleItem based on a named tuple and has some extra methods to combine SampleItems easily.

__add__(*other*)
The addition operator combines two SampleItems into a single SampleItems. It merges the data and jobs and takes the index and id of the left-hand item.

Parameters **other** (SampleItem) – The other item to add to this one

Returns the combined SampleItem

Return type *SampleItem*

__dict__ = mappingproxy({'__module__': 'fastr.core.samples', '__doc__': '\n This cla

__getnewargs__()
Get new args gives the arguments to use to re-create this object, This is used for serialization.

__module__ = 'fastr.core.samples'

static __new__(*cls*, *index*, *id*, *data*, *jobs=None*, *failed_annotations=None*)
Create a SampleItem. Data should be an OrderedDict of tuples.

Parameters

- **index** (*tuple, slice*) – the sample index
- **id** (SampleId) – the sample id
- **data** (SampleValue, *Mapping*) – the data values
- **jobs** (*set*) – set, tuple or list of jobs on which this SampleItems data depends.
- **failed_annotations** (*set*) – set of tuples. The tuple is contructed like follows: (job_id, reason).

__repr__()
Get a string representation for the SampleItem

Returns the string representation

Return type str

property cardinality
The cardinality of this Sample

static combine(**args*)
Combine a number of SampleItems into a new one.

Parameters **args** (*iterable of SampleItems*) – the SampleItems to combine

Returns the combined SampleItem

Return type *SampleItem*

It is possible to both give multiple arguments, where each argument is a SampleItem, or a single argument which is an iterable yielding SampleItems.

```
# variables a, b, c, d are SampleItems to combine
# These are all valid ways of combining the SampleItems
comb1 = SampleItem.combine(a, b, c, d)  # Using multiple arguments
l = [a, b, c, d]
comb2 = SampleItem.combine(l)  # Using a list of arguments
comb3 = SampleItem.combine(l.__iter__())  # Using an iterator
```

property data
The data SampleValue of the SampleItem

Returns The value of this SampleItem

Return type *SampleValue*

property dimensionality
The dimensionality of this Sample

property failed_annotations

property id
The sample id of the SampleItem

Returns The id of this SampleItem

Return type *SampleId*

property index
The index of the SampleItem

Returns The index of this SampleItem

Return type *SampleIndex*

property jobs
The set of the jobs on which this SampleItem depends

Returns The jobs that generated the data for this SampleItem

Return type set

class fastr.core.samples.**SamplePayload**(*index*, *id*, *data*, *jobs=None*, *failed_annotations=None*)
Bases: *fastr.core.samples.SampleItemBase*

__add__(*other*)
The addition operator combines two SampleItems into a single SampleItems. It merges the data and jobs and takes the index and id of the left-hand item.

Parameters **other** (SampleItem) – The other item to add to this one

Returns the combined SamplePayload

Return type *SamplePayload*

__module__ = 'fastr.core.samples'

static __new__(*cls*, *index*, *id*, *data*, *jobs=None*, *failed_annotations=None*)
Create a SampleItem. Data should be an OrderedDict of tuples.

Parameters

- **index** (*tuple, slice*) – the sample index
- **id** (SampleId) – the sample id
- **data** (SampleValue, *Mapping*) – the data values
- **jobs** (*set*) – set of jobs on which this SampleItems data depends.
- **failed_annotations** (*set*) – set of tuples. The tuple is contructed like follows: (job_id, reason).

class fastr.core.samples.**SampleValue**(**args*, ***kwargs*)
Bases: collections.abc.MutableMapping

A collection containing the content of a sample

__abstractmethods__ = frozenset({})

__add__(*other*)

__delitem__(*key*)

__dict__ = mappingproxy({'__module__': 'fastr.core.samples', '__doc__': '\n A collec

__getitem__(*item*)

__getstate__()

__init__(**args*, ***kwargs*)
Initialize self. See help(type(self)) for accurate signature.

__iter__()

__len__()

__module__ = 'fastr.core.samples'

__radd__(*other*)

__repr__()
Return repr(self).

__setitem__(*key*, *value*)

__setstate__(*state*)

__weakref__
list of weak references to the object (if defined)

cast(*datatype*)

property is_mapping

property is_sequence

iterelements()

mapping_part()

sequence_part()

target Module

The module containing the classes describing the targets.

class fastr.core.target.**ProcessUsageCollection**
Bases: collections.abc.Sequence

__abstractmethods__ = frozenset({})

__dict__ = mappingproxy({'__module__': 'fastr.core.target', 'usage_type': <class 'fa

__getitem__(*item*)

__init__()
Initialize self. See help(type(self)) for accurate signature.

__len__()

__module__ = 'fastr.core.target'

__weakref__
list of weak references to the object (if defined)

aggregate(*number_of_points*)

append(*value*)

usage_type
alias of *SystemUsageInfo*

class fastr.core.target.**SubprocessBasedTarget**
Bases: *fastr.core.target.Target*

Abstract based class for targets which call the target via a subprocess. Supplies a call_subprocess which executes the command and profiles the resulting subprocess.

__abstractmethods__ = frozenset({'run_command'})

__module__ = 'fastr.core.target'

call_subprocess(*command*)
Call a subprocess with logging/timing/profiling

Parameters **command** (*list*) – the command to execute

Returns execution info

Return type dict

monitor_process(*process*, *resources*)
Monitor a process and profile the cpu, memory and io use. Register the resource use every _MONITOR_INTERVAL seconds.

Parameters

- **process** (*subproces.Popen*) – process to monitor
- **resources** (ProcessUsageCollection) – list to append measurements to

class fastr.core.target.**SystemUsageInfo**(*timestamp*, *cpu_percent*, *vmem*, *rmem*, *read_bytes*, *write_bytes*)
Bases: tuple

__getnewargs__()
Return self as a plain tuple. Used by copy and pickle.

__module__ = 'fastr.core.target'

static __new__(*_cls*, *timestamp*, *cpu_percent*, *vmem*, *rmem*, *read_bytes*, *write_bytes*)
Create new instance of SystemUsageInfo(timestamp, cpu_percent, vmem, rmem, read_bytes, write_bytes)

__repr__()
Return a nicely formatted representation string

__slots__ = ()

property cpu_percent
Alias for field number 1

property read_bytes
Alias for field number 4

property rmem
Alias for field number 3

property timestamp
Alias for field number 0

property vmem
Alias for field number 2

property write_bytes
Alias for field number 5

class fastr.core.target.**Target**
Bases: fastr.abc.baseplugin.Plugin

The abstract base class for all targets. Execution with a target should follow the following pattern:

```
>>> with Target() as target:
...     target.run_commmand(['sleep', '10'])
```

The Target context operator will set the correct paths/initialization. Within the context command can be ran and when leaving the context the target reverts the state before.

__abstractmethods__ = frozenset({'run_command'})

__enter__()
Set the environment in such a way that the target will be on the path.

__exit__(*exc_type*, *exc_value*, *traceback*)
Cleanup the environment where needed

__module__ = 'fastr.core.target'

abstract run_command(*command*)
Run a command with the target

Return type *TargetResult*

classmethod test()
Test the plugin, interfaces do not need to be tested on import

class fastr.core.target.**TargetResult**(*return_code*, *stdout*, *stderr*, *command*, *resource_usage*, *time_elapsed*)

Bases: object

__dict__ = mappingproxy({'__module__': 'fastr.core.target', '__init__': <function Ta

__init__(*return_code*, *stdout*, *stderr*, *command*, *resource_usage*, *time_elapsed*)
Class to formalize the resulting data of a Target

Parameters

- **return_code** (int) – the return code of the process
- **stdout** (Union[str, bytes]) – the stdout generated by the process
- **stderr** (Union[str, bytes]) – the stderr generated by the process
- **command** (List[Union[str, bytes]]) – the command executed
- **resource_usage** (List[*SystemUsageInfo*]) – the resource use during execution
- **time_elapsed** (int) – time used (in seconds)

__module__ = 'fastr.core.target'

__weakref__
list of weak references to the object (if defined)

as_dict()
A dictionary of the data in the object (meant for serialization)

Return type Dict[str, Union[int, str, List]]

tool Module

A module to maintain a tool.

Exported classes:

- Tool – A class encapsulating a tool.
- ParameterDescription – The base class containing the shared description of a parameter (both input and ouput).
- InputParameterDescription – A class containing the description of an input parameter.
- Output ParameterDescription – A class containing the description of an output parameter.

class fastr.core.tool.**Tool**(*doc=None*)

Bases: fastr.abc.serializable.Serializable

The class encapsulating a tool.

DEFAULT_TARGET_CLASS = {'MacroNode': 'MacroTarget'}

TOOL_REFERENCE_FILE_NAME = '__fastr_tool_ref__.json'

TOOL_RESULT_FILE_NAME = '__fastr_tool_result.pickle.gz'

__dataschemafile__ = 'Tool.schema.json'

__eq__(*other*)

Compare two Tool instances with each other.

Parameters **other** (Tool) – the other instances to compare to

Returns True if equal, False otherwise

__getstate__()

Retrieve the state of the Tool

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*doc=None*)

Create a new Tool :param doc: path of toolfile or a dict containing the tool data :type doc: str or dict

__module__ = 'fastr.core.tool'

__repr__()

Get a string representation for the Tool. This will show the inputs and output defined in a table-like structure.

Returns the string representation

Return type str

__setstate__(*state*)

Set the state of the Tool by the given state.

Parameters **state** (*dict*) – The state to populate the object with

__str__()

Get a string version for the Tool

Returns the string version

Return type str

authors
List of authors of the tool. These people wrapped the executable but are not responsible for executable itself.

cite
This holds the citation you should use when publishing something based on this Tool

command
Command is a dictionary contain information about the command which is called by this Tool: command['interpreter'] holds the (possible) interpreter to use command['targets'] holds a per os/arch dictionary of files that should be executed command['url'] is the webpage of the command to be called command['version'] is the version of the command used command['description'] can help a description of the command command['authors'] lists the original authors of the command

property command_version

static compare_output_data(*current_output_data*, *reference_output_data*, *validation_result*, *output*)

create_reference(*input_data*, *output_directory*, *mount_name='__ref_tmp__'*, *copy_input=True*)

description
Description of the tool and it's functionality

execute(*payload=None*, ***kwargs*)
Execute a Tool given the payload for a single run

Parameters **payload** – the data to execute the Tool with

Returns The result of the execution

Return type InterFaceResult

property fullid
The full id of this tool

property hash

help
Man page for the Tool. Here usage and examples can be described in detail

property id

property inputs

name
Name of the tool, this should be a descriptive, human readable name.

namespace
The namespace this tools lives in, this will be set by the ToolManager on load

node_class
Class for of the Node to use

property ns_id
The namespace and id of the Tool

property outputs

property path
The path of the directory in which the tool definition file was located.

references
A list of documents and in depth reading about the methods used in this tool

requirements
Requirements for this Tool

> **Warning:** Not yet implemented

serialize()
Prepare data for serialization, this removes some fields from the state that are not needed when serializing to a file

tags
List of tags for this tool

property target
The OS and arch matched target definition.

test(*reference=None*)
Run the tests for this tool

test_spec
alias of `TestSpecification`

classmethod test_tool(*reference_data_dir*, *tool=None*, *input_data=None*)
Execute the tool with the input data specified and test the results against the refence data. This effectively tests the tool execution.

Parameters

- **reference_data_dir** (*str*) – The path or vfs url of reference data to compare with
- **source_data** (*dict*) – The source data to use

url
URL to website where this tool can be downloaded from

version
Version of the tool, not of the underlying software

version Module

Module containing the class that represent versions

class fastr.core.version.**Version**(**version*)
Bases: `tuple`

Class representing a software version definition. Allows for sorting and extraction of parts.

__dict__ = mappingproxy({'__module__': 'fastr.core.version', '__doc__': '\n Class re

__module__ = 'fastr.core.version'

static __new__(*cls*, **version*)
Class containing a version

Can be constructed by:

```
Version( 'major.$minor.$extra[0].$extra[1]$seperator$status$build$suffix' )
Version( major, minor, extra, status, build, suffix, seperator )
Version( (major, minor, extra, status, build, suffix, seperator) )
Version( [major, minor, extra, status, build, suffix, seperator] )
```

Parameters

- **major** (*int*) – interger giving major version
- **minor** (*int*) – is an integer (required)
- **extra** (*list of int*) – is a list of integers
- **status** (*str*) – can be “a”, “alpha”, “b”, “beta”, “rc”, or “r”
- **build** (*int*) – is an integer
- **suffix** (*str*) – can contain any combination of alpha-numeric character and “._-“
- **seperator** (*str*) – is any of “.”, “-“, or “_”, which is located between $extra and $build

Note: The method based on strings is the recommended method. For strings the major and minor version are required, where for tuple and list constructors all seven elements are optional.

Examples:

```
>>> a = Version('0.1')
>>> print(tuple(a))
(0, 1, None, None, None, '', None)
>>> b = Version('2.5.3-rc2')
>>> print(tuple(b))
(2, 5, [3], 'rc', 2, '', '-')
>>> c = Version('1.2.3.4.5.6.7-beta8_with_suffix')
>>> print(tuple(c))
(1, 2, [3, 4, 5, 6, 7], 'beta', 8, '_with_suffix', '-')
```

__repr__()
Return a in-editor representation of the version

__str__()
Return a string representation of the version

property build
the build number, this is following the status (e.g. for 3.2-beta4, this would be 4)

date_version_matcher = re.compile('(\\d+)-(\\d+)-(\\d+)([_\\-\\.])?(.*)')

property extra
extra version extension as a list

property extra_string
extra version extension as a string

property major
major version

property minor
minor version

property status
the status of the version (a, alpha, b, beta, rc or r)

property suffix
the remainder of the version which was not formatted in a known way

version_matcher = re.compile('(\\d+)\\.(\\d+)((?:\\.\\d+)+)?([_\\-\\.])?(a(?=\\d)|b(?=

vfs Module

This module contains the virtual file system code. This is internally used object as used as base class for the IOPlugin.

class fastr.core.vfs.**VirtualFileSystem**
Bases: object

The virtual file system class. This is an IOPlugin, but also heavily used internally in fastr for working with directories. The VirtualFileSystem uses the vfs:// url scheme.

A typical virtual filesystem url is formatted as vfs://mountpoint/relative/dir/from/mount.ext

Where the mountpoint is defined in the *Config file*. A list of the currently known mountpoints can be found in the fastr.config object

```
>>> fastr.config.mounts
{'example_data': '/home/username/fastr-feature-documentation/fastr/fastr/examples/
↪data',
 'home': '/home/username/',
 'tmp': '/home/username/FastrTemp'}
```

This shows that a url with the mount home such as vfs://home/tempdir/testfile.txt would be translated into /home/username/tempdir/testfile.txt.

There are a few default mount points defined by Fastr (that can be changed via the config file).

mountpoint	default location
home	the users home directory (expanduser('~/'))
tmp	the fastr temprorary dir, defaults to tempfile.gettempdir()
example_data	the fastr example data directory, defaults $FASTRDIR/example/data

__dict__ = mappingproxy({'__module__': 'fastr.core.vfs', '__doc__': "\n The virtual

__init__()
Instantiate the VFS plugin

Returns the VirtualFileSysten plugin

__module__ = 'fastr.core.vfs'

__weakref__
list of weak references to the object (if defined)

abstract = False

static copy_file_dir(*inpath*, *outpath*)
Helper function, copies a file or directory not caring what the inpath actually is

Parameters

- **inpath** – path of the things to be copied
- **outpath** – path of the destination

Returns the result of shutil.copy2 or shutil.copytree (depending on inpath pointing to a file or directory)

expand_url(*url*)
Try to expand the url. For vfs with will return the original url.

Parameters **url** – url to expand

Returns the expanded url (same as url)

fetch_url(*inurl*, *outpath*)
Fetch the files from the vfs.

Parameters

- **inurl** – url to the item in the data store, starts with `vfs://`
- **outpath** – path where to store the fetch data locally

fetch_value(*inurl*)
Fetch a value from an external vfs file.

Parameters **inurl** – url of the value to read

Returns the fetched value

path_to_url(*path*, *mountpoint=None*, *scheme=None*)
Construct an url from a given mount point and a relative path to the mount point.

Parameters **path** (*str*) – the path to find the url for

Mountpoint str mountpoint the url should be under

Returns url of the

put_url(*inpath*, *outurl*)
Put the files to the external data store.

Parameters

- **inpath** – path of the local data
- **outurl** – url to where to store the data, starts with `vfs://`

put_value(*value*, *outurl*)
Put the value in the external data store.

Parameters

- **value** – value to store
- **outurl** – url to where to store the data, starts with `vfs://`

property scheme

setup()
The plugin setup, does nothing but needs to be implemented

url_to_path(*url*, *scheme=None*)
Get the path to a file from a vfs url

Parameters **url** (*str*) – url to get the path for

Returns the matching path

Return type str

Raises

- ***FastrMountUnknownError*** – if the mount in url is unknown
- ***FastrUnknownURLSchemeError*** – if the url scheme is not correct

Example (the mountpoint tmp points to /tmp):

```
>>> fastr.vfs.url_to_path('vfs://tmp/file.ext')
'/tmp/file.ext'
```

Subpackages

test Package

test Package

test_datatypemanager Module

test_dimension Module

test_samples Module

test_tool Module

test_version Module

test_vfs Module

data Package

data Package

Package containig data related modules

url Module

Module providing tools to parse and create valid urls and paths.

usage example:

When in fastr.config under the mounts section the data mount is set to /media/data, you will get the following. .. code-block:: python

```
>>> from fastr.data.url import get_path_from_url
>>> get_path_from_url('vfs://data/temp/blaat1.png')
'/media/data/temp/blaat1.png'
```

fastr.data.url.**basename**(*url*)
Get basename of url

Parameters **url** (*str*) – the url

Returns the basename of the path in the url

fastr.data.url.**create_vfs_url**(*mountpoint*, *path*)
Construct an url from a given mount point and a relative path to the mount point.

Parameters

- **mountpoint** (*str*) – the name of the mountpoint
- **path** (*str*) – relative path from the mountpoint

Returns the created vfs url

fastr.data.url.**dirname**(*url*)
Get the dirname of the url

Parameters **url** (*str*) – the url

Returns the dirname of the path in the url

fastr.data.url.**dirurl**(*url*)
Get the a new url only having the dirname as the path

Parameters **url** (*str*) – the url

Returns the modified url with only dirname as path

fastr.data.url.**full_split**(*urlpath*)
Split the path in the url in a list of parts

Parameters **urlpath** – the url path

Returns a list of parts

fastr.data.url.**get_path_from_url**(*url*)
Get the path to a file from a url. Currently supports the file:// and vfs:// scheme's

Examples:

```
>>> url.get_path_from_url('vfs://neurodata/user/project/file.ext')
'Y:\neuro3\user\project\file.ext'


>>> 'file:///d:/data/project/file.ext'
'd:\data\project\file.ext'
```

Warning: file:// will not function cross platform and is mainly for testing

fastr.data.url.**get_url_scheme**(*url*)
Get the schem of the url

Parameters **url** (*str*) – url to extract scheme from

Returns the url scheme

Return type str

fastr.data.url.**isurl**(*string*)
Check if string is a valid url

Parameters **string** (*str*) – potential url

Returns flag indicating if string is a valid url

fastr.data.url.**join**(*url*, **p*)
Join the path in the url with p

Parameters

- **url** (*str*) – the base url to join with

- **p** – additional parts of the path

Returns the url with the parts added to the path

fastr.data.url.**normurl**(*url*)
Normalized the path of the url

Parameters **url** (*str*) – the url

Returns the normalized url

fastr.data.url.**register_url_scheme**(*scheme*)
Register a custom scheme to behave http like. This is needed to parse all things properly.

fastr.data.url.**split**(*url*)
Split a url in a url with the dirname and the basename part of the path of the url

Parameters **url** (*str*) – the url

Returns a tuple with (dirname_url, basename)

datatypes Package

datatypes Package

The datatypes module holds all DataTypes generated by fastr and all the base classes for these datatypes.

class fastr.datatypes.**AnyFile**(*value=None*, *format_=None*)
Bases: *fastr.datatypes.TypeGroup*

Special Datatype in fastr that is a TypeGroup with all known DataTypes as its members.

__abstractmethods__ = frozenset({})

__module__ = 'fastr.datatypes'

description = 'TypeGroup AnyFile\nAnyFile (AnyFile) is a group of consisting of all URI

class fastr.datatypes.**AnyType**(*value=None*, *format_=None*)
Bases: *fastr.datatypes.TypeGroup*

Special Datatype in fastr that is a TypeGroup with all known DataTypes as its members.

__abstractmethods__ = frozenset({})

__module__ = 'fastr.datatypes'

description = 'TypeGroup AnyType\nAnyType (AnyType) is a group of consisting of all Dat

class fastr.datatypes.**BaseDataType**(*value=None*, *format_=None*)
Bases: fastr.abc.baseplugin.BasePlugin

The base class for all datatypes in the fastr type system.

__abstractmethods__ = frozenset({'__init__'})

__eq__(*other*)
Test the equality of two DataType objects

Parameters **other** (DataType) – the object to compare against

Returns flag indicating equality

Return type bool

__getstate__()

__hash__ = None

abstract __init__(*value=None*, *format_=None*)
The BaseDataType constructor.

Parameters

- **value** – value to assign to the new BaseDataType object
- **format** – the format used for the ValueType

Returns new BaseDataType object

Raises ***FastrNotImplementedError*** – if *id*, *name*, *version* or *description* is None

__module__ = 'fastr.datatypes'

__ne__(*other*)
Test if two objects are not equal. This is by default done by negating the __eq__ operator

Parameters **other** (DataType) – the object to compare against

Returns flag indicating equality

Return type bool

__reduce_ex__(**args*, ***kwargs*)
helper for pickle

__repr__()
Returns string representation of the BaseDataType

Returns string represenation

Return type str

__setstate__(*state*)

__str__()
Returns the string version of the BaseDataType

Returns string version

Return type str

checksum()
Generate a checksum for the value of this DataType

Returns the checksum of the value

Return type str

description = ''
Description of the DataType

dot_extension = None

extension = None
Extension related to the Type

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

fullid = 'fastr://types/BaseDataType'

id = 'BaseDataType'

classmethod isinstance(*value*)
Indicate whether value is an instance for this DataType.

Returns the flag indicating the value is of this DataType

Return type bool

name = 'BaseDataType'

parent = DataTypeManager AnalyzeImageFile : <URLType: AnalyzeImageFile> AnyFile : <

property parsed_value
The parsed value of object instantiation of this DataType.

property raw_value
The raw value of object instantiation of this DataType. For datatypes that override value (like Deferred) this is the way to access the _value field.

classmethod test()
Define the test for the BasePluginManager. Make sure we are not one of the base classes

property valid
A boolean flag that indicates weather or not the value assigned to this DataType is valid. This property is generally overwritten by implementation of specific DataTypes.

property value
The value of object instantiation of this DataType.

version = <Version: 1.0>
Version of the DataType definition

class fastr.datatypes.**DataType**(*value=None*, *format_=None*)
Bases: *fastr.datatypes.BaseDataType*, fastr.abc.serializable.Serializable

This class is the base class for all DataTypes that can hold a value.

__abstractmethods__ = frozenset({'__init__'})

abstract __init__(*value=None*, *format_=None*)
The DataType constructor.

Parameters

- **value** – value to assign to the new DataType object
- **format** – the format used for the ValueType

Returns new DataType object

__module__ = 'fastr.datatypes'

action(*name*)
This function can be overwritten by subclasses to implement certain action that should be performed. For example, the *Directory* DataType has an action *ensure*. This method makes sure the Directory exists. A Tool can indicate an action that should be called for an Output which will be called before execution.

Parameters **name** (*str*) – name of the action to execute

Returns None

classmethod deserialize(*doc*, *_=None*)
Classmethod that returns an object constructed based on the str/dict (or OrderedDict) representing the object

Parameters **doc** (dict) – the state of the object to create

Return type *DataType*

Returns newly created object (of datatype indicated by the doc)

serialize()
Method that returns a dict structure with the datatype the object.

Return type dict

Returns serialized representation of object

class fastr.datatypes.**DataTypeManager**
Bases: fastr.abc.basepluginmanager.BasePluginManager

The DataTypeManager hold a mapping of all DataTypes in the fast system and can create new DataTypes from files/data structures.

__abstractmethods__ = frozenset({})

__init__()
The DataTypeManager constructor will create a new DataTypeManager and populate it with all DataTypes it can find in the paths set in config.types_path.

Returns the created DataTypeManager

__keytransform__(*key*)
Key transformation for this mapping. The key transformation allows indexing by both the DataType name as well as the DataType it self.

Parameters **key** (fastr.datatypes.BaseDataType *or* *str*) – The name of the requested datatype or the datatype itself

Returns The requested datatype

__module__ = 'fastr.datatypes'

create_enumtype(*type_id*, *options*, *name=None*)
Create a python class based on an XML file. This function return a completely functional python class based on the contents of a DataType XML file.

Such a class will be of type EnumType.

Parameters

- **type_id** (*str*) – the id of the new class
- **options** (*iterable*) – an iterable of options, each option should be str

Returns the newly created subclass of EnumType

Raises ***FastrTypeError*** – if the options is not an iterable of str

property fullid
The fullid of the datatype manager

get_type(*name*)
Read a type given a typename. This will scan all directories in types_path and attempt to load the newest version of the DataType.

Parameters **name** (*str*) – Name of the datatype that should be imported in the system

Returns the datatype with the requested name, or None if datatype is not found

---

Note: If type is already in TypeManager it will not load anything and return the already loaded version.

---

guess_type(*value*, *exists=True*, *options=None*, *preferred=None*)
Guess the DataType based on a value str.

Parameters

- **value** (*str*) – the value to guess the type for
- **options** (*TypeGroup, DataType or tuple of DataTypes*) – The options that are allowed to be guessed from
- **extists** (*bool*) – Indicate the value exists (if file) and can be checked for validity, if false skip validity check
- **preferred** (*iterable*) – An iterable of preferred types in case multiple types match.

Returns The resulting DataType or None if no match was found

Raises ***FastrTypeError*** – if the options argument is of the wrong type

The function will first create a list of all candidate DataTypes. Subsequently, it will check for each candidate if the value would valid. If there are multiple matches, the config value for preferred types is consulted to break the ties. If non of the DataTypes are in the preferred types list, a somewhat random DataType will be picked as the most optimal result.

has_type(*name*)
Check if the datatype with requested name exists

Parameters **name** (*str*) – the name of the requested datatype

Returns flag indicating if the datatype exists

Return type bool

static isdatatype(*item*)
Check if item is a valid datatype for the fastr system.

Parameters **item** – item to check

Returns flag indicating if the item is a fastr datatype

Return type bool

match_types(**args*, ***kwargs*)
Find the match between a list of DataTypes/TypeGroups, see *Resolving Datatypes* for details

Parameters

- **args** – A list of DataType/TypeGroup objects to match
- **kwargs** – A 'preferred' keyword argument can be used to indicate a list of DataTypes to prefer in case of ties (first has precedence over later in list)

Returns The best DataType match, or None if no match is possible.

Raises ***FastrTypeError*** – if not all args are subclasses of BaseDataType

match_types_any(**args*)
Find the match between a list of DataTypes/TypeGroups, see *Resolving Datatypes* for details

Parameters **args** – A list of DataType/TypeGroup objects to match

Returns A set with all DataTypes that match.

Return type set

Raises ***FastrTypeError*** – if not all args are subclasses of BaseDataType

property plugin_class
The PluginClass of the items of the BasePluginManager

poll_datatype(*filename*)
Poll an xml file to see if there is a definition of a datatype in it.

Parameters **filename** (*str*) – path of the file to poll

Returns tuple with (id, version, basetype) if a datatype is found or (None, None, None) if no datatype is found

populate()
Populate Manager. After scanning for DataTypes, create the AnyType and set the preferred types

property preferred_types

class fastr.datatypes.**Deferred**(*value=None*, *format_=None*)
Bases: *fastr.datatypes.DataType*

__abstractmethods__ = frozenset({})

__getstate__()

__init__(*value=None*, *format_=None*)
The Deferred constructor.

Parameters

- **value** – value to assign to the new DataType object
- **format** – This is ignore but here for compatibility

Returns new Deferred object

__module__ = 'fastr.datatypes'

__repr__()
Returns string representation of the BaseDataType

Returns string represenation

Return type str

__setstate__(*state*)

checksum()
Generate a checksum for the value of this DataType

Returns the checksum of the value

Return type str

property job

classmethod lookup(*value*)
Look up the deferred target and return that object

Param value

Returns The value the deferred points to

Return type *DataType*

Raises

- ***FastrKeyError*** – if the deferred is not available (yet)
- ***FastrValueError*** – if the value is not a valid deferrred url

property parsed_value
The value of object instantiation of this DataType.

property provenance

property target
Target object for this deferred.

Raises

- ***FastrKeyError*** – if the deferred is not available (yet)
- ***FastrValueError*** – if the value is not a valid deferrred url

property value
The value of object instantiation of this DataType.

class fastr.datatypes.**EnumType**(*value=None*, *format_=None*)
Bases: *fastr.datatypes.DataType*

The EnumType is the base for DataTypes that can have a value which is an option from a predefined set of possibilities (similar to an enum type in many programming languages).

__abstractmethods__ = frozenset({})

__init__(*value=None*, *format_=None*)
The EnumType constructor.

Parameters

- **value** – value to assign to the new EnumType object
- **format** – the format used for the ValueType

Returns new EnumType object

Raises ***FastrDataTypeNotInstantiableError*** – if not subclassed

__module__ = 'fastr.datatypes'

__reduce_ex__(**args*, ***kwargs*)
helper for pickle

description = 'EnumType (EnumType) is a enumerate type with options:\n\n\nEnumType can

options = frozenset({})

version = <Version: 1.0>
Enums always have version 1.0

class fastr.datatypes.**TypeGroup**(*value=None*, *format_=None*)
Bases: *fastr.datatypes.BaseDataType*

The TypeGroup is a special DataType that does not hold a value of its own but is used to group a number of DataTypes. For example ITK has a list of supported file formats that all tools build on ITK support. A group can be used to conveniently specify this in multiple Tools that use the same set DataTypes.

__abstractmethods__ = frozenset({'_members'})

__init__(*value=None*)
Dummy constructor. TypeGroups are not instantiable and cannot hold a value of its own.

Raises ***FastrDataTypeNotInstantiableError*** – if called

__module__ = 'fastr.datatypes'

static __new__(*cls*, *value=None*, *format_=None*)
Instantiate a TypeGroup. This will for match the value to the best matching type and instantiate that. Not that the returned object will not be of type TypeGroup but one of the TypeGroup members.

classmethod isinstance(*value*)
Indicate whether value is an instance for this DataType.

Returns the flag indicating the value is of this DataType

Return type bool

members
A descriptor that can act like a property for a class.

preference
A descriptor that can act like a property for a class.

class fastr.datatypes.**URLType**(*value=None*, *format_=None*)
Bases: *fastr.datatypes.DataType*

The URLType is the base for DataTypes that point to a resource somewhere else (typically a filesystem). The true value is actually the resource referenced by the value in this object.

__abstractmethods__ = frozenset({})

__eq__(*other*)
Test the equality of two DataType objects

Parameters **other** (URLType) – the object to compare against

Returns flag indicating equality

Return type bool

__hash__ = None

__init__(*value=None*, *format_=None*)
The URLType constructor

Parameters

- **value** – value to assign to the new URLType
- **format** – the format used for the ValueType

Returns new URLType object

__module__ = 'fastr.datatypes'

checksum()
Return the checksum of this URL type

Returns checksum string

Return type str

classmethod content(*inval*, *outval=None*)
Give the contents of a URLType, this is generally useful for filetypes that consists of multiple files (e.g. AnalyzeImageFile, DICOM). The value will indicate the main file, and the contents function can determine all files that form a single data value.

Parameters

- **inval** – a value to figure out contents for this type
- **outval** – the place where the copy should point to

Returns a list of all files part of the value (e.g. header and data file)

Return type list

property parsed_value
The parsed value of object instantiation of this DataType.

property valid
A boolean flag that indicates weather or not the value assigned to this DataType is valid. This property is generally overwritten by implementation of specific DataTypes.

class fastr.datatypes.**ValueType**(*value=None*, *format_=None*)
Bases: *fastr.datatypes.DataType*

The ValueType is the base for DataTypes that hold simple values (not an EnumType and not a file/URL). The values is generally represented by a string.

__abstractmethods__ = frozenset({})

__init__(*value=None*, *format_=None*)
The ValueType constructor

Parameters

- **value** – value to assign to the new ValueType
- **format** – the format used for the ValueType

Returns new ValueType object

__module__ = 'fastr.datatypes'

fastr.datatypes.**fastr_isinstance**(*obj*, *datatype*)
Check if an object is of a specific datatype.

Parameters

- **obj** – Object to inspect
- **datatype** (*tuple, BaseDataType*) – The datatype(s) to check

Returns flag indicating object is of datatype

Return type bool

execution Package

execution Package

This package contains all modules related directly to the execution

basenoderun Module

class fastr.execution.basenoderun.**BaseNodeRun**
Bases: fastr.abc.updateable.Updateable, fastr.abc.serializable.Serializable

NODE_RUN_MAP = {'AdvancedFlowNode': <class 'fastr.execution.flownoderun.AdvancedFlowN

NODE_RUN_TYPES = {'AdvancedFlowNodeRun': <class 'fastr.execution.flownoderun.Advanced

__abstractmethods__ = frozenset({'_update'})

classmethod __init_subclass__(***kwargs*)
Register nodes in class for easly location

__module__ = 'fastr.execution.basenoderun'

environmentmodules Module

This module contains a class to interact with EnvironmentModules

class fastr.execution.environmentmodules.**EnvironmentModules**(*protected=None*)
Bases: object

This class can control the module environments in python. It can list, load and unload environmentmodules. These modules are then used if subprocess is called from python.

__dict__ = mappingproxy({'__module__': 'fastr.execution.environmentmodules', '__doc__

__init__(*protected=None*)
Create the environmentmodules control object

Parameters **protected** (*list*) – list of modules that should never be unloaded

Returns newly created EnvironmentModules

__module__ = 'fastr.execution.environmentmodules'

__repr__()
Return repr(self).

__weakref__
list of weak references to the object (if defined)

avail(*namestart=None*)
Print available modules in same way as commandline version

Parameters **namestart** – filter on modules that start with namestart

property avail_modules
List of avaible modules

clear()
Unload all modules (except the protected modules as they cannot be unloaded). This should result in a clean environment.

isloaded(*module*)
Check if a specific module is loaded

Parameters **module** – module to check

Returns flag indicating the module is loaded

load(*module*)
Load specified module

Parameters **module** – module to load

property loaded_modules
List of currently loaded modules

reload(*module*)
Reload specified module

Parameters **module** – module to reload

swap(*module1*, *module2*)
Swap one module for another one

Parameters

- **module1** – module to unload

- **module2** – module to load

sync()
Sync the object with the underlying environment. Re-checks the available and loaded modules

static tostring_modvalue(*value*)
Turn a representation of a module into a string representation

Parameters **value** – module representation (either str or tuple)

Returns string representation

static totuple_modvalue(*value*)
Turn a representation of a module into a tuple representation

Parameters **value** – module representation (either str or tuple)

Returns tuple representation (name, version, default)

unload(*module*)
Unload specified module

Parameters **module** – module to unload

class fastr.execution.environmentmodules.**ModuleSystem**(*value*)
Bases: enum.Enum

An enumeration.

__module__ = 'fastr.execution.environmentmodules'

envmod = 'enviromentmodules'

lmod = 'Lmod'

executionscript Module

The executionscript is the script that wraps around a tool executable. It takes a job, builds the command, executes the command (while profiling it) and collects the results.

fastr.execution.executionscript.**execute_job**(*job*)
Execute a Job and save the result to disk

Parameters **job** – the job to execute

fastr.execution.executionscript.**main**(*joblist=None*)
This is the main code. Wrapped inside a function to avoid the variables being seen as globals and to shut up pylint. Also if the joblist argument is given it can run any given job, otherwise it takes the first command line argument.

flownoderun Module

class fastr.execution.flownoderun.**AdvancedFlowNodeRun**(*node*, *parent*)
Bases: *fastr.execution.flownoderun.FlowNodeRun*

__abstractmethods__ = frozenset({})

__module__ = 'fastr.execution.flownoderun'

execute()
Execute the node and create the jobs that need to run

Returns list of jobs to run

Return type list of *Jobs*

set_result (*job*, *failed_annotation*)
Incorporate result of a job into the FlowNodeRun.

Parameters **job** (*Type*) – job of which the result to store

class fastr.execution.flownoderun.**FlowNodeRun** (*node*, *parent*)
Bases: *fastr.execution.noderun.NodeRun*

A Flow NodeRun is a special subclass of Nodes in which the amount of samples can vary per Output. This allows non-default data flows.

__abstractmethods__ = frozenset({})

__module__ = 'fastr.execution.flownoderun'

property blocking
A FlowNodeRun is (for the moment) always considered blocking.

Returns True

property dimnames
Names of the dimensions in the NodeRun output. These will be reflected in the SampleIdList of this NodeRun.

property outputsize
Size of the outputs in this NodeRun

set_result (*job*, *failed_annotation*)
Incorporate result of a job into the FlowNodeRun.

Parameters **job** (*Type*) – job of which the result to store

inputoutputrun Module

Classes for arranging the input and output for nodes.

Exported classes:

Input – An input for a node (holding datatype). Output – The output of a node (holding datatype and value). ConstantOutput – The output of a node (holding datatype and value).

Warning: Don't mess with the Link, Input and Output internals from other places. There will be a huge chances of breaking the network functionality!

class fastr.execution.inputoutputrun.**AdvancedFlowOutputRun** (*node_run*, *template*)
Bases: *fastr.execution.inputoutputrun.OutputRun*

__abstractmethods__ = frozenset({})

__module__ = 'fastr.execution.inputoutputrun'

class fastr.execution.inputoutputrun.**BaseInputRun** (*node_run*, *template*)
Bases: *fastr.core.samples.HasSamples*, *fastr.planning.inputoutput.BaseInput*

Base class for all inputs runs.

__abstractmethods__ = frozenset({'__getitem__', '_update', 'dimensions', 'fullid', 'it

__init__(*node_run*, *template*)
Instantiate a BaseInput

Parameters

- **node** – the parent node the input/output belongs to.
- **description** – the `ParameterDescription` describing the input/output.

Returns the created BaseInput

Raises

- ***FastrTypeError*** – if description is not of class `ParameterDescription`
- ***FastrDataTypeNotAvailableError*** – if the DataType requested cannot be found in the `fastr.types`

__module__ = 'fastr.execution.inputoutputrun'

abstract itersubinputs()
Iterator over the SubInputs

Returns iterator

example:

```
>>> for subinput in input_a.itersubinputs():
        print subinput
```

class fastr.execution.inputoutputrun.**InputRun**(*node_run*, *template*)
Bases: *fastr.execution.inputoutputrun.BaseInputRun*

Class representing an input of a node. Such an input will be connected to the output of another node or the output of an constant node to provide the input value.

__abstractmethods__ = frozenset({})

__getitem__(*key*)
Retrieve an item from this Input.

Parameters **key** (str, `SampleId` or tuple) – the key of the requested item, can be a key str, sample index tuple or a `SampleId`

Returns the return value depends on the requested key. If the key was an int the corresponding *SubInput* will be returned. If the key was a `SampleId` or sample index tuple, the corresponding `SampleItem` will be returned.

Return type `SampleItem` or *SubInput*

Raises

- ***FastrTypeError*** – if key is not of a valid type
- ***FastrKeyError*** – if the key is not found

__getstate__()
Retrieve the state of the Input

Returns the state of the object

Rtype dict

__init__(*node_run*, *template*)
Instantiate an input.

Parameters **template** – the Input that the InputRun is based on

__module__ = 'fastr.execution.inputoutputrun'

__setstate__(*state*)
Set the state of the Input by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

__str__()
Get a string version for the Input

Returns the string version

Return type str

cardinality(*key=None*, *job_data=None*)
Cardinality for an Input is the sum the cardinalities of the SubInputs, unless defined otherwise.

Parameters **key** (tuple of int or SampleId) – key for a specific sample, can be sample index or id

Returns the cardinality

Return type int, sympy.Symbol, or None

property datatype
The datatype of this Input

property dimensions
The size of the sample collections that can accessed via this Input.

property fullid
The full defining ID for the Input

get_sourced_nodes()
Get a list of all *Nodes* connected as sources to this Input

Returns list of all connected *Nodes*

Return type list

get_sourced_outputs()
Get a list of all *Outputs* connected as sources to this Input

Returns tuple of all connected *Outputs*

Return type tuple

get_subinput_cardinality(*index*, *key=None*, *job_data=None*)
Cardinality for a SubInput

Parameters

- **index** (*int*) – index for a specific sample
- **key** (tuple of int or SampleId) – key for a specific sample, can be sample index or id

Returns the cardinality

Return type int, sympy.Symbol, or None

index(*value*)
Find index of a SubInput

Parameters **value** (*SubInput*) – the *SubInput* to find the index of

Returns key

Return type int, str

property input_group
The id of the `InputGroup` this Input belongs to.

insert(*index*)
Insert a new SubInput at index in the sources list

Parameters **key** (*int*) – positive integer for position in _source list to insert to

Returns newly inserted *SubInput*

Return type *SubInput*

itersubinputs()
Iterate over the *SubInputs* in this Input.

Returns iterator yielding *SubInput*

example:

```
>>> for subinput in input_a.itersubinputs():
        print subinput
```

remove(*value*)
Remove a SubInput from the SubInputs list.

Parameters **value** (*SubInput*) – the *SubInput* to removed from this Input

property source
The mapping of *SubInputs* that are connected and have more than 0 elements.

class fastr.execution.inputoutputrun.**MacroOutputRun**(*node_run*, *template*)
Bases: *fastr.execution.inputoutputrun.OutputRun*

__abstractmethods__ = frozenset({})

__module__ = 'fastr.execution.inputoutputrun'

property dimensions
The dimensions has to be implemented by any subclass. It has to provide a tuple of Dimensions.

Returns dimensions

Return type tuple

class fastr.execution.inputoutputrun.**NamedSubinputRun**(*parent*)
Bases: *fastr.execution.inputoutputrun.InputRun*

A named subinput for cases where the value of an input is mapping.

__abstractmethods__ = frozenset({})

__getitem__(*key*)
Retrieve an item (a SubInput) from this NamedSubInput.

Parameters **key** (*int*) – the key of the requested item

Return type Union[*SubInputRun*, *SampleItem*]

Returns The *SubInput* corresponding with the key will be returned.

Raises

- ***FastrTypeError*** – if key is not of a valid type
- ***FastrKeyError*** – if the key is not found

__init__(*parent*)
Instantiate an input.

Parameters **template** – the Input that the InputRun is based on

__module__ = 'fastr.execution.inputoutputrun'

__str__()
Get a string version for the NamedSubInput

Returns the string version

Return type str

property fullid
The full defining ID for the NamedSubInputRun

property item_index

class fastr.execution.inputoutputrun.**OutputRun**(*node_run*, *template*)
Bases: *fastr.planning.inputoutput.BaseOutput*, *fastr.core.samples.ContainsSamples*

Class representing an output of a node. It holds the output values of the tool ran. Output fields can be connected to inputs of other nodes.

__abstractmethods__ = frozenset({})

__getitem__(*key*)
Retrieve an item from this Output. The returned value depends on what type of key used:

- Retrieving data using index tuple: [index_tuple]
- Retrieving data sample_id str: [SampleId]
- Retrieving a list of data using SampleId list: [sample_id1, . . . , sample_idN]
- Retrieving a *SubOutput* using an int or slice: [n] or [n:m]

Parameters **key** (int, slice, SampleId or tuple) – the key of the requested item, can be a number, slice, sample index tuple or a SampleId

Returns the return value depends on the requested key. If the key was an int or slice the corresponding *SubOutput* will be returned (and created if needed). If the key was a SampleId or sample index tuple, the corresponding SampleItem will be returned. If the key was a list of SampleId a tuple of SampleItem will be returned.

Return type *SubInput* or SampleItem or list of SampleItem

Raises

- ***FastrTypeError*** – if key is not of a valid type
- ***FastrKeyError*** – if the parent Node has not been executed

__getstate__()
Retrieve the state of the Output

Returns the state of the object

Rtype dict

__init__(*node_run*, *template*)
Instantiate an Output

Parameters

- **node** – the parent node the output belongs to.
- **description** – the `ParameterDescription` describing the output.

Returns created Output

Raises

- ***FastrTypeError*** – if description is not of class `ParameterDescription`
- ***FastrDataTypeNotAvailableError*** – if the DataType requested cannot be found in the `fastr.types`

__module__ = 'fastr.execution.inputoutputrun'

__setitem__(*key*, *value*)
Store an item in the Output

Parameters

- **key** (tuple of int or `SampleId`) – key of the value to store
- **value** – the value to store

Returns None

Raises ***FastrTypeError*** – if key is not of correct type

__setstate__(*state*)
Set the state of the Output by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

__str__()
Get a string version for the Output

Returns the string version

Return type str

property automatic
Flag indicating that the Output is generated automatically without being specified on the command line

cardinality(*key=None*, *job_data=None*)
Cardinality of this Output, may depend on the inputs of the parent Node.

Parameters **key** (tuple of int or `SampleId`) – key for a specific sample, can be sample index or id

Returns the cardinality

Return type int, sympy.Symbol, or None

Raises

- ***FastrCardinalityError*** – if cardinality references an invalid *Input*
- ***FastrTypeError*** – if the referenced cardinality values type cannot be case to int
- ***FastrValueError*** – if the referenced cardinality value cannot be case to int

property datatype
The datatype of this Output

property fullid
The full defining ID for the Output

iterconvergingindices(*collapse_dims*)
Iterate over all data, but collapse certain dimension to create lists of data.

Parameters **collapse_dims** (*iterable of int*) – dimension to collapse

Returns iterator SampleIndex (possibly containing slices)

property listeners
The list of *Links* connected to this Output.

property preferred_types
The list of preferred DataTypes for this Output.

property resulting_datatype
The DataType that will the results of this Output will have.

property samples
The SampleCollection of the samples in this Output. None if the NodeRun has not yet been executed. Otherwise a SampleCollection.

property valid
Check if the output is valid, i.e. has a valid cardinality

class fastr.execution.inputoutputrun.**SourceOutputRun**(*node_run*, *template*)
Bases: *fastr.execution.inputoutputrun.OutputRun*

Output for a SourceNodeRun, this type of Output determines the cardinality in a different way than a normal NodeRun.

__abstractmethods__ = frozenset({})

__getitem__(*item*)
Retrieve an item from this Output. The returned value depends on what type of key used:

- Retrieving data using index tuple: [index_tuple]
- Retrieving data sample_id str: [SampleId]
- Retrieving a list of data using SampleId list: [sample_id1, . . . , sample_idN]
- Retrieving a *SubOutput* using an int or slice: [n] or [n:m]

Parameters **key** (int, slice, SampleId or tuple) – the key of the requested item, can be a number, slice, sample index tuple or a SampleId

Returns the return value depends on the requested key. If the key was an int or slice the corresponding *SubOutput* will be returned (and created if needed). If the key was a SampleId or sample index tuple, the corresponding SampleItem will be returned. If the key was a list of SampleId a tuple of SampleItem will be returned.

Return type *SubInput* or SampleItem or list of SampleItem

Raises

- ***FastrTypeError*** – if key is not of a valid type
- ***FastrKeyError*** – if the parent NodeRun has not been executed

__init__(*node_run*, *template*)
Instantiate a FlowOutput

Parameters

- **node** – the parent node the output belongs to.

- **description** – the `ParameterDescription` describing the output.

Returns created FlowOutput

Raises

- ***FastrTypeError*** – if description is not of class `ParameterDescription`
- ***FastrDataTypeNotAvailableError*** – if the DataType requested cannot be found in the `fastr.types`

__module__ = 'fastr.execution.inputoutputrun'

__setitem__(*key*, *value*)
Store an item in the Output

Parameters

- **key** (tuple of int or `SampleId`) – key of the value to store
- **value** – the value to store

Returns None

Raises ***FastrTypeError*** – if key is not of correct type

cardinality(*key=None*, *job_data=None*)
Cardinality of this SourceOutput, may depend on the inputs of the parent NodeRun.

Parameters **key** (tuple of int or `SampleId`) – key for a specific sample, can be sample index or id

Returns the cardinality

Return type int, sympy.Symbol, or None

property dimensions
The dimensions of this SourceOutputRun

property linearized
A linearized version of the sample data, this is lazily cached linearized version of the underlying SampleCollection.

property ndims
The number of dimensions in this SourceOutput

property size
The sample size of the SourceOutput

class `fastr.execution.inputoutputrun.`**SubInputRun**(*input_*)
Bases: *`fastr.execution.inputoutputrun.BaseInputRun`*

This class is used by *`Input`* to allow for multiple links to an *`Input`*. The SubInput class can hold only a single Link to a (Sub)Output, but behaves very similar to an *`Input`* otherwise.

__abstractmethods__ = frozenset({})

__getitem__(*key*)
Retrieve an item from this SubInput.

Parameters **key** (int, `SampleId` or `SampleIndex`) – the key of the requested item, can be a number, sample index tuple or a `SampleId`

Returns the return value depends on the requested key. If the key was an int the corresponding *`SubInput`* will be returned. If the key was a `SampleId` or sample index tuple, the corresponding `SampleItem` will be returned.

Return type SampleItem or *SubInput*

Raises ***FastrTypeError*** – if key is not of a valid type

Note: As a SubInput has only one SubInput, only requesting int key 0 or -1 is allowed, and it will return self

---

__getstate__()
Retrieve the state of the SubInput

Returns the state of the object

Rtype dict

__init__(*input_*)
Instantiate an SubInput.

Parameters **input** (*Input*) – the parent of this SubInput.

Returns the created SubInput

__module__ = 'fastr.execution.inputoutputrun'

__setstate__(*state*)
Set the state of the SubInput by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

__str__()
Get a string version for the SubInput

Returns the string version

Return type str

cardinality(*key=None*, *job_data=None*)
Get the cardinality for this SubInput. The cardinality for a SubInputs is defined by the incoming link.

Parameters **key** (SampleIndex or SampleId) – key for a specific sample, can be sample index or id

Returns the cardinality

Return type int, sympy.Symbol, or None

property description
The description object of this input/output

property dimensions
The sample size of the SubInput

property fullid
The full defining ID for the SubInput

get_sourced_nodes()
Get a list of all *Nodes* connected as sources to this SubInput

Returns list of all connected *Nodes*

Return type list

get_sourced_outputs()
Get a list of all *Outputs* connected as sources to this SubInput

Returns list of all connected *Outputs*

Return type list

property input_group
The id of the InputGroup this SubInputs parent belongs to.

property item_index

iteritems()
Iterate over the SampleItems that are in the SubInput.

Returns iterator yielding SampleItem objects

itersubinputs()
Iterate over SubInputs (for a SubInput it will yield self and stop iterating after that)

Returns iterator yielding *SubInput*

example:

```
>>> for subinput in input_a.itersubinputs():
        print subinput
```

property node
The Node to which this SubInputs parent belongs

property source
A list with the source *Link*. The list is to be compatible with *Input*

property source_output
The *Output* linked to this SubInput

class fastr.execution.inputoutputrun.**SubOutputRun**(*output*, *index*)
Bases: *fastr.execution.inputoutputrun.OutputRun*

The SubOutput is an Output that represents a slice of another Output.

__abstractmethods__ = frozenset({})

__getitem__(*key*)
Retrieve an item from this SubOutput. The returned value depends on what type of key used:

- Retrieving data using index tuple: [index_tuple]
- Retrieving data sample_id str: [SampleId]
- Retrieving a list of data using SampleId list: [sample_id1, ..., sample_idN]
- Retrieving a *SubOutput* using an int or slice: [n] or [n:m]

Parameters **key** (int, slice, SampleId or tuple) – the key of the requested item, can be a number, slice, sample index tuple or a SampleId

Returns the return value depends on the requested key. If the key was an int or slice the corresponding *SubOutput* will be returned (and created if needed). If the key was a SampleId or sample index tuple, the corresponding SampleItem will be returned. If the key was a list of SampleId a tuple of SampleItem will be returned.

Return type *SubInput* or SampleItem or list of SampleItem

Raises ***FastrTypeError*** – if key is not of a valid type

__getstate__()
Retrieve the state of the SubOutput

Returns the state of the object

Rtype dict

__init__(*output*, *index*)
Instantiate a SubOutput

Parameters

- **output** – the parent output the suboutput slices.
- **index** (*int or slice*) – the way to slice the parent output

Returns created SubOutput

Raises

- ***FastrTypeError*** – if the output argument is not an instance of *Output*
- ***FastrTypeError*** – if the index argument is not an `int` or `slice`

__len__()
Return the length of the Output.

Note: In a SubOutput this is always 1.

__module__ = 'fastr.execution.inputoutputrun'

__setitem__(*key*, *value*)
A function blocking the assignment operator. Values cannot be assigned to a SubOutput.

Raises ***FastrNotImplementedError*** – if called

__setstate__(*state*)
Set the state of the SubOutput by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

__str__()
Get a string version for the SubOutput

Returns the string version

Return type str

cardinality(*key=None*, *job_data=None*)
Cardinality of this SubOutput depends on the parent Output and `self.index`

Parameters **key** (tuple of int or `SampleId`) – key for a specific sample, can be sample index or id

Returns the cardinality

Return type int, sympy.Symbol, or None

Raises

- ***FastrCardinalityError*** – if cardinality references an invalid *Input*
- ***FastrTypeError*** – if the referenced cardinality values type cannot be case to int
- ***FastrValueError*** – if the referenced cardinality value cannot be case to int

property datatype
The datatype of this SubOutput

property fullid
The full defining ID for the SubOutput

property indexrep
Simple representation of the index.

property listeners
The list of *Links* connected to this Output.

property node
The NodeRun to which this SubOutput belongs

property preferred_types
The list of preferred `DataTypes` for this SubOutput.

property resulting_datatype
The `DataType` that will the results of this SubOutput will have.

property samples
The `SampleCollection` for this SubOutput

job Module

This module contains the Job class and some related classes.

class fastr.execution.job.**InlineJob**(**args*, ***kwargs*)
Bases: *fastr.execution.job.Job*

Job that does not actually need to run but is used for consistency in data processing and logging.

__init__(**args*, ***kwargs*)
Create a job

Parameters

- **node** (fastr.planning.node.Node) – the node the job is based on
- **sample_id** – the id of the sample
- **sample_index** – the index of the sample
- **input_arguments** – the argument list
- **output_arguments** – the argument list
- **hold_jobs** – the jobs on which this jobs depend
- **preferred_types** – The list of preferred types to use

Returns

__module__ = 'fastr.execution.job'

collect_provenance()
Collect the provenance for this job

get_result()
Get the result of the job if it is available. Load the output file if found and check if the job matches the current object. If so, load and return the result.

Returns Job after execution or None if not available

Return type Job | None

class fastr.execution.job.**Job**(*node*, *sample_id*, *sample_index*, *input_arguments*, *output_arguments*, *hold_jobs=None*, *preferred_types=None*)

Bases: fastr.abc.serializable.Serializable

Class describing a job.

Arguments: tool_name - the name of the tool (str) tool_version - the version of the tool (Version) argument - the arguments used when calling the tool (list) tmpdir - temporary directory to use to store output data hold_jobs - list of jobs that need to finished before this job can run (list)

COMMAND_DUMP = '__fastr_command__.yaml'

INFO_DUMP = '__fastr_extra_job_info__.yaml'

PROV_DUMP = '__fastr_prov__.json'

RESULT_DUMP = '__fastr_result__.yaml'

STDERR_DUMP = '__fastr_stderr__.txt'

STDOUT_DUMP = '__fastr_stdout__.txt'

__getstate__()

Get the state of the job

Returns job state

Return type dict

__init__(*node*, *sample_id*, *sample_index*, *input_arguments*, *output_arguments*, *hold_jobs=None*, *preferred_types=None*)

Create a job

Parameters

- **node** (fastr.planning.node.Node) – the node the job is based on
- **sample_id** (*SampleId*) – the id of the sample
- **sample_index** (*SampleIndex*) – the index of the sample
- **input_arguments** (Dict[str, *SampleItem*]) – the argument list
- **output_arguments** (Dict[str, Dict]) – the argument list
- **hold_jobs** (Optional[List[str]]) – the jobs on which this jobs depend
- **preferred_types** (Optional[List]) – The list of preferred types to use

Returns

__module__ = 'fastr.execution.job'

__repr__()

String representation of the Job

__setstate__(*state*)

Set the state of the job

Parameters **state** (*dict*) –

static cast_to_type(*value*, *datatypes*)

Try to cast value to one of the given datatypes. Will try all the datatypes in order.

Parameters **datatypes** (*tuple*) – Possible datatypes to cast to

Return type *DataType*

Returns casted value

clean()

collect_provenance()
Collect the provenance for this job.

property commandfile
The path of the command pickle

Return type Path

property commandurl
The url of the command pickle

create_payload()
Create the payload for this object based on all the input/output arguments

Returns the payload

Return type dict

ensure_tmp_dir()

execute()
Execute this job

Returns The result of the execution

Return type InterFaceResult

property extrainfofile
The path where the extra job info document is saved

Return type Path

property extrainfourl
The url where the extra job info document is saved

classmethod fill_output_argument(*output_spec*, *cardinality*, *desired_type*, *requested*, *tmpurl*)
This is an abstract class method. The method should take the argument_dict generated from calling self.get_argument_dict() and turn it into a list of commandline arguments that represent this Input/Output.

Parameters

- **cardinality** (*int*) – the cardinality for this output (can be non for automatic outputs)
- **desired_type** (DataType) – the desired datatype for this output
- **requested** (*bool*) – flag to indicate that the output is requested by Fastr

Returns the values for this output

Return type list

property fullid
The full id of the job

get_deferred(*output_id*, *cardinality_nr*, *sample_id=None*)
Get a deferred pointing to a specific output value in the Job

Parameters

- **output_id** (*str*) – the output to select from
- **cardinality_nr** (*int*) – the index of the cardinality

- **sample_id** (*str*) – the sample id to select (optional)

Returns The deferred

get_output_datatype(*output_id*)
Get the datatype for a specific output

Parameters **output_id** (*str*) – the id of the output to get the datatype for

Returns the requested datatype

Return type tuple

get_result()
Get the result of the job if it is available. Load the output file if found and check if the job matches the current object. If so, load and return the result.

Returns Job after execution or None if not available

Return type Job | None

classmethod get_value(*value*)
Get a value

Parameters

- **value** – the url of the value
- **datatype** – datatype of the value

Returns the retrieved value

hash_inputs()
Create hashes for all input values and store them in the info store

hash_results()
Create hashes of all output values and store them in the info store

property id
The id of this job

property logfile
The path of the result pickle

Return type Path

property logurl
The url of the result pickle

property provfile
The path where the prov document is saved

Return type Path

property provurl
The url where the prov document is saved

property resources
The compute resources required for this job

property status
The status of the job

property stderrfile
The path where the stderr text is saved

Return type Path

property stderrurl
The url where the stderr text is saved

property stdoutfile
The path where the stdout text is saved

Return type Path

property stdouturl
The url where the stdout text is saved

property tmpdir
Path of tempdir for the job

Return type Path

property tmpurl
The URL of the tmpdir to use

property tool

classmethod translate_argument(*value*)
Translate an argument from a URL to an actual path.

Parameters

- **value** – value to translate
- **datatype** – the datatype of the value

Returns the translated value

static translate_output_results(*value*, *datatypes*, *mountpoint=None*)
Translate the results for on Output

Parameters

- **value** – the results value for the output
- **datatypes** (*tuple*) – tuple of possible datatypes for the output
- **preferred_type** – the preferred datatype of the output

Returns the update value for the result

translate_results(*result*)
Translate the results of an interface (using paths etc) to the proper form using URI's instead.

Parameters **result** (*dict*) – the result data of an interface

Returns the translated result

Return type dict

validate_results(*payload*)
Validate the results of the Job

Returns flag indicating the results are complete and valid

write()

class fastr.execution.job.**JobCleanupLevel**(*value*)
Bases: enum.Enum

The cleanup level for Jobs that are finished.

__module__ = 'fastr.execution.job'

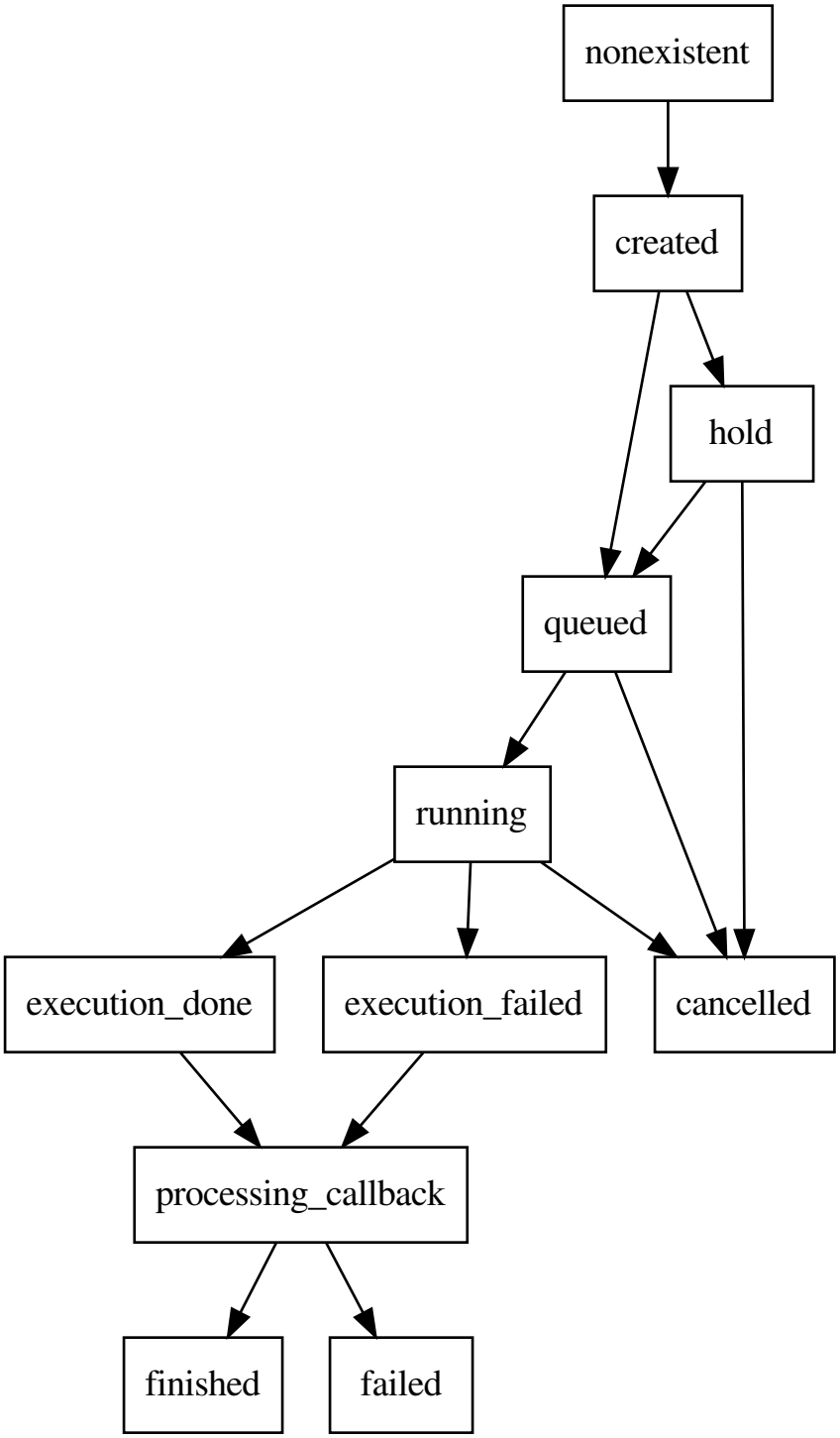
all = 'all'

no_cleanup = 'no_cleanup'

non_failed = 'non_failed'

class fastr.execution.job.**JobState**(*value*)
Bases: enum.Enum

The possible states a Job can be in. An overview of the states and the adviced transitions are depicted in the following figure:



__init__(_, *stage*, *error*)

Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.execution.job'

cancelled = ('cancelled', 'done', True)

created = ('created', 'idle', False)

property done

execution_done = ('execution_done', 'in_progress', False)

execution_failed = ('execution_failed', 'in_progress', True)

failed = ('failed', 'done', True)

finished = ('finished', 'done', False)

hold = ('hold', 'idle', False)

property idle

property in_progress

nonexistent = ('nonexistent', 'idle', False)

processing_callback = ('processing_callback', 'in_progress', False)

queued = ('queued', 'idle', False)

running = ('running', 'in_progress', False)

class fastr.execution.job.**SinkJob**(*node*, *sample_id*, *sample_index*, *input_arguments*, *output_arguments*, *hold_jobs=None*, *substitutions=None*, *preferred_types=None*)

Bases: *fastr.execution.job.Job*

Special SinkJob for the Sink

__getstate__()

Get the state of the job

Returns job state

Return type dict

__init__(*node*, *sample_id*, *sample_index*, *input_arguments*, *output_arguments*, *hold_jobs=None*, *substitutions=None*, *preferred_types=None*)

Create a job

Parameters

- **node** (fastr.planning.node.Node) – the node the job is based on
- **sample_id** – the id of the sample
- **sample_index** – the index of the sample
- **input_arguments** – the argument list
- **output_arguments** – the argument list
- **hold_jobs** – the jobs on which this jobs depend
- **preferred_types** – The list of preferred types to use

Returns

__module__ = 'fastr.execution.job'

__repr__()
String representation for the SinkJob

__setstate__(*state*)
Set the state of the job

Parameters **state** (*dict*) –

create_payload()
Create the payload for this object based on all the input/output arguments

Returns the payload

Return type dict

get_result()
Get the result of the job if it is available. Load the output file if found and check if the job matches the current object. If so, load and return the result.

Returns Job after execution

hash_inputs()
Create hashes for all input values and store them in the info store

property id
The id of this job

substitute(*value*, *datatype=None*)
Substitute the special fields that can be used in a SinkJob.

Parameters

- **value** (*str*) – the value to substitute fields in
- **datatype** (BaseDataType) – the datatype for the value

Returns string with substitutions performed

Return type str

property tmpurl
The URL of the tmpdir to use

validate_results(*payload*)
Validate the results of the SinkJob

Returns flag indicating the results are complete and valid

class fastr.execution.job.**SourceJob**(*datatype*, ***kwargs*)
Bases: *fastr.execution.job.Job*

Special SourceJob for the Source

__getstate__()
Get the state of the job

Returns job state

Return type dict

__init__(*datatype*, ***kwargs*)
Create a job

Parameters

- **node** (fastr.planning.node.Node) – the node the job is based on

- **sample_id** – the id of the sample
- **sample_index** – the index of the sample
- **input_arguments** – the argument list
- **output_arguments** – the argument list
- **hold_jobs** – the jobs on which this jobs depend
- **preferred_types** – The list of preferred types to use

Returns

__module__ = 'fastr.execution.job'

__repr__()
String representation for the SourceJob

__setstate__(*state*)
Set the state of the job

Parameters **state** (*dict*) –

collect_provenance()
Collect the provenance for this job

get_output_datatype(*output_id*)
Get the datatype for a specific output

Parameters **output_id** (*str*) – the id of the output to get the datatype for

Returns the requested datatype

Return type *BaseDataType*

hash_inputs()
Create hashes for all input values and store them in the info store

validate_results(*payload*)
Validate the results of the Job

Returns flag indicating the results are complete and valid

linkrun Module

The link module contain the Link class. This class represents the links in a network. These links lead from an output (BaseOutput) to an input (BaseInput) and indicate the desired data flow. Links are smart objects, in the sense that when you set their start or end point, they register themselves with the Input and Output. They do all the book keeping, so as long as you only set the source and target of the Link, the link should be valid.

Warning: Don't mess with the Link, Input and Output internals from other places. There will be a huge chances of breaking the network functionality!

class fastr.execution.linkrun.**LinkRun**(*link*, *parent=None*)
Bases: fastr.abc.updateable.Updateable, fastr.abc.serializable.Serializable

Class for linking outputs (*BaseOutput*) to inputs (*BaseInput*)

Examples:

```
>>> import fastr
>>> network = fastr.Network()
>>> link1 = network.create_link( n1.ouputs['out1'], n2.inputs['in2'] )

link2 = Link()
link2.source = n1.ouputs['out1']
link2.target = n2.inputs['in2']
```

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'Link.schema.json'

__eq__(*other*)
Test for equality between two Links

Parameters **other** (LinkRun) – object to test against

Returns True for equality, False otherwise

Return type bool

__getitem__(*index*)
Get a an item for this Link. The item will be retrieved from the connected output, but a diverging or converging flow can change the number of samples/cardinality.

Parameters **index** (SampleIndex) – index of the item to retrieve

Returns the requested item

Return type SampleItem

Raises ***FastrIndexError*** – if the index length does not match the number dimensions in the source data (after collapsing/expanding)

__getstate__()
Retrieve the state of the Link

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*link*, *parent=None*)
Create a new Link in a Network.

Parameters

- **link** (*Link*) – the base link
- **parent** (*Network* or None) – the parent network, if None is given the fastr.current_network is assumed to be the parent

Returns newly created LinkRun

Raises

- ***FastrValueError*** – if parent is not given and *fastr.current_network* is not set
- ***FastrValueError*** – if the source output is not in the same network as the Link
- ***FastrValueError*** – if the target input is not in the same network as the Link

__module__ = 'fastr.execution.linkrun'

__repr__()
Get a string representation for the Link

Returns the string representation

Return type str

__setstate__(*state*)
Set the state of the Link by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

Raises ***FastrValueError*** – if the parent network and *fastr.current_network* are not set

cardinality(*index=None*)
Cardinality for a Link is given by source Output and the collapse/expand settings

Parameters **key** (SampleIndex) – key for a specific sample (can be only a sample index!)

Returns the cardinality

Return type int, sympy.Symbol

Raises ***FastrIndexError*** – if the index length does not match the number of dimension in the data

property collapse
The converging dimensions of this link. Collapsing changes some dimensions of sample lists into cardinality, reshaping the data.

Collapse can be set to a tuple or an int/str, in which case it will be automatically wrapped in a tuple. The int will be seen as indices of the dimensions to collapse. The str will be seen as the name of the dimensions over which to collapse.

Raises ***FastrTypeError*** – if assigning a collapse value of a wrong type

property collapse_indexes
The converging dimensions of this link as integers. Dimension names are replaces with the corresponding int.

Collapsing changes some dimensions of sample lists into cardinality, reshaping the data

classmethod createobj(*state*, *network=None*)
Create object function for Link

Parameters

- **cls** – The class to create
- **state** – The state to use to create the Link
- **network** – the parent Network

Returns newly created Link

destroy()
The destroy function of a link removes all default references to a link. This means the references in the network, input and output connected to this link. If there is no references in other places in the code, it will destroy the link (reference count dropping to zero).

This function is called when a source for an input is set to another value and the links becomes disconnected. This makes sure there is no dangling links.

property dimensions
The dimensions of the data delivered by the link. This can be different from the source dimensions because the link can make data collapse or expand.

property expand
Flag indicating that the link will expand the cardininality into a new sample dimension to be created.

property fullid
The full defining ID for the Input

property parent
The Network to which this Link belongs.

property size
The size of the data delivered by the link. This can be different from the source size because the link can make data collapse or expand.

property source
The source *BaseOutput* of the Link. Setting the source will automatically register the Link with the source BaseOutput. Updating source will also make sure the Link is unregistered with the previous source.

Raises ***FastrTypeError*** – if assigning a non *BaseOutput*

property status

property target
The target *BaseInput* of the Link. Setting the target will automatically register the Link with the target BaseInput. Updating target will also make sure the Link is unregistered with the previous target.

Raises ***FastrTypeError*** – if assigning a non *BaseInput*

macronoderun Module

class fastr.execution.macronoderun.**MacroNodeRun**(*node*, *parent*)
Bases: *fastr.execution.noderun.NodeRun*

MacroNodeRun encapsulates an entire network in a single node.

__abstractmethods__ = frozenset({})

__getstate__()
Retrieve the state of the MacroNodeRun

Returns the state of the object

Rtype dict

__init__(*node*, *parent*)

Parameters **network** (*fastr.planning.network.Network*) – network to create macronode for

__module__ = 'fastr.execution.macronoderun'

__setstate__(*state*)
Set the state of the NodeRun by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

execute()
Execute the node and create the jobs that need to run

Returns list of jobs to run

Return type list of *Jobs*

get_output_info(*output*)

property network_run

networkanalyzer Module

Module that defines the NetworkAnalyzer and holds the reference implementation.

class fastr.execution.networkanalyzer.**DefaultNetworkAnalyzer**
Bases: *fastr.execution.networkanalyzer.NetworkAnalyzer*

Default implementation of the NetworkAnalyzer.

__module__ = 'fastr.execution.networkanalyzer'

analyze_network(*network*, *chunk*)
Analyze a chunk of a Network. Simply process the Nodes in the chunk sequentially.

Parameters

- **network** – Network corresponding with the chunk
- **chunk** – The chunk of the network to analyze

class fastr.execution.networkanalyzer.**NetworkAnalyzer**
Bases: object

Base class for NetworkAnalyzers

__dict__ = mappingproxy({'__module__': 'fastr.execution.networkanalyzer', '__doc__':

__module__ = 'fastr.execution.networkanalyzer'

__weakref__
list of weak references to the object (if defined)

abstract analyze_network(*network*, *chunk*)
Analyze a chunk of a Network.

Parameters

- **network** – Network corresponding with the chunk
- **chunk** – The chunk of the network to analyze

networkchunker Module

This module contains the NetworkChunker class and its default implementation the DefaultNetworkChunker

class fastr.execution.networkchunker.**DefaultNetworkChunker**
Bases: *fastr.execution.networkchunker.NetworkChunker*

The default implementation of the NetworkChunker. It tries to create as large as possible chunks so the execution blocks as little as possible.

__init__()
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.execution.networkchunker'

chunck_network(*network*)
Create a list of Network chunks that can be pre-analyzed completely. Each chunk needs to be executed before the next can be analyzed and executed.

The returned chunks are (at the moment) in the format of a tuple (start, nodes) which are both tuples. The tuple contain the nodes where to start execution (should ready if previous chunks are done) and all nodes of the chunk respectively.

Parameters **network** – Network to split into chunks

Returns tuple containing chunks

class fastr.execution.networkchunker.**NetworkChunker**
Bases: object

The base class for NetworkChunkers. A Network chunker is a class that takes a Network and produces a list of chunks that can each be analyzed and executed in one go.

__dict__ = mappingproxy({'__module__': 'fastr.execution.networkchunker', '__doc__':

__module__ = 'fastr.execution.networkchunker'

__weakref__
list of weak references to the object (if defined)

abstract chunck_network(*network*)
Create a list of Network chunks that can be pre-analyzed completely. Each chunk needs to be executed before the next can be analyzed and executed.

Parameters **network** – Network to split into chunks

Returns list containing chunks

networkrun Module

Network module containing Network facilitators and analysers.

class fastr.execution.networkrun.**NetworkRun**(*network*)
Bases: fastr.abc.serializable.Serializable

The Network class represents a workflow. This includes all Nodes (including ConstantNodes, SourceNodes and Sinks) and Links.

NETWORK_DUMP_FILE_NAME = '__fastr_network__.json'

SINK_DUMP_FILE_NAME = '__sink_data__.json'

SOURCE_DUMP_FILE_NAME = '__source_data__.pickle.gz'

__bool__()
A network run is True if it finish running successfully and False otherwise

__eq__(*other*)
Compare two Networks and see if they are equal.

Parameters **other** (*Network*) –

Returns flag indicating that the Networks are the same

Return type bool

__getitem__(*item*)
Get an item by its fullid. The fullid can point to a link, node, input, output or even subinput/suboutput.

Parameters **item** (*str, unicode*) – fullid of the item to retrieve

Returns the requested item

__getstate__()
Retrieve the state of the Network

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*network*)
Create a new, empty Network

Parameters **name** (*str*) – name of the Network

Returns newly created Network

Raises **OSError** – if the tmp mount in the config is not a writable directory

__module__ = 'fastr.execution.networkrun'

__ne__(*other*)
Tests for non-equality, this is the negated version __eq__

__repr__()
Return repr(self).

__setstate__(*state*)
Set the state of the Network by the given state. This completely overwrites the old state!

Parameters **state** (*dict*) – The state to populate the object with

Returns None

abort(*signal_code=None*, *current_frame=None*)

check_id(*id_*)
Check if an id for an object is valid and unused in the Network. The method will always returns True if it does not raise an exception.

Parameters **id** (*str*) – the id to check

Returns True

Raises

- ***FastrValueError*** – if the id is not correctly formatted
- ***FastrValueError*** – if the id is already in use

property constantlist

execute(*sourcedata*, *sinkdata*, *execution_plugin=None*, *tmpdir=None*, *cluster_queue=None*, *timestamp=None*)
Execute the Network with the given data. This will analyze the Network, create jobs and send them to the execution backend of the system.

Parameters

- **sourcedata** (*dict*) – dictionary containing all data for the sources
- **sinkdata** (*dict*) – dictionary containing directives for the sinks
- **execution_plugin** (*str*) – the execution plugin to use (None will use the config value)

Raises

- ***FastrKeyError*** – if a source has not corresponding key in sourcedata
- ***FastrKeyError*** – if a sink has not corresponding key in sinkdata

execution_finished()

property fullid
The fullid of the Network

generate_jobs()

property global_id
The global id of the Network, this is different for networks used in macronodes, as they still have parents.

property id
The id of the Network. This is a read only property.

job_finished(*job*)
Call-back handler for when a job is finished. Will collect the results and handle blocking jobs. This function is automatically called when the execution plugin finished a job.

Parameters **job** (*Job*) – the job that finished

property long_id

property network

property nodegroups
Give an overview of the nodegroups in the network

register_signals()
Register handles to handle SIGINT and SIGTERM handlers to gracefully shut down the execution :return:

set_data(*sourcedata*, *sinkdata*)

property sinklist

property sourcelist

unregister_signals()
Unregister the signal handlers (set to default). Sending these signals twice will result that the second time the default handler is used.

noderun Module

A module to maintain a run of a network node.

class fastr.execution.noderun.**NodeRun**(*node*, *parent*)
Bases: *fastr.execution.basenoderun.BaseNodeRun*

The class encapsulating a node in the network. The node is responsible for setting and checking inputs and outputs based on the description provided by a tool instance.

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'NodeRun.schema.json'

__eq__(*other*)
Compare two Node instances with each other. This function ignores the parent and update status, but tests rest of the dict for equality. equality

Parameters **other** (NodeRun) – the other instances to compare to

Returns True if equal, False otherwise

__getstate__()
Retrieve the state of the NodeRun

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*node*, *parent*)
Instantiate a node.

Parameters

- **node** (Tool) – The node to base the noderun on
- **parent** (*Network*) – the parent network of the node

Returns the newly created NodeRun

__module__ = 'fastr.execution.noderun'

__repr__()
Get a string representation for the NodeRun

Returns the string representation

Return type str

__setstate__(*state*)
Set the state of the NodeRun by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

__str__()
Get a string version for the NodeRun

Returns the string version

Return type str

property blocking
Indicate that the results of this NodeRun cannot be determined without first executing the NodeRun, causing a blockage in the creation of jobs. A blocking Nodes causes the Chunk borders.

create_job(*sample_id*, *sample_index*, *job_data*, *job_dependencies*, ***kwargs*)
Create a job based on the sample id, job data and job dependencies.

Parameters

- **sample_id** (SampleId) – the id of the corresponding sample
- **sample_index** (SampleIndex) – the index of the corresponding sample
- **job_data** (*dict*) – dictionary containing all input data for the job
- **job_dependencies** – other jobs that need to finish before this job can run

Returns the created job

Return type *Job*

classmethod createobj(*state*, *network=None*)
Create object function for generic objects

Parameters

- **cls** – The class to create
- **state** – The state to use to create the Link
- **network** – the parent Network

Returns newly created Link

property dimnames
Names of the dimensions in the NodeRun output. These will be reflected in the SampleIdList of this NodeRun.

execute()
Execute the node and create the jobs that need to run

Returns list of jobs to run

Return type list of *Jobs*

find_source_index(*target_index*, *target*, *source*)

property fullid
The full defining ID for the NodeRun inside the network

get_sourced_nodes()
A list of all Nodes connected as sources to this NodeRun

Returns list of all nodes that are connected to an input of this node

property global_id
The global defining ID for the Node from the main network (goes out of macro nodes to root network)

property id
The id of the NodeRun

property input_groups

A list of input groups for this NodeRun. An input group is InputGroup object filled according to the NodeRun

property listeners
All the listeners requesting output of this node, this means the listeners of all Outputs and SubOutputs

property merge_dimensions

property name
Name of the Tool the NodeRun was based on. In case a Toolless NodeRun was used the class name is given.

property outputsize
Size of the outputs in this NodeRun

property parent
The parent network of this node.

property resources
Number of cores required for the execution of this NodeRun

set_result(*job*, *failed_annotation*)
Incorporate result of a job into the NodeRun.

Parameters

- **job** (*Type*) – job of which the result to store

- **failed_annotation** – A set of annotations, None if no errors else containing a tuple describing the errors

property status

property tool

update_input_groups()
Update all input groups in this node

sinknoderun Module

class fastr.execution.sinknoderun.**SinkNodeRun**(*node*, *parent*)
Bases: *fastr.execution.noderun.NodeRun*

Class which handles where the output goes. This can be any kind of file, e.g. image files, textfiles, config files, etc.

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'SinkNodeRun.schema.json'

__getstate__()
Retrieve the state of the NodeRun

Returns the state of the object

Rtype dict

__init__(*node*, *parent*)
Instantiation of the SinkNodeRun.

Parameters

- **node** (fastr.planning.node.Node) – The Node that this Run is based on.
- **parent** (NetworkRun) – The NetworkRun that this NodeRun belongs to

Returns newly created sink node run

__module__ = 'fastr.execution.sinknoderun'

__setstate__(*state*)
Set the state of the NodeRun by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

create_job(*sample_id*, *sample_index*, *job_data*, *job_dependencies*, ***kwargs*)
Create a job for a sink based on the sample id, job data and job dependencies.

Parameters

- **sample_id** (SampleId) – the id of the corresponding sample
- **job_data** (*dict*) – dictionary containing all input data for the job
- **job_dependencies** – other jobs that need to finish before this job can run

Returns the created job

Return type *Job*

property datatype
The datatype of the data this sink can store.

execute()
Execute the sink node and create the jobs that need to run

Returns list of jobs to run

Return type list of *Jobs*

property input
The default input of the sink NodeRun

set_data(*data*)
Set the targets of this sink node.

Parameters **data** (*dict or list of urls*) – the targets rules for where to write the data

The target rules can include a few fields that can be filled out:

field	description
sample_id	the sample id of the sample written in string form
cardinality	the cardinality of the sample written
ext	the extension of the datatype of the written data, including the .
extension	the extension of the datatype of the written data, excluding the .
network	the id of the network the sink is part of
node	the id of the node of the sink
timestamp	the iso formatted datetime the network execution started
uuid	the uuid of the network run (generated using uuid.uuid1)

An example of a valid target could be:

```
>>> target = 'vfs://output_mnt/some/path/image_{sample_id}_{cardinality}{ext}'
```

Note: The `{ext}` and `{extension}` are very similar but are both offered. In many cases having a `name.{extension}` will feel like the correct way to do it. However, if you have DataTypes with and without extension that can both exported by the same sink, this would cause either `name.ext` or `name.` to be generated. In this particular case `name{ext}` can help as it will create either `name.ext` or `name`.

Note: If a datatype has multiple extensions (e.g. .tiff and .tif) the first extension defined in the extension tuple of the datatype will be used.

set_result(*job*, *failed_annotation*)
Incorporate result of a sink job into the Network.

Parameters

- **job** (*Type*) – job of which the result to store
- **failed_annotation** (*set*) – A set of annotations, None if no errors else containing a tuple describing the errors

sourcenoderun Module

class fastr.execution.sourcenoderun.**ConstantNodeRun**(*node*, *parent*)
Bases: *fastr.execution.sourcenoderun.SourceNodeRun*

Class encapsulating one output for which a value can be set. For example used to set a scalar value to the input of a node.

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'ConstantNodeRun.schema.json'

__getstate__()
Retrieve the state of the ConstantNodeRun

Returns the state of the object

Rtype dict

__init__(*node*, *parent*)
Instantiation of the ConstantNodeRun.

Parameters

- **datatype** – The datatype of the output.
- **data** – the prefilled data to use.
- **id** – The url pattern.

This class should never be instantiated directly (unless you know what you are doing). Instead create a constant using the network class like shown in the usage example below.

usage example:

```
>>> import fastr
>>> network = fastr.Network()
>>> source = network.create_source(datatype=types['ITKImageFile'], id_=
↪'sourceN')
```

or alternatively create a constant node by assigning data to an item in an InputDict:

```
>>> node_a.inputs['in'] = ['some', 'data']
```

which automatically creates and links a ConstantNodeRun to the specified Input

__module__ = 'fastr.execution.sourcenoderun'

__setstate__(*state*)
Set the state of the ConstantNodeRun by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

property data
The data stored in this constant node

execute()
Execute the constant node and create the jobs that need to run

Returns list of jobs to run

Return type list of *Jobs*

set_data(*data=None*, *ids=None*)
Set the data of this constant node in the correct way. This is mainly for compatibility with the parent class SourceNodeRun

Parameters

- **data** (*dict or list of urls*) – the data to use
- **ids** – if data is a list, a list of accompanying ids

class fastr.execution.sourcenoderun.**SourceNodeRun**(*node*, *parent*)
Bases: *fastr.execution.flownoderun.FlowNodeRun*

Class providing a connection to data resources. This can be any kind of file, stream, database, etc from which data can be received.

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'SourceNodeRun.schema.json'

__eq__(*other*)
Compare two Node instances with each other. This function ignores the parent and update status, but tests rest of the dict for equality. equality

Parameters **other** (NodeRun) – the other instances to compare to

Returns True if equal, False otherwise

__getstate__()
Retrieve the state of the SourceNodeRun

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*node*, *parent*)
Instantiation of the SourceNodeRun.

Parameters

- **node** (fastr.planning.node.Node) – The Node that this Run is based on.
- **parent** (NetworkRun) – The NetworkRun that this NodeRun belongs to

Returns newly created sink node run

__module__ = 'fastr.execution.sourcenoderun'

__setstate__(*state*)
Set the state of the SourceNodeRun by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

create_job(*sample_id*, *sample_index*, *job_data*, *job_dependencies*, ***kwargs*)
Create a job based on the sample id, job data and job dependencies.

Parameters

- **sample_id** (SampleId) – the id of the corresponding sample
- **sample_index** (SampleIndex) – the index of the corresponding sample
- **job_data** (*dict*) – dictionary containing all input data for the job

- **job_dependencies** – other jobs that need to finish before this job can run

Returns the created job

Return type *Job*

property datatype
The datatype of the data this source supplies.

property dimnames
Names of the dimensions in the SourceNodeRun output. These will be reflected in the SampleIdLists.

execute()
Execute the source node and create the jobs that need to run

Returns list of jobs to run

Return type list of *Jobs*

property output
Shorthand for `self.outputs['output']`

property outputsize
The size of output of this SourceNodeRun

set_data(*data*, *ids=None*)
Set the data of this source node.

Parameters

- **data** (*dict, OrderedDict or list of urls*) – the data to use
- **ids** – if data is a list, a list of accompanying ids

property sourcegroup

property valid
This does nothing. It only overloads the valid method of NodeRun(). The original is intended to check if the inputs are connected to some output. Since this class does not implement inputs, it is skipped.

helpers Package

helpers Package

fastr.helpers.**config = # [bool] Flag to enable/disable debugging debug = False # [str] Dire**
Configuration of the fastr system

checksum Module

This module contains a number of functions for checksumming files and objects

fastr.helpers.checksum.**checksum**(*filepath*, *algorithm='md5'*, *hasher=None*, *chunksize=32768*)
Generate the checksum of a file

Parameters

- **filepath** (*str, list*) – path of the file(s) to checksum
- **algorithm** (*str*) – the algorithm to use
- **hasher** (*_hashlib.HASH*) – a hasher to continue updating (rather then creating a new one)

Returns the checksum

Return type str

fastr.helpers.checksum.**checksum_directory**(*directory*, *algorithm='md5'*, *hasher=None*)
Generate the checksum of an entire directory

Parameters

- **directory** (*str*) – path of the file(s) to checksum
- **algorithm** (*str*) – the algorithm to use
- **hasher** (*_hashlib.HASH*) – a hasher to continue updating (rather then creating a new one)

Returns the checksum

Return type str

fastr.helpers.checksum.**hashsum**(*objects*, *hasher=None*)
Generate the md5 checksum of (a) python object(s)

Parameters

- **objects** – the objects to hash
- **hasher** – the hasher to use as a base

Returns the hash generated

Return type str

fastr.helpers.checksum.**md5_checksum**(*filepath*)
Generate the md5 checksum of a file

Parameters **filepath** (*str, list*) – path of the file(s) to checksum

Returns the checksum

Return type str

fastr.helpers.checksum.**sha1_checksum**(*filepath*)
Generate the sha1 checksum of a file

Parameters **filepath** (*str, list*) – path of the file(s) to checksum

Returns the checksum

Return type str

classproperty Module

Module containing the code to create class properties.

class fastr.helpers.classproperty.**ClassPropertyDescriptor**(*fget*)
Bases: object

A descriptor that can act like a property for a class.

__dict__ = mappingproxy({'__module__': 'fastr.helpers.classproperty', '__doc__': '\n

__get__(*obj*, *cls=None*)

__init__(*fget*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.helpers.classproperty'

__weakref__
list of weak references to the object (if defined)

fastr.helpers.classproperty.**classproperty**(*func*)
Decorator to create a "class property"

Parameters **func** – the function to wrap

Returns a class property

Return type *ClassPropertyDescriptor*

clear_pycs Module

A small tool to wipe all .pyc files from fastr

fastr.helpers.clear_pycs.**dir_list**(*directory*)
Find all .pyc files

Parameters **directory** (*str*) – directory to search

Returns all .pyc files

Return type list

fastr.helpers.clear_pycs.**main**()
Main entry poitn

configmanager Module

This module defines the Fastr Config class for managing the configuration of Fastr. The config object is stored directly in the fastr top-level module.

class fastr.helpers.configmanager.**Config**(**configfiles*)
Bases: object

Class contain the fastr configuration

DEFAULT_FIELDS = {'debug': (<class 'bool'>, False, 'Flag to enable/disable debugging'

__dict__ = mappingproxy({'__module__': 'fastr.helpers.configmanager', '__doc__': '\n

__init__(**configfiles*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.helpers.configmanager'

__repr__()
Return repr(self).

__weakref__
list of weak references to the object (if defined)

property debug

property examplesdir

property execution_plugin

property executionscript

property extra_config_dirs

property filesynchelper_url

get_field(*item*)

property job_cleanup_level

property log_to_file

property logdir

property logging_config

property loglevel

property logtype

property mounts

property networks_path

property pim_batch_size

property pim_debug

property pim_finished_timeout

property pim_host

property pim_update_interval

property pim_username

property plugins_path

property preferred_types

property process_pool_worker_number

property protected_modules

property queue_report_interval

read_config(*filename*)
Read a configuration and update the configuration object accordingly

Parameters **filename** – the configuration file to read

read_config_files
Trace of the config files read by this object

read_config_string(*value*)

register_fields(*fields_spec*)
Register extra fields to the configuration manager.

property reporting_plugins

property resourcesdir

property schemadir

set_field(*item*, *value*)

property source_job_limit

property systemdir

property tools_path

property types_path

property userdir

property warn_develop

property web_hostname

web_url()
Construct a fqdn from the web['hostname'] and web['port'] settings. :return: FQDN :rtype: str

class fastr.helpers.configmanager.**EmptyDefault**(*data=None*)
Bases: object

Empty defaultdict.

__add__(*right*)

__delitem__(*key*)

__dict__ = mappingproxy({'__module__': 'fastr.helpers.configmanager', '__doc__': '

__getitem__(*item*)

__iadd__(*right*)

__init__(*data=None*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.helpers.configmanager'

__radd__(*other*)

__setitem__(*key*, *value*)

__weakref__
list of weak references to the object (if defined)

append(*value*)

asdict()

aslist()

extend(*other*)

merge_default(*field_spec*)
Merge the default into this EmptyDefault given the field spec :param field_spec: Field specification :return: Merged value

prepend(*value*)

update(*other*)

events Module

class fastr.helpers.events.**EventType**(*value*)
Bases: enum.Enum

An enumeration.

__module__ = 'fastr.helpers.events'

job_updated = 'job_updated'

log_record_emitted = 'log_record_emitted'

run_finished = 'run_finished'

run_started = 'run_started'

class fastr.helpers.events.**FastrLogEventHandler**(*level=0*)
Bases: logging.Handler

Logging handler that sends the log records into the event system

__module__ = 'fastr.helpers.events'

emit(*record*)
Do whatever it takes to actually log the specified logging record.

This version is intended to be implemented by subclasses and so raises a NotImplementedError.

fastr.helpers.events.**emit_event**(*event_type*, *data*)
Emit an event to all listeners :type event_type: *EventType* :param event_type: The type of event to emit :param data: The data object to send along

fastr.helpers.events.**register_listener**(*event_type*, *function*)
Register a listeners to a specific event type

Parameters

- **event_type** (*EventType*) – The EventType to listen on
- **function** (Callable[[object], None]) – The callable that will be called on each event

fastr.helpers.events.**remove_listener**(*event_type*, *function*)
Remove a listeren from a type of event

Parameters

- **event_type** (*EventType*) – The event type to remove the listeners from
- **function** (Callable[[object], None]) – The function to remove

filesynchelper Module

Some helper functions that aid with NFS file sync issues.

class fastr.helpers.filesynchelper.**FileSyncHelper**
Bases: object

__dict__ = mappingproxy({'__module__': 'fastr.helpers.filesynchelper', '_namespace':

__init__()
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.helpers.filesynchelper'

__weakref__
list of weak references to the object (if defined)

has_file_promise(*url*)

job_finished(*jobfile*)

load(*url*)

make_file_promise(*url*)

store(*url*, *data*)

wait_for_file(*path*, *timeout=300*)

wait_for_job(*jobfile*)

wait_for_pickle(*url*, *timeout=300*)

wait_for_vfs_url(*vfs_url*, *timeout=300*)

fastr.helpers.filesynchelper.**filesynchelper_enabled**()

iohelpers Module

fastr.helpers.iohelpers.**link_or_copy**(*source*, *destination*)

fastr.helpers.iohelpers.**load_gpickle**(*path*, *retry_scheme=None*)

fastr.helpers.iohelpers.**load_json**(*path*)

fastr.helpers.iohelpers.**save_gpickle**(*path*, *data*)

fastr.helpers.iohelpers.**save_json**(*path*, *data*, *indent=2*)

jsonschemaparser Module

The JSON schema parser validates a json data structure and if possible casts data to the correct type and fills out default values. The result in a valid document that can be used to construct objects.

class fastr.helpers.jsonschemaparser.**FastrRefResolver**(*base_uri*, *referrer*, *store=()*, *cache_remote=True*, *handlers=()*)

Bases: jsonschema.validators.RefResolver

Adapted version of the RefResolver for handling inter-file references more to our liking

__init__(*base_uri*, *referrer*, *store=()*, *cache_remote=True*, *handlers=()*)

Create a new FastrRefResolver

Parameters

- **base_uri** (*str*) – URI of the referring document
- **referrer** – the actual referring document
- **store** (*dict*) – a mapping from URIs to documents to cache
- **cache_remote** (*bool*) – whether remote refs should be cached after first resolution
- **handlers** (*dict*) – a mapping from URI schemes to functions that should be used to retrieve them

__module__ = 'fastr.helpers.jsonschemaparser'

classmethod from_schema(*schema*, **args*, ***kwargs*)

Instantiate a RefResolver based on a schema

static readfastrschema(*name*)

Open a json file based on a fastr:// url that points to a file in the fastr.schemadir

Parameters **name** (*str*) – the url of the file to open

Returns the resulting json schema data

static readfile(*filename*)

Open a json file based on a simple filename

Parameters **filename** (*str*) – the path of the file to read

Returns the resulting json schema data

fastr.helpers.jsonschemaparser.**any_of_draft4**(*validator*, *any_of*, *instance*, *schema*)
The oneOf directory needs to be done stepwise, because a validation even if it fails will try to change types / set defaults etc. Therefore we first create a copy of the data per subschema and test if they match. Then for all the schemas that are valid, we perform the validation on the actual data so that only the valid subschemas will effect the data.

Parameters

- **validator** – the json schema validator
- **any_of** (*dict*) – the current oneOf
- **instance** – the current object instance
- **schema** (*dict*) – the current json schema

fastr.helpers.jsonschemaparser.**extend**(*validator_cls*)
Extend the given `jsonschema.IValidator` with the Seep layer.

fastr.helpers.jsonschemaparser.**getblueprinter**(*uri*, *blueprint=None*)
Instantiate the given data using the blueprinter.

Parameters **blueprint** – a blueprint (JSON Schema with Seep properties)

fastr.helpers.jsonschemaparser.**items_prevalidate**(*validator*, *items*, *instance*, *schema*)
The pre-validation function for items

Parameters

- **validator** – the json schema validator
- **items** (*dict*) – the current items
- **instance** – the current object instance
- **schema** (*dict*) – the current json schema

fastr.helpers.jsonschemaparser.**not_draft4**(*validator*, *not_schema*, *instance*, *schema*)
The not needs to use a temporary copy of the instance, not to change the instance with the invalid schema

Parameters

- **validator** – the json schema validator
- **not_schema** (*dict*) – the current oneOf
- **instance** – the current object instance
- **schema** (*dict*) – the current json schema

fastr.helpers.jsonschemaparser.**one_of_draft4**(*validator*, *one_of*, *instance*, *schema*)
The one_of directory needs to be done stepwise, because a validation even if it fails will try to change types / set defaults etc. Therefore we first create a copy of the data per subschema and test if they match. Once we found a proper match, we only validate that branch on the real data so that only the valid piece of schema will effect the data.

Parameters

- **validator** – the json schema validator
- **one_of** (*dict*) – the current one_of
- **instance** – the current object instance

- **schema** (*dict*) – the current json schema

fastr.helpers.jsonschemaparser.**pattern_properties_prevalid**(*validator*, *pattern_properties*, *instance*, *schema*)

The pre-validation function for patternProperties

Parameters

- **validator** – the json schema validator
- **pattern_properties** (*dict*) – the current patternProperties
- **instance** (*dict*) – the current object instance
- **schema** (*dict*) – the current json schema

fastr.helpers.jsonschemaparser.**properties_postvalidate**(*validator*, *properties*, *instance*, *schema*)

All arguments must be used because this function is called like this # pylint: disable=unused-argument The post-validation function for properties

Parameters

- **validator** – the json schema validator
- **properties** (*dict*) – the current properties
- **instance** – the current object instance
- **schema** (*dict*) – the current json schema

fastr.helpers.jsonschemaparser.**properties_prevalidate**(*validator*, *properties*, *instance*, *schema*)

The pre-validation function for properties

Parameters

- **validator** – the json schema validator
- **properties** (*dict*) – the current properties
- **instance** – the current object instance
- **schema** (*dict*) – the current json schema

lazy_module Module

This module contains the Manager class for Plugins in the fastr system

class fastr.helpers.lazy_module.**LazyModule**(*name*, *parent*, *plugin_manager*)

Bases: module

A module that allows content to be loaded lazily from plugins. It generally is (almost) empty and gets (partially) populated when an attribute cannot be found. This allows lazy loading and plugins depending on other plugins.

__getattr__(*item*)

The getattr is called when getattribute does not return a value and is used as a fallback. In this case we try to find the value normally and will trigger the plugin manager if it cannot be found.

Parameters **item** (*str*) – attribute to retrieve

Returns the requested attribute

__init__(*name*, *parent*, *plugin_manager*)

Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.helpers.lazy_module'

__repr__()
Return repr(self).

lockfile Module

A module implenting a lock that ensures a directory is only being used by a single fastr run.

class fastr.helpers.lockfile.**DirectoryLock**(*directory*)
Bases: object

A lock for a directory, it creates a directory to set the locked state and if successful writes the pid in a file inside that directory to claim the lock

__del__()

__dict__ = mappingproxy({'__module__': 'fastr.helpers.lockfile', '__doc__': '\n A lo

__enter__()

__exit__(*type*, *value*, *traceback*)

__init__(*directory*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.helpers.lockfile'

__weakref__
list of weak references to the object (if defined)

acquire()

property lock_dir

lock_dir_name = '.fastr.lock'

property pid_file

pid_file_name = 'pid'

release()

procutils Module

fastr.helpers.procutils.**which**(*name*)

Find executable by name on the PATH, returns the executable that will be found in case it is used for a Popen call

report Module

Some reporting functions, e.g. to print a report based on a job result

fastr.helpers.report.**print_job_result**(*job_file*, *print_func=<built-in function print>*, *verbose=False*)

rest_generation Module

fastr.helpers.rest_generation.**create_rest_table**(*data*, *headers*)
Create a ReST table from data. The data should be a list of columns and the headers should be a list of column names.

Parameters

- **data** (*list*) – List of lists/tuples representing the columns
- **headers** (*list*) – List of strings for the column names

Returns a string representing the table in ReST

Return type str

schematotable Module

A module to generate reStructuredText tables from json schema files

class fastr.helpers.schematotable.**SchemaPrinter**(*schema*, *skipfirst=False*)
Bases: object

Object that create a table in reStructuedText from a json schema

__dict__ = mappingproxy({'__module__': 'fastr.helpers.schematotable', '__doc__': '\n

__init__(*schema*, *skipfirst=False*)
Create the printer object

Parameters

- **schema** (*dict*) – the json schema to print
- **skipfirst** (*bool*) – flag to indicate that the first line should not be printed

__module__ = 'fastr.helpers.schematotable'

__str__()
String representation of json schema (that is the printed table)

__weakref__
list of weak references to the object (if defined)

descend(*properties*)
Descend into a subschema

Parameters **properties** (*dict*) – the properties in the subschema

parse(*schema=None*)
Parse a schema

Parameters **schema** (*dict*) – the schema to parse

printlines()
Given a parsed schema (parsing happens when the object is constructed), print all the lines

Returns the printed table

Return type str

shellescape Module

Module with helper for shell escaping

fastr.helpers.shellescape.**quote_argument**(*arg*)
Use shlex module to quote the argument properly :type arg: str :param arg: argument to quote :rtype: str :return: argument with quotes for safe use in a bash-like shell

sysinfo Module

This module contains function to help gather system information use for the provenance of the Job execution.

fastr.helpers.sysinfo.**get_cpu_usage**()
Get the current CPU usage

Returns CPU usage info

Return type dict

fastr.helpers.sysinfo.**get_drmaa_info**()
Get information about the SGE cluster (if applicable)

Returns cluster info

Return type dict

fastr.helpers.sysinfo.**get_hostinfo**()
Get all information about the current host machine

Returns host info

Return type dict

fastr.helpers.sysinfo.**get_memory_usage**()
Get the current memory usage

Returns memory usage info

Return type dict

fastr.helpers.sysinfo.**get_mounts**()
Get the current mounts known on the system

Returns mount info

Return type dict

fastr.helpers.sysinfo.**get_os**()
Get information about the OS

Returns OS information

Return type dict

fastr.helpers.sysinfo.**get_processes**()
Get a list of all currently running processes

Returns process information

Return type list

fastr.helpers.sysinfo.**get_python**()
Get information about the currently used Python implementation

Returns python info

Return type dict

fastr.helpers.sysinfo.**get_sysinfo**()
Get system information (cpu, memory, mounts and users)

Returns system information

Return type dict

fastr.helpers.sysinfo.**get_users**()
Get current users on the system

Returns user info

Return type dict

fastr.helpers.sysinfo.**namedtuple_to_dict**(*ntuple*)
Helper function to convert a named tuple into a dict

Parameters **ntuple** (*namedtuple*) – the namedtuple to convert

Returns named tuple as a dict

Return type dict

xmltodict Module

This module contains tool for converting python dictionaries into XML object and vice-versa.

fastr.helpers.xmltodict.**dump**(*data*, *filehandle*)
Write a dict to an XML file

Parameters

- **data** – data to write
- **filehandle** – file handle to write to

fastr.helpers.xmltodict.**dumps**(*data*)
Write a dict to an XML string

Parameters **data** – data to write

Returns the XML data

Return type str

fastr.helpers.xmltodict.**load**(*filehandle*)
Load an xml file and parse it to a dict

Parameters **filehandle** – file handle to load

Returns the parsed data

fastr.helpers.xmltodict.**loads**(*data*)
Load an xml string and parse it to a dict

Parameters **data** (*str*) – the xml data to load

Returns the parsed data

planning Package

planning Package

inputgroup Module

class fastr.planning.inputgroup.**InputGroup**(**args*, ***kwargs*)

Bases: collections.OrderedDict, *fastr.core.dimension.HasDimensions*

A class representing a group of inputs. Input groups allow the

__abstractmethods__ = frozenset({})

__getitem__(*key*)

x.__getitem__(y) <==> x[y]

__init__(**args*, ***kwargs*)

Create a new InputGroup representation

Parameters

- **parent** (NodeRun) – the parent node
- **id** (*str*) – the id of the input group

Raises ***FastrTypeError*** – if parent is not a NodeRun

Note: This is a wrapped version of fastr.planning.inputgroup.__init__ which triggers an update of the object after being called

---

__module__ = 'fastr.planning.inputgroup'

__setitem__(**args*, ***kwargs*)

Assign an input to this input group.

Parameters

- **key** (*str*) – id of the input
- **value** (*Input*) – the input to assign

Raises ***FastrTypeError*** – if value of valid type

Note: This is a wrapped version of fastr.planning.inputgroup.__setitem__ which triggers an update of the object after being called

---

__updatefunc__()

Update the InputGroup. Triggers when a change is made to the content of the InputGroup. Automatically recalculates the size, primary Input etc.

__updatetriggers__ = ['__init__', '__setitem__', '__delitem__', 'clear', 'pop', 'popit

property dimensions

The dimensions of this InputGroup

property empty
Bool indicating that this InputGroup is empty (has no data connected)

find_source_index(*target_size*, *target_dimnames*, *source_size*, *source_dimnames*, *target_index*)

property fullid

property iterinputvalues
Iterate over the item in this InputGroup

Returns iterator yielding `SampleItems`

property parent
The parent node of this InputGroup

property primary
The primary Input in this InputGroup. The primary Input is the Input that defines the size of this InputGroup. In case of ties it will be the first in the tool definition.

classmethod solve_broadcast(*target_size*, *target_dimnames*, *source_size*, *source_dimnames*, *target_index*, *nodegroups=None*)

inputgroupcombiner Module

class fastr.planning.inputgroupcombiner.**BaseInputGroupCombiner**(*parent*)
Bases: *fastr.core.dimension.HasDimensions*

An object that takes the different input groups and combines them in the correct way.

__abstractmethods__ = frozenset({'iter_input_groups', 'merge', 'unmerge'})

__init__(*parent*)
Initialize self. See help(type(self)) for accurate signature.

__iter__()

__module__ = 'fastr.planning.inputgroupcombiner'

property dimensions
The dimensions has to be implemented by any subclass. It has to provide a tuple of Dimensions.

Returns dimensions

Return type tuple

property fullid
The full id of the InputGroupCombiner

property input_groups

abstract iter_input_groups()
Iterate over all the merged samples :return:

abstract merge(*list_of_items*)
Given a list of items for each input group, it returns the combined list of items.

Parameters **list_of_items** (*list*) – items to combine

Returns combined list

merge_failed_annotations(*list_of_failed_annotations*)

merge_payloads(*sample_payloads*)

merge_sample_data(*list_of_sample_data*)

merge_sample_id(*list_of_sample_ids*)

merge_sample_index(*list_of_sample_indexes*)

merge_sample_jobs(*list_of_sample_jobs*)

abstract unmerge(*item*)
Given a item it will recreate the seperate items, basically this is the inverse operation of merge. However, this create an OrderedDict so that specific input groups can be easily retrieved. To get a round trip, the values of the OrderedDict should be taken:

```
>>> odict_of_items = combiner.unmerge(item)
>>> item = combiner.merge(odict_of_items.values())
```

Parameters **item** (*list*) – the item to unmerge

Returns items

Return type OrderedDict

update()

class fastr.planning.inputgroupcombiner.**DefaultInputGroupCombiner**(*parent*)
Bases: *fastr.planning.inputgroupcombiner.BaseInputGroupCombiner*

The default input group combiner combines the input group in a cross product version, taking each combinations of samples between the input groups. So if there are two input groups with one with size N and the other with size M x P the result would be N x M x P samples, with all possible combinations of the samples in each input group.

__abstractmethods__ = frozenset({})

__module__ = 'fastr.planning.inputgroupcombiner'

iter_input_groups()
Iterate over all the merged samples :return:

merge(*list_of_items*)
Given a list of items for each input group, it returns the combined list of items.

Parameters **list_of_items** (*list*) – items to combine

Returns combined list

unmerge(*item*)
Given a item it will recreate the seperate items, basically this is the inverse operation of merge. However, this create an OrderedDict so that specific input groups can be easily retrieved. To get a round trip, the values of the OrderedDict should be taken:

```
>>> odict_of_items = combiner.unmerge(item)
>>> item = combiner.merge(odict_of_items.values())
```

Parameters **item** (*list*) – the item to unmerge

Returns items

Return type OrderedDict

class fastr.planning.inputgroupcombiner.**MergingInputGroupCombiner**(*input_groups*, *merge_dimension*)
Bases: *fastr.planning.inputgroupcombiner.BaseInputGroupCombiner*

The merging input group combiner takes a similar approach as the default combiner but merges dimensions that are the same. If input group A has N(3) x M(2) samples and B has M(2) x P(4) it wil not result in N(3) x M(2) x M(2) x P(4), but merge the dimensions M leading to N(3) x M(2) x P(4) in resulting size.

__abstractmethods__ = frozenset({})

__init__(*input_groups*, *merge_dimension*)
Initialize self. See help(type(self)) for accurate signature.

__module__ = 'fastr.planning.inputgroupcombiner'

iter_input_groups()
Iterate over all the merged samples :return:

merge(*list_of_items*)
Given a list of items for each input group, it returns the combined list of items.

Parameters **list_of_items** (*list*) – items to combine

Returns combined list

unmerge(*item*)
Given a item it will recreate the seperate items, basically this is the inverse operation of merge. However, this create an OrderedDict so that specific input groups can be easily retrieved. To get a round trip, the values of the OrderedDict should be taken:

```
>>> odict_of_items = combiner.unmerge(item)
>>> item = combiner.merge(odict_of_items.values())
```

Parameters **item** (*list*) – the item to unmerge

Returns items

Return type OrderedDict

update()

inputoutput Module

Classes for arranging the input and output for nodes.

Exported classes:

Input – An input for a node (holding datatype). Output – The output of a node (holding datatype and value). ConstantOutput – The output of a node (holding datatype and value).

Warning: Don't mess with the Link, Input and Output internals from other places. There will be a huge chances of breaking the network functionality!

class fastr.planning.inputoutput.**AdvancedFlowOutput**(*node*, *description*)
Bases: *fastr.planning.inputoutput.Output*

Output for nodes that have an advanced flow. This means that the output sample id and index is not the same as the input sample id and index. The AdvancedFlowOutput has one extra dimensions that is created by the Node.

__abstractmethods__ = frozenset({})

__module__ = 'fastr.planning.inputoutput'

property dimensions
The list of the dimensions in this Output. This will be a tuple of Dimension.

class fastr.planning.inputoutput.**BaseInput**(*node*, *description*)
Bases: *fastr.planning.inputoutput.BaseInputOutput*

Base class for all inputs.

__abstractmethods__ = frozenset({'_update', 'dimensions', 'fullid', 'itersubinputs'})

__init__(*node*, *description*)
Instantiate a BaseInput

Parameters

- **node** – the parent node the input/output belongs to.
- **description** – the ParameterDescription describing the input/output.

Returns the created BaseInput

Raises

- ***FastrTypeError*** – if description is not of class ParameterDescription
- ***FastrDataTypeNotAvailableError*** – if the DataType requested cannot be found in the types

__lshift__(*other*)

__module__ = 'fastr.planning.inputoutput'

__rrshift__(*other*)

check_cardinality(*key=None*, *planning=False*)
Check if the actual cardinality matches the cardinality specified in the ParameterDescription. Optionally you can use a key to test for a specific sample.

Parameters **key** – sample_index (tuple of int) or SampleId for desired sample

Returns flag indicating that the cardinality is correct

Return type bool

Raises ***FastrCardinalityError*** – if the Input/Output has an incorrect cardinality description.

constant_id()
The id that should be used for a constant created to serve this input.

Return type str

create_link_from(*value*)

property default
Default value

description_type
alias of *fastr.core.interface.InputSpec*

property item_index

abstract itersubinputs()
Iterator over the SubInputs

Returns iterator

example:

```
>>> for subinput in input_a.itersubinputs():
        print subinput
```

class fastr.planning.inputoutput.**BaseInputOutput**(*node*, *description*)

Bases: *fastr.core.dimension.HasDimensions*, fastr.abc.updateable.Updateable, fastr.abc.serializable.Serializable

Base class for Input and Output classes. It mainly implements the properties to access the data from the underlying ParameterDescription.

__abstractmethods__ = frozenset({'_update', 'dimensions', 'fullid'})

__getstate__()

Retrieve the state of the BaseInputOutput

Returns the state of the object

Rtype dict

__init__(*node*, *description*)

Instantiate a BaseInputOutput

Parameters

- **node** – the parent node the input/output belongs to.
- **description** – the ParameterDescription describing the input/output.

Returns created BaseInputOutput

Raises

- ***FastrTypeError*** – if description is not of class ParameterDescription
- ***FastrDataTypeNotAvailableError*** – if the DataType requested cannot be found in the types

__iter__()

This function is blocked to avoid support for iteration using a lecacy __getitem__ method.

Returns None

Raises ***FastrNotImplementedError*** – always

__module__ = 'fastr.planning.inputoutput'

__ne__(*other*)

Check two Node instances for inequality. This is the inverse of __eq__

Parameters **other** (BaseInputOutput) – the other instances to compare to

Returns True if unequal, False otherwise

__repr__()

Get a string representation for the Input/Output

Returns the string representation

Return type str

__setstate__(*state*)

Set the state of the BaseInputOutput by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

cardinality(*key=None*, *job_data=None*)
Determine the cardinality of this Input/Output. Optionally a key can be given to determine for a sample.

Parameters **key** – key for a specific sample

Returns the cardinality

Return type int, sympy.Symbol, or None

check_cardinality(*key=None*, *planning=False*)
Check if the actual cardinality matches the cardinality specified in the ParameterDescription. Optionally you can use a key to test for a specific sample.

Parameters **key** – sample_index (tuple of int) or `SampleId` for desired sample

Returns flag indicating that the cardinality is correct

Return type bool

Raises ***FastrCardinalityError*** – if the Input/Output has an incorrect cardinality description.

property datatype
The datatype of this Input/Output

property description
The description object of this input/output

description_type = None

abstract property fullid
The fullid of the Input/Output, the fullid should be unnique and makes the object retrievable by the network.

property id
Id of the Input/Output

property node
The NodeRun to which this Input/Output belongs

property required
Flag indicating that the Input/Output is required

class fastr.planning.inputoutput.**BaseOutput**(*node*, *description*)
Bases: *fastr.planning.inputoutput.BaseInputOutput*

Base class for all outputs.

__abstractmethods__ = frozenset({'_update', 'dimensions', 'fullid'})

__init__(*node*, *description*)
Instantiate a BaseOutput

Parameters

- **node** – the parent node the output belongs to.
- **description** – the `ParameterDescription` describing the output.

Returns created BaseOutput

Raises

- ***FastrTypeError*** – if description is not of class `ParameterDescription`
- ***FastrDataTypeNotAvailableError*** – if the DataType requested cannot be found in the `types`

__module__ = 'fastr.planning.inputoutput'

property automatic
Flag indicating that the Output is generated automatically without being specified on the command line

property blocking
Flag indicating that this Output will cause blocking in the execution

description_type
alias of *fastr.core.interface.OutputSpec*

class fastr.planning.inputoutput.**Input**(*node*, *description*)
Bases: *fastr.planning.inputoutput.BaseInput*

Class representing an input of a node. Such an input will be connected to the output of another node or the output of an constant node to provide the input value.

__abstractmethods__ = frozenset({})

__eq__(*other*)
Compare two Input instances with each other. This function ignores the parent node and update status, but tests rest of the dict for equality.

Parameters **other** (*Input*) – the other instances to compare to

Returns True if equal, False otherwise

Return type bool

__getitem__(*key*)
Retrieve an item from this Input.

Parameters **key** (Union[int, str]) – the key of the requested item

Return type Union[*SubInput*, *NamedSubInput*]

Returns The *SubInput* corresponding with the key will be returned.

Raises

- ***FastrTypeError*** – if key is not of a valid type
- ***FastrKeyError*** – if the key is not found

__getstate__()
Retrieve the state of the Input

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*node*, *description*)
Instantiate an input.

Parameters

- **node** (NodeRun) – the parent node of this input.
- **description** (*ParameterDescription*) – the ParameterDescription of the input.

Returns the created Input

__module__ = 'fastr.planning.inputoutput'

__setitem__(*key*, *value*)
Create a link between a SubInput of this Inputs and an Output/Constant

Parameters

- **key** (*int*, *str*) – the key of the SubInput
- **value** (BaseOutput, *list*, *tuple*, *dict*, *OrderedDict*) – the target to link, can be an output or a value to create a constant for

Raises ***FastrTypeError*** – if key is not of a valid type

__setstate__(*state*)
Set the state of the Input by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

__str__()
Get a string version for the Input

Returns the string version

Return type str

append(*value*)
When you want to append a link to an Input, you can use the append property. This will automatically create a new SubInput to link to.

example:

```
>>> link = node2['input'].append(node1['output'])
```

will create a new SubInput in node2[‘input’] and link to that.

cardinality(*key=None*, *job_data=None*)
Cardinality for an Input is the sum the cardinalities of the SubInputs, unless defined otherwise.

Parameters **key** (tuple of int or SampleId) – key for a specific sample, can be sample index or id

Returns the cardinality

Return type int, sympy.Symbol, or None

clear()

property constant_id
The id for a constant node that is attached to this input.

Return type str

property datatype
The datatype of this Input

property dimensions
The list names of the dimensions in this Input. This will be a list of str.

property fullid
The full defining ID for the Input

Return type str

get_sourced_nodes()
Get a list of all *Nodes* connected as sources to this Input

Returns list of all connected *Nodes*

Return type list

get_sourced_outputs()
Get a list of all *Outputs* connected as sources to this Input

Returns tuple of all connected *Outputs*

Return type tuple

property id
Id of the Input/Output

index(*value*)
Find index of a SubInput

Parameters **value** (*SubInput*) – the *SubInput* to find the index of

Returns key

Return type int, str

property input_group
The id of the `InputGroup` this Input belongs to.

Return type `str`

insert(*index*)
Insert a new SubInput at index in the sources list

Parameters **key** (*int*) – positive integer for position in _source list to insert to

Returns newly inserted *SubInput*

Return type *SubInput*

itersubinputs()
Iterate over the *SubInputs* in this Input.

Returns iterator yielding *SubInput*

example:

```
>>> for subinput in input_a.itersubinputs():
        print subinput
```

remove(*value*)
Remove a SubInput from the SubInputs list based on the connected Link.

Parameters **value** (*SubInput*, <fastr.planning.inputoutput.SubInput>`) – the *SubInput* or *Link* to removed from this Input

property source
The mapping of *SubInputs* that are connected and have more than 0 elements.

class fastr.planning.inputoutput.**MacroInput**(*node*, *description*)
Bases: *fastr.planning.inputoutput.Input*

__abstractmethods__ = frozenset({})

__module__ = 'fastr.planning.inputoutput'

property input_group
The id of the `InputGroup` this Input belongs to.

class fastr.planning.inputoutput.**MacroOutput**(*node*, *description*)
Bases: *fastr.planning.inputoutput.Output*

__abstractmethods__ = frozenset({})

__module__ = 'fastr.planning.inputoutput'

property dimensions
The list of the dimensions in this Output. This will be a tuple of Dimension.

class fastr.planning.inputoutput.**NamedSubInput**(*parent*)
Bases: *fastr.planning.inputoutput.Input*

A named subinput for cases where the value of an input is mapping.

__abstractmethods__ = frozenset({})

__getitem__(*key*)
Retrieve an item (a SubInput) from this NamedSubInput.

Parameters **key** (int) – the key of the requested item

Return type *SubInput*

Returns The *SubInput* corresponding with the key will be returned.

Raises

- ***FastrTypeError*** – if key is not of a valid type
- ***FastrKeyError*** – if the key is not found

__init__(*parent*)
Instantiate an input.

Parameters

- **node** (NodeRun) – the parent node of this input.
- **description** (*ParameterDescription*) – the ParameterDescription of the input.

Returns the created Input

__module__ = 'fastr.planning.inputoutput'

__str__()
Get a string version for the NamedSubInput

Returns the string version

Return type str

property constant_id
The id for a constant node that is attached to this input.

Return type str

property fullid
The full defining ID for the SubInput

property item_index

class fastr.planning.inputoutput.**Output**(*node*, *description*)
Bases: *fastr.planning.inputoutput.BaseOutput*

Class representing an output of a node. It holds the output values of the tool ran. Output fields can be connected to inputs of other nodes.

__abstractmethods__ = frozenset({})

__eq__(*other*)
Compare two Output instances with each other. This function ignores the parent node, listeners and update status, but tests rest of the dict for equality.

Parameters **other** (fastr.planning.inputoutput.Output) – the other instances to compare to

Returns True if equal, False otherwise

Return type bool

__getitem__(*key*)
Retrieve an item from this Output. The returned value depends on what type of key used:

- Retrieving data using index tuple: [index_tuple]
- Retrieving data sample_id str: [SampleId]
- Retrieving a list of data using SampleId list: [sample_id1, ..., sample_idN]
- Retrieving a *SubOutput* using an int or slice: [n] or [n:m]

Parameters **key** (Union[int, slice]) – the key of the requested suboutput, can be a numberor slice

Return type *SubOutput*

Returns the *SubOutput* for the corresponding index

Raises ***FastrTypeError*** – if key is not of a valid type

__getstate__()
Retrieve the state of the Output

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*node*, *description*)
Instantiate an Output

Parameters

- **node** – the parent node the output belongs to.
- **description** – the ParameterDescription describing the output.

Returns created Output

Raises

- ***FastrTypeError*** – if description is not of class ParameterDescription
- ***FastrDataTypeNotAvailableError*** – if the DataType requested cannot be found in the types

__module__ = 'fastr.planning.inputoutput'

__setstate__(*state*)
Set the state of the Output by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

__str__()
Get a string version for the Output

Returns the string version

Return type str

cardinality()
Cardinality of this Output, may depend on the inputs of the parent Node.

Returns the cardinality

Return type int, sympy.Symbol, or None

Raises

- ***FastrCardinalityError*** – if cardinality references an invalid *Input*
- ***FastrTypeError*** – if the referenced cardinality values type cannot be case to int
- ***FastrValueError*** – if the referenced cardinality value cannot be case to int

property datatype
The datatype of this Output

property dimensions
The list of the dimensions in this Output. This will be a tuple of Dimension.

property fullid
The full defining ID for the Output

property listeners
The list of *Links* connected to this Output.

property preferred_types
The list of preferred DataTypes for this Output.

property resulting_datatype
The DataType that will the results of this Output will have.

property valid
Check if the output is valid, i.e. has a valid cardinality

class fastr.planning.inputoutput.**SourceOutput**(*node*, *description*)
Bases: *fastr.planning.inputoutput.Output*

Output for a SourceNodeRun, this type of Output determines the cardinality in a different way than a normal NodeRun.

__abstractmethods__ = frozenset({})

__init__(*node*, *description*)
Instantiate a FlowOutput

Parameters

- **node** – the parent node the output belongs to.
- **description** – the ParameterDescription describing the output.

Returns created FlowOutput

Raises

- ***FastrTypeError*** – if description is not of class ParameterDescription
- ***FastrDataTypeNotAvailableError*** – if the DataType requested cannot be found in the types

__module__ = 'fastr.planning.inputoutput'

cardinality()
Cardinality of this SourceOutput, may depend on the inputs of the parent NodeRun.

Parameters **key** (tuple of int or SampleId) – key for a specific sample, can be sample index or id

Returns the cardinality

Return type int, sympy.Symbol, or None

property linearized
A linearized version of the sample data, this is lazily cached linearized version of the underlying SampleCollection.

class fastr.planning.inputoutput.**SubInput**(*input_*)
Bases: *fastr.planning.inputoutput.BaseInput*

This class is used by *Input* to allow for multiple links to an *Input*. The SubInput class can hold only a single Link to a (Sub)Output, but behaves very similar to an *Input* otherwise.

__abstractmethods__ = frozenset({})

__eq__(*other*)
Compare two SubInput instances with each other. This function ignores the parent, node, source and update status, but tests rest of the dict for equality.

Parameters **other** (SubInput) – the other instances to compare to

Returns True if equal, False otherwise

__getitem__(*key*)
Retrieve an item from this SubInput.

Parameters **key** (*int*) – the index of the requested item

Returns the corresponding *SubInput*

Return type *SubInput*

Raises ***FastrTypeError*** – if key is not of a valid type

Note: As a SubInput has only one SubInput, only requesting int key 0 or -1 is allowed, and it will return self

---

__getstate__()
Retrieve the state of the SubInput

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*input_*)
Instantiate an SubInput.

Parameters **input** (*Input*) – the parent of this SubInput.

Returns the created SubInput

__module__ = 'fastr.planning.inputoutput'

__setstate__(*state*)
Set the state of the SubInput by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

__str__()
Get a string version for the SubInput

Returns the string version

Return type str

cardinality(*key=None*, *job_data=None*)
Get the cardinality for this SubInput. The cardinality for a SubInputs is defined by the incoming link.

Parameters **key** (SampleIndex or SampleId) – key for a specific sample, can be sample index or id

Returns the cardinality

Return type int, sympy.Symbol, or None

property constant_id
The id for a constant node that is attached to this input.

Return type str

property description
The description object of this input/output

property dimensions
List of dimension for this SubInput

property fullid
The full defining ID for the SubInput

get_sourced_nodes()
Get a list of all *Nodes* connected as sources to this SubInput

Returns list of all connected *Nodes*

Return type list

get_sourced_outputs()
Get a list of all *Outputs* connected as sources to this SubInput

Returns list of all connected *Outputs*

Return type list

property input_group
The id of the InputGroup this SubInputs parent belongs to.

property item_index

iteritems()
Iterate over the SampleItems that are in the SubInput.

Returns iterator yielding SampleItem objects

itersubinputs()
Iterate over SubInputs (for a SubInput it will yield self and stop iterating after that)

Returns iterator yielding *SubInput*

example:

```
>>> for subinput in input_a.itersubinputs():
        print subinput
```

property node
The Node to which this SubInputs parent belongs

remove(*value*)
Remove a SubInput from parent Input.

Parameters **value** (*SubInput*) – the *SubInput* to removed from this Input

property source
A list with the source *Link*. The list is to be compatible with *Input*

property source_output
The *Output* linked to this SubInput

class fastr.planning.inputoutput.**SubOutput**(*output*, *index*)
Bases: *fastr.planning.inputoutput.Output*

The SubOutput is an Output that represents a slice of another Output.

__abstractmethods__ = frozenset({})

__eq__(*other*)
Compare two SubOutput instances with each other. This function ignores the parent, node and update status, but tests rest of the dict for equality. equality

Parameters **other** (SubOutput) – the other instances to compare to

Returns True if equal, False otherwise

Return type bool

__getstate__()
Retrieve the state of the SubOutput

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*output*, *index*)
Instantiate a SubOutput

Parameters

- **output** – the parent output the suboutput slices.
- **index** (*int or slice*) – the way to slice the parent output

Returns created SubOutput

Raises

- ***FastrTypeError*** – if the output argument is not an instance of *Output*
- ***FastrTypeError*** – if the index argument is not an `int` or `slice`

__len__()
Return the length of the Output.

Note: In a SubOutput this is always 1.

__module__ = 'fastr.planning.inputoutput'

__setstate__(*state*)
Set the state of the SubOutput by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

__str__()
Get a string version for the SubOutput

Returns the string version

Return type str

cardinality()
Cardinality of this SubOutput depends on the parent Output and `self.index`

Parameters **key** (tuple of int or `SampleId`) – key for a specific sample, can be sample index or id

Returns the cardinality

Return type int, sympy.Symbol, or None

Raises

- ***FastrCardinalityError*** – if cardinality references an invalid *Input*
- ***FastrTypeError*** – if the referenced cardinality values type cannot be case to int
- ***FastrValueError*** – if the referenced cardinality value cannot be case to int

property datatype
The datatype of this SubOutput

property fullid
The full defining ID for the SubOutput

property indexrep
Simple representation of the index.

property listeners
The list of *Links* connected to this Output.

property node
The NodeRun to which this SubOutput belongs

property preferred_types
The list of preferred `DataTypes` for this SubOutput.

property resulting_datatype
The `DataType` that will the results of this SubOutput will have.

property samples
The `SampleCollection` for this SubOutput

link Module

The link module contain the Link class. This class represents the links in a network. These links lead from an output (BaseOutput) to an input (BaseInput) and indicate the desired data flow. Links are smart objects, in the sense that when you set their start or end point, they register themselves with the Input and Output. They do all the book keeping, so as long as you only set the source and target of the Link, the link should be valid.

Warning: Don't mess with the Link, Input and Output internals from other places. There will be a huge chances of breaking the network functionality!

class fastr.planning.link.**Link**(*source*, *target*, *parent*, *id_=None*, *collapse=None*, *expand=None*)

Bases: *fastr.core.dimension.HasDimensions*, fastr.abc.updateable.Updateable, fastr.abc.serializable.Serializable

Class for linking outputs (*BaseOutput*) to inputs (*BaseInput*)

Examples:

```
>>> import fastr
>>> network = fastr.create_network()
>>> link1 = network.create_link( n1.ouputs['out1'], n2.inputs['in2'] )

link2 = Link()
link2.source = n1.ouputs['out1']
link2.target = n2.inputs['in2']
```

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'Link.schema.json'

__eq__(*other*)

Test for equality between two Links

Parameters **other** (*Link*) – object to test against

Return type bool

Returns True for equality, False otherwise

__getstate__()

Retrieve the state of the Link

Return type dict

Returns the state of the object

__hash__ = None

__init__(*source*, *target*, *parent*, *id_=None*, *collapse=None*, *expand=None*)

Create a new Link in a Network.

Parameters

- **source** (*BaseOutput*) – the source output
- **target** (*BaseInput*) – the target input
- **parent** (*Network* or None) – the parent network
- **id** – the id of the link, if no id_ is given, the id will be in the form of "link_{:d}"

- **collapse** (Union[str, int, Tuple[str, ...], None]) – the dimensions that the link has to collapse on
- **expand** (Optional[bool]) – Does this link need to expand the cardinality into a new sample dimension

Returns newly created Link

Raises

- ***FastrValueError*** – if parent is not given
- ***FastrValueError*** – if the source output is not in the same network as the Link
- ***FastrValueError*** – if the target input is not in the same network as the Link

__module__ = 'fastr.planning.link'

__repr__()
Get a string representation for the Link

Return type str

__setstate__(*state*)
Set the state of the Link by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

Raises ***FastrValueError*** – if the parent network is not set

cardinality(*index=None*)
Cardinality for a Link is given by source Output and the collapse/expand settings

Parameters **index** (Optional[*SampleIndex*]) – index for a specific sample (can be only a sample index!)

Return type Union[int, Symbol]

Returns the cardinality

Raises ***FastrIndexError*** – if the index length does not match the number of dimension in the data

property collapse
The converging dimensions of this link. Collapsing changes some dimensions of sample lists into cardinality, reshaping the data.

Collapse can be set to a tuple or an int/str, in which case it will be automatically wrapped in a tuple. The int will be seen as indices of the dimensions to collapse. The str will be seen as the name of the dimensions over which to collapse.

Raises ***FastrTypeError*** – if assigning a collapse value of a wrong type

property collapse_indexes
The converging dimensions of this link as integers. Dimension names are replaces with the corresponding int.

Collapsing changes some dimensions of sample lists into cardinality, reshaping the data

classmethod createobj(*state*, *network=None*)
Create object function for Link

Parameters

- **cls** – The class to create

- **state** (dict) – The state to use to create the Link
- **network** – the parent Network

Returns newly created Link

destroy()
The destroy function of a link removes all default references to a link. This means the references in the network, input and output connected to this link. If there is no references in other places in the code, it will destroy the link (reference count dropping to zero).

This function is called when a source for an input is set to another value and the links becomes disconnected. This makes sure there is no dangling links.

property dimensions
The dimensions of the data delivered by the link. This can be different from the source dimensions because the link can make data collapse or expand.

draw(*context*, *graph*)

property expand
Flag indicating that the link will expand the cardininality into a new sample dimension to be created.

property fullid
The full defining ID for the Input

property parent
The Network to which this Link belongs.

property source
The source *BaseOutput* of the Link. Setting the source will automatically register the Link with the source BaseOutput. Updating source will also make sure the Link is unregistered with the previous source.

Raises ***FastrTypeError*** – if assigning a non *BaseOutput*

property status

property target
The target *BaseInput* of the Link. Setting the target will automatically register the Link with the target BaseInput. Updating target will also make sure the Link is unregistered with the previous target.

Raises ***FastrTypeError*** – if assigning a non *BaseInput*

network Module

Network module containing Network facilitators and analysers.

class fastr.planning.network.**Network**(*id_='unnamed_network'*, *version=None*, *filename=None*)
Bases: fastr.abc.serializable.Serializable

The NetworkRun contains the entire Run state for a Network execution. It has a working copy of the network, but also includes all temporary data required for the execution. These objects are meant to be single use.

NETWORK_DUMP_FILE_NAME = '__fastr_network__.yaml'

SINK_DUMP_FILE_NAME = '__sink_data__.json'

SOURCE_DUMP_FILE_NAME = '__source_data__.pickle.gz'

__dataschemafile__ = 'Network.schema.json'

__eq__(*other*)
Compare two Networks and see if they are equal.

Parameters **other** (*Network*) –

Returns flag indicating that the Networks are the same

Return type bool

__getitem__(*item*)
Get an item by its fullid. The fullid can point to a link, node, input, output or even subinput/suboutput.

Parameters **item** (*str, unicode*) – fullid of the item to retrieve

Returns the requested item

__getstate__()
Retrieve the state of the Network

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*id_='unnamed_network'*, *version=None*, *filename=None*)
Create a new, empty Network

Parameters **name** (*str*) – name of the Network

Returns newly created Network

Raises **OSError** – if the tmp mount in the config is not a writable directory

__module__ = 'fastr.planning.network'

__ne__(*other*)
Tests for non-equality, this is the negated version __eq__

__repr__()
Return repr(self).

__setstate__(*state*)
Set the state of the Network by the given state. This completely overwrites the old state!

Parameters **state** (*dict*) – The state to populate the object with

Returns None

add_link(*link*)
Add a Link to the Network. Make sure the link is in the link list and the link parent is set to this Network

Parameters **link** (*Link*) – link to add

Raises

- ***FastrTypeError*** – if link is incorrectly typed
- ***FastrNetworkMismatchError*** – if the link already belongs to another Network

add_node(*node*)
Add a Node to the Network. Make sure the node is in the node list and the node parent is set to this Network

Parameters **node** (*Node*) – node to add

Raises ***FastrTypeError*** – if node is incorrectly typed

add_stepid(*stepid*, *node*)
Add a Node to a specific step id

Parameters

- **stepid** (*str*) – the stepid that the node will be added to
- **node** (*Node*) – the node to add to the stepid

check_id(*id_*)
Check if an id for an object is valid and unused in the Network. The method will always returns True if it does not raise an exception.

Parameters **id** (*str*) – the id to check

Returns True

Raises

- ***FastrValueError*** – if the id is not correctly formatted
- ***FastrValueError*** – if the id is already in use

create_constant(*datatype*, *data*, *id_=None*, *stepid=None*, *resources=None*, *nodegroup=None*)
Create a ConstantNode in this Network. The Node will be automatically added to the Network.

Parameters

- **datatype** (BaseDataType) – The DataType of the constant node
- **data** (*datatype or list of datatype*) – The data to hold in the constant node
- **id** (*str*) – The id of the constant node to be created
- **stepid** (*str*) – The stepid to add the created constant node to
- **resources** – The resources required to run this node
- **nodegroup** (*str*) – The group the node belongs to, this can be important for FlowNodes and such, as they will have matching dimension names.

Returns the newly created constant node

Return type *ConstantNode*

create_link(*source*, *target*, *id_=None*, *collapse=None*, *expand=None*)
Create a link between two Nodes and add it to the current Network.

Parameters

- **source** (*BaseOutput*) – the output that is the source of the link
- **target** (*BaseInput*) – the input that is the target of the link
- **id** (*str*) – the id of the link

Returns the created link

Type *Link*

create_macro(*network*, *resources=None*, *id_=None*)

create_node(*tool*, *tool_version*, *id_=None*, *stepid=None*, *resources=None*, *nodegroup=None*)
Create a Node in this Network. The Node will be automatically added to the Network.

Parameters

- **tool** (*Tool*) – The Tool to base the Node on
- **id** (*str*) – The id of the node to be created
- **stepid** (*str*) – The stepid to add the created node to

- **resources** – The resources required to run this node
- **nodegroup** (*str*) – The group the node belongs to, this can be important for FlowNodes and such, as they will have matching dimension names.

Returns the newly created node

Return type *Node*

create_reference(*source_data*, *output_directory*)

create_sink(*datatype*, *id_=None*, *stepid=None*, *resources=None*, *nodegroup=None*)
Create a SinkNode in this Network. The Node will be automatically added to the Network.

Parameters

- **datatype** (BaseDataType) – The DataType of the sink node
- **id** (*str*) – The id of the sink node to be created
- **stepid** (*str*) – The stepid to add the created sink node to
- **resources** – The resources required to run this node

Returns the newly created sink node

Return type *SinkNode*

create_source(*datatype*, *id_=None*, *stepid=None*, *resources=None*, *nodegroup=None*)
Create a SourceNode in this Network. The Node will be automatically added to the Network.

Parameters

- **datatype** (BaseDataType) – The DataType of the source source_node
- **id** (*str*) – The id of the source source_node to be created
- **stepid** (*str*) – The stepid to add the created source source_node to
- **resources** – The resources required to run this node
- **nodegroup** (*str*) – The group the node belongs to, this can be important for FlowNodes and such, as they will have matching dimension names.

Returns the newly created source source_node

Return type SourceNode

dependencies()

draw(*name=None*, *draw_dimensions=True*, *hide_unconnected=True*, *context=None*, *graph=None*, *expand_macro=False*, *font_size=14*)

draw_network(*name='network_layout'*, *img_format='svg'*, *draw_dimension=True*, *hide_unconnected=True*, *expand_macro=False*, *font_size=14*)
Output a dot file and try to convert it to an image file.

Parameters **img_format** (*str*) – extension of the image format to convert to

Returns path of the image created or None if failed

Return type str or None

execute(*sourcedata*, *sinkdata*, *blocking=True*, ***kwargs*)

property fullid
The fullid of the Network, within the network scope

property global_id
The global id of the Network, this is different for networks used in macronodes, as they still have parents.

property id
The id of the Network. This is a read only property.

is_valid()

namespace
The namespace this network lives in, this will be set by the NetworkManager on load

property nodegroups
Give an overview of the nodegroups in the network

property ns_id
The namespace and id of the Tool

remove(*value*)
Remove an item from the Network.

Parameters **value** (*Node* or *Link*) – the item to remove

classmethod test(*reference_data_dir*, *network=None*, *source_data=None*, *force_remove_temp=False*, *tmp_results_dir=None*)
Execute the network with the source data specified and test the results against the refence data. This effectively tests the network execution.

Parameters

- **reference_data_dir** (*str*) – The path or vfs url of reference data to compare with
- **source_data** (*dict*) – The source data to use
- **force_remove_temp** – Make sure the tmp results directory is cleaned at end of test
- **tmp_results_dir** – Path to results directory

node Module

A module to maintain a network node.

Exported classes:

Node – A class encapsulating a tool. ConstantNode – A node encapsulating an Output to set scalar values. SourceNode – A class providing a handle to a file.

class fastr.planning.node.**AdvancedFlowNode**(*tool*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)
Bases: *fastr.planning.node.FlowNode*

__abstractmethods__ = frozenset({})

__module__ = 'fastr.planning.node'

class fastr.planning.node.**BaseNode**
Bases: *fastr.core.dimension.HasDimensions*, fastr.abc.updateable.Updateable, fastr.abc.serializable.Serializable

NODE_TYPES = {'AdvancedFlowNode': <class 'fastr.planning.node.AdvancedFlowNode'>, 'Co

__abstractmethods__ = frozenset({'_update', 'dimensions'})

classmethod __init_subclass__(***kwargs*)
Register nodes in class for easly location

__module__ = 'fastr.planning.node'

class fastr.planning.node.**ConstantNode**(*datatype*, *data*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)

Bases: *fastr.planning.node.SourceNode*

Class encapsulating one output for which a value can be set. For example used to set a scalar value to the input of a node.

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'ConstantNode.schema.json'

__getstate__()

Retrieve the state of the ConstantNode

Returns the state of the object

Rtype dict

__init__(*datatype*, *data*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)

Instantiation of the ConstantNode.

Parameters

- **datatype** – The datatype of the output.
- **data** – the prefilled data to use.
- **id** – The url pattern.

This class should never be instantiated directly (unless you know what you are doing). Instead create a constant using the network class like shown in the usage example below.

usage example:

```
>>> import fastr
>>> network = fastr.create_network()
>>> source = network.create_source(datatype=types['ITKImageFile'], id_=
↪'sourceN')
```

or alternatively create a constant node by assigning data to an item in an InputDict:

```
>>> node_a.inputs['in'] = ['some', 'data']
```

which automatically creates and links a ConstantNode to the specified Input

__module__ = 'fastr.planning.node'

__setstate__(*state*)

Set the state of the ConstantNode by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

property data

The data stored in this constant node

draw(*context*, *graph*, *color=None*)

property print_value

set_data(*data=None*, *ids=None*)

Set the data of this constant node in the correct way. This is mainly for compatibility with the parent class SourceNode

Parameters

- **data** (*dict or list of urls*) – the data to use
- **ids** – if data is a list, a list of accompanying ids

class fastr.planning.node.**FlowNode**(*tool*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)

Bases: *fastr.planning.node.Node*

A Flow Node is a special subclass of Nodes in which the amount of samples can vary per Output. This allows non-default data flows.

__abstractmethods__ = frozenset({})

__init__(*tool*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)

Instantiate a flow node.

Parameters

- **tool** (*Tool*) – The tool to base the node on
- **id** (*str*) – the id of the node
- **parent** (*Network*) – the parent network of the node

Returns the newly created FlowNode

__module__ = 'fastr.planning.node'

property blocking

A FlowNode is (for the moment) always considered blocking.

Returns True

property dimensions

Names of the dimensions in the Node output. These will be reflected in the SampleIdList of this Node.

property outputsize

Size of the outputs in this Node

class fastr.planning.node.**InputDict**

Bases: collections.OrderedDict

The container containing the Inputs of Node. Implements helper functions for the easy linking syntax.

__module__ = 'fastr.planning.node'

__setitem__(*key*, *value*)

Set an item in the input dictionary. The behaviour depends on the type of the value. For a *BaseInput*, the input will simply be added to the list of inputs. For a *BaseOutput*, a link between the output and input will be created.

Parameters

- **key** (*str*) – id of the input to assign/link
- **value** (*BaseInput* or *BaseOutput*) – either the input to add or the output to link
- **dict_setitem** – the setitem function to use for the underlying OrderedDict insert

class fastr.planning.node.**MacroNode**(*value*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)

Bases: *fastr.planning.node.Node*

MacroNode encapsulates an entire network in a single node.

__abstractmethods__ = frozenset({})

__eq__(*other*)
Compare two MacroNode instances with each other. This function ignores the parent and update status, but tests rest of the dict for equality. equality

Parameters **other** (MacroNode) – the other instances to compare to

Returns True if equal, False otherwise

__getstate__()
Retrieve the state of the MacroNode

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*value*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)

Parameters **network** (fastr.planning.network.Network) – network to create macronode for

__module__ = 'fastr.planning.node'

__setstate__(*state*)
Set the state of the Node by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

draw(*context*, *graph*, *color=None*)

draw_link_target(*context*, *port_name*, *input=True*)

get_output_info(*output*)
This functions maps the output dimensions based on the input dimensions of the macro. This is cached for speed as this can become rather costly otherwise

Parameters **output** – output to get info for

Returns tuple of Dimensions

property network

class fastr.planning.node.**Node**(*tool*, *id_=None*, *node_class=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)
Bases: *fastr.planning.node.BaseNode*

The class encapsulating a node in the network. The node is responsible for setting and checking inputs and outputs based on the description provided by a tool instance.

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'Node.schema.json'

__eq__(*other*)
Check two Node instances for equality.

Parameters **other** (fastr.planning.node.Node) – the other instances to compare to

Returns True if equal, False otherwise

__getstate__()
Retrieve the state of the Node

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*tool*, *id_=None*, *node_class=None*, *parent=None*, *resource_limits=None*, *node-group=None*)

Instantiate a node.

Parameters

- **tool** (*Tool*) – The tool to base the node on
- **id** (*str*) – the id of the node
- **node_class** (*str*) – The class of the NodeRun to create (e.g. SourceNodeRun, NodeRun)
- **parent** (*Network*) – the parent network of the node
- **cores** (*int*) – number of cores required for executing this Node
- **memory** (*str*) – amount of memory required in the form d+[mMgG] where M is for megabyte and G for gigabyte
- **walltime** (*str*) – amount of time required in second or in the form HOURS:MINUTES:SECOND

Returns the newly created Node

__module__ = 'fastr.planning.node'

__ne__(*other*)

Check two Node instances for inequality. This is the inverse of __eq__

Parameters **other** (fastr.planning.node.Node) – the other instances to compare to

Returns True if unequal, False otherwise

__repr__()

Get a string representation for the Node

Returns the string representation

Return type str

__setstate__(*state*)

Set the state of the Node by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

__str__()

Get a string version for the Node

Returns the string version

Return type str

property blocking

Indicate that the results of this Node cannot be determined without first executing the Node, causing a blockage in the creation of jobs. A blocking Nodes causes the Chunk borders.

classmethod createobj(*state*, *network=None*)

Create object function for generic objects

Parameters

- **cls** – The class to create
- **state** – The state to use to create the Link
- **network** – the parent Network

Returns newly created Link

property dimensions
The dimensions has to be implemented by any subclass. It has to provide a tuple of Dimensions.

Returns dimensions

Return type tuple

property dimnames
Names of the dimensions in the Node output. These will be reflected in the SampleIdList of this Node.

draw(*context*, *graph*, *color=None*)

draw_id(*context*)

draw_link_target(*context*, *port_name*, *input=True*)

find_source_index(*target_index*, *target*, *source*)

property fullid
The full defining ID for the Node inside the network

get_sourced_nodes()
A list of all Nodes connected as sources to this Node

Returns list of all nodes that are connected to an input of this node

property global_id
The global defining ID for the Node from the main network (goes out of macro nodes to root network)

property id
The id of the Node

property input_groups

A list of input groups for this Node. An input group is InputGroup object filled according to the Node

inputs
A list of inputs of this Node

property listeners
All the listeners requesting output of this node, this means the listeners of all Outputs and SubOutputs

property merge_dimensions

property name
Name of the Tool the Node was based on. In case a Toolless Node was used the class name is given.

property nodegroup

outputs
A list of outputs of this Node

property outputsize
The size of output of this SourceNode

property parent
The parent is the Network this Node is part of

property status

property tool

update_input_groups()
Update all input groups in this node

class fastr.planning.node.**OutputDict**
Bases: collections.OrderedDict

The container containing the Inputs of Node. Only checks if the inserted values are actually outputs.

__module__ = 'fastr.planning.node'

__setitem__(*key*, *value*)
Set an output.

Parameters

- **key** (*str*) – the of the item to set
- **value** (*BaseOutput*) – the output to set
- **dict_setitem** – the setitem function to use for the underlying OrderedDict insert

class fastr.planning.node.**SinkNode**(*datatype*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)
Bases: *fastr.planning.node.Node*

Class which handles where the output goes. This can be any kind of file, e.g. image files, textfiles, config files, etc.

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'SinkNode.schema.json'

__getstate__()
Retrieve the state of the Node

Returns the state of the object

Rtype dict

__init__(*datatype*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)
Instantiation of the SourceNode.

Parameters

- **datatype** – The datatype of the output.
- **id** – the id of the node to create

Returns newly created sink node

usage example:

```
>>> import fastr
>>> network = fastr.create_network()
>>> sink = network.create_sink(datatype=types['ITKImageFile'], id_='SinkN')
```

__module__ = 'fastr.planning.node'

__setstate__(*state*)
Set the state of the Node by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

property datatype
The datatype of the data this sink can store.

draw(*context*, *graph*, *color=None*)

property input
The default input of the sink Node

class fastr.planning.node.**SourceNode**(*datatype*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)
Bases: *fastr.planning.node.FlowNode*

Class providing a connection to data resources. This can be any kind of file, stream, database, etc from which data can be received.

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'SourceNode.schema.json'

__getstate__()
Retrieve the state of the SourceNode

Returns the state of the object

Rtype dict

__init__(*datatype*, *id_=None*, *parent=None*, *resource_limits=None*, *nodegroup=None*)
Instantiation of the SourceNode.

Parameters

- **datatype** – The (id of) the datatype of the output.
- **id** – The url pattern.

This class should never be instantiated directly (unless you know what you are doing). Instead create a source using the network class like shown in the usage example below.

usage example:

```
>>> import fastr
>>> network = fastr.create_network()
>>> source = network.create_source(datatype=types['ITKImageFile'], id_=
↪'sourceN')
```

__module__ = 'fastr.planning.node'

__setstate__(*state*)
Set the state of the SourceNode by the given state.

Parameters **state** (*dict*) – The state to populate the object with

Returns None

property datatype
The datatype of the data this source supplies.

property dimensions
The dimensions in the SourceNode output. These will be reflected in the SampleIdLists.

draw(*context*, *graph*, *color=None*)

property nodegroup

property output
Shorthand for `self.outputs['output']`

set_data(*data*, *ids=None*)
Set the data of this source node.

Parameters

- **data** (*dict, OrderedDict or list of urls*) – the data to use
- **ids** – if data is a list, a list of accompanying ids

property sourcegroup

property valid
This does nothing. It only overloads the valid method of Node(). The original is intended to check if the inputs are connected to some output. Since this class does not implement inputs, it is skipped.

Subpackages

test Package

test_network Module

test_node Module

plugins Package

plugins Package

The plugins module holds all plugins loaded by Fastr. It is empty on start and gets filled by the BasePluginManager

class fastr.plugins.**BlockingExecution**(*finished_callback=None*, *cancelled_callback=None*)
Bases: *fastr.plugins.executionplugin.ExecutionPlugin*

The blocking execution plugin is a special plugin which is meant for debug purposes. It will not queue jobs but immediately execute them inline, effectively blocking fastr until the Job is finished. It is the simplest execution plugin and can be used as a template for new plugins or for testing purposes.

__abstractmethods__ = frozenset({})

__init__(*finished_callback=None*, *cancelled_callback=None*)
Setup the ExecutionPlugin

Parameters

- **finished_callback** – the callback to call after a job finished
- **cancelled_callback** – the callback to call after a job cancelled

Returns newly created ExecutionPlugin

__module__ = 'fastr.plugins'

cleanup()
Method to call to clean up the ExecutionPlugin. This can be to clear temporary data, close connections, etc.

Parameters **force** – force cleanup (e.g. kill instead of join a process)

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'blockingexecution' from '/home/docs/checkouts/readthedocs.org/user_b

classmethod test()
Test the plugin, default behaviour is just to instantiate the plugin

class fastr.plugins.**CommaSeperatedValueFile**
Bases: *fastr.core.ioplugin.IOPlugin*

The CommaSeperatedValueFile an expand-only type of IOPlugin. No URLs can actually be fetched, but it can expand a single URL into a larger amount of URLs.

The `csv://` URL is a `vfs://` URL with a number of query variables available. The URL mount and path should point to a valid CSV file. The query variable then specify what column(s) of the file should be used.

The following variable can be set in the query:

variable	usage
value	the column containing the value of interest, can be int for index or string for key
id	the column containing the sample id (optional)
header	indicates if the first row is considered the header, can be `true` or `false` (optional)
delimiter	the delimiter used in the csv file (optional)
quote	the quote character used in the csv file (optional)
reformat	a reformatting string so that `value = reformat.format(value)` (used before relative_path)
relative_path	indicates the entries are relative paths (for files), can be `true` or `false` (optional)

The header is by default `false` if the neither the `value` and `id` are set as a string. If either of these are a string, the header is required to define the column names and it automatically is assumed `true`

The delimiter and quota characters of the file should be detected automatically using the `Sniffer`, but can be forced by setting them in the URL.

Example of valid `csv` URLs:

```
# Use the first column in the file (no header row assumed)
csv://mount/some/dir/file.csv?value=0

# Use the images column in the file (first row is assumed header row)
csv://mount/some/dir/file.csv?value=images

# Use the segmentations column in the file (first row is assumed header row)
# and use the id column as the sample id
csv://mount/some/dir/file.csv?value=segmentations&id=id

# Use the first column as the id and the second column as the value
# and skip the first row (considered the header)
csv://mount/some/dir/file.csv?value=1&id=0&header=true

# Use the first column and force the delimiter to be a comma
csv://mount/some/dir/file.csv?value=0&delimiter=,
```

__abstractmethods__ = frozenset({})

__init__()
Initialization for the IOPlugin

Returns newly created IOPlugin

__module__ = 'fastr.plugins'

expand_url(*url*)
(abstract) Expand an URL. This allows a source to collect multiple samples from a single url. The URL will have a wildcard or point to something with info and multiple urls will be returned.

Parameters **url** (*str*) – url to expand

Returns the resulting url(s), a tuple if multiple, otherwise a str

Return type str or tuple of str

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'commaseperatedvaluefile' from '/home/docs/checkouts/readthedocs.org/

scheme = 'csv'

class fastr.plugins.**CrossValidation**
Bases: flowinterface.FlowPlugin

Advanced flow plugin that generated a cross-validation data flow. The node need an input with data and an input number of folds. Based on that the outputs test and train will be supplied with a number of data sets.

__abstractmethods__ = frozenset({})

__module__ = 'fastr.plugins'

static execute(*payload*)

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'crossvalidation' from '/home/docs/checkouts/readthedocs.org/user_bui

class fastr.plugins.**DRMAAExecution**(*finished_callback=None*, *cancelled_callback=None*)
Bases: *fastr.plugins.executionplugin.ExecutionPlugin*

A DRMAA execution plugin to execute Jobs on a Grid Engine cluster. It uses a configuration option for selecting the queue to submit to. It uses the python drmaa package.

Note: To use this plugin, make sure the drmaa package is installed and that the execution is started on an SGE submit host with DRMAA libraries installed.

Note: This plugin is at the moment tailored to SGE, but it should be fairly easy to make different subclasses for different DRMAA supporting systems.

CANCELS_DEPENDENCIES = False

GE_NATIVE_SPEC = {'DEPENDS': '-hold_jid {hold_list}', 'DEPENDS_SEP': ',', 'ERRORLOG':

NATIVE_SPEC = {'grid_engine': {'DEPENDS': '-hold_jid {hold_list}', 'DEPENDS_SEP': ','

SUPPORTS_CANCEL = True

SUPPORTS_DEPENDENCY = True

SUPPORTS_HOLD_RELEASE = True

TORQUE_NATIVE_SPEC = {'CWD': '', 'DEPENDS': '-W depend=afterok:{hold_list}', 'DEPENDS_

__abstractmethods__ = frozenset({})

__init__(*finished_callback=None*, *cancelled_callback=None*)
Setup the ExecutionPlugin

Parameters

- **finished_callback** – the callback to call after a job finished
- **cancelled_callback** – the callback to call after a job cancelled

Returns newly created ExecutionPlugin

__module__ = 'fastr.plugins'

check_threads()
Check if the threads are still alive, but make sure it is only done once per minute

cleanup()
Method to call to clean up the ExecutionPlugin. This can be to clear temporary data, close connections, etc.

Parameters **force** – force cleanup (e.g. kill instead of join a process)

collect_jobs()

configuration_fields = {'drmaa_engine': (<class 'str'>, 'grid_engine', 'The engine to

create_native_spec(*queue*, *walltime*, *memory*, *ncores*, *outputLog*, *errorLog*, *hold_job*, *hold*, *work_dir*)
Create the native spec for the DRMAA scheduler. Needs to be implemented in the subclasses

Parameters

- **queue** (*str*) – the queue to submit to
- **walltime** (*str*) – walltime specified
- **memory** (*str*) – memory requested
- **ncores** (*int*) – number of cores requested
- **outputLog** (*str*) – the location of the stdout log
- **errorLog** (*str*) – the location of stderr log
- **hold_job** (*list*) – list of jobs to depend on
- **hold** (*bool*) – flag if job should be submitted in hold mode

Returns

dispatch_callbacks()

ensure_threads()
Start thread if not defined, or restart if they somehow died accidentallyy

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'drmaaexecution' from '/home/docs/checkouts/readthedocs.org/user_build

property n_current_jobs

regression_check()

send_job(*command*, *arguments*, *work_dir*, *queue=None*, *resources=None*, *job_name=None*, *joinLogFiles=False*, *outputLog=None*, *errorLog=None*, *hold_job=None*, *hold=False*)

property spec_fields

submit_jobs()

classmethod test()
Test the plugin, default behaviour is just to instantiate the plugin

class fastr.plugins.**DockerTarget**(*binary*, *docker_image*)
Bases: *fastr.core.target.Target*

A tool target that is located in a Docker images. Can be run using docker-py. A docker target only need two variables: the binary to call within the docker container, and the docker container to use.

```
{
  "arch": "*",
  "os": "*",
  "binary": "bin/test.py",
  "docker_image": "fastr/test"
}
```

```
<target os="*" arch="*" binary="bin/test.py" docker_image="fastr/test">
```

__abstractmethods__ = frozenset({})

__enter__()
Set the environment in such a way that the target will be on the path.

__exit__(*exc_type*, *exc_value*, *traceback*)
Cleanup the environment where needed

__init__(*binary*, *docker_image*)
Define a new docker target.

Parameters **docker_image** (*str*) – Docker image to use

__module__ = 'fastr.plugins'

property container

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'dockertarget' from '/home/docs/checkouts/readthedocs.org/user_builds

monitor_docker(*container*, *resources*)
Monitor a docker container and profile the cpu, memory and io use. Register the resource use every _MONITOR_INTERVAL seconds.

Parameters

- **container** (*ContainerCollection*) – process to monitor
- **resources** (ProcessUsageCollection) – list to append measurements to

run_command(*command*)
Run a command with the target

Return type *TargetResult*

class fastr.plugins.**ElasticsearchReporter**
Bases: *fastr.plugins.reportingplugin.ReportingPlugin*

__abstractmethods__ = frozenset({})

__init__()
The BasePlugin constructor.

Returns the created plugin

Return type BasePlugin

Raises ***FastrPluginNotLoaded*** – if the plugin did not load correctly

__module__ = 'fastr.plugins'

activate()
Activate the reporting plugin

configuration_fields = {'elasticsearch_debug': (<class 'bool'>, False, 'Setup elastic

elasticsearch_update_status(*job*)

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

job_updated(*job*)

module = <module 'elasticsearchreporter' from '/home/docs/checkouts/readthedocs.org/us

classmethod test()
Test the plugin, default behaviour is just to instantiate the plugin

class fastr.plugins.**FastrInterface**(*id_*, *document*)
Bases: *fastr.core.interface.Interface*

The default Interface for fastr. For the command-line Tools as used by fastr. It build a commandline call based on the input/output specification.

The fields that can be set in the interface:

Attribute		Description
id		The id of this Tool (used internally in fastr)
inputs[]		List of Inputs that can are accepted by the Tool
	id	ID of the Input
	name	Longer name of the Input (more human readable)
	datatype	The ID of the DataType of the Input[1]
	enum[]	List of possible values for an EnumType (created on the fly by fastr)[1]
	prefix	Commandline prefix of the Input (e.g. –in, -i)
	cardinality	Cardinality of the Input
	repeat_prefix	Flag indicating if for every value of the Input the prefix is repeated
	required	Flag indicating if the input is required
	nospace	Flag indicating if there is no space between prefix and value (e.g. –in=val)
	format	For DataTypes that have multiple representations, indicate which one to use
	default	Default value for the Input
	description	Long description for an input
outputs[]		List of Outputs that are generated by the Tool (and accessible to fastr)
	id	ID of the Output

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Table 3.1 – continued from previous page

Attribute		Description
	`name`	Longer name of the Output (more human readable)
	`datatype`	The ID of the DataType of the Output[1]
	`enum[]`	List of possible values for an EnumType (created on the fly by fastr)[1]
	`prefix`	Commandline prefix of the Output (e.g. –out, -o)
	`cardinality`	Cardinality of the Output
	`repeat_prefix`	Flag indicating if for every value of the Output the prefix is repeated
	`required`	Flag indicating if the input is required
	`nospace`	Flag indicating if there is no space between prefix and value (e.g. –out=val)
	`format`	For DataTypes that have multiple representations, indicate which one to use
	`description`	Long description for an input
	`action`	Special action (defined per DataType) that needs to be performed before creating output value (e.g. 'ensure' will make sure an output directory exists)
	`automatic`	Indicate that output doesn't require commandline argument, but is created automatically by a Tool[2]
	`method`	The collector plugin to use for the gathering automatic output, see the *Collector plugins*
	`location`	Definition where to an automatically, usage depends on the `method`[2]

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'FastrInterface.schema.json'

__eq__(*other*)
Return self==value.

__getstate__()
Get the state of the FastrInterface object.

Returns state of interface

Return type dict

[1] `datatype` and `enum` are conflicting entries, if both specified `datatype` has presedence
[2] More details on defining automatica output are given in [TODO]

__hash__ = None

__init__(*id_*, *document*)
The BasePlugin constructor.

Returns the created plugin

Return type BasePlugin

Raises ***FastrPluginNotLoaded*** – if the plugin did not load correctly

__module__ = 'fastr.plugins'

__setstate__(*state*)
Set the state of the Interface

check_input_id(*id_*)
Check if an id for an object is valid and unused in the Tool. The method will always returns True if it does not raise an exception.

Parameters **id** (*str*) – the id to check

Returns True

Raises

- ***FastrValueError*** – if the id is not correctly formatted
- ***FastrValueError*** – if the id is already in use

check_output_id(*id_*)
Check if an id for an object is valid and unused in the Tool. The method will always returns True if it does not raise an exception.

Parameters **id** (*str*) – the id to check

Returns True

Raises

- ***FastrValueError*** – if the id is not correctly formatted
- ***FastrValueError*** – if the id is already in use

static collect_errors(*result*)
Special error collection for fastr interfaces

collect_results(*result*)
Collect all results of the interface

collector_plugin_type
alias of `fastrinterface.CollectorPlugin`

collectors = CollectorPluginManager [37m[42m[1mLoaded[0m json : <CollectorPlugin: Js

execute(*target*, *payload*)
Execute the interface using a specific target and payload (containing a set of values for the arguments)

Parameters

- **target** (*SampleId*) – the target to use
- **payload** (*dict*) – the values for the arguments

Returns result of the execution

Return type *InterfaceResult*

property expanding
Indicates whether or not this Interface will result in multiple samples per run. If the flow is unaffected, this will be zero, if it is nonzero it means that number of dimension will be added to the sample array.

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

get_arguments(*values*)
Get the argument list for this interface

Returns return list of arguments

get_command(*target*, *payload*)

get_specials(*payload*, *output*, *cardinality_nr*)
Get special attributes. Returns tuples for specials, inputs and outputs that are used for formatting substitutions.

Parameters

- **output** – Output for which to get the specials
- **cardinality_nr** (*int*) – the cardinality number

property inputs
OrderedDict of Inputs connected to the Interface. The format should be {input_id: InputSpec}.

module = <module 'fastrinterface' from '/home/docs/checkouts/readthedocs.org/user_buil

property outputs
OrderedDict of Output connected to the Interface. The format should be {output_id: OutputSpec}.

class fastr.plugins.**FileSystem**
Bases: *fastr.core.ioplugin.IOPlugin*

The FileSystem plugin is create to handle `file://` type or URLs. This is generally not a good practice, as this is not portable over between machines. However, for test purposes it might be useful.

The URL scheme is rather simple: `file://host/path` (see wikipedia for details)

We do not make use of the `host` part and at the moment only support localhost (just leave the host empty) leading to `file:///` URLs.

Warning: This plugin ignores the hostname in the URL and does only accept driver letters on Windows in the form `c:/`

__abstractmethods__ = frozenset({})

__init__()
Initialization for the IOPlugin

Returns newly created IOPlugin

__module__ = 'fastr.plugins'

fetch_url(*inurl*, *outpath*)
Fetch the files from the file.

Parameters

- **inurl** – url to the item in the data store, starts with `file://`
- **outpath** – path where to store the fetch data locally

fetch_value(*inurl*)
Fetch a value from an external file file.

Parameters **inurl** – url of the value to read

Returns the fetched value

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'filesystem' from '/home/docs/checkouts/readthedocs.org/user_builds/f

path_to_url(*path*, *mountpoint=None*)
Construct an url from a given mount point and a relative path to the mount point.

put_url(*inpath*, *outurl*)
Put the files to the external data store.

Parameters

- **inpath** – path of the local data
- **outurl** – url to where to store the data, starts with `file://`

put_value(*value*, *outurl*)
Put the value in the external data store.

Parameters

- **value** – value to store
- **outurl** – url to where to store the data, starts with `file://`

scheme = 'file'

url_to_path(*url*)
Get the path to a file from a url. Currently supports the file:// scheme

Examples:

```
>>> 'file:///d:/data/project/file.ext'
'd:\data\project\file.ext'
```

Warning: file:// will not function cross platform and is mainly for testing

class fastr.plugins.**FlowInterface**(*id_*, *document*)
Bases: *fastr.core.interface.Interface*

The Interface use for AdvancedFlowNodes to create the advanced data flows that are not implemented in the fastr. This allows nodes to implement new data flows using the plugin system.

The definition of `FlowInterfaces` are very similar to the default `FastrInterfaces`.

Note: A flow interface should be using a specific FlowPlugin

__abstractmethods__ = frozenset({})

__dataschemafile__ = 'FastrInterface.schema.json'

__eq__(*other*)
Return self==value.

__getstate__()
Get the state of the FastrInterface object.

Returns state of interface

Return type dict

__hash__ = None

__init__(*id_*, *document*)
The BasePlugin constructor.

Returns the created plugin

Return type BasePlugin

Raises ***FastrPluginNotLoaded*** – if the plugin did not load correctly

__module__ = 'fastr.plugins'

__setstate__(*state*)
Set the state of the Interface

execute(*target*, *payload*)
Execute the interface given the a target and payload. The payload should have the form:

```
{
  'input': {
    'input_id_a': (value, value),
    'input_id_b': (value, value)
  },
  'output': {
    'output_id_a': (value, value),
    'output_id_b': (value, value)
  }
}
```

Parameters

- **target** – the target to call
- **payload** – the payload to use

Returns the result of the execution

Return type (tuple of) *InterfaceResult*

property expanding
Indicates whether or not this Interface will result in multiple samples per run. If the flow is unaffected, this will be zero, if it is nonzero it means that number of dimension will be added to the sample array.

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

flow_plugin_type
alias of `flowinterface.FlowPlugin`

flow_plugins = FlowPluginManager [37m[42m[1mLoaded[0m CrossValidation : <FlowPlugin:

property inputs
OrderedDict of Inputs connected to the Interface. The format should be {input_id: InputSpec}.

module = <module 'flowinterface' from '/home/docs/checkouts/readthedocs.org/user_builds

property outputs
OrderedDict of Output connected to the Interface. The format should be {output_id: OutputSpec}.

class fastr.plugins.**HTTPPlugin**
Bases: *fastr.core.ioplugin.IOPlugin*

> **Warning:** This Plugin is still under development and has not been tested at all. example url: https://server.io/path/to/resource

__abstractmethods__ = frozenset({})

__init__()
Initialization for the IOPlugin

Returns newly created IOPlugin

__module__ = 'fastr.plugins'

fetch_url(*inurl*, *outpath*)
Download file from server.

Parameters

- **inurl** – url to the file.
- **outpath** – path to store file

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'httpplugin' from '/home/docs/checkouts/readthedocs.org/user_builds/f

scheme = ('https', 'http')

class fastr.plugins.**LinearExecution**(*finished_callback=None*, *cancelled_callback=None*)
Bases: *fastr.plugins.executionplugin.ExecutionPlugin*

An execution engine that has a background thread that executes the jobs in order. The queue is a simple FIFO queue and there is one worker thread that operates in the background. This plugin is meant as a fallback when other plugins do not function properly. It does not multi-processing so it is safe to use in environments that do no support that.

__abstractmethods__ = frozenset({})

__init__(*finished_callback=None*, *cancelled_callback=None*)
Setup the ExecutionPlugin

Parameters

- **finished_callback** – the callback to call after a job finished
- **cancelled_callback** – the callback to call after a job cancelled

Returns newly created ExecutionPlugin

__module__ = 'fastr.plugins'

cleanup()
Method to call to clean up the ExecutionPlugin. This can be to clear temporary data, close connections, etc.

Parameters **force** – force cleanup (e.g. kill instead of join a process)

exec_worker()

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'linearexecution' from '/home/docs/checkouts/readthedocs.org/user_bui

classmethod test()
Test the plugin, default behaviour is just to instantiate the plugin

class fastr.plugins.**LocalBinaryTarget**(*binary*, *paths=None*, *environment_variables=None*, *initscripts=None*, *modules=None*, *interpreter=None*, ***kwargs*)
Bases: *fastr.core.target.SubprocessBasedTarget*

A tool target that is a local binary on the system. Can be found using environmentmodules or a path on the executing machine. A local binary target has a number of fields that can be supplied:

- `binary (required)`: the name of the binary/script to call, can also be called `bin` for backwards compatibility.
- `modules`: list of modules to load, this can be environmentmodules or lmod modules. If modules are given, the `paths`, `environment_variables` and `initscripts` are ignored.
- `paths`: a list of paths to add following the structure `{"value": "/path/to/dir", "type": "bin"}`. The types can be `bin` if the it should be added to $PATH or `lib` if it should be added to te library path (e.g. $LD_LIBRARY_PATH for linux).
- `environment_variables`: a dictionary of environment variables to set.
- `initscript`: a list of script to run before running the main tool
- `interpreter`: the interpreter to use to call the binary e.g. `python`

The LocalBinaryTarget will first check if there are modules given and the module subsystem is loaded. If that is the case it will simply unload all current modules and load the given modules. If not it will try to set up the environment itself by using the following steps:

1. Prepend the bin paths to $PATH
2. Prepend the lib paths to the correct environment variable
3. Setting the other environment variables given ($PATH and the system library path are ignored and cannot be set that way)
4. Call the initscripts one by one

The definition of the target in JSON is very straightforward:

```
{
  "binary": "bin/test.py",
  "interpreter": "python",
  "paths": [
    {
      "type": "bin",
      "value": "vfs://apps/test/bin"
    },
    {
      "type": "lib",
      "value": "./lib"
    }
  ],
  "environment_variables": {
    "othervar": 42,
    "short_var": 1,
    "testvar": "value1"
  },
  "initscripts": [
```

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```
    "bin/init.sh"
  ],
  "modules": ["elastix/4.8"]
}
```

In XML the definition would be in the form of:

```
<target os="linux" arch="*" modules="elastix/4.8" bin="bin/test.py" interpreter=
↪"python">
  <paths>
    <path type="bin" value="vfs://apps/test/bin" />
    <path type="lib" value="./lib" />
  </paths>
  <environment_variables short_var="1">
    <testvar>value1</testvar>
    <othervar>42</othervar>
  </environment_variables>
  <initscripts>
    <initscript>bin/init.sh</initscript>
  </initscripts>
</target>
```

DYNAMIC_LIBRARY_PATH_DICT = {'darwin': 'DYLD_LIBRARY_PATH', 'linux': 'LD_LIBRARY_PATH

__abstractmethods__ = frozenset({})

__enter__()
Set the environment in such a way that the target will be on the path.

__exit__(*exc_type*, *exc_value*, *traceback*)
Cleanup the environment

__init__(*binary*, *paths=None*, *environment_variables=None*, *initscripts=None*, *modules=None*, *interpreter=None*, ***kwargs*)
Define a new local binary target. Must be defined either using paths and optionally environment_variables and initscripts, or enviroment modules.

__module__ = 'fastr.plugins'

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'localbinarytarget' from '/home/docs/checkouts/readthedocs.org/user_b

property paths

run_command(*command*)
Run a command with the target

Return type *TargetResult*

class fastr.plugins.**MacroTarget**(*network_file*, *method=None*, *function='main'*)
Bases: *fastr.core.target.Target*

A target for MacroNodes. This target cannot be executed as the MacroNode handles execution differently. But this contains the information for the MacroNode to find the internal Network.

__abstractmethods__ = frozenset({})

__init__(*network_file*, *method=None*, *function='main'*)
Define a new local binary target. Must be defined either using paths and optionally environment_variables and initscripts, or enviroment modules.

__module__ = 'fastr.plugins'

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'macrotarget' from '/home/docs/checkouts/readthedocs.org/user_builds/

run_command(*command*)
Run a command with the target

classmethod test()
Test if singularity is availble on the path

class fastr.plugins.**NipypeInterface**(*id_*, *nipype_cls=None*, *document=None*)
Bases: *fastr.core.interface.Interface*

Experimental interfaces to using `nipype` interfaces directly in fastr tools, only using a simple reference.

To create a tool using a nipype interface just create an interface with the correct type and set the `nipype` argument to the correct class. For example in an xml tool this would become:

```
<interface class="NipypeInterface">
  <nipype_class>nipype.interfaces.elastix.Registration</nipype_class>
</interface>
```

Note: To use these interfaces `nipype` should be installed on the system.

Warning: This interface plugin is basically functional, but highly experimental!

__abstractmethods__ = frozenset({})

__eq__(*other*)
Return self==value.

__getstate__()
Retrieve the state of the Interface

Returns the state of the object

Rtype dict

__hash__ = None

__init__(*id_*, *nipype_cls=None*, *document=None*)
The BasePlugin constructor.

Returns the created plugin

Return type BasePlugin

Raises ***FastrPluginNotLoaded*** – if the plugin did not load correctly

__module__ = 'fastr.plugins'

__setstate__(*state*)
Set the state of the Interface

execute(*target*, *payload*)
Execute the interface using a specific target and payload (containing a set of values for the arguments)

Parameters

- **target** (*SampleId*) – the target to use
- **payload** (*dict*) – the values for the arguments

Returns result of the execution

Return type *InterfaceResult*

property expanding
Indicates whether or not this Interface will result in multiple samples per run. If the flow is unaffected, this will be zero, if it is nonzero it means that number of dimension will be added to the sample array.

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

get_type(*trait*)

property inputs
OrderedDict of Inputs connected to the Interface. The format should be {input_id: InputSpec}.

module = <module 'nipypeinterface' from '/home/docs/checkouts/readthedocs.org/user_bui

property outputs
OrderedDict of Output connected to the Interface. The format should be {output_id: OutputSpec}.

classmethod test()
Test the plugin, interfaces do not need to be tested on import

class fastr.plugins.**Null**
Bases: *fastr.core.ioplugin.IOPlugin*

The Null plugin is create to handle `null://` type or URLs. These URLs are indicating the sink should not do anything. The data is not written to anywhere. Besides the scheme, the rest of the URL is ignored.

__abstractmethods__ = frozenset({})

__init__()
Initialization for the IOPlugin

Returns newly created IOPlugin

__module__ = 'fastr.plugins'

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'null' from '/home/docs/checkouts/readthedocs.org/user_builds/fastr/e

put_url(*inpath*, *outurl*)
Put the files to the external data store.

Parameters

- **inpath** – path of the local data
- **outurl** – url to where to store the data, starts with `file://`

put_value(*value*, *outurl*)
Put the value in the external data store.

Parameters

- **value** – value to store
- **outurl** – url to where to store the data, starts with `file://`

scheme = 'null'

class fastr.plugins.**PimReporter**
Bases: *fastr.plugins.reportingplugin.ReportingPlugin*

SUPPORTED_APIS = {2: <class 'pimreporter.PimAPIv2'>}

__abstractmethods__ = frozenset({})

__init__()
The BasePlugin constructor.

Returns the created plugin

Return type BasePlugin

Raises ***FastrPluginNotLoaded*** – if the plugin did not load correctly

__module__ = 'fastr.plugins'

activate()
Activate the reporting plugin

configuration_fields = {'pim_batch_size': (<class 'int'>, 100, 'Maximum number of jobs

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

job_updated(*job*)

log_record_emitted(*record*)

module = <module 'pimreporter' from '/home/docs/checkouts/readthedocs.org/user_builds/

run_finished(*run*)

run_started(*run*)

class fastr.plugins.**ProcessPoolExecution**(*finished_callback=None*, *cancelled_callback=None*, *nr_of_workers=None*)
Bases: *fastr.plugins.executionplugin.ExecutionPlugin*

A local execution plugin that uses multiprocessing to create a pool of worker processes. This allows fastr to execute jobs in parallel with true concurrency. The number of workers can be specified in the fastr configuration, but the default amount is the `number of cores - 1` with a minimum of `1`.

Warning: The ProcessPoolExecution does not check memory requirements of jobs and running many workers might lead to memory starvation and thus an unresponsive system.

__abstractmethods__ = frozenset({})

__init__(*finished_callback=None*, *cancelled_callback=None*, *nr_of_workers=None*)
Setup the ExecutionPlugin

Parameters

- **finished_callback** – the callback to call after a job finished
- **cancelled_callback** – the callback to call after a job cancelled

Returns newly created ExecutionPlugin

__module__ = 'fastr.plugins'

cleanup()
Method to call to clean up the ExecutionPlugin. This can be to clear temporary data, close connections, etc.

Parameters **force** – force cleanup (e.g. kill instead of join a process)

configuration_fields = {'process_pool_worker_number': (<class 'int'>, 1, 'Number of w

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

job_finished_callback(*result*)
Reciever for the callback, it will split the result tuple and call job_finished

Parameters **result** (*tuple*) – return value of run_job

module = <module 'processpoolexecution' from '/home/docs/checkouts/readthedocs.org/use

classmethod test()
Test the plugin, default behaviour is just to instantiate the plugin

class fastr.plugins.**Reference**
Bases: *fastr.core.ioplugin.IOPlugin*

The Reference plugin is create to handle `ref://` type or URLs. These URLs are to make the sink just write a simple reference file to the data. The reference file contains the DataType and the value so the result can be reconstructed. It for files just leaves the data on disk by reference. This plugin is not useful for production, but is used for testing purposes.

__abstractmethods__ = frozenset({})

__init__()
Initialization for the IOPlugin

Returns newly created IOPlugin

__module__ = 'fastr.plugins'

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'reference' from '/home/docs/checkouts/readthedocs.org/user_builds/fa

push_sink_data(*value*, *outurl*, *datatype=None*)
Write out the sink data from the inpath to the outurl.

Parameters

- **value** (*str*) – the path of the data to be pushed
- **outurl** (*str*) – the url to write the data to
- **datatype** (DataType) – the datatype of the data, used for determining the total contents of the transfer

Returns None

scheme = 'ref'

class fastr.plugins.**S3Filesystem**
Bases: *fastr.core.ioplugin.IOPlugin*

> **Warning:** As this IOPlugin is under development, it has not been thoroughly tested.
>
> example url: s3://bucket.server/path/to/resource

__abstractmethods__ = frozenset({})

__init__()
Initialization for the IOPlugin

Returns newly created IOPlugin

__module__ = 'fastr.plugins'

cleanup()
(abstract) Clean up the IOPlugin. This is to do things like closing files or connections. Will be called when the plugin is no longer required.

expand_url(*url*)
Expand an S3 URL. This allows a source to collect multiple samples from a single url.

Parameters **url** (*str*) – url to expand

Returns the resulting url(s), a tuple if multiple, otherwise a str

Return type str or tuple of str

fetch_url(*inurl*, *outpath*)
Get the file(s) or values from s3.

Parameters

- **inurl** – url to the item in the data store
- **outpath** – path where to store the fetch data locally

fetch_value(*inurl*)
Fetch a value from S3

Parameters **inurl** – url of the value to read

Returns the fetched value

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 's3filesystem' from '/home/docs/checkouts/readthedocs.org/user_builds

put_url(*inpath*, *outurl*)
Upload the files to the S3 storage

Parameters

- **inpath** – path to the local data
- **outurl** – url to where to store the data in the external data store.

put_value(*value*, *outurl*)
Put the value in S3

Parameters

- **value** – value to store
- **outurl** – url to where to store the data, starts with `file://`

scheme = ('s3', 's3list')

classmethod test()
Test the plugin, default behaviour is just to instantiate the plugin

class fastr.plugins.**SimpleReport**
Bases: *fastr.plugins.reportingplugin.ReportingPlugin*

__abstractmethods__ = frozenset({})

__module__ = 'fastr.plugins'

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'simplereport' from '/home/docs/checkouts/readthedocs.org/user_builds

run_finished(*run*)

class fastr.plugins.**SingularityTarget**(*binary*, *container*, *interpreter=None*)
Bases: *fastr.core.target.SubprocessBasedTarget*

A tool target that is run using a singularity container, see the singulary website

- `binary (required)`: the name of the binary/script to call, can also be called `bin` for backwards compatibility.
- **`container (required)`: the singularity container to run, this can be in url form for singularity** pull or as a path to a local container
- `interpreter`: the interpreter to use to call the binary e.g. `python`

SINGULARITY_BIN = 'singularity'

__abstractmethods__ = frozenset({})

__enter__()
Set the environment in such a way that the target will be on the path.

__exit__(*exc_type*, *exc_value*, *traceback*)
Cleanup the environment

__init__(*binary*, *container*, *interpreter=None*)
Define a new local binary target. Must be defined either using paths and optionally environment_variables and initscripts, or enviroment modules.

__module__ = 'fastr.plugins'

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'singularitytarget' from '/home/docs/checkouts/readthedocs.org/user_b

run_command(*command*)
Run a command with the target

classmethod test()
Test if singularity is availble on the path

class fastr.plugins.**VirtualFileSystem**
Bases: *fastr.core.vfs.VirtualFileSystem*, *fastr.core.ioplugin.IOPlugin*

The virtual file system class. This is an IOPlugin, but also heavily used internally in fastr for working with directories. The VirtualFileSystem uses the `vfs://` url scheme.

A typical virtual filesystem url is formatted as `vfs://mountpoint/relative/dir/from/mount.ext`

Where the `mountpoint` is defined in the *Config file*. A list of the currently known mountpoints can be found in the `fastr.config` object

```
>>> fastr.config.mounts
{'example_data': '/home/username/fastr-feature-documentation/fastr/fastr/examples/
↪data',
 'home': '/home/username/',
 'tmp': '/home/username/FastrTemp'}
```

This shows that a url with the mount `home` such as `vfs://home/tempdir/testfile.txt` would be translated into `/home/username/tempdir/testfile.txt`.

There are a few default mount points defined by Fastr (that can be changed via the config file).

mountpoint	default location
home	the users home directory (`expanduser('~/')`)
tmp	the fastr temprorary dir, defaults to `tempfile.gettempdir()`
example_data	the fastr example data directory, defaults `$FASTRDIR/example/data`

__abstractmethods__ = frozenset({})

__module__ = 'fastr.plugins'

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'virtualfilesystem' from '/home/docs/checkouts/readthedocs.org/user_b

scheme = 'vfs'

class fastr.plugins.**VirtualFileSystemRegularExpression**

Bases: *fastr.core.ioplugin.IOPlugin*

The VirtualFileSystemValueList an expand-only type of IOPlugin. No URLs can actually be fetched, but it can expand a single URL into a larger amount of URLs.

A `vfsregex://` URL is a vfs URL that can contain regular expressions on every level of the path. The regular expressions follow the `re module` definitions.

An example of a valid URLs would be:

```
vfsregex://tmp/network_dir/.*/.*/__fastr_result__.pickle.gz
vfsregex://tmp/network_dir/nodeX/(?P<id>.*)/__fastr_result__.pickle.gz
```

The first URL would result in all the `__fastr_result__.pickle.gz` in the working directory of a Network. The second URL would only result in the file for a specific node (nodeX), but by adding the named group `id` using `(?P<id>.*)` the sample id of the data is automatically set to that group (see Regular Expression Syntax under the special characters for more info on named groups in regular expression).

Concretely if we would have a directory `vfs://mount/somedir` containing:

```
image_1/Image.nii
image_2/image.nii
image_3/anotherimage.nii
image_5/inconsistentnamingftw.nii
```

we could match these files using `vfsregex://mount/somedir/(?P<id>image_\d+)/.*\.nii` which would result in the following source data after expanding the URL:

```
{'image_1': 'vfs://mount/somedir/image_1/Image.nii',
 'image_2': 'vfs://mount/somedir/image_2/image.nii',
 'image_3': 'vfs://mount/somedir/image_3/anotherimage.nii',
 'image_5': 'vfs://mount/somedir/image_5/inconsistentnamingftw.nii'}
```

Showing the power of this regular expression filtering. Also it shows how the ID group from the URL can be used to have sensible sample ids.

> **Warning:** due to the nature of regexp on multiple levels, this method can be slow when having many matches on the lower level of the path (because the tree of potential matches grows) or when directories that are parts of the path are very large.

__abstractmethods__ = frozenset({})

__init__()
Initialization for the IOPlugin

Returns newly created IOPlugin

__module__ = 'fastr.plugins'

expand_url(*url*)
(abstract) Expand an URL. This allows a source to collect multiple samples from a single url. The URL will have a wildcard or point to something with info and multiple urls will be returned.

Parameters **url** (*str*) – url to expand

Returns the resulting url(s), a tuple if multiple, otherwise a str

Return type str or tuple of str

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'virtualfilesystemregularexpression' from '/home/docs/checkouts/readt

scheme = 'vfsregex'

class fastr.plugins.**VirtualFileSystemValueList**
Bases: *fastr.core.ioplugin.IOPlugin*

The VirtualFileSystemValueList an expand-only type of IOPlugin. No URLs can actually be fetched, but it can expand a single URL into a larger amount of URLs. A `vfslist://` URL basically is a url that points to a file using vfs. This file then contains a number lines each containing another URL.

If the contents of a file `vfs://mount/some/path/contents` would be:

```
vfs://mount/some/path/file1.txt
vfs://mount/some/path/file2.txt
vfs://mount/some/path/file3.txt
vfs://mount/some/path/file4.txt
```

Then using the URL `vfslist://mount/some/path/contents` as source data would result in the four files being pulled.

Note: The URLs in a vfslist file do not have to use the `vfs` scheme, but can use any scheme known to the Fastr system.

__abstractmethods__ = frozenset({})

__init__()
Initialization for the IOPlugin

Returns newly created IOPlugin

__module__ = 'fastr.plugins'

expand_url(*url*)
(abstract) Expand an URL. This allows a source to collect multiple samples from a single url. The URL will have a wildcard or point to something with info and multiple urls will be returned.

Parameters **url** (*str*) – url to expand

Returns the resulting url(s), a tuple if multiple, otherwise a str

Return type str or tuple of str

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'virtualfilesystemvaluelist' from '/home/docs/checkouts/readthedocs.o

scheme = 'vfslist'

class fastr.plugins.**XNATStorage**

Bases: *fastr.core.ioplugin.IOPlugin*

> **Warning:** As this IOPlugin is under development, it has not been thoroughly tested.

The XNATStorage plugin is an IOPlugin that can download data from and upload data to an XNAT server. It uses its own `xnat://` URL scheme. This is a scheme specific for this plugin and though it looks somewhat like the XNAT rest interface, a different type or URL.

Data resources can be access directly by a data url:

```
xnat://xnat.example.com/data/archive/projects/sandbox/subjects/subject001/
↪experiments/experiment001/scans/T1/resources/DICOM
xnat://xnat.example.com/data/archive/projects/sandbox/subjects/subject001/
↪experiments/*_BRAIN/scans/T1/resources/DICOM
```

In the second URL you can see a wildcard being used. This is possible at long as it resolves to exactly one item.

The `id` query element will change the field from the default experiment to subject and the `label` query element sets the use of the label as the fastr id (instead of the XNAT id) to `True` (the default is `False`)

To disable `https` transport and use `http` instead the query string can be modified to add `insecure=true`. This will make the plugin send requests over `http`:

```
xnat://xnat.example.com/data/archive/projects/sandbox/subjects/subject001/
↪experiments/*_BRAIN/scans/T1/resources/DICOM?insecure=true
```

For sinks it is import to know where to save the data. Sometimes you want to save data in a new assessor/resource and it needs to be created. To allow the Fastr sink to create an object in XNAT, you have to supply the type as a query parameter:

```
xnat://xnat.bmia.nl/data/archive/projects/sandbox/subjects/S01/experiments/_BRAIN/
↪assessors/test_assessor/resources/IMAGE/files/image.nii.gz?resource_
↪type=xnat:resourceCatalog&assessor_type=xnat:qcAssessmentData
```

Valid options are: subject_type, experiment_type, assessor_type, scan_type, and resource_type.

If you want to do a search where multiple resources are returned, it is possible to use a search url:

```
xnat://xnat.example.com/search?projects=sandbox&subjects=subject[0-9][0-9][0-9]&
↪experiments=*_BRAIN&scans=T1&resources=DICOM
```

This will return all DICOMs for the T1 scans for experiments that end with _BRAIN that belong to a subjectXXX where XXX is a 3 digit number. By default the ID for the samples will be the experiment XNAT ID (e.g. XNAT_E00123). The wildcards that can be the used are the same UNIX shell-style wildcards as provided by the module `fnmatch`.

It is possible to change the id to a different fields id or label. Valid fields are project, subject, experiment, scan, and resource:

```
xnat://xnat.example.com/search?projects=sandbox&subjects=subject[0-9][0-9][0-9]&
↪experiments=*_BRAIN&scans=T1&resources=DICOM&id=subject&label=true
```

The following variables can be set in the search query:

variable	default	usage
projects	*	The project(s) to select, can contain wildcards (see fnmatch)
subjects	*	The subject(s) to select, can contain wildcards (see fnmatch)
experiments	*	The experiment(s) to select, can contain wildcards (see fnmatch)
scans	*	The scan(s) to select, can contain wildcards (see fnmatch)
resources	*	The resource(s) to select, can contain wildcards (see fnmatch)
id	experiment	What field to use a the id, can be: project, subject, experiment, scan, or resource
label	false	Indicate the XNAT label should be used as fastr id, options true or false
insecure	false	Change the url scheme to be used to http instead of https
verify	true	(Dis)able the verification of SSL certificates
regex	false	Change search to use regex re.match() instead of fnmatch for matching
overwrite	false	Tell XNAT to overwrite existing files if a file with the name is already present

For storing credentials the .netrc file can be used. This is a common way to store credentials on UNIX systems. It is required that the file is only accessible by the owner only or a NetrcParseError will be raised. A netrc file is really easy to create, as its entries look like:

```
machine xnat.example.com
        login username
        password secret123
```

See the netrc module or the GNU inet utils website for more information about the .netrc file.

Note: On windows the location of the netrc file is assumed to be os.path.expanduser('~/_netrc'). The leading underscore is because windows does not like filename starting with a dot.

Note: For scan the label will be the scan type (this is initially the same as the series description, but can be updated manually or the XNAT scan type cleanup).

Warning: labels in XNAT are not guaranteed to be unique, so be careful when using them as the sample ID.

For background on XNAT, see the XNAT API DIRECTORY for the REST API of XNAT.

__abstractmethods__ = frozenset({})

__init__()
Initialization for the IOPlugin

Returns newly created IOPlugin

__module__ = 'fastr.plugins'

cleanup()
(abstract) Clean up the IOPlugin. This is to do things like closing files or connections. Will be called when the plugin is no longer required.

connect(*server*, *path=''*, *insecure=False*, *verify=True*)

expand_url(*url*)
(abstract) Expand an URL. This allows a source to collect multiple samples from a single url. The URL will have a wildcard or point to something with info and multiple urls will be returned.

Parameters **url** (*str*) – url to expand

Returns the resulting url(s), a tuple if multiple, otherwise a str

Return type str or tuple of str

fetch_url(*inurl*, *outpath*)
Get the file(s) or values from XNAT.

Parameters

- **inurl** – url to the item in the data store
- **outpath** – path where to store the fetch data locally

filename = '/home/docs/checkouts/readthedocs.org/user_builds/fastr/envs/3.2.0/lib/pyth

module = <module 'xnatstorage' from '/home/docs/checkouts/readthedocs.org/user_builds/

parse_uri(*url*)

put_url(*inpath*, *outurl*)
Upload the files to the XNAT storage

Parameters

- **inpath** – path to the local data
- **outurl** – url to where to store the data in the external data store.

scheme = ('xnat', 'xnat+http', 'xnat+https')

property server

static upload(*resource*, *in_path*, *location*, *retries=3*, *overwrite=False*)

property xnat

fastr.plugins.**json**
alias of fastr.plugins.JsonCollector

fastr.plugins.**path**
alias of fastr.plugins.PathCollector

fastr.plugins.**stdout**
alias of fastr.plugins.StdoutCollector

executionplugin Module

class fastr.plugins.executionplugin.**ExecutionPlugin**(*finished_callback=None*, *cancelled_callback=None*)
Bases: fastr.abc.baseplugin.Plugin

This class is the base for all Plugins to execute jobs somewhere. There are many methods already in place for taking care of stuff.

There are fall-backs for certain features, but if a system already implements those it is usually preferred to skip the fall-back and let the external system handle it. There are a few flags to enable disable these features:

- cls.SUPPORTS_CANCEL indicates that the plugin can cancel queued jobs

- `cls.SUPPORTS_HOLD_RELEASE` indicates that the plugin can queue jobs in a hold state and can release them again (if not, the base plugin will create a hidden queue for held jobs). The plugin should respect the `Job.status == JobState.hold` when queueing jobs.
- `cls.SUPPORTS_DEPENDENCY` indicate that the plugin can manage job dependencies, if not the base plugin job dependency system will be used and jobs with only be submitted when all dependencies are met.
- `cls.CANCELS_DEPENDENCIES` indicates that if a job is cancelled it will automatically cancel all jobs depending on that job. If not the plugin traverse the dependency graph and kill each job manual.

Note: If a plugin supports dependencies it is assumed that when a job gets cancelled, the depending job also get cancelled automatically!

Most plugins should only need to redefine a few abstract methods:

- `__init__` the constructor
- `cleanup` a clean up function that frees resources, closes connections, etc
- `_queue_job` the method that queues the job for execution

Optionally an extra job finished callback could be added:

- `_job_finished` extra callback for when a job finishes

If `SUPPORTS_CANCEL` is set to True, the plugin should also implement:

- `_cancel_job` cancels a previously queued job

If `SUPPORTS_HOLD_RELEASE` is set to True, the plugin should also implement:

- `_hold_job` hold_job a job that is currently held
- `_release_job` releases a job that is currently held

If `SUPPORTED_DEPENDENCY` is set to True, the plugin should:

- Make sure to use the `Job.hold_jobs` as a list of its dependencies

Not all of the functions need to actually do anything for a plugin. There are examples of plugins that do not really need a `cleanup`, but for safety you need to implement it. Just using a `pass` for the method could be fine in such a case.

Warning: When overwriting other functions, extreme care must be taken not to break the plugins working, as there is a lot of bookkeeping that can go wrong.

CANCELS_DEPENDENCIES = False
Indicates that when a job is cancelled the dependencies

SUPPORTS_CANCEL = False
Indicates if the plugin can cancel queued jobs

SUPPORTS_DEPENDENCY = False
Indicate if the plugin can manage job dependencies, if not the base plugin job dependency system will be used and jobs with only be submitted when all dependencies are met.

SUPPORTS_HOLD_RELEASE = False
Indicates if the plugin can queue jobs in a hold state and can release them again (if not, the base plugin will create a hidden queue for held jobs)

__abstractmethods__ = frozenset({'__init__', '_queue_job', 'cleanup'})

__del__()
Cleanup if the variable was deleted on purpose

__enter__()

__exit__(*type_*, *value*, *tb*)

abstract __init__(*finished_callback=None*, *cancelled_callback=None*)
Setup the ExecutionPlugin

Parameters

- **finished_callback** – the callback to call after a job finished
- **cancelled_callback** – the callback to call after a job cancelled

Returns newly created ExecutionPlugin

__module__ = 'fastr.plugins.executionplugin'

cancel_job(*job*)
Cancel a job previously queued

Parameters **job** – job to cancel

check_job_requirements(*job_id*)
Check if the requirements for a job are fulfilled.

Parameters **job_id** – job to check

Returns directive what should happen with the job

Return type *JobAction*

check_job_status(*job_id*)
Get the status of a specified job

Parameters **job_id** – the target job

Returns the status of the job (or None if job not found)

check_nr_queued_jobs()

clean_free_jobs(*job*)

abstract cleanup()
Method to call to clean up the ExecutionPlugin. This can be to clear temporary data, close connections, etc.

Parameters **force** – force cleanup (e.g. kill instead of join a process)

get_job(*job_id*)

get_status(*job*)

hold_job(*job*)

job_finished(*job*, *errors=None*, *blocking=False*)
The default callback that is called when a Job finishes. This will create a new thread that handles the actual callback.

Parameters

- **job** (Job) – the job that finished
- **errors** – optional list of errors encountered

- **blocking** (*bool*) – if blocking, do not create threads

Returns

process_callbacks()

queue_job(*job*)
Add a job to the execution queue

Parameters **job** (Job) – job to add

register_job(*job*)

release_job(*job*)
Release a job that has been put on hold

Parameters **job** – job to release

show_jobs(*req_status=None*)
List the queued jobs, possible filtered by status

Parameters **req_status** – requested status to filter on

Returns list of jobs

signal_dependent_jobs(*job_id*)
Check all depedent jobs and process them if all their dependencies are met. :param job_id: :return:

class fastr.plugins.executionplugin.**JobAction**(*value*)
Bases: enum.Enum

Job actions that can be performed. This is used for checking if held jobs should be queued, held longer or be cancelled.

__module__ = 'fastr.plugins.executionplugin'

cancel = 'cancel'

hold = 'hold'

queue = 'queue'

reportingplugin Module

class fastr.plugins.reportingplugin.**ReportingPlugin**
Bases: fastr.abc.baseplugin.Plugin

Base class for all reporting plugins. The plugin has a number of methods that can be implemented that will be called on certain events. On these events the plugin can inspect the presented data and take reporting actions.

__abstractmethods__ = frozenset({})

__module__ = 'fastr.plugins.reportingplugin'

activate()

deactivate()

job_updated(*job*)

log_record_emitted(*record*)

run_finished(*run*)

run_started(*run*)

Subpackages

managers Package

managers Package

executionpluginmanager Module

This module holds the ExecutionPluginManager as well as the base-class for all ExecutionPlugins.

class fastr.plugins.managers.executionpluginmanager.**ExecutionPluginManager**(*parent*)
Bases: *fastr.plugins.managers.pluginmanager.PluginSubManager*

Container holding all the ExecutionPlugins known to the Fastr system

__abstractmethods__ = frozenset({})

__init__(*parent*)
Initialize a ExecutionPluginManager and load plugins.

Parameters

- **path** – path to search for plugins
- **recursive** – flag for searching recursively

Returns newly created ExecutionPluginManager

__module__ = 'fastr.plugins.managers.executionpluginmanager'

interfacemanager Module

This module holds the ExecutionPluginManager as well as the base-class for all ExecutionPlugins.

class fastr.plugins.managers.interfacemanager.**InterfacePluginManager**(*parent*)
Bases: *fastr.plugins.managers.pluginmanager.PluginSubManager*

Container holding all the CollectorPlugins

__abstractmethods__ = frozenset({})

__init__(*parent*)
Create the Coll :param path: :param recursive: :return:

__module__ = 'fastr.plugins.managers.interfacemanager'

iopluginmanager Module

class fastr.plugins.managers.iopluginmanager.**IOPluginManager**(*parent*)
Bases: *fastr.plugins.managers.pluginmanager.PluginSubManager*

A mapping containing the IOPlugins known to this system

__abstractmethods__ = frozenset({})

__init__(*parent*)
Create the IOPluginManager and populate it.

Returns newly created IOPluginManager

__iter__()
Get an iterator from the BaseManager. The iterator will iterate over the keys of the BaseManager.

Returns the iterator

Return type dictionary-keyiterator

__keytransform__(*key*)
Identity transform for the keys. This function can be reimplemented by a subclass to implement a different key transform.

Parameters **key** – key to transform

Returns the transformed key (in this case the same key as inputted)

__module__ = 'fastr.plugins.managers.iopluginmanager'

cleanup()
Cleanup all plugins, this closes files, connections and other things that could be left dangling otherwise.

static create_ioplugin_tool(*tools*, *interfaces*)
Create the tools which handles sinks and sources. The command of this tool is the main of core.ioplugin.

expand_url(*url*)
Expand the url by filling the wildcards. This function checks the url scheme and uses the expand function of the correct IOPlugin.

Parameters **url** (*str*) – url to expand

Returns list of urls

Return type list of str

pull_source_data(*url*, *outdir*, *sample_id*, *datatype=None*)
Retrieve data from an external source. This function checks the url scheme and selects the correct IOPlugin to retrieve the data.

Parameters

- **url** – url to pull
- **outdir** (*str*) – the directory to write the data to
- **datatype** (DataType) – the datatype of the data, used for determining the total contents of the transfer

Returns None

push_sink_data(*inpath*, *outurl*, *datatype=None*)
Send data to an external source. This function checks the url scheme and selects the correct IOPlugin to retrieve the data.

Parameters

- **inpath** (*str*) – the path of the data to be pushed
- **outurl** (*str*) – the url to write the data to
- **datatype** (DataType) – the datatype of the data, used for determining the total contents of the transfer

put_url(*inpath*, *outurl*)
Put the files to the external data store.

Parameters

- **inpath** – path to the local data

- **outurl** – url to where to store the data in the external data store.

static register_url_scheme(*scheme*)
Register a custom scheme to behave http like. This is needed to parse all things properly with urlparse.

Parameters **scheme** – the scheme to register

url_to_path(*url*)
Retrieve the path for a given url

Parameters **url** (*str*) – the url to parse

Returns the path corresponding to the input url

Return type str

networkmanager Module

This module contains the tool manager class

class fastr.plugins.managers.networkmanager.**NetworkManager**(*path*)
Bases: *fastr.plugins.managers.objectmanager.ObjectManager*

__abstractmethods__ = frozenset({})

__module__ = 'fastr.plugins.managers.networkmanager'

get_object_version(*obj*)
Get the version of a given object

Parameters **object** – the object to use

Returns the version of the object

property object_class
The class of the objects to populate the manager with

objectmanager Module

This module contains the object manager class

class fastr.plugins.managers.objectmanager.**ObjectManager**(*path*)
Bases: fastr.abc.basemanager.BaseManager

Class for managing all the objects loaded in the fastr system

__abstractmethods__ = frozenset({'get_object_version', 'object_class'})

__contains__(*key*)
Check if an item is in the ObjectManager

Parameters **key** (*str or tuple*) – object id or tuple (Objectid, version)

Returns flag indicating the item is in the manager

__getitem__(*key*)
Retrieve a Object from the ObjectManager. You can request by only an id, which results in the newest version of the Object being returned, or request using both an id and a version.

Parameters **key** (*str or tuple*) – object id or tuple (Objectid, version)

Returns the requested Object

Raises ***FastrObjectUnknownError*** – if a non-existing Object was requested

__init__(*path*)
Create a ObjectManager and scan path to search for Objects

Parameters **path** (*str or iterable of str*) – the path(s) to scan for Objects

Returns newly created ObjectManager

__keytransform__(*key*)
Key transform, used for allowing indexing both by id-only and by `(id, version)`

Parameters **key** – key to transform

Returns key in form `(id, version)`

__module__ = 'fastr.plugins.managers.objectmanager'

abstract get_object_version(*obj*)
Get the version of a given object

Parameters **object** – the object to use

Returns the version of the object

abstract property object_class
The class of the objects to populate the manager with

objectversions(*obj*)
Return a list of available versions for the object

Parameters **object** – The object to check the versions for. Can be either a *Object* or a *str*.

Returns List of version objects. Returns *None* when the given object is not known.

todict()
Return a dictionary version of the Manager

Returns manager as a dict

pluginmanager Module

This module contains the Manager class for Plugins in the fastr system

class fastr.plugins.managers.pluginmanager.**PluginManager**(*path=None*)
Bases: fastr.abc.basepluginmanager.BasePluginManager

__abstractmethods__ = frozenset({})

__init__(*path=None*)
Create a BasePluginManager and scan the give path for matching plugins

Parameters

- **path** (*str*) – path to scan
- **recursive** (*bool*) – flag to indicate a recursive search
- **module** (*module*) – the module to register plugins into

Returns newly created plugin manager

Raises ***FastrTypeError*** – if self._plugin_class is set to a class not subclassing BasePlugin

__module__ = 'fastr.plugins.managers.pluginmanager'

__setitem__(*key*, *value*)
Store an item in the BaseManager, will ignore the item if the key is already present in the BaseManager.

Parameters

- **name** – the key of the item to save
- **value** – the value of the item to save

Returns None

property plugin_class
The plugin manager contains any Plugin subclass

class fastr.plugins.managers.pluginmanager.**PluginSubManager**(*parent*, *plugin_class*)
Bases: fastr.abc.baseplugin manager.BasePluginManager

A PluginManager that is a selection of a parent plugin manger. It uses the PluginsView to only exposne part of the parent PluginManager. This is used to create plugin plugins.managers for only certain types of plugins (e.g. IOPlugins) without loading them multiple times.

__abstractmethods__ = frozenset({})

__init__(*parent*, *plugin_class*)
Create a BasePluginManager and scan the give path for matching plugins

Parameters

- **path** (*str*) – path to scan
- **recursive** (*bool*) – flag to indicate a recursive search
- **module** (*module*) – the module to register plugins into

Returns newly created plugin manager

Raises ***FastrTypeError*** – if self._plugin_class is set to a class not subclassing BasePlugin

__module__ = 'fastr.plugins.managers.pluginmanager'

property data
The actual data dict underlying this Manager

property plugin_class
PluginSubManagers only expose the plugins of a certain class

class fastr.plugins.managers.pluginmanager.**PluginsView**(*parent*, *plugin_class*)
Bases: collections.abc.MutableMapping

A collection that acts like view of the plugins of another plugin manager. This is a proxy object that only gives access the plugins of a certain plugin class. It behaves like a mapping and is used as the data object for a PluginSubManager.

__abstractmethods__ = frozenset({})

__delitem__(*key*)

__dict__ = mappingproxy({'__module__': 'fastr.plugins.managers.pluginmanager', '__doc

__getitem__(*item*)

__init__(*parent*, *plugin_class*)
Constructor for the plugins view

Parameters

- **parent** (*BasePluginManager*) – the parent plugin manager

- **plugin_class** (*class*) – the class of the plugins to expose

__iter__()

__len__()

__module__ = 'fastr.plugins.managers.pluginmanager'

__setitem__(*key*, *value*)

__weakref__
list of weak references to the object (if defined)

filter_plugin(*plugin*)

targetmanager Module

This module holds the ExecutionPluginManager as well as the base-class for all ExecutionPlugins.

class fastr.plugins.managers.targetmanager.**TargetManager**(*parent*)
Bases: *fastr.plugins.managers.pluginmanager.PluginSubManager*

Container holding all the ExecutionPlugins known to the Fastr system

__abstractmethods__ = frozenset({})

__init__(*parent*)
Initialize a ExecutionPluginManager and load plugins.

Returns newly created ExecutionPluginManager

__module__ = 'fastr.plugins.managers.targetmanager'

toolmanager Module

This module contains the tool manager class

class fastr.plugins.managers.toolmanager.**ToolManager**(*path*)
Bases: *fastr.plugins.managers.objectmanager.ObjectManager*

__abstractmethods__ = frozenset({})

__module__ = 'fastr.plugins.managers.toolmanager'

get_object_version(*obj*)
Get the version of a given object

Parameters **object** – the object to use

Returns the version of the object

property object_class
The class of the objects to populate the manager with

populate()
Populate the manager with the data. This is a method that will be called when the Managers data is first accessed. This way we avoid doing expensive directory scans when the data is never requested.

toolversions(*tool*)
Return a list of available versions for the tool

Parameters **tool** – The tool to check the versions for. Can be either a *Tool* or a *str*.

Returns List of version objects. Returns *None* when the given tool is not known.

test Package

test Package

test_datatypes Module

utils Package

utils Package

A collections of utils for fastr (command line tools or non-core functionality)

compare Module

Module to compare various fastr specific things such as a execution directory or a reference directory.

fastr.utils.compare.**compare_execution_dir**(*path1*, *path2*)

fastr.utils.compare.**compare_job_dirs**(*sample*, *node*, *node_dir1*, *node_dir2*)

fastr.utils.compare.**compare_job_output_data**(*output*, *job1*, *job2*)

fastr.utils.compare.**compare_set**(*set1*, *set2*, *path*, *sub_compare_func*, *f_args=None*, *f_kwargs=None*)

Compare two sets and dispatch each item to a sub comparison function

Parameters

- **set1** (*Iterable*) – first set of items
- **set2** (*Iterable*) – second set of items
- **path** (*str*) – identifier of the data location
- **sub_compare_func** – function to apply to items
- **f_args** – args to pass to sub_compare_func
- **f_kwargs** – kwargs to pass to sub_compare_func

Returns generator that iterates over the differences

Return type generator

fastr.utils.compare.**compare_value_dict_item**(*key*, *data1*, *data2*, *path*)

fastr.utils.compare.**compare_value_list**(*data1*, *data2*, *path*, *key=None*)

dicteq Module

Some helper function to compare dictionaries and find the parts of the dict that are different. This is mostly to help in debugging.

fastr.utils.dicteq.**dicteq**(*self*, *other*)
Compare two dicts for equality

Parameters

- **self** – the first object to compare
- **other** – the oth

Returns

fastr.utils.dicteq.**diffdict**(*self*, *other*, *path=None*, *visited=None*)
Find the differences in two dictionaries.

Parameters

- **self** – the first object to compare
- **other** (*dict*) – other dictionary
- **path** (*list*) – the path for nested dicts (too keep track of recursion)

Returns list of messages indicating the differences

Return type list

fastr.utils.dicteq.**diffobj**(*self*, *other*, *path=None*, *visited=None*)
Compare two objects by comparing their __dict__ entries

Parameters

- **self** – the first object to compare
- **other** – other objects to compare
- **path** (*list*) – the path for nested dicts (too keep track of recursion)

Returns list of messages

Return type list

fastr.utils.dicteq.**diffobj_str**(*self*, *other*)
Compare two objects by comparing their __dict__ entries, but returns the differences in a single string ready for logging.

Parameters

- **self** – the first object to compare
- **other** – other object to compare to

Returns the description of the differences

Return type str

gettools Module

fastr.utils.gettools.**main**()

multiprocesswrapper Module

fastr.utils.multiprocesswrapper.**function_wrapper**(*filepath*, *fnc_name*, **args*, ***kwargs*)

verify Module

fastr.utils.verify.**verify_resource_loading**(*filename*, *log=<Logger fastr (INFO)>*)
Verify that a resource file can be loaded. Returns loaded object.

Parameters

- **filename** (str) – path of the object to load
- **log** – the logger to use to send messages to

Returns loaded resource

fastr.utils.verify.**verify_tool**(*filename*, *log=<Logger fastr (INFO)>*, *perform_tests=True*)
Verify that a file

Subpackages

cmd Package

cmd Package

fastr.utils.cmd.**add_parser_doc_link**(*parser*, *filepath*)

fastr.utils.cmd.**find_commands**()

fastr.utils.cmd.**get_command_module**(*command*)

fastr.utils.cmd.**main**()

fastr.utils.cmd.**print_help**(*commands=None*)

cat Module

fastr.utils.cmd.cat.**fastr_cat**(*infile*, *path*)

fastr.utils.cmd.cat.**get_parser**()

fastr.utils.cmd.cat.**main**()
Print information from a job file

dump Module

fastr.utils.cmd.dump.**create_zip**(*directory*, *output_file*)

fastr.utils.cmd.dump.**get_parser**()

fastr.utils.cmd.dump.**main**()
Dump the contents of a network run tempdir into a zip for remote assistance

execute Module

fastr.utils.cmd.execute.**get_parser**()

fastr.utils.cmd.execute.**main**()
Execute a fastr job file

extract_argparse Module

fastr.utils.cmd.extract_argparse.**cardinality_from_nargs**(*value*)

fastr.utils.cmd.extract_argparse.**datatype_from_type**(*type_*, *metavar*)

fastr.utils.cmd.extract_argparse.**extract_argparser**(*filepath*)

fastr.utils.cmd.extract_argparse.**find_argparser**(*entry*, *basename='/home/docs/checkouts/readthedocs.org/user_ build'*)

fastr.utils.cmd.extract_argparse.**get_parser**()

fastr.utils.cmd.extract_argparse.**main**()
Create a stub for a Tool based on a python script using argparse

provenance Module

fastr.utils.cmd.provenance.**get_parser**()

fastr.utils.cmd.provenance.**get_prov_document**(*result*)

fastr.utils.cmd.provenance.**main**()
Get PROV information from the result pickle.

pylint Module

fastr.utils.cmd.pylint.**get_parser**()

fastr.utils.cmd.pylint.**main**()
Tiny wrapper in pylint so the output can be saved to a file (for test automation)

fastr.utils.cmd.pylint.**run_pylint**(*out_file*, *pylint_args*)

report Module

fastr.utils.cmd.report.**get_parser**()

fastr.utils.cmd.report.**main**()
Print report of a job result (__fastr_result__.pickle.gz) file

run Module

fastr.utils.cmd.run.**create_network_parser**(*network*)

fastr.utils.cmd.run.**get_parser**()

fastr.utils.cmd.run.**main**()
Run a Network from the commandline

sink Module

fastr.utils.cmd.sink.**get_parser**()

fastr.utils.cmd.sink.**main**()
Command line access to the IOPlugin sink

fastr.utils.cmd.sink.**sink**()

source Module

fastr.utils.cmd.source.**get_parser**()

fastr.utils.cmd.source.**main**()
Command line access to the IOPlugin source

fastr.utils.cmd.source.**source**()

test Module

fastr.utils.cmd.test.**check_network**(*args*)

fastr.utils.cmd.test.**check_networks**(*args*)

fastr.utils.cmd.test.**check_tool**(*args*)

fastr.utils.cmd.test.**check_tools**(*args*)

fastr.utils.cmd.test.**directory**(*path*)
Make sure the path is a valid directory for argparse

fastr.utils.cmd.test.**get_parser**()

fastr.utils.cmd.test.**main**()
Run the tests of a tool to verify the proper function

fastr.utils.cmd.test.**tool**(*value*)
Make sure the value is a correct tool for argparse or reference directory

trace Module

fastr.utils.cmd.trace.**get_parser**()

fastr.utils.cmd.trace.**main**()
Trace samples/sinks from a run

fastr.utils.cmd.trace.**print_sample_sink**(*sink_data*, *dirname*, *sample_sink_tuples*, *verbose*)

fastr.utils.cmd.trace.**print_samples**(*sink_data*, *sample_ids*, *verbose*)

fastr.utils.cmd.trace.**print_sinks**(*sink_data*, *sink_ids*, *verbose*)

fastr.utils.cmd.trace.**read_sink_data**(*infile*)

fastr.utils.cmd.trace.**switch_sample_sink**(*sink_data*)

upgrade Module

class fastr.utils.cmd.upgrade.**FastrNamespaceType**(*toollist*, *typelist*)
Bases: tuple

__getnewargs__()
Return self as a plain tuple. Used by copy and pickle.

__module__ = 'fastr.utils.cmd.upgrade'

static __new__(*_cls*, *toollist*, *typelist*)
Create new instance of FastrNamespaceType(toollist, typelist)

__repr__()
Return a nicely formatted representation string

__slots__ = ()

property toollist
Alias for field number 0

property typelist
Alias for field number 1

class fastr.utils.cmd.upgrade.**dummy_container**
Bases: object

__dict__ = mappingproxy({'__module__': 'fastr.utils.cmd.upgrade', '__getitem__': <fu

__getitem__(*value*)

__module__ = 'fastr.utils.cmd.upgrade'

__weakref__
list of weak references to the object (if defined)

fastr.utils.cmd.upgrade.**find_tool**(*toolspec*)

fastr.utils.cmd.upgrade.**get_parser**()

fastr.utils.cmd.upgrade.**main**()
Upgrade a fastr 2.x python file to fastr 3.x syntax

fastr.utils.cmd.upgrade.**upgrade_network**(*infile*, *outfile*)

fastr.utils.cmd.upgrade.**upgrade_tool**(*infile*, *outfile*)

verify Module

fastr.utils.cmd.verify.**get_parser**()

fastr.utils.cmd.verify.**main**()
Verify fastr resources, at the moment only tool definitions are supported.

secrets Package

secrets Package

secretprovider Module

secretservice Module

Subpackages

exceptions Package

exceptions Package

couldnotdeletecredentials Module

couldnotretrievecredentials Module

couldnotsetcredentials Module

notimplemented Module

providernotfound Module

providers Package

providers Package

keyringprovider Module

netrcprovider Module

CHAPTER

FOUR

INDICES AND TABLES

- genindex
- modindex
- search

PYTHON MODULE INDEX

f

fastr.__init__, 79
fastr.api, 88
fastr.core, 90
fastr.core.cardinality, 90
fastr.core.dimension, 95
fastr.core.interface, 97
fastr.core.ioplugin, 99
fastr.core.provenance, 101
fastr.core.resourcelimit, 102
fastr.core.samples, 103
fastr.core.target, 109
fastr.core.test, 118
fastr.core.tool, 112
fastr.core.version, 114
fastr.core.vfs, 116
fastr.data, 118
fastr.data.url, 118
fastr.datatypes, 120
fastr.exceptions, 80
fastr.execution, 128
fastr.execution.basenoderun, 128
fastr.execution.environmentmodules, 129
fastr.execution.executionscript, 130
fastr.execution.flownoderun, 130
fastr.execution.inputoutputrun, 131
fastr.execution.job, 142
fastr.execution.linkrun, 151
fastr.execution.macronoderun, 154
fastr.execution.networkanalyzer, 155
fastr.execution.networkchunker, 155
fastr.execution.networkrun, 156
fastr.execution.noderun, 158
fastr.execution.sinknoderun, 161
fastr.execution.sourcenoderun, 163
fastr.helpers, 165
fastr.helpers.checksum, 165
fastr.helpers.classproperty, 166
fastr.helpers.clear_pycs, 167
fastr.helpers.configmanager, 167
fastr.helpers.events, 169
fastr.helpers.filesynchelper, 170
fastr.helpers.iohelpers, 171
fastr.helpers.jsonschemaparser, 171
fastr.helpers.lazy_module, 173
fastr.helpers.lockfile, 174
fastr.helpers.procutils, 174
fastr.helpers.report, 175
fastr.helpers.rest_generation, 175
fastr.helpers.schematotable, 175
fastr.helpers.shellescape, 176
fastr.helpers.sysinfo, 176
fastr.helpers.xmltodict, 177
fastr.planning, 178
fastr.planning.inputgroup, 178
fastr.planning.inputgroupcombiner, 179
fastr.planning.inputoutput, 181
fastr.planning.link, 195
fastr.planning.network, 197
fastr.planning.node, 201
fastr.plugins, 209
fastr.plugins.executionplugin, 233
fastr.plugins.managers, 237
fastr.plugins.managers.executionpluginmanager, 237
fastr.plugins.managers.interfacemanager, 237
fastr.plugins.managers.iopluginmanager, 237
fastr.plugins.managers.networkmanager, 239
fastr.plugins.managers.objectmanager, 239
fastr.plugins.managers.pluginmanager, 240
fastr.plugins.managers.targetmanager, 242
fastr.plugins.managers.toolmanager, 242
fastr.plugins.reportingplugin, 236
fastr.test, 243
fastr.utils, 243
fastr.utils.cmd, 245
fastr.utils.cmd.cat, 245
fastr.utils.cmd.dump, 246

fastr.utils.cmd.execute, 246
fastr.utils.cmd.extract_argparse, 246
fastr.utils.cmd.provenance, 246
fastr.utils.cmd.pylint, 246
fastr.utils.cmd.report, 247
fastr.utils.cmd.run, 247
fastr.utils.cmd.sink, 247
fastr.utils.cmd.source, 247
fastr.utils.cmd.test, 247
fastr.utils.cmd.trace, 248
fastr.utils.cmd.upgrade, 248
fastr.utils.cmd.verify, 249
fastr.utils.compare, 243
fastr.utils.dicteq, 244
fastr.utils.gettools, 245
fastr.utils.multiprocesswrapper, 245
fastr.utils.verify, 245
fastr.version, 88

INDEX

Symbols

__abstractmethods__ (*fastr.core.dimension.ForwardsDimensions attribute*), 96
__abstractmethods__ (*fastr.core.dimension.HasDimensions attribute*), 96
__abstractmethods__ (*fastr.core.interface.Interface attribute*), 97
__abstractmethods__ (*fastr.core.ioplugin.IOPlugin attribute*), 99
__abstractmethods__ (*fastr.core.samples.ContainsSamples attribute*), 103
__abstractmethods__ (*fastr.core.samples.HasSamples attribute*), 103
__abstractmethods__ (*fastr.core.samples.SampleCollection attribute*), 104
__abstractmethods__ (*fastr.core.samples.SampleValue attribute*), 108
__abstractmethods__ (*fastr.core.target.ProcessUsageCollection attribute*), 109
__abstractmethods__ (*fastr.core.target.SubprocessBasedTarget attribute*), 109
__abstractmethods__ (*fastr.core.target.Target attribute*), 111
__abstractmethods__ (*fastr.datatypes.AnyFile attribute*), 120
__abstractmethods__ (*fastr.datatypes.AnyType attribute*), 120
__abstractmethods__ (*fastr.datatypes.BaseDataType attribute*), 120
__abstractmethods__ (*fastr.datatypes.DataType attribute*), 122
__abstractmethods__ (*fastr.datatypes.DataTypeManager attribute*), 123
__abstractmethods__ (*fastr.datatypes.Deferred attribute*), 125
__abstractmethods__ (*fastr.datatypes.EnumType attribute*), 126
__abstractmethods__ (*fastr.datatypes.TypeGroup attribute*), 126
__abstractmethods__ (*fastr.datatypes.URLType attribute*), 127
__abstractmethods__ (*fastr.datatypes.ValueType attribute*), 128
__abstractmethods__ (*fastr.execution.basenoderun.BaseNodeRun attribute*), 128
__abstractmethods__ (*fastr.execution.flownoderun.AdvancedFlowNodeRun attribute*), 130
__abstractmethods__ (*fastr.execution.flownoderun.FlowNodeRun attribute*), 131
__abstractmethods__ (*fastr.execution.inputoutputrun.AdvancedFlowOutputRun attribute*), 131
__abstractmethods__ (*fastr.execution.inputoutputrun.BaseInputRun attribute*), 131
__abstractmethods__ (*fastr.execution.inputoutputrun.InputRun attribute*), 132
__abstractmethods__ (*fastr.execution.inputoutputrun.MacroOutputRun attribute*), 134
__abstractmethods__ (*fastr.execution.inputoutputrun.NamedSubinputRun attribute*), 134
__abstractmethods__ (*fastr.execution.inputoutputrun.OutputRun attribute*), 135
__abstractmethods__ (*fastr.execution.inputoutputrun.SourceOutputRun attribute*), 137

__abstractmethods__ (*fastr.execution.inputoutputrun.SubInputRun attribute*), 138
__abstractmethods__ (*fastr.execution.inputoutputrun.SubOutputRun attribute*), 140
__abstractmethods__ (*fastr.execution.linkrun.LinkRun attribute*), 152
__abstractmethods__ (*fastr.execution.macronoderun.MacroNodeRun attribute*), 154
__abstractmethods__ (*fastr.execution.noderun.NodeRun attribute*), 158
__abstractmethods__ (*fastr.execution.sinknoderun.SinkNodeRun attribute*), 161
__abstractmethods__ (*fastr.execution.sourcenoderun.ConstantNodeRun attribute*), 163
__abstractmethods__ (*fastr.execution.sourcenoderun.SourceNodeRun attribute*), 164
__abstractmethods__ (*fastr.planning.inputgroup.InputGroup attribute*), 178
__abstractmethods__ (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner attribute*), 179
__abstractmethods__ (*fastr.planning.inputgroupcombiner.DefaultInputGroupCombiner attribute*), 180
__abstractmethods__ (*fastr.planning.inputgroupcombiner.MergingInputGroupCombiner attribute*), 181
__abstractmethods__ (*fastr.planning.inputoutput.AdvancedFlowOutput attribute*), 181
__abstractmethods__ (*fastr.planning.inputoutput.BaseInput attribute*), 182
__abstractmethods__ (*fastr.planning.inputoutput.BaseInputOutput attribute*), 183
__abstractmethods__ (*fastr.planning.inputoutput.BaseOutput attribute*), 184
__abstractmethods__ (*fastr.planning.inputoutput.Input attribute*), 185
__abstractmethods__ (*fastr.planning.inputoutput.MacroInput attribute*), 187
__abstractmethods__ (*fastr.planning.inputoutput.MacroOutput attribute*), 187
__abstractmethods__ (*fastr.planning.inputoutput.NamedSubInput attribute*), 188
__abstractmethods__ (*fastr.planning.inputoutput.Output attribute*), 188
__abstractmethods__ (*fastr.planning.inputoutput.SourceOutput attribute*), 190
__abstractmethods__ (*fastr.planning.inputoutput.SubInput attribute*), 191
__abstractmethods__ (*fastr.planning.inputoutput.SubOutput attribute*), 193
__abstractmethods__ (*fastr.planning.link.Link attribute*), 195
__abstractmethods__ (*fastr.planning.node.AdvancedFlowNode attribute*), 201
__abstractmethods__ (*fastr.planning.node.BaseNode attribute*), 201
__abstractmethods__ (*fastr.planning.node.ConstantNode attribute*), 202
__abstractmethods__ (*fastr.planning.node.FlowNode attribute*), 203
__abstractmethods__ (*fastr.planning.node.MacroNode attribute*), 203
__abstractmethods__ (*fastr.planning.node.Node attribute*), 204
__abstractmethods__ (*fastr.planning.node.SinkNode attribute*), 207
__abstractmethods__ (*fastr.planning.node.SourceNode attribute*), 208
__abstractmethods__ (*fastr.plugins.BlockingExecution attribute*), 209
__abstractmethods__ (*fastr.plugins.CommaSeperatedValueFile attribute*), 210
__abstractmethods__ (*fastr.plugins.CrossValidation attribute*), 211
__abstractmethods__ (*fastr.plugins.DRMAAExecution attribute*),

211
__abstractmethods__ (*fastr.plugins.DockerTarget attribute*), 213
__abstractmethods__ (*fastr.plugins.ElasticsearchReporter attribute*), 213
__abstractmethods__ (*fastr.plugins.FastrInterface attribute*), 215
__abstractmethods__ (*fastr.plugins.FileSystem attribute*), 217
__abstractmethods__ (*fastr.plugins.FlowInterface attribute*), 218
__abstractmethods__ (*fastr.plugins.HTTPPlugin attribute*), 220
__abstractmethods__ (*fastr.plugins.LinearExecution attribute*), 220
__abstractmethods__ (*fastr.plugins.LocalBinaryTarget attribute*), 222
__abstractmethods__ (*fastr.plugins.MacroTarget attribute*), 222
__abstractmethods__ (*fastr.plugins.NipypeInterface attribute*), 223
__abstractmethods__ (*fastr.plugins.Null attribute*), 224
__abstractmethods__ (*fastr.plugins.PimReporter attribute*), 225
__abstractmethods__ (*fastr.plugins.ProcessPoolExecution attribute*), 225
__abstractmethods__ (*fastr.plugins.Reference attribute*), 226
__abstractmethods__ (*fastr.plugins.S3Filesystem attribute*), 226
__abstractmethods__ (*fastr.plugins.SimpleReport attribute*), 227
__abstractmethods__ (*fastr.plugins.SingularityTarget attribute*), 228
__abstractmethods__ (*fastr.plugins.VirtualFileSystem attribute*), 229
__abstractmethods__ (*fastr.plugins.VirtualFileSystemRegularExpression attribute*), 229
__abstractmethods__ (*fastr.plugins.VirtualFileSystemValueList attribute*), 230
__abstractmethods__ (*fastr.plugins.XNATStorage attribute*), 232
__abstractmethods__ (*fastr.plugins.executionplugin.ExecutionPlugin attribute*), 234
__abstractmethods__ (*fastr.plugins.managers.executionpluginmanager.ExecutionPlugin attribute*), 237
__abstractmethods__ (*fastr.plugins.managers.interfacemanager.InterfacePluginManage attribute*), 237
__abstractmethods__ (*fastr.plugins.managers.iopluginmanager.IOPluginManager attribute*), 237
__abstractmethods__ (*fastr.plugins.managers.networkmanager.NetworkManager attribute*), 239
__abstractmethods__ (*fastr.plugins.managers.objectmanager.ObjectManager attribute*), 239
__abstractmethods__ (*fastr.plugins.managers.pluginmanager.PluginManager attribute*), 240
__abstractmethods__ (*fastr.plugins.managers.pluginmanager.PluginSubManager attribute*), 241
__abstractmethods__ (*fastr.plugins.managers.pluginmanager.PluginsView attribute*), 241
__abstractmethods__ (*fastr.plugins.managers.targetmanager.TargetManager attribute*), 242
__abstractmethods__ (*fastr.plugins.managers.toolmanager.ToolManager attribute*), 242
__abstractmethods__ (*fastr.plugins.reportingplugin.ReportingPlugin attribute*), 236
__add__() (*fastr.core.samples.SampleBaseId method*), 103
__add__() (*fastr.core.samples.SampleItemBase method*), 106
__add__() (*fastr.core.samples.SamplePayload method*), 108
__add__() (*fastr.core.samples.SampleValue method*), 108
__add__() (*fastr.helpers.configmanager.EmptyDefault method*), 169
__bool__() (*fastr.execution.networkrun.NetworkRun method*), 156
__contains__() (*fastr.core.samples.HasSamples method*), 103
__contains__() (*fastr.core.samples.SampleCollection method*), 104
__contains__() (*fastr.plugins.managers.objectmanager.ObjectManage method*), 239
__dataschemafile__ (*fastr.core.tool.Tool attribute*), 112

__dataschemafile__ (*fastr.execution.linkrun.LinkRun attribute*), 152
__dataschemafile__ (*fastr.execution.noderun.NodeRun attribute*), 158
__dataschemafile__ (*fastr.execution.sinknoderun.SinkNodeRun attribute*), 161
__dataschemafile__ (*fastr.execution.sourcenoderun.ConstantNodeRun attribute*), 163
__dataschemafile__ (*fastr.execution.sourcenoderun.SourceNodeRun attribute*), 164
__dataschemafile__ (*fastr.planning.link.Link attribute*), 195
__dataschemafile__ (*fastr.planning.network.Network attribute*), 197
__dataschemafile__ (*fastr.planning.node.ConstantNode attribute*), 202
__dataschemafile__ (*fastr.planning.node.Node attribute*), 204
__dataschemafile__ (*fastr.planning.node.SinkNode attribute*), 207
__dataschemafile__ (*fastr.planning.node.SourceNode attribute*), 208
__dataschemafile__ (*fastr.plugins.FastrInterface attribute*), 215
__dataschemafile__ (*fastr.plugins.FlowInterface attribute*), 218
__del__() (*fastr.helpers.lockfile.DirectoryLock method*), 174
__del__() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
__delitem__() (*fastr.core.samples.SampleCollection method*), 104
__delitem__() (*fastr.core.samples.SampleValue method*), 108
__delitem__() (*fastr.helpers.configmanager.EmptyDefault method*), 169
__delitem__() (*fastr.plugins.managers.pluginmanager.PluginsView method*), 241
__dict__ (*fastr.core.cardinality.CardinalitySpec attribute*), 91
__dict__ (*fastr.core.dimension.HasDimensions attribute*), 96
__dict__ (*fastr.core.interface.InputSpec attribute*), 97
__dict__ (*fastr.core.interface.InterfaceResult attribute*), 98
__dict__ (*fastr.core.interface.OutputSpec attribute*), 98
__dict__ (*fastr.core.provenance.Provenance attribute*), 101
__dict__ (*fastr.core.samples.SampleBaseId attribute*), 103
__dict__ (*fastr.core.samples.SampleCollection attribute*), 104
__dict__ (*fastr.core.samples.SampleItemBase attribute*), 106
__dict__ (*fastr.core.samples.SampleValue attribute*), 108
__dict__ (*fastr.core.target.ProcessUsageCollection attribute*), 109
__dict__ (*fastr.core.target.TargetResult attribute*), 111
__dict__ (*fastr.core.version.Version attribute*), 114
__dict__ (*fastr.core.vfs.VirtualFileSystem attribute*), 116
__dict__ (*fastr.execution.environmentmodules.EnvironmentModules attribute*), 129
__dict__ (*fastr.execution.networkanalyzer.NetworkAnalyzer attribute*), 155
__dict__ (*fastr.execution.networkchunker.NetworkChunker attribute*), 156
__dict__ (*fastr.helpers.classproperty.ClassPropertyDescriptor attribute*), 166
__dict__ (*fastr.helpers.configmanager.Config attribute*), 167
__dict__ (*fastr.helpers.configmanager.EmptyDefault attribute*), 169
__dict__ (*fastr.helpers.filesynchelper.FileSyncHelper attribute*), 170
__dict__ (*fastr.helpers.lockfile.DirectoryLock attribute*), 174
__dict__ (*fastr.helpers.schematotable.SchemaPrinter attribute*), 175
__dict__ (*fastr.plugins.managers.pluginmanager.PluginsView attribute*), 241
__dict__ (*fastr.utils.cmd.upgrade.dummy_container attribute*), 248
__dir__() (*in module fastr.__init__*), 79
__enter__() (*fastr.core.target.Target method*), 111
__enter__() (*fastr.helpers.lockfile.DirectoryLock method*), 174
__enter__() (*fastr.plugins.DockerTarget method*), 213
__enter__() (*fastr.plugins.LocalBinaryTarget method*), 222
__enter__() (*fastr.plugins.SingularityTarget method*), 228
__enter__() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
__eq__() (*fastr.api.ResourceLimit method*), 88
__eq__() (*fastr.core.cardinality.AnyCardinalitySpec*

method), 90
__eq__() (*fastr.core.cardinality.AsCardinalitySpec method*), 90
__eq__() (*fastr.core.cardinality.CardinalitySpec method*), 91
__eq__() (*fastr.core.cardinality.ChoiceCardinalitySpec method*), 92
__eq__() (*fastr.core.cardinality.IntCardinalitySpec method*), 92
__eq__() (*fastr.core.cardinality.MaxCardinalitySpec method*), 93
__eq__() (*fastr.core.cardinality.MinCardinalitySpec method*), 93
__eq__() (*fastr.core.cardinality.RangeCardinalitySpec method*), 94
__eq__() (*fastr.core.cardinality.ValueCardinalitySpec method*), 94
__eq__() (*fastr.core.dimension.Dimension method*), 95
__eq__() (*fastr.core.resourcelimit.ResourceLimit method*), 102
__eq__() (*fastr.core.tool.Tool method*), 112
__eq__() (*fastr.datatypes.BaseDataType method*), 120
__eq__() (*fastr.datatypes.URLType method*), 127
__eq__() (*fastr.execution.linkrun.LinkRun method*), 152
__eq__() (*fastr.execution.networkrun.NetworkRun method*), 156
__eq__() (*fastr.execution.noderun.NodeRun method*), 158
__eq__() (*fastr.execution.sourcenoderun.SourceNodeRun method*), 164
__eq__() (*fastr.planning.inputoutput.Input method*), 185
__eq__() (*fastr.planning.inputoutput.Output method*), 188
__eq__() (*fastr.planning.inputoutput.SubInput method*), 191
__eq__() (*fastr.planning.inputoutput.SubOutput method*), 193
__eq__() (*fastr.planning.link.Link method*), 195
__eq__() (*fastr.planning.network.Network method*), 197
__eq__() (*fastr.planning.node.MacroNode method*), 203
__eq__() (*fastr.planning.node.Node method*), 204
__eq__() (*fastr.plugins.FastrInterface method*), 215
__eq__() (*fastr.plugins.FlowInterface method*), 218
__eq__() (*fastr.plugins.NipypeInterface method*), 223
__exit__() (*fastr.core.target.Target method*), 111
__exit__() (*fastr.helpers.lockfile.DirectoryLock method*), 174
__exit__() (*fastr.plugins.DockerTarget method*), 213
__exit__() (*fastr.plugins.LocalBinaryTarget method*), 222
__exit__() (*fastr.plugins.SingularityTarget method*), 228
__exit__() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
__format__() (*in module fastr.__init__*), 79
__get__() (*fastr.helpers.classproperty.ClassPropertyDescriptor method*), 166
__getattr__() (*fastr.helpers.lazy_module.LazyModule method*), 173
__getitem__() (*fastr.api.Output method*), 77
__getitem__() (*fastr.core.samples.ContainsSamples method*), 103
__getitem__() (*fastr.core.samples.HasSamples method*), 103
__getitem__() (*fastr.core.samples.SampleCollection method*), 104
__getitem__() (*fastr.core.samples.SampleValue method*), 108
__getitem__() (*fastr.core.target.ProcessUsageCollection method*), 109
__getitem__() (*fastr.execution.inputoutputrun.InputRun method*), 132
__getitem__() (*fastr.execution.inputoutputrun.NamedSubinputRun method*), 134
__getitem__() (*fastr.execution.inputoutputrun.OutputRun method*), 135
__getitem__() (*fastr.execution.inputoutputrun.SourceOutputRun method*), 137
__getitem__() (*fastr.execution.inputoutputrun.SubInputRun method*), 138
__getitem__() (*fastr.execution.inputoutputrun.SubOutputRun method*), 140
__getitem__() (*fastr.execution.linkrun.LinkRun method*), 152
__getitem__() (*fastr.execution.networkrun.NetworkRun method*), 156
__getitem__() (*fastr.helpers.configmanager.EmptyDefault method*), 169
__getitem__() (*fastr.planning.inputgroup.InputGroup method*), 178
__getitem__() (*fastr.planning.inputoutput.Input method*), 185
__getitem__() (*fastr.planning.inputoutput.NamedSubInput method*), 188
__getitem__() (*fastr.planning.inputoutput.Output method*), 189
__getitem__() (*fastr.planning.inputoutput.SubInput method*), 191
__getitem__() (*fastr.planning.network.Network method*), 198
__getitem__() (*fastr.plugins.managers.objectmanager.ObjectManager method*), 239
__getitem__() (*fastr.plugins.managers.pluginmanager.PluginsView method*), 241

__getitem__() (*fastr.utils.cmd.upgrade.dummy_container method*), 248
__getnewargs__() (*fastr.core.samples.SampleBaseId method*), 103
__getnewargs__() (*fastr.core.samples.SampleItemBase method*), 107
__getnewargs__() (*fastr.core.target.SystemUsageInfo method*), 110
__getnewargs__() (*fastr.utils.cmd.upgrade.FastrNamespaceType method*), 248
__getstate__() (*fastr.api.ResourceLimit method*), 88
__getstate__() (*fastr.core.interface.Interface method*), 97
__getstate__() (*fastr.core.resourcelimit.ResourceLimit method*), 102
__getstate__() (*fastr.core.samples.SampleValue method*), 108
__getstate__() (*fastr.core.tool.Tool method*), 112
__getstate__() (*fastr.datatypes.BaseDataType method*), 120
__getstate__() (*fastr.datatypes.Deferred method*), 125
__getstate__() (*fastr.execution.inputoutputrun.InputRun method*), 132
__getstate__() (*fastr.execution.inputoutputrun.OutputRun method*), 135
__getstate__() (*fastr.execution.inputoutputrun.SubInputRun method*), 139
__getstate__() (*fastr.execution.inputoutputrun.SubOutputRun method*), 140
__getstate__() (*fastr.execution.job.Job method*), 143
__getstate__() (*fastr.execution.job.SinkJob method*), 149
__getstate__() (*fastr.execution.job.SourceJob method*), 150
__getstate__() (*fastr.execution.linkrun.LinkRun method*), 152
__getstate__() (*fastr.execution.macronoderun.MacroNodeRun method*), 154
__getstate__() (*fastr.execution.networkrun.NetworkRun method*), 157
__getstate__() (*fastr.execution.noderun.NodeRun method*), 159
__getstate__() (*fastr.execution.sinknoderun.SinkNodeRun method*), 161
__getstate__() (*fastr.execution.sourcenoderun.ConstantNodeRun method*), 163
__getstate__() (*fastr.execution.sourcenoderun.SourceNodeRun method*), 164
__getstate__() (*fastr.planning.inputoutput.BaseInputOutput method*), 183
__getstate__() (*fastr.planning.inputoutput.Input method*), 185
__getstate__() (*fastr.planning.inputoutput.Output method*), 189
__getstate__() (*fastr.planning.inputoutput.SubInput method*), 191
__getstate__() (*fastr.planning.inputoutput.SubOutput method*), 193
__getstate__() (*fastr.planning.link.Link method*), 195
__getstate__() (*fastr.planning.network.Network method*), 198
__getstate__() (*fastr.planning.node.ConstantNode method*), 202
__getstate__() (*fastr.planning.node.MacroNode method*), 204
__getstate__() (*fastr.planning.node.Node method*), 204
__getstate__() (*fastr.planning.node.SinkNode method*), 207
__getstate__() (*fastr.planning.node.SourceNode method*), 208
__getstate__() (*fastr.plugins.FastrInterface method*), 215
__getstate__() (*fastr.plugins.FlowInterface method*), 218
__getstate__() (*fastr.plugins.NipypeInterface method*), 223
__hash__ (*fastr.api.ResourceLimit attribute*), 89
__hash__ (*fastr.core.cardinality.AnyCardinalitySpec attribute*), 90
__hash__ (*fastr.core.cardinality.AsCardinalitySpec attribute*), 90
__hash__ (*fastr.core.cardinality.CardinalitySpec attribute*), 91
__hash__ (*fastr.core.cardinality.ChoiceCardinalitySpec attribute*), 92
__hash__ (*fastr.core.cardinality.IntCardinalitySpec attribute*), 93
__hash__ (*fastr.core.cardinality.MaxCardinalitySpec attribute*), 93
__hash__ (*fastr.core.cardinality.MinCardinalitySpec attribute*), 94
__hash__ (*fastr.core.cardinality.RangeCardinalitySpec attribute*), 94
__hash__ (*fastr.core.cardinality.ValueCardinalitySpec attribute*), 94
__hash__ (*fastr.core.dimension.Dimension attribute*), 95
__hash__ (*fastr.core.resourcelimit.ResourceLimit attribute*), 102
__hash__ (*fastr.core.tool.Tool attribute*), 112
__hash__ (*fastr.datatypes.BaseDataType attribute*), 120
__hash__ (*fastr.datatypes.URLType attribute*), 127

__hash__ (*fastr.execution.linkrun.LinkRun attribute*), 152
__hash__ (*fastr.execution.networkrun.NetworkRun attribute*), 157
__hash__ (*fastr.execution.noderun.NodeRun attribute*), 159
__hash__ (*fastr.execution.sourcenoderun.SourceNodeRun attribute*), 164
__hash__ (*fastr.planning.inputoutput.Input attribute*), 185
__hash__ (*fastr.planning.inputoutput.Output attribute*), 189
__hash__ (*fastr.planning.inputoutput.SubInput attribute*), 191
__hash__ (*fastr.planning.inputoutput.SubOutput attribute*), 193
__hash__ (*fastr.planning.link.Link attribute*), 195
__hash__ (*fastr.planning.network.Network attribute*), 198
__hash__ (*fastr.planning.node.MacroNode attribute*), 204
__hash__ (*fastr.planning.node.Node attribute*), 205
__hash__ (*fastr.plugins.FastrInterface attribute*), 215
__hash__ (*fastr.plugins.FlowInterface attribute*), 219
__hash__ (*fastr.plugins.NipypeInterface attribute*), 223
__iadd__() (*fastr.helpers.configmanager.EmptyDefault method*), 169
__init__() (*fastr.api.ResourceLimit method*), 89
__init__() (*fastr.core.cardinality.AsCardinalitySpec method*), 90
__init__() (*fastr.core.cardinality.CardinalitySpec method*), 91
__init__() (*fastr.core.cardinality.ChoiceCardinalitySpec method*), 92
__init__() (*fastr.core.cardinality.IntCardinalitySpec method*), 93
__init__() (*fastr.core.cardinality.MaxCardinalitySpec method*), 93
__init__() (*fastr.core.cardinality.MinCardinalitySpec method*), 94
__init__() (*fastr.core.cardinality.RangeCardinalitySpec method*), 94
__init__() (*fastr.core.cardinality.ValueCardinalitySpec method*), 94
__init__() (*fastr.core.dimension.Dimension method*), 95
__init__() (*fastr.core.interface.InterfaceResult method*), 98
__init__() (*fastr.core.ioplugin.IOPlugin method*), 99
__init__() (*fastr.core.provenance.Provenance method*), 101
__init__() (*fastr.core.resourcelimit.ResourceLimit method*), 102
__init__() (*fastr.core.samples.SampleCollection method*), 105
__init__() (*fastr.core.samples.SampleValue method*), 108
__init__() (*fastr.core.target.ProcessUsageCollection method*), 109
__init__() (*fastr.core.target.TargetResult method*), 111
__init__() (*fastr.core.tool.Tool method*), 112
__init__() (*fastr.core.vfs.VirtualFileSystem method*), 116
__init__() (*fastr.datatypes.BaseDataType method*), 121
__init__() (*fastr.datatypes.DataType method*), 122
__init__() (*fastr.datatypes.DataTypeManager method*), 123
__init__() (*fastr.datatypes.Deferred method*), 125
__init__() (*fastr.datatypes.EnumType method*), 126
__init__() (*fastr.datatypes.TypeGroup method*), 126
__init__() (*fastr.datatypes.URLType method*), 127
__init__() (*fastr.datatypes.ValueType method*), 128
__init__() (*fastr.exceptions.FastrError method*), 81
__init__() (*fastr.exceptions.FastrExecutableNotFoundError method*), 81
__init__() (*fastr.exceptions.FastrFileNotFound method*), 82
__init__() (*fastr.exceptions.FastrLockNotAcquired method*), 82
__init__() (*fastr.exceptions.FastrScriptNotFoundError method*), 85
__init__() (*fastr.exceptions.FastrSerializationError method*), 85
__init__() (*fastr.execution.environmentmodules.EnvironmentModules method*), 129
__init__() (*fastr.execution.inputoutputrun.BaseInputRun method*), 131
__init__() (*fastr.execution.inputoutputrun.InputRun method*), 132
__init__() (*fastr.execution.inputoutputrun.NamedSubinputRun method*), 134
__init__() (*fastr.execution.inputoutputrun.OutputRun method*), 135
__init__() (*fastr.execution.inputoutputrun.SourceOutputRun method*), 137
__init__() (*fastr.execution.inputoutputrun.SubInputRun method*), 139
__init__() (*fastr.execution.inputoutputrun.SubOutputRun method*), 141
__init__() (*fastr.execution.job.InlineJob method*), 142
__init__() (*fastr.execution.job.Job method*), 143
__init__() (*fastr.execution.job.JobState method*), 148
__init__() (*fastr.execution.job.SinkJob method*), 149
__init__() (*fastr.execution.job.SourceJob method*), 150

__init__() (*fastr.execution.linkrun.LinkRun method*), 152
__init__() (*fastr.execution.macronoderun.MacroNodeRun method*), 154
__init__() (*fastr.execution.networkchunker.DefaultNetworkChunker method*), 155
__init__() (*fastr.execution.networkrun.NetworkRun method*), 157
__init__() (*fastr.execution.noderun.NodeRun method*), 159
__init__() (*fastr.execution.sinknoderun.SinkNodeRun method*), 161
__init__() (*fastr.execution.sourcenoderun.ConstantNodeRun method*), 163
__init__() (*fastr.execution.sourcenoderun.SourceNodeRun method*), 164
__init__() (*fastr.helpers.classproperty.ClassPropertyDescriptor method*), 166
__init__() (*fastr.helpers.configmanager.Config method*), 167
__init__() (*fastr.helpers.configmanager.EmptyDefault method*), 169
__init__() (*fastr.helpers.filesynchelper.FileSyncHelper method*), 170
__init__() (*fastr.helpers.jsonschemaparser.FastrRefResolver method*), 171
__init__() (*fastr.helpers.lazy_module.LazyModule method*), 173
__init__() (*fastr.helpers.lockfile.DirectoryLock method*), 174
__init__() (*fastr.helpers.schematotable.SchemaPrinter method*), 175
__init__() (*fastr.planning.inputgroup.InputGroup method*), 178
__init__() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 179
__init__() (*fastr.planning.inputgroupcombiner.MergingInputGroupCombiner method*), 181
__init__() (*fastr.planning.inputoutput.BaseInput method*), 182
__init__() (*fastr.planning.inputoutput.BaseInputOutput method*), 183
__init__() (*fastr.planning.inputoutput.BaseOutput method*), 184
__init__() (*fastr.planning.inputoutput.Input method*), 185
__init__() (*fastr.planning.inputoutput.NamedSubInput method*), 188
__init__() (*fastr.planning.inputoutput.Output method*), 189
__init__() (*fastr.planning.inputoutput.SourceOutput method*), 190
__init__() (*fastr.planning.inputoutput.SubInput method*), 191
__init__() (*fastr.planning.inputoutput.SubOutput method*), 193
__init__() (*fastr.planning.link.Link method*), 195
__init__() (*fastr.planning.network.Network method*), 198
__init__() (*fastr.planning.node.ConstantNode method*), 202
__init__() (*fastr.planning.node.FlowNode method*), 203
__init__() (*fastr.planning.node.MacroNode method*), 204
__init__() (*fastr.planning.node.Node method*), 205
__init__() (*fastr.planning.node.SinkNode method*), 207
__init__() (*fastr.planning.node.SourceNode method*), 208
__init__() (*fastr.plugins.BlockingExecution method*), 209
__init__() (*fastr.plugins.CommaSeperatedValueFile method*), 210
__init__() (*fastr.plugins.DRMAAExecution method*), 211
__init__() (*fastr.plugins.DockerTarget method*), 213
__init__() (*fastr.plugins.ElasticsearchReporter method*), 213
__init__() (*fastr.plugins.FastrInterface method*), 216
__init__() (*fastr.plugins.FileSystem method*), 217
__init__() (*fastr.plugins.FlowInterface method*), 219
__init__() (*fastr.plugins.HTTPPlugin method*), 220
__init__() (*fastr.plugins.LinearExecution method*), 220
__init__() (*fastr.plugins.LocalBinaryTarget method*), 222
__init__() (*fastr.plugins.MacroTarget method*), 222
__init__() (*fastr.plugins.NipypeInterface method*), 223
__init__() (*fastr.plugins.Null method*), 224
__init__() (*fastr.plugins.PimReporter method*), 225
__init__() (*fastr.plugins.ProcessPoolExecution method*), 225
__init__() (*fastr.plugins.Reference method*), 226
__init__() (*fastr.plugins.S3Filesystem method*), 226
__init__() (*fastr.plugins.SingularityTarget method*), 228
__init__() (*fastr.plugins.VirtualFileSystemRegularExpression method*), 229
__init__() (*fastr.plugins.VirtualFileSystemValueList method*), 230
__init__() (*fastr.plugins.XNATStorage method*), 232
__init__() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
__init__() (*fastr.plugins.managers.executionpluginmanager.ExecutionP method*), 237
__init__() (*fastr.plugins.managers.interfacemanager.InterfacePluginM

method), 237
__init__() (*fastr.plugins.managers.iopluginmanager.IOPluginManager method*), 237
__init__() (*fastr.plugins.managers.objectmanager.ObjectManager method*), 240
__init__() (*fastr.plugins.managers.pluginmanager.PluginManager method*), 240
__init__() (*fastr.plugins.managers.pluginmanager.PluginSubManager method*), 241
__init__() (*fastr.plugins.managers.pluginmanager.PluginsView method*), 241
__init__() (*fastr.plugins.managers.targetmanager.TargetManager method*), 242
__init_subclass__() (*fastr.execution.basenoderun.BaseNodeRun class method*), 128
__init_subclass__() (*fastr.planning.node.BaseNode class method*), 201
__init_subclass__() (*in module fastr.__init__*), 79
__iter__() (*fastr.core.samples.HasSamples method*), 103
__iter__() (*fastr.core.samples.SampleCollection method*), 105
__iter__() (*fastr.core.samples.SampleValue method*), 108
__iter__() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 179
__iter__() (*fastr.planning.inputoutput.BaseInputOutput method*), 183
__iter__() (*fastr.plugins.managers.iopluginmanager.IOPluginManager method*), 237
__iter__() (*fastr.plugins.managers.pluginmanager.PluginsView method*), 242
__keytransform__() (*fastr.datatypes.DataTypeManager method*), 123
__keytransform__() (*fastr.plugins.managers.iopluginmanager.IOPluginManager method*), 238
__keytransform__() (*fastr.plugins.managers.objectmanager.ObjectManager method*), 240
__len__() (*fastr.core.samples.SampleCollection method*), 105
__len__() (*fastr.core.samples.SampleValue method*), 109
__len__() (*fastr.core.target.ProcessUsageCollection method*), 109
__len__() (*fastr.execution.inputoutputrun.SubOutputRun method*), 141
__len__() (*fastr.planning.inputoutput.SubOutput method*), 193
__len__() (*fastr.plugins.managers.pluginmanager.PluginsView method*), 242
__lshift__() (*fastr.api.Input method*), 76
__lshift__() (*fastr.planning.inputoutput.BaseInput method*), 182
__module__ (*fastr.api.ResourceLimit attribute*), 89
__module__ (*fastr.core.cardinality.AnyCardinalitySpec attribute*), 90
__module__ (*fastr.core.cardinality.AsCardinalitySpec attribute*), 90
__module__ (*fastr.core.cardinality.CardinalitySpec attribute*), 91
__module__ (*fastr.core.cardinality.ChoiceCardinalitySpec attribute*), 92
__module__ (*fastr.core.cardinality.IntCardinalitySpec attribute*), 93
__module__ (*fastr.core.cardinality.MaxCardinalitySpec attribute*), 93
__module__ (*fastr.core.cardinality.MinCardinalitySpec attribute*), 94
__module__ (*fastr.core.cardinality.RangeCardinalitySpec attribute*), 94
__module__ (*fastr.core.cardinality.ValueCardinalitySpec attribute*), 94
__module__ (*fastr.core.dimension.Dimension attribute*), 95
__module__ (*fastr.core.dimension.ForwardsDimensions attribute*), 96
__module__ (*fastr.core.dimension.HasDimensions attribute*), 96
__module__ (*fastr.core.interface.InputSpec attribute*), 97
__module__ (*fastr.core.interface.Interface attribute*), 97
__module__ (*fastr.core.interface.InterfaceResult attribute*), 98
__module__ (*fastr.core.interface.OutputSpec attribute*), 98
__module__ (*fastr.core.ioplugin.IOPlugin attribute*), 99
__module__ (*fastr.core.provenance.Provenance attribute*), 101
__module__ (*fastr.core.resourcelimit.ResourceLimit attribute*), 102
__module__ (*fastr.core.samples.ContainsSamples attribute*), 103
__module__ (*fastr.core.samples.HasSamples attribute*), 103
__module__ (*fastr.core.samples.SampleBaseId attribute*), 103
__module__ (*fastr.core.samples.SampleCollection attribute*), 105
__module__ (*fastr.core.samples.SampleId attribute*), 105

__module__ (*fastr.core.samples.SampleIndex attribute*), 106
__module__ (*fastr.core.samples.SampleItem attribute*), 106
__module__ (*fastr.core.samples.SampleItemBase attribute*), 107
__module__ (*fastr.core.samples.SamplePayload attribute*), 108
__module__ (*fastr.core.samples.SampleValue attribute*), 109
__module__ (*fastr.core.target.ProcessUsageCollection attribute*), 109
__module__ (*fastr.core.target.SubprocessBasedTarget attribute*), 109
__module__ (*fastr.core.target.SystemUsageInfo attribute*), 110
__module__ (*fastr.core.target.Target attribute*), 111
__module__ (*fastr.core.target.TargetResult attribute*), 111
__module__ (*fastr.core.tool.Tool attribute*), 112
__module__ (*fastr.core.version.Version attribute*), 114
__module__ (*fastr.core.vfs.VirtualFileSystem attribute*), 116
__module__ (*fastr.datatypes.AnyFile attribute*), 120
__module__ (*fastr.datatypes.AnyType attribute*), 120
__module__ (*fastr.datatypes.BaseDataType attribute*), 121
__module__ (*fastr.datatypes.DataType attribute*), 122
__module__ (*fastr.datatypes.DataTypeManager attribute*), 123
__module__ (*fastr.datatypes.Deferred attribute*), 125
__module__ (*fastr.datatypes.EnumType attribute*), 126
__module__ (*fastr.datatypes.TypeGroup attribute*), 126
__module__ (*fastr.datatypes.URLType attribute*), 127
__module__ (*fastr.datatypes.ValueType attribute*), 128
__module__ (*fastr.exceptions.FastrAttributeError attribute*), 80
__module__ (*fastr.exceptions.FastrCannotChangeAttributeError attribute*), 80
__module__ (*fastr.exceptions.FastrCardinalityError attribute*), 80
__module__ (*fastr.exceptions.FastrCollectorError attribute*), 80
__module__ (*fastr.exceptions.FastrDataTypeFileNotReadable attribute*), 80
__module__ (*fastr.exceptions.FastrDataTypeMismatchError attribute*), 80
__module__ (*fastr.exceptions.FastrDataTypeNotAvailableError attribute*), 80
__module__ (*fastr.exceptions.FastrDataTypeNotInstantiableError attribute*), 80
__module__ (*fastr.exceptions.FastrDataTypeValueError attribute*), 81
__module__ (*fastr.exceptions.FastrError attribute*), 81
__module__ (*fastr.exceptions.FastrErrorInSubprocess attribute*), 81
__module__ (*fastr.exceptions.FastrExecutableNotFoundError attribute*), 81
__module__ (*fastr.exceptions.FastrExecutionError attribute*), 81
__module__ (*fastr.exceptions.FastrFileNotFound attribute*), 82
__module__ (*fastr.exceptions.FastrIOError attribute*), 82
__module__ (*fastr.exceptions.FastrImportError attribute*), 82
__module__ (*fastr.exceptions.FastrIndexError attribute*), 82
__module__ (*fastr.exceptions.FastrIndexNonexistent attribute*), 82
__module__ (*fastr.exceptions.FastrKeyError attribute*), 82
__module__ (*fastr.exceptions.FastrLockNotAcquired attribute*), 82
__module__ (*fastr.exceptions.FastrLookupError attribute*), 83
__module__ (*fastr.exceptions.FastrMountUnknownError attribute*), 83
__module__ (*fastr.exceptions.FastrNetworkMismatchError attribute*), 83
__module__ (*fastr.exceptions.FastrNetworkUnknownError attribute*), 83
__module__ (*fastr.exceptions.FastrNoValidTargetError attribute*), 83
__module__ (*fastr.exceptions.FastrNodeAreadyPreparedError attribute*), 83
__module__ (*fastr.exceptions.FastrNodeNotPreparedError attribute*), 83
__module__ (*fastr.exceptions.FastrNodeNotValidError attribute*), 83
__module__ (*fastr.exceptions.FastrNotExecutableError attribute*), 83
__module__ (*fastr.exceptions.FastrNotImplementedError attribute*), 84
__module__ (*fastr.exceptions.FastrOSError attribute*), 84
__module__ (*fastr.exceptions.FastrObjectUnknownError attribute*), 84
__module__ (*fastr.exceptions.FastrOptionalModuleNotAvailableError attribute*), 84
__module__ (*fastr.exceptions.FastrOutputValidationError attribute*), 84
__module__ (*fastr.exceptions.FastrParentMismatchError attribute*), 84
__module__ (*fastr.exceptions.FastrPluginCapabilityNotImplemented attribute*), 84
__module__ (*fastr.exceptions.FastrPluginNotAvailable attribute*), 84

__module__ (*fastr.exceptions.FastrPluginNotLoaded attribute*), 84
__module__ (*fastr.exceptions.FastrResultFileNotFound attribute*), 85
__module__ (*fastr.exceptions.FastrScriptNotFoundError attribute*), 85
__module__ (*fastr.exceptions.FastrSerializationError attribute*), 85
__module__ (*fastr.exceptions.FastrSerializationIgnoreDefaultError attribute*), 85
__module__ (*fastr.exceptions.FastrSerializationInvalidDataError attribute*), 85
__module__ (*fastr.exceptions.FastrSerializationMethodError attribute*), 86
__module__ (*fastr.exceptions.FastrSinkDataUnavailableError attribute*), 86
__module__ (*fastr.exceptions.FastrSizeInvalidError attribute*), 86
__module__ (*fastr.exceptions.FastrSizeMismatchError attribute*), 86
__module__ (*fastr.exceptions.FastrSizeUnknownError attribute*), 86
__module__ (*fastr.exceptions.FastrSourceDataUnavailableError attribute*), 86
__module__ (*fastr.exceptions.FastrStateError attribute*), 86
__module__ (*fastr.exceptions.FastrSubprocessNotFinished attribute*), 86
__module__ (*fastr.exceptions.FastrToolNotAvailableError attribute*), 86
__module__ (*fastr.exceptions.FastrToolTargetNotFound attribute*), 86
__module__ (*fastr.exceptions.FastrToolUnknownError attribute*), 87
__module__ (*fastr.exceptions.FastrToolVersionError attribute*), 87
__module__ (*fastr.exceptions.FastrTypeError attribute*), 87
__module__ (*fastr.exceptions.FastrUnknownURLSchemeError attribute*), 87
__module__ (*fastr.exceptions.FastrValueError attribute*), 87
__module__ (*fastr.exceptions.FastrVersionInvalidError attribute*), 87
__module__ (*fastr.exceptions.FastrVersionMismatchError attribute*), 87
__module__ (*fastr.execution.basenoderun.BaseNodeRun attribute*), 128
__module__ (*fastr.execution.environmentmodules.EnvironmentModules attribute*), 129
__module__ (*fastr.execution.environmentmodules.ModuleSystem attribute*), 130
__module__ (*fastr.execution.flownoderun.AdvancedFlowNodeRun attribute*), 130
__module__ (*fastr.execution.flownoderun.FlowNodeRun attribute*), 131
__module__ (*fastr.execution.inputoutputrun.AdvancedFlowOutputRun attribute*), 131
__module__ (*fastr.execution.inputoutputrun.BaseInputRun attribute*), 132
__module__ (*fastr.execution.inputoutputrun.InputRun attribute*), 132
__module__ (*fastr.execution.inputoutputrun.MacroOutputRun attribute*), 134
__module__ (*fastr.execution.inputoutputrun.NamedSubinputRun attribute*), 135
__module__ (*fastr.execution.inputoutputrun.OutputRun attribute*), 136
__module__ (*fastr.execution.inputoutputrun.SourceOutputRun attribute*), 138
__module__ (*fastr.execution.inputoutputrun.SubInputRun attribute*), 139
__module__ (*fastr.execution.inputoutputrun.SubOutputRun attribute*), 141
__module__ (*fastr.execution.job.InlineJob attribute*), 142
__module__ (*fastr.execution.job.Job attribute*), 143
__module__ (*fastr.execution.job.JobCleanupLevel attribute*), 146
__module__ (*fastr.execution.job.JobState attribute*), 149
__module__ (*fastr.execution.job.SinkJob attribute*), 149
__module__ (*fastr.execution.job.SourceJob attribute*), 151
__module__ (*fastr.execution.linkrun.LinkRun attribute*), 152
__module__ (*fastr.execution.macronoderun.MacroNodeRun attribute*), 154
__module__ (*fastr.execution.networkanalyzer.DefaultNetworkAnalyzer attribute*), 155
__module__ (*fastr.execution.networkanalyzer.NetworkAnalyzer attribute*), 155
__module__ (*fastr.execution.networkchunker.DefaultNetworkChunker attribute*), 155
__module__ (*fastr.execution.networkchunker.NetworkChunker attribute*), 156
__module__ (*fastr.execution.networkrun.NetworkRun attribute*), 157
__module__ (*fastr.execution.noderun.NodeRun attribute*), 159
__module__ (*fastr.execution.sinknoderun.SinkNodeRun attribute*), 161
__module__ (*fastr.execution.sourcenoderun.ConstantNodeRun attribute*), 163
__module__ (*fastr.execution.sourcenoderun.SourceNodeRun attribute*), 164
__module__ (*fastr.helpers.classproperty.ClassPropertyDescriptor*

attribute), 166
__module__ (fastr.helpers.configmanager.Config attribute), 167
__module__ (fastr.helpers.configmanager.EmptyDefault attribute), 169
__module__ (fastr.helpers.events.EventType attribute), 169
__module__ (fastr.helpers.events.FastrLogEventHandler attribute), 170
__module__ (fastr.helpers.filesynchelper.FileSyncHelper attribute), 170
__module__ (fastr.helpers.jsonschemaparser.FastrRefResolver attribute), 171
__module__ (fastr.helpers.lazy_module.LazyModule attribute), 174
__module__ (fastr.helpers.lockfile.DirectoryLock attribute), 174
__module__ (fastr.helpers.schematotable.SchemaPrinter attribute), 175
__module__ (fastr.planning.inputgroup.InputGroup attribute), 178
__module__ (fastr.planning.inputgroupcombiner.BaseInputGroupCombiner attribute), 179
__module__ (fastr.planning.inputgroupcombiner.DefaultInputGroupCombiner attribute), 180
__module__ (fastr.planning.inputgroupcombiner.MergingInputGroupCombiner attribute), 181
__module__ (fastr.planning.inputoutput.AdvancedFlowOutput attribute), 181
__module__ (fastr.planning.inputoutput.BaseInput attribute), 182
__module__ (fastr.planning.inputoutput.BaseInputOutput attribute), 183
__module__ (fastr.planning.inputoutput.BaseOutput attribute), 184
__module__ (fastr.planning.inputoutput.Input attribute), 185
__module__ (fastr.planning.inputoutput.MacroInput attribute), 187
__module__ (fastr.planning.inputoutput.MacroOutput attribute), 187
__module__ (fastr.planning.inputoutput.NamedSubInput attribute), 188
__module__ (fastr.planning.inputoutput.Output attribute), 189
__module__ (fastr.planning.inputoutput.SourceOutput attribute), 190
__module__ (fastr.planning.inputoutput.SubInput attribute), 191
__module__ (fastr.planning.inputoutput.SubOutput attribute), 193
__module__ (fastr.planning.link.Link attribute), 196
__module__ (fastr.planning.network.Network attribute), 198
__module__ (fastr.planning.node.AdvancedFlowNode attribute), 201
__module__ (fastr.planning.node.BaseNode attribute), 201
__module__ (fastr.planning.node.ConstantNode attribute), 202
__module__ (fastr.planning.node.FlowNode attribute), 203
__module__ (fastr.planning.node.InputDict attribute), 203
__module__ (fastr.planning.node.MacroNode attribute), 204
__module__ (fastr.planning.node.Node attribute), 205
__module__ (fastr.planning.node.OutputDict attribute), 207
__module__ (fastr.planning.node.SinkNode attribute), 207
__module__ (fastr.planning.node.SourceNode attribute), 208
__module__ (fastr.plugins.BlockingExecution attribute), 209
__module__ (fastr.plugins.CommaSeperatedValueFile attribute), 210
__module__ (fastr.plugins.CrossValidation attribute), 211
__module__ (fastr.plugins.DRMAAExecution attribute), 212
__module__ (fastr.plugins.DockerTarget attribute), 213
__module__ (fastr.plugins.ElasticsearchReporter attribute), 213
__module__ (fastr.plugins.FastrInterface attribute), 216
__module__ (fastr.plugins.FileSystem attribute), 217
__module__ (fastr.plugins.FlowInterface attribute), 219
__module__ (fastr.plugins.HTTPPlugin attribute), 220
__module__ (fastr.plugins.LinearExecution attribute), 220
__module__ (fastr.plugins.LocalBinaryTarget attribute), 222
__module__ (fastr.plugins.MacroTarget attribute), 222
__module__ (fastr.plugins.NipypeInterface attribute), 223
__module__ (fastr.plugins.Null attribute), 224
__module__ (fastr.plugins.PimReporter attribute), 225
__module__ (fastr.plugins.ProcessPoolExecution attribute), 225
__module__ (fastr.plugins.Reference attribute), 226
__module__ (fastr.plugins.S3Filesystem attribute), 226
__module__ (fastr.plugins.SimpleReport attribute), 227
__module__ (fastr.plugins.SingularityTarget attribute), 228

__module__ (*fastr.plugins.VirtualFileSystem attribute*), 229
__module__ (*fastr.plugins.VirtualFileSystemRegularExpression attribute*), 230
__module__ (*fastr.plugins.VirtualFileSystemValueList attribute*), 230
__module__ (*fastr.plugins.XNATStorage attribute*), 232
__module__ (*fastr.plugins.executionplugin.ExecutionPlugin attribute*), 235
__module__ (*fastr.plugins.executionplugin.JobAction attribute*), 236
__module__ (*fastr.plugins.managers.executionpluginmanager.ExecutionPluginManager attribute*), 237
__module__ (*fastr.plugins.managers.interfacemanager.InterfacePluginManager attribute*), 237
__module__ (*fastr.plugins.managers.iopluginmanager.IOPluginManager attribute*), 238
__module__ (*fastr.plugins.managers.networkmanager.NetworkManager attribute*), 239
__module__ (*fastr.plugins.managers.objectmanager.ObjectManager attribute*), 240
__module__ (*fastr.plugins.managers.pluginmanager.PluginManager attribute*), 240
__module__ (*fastr.plugins.managers.pluginmanager.PluginSubManager attribute*), 241
__module__ (*fastr.plugins.managers.pluginmanager.PluginsView attribute*), 242
__module__ (*fastr.plugins.managers.targetmanager.TargetManager attribute*), 242
__module__ (*fastr.plugins.managers.toolmanager.ToolManager attribute*), 242
__module__ (*fastr.plugins.reportingplugin.ReportingPlugin attribute*), 236
__module__ (*fastr.utils.cmd.upgrade.FastrNamespaceType attribute*), 248
__module__ (*fastr.utils.cmd.upgrade.dummy_container attribute*), 248
__ne__() (*fastr.api.ResourceLimit method*), 89
__ne__() (*fastr.core.cardinality.CardinalitySpec method*), 91
__ne__() (*fastr.core.dimension.Dimension method*), 95
__ne__() (*fastr.core.resourcelimit.ResourceLimit method*), 102
__ne__() (*fastr.datatypes.BaseDataType method*), 121
__ne__() (*fastr.execution.networkrun.NetworkRun method*), 157
__ne__() (*fastr.planning.inputoutput.BaseInputOutput method*), 183
__ne__() (*fastr.planning.network.Network method*), 198
__ne__() (*fastr.planning.node.Node method*), 205
__new__() (*fastr.core.interface.InputSpec static method*), 97
__new__() (*fastr.core.interface.OutputSpec static method*), 98
__new__() (*fastr.core.samples.SampleBaseId static method*), 103
__new__() (*fastr.core.samples.SampleItem static method*), 106
__new__() (*fastr.core.samples.SampleItemBase static method*), 107
__new__() (*fastr.core.samples.SamplePayload static method*), 108
__new__() (*fastr.core.target.SystemUsageInfo static method*), 110
__new__() (*fastr.core.version.Version static method*), 114
__new__() (*fastr.datatypes.TypeGroup static method*), 126
__new__() (*fastr.utils.cmd.upgrade.FastrNamespaceType static method*), 248
__new__() (*in module fastr.__init__*), 79
__radd__() (*fastr.core.samples.SampleBaseId method*), 104
__radd__() (*fastr.core.samples.SampleValue method*), 109
__radd__() (*fastr.helpers.configmanager.EmptyDefault method*), 169
__reduce__() (*in module fastr.__init__*), 79
__reduce_ex__() (*fastr.datatypes.BaseDataType method*), 121
__reduce_ex__() (*fastr.datatypes.EnumType method*), 126
__reduce_ex__() (*in module fastr.__init__*), 79
__repr__() (*fastr.core.cardinality.CardinalitySpec method*), 91
__repr__() (*fastr.core.dimension.Dimension method*), 96
__repr__() (*fastr.core.samples.SampleBaseId method*), 104
__repr__() (*fastr.core.samples.SampleCollection method*), 105
__repr__() (*fastr.core.samples.SampleIndex method*), 106
__repr__() (*fastr.core.samples.SampleItemBase method*), 107
__repr__() (*fastr.core.samples.SampleValue method*), 109
__repr__() (*fastr.core.target.SystemUsageInfo method*), 110
__repr__() (*fastr.core.tool.Tool method*), 112
__repr__() (*fastr.core.version.Version method*), 115
__repr__() (*fastr.datatypes.BaseDataType method*), 121
__repr__() (*fastr.datatypes.Deferred method*), 125
__repr__() (*fastr.exceptions.FastrError method*), 81
__repr__() (*fastr.exceptions.FastrSerializationError*

method), 85
__repr__() (fastr.execution.environmentmodules.EnvironmentModules method), 129
__repr__() (fastr.execution.job.Job method), 143
__repr__() (fastr.execution.job.SinkJob method), 149
__repr__() (fastr.execution.job.SourceJob method), 151
__repr__() (fastr.execution.linkrun.LinkRun method), 152
__repr__() (fastr.execution.networkrun.NetworkRun method), 157
__repr__() (fastr.execution.noderun.NodeRun method), 159
__repr__() (fastr.helpers.configmanager.Config method), 167
__repr__() (fastr.helpers.lazy_module.LazyModule method), 174
__repr__() (fastr.planning.inputoutput.BaseInputOutput method), 183
__repr__() (fastr.planning.link.Link method), 196
__repr__() (fastr.planning.network.Network method), 198
__repr__() (fastr.planning.node.Node method), 205
__repr__() (fastr.utils.cmd.upgrade.FastrNamespaceType method), 248
__rrshift__() (fastr.api.Input method), 76
__rrshift__() (fastr.planning.inputoutput.BaseInput method), 182
__setitem__() (fastr.core.samples.ContainsSamples method), 103
__setitem__() (fastr.core.samples.SampleCollection method), 105
__setitem__() (fastr.core.samples.SampleValue method), 109
__setitem__() (fastr.execution.inputoutputrun.OutputRun method), 136
__setitem__() (fastr.execution.inputoutputrun.SourceOutputRun method), 138
__setitem__() (fastr.execution.inputoutputrun.SubOutputRun method), 141
__setitem__() (fastr.helpers.configmanager.EmptyDefault method), 169
__setitem__() (fastr.planning.inputgroup.InputGroup method), 178
__setitem__() (fastr.planning.inputoutput.Input method), 185
__setitem__() (fastr.planning.node.InputDict method), 203
__setitem__() (fastr.planning.node.OutputDict method), 207
__setitem__() (fastr.plugins.managers.pluginmanager.PluginManager method), 240
__setitem__() (fastr.plugins.managers.pluginmanager.PluginsView method), 242
__setstate__() (fastr.api.ResourceLimit method), 80
__setstate__() (fastr.core.interface.Interface method), 97
__setstate__() (fastr.core.resourcelimit.ResourceLimit method), 102
__setstate__() (fastr.core.samples.SampleValue method), 109
__setstate__() (fastr.core.tool.Tool method), 112
__setstate__() (fastr.datatypes.BaseDataType method), 121
__setstate__() (fastr.datatypes.Deferred method), 125
__setstate__() (fastr.execution.inputoutputrun.InputRun method), 133
__setstate__() (fastr.execution.inputoutputrun.OutputRun method), 136
__setstate__() (fastr.execution.inputoutputrun.SubInputRun method), 139
__setstate__() (fastr.execution.inputoutputrun.SubOutputRun method), 141
__setstate__() (fastr.execution.job.Job method), 143
__setstate__() (fastr.execution.job.SinkJob method), 150
__setstate__() (fastr.execution.job.SourceJob method), 151
__setstate__() (fastr.execution.linkrun.LinkRun method), 153
__setstate__() (fastr.execution.macronoderun.MacroNodeRun method), 154
__setstate__() (fastr.execution.networkrun.NetworkRun method), 157
__setstate__() (fastr.execution.noderun.NodeRun method), 159
__setstate__() (fastr.execution.sinknoderun.SinkNodeRun method), 161
__setstate__() (fastr.execution.sourcenoderun.ConstantNodeRun method), 163
__setstate__() (fastr.execution.sourcenoderun.SourceNodeRun method), 164
__setstate__() (fastr.planning.inputoutput.BaseInputOutput method), 183
__setstate__() (fastr.planning.inputoutput.Input method), 186
__setstate__() (fastr.planning.inputoutput.Output method), 189
__setstate__() (fastr.planning.inputoutput.SubInput method), 191
__setstate__() (fastr.planning.inputoutput.SubOutput method), 194
__setstate__() (fastr.planning.link.Link method), 196
__setstate__() (fastr.planning.network.Network

method), 198
__setstate__() (*fastr.planning.node.ConstantNode method*), 202
__setstate__() (*fastr.planning.node.MacroNode method*), 204
__setstate__() (*fastr.planning.node.Node method*), 205
__setstate__() (*fastr.planning.node.SinkNode method*), 207
__setstate__() (*fastr.planning.node.SourceNode method*), 208
__setstate__() (*fastr.plugins.FastrInterface method*), 216
__setstate__() (*fastr.plugins.FlowInterface method*), 219
__setstate__() (*fastr.plugins.NipypeInterface method*), 223
__sizeof__() (*in module fastr.__init__*), 79
__slots__ (*fastr.api.ResourceLimit attribute*), 89
__slots__ (*fastr.core.dimension.Dimension attribute*), 96
__slots__ (*fastr.core.resourcelimit.ResourceLimit attribute*), 102
__slots__ (*fastr.core.target.SystemUsageInfo attribute*), 110
__slots__ (*fastr.utils.cmd.upgrade.FastrNamespaceType attribute*), 248
__str__() (*fastr.core.cardinality.AnyCardinalitySpec method*), 90
__str__() (*fastr.core.cardinality.AsCardinalitySpec method*), 90
__str__() (*fastr.core.cardinality.CardinalitySpec method*), 91
__str__() (*fastr.core.cardinality.ChoiceCardinalitySpec method*), 92
__str__() (*fastr.core.cardinality.IntCardinalitySpec method*), 93
__str__() (*fastr.core.cardinality.MaxCardinalitySpec method*), 93
__str__() (*fastr.core.cardinality.MinCardinalitySpec method*), 94
__str__() (*fastr.core.cardinality.RangeCardinalitySpec method*), 94
__str__() (*fastr.core.cardinality.ValueCardinalitySpec method*), 94
__str__() (*fastr.core.samples.SampleBaseId method*), 104
__str__() (*fastr.core.samples.SampleIndex method*), 106
__str__() (*fastr.core.tool.Tool method*), 112
__str__() (*fastr.core.version.Version method*), 115
__str__() (*fastr.datatypes.BaseDataType method*), 121
__str__() (*fastr.exceptions.FastrError method*), 81
__str__() (*fastr.exceptions.FastrExecutableNotFoundError method*), 81
__str__() (*fastr.exceptions.FastrScriptNotFoundError method*), 85
__str__() (*fastr.exceptions.FastrSerializationError method*), 85
__str__() (*fastr.execution.inputoutputrun.InputRun method*), 133
__str__() (*fastr.execution.inputoutputrun.NamedSubinputRun method*), 135
__str__() (*fastr.execution.inputoutputrun.OutputRun method*), 136
__str__() (*fastr.execution.inputoutputrun.SubInputRun method*), 139
__str__() (*fastr.execution.inputoutputrun.SubOutputRun method*), 141
__str__() (*fastr.execution.noderun.NodeRun method*), 159
__str__() (*fastr.helpers.schematotable.SchemaPrinter method*), 175
__str__() (*fastr.planning.inputoutput.Input method*), 186
__str__() (*fastr.planning.inputoutput.NamedSubInput method*), 188
__str__() (*fastr.planning.inputoutput.Output method*), 189
__str__() (*fastr.planning.inputoutput.SubInput method*), 192
__str__() (*fastr.planning.inputoutput.SubOutput method*), 194
__str__() (*fastr.planning.node.Node method*), 205
__subclasshook__() (*in module fastr.__init__*), 79
__updatefunc__() (*fastr.planning.inputgroup.InputGroup method*), 178
__updatetriggers__ (*fastr.planning.inputgroup.InputGroup attribute*), 178
__weakref__ (*fastr.core.cardinality.CardinalitySpec attribute*), 91
__weakref__ (*fastr.core.dimension.HasDimensions attribute*), 96
__weakref__ (*fastr.core.interface.InterfaceResult attribute*), 98
__weakref__ (*fastr.core.provenance.Provenance attribute*), 101
__weakref__ (*fastr.core.samples.SampleCollection attribute*), 105
__weakref__ (*fastr.core.samples.SampleValue attribute*), 109
__weakref__ (*fastr.core.target.ProcessUsageCollection attribute*), 109
__weakref__ (*fastr.core.target.TargetResult attribute*), 111
__weakref__ (*fastr.core.vfs.VirtualFileSystem at-*

tribute), 116
__weakref__ (*fastr.exceptions.FastrError attribute*), 81
__weakref__ (*fastr.exceptions.FastrIOError attribute*), 82
__weakref__ (*fastr.exceptions.FastrImportError attribute*), 82
__weakref__ (*fastr.exceptions.FastrOSError attribute*), 84
__weakref__ (*fastr.execution.environmentmodules.EnvironmentModules attribute*), 129
__weakref__ (*fastr.execution.networkanalyzer.NetworkAnalyzer attribute*), 155
__weakref__ (*fastr.execution.networkchunker.NetworkChunker attribute*), 156
__weakref__ (*fastr.helpers.classproperty.ClassPropertyDescriptor attribute*), 167
__weakref__ (*fastr.helpers.configmanager.Config attribute*), 167
__weakref__ (*fastr.helpers.configmanager.EmptyDefault attribute*), 169
__weakref__ (*fastr.helpers.filesynchelper.FileSyncHelper attribute*), 170
__weakref__ (*fastr.helpers.lockfile.DirectoryLock attribute*), 174
__weakref__ (*fastr.helpers.schematotable.SchemaPrinter attribute*), 175
__weakref__ (*fastr.plugins.managers.pluginmanager.PluginVisitor attribute*), 242
__weakref__ (*fastr.utils.cmd.upgrade.dummy_container attribute*), 248

A

abort() (*fastr.execution.networkrun.NetworkRun method*), 157
abstract (*fastr.core.vfs.VirtualFileSystem attribute*), 116
acquire() (*fastr.helpers.lockfile.DirectoryLock method*), 174
action() (*fastr.datatypes.DataType method*), 122
activate() (*fastr.plugins.ElasticsearchReporter method*), 214
activate() (*fastr.plugins.PimReporter method*), 225
activate() (*fastr.plugins.reportingplugin.ReportingPlugin method*), 236
activity() (*fastr.core.provenance.Provenance method*), 101
add_link() (*fastr.planning.network.Network method*), 198
add_node() (*fastr.planning.network.Network method*), 198
add_parser_doc_link() (*in module fastr.utils.cmd*), 245
add_stepid() (*fastr.planning.network.Network method*), 198
AdvancedFlowNode (*class in fastr.planning.node*), 201
AdvancedFlowNodeRun (*class in fastr.execution.flownoderun*), 130
AdvancedFlowOutput (*class in fastr.planning.inputoutput*), 181
AdvancedFlowOutputRun (*class in fastr.execution.inputoutputrun*), 131
agent() (*fastr.core.provenance.Provenance method*), 101
aggregate() (*fastr.core.target.ProcessUsageCollection method*), 109
all (*fastr.execution.job.JobCleanupLevel attribute*), 146
analyze_network() (*fastr.execution.networkanalyzer.DefaultNetworkAnalyzer method*), 155
analyze_network() (*fastr.execution.networkanalyzer.NetworkAnalyzer method*), 155
any_of_draft4() (*in module fastr.helpers.jsonschemaparser*), 172
AnyCardinalitySpec (*class in fastr.core.cardinality*), 90
AnyFile (*class in fastr.datatypes*), 120
AnyType (*class in fastr.datatypes*), 120
append() (*fastr.api.Input method*), 76
append() (*fastr.core.target.ProcessUsageCollection method*), 109
append() (*fastr.helpers.configmanager.EmptyDefault method*), 169
append() (*fastr.planning.inputoutput.Input method*), 186
as_dict() (*fastr.core.target.TargetResult method*), 111
AsCardinalitySpec (*class in fastr.core.cardinality*), 90
asdict() (*fastr.core.interface.InputSpec method*), 97
asdict() (*fastr.core.interface.OutputSpec method*), 98
asdict() (*fastr.helpers.configmanager.EmptyDefault method*), 169
aslist() (*fastr.helpers.configmanager.EmptyDefault method*), 169
authors (*fastr.core.tool.Tool attribute*), 112
automatic() (*fastr.execution.inputoutputrun.OutputRun property*), 136
automatic() (*fastr.planning.inputoutput.BaseOutput property*), 185
avail() (*fastr.execution.environmentmodules.EnvironmentModules method*), 129
avail_modules() (*fastr.execution.environmentmodules.EnvironmentModules property*), 129

B

BaseDataType (*class in fastr.datatypes*), 120
BaseInput (*class in fastr.planning.inputoutput*), 182
BaseInputGroupCombiner (*class in fastr.planning.inputgroupcombiner*), 179
BaseInputOutput (*class in fastr.planning.inputoutput*), 183
BaseInputRun (*class in fastr.execution.inputoutputrun*), 131
basename() (*in module fastr.data.url*), 118
BaseNode (*class in fastr.planning.node*), 201
BaseNodeRun (*class in fastr.execution.basenoderun*), 128
BaseOutput (*class in fastr.planning.inputoutput*), 184
blocking() (*fastr.execution.flownoderun.FlowNodeRun property*), 131
blocking() (*fastr.execution.noderun.NodeRun property*), 159
blocking() (*fastr.planning.inputoutput.BaseOutput property*), 185
blocking() (*fastr.planning.node.FlowNode property*), 203
blocking() (*fastr.planning.node.Node property*), 205
BlockingExecution (*class in fastr.plugins*), 209
build() (*fastr.core.version.Version property*), 115

C

calculate_execution_cardinality() (*fastr.core.cardinality.AsCardinalitySpec method*), 91
calculate_execution_cardinality() (*fastr.core.cardinality.CardinalitySpec method*), 92
calculate_execution_cardinality() (*fastr.core.cardinality.IntCardinalitySpec method*), 93
calculate_execution_cardinality() (*fastr.core.cardinality.ValueCardinalitySpec method*), 94
calculate_job_cardinality() (*fastr.core.cardinality.AsCardinalitySpec method*), 91
calculate_job_cardinality() (*fastr.core.cardinality.CardinalitySpec method*), 92
calculate_job_cardinality() (*fastr.core.cardinality.IntCardinalitySpec method*), 93
calculate_job_cardinality() (*fastr.core.cardinality.ValueCardinalitySpec method*), 94
calculate_planning_cardinality() (*fastr.core.cardinality.AsCardinalitySpec method*), 91
calculate_planning_cardinality() (*fastr.core.cardinality.CardinalitySpec method*), 92
calculate_planning_cardinality() (*fastr.core.cardinality.IntCardinalitySpec method*), 93
call_subprocess() (*fastr.core.target.SubprocessBasedTarget method*), 110
cancel (*fastr.plugins.executionplugin.JobAction attribute*), 236
cancel_job() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
cancelled (*fastr.execution.job.JobState attribute*), 149
CANCELS_DEPENDENCIES (*fastr.plugins.DRMAAExecution attribute*), 211
CANCELS_DEPENDENCIES (*fastr.plugins.executionplugin.ExecutionPlugin attribute*), 234
cardinality() (*fastr.core.samples.SampleItemBase property*), 107
cardinality() (*fastr.execution.inputoutputrun.InputRun method*), 133
cardinality() (*fastr.execution.inputoutputrun.OutputRun method*), 136
cardinality() (*fastr.execution.inputoutputrun.SourceOutputRun method*), 138
cardinality() (*fastr.execution.inputoutputrun.SubInputRun method*), 139
cardinality() (*fastr.execution.inputoutputrun.SubOutputRun method*), 141
cardinality() (*fastr.execution.linkrun.LinkRun method*), 153
cardinality() (*fastr.planning.inputoutput.BaseInputOutput method*), 183
cardinality() (*fastr.planning.inputoutput.Input method*), 186
cardinality() (*fastr.planning.inputoutput.Output method*), 190
cardinality() (*fastr.planning.inputoutput.SourceOutput method*), 190
cardinality() (*fastr.planning.inputoutput.SubInput method*), 192
cardinality() (*fastr.planning.inputoutput.SubOutput method*), 194
cardinality() (*fastr.planning.link.Link method*), 196
cardinality_from_nargs() (*in module fastr.utils.cmd.extract_argparse*), 246
CardinalitySpec (*class in fastr.core.cardinality*), 91
cast() (*fastr.core.samples.SampleValue method*), 109
cast_to_type() (*fastr.execution.job.Job static method*), 143

check_cardinality() (*fastr.planning.inputoutput.BaseInput method*), 182
check_cardinality() (*fastr.planning.inputoutput.BaseInputOutput method*), 184
check_id() (*fastr.execution.networkrun.NetworkRun method*), 157
check_id() (*fastr.planning.network.Network method*), 199
check_input_id() (*fastr.plugins.FastrInterface method*), 216
check_job_requirements() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
check_job_status() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
check_network() (*in module fastr.utils.cmd.test*), 247
check_networks() (*in module fastr.utils.cmd.test*), 247
check_nr_queued_jobs() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
check_output_id() (*fastr.plugins.FastrInterface method*), 216
check_threads() (*fastr.plugins.DRMAAExecution method*), 212
check_tool() (*in module fastr.utils.cmd.test*), 247
check_tools() (*in module fastr.utils.cmd.test*), 247
checksum() (*fastr.datatypes.BaseDataType method*), 121
checksum() (*fastr.datatypes.Deferred method*), 125
checksum() (*fastr.datatypes.URLType method*), 127
checksum() (*in module fastr.helpers.checksum*), 165
checksum_directory() (*in module fastr.helpers.checksum*), 166
ChoiceCardinalitySpec (*class in fastr.core.cardinality*), 92
chunck_network() (*fastr.execution.networkchunker.DefaultNetworkChunker method*), 155
chunck_network() (*fastr.execution.networkchunker.NetworkChunker method*), 156
cite (*fastr.core.tool.Tool attribute*), 113
classproperty() (*in module fastr.helpers.classproperty*), 167
ClassPropertyDescriptor (*class in fastr.helpers.classproperty*), 166
clean() (*fastr.execution.job.Job method*), 144
clean_free_jobs() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
cleanup() (*fastr.core.ioplugin.IOPlugin method*), 99
cleanup() (*fastr.plugins.BlockingExecution method*), 209
cleanup() (*fastr.plugins.DRMAAExecution method*), 212
cleanup() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
cleanup() (*fastr.plugins.LinearExecution method*), 220
cleanup() (*fastr.plugins.managers.iopluginmanager.IOPluginManager method*), 238
cleanup() (*fastr.plugins.ProcessPoolExecution method*), 225
cleanup() (*fastr.plugins.S3Filesystem method*), 226
cleanup() (*fastr.plugins.XNATStorage method*), 232
clear() (*fastr.execution.environmentmodules.EnvironmentModules method*), 129
clear() (*fastr.planning.inputoutput.Input method*), 186
clear_version() (*in module fastr.version*), 88
collapse() (*fastr.api.Link property*), 75
collapse() (*fastr.execution.linkrun.LinkRun property*), 153
collapse() (*fastr.planning.link.Link property*), 196
collapse_indexes() (*fastr.execution.linkrun.LinkRun property*), 153
collapse_indexes() (*fastr.planning.link.Link property*), 196
collect_errors() (*fastr.plugins.FastrInterface static method*), 216
collect_input_argument_provenance() (*fastr.core.provenance.Provenance method*), 101
collect_jobs() (*fastr.plugins.DRMAAExecution method*), 212
collect_provenance() (*fastr.core.provenance.Provenance method*), 101
collect_provenance() (*fastr.execution.job.InlineJob method*), 142
collect_provenance() (*fastr.execution.job.Job method*), 144
collect_provenance() (*fastr.execution.job.SourceJob method*), 151
collect_results() (*fastr.plugins.FastrInterface method*), 216
collector_plugin_type (*fastr.plugins.FastrInterface attribute*), 216
collectors (*fastr.plugins.FastrInterface attribute*), 216
combine() (*fastr.core.samples.SampleItemBase static method*), 107
combine_dimensions() (*fastr.core.dimension.ForwardsDimensions method*), 96

command (*fastr.core.tool.Tool attribute*), 113
COMMAND_DUMP (*fastr.execution.job.Job attribute*), 143
command_version() (*fastr.core.tool.Tool property*), 113
commandfile() (*fastr.execution.job.Job property*), 144
commandurl() (*fastr.execution.job.Job property*), 144
CommaSeperatedValueFile (*class in fastr.plugins*), 210
compare_execution_dir() (*in module fastr.utils.compare*), 243
compare_job_dirs() (*in module fastr.utils.compare*), 243
compare_job_output_data() (*in module fastr.utils.compare*), 243
compare_output_data() (*fastr.core.tool.Tool static method*), 113
compare_set() (*in module fastr.utils.compare*), 243
compare_value_dict_item() (*in module fastr.utils.compare*), 243
compare_value_list() (*in module fastr.utils.compare*), 243
Config (*class in fastr.helpers.configmanager*), 167
config (*in module fastr.helpers*), 165
configuration_fields (*fastr.plugins.DRMAAExecution attribute*), 212
configuration_fields (*fastr.plugins.ElasticsearchReporter attribute*), 214
configuration_fields (*fastr.plugins.PimReporter attribute*), 225
configuration_fields (*fastr.plugins.ProcessPoolExecution attribute*), 225
connect() (*fastr.plugins.XNATStorage method*), 232
constant_id() (*fastr.planning.inputoutput.BaseInput method*), 182
constant_id() (*fastr.planning.inputoutput.Input property*), 186
constant_id() (*fastr.planning.inputoutput.NamedSubInput property*), 188
constant_id() (*fastr.planning.inputoutput.SubInput property*), 192
constantlist() (*fastr.execution.networkrun.NetworkRun property*), 157
ConstantNode (*class in fastr.planning.node*), 202
ConstantNodeRun (*class in fastr.execution.sourcenoderun*), 163
container() (*fastr.plugins.DockerTarget property*), 213
ContainsSamples (*class in fastr.core.samples*), 103
content() (*fastr.datatypes.URLType class method*), 127
copy() (*fastr.api.ResourceLimit method*), 89
copy() (*fastr.core.dimension.Dimension method*), 96
copy() (*fastr.core.resourcelimit.ResourceLimit method*), 102
copy_file_dir() (*fastr.core.vfs.VirtualFileSystem static method*), 116
cores() (*fastr.api.ResourceLimit property*), 89
cores() (*fastr.core.resourcelimit.ResourceLimit property*), 102
cpu_percent() (*fastr.core.target.SystemUsageInfo property*), 110
create_cardinality() (*in module fastr.core.cardinality*), 95
create_constant() (*fastr.api.Network method*), 72
create_constant() (*fastr.planning.network.Network method*), 199
create_enumtype() (*fastr.datatypes.DataTypeManager method*), 123
create_ioplugin_tool() (*fastr.plugins.managers.iopluginmanager.IOPluginManager static method*), 238
create_job() (*fastr.execution.noderun.NodeRun method*), 159
create_job() (*fastr.execution.sinknoderun.SinkNodeRun method*), 161
create_job() (*fastr.execution.sourcenoderun.SourceNodeRun method*), 164
create_link() (*fastr.api.Network method*), 72
create_link() (*fastr.planning.network.Network method*), 199
create_link_from() (*fastr.planning.inputoutput.BaseInput method*), 182
create_macro() (*fastr.api.Network method*), 73
create_macro() (*fastr.planning.network.Network method*), 199
create_native_spec() (*fastr.plugins.DRMAAExecution method*), 212
create_network() (*in module fastr.api*), 72, 89
create_network_copy() (*in module fastr.api*), 72, 89
create_network_parser() (*in module fastr.utils.cmd.run*), 247
create_node() (*fastr.api.Network method*), 73
create_node() (*fastr.planning.network.Network method*), 199
create_payload() (*fastr.execution.job.Job method*), 144
create_payload() (*fastr.execution.job.SinkJob method*), 150
create_reference() (*fastr.core.tool.Tool method*),

113
create_reference() (*fastr.planning.network.Network method*), 200
create_rest_table() (*in module fastr.helpers.rest_generation*), 175
create_sink() (*fastr.api.Network method*), 73
create_sink() (*fastr.planning.network.Network method*), 200
create_source() (*fastr.api.Network method*), 73
create_source() (*fastr.planning.network.Network method*), 200
create_vfs_url() (*in module fastr.data.url*), 118
create_zip() (*in module fastr.utils.cmd.dump*), 246
created (*fastr.execution.job.JobState attribute*), 149
createobj() (*fastr.execution.linkrun.LinkRun class method*), 153
createobj() (*fastr.execution.noderun.NodeRun class method*), 159
createobj() (*fastr.planning.link.Link class method*), 196
createobj() (*fastr.planning.node.Node class method*), 205
CrossValidation (*class in fastr.plugins*), 211

D

data() (*fastr.core.samples.SampleItemBase property*), 107
data() (*fastr.execution.sourcenoderun.ConstantNodeRun property*), 163
data() (*fastr.planning.node.ConstantNode property*), 202
data() (*fastr.plugins.managers.pluginmanager.PluginSubManager property*), 241
data_uri() (*fastr.core.provenance.Provenance static method*), 101
DataType (*class in fastr.datatypes*), 122
datatype() (*fastr.execution.inputoutputrun.InputRun property*), 133
datatype() (*fastr.execution.inputoutputrun.OutputRun property*), 136
datatype() (*fastr.execution.inputoutputrun.SubOutputRun property*), 141
datatype() (*fastr.execution.sinknoderun.SinkNodeRun property*), 161
datatype() (*fastr.execution.sourcenoderun.SourceNodeRun property*), 165
datatype() (*fastr.planning.inputoutput.BaseInputOutput property*), 184
datatype() (*fastr.planning.inputoutput.Input property*), 186
datatype() (*fastr.planning.inputoutput.Output property*), 190
datatype() (*fastr.planning.inputoutput.SubOutput property*), 194
datatype() (*fastr.planning.node.SinkNode property*), 207
datatype() (*fastr.planning.node.SourceNode property*), 208
datatype_from_type() (*in module fastr.utils.cmd.extract_argparse*), 246
DataTypeManager (*class in fastr.datatypes*), 123
date_version_matcher (*fastr.core.version.Version attribute*), 115
deactivate() (*fastr.plugins.reportingplugin.ReportingPlugin method*), 236
debug() (*fastr.helpers.configmanager.Config property*), 167
default() (*fastr.planning.inputoutput.BaseInput property*), 182
DEFAULT_FIELDS (*fastr.helpers.configmanager.Config attribute*), 167
DEFAULT_TARGET_CLASS (*fastr.core.tool.Tool attribute*), 112
DefaultInputGroupCombiner (*class in fastr.planning.inputgroupcombiner*), 180
DefaultNetworkAnalyzer (*class in fastr.execution.networkanalyzer*), 155
DefaultNetworkChunker (*class in fastr.execution.networkchunker*), 155
Deferred (*class in fastr.datatypes*), 125
dependencies() (*fastr.planning.network.Network method*), 200
descend() (*fastr.helpers.schematotable.SchemaPrinter method*), 175
description (*fastr.core.tool.Tool attribute*), 113
description (*fastr.datatypes.AnyFile attribute*), 120
description (*fastr.datatypes.AnyType attribute*), 120
description (*fastr.datatypes.BaseDataType attribute*), 121
description (*fastr.datatypes.EnumType attribute*), 126
description() (*fastr.execution.inputoutputrun.SubInputRun property*), 139
description() (*fastr.planning.inputoutput.BaseInputOutput property*), 184
description() (*fastr.planning.inputoutput.SubInput property*), 192
description_type (*fastr.planning.inputoutput.BaseInput attribute*), 182
description_type (*fastr.planning.inputoutput.BaseInputOutput attribute*), 184
description_type (*fastr.planning.inputoutput.BaseOutput attribute*), 185
deserialize() (*fastr.datatypes.DataType class method*), 122
destroy() (*fastr.execution.linkrun.LinkRun method*),

153
destroy() (*fastr.planning.link.Link method*), 197
dicteq() (*in module fastr.utils.dicteq*), 244
diffdict() (*in module fastr.utils.dicteq*), 244
diffobj() (*in module fastr.utils.dicteq*), 244
diffobj_str() (*in module fastr.utils.dicteq*), 244
Dimension (*class in fastr.core.dimension*), 95
dimensionality() (*fastr.core.samples.SampleItemBase property*), 107
dimensions() (*fastr.core.dimension.ForwardsDimensions property*), 96
dimensions() (*fastr.core.dimension.HasDimensions property*), 96
dimensions() (*fastr.core.samples.ContainsSamples property*), 103
dimensions() (*fastr.core.samples.SampleCollection property*), 105
dimensions() (*fastr.execution.inputoutputrun.InputRun property*), 133
dimensions() (*fastr.execution.inputoutputrun.MacroOutputRun property*), 134
dimensions() (*fastr.execution.inputoutputrun.SourceOutputRun property*), 138
dimensions() (*fastr.execution.inputoutputrun.SubInputRun property*), 139
dimensions() (*fastr.execution.linkrun.LinkRun property*), 153
dimensions() (*fastr.planning.inputgroup.InputGroup property*), 178
dimensions() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner property*), 179
dimensions() (*fastr.planning.inputoutput.AdvancedFlowOutput property*), 181
dimensions() (*fastr.planning.inputoutput.Input property*), 186
dimensions() (*fastr.planning.inputoutput.MacroOutput property*), 188
dimensions() (*fastr.planning.inputoutput.Output property*), 190
dimensions() (*fastr.planning.inputoutput.SubInput property*), 192
dimensions() (*fastr.planning.link.Link property*), 197
dimensions() (*fastr.planning.node.FlowNode property*), 203
dimensions() (*fastr.planning.node.Node property*), 206
dimensions() (*fastr.planning.node.SourceNode property*), 208
dimnames() (*fastr.core.dimension.HasDimensions property*), 96
dimnames() (*fastr.execution.flownoderun.FlowNodeRun property*), 131
dimnames() (*fastr.execution.noderun.NodeRun property*), 160
dimnames() (*fastr.execution.sourcenoderun.SourceNodeRun property*), 165
dimnames() (*fastr.planning.node.Node property*), 206
dir_list() (*in module fastr.helpers.clear_pycs*), 167
directory() (*in module fastr.utils.cmd.test*), 247
DirectoryLock (*class in fastr.helpers.lockfile*), 174
dirname() (*in module fastr.data.url*), 119
dirurl() (*in module fastr.data.url*), 119
dispatch_callbacks() (*fastr.plugins.DRMAAExecution method*), 212
DockerTarget (*class in fastr.plugins*), 212
done() (*fastr.execution.job.JobState property*), 149
dot_extension (*fastr.datatypes.BaseDataType attribute*), 121
draw() (*fastr.api.Network method*), 74
draw() (*fastr.planning.link.Link method*), 197
draw() (*fastr.planning.network.Network method*), 200
draw() (*fastr.planning.node.ConstantNode method*), 202
draw() (*fastr.planning.node.MacroNode method*), 204
draw() (*fastr.planning.node.Node method*), 206
draw() (*fastr.planning.node.SinkNode method*), 208
draw() (*fastr.planning.node.SourceNode method*), 208
draw_id() (*fastr.planning.node.Node method*), 206
draw_link_target() (*fastr.planning.node.MacroNode method*), 204
draw_link_target() (*fastr.planning.node.Node method*), 206
draw_network() (*fastr.planning.network.Network method*), 200
DRMAAExecution (*class in fastr.plugins*), 211
dummy_container (*class in fastr.utils.cmd.upgrade*), 248
dump() (*in module fastr.helpers.xmltodict*), 177
dumps() (*in module fastr.helpers.xmltodict*), 177
DYNAMIC_LIBRARY_PATH_DICT (*fastr.plugins.LocalBinaryTarget attribute*), 222

E

elasticsearch_update_status() (*fastr.plugins.ElasticsearchReporter method*), 214
ElasticsearchReporter (*class in fastr.plugins*), 213
emit() (*fastr.helpers.events.FastrLogEventHandler method*), 170
emit_event() (*in module fastr.helpers.events*), 170
empty() (*fastr.planning.inputgroup.InputGroup property*), 178
EmptyDefault (*class in fastr.helpers.configmanager*), 169

ensure_threads() (*fastr.plugins.DRMAAExecution method*), 212
ensure_tmp_dir() (*fastr.execution.job.Job method*), 144
entity() (*fastr.core.provenance.Provenance method*), 101
EnumType (*class in fastr.datatypes*), 126
EnvironmentModules (*class in fastr.execution.environmentmodules*), 129
envmod (*fastr.execution.environmentmodules.ModuleSystem attribute*), 130
EventType (*class in fastr.helpers.events*), 169
examplesdir() (*fastr.helpers.configmanager.Config property*), 167
excerpt() (*fastr.exceptions.FastrError method*), 81
exec_worker() (*fastr.plugins.LinearExecution method*), 220
execute() (*fastr.api.Network method*), 74
execute() (*fastr.core.interface.Interface method*), 97
execute() (*fastr.core.tool.Tool method*), 113
execute() (*fastr.execution.flownoderun.AdvancedFlowNodeRun method*), 130
execute() (*fastr.execution.job.Job method*), 144
execute() (*fastr.execution.macronoderun.MacroNodeRun method*), 154
execute() (*fastr.execution.networkrun.NetworkRun method*), 157
execute() (*fastr.execution.noderun.NodeRun method*), 160
execute() (*fastr.execution.sinknoderun.SinkNodeRun method*), 161
execute() (*fastr.execution.sourcenoderun.ConstantNodeRun method*), 163
execute() (*fastr.execution.sourcenoderun.SourceNodeRun method*), 165
execute() (*fastr.planning.network.Network method*), 200
execute() (*fastr.plugins.CrossValidation static method*), 211
execute() (*fastr.plugins.FastrInterface method*), 216
execute() (*fastr.plugins.FlowInterface method*), 219
execute() (*fastr.plugins.NipypeInterface method*), 223
execute_job() (*in module fastr.execution.executionscript*), 130
execution_done (*fastr.execution.job.JobState attribute*), 149
execution_failed (*fastr.execution.job.JobState attribute*), 149
execution_finished() (*fastr.execution.networkrun.NetworkRun method*), 158
execution_plugin() (*fastr.helpers.configmanager.Config property*), 167
ExecutionPlugin (*class in fastr.plugins.executionplugin*), 233
ExecutionPluginManager (*class in fastr.plugins.managers.executionpluginmanager*), 237
executionscript() (*fastr.helpers.configmanager.Config property*), 167
expand() (*fastr.api.Link property*), 75
expand() (*fastr.core.samples.SampleIndex method*), 106
expand() (*fastr.execution.linkrun.LinkRun property*), 154
expand() (*fastr.planning.link.Link property*), 197
expand_url() (*fastr.core.ioplugin.IOPlugin method*), 99
expand_url() (*fastr.core.vfs.VirtualFileSystem method*), 116
expand_url() (*fastr.plugins.CommaSeperatedValueFile method*), 210
expand_url() (*fastr.plugins.managers.iopluginmanager.IOPluginMana method*), 238
expand_url() (*fastr.plugins.S3Filesystem method*), 227
expand_url() (*fastr.plugins.VirtualFileSystemRegularExpression method*), 230
expand_url() (*fastr.plugins.VirtualFileSystemValueList method*), 230
expand_url() (*fastr.plugins.XNATStorage method*), 232
expanding() (*fastr.core.interface.Interface property*), 98
expanding() (*fastr.plugins.FastrInterface property*), 216
expanding() (*fastr.plugins.FlowInterface property*), 219
expanding() (*fastr.plugins.NipypeInterface property*), 224
extend() (*fastr.helpers.configmanager.EmptyDefault method*), 169
extend() (*in module fastr.helpers.jsonschemaparser*), 172
extension (*fastr.datatypes.BaseDataType attribute*), 121
extra() (*fastr.core.version.Version property*), 115
extra_config_dirs() (*fastr.helpers.configmanager.Config property*), 167
extra_string() (*fastr.core.version.Version property*), 115
extract_argparser() (*in module fastr.utils.cmd.extract_argparse*), 246
extrainfofile() (*fastr.execution.job.Job property*), 144

extrainfourl() (*fastr.execution.job.Job property*), 144

F

failed (*fastr.execution.job.JobState attribute*), 149
failed_annotations() (*fastr.core.samples.SampleItemBase property*), 107
fastr.__init__
    module, 79
fastr.api
    module, 88
fastr.core
    module, 90
fastr.core.cardinality
    module, 90
fastr.core.dimension
    module, 95
fastr.core.interface
    module, 97
fastr.core.ioplugin
    module, 99
fastr.core.provenance
    module, 101
fastr.core.resourcelimit
    module, 102
fastr.core.samples
    module, 103
fastr.core.target
    module, 109
fastr.core.test
    module, 118
fastr.core.tool
    module, 112
fastr.core.version
    module, 114
fastr.core.vfs
    module, 116
fastr.data
    module, 118
fastr.data.url
    module, 118
fastr.datatypes
    module, 120
fastr.exceptions
    module, 80
fastr.execution
    module, 128
fastr.execution.basenoderun
    module, 128
fastr.execution.environmentmodules
    module, 129
fastr.execution.executionscript
    module, 130
fastr.execution.flownoderun
    module, 130
fastr.execution.inputoutputrun
    module, 131
fastr.execution.job
    module, 142
fastr.execution.linkrun
    module, 151
fastr.execution.macronoderun
    module, 154
fastr.execution.networkanalyzer
    module, 155
fastr.execution.networkchunker
    module, 155
fastr.execution.networkrun
    module, 156
fastr.execution.noderun
    module, 158
fastr.execution.sinknoderun
    module, 161
fastr.execution.sourcenoderun
    module, 163
fastr.helpers
    module, 165
fastr.helpers.checksum
    module, 165
fastr.helpers.classproperty
    module, 166
fastr.helpers.clear_pycs
    module, 167
fastr.helpers.configmanager
    module, 167
fastr.helpers.events
    module, 169
fastr.helpers.filesynchelper
    module, 170
fastr.helpers.iohelpers
    module, 171
fastr.helpers.jsonschemaparser
    module, 171
fastr.helpers.lazy_module
    module, 173
fastr.helpers.lockfile
    module, 174
fastr.helpers.procutils
    module, 174
fastr.helpers.report
    module, 175
fastr.helpers.rest_generation
    module, 175
fastr.helpers.schematotable
    module, 175
fastr.helpers.shellescape
    module, 176

fastr.helpers.sysinfo
    module, 176
fastr.helpers.xmltodict
    module, 177
fastr.planning
    module, 178
fastr.planning.inputgroup
    module, 178
fastr.planning.inputgroupcombiner
    module, 179
fastr.planning.inputoutput
    module, 181
fastr.planning.link
    module, 195
fastr.planning.network
    module, 197
fastr.planning.node
    module, 201
fastr.plugins
    module, 209
fastr.plugins.executionplugin
    module, 233
fastr.plugins.managers
    module, 237
fastr.plugins.managers.executionpluginmanager
    module, 237
fastr.plugins.managers.interfacemanager
    module, 237
fastr.plugins.managers.iopluginmanager
    module, 237
fastr.plugins.managers.networkmanager
    module, 239
fastr.plugins.managers.objectmanager
    module, 239
fastr.plugins.managers.pluginmanager
    module, 240
fastr.plugins.managers.targetmanager
    module, 242
fastr.plugins.managers.toolmanager
    module, 242
fastr.plugins.reportingplugin
    module, 236
fastr.test
    module, 243
fastr.utils
    module, 243
fastr.utils.cmd
    module, 245
fastr.utils.cmd.cat
    module, 245
fastr.utils.cmd.dump
    module, 246
fastr.utils.cmd.execute
    module, 246
fastr.utils.cmd.extract_argparse
    module, 246
fastr.utils.cmd.provenance
    module, 246
fastr.utils.cmd.pylint
    module, 246
fastr.utils.cmd.report
    module, 247
fastr.utils.cmd.run
    module, 247
fastr.utils.cmd.sink
    module, 247
fastr.utils.cmd.source
    module, 247
fastr.utils.cmd.test
    module, 247
fastr.utils.cmd.trace
    module, 248
fastr.utils.cmd.upgrade
    module, 248
fastr.utils.cmd.verify
    module, 249
fastr.utils.compare
    module, 243
fastr.utils.dicteq
    module, 244
fastr.utils.gettools
    module, 245
fastr.utils.multiprocesswrapper
    module, 245
fastr.utils.verify
    module, 245
fastr.version
    module, 88
fastr_cat() (*in module fastr.utils.cmd.cat*), 245
fastr_isinstance() (*in module fastr.datatypes*), 128
FastrAttributeError, 80
FastrCannotChangeAttributeError, 80
FastrCardinalityError, 80
FastrCollectorError, 80
FastrDataTypeFileNotReadable, 80
FastrDataTypeMismatchError, 80
FastrDataTypeNotAvailableError, 80
FastrDataTypeNotInstantiableError, 80
FastrDataTypeValueError, 80
FastrError, 81
FastrErrorInSubprocess, 81
FastrExecutableNotFoundError, 81
FastrExecutionError, 81
FastrFileNotFound, 81
FastrImportError, 82
FastrIndexError, 82
FastrIndexNonexistent, 82

FastrInterface (*class in fastr.plugins*), 214
FastrIOError, 82
FastrKeyError, 82
FastrLockNotAcquired, 82
FastrLogEventHandler (*class in fastr.helpers.events*), 170
FastrLookupError, 82
FastrMountUnknownError, 83
FastrNamespaceType (*class in fastr.utils.cmd.upgrade*), 248
FastrNetworkMismatchError, 83
FastrNetworkUnknownError, 83
FastrNodeAreadyPreparedError, 83
FastrNodeNotPreparedError, 83
FastrNodeNotValidError, 83
FastrNotExecutableError, 83
FastrNotImplementedError, 83
FastrNoValidTargetError, 83
FastrObjectUnknownError, 84
FastrOptionalModuleNotAvailableError, 84
FastrOSError, 84
FastrOutputValidationError, 84
FastrParentMismatchError, 84
FastrPluginCapabilityNotImplemented, 84
FastrPluginNotAvailable, 84
FastrPluginNotLoaded, 84
FastrRefResolver (*class in fastr.helpers.jsonschemaparser*), 171
FastrResultFileNotFound, 84
FastrScriptNotFoundError, 85
FastrSerializationError, 85
FastrSerializationIgnoreDefaultError, 85
FastrSerializationInvalidDataError, 85
FastrSerializationMethodError, 85
FastrSinkDataUnavailableError, 86
FastrSizeInvalidError, 86
FastrSizeMismatchError, 86
FastrSizeUnknownError, 86
FastrSourceDataUnavailableError, 86
FastrStateError, 86
FastrSubprocessNotFinished, 86
FastrToolNotAvailableError, 86
FastrToolTargetNotFound, 86
FastrToolUnknownError, 87
FastrToolVersionError, 87
FastrTypeError, 87
FastrUnknownURLSchemeError, 87
FastrValueError, 87
FastrVersionInvalidError, 87
FastrVersionMismatchError, 87
fetch_url() (*fastr.core.ioplugin.IOPlugin method*), 99
fetch_url() (*fastr.core.vfs.VirtualFileSystem method*), 117
fetch_url() (*fastr.plugins.FileSystem method*), 217
fetch_url() (*fastr.plugins.HTTPPlugin method*), 220
fetch_url() (*fastr.plugins.S3Filesystem method*), 227
fetch_url() (*fastr.plugins.XNATStorage method*), 233
fetch_value() (*fastr.core.ioplugin.IOPlugin method*), 99
fetch_value() (*fastr.core.vfs.VirtualFileSystem method*), 117
fetch_value() (*fastr.plugins.FileSystem method*), 217
fetch_value() (*fastr.plugins.S3Filesystem method*), 227
filename (*fastr.datatypes.BaseDataType attribute*), 121
filename (*fastr.plugins.BlockingExecution attribute*), 209
filename (*fastr.plugins.CommaSeperatedValueFile attribute*), 211
filename (*fastr.plugins.CrossValidation attribute*), 211
filename (*fastr.plugins.DockerTarget attribute*), 213
filename (*fastr.plugins.DRMAAExecution attribute*), 212
filename (*fastr.plugins.ElasticsearchReporter attribute*), 214
filename (*fastr.plugins.FastrInterface attribute*), 217
filename (*fastr.plugins.FileSystem attribute*), 218
filename (*fastr.plugins.FlowInterface attribute*), 219
filename (*fastr.plugins.HTTPPlugin attribute*), 220
filename (*fastr.plugins.LinearExecution attribute*), 220
filename (*fastr.plugins.LocalBinaryTarget attribute*), 222
filename (*fastr.plugins.MacroTarget attribute*), 223
filename (*fastr.plugins.NipypeInterface attribute*), 224
filename (*fastr.plugins.Null attribute*), 224
filename (*fastr.plugins.PimReporter attribute*), 225
filename (*fastr.plugins.ProcessPoolExecution attribute*), 225
filename (*fastr.plugins.Reference attribute*), 226
filename (*fastr.plugins.S3Filesystem attribute*), 227
filename (*fastr.plugins.SimpleReport attribute*), 227
filename (*fastr.plugins.SingularityTarget attribute*), 228
filename (*fastr.plugins.VirtualFileSystem attribute*), 229
filename (*fastr.plugins.VirtualFileSystemRegularExpression attribute*), 230
filename (*fastr.plugins.VirtualFileSystemValueList attribute*), 230
filename (*fastr.plugins.XNATStorage attribute*), 233
FileSyncHelper (*class in*

fastr.helpers.filesynchelper), 170
filesynchelper_enabled() (*in module fastr.helpers.filesynchelper*), 171
filesynchelper_url() (*fastr.helpers.configmanager.Config property*), 168
FileSystem (*class in fastr.plugins*), 217
fill_output_argument() (*fastr.execution.job.Job class method*), 144
filter_plugin() (*fastr.plugins.managers.pluginmanager.PluginSpec method*), 242
find_argparser() (*in module fastr.utils.cmd.extract_argparse*), 246
find_commands() (*in module fastr.utils.cmd*), 245
find_source_index() (*fastr.execution.noderun.NodeRun method*), 160
find_source_index() (*fastr.planning.inputgroup.InputGroup method*), 179
find_source_index() (*fastr.planning.node.Node method*), 206
find_tool() (*in module fastr.utils.cmd.upgrade*), 248
finished (*fastr.execution.job.JobState attribute*), 149
flow_plugin_type (*fastr.plugins.FlowInterface attribute*), 219
flow_plugins (*fastr.plugins.FlowInterface attribute*), 219
FlowInterface (*class in fastr.plugins*), 218
FlowNode (*class in fastr.planning.node*), 203
FlowNodeRun (*class in fastr.execution.flownoderun*), 131
ForwardsDimensions (*class in fastr.core.dimension*), 96
from_schema() (*fastr.helpers.jsonschemaparser.FastrRefResolver class method*), 171
full_split() (*in module fastr.data.url*), 119
fullid (*fastr.datatypes.BaseDataType attribute*), 121
fullid() (*fastr.core.samples.SampleCollection property*), 105
fullid() (*fastr.core.tool.Tool property*), 113
fullid() (*fastr.datatypes.DataTypeManager property*), 123
fullid() (*fastr.execution.inputoutputrun.InputRun property*), 133
fullid() (*fastr.execution.inputoutputrun.NamedSubinputRun property*), 135
fullid() (*fastr.execution.inputoutputrun.OutputRun property*), 136
fullid() (*fastr.execution.inputoutputrun.SubInputRun property*), 139
fullid() (*fastr.execution.inputoutputrun.SubOutputRun property*), 142
fullid() (*fastr.execution.job.Job property*), 144
fullid() (*fastr.execution.linkrun.LinkRun property*), 154
fullid() (*fastr.execution.networkrun.NetworkRun property*), 158
fullid() (*fastr.execution.noderun.NodeRun property*), 160
fullid() (*fastr.planning.inputgroup.InputGroup property*), 179
fullid() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner property*), 179
fullid() (*fastr.planning.inputoutput.BaseInputOutput property*), 184
fullid() (*fastr.planning.inputoutput.Input property*), 186
fullid() (*fastr.planning.inputoutput.NamedSubInput property*), 188
fullid() (*fastr.planning.inputoutput.Output property*), 190
fullid() (*fastr.planning.inputoutput.SubInput property*), 192
fullid() (*fastr.planning.inputoutput.SubOutput property*), 194
fullid() (*fastr.planning.link.Link property*), 197
fullid() (*fastr.planning.network.Network property*), 200
fullid() (*fastr.planning.node.Node property*), 206
function_wrapper() (*in module fastr.utils.multiprocesswrapper*), 245

G

GE_NATIVE_SPEC (*fastr.plugins.DRMAAExecution attribute*), 211
generate_jobs() (*fastr.execution.networkrun.NetworkRun method*), 158
get_arguments() (*fastr.plugins.FastrInterface method*), 217
get_base_version() (*in module fastr.version*), 88
get_command() (*fastr.plugins.FastrInterface method*), 217
get_command_module() (*in module fastr.utils.cmd*), 245
get_cpu_usage() (*in module fastr.helpers.sysinfo*), 176
get_deferred() (*fastr.execution.job.Job method*), 144
get_drmaa_info() (*in module fastr.helpers.sysinfo*), 176
get_field() (*fastr.helpers.configmanager.Config method*), 168
get_hg_info() (*in module fastr.version*), 88
get_hostinfo() (*in module fastr.helpers.sysinfo*), 176
get_job() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235

get_memory_usage() (*in module fastr.helpers.sysinfo*), 176
get_message() (*in module fastr.exceptions*), 87
get_mounts() (*in module fastr.helpers.sysinfo*), 176
get_object_version() (*fastr.plugins.managers.networkmanager.NetworkManager method*), 239
get_object_version() (*fastr.plugins.managers.objectmanager.ObjectManager method*), 240
get_object_version() (*fastr.plugins.managers.toolmanager.ToolManager method*), 242
get_ordereddict_cardinality() (*fastr.core.cardinality.AsCardinalitySpec method*), 91
get_os() (*in module fastr.helpers.sysinfo*), 176
get_output_datatype() (*fastr.execution.job.Job method*), 145
get_output_datatype() (*fastr.execution.job.SourceJob method*), 151
get_output_info() (*fastr.execution.macronoderun.MacroNodeRun method*), 155
get_output_info() (*fastr.planning.node.MacroNode method*), 204
get_parent_provenance() (*fastr.core.provenance.Provenance static method*), 101
get_parser() (*in module fastr.utils.cmd.cat*), 245
get_parser() (*in module fastr.utils.cmd.dump*), 246
get_parser() (*in module fastr.utils.cmd.execute*), 246
get_parser() (*in module fastr.utils.cmd.extract_argparse*), 246
get_parser() (*in module fastr.utils.cmd.provenance*), 246
get_parser() (*in module fastr.utils.cmd.pylint*), 246
get_parser() (*in module fastr.utils.cmd.report*), 247
get_parser() (*in module fastr.utils.cmd.run*), 247
get_parser() (*in module fastr.utils.cmd.sink*), 247
get_parser() (*in module fastr.utils.cmd.source*), 247
get_parser() (*in module fastr.utils.cmd.test*), 247
get_parser() (*in module fastr.utils.cmd.trace*), 248
get_parser() (*in module fastr.utils.cmd.upgrade*), 248
get_parser() (*in module fastr.utils.cmd.verify*), 249
get_path_from_url() (*in module fastr.data.url*), 119
get_processes() (*in module fastr.helpers.sysinfo*), 176
get_prov_document() (*in module fastr.utils.cmd.provenance*), 246
get_python() (*in module fastr.helpers.sysinfo*), 177
get_result() (*fastr.execution.job.InlineJob method*), 142
get_result() (*fastr.execution.job.Job method*), 145
get_result() (*fastr.execution.job.SinkJob method*), 150
get_served_version() (*in module fastr.version*), 88
get_sourced_nodes() (*fastr.execution.inputoutputrun.InputRun method*), 133
get_sourced_nodes() (*fastr.execution.inputoutputrun.SubInputRun method*), 139
get_sourced_nodes() (*fastr.execution.noderun.NodeRun method*), 160
get_sourced_nodes() (*fastr.planning.inputoutput.Input method*), 186
get_sourced_nodes() (*fastr.planning.inputoutput.SubInput method*), 192
get_sourced_nodes() (*fastr.planning.node.Node method*), 206
get_sourced_outputs() (*fastr.execution.inputoutputrun.InputRun method*), 133
get_sourced_outputs() (*fastr.execution.inputoutputrun.SubInputRun method*), 139
get_sourced_outputs() (*fastr.planning.inputoutput.Input method*), 187
get_sourced_outputs() (*fastr.planning.inputoutput.SubInput method*), 192
get_specials() (*fastr.plugins.FastrInterface method*), 217
get_status() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
get_subinput_cardinality() (*fastr.execution.inputoutputrun.InputRun method*), 133
get_sysinfo() (*in module fastr.helpers.sysinfo*), 177
get_target() (*fastr.core.cardinality.AsCardinalitySpec method*), 91
get_type() (*fastr.datatypes.DataTypeManager method*), 123
get_type() (*fastr.plugins.NipypeInterface method*), 224
get_url_scheme() (*in module fastr.data.url*), 119
get_users() (*in module fastr.helpers.sysinfo*), 177
get_value() (*fastr.execution.job.Job class method*), 145
getblueprinter() (*in module*

fastr.helpers.jsonschemaparser), 172
global_id() (*fastr.execution.networkrun.NetworkRun property*), 158
global_id() (*fastr.execution.noderun.NodeRun property*), 160
global_id() (*fastr.planning.network.Network property*), 200
global_id() (*fastr.planning.node.Node property*), 206
guess_type() (*fastr.datatypes.DataTypeManager method*), 123

H

has_file_promise() (*fastr.helpers.filesynchelper.FileSyncHelper method*), 170
has_type() (*fastr.datatypes.DataTypeManager method*), 124
HasDimensions (*class in fastr.core.dimension*), 96
hash() (*fastr.core.tool.Tool property*), 113
hash_inputs() (*fastr.execution.job.Job method*), 145
hash_inputs() (*fastr.execution.job.SinkJob method*), 150
hash_inputs() (*fastr.execution.job.SourceJob method*), 151
hash_results() (*fastr.execution.job.Job method*), 145
hashsum() (*in module fastr.helpers.checksum*), 166
HasSamples (*class in fastr.core.samples*), 103
help (*fastr.core.tool.Tool attribute*), 113
hold (*fastr.execution.job.JobState attribute*), 149
hold (*fastr.plugins.executionplugin.JobAction attribute*), 236
hold_job() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
HTTPPlugin (*class in fastr.plugins*), 220

I

id (*fastr.datatypes.BaseDataType attribute*), 121
id() (*fastr.api.Input property*), 76
id() (*fastr.api.Link property*), 75
id() (*fastr.api.Network property*), 74
id() (*fastr.api.Node property*), 75
id() (*fastr.api.Output property*), 77
id() (*fastr.core.samples.SampleItemBase property*), 107
id() (*fastr.core.tool.Tool property*), 113
id() (*fastr.execution.job.Job property*), 145
id() (*fastr.execution.job.SinkJob property*), 150
id() (*fastr.execution.networkrun.NetworkRun property*), 158
id() (*fastr.execution.noderun.NodeRun property*), 160
id() (*fastr.planning.inputoutput.BaseInputOutput property*), 184
id() (*fastr.planning.inputoutput.Input property*), 187
id() (*fastr.planning.network.Network property*), 201
id() (*fastr.planning.node.Node property*), 206
idle() (*fastr.execution.job.JobState property*), 149
ids() (*fastr.core.samples.HasSamples method*), 103
in_progress() (*fastr.execution.job.JobState property*), 149
index() (*fastr.core.samples.SampleItemBase property*), 108
index() (*fastr.execution.inputoutputrun.InputRun method*), 133
index() (*fastr.planning.inputoutput.Input method*), 187
indexes() (*fastr.core.samples.HasSamples method*), 103
indexrep() (*fastr.execution.inputoutputrun.SubOutputRun property*), 142
indexrep() (*fastr.planning.inputoutput.SubOutput property*), 194
INFO_DUMP (*fastr.execution.job.Job attribute*), 143
init_provenance() (*fastr.core.provenance.Provenance method*), 101
InlineJob (*class in fastr.execution.job*), 142
Input (*class in fastr.api*), 76
Input (*class in fastr.planning.inputoutput*), 185
input() (*fastr.api.Node property*), 75
input() (*fastr.execution.sinknoderun.SinkNodeRun property*), 162
input() (*fastr.planning.node.SinkNode property*), 208
input_group() (*fastr.api.Input property*), 77
input_group() (*fastr.execution.inputoutputrun.InputRun property*), 134
input_group() (*fastr.execution.inputoutputrun.SubInputRun property*), 140
input_group() (*fastr.planning.inputoutput.Input property*), 187
input_group() (*fastr.planning.inputoutput.MacroInput property*), 187
input_group() (*fastr.planning.inputoutput.SubInput property*), 192
input_groups() (*fastr.execution.noderun.NodeRun property*), 160
input_groups() (*fastr.planning.inputgroupcombiner.BaseInputGroupC property*), 179
input_groups() (*fastr.planning.node.Node property*), 206
InputDict (*class in fastr.planning.node*), 203
InputGroup (*class in fastr.planning.inputgroup*), 178
InputRun (*class in fastr.execution.inputoutputrun*), 132
inputs (*fastr.planning.node.Node attribute*), 206
inputs() (*fastr.api.Node property*), 75
inputs() (*fastr.core.interface.Interface property*), 98
inputs() (*fastr.core.tool.Tool property*), 113
inputs() (*fastr.plugins.FastrInterface property*), 217
inputs() (*fastr.plugins.FlowInterface property*), 219

inputs() (*fastr.plugins.NipypeInterface property*), 224
InputSpec (*class in fastr.core.interface*), 97
InputSpecBase (*in module fastr.core.interface*), 97
insert() (*fastr.execution.inputoutputrun.InputRun method*), 134
insert() (*fastr.planning.inputoutput.Input method*), 187
IntCardinalitySpec (*class in fastr.core.cardinality*), 92
Interface (*class in fastr.core.interface*), 97
InterfacePluginManager (*class in fastr.plugins.managers.interfacemanager*), 237
InterfaceResult (*class in fastr.core.interface*), 98
IOPlugin (*class in fastr.core.ioplugin*), 99
IOPluginManager (*class in fastr.plugins.managers.iopluginmanager*), 237
is_mapping() (*fastr.core.samples.SampleValue property*), 109
is_sequence() (*fastr.core.samples.SampleValue property*), 109
is_valid() (*fastr.planning.network.Network method*), 201
isdatatype() (*fastr.datatypes.DataTypeManager static method*), 124
isinstance() (*fastr.datatypes.BaseDataType class method*), 121
isinstance() (*fastr.datatypes.TypeGroup class method*), 126
isloaded() (*fastr.execution.environmentmodules.EnvironmentModules method*), 129
isslice() (*fastr.core.samples.SampleIndex property*), 106
isurl() (*fastr.core.ioplugin.IOPlugin static method*), 99
isurl() (*in module fastr.data.url*), 119
item_index() (*fastr.execution.inputoutputrun.NamedSubinputRun property*), 135
item_index() (*fastr.execution.inputoutputrun.SubInputRun property*), 140
item_index() (*fastr.planning.inputoutput.BaseInput property*), 182
item_index() (*fastr.planning.inputoutput.NamedSubInput property*), 188
item_index() (*fastr.planning.inputoutput.SubInput property*), 192
items() (*fastr.core.samples.HasSamples method*), 103
items_prevalidate() (*in module fastr.helpers.jsonschemaparser*), 172
iter_input_groups() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 179
iter_input_groups() (*fastr.planning.inputgroupcombiner.DefaultInputGroupCombiner method*), 180
iter_input_groups() (*fastr.planning.inputgroupcombiner.MergingInputGroupCombiner method*), 181
iterconvergingindices() (*fastr.execution.inputoutputrun.OutputRun method*), 136
iterelements() (*fastr.core.samples.SampleValue method*), 109
iterinputvalues() (*fastr.planning.inputgroup.InputGroup property*), 179
iteritems() (*fastr.core.samples.HasSamples method*), 103
iteritems() (*fastr.execution.inputoutputrun.SubInputRun method*), 140
iteritems() (*fastr.planning.inputoutput.SubInput method*), 192
itersubinputs() (*fastr.execution.inputoutputrun.BaseInputRun method*), 132
itersubinputs() (*fastr.execution.inputoutputrun.InputRun method*), 134
itersubinputs() (*fastr.execution.inputoutputrun.SubInputRun method*), 140
itersubinputs() (*fastr.planning.inputoutput.BaseInput method*), 182
itersubinputs() (*fastr.planning.inputoutput.Input method*), 187
itersubinputs() (*fastr.planning.inputoutput.SubInput method*), 192

J

Job (*class in fastr.execution.job*), 143
job() (*fastr.datatypes.Deferred property*), 125
job_cleanup_level() (*fastr.helpers.configmanager.Config property*), 168
job_finished() (*fastr.execution.networkrun.NetworkRun method*), 158
job_finished() (*fastr.helpers.filesynchelper.FileSyncHelper method*), 170
job_finished() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 235
job_finished_callback() (*fastr.plugins.ProcessPoolExecution method*), 226
job_updated (*fastr.helpers.events.EventType attribute*), 169
job_updated() (*fastr.plugins.ElasticsearchReporter method*), 214
job_updated() (*fastr.plugins.PimReporter method*), 225

job_updated() (*fastr.plugins.reportingplugin.ReportingPlugin method*), 236
JobAction (*class in fastr.plugins.executionplugin*), 236
JobCleanupLevel (*class in fastr.execution.job*), 146
jobs() (*fastr.core.samples.SampleItemBase property*), 108
JobState (*class in fastr.execution.job*), 147
join() (*in module fastr.data.url*), 119
json (*in module fastr.plugins*), 233

L

LazyModule (*class in fastr.helpers.lazy_module*), 173
LinearExecution (*class in fastr.plugins*), 220
linearized() (*fastr.execution.inputoutputrun.SourceOutputRun property*), 138
linearized() (*fastr.planning.inputoutput.SourceOutput property*), 191
Link (*class in fastr.api*), 75
Link (*class in fastr.planning.link*), 195
link_or_copy() (*in module fastr.helpers.iohelpers*), 171
LinkRun (*class in fastr.execution.linkrun*), 151
listeners() (*fastr.execution.inputoutputrun.OutputRun property*), 137
listeners() (*fastr.execution.inputoutputrun.SubOutputRun property*), 142
listeners() (*fastr.execution.noderun.NodeRun property*), 160
listeners() (*fastr.planning.inputoutput.Output property*), 190
listeners() (*fastr.planning.inputoutput.SubOutput property*), 194
listeners() (*fastr.planning.node.Node property*), 206
lmod (*fastr.execution.environmentmodules.ModuleSystem attribute*), 130
load() (*fastr.api.Network class method*), 75
load() (*fastr.execution.environmentmodules.EnvironmentModules method*), 129
load() (*fastr.helpers.filesynchelper.FileSyncHelper method*), 170
load() (*in module fastr.helpers.xmltodict*), 177
load_gpickle() (*in module fastr.helpers.iohelpers*), 171
load_json() (*in module fastr.helpers.iohelpers*), 171
loaded_modules() (*fastr.execution.environmentmodules.EnvironmentModules property*), 129
loads() (*in module fastr.helpers.xmltodict*), 177
LocalBinaryTarget (*class in fastr.plugins*), 221
lock_dir() (*fastr.helpers.lockfile.DirectoryLock property*), 174
lock_dir_name (*fastr.helpers.lockfile.DirectoryLock attribute*), 174
log_record_emitted (*fastr.helpers.events.EventType attribute*), 169
log_record_emitted() (*fastr.plugins.PimReporter method*), 225
log_record_emitted() (*fastr.plugins.reportingplugin.ReportingPlugin method*), 236
log_to_file() (*fastr.helpers.configmanager.Config property*), 168
logdir() (*fastr.helpers.configmanager.Config property*), 168
logfile() (*fastr.execution.job.Job property*), 145
logging_config() (*fastr.helpers.configmanager.Config property*), 168
loglevel() (*fastr.helpers.configmanager.Config property*), 168
logtype() (*fastr.helpers.configmanager.Config property*), 168
logurl() (*fastr.execution.job.Job property*), 145
long_id() (*fastr.execution.networkrun.NetworkRun property*), 158
lookup() (*fastr.datatypes.Deferred class method*), 125

M

MacroInput (*class in fastr.planning.inputoutput*), 187
MacroNode (*class in fastr.planning.node*), 203
MacroNodeRun (*class in fastr.execution.macronoderun*), 154
MacroOutput (*class in fastr.planning.inputoutput*), 187
MacroOutputRun (*class in fastr.execution.inputoutputrun*), 134
MacroTarget (*class in fastr.plugins*), 222
main() (*in module fastr.execution.executionscript*), 130
main() (*in module fastr.helpers.clear_pycs*), 167
main() (*in module fastr.utils.cmd*), 245
main() (*in module fastr.utils.cmd.cat*), 245
main() (*in module fastr.utils.cmd.dump*), 246
main() (*in module fastr.utils.cmd.execute*), 246
main() (*in module fastr.utils.cmd.extract_argparse*), 246
main() (*in module fastr.utils.cmd.provenance*), 246
main() (*in module fastr.utils.cmd.pylint*), 246
main() (*in module fastr.utils.cmd.report*), 247
main() (*in module fastr.utils.cmd.run*), 247
main() (*in module fastr.utils.cmd.sink*), 247
main() (*in module fastr.utils.cmd.source*), 247
main() (*in module fastr.utils.cmd.test*), 247
main() (*in module fastr.utils.cmd.trace*), 248
main() (*in module fastr.utils.cmd.upgrade*), 248
main() (*in module fastr.utils.cmd.verify*), 249
main() (*in module fastr.utils.gettools*), 245
major() (*fastr.core.version.Version property*), 115

make_file_promise() (*fastr.helpers.filesynchelper.FileSyncHelper method*), 170
mapping_part() (*fastr.core.samples.SampleValue method*), 109
match_types() (*fastr.datatypes.DataTypeManager method*), 124
match_types_any() (*fastr.datatypes.DataTypeManager method*), 124
MaxCardinalitySpec (*class in fastr.core.cardinality*), 93
md5_checksum() (*in module fastr.helpers.checksum*), 166
members (*fastr.datatypes.TypeGroup attribute*), 127
memory() (*fastr.api.ResourceLimit property*), 89
memory() (*fastr.core.resourcelimit.ResourceLimit property*), 102
merge() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 179
merge() (*fastr.planning.inputgroupcombiner.DefaultInputGroupCombiner method*), 180
merge() (*fastr.planning.inputgroupcombiner.MergingInputGroupCombiner method*), 181
merge_default() (*fastr.helpers.configmanager.EmptyDefault method*), 169
merge_dimensions() (*fastr.execution.noderun.NodeRun property*), 160
merge_dimensions() (*fastr.planning.node.Node property*), 206
merge_failed_annotations() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 179
merge_payloads() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 179
merge_sample_data() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 179
merge_sample_id() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 179
merge_sample_index() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 180
merge_sample_jobs() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 180
MergingInputGroupCombiner (*class in fastr.planning.inputgroupcombiner*), 180
MinCardinalitySpec (*class in fastr.core.cardinality*), 93
minor() (*fastr.core.version.Version property*), 115
module
    fastr.__init__, 79
    fastr.api, 88
    fastr.core, 90
    fastr.core.cardinality, 90
    fastr.core.dimension, 95
    fastr.core.interface, 97
    fastr.core.ioplugin, 99
    fastr.core.provenance, 101
    fastr.core.resourcelimit, 102
    fastr.core.samples, 103
    fastr.core.target, 109
    fastr.core.test, 118
    fastr.core.tool, 112
    fastr.core.version, 114
    fastr.core.vfs, 116
    fastr.data, 118
    fastr.data.url, 118
    fastr.datatypes, 120
    fastr.exceptions, 80
    fastr.execution, 128
    fastr.execution.basenoderun, 128
    fastr.execution.environmentmodules, 129
    fastr.execution.executionscript, 130
    fastr.execution.flownoderun, 130
    fastr.execution.inputoutputrun, 131
    fastr.execution.job, 142
    fastr.execution.linkrun, 151
    fastr.execution.macronoderun, 154
    fastr.execution.networkanalyzer, 155
    fastr.execution.networkchunker, 155
    fastr.execution.networkrun, 156
    fastr.execution.noderun, 158
    fastr.execution.sinknoderun, 161
    fastr.execution.sourcenoderun, 163
    fastr.helpers, 165
    fastr.helpers.checksum, 165
    fastr.helpers.classproperty, 166
    fastr.helpers.clear_pycs, 167
    fastr.helpers.configmanager, 167
    fastr.helpers.events, 169
    fastr.helpers.filesynchelper, 170
    fastr.helpers.iohelpers, 171
    fastr.helpers.jsonschemaparser, 171
    fastr.helpers.lazy_module, 173
    fastr.helpers.lockfile, 174
    fastr.helpers.procutils, 174
    fastr.helpers.report, 175
    fastr.helpers.rest_generation, 175
    fastr.helpers.schematotable, 175
    fastr.helpers.shellescape, 176
    fastr.helpers.sysinfo, 176
    fastr.helpers.xmltodict, 177
    fastr.planning, 178

fastr.planning.inputgroup, 178
fastr.planning.inputgroupcombiner, 179
fastr.planning.inputoutput, 181
fastr.planning.link, 195
fastr.planning.network, 197
fastr.planning.node, 201
fastr.plugins, 209
fastr.plugins.executionplugin, 233
fastr.plugins.managers, 237
fastr.plugins.managers.executionpluginmanager, 237
fastr.plugins.managers.interfacemanager, 237
fastr.plugins.managers.iopluginmanager, 237
fastr.plugins.managers.networkmanager, 239
fastr.plugins.managers.objectmanager, 239
fastr.plugins.managers.pluginmanager, 240
fastr.plugins.managers.targetmanager, 242
fastr.plugins.managers.toolmanager, 242
fastr.plugins.reportingplugin, 236
fastr.test, 243
fastr.utils, 243
fastr.utils.cmd, 245
fastr.utils.cmd.cat, 245
fastr.utils.cmd.dump, 246
fastr.utils.cmd.execute, 246
fastr.utils.cmd.extract_argparse, 246
fastr.utils.cmd.provenance, 246
fastr.utils.cmd.pylint, 246
fastr.utils.cmd.report, 247
fastr.utils.cmd.run, 247
fastr.utils.cmd.sink, 247
fastr.utils.cmd.source, 247
fastr.utils.cmd.test, 247
fastr.utils.cmd.trace, 248
fastr.utils.cmd.upgrade, 248
fastr.utils.cmd.verify, 249
fastr.utils.compare, 243
fastr.utils.dicteq, 244
fastr.utils.gettools, 245
fastr.utils.multiprocesswrapper, 245
fastr.utils.verify, 245
fastr.version, 88
module (*fastr.plugins.BlockingExecution attribute*), 209
module (*fastr.plugins.CommaSeperatedValueFile attribute*), 211
module (*fastr.plugins.CrossValidation attribute*), 211
module (*fastr.plugins.DockerTarget attribute*), 213
module (*fastr.plugins.DRMAAExecution attribute*), 212
module (*fastr.plugins.ElasticsearchReporter attribute*), 214
module (*fastr.plugins.FastrInterface attribute*), 217
module (*fastr.plugins.FileSystem attribute*), 218
module (*fastr.plugins.FlowInterface attribute*), 219
module (*fastr.plugins.HTTPPlugin attribute*), 220
module (*fastr.plugins.LinearExecution attribute*), 221
module (*fastr.plugins.LocalBinaryTarget attribute*), 222
module (*fastr.plugins.MacroTarget attribute*), 223
module (*fastr.plugins.NipypeInterface attribute*), 224
module (*fastr.plugins.Null attribute*), 224
module (*fastr.plugins.PimReporter attribute*), 225
module (*fastr.plugins.ProcessPoolExecution attribute*), 226
module (*fastr.plugins.Reference attribute*), 226
module (*fastr.plugins.S3Filesystem attribute*), 227
module (*fastr.plugins.SimpleReport attribute*), 227
module (*fastr.plugins.SingularityTarget attribute*), 228
module (*fastr.plugins.VirtualFileSystem attribute*), 229
module (*fastr.plugins.VirtualFileSystemRegularExpression attribute*), 230
module (*fastr.plugins.VirtualFileSystemValueList attribute*), 230
module (*fastr.plugins.XNATStorage attribute*), 233
ModuleSystem (*class in fastr.execution.environmentmodules*), 130
monitor_docker() (*fastr.plugins.DockerTarget method*), 213
monitor_process() (*fastr.core.target.SubprocessBasedTarget method*), 110
mounts() (*fastr.helpers.configmanager.Config property*), 168

N

n_current_jobs() (*fastr.plugins.DRMAAExecution property*), 212
name (*fastr.core.tool.Tool attribute*), 113
name (*fastr.datatypes.BaseDataType attribute*), 122
name() (*fastr.core.dimension.Dimension property*), 96
name() (*fastr.execution.noderun.NodeRun property*), 160
name() (*fastr.planning.node.Node property*), 206
NamedSubInput (*class in fastr.planning.inputoutput*), 188
NamedSubinputRun (*class in fastr.execution.inputoutputrun*), 134
namedtuple_to_dict() (*in module fastr.helpers.sysinfo*), 177
namespace (*fastr.core.tool.Tool attribute*), 113

namespace (*fastr.planning.network.Network attribute*), 201
NATIVE_SPEC (*fastr.plugins.DRMAAExecution attribute*), 211
ndims() (*fastr.core.dimension.HasDimensions property*), 96
ndims() (*fastr.core.samples.SampleCollection property*), 105
ndims() (*fastr.execution.inputoutputrun.SourceOutputRun property*), 138
Network (*class in fastr.api*), 72
Network (*class in fastr.planning.network*), 197
network() (*fastr.execution.networkrun.NetworkRun property*), 158
network() (*fastr.planning.node.MacroNode property*), 204
NETWORK_DUMP_FILE_NAME (*fastr.execution.networkrun.NetworkRun attribute*), 156
NETWORK_DUMP_FILE_NAME (*fastr.planning.network.Network attribute*), 197
network_run() (*fastr.execution.macronoderun.MacroNodeRun property*), 155
NetworkAnalyzer (*class in fastr.execution.networkanalyzer*), 155
NetworkChunker (*class in fastr.execution.networkchunker*), 156
NetworkManager (*class in fastr.plugins.managers.networkmanager*), 239
NetworkRun (*class in fastr.execution.networkrun*), 156
networks (*fastr attribute*), 72
networks_path() (*fastr.helpers.configmanager.Config property*), 168
NipypeInterface (*class in fastr.plugins*), 223
no_cleanup (*fastr.execution.job.JobCleanupLevel attribute*), 147
Node (*class in fastr.api*), 75
Node (*class in fastr.planning.node*), 204
node() (*fastr.core.cardinality.AsCardinalitySpec property*), 91
node() (*fastr.core.cardinality.ValueCardinalitySpec property*), 94
node() (*fastr.execution.inputoutputrun.SubInputRun property*), 140
node() (*fastr.execution.inputoutputrun.SubOutputRun property*), 142
node() (*fastr.planning.inputoutput.BaseInputOutput property*), 184
node() (*fastr.planning.inputoutput.SubInput property*), 193
node() (*fastr.planning.inputoutput.SubOutput property*), 194
node_class (*fastr.core.tool.Tool attribute*), 113
NODE_RUN_MAP (*fastr.execution.basenoderun.BaseNodeRun attribute*), 128
NODE_RUN_TYPES (*fastr.execution.basenoderun.BaseNodeRun attribute*), 128
NODE_TYPES (*fastr.planning.node.BaseNode attribute*), 201
nodegroup() (*fastr.planning.node.Node property*), 206
nodegroup() (*fastr.planning.node.SourceNode property*), 208
nodegroups() (*fastr.execution.networkrun.NetworkRun property*), 158
nodegroups() (*fastr.planning.network.Network property*), 201
NodeRun (*class in fastr.execution.noderun*), 158
non_failed (*fastr.execution.job.JobCleanupLevel attribute*), 147
nonexistent (*fastr.execution.job.JobState attribute*), 149
normurl() (*in module fastr.data.url*), 120
not_draft4() (*in module fastr.helpers.jsonschemaparser*), 172
ns_id() (*fastr.core.tool.Tool property*), 113
ns_id() (*fastr.planning.network.Network property*), 201
Null (*class in fastr.plugins*), 224

O

object_class() (*fastr.plugins.managers.networkmanager.NetworkMan property*), 239
object_class() (*fastr.plugins.managers.objectmanager.ObjectManage property*), 240
object_class() (*fastr.plugins.managers.toolmanager.ToolManager property*), 242
ObjectManager (*class in fastr.plugins.managers.objectmanager*), 239
objectversions() (*fastr.plugins.managers.objectmanager.ObjectMana method*), 240
one_of_draft4() (*in module fastr.helpers.jsonschemaparser*), 172
options (*fastr.datatypes.EnumType attribute*), 126
Output (*class in fastr.api*), 77
Output (*class in fastr.planning.inputoutput*), 188
output() (*fastr.api.Node property*), 75
output() (*fastr.execution.sourcenoderun.SourceNodeRun property*), 165
output() (*fastr.planning.node.SourceNode property*), 208
OutputDict (*class in fastr.planning.node*), 207
OutputRun (*class in fastr.execution.inputoutputrun*), 135
outputs (*fastr.planning.node.Node attribute*), 206
outputs() (*fastr.api.Node property*), 76

outputs() (*fastr.core.interface.Interface property*), 98
outputs() (*fastr.core.tool.Tool property*), 113
outputs() (*fastr.plugins.FastrInterface property*), 217
outputs() (*fastr.plugins.FlowInterface property*), 219
outputs() (*fastr.plugins.NipypeInterface property*), 224
outputsize() (*fastr.execution.flownoderun.FlowNodeRun property*), 131
outputsize() (*fastr.execution.noderun.NodeRun property*), 160
outputsize() (*fastr.execution.sourcenoderun.SourceNodeRun property*), 165
outputsize() (*fastr.planning.node.FlowNode property*), 203
outputsize() (*fastr.planning.node.Node property*), 206
OutputSpec (*class in fastr.core.interface*), 98
OutputSpecBase (*in module fastr.core.interface*), 98

P

parent (*fastr.datatypes.BaseDataType attribute*), 122
parent() (*fastr.core.samples.SampleCollection property*), 105
parent() (*fastr.execution.linkrun.LinkRun property*), 154
parent() (*fastr.execution.noderun.NodeRun property*), 160
parent() (*fastr.planning.inputgroup.InputGroup property*), 179
parent() (*fastr.planning.link.Link property*), 197
parent() (*fastr.planning.node.Node property*), 206
parse() (*fastr.helpers.schematotable.SchemaPrinter method*), 175
parse_uri() (*fastr.plugins.XNATStorage method*), 233
parsed_value() (*fastr.datatypes.BaseDataType property*), 122
parsed_value() (*fastr.datatypes.Deferred property*), 125
parsed_value() (*fastr.datatypes.URLType property*), 127
path (*in module fastr.plugins*), 233
path() (*fastr.core.tool.Tool property*), 113
path_to_url() (*fastr.core.ioplugin.IOPlugin method*), 99
path_to_url() (*fastr.core.vfs.VirtualFileSystem method*), 117
path_to_url() (*fastr.plugins.FileSystem method*), 218
paths() (*fastr.plugins.LocalBinaryTarget property*), 222
pattern_properties_prevalid() (*in module fastr.helpers.jsonschemaparser*), 173
pid_file() (*fastr.helpers.lockfile.DirectoryLock property*), 174
pid_file_name (*fastr.helpers.lockfile.DirectoryLock attribute*), 174
pim_batch_size() (*fastr.helpers.configmanager.Config property*), 168
pim_debug() (*fastr.helpers.configmanager.Config property*), 168
pim_finished_timeout() (*fastr.helpers.configmanager.Config property*), 168
pim_host() (*fastr.helpers.configmanager.Config property*), 168
pim_update_interval() (*fastr.helpers.configmanager.Config property*), 168
pim_username() (*fastr.helpers.configmanager.Config property*), 168
PimReporter (*class in fastr.plugins*), 224
plugin_class() (*fastr.datatypes.DataTypeManager property*), 124
plugin_class() (*fastr.plugins.managers.pluginmanager.PluginManage property*), 241
plugin_class() (*fastr.plugins.managers.pluginmanager.PluginSubMa property*), 241
PluginManager (*class in fastr.plugins.managers.pluginmanager*), 240
plugins_path() (*fastr.helpers.configmanager.Config property*), 168
PluginSubManager (*class in fastr.plugins.managers.pluginmanager*), 241
PluginsView (*class in fastr.plugins.managers.pluginmanager*), 241
poll_datatype() (*fastr.datatypes.DataTypeManager method*), 124
populate() (*fastr.datatypes.DataTypeManager method*), 125
populate() (*fastr.plugins.managers.toolmanager.ToolManager method*), 242
predefined() (*fastr.core.cardinality.AsCardinalitySpec property*), 91
predefined() (*fastr.core.cardinality.CardinalitySpec property*), 92
predefined() (*fastr.core.cardinality.IntCardinalitySpec property*), 93
preference (*fastr.datatypes.TypeGroup attribute*), 127
preferred_types() (*fastr.datatypes.DataTypeManager property*), 125
preferred_types() (*fastr.execution.inputoutputrun.OutputRun property*), 137
preferred_types() (*fastr.execution.inputoutputrun.SubOutputRun

property), 142
preferred_types() (fastr.helpers.configmanager.Config property), 168
preferred_types() (fastr.planning.inputoutput.Output property), 190
preferred_types() (fastr.planning.inputoutput.SubOutput property), 194
prepend() (fastr.helpers.configmanager.EmptyDefault method), 169
primary() (fastr.planning.inputgroup.InputGroup property), 179
print_help() (in module fastr.utils.cmd), 245
print_job_result() (in module fastr.helpers.report), 175
print_result() (fastr.core.ioplugin.IOPlugin static method), 100
print_sample_sink() (in module fastr.utils.cmd.trace), 248
print_samples() (in module fastr.utils.cmd.trace), 248
print_sinks() (in module fastr.utils.cmd.trace), 248
print_value() (fastr.planning.node.ConstantNode property), 202
printlines() (fastr.helpers.schematotable.SchemaPrinter method), 175
process_callbacks() (fastr.plugins.executionplugin.ExecutionPlugin method), 236
process_pool_worker_number() (fastr.helpers.configmanager.Config property), 168
processing_callback (fastr.execution.job.JobState attribute), 149
ProcessPoolExecution (class in fastr.plugins), 225
ProcessUsageCollection (class in fastr.core.target), 109
properties_postvalidate() (in module fastr.helpers.jsonschemaparser), 173
properties_prevalidate() (in module fastr.helpers.jsonschemaparser), 173
protected_modules() (fastr.helpers.configmanager.Config property), 168
PROV_DUMP (fastr.execution.job.Job attribute), 143
Provenance (class in fastr.core.provenance), 101
provenance() (fastr.datatypes.Deferred property), 125
provfile() (fastr.execution.job.Job property), 145
provurl() (fastr.execution.job.Job property), 145
pull_source_data() (fastr.core.ioplugin.IOPlugin method), 100
pull_source_data() (fastr.plugins.managers.iopluginmanager.IOPluginManager method), 238
push_sink_data() (fastr.core.ioplugin.IOPlugin method), 100
push_sink_data() (fastr.plugins.managers.iopluginmanager.IOPluginManager method), 238
push_sink_data() (fastr.plugins.Reference method), 226
put_url() (fastr.core.ioplugin.IOPlugin method), 100
put_url() (fastr.core.vfs.VirtualFileSystem method), 117
put_url() (fastr.plugins.FileSystem method), 218
put_url() (fastr.plugins.managers.iopluginmanager.IOPluginManager method), 238
put_url() (fastr.plugins.Null method), 224
put_url() (fastr.plugins.S3Filesystem method), 227
put_url() (fastr.plugins.XNATStorage method), 233
put_value() (fastr.core.ioplugin.IOPlugin method), 100
put_value() (fastr.core.vfs.VirtualFileSystem method), 117
put_value() (fastr.plugins.FileSystem method), 218
put_value() (fastr.plugins.Null method), 224
put_value() (fastr.plugins.S3Filesystem method), 227
Python Enhancement Proposals
PEP 8#class-names, 28
PEP 8#global-variable-names, 28
PEP 8#method-names-and-instance-variables, 28
PEP 8#package-and-module-names, 28
PEP 8#prescriptive-naming-conventions, 28
Python Enhancement Proposals
PEP 8, 28

Q

queue (fastr.plugins.executionplugin.JobAction attribute), 236
queue_job() (fastr.plugins.executionplugin.ExecutionPlugin method), 236
queue_report_interval() (fastr.helpers.configmanager.Config property), 168
queued (fastr.execution.job.JobState attribute), 149
quote_argument() (in module fastr.helpers.shellescape), 176

R

RangeCardinalitySpec (class in fastr.core.cardinality), 94
raw_value() (fastr.datatypes.BaseDataType property), 122

read_bytes() (*fastr.core.target.SystemUsageInfo property*), 110
read_config() (*fastr.helpers.configmanager.Config method*), 168
read_config_files (*fastr.helpers.configmanager.Config attribute*), 168
read_config_string() (*fastr.helpers.configmanager.Config method*), 168
read_sink_data() (*in module fastr.utils.cmd.trace*), 248
readfastrschema() (*fastr.helpers.jsonschemaparser.FastrRefResolver static method*), 171
readfile() (*fastr.helpers.jsonschemaparser.FastrRefResolver static method*), 171
Reference (*class in fastr.plugins*), 226
references (*fastr.core.tool.Tool attribute*), 113
register_fields() (*fastr.helpers.configmanager.Config method*), 168
register_job() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 236
register_listener() (*in module fastr.helpers.events*), 170
register_signals() (*fastr.execution.networkrun.NetworkRun method*), 158
register_url_scheme() (*fastr.plugins.managers.iopluginmanager.IOPluginManager static method*), 239
register_url_scheme() (*in module fastr.data.url*), 120
regression_check() (*fastr.plugins.DRMAAExecution method*), 212
release() (*fastr.helpers.lockfile.DirectoryLock method*), 174
release_job() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 236
reload() (*fastr.execution.environmentmodules.EnvironmentModules method*), 129
remove() (*fastr.execution.inputoutputrun.InputRun method*), 134
remove() (*fastr.planning.inputoutput.Input method*), 187
remove() (*fastr.planning.inputoutput.SubInput method*), 193
remove() (*fastr.planning.network.Network method*), 201
remove_listener() (*in module fastr.helpers.events*), 170
reporting_plugins() (*fastr.helpers.configmanager.Config property*), 168
ReportingPlugin (*class in fastr.plugins.reportingplugin*), 236
required() (*fastr.planning.inputoutput.BaseInputOutput property*), 184
requirements (*fastr.core.tool.Tool attribute*), 113
ResourceLimit (*class in fastr.api*), 88
ResourceLimit (*class in fastr.core.resourcelimit*), 102
resources() (*fastr.execution.job.Job property*), 145
resources() (*fastr.execution.noderun.NodeRun property*), 160
resourcesdir() (*fastr.helpers.configmanager.Config property*), 168
RESULT_DUMP (*fastr.execution.job.Job attribute*), 143
resulting_datatype() (*fastr.execution.inputoutputrun.OutputRun property*), 137
resulting_datatype() (*fastr.execution.inputoutputrun.SubOutputRun property*), 142
resulting_datatype() (*fastr.planning.inputoutput.Output property*), 190
resulting_datatype() (*fastr.planning.inputoutput.SubOutput property*), 194
rmem() (*fastr.core.target.SystemUsageInfo property*), 110
run_command() (*fastr.core.target.Target method*), 111
run_command() (*fastr.plugins.DockerTarget method*), 213
run_command() (*fastr.plugins.LocalBinaryTarget method*), 222
run_command() (*fastr.plugins.MacroTarget method*), 223
run_command() (*fastr.plugins.SingularityTarget method*), 228
run_finished (*fastr.helpers.events.EventType attribute*), 169
run_finished() (*fastr.plugins.PimReporter method*), 225
run_finished() (*fastr.plugins.reportingplugin.ReportingPlugin method*), 236
run_finished() (*fastr.plugins.SimpleReport method*), 227
run_pylint() (*in module fastr.utils.cmd.pylint*), 246
run_started (*fastr.helpers.events.EventType attribute*), 170
run_started() (*fastr.plugins.PimReporter method*), 225
run_started() (*fastr.plugins.reportingplugin.ReportingPlugin method*), 236

running (*fastr.execution.job.JobState attribute*), 149

S

S3Filesystem (*class in fastr.plugins*), 226
SampleBaseId (*class in fastr.core.samples*), 103
SampleCollection (*class in fastr.core.samples*), 104
SampleId (*class in fastr.core.samples*), 105
SampleIndex (*class in fastr.core.samples*), 105
SampleItem (*class in fastr.core.samples*), 106
SampleItemBase (*class in fastr.core.samples*), 106
SamplePayload (*class in fastr.core.samples*), 108
samples() (*fastr.core.samples.ContainsSamples property*), 103
samples() (*fastr.execution.inputoutputrun.OutputRun property*), 137
samples() (*fastr.execution.inputoutputrun.SubOutputRun property*), 142
samples() (*fastr.planning.inputoutput.SubOutput property*), 194
SampleValue (*class in fastr.core.samples*), 108
save() (*fastr.api.Network method*), 75
save_gpickle() (*in module fastr.helpers.iohelpers*), 171
save_json() (*in module fastr.helpers.iohelpers*), 171
save_version() (*in module fastr.version*), 88
schemadir() (*fastr.helpers.configmanager.Config property*), 168
SchemaPrinter (*class in fastr.helpers.schematotable*), 175
scheme (*fastr.plugins.CommaSeperatedValueFile attribute*), 211
scheme (*fastr.plugins.FileSystem attribute*), 218
scheme (*fastr.plugins.HTTPPlugin attribute*), 220
scheme (*fastr.plugins.Null attribute*), 224
scheme (*fastr.plugins.Reference attribute*), 226
scheme (*fastr.plugins.S3Filesystem attribute*), 227
scheme (*fastr.plugins.VirtualFileSystem attribute*), 229
scheme (*fastr.plugins.VirtualFileSystemRegularExpression attribute*), 230
scheme (*fastr.plugins.VirtualFileSystemValueList attribute*), 231
scheme (*fastr.plugins.XNATStorage attribute*), 233
scheme() (*fastr.core.ioplugin.IOPlugin property*), 100
scheme() (*fastr.core.vfs.VirtualFileSystem property*), 117
send_job() (*fastr.plugins.DRMAAExecution method*), 212
sequence_part() (*fastr.core.samples.SampleValue method*), 109
serialize() (*fastr.core.provenance.Provenance method*), 101
serialize() (*fastr.core.tool.Tool method*), 114
serialize() (*fastr.datatypes.DataType method*), 122
server() (*fastr.plugins.XNATStorage property*), 233
set_data() (*fastr.execution.networkrun.NetworkRun method*), 158
set_data() (*fastr.execution.sinknoderun.SinkNodeRun method*), 162
set_data() (*fastr.execution.sourcenoderun.ConstantNodeRun method*), 163
set_data() (*fastr.execution.sourcenoderun.SourceNodeRun method*), 165
set_data() (*fastr.planning.node.ConstantNode method*), 202
set_data() (*fastr.planning.node.SourceNode method*), 208
set_field() (*fastr.helpers.configmanager.Config method*), 168
set_result() (*fastr.execution.flownoderun.AdvancedFlowNodeRun method*), 131
set_result() (*fastr.execution.flownoderun.FlowNodeRun method*), 131
set_result() (*fastr.execution.noderun.NodeRun method*), 160
set_result() (*fastr.execution.sinknoderun.SinkNodeRun method*), 162
setup() (*fastr.core.ioplugin.IOPlugin method*), 100
setup() (*fastr.core.vfs.VirtualFileSystem method*), 117
sha1_checksum() (*in module fastr.helpers.checksum*), 166
show_jobs() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 236
signal_dependent_jobs() (*fastr.plugins.executionplugin.ExecutionPlugin method*), 236
SimpleReport (*class in fastr.plugins*), 227
SINGULARITY_BIN (*fastr.plugins.SingularityTarget attribute*), 228
SingularityTarget (*class in fastr.plugins*), 227
sink() (*in module fastr.utils.cmd.sink*), 247
SINK_DUMP_FILE_NAME (*fastr.execution.networkrun.NetworkRun attribute*), 156
SINK_DUMP_FILE_NAME (*fastr.planning.network.Network attribute*), 197
SinkJob (*class in fastr.execution.job*), 149
sinklist() (*fastr.execution.networkrun.NetworkRun property*), 158
SinkNode (*class in fastr.planning.node*), 207
SinkNodeRun (*class in fastr.execution.sinknoderun*), 161
size() (*fastr.core.dimension.Dimension property*), 96
size() (*fastr.core.dimension.HasDimensions property*), 97
size() (*fastr.execution.inputoutputrun.SourceOutputRun property*), 138
size() (*fastr.execution.linkrun.LinkRun property*), 154

solve_broadcast() (*fastr.planning.inputgroup.InputGroup class method*), 179
source() (*fastr.core.dimension.ForwardsDimensions property*), 96
source() (*fastr.execution.inputoutputrun.InputRun property*), 134
source() (*fastr.execution.inputoutputrun.SubInputRun property*), 140
source() (*fastr.execution.linkrun.LinkRun property*), 154
source() (*fastr.planning.inputoutput.Input property*), 187
source() (*fastr.planning.inputoutput.SubInput property*), 193
source() (*fastr.planning.link.Link property*), 197
source() (*in module fastr.utils.cmd.source*), 247
SOURCE_DUMP_FILE_NAME (*fastr.execution.networkrun.NetworkRun attribute*), 156
SOURCE_DUMP_FILE_NAME (*fastr.planning.network.Network attribute*), 197
source_job_limit() (*fastr.helpers.configmanager.Config property*), 168
source_output() (*fastr.execution.inputoutputrun.SubInputRun property*), 140
source_output() (*fastr.planning.inputoutput.SubInput property*), 193
sourcegroup() (*fastr.execution.sourcenoderun.SourceNodeRun property*), 165
sourcegroup() (*fastr.planning.node.SourceNode property*), 209
SourceJob (*class in fastr.execution.job*), 150
sourcelist() (*fastr.execution.networkrun.NetworkRun property*), 158
SourceNode (*class in fastr.planning.node*), 208
SourceNodeRun (*class in fastr.execution.sourcenoderun*), 164
SourceOutput (*class in fastr.planning.inputoutput*), 190
SourceOutputRun (*class in fastr.execution.inputoutputrun*), 137
spec_fields() (*fastr.plugins.DRMAAExecution property*), 212
split() (*in module fastr.data.url*), 120
status() (*fastr.core.version.Version property*), 115
status() (*fastr.execution.job.Job property*), 145
status() (*fastr.execution.linkrun.LinkRun property*), 154
status() (*fastr.execution.noderun.NodeRun property*), 161
status() (*fastr.planning.link.Link property*), 197
status() (*fastr.planning.node.Node property*), 206
STDERR_DUMP (*fastr.execution.job.Job attribute*), 143
stderrfile() (*fastr.execution.job.Job property*), 145
stderrurl() (*fastr.execution.job.Job property*), 145
stdout (*in module fastr.plugins*), 233
STDOUT_DUMP (*fastr.execution.job.Job attribute*), 143
stdoutfile() (*fastr.execution.job.Job property*), 146
stdouturl() (*fastr.execution.job.Job property*), 146
store() (*fastr.helpers.filesynchelper.FileSyncHelper method*), 170
SubInput (*class in fastr.planning.inputoutput*), 191
SubInputRun (*class in fastr.execution.inputoutputrun*), 138
submit_jobs() (*fastr.plugins.DRMAAExecution method*), 212
SubOutput (*class in fastr.planning.inputoutput*), 193
SubOutputRun (*class in fastr.execution.inputoutputrun*), 140
SubprocessBasedTarget (*class in fastr.core.target*), 109
substitute() (*fastr.execution.job.SinkJob method*), 150
suffix() (*fastr.core.version.Version property*), 115
SUPPORTED_APIS (*fastr.plugins.PimReporter attribute*), 224
SUPPORTS_CANCEL (*fastr.plugins.DRMAAExecution attribute*), 211
SUPPORTS_CANCEL (*fastr.plugins.executionplugin.ExecutionPlugin attribute*), 234
SUPPORTS_DEPENDENCY (*fastr.plugins.DRMAAExecution attribute*), 211
SUPPORTS_DEPENDENCY (*fastr.plugins.executionplugin.ExecutionPlugin attribute*), 234
SUPPORTS_HOLD_RELEASE (*fastr.plugins.DRMAAExecution attribute*), 211
SUPPORTS_HOLD_RELEASE (*fastr.plugins.executionplugin.ExecutionPlugin attribute*), 234
swap() (*fastr.execution.environmentmodules.EnvironmentModules method*), 129
switch_sample_sink() (*in module fastr.utils.cmd.trace*), 248
sync() (*fastr.execution.environmentmodules.EnvironmentModules method*), 130
systemdir() (*fastr.helpers.configmanager.Config property*), 168
SystemUsageInfo (*class in fastr.core.target*), 110

T

tags (*fastr.core.tool.Tool attribute*), 114
Target (*class in fastr.core.target*), 110

target() (*fastr.core.tool.Tool property*), 114
target() (*fastr.datatypes.Deferred property*), 126
target() (*fastr.execution.linkrun.LinkRun property*), 154
target() (*fastr.planning.link.Link property*), 197
TargetManager (*class in fastr.plugins.managers.targetmanager*), 242
TargetResult (*class in fastr.core.target*), 111
test() (*fastr.core.interface.Interface class method*), 98
test() (*fastr.core.target.Target class method*), 111
test() (*fastr.core.tool.Tool method*), 114
test() (*fastr.datatypes.BaseDataType class method*), 122
test() (*fastr.planning.network.Network class method*), 201
test() (*fastr.plugins.BlockingExecution class method*), 209
test() (*fastr.plugins.DRMAAExecution class method*), 212
test() (*fastr.plugins.ElasticsearchReporter class method*), 214
test() (*fastr.plugins.LinearExecution class method*), 221
test() (*fastr.plugins.MacroTarget class method*), 223
test() (*fastr.plugins.NipypeInterface class method*), 224
test() (*fastr.plugins.ProcessPoolExecution class method*), 226
test() (*fastr.plugins.S3Filesystem class method*), 227
test() (*fastr.plugins.SingularityTarget class method*), 228
test_spec (*fastr.core.tool.Tool attribute*), 114
test_tool() (*fastr.core.tool.Tool class method*), 114
time() (*fastr.api.ResourceLimit property*), 89
time() (*fastr.core.resourcelimit.ResourceLimit property*), 102
timestamp() (*fastr.core.target.SystemUsageInfo property*), 110
tmpdir() (*fastr.execution.job.Job property*), 146
tmpurl() (*fastr.execution.job.Job property*), 146
tmpurl() (*fastr.execution.job.SinkJob property*), 150
todict() (*fastr.plugins.managers.objectmanager.ObjectManager method*), 240
Tool (*class in fastr.core.tool*), 112
tool() (*fastr.execution.job.Job property*), 146
tool() (*fastr.execution.noderun.NodeRun property*), 161
tool() (*fastr.planning.node.Node property*), 207
tool() (*in module fastr.utils.cmd.test*), 247
TOOL_REFERENCE_FILE_NAME (*fastr.core.tool.Tool attribute*), 112
TOOL_RESULT_FILE_NAME (*fastr.core.tool.Tool attribute*), 112
toollist() (*fastr.utils.cmd.upgrade.FastrNamespaceType property*), 248
ToolManager (*class in fastr.plugins.managers.toolmanager*), 242
tools (*fastr attribute*), 71
tools_path() (*fastr.helpers.configmanager.Config property*), 168
toolversions() (*fastr.plugins.managers.toolmanager.ToolManager method*), 242
TORQUE_NATIVE_SPEC (*fastr.plugins.DRMAAExecution attribute*), 211
tostring_modvalue() (*fastr.execution.environmentmodules.EnvironmentModules static method*), 130
totuple_modvalue() (*fastr.execution.environmentmodules.EnvironmentModules static method*), 130
translate_argument() (*fastr.execution.job.Job class method*), 146
translate_output_results() (*fastr.execution.job.Job static method*), 146
translate_results() (*fastr.execution.job.Job method*), 146
TypeGroup (*class in fastr.datatypes*), 126
typelist() (*fastr.utils.cmd.upgrade.FastrNamespaceType property*), 248
types (*fastr attribute*), 71
types_path() (*fastr.helpers.configmanager.Config property*), 168

U

unload() (*fastr.execution.environmentmodules.EnvironmentModules method*), 130
unmerge() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombine method*), 180
unmerge() (*fastr.planning.inputgroupcombiner.DefaultInputGroupComb method*), 180
unmerge() (*fastr.planning.inputgroupcombiner.MergingInputGroupComb method*), 181
unregister_signals() (*fastr.execution.networkrun.NetworkRun method*), 158
update() (*fastr.helpers.configmanager.EmptyDefault method*), 169
update() (*fastr.planning.inputgroupcombiner.BaseInputGroupCombiner method*), 180
update() (*fastr.planning.inputgroupcombiner.MergingInputGroupCombi method*), 181
update_input_groups() (*fastr.execution.noderun.NodeRun method*), 161
update_input_groups() (*fastr.planning.node.Node method*), 207

update_size() (*fastr.core.dimension.Dimension method*), 96
upgrade_network() (*in module fastr.utils.cmd.upgrade*), 248
upgrade_tool() (*in module fastr.utils.cmd.upgrade*), 248
upload() (*fastr.plugins.XNATStorage static method*), 233
url (*fastr.core.tool.Tool attribute*), 114
url_to_path() (*fastr.core.ioplugin.IOPlugin method*), 100
url_to_path() (*fastr.core.vfs.VirtualFileSystem method*), 117
url_to_path() (*fastr.plugins.FileSystem method*), 218
url_to_path() (*fastr.plugins.managers.iopluginmanager.IOPluginManager method*), 239
URLType (*class in fastr.datatypes*), 127
usage_type (*fastr.core.target.ProcessUsageCollection attribute*), 109
userdir() (*fastr.helpers.configmanager.Config property*), 169

V

valid() (*fastr.datatypes.BaseDataType property*), 122
valid() (*fastr.datatypes.URLType property*), 128
valid() (*fastr.execution.inputoutputrun.OutputRun property*), 137
valid() (*fastr.execution.sourcenoderun.SourceNodeRun property*), 165
valid() (*fastr.planning.inputoutput.Output property*), 190
valid() (*fastr.planning.node.SourceNode property*), 209
validate() (*fastr.core.cardinality.AnyCardinalitySpec method*), 90
validate() (*fastr.core.cardinality.CardinalitySpec method*), 92
validate_results() (*fastr.execution.job.Job method*), 146
validate_results() (*fastr.execution.job.SinkJob method*), 150
validate_results() (*fastr.execution.job.SourceJob method*), 151
value() (*fastr.datatypes.BaseDataType property*), 122
value() (*fastr.datatypes.Deferred property*), 126
ValueCardinalitySpec (*class in fastr.core.cardinality*), 94
ValueType (*class in fastr.datatypes*), 128
verify_resource_loading() (*in module fastr.utils.verify*), 245
verify_tool() (*in module fastr.utils.verify*), 245
Version (*class in fastr.core.version*), 114
version (*fastr.core.tool.Tool attribute*), 114
version (*fastr.datatypes.BaseDataType attribute*), 122
version (*fastr.datatypes.EnumType attribute*), 126
version() (*fastr.api.Network property*), 75
version_matcher (*fastr.core.version.Version attribute*), 115
VirtualFileSystem (*class in fastr.core.vfs*), 116
VirtualFileSystem (*class in fastr.plugins*), 228
VirtualFileSystemRegularExpression (*class in fastr.plugins*), 229
VirtualFileSystemValueList (*class in fastr.plugins*), 230
vmem() (*fastr.core.target.SystemUsageInfo property*), 110

W

wait_for_change() (*fastr.helpers.filesynchelper.FileSyncHelper method*), 170
wait_for_job() (*fastr.helpers.filesynchelper.FileSyncHelper method*), 171
wait_for_pickle() (*fastr.helpers.filesynchelper.FileSyncHelper method*), 171
wait_for_vfs_url() (*fastr.helpers.filesynchelper.FileSyncHelper method*), 171
warn_develop() (*fastr.helpers.configmanager.Config property*), 169
web_hostname() (*fastr.helpers.configmanager.Config property*), 169
web_url() (*fastr.helpers.configmanager.Config method*), 169
which() (*in module fastr.helpers.procutils*), 174
write() (*fastr.execution.job.Job method*), 146
write_bytes() (*fastr.core.target.SystemUsageInfo property*), 110

X

xnat() (*fastr.plugins.XNATStorage property*), 233
XNATStorage (*class in fastr.plugins*), 231