
decisionengine

Release 1.6.0rc

Fermilab

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CONTENTS

1	Release Notes	3
2	Developer Documentation	13
3	Source code	17
4	Indices and tables	49
	Python Module Index	51
	Index	53

The Decision Engine is a critical component of the HEP Cloud Facility. It provides the functionality of resource scheduling for disparate resource providers, including those which may have a cost or a restricted allocation of cycles

RELEASE NOTES

1.1 Release 1.5.0

In this release:

- Introduce data product query interface
- Cleanup of Lagic Engine code
- Improvements in error handling
- Improvements in testing and CI

1.1.1 Issues fixed in this release

- 217 , 218 : Add option to de-client --print-product to only print the column names in a data block and-or to print one or more records in key/value format ([fe7abcf](#))
- 240 : Logic Engine call leads to immediate taskmanager segfault exit ([d855aa0](#))
- 239 : implement data product browsing interface ([fe9faa9](#))

1.1.2 Full list of commits since version 1.4.1

[d66c54b](#) : Add PEP-0396 metadata (#243)

[bfc91a6](#) : More compat between psycpg2/psycpg2cffi (#248)

[f5d31a6](#) : Cleanup Fixture FIXME (#249)

[0dfaf3c](#) : Adding docker documentation (#251)

[4b166a2](#) : Since we are python3 only now, drop python-six compat layer (#252)

[fe7abcf](#) : Add format support to de-client (#217) (#241)

[df5a3d7](#) : Add wheel support for easier testing (#247)

[7de970d](#) : Add place to inject env if need be (#242)

[84e2930](#) : Fix race in test case (#250)

[d855aa0](#) : Fix fact-lookup to support duplicate names in separate rules. (#245)

[51370fb](#) : Resolve fixture 'quickstart' issue (#238)

[3ea9129](#) : Move from TravisCI to raw actions (#235)

fe9faa9 : implement data product browsing interface (#239)
cf0f3c0 : Add support to use custom base docker container to run tests (#234)
d91722f : Compat with psycpg2cffi (#233)
7d15a8c : Test failing source proxy. (#232)
b9a4bbb : Add debug logs for which threads are created #176 (#231)
6e6f4c9 : Updated Jenkins configuration documentation (#229)
2d9fd7b : Log if config passed validation #117 (#230)
60c46d3 : Self-test needs a real namespace to 'import numpy' in new python eval (#228)
a120077 : Test that the doc actually builds during CI (#227)
4b6240a : Extend timeout for coverage combine (#226)
b059696 : Update workflow per changes at github (#225)
7a71cac : Use newer compilers/runtimes (#224)
15ffd93 : Add header for strict includes (#222)
71b141a : Add special PyPy only requirement (#221)
9dbb932 : Move Python C extension to versioned .so file (#220)
ea7ade5 : Migrate from boost-python to pybind11 (#215)
e6b2eae : Add python 3.9 to testing matrix (#219)
04c8f9c : Add the option to print columns types on de-client (#216)
8815dc6 : Logic-engine cleanups (#211)
086d0d5 : fix missing back tick
54cc084 : modified release notes
24744cf : Synchronize access to the task managers (#214)
87a7fda : replde dash with underscore
743d0fd : try sphinx_rtd_theme
18c7909 : added 1.4.0 release notes
ff3d491 : force docker pull when building the docker container to make sure to use an updated base layer (#210)

1.2 Release 1.4.1

In this release:

- Bug fixes to 1.4.0 release

1.2.1 Issues fixed in this release

- [213](#) : de-client hangs under certain circumstances in version 1.4 and greater (race condition) ([84ecfe2](#))

1.2.2 Full list of commits since version 1.4.0

[9799b9a](#) : update release version to 1.4.1

[84ecfe2](#) : Synchronize access to the task managers (#214)

[751b6b8](#) : Address data races; remove need to sleep in unit tests (#205)

1.3 Release 1.4.0

In this release:

- Improvements in error handling and client/server interactions
- Added log rotation by time
- Improvements in code coverage

1.3.1 Issues fixed in this release

- [153](#) : Have de-client --print-product return different error message if product does not exist ([18a950c](#))
- [171](#) : yum update on decision engine rpm from python2 to python3 doesn't undo the symlinks ([eb85c97](#))
- [188](#) : Channel debug info now leaks into startup.log ([99d20a5](#))
- [208](#) : Error when trying to run reaper in version 1.4.0 ([84eccf3](#))

1.3.2 Full list of commits since version 1.3

[84eccf3](#) : Fix typo in reaper script. (#209)

[d836abf](#) : next RC

[926944a](#) : Fix coveralls reporting (#198)

[b95c323](#) : Updating base Dockerfile (#199)

[d302e31](#) : Help jsonnet, which doesn't understand PosixPath objects. (#204)

[2d791a7](#) : Test configuration policies. (#197)

[236e27a](#) : Ensure items are returned in a stable order (#202)

[e974f5f](#) : add pylint and pycodestyle (#203)

[fbc7616](#) : Test task manager (#196)

[686ca80](#) : require more recent version of pytest-postgresql (#195)

[99d20a5](#) : Fix double-logging problem. (#192)

[4ce3d17](#) : A set of fixtures to simplify unit tests (#183)

[65f8052](#) : Fix typo (#190)

f3a4be8 : Protect against None workers (#187)
ec310fb : remove py3 from package name
7006489 : bump version to 1.4.0rc
158d835 : decisionengine/framework/modules: Fix SourceProxy retries (#184)
1356bf1 : Add support to test any branch in Jenkins (#182)
692fa8e : Add timeout support for unit test on Jenkins (#181)
e3d6e6a : Updated Jenkins documentation to take into account unit tests timeout parametr (#180)
2586a3e : Configuration redesign (#168)
fac984d : Fix error with DBUtils import. Looks like names of modules changed (#175)
7d661ee : Move postgres-specific implementation to postgres source. (#174)
eb85c97 : Rpm (#173)
10fe843 : Adding log rotation by time (#170)
a8d239b : Various improvements. (#167)
d9b92ee : Ignore vim's *.swp files (#166)
d9f72ef : Fix call to shutdown_timeout (and add sample entry to config) (#165)
3161795 : Add drops for items using tables being dropped (#164)
77d186d : Show output of test runtimes in travis (#163)
81820a4 : Allow server to start with no channels. (#161)
49879a6 : DE server and client usability improvements (#160)
de91c4f : Add tests to default and override config (#158)
14df1f6 : Use python fallback for options (#159)
ac64a92 : Drop python 2.7 integration tests since we are python3 only (#157)
d963301 : Update Jenkins pipeline to properly test closing PR (#156)
64248cb : Merge 'runtime' tests into running channel tests (#150)
065ad77 : Adding Jenkins pipeline documentation (#155)
18a950c : fix print-product to report non-existing product as such (#154)
6493735 : Fix invalid attribute name (#152)
d953c6a : Remove unnecessary set_start_method call (#149)
c8c9b65 : guarantee that process is killed so test never hang (#147)
f1542b6 : Channel test (#146)
7f349a8 : Fix faulty TaskManager state type (#145)
d50f1c4 : fix logging regression introduced in f5e299969e0611e3480e9fa2782052df... (#142)
becfa26 : Pass the correct type. (#144)
1a60daf : DecisionEngine: fix typo (#143)
9e7b867 : Updating Jenkins pipeline configuration (#140)
e3a6703 : fix regression introduced in f5e299969e0611e3480e9fa2782052df86d7c4ed (#141)

4900bc6 : Restore runtime test. (#139)
0823f3d : Consolidate DE server/client tests into one file. (#138)
4f84435 : A few more access fixes.
160cfd1 : Fix task manager state access.
c00d819 : A few more cleanups.
ec087e2 : Various cleanups
a309ffe : Improvements to DE client CLI.

1.4 Release 1.3.0

In this release:

- Introduced Jsonnet based configuration system
- Improved logging
- Improved coverage of datasource

1.4.1 Full list of commits since version 1.2

239e82c : postgresql: improve SQL query (#133)
668eb1f : Update to make the code compatible with both python and JSON based config files (#129)
afd8837 : Configuration-manager fixes (#128)
571e2be : Remove pip installed system python packages
407d9ed : Update Dockerfile
1fefc69 : Implement unit tests for datablock.py (#122)
43c8d7a : Adjust global configuration to include program-option values. (#126)
2840813 : Switch to Jsonnet configuration system (#125)
5c4ae0e : logging changes: added config file and command line interface (#124)
6697f22 : Further config-manager testing and factorizations. (#123)
fa89fd0 : Insulate multiprocessing test from parent environment. (#120)
139a537 : Allow empty base directory for log file. (#119)
f14d40c : Factorize configuration-loading steps. (#118)
e00afee : Enhance testing and error reporting of ConfigManager (#117)
c3d1be3 : Python 3 upgrades. (#116)
e7399af : Header fix (#114)
0456abf : Adding editor config file, see <https://editorconfig.org/> (#115)
82112d1 : Dockerfile: fetch osg 3.5 repo rpm (#113)
97c21b1 : osg version 3.5 (#112)
33f28a8 : Introduce jsonnet dependency (#110)

3f8b55e : improve server error handling (#108)

f15588e : added 1.2.0 release notes

b433325 : Remove unnecessary 'main' functionality. (#107)

1.5 Release 1.2.0

In this release:

- Switched to python3
- Improved coverage
- Database data retention : added reaper to remove data older than configurable number of days
- Improved logging

1.5.1 decisionengine

3dfe167 : Jenkins pipeline improvements (#106)

22a7073 : pull request for review request 137 (#105)

cafff2 : Make it possible to run code directly (for tests), and (#100)

802e98b : replace psycog2 with psycog2-binary (#101)

573ce8f : Jenkins pipeline improvements (#99)

9d08835 : Run coveralls even under failed state (#97)

bc1df4b : Add tests for PostgreSQL datasource (#71)

c1ac391 : Fix missing py-modules.html (#96)

8dbfdee : Setup gh-pages doc workflow (#94)

cd4a01a : Doc (#93)

673080d : set version to 1.2.0 (for now). Supply conf file that corresponds to (#91)

f912225 : Db (#92)

dc8b68a : Add reaper to the RPC (#83) (#90)

29ade91 : adding .Jenkinsfile with Jenkins pipeline configuration (#86)

c1dfe5c : Don't exclude E1004 from pylint, do exclude line breaks (#89)

440f949 : Fix varname (#88)

313d135 : Compress (#87)

6b8dc4b : Revert "Add reaper to the RPC (#83)"

dbea8e5 : Update utils.sh so pytest will complete.

e848316 : Update to postgresql11

7f4b805 : Add reaper to the RPC (#83)

0ba2c51 : remove astpp module and dependencies it pulls in (#81)

6b8eab9 : don't track test coverage of tests (#80)

0da18ec : made reaper.py executable
aca24a3 : make reaper.py executable, make symbolic link to it from /usr/bin (#72)
0202acf : Implementation of data reaper (#70)
16b6be1 : Simple changes for Python 3 deployment (#69)
fd2418c : Fix warnings caught by PEP-8 Speaks.
d16359b : Python 3 (and other) simplifications.
3c7b6b7 : Only run Github Actions for python3.6 (#68)
453cbba : Update README.md
b27ed53 : remove unnecessary (and atually harmful) python shebang (#66)

1.5.2 decisionengine_modules

30d928b : clone version 1.2.0 of decisionengine
ae7c5a6 : Jenkins pipeline improvements (#236)
310befd : T198 (#235)
a65886d : Fix import as reported in : <https://github.com/HEPCloud/decisionengin...> (#232)
93711cc : Run coveralls even if tests fail (#229)
03d763a : Jenkins pipeline improvements (#230)
f48d30f : Fix/223 (#228)
c8aa262 : github ticket 199 (#222)
0323bda : Address : https://github.com/HEPCloud/decisionengine_modules/issues/224 (#226)
62e4df6 : Add support to run CI on Jenkins (#221)
5ab1541 : bump master version to 1.2.0 (for now) (#219)
bc19c65 : decisionengine_modules/NERSC: Added retry loop for NERSC API Calls (#220)
41a50de : Sync up pep8speaks and run_pylint.sh with decisionengine settings (#218)
db4634f : silence pylint error (#217)
1b95141 : Fix whitespace around operator error
746ea38 : ignore W503
8a8b5f4 : remove unused variable
a6668bf : fix PEP8 warnings
13773ee : address pep8 warnings
6bea4ca : silence pylint error
f589895 : Pass sort=True parameter to fix future warning (#215)
a1d0507 : fixing pep8 warning
a10bd17 : debugging one import error
ec501ad : make coveralls.io links work
deab1a7 : T201 (#204)

69f2645 : Add coverage

6d8a5f5 : decisionengine_modules/NERSC: Make Nersc API call backward-compatible with old config (#196)

a7e0af9 : Only run Github Actions for python3.6 (#24)

1.6 Release 1.1.0

In this release:

- Fixed. https://github.com/HEPCloud/decisionengine_modules/issues/108 “Supply Postgres script to delete fields in main database before a certain date”
- significant code cleanup and pep8 compliance
- unit test work
- CI (GitHub actions and Travis) is introduced

commits

f894b1d : Skip unittest (#77)

632e64b : Add ipython

f681a79 : Make python 2.7 tests run on 1.1 branch

d6a32c0 : implementation of data reaper (#75)

2ad8614 : Use sparse checkout for first checkout to get .github/actions (#65)

812f032 : Cat output of pytest log Exit pylint entrypoint with the line count of pep8 and pylint logs Deal with (detach from ...) Only tar up (S)RPMS dirs for rpm build.

6b05ec7 : Fix errors reported by run_pylint (#62)

d9f5b66 : Setup pep8speaks

c3b8ac2 : Run github actions as non-root uid. Install packages in virtualenv and remove system rpms.

ae01f9e : Support Python 3 for Boost Python

579761c : Support Python 3 for Boost Python

044b979 : Remove unnecessary using declarations.

00f6d00 : Add extra header dependency due to Boost Python omission.

24e0795 : Apply clang-format

17c17f9 : Remove JSON dependency.

faa0b22 : Massive cleanup.

07b555f : Updates to Github Actions to allow building with python3.6

fef6c11 : Fix errors when running pylint.sh multiple times

da6f077 : Autopep8 -i fixes

39fe5b3 : TaskManager: fix calling log_exception with correct number of arguments and minor format changes to reduce PEP8 warnings

17396da : logengine: get rid of compiler warnings

01dc3d1 : Only track what we need

b609d73 : Configure coveralls (and some minor cleanup)

bd9ed5e : Many C++ cleanups

2a61876 : Add Badges

c864f27 : Do not call pytest fixtures directly.

307db5f : white space fix

882b58f : fix unit tests

1da687c : Replace Boost facilities with C++ STL ones.

5a6e6b1 : Run tests on push

8404245 : Add missing Boost regex library dependency.

ceb5fe7 : Apply clang-format to files that were missed earlier.

3de9940 : Apply clang-format to C++ code.

8a8f560 : Cache venv directory instead

ad017ce : Build private boost for testing

928c64a : Test pip cache

358939a : Adjust CMakeLists.txt files to use correct Python versions

9f0ddb3 : Add pylint github action.

5e6ce4a : Remove more unused C++ files.

63717fe : Setup travis to use new cmake var

74fab2a : Use cmake argument -DPYVER=3.6 to build python3 library <https://fermicloud140.fnal.gov/reviews/r/31/>

843f30c : Minor cleanups per travis-lint

a538cac : Remove unused C++ files.

4c9d125 : Update repo where action is taken from

87fb2d9 : Update rpms installed in docker image. Update entrypoint.sh to use cmake3.

199ee87 : Find python3 libraries using cmake3 from epel rpm Also need to install python3-devel

4c79d2c : Remove unnused GNUmakefiles.

94342ee : Add unit test as a Github Action

1a0e102 : more advanced travis.yml

0be413f : Add helper file for pip

7794327 : Make recursive import happy

7005c78 : Add simple target

de8b0fa : python3 compliance: replace string.join() where appropriate, handle UserDict

2662e6c : note required packages

3b87119 : Add missing header includes.

3e79b84 : Remove defunct code and its tests

b1dbe1a : Ensure attritb are defined at **init**

[c4ad78a](#) : Correct logger arguments do avoid duplicate string parse

[a8dcc67](#) : Remove unused imports (per pylint)

[d3502b5](#) : Remove obsolete CVS directories.

[d744111](#) : add six module to the list of required modules

[0a9b1e8](#) : Fix class declaration

[b83157e](#) : Handle metaclasses

[549f33b](#) : Add config for Travis CI

[ee71044](#) : Drop trailing white space

[3f82af6](#) : Python3 forward compatible syntax

[28bf291](#) : Add safe (for python 2.7) python3 compatible syntax

[1d1d76f](#) : prepare for python3

DEVELOPER DOCUMENTATION

First command `cd` is just to make sure that you end up in a directory that will contain two subdirectory `decisionengine` and `decisionengine_modules`. Of course this can be done in any directory, not necessarily home directory.

2.1 Decisionengine framework

2.1.1 Prerequisites:

```
yum install -y https://dl.fedoraproject.org/pub/epel/epel-release-latest-7.noarch.rpm
yum install -y https://download.postgresql.org/pub/repos/yum/repos/pms/EL-7-x86_64/
➔ pgdg-redhat-repo-latest.noarch.rpm
yum install -y python3 python3-pip python36-devel postgresql11 postgresql11-server
pip3 install pandas DBUtils psycopg2-binary tabulate mock pytest toposort
```

2.1.2 Build & test

```
cd
git clone https://github.com/HEPCloud/decisionengine

export PYTHONPATH=`pwd`

python3 -m pytest

===== test session starts _
➔ =====
platform linux -- Python 3.6.8, pytest-6.0.1, py-1.9.0, pluggy-0.13.1
rootdir: /cloud/login/knoepfel/de-devel/decisionengine
plugins: timeout-1.4.2, postgresql-2.5.1, profiling-1.7.0
collected 89 items

framework/config/tests/test_config.py .....
➔ [ 14%]
framework/config/tests/test_policies.py ....
➔ [ 19%]
framework/dataspace/datasources/tests/test_postgresql.py .....
➔ [ 25%]
framework/dataspace/tests/test_Reaper.py .....
➔ [ 33%]
framework/dataspace/tests/test_datablock.py .....
➔ [ 49%]
```

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```

framework/engine/tests/test_client_only.py ..
↳ [ 51%]
framework/engine/tests/test_startup.py ..
↳ [ 53%]
framework/logicengine/tests/test_cascaded_rules.py ..
↳ [ 56%]
framework/logicengine/tests/test_construction.py .....
↳ [ 61%]
framework/logicengine/tests/test_facts.py .....
↳ [ 67%]
framework/logicengine/tests/test_pandas_fact.py ..
↳ [ 69%]
framework/logicengine/tests/test_rule_with_negated_fact.py ..
↳ [ 71%]
framework/logicengine/tests/test_simple_configuration.py ..
↳ [ 74%]
framework/taskmanager/tests/test_processing_state.py .....
↳ [ 79%]
framework/taskmanager/tests/test_task_manager.py ...
↳ [ 83%]
framework/tests/test_defaults.py ...
↳ [ 86%]
framework/tests/test_reaper.py ...
↳ [ 89%]
framework/tests/test_restart_channel.py .
↳ [ 91%]
framework/tests/test_sample_config.py ...
↳ [ 94%]
framework/tests/test_start_with_no_channels.py .
↳ [ 95%]
framework/util/tests/test_fs.py ...
↳ [ 98%]
framework/util/tests/test_tsort.py .
↳ [100%]

===== 89 passed in 90.01s (0:01:30)
↳ =====

```

2.2 Decisionengine_modules

2.2.1 Prerequisites:

In Addition to above installed packages

```

yum install condor
pip3 install htcondor boto boto3 google_auth google-api-python-client gcs-oauth2-boto-
↳ plugin

```

2.2.2 Test

```
cd

git clone https://github.com/HEPCloud/decisionengine_modules
python3 -m pytest decisionengine_modules
```

Current status:

```
[root@fermicloud371 tmp]# python3 -m pytest decisionengine_modules
===== test session starts =====
platform linux -- Python 3.6.8, pytest-5.3.5, py-1.8.1, pluggy-0.13.1
rootdir: /root/junjk
collected 85 items

decisionengine_modules/AWS/tests/test_AWSInstancePerformance.py ..
→ [ 2%]
decisionengine_modules/AWS/tests/test_AWSJobLimits.py ..
→ [ 4%]
decisionengine_modules/AWS/tests/test_AWSOccupancyWithSourceProxy.py ..
→ [ 7%]
decisionengine_modules/AWS/tests/test_AWSSpotPriceWithSourceProxy.py ..
→ [ 9%]
decisionengine_modules/AWS/tests/test_AWS_figure_of_merit_publisher.py ..
→ [ 11%]
decisionengine_modules/AWS/tests/test_AWS_price_performance_publisher.py ..
→ [ 14%]
decisionengine_modules/AWS/tests/test_FigureOfMerit.py ...
→ [ 17%]
decisionengine_modules/tests/test_AwsBurnRate.py ..
→ [ 20%]
decisionengine_modules/tests/test_GCEBillingInfo.py ..
→ [ 22%]
decisionengine_modules/tests/test_GCEFigureOfMerit_publisher.py ..
→ [ 24%]
decisionengine_modules/tests/test_GCEInstancePerformanceInfo.py ..
→ [ 27%]
decisionengine_modules/tests/test_GCEPricePerformance_publisher.py ..
→ [ 29%]
decisionengine_modules/tests/test_GCEResourceLimits.py ..
→ [ 31%]
decisionengine_modules/tests/test_GceBurnRate.py ..
→ [ 34%]
decisionengine_modules/tests/test_GceFigureOfMerit.py ..
→ [ 36%]
decisionengine_modules/tests/test_GceOccupancy.py ..
→ [ 38%]
decisionengine_modules/tests/test_NerscAllocationInfo.py ..
→ [ 41%]
decisionengine_modules/tests/test_NerscFigureOfMerit.py ..
→ [ 43%]
decisionengine_modules/tests/test_NerscFigureOfMerit_publisher.py ..
→ [ 45%]
decisionengine_modules/tests/test_NerscInstancePerformance.py ..
→ [ 48%]
decisionengine_modules/tests/test_NerscJobInfo.py ..
→ [ 50%]
```

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```

decisionengine_modules/tests/test_factory_client.py ....
↳ [ 55%]
decisionengine_modules/tests/test_factory_entries.py ....
↳ [ 60%]
decisionengine_modules/tests/test_factory_global.py ....
↳ [ 64%]
decisionengine_modules/tests/test_fomorderplugin.py ....
↳ [ 69%]
decisionengine_modules/tests/test_grid_figure_of_merit.py .
↳ [ 70%]
decisionengine_modules/tests/test_htcondor_query.py ....
↳ [ 75%]
decisionengine_modules/tests/test_job_clustering.py .....
↳ [ 81%]
decisionengine_modules/tests/test_job_clustering_publisher.py ..
↳ [ 83%]
decisionengine_modules/tests/test_job_q.py ...
↳ [ 87%]
decisionengine_modules/tests/test_slots.py ..
↳ [ 89%]
decisionengine_modules/tests/glideinwms/publishers/test_decisionenginemonitor.py ...
↳ [ 92%]
decisionengine_modules/tests/glideinwms/publishers/test_fe_group_classads.py ...
↳ [ 96%]
decisionengine_modules/tests/glideinwms/publishers/test_glideclientglobal.py ...
↳ [100%]

===== warnings summary
↳ =====
/usr/local/lib/python3.6/site-packages/boto/plugin.py:40
  /usr/local/lib/python3.6/site-packages/boto/plugin.py:40: DeprecationWarning: the
↳ imp module is deprecated in favour of importlib; see the module's documentation for
↳ alternative uses
  import imp

-- Docs: https://docs.pytest.org/en/latest/warnings.html
===== 85 passed, 1 warning in 9.73s
↳ =====

```

SOURCE CODE

3.1 Welcome to decisionengine's documentation!

3.1.1 decisionengine package

Subpackages

decisionengine.framework package

Subpackages

decisionengine.framework.config package

Subpackages

decisionengine.framework.config.tests package

Submodules

decisionengine.framework.config.tests.test_config module

```
decisionengine.framework.config.tests.test_config._channel_config_dir(relative_dir)
decisionengine.framework.config.tests.test_config._global_config_file(relative_filename)
decisionengine.framework.config.tests.test_config.load()
decisionengine.framework.config.tests.test_config.test_channel_empty_config(load,
                                                                              cap-
                                                                              sys,
                                                                              caplog)
decisionengine.framework.config.tests.test_config.test_channel_empty_dictionary(load,
                                                                                  caplog)
decisionengine.framework.config.tests.test_config.test_channel_loading(caplog)
decisionengine.framework.config.tests.test_config.test_channel_names(load)
decisionengine.framework.config.tests.test_config.test_channel_no_config_files(load)
decisionengine.framework.config.tests.test_config.test_channel_no_modules(load)
```

```
decisionengine.framework.config.tests.test_config.test_empty_config(load)
decisionengine.framework.config.tests.test_config.test_empty_dict(load)
decisionengine.framework.config.tests.test_config.test_empty_dict_with_leading_comment(load)
decisionengine.framework.config.tests.test_config.test_minimal_jsonnet_right_extension(load,
                                                                                          cap-
                                                                                          sys)
decisionengine.framework.config.tests.test_config.test_minimal_jsonnet_wrong_extension(load,
                                                                                          cap-
                                                                                          sys)
decisionengine.framework.config.tests.test_config.test_minimal_python(load,
                                                                                          cap-
                                                                                          sys)
decisionengine.framework.config.tests.test_config.test_wrong_type(load)
```

decisionengine.framework.config.tests.test_policies module

```
decisionengine.framework.config.tests.test_policies.test_channel_config_dir(tmp_path,
                                                                              mon-
                                                                              key-
                                                                              patch)
decisionengine.framework.config.tests.test_policies.test_global_config_dir(tmp_path,
                                                                              mon-
                                                                              key-
                                                                              patch)
decisionengine.framework.config.tests.test_policies.test_global_config_file(tmp_path,
                                                                              mon-
                                                                              key-
                                                                              patch)
decisionengine.framework.config.tests.test_policies.test_valid_dir(tmp_path)
```

Module contents

Submodules

decisionengine.framework.config.ChannelConfigHandler module

Manager of channel configurations.

The ChannelConfigHandler manages only channel configurations and not the global decision-engine configuration. It is responsible for loading channel configuration files and validating that the channels have the correct configuration artifacts and inter-module product dependencies.

```
class decisionengine.framework.config.ChannelConfigHandler.ChannelConfigHandler(global_config,
                                                                                      chan-
                                                                                      nel_config_dir)

    Bases: object

    _load_channel(channel_name, path)

    get_channels()
```

get_produces (*channel_config*)

load_all_channels ()

Load all channel configurations inside the stored channel-configuration directory.

Any cached configurations will be dropped prior to reloading.

load_channel (*channel_name*)

Load a single configuration for a channel with the supplied name.

The behavior is to read a configuration file whose path is:

<cached channel config. dir>/{channel_name}.jsonnet

where the cached channel-configuration directory was stored whenever the ChannelConfigHandler object was created, and {channel_name} is the value of the supplied method argument.

print_channel_config (*channel*)

decisionengine.framework.config.ChannelConfigHandler.**_check_keys** (*channel_conf_dict*)
check that channel config has mandatory keys :type data: dict

decisionengine.framework.config.ChannelConfigHandler.**_make_logger** (*global_config*)

decisionengine.framework.config.ChannelConfigHandler.**_validate** (*channel*)
Validate channels :type channel: dict

decisionengine.framework.config.ValidConfig module

ValidConfig represents a valid JSON document.

The decision engine requires each of its configuration files to be valid JSON. This is achieved by either supplying a valid Jsonnet or JSON document upfront, or by providing a Python dictionary that can be trivially converted to a JSON document.

Vetting of a file for JSON validity happens upon construction of a ‘ValidConfig’ object. A fully constructed ‘ValidConfig’ object thus corresponds to a valid JSON document.

class decisionengine.framework.config.ValidConfig.**ValidConfig** (*filename*)
Bases: collections.UserDict

ValidConfig represents a valid JSON configuration in the form of a dictionary.

In addition to the normal dictionary operations, users may call ‘dump()’ to print out in a string form the JSON configuration.

_abc_impl = <_abc._abc_data object>

dump ()

Print dictionary data to a valid JSON string.

decisionengine.framework.config.ValidConfig.**_config_from_file** (*config_file*)

decisionengine.framework.config.ValidConfig.**_convert_to_json** (*config_file*)
Attempt to convert JSON non-compliant configuration into a compliant one.

This is a temporary facility to aid the migration of Python-based configurations to Jsonnet-based ones. Python dictionaries that are similar in structure to JSON documents are generally trivially convertible.

decisionengine.framework.config.policies module

Decision-engine default configuration policies.

For the decision-engine process, the configuration policies are:

- The global configuration file must be named ‘decision_engine.jsonnet’ and it must reside in (a) a directory that can be accessed through the ‘CONFIG_PATH’ environment variable, or (b) the /etc/decisionengine directory.
- All channel configurations must reside in (a) a directory accessible through the ‘CHANNEL_CONFIG_PATH’ environment variable, or (b) a ‘config.d’ subdirectory of the /etc/decisionengine directory.

The utilities provided in this module provide simple means of accessing the configuration artifacts according to the policies listed above. Please consult the documentation for each function below for more detailed information.

`decisionengine.framework.config.policies.channel_config_dir` (*parent_dir=None*)

Retrieve the channel configuration directory as a `pathlib.Path` object.

This function returns a path object according to the following precedence rules:

1. If the ‘parent_dir’ argument is provided, the returned path object will correspond to ‘{parent_dir}/config.d’.
2. If the ‘CHANNEL_CONFIG_PATH’ environment variable has been set, the returned path object will correspond to ‘{CHANNEL_CONFIG_PATH}’.
3. If neither 1 or 2 apply, the returned path object corresponds to ‘{global_config_dir()}/config.d’ (see documentation for ‘global_config_dir()’).

Regardless of the precedence rule used, the returned path object must be a valid directory or an exception will be raised—i.e. if the ‘parent_dir’ argument is supplied, and the resulting path object is not a valid directory, the function will exit with an exception and not attempt rule 2 or 3.

`decisionengine.framework.config.policies.global_config_dir` ()

Retrieve global configuration dir as `pathlib.Path` object.

This is the directory that houses the ‘decision_engine.jsonnet’ global configuration file.

This function checks that the ‘CONFIG_PATH’ variable has been set or will use /etc/decisionengine otherwise. If the path exists as a directory, then the directory path is returned as a string; otherwise an exception is raised.

`decisionengine.framework.config.policies.global_config_file` (*parent_dir=None*)

Return the `pathlib.Path` object corresponding to the global configuration.

If supplied, the ‘parent_dir’ is assumed to be the full path corresponding to a directory containing the ‘decision_engine.jsonnet’ file. If not provided, the global configuration directory is determined based on the behavior of the ‘global_config_dir()’ function.

An exception is raised if no ‘decision_engine.jsonnet’ file is found.

`decisionengine.framework.config.policies.valid_dir` (*path, scope*)

Throws if the supplied path object is not a directory, otherwise returns the path object.

Module contents

decisionengine.framework.dataspace package

Subpackages

decisionengine.framework.dataspace.datasources package

Subpackages

decisionengine.framework.dataspace.datasources.tests package

Submodules

decisionengine.framework.dataspace.datasources.tests.fixtures module

pytest fixtures/constants

`decisionengine.framework.dataspace.datasources.tests.fixtures.mock_data_block()`
This fixture replaces the standard datablock implementation.

The current DataBlock implementation does not own any data products but forwards them immediately to a backend datasource. The only implemented datasource requires Postgres, which is overkill when needing to test simple data-product communication between modules.

This mock datablock class directly owns the data products, thus avoiding the need for a datasource backend. It is anticipated that a future design of the DataBlock will own the data products, thus making this mock class unnecessary.

decisionengine.framework.dataspace.datasources.tests.test_postgresql module

`decisionengine.framework.dataspace.datasources.tests.test_postgresql.data()`

`decisionengine.framework.dataspace.datasources.tests.test_postgresql.dataproduct()`

`decisionengine.framework.dataspace.datasources.tests.test_postgresql.datasource(postgresql, data)`

`decisionengine.framework.dataspace.datasources.tests.test_postgresql.header(data)`

`decisionengine.framework.dataspace.datasources.tests.test_postgresql.metadata(data)`

`decisionengine.framework.dataspace.datasources.tests.test_postgresql.taskmanager()`

`decisionengine.framework.dataspace.datasources.tests.test_postgresql.test_create_tables(data)`

`decisionengine.framework.dataspace.datasources.tests.test_postgresql.test_generate_insert_c`

`decisionengine.framework.dataspace.datasources.tests.test_postgresql.test_get_last_generat`

`decisionengine.framework.dataspace.datasources.tests.test_postgresql.test_get_taskmanager`

```
decisionengine.framework.dataspace.datasources.tests.test_postgresql.test_insert (datasource,
dat-
aprod-
uct,
header,
meta-
data)

decisionengine.framework.dataspace.datasources.tests.test_postgresql.test_store_taskmanager
```

Module contents

Submodules

decisionengine.framework.dataspace.datasources.postgresql module

```
class decisionengine.framework.dataspace.datasources.postgresql.Postgresql (config_dict)
    Bases: decisionengine.framework.dataspace.datasource.DataSource
    Implementation of postgresql data source
    __query (query_string, values=None, cursor_factory=None)
    _abc_impl = <_abc._abc_data object>
    _delete (sql_query, values=None)
    _insert (table_name_or_sql_query, record=None)
    _insert_returning_result (table_name_or_sql_query, record=None)
    _remove (sql_query, values=None)
    _select (query_string, values=None, cursor_factory=None)
    _select_dictresult (sql_query, values=None)
    _select_getresult (sql_query, values=None)
    _select_tuple (sql_query, values)
    _update (query_string, values=None)
    _update_returning_result (query_string, values=None)
    close ()
        Close all connections to the database
    connect ()
        Create a pool of database connections
    create_tables ()
        Create database tables
    delete_data_older_than (days)
        Delete data older than days interval :type days: int :arg days: remove data older than days interval
    duplicate_datablock (taskmanager_id, generation_id, new_generation_id)
        For the given taskmanager_id, make a copy of the datablock with given generation_id, set the generation_id
        for the datablock copy
```

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **new_generation_id** (int) – generation_id of the new datablock created

get_connection ()

get_datablock (taskmanager_id, generation_id)

Return the entire datablock from the dataproduct table for the given taskmanager_id, generation_id

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data

get_dataproduct (taskmanager_id, generation_id, key)

Return the data from the dataproduct table for the given taskmanager_id, generation_id, key

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **key** (string) – key for the value

get_dataproducts (taskmanager_id)

Return list of all data products associated with with taskmanager_id

get_header (taskmanager_id, generation_id, key)

Return the header from the header table for the given taskmanager_id, generation_id, key

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **key** (string) – key for the value

get_last_generation_id (taskmanager_name, taskmanager_id=None)

Return last generation id for current task manager or taskmanager w/ task_manager_id.

Parameters

- **name** (string) – task manager name
- **taskmanager_id** (string) – task manager id

get_metadata (taskmanager_id, generation_id, key)

Return the metadata from the metadata table for the given taskmanager_id, generation_id, key

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **key** (string) – key for the value

get_schema (table=None)

Given the table name return it's schema

Parameters **table** (string) – Name of the table

get_taskmanager (taskmanager_name, taskmanager_id=None)

Retrieve TaskManager :type taskmanager_name: string :arg taskmanager_name: name of taskmanager to retrieve :type taskmanager_id: string :arg taskmanager_id: id of taskmanager to retrieve

get_taskmanagers (taskmanager_name=None, start_time=None, end_time=None)

Retrieve TaskManagers :type taskmanager_name: string :arg taskmanager_name: name of taskmanager to retrieve :type taskmanager_id: string :arg taskmanager_id: id of taskmanager to retrieve

insert (taskmanager_id, generation_id, key, value, header, metadata)

Insert data into respective tables for the given taskmanager_id, generation_id, key

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **key** (string) – key for the value
- **value** (object) – Value can be an object or dict
- **header** (Header) – Header for the value
- **header** – Metadata for the value

store_taskmanager (name, taskmanager_id)

Store TaskManager :type taskmanager_name: string :arg taskmanager_name: name of taskmanager to retrieve :type taskmanager_id: string :arg taskmanager_id: id of taskmanager to retrieve

tables = {'dataprodukt': ['taskmanager_id TEXT', 'generation_id INT', 'key TEXT', 'va

update (taskmanager_id, generation_id, key, value, header, metadata)

Update the data in respective tables for the given taskmanager_id, generation_id, key

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **key** (string) – key for the value
- **value** (object) – Value can be an object or dict
- **header** (Header) – Header for the value
- **header** – Metadata for the value

decisionengine.framework.dataspace.datasources.postgresql.**generate_insert_query** (table_name, keys)

Generate insert query given table name and list of fields

Parameters

- **table_name** (str) – Name of the table to insert into
- **keys** – List of column names

Keys list

Return type str - insert query

Module contents

Submodules

decisionengine.framework.dataspace.datablock module

```
class decisionengine.framework.dataspace.datablock.DataBlock (dataspace,  
                                                         name, taskman-  
                                                         ager_id=None,  
                                                         genera-  
                                                         tion_id=None, se-  
                                                         quence_id=None)
```

Bases: object

__insert (*key, value, header, metadata*)
Insert a new product into database with header and metadata

__setitem (*key, value, header, metadata=None*)
put a product in the database with header and metadata

__update (*key, value, header, metadata*)
Update an existing product in the database with header and metadata

duplicate ()
Duplicate the datablock and return this new DataBlock. The intent is that at the point the duplication occurs there is only information from the sources in the DataBlock. This also increments the generation_id of this DataBlock.

TODO: Also update the header and the metadata information TODO: Make this threadsafe

Return type *DataBlock*

get (*key, default=None*)
Return the value associated with the key in the database

Return type dict

get_dataproducts ()

get_header (*key*)
Return the Header associated with the key in the database

Return type *Header*

get_metadata (*key*)
Return the metadata associated with the key in the database

Return type *Metadata*

get_taskmanager (*taskmanager_name, taskmanager_id=None*)
Retrieve TaskManager :type taskmanager_name: string :arg taskmanager_name: name of taskmanager to retrieve :type taskmanager_id: string :arg taskmanager_id: id of taskmanager to retrieve :rtype: :obj: dict

The dictionary returned looks like : {'datestamp': datetime.datetime(2017, 12, 20, 17, 37, 17, 503210,

```
        tzinfo=psycogp2.tz.FixedOffsetTimezone(offset=-360, name=None)),
        'sequence_id': 135L, 'name': 'AWS_Calculations', 'taskmanager_id': '77B16EB5-C79E-
        45B0-B1B1-37E846692E1D'})

is_expired (key=None)
    Check if the dataproduct for a given key or any key is expired

keys ()

mark_expired (expiration_time)
    Set the expiration_time for the current generation of the dataproduct and mark it as expired if expira-
    tion_time <= current time

put (key, value, header, metadata=None)
    Put data into the DataBlock

store_taskmanager (taskmanager_name, taskmanager_id)
    Persist TaskManager, returns sequence number :type taskmanager_name: string :type taskmanager_id:
    :obj: string :rtype: int

class decisionengine.framework.dataspace.datablock.Header (taskmanager_id, create_time=None, expira-
tion_time=None, sched-
uled_create_time=None,
creator='module',
schema_id=None)

    Bases: collections.UserDict

    _abc_impl = <_abc._abc_data object>

    default_data_lifetime = 1800

    is_valid ()
        Check if the Header has minimum required information

    required_keys = {'create_time', 'creator', 'expiration_time', 'scheduled_create_time',

exception decisionengine.framework.dataspace.datablock.InvalidMetadataError
    Bases: Exception

    Errors due to invalid Metadata

class decisionengine.framework.dataspace.datablock.Metadata (taskmanager_id,
state='NEW', gener-
ation_id=None, gen-
eration_time=None,
missed_update_count=0)

    Bases: collections.UserDict

    _abc_impl = <_abc._abc_data object>

    required_keys = {'generation_id', 'generation_time', 'missed_update_count', 'state', '

    set_state (state)
        Set the state for the Metadata

    valid_states = {'END_CYCLE', 'METADATA_UPDATE', 'NEW', 'START_BACKUP'}

decisionengine.framework.dataspace.datablock.compress (obj)
    Compress python object :param obj: python object :return: compressed object
```

`decisionengine.framework.dataspace.datablock.decompress (zbytes)`
 Decompress zipped byte stream, convert to string. :param zbytes: byte stream :return: uncompressed string

`decisionengine.framework.dataspace.datablock.zdumps (obj)`
 Pickle and compress :param obj: a python object :return: compressed string

`decisionengine.framework.dataspace.datablock.zloads (zbytes)`
 Decompress and unpickle If input is not compressed attempts to just unpickle it

Parameters **zbytes** – compressed bytes

Returns returns python object

decisionengine.framework.dataspace.datasource module

class `decisionengine.framework.dataspace.datasource.DataSource (config)`
 Bases: object

_abc_impl = `<_abc._abc_data object>`

abstract close ()
 Close all connections to the database

abstract connect ()
 Create a pool of database connections

abstract create_tables ()
 Create database tables

dataproducit_table = `'dataproducit'`
 Name of the dataproducit table

abstract delete_data_older_than (days)
 Delete data older that interval :type days: long :arg days: remove data older than interval

abstract duplicate_datablock (taskmanager_id, generation_id, new_generation_id)
 For the given taskmanager_id, make a copy of the datablock with given generation_id, set the generation_id for the datablock copy

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **new_generation_id** (int) – generation_id of the new datablock created

abstract get_datablock (taskmanager_id, generation_id)
 Return the entire datablock from the dataproducit table for the given taskmanager_id, generation_id

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data

abstract get_dataproduct (taskmanager_id, generation_id, key)
 Return the data from the dataproducit table for the given taskmanager_id, generation_id, key

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data

- **key** (string) – key for the value

abstract get_dataproducts (taskmanager_id)

Return list of all data products associated with taskmanager_id

abstract get_header (taskmanager_id, generation_id, key)

Return the header from the header table for the given taskmanager_id, generation_id, key

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **key** (string) – key for the value

abstract get_last_generation_id (name, taskmanager_id=None)

Return last generation id for current task manager or taskmanager w/ task_manager_id.

Parameters

- **name** (string) – task manager name
- **taskmanager_id** (string) – task manager id

abstract get_metadata (taskmanager_id, generation_id, key)

Return the metadata from the metadata table for the given taskmanager_id, generation_id, key

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **key** (string) – key for the value

abstract get_schema (table=None)

Given the table name return it's schema

Parameters table (string) – Name of the table

abstract get_taskmanager (taskmanager_name, taskmanager_id)

Retrieve TaskManager :type taskmanager_name: string :arg taskmanager_name: name of taskmanager to retrieve :type taskmanager_id: string :arg taskmanager_id: id of taskmanager to retrieve

abstract get_taskmanagers (taskmanager_name=None, start_time=None, end_time=None)

Retrieve TaskManagers :type taskmanager_name: string :arg taskmanager_name: name of taskmanager to retrieve :type taskmanager_id: string :arg taskmanager_id: id of taskmanager to retrieve

header_table = 'header'

Name of the header table

abstract insert (taskmanager_id, generation_id, key, value, header, metadata)

Insert data into respective tables for the given taskmanager_id, generation_id, key

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **key** (string) – key for the value
- **value** (object) – Value can be an object or dict
- **header** (Header) – Header for the value

- **header** – Metadata for the value

metadata_table = 'metadata'

Name of the metadata table

abstract store_taskmanager (*taskmanager_name, taskmanager_id*)

Store TaskManager :type taskmanager_name: string :arg taskmanager_name: name of taskmanager to

retrieve :type taskmanager_id: string :arg taskmanager_id: id of taskmanager to retrieve

taskmanager_table = 'taskmanager'

Name of the taskmanager table

abstract update (*taskmanager_id, generation_id, key, value, header, metadata*)

Update the data in respective tables for the given taskmanager_id, generation_id, key

Parameters

- **taskmanager_id** (string) – taskmanager_id for generation to be retrieved
- **generation_id** (int) – generation_id of the data
- **key** (string) – key for the value
- **value** (object) – Value can be an object or dict
- **header** (Header) – Header for the value
- **header** – Metadata for the value

decisionengine.framework.dataspace.dataspace module

class decisionengine.framework.dataspace.dataspace.**DataSourceLoader** (**args, **kwargs*)

Bases: object

_ds = None

static create_datasource (*module_name, class_name, config*)

class decisionengine.framework.dataspace.dataspace.**DataSpace** (*config*)

Bases: object

DataSpace class is collection of datablocks and provides interface to the database used to store the actual data

_tables_created = False

Description of tables and their columns

close ()

delete (*taskmanager_id, all_generations=False*)

duplicate_datablock (*taskmanager_id, generation_id, new_generation_id*)

get_dataproduct (*taskmanager_id, generation_id, key*)

get_dataproducts (*taskmanager_id*)

get_header (*taskmanager_id, generation_id, key*)

get_last_generation_id (*taskmanager_name, taskmanager_id=None*)

get_metadata (*taskmanager_id, generation_id, key*)

get_taskmanager (*taskmanager_name, taskmanager_id=None*)

get_taskmanagers (*taskmanager_name=None, start_time=None, end_time=None*)

```
insert (taskmanager_id, generation_id, key, value, header, metadata)
mark_demented (taskmanager_id, keys, generation_id=None)
mark_expired (taskmanager_id, generation_id, key, expiry_time)
store_taskmanager (name, id)
update (taskmanager_id, generation_id, key, value, header, metadata)

exception decisionengine.framework.dataspace.dataspace.DataSpaceConfigurationError
    Bases: Exception
    Errors related to database access

exception decisionengine.framework.dataspace.dataspace.DataSpaceConnectionError
    Bases: Exception
    Errors related to database access

exception decisionengine.framework.dataspace.dataspace.DataSpaceError
    Bases: Exception
    Errors related to database access

exception decisionengine.framework.dataspace.dataspace.DataSpaceExistsError
    Bases: Exception
    Errors related to database access

class decisionengine.framework.dataspace.dataspace.Reaper (config)
    Bases: object
    Reaper provides functionality of periodic deletion of data older than retention_interval in days

    __has_state_no_lock (this_state)
        During startup we check state, but we don't want to lock and prevent the thread from changing the state.
        That is the condition we are actively looking for!

    __reaper_loop (delay)
        The first thing this loop does should be to set the state to State.STARTING so the caller can validate the
        thread is in fact running and doing things.

    __set_state (value)

    get_retention_interval ()

    get_state ()

    reap ()

    set_retention_interval (interval)

    start (delay=0)
        Start thread with an optional delay to start the thread in X seconds

    stop ()

class decisionengine.framework.dataspace.dataspace.Singleton
    Bases: type
    Singleton pattern using Metaclass http://stackoverflow.com/questions/6760685/creating-a-singleton-in-python

    _instances = {}
```

```

class decisionengine.framework.dataspace.dataspace.State (value)
    Bases: enum.Enum

    An enumeration.

    ERROR = 7
    IDLE = 1
    RUNNING = 3
    SLEEPING = 4
    STARTING = 2
    STOPPED = 6
    STOPPING = 5

```

Module contents

decisionengine.framework.engine package

Submodules

decisionengine.framework.engine.DecisionEngine module

Main loop for Decision Engine. The following environment variable points to decision engine configuration file: `DECISION_ENGINE_CONFIG_FILE` if this environment variable is not defined the `DE-Config.py` file from the `../tests/etc/` directory will be used.

```

class decisionengine.framework.engine.DecisionEngine.DecisionEngine (global_config,
                                                                    chan-
                                                                    nel_config_loader,
                                                                    server_address)

    Bases: socketserver.ThreadingMixIn, xmlrpc.server.SimpleXMLRPCServer

    _dispatch (method, params)
        Dispatches the XML-RPC method.

        XML-RPC calls are forwarded to a registered function that matches the called XML-RPC method name.
        If no such function exists then the call is forwarded to the registered instance, if available.

        If the registered instance has a _dispatch method then that method will be called with the name of the
        XML-RPC method and its parameters as a tuple e.g. instance._dispatch('add',(2,3))

        If the registered instance does not have a _dispatch method then the instance will be searched to find a
        matching method and, if found, will be called.

        Methods beginning with an '_' are considered private and will not be called.

    block_until (state)

    block_while (state)

    get_logger ()

    handle_sighup (signum, frame)

    reaper_start (delay)

    reaper_status ()

```

```
reaper_stop ()
rpc_block_while (state_str)
rpc_get_channel_log_level (channel)
rpc_get_log_level ()
rpc_print_product (product, columns=None, query=None, types=False, format=None)
rpc_print_products ()
rpc_reaper_start (delay=0)
    Start the reaper process after 'delay' seconds. Default 0 seconds delay. :type delay: int
rpc_reaper_status ()
rpc_reaper_stop ()
rpc_set_channel_log_level (channel, log_level)
    Assumes log_level is a string corresponding to the supported logging-module levels.
rpc_show_config (channel)
    Show the configuration for a channel.

rpc_show_de_config ()
rpc_start_channel (channel_name)
rpc_start_channels ()
rpc_status ()
rpc_stop ()
rpc_stop_channel (channel)
rpc_stop_channels ()
start_channel (channel_name, channel_config)
start_channels ()
stop_channel (channel)
stop_channels ()
stop_worker (worker)

class decisionengine.framework.engine.DecisionEngine.RequestHandler (request,
                                                                    client_address,
                                                                    server)
    Bases: xmlrpc.server.SimpleXMLRPCRequestHandler
    rpc_paths = ('/RPC2',)

decisionengine.framework.engine.DecisionEngine._channel_preamble (name)
decisionengine.framework.engine.DecisionEngine._create_de_server (global_config,
                                                                    chan-
                                                                    nel_config_loader)
    Create the DE server with the passed global configuration and config manager
decisionengine.framework.engine.DecisionEngine._get_de_conf_manager (global_config_dir,
                                                                    chan-
                                                                    nel_config_dir,
                                                                    options)
```

```
decisionengine.framework.engine.DecisionEngine._get_global_config(config_file,
                                                                options)
```

```
decisionengine.framework.engine.DecisionEngine._start_de_server(global_config,
                                                                chan-
                                                                nel_config_loader)
```

Create and start the DE server with the passed global configuration and config manager

```
decisionengine.framework.engine.DecisionEngine.main(args=None)
```

If *args* is *None*, *sys.argv* will be used instead. If *args* is a list, it will be used instead of *sys.argv* (for unit testing)

```
decisionengine.framework.engine.DecisionEngine.parse_program_options(args=None)
```

If *args* is a list, it will be used instead of *sys.argv*

decisionengine.framework.engine.Workers module

```
class decisionengine.framework.engine.Workers.Worker(task_manager, logger_config)
```

Bases: multiprocessing.context.Process

Class that encapsulates a channel's task manager as a separate process.

This class' run function is called whenever the process is started. If the process is abruptly terminated—e.g. the run method is pre-empted by a signal or an *os._exit(n)* call—the Worker object will still exist even if the operating-system process no longer does.

To determine the exit code of this process, use the *Worker.exitcode* value, provided by the multiprocessing.Process base class.

```
get_state_name ()
```

```
run ()
```

Method to be run in sub-process; can be overridden in sub-class

```
wait_until (state)
```

```
wait_while (state)
```

```
class decisionengine.framework.engine.Workers.Workers
```

Bases: object

This class manages and provides access to the task-manager workers.

The intention is that the decision engine never directly interacts with the workers but refers to them via a context manager:

```
with workers.access() as ws: # Access to ws now protected ws['new_channel'] = Worker(...)
```

In cases where the decision engine's *block_while* or *block_until* methods must be called (e.g. during tests), one should use the unguarded access:

```
with workers.unguarded_access() as ws: # Access to ws is unprotected
    ws['new_channel'].wait_until(...)
```

Calling a blocking method while using the protected context manager (i.e. *workers.access()*) will likely result in a deadlock.

```
class Access(workers, lock)
```

Bases: object

```
_update_channel_states ()
```

```
access ()
```

```
unguarded_access ()
```

decisionengine.framework.engine.de_client module

```
decisionengine.framework.engine.de_client.create_parser()  
decisionengine.framework.engine.de_client.execute_command_from_args(argsparsed,  
                                                                    de_socket)  
    argsparsed should be from create_parser in this file  
decisionengine.framework.engine.de_client.main(args_to_parse=None)  
    If you pass a list of args, they will be used instead of sys.argv
```

Module contents

decisionengine.framework.logicengine package

Subpackages

decisionengine.framework.logicengine.tests package

Submodules

decisionengine.framework.logicengine.tests.test_cascaded_rules module

```
decisionengine.framework.logicengine.tests.test_cascaded_rules.myengine()  
decisionengine.framework.logicengine.tests.test_cascaded_rules.test_rule_that_does_not_fire()  
decisionengine.framework.logicengine.tests.test_cascaded_rules.test_rule_that_fires(myengine)
```

decisionengine.framework.logicengine.tests.test_construction module

```
decisionengine.framework.logicengine.tests.test_construction.test_configuration_with_fact_v  
decisionengine.framework.logicengine.tests.test_construction.test_configuration_with_nu  
decisionengine.framework.logicengine.tests.test_construction.test_default_construction()  
    LogicEngine is not default constructible.  
decisionengine.framework.logicengine.tests.test_construction.test_trivial_configuration()  
    Logic engine constructed with trivial rules and facts.  
decisionengine.framework.logicengine.tests.test_construction.test_wrong_configuration()  
    LogicEngine construction requires rules and facts; if we don't supply them it is an error.
```

decisionengine.framework.logicengine.tests.test_duplicate_fact_names module

```
decisionengine.framework.logicengine.tests.test_duplicate_fact_names.test_duplicate_fact_names()
```

decisionengine.framework.logicengine.tests.test_facts module

```
decisionengine.framework.logicengine.tests.test_facts.make_db(maximum)
decisionengine.framework.logicengine.tests.test_facts.test_compound_fact()
decisionengine.framework.logicengine.tests.test_facts.test_fact_using_numpy_array()
decisionengine.framework.logicengine.tests.test_facts.test_fact_using_numpy_function()
decisionengine.framework.logicengine.tests.test_facts.test_fact_with_nested_names()
decisionengine.framework.logicengine.tests.test_facts.test_simple_fact()
```

decisionengine.framework.logicengine.tests.test_pandas_fact module

```
decisionengine.framework.logicengine.tests.test_pandas_fact.mydata(y)
    Return a 'datablock' surrogate carrying a Pandas DataFrame, and a parameter named 'y' with value y.
decisionengine.framework.logicengine.tests.test_pandas_fact.myengine()
decisionengine.framework.logicengine.tests.test_pandas_fact.test_rule_that_does_not_fire(myengine)
    Rules that do not fire do not create entries in the returned actions and newfacts.
decisionengine.framework.logicengine.tests.test_pandas_fact.test_rule_that_fires(myengine)
```

decisionengine.framework.logicengine.tests.test_rule_with_negated_fact module

```
decisionengine.framework.logicengine.tests.test_rule_with_negated_fact.myengine()
decisionengine.framework.logicengine.tests.test_rule_with_negated_fact.test_rule_that_does_not_fire(myengine)
    Rules that do not fire do not create entries in the returned actions and newfacts.
decisionengine.framework.logicengine.tests.test_rule_with_negated_fact.test_rule_that_fires(myengine)
```

decisionengine.framework.logicengine.tests.test_simple_configuration module

```
decisionengine.framework.logicengine.tests.test_simple_configuration.myengine()
decisionengine.framework.logicengine.tests.test_simple_configuration.test_rule_that_does_not_fire(myengine)
    Rules that do not fire do not create entries in the returned actions and newfacts.
decisionengine.framework.logicengine.tests.test_simple_configuration.test_rule_that_fires(myengine)
```

Module contents

Submodules

decisionengine.framework.logicengine.BooleanExpression module

```
class decisionengine.framework.logicengine.BooleanExpression.BooleanExpression (expr)
    Bases: object

    evaluate (d)
        Return the evaluated Boolean value of this expression in the context of the given data 'd'.

exception decisionengine.framework.logicengine.BooleanExpression.LogicError
    Bases: TypeError

decisionengine.framework.logicengine.BooleanExpression.function_name_from_call (callnode)
```

decisionengine.framework.logicengine.FactLookup module

```
class decisionengine.framework.logicengine.FactLookup.FactLookup (fact_names,
                                                                rules_cfg)
    Bases: object
```

Establishes a policy for looking up a fact based on the given name.

To wit, the first fact with a given name is the one that is used in the evaluation of all subsequent facts.

As an example, consider the following configuration:

```
facts: { should_publish: "(True)",
}, rules: {
    publish_1: { expression: "should_publish", facts: ["should_publish"]
    }, publish_2: {
        expression: "should_publish", actions: ["go_to_press"] facts: ["should_publish"]
    } retract: {
        expression: "not should_publish", facts: ["should_retract"]
    }
}
```

In the above, the first fact to be evaluated will always be the top-level facts (i.e. those not encapsulated by the 'rules' table). The rules labeled 'publish_1' and 'publish_2' both rely on the 'should_publish' fact in their expressions, and they in turn create their own facts with the same name. FactLookup ensures that 'publish_1' and 'publish_2' will both use the evaluated fact from the top-level 'facts' table.

```
rule_for (fact_name)
```

Selects rule required to evaluate fact with the supplied name.

Parameters **fact_name** (*str*) – Name of fact for which rule will be selected.

Return type *str*

Returns Rule name

```
sorted_rules (rules_cfg)
```

Rules sorted according to rule dependencies.

Parameters **rules_cfg** (*dict*) – rules as specified in logic-engine configuration

Return type list

Returns Rules to be evaluated by the rule engine.

decisionengine.framework.logicengine.LogicEngine module

```
class decisionengine.framework.logicengine.LogicEngine.LogicEngine (cfg)
    Bases: decisionengine.framework.modules.Module.Module
    _create_facts_dataframe (newfacts)
        Convert newfacts dict in format below to dataframe with columns ['rule_name', 'fact_name', fact_value']
        facts dict format: 'newfacts': {
            'publish_glidein_requests': { 'allow_hpc_new': True, 'allow_foo': True
            }, 'dummy_rule': {
                'dummy_new_fact': True
            }
        }
    consumes ()
        Return the names of all the items that must be in the DataBlock for the rules to be evaluated.
    evaluate (db)
        Evaluate our facts and rules, in the context of the given data. db can be any mappable, in particular a
        DataBlock or dictionary.
        Parameters db (DataBlock) – Products used to evaluate facts.
    evaluate_facts (db)
        Parameters db (DataBlock) – Products used to evaluate facts.
        Return type dict
        Returns Evaluated fact values (e.g. True or False) for each fact name.
    produces ()
```

decisionengine.framework.logicengine.Rule module

```
class decisionengine.framework.logicengine.Rule.Rule (rule_name, rule_cfg)
    Bases: object
    In-memory representation of logic-engine rule, relying on parsing utilities in BooleanExpression.
    evaluate (evaluated_facts)
        Evaluates a compiled expression given the supplied facts.
        Parameters evaluated_facts (dict) – Initial fact values (e.g. True or False) for each fact
        name.
        Return type bool
```

decisionengine.framework.logicengine.RuleEngine module

class decisionengine.framework.logicengine.RuleEngine.**RuleEngine** (*fact_names*,
rules_cfg)

Bases: object

Engine responsible for evaluating logic-engine rules.

This class is responsible for (a) forming a sorted set of rules that supports dependencies between them, and (b) evaluating the rules according to a specified fact-lookup policy.

execute (*evaluated_facts*)

Evaluates all rules given the supplied facts.

Parameters **evaluated_facts** (*dict*) – Initial fact values (e.g. True or False) for each fact name.

Return type tuple

Returns Actions to be taken based on rule evaluation; new facts produced during that evaluation.

Module contents

decisionengine.framework.modules package

Submodules

decisionengine.framework.modules.LogicEngine module

class decisionengine.framework.modules.LogicEngine.**LogicEngine** (*set_of_parameters*)

Bases: *decisionengine.framework.modules.Module.Module*

evaluate (*data_block*)

decisionengine.framework.modules.Module module

class decisionengine.framework.modules.Module.**Module** (*set_of_parameters*)

Bases: object

get_data_block ()

get_paramaters ()

set_data_block (*data_block*)

decisionengine.framework.modules.Publisher module

class decisionengine.framework.modules.Publisher.**Publisher** (*set_of_parameters*)

Bases: *decisionengine.framework.modules.Module.Module*

consumes (*name_list*)

publish (*data_block=None*)

decisionengine.framework.modules.Source module

```
class decisionengine.framework.modules.Source.Source (set_of_parameters)
    Bases: decisionengine.framework.modules.Module.Module

    acquire ()

    post_create (global_config)

    produces (name_schema_id_list)
```

decisionengine.framework.modules.SourceProxy module

Fill in data from another channel data block

```
class decisionengine.framework.modules.SourceProxy.SourceProxy (*args,
                                                                **kwargs)
```

Bases: *decisionengine.framework.modules.Source.Source*

Source Proxy Channel configuration using source proxy must have in parameters 'channel_name', defining foreign channel name and 'Dataproducts', defining foreign (and optionally local) data keys. See consumes() doc. Example of source proxy configuration:

```
    "AWSJobLimits": { "module": "modules.source_proxy", "name": "SourceProxy", "parameters":
    {"channel_name": "channel_aws_config_data",
      "Dataproducts": [("aws_instance_limits", "Job_Limits")], "retries": 3,
      "retry_timeout": 20,
    },
    "schedule": 360,
  },
  _get_data (data_block, key)

  acquire ()
    Overrides Source class method

  consumes ()

    Assumes that self.datakeys has the following structure: is a list of tuples or singletons: [
      (data_product_name, data_product_name_translation), .... ] or [ data_product_name, ....
    ]

  must_have = ('channel_name', 'Dataproducts')

  post_create (global_config)

  produces ()
```

Assumes that self.datakeys has the following structure or

```
decisionengine.framework.modules.SourceProxy.main ()
```

Call this a a test unit or use as CLI of this module

```
decisionengine.framework.modules.SourceProxy.module_config_info ()
```

print this module configuration information

```
decisionengine.framework.modules.SourceProxy.module_config_template ()
```

print a template for this module configuration data

decisionengine.framework.modules.Transform module

```
class decisionengine.framework.modules.Transform.Transform(set_of_parameters)
    Bases: decisionengine.framework.modules.Module.Module

    consumes (name_list)

    produces (name_schema_id_list)

    transform()
```

decisionengine.framework.modules.de_logger module

Logger to use in all modules

```
decisionengine.framework.modules.de_logger.get_logger()
    get default logger - "decision_engine":rtype: logging.Logger - rotating file logger
```

```
decisionengine.framework.modules.de_logger.set_logging(log_level,    file_rotate_by,
                                                         rotation_time_unit,
                                                         rotation_interval,
                                                         max_backup_count,
                                                         max_file_size=200000000,
                                                         log_file_name='/tmp/decision_engine_logs/decision_
```

Parameters

- **log_level** (str) – log level
- **file_rotate_by** – files rotation by size or by time
- **rotation_time_unit** (str) – unit of time for file rotation
- **rotation_interval** (int) – time in rotation_time_units between file rotations
- **log_file_name** (str) – log file name
- **max_file_size** (int) – maximal size of log file. If reached save and start new log.
- **max_backup_count** (int) – start rotaion after this number is reached

Return type logging.Logger - rotating file logger

```
decisionengine.framework.modules.de_logger.set_stream_logging(logger_name="")
    This is for debugging. Set stream logging for logger.
```

Parameters **logger_name** (str) – logger name

Return type logging.Logger

Module contents

decisionengine.framework.taskmanager package

Submodules

decisionengine.framework.taskmanager.ProcessingState module

The ProcessingState class can represent any of the following task-manager states:

BOOT STEADY OFFLINE SHUTTINGDOWN SHUTDOWN ERROR

In addition, the class supports ‘wait_until(state)’ and ‘wait_while(state)’ methods, which, when called from a different process, block until the state has been entered or exited, respectively.

```
class decisionengine.framework.taskmanager.ProcessingState.ProcessingState (state=<State.BOOT:
                                                                    0>)
    Bases: object
    get ()
    has_value (state)
    inactive ()
    set (state)
    should_stop ()
    wait_until (state)
    wait_while (state)

class decisionengine.framework.taskmanager.ProcessingState.State (value)
    Bases: enum.Enum
    An enumeration.
    BOOT = 0
    ERROR = 5
    OFFLINE = 4
    SHUTDOWN = 3
    SHUTTINGDOWN = 2
    STEADY = 1
```

decisionengine.framework.taskmanager.TaskManager module

Task Manager

```
class decisionengine.framework.taskmanager.TaskManager.Channel (channel_dict)
    Bases: object
    Decision Channel. Instantiates workers according to channel configuration

class decisionengine.framework.taskmanager.TaskManager.TaskManager (name,
                                                                    genera-
                                                                    tion_id,
                                                                    chan-
                                                                    nel_dict,
                                                                    global_config)
    Bases: object
    Task Manager
    data_block_put (data, header, data_block)
        Put data into data block

    Parameters
        • data (dict) – key, value pairs
```

- **header** (*Header*) – data header
- **data_block** (*DataBlock*) – data block

decision_cycle ()

Decision cycle to be run periodically (by trigger)

do_backup ()

Duplicate current data block and return its copy

Return type *DataBlock*

get_loglevel ()

get_state ()

get_state_name ()

get_state_value ()

run ()

Task Manager main loop

run_logic_engine (*data_block=None*)

Run Logic Engine.

Parameters **data_block** (*DataBlock*) – data block

run_publishers (*actions, facts, data_block=None*)

Run Publishers in main process.

Parameters **data_block** (*DataBlock*) – data block

run_source (*src*)

Get the data from source and put it into the data block

Parameters **src** (*Worker*) – source Worker

run_transform (*transform, data_block*)

Run a transform

Parameters

- **transform** (*Worker*) – source Worker
- **data_block** (*DataBlock*) – data block

run_transforms (*data_block=None*)

Run transforms. So far in main process.

Parameters **data_block** (*DataBlock*) – data block

set_loglevel (*log_level*)

Assumes log_level is a string corresponding to the supported logging-module levels.

start_sources (*data_block=None*)

Start sources, each in a separate thread

Parameters **data_block** (*DataBlock*) – data block

take_offline (*current_data_block*)

offline and stop task manager

wait_for_all (*events_done*)

Wait for all sources or transforms to finish

Parameters **events_done** (*list*) – list of events to wait for

wait_for_any (*events_done*)
Wait for any sources to finish

Parameters **events_done** (*list*) – list of events to wait for

class `decisionengine.framework.taskmanager.TaskManager.Worker` (*conf_dict*)
Bases: `object`

Provides interface to loadable modules an events to synchronise execution

`decisionengine.framework.taskmanager.TaskManager._create_worker` (*module_name*,
class_name,
parameters)

Create instance of dynamically loaded module

`decisionengine.framework.taskmanager.TaskManager._make_workers_for` (*configs*)

Module contents

decisionengine.framework.tests package

Submodules

decisionengine.framework.tests.FailingPublisher module

class `decisionengine.framework.tests.FailingPublisher.FailingPublisher` (*config*)
Bases: `decisionengine.framework.modules.Publisher.Publisher`
consumes (*name_list*)
publish (*data_block*)

decisionengine.framework.tests.FailingSourceProxy module

class `decisionengine.framework.tests.FailingSourceProxy.FailingSourceProxy` (*config*)
Bases: `decisionengine.framework.modules.SourceProxy.SourceProxy`
acquire ()
Overrides Source class method
produces ()
Assumes that `self.datakeys` has the following structure `data_keys[key1] = (data_product_name, data_product_name_translation) ...` or

decisionengine.framework.tests.PublisherNOP module

class `decisionengine.framework.tests.PublisherNOP.PublisherNOP` (*config*)
Bases: `decisionengine.framework.modules.Publisher.Publisher`
consumes (*name_list=None*)
publish (*data_block=None*)

decisionengine.framework.tests.SourceNOP module

```
class decisionengine.framework.tests.SourceNOP.SourceNOP (config)
    Bases: decisionengine.framework.modules.Source.Source

    acquire ()

    produces ()
```

decisionengine.framework.tests.TransformNOP module

```
class decisionengine.framework.tests.TransformNOP.TransformNOP (config)
    Bases: decisionengine.framework.modules.Transform.Transform

    consumes (name_list=None)

    produces (name_schema_id_list=None)

    transform (data_block)
```

decisionengine.framework.tests.fixtures module

defaults for pytest

```
decisionengine.framework.tests.fixtures.DEServer (conf_path=None,
                                                    conf_override=None,      chan-
                                                    nel_conf_path=None,      chan-
                                                    nel_conf_override=None,
                                                    host='127.0.0.1',      port=None,
                                                    pg_prog_name='PG_PROG',
                                                    pg_db_conn_name='DE_DB')
```

A DE Server using a private database

```
decisionengine.framework.tests.fixtures.DE_DB (request: _pytest.fixtures.FixtureRequest)
    → psycopg2.extensions.connection
```

Fixture factory for PostgreSQL.

Parameters **request** (*FixtureRequest*) – fixture request object

Returns postgresql client

```
decisionengine.framework.tests.fixtures.PG_PROG (request:
    _pytest.fixtures.FixtureRequest,
    tmpdir_factory:
    _pytest.tmpdir.TempdirFactory) →
    pytest_postgresql.executor.PostgreSQLExecutor
```

Process fixture for PostgreSQL.

Parameters **request** (*FixtureRequest*) – fixture request object

Return type *pytest_dbfixtures.executors.TCPExecutor*

Returns tcp executor

decisionengine.framework.tests.test_client_server module

Fixture based DE Server for the de-client tests

`decisionengine.framework.tests.test_client_server.test_client_print_product` (*deserver*)

decisionengine.framework.tests.test_defaults module

Fixture based DE Server tests of the sample config

`decisionengine.framework.tests.test_defaults.test_client_can_get_de_server_show_channel_log_level`
Verify unknown channel has NOTSET

`decisionengine.framework.tests.test_defaults.test_client_de_config_is_json` (*deserver*)
Verify config can be fetched in json format

`decisionengine.framework.tests.test_defaults.test_global_channel_log_level_in_config` (*deserver*)
Verify global_channel_log_level setting exists

decisionengine.framework.tests.test_failing_source_proxy module

Fixture based DE Server tests of the server without channels, then with them

`decisionengine.framework.tests.test_failing_source_proxy.test_stop_failing_source_proxy` (*deserver*)

decisionengine.framework.tests.test_reaper module

Fixture based DE Server for the reaper tests

`decisionengine.framework.tests.test_reaper.test_client_can_get_de_server_reaper_start_delay`
Verify reaper can start with delay

`decisionengine.framework.tests.test_reaper.test_client_can_get_de_server_reaper_status` (*deserver*)
Verify reaper status

`decisionengine.framework.tests.test_reaper.test_client_can_get_de_server_reaper_stop` (*deserver*)
Verify reaper can stop

decisionengine.framework.tests.test_restart_channel module

`decisionengine.framework.tests.test_restart_channel.deserver_mock_data_block` (*mock_data_block*)

`decisionengine.framework.tests.test_restart_channel.test_restart_channel` (*deserver_mock_data_block*)

decisionengine.framework.tests.test_sample_config module

Fixture based DE Server tests of the defaults

decisionengine.framework.tests.test_sample_config.test_client_can_get_de_server_show_config

Verify config has expected items

decisionengine.framework.tests.test_sample_config.test_client_can_get_de_server_show_loglevel

Verify can fetch log level

decisionengine.framework.tests.test_sample_config.test_client_can_get_de_server_status (deser

Verify channel enters stable state

decisionengine.framework.tests.test_start_with_no_channels module

Fixture based DE Server tests of the server without channels, then with them

decisionengine.framework.tests.test_start_with_no_channels.deserver_mock_data_block (mock_data

decisionengine.framework.tests.test_start_with_no_channels.test_start_from_nothing (deserver_m

Module contents

decisionengine.framework.util package

Submodules

decisionengine.framework.util.fs module

decisionengine.framework.util.fs.files_with_extensions (dir_path, *extensions)

Return all files in dir_path that match the provided extensions.

If no extensions are given, then all files in dir_path are returned.

Results are sorted by channel name to ensure stable output.

decisionengine.framework.util.sockets module

decisionengine.framework.util.sockets.get_random_port ()

decisionengine.framework.util.tsort module

See:

https://en.wikipedia.org/wiki/Topological_sorting

Kahn's topological sorting algorithm

L Empty list that will contain the sorted elements S Set of all nodes with no incoming edge while S is non-empty do

remove a node n from S add n to tail of L for each node m with an edge e from n to m do

remove edge e from the graph if m has no other incoming edges then

insert m into S

if graph has edges then return error (graph has at least one cycle)

else return L (a topologically sorted order)

`decisionengine.framework.util.tsort.tsort` (*graph*)

Function implementing Kahn's topological sorting algorithm returns two lists : sorted list and cyclic lost (if graph is acyclic second list is always None)

Return type list

Module contents

Submodules

`decisionengine.framework.about` module

PEP-0396 provides instructions for providing module versions While we are at it, add a few other useful bits

Module contents

Module contents

3.2 Indices and tables

- `genindex`
- `modindex`
- `search`

INDICES AND TABLES

- `genindex`
- `modindex`
- `search`

PYTHON MODULE INDEX

d

decisionengine, 47	38
decisionengine.framework, 47	36
decisionengine.framework.about, 47	decisionengine.framework.logicengine.BooleanExpress
decisionengine.framework.config, 21	36
decisionengine.framework.config.ChannelConfigHandler,	decisionengine.framework.logicengine.LogicEngine,
18	37
decisionengine.framework.config.policies,	decisionengine.framework.logicengine.Rule,
20	37
decisionengine.framework.config.tests,	decisionengine.framework.logicengine.RuleEngine,
18	38
decisionengine.framework.config.tests.test_config,	decisionengine.framework.logicengine.tests,
17	36
decisionengine.framework.config.tests.test_policies,	decisionengine.framework.logicengine.tests.test_ca
18	34
decisionengine.framework.config.ValidConfig,	decisionengine.framework.logicengine.tests.test_cor
19	34
decisionengine.framework.dataspace, 31	decisionengine.framework.logicengine.tests.test_du
decisionengine.framework.dataspace.datablock,	35
25	decisionengine.framework.logicengine.tests.test_fa
decisionengine.framework.dataspace.datasource,	35
27	decisionengine.framework.logicengine.tests.test_pa
decisionengine.framework.dataspace.datasources,	35
25	decisionengine.framework.logicengine.tests.test_ru
decisionengine.framework.dataspace.datasources.postgresql,	35
22	decisionengine.framework.logicengine.tests.test_si
decisionengine.framework.dataspace.datasources.tests,	35
22	decisionengine.framework.modules, 40
decisionengine.framework.dataspace.datasources.tests.fixtures,	decisionengine.framework.modules.de_logger,
21	40
decisionengine.framework.dataspace.datasources.tests.test_postgresql,	decisionengine.framework.modules.LogicEngine,
21	38
decisionengine.framework.dataspace.dataspace,	decisionengine.framework.modules.Module,
29	38
decisionengine.framework.engine, 34	decisionengine.framework.modules.Publisher,
decisionengine.framework.engine.de_client,	38
34	decisionengine.framework.modules.Source,
decisionengine.framework.engine.DecisionEngine,	39
31	decisionengine.framework.modules.SourceProxy,
decisionengine.framework.engine.Workers,	39
33	decisionengine.framework.modules.Transform,
decisionengine.framework.logicengine,	40

decisionengine.framework.taskmanager,
 [43](#)
decisionengine.framework.taskmanager.ProcessingState,
 [40](#)
decisionengine.framework.taskmanager.TaskManager,
 [41](#)
decisionengine.framework.tests, [46](#)
decisionengine.framework.tests.FailingPublisher,
 [43](#)
decisionengine.framework.tests.FailingSourceProxy,
 [43](#)
decisionengine.framework.tests.fixtures,
 [44](#)
decisionengine.framework.tests.PublisherNOP,
 [43](#)
decisionengine.framework.tests.SourceNOP,
 [44](#)
decisionengine.framework.tests.test_client_server,
 [45](#)
decisionengine.framework.tests.test_defaults,
 [45](#)
decisionengine.framework.tests.test_failing_source_proxy,
 [45](#)
decisionengine.framework.tests.test_reaper,
 [45](#)
decisionengine.framework.tests.test_restart_channel,
 [45](#)
decisionengine.framework.tests.test_sample_config,
 [46](#)
decisionengine.framework.tests.test_start_with_no_channels,
 [46](#)
decisionengine.framework.tests.TransformNOP,
 [44](#)
decisionengine.framework.util, [47](#)
decisionengine.framework.util.fs, [46](#)
decisionengine.framework.util.sockets,
 [46](#)
decisionengine.framework.util.tsort, [46](#)

INDEX

Symbols

<code>__has_state_no_lock()</code>	(decisionengine.framework.dataspace.dataspace.Reaper method), 30	<code>__ds</code> (decisionengine.framework.dataspace.dataspace.DataSourceLoader attribute), 29
<code>__query()</code> (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 22	<code>__get_data()</code> (decisionengine.framework.modules.SourceProxy.SourceProxy method), 39	<code>__get_data()</code> (decisionengine.framework.modules.SourceProxy.SourceProxy method), 39
<code>_abc_impl</code> (decisionengine.framework.config.ValidConfig.ValidConfig attribute), 19	<code>_get_global_config_manager()</code> (in module decisionengine.framework.engine.DecisionEngine), 32	<code>_get_global_config()</code> (in module decisionengine.framework.engine.DecisionEngine), 33
<code>_abc_impl</code> (decisionengine.framework.dataspace.datablock.Header attribute), 26	<code>_global_config_file()</code> (in module decisionengine.framework.config.tests.test_config), 17	<code>_insert()</code> (decisionengine.framework.dataspace.datablock.DataBlock method), 25
<code>_abc_impl</code> (decisionengine.framework.dataspace.datablock.Metadata attribute), 26	<code>_insert()</code> (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 22	<code>_insert_returning_result()</code> (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 22
<code>_abc_impl</code> (decisionengine.framework.dataspace.datasources.DataSource attribute), 27	<code>_instances</code> (decisionengine.framework.dataspace.dataspace.Singleton attribute), 30	<code>_load_channel()</code> (decisionengine.framework.config.ChannelConfigHandler.ChannelConfig method), 18
<code>_abc_impl</code> (decisionengine.framework.dataspace.datasources.postgresql.Postgresql attribute), 22	<code>_make_logger()</code> (in module decisionengine.framework.config.ChannelConfigHandler), 19	<code>_make_workers_for()</code> (in module decisionengine.framework.taskmanager.TaskManager), 43
<code>_channel_config_dir()</code> (in module decisionengine.framework.config.tests.test_config), 17	<code>_make_workers_for()</code> (in module decisionengine.framework.taskmanager.TaskManager), 43	<code>_reaper_loop()</code> (decisionengine.framework.dataspace.dataspace.Reaper method), 30
<code>_channel_preamble()</code> (in module decisionengine.framework.engine.DecisionEngine), 32	<code>_remove()</code> (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 22	<code>_select()</code> (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 22
<code>_check_keys()</code> (in module decisionengine.framework.config.ChannelConfigHandler), 19	<code>_select()</code> (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 22	<code>_select_dictresult()</code> (decisionengine.framework.engine.DecisionEngine method), 31
<code>_config_from_file()</code> (in module decisionengine.framework.config.ValidConfig), 19	<code>_select_dictresult()</code> (decisionengine.framework.engine.DecisionEngine method), 31	
<code>_convert_to_json()</code> (in module decisionengine.framework.config.ValidConfig), 19		
<code>_create_de_server()</code> (in module decisionengine.framework.engine.DecisionEngine), 32		
<code>_create_facts_dataframe()</code> (decisionengine.framework.logicengine.LogicEngine.LogicEngine method), 37		
<code>_create_worker()</code> (in module decisionengine.framework.taskmanager.TaskManager), 43		
<code>_delete()</code> (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 22		
<code>_dispatch()</code> (decisionengine.framework.engine.DecisionEngine method), 31		

`engine.framework.dataspace.datasources.postgresql.Postgresql`
`method), 22`
`_select_getresult()` `(decisionengine.framework.dataspace.datasources.postgresql.Postgresql`
`method), 22`
`_select_tuple()` `(decisionengine.framework.dataspace.datasources.postgresql.Postgresql`
`method), 22`
`_set_state()` `(decisionengine.framework.taskmanager.ProcessingState.State`
`method), 22`
`_setitem()` `(decisionengine.framework.taskmanager.TaskManager), 41`
`_start_de_server()` `(in module decisionengine.framework.config.policies), 20`
`33`
`_tables_created` `(decisionengine.framework.config.ChannelConfigHandler), 18`
`attribute), 29`
`_update()` `(decisionengine.framework.dataspace.datablock.DataBlock`
`method), 25`
`_update()` `(decisionengine.framework.dataspace.datasources.postgresql.Postgresql`
`method), 22`
`_update_channel_states()` `(decisionengine.framework.dataspace.dataspace.DataSource`
`method), 33`
`_update_returning_result()` `(decisionengine.framework.dataspace.dataspace.DataSource`
`method), 22`
`_validate()` `(in module decisionengine.framework.logice.engine.LogicEngine.LogicEngine`
`method), 19`
A
`access()` `(decisionengine.framework.modules.SourceProxy.SourceProxy`
`method), 33`
`acquire()` `(decisionengine.framework.modules.Transform.Transform`
`method), 39`
`acquire()` `(decisionengine.framework.modules.Transform.Transform`
`method), 39`
`acquire()` `(decisionengine.framework.tests.FailingSourceProxy.FailingSourceProxy`
`method), 43`
`acquire()` `(decisionengine.framework.tests.FailingPublisher.FailingPublisher`
`method), 44`
B
`block_until()` `(decisionengine.framework.tests.TransformNOP.TransformNOP`
`method), 31`
`block_while()` `(decisionengine.framework.tests.TransformNOP.TransformNOP`
`method), 31`

create_tables() (decisionengine.framework.dataspace.datasource.DataSource module, 21
 method), 27
 create_tables() (decisionengine.framework.config.ChannelConfigHandle module, 18
 decisionengine.framework.config.policies module, 20
 decisionengine.framework.config.tests module, 18
 decisionengine.framework.config.tests.test_config module, 17
 decisionengine.framework.config.tests.test_policies module, 18
 data() (in decisionengine.framework.dataspace.datasources.tests.test_postgresql module, 21
 data_block_put() (decisionengine.framework.taskmanager.TaskManager module, 19
 method), 41
 DataBlock (class in decisionengine.framework.dataspace.datablock module, 25
 dataproduct() (in decisionengine.framework.dataspace.datasources.tests.test_postgresql module, 21
 decisionengine.framework.dataspace.datasources module, 25
 dataproduct_table (decisionengine.framework.dataspace.datasource.DataSource module, 22
 attribute), 27
 DataSource (class in decisionengine.framework.dataspace.datasource module, 27
 decisionengine.framework.dataspace.datasources.test module, 22
 decisionengine.framework.dataspace.datasources.test module, 21
 decisionengine.framework.dataspace.datasources.test module, 21
 DataSourceLoader (class in decisionengine.framework.dataspace.dataspace module, 29
 decisionengine.framework.engine module, 34
 DataSpace (class in decisionengine.framework.dataspace.dataspace module, 29
 decisionengine.framework.engine.de_client module, 34
 DataSpaceConfigurationError, 30
 DataSpaceConnectionError, 30
 DataSpaceError, 30
 DataSpaceExistsError, 30
 DE_DB() (in decisionengine.framework.tests.fixtures module, 44
 decision_cycle() (decisionengine.framework.taskmanager.TaskManager module, 42
 method), 42
 decisionengine module, 47
 DecisionEngine (class in decisionengine.framework.engine.DecisionEngine module, 31
 decisionengine.framework module, 47
 decisionengine.framework.about module, 47
 decisionengine.framework.config

module, 34
 decisionengine.framework.logicengine.tests.decisionengine.framework.tests.test_restart_channel
 module, 34
 decisionengine.framework.logicengine.tests.decisionengine.framework.tests.test_sample_config
 module, 35
 decisionengine.framework.logicengine.tests.decisionengine.framework.tests.test_start_with_no_
 module, 35
 decisionengine.framework.logicengine.tests.decisionengine.framework.tests.TransformNOP
 module, 35
 decisionengine.framework.logicengine.tests.decisionengine.framework.util.fs
 module, 35
 decisionengine.framework.modules decisionengine.framework.util.sockets
 module, 40
 module, 46
 decisionengine.framework.modules.de_logger decisionengine.framework.util.tsort
 module, 40
 module, 46
 decisionengine.framework.modules.LogicEngine (in module decision-
 module, 38 engine.framework.dataspace.datablock),
 26
 decisionengine.framework.modules.Module default_data_lifetime (decision-
 module, 38 engine.framework.dataspace.datablock.Header
 attribute), 26
 decisionengine.framework.modules.Publisher
 module, 38
 decisionengine.framework.modules.Source delete () (decisionengine.framework.dataspace.dataspace.DataSpace
 module, 39 method), 29
 decisionengine.framework.modules.SourceProxy delete_data_older_than () (decision-
 module, 39 engine.framework.dataspace.datasource.DataSource
 method), 27
 decisionengine.framework.modules.Transform delete_data_older_than () (decision-
 module, 40 engine.framework.dataspace.datasources.postgresql.Postgresql
 method), 22
 decisionengine.framework.taskmanager DESerializer (in module decision-
 module, 40 engine.framework.tests.fixtures), 44
 decisionengine.framework.taskmanager.TaskManager mock_data_block ()
 module, 41 (in module decision-
 engine.framework.tests.test_restart_channel),
 45
 decisionengine.framework.tests FailingPublisher mock_data_block ()
 module, 43 (in module decision-
 engine.framework.tests.test_start_with_no_channels),
 46
 decisionengine.framework.tests.FailingSourceProxy
 module, 43
 decisionengine.framework.tests.fixtures do_backup () (decision-
 module, 44 engine.framework.taskmanager.TaskManager.TaskManager
 method), 42
 decisionengine.framework.tests.PublisherNOP dump () (decisionengine.framework.config.ValidConfig.ValidConfig
 module, 43 method), 19
 decisionengine.framework.tests.SourceNOP duplicate () (decision-
 module, 44 engine.framework.dataspace.datablock.DataBlock
 method), 25
 decisionengine.framework.tests.test_client_server duplicate_data_block () (decision-
 module, 45 engine.framework.dataspace.datasource.DataSource
 method), 27
 decisionengine.framework.tests.test_default duplicate_data_block () (decision-
 module, 45 engine.framework.dataspace.datasources.postgresql.Postgresql
 method), 27
 decisionengine.framework.tests.test_failing_source
 module, 45
 decisionengine.framework.tests.test_reaper

method), 22
 duplicate_datablock() (decisionengine.framework.dataspace.dataspace.DataSpace method), 29
E
 ERROR (decisionengine.framework.dataspace.dataspace.State attribute), 31
 ERROR (decisionengine.framework.taskmanager.ProcessingState.State attribute), 41
 evaluate() (decisionengine.framework.logicengine.BooleanExpression.BooleanExpression method), 36
 evaluate() (decisionengine.framework.logicengine.LogicEngine.LogicEngine method), 37
 evaluate() (decisionengine.framework.logicengine.Rule.Rule method), 37
 evaluate() (decisionengine.framework.modules.LogicEngine.LogicEngine method), 38
 evaluate_facts() (decisionengine.framework.logicengine.LogicEngine.LogicEngine method), 37
 execute() (decisionengine.framework.logicengine.RuleEngine.RuleEngine method), 38
 execute_command_from_args() (in module decisionengine.framework.engine.de_client), 34
F
 FactLookup (class in decisionengine.framework.logicengine.FactLookup), 36
 FailingPublisher (class in decisionengine.framework.tests.FailingPublisher), 43
 FailingSourceProxy (class in decisionengine.framework.tests.FailingSourceProxy), 43
 files_with_extensions() (in module decisionengine.framework.util.fs), 46
 function_name_from_call() (in module decisionengine.framework.logicengine.BooleanExpression), 36
G
 generate_insert_query() (in module decisionengine.framework.dataspace.datasources.postgresql), 24
 get() (decisionengine.framework.dataspace.datablock.DataBlock method), 25
 get() (decisionengine.framework.taskmanager.ProcessingState.ProcessingState method), 41
 get_channels() (decisionengine.framework.config.ChannelConfigHandler.ChannelConfig method), 18
 get_connection() (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 23
 get_data_block() (decisionengine.framework.modules.Module.Module method), 38
 get_datablock() (decisionengine.framework.dataspace.datasource.DataSource method), 27
 get_datablock() (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 23
 get_dataproduct() (decisionengine.framework.dataspace.datasource.DataSource method), 27
 get_dataproduct() (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 23
 get_dataproduct() (decisionengine.framework.dataspace.dataspace.DataSpace method), 29
 get_dataproducts() (decisionengine.framework.dataspace.datablock.DataBlock method), 25
 get_dataproducts() (decisionengine.framework.dataspace.datasource.DataSource method), 28
 get_dataproducts() (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 23
 get_dataproducts() (decisionengine.framework.dataspace.dataspace.DataSpace method), 29
 get_header() (decisionengine.framework.dataspace.datablock.DataBlock method), 25
 get_header() (decisionengine.framework.dataspace.datasource.DataSource method), 28
 get_header() (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 23
 get_header() (decisionengine.framework.dataspace.dataspace.DataSpace method), 29
 get_last_generation_id() (decisionengine.framework.dataspace.datasource.DataSource method), 28
 get_last_generation_id() (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 23

get_last_generation_id()	(decisionengine.framework.dataspace.dataspace.DataSpace method), 29	nengine.framework.taskmanager.TaskManager.TaskManager method), 42
get_logger()	(decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 25	get_taskmanager() (decisionengine.framework.dataspace.datablock.DataBlock method), 25
get_logger() (in module decisionengine.framework.modules.de_logger), 40		get_taskmanager() (decisionengine.framework.dataspace.datasource.DataSource method), 28
get_loglevel()	(decisionengine.framework.taskmanager.TaskManager.TaskManager method), 42	get_taskmanager() (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 24
get_metadata()	(decisionengine.framework.dataspace.datablock.DataBlock method), 25	get_taskmanager() (decisionengine.framework.dataspace.dataspace.DataSpace method), 29
get_metadata()	(decisionengine.framework.dataspace.datasource.DataSource method), 28	get_taskmanagers() (decisionengine.framework.dataspace.datasource.DataSource method), 28
get_metadata()	(decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 23	get_taskmanagers() (decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 24
get_metadata()	(decisionengine.framework.dataspace.dataspace.DataSpace method), 29	get_taskmanagers() (decisionengine.framework.dataspace.dataspace.DataSpace method), 29
get_paramaters()	(decisionengine.framework.modules.Module.Module method), 38	global_config_dir() (in module decisionengine.framework.config.policies), 20
get_produces()	(decisionengine.framework.config.ChannelConfigHandler.ChannelConfigHandler method), 18	global_config_file() (in module decisionengine.framework.config.policies), 20
get_random_port() (in module decisionengine.framework.util.sockets), 46		handle_sighup() (decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 31
get_retention_interval()	(decisionengine.framework.dataspace.dataspace.Reaper method), 30	has_value() (decisionengine.framework.taskmanager.ProcessingState.ProcessingState method), 41
get_schema()	(decisionengine.framework.dataspace.datasource.DataSource method), 28	Header (class in decisionengine.framework.dataspace.datablock), 26
get_schema()	(decisionengine.framework.dataspace.datasources.postgresql.Postgresql method), 23	header() (in module decisionengine.framework.dataspace.datasources.tests.test_postgresql), 21
get_state()	(decisionengine.framework.dataspace.dataspace.Reaper method), 30	header_table (decisionengine.framework.dataspace.datasource.DataSource attribute), 28
get_state()	(decisionengine.framework.taskmanager.TaskManager.TaskManager method), 42	
get_state_name()	(decisionengine.framework.engine.Workers.Worker method), 33	IDLE (decisionengine.framework.dataspace.dataspace.State attribute), 31
get_state_name()	(decisionengine.framework.taskmanager.TaskManager.TaskManager method), 42	inactive() (decisionengine.framework.taskmanager.ProcessingState.ProcessingState method), 41
get_state_value()	(decisionengine.framework.taskmanager.TaskManager.TaskManager method), 42	insert() (decisionengine.framework.dataspace.datasource.DataSource method), 28

insert () (decisionengine.framework.dataspace.datasources.postgresql.Postgresql, (decisionengine.framework.dataspace.dataspace.DataSpace method), 24
 insert () (decisionengine.framework.dataspace.dataspace.DataSpace method), 30
 Metadata (class in decisionengine.framework.dataspace.datablock),
 InvalidMetadataError, 26
 is_expired () (decisionengine.framework.dataspace.datablock.DataBlock metadata (), (in module decisionengine.framework.dataspace.datasources.tests.test_postgresql), method), 26
 is_valid () (decisionengine.framework.dataspace.datablock.Header metadata_table (decisionengine.framework.dataspace.datasource.DataSource attribute), 29 method), 26
 K
 mock_data_block () (in module decisionengine.framework.dataspace.datasources.tests.fixtures), 21
 keys () (decisionengine.framework.datablock.DataBlock method), 26
 L
 load () (in module decisionengine.framework.config.tests.test_config), 17
 load_all_channels () (decisionengine.framework.config.ChannelConfigHandler.ChannelConfigHandler method), 19
 load_channel () (decisionengine.framework.config.ChannelConfigHandler.ChannelConfigHandler method), 19
 LogicEngine (class in decisionengine.framework.logicengine.LogicEngine), 37
 LogicEngine (class in decisionengine.framework.modules.LogicEngine), 38
 LogicError, 36
 M
 main () (in module decisionengine.framework.engine.de_client), 34
 main () (in module decisionengine.framework.engine.DecisionEngine), 33
 main () (in module decisionengine.framework.modules.SourceProxy), 39
 make_db () (in module decisionengine.framework.logicengine.tests.test_facts), 35
 mark_demented () (decisionengine.framework.dataspace.dataspace.DataSpace method), 30
 mark_expired () (decisionengine.framework.dataspace.datablock.DataBlock method), 26
 decisionengine, 47
 decisionengine.framework, 47
 decisionengine.framework.about, 47
 decisionengine.framework.config, 21
 decisionengine.framework.config.ChannelConfigHandler, 18
 decisionengine.framework.config.policies, 20
 decisionengine.framework.config.tests, 18
 decisionengine.framework.config.tests.test_conf, 17
 decisionengine.framework.config.tests.test_poli, 18
 decisionengine.framework.config.ValidConfig, 19
 decisionengine.framework.dataspace, 31
 decisionengine.framework.dataspace.datablock, 25
 decisionengine.framework.dataspace.datasource, 27
 decisionengine.framework.dataspace.datasources, 25
 decisionengine.framework.dataspace.datasources, 22
 decisionengine.framework.dataspace.datasources, 22
 decisionengine.framework.dataspace.datasources, 21
 decisionengine.framework.dataspace.datasources, 21
 decisionengine.framework.dataspace.dataspace, 29
 decisionengine.framework.engine, 34
 decisionengine.framework.engine.de_client, 34
 decisionengine.framework.engine.DecisionEngine,

31
 decisionengine.framework.engine.Workers, decisionengine.framework.tests.FailingSourcePro
 33
 43
 decisionengine.framework.logicengine, decisionengine.framework.tests.fixtures,
 38
 44
 decisionengine.framework.logicengine.BootstrapEngine, framework.tests.PublisherNOP,
 36
 43
 decisionengine.framework.logicengine.FactLookupEngine, framework.tests.SourceNOP,
 36
 44
 decisionengine.framework.logicengine.LogDefEngine, framework.tests.test_client_serv
 37
 45
 decisionengine.framework.logicengine.RuleDecisionEngine, framework.tests.test_defaults,
 37
 45
 decisionengine.framework.logicengine.RuleEngine, framework.tests.test_failing_sou
 38
 45
 decisionengine.framework.logicengine.testdecisionengine, framework.tests.test_reaper,
 36
 45
 decisionengine.framework.logicengine.testdecisionengine, framework.tests.test_restart_cha
 34
 45
 decisionengine.framework.logicengine.testdecisionengine, framework.tests.test_sample_conf
 34
 46
 decisionengine.framework.logicengine.testdecisionengine, framework.tests.test_start_with_
 35
 46
 decisionengine.framework.logicengine.testdecisionengine, framework.tests.TransformNOP,
 35
 44
 decisionengine.framework.logicengine.testdecisionengine, framework.util, 47
 35
 decisionengine.framework.logicengine.testdecisionengine, framework.util.fs, 46
 decisionengine.framework.logicengine.testdecisionengine, framework.util.sockets,
 35
 46
 decisionengine.framework.logicengine.testdecisionengine, framework.util.sort,
 35
 46
 decisionengine.framework.modules, 40 Module (class in decisio-
 decisionengine.framework.modules.de_logger, nengine.framework.modules.Module), 38
 40 module_config_info() (in module decisio-
 decisionengine.framework.modules.LogicEngine, nengine.framework.modules.SourceProxy),
 38 39
 decisionengine.framework.modules.Module, module_config_template() (in module decisio-
 38 nengine.framework.modules.SourceProxy), 39
 decisionengine.framework.modules.Publisher, must_have (decisionengine.framework.modules.SourceProxy.SourceProx
 38 attribute), 39
 decisionengine.framework.modules.SourceData, (in module decisio-
 39 nengine.framework.logicengine.tests.test_pandas_fact),
 decisionengine.framework.modules.SourceProxy, 35
 39 myengine() (in module decisio-
 decisionengine.framework.modules.Transform, nengine.framework.logicengine.tests.test_cascaded_rules),
 40 34
 decisionengine.framework.taskmanager, myengine() (in module decisio-
 43 nengine.framework.logicengine.tests.test_pandas_fact),
 decisionengine.framework.taskmanager.ProcessingState, 35
 40 myengine() (in module decisio-
 decisionengine.framework.taskmanager.TaskManager, nengine.framework.logicengine.tests.test_rule_with_negated_fact
 41 35
 decisionengine.framework.tests, 46 myengine() (in module decisio-
 decisionengine.framework.tests.FailingPublisher, nengine.framework.logicengine.tests.test_simple_configuration),

35

O

OFFLINE (decisionengine.framework.taskmanager.ProcessingState attribute), 41

P

parse_program_options() (in module decisionengine.framework.engine.DecisionEngine), 33

PG_PROG() (in module decisionengine.framework.tests.fixtures), 44

post_create() (decisionengine.framework.modules.Source.Source method), 39

post_create() (decisionengine.framework.modules.SourceProxy.SourceProxy method), 39

Postgresql (class in decisionengine.framework.dataspace.datasources.postgresql), 22

print_channel_config() (decisionengine.framework.config.ChannelConfigHandler.ChannelConfigHandler method), 19

ProcessingState (class in decisionengine.framework.taskmanager.ProcessingState), 41

produces() (decisionengine.framework.logicengine.LogicEngine.LogicEngine method), 37

produces() (decisionengine.framework.modules.Source.Source method), 39

produces() (decisionengine.framework.modules.SourceProxy.SourceProxy method), 39

produces() (decisionengine.framework.modules.Transform.Transform method), 40

produces() (decisionengine.framework.tests.FailingSourceProxy.FailingSourceProxy method), 43

produces() (decisionengine.framework.tests.SourceNOP.SourceNOP method), 44

produces() (decisionengine.framework.tests.TransformNOP.TransformNOP method), 44

publish() (decisionengine.framework.modules.Publisher.Publisher method), 38

publish() (decisionengine.framework.tests.FailingPublisher.FailingPublisher method), 43

publish() (decisionengine.framework.tests.PublisherNOP.PublisherNOP method), 43

Publisher (class in decisionengine.framework.modules.Publisher), 38

PublisherNOP (class in decisionengine.framework.tests.PublisherNOP), 43

put() (decisionengine.framework.dataspace.datablock.DataBlock method), 26

R

reap() (decisionengine.framework.dataspace.dataspace.Reaper method), 30

Reaper (class in decisionengine.framework.dataspace.dataspace), 30

reaper_start() (decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 31

reaper_status() (decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 31

reaper_stop() (decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 31

RequestHandler (class in decisionengine.framework.engine.DecisionEngine), 32

required_keys (decisionengine.framework.dataspace.datablock.Header attribute), 26

required_keys (decisionengine.framework.dataspace.datablock.Metadata attribute), 26

rpc_block_while() (decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 32

rpc_get_channel_log_level() (decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 32

rpc_get_log_level() (decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 32

rpc_paths (decisionengine.framework.engine.DecisionEngine.RequestHandler attribute), 32

rpc_print_product() (decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 32

rpc_print_products() (decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 32

rpc_reaper_status() (decisionengine.framework.engine.DecisionEngine.DecisionEngine method), 32

```

nengine.framework.engine.DecisionEngine.DecisionEngine nengine.framework.taskmanager.TaskManager.TaskManager
method), 32 method), 42
rpc_reaper_stop() (decision- run_transforms() (decision-
nengine.framework.engine.DecisionEngine.DecisionEngine nengine.framework.taskmanager.TaskManager.TaskManager
method), 32 method), 42
rpc_set_channel_log_level() (decision- RUNNING (decisionengine.framework.dataspace.dataspace.State
nengine.framework.engine.DecisionEngine.DecisionEngine attribute), 31
method), 32
rpc_show_config() (decision- S
nengine.framework.engine.DecisionEngine.DecisionEngine set() (decisionengine.framework.taskmanager.ProcessingState.ProcessingState
method), 32 method), 41
rpc_show_de_config() (decision- set_data_block() (decision-
nengine.framework.engine.DecisionEngine.DecisionEngine nengine.framework.modules.Module.Module
method), 32 method), 38
rpc_start_channel() (decision- set_logging() (in module decisio-
nengine.framework.engine.DecisionEngine.DecisionEngine nengine.framework.modules.de_logger),
method), 32 40
rpc_start_channels() (decision- set_loglevel() (decision-
nengine.framework.engine.DecisionEngine.DecisionEngine nengine.framework.taskmanager.TaskManager.TaskManager
method), 32 method), 42
rpc_status() (decision- set_retention_interval() (decision-
nengine.framework.engine.DecisionEngine.DecisionEngine nengine.framework.dataspace.dataspace.Reaper
method), 32 method), 30
rpc_stop() (decision- set_state() (decision-
nengine.framework.engine.DecisionEngine.DecisionEngine nengine.framework.dataspace.datablock.Metadata
method), 32 method), 26
rpc_stop_channel() (decision- set_stream_logging() (in module decisio-
nengine.framework.engine.DecisionEngine.DecisionEngine nengine.framework.modules.de_logger), 40
method), 32
rpc_stop_channels() (decision- should_stop() (decision-
nengine.framework.engine.DecisionEngine.DecisionEngine nengine.framework.taskmanager.ProcessingState.ProcessingState
method), 32 method), 41
Rule (class in decisio- SHUTDOWN (decisionengine.framework.taskmanager.ProcessingState.State
nengine.framework.logicengine.Rule), 37 attribute), 41
rule_for() (decision- SHUTTINGDOWN (decision-
nengine.framework.logicengine.FactLookup.FactLookup attribute), 41
method), 36
RuleEngine (class in decisio- Singleton (class in decisio-
nengine.framework.logicengine.RuleEngine), 30
method), 38
run() (decisionengine.framework.engine.Workers.Worker SLEEPING (decisionengine.framework.dataspace.dataspace.State
method), 33 attribute), 31
run() (decisionengine.framework.taskmanager.TaskManager.TaskManager sorted_rules() (decision-
method), 42 nengine.framework.logicengine.FactLookup.FactLookup
method), 36
run_logic_engine() (decision- Source (class in decisio-
nengine.framework.taskmanager.TaskManager.TaskManager nengine.framework.modules.Source), 39
method), 42 SourceNOP (class in decisio-
run_publishers() (decision- nengine.framework.tests.SourceNOP), 44
nengine.framework.taskmanager.TaskManager.TaskManager SourceProxy (class in decisio-
method), 42 nengine.framework.modules.SourceProxy),
run_source() (decision- 39
nengine.framework.taskmanager.TaskManager.TaskManager set() (decisionengine.framework.dataspace.dataspace.Reaper
method), 42 method), 30
run_transform() (decision-

```

start_channel() (decisionengine.framework.engine.DecisionEngine.TaskManager (class in decisionengine.framework.taskmanager.TaskManager), method), 32, 41
 start_channels() (decisionengine.framework.engine.DecisionEngine.taskmanager() (in module decisionengine.framework.dataspace.datasources.tests.test_postgresql), method), 32, 21
 start_sources() (decisionengine.framework.taskmanager.TaskManager.taskmanager_table (decisionengine.framework.dataspace.datasource.DataSource (class in decisionengine.framework.config.tests.test_policies), method), 42, 29
 STARTING (decisionengine.framework.dataspace.dataspace.State_channel_config_dir() (in module decisionengine.framework.config.tests.test_policies), attribute), 31, 18
 State (class in decisionengine.framework.dataspace.dataspace), test_channel_empty_config() (in module decisionengine.framework.config.tests.test_config), 30, 17
 State (class in decisionengine.framework.taskmanager.ProcessingState), test_channel_empty_dictionary() (in module decisionengine.framework.config.tests.test_config), 41, 17
 STEADY (decisionengine.framework.taskmanager.ProcessingState.State_channel_loading() (in module decisionengine.framework.config.tests.test_config), attribute), 41, 17
 stop() (decisionengine.framework.dataspace.dataspace.Reaper.test_channel_loading() (in module decisionengine.framework.config.tests.test_config), method), 30, 17
 stop_channel() (decisionengine.framework.engine.DecisionEngine.test_channel_names() (in module decisionengine.framework.config.tests.test_config), method), 32, 17
 stop_channels() (decisionengine.framework.engine.DecisionEngine.test_channel_no_config_files() (in module decisionengine.framework.config.tests.test_config), method), 32, 17
 stop_worker() (decisionengine.framework.engine.DecisionEngine.test_channel_no_modules() (in module decisionengine.framework.config.tests.test_config), method), 32, 17
 STOPPED (decisionengine.framework.dataspace.dataspace.State_test_client_can_get_de_server_reaper_start_delay() (in module decisionengine.framework.tests.test_reaper), attribute), 31, 45
 STOPPING (decisionengine.framework.dataspace.dataspace.State_test_client_can_get_de_server_reaper_status() (in module decisionengine.framework.tests.test_reaper), attribute), 31, 45
 store_taskmanager() (decisionengine.framework.dataspace.datablock.DataBlock (in module decisionengine.framework.tests.test_reaper), method), 26, 45
 store_taskmanager() (decisionengine.framework.dataspace.datasource.DataSource (in module decisionengine.framework.tests.test_reaper), method), 29, 45
 store_taskmanager() (decisionengine.framework.dataspace.datasources.postgresql.Postgresql (in module decisionengine.framework.tests.test_defaults), method), 24, 45
 store_taskmanager() (decisionengine.framework.dataspace.dataspace.DataSpace (in module decisionengine.framework.tests.test_sample_config), method), 30, 46
 T
 tables (decisionengine.framework.dataspace.datasources.postgresql.Postgresql (in module decisionengine.framework.tests.test_sample_config), attribute), 24, 46
 take_offline() (decisionengine.framework.taskmanager.TaskManager.test_client_can_get_de_server_status() (in module decisionengine.framework.tests.test_sample_config), method), 42, 46

<code>test_client_de_config_is_json()</code> (in module <code>decisionengine.framework.tests.test_defaults</code>), 45	<code>test_get_last_generation_id()</code> (in module <code>decisionengine.framework.dataspace.datasources.tests.test_postgresql</code>), 21
<code>test_client_print_product()</code> (in module <code>decisionengine.framework.tests.test_client_server</code>), 45	<code>test_get_taskmanager()</code> (in module <code>decisionengine.framework.dataspace.datasources.tests.test_postgresql</code>), 21
<code>test_compound_fact()</code> (in module <code>decisionengine.framework.logicengine.tests.test_facts</code>), 35	<code>test_global_channel_log_level_in_config()</code> (in module <code>decisionengine.framework.tests.test_defaults</code>), 45
<code>test_configuration_with_fact_using_function()</code> (in module <code>decisionengine.framework.logicengine.tests.test_construction</code>), 34	<code>test_global_config_dir()</code> (in module <code>decisionengine.framework.config.tests.test_policies</code>), 18
<code>test_configuration_with_numpy_facts()</code> (in module <code>decisionengine.framework.logicengine.tests.test_construction</code>), 34	<code>test_global_config_file()</code> (in module <code>decisionengine.framework.config.tests.test_policies</code>), 18
<code>test_create_tables()</code> (in module <code>decisionengine.framework.dataspace.datasources.tests.test_postgresql</code>), 21	<code>test_insert()</code> (in module <code>decisionengine.framework.dataspace.datasources.tests.test_postgresql</code>), 21
<code>test_default_construction()</code> (in module <code>decisionengine.framework.logicengine.tests.test_construction</code>), 34	<code>test_minimal_jsonnet_right_extension()</code> (in module <code>decisionengine.framework.config.tests.test_config</code>), 18
<code>test_duplicate_fact_names()</code> (in module <code>decisionengine.framework.logicengine.tests.test_duplicate_fact_names</code>), 35	<code>test_minimal_jsonnet_wrong_extension()</code> (in module <code>decisionengine.framework.config.tests.test_config</code>), 18
<code>test_empty_config()</code> (in module <code>decisionengine.framework.config.tests.test_config</code>), 17	<code>test_minimal_python()</code> (in module <code>decisionengine.framework.config.tests.test_config</code>), 18
<code>test_empty_dict()</code> (in module <code>decisionengine.framework.config.tests.test_config</code>), 18	<code>test_restart_channel()</code> (in module <code>decisionengine.framework.tests.test_restart_channel</code>), 45
<code>test_empty_dict_with_leading_comment()</code> (in module <code>decisionengine.framework.config.tests.test_config</code>), 18	<code>test_rule_that_does_not_fire()</code> (in module <code>decisionengine.framework.logicengine.tests.test_cascaded_rules</code>), 34
<code>test_fact_using_numpy_array()</code> (in module <code>decisionengine.framework.logicengine.tests.test_facts</code>), 35	<code>test_rule_that_does_not_fire()</code> (in module <code>decisionengine.framework.logicengine.tests.test_pandas_fact</code>), 35
<code>test_fact_using_numpy_function()</code> (in module <code>decisionengine.framework.logicengine.tests.test_facts</code>), 35	<code>test_rule_that_does_not_fire()</code> (in module <code>decisionengine.framework.logicengine.tests.test_rule_with_negated_fact</code>), 35
<code>test_fact_with_nested_names()</code> (in module <code>decisionengine.framework.logicengine.tests.test_facts</code>), 35	<code>test_rule_that_does_not_fire()</code> (in module <code>decisionengine.framework.logicengine.tests.test_simple_configuration</code>), 35
<code>test_generate_insert_query()</code> (in module <code>decisionengine.framework.dataspace.datasources.tests.test_postgresql</code>), 21	<code>test_rule_that_fires()</code> (in module <code>decisionengine.framework.logicengine.tests.test_cascaded_rules</code>), 34
	<code>test_rule_that_fires()</code> (in module <code>decisionengine.framework.logicengine.tests.test_pandas_fact</code>), 35

35 update() (decisionengine.framework.dataspace.datasource.DataSource
 test_rule_that_fires() (in module decisio- method), 29
 nengine.framework.logicengine.tests.test_rule_with_negated_full),
 35 method), 24
 test_rule_that_fires() (in module decisio- update() (decisionengine.framework.dataspace.dataspace.DataSpace
 nengine.framework.logicengine.tests.test_simple_configuration), 30
 35
 test_simple_fact() (in module decisio- **V**
 nengine.framework.logicengine.tests.test_facts), valid_dir() (in module decisio-
 35 nengine.framework.config.policies), 20
 test_start_from_nothing() (in module decisio- valid_states (decisio-
 nengine.framework.tests.test_start_with_no_channels), nengine.framework.dataspace.datablock.Metadata
 46 attribute), 26
 test_stop_failing_source_proxy() ValidConfig (class in decisio-
 (in module decisio- nengine.framework.config.ValidConfig), 19
 nengine.framework.tests.test_failing_source_proxy),
 45 **W**
 test_store_taskmanager() (in module decisio- wait_for_all() (decisio-
 nengine.framework.dataspace.datasources.tests.test_postgresql), nengine.framework.taskmanager.TaskManager.TaskManager
 22 method), 42
 test_trivial_configuration() wait_for_any() (decisio-
 (in module decisio- nengine.framework.taskmanager.TaskManager.TaskManager
 nengine.framework.logicengine.tests.test_construction), method), 42
 34
 test_valid_dir() (in module decisio- wait_until() (decisio-
 nengine.framework.config.tests.test_policies), nengine.framework.engine.Workers.Worker
 18 method), 33
 test_wrong_configuration() wait_until() (decisio-
 (in module decisio- nengine.framework.taskmanager.ProcessingState.ProcessingState
 nengine.framework.logicengine.tests.test_construction), method), 41
 34 wait_while() (decisio-
 test_wrong_type() (in module decisio- nengine.framework.engine.Workers.Worker
 nengine.framework.config.tests.test_config), method), 33
 18 wait_while() (decisio-
 Transform (class in decisio- nengine.framework.taskmanager.ProcessingState.ProcessingState
 nengine.framework.modules.Transform), method), 41
 40 Worker (class in decisio-
 transform() (decisio- nengine.framework.engine.Workers), 33
 nengine.framework.modules.Transform.Transform Worker (class in decisio-
 method), 40 nengine.framework.taskmanager.TaskManager),
 43
 transform() (decisio- Workers (class in decisio-
 nengine.framework.tests.TransformNOP.TransformNOP nengine.framework.engine.Workers), 33
 method), 44 Workers.Access (class in decisio-
 TransformNOP (class in decisio- nengine.framework.engine.Workers), 33
 nengine.framework.tests.TransformNOP),
 44
 tsort() (in module decisio- **Z**
 nengine.framework.util.tsort), 47
 z.dumps() (in module decisio-
 27
 z.loads() (in module decisio-
 nengine.framework.dataspace.datablock),
 27
 27

U
 unguarded_access() (decisio-
 nengine.framework.engine.Workers.Workers
 method), 33