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# **pytest-workflow Documentation**

***Release 0.4.0***

**Leiden University Medical Center**

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# CHAPTER 1

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## Introduction

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Writing workflows is hard. Testing if they are correct is even harder. Testing with bash scripts or other code has some flaws. Is this bug in the pipeline or in my test-framework? Pytest-workflow aims to make testing as simple as possible so you can focus on debugging your pipeline.





## CHAPTER 2

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### Installation

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Pytest-workflow is tested on python 3.5, 3.6 and 3.7. Python 2 is not supported.

In a virtual environment:

- Create a new python3 virtual environment.
- Make sure your virtual environment is activated.
- Install using `pip install pytest-workflow`

On Ubuntu or Debian:

- This requires the `python3` and `python3-pip` packages to be installed.
- Installing
  - system-wide: `sudo python3 -m pip install pytest-workflow`
  - for your user only (no sudo needed): `python3 -m pip install --user pytest-workflow`
- `pytest` can now be run with `python3 -m pytest`.

NOTE: Running plain `pytest` on Ubuntu or Debian outside of a virtual environment will not work with `pytest-workflow` because this will start the python2 version of `pytest`. This is because python2 is the default python on any distribution released before January 1st 2020.



## CHAPTER 3

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### Writing tests with pytest-workflow

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In order to write tests that are discoverable by the plugin you need to complete the following steps.

- Create a `tests` directory in the root of your repository.
- Create your test yaml files in the `tests` directory. The files need to start with `test` and have a `.yaml` or `.yml` extension.

Below is an example of a YAML file that defines a test:

```
- name: Touch a file
  command: touch test.file
  files:
    - path: test.file
```

This will run `touch test.file` and check afterwards if a file with `path: test.file` is present. It will also check if the `command` has exited with exit code 0, which is the only default test that is run. Testing workflows that exit with another exit code is also possible.

A more advanced example:

```
- name: moo file                                # The name of the workflow (required)
  command: bash moo_workflow.sh                 # The command to execute the workflow (required)
  files:                                         # A list of files to check (optional)
    - path: "moo.txt"                           # File path. (Required for each file)
      contains:                                  # A list of strings that should be in the file_
        - "moo"
      must_not_contain:                          # A list of strings that should NOT be in the_
        - "Cock a doodle doo"                   # file (optional)
      md5sum: e583af1f8b00b53cda87ae9ead880224  # Md5sum of the file (optional)

- name: simple echo                             # A second workflow. Notice the starting ` ` _
  command: "echo moo"                           # that workflow items are in a list. You can add_
  as_much_workflows_as_you_want                 # as much workflows as you want
```

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```

files:
  - path: "moo.txt"
    should_exist: false           # Whether a file should be there or not.
    ↪(optional, if not given defaults to true)
  stdout:                        # Options for testing stdout (optional)
    contains:                    # List of strings which should be in stdout
    ↪(optional)
      - "moo"
    must_not_contain:            # List of strings that should NOT be in stout
    ↪(optional)
      - "Cock a doodle doo"

- name: mission impossible      # Also failing workflows can be tested
  tags:                          # A list of tags that can be used to select
  ↪which test
    - should fail                # is run with pytest using the `--tag` flag.
  command: bash impossible.sh
  exit_code: 2                   # What the exit code should be (optional, if not
  ↪given defaults to 0)
  files:
    - path: "fail.log"           # Multiple files can be tested for each workflow
    - path: "TomCruise.txt"
  stderr:                        # Options for testing stderr (optional)
    contains:                    # A list of strings which should be in stderr
    ↪(optional)
      - "BSOD error, please contact the IT crowd"
    must_not_contain:            # A list of strings which should NOT be in
    ↪stderr (optional)
      - "Mission accomplished!"

```

The above YAML file contains all the possible options for a workflow test.

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## Running pytest-workflow

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Run `pytest` from an environment with `pytest-workflow` installed or `python3 -m pytest` if using a system-wide or user-wide installation. Pytest will automatically gather files in the `tests` directory starting with `test` and ending in `.yaml` or `.yml`.

The workflows are run automatically. Each workflow gets its own temporary directory to run. These directories are cleaned up after the tests are completed. If you wish to inspect the output of a failing workflow you can use the `--keep-workflow-wd` flag to disable cleanup. This will also make sure the logs of the pipeline are saved in the temporary directory. When `--keep-workflow-wd` is set, the paths to the logs and the temporary directory are reported in pytest's output. The `--keep-workflow-wd` flag is highly recommended when debugging pipelines.

If you wish to change the temporary directory in which the workflows are run use `--basetemp <dir>` to change pytest's base temp directory.

**WARNING:** When a directory is passed to `--basetemp` some of the directory contents will be deleted. For example: if your workflow is named `"my_workflow"` then any file or directory named `my_workflow` will be deleted. This makes sure you start with a clean slate if you run `pytest` again with the same `basetemp` directory. **DO NOT** use `--basetemp` on directories where none of the contents should be deleted.

To run multiple workflows simultaneously you can use `--workflow-threads <int>` or `--wt <int>` flag. This defines the number of workflows that can be run simultaneously. This will speed up things if you have enough resources to process these workflows simultaneously.

### 4.1 Running specific workflows

To run a specific workflow use the `--tag` flag. Each workflow is tagged with its own name and additional tags in the `tags` key of the `yaml`.

```
- name: moo
  tags:
    - animal
  command: echo moo
- name: cock-a-doodle-doo
```

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```
tags:
  - rooster sound
  - animal
command: echo cock-a-doodle-doo
- name: vroom vroom
  tags:
    - car
  command: echo vroom vroom
```

With the command `pytest --tag moo` only the workflow named ‘moo’ will be run. With `pytest --tag 'rooster sound'` only the ‘cock-a-doodle-doo’ workflow will run. Multiple tags can be used like this: `pytest --tag 'rooster sound' --tag animal` This will run all workflows that have both ‘rooster sound’ and ‘animal’.

Internally names and tags are handled the same so if the following tests:

```
- name: hello
  command: echo 'hello'
- name: hello2
  command: echo 'hello2'
  tags:
    - hello
```

are run with `pytest --tag hello` then both `hello` and `hello2` are run.

## 5.1 Snakemake example

An example yaml file that could be used to test a snakemake pipeline is listed below.

```
- name: test-dry-run
  command: snakemake -n -r -p -s Snakefile
- name: test-full-run
  command: snakemake -r -p -s Snakefile
  files:
    - "my_output.txt"
  stderr:
    contains:
      - "(100%) done"
```

## 5.2 WDL with Cromwell example

Below an example yaml file is explained which can be used to test a WDL pipeline run through Cromwell.

One problem with Cromwell is the way it handles relative paths and how it handles the input file:

- Relative paths are written only within the `cromwell-executions` folder. If you want to write outside this folder you need absolute paths. This is fine but for testing your pipeline `pytest-workflow` creates a temporary folder from which the pipeline is run. You don't know beforehand which path this is, but you could use the environment variable `$PWD`.
- However the second problem is that inputs can only be supplied to Cromwell in a json file, not on the command line. So you cannot dynamically choose an output folder. You have to rewrite the input file.

To fix this problem you can write `command` to be a bash script that injects `$PWD` into the inputs.json.

```
- name: My pipeline
  command: >-
    bash -c '
      TEST_JSON=tests/inputs/my_pipeline_test1.json ;
      sed -i "2i\"my_pipeline.output_dir\": \"\$PWD/test-output\"," $TEST_JSON ;
      cromwell run -i $TEST_JSON simple.wdl'
  files:
    - path: test-output/moo.txt.gz
      md5sum: 173fd8023240a8016033b33f42db14a2
  stdout:
    contains:
      - "WorkflowSucceededState"
```

`sed -i "2i\"my_pipeline.output_dir\": \"\$PWD/test-output\"," $TEST_JSON` inserts `"my_pipeline.output_dir": "</pytest/temporary/dir>/test-output"`, on the second line of `$TEST_JSON`. This solves the problem. File paths can now be traced from `test-output` as demonstrated in the example.



## CHAPTER 6

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### Known issues

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- `pytest-workflow` does not work well together with `pytest-cov`. This is due to the temporary directory creating nature of `pytest-workflow`. This can be solved by using:

```
coverage run --source=<your_source_here> -m py.test <your_test_dir>
```

This will work as expected.



## CHAPTER 7

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### Reporting bugs and feature requests

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Bugs can be reported and features can be requested on our [Github issue tracker](#).

The aim of this project is to be as user-friendly as possible for writing workflow tests, so all suggestions and bug reports are welcome!



## CHAPTER 8

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### Contributing

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If you feel like this project is missing a certain something, feel free to make a pull request. You can find [our Github page here](#).



### 9.1 Version 0.4.0

- Added more information to the manual on how to debug pipelines and use `pytest-workflow` outside a virtual environment.
- Reworked code to use `tempfile.mkdtemp` to create a truly unique temporary working directory if the `--basetemp` flag is not used. This replaces the old code which depended on pytest internal code which was flagged as deprecated. Also more information was added to the manual about the use of `--basetemp`.
- Added a test case for WDL pipelines run with Cromwell and wrote an example for using WDL+Cromwell in the manual.
- Added `--tag` flag to allow for easier selection of workflows during testing.
- Added a test case for snakemake pipelines and wrote an example for using `pytest-workflow` with `snakemake` in the manual.

### 9.2 Version 0.3.0

- Improved the log output to look nicer and make workflow log paths easier to find in the test output.
- Fixed an error that polluted the log message with a `pytest stacktrace` when running more than one workflow. Measures are taken in our test framework to detect such issues in the future.
- Added the possibility to run multiple workflows simultaneously with the `--workflow-threads` or `--wt` flag.
- Made code easier to maintain by using `stdlib` instead of `pytest's py lib` in all of the code.
- Added a schema check to ensure that tests have unique names when whitespace is removed.

## 9.3 Version 0.2.0

- Cleanup the readme and move advanced usage documentation to our readthedocs page.
- Start using sphinx and readthedocs.org for creating project documentation.
- The temporary directories in which workflows are run are automatically cleaned up at the end of each workflow test. You can disable this behaviour by using the `--keep-workflow-wd` flag, which allows you to inspect the working directory after the workflow tests have run. This is useful for debugging workflows.
- The temporary directories in which workflows are run can now be changed by using the `--basetemp` flag. This is because pytest-workflow now uses the built-in tmpdir capabilities of pytest.
- Save stdout and stderr of each workflow to a file and report their locations to stdout when running `pytest`.
- Comprehensible failure messages were added to make debugging workflows easier.

## 9.4 Version 0.1.0

- A full set of examples is now provided in the README.
- Our code base is now checked by pylint and bandit as part of our test procedure to ensure that our code adheres to python and security best practices.
- Add functionality to test whether certain strings exist in files, stdout and stderr.
- Enable easy to understand output when using pytest verbose mode (`pytest -v`). The required code refactoring has simplified the code base and made it easier to maintain.
- Enable the checking of non-existing files
- Enable the checking of file md5sums
- Use a schema structure that is easy to use and understand.
- Pytest-workflow now has continuous integration and coverage reporting, so we can detect regressions quickly and only publish well-tested versions.
- Fully parametrized tests enabled by changing code structure.
- Initialized pytest-workflow with option to test if files exist.