Setting Jenkins CI for python application

Oct 14, 2017 • Michal Dyzma •

Estimated read time: **34 mins**

Jenkins is an open source automation server. It can run any task with sophisticated set of rules regarding source control and/or dependencies between jobs. It is used to automate all sorts of tasks such as building, testing, and deploying software. Jenkins can be installed through native system packages, Docker, or even run standalone by any machine with the Java Runtime Environment installed. In this article I will show how to set up automatic CI/CD pipelines for python applications using Jenkins.

Source code from the article can be downloaded from this **GitHub repository** (https://github.com/mdyzma/jenkins-python-test)

Jenkins

It works on my machine!

How many times did you hear this sentence? Whenever I hear it, it is clear to me, that project has no Continuous Integration implemented. It is built and tested manually (at best) and it is always a bad idea.

Continuous integration is very powerful practice used during software development. And helps save tons of money. Bugs caught early cost ten times less, compared to the bugs spotted at production. Jenkins is considered one of the best DevOps tool, which maximizes chance to produce bug free software, which results in high quality software. It allows to quickly take the code, build it (step omitted in case of python packages, which usually do not require compilation step) on a frequent schedule and deploy into designated, representative environment for testing. Without the ability to automate code deployment, you are left with an enormous piece of manual, repetitive tasks in deployment pipeline:

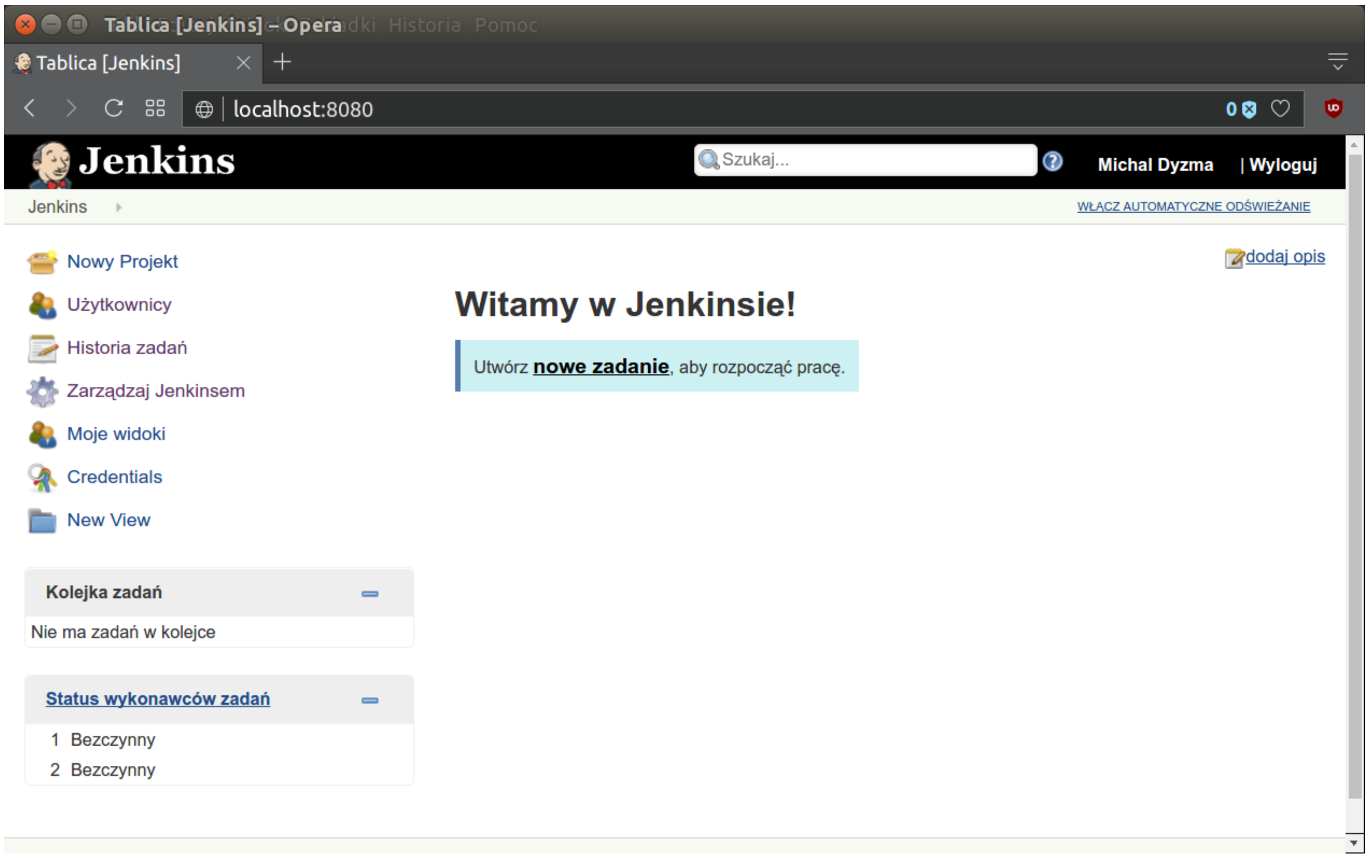
1. Get current software version from source control server
2. Create test environment
3. Install dependencies
4. Test software (unit and integration tests)
5. Deploy

This is typical pipeline in most IT projects. Jenkins can help to automate this work. And not only automate, but to establish common baseline for all developers working in the project. What is baseline? It is entire projects configuration and dependencies i.e. third party packages used in computation, environmental variables and other settings characteristic for the project.

Also, Jenkins is free and has over 1000 plugins, created by active community, which extend its functionality in every possible way. Plugins provide tools for many languages and functionalities developers around the world add for few decades now.

In this article I assume Jenkins is already installed in the system and runs on http://localhost:8080 (http://localhost:8080). If not, please follow instructions from https://jenkins.io (https://jenkins.io).

Jenkins fresh out of the box is not very appealing. When logged to the server, you should see following picture:



Witamy w Jenkinsie!

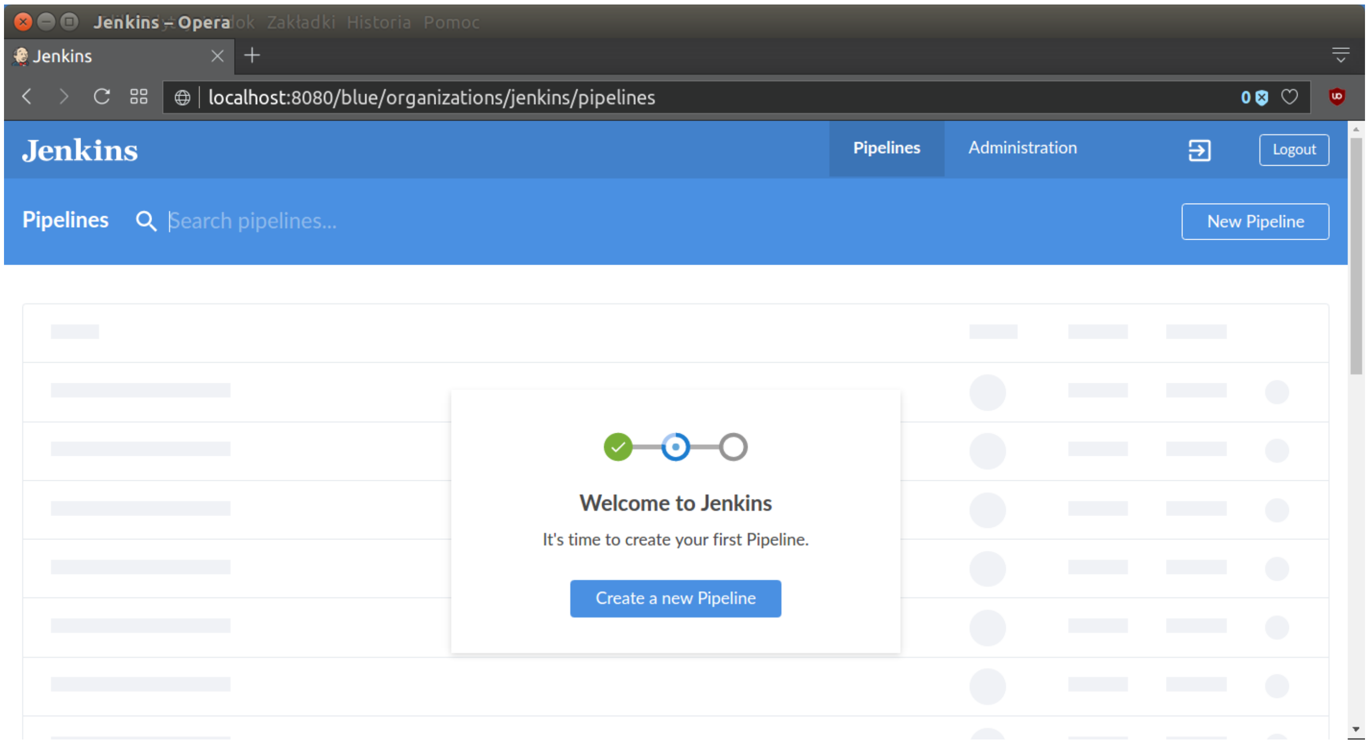
Utwórz **nowe zadanie**, aby rozpocząć pracę.

Nie ma zadań w kolejce

1 Bezczynny
2 Bezczynny

This is very basic view of Jenkins home page, which is crude and very old-school.

True power of Jenkins is within its plugins to support building, deploying and automating any project. Very promising is set of plugins grouped under common name **Blue Ocean** (https://jenkins.io/doc/book/blueocean/). It is new opening of the Jenkins UI. It has also lots of extensions integrating it with GitLab, GitHub or BitBucket, including very handy creators.



You can find basic tutorial about Blue Ocean UI functionalities on Jenkins Blue Ocean tutorial (https://jenkins.io/doc/book/blueocean/getting-started/).

There are many ways of creating Jenkins pipeline:

- free style jobs combinations (not recommended)
- scripted pipelines
- declarative pipelines

In this post, but I will focus only on the last one, most recent and most feature rich and safest option.

Free style jobs chaining was common practice before. Its advantage was simplicity. Click here and there, add bash command to the form on the project page and voila. But when project reaches several dozens of stages communicating them becomes nightmare.

Much better approach is to move stages and their logic into separate `groovy` script. In scripted pipelines script is again block of code pasted in the projects form on Jenkins site. Single steps of the pipeline are encoded in Jenkins scripted language resembling `groovy`, so we have part of the pipeline moved to the cohesive script and use Jenkins internal structures, but it shares same disadvantage as previous solution. It exists only in Jenkins local configuration files. Once your Jenkins installation is gone, so is your pipeline.

The best solution is to keep everything under version control. In special files describing entire pipeline to any Jenkins instance. This is so called **declarative pipeline**. Let's create special `Jenkinsfile` and put there some basic pipeline from the tutorial.

Setting up GitHub project

First we need to create GitHub repository (with `LICENSE` and `.gitignore` for example) and add `Jenkinsfile` to it. For this post I decided to create dummy project deployed to PyPI which will be simple Iris data set classifier. Basic project structure is:

```
.
├── .behaverc
├── .gitignore
├── irisvmpy
│   ├── __init__.py
│   └── iris.py
├── Jenkinsfile
├── LICENSE
├── Manifest.in
├── README.md
├── setup.cfg
├── setup.py
└── tests/
    ├── features
    │   ├── environment.py
    │   ├── iris.feature
    │   └── steps
    │       └── iris_steps.py
    └── test_iris.py
```

Project pushed to the GitHub repository **H E R E** (https://github.com/mdyzma/jenkins-python-test/tree/master/irisvmpy). It is a simple Iris classifier using SVM. It contains all files necessary to build decent python project.

Basic pipeline structure, recommended on Jenkins pipeline documentation (https://jenkins.io/doc/book/pipeline/) is as follows:

Jenkinsfile

```
pipeline {
    agent any

    stages {
        stage('Build') {
            steps {
                echo 'Building'
            }
        }
        stage('Test') {
            steps {
                echo 'Testing'
            }
        }
        stage('Deploy') {
            steps {
                echo 'Deploying'
            }
        }
    }
    post {
        always {
            echo 'This will always run'
        }
        success {
            echo 'This will run only if successful'
        }
        failure {
            echo 'This will run only if failed'
        }
        unstable {
            echo 'This will run only if the run was marked as unstable'
        }
        changed {
            echo 'This will run only if the state of the Pipeline has changed'
            echo 'For example, if the Pipeline was previously failing but is now successfu
l'
        }
    }
}
```

Main block of each declarative pipeline is `pipeline{}` block. In pipeline one can define `stages{}`, as group of `stage{}` elements. Each containing specific `steps{}`, their order and logic. Beside `stages{}` one can also set pipelines `properties{}`, `options{}` or `environment{}` blocs. Also, some directives to the source control manager concerning frequency of checking GitHub repository for changes in `triggers{}` block (it accepts cron syntax). Check Crontab Guru (https://crontab.guru) for examples.

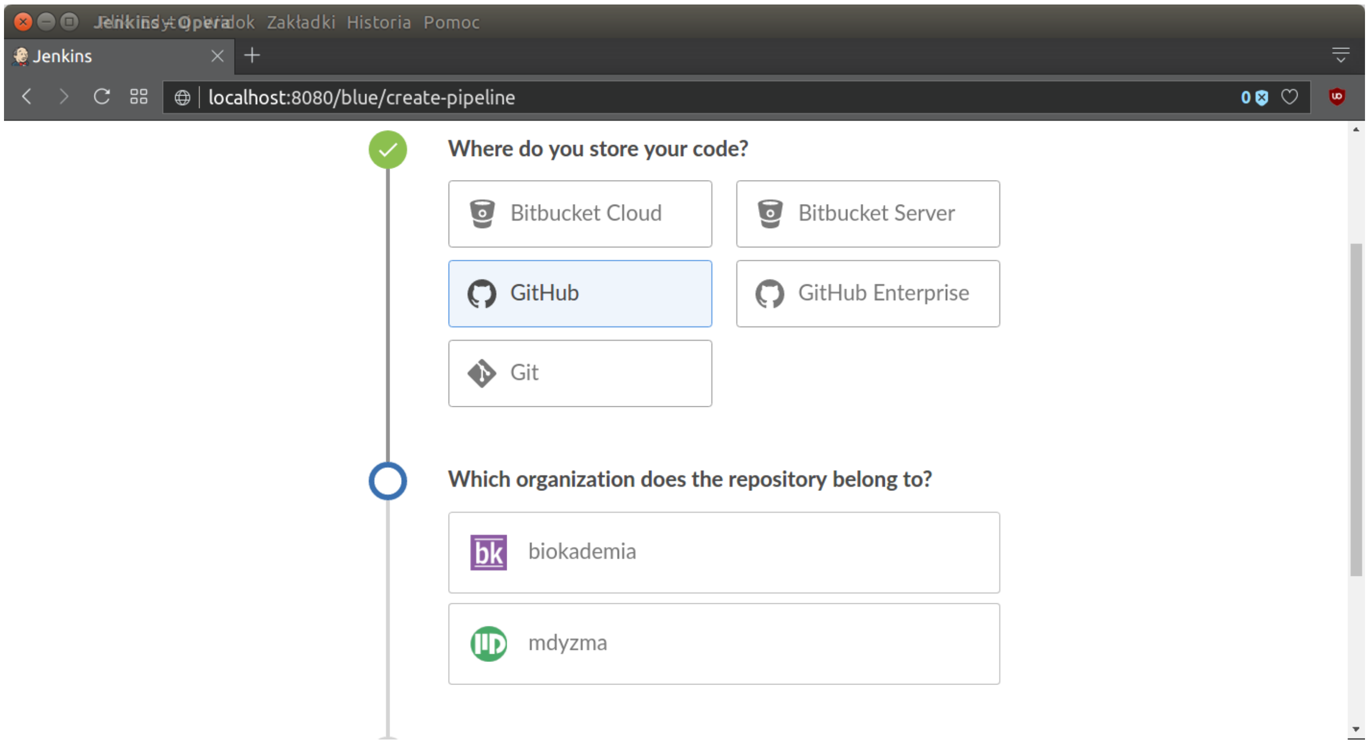
Jenkins allows running jobs on multiple machines in various configurations. So user usually can specify agent, which runs specific step or all steps included in the pipeline. Agent may be local jenkins instance, some virtual machine connected to it (and running different OS for example) or docker container run by host machine.

In this pipeline there is also extensive `post{}` block with some messages displayed on the screen under specific conditions. As their names indicate, some will always be displayed, some upon success or failure. Post part can be used to communicate with developer to send message about project status.

Three of them will be used in almost every project:

1. **Always** will be displayed every time Jenkins finishes. Useful when we want to archive logs, or clean up after each run.
2. **Success** only when no errors were noted during pipeline processing. Good to archive successful builds.
3. **Failed** is an option processed when pipeline failed. This variant of post part is very useful to send feedback to the team, via e-mail or other medium like slack channel, that something went wrong and changes committed lately did not pass regression tests and require urgent attention. When CI is tightly combined with delivery process (i.e. copying web app to the production server), post failure option may be used to roll back to the last successful build.

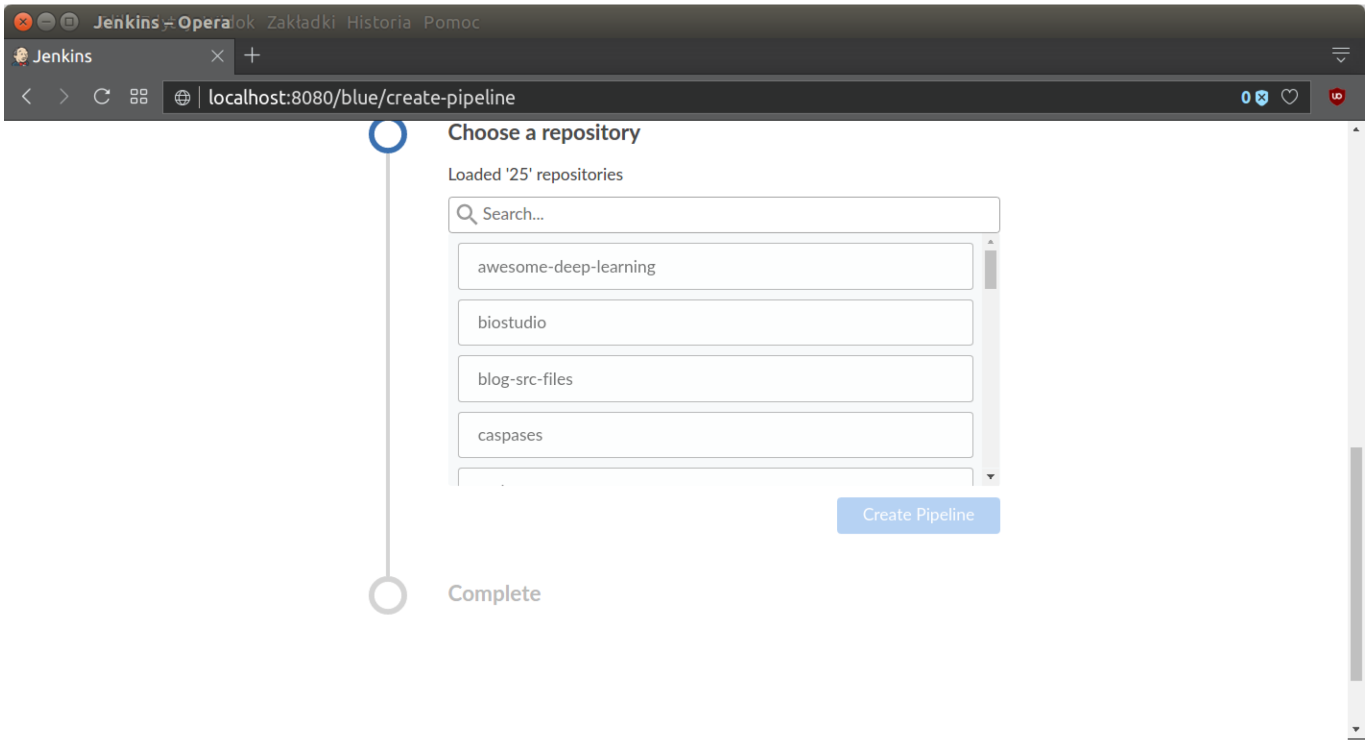
It is time to connect our project with Jenkins. To do that I will use Blue Ocean creator. First one needs to connect GitHub account with Jenkins user account (add Personal Access Token), then connect GitHub account. More details about pipeline creation and adding GitHub access token from scratch - here (https://jenkins.io/doc/book/blueocean/creating-pipelines/). In general process can be summed up in three slides:



Where do you store your code?

Which organization does the repository belong to?

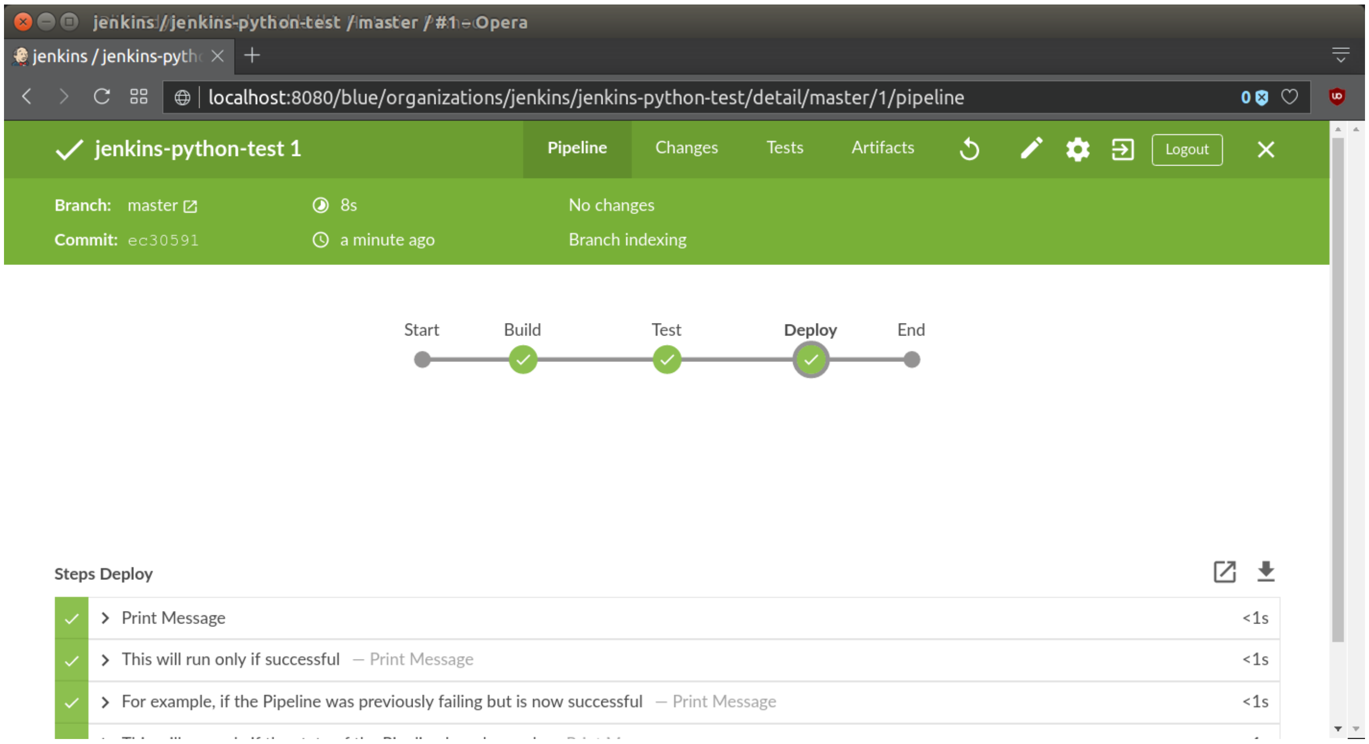
After that creator leads to specific repository:



Choose a repository

Loaded '25' repositories

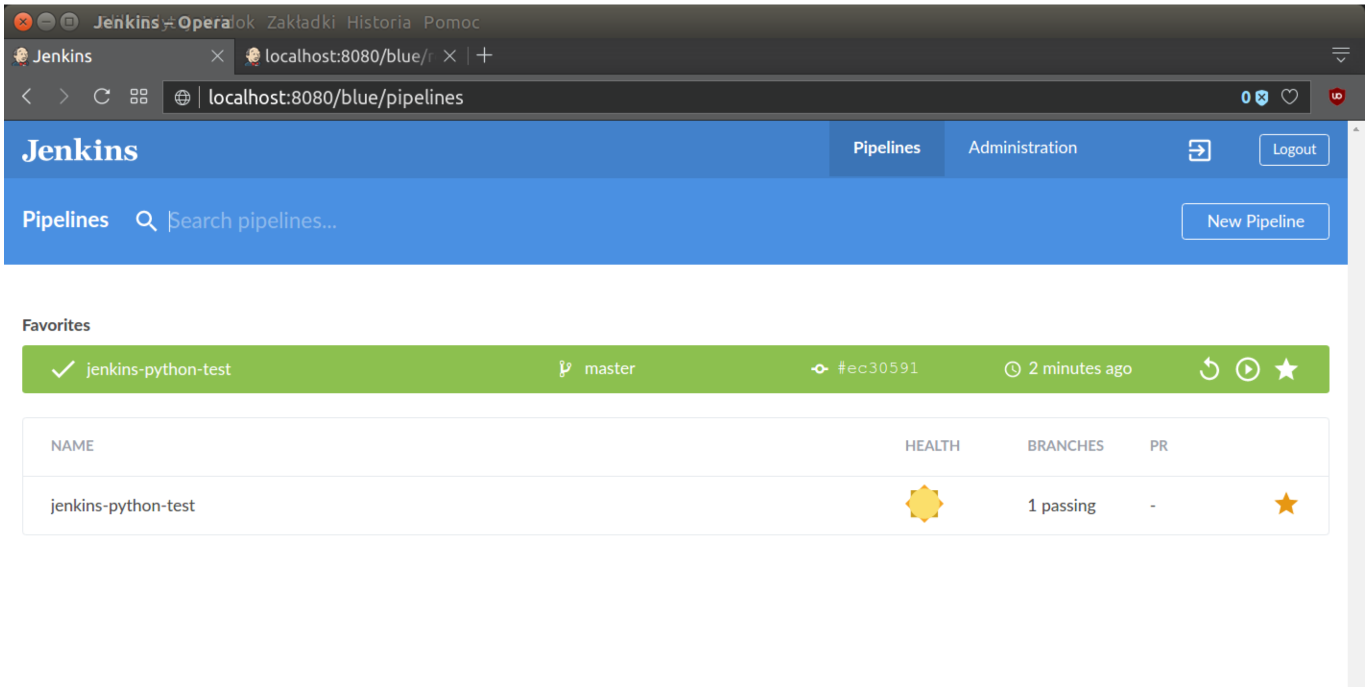
and finally, Jenkins will auto-discover all steps from `Jenkinsfile` present in the repository. Alternatively one can use Blue Ocean Pipeline Editor (https://jenkins.io/doc/book/blueocean/pipeline-editor/) and create everything using nice GUI based user interface. Pipeline will be displayed on the screen:



```
Print Message                                                                          <1s
This will run only if successful  — Print Message                                      <1s
For example, if the Pipeline was previously failing but is now successful  — Print Message   <1s
```

Jenkins will automatically run the pipeline and display all the messages, which apply, from the `post` section. In this case we will get green status, since Jenkinsfile is comprised just several echo statements.

There is also a page summarizing statuses of all projects under this jenkins server control. General list of all projects on Jenkins server looks like this:



When the project is properly connected to the CI server, we can start extending pipeline to fit our needs.

Project steps

Unlike compiled languages, Python does not need a "build" stage per se, but Python projects can still benefit greatly from using Jenkins for continuous integration and delivery. In Python ecosystem there are tools which can be integrated into Jenkins for testing and reporting (i.e. unit tests runners (`pytest` , `nose`) or code metrics reports creators (`pylint` , `Radon`).

Traditionally our basic pipeline will comprise of the following elements:

1. Creating test environment
    - automatic source code pull (from GitHub)
    - installing proper python version
    - installing dependencies
2. Running static code metrics:
    - various raw metrics:
    - tests coverage
    - errors and style check
3. Testing pulled source code

- unit tests
- integration tests

4. Building proper python distribution package (`.whl`)
5. Deploying to PyPI

It is time to rebuild our `Jenkinsfile` to reflect steps given above.

Jenkins anatomy

Jenkins uses its user service account to create job folders and files, manage work-space and its plugins. All configuration options are kept in `.xml` files in specific locations in Jenkins `$HOME` directory for jenkins user. On debian derived OS it is placed in `/var/lib/jenkins/` directory. This is location of our agent, so called service account without interactive properties. It means it does not have designated shell, no `/home/jenkins/` folder and one can not login to this account interactively.

In this directory Jenkins server stores information about its activity. Processed **jobs** in `/var/lib/jenkins/jobs/` sub-folder (it contains logs and meta-data in `.xml` format for all or, specified number of runs, (this option can be set for each project). For example:

```
[mdyzma@devbox jenkins-python-test]$ tree /var/lib/jenkins/jobs/jenkins-python-test/branche
s/master
/var/lib/jenkins/jobs/jenkins-python-test/branches/master
├── builds
│   ├── 1
│   │   ├── 1.log
│   │   ├── 2.log
│   │   ├── 3.log
│   │   ├── 4.log
│   │   ├── build.xml
│   │   ├── changelog0.xml
│   │   ├── log
│   │   └── workflow
│   │       ├── 1.xml
│   │       ├── 2.xml
│   │       ├── 3.xml
│   │       └── 4.xml
│   ├── lastFailedBuild -> -1
│   ├── lastStableBuild -> 1
│   ├── lastSuccessfulBuild -> 1
│   └── legacyIds
├── config.xml
├── lastStable -> builds/lastStableBuild
├── lastSuccessful -> builds/lastSuccessfulBuild
├── name-utf8.txt
├── nextBuildNumber
└── scm-revision-hash.xml
```

Most important is `config.xml`, which is Jenkinsfile reflection and stores all steps, commands and logic translated to the xml format. Few years ago it was very important file, since it was used to back up all settings for Jenkins job and pipelines created via web UI. In our project all information is stored in `Jenkinsfile`.

Source code and its processing i.e. testing, is done in workspace sub-folder (`/var/lib/jenkins/workspace/`). This location is also accessible as a `$WORKSPACE` internal variable from the pipeline level.

Python environment for Jenkins

There are two bad news about jenkins and python virtual environments:

1. Jenkins user by default uses shell (it means no `source` command)
2. Jenkins user is non-interactive service account. It means it doesn't run through the same set of scripts that alter the PATH environment variable for logged users. There is no `.bashrc` and neither `/etc/profile` nor `/etc/bash.bashrc` configurations have any effect. As a consequence it usually uses interpreter located in `/usr/bin/python` or something like this (basic default system interpreter). If you have some Anaconda

or Miniconda custom python installation in the system, there is a good chance, that jenkins will not see it.

There is also Jenkins special plugin called *Shiny Panda*, which allows managing python virtual environments in Jenkins, but I do not recommend it. It is easier and safer to configure proper python interpreter and environment using Miniconda and Jenkins settings.

So … Jenkins does not see our nice system Miniconda installation. We will have to make Jenkins use proper python interpreter and create virtual environments accessible in the workspace of the project every time job is run.

The best solution is to install Miniconda and manage environments from the jenkins user level. Miniconda will expose `conda` package manager, which is also capable to easily manage python virtual environments.

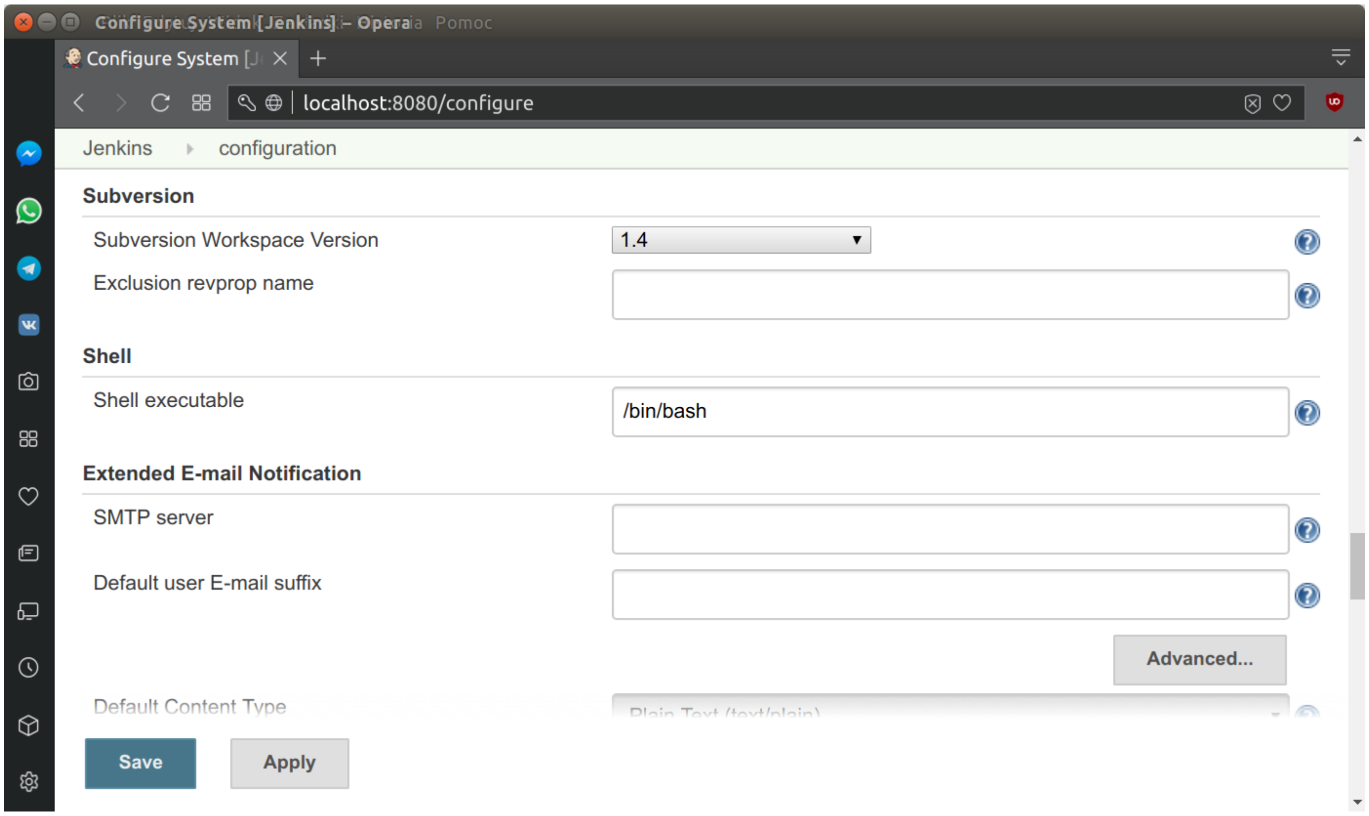
First, lets install Miniconda as jenkins user (all sh or bash command invoked in pipeline are executed as jenkins user), therefore we need to switch to the jenkins user and tell system what shell to use, since jenkins has none assigned by design. This set of commands will install latest miniconda in `/var/lib/jenkins/miniconda3/`:

```
[mdyzma@devbox jenkins-python-test]$ sudo su
[sudo] password for mdyzma: # sudo pass
root@devbox:/home/mdyzma/GitHub/jenkins-python-test# su - jenkins

$ cd /var/lib/jenkins # go to jenkins $HOME dir
$ wget https://repo.continuum.io/miniconda/Miniconda3-latest-Linux-x86_64.sh (https://repo.
continuum.io/miniconda/Miniconda3-latest-Linux-x86_64.sh)
...
71% [=====================================================>       ] 41.491.372   508KB/s  et
a 39s

$ bash Miniconda3-latest-Linux-x86_64.sh

Welcome to Miniconda3 4.3.31

In order to continue the installation process, please review the license
agreement.
Please, press ENTER to continue
>>>
Miniconda3 will now be installed into this location:
/var/lib/jenkins/miniconda3

- Press ENTER to confirm the location
- Press CTRL-C to abort the installation
- Or specify a different location below

...
installation finished.
Do you wish the installer to prepend the Miniconda3 install location
to PATH in your /var/lib/jenkins/.bashrc ? [yes|no]
[no] >>>  #say no
```

Modifying `.bashrc` of environment processing element was pointless. As I mentioned, Jenkins usually connects to the service via non-interactive shell, so neither `/etc/profile` nor `/etc/bash.bashrc` configurations would have any effect. To make it work two things need to be done:

1. change main Jenkins shell to bash (this will activate `source` command)
2. make conda binaries to be visible for jenkins user shell from the pipeline

To activate `source` command we need to switch to Bourne-again shell (bash) as default shell. Go to **Manage Jenkins -> Configure System -> Shell -> Shell executable** (or http://localhost:8080/configure (http://localhost:8080/configure)), and input `/bin/bash` into the form. Save changes.



Subversion

Subversion Workspace Version: 1.4

Exclusion revprop name:

Shell

Shell executable: /bin/bash

Extended E-mail Notification

SMTP server:

Default user E-mail suffix:

Still, we have to expose miniconda binaries to the non-login Jenkins profile. Declarative Pipelines support an environment directive, which allows defining environmental variables. Environment directive used in the top-level pipeline block will apply to all steps within the Pipeline (see: Jenkins documentation (https://jenkins.io/doc/book/pipeline/syntax/#environment)). We will use it to modify PATH variable.

Now we can easily create and destroy python virtual environment within jenkins pipeline. We can also install all dependencies locally. The post block of the script will remove this environment when pipeline finishes.

Sadly, every time we call the sh command, jenkins will create new temporary shell. This means that if we use source activate in a sh it will be only sources in that shell session. Therefore, we have to activate env in each stage or new sh command we invoke. Let me show you how it looks like:

Jenkinsfile

```
pipeline {
    agent any

    triggers {
        pollSCM('*/5 * * * 1-5')
    }
    options {
        skipDefaultCheckout(true)
        // Keep the 10 most recent builds
        buildDiscarder(logRotator(numToKeepStr: '10'))
        timestamps()
    }
    environment {
      PATH="/var/lib/jenkins/miniconda3/bin:$PATH"
    }

    stages {

        stage ("Code pull"){
            steps{
                checkout scm
            }
        }
        stage('Build environment') {
            steps {
                sh '''conda create --yes -n ${BUILD_TAG} python
                      source activate ${BUILD_TAG}
                      pip install -r requirements.txt
                    '''
            }
        }
        stage('Test environment') {
            steps {
                sh '''source activate ${BUILD_TAG}
                      pip list
                      which pip
                      which python
                    '''
            }
        }
    }
    post {
        always {
            sh 'conda remove --yes -n ${BUILD_TAG} --all'
        }
        filure {
            echo "Send e-mail, when failed"
        }
    }
}
```

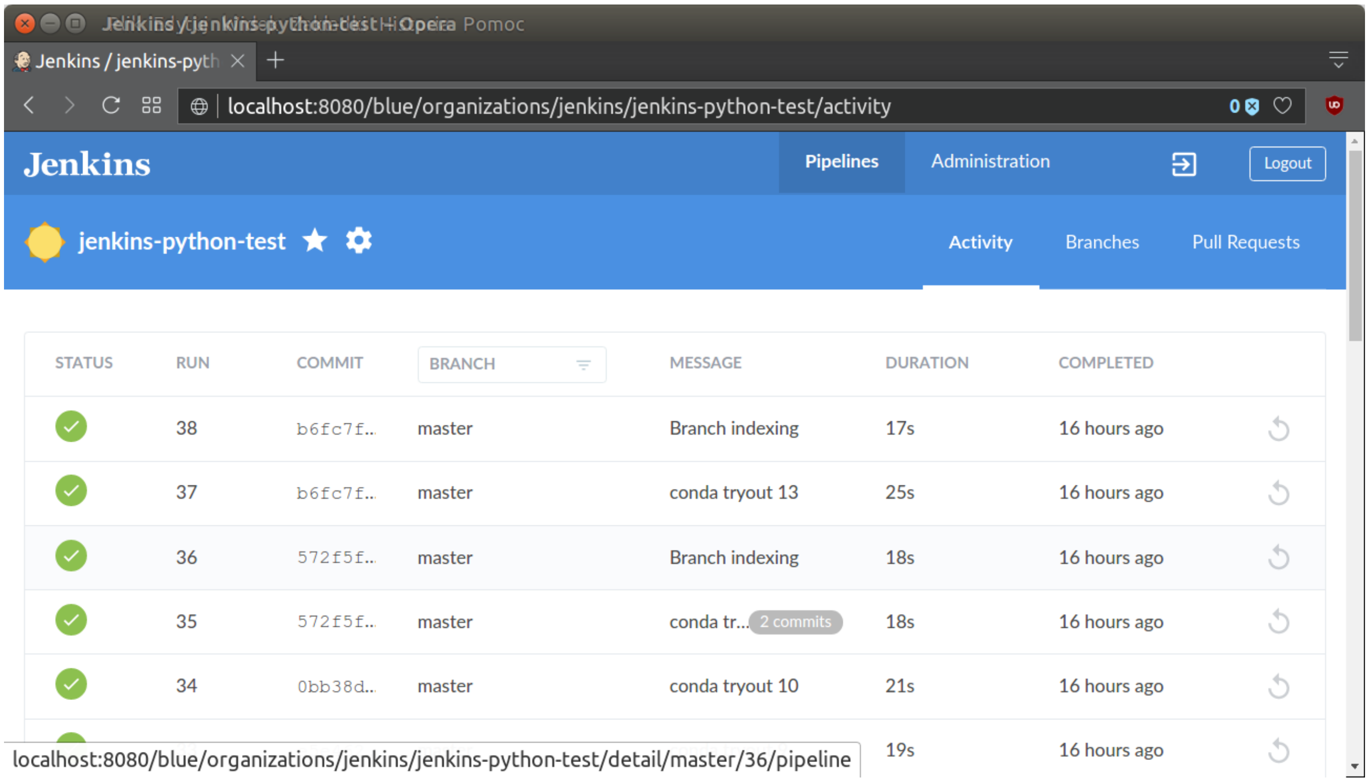
Basic frames for pipeline was enclosed in the listing above. GitHub is checked with */5 * * * 1-5 frequency (at every 5th minute on every day-of-week from Monday through Friday). Default code checkout was suppressed in pipeline options. In options, we have also established rules regarding keeping old builds (Round Robin rotation of last 10 builds) and we also established, that each log entry will be timestamped. During first stage we create conda environment and install all project dependencies. During second stage we check interpreter localization. There is also possibility to create separate environment for different python versions (i.e. 2.7 branch). All is needed is python version in create command i.e.: `conda create --yes -n env_name python=2`.

`${BUILD_TAG}` is a string created by Jenkins from combination of `jenkins-${JOB_NAME}-${BUILD_NUMBER}` variables. Convenient to put into a resource file or for easier identification of virtual environment.

Last, but not least is post block for entire pipeline. Always when pipeline finishes (regardless the status), conda environment will be purged from the disk.

Quick peek at conda envs list shows, that system works (38 jobs ran and there is only one - `root` environment):

```
[jenkins@devbox ~]$ conda env list
# conda environments:
#
root                  *  /var/lib/jenkins/miniconda3
```



STATUS	RUN	COMMIT	BRANCH	MESSAGE	DURATION	COMPLETED
✓	38	b6fc7f..	master	Branch indexing	17s	16 hours ago
✓	37	b6fc7f..	master	conda tryout 13	25s	16 hours ago
✓	36	572f5f..	master	Branch indexing	18s	16 hours ago
✓	35	572f5f..	master	conda tr... 2 commits	18s	16 hours ago
✓	34	0bb38d..	master	conda tryout 10	21s	16 hours ago
					19s	16 hours ago

Jenkins / jenkins-python-test - Opera
localhost:8080/blue/organizations/jenkins/jenkins-python-test/activity
Jenkins
Pipelines
Administration
Logout
jenkins-python-test
Activity
Branches
Pull Requests
localhost:8080/blue/organizations/jenkins/jenkins-python-test/detail/master/36/pipeline

Static code metrics

In this part we will configure static code analysis tools to determine complexity and non-standard practices in the code base. In attempt to provide top quality of the code, we can automate following checks to be done each time we commit changes:

1. Raw code metrics:
   - SLOC, comment lines, blank lines, &c. (`clock` or `sloccount`)
   - Cyclomatic Complexity (i.e. McCabe's Complexity)
   - the Maintainability Index (a Visual Studio metric)
2. Code coverage reports (`coverage`, `pytest-cov`)
3. PEP8 check (`pylint`)

There is large diversity of formats among tools. They can produce reports as JSON, HTML and sometimes XML.

Coverage and pytest-cov produce XML outputs in JUnit format. Very good option to quickly obtain test coverage report and progress graph using basic jenkins plugins. `.xml` files very easily integrate with Jenkins toolkit. To process this reports we will use JUnit Plugin (https://wiki.jenkins.io/display/JENKINS/JUnit+Plugin).

Pylint can generate its own output files, which can be read by Violation Columns Plugin (https://wiki.jenkins.io/display/JENKINS/Violation+Columns+Plugin).

Radon generates JSON outputs, which are the most problematic, since Jenkins does not have specific plugin for this tool. One possible option is to use allure tool to convert them to nice HTML reports and serve using general purpose HTML Publisher Plugin (https://wiki.jenkins.io/display/JENKINS/HTML+Publisher+Plugin).

Let's start with code raw metrics.

Raw code metrics

We will use `Radon` package to produce data in json format. Then json and report will be archived (moved to the `build/` folder).

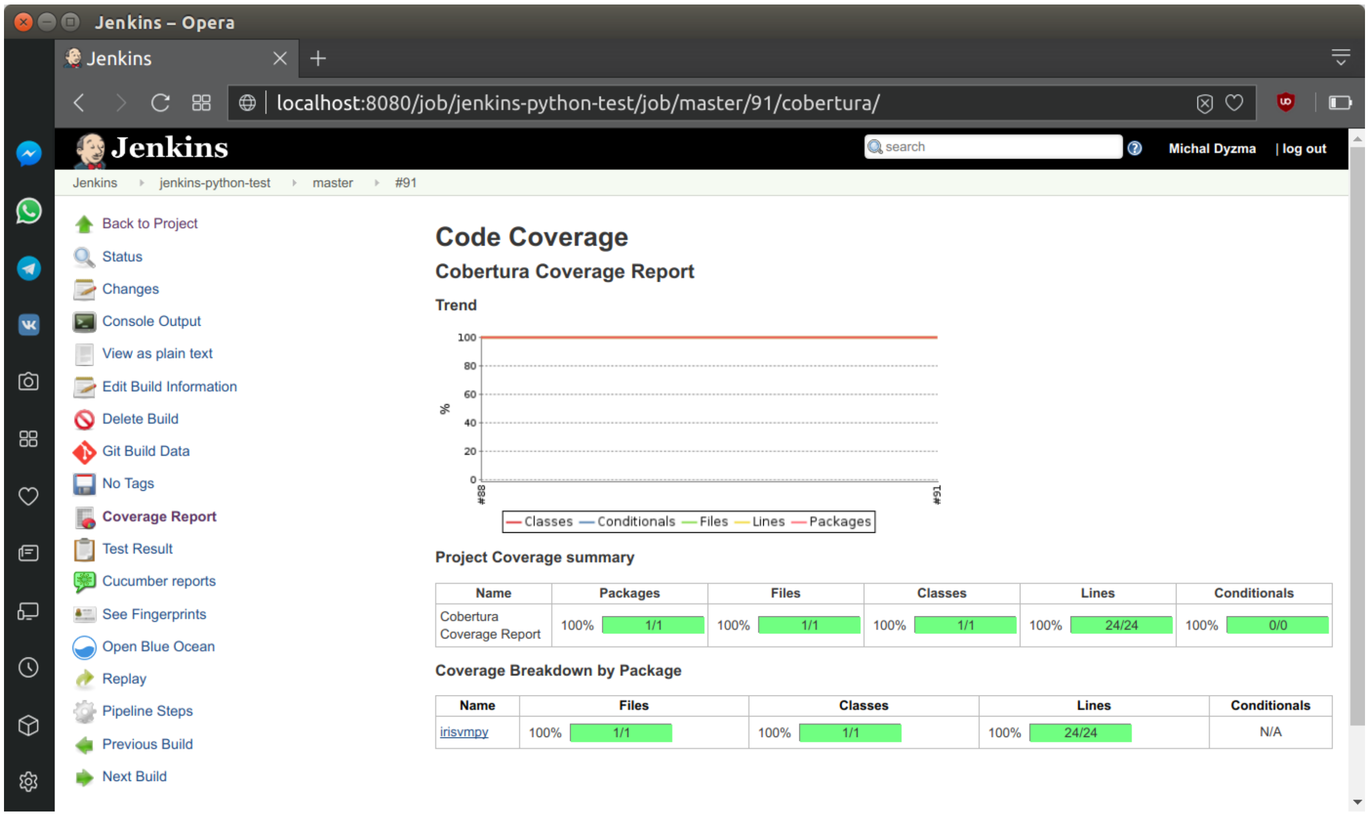
```
...
        stage('Static code metrics') {
            steps {
                echo "Raw metrics"
                sh  ''' source activate ${BUILD_TAG}
                        radon raw --json irisvmpy/ > raw_report.json
                        radon cc --json irisvmpy/ > cc_report.json
                        radon mi --json irisvmpy/ > mi_report.json
                        //TODO: add conversion and HTML publisher step
                    '''
            }
        }

...
```

Code coverage report

Jenkins has very powerful CoberturaPublisher Plugin (https://wiki.jenkins.io/display/JENKINS/Cobertura+Plugin). We will create proper `.xml` report with code coverage using `coverage` package and publish it to HTML using post section of this step. It will always grab info located in `/reports/coverage.xml` and transform it to the HTML report visible in the side menu of the Jenkins project.

```
...
        stage('Static code metrics') {
            steps {
                echo "Code Coverage"
                sh  ''' source activate ${BUILD_TAG}
                        coverage run irisvmpy/iris.py 1 1 2 3
                        python -m coverage xml -o ./reports/coverage.xml
                    '''
            }
            post{
                always{
                    step([$class: 'CoberturaPublisher',
                                   autoUpdateHealth: false,
                                   autoUpdateStability: false,
                                   coberturaReportFile: 'reports/coverage.xml',
                                   failNoReports: false,
                                   failUnhealthy: false,
                                   failUnstable: false,
                                   maxNumberOfBuilds: 10,
                                   onlyStable: false,
                                   sourceEncoding: 'ASCII',
                                   zoomCoverageChart: false])
                }
            }
        }
...
```

Code coverage report is accessible only from classical Jenkins view. It appears as a link on the left side menu and as a miniature in main project view.



Code Coverage

Cobertura Coverage Report

Project Coverage summary

Name	Packages		Files		Classes		Lines		Conditionals	
Cobertura Coverage Report	100%	1/1	100%	1/1	100%	1/1	100%	24/24	100%	0/0

Coverage Breakdown by Package

Name	Files		Classes		Lines		Conditionals
irisvmpy	100%	1/1	100%	1/1	100%	24/24	N/A

PEP8 & code metrics reports

We can also check code errors and style violations. Unfortunately `pylint` has tendency to return a non-zero exit code even only if a small warning issue was found. Only when everything was fine, 0 is returned. All non-zero steps are signal for Jenkins to fail the pipeline. This is unacceptable in case of small style differences. In this situation I use pylint report as a "tip" and allow it to fail. My shell command will always return true.

```
...
        stage('Static code metrics') {
            steps {
                echo "PEP8 style check"
                sh  ''' source activate ${BUILD_TAG}
                        pylint --disable=C irisvmpy || true
                    '''
            }
        }
...
```

Testing

Two types of testing are essential:

1. Unit tests (`pytest` or `unittest`)
2. Integration tests (`behave`)

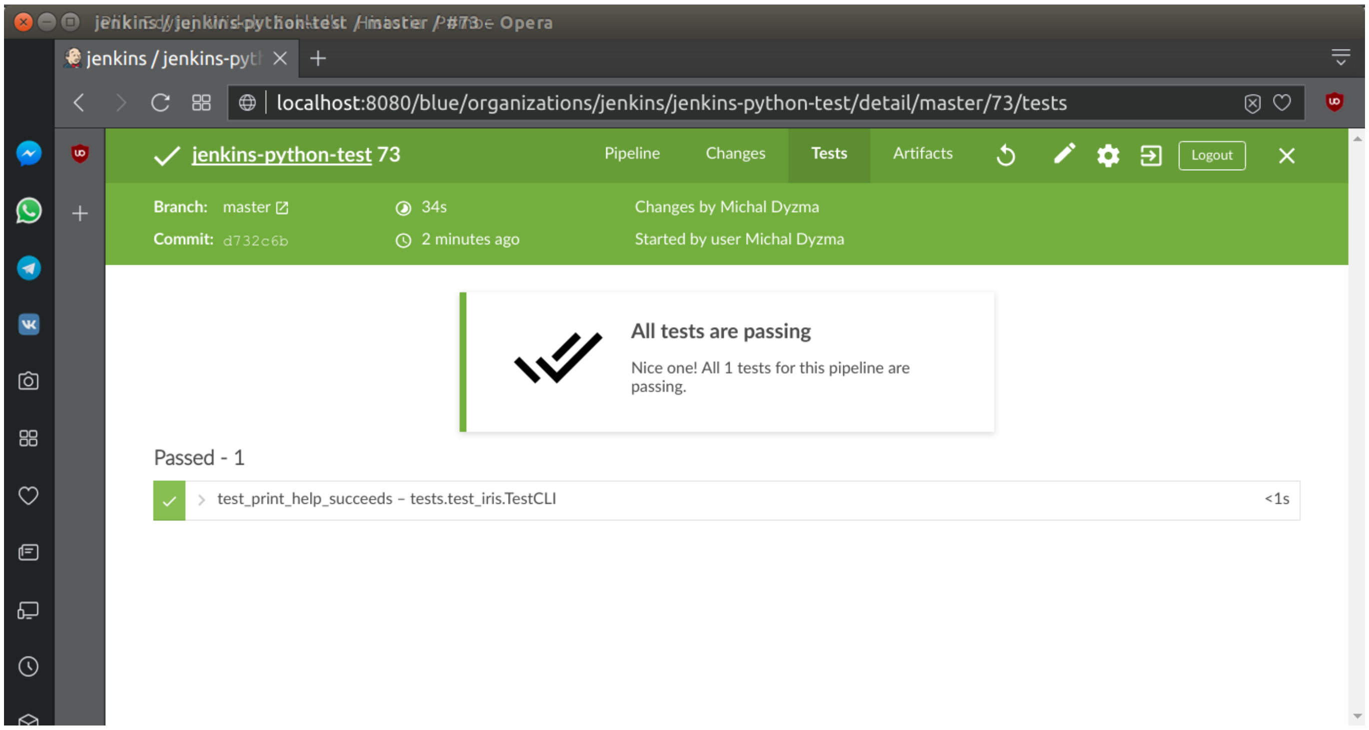
In case of more complex software integration tests may be added to the list. According to agile "outside-in" approach first we should write integration tests (more general test), then precise unit tests (classic TDD). Test results will be stored for comparison. JUnit plugin gives quick and easy access to the tests.

Unit tests

Stage with unit tests and their archiving:

```
...
        stage('Unit tests') {
            steps {
                sh  ''' source activate ${BUILD_TAG}
                        python -m pytest --verbose --junit-xml test-reports/results.xml
                    '''
            }
            post {
                always {
                    // Archive unit tests for the future
                    junit allowEmptyResults: true, testResults: 'test-reports/results.xml',
fingerprint: true
                }
            }
        }
...
```

Tests report is accessible on special **Tests** tab:


jenkins / jenkins-python-test / master / #73 - Opera
jenkins / jenkins-pyt
localhost:8080/blue/organizations/jenkins/jenkins-python-test/detail/master/73/tests
jenkins-python-test 73
Pipeline
Changes
Tests
Artifacts
Logout
Branch: master
Commit: d732c6b
34s
2 minutes ago
Changes by Michal Dyzma
Started by user Michal Dyzma

All tests are passing

Nice one! All 1 tests for this pipeline are passing.

Passed - 1

test_print_help_succeeds – tests.test_iris.TestCLI <1s

Integration tests

Behave package is able to return results of integration tests in JSON format, however this format is not compatible with any Jenkins cucumber repoprt plugins. There is a workaround to this problem. Actually two.

1. Use custom json formatter (there is gist published on GitHub (https://gist.github.com/fredizzimo/b92adf1d4596c0c1da1b05cc9899574b) with formatter compatible with cuccumber plugin style)). How to use user-specific

formatters with behave, please checks behave documentation (http://behave.readthedocs.io/en/latest/formatters.html#user-defined-formatters).
2. Use `behave2cucumber` package (https://github.com/behalf-oss/behave2cucumber), which adds another dependency to te project. Also, last post post in this (https://github.com/behave/behave/issues/267) discussions suggests, that `behave2cucumber` fails in some cases.

first option

```
...
        stage('integration tests') {
            steps {
                sh  ''' source activate ${BUILD_TAG}
                        behave -f=formatters.cucumber_json:PrettyCucumberJSONFormatter -o
 ./reports/integration.json
                    '''
            }
            post {
                always {
                    cucumber (fileIncludePattern: '**/integration*.json',
                              jsonReportDirectory: './reports/',
                              parallelTesting: true,
                              sortingMethod: 'ALPHABETICAL')
                }
            }
        }
...
```

second option

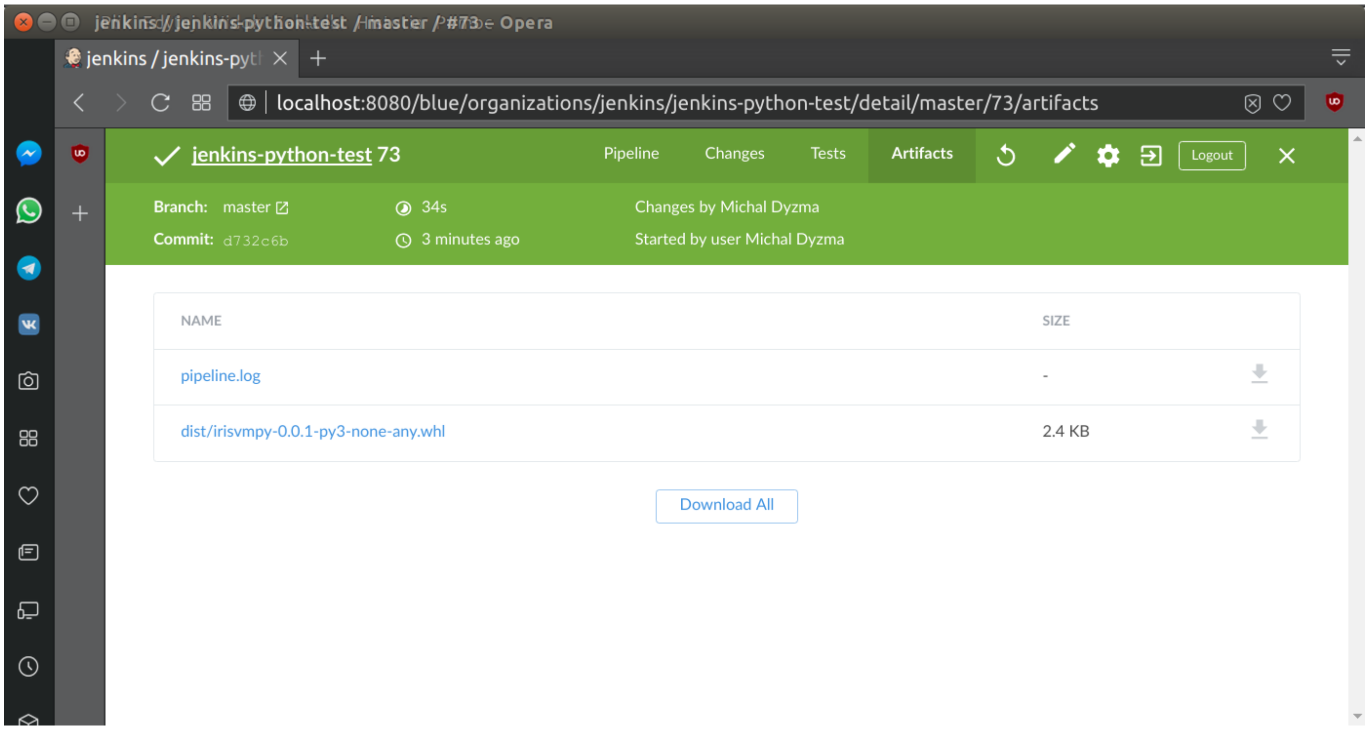
```
...
        stage('integration tests') {
            steps {
                sh  ''' source activate ${BUILD_TAG}
                        behave -f=json.pretty -o ./reports/integration.json
                        python -m behave2cucumber ./reports/integration.json
                    '''
            }
            post {
                always {
                    cucumber (fileIncludePattern: '**/integration*.json',
                              jsonReportDirectory: './reports/',
                              parallelTesting: true,
                              sortingMethod: 'ALPHABETICAL')
                }
            }
        }
...
```

Building python package

We will also build wheel package when all tests and code metrics was completed. Jenkins will check internal variable `currentBuild.result`. If nothing changed or there was no failure, Jenkins will initialize `setup.py` script. When build process is finished Jenkins will archive `.whl` file and store it for download. Blue Ocean and classical Jenkins create "Artifacts" page with all files marked to archivisation during pipeline run.

```
...
        stage('Build package') {
            when {
                expression {
                    currentBuild.result == null || currentBuild.result == 'SUCCESS'
                }
            }
            steps {
                sh  ''' source activate ${BUILD_TAG}
                        python setup.py bdist_wheel
                    '''
            }
            post {
                always {
                    // Archive unit tests for the future
                    archiveArtifacts allowEmptyArchive: true, artifacts: 'dist/*whl', finge
rprint: true)
                }
            }
        }
...
```

As we can see python package was archived as expected:


jenkins / jenkins-python-test / master / #73 - Opera
localhost:8080/blue/organizations/jenkins/jenkins-python-test/detail/master/73/artifacts
jenkins-python-test 73
Pipeline
Changes
Tests
Artifacts
Logout
Branch: master
Commit: d732c6b
34s
3 minutes ago
Changes by Michal Dyzma
Started by user Michal Dyzma
Download All

NAME	SIZE
pipeline.log	-
dist/irisvmpy-0.0.1-py3-none-any.whl	2.4 KB

Deployment

Package, which passed tests and was successfully built will be uploaded to PyPI server.

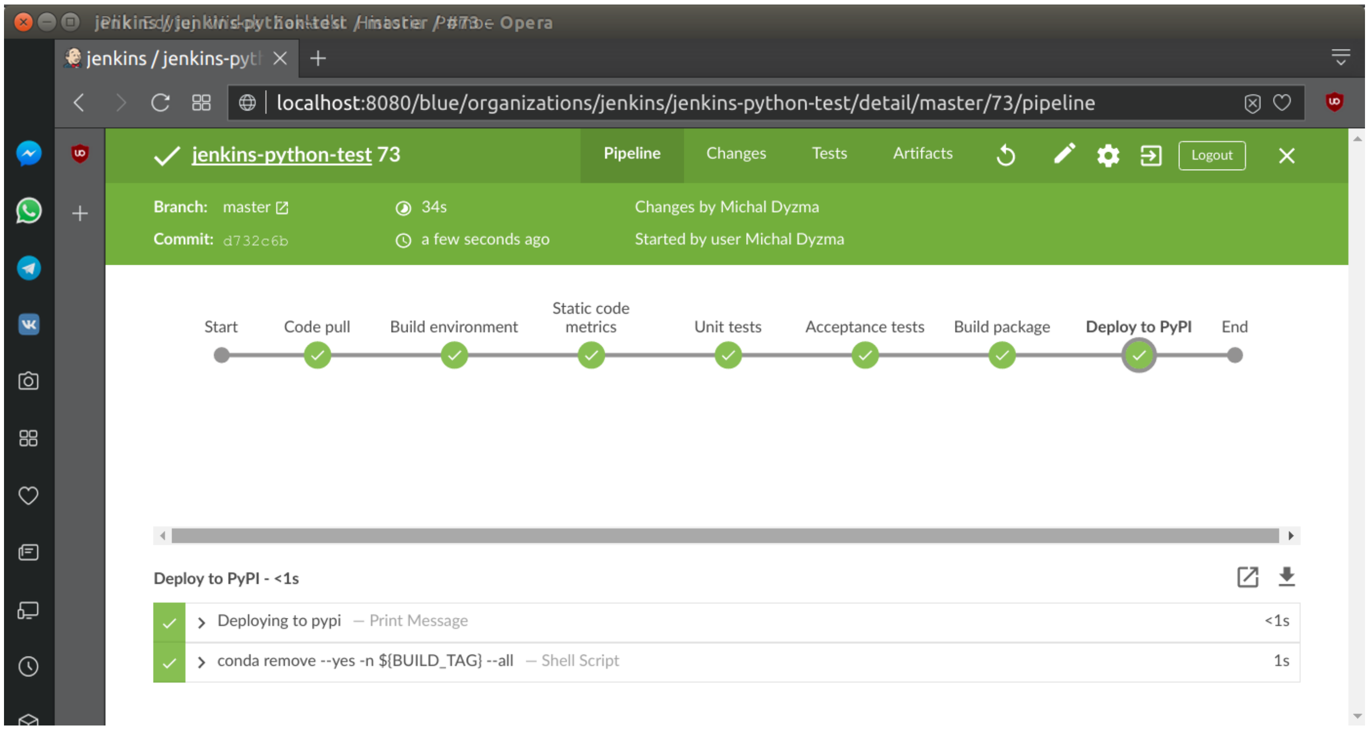
```
...
        stage("Deploy to PyPI") {
            }
            steps {
                sh "twine upload dist/*"
            }
        }
...
```

Summary

To summ up. Here is listing of the complete Jenkinsfile:

```
pipeline {
    agent any

    triggers {
        pollSCM('*/5 * * * 1-5')
    }

    options {
        skipDefaultCheckout(true)
        // Keep the 10 most recent builds
        buildDiscarder(logRotator(numToKeepStr: '10'))
        timestamps()
    }

    environment {
      PATH="/var/lib/jenkins/miniconda3/bin:$PATH"
    }

    stages {

        stage ("Code pull"){
            steps{
                checkout scm
            }
        }

        stage('Build environment') {
            steps {
                echo "Building virtualenv"
                sh  ''' conda create --yes -n ${BUILD_TAG} python
                        source activate ${BUILD_TAG}
                        pip install -r requirements/dev.txt
                    '''
            }
        }

        stage('Static code metrics') {
            steps {
                echo "Raw metrics"
                sh  ''' source activate ${BUILD_TAG}
                        radon raw --json irisvmpy > raw_report.json
                        radon cc --json irisvmpy > cc_report.json
                        radon mi --json irisvmpy > mi_report.json
                        sloccount --duplicates --wide irisvmpy > sloccount.sc
                    '''
                echo "Test coverage"
                sh  ''' source activate ${BUILD_TAG}
                        coverage run irisvmpy/iris.py 1 1 2 3
                        python -m coverage xml -o reports/coverage.xml
                    '''
                echo "Style check"
                sh  ''' source activate ${BUILD_TAG}
                        pylint irisvmpy || true
                '''
            }
            post{
                always{
                    step([$class: 'CoberturaPublisher',
                                   autoUpdateHealth: false,
                                   autoUpdateStability: false,
                                   coberturaReportFile: 'reports/coverage.xml',
                                   failNoReports: false,
                                   failUnhealthy: false,
                                   failUnstable: false,
                                   maxNumberOfBuilds: 10,
                                   onlyStable: false,
                                   sourceEncoding: 'ASCII',
                                   zoomCoverageChart: false])
                }
            }
        }

        stage('Unit tests') {
            steps {
                sh  ''' source activate ${BUILD_TAG}
                        python -m pytest --verbose --junit-xml reports/unit_tests.xml
                    '''
            }
            post {
                always {
                    // Archive unit tests for the future
                    junit (allowEmptyResults: true,
                          testResults: './reports/unit_tests.xml',
                          fingerprint: true)
                }
            }
        }

        stage('Integration tests') {
            steps {
                sh  ''' source activate ${BUILD_TAG}
                        behave -f=formatters.cucumber_json:PrettyCucumberJSONFormatter -o
./reports/integration.json
                    '''
            }
            post {
                always {
                    cucumber (fileIncludePattern: '**/*.json',
                              jsonReportDirectory: './reports/',
                              parallelTesting: true,
                              sortingMethod: 'ALPHABETICAL')
                }
            }
        }

        stage('Build package') {
            when {
                expression {
                    currentBuild.result == null || currentBuild.result == 'SUCCESS'
                }
            }
            steps {
                sh  ''' source activate ${BUILD_TAG}
                        python setup.py bdist_wheel
                    '''
            }
            post {
                always {
                    // Archive unit tests for the future
                    archiveArtifacts (allowEmptyArchive: true,
                                     artifacts: 'dist/*whl',
                                     fingerprint: true)
                }
            }
        }

        stage("Deploy to PyPI") {
            }
            steps {
                sh "twine upload dist/*"
            }
        }
    }

    post {
        always {
            sh 'conda remove --yes -n ${BUILD_TAG} --all'
        }
        failure {
            emailext (
                subject: "FAILED: Job '${env.JOB_NAME} [${env.BUILD_NUMBER}]'",
                body: """<p>FAILED: Job '${env.JOB_NAME} [${env.BUILD_NUMBER}]':</p>
                         <p>Check console output at &QUOT;<a href='${env.BUILD_URL}'>${env.
JOB_NAME} [${env.BUILD_NUMBER}]</a>&QUOT;</p>""",
                recipientProviders: [[$class: 'DevelopersRecipientProvider']]
            )
        }
    }
}
```

Running entire pipeline results all green, successful run:



Branch: master
Commit: d732c6b
34s
a few seconds ago
Changes by Michal Dyzma
Started by user Michal Dyzma

Deploy to PyPI - <1s

✓	Deploying to pypi — Print Message	<1s
✓	conda remove --yes -n ${BUILD_TAG} --all — Shell Script	1s

Source code from the article can be downloaded from this **GitHub repository** (https://github.com/mdyzma/jenkins-python-test)

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Name

Utkarsh Pandit • 3 months ago

I get this error while running: "behave -f=formatters.cucumber_json:PrettyCucumberJSONFormatter -o ./reports/<my_file>.json"
Error: " behave: error: format=formatters.cucumber_json:PrettyCucumberJSONFormatter is unknown"

Reply • Share ›

Dario • a year ago

I got this when i try exec stage('Build environment')

+ source activate jenkins-pipeline-master-12

/var/lib/jenkins/workspace/pipeline_master@tmp/durable-cf8934f3/script.sh: 3: /var/lib/jenkins/workspace/pipeline_master@tmp/durable-cf8934f3/script.sh: source: not found

Reply • Share ›

Drafter250 • 2 years ago