l'Observatoire de Paris | LESIA

Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique

RPW ROC

Get started with GitLab CI/CD

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Join GitLab !

Sign in to a GitLab:

- with your LDAP account: https://gitlab.obspm.fr/
- or using your personal gitlab.com account: https://gitlab.com/

Demo sources (public repository):

- https://gitlab.obspm.fr/slion/gitlab-ci-cd-demo

Development Workflow Summary

Commit

New codes are integrated to the base code

Build

Source code is converted into an executable form

Test

Checks the interaction between builds and if the app is working

Deploy

Deploys the app to production environment

This manual process takes up a huge amount of time and energy, which could have been used for development instead.

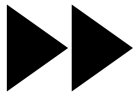
→ **CI/CD** to the rescue !

CI-CD concepts

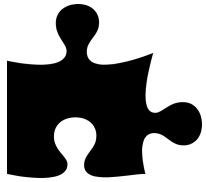
Continuous integration, delivery and deployment is known collectively as CI-CD

CI-CD essentially involves continuously **building**, **testing** and **deploying code** changes at every **small iteration**, reducing chance of developing new code based on bugged or failed previous versions.

Reduces Errors in Code

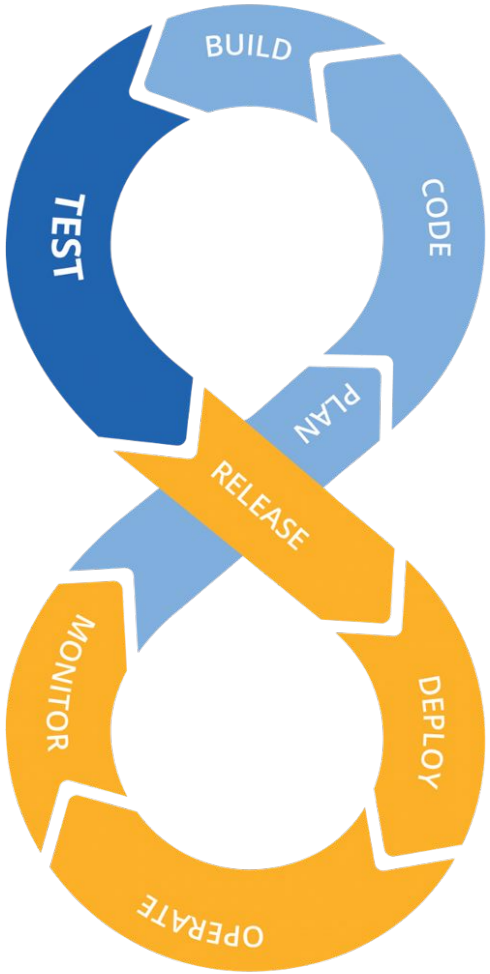


Speeds up Coding Process



Integrates Code Seamlessly

CI-CD step by step



Continuous Integration

For **every push** to the repository, you can create a set of scripts to **build and test** your application **automatically**. These scripts help **decrease** the chances that you introduce **errors** in your application.

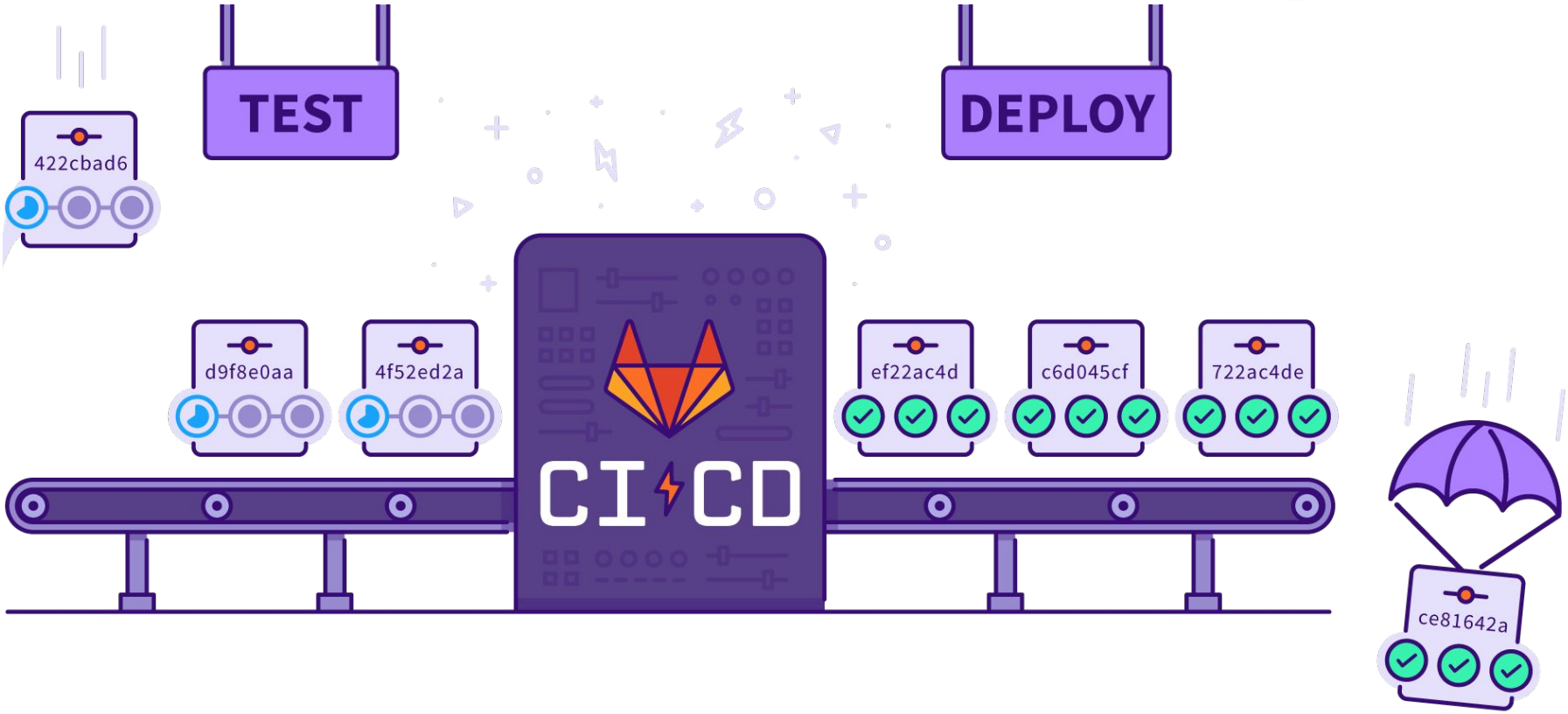
Continuous Delivery

Continuous Delivery is a step beyond Continuous Integration. Not only is your application built and tested each time a code change is pushed to the codebase, the application is also **automatically prepared** for a **release** to production.

Continuous Deployment

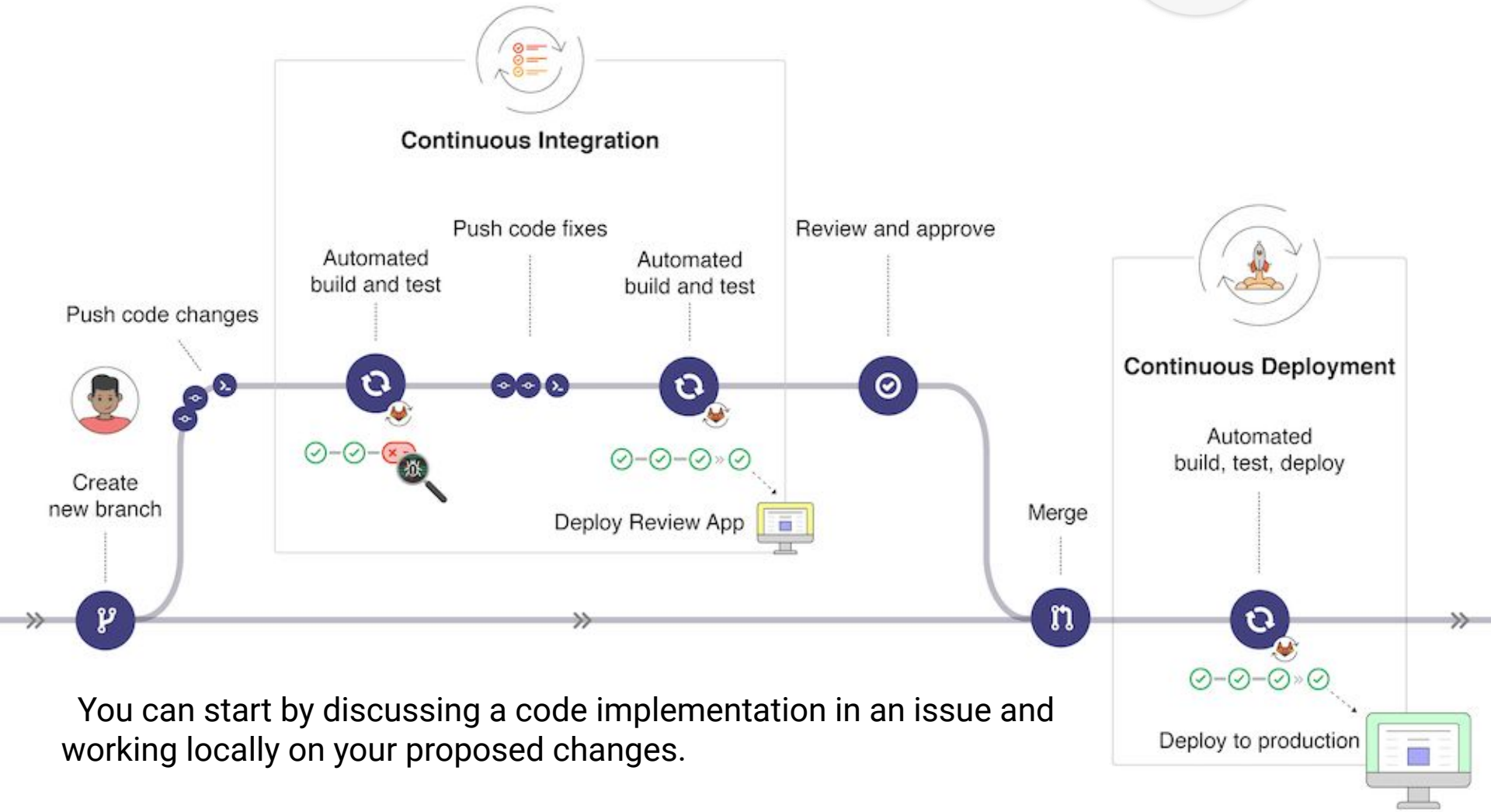
Continuous deployment is like continuous delivery, except that **releases happen automatically**.

GitLab CI-CD ?



GitLab CI/CD is a powerful tool built into Gitlab that allows you to apply Continuous Integration, Continuous Delivery, and Continuous Deployment to your software with **no third-party application** or integration needed. Moreover you can visualize all the steps in the GitLab UI.

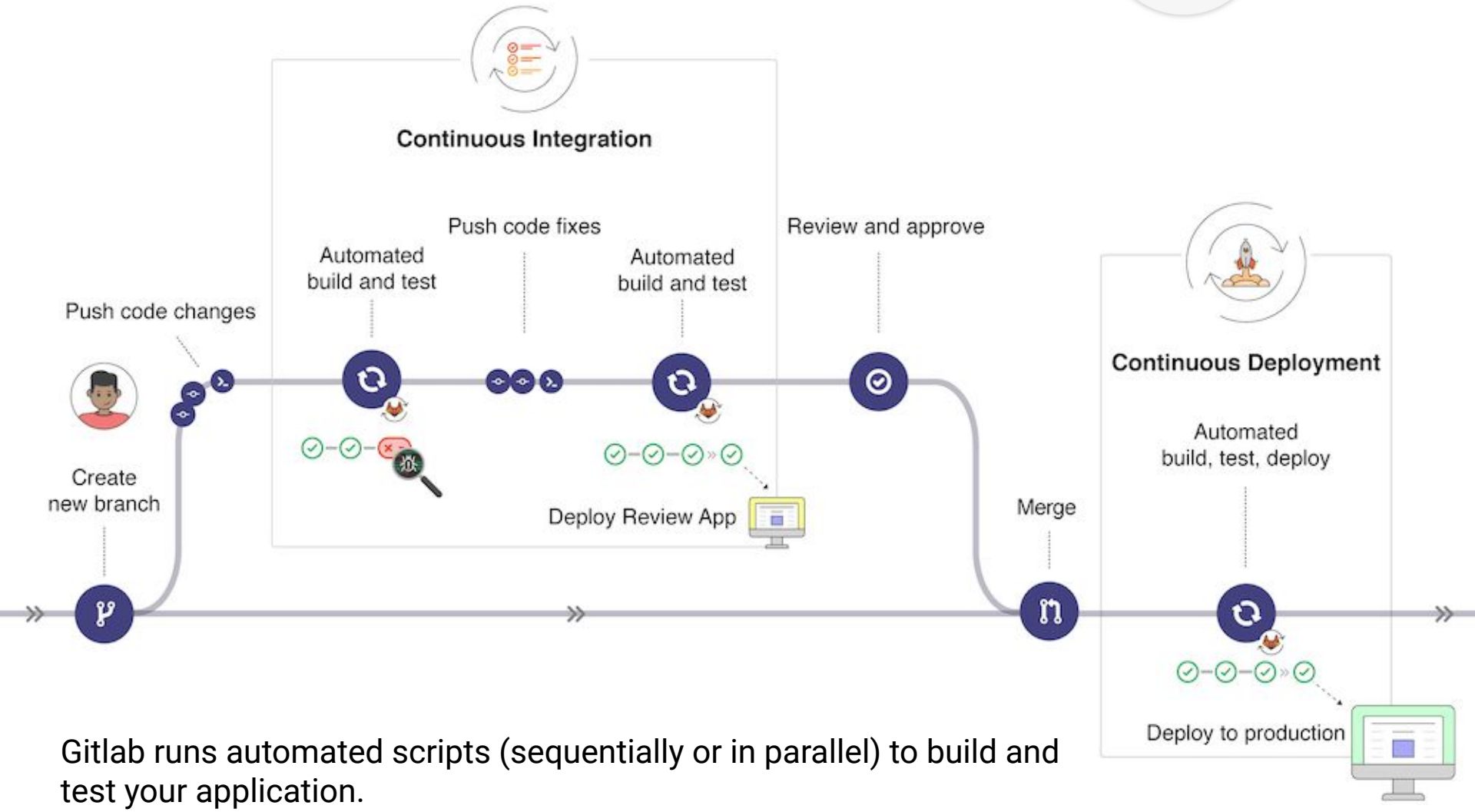
GitLab CI/CD workflow (1/3) - Push code changes



You can start by discussing a code implementation in an issue and working locally on your proposed changes.

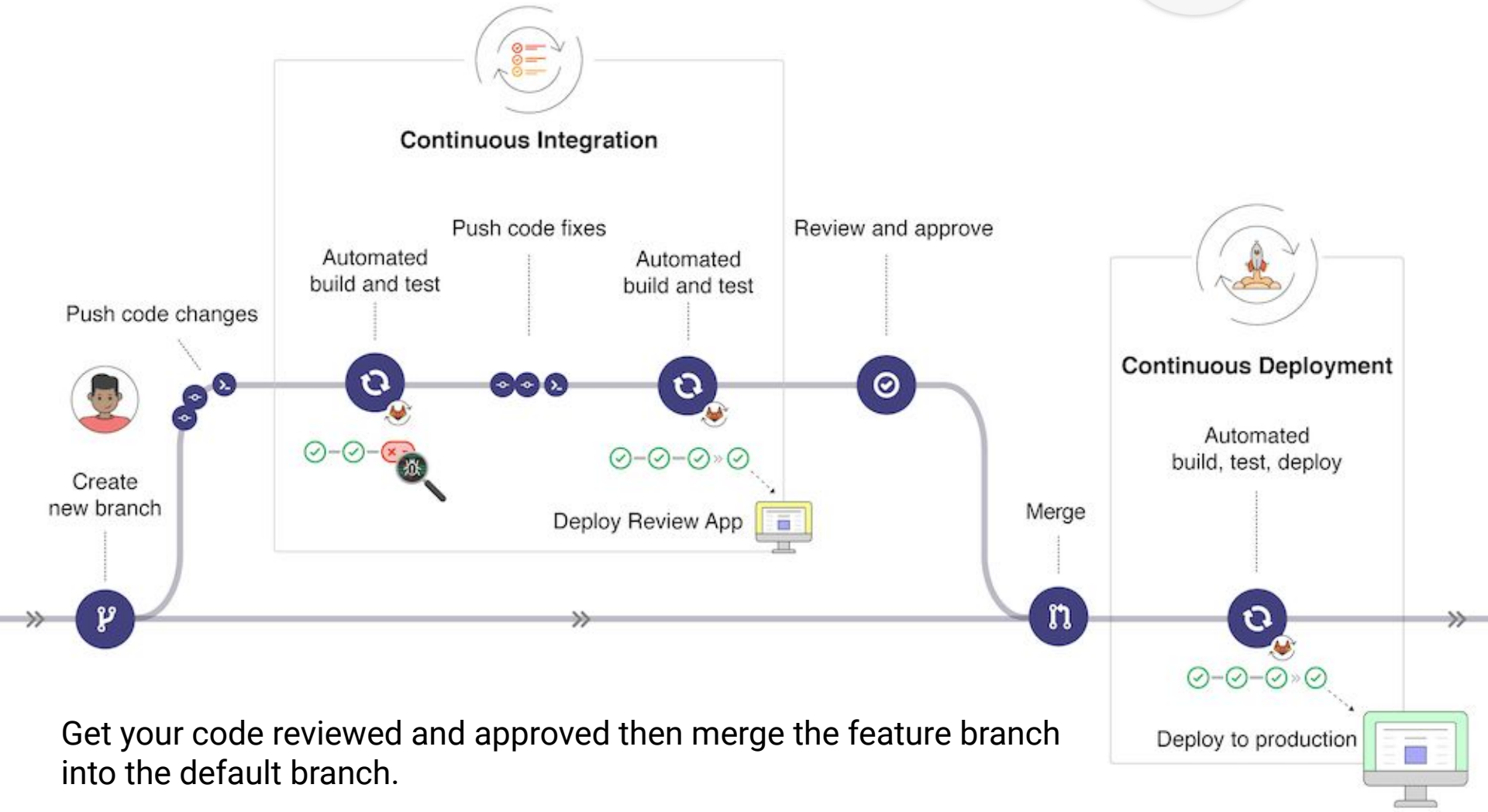
Then you can push your commits to a feature branch in a remote repository that's hosted in GitLab. The push triggers the CI/CD pipeline for your project

GitLab CI/CD workflow (2/3) - Continuous Integration



Gitlab runs automated scripts (sequentially or in parallel) to build and test your application.

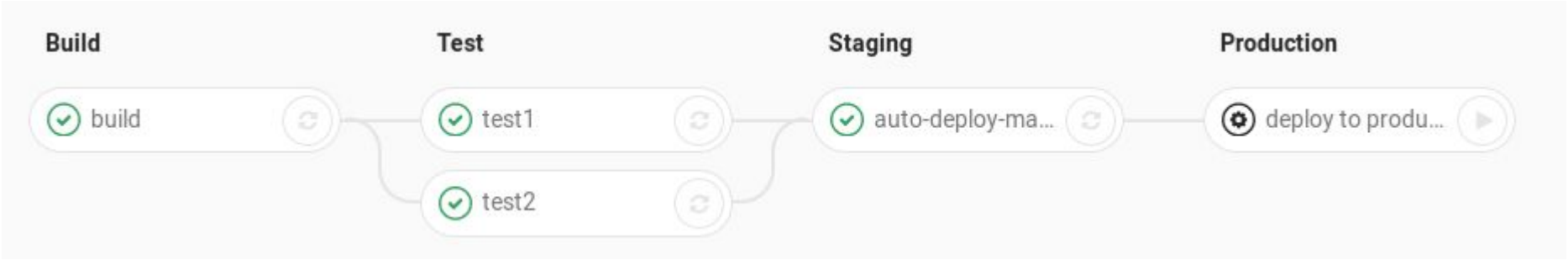
GitLab CI/CD workflow (3/3) - Review, merge and deployment



Get your code reviewed and approved then merge the feature branch into the default branch.

GitLab CI/CD deploys your changes automatically to a production environment.

CI/CD pipelines



Pipelines are the top-level component of continuous integration, delivery, and deployment.

Pipelines comprise:

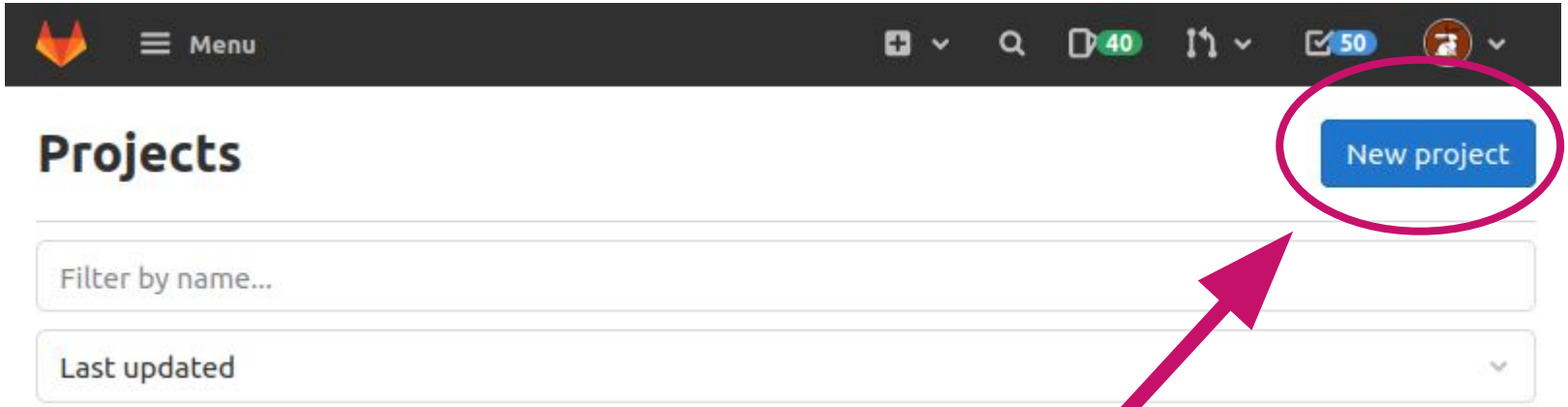
- **Jobs**, which define what to do. For example, jobs that compile or test code.
- **Stages**, which define when to run the jobs. For example, stages that run tests after stages that compile the code.

Jobs are executed by **runners**. Multiple jobs in the same stage are executed in parallel, if there are enough concurrent runners.

If all jobs in a stage **succeed**, the pipeline moves on to the **next stage**.

If any job in a stage **fails**, the **next stage** is **not** (usually) **executed** and the pipeline ends early.

Get started - New project (1/2)



Create a blank project using the Gitlab UI

Get started - New project (2/2)

Create blank project

Create a blank project to house your files, plan your work, and collaborate on code, among other things.

New project › **Create blank project**

Project name

My awesome project

Project URL

https://gitlab.obspm.fr/ slion

Project slug

my-awesome-project

Want to house several dependent projects under the same namespace? Create a group.

Project description (optional)

Description format

Visibility Level

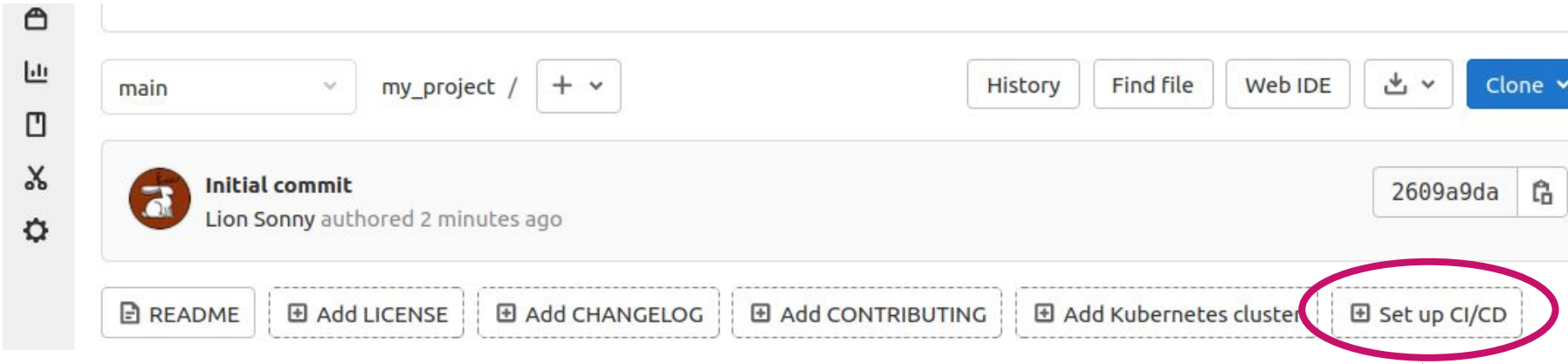
- Private
  Project access must be granted explicitly to each user. If this project is part of a group, access will be granted to members of the group.
- Internal
  The project can be accessed by any logged in user except external users.
- Public
  The project can be accessed without any authentication.

Initialize repository with a README

Allows you to immediately clone this project's repository. Skip this if you plan to push up an existing repository.

Create project | Cancel

Get started - First CI/CD pipeline with Gitlab



Step 1

The .gitlab-ci.yml file is a YAML file where you configure specific instructions for GitLab CI/CD.

In this file, you define the structure and order of jobs, including conditional execution.

Optimize your workflow with CI/CD Pipelines

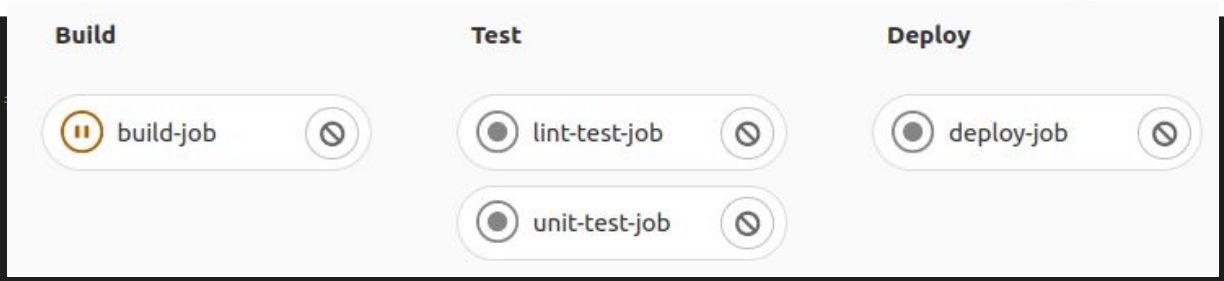
Create a new `.gitlab-ci.yml` file at the root of the repository to get started.

Create new CI/CD pipeline

Step 2

Get started - The YAML file (.gitlab-ci.yml)

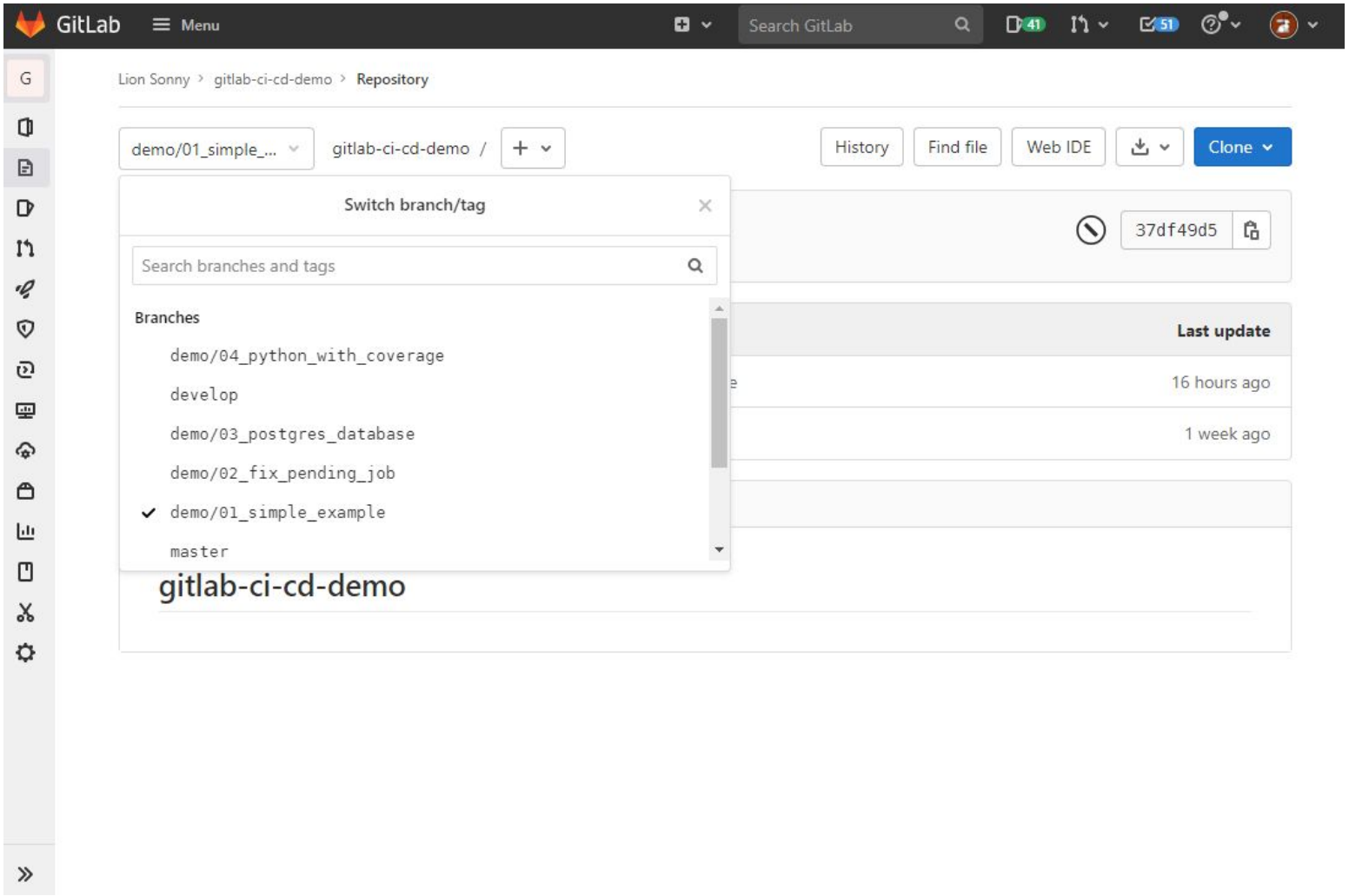
✔ demo/01_simple_example



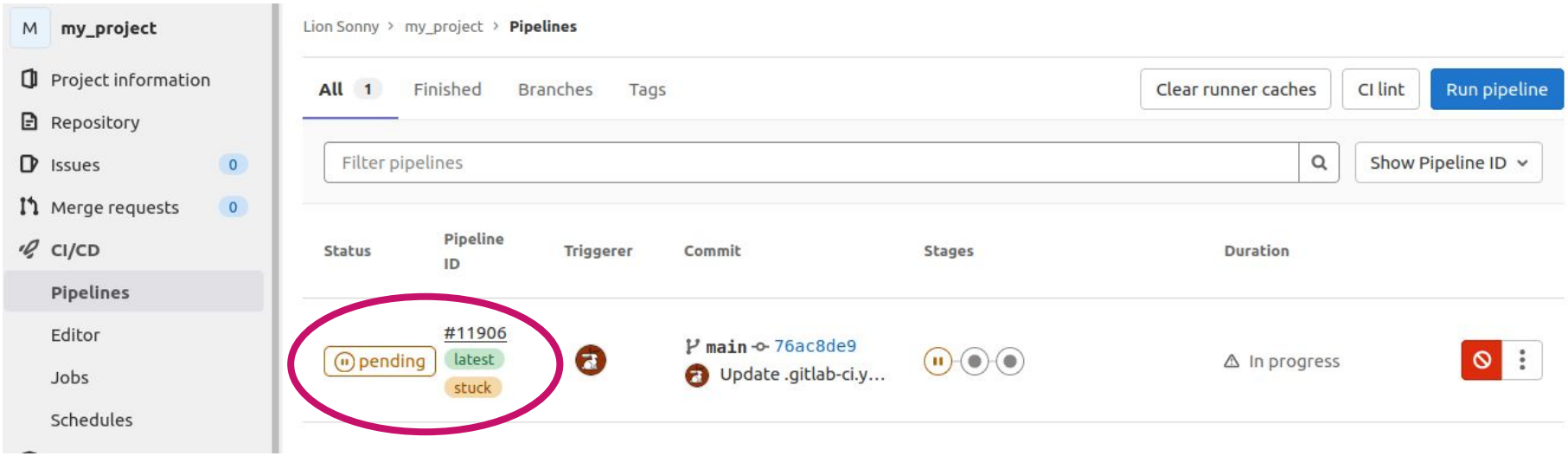

```yaml
stages:
 - build
 - test
 - deploy

build-job:       # This job runs in the build stage, which runs first.
 stage: build
 script:
   - echo "Compiling the code..."
   - echo "Compile complete."

unit-test-job:   # This job runs in the test stage.
 stage: test    # It only starts when the job in the build stage completes successfully.
 script:
   - echo "Running unit tests... This will take about 60 seconds."
   - sleep 60
   - echo "Code coverage is 90%"

lint-test-job:   # This job also runs in the test stage.
 stage: test    # It can run at the same time as unit-test-job (in parallel).
 script:
   - echo "Linting code... This will take about 10 seconds."
   - sleep 10
   - echo "No lint issues found."
```

Demo 01

https://gitlab.obspm.fr/slion/gitlab-ci-cd-demo/-/tree/demo/01_simple_example



Pipeline stuck on pending



GitLab Runners ?

GitLab Runner is the open source project written in Go that is used to run your CI/CD jobs and send the results back to GitLab

It can be run as a single binary; no language-specific requirements are needed.

You can install GitLab Runner on several different supported operating systems.

Runner registration

After you install the application, you have to register individual runners. When you register a runner, you are setting up communication between your GitLab instance and the machine where GitLab Runner is installed.

Executors

GitLab Runner implements a number of executors that can be used to run your builds in different scenarios:

- **Docker** > In a separate and isolated Docker container
- Shell > Locally on the machine where GitLab Runner is installed
- SSH > On a remote machine by executing commands over SSH
- Kubernetes > on a Kubernetes cluster
- etc.

The executors support different platforms and methodologies for building a project.

Examples

If you want your CI/CD job to run PowerShell commands, you might install GitLab Runner on a Windows server and then register a runner that uses the shell executor.

If you want your CI/CD job to run commands in a custom Docker container, you might install GitLab Runner on a Linux server and register a runner that uses the Docker executor.

Runners access and Tags

Who has access to runners in the GitLab UI

There are three types of runners, based on who you want to have access:

- Shared runners are for use by all projects
- Group runners are for all projects and subgroups in a group
- Specific runners are for individual projects

When you register a runner, you specify a token for the GitLab instance, group, or project. This is how the runner knows which projects it's available for.

Tags

When you register a runner, you can add tags to it.

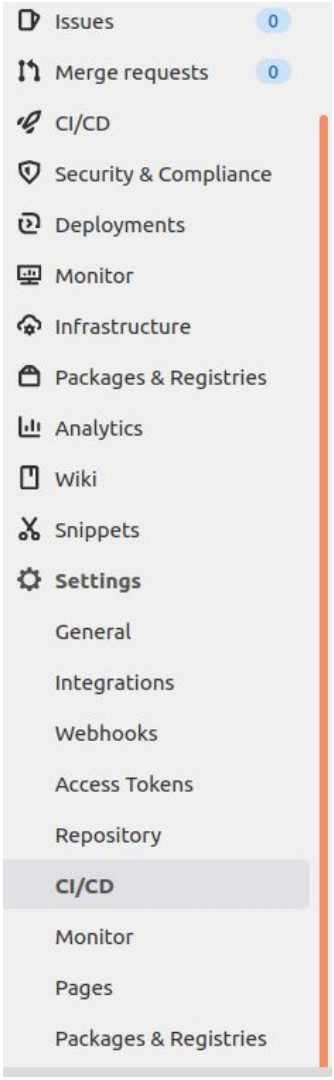
When a CI/CD job runs, it knows which runner to use by looking at the assigned tags.

For example, if a runner has the ruby tag, you would add this code to your project's .gitlab-ci.yml file:

```
my-job:
  tags:
   - ruby
```

When the job runs, it uses the runner with the ruby tag

Check available runners



Runners

Collapse

Runners are processes that pick up and execute CI/CD jobs for GitLab. How do I configure runners?

Register as many runners as you want. You can register runners as separate users, on separate servers, and on your local machine.
Runners are either:

- active - Available to run jobs.
- paused - Not available to run jobs.

Specific runners

These runners are specific to this project.

Set up a specific Runner for a project

1. Install GitLab Runner and ensure it's running.
2. Register the runner with this URL:
   `https://gitlab.obspm.fr/`

   And this registration token:
   `fsMzeZNTySLkix1Qy8Wj`

Reset registration token

Show Runner installation instructions

Shared runners

These runners are shared across this GitLab instance.

The same shared runner executes code from multiple projects, unless you configure autoscaling with MaxBuilds set to 1 (which it is on GitLab.com).

Enable shared runners for this project

Available shared runners: 2

#35 (FGmL_Pwr)
docker
docker_dio

#18 (4147eff3)
Docker DIO pour DIND
docker_dio_dind

Fix the pipeline

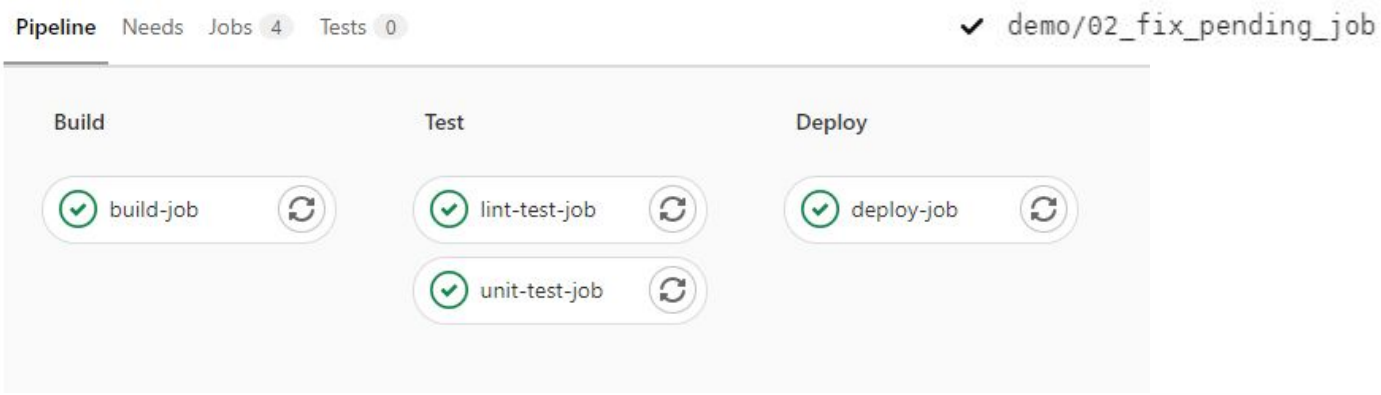
```yaml
default:
  image: alpine
  tags:
   - docker_dio

stages:          # List of stages for
jobs, and their order of execution
  - build
  - test
  - deploy
```

Available shared runners: 2

#35 (FGmL_Pwr)
docker
docker_dio

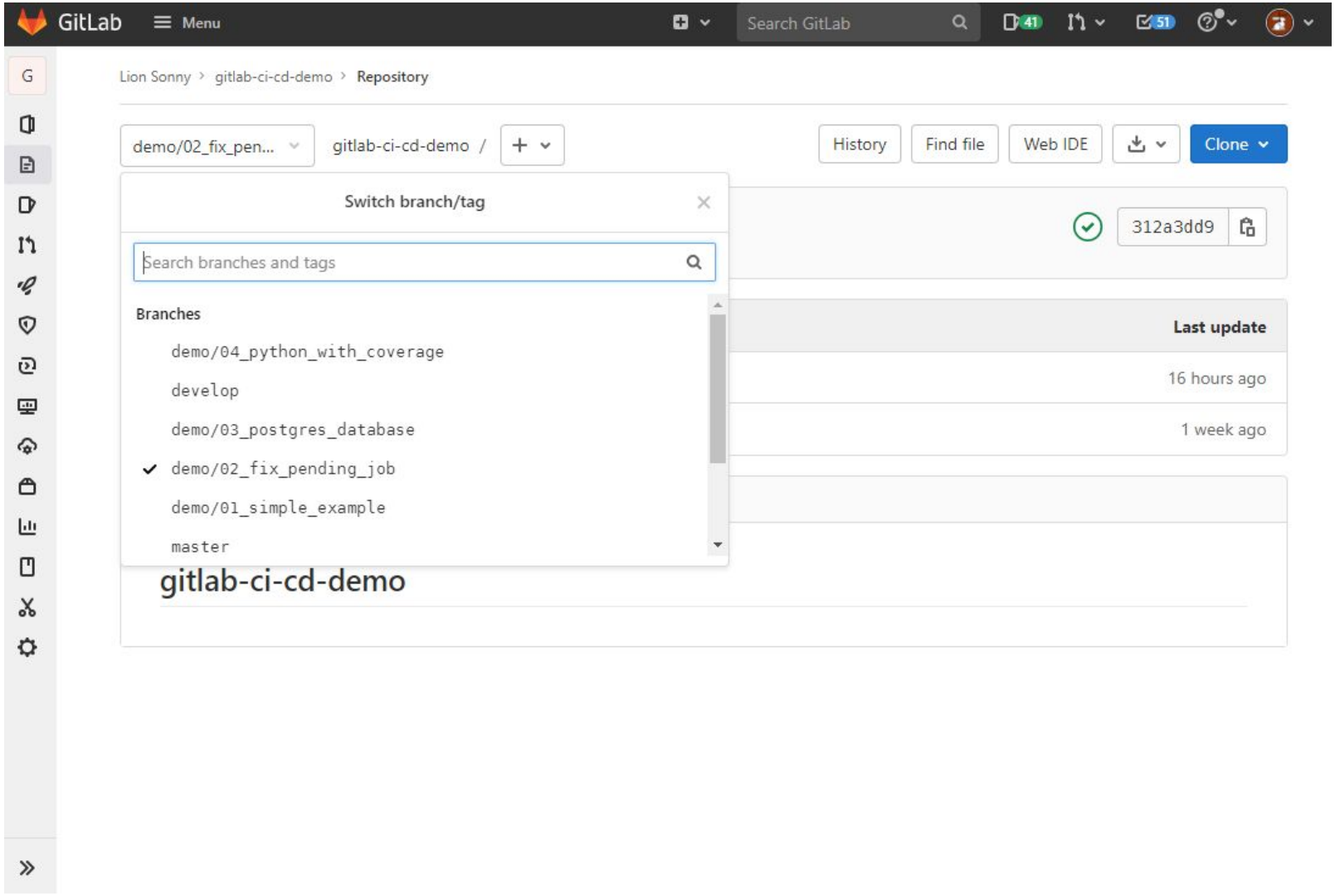
#18 (4147eff3)
Docker DIO pour DIND
docker_dio_dind

Set the default docker image to **alpine** and add the **docker_dio** tag



Demo 02

https://gitlab.obspm.fr/slion/gitlab-ci-cd-demo/-/tree/demo/02_fix_pending_job

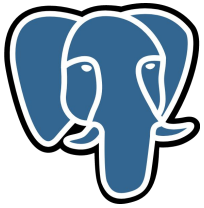


Services

The services keyword defines a **Docker image** that runs during a job **linked** to the **Docker image** that the image keyword defines. This allows you to access the service image during build time.

The service image can run any application, but the most common use case is to run a **database container**, for example:

- MySQL
- PostgreSQL
- Redis
- etc.



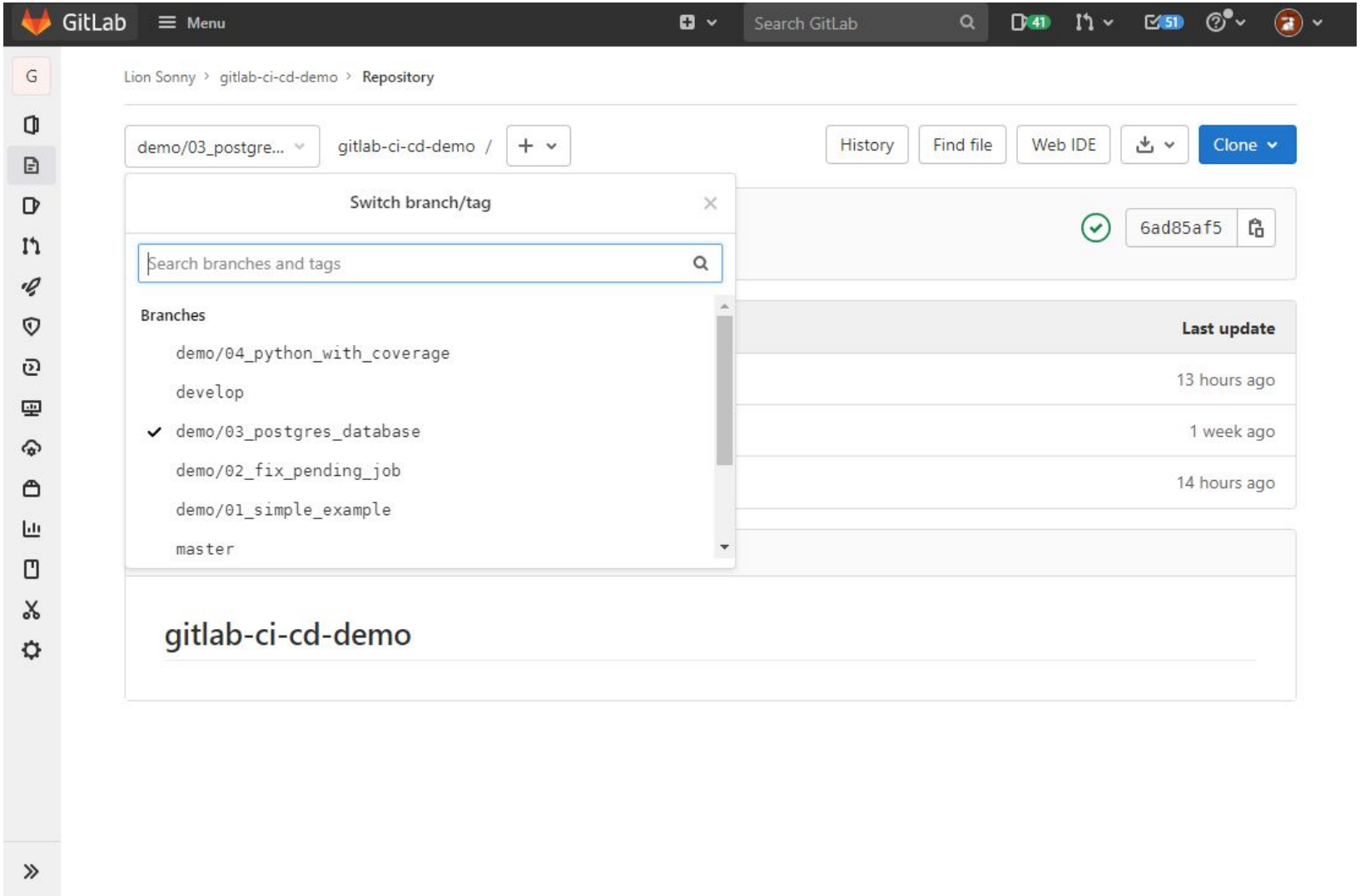
It's easier and faster to use an existing image and run it as an additional container than to install mysql, for example, every time the project is built.

You're **not limited to only database services**. You can add as many services you need to .gitlab-ci.yml or manually modify config.toml. Any image found at Docker Hub or your private Container Registry can be used as a service.

Services are **not shared between jobs**

Demo 03

https://gitlab.obspm.fr/slion/gitlab-ci-cd-demo/-/tree/demo/03_postgres_database



Cache and artifacts

Use cache for dependencies, like packages you download from the internet. Subsequent jobs that use the same cache don't have to download the files again, so they execute more quickly. Cache is stored where GitLab Runner is installed.

Artifacts are generated by a job, stored in GitLab, and can be downloaded. Use artifacts to pass intermediate build results between stages.

Cache

- Define cache per job by using the cache: keyword. Otherwise it is disabled.
- Subsequent pipelines can use the cache.
- Subsequent jobs in the same pipeline can use the cache, if the dependencies are identical.
- Different projects cannot share the cache.

Artifacts

- Define artifacts per job.
- Subsequent jobs in later stages of the same pipeline can use artifacts.
- Different projects cannot share artifacts.
- Artifacts expire after 30 days by default. You can define a custom expiration time.
- The latest artifacts do not expire if keep latest artifacts is enabled.
- Use dependencies to control which jobs fetch the artifacts.

Good caching practices

To ensure maximum availability of the cache, do one or more of the following:

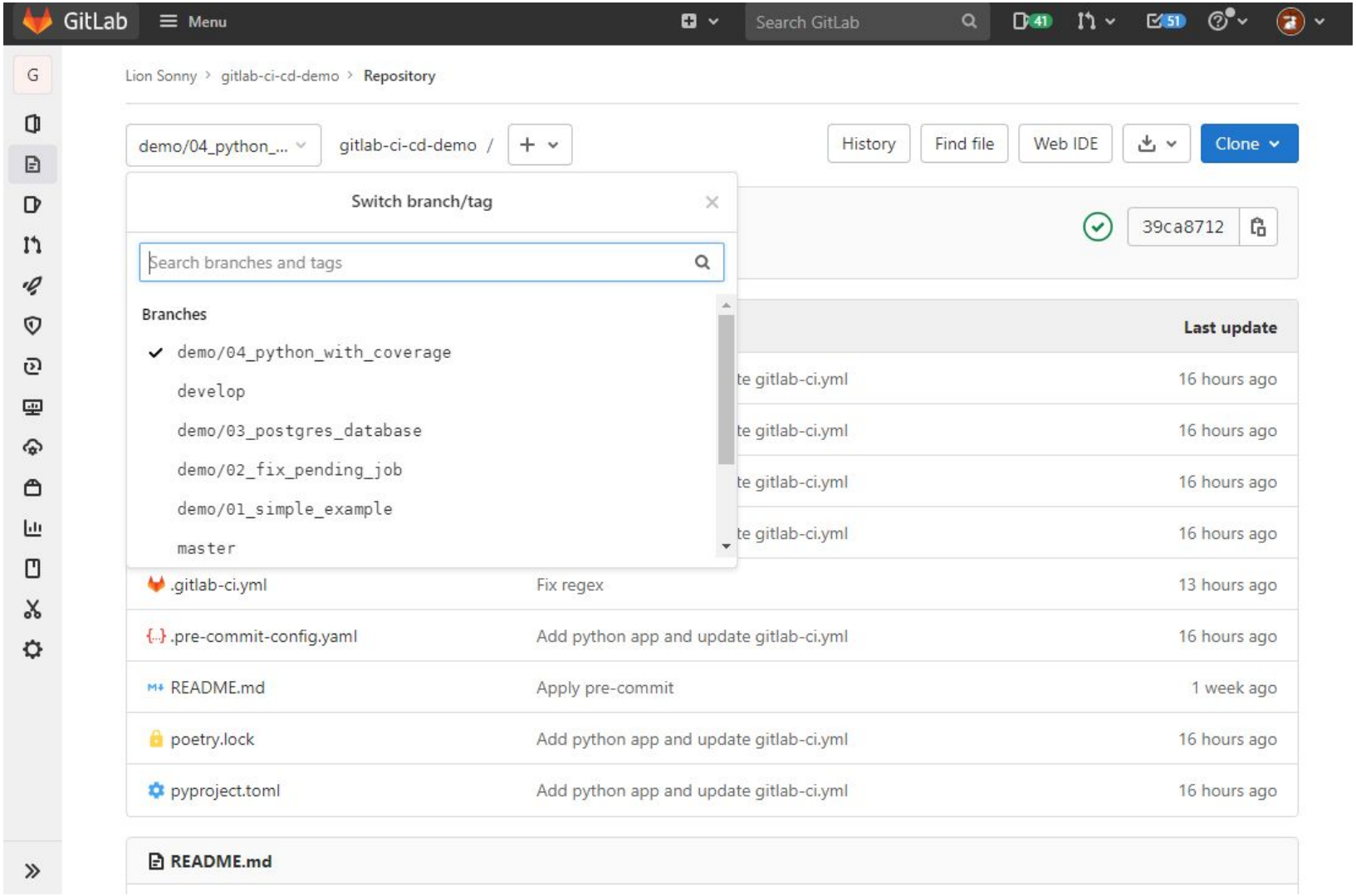
- Tag your runners and use the tag on jobs that share the cache.
- Use runners that are only available to a particular project.
- Use a key that fits your workflow. For example, you can configure a different cache for each branch.

For runners to work with caches efficiently, you must do one of the following:

- Use a single runner for all your jobs.
- Use multiple runners that have distributed caching, where the cache is stored in S3 buckets. Shared runners on GitLab.com behave this way. These runners can be in autoscale mode, but they don’t have to be.
- Use multiple runners with the same architecture and have these runners share a common network-mounted directory to store the cache. This directory should use NFS or something similar. These runners must be in autoscale mode

Demo 04

https://gitlab.obspm.fr/slion/gitlab-ci-cd-demo/-/tree/demo/04_python_with_coverage



Test and deploy a Python package

We start from a repository containing the sources of a simple python application, some tests, the documentation and some coding conventions to check.

sources

docs

tests

guidelines

requirements

Name	Last commit	Last update
demo_app	Apply pre-commit	1 week ago
docs	Apply pre-commit	1 week ago
tests	Apply pre-commit	1 week ago
.gitignore	Apply pre-commit	1 week ago
.gitlab-ci.yml	Add junit report	1 week ago
.pre-commit-config.yaml	Add python src code, gitlab-ci an...	1 week ago
README.md	Apply pre-commit	1 week ago
poetry.lock	Apply pre-commit	1 week ago
pyproject.toml	Apply pre-commit	1 week ago

Registries

Package Registry

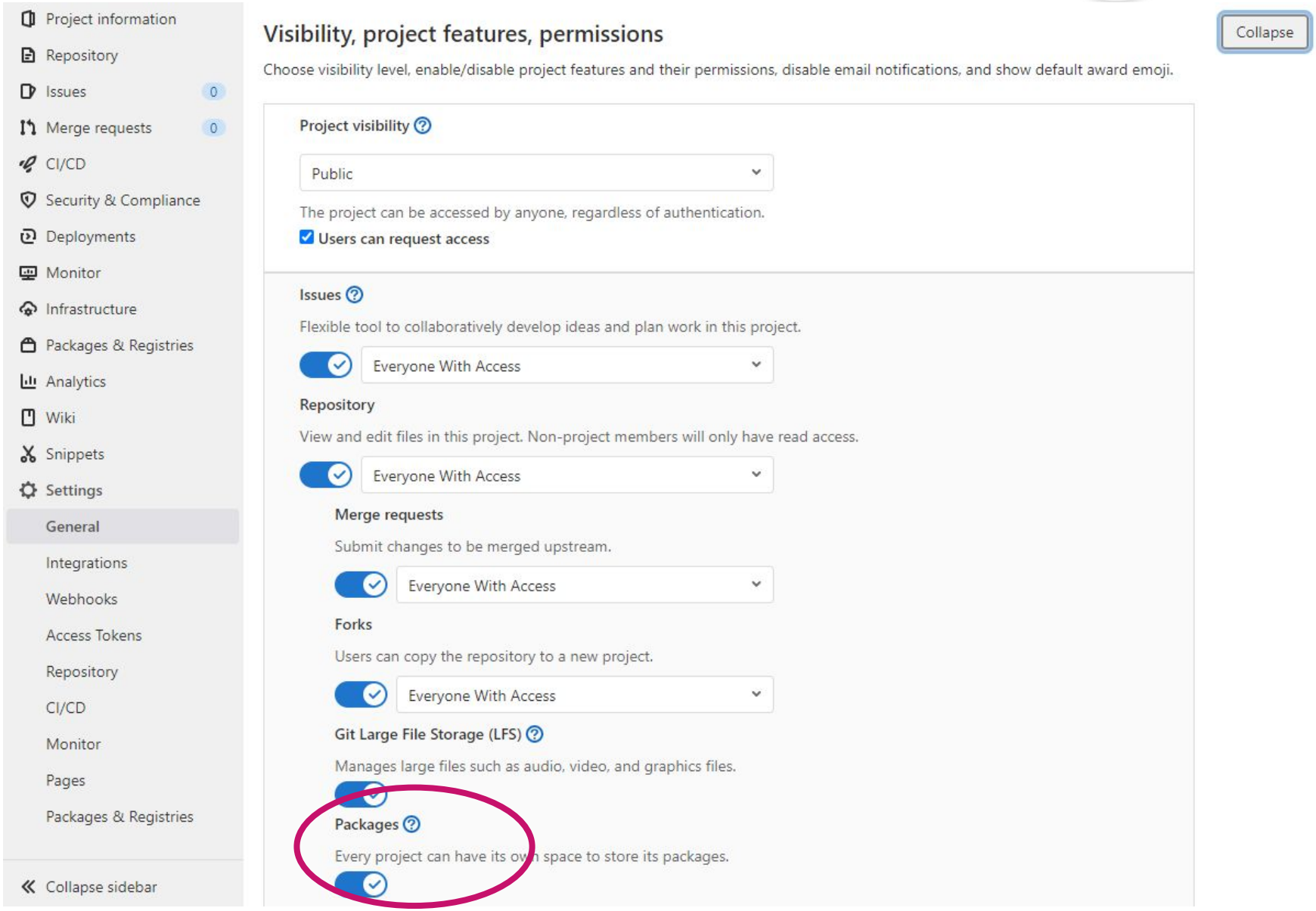


The GitLab Package Registry acts as a private or public registry for a variety of common package managers (npm, PyPI, Ruby gems, etc.). You can publish and share packages, which can be easily consumed as a dependency in downstream projects.

Container Registry

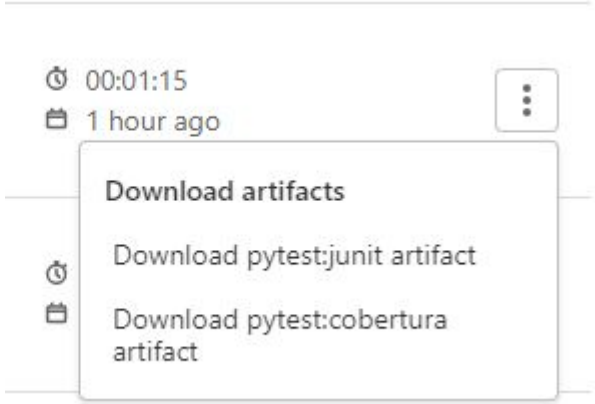
The GitLab Container Registry is a secure and private registry for container images. It's built on open source software and completely integrated within GitLab. Use GitLab CI/CD to create and publish images. Use the GitLab API to manage the registry across groups and projects.

Check if the package registry feature is enabled



Artifacts, test reports and coverage

```yaml
# test the code and display coverage
pytest:
  stage: test
  tags:
    - docker_dio
  before_script:
    - python --version
    - pip install --upgrade pip
    - pip install poetry
    - poetry config virtualenvs.in-project true --local
    - poetry install
  coverage: '^TOTAL.+?(\d+\%)$'
  script:
    - poetry run pytest --cov=demo_app -
    - poetry run coverage xml
  artifacts:
    reports:
      junit: report.xml
      cobertura: coverage.xml
```



Coverage report · coverage 80.00%

Pipeline Needs Jobs 2 Tests 1

Summary

1 tests	0 failures	0 errors	100% success rate	3.00ms

Jobs

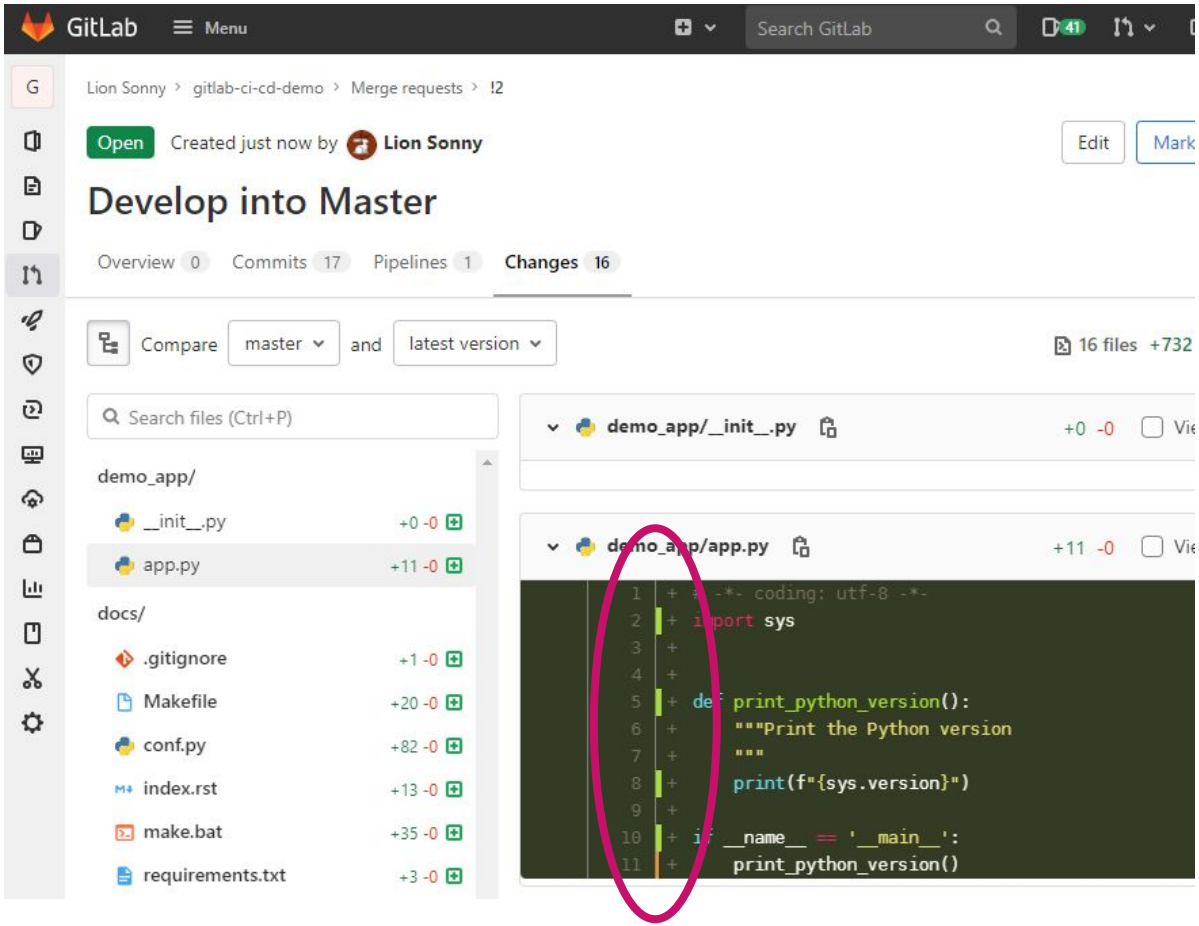
Job	Duration	Failed	Errors	Skipped	Passed	Total
pytest	3.00ms	0	0	0	1	1

Test coverage visualization

Once configured, if you create a merge request that triggers a pipeline which collects coverage reports, the coverage is shown in the diff view. This includes reports from any job in any stage in the pipeline.

The coverage displays for each line:

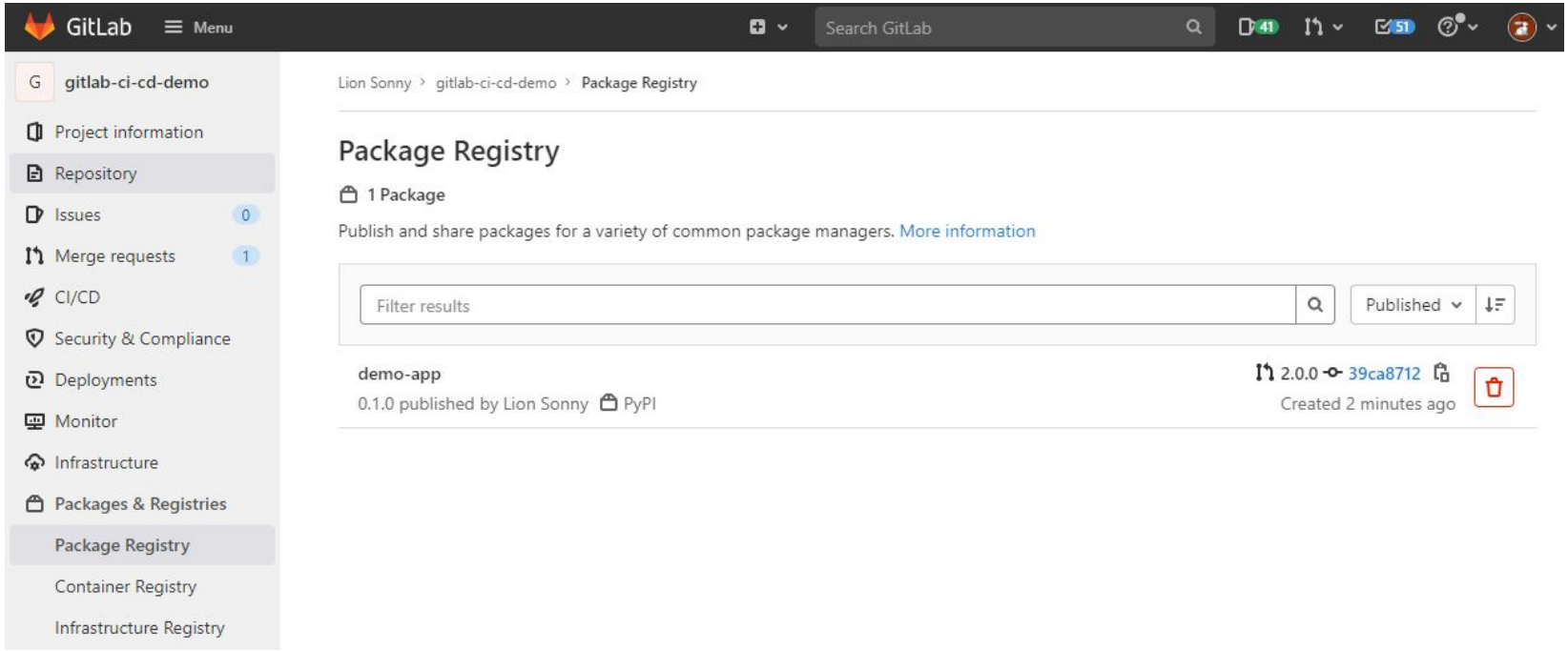
- covered (green)
- no test coverage (orange)
- no coverage information



Tag-triggered deployment

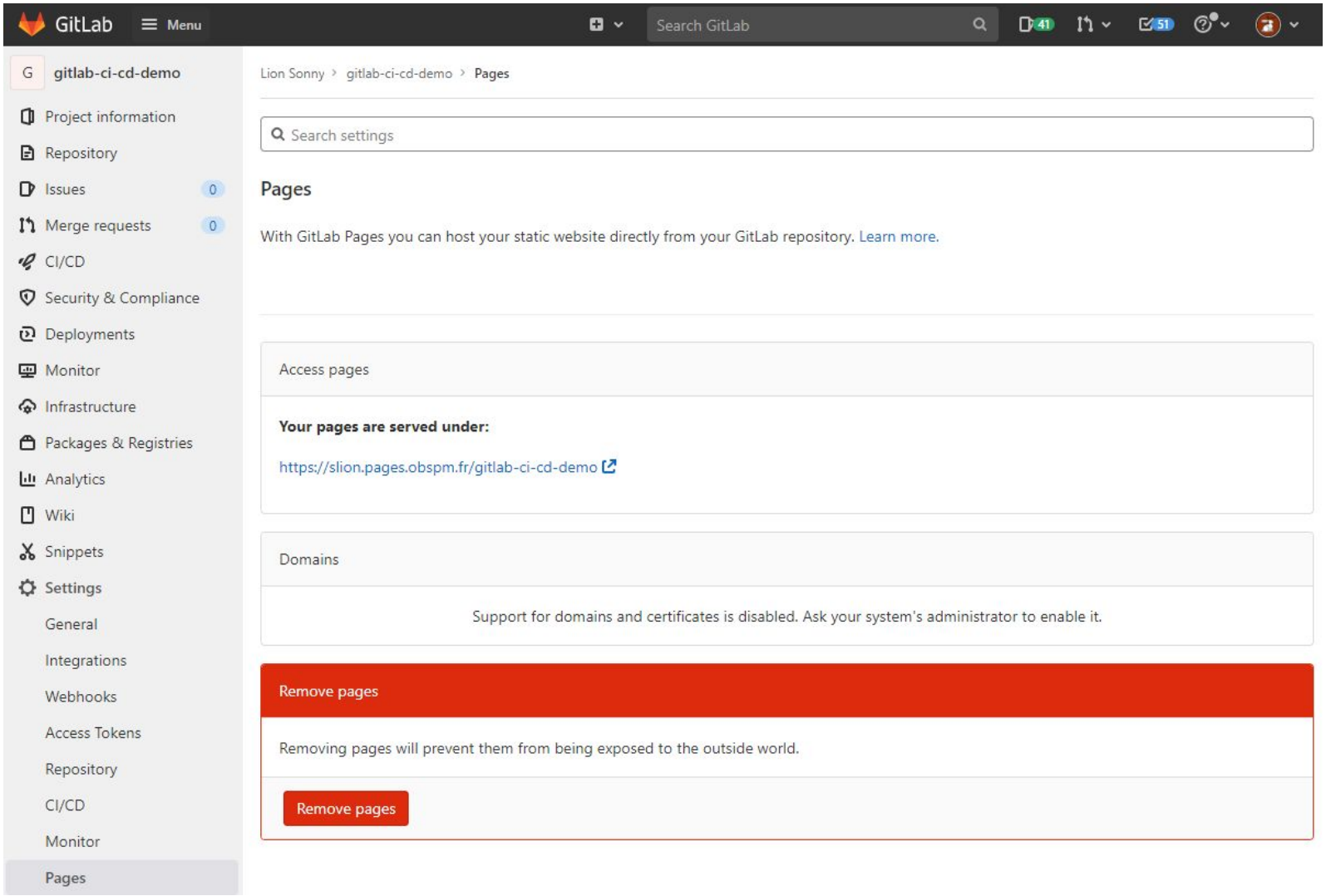
You can also use GitLab CI/CD to build and publish packages

```yaml
# publish python package on gitlab registry
publish:
  stage: deploy
  tags:
    - docker_dio
  before_script:
    - python --version
    - pip install --upgrade pip
    - pip install poetry
  script:
    # publish on a dedicated and centralized repository
    - poetry config repositories.gitlab ${CI_API_V4_URL}/projects/${CI_PROJECT_ID}/packages/pypi
    - poetry build
    - poetry publish -r gitlab -u gitlab-ci-token -p $CI_JOB_TOKEN
  only:
    - tags
    - web
```



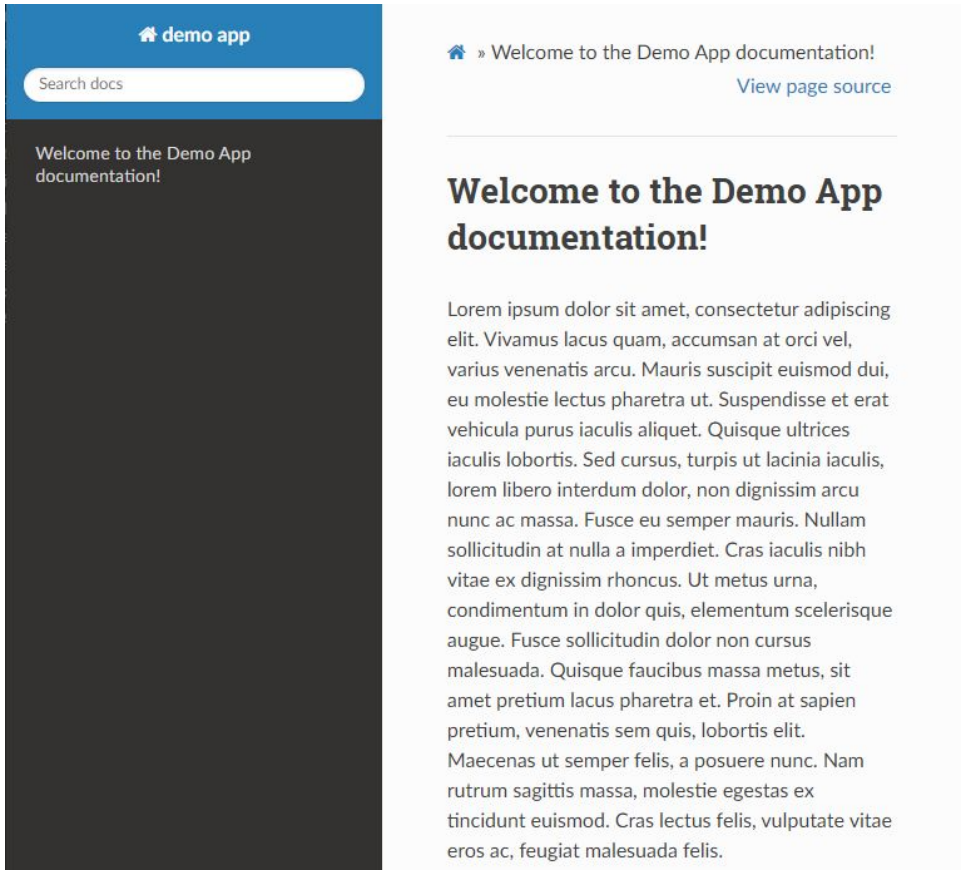
Exploring GitLab Pages

With GitLab Pages, you can publish static websites directly from a repository in GitLab.



Generate the documentation

A specific job called pages in the configuration file makes GitLab aware that you're deploying a GitLab Pages website.



GitLab always deploys your website from a very specific folder called **public**

```yaml
# deploy doc pages
pages:
  stage: deploy
  tags:
    - docker_dio
  script:
    - pip install -r docs/requirements.txt
    - sphinx-build -b html docs public
  artifacts:
    paths:
        - public
  rules:
    - if: $CI_COMMIT_BRANCH == $CI_DEFAULT_BRANCH
```

Usinge **rules** we specify that the website should be deployed only from the default branch

Pipeline schedules

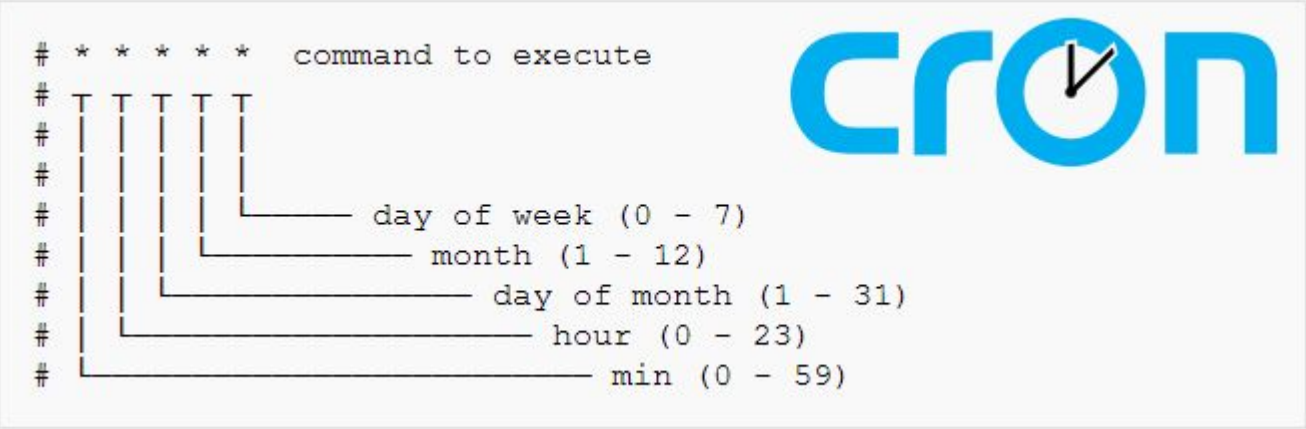
Pipelines are normally run based on certain conditions being met. For example, when a branch is pushed to repository.

Pipeline schedules can be used to also **run pipelines at specific intervals**. For example:

- Every month on the 22nd for a certain branch.
- Once every day.

In addition to using the GitLab UI, pipeline schedules can be maintained using the Pipeline schedules API.

Schedule timing is configured with **cron notation**



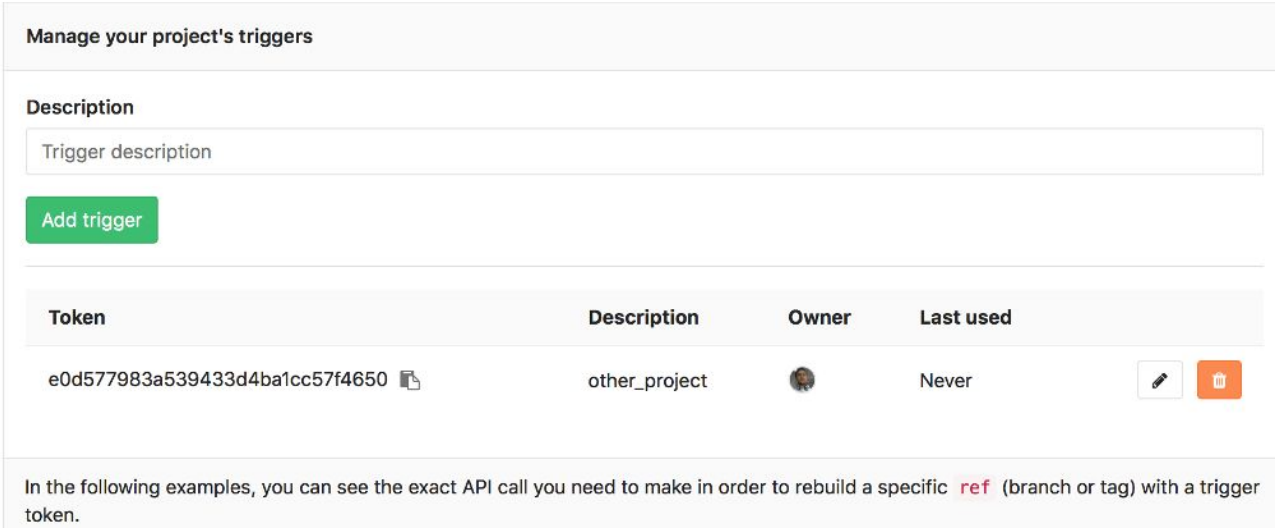
Triggering pipelines through the API

Triggers can be used to force a pipeline rerun of a specific *ref* (branch or tag) with an API call.

Adding a new trigger

Go to your **Settings > CI/CD** under **Triggers** to add a new trigger. The **Add trigger** button creates a new token which you can then use to trigger a rerun of this particular project's pipeline.

Every new trigger you create, gets assigned a different token which you can then use inside your scripts or .gitlab-ci.yml. You also have a nice overview of the time the triggers were last used.



Revoking a trigger

You can revoke a trigger any time by going at your project's **Settings > CI/CD** under **Triggers** and hitting the **Revoke** button. The action is irreversible.

Trigger a pipeline using cURL

Passing plain text tokens in public projects is a security issue. Potential attackers can impersonate the user that exposed their trigger token publicly in their .gitlab-ci.yml file. Use CI/CD variables to protect trigger tokens.

To trigger a pipeline you need to send a **POST** request to the **GitLab API endpoint**:

```
POST /projects/:id/trigger/pipeline
```

The required parameters are the **trigger's token** and the Git **ref** on which the trigger is performed. Valid refs are branches or tags. The **:id** of a project can be found by querying the API or by visiting the CI/CD settings page which provides self-explanatory examples.

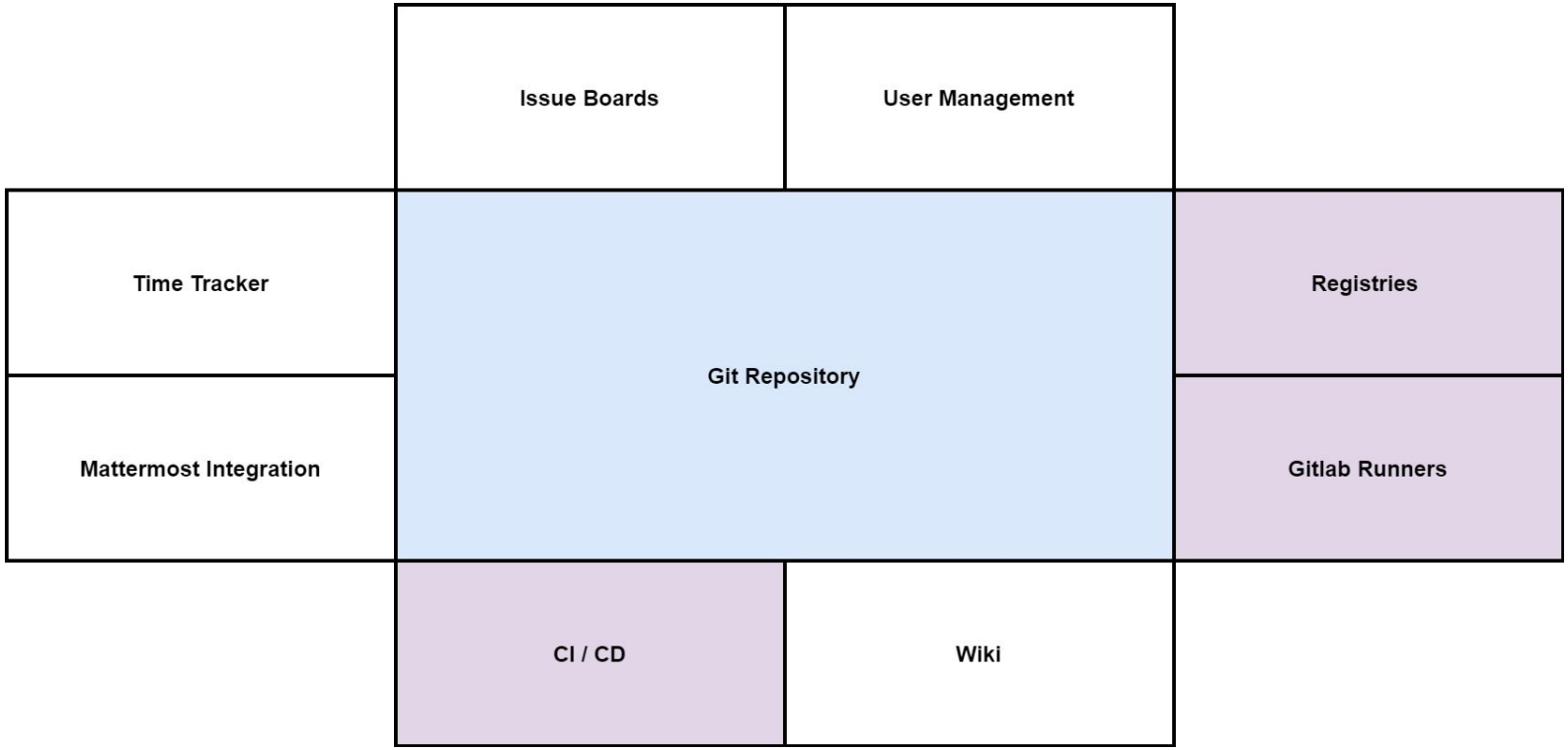
By using **cURL** you can trigger a pipeline rerun with minimal effort, for example:

```
curl -X POST \
     -F token=<my-token> \
     -F "ref=<ref-name-like-branch-or-tag>" \
     https://gitlab.obspm.fr/api/v4/projects/<project-id>/trigger/pipeline
```

Alternatively, you can pass the token and ref arguments in the query string:

```
curl --request POST \
"https://gitlab.example.com/api/v4/projects/<project-id>/trigger/pipeline?token=TOKEN&ref=main"
```

This is just the beginning...



Gitlab comes with a lot of built-in features and you still have a lot to discover...

→ **https://docs.gitlab.com/**