GitLab CI Pipeline. Build docker image in pipeline job.

Gitlab allows seamlessly using docker image from public and private hubs. I bet that most of you uses docker executors. All works great and without a hassle until you need to build your own docker image. Fortunately, you can build your docker image automatically in pipeline by leveraging docker-in-docker image build. I'll show you how to include docker image build in Gitlab CI Pipeline, push it to Gitlab Repo and use it in another job.

Prerequisite

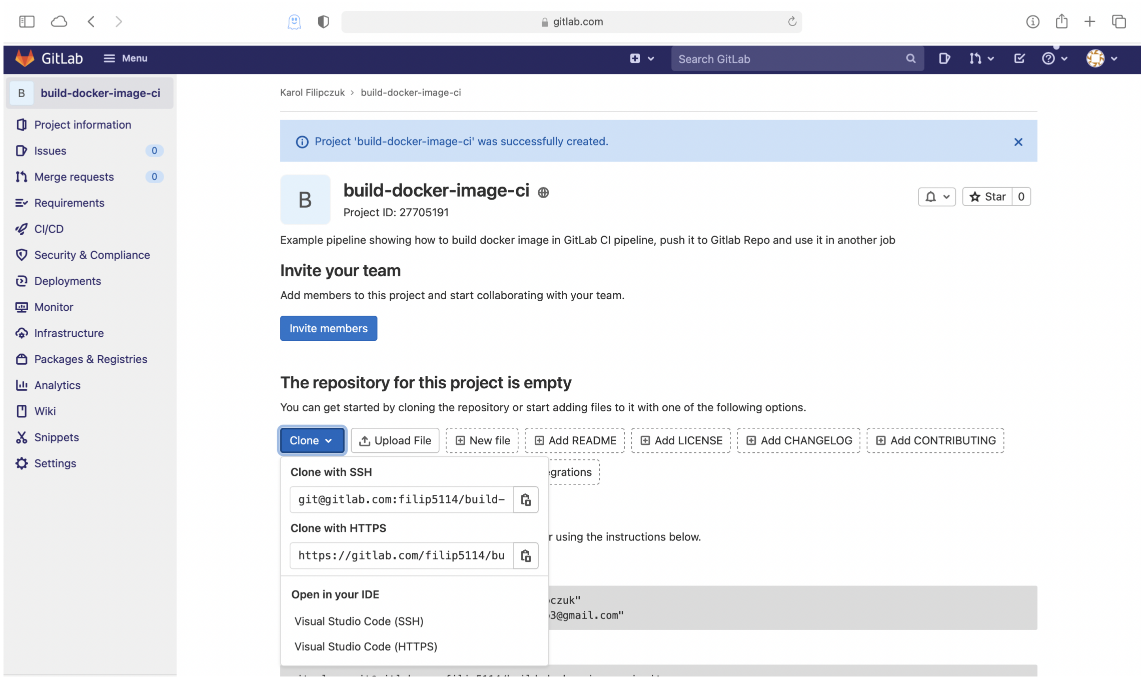
- Gitlab account
- Docker basic knowledge

Agenda

1. Create Gitlab blank project
2. Create Dockerfile
3. Create Gitlab CI pipeline (.gitlab-ci.yml)
    1. Build and push docker image
    2. Use custom docker image
    3. Be efficient!
4. Summary

Create new GitLab project

Create new blank project which we will use throughout this lab. Login into GitLab and navigate to `New project -> Create blank project/repository`. Give it a project name and hit `Create project`.



Project 'build-docker-image-ci' was successfully created.

build-docker-image-ci

Project ID: 27705191

Example pipeline showing how to build docker image in GitLab CI pipeline, push it to Gitlab Repo and use it in another job

Invite your team

Add members to this project and start collaborating with your team.

The repository for this project is empty

You can get started by cloning the repository or start adding files to it with one of the following options.

Clone with SSH

`git@gitlab.com:filip5114/build-`

Clone with HTTPS

`https://gitlab.com/filip5114/bu`

Clone the project and we are ready to go.

Create Dockerfile

We need to create a Dockerfile, which will be used to build an docker image. Let's use `Alpine Linux` as base image. It is a minimal linux distribution ~5MB. Alpine Linux is great choice when you have specific task to accomplish and you want to use less storage, have fast build times.

Alpine doesn't have java installed by default - command `java -version` would fail. We will create Dockerfile to create new docker image based on Alpine with `openjdk11` installation. After building and pushing image to repo, we will use it in another job and run command `java -version` which should run successfully.

Creating new image is not the only option. You can use base Alpine image in your pipeline job, then in `script` section of the job install java with regular linux command. It will also work. Just keep in mind that that our example is simple. Real world scenario could include multiple software installation and configuration. You wouldn't want to run it every time pipeline is trigged. Time is precious in CI/CD pipeline. It's more efficient to build image at first and rebuild it only if Docker file changes.

```
FROM alpine:3

RUN apk add openjdk11

CMD ["/bin/sh"]
```

Our Dockerfile couldn't be more simple:

- `FROM alpine:3` - use Alpine image with tag 3 as base image
- `RUN apk add openjdk11` - run command to install openjdk11
- `CMD ["/bin/sh"]` - specifies what command to run in container

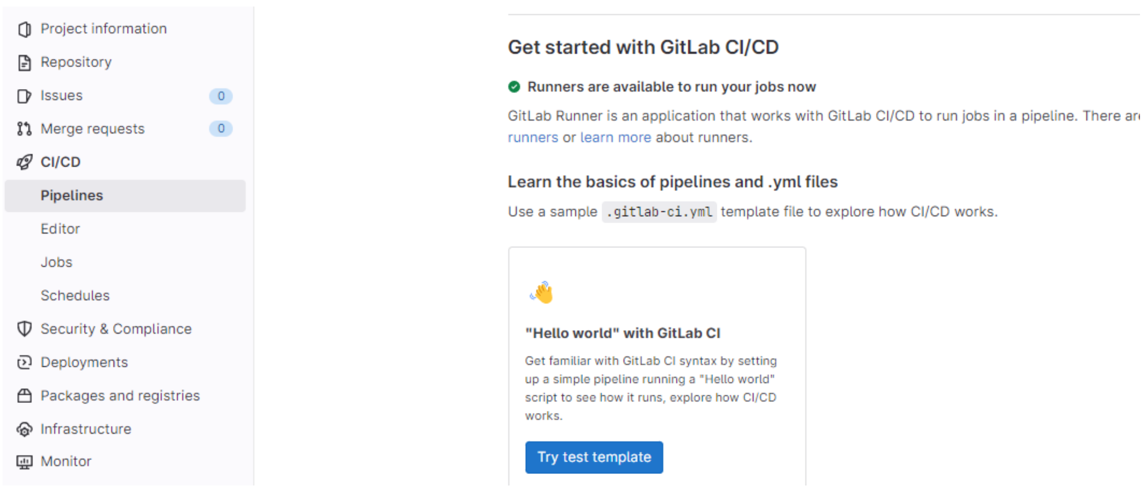
Dockerfile is ready. Push it to Gitlab repo or create Dockerfile directly in Gitlab.

Create Gitlab CI pipeline (.gitlab-ci.yml)

We will now create Gitlab CI pipeline and there are two options we could use:

1. Create a `.gitlab-ci.yml` file in the root of the repository
2. Use Gitlab CI/CD editor (in Gitlab, `CI/CD -> Editor`)

Option 1 is probably used more often, especially in project using a git branch strategy. Option 2 is more than enough for our scenario.



Get started with GitLab CI/CD

Runners are available to run your jobs now

GitLab Runner is an application that works with GitLab CI/CD to run jobs in a pipeline. There ar
runners or learn more about runners.

Learn the basics of pipelines and .yml files

Use a sample `.gitlab-ci.yml` template file to explore how CI/CD works.

"Hello world" with GitLab CI

Get familiar with GitLab CI syntax by setting up a simple pipeline running a "Hello world" script to see how it runs, explore how CI/CD works.

Click on `Try test template`. You will directed to editor with an example pipeline. We can use it, but we only need `stage` section including `build` and `test` stages. Remove the rest of the pipline and we can start creating jobs.

Build and push docker image

Pipeline job for building docker image must have 3 main actions:

- login into container registry
- build docker image
- push image to the docker registry

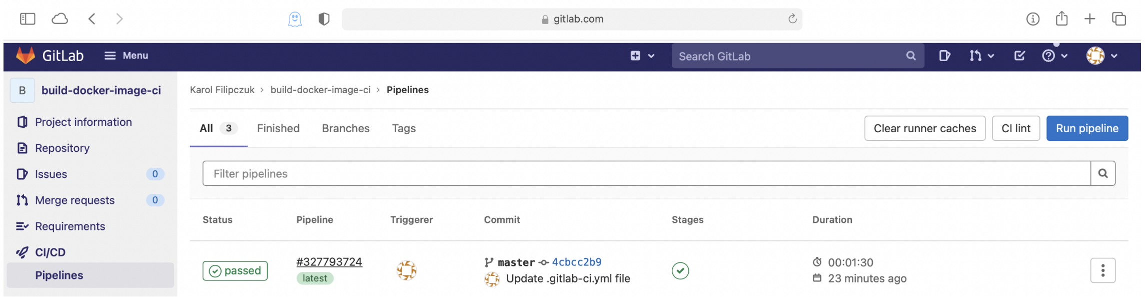
```
stages:
  - build
  - test

build:docker-alpine-java:
  image: docker:20
  stage: build
  services:
    - docker:20-dind
  variables:
    TAG: "$CI_REGISTRY_IMAGE/docker-alpine-java"
  before_script:
    - docker login -u $CI_REGISTRY_USER -p $CI_REGISTRY_PASSWORD $CI_REGISTRY
  script:
    - docker pull $TAG:latest || true
    - docker build --cache-from $TAG:latest --tag $TAG:$CI_COMMIT_REF_NAME --tag
$TAG:latest .
    - docker push $TAG:$CI_COMMIT_REF_NAME
    - docker push $TAG:latest
```

Currently our pipeline has job for building docker image. Let's explain it:

- `build:docker-alpine-java` - A job's name
- `stage` - Stage in which job runs.
- `image` - An image which will be used to create container for running our script
- `services` - Defines docker image that runs during the job linked to the docker image specified in `image`. We are using docker-in-docker (job is running docker as image and as service)
- `variables` - Defines variables for the job. We only define one variable, image name.
- `before_script` - Defines commands to be run before commands in `script` section. We use it to login into Gitlab container registry. The variables used are predefined Gitlab variables.
- `script` - Defines the main commands to be run during job. There are 3 main steps in the script:
  - `docker pull $TAG:latest || true` Pulls image with latest tag or returns `true`. It will ensure that job will not fail if there is no image with latest tag.
  - `docker build --cache-from $TAG:latest --tag $TAG:$CI_COMMIT_REF_NAME --tag $TAG:latest .` Builds image using Dockerfile in repo root directory and tags it twice (branch name and latest). Uses option `--cache-from` to use cache from latest avaiable image in container registry. Since we are running docker-in-docker, each time in fresh environment, current runtime has no data from previous runs. The docker runtime can't use cache from previous build, unlesss we manually pull latest image and supply it in `--cache-from` option.

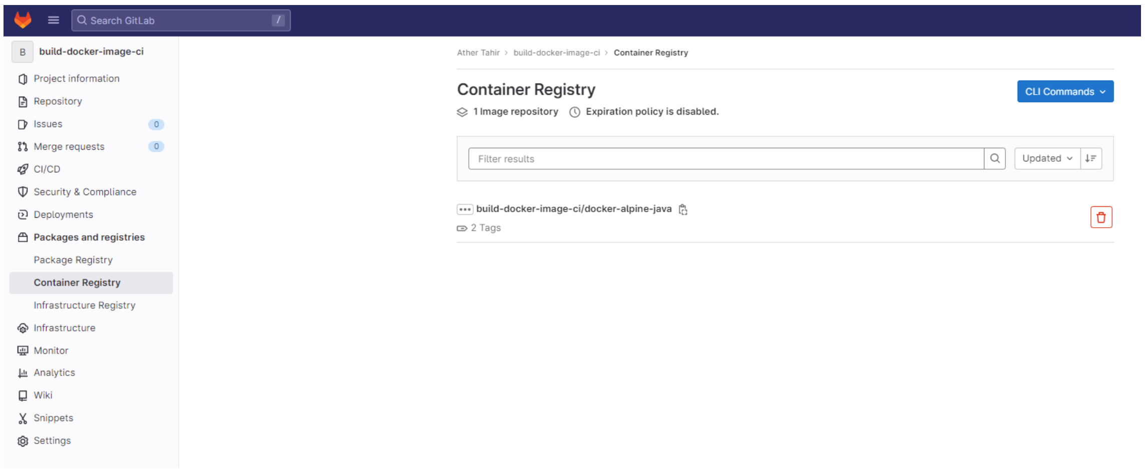
- `docker push $TAG:$CI_COMMIT_REF_NAME` Push image tagged with branch name to container repository.
- `docker push $TAG:latest` Push image tagged with latest to container repository. Hit button `Commit changes` below editor and the pipeline should start automatically. Go to `CI/CD -> Pipelines` .



Status	Pipeline	Triggerer	Commit	Stages	Duration
passed	#327793724 latest		master 4cbcc2b9 Update .gitlab-ci.yml file	✓	00:01:30 23 minutes ago

First pipeline run for docker image build

You can click on `Status` to check the logs and more detailed information. Pipeline run succesfully. Let's check the container registry. Go to `Packages & Registry -> Container Registry`.



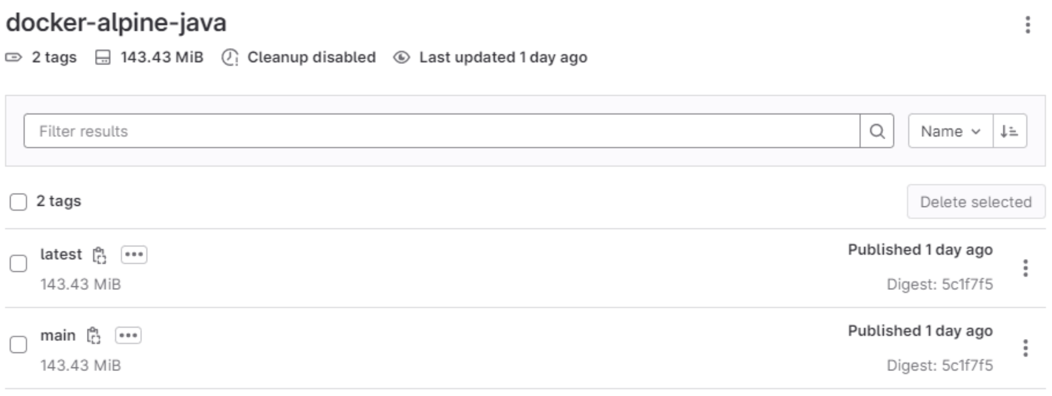
Container Registry

1 Image repository   Expiration policy is disabled.

build-docker-image-ci/docker-alpine-java

2 Tags

You should see an image with a name the same as defiend in `$TAG` variable inside pipeline job. Under the name there is information that two tagged image exist. Click on image name.


docker-alpine-java

2 tags · 143.43 MiB · Cleanup disabled · Last updated 1 day ago

2 tags		
latest	143.43 MiB	Published 1 day ago · Digest: 5c1f7f5
main	143.43 MiB	Published 1 day ago · Digest: 5c1f7f5

Two images exist as expected: one tagged latest and second tagged with branch name (main in mine case).

Use custom docker image

Docker image build is working now as expected and is part of the pipeline. Now we will use newly created image in another pipeline job. Second job will use `docker-alpine-java` image and run script `java -version` to see that in fact we are using our custom alpine image with java installed.

```
stages:
  - build
  - test

build:docker-alpine-java:
  image: docker:20
  stage: build
  services:
    - docker:20-dind
  variables:
    TAG: "$CI_REGISTRY_IMAGE/docker-alpine-java"
  before_script:
    - docker login -u $CI_REGISTRY_USER -p $CI_REGISTRY_PASSWORD $CI_REGISTRY
  script:
    - docker pull $TAG:latest || true
    - docker build --cache-from $TAG:latest --tag $TAG:$CI_COMMIT_REF_NAME --tag
$TAG:latest .
    - docker push $TAG:$CI_COMMIT_REF_NAME
    - docker push $TAG:latest

test:alpine-java:
  image: $CI_REGISTRY_IMAGE/docker-alpine-java:latest
  stage: test
  script:
    - java -version
```

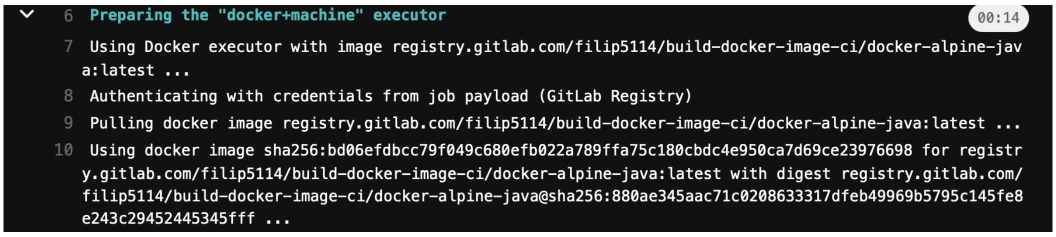
Testing custom image job is quite simpler.

- `test:alpine-java` - Job name.
- `image` - Image used by job. It's path to our custom image in Gitlab container registry

- `stage` - Stage in which job runs.
- `script` - Defines the main commands to be run during job. Java version check in our case.

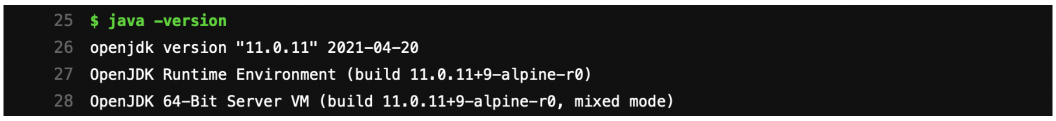
Go to the `CI/CD -> Pipelines`, then click on last one to see that two jobs were done succesfully (build and test). Click on test job to check the logs. / We are looking for two interesting parts:

- logs showing which image is being used



```
Preparing the "docker+machine" executor                                    00:14
Using Docker executor with image registry.gitlab.com/filip5114/build-docker-image-ci/docker-alpine-jav
a:latest ...
Authenticating with credentials from job payload (GitLab Registry)
Pulling docker image registry.gitlab.com/filip5114/build-docker-image-ci/docker-alpine-java:latest ...
Using docker image sha256:bd06efdbcc79f049c680efb022a789ffa75c180cbdc4e950ca7d69ce23976698 for registr
y.gitlab.com/filip5114/build-docker-image-ci/docker-alpine-java:latest with digest registry.gitlab.com/
filip5114/build-docker-image-ci/docker-alpine-java@sha256:880ae345aac71c0208633317dfeb49969b5795c145fe8
e243c29452445345fff ...
```

- logs showing `java -version` command



```
$ java -version
openjdk version "11.0.11" 2021-04-20
OpenJDK Runtime Environment (build 11.0.11+9-alpine-r0)
OpenJDK 64-Bit Server VM (build 11.0.11+9-alpine-r0, mixed mode)
```

Be efficient!

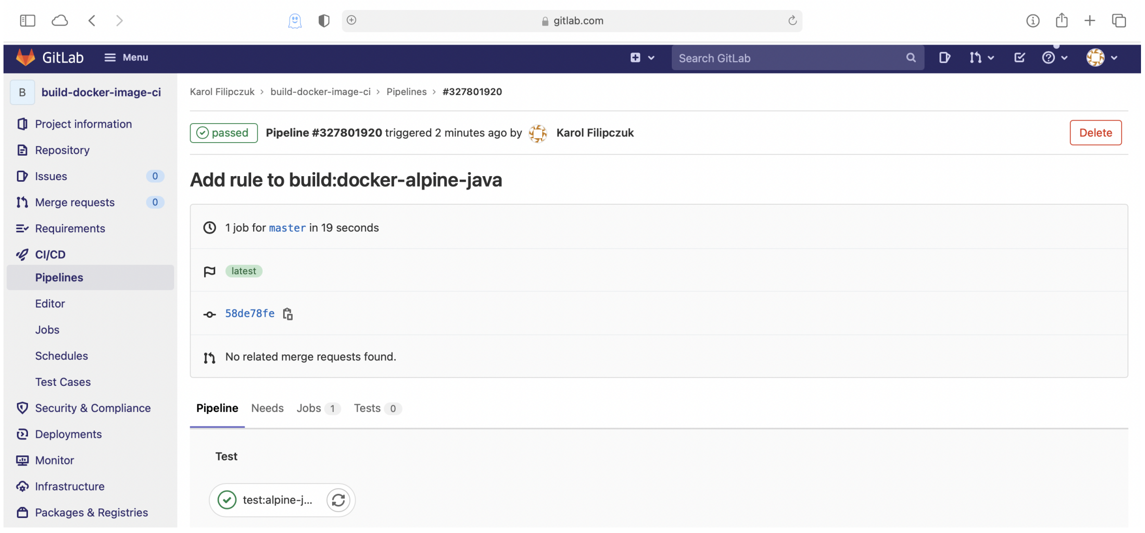
You might have noticed a flaw in pipeline. When pipeline run at first it had built alpine-java image and pushed it to repository. When pipeline has run the second time it built alpine-image again, even though it was not necessary. It's casued by not having any rules defining when to run a job in piepline. Fortunately it is a quick fix. Add a rule section in `build:docker-alpine-java` job. The rule will allow job to run only if there is any change in `Dockerfile`.

```
stages:
  - build
  - test

build:docker-alpine-java:
  image: docker:20
  stage: build
  services:
    - docker:20-dind
  variables:
    TAG: "$CI_REGISTRY_IMAGE/docker-alpine-java"
  before_script:
    - docker login -u $CI_REGISTRY_USER -p $CI_REGISTRY_PASSWORD $CI_REGISTRY
  script:
    - docker pull $TAG:latest || true
    - docker build --cache-from $TAG:latest --tag $TAG:$CI_COMMIT_REF_NAME --tag
$TAG:latest .
    - docker push $TAG:$CI_COMMIT_REF_NAME
    - docker push $TAG:latest
  rules:
    - changes:
      - Dockerfile
```

```
test:alpine-java:
  image: $CI_REGISTRY_IMAGE/docker-alpine-java:latest
  stage: test
  script:
    - java -version
```

If you now check latest pipeline run you will notice that only `test:alpine-java` was run in pipeline.



passed Pipeline #327801920 triggered 2 minutes ago by Karol Filipczuk

Add rule to build:docker-alpine-java

1 job for master in 19 seconds

latest

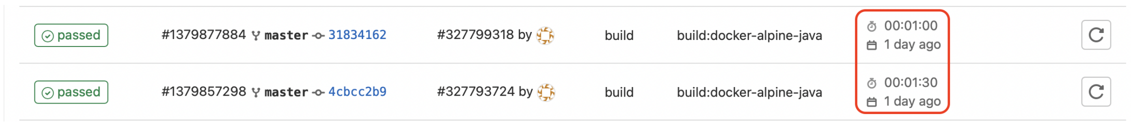
58de78fe

No related merge requests found.

Test

test:alpine-j...

Moreover, thanks to the flaw we have just fixed, you can compare diffrence in duration of two docker build jobs.



passed	#1379877884 master 31834162	#327799318 by	build	build:docker-alpine-java	00:01:00 1 day ago
passed	#1379857298 master 4cbcc2b9	#327793724 by	build	build:docker-alpine-java	00:01:30 1 day ago

Maybe you already figured why the build job took 1 min 30 sec when was run first time, but only 1 min when run second time? The answer is cache. Second run built exactly the same image as the first run, beacause there was no diffrence in Dockerfile. Since we implemented cache usage in docker image build job, the second run was much quicker.

Summary

In this lab, we have succesfully:

- Created Dockerfile
- Implemented docker image build in Gitlab pipeline job
- Used the newly created image in another job