Practical Lab

Cloud Systems Engineering

(cloud-lab)

Chair of Decentralized Systems Engineering
https://dse.in.tum.de/

Welcome to the cloud-lab!

The assignments

- 4 graded assignments
  - No exams, presentation, etc.
- About three weeks time for each assignment
  - Videos explaining tasks and background released on Mondays
  - Q&A sessions for assignments on Thursdays
- Each assignment comes with tests that we run to grade your solution
  - Tests run on our own CI runners whenever a commit is pushed
  - Passed tests result in points which determine your grade
  - Only the last commit before deadline is graded

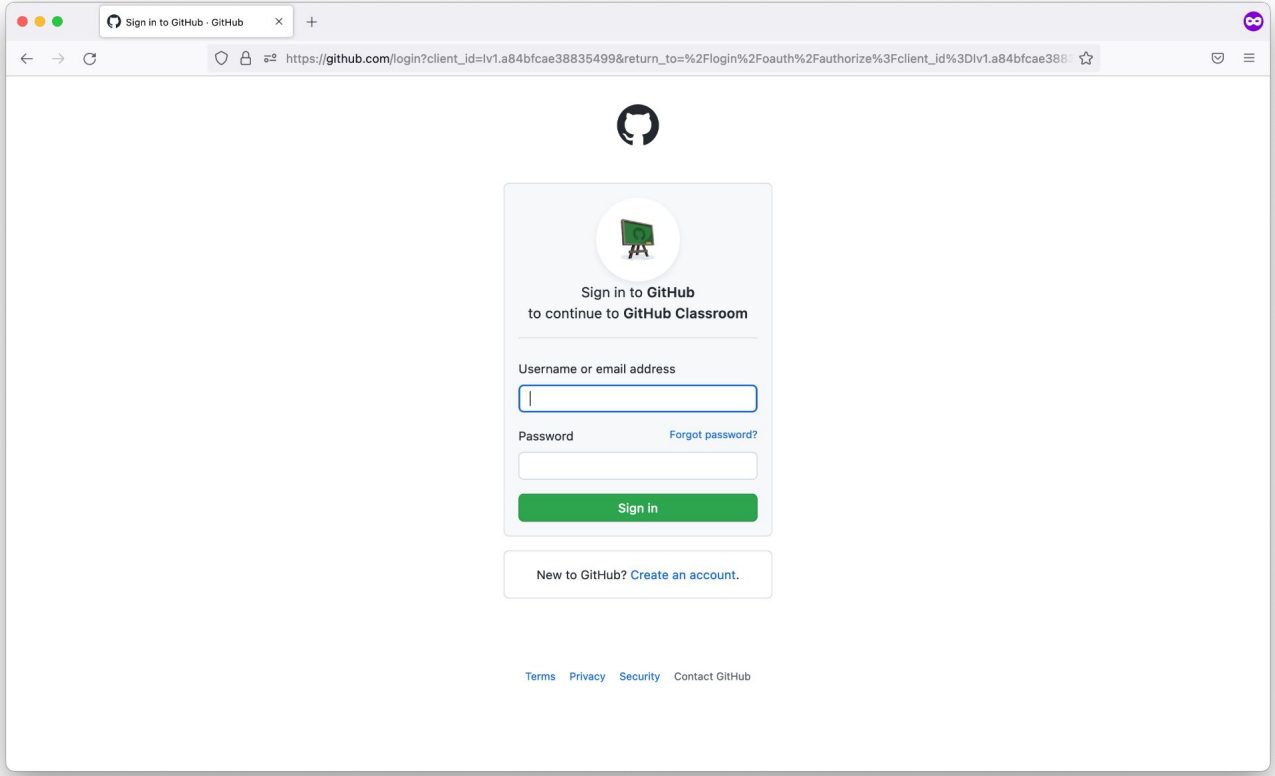
The assignments

- Code should be written in C++
  - Other system programming languages like Rust may be used as well but there is no support by us
- In detail task description in README.md in the task folder
- Code is hosted on GitHub and will be auto-graded via GitHub classroom
  - You will need to create a GitHub account
  - We will send you invitation links for each assignment via Slack

Our CI runners

- Fancy kubernetes cluster
- Three servers, each equipped with
  - 2x Intel Xeon 5215
    (10 cores / 20 threads each)
  - 128 GiB RAM
  - 10G NICs

Getting the assignment code



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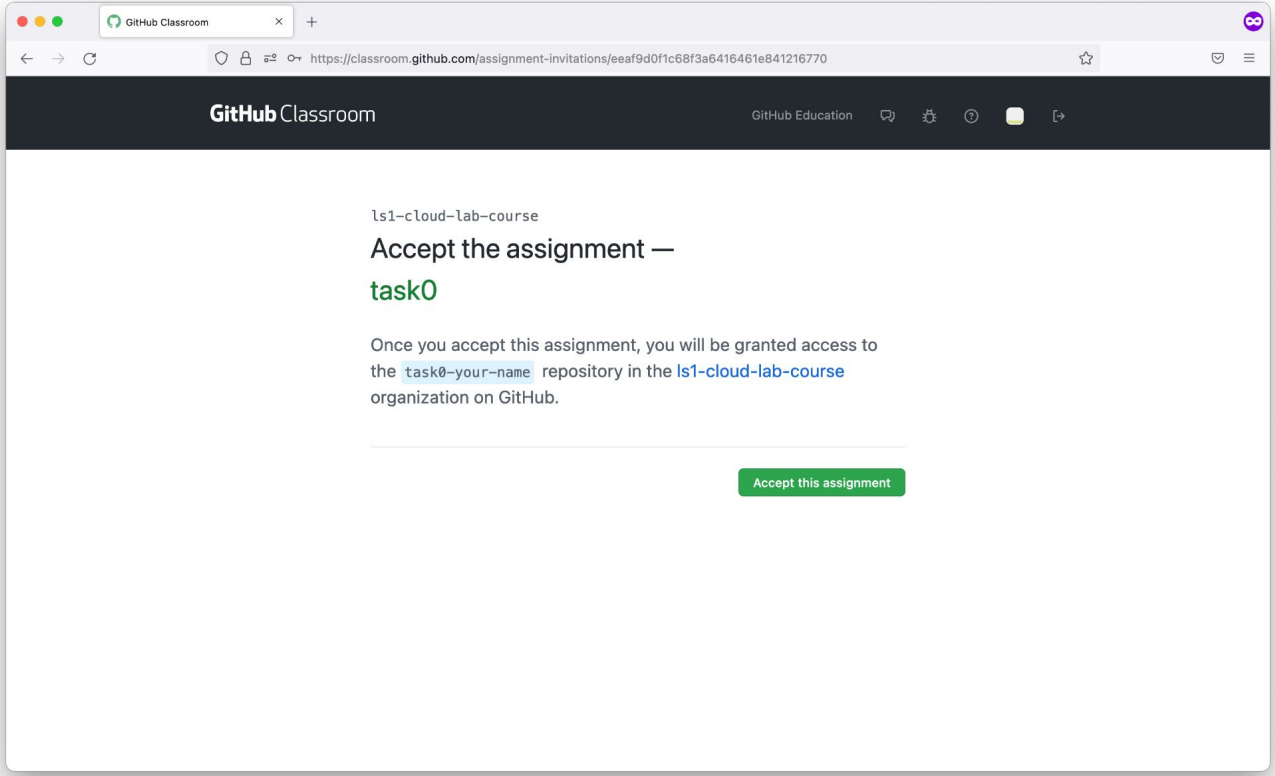

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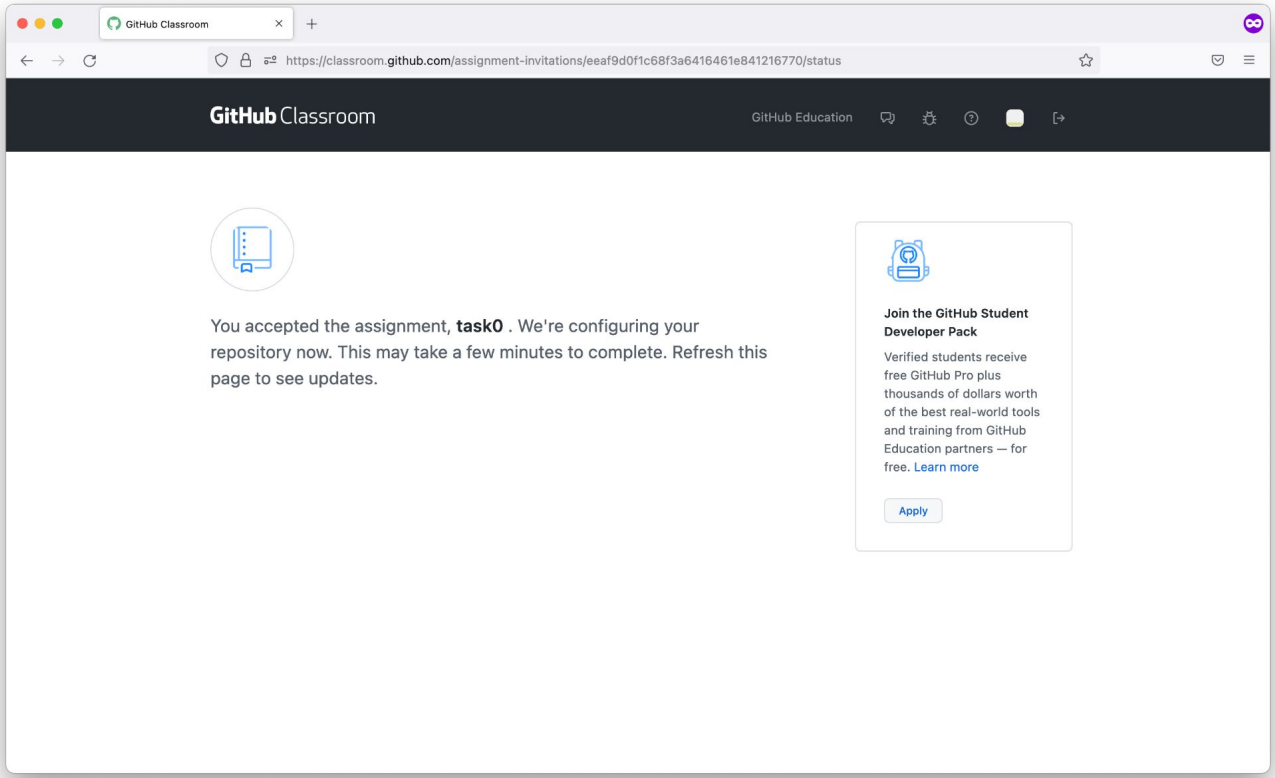

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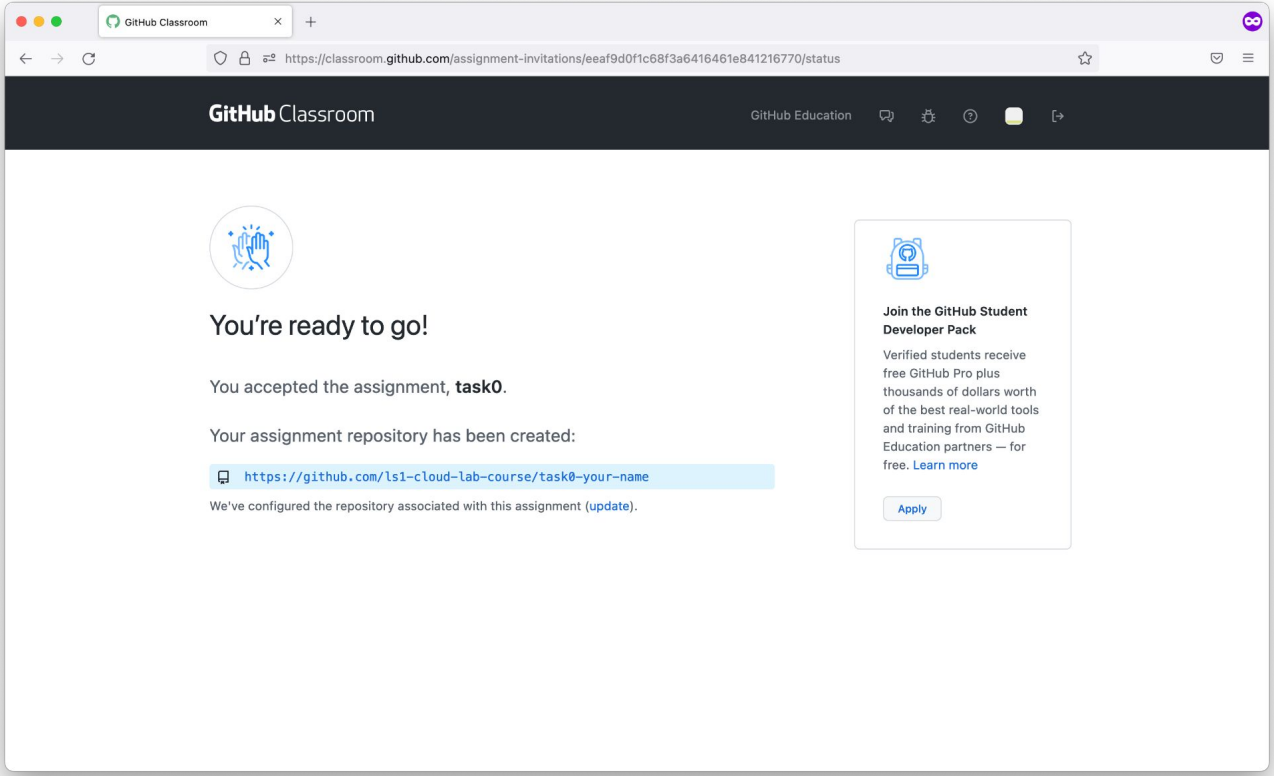

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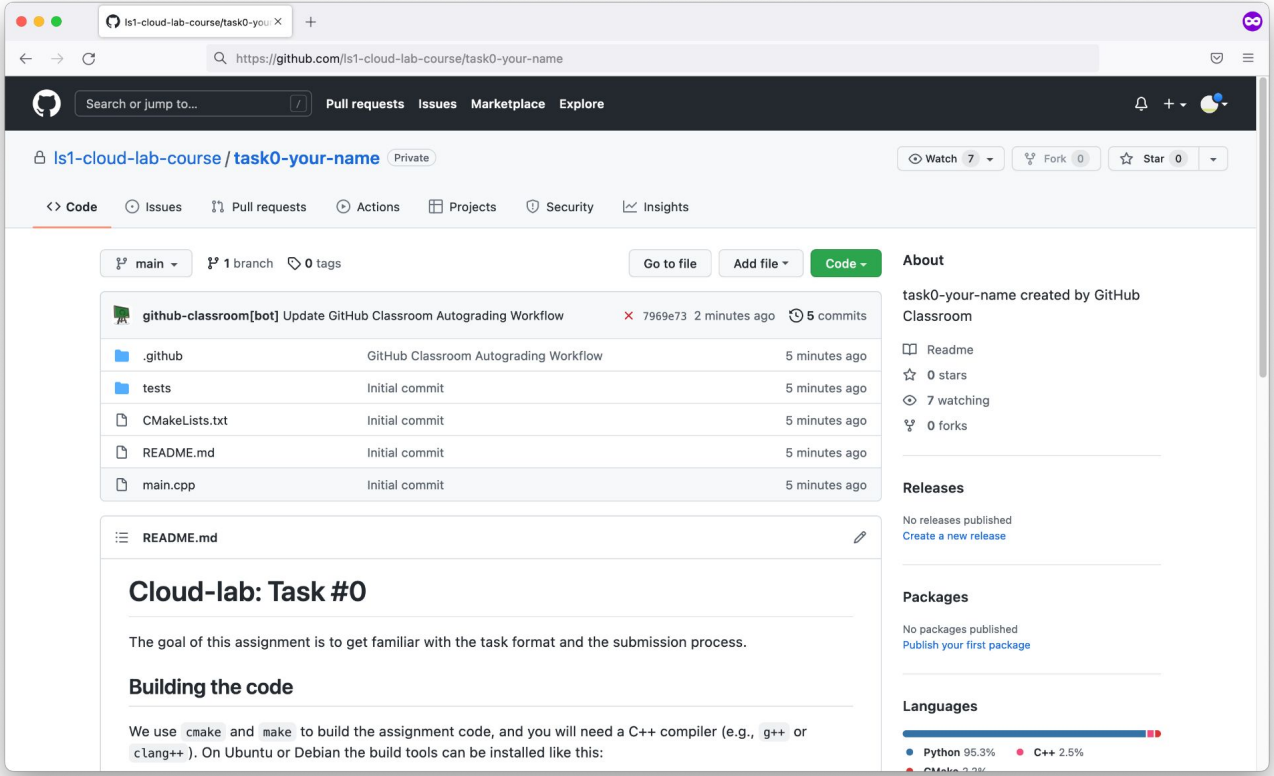
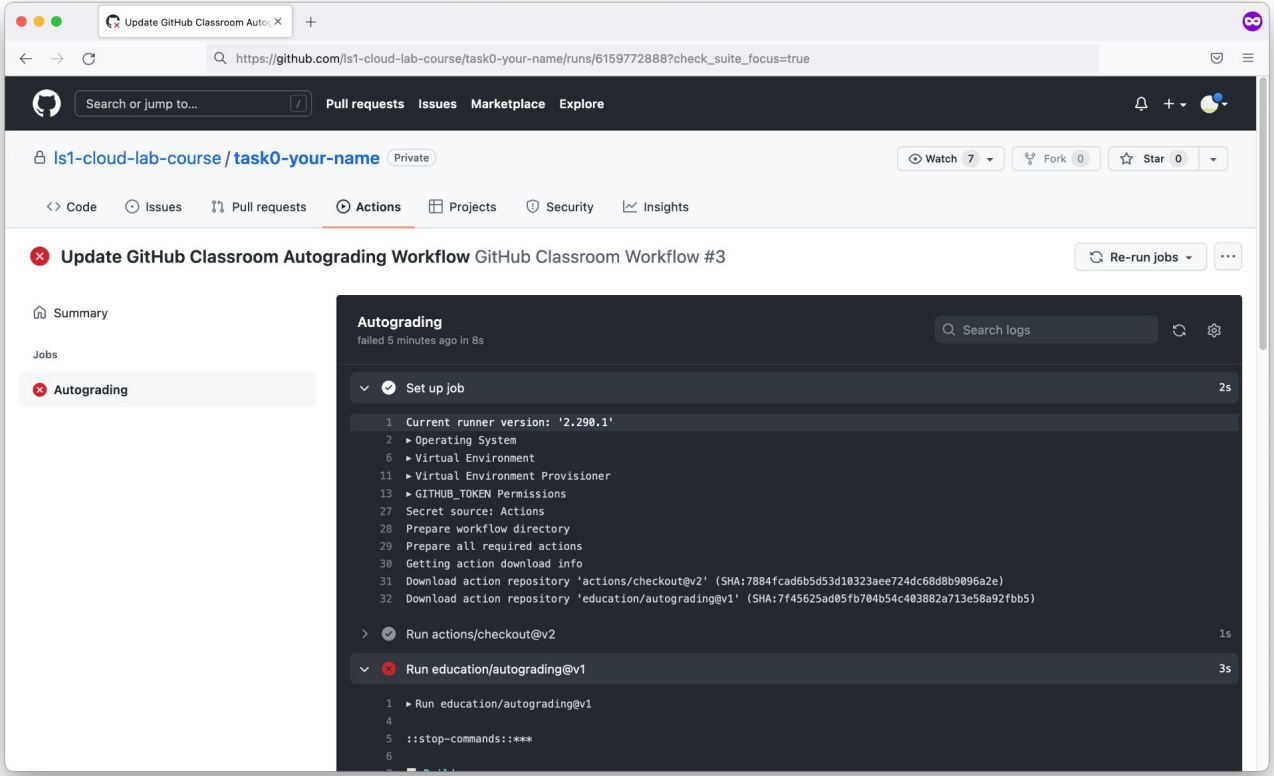


Submitting your code



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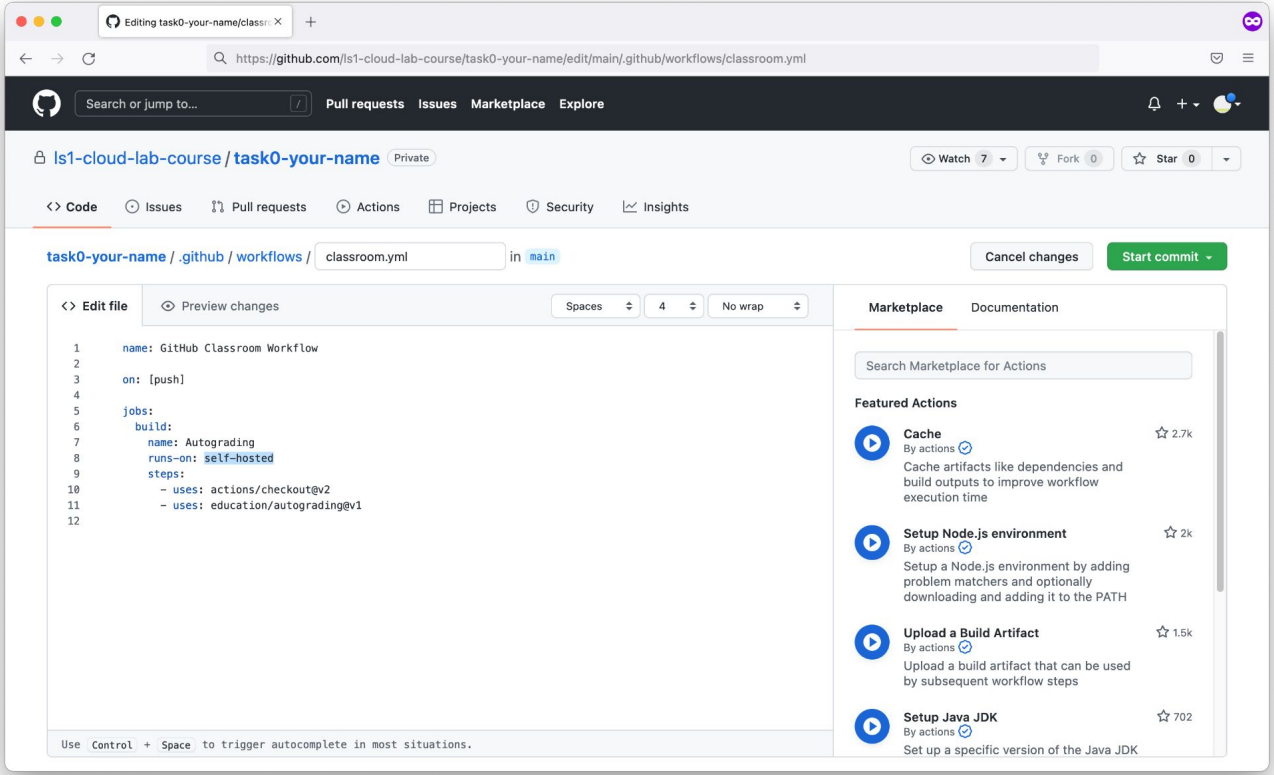

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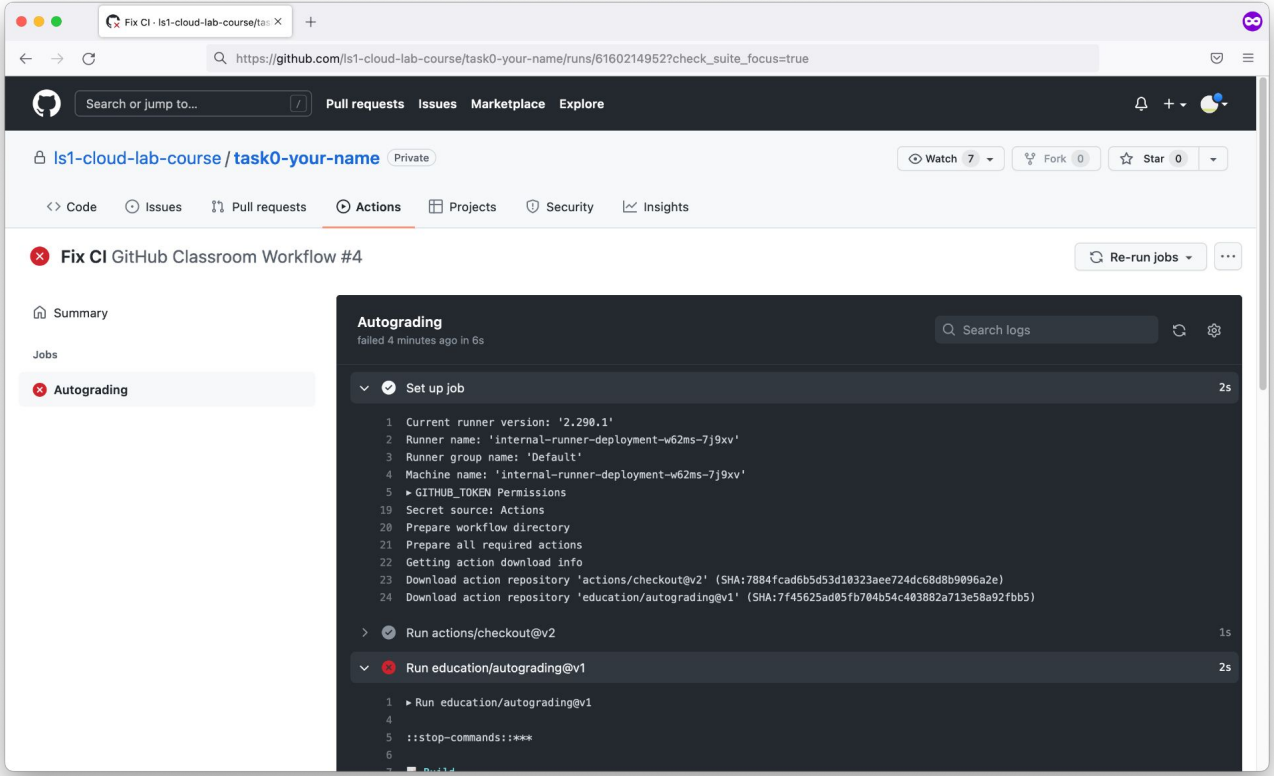

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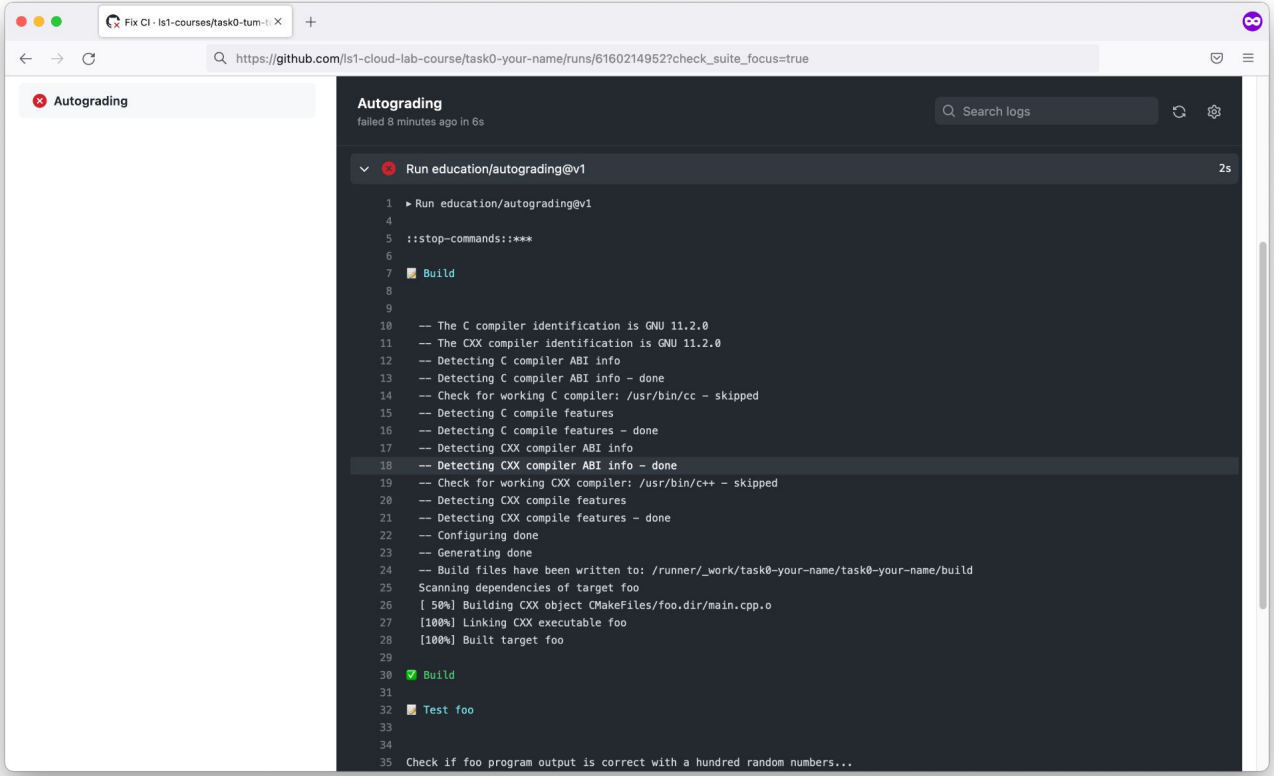

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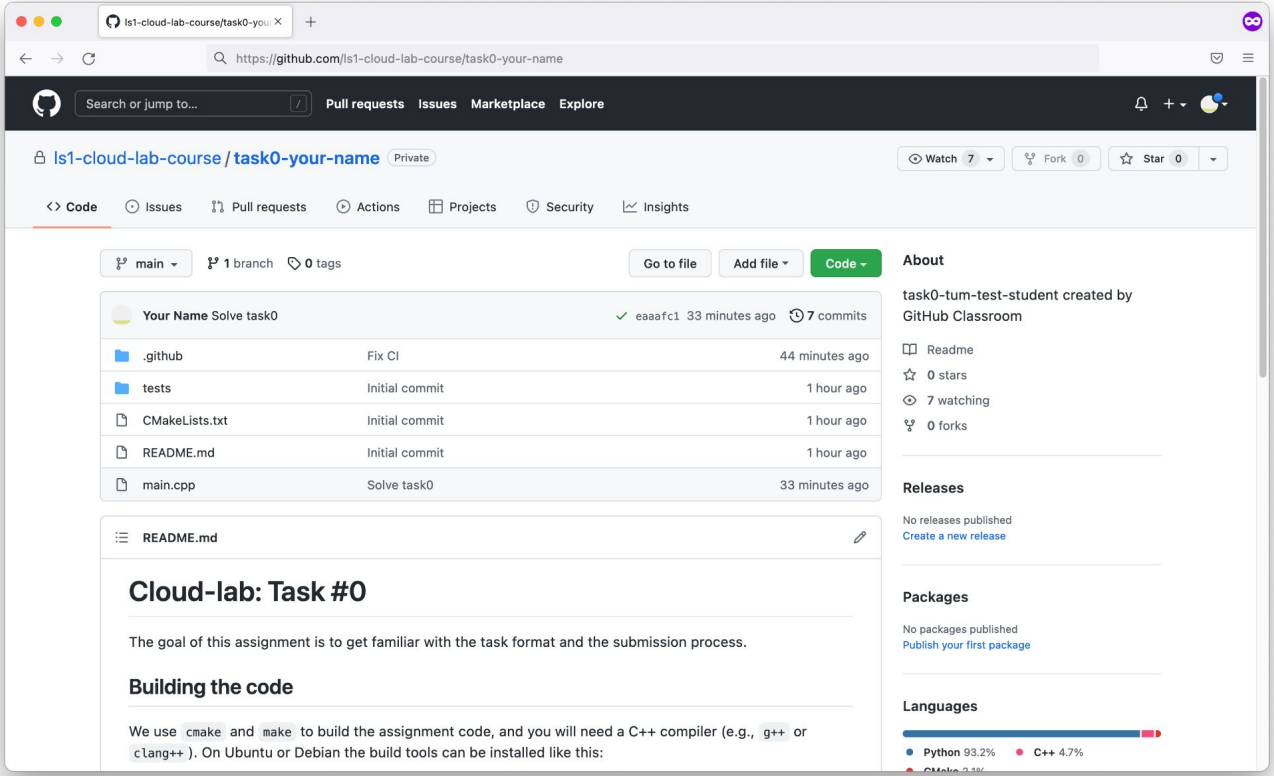


Containers

Motivation

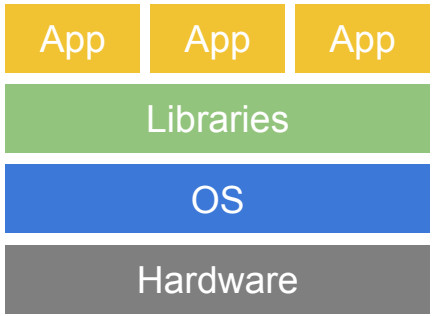
Share resources (IaaS, PaaS, …) in a flexible and cost-effective way

→ split applications into microservices

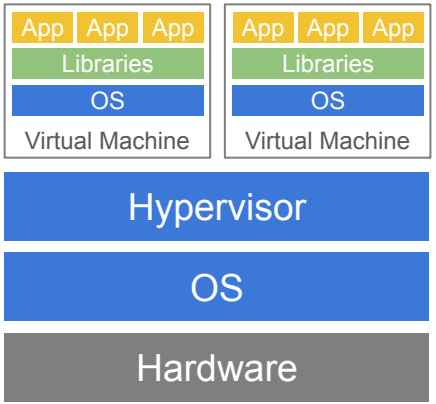
Advantages:

- Greater hardware resource-utilization
- Simply maintainable
- Scalable

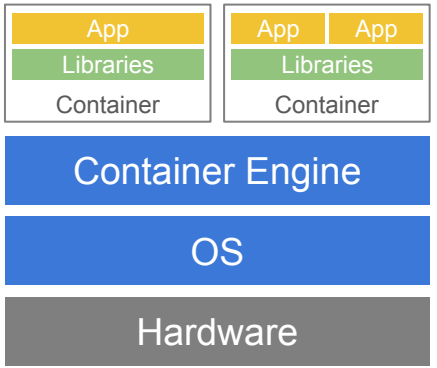
Containers



Traditional system



Virtual machines



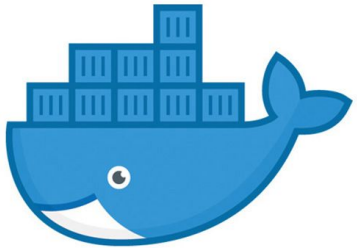
Containers

Containers

Unlike virtual machines …

- containers often contain only one application
- containers do not include an operating system (OS)
- containers limit access to resources through host OS mechanisms

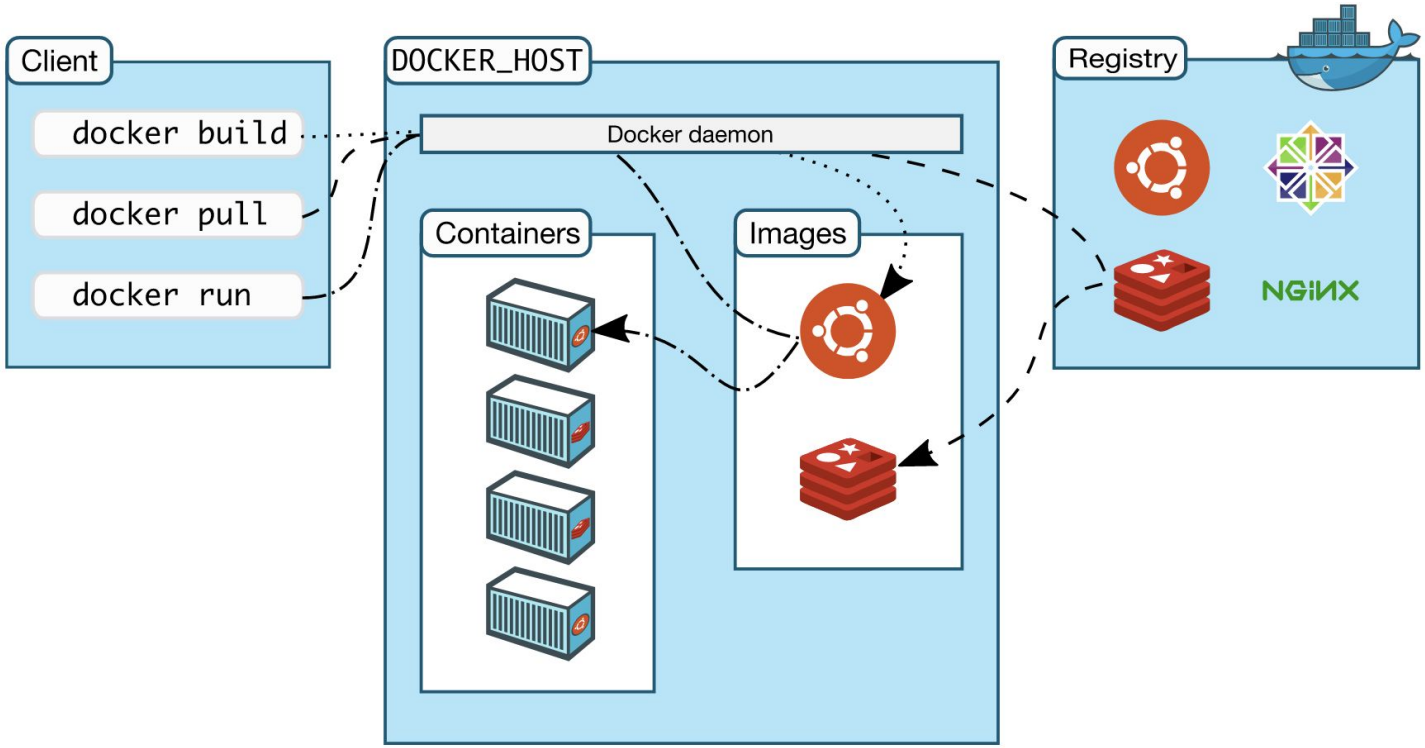
Container solutions



Docker

- Application container engine
  - Unlike LXC which is a system container engine
- Uses the resource isolation mechanisms of the Linux kernel
  - Namespaces
  - Cgroups
  - Layered filesystems
- Consists of three components: Software, objects and registry

Docker


Client
docker build
docker pull
docker run
DOCKER_HOST
Docker daemon
Containers
Images
Registry
NGINX

Getting started

1. Install Docker on your system, e.g.: `# apt install docker-ce`
2. Run some container: `$ docker run -it ubuntu /bin/bash`

Hints:

- List all containers: `$ docker ps -a`
- Get a shell for a running container: `$ docker exec -it <container name> /bin/sh`

Getting started

1. Create a simple Dockerfile (see Docker's docs)
2. Build an image based on the Dockerfile: `$ docker build -t <image name> .`
3. Run the container: `$ docker run -d <image name>`
4. Create and run multiple containers using Docker compose

Hints:

- Force clean rebuild of image: `$ docker build --no-cache -t <image name> .`
- To prevent a container from exiting early when debugging, add `CMD tail -f /dev/null` to end of Dockerfile

First assignment

Your assignment for the next two weeks

- Task to get familiar with the submission process
  - Will be graded like all other assignments
- Write a client/server application using Linux's socket API
  - Detailed description of what to do in the task repository
- Let the server run in a Docker container
  - Write a Dockerfile for the server
- Invitation link for the assignment will be handed out via Slack
  - Make sure that you are part of the channel #ss-22-cloud-lab!