Escuela de Ingeniería Informática

Universidad de Oviedo

Lab 3

Deployment concepts

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Deployment

Deploying an application requires at least:

- Compiling source code
- Obtaining dependencies and libraries
- Configure environment
- Packaging
- Send package to host machine
- Launch in execution environment

Execution environment

Where will the software be run?

What dependencies does it have?

- Operating system
- Shared libraries

Several options

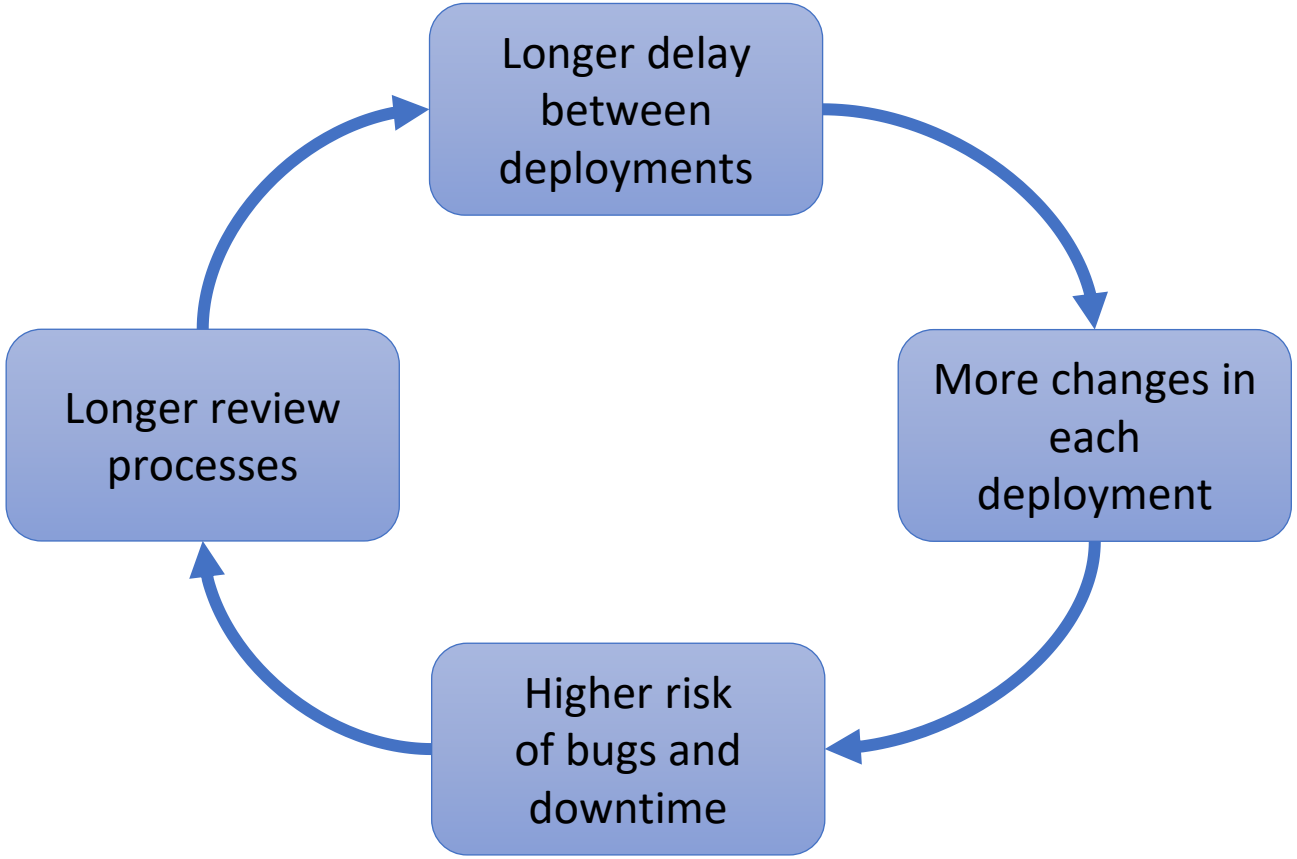
- Physical machines
- Virtual machines
- Containers

Several ways to do the deployment

- Manually
  - It can be easier initially when there are few deployments
- Automatic
  - Facilitates re-configuration and error checking
- Automatic and continuous
  - Goal: Increase teams agility

Be careful with manual deployments

Vicious circle of deployment size and risk



Continuous deployment

"If it hurts do it more often"

In the limit: "Do everything continuously"

Run the full pipeline in every commit

Final stage: deployment in production

- Possibilities
  - Confirmation by some human before going to production
  - Automatic deployment to production
  - Deployment to production marked by some tags
- Trade-off
  - Cost of moving slower vs cost of error in deployment

Virtual machines

Running apps on virtual machines

- Require operating system + libraries
- Isolate apps from specific hardware
- Cloud virtual machine providers: Azure, AWS, Google, Alibaba, ...

Azure example

- https://portal.azure.com/#home

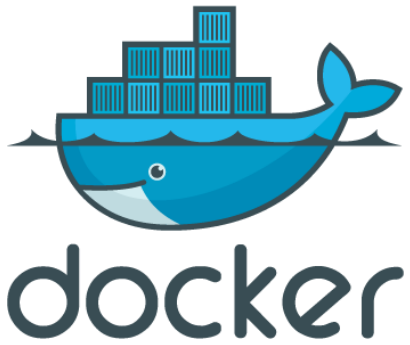
What is Docker?

Platform for developers and system administrators

Started in 2011

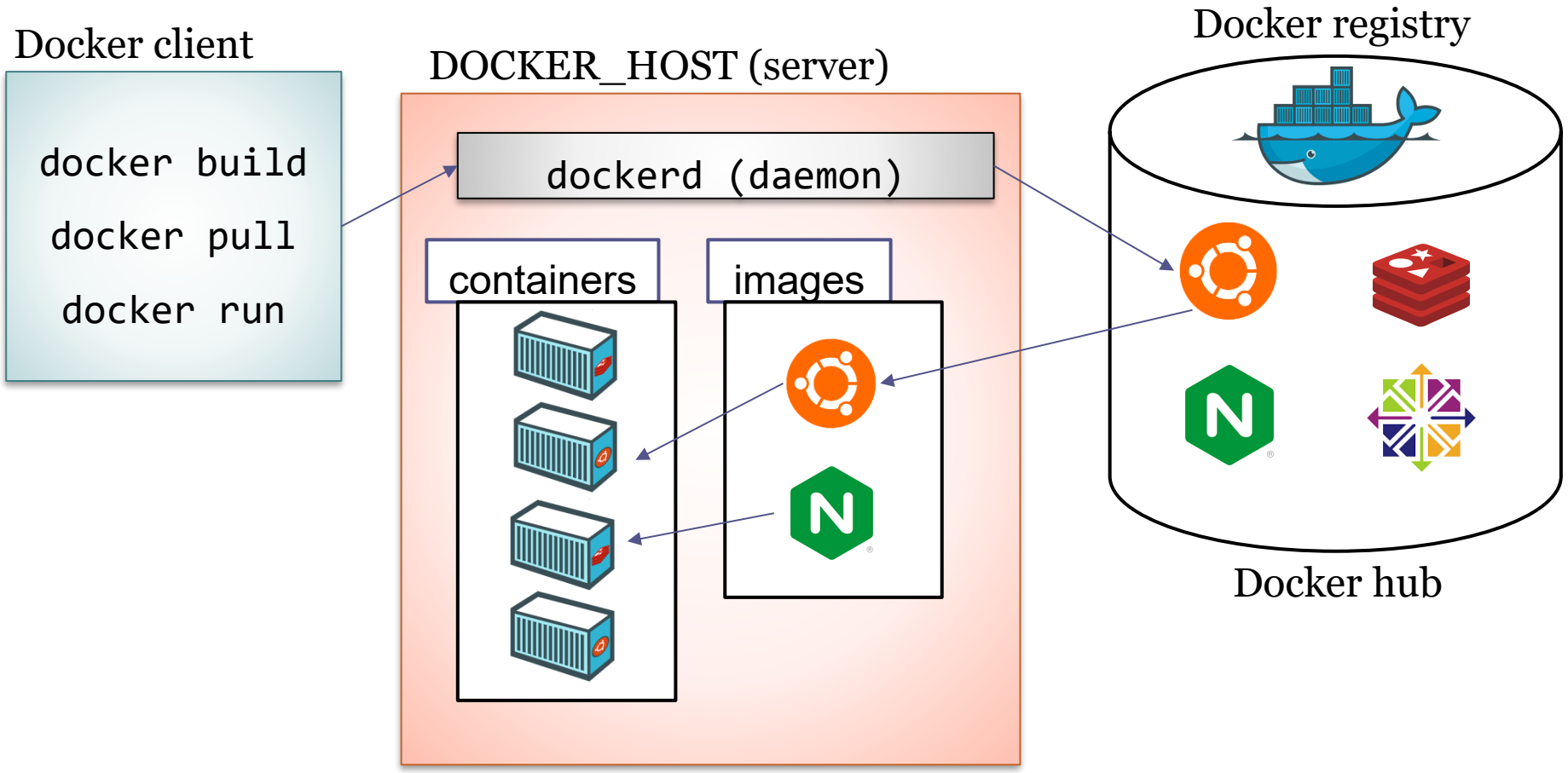
Based on containers and images

- Several parts
  - Specification for container descriptions (images)
  - Platform that runs containers
  - Container registry (Docker-hub)



Docker high-level architecture

Client-server architecture



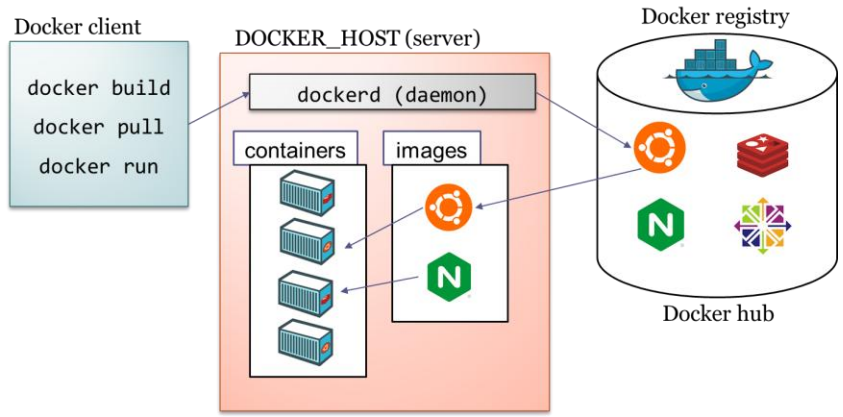
What is an image?

A file that can be used to create a runnable package

Includes all things necessary to run the application:

- Code
- Runtime system
- Libraries
- Runtime variables
- Configuration files

It doesn't have state and never changes



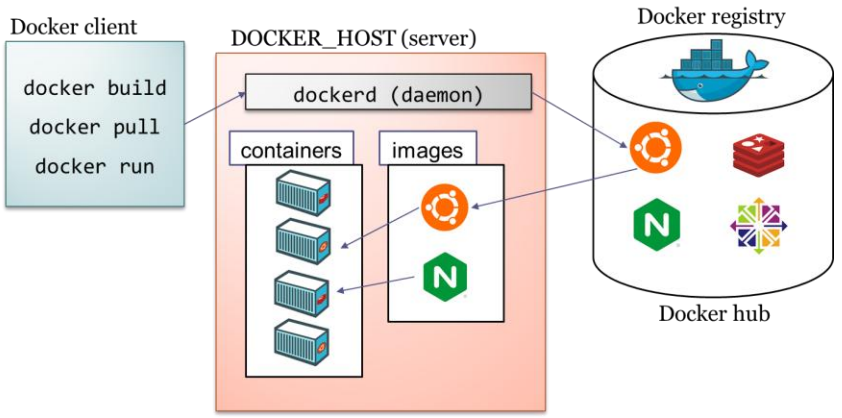
What is a container?

It is a live instance of an image

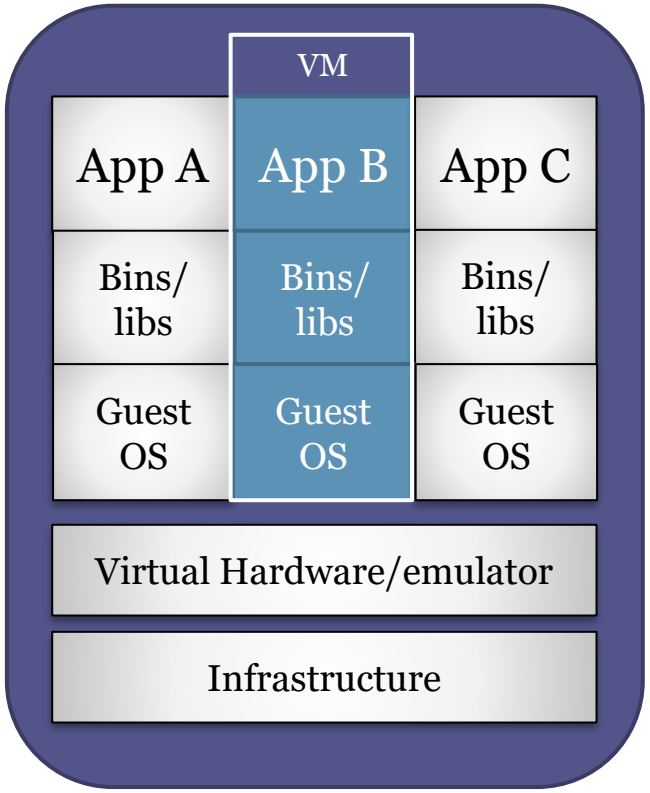
Docker is based on containers that enclose applications

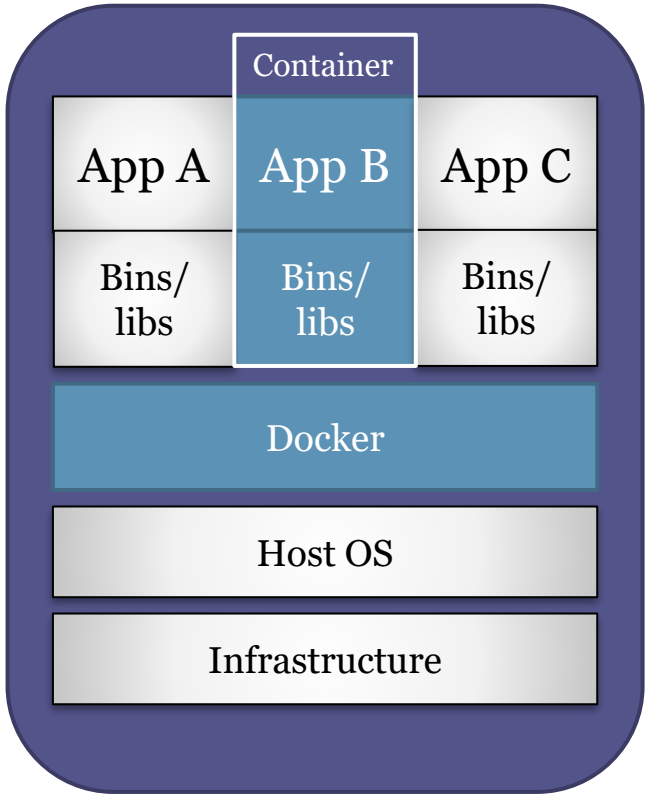
Docker allows orchestration between containers

Linking several containers we can make a complex architecture



Containers vs Virtual machines





Source: https://docs.docker.com/get-started/#containers-and-virtual-machines
https://stackoverflow.com/questions/16047306/how-is-docker-different-from-a-virtual-machine

https://docs.docker.com/get-started/#containers-and-virtual-machines

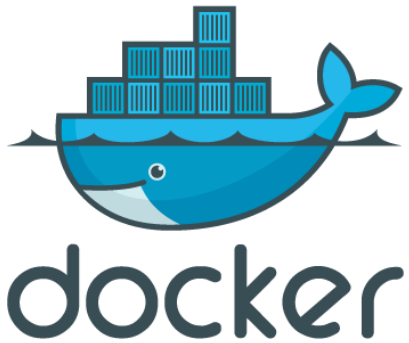
Obtaining docker

https://www.docker.com

Available for GNU/Linux, windows and Mac

Docker desktop (Windows/Mac)

Docker ToolBox faq#issue3



Docker image registries

- Docker Hub
  - Docker image repository https://hub.docker.com/
  - Example: Need a web-server for development

```
docker pull nginx
docker pull httpd
```

- Github Container Registry (https://ghcr.io/)
  - Previously called github packages

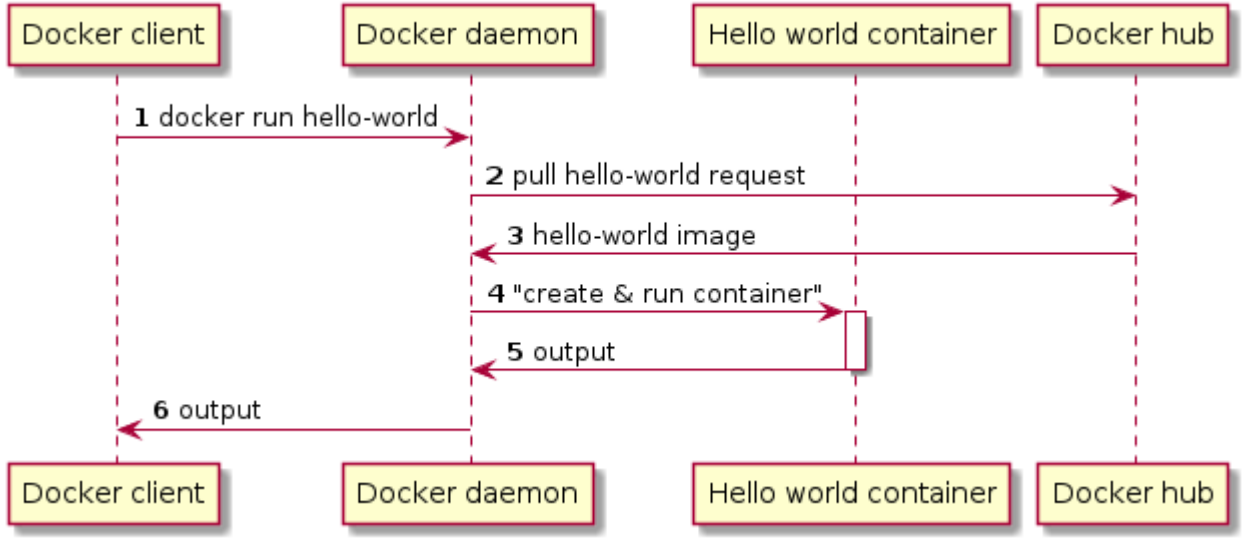
Docker step by step

Install Docker

```
$ docker -v
```

Run “Hello World”

```
$ docker run hello-world
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
1b930d010525: Pull complete
Digest: sha256:f9dfddf63636d84ef479d645ab5885156ae030f...
Status: Downloaded newer image for hello-world:latest
```



Docker example running Linux

Run Ubuntu

```
$ docker run -it ubuntu:latest /bin/bash
. . .
root@813cb77cebb2:/# ls -la
total 72
drwxr-xr-x   1 root root 4096 Mar 30 05:46 .
drwxr-xr-x   1 root root 4096 Mar 30 05:46 ..
-rwxr-xr-x   1 root root    0 Mar 30 05:46 .dockerenv
drwxr-xr-x   2 root root 4096 Mar 11 21:05 bin
drwxr-xr-x   2 root root 4096 Apr 24  2018 boot
drwxr-xr-x   5 root root  360 Mar 30 05:47 dev
drwxr-xr-x   1 root root 4096 Mar 30 05:46 etc
. . .
drwxr-xr-x   1 root root 4096 Mar 11 21:03 usr
drwxr-xr-x   1 root root 4096 Mar 11 21:05 var
root@813cb77cebb2:/#
```

Docker status

Commands to check status

```
$ docker image ls
REPOSITORY    TAG     IMAGE ID       CREATED         SIZE
hello-world   latest  fce289e99eb9   14 months ago   1.84kB

$ docker container ls --all
CONTAINER ID  IMAGE       COMMAND  CREATED       STATUS
8b6518da11db  hello-world "/hello" 9 minutes ago Exited (0) 9 minutes ago
```

https://github.com/pglez82/docker_cheatsheet

Docker simple web server

Run a web server with Docker

Run in background

publish:expose port

```
$ docker run --detach --publish=80:80 --name=webserver nginx
Unable to find image 'nginx:latest' locally
latest: Pulling from library/nginx
68ced04f60ab: Pull complete
28252775b295: Pull complete
a616aa3b0bf2: Pull complete
Digest: sha256:2539d4344dd18e1df02be842ffc435f8e1f699cfc55516e2cf2cb16b7a9aea0b
Status: Downloaded newer image for nginx:latest
b7e9213eb3367cd465b29701a7e6441a721
```

Some commands

```
docker info
docker ps
docker image ls
docker container ls –all
docker pull
docker run
docker stop
docker rm
```

How to build an image

DSL to build images

We need to create a file, called **Dockerfile**

It contains commands necessary to build the image

Keywords: `FROM`, `RUN`, `ADD`, `COPY`, `ENV`, `EXPOSE`, `CMD`…

Dockerfile

```
FROM ubuntu
CMD echo "Hi Software architecture students"
```

Building an image

1. Create a folder for the project
2. Edit a Dockerfile (no extension)
3. docker build –t image_name .
4. docker images (list images)
5. docker run image_name

Dockerfile

```
FROM ubuntu
CMD echo "Hi ASW students"
```

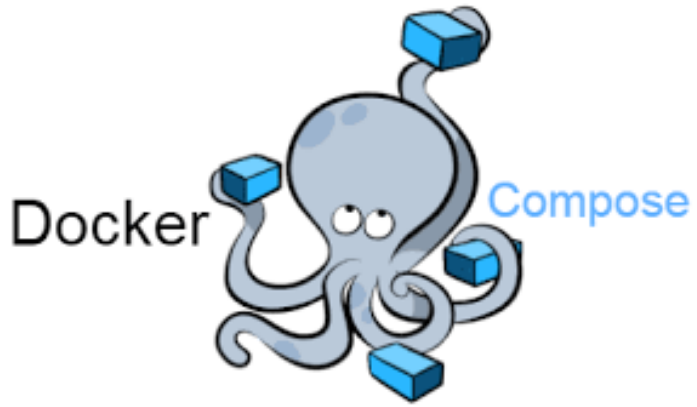
```
λ docker build -t "example1" .
Sending build context to Docker daemon  2.048kB
Step 1/2 : FROM ubuntu
latest: Pulling from library/ubuntu
5bed26d33875: Pull complete
...
Digest: sha256:bec5a2727be7fff3d308193cfde3491f8fba1a2...
Status: Downloaded newer image for ubuntu:latest
 ---> 4e5021d210f6
Step 2/2 : CMD echo "Hi Software architecture students"
 ---> Running in 9d5516995c2b
Removing intermediate container 9d5516995c2b
 ---> 41784c740df4
Successfully built 41784c740df4
Successfully tagged example1:latest
```

```
λ docker images
REPOSITORY TAG    IMAGE ID  CREATED        SIZE
example1   latest 41784c740 32 seconds ago 64.2MB
```

```
λ docker run example1
Hi ASW students
```

Combining multiple docker containers

Docker compose allows modularization of an application or architecture
Different services are defined that communicate among them
Each service is in a separate container
File: docker-compose.yml



Note: More advanced control with Kubernetes

Running Docker compose

Configuration

- We can configure multiple services
- Each service can depend on others
- By default, all services share the same network and are accessible through their container name

Running

- For running (or stopping) a docker-compose file we execute:
  docker-compose (up|down)

Deployment of our application

Automated deployment with Github actions

It allows to run automatically *workflows*

From some actions

- Like for each commit, each release,…

Configuration: YAML files in .github/workflows

- Example: https://github.com/Arquisoft/yovi_0/tree/master/.github/workflows

Requirements

- Virtual machine created
  - You can use: Azure, Oracle Cloud, AWS, …
  - Public IP for the virtual machine
  - Access through ssh to the virtual machine
  - Open inbound ports: 80, 3000, 4000, 9090 and 9091
  - Docker installed in virtual machine
- Configure github repo environment variables
  - How to access the virtual machine from github actions

VM in Azure

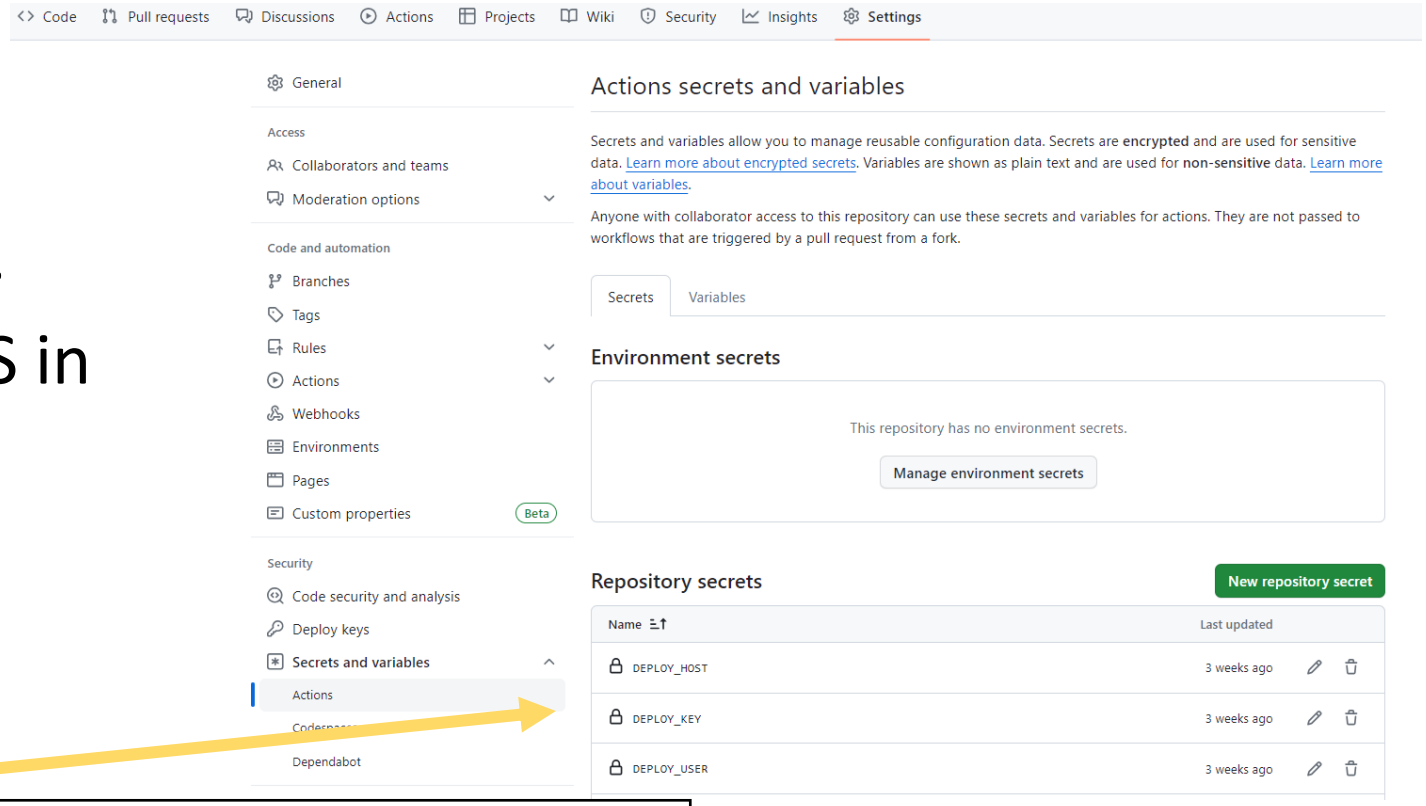
- Azure for students subscription (100$/month)
  - Location: France Central
  - Type: Linux Ubuntu
  - Size: Standard B2ats v2 (2 vcpus, 1 GiB memory)
  - Public IP (required for accessing the web application)
  - SSH access (store the private key for next slide)
  - Create rules to open inbound ports
- Install docker in the virtual machine
  - Follow: https://docs.docker.com/engine/install/ubuntu/#install-using-the-repository

Runtime environment variables

They allow to parameterize the deployment

Defining credentials, identifiers,…

Github allows to define SECRETS in each repository



In yovi_xxx:

DEPLOY_HOST: IP of virtual machine

DEPLOY_USER: User that can have ssh Access to the virtual machine

DEPLOY_KEY: Private key of that user

Continuous deployment for each release

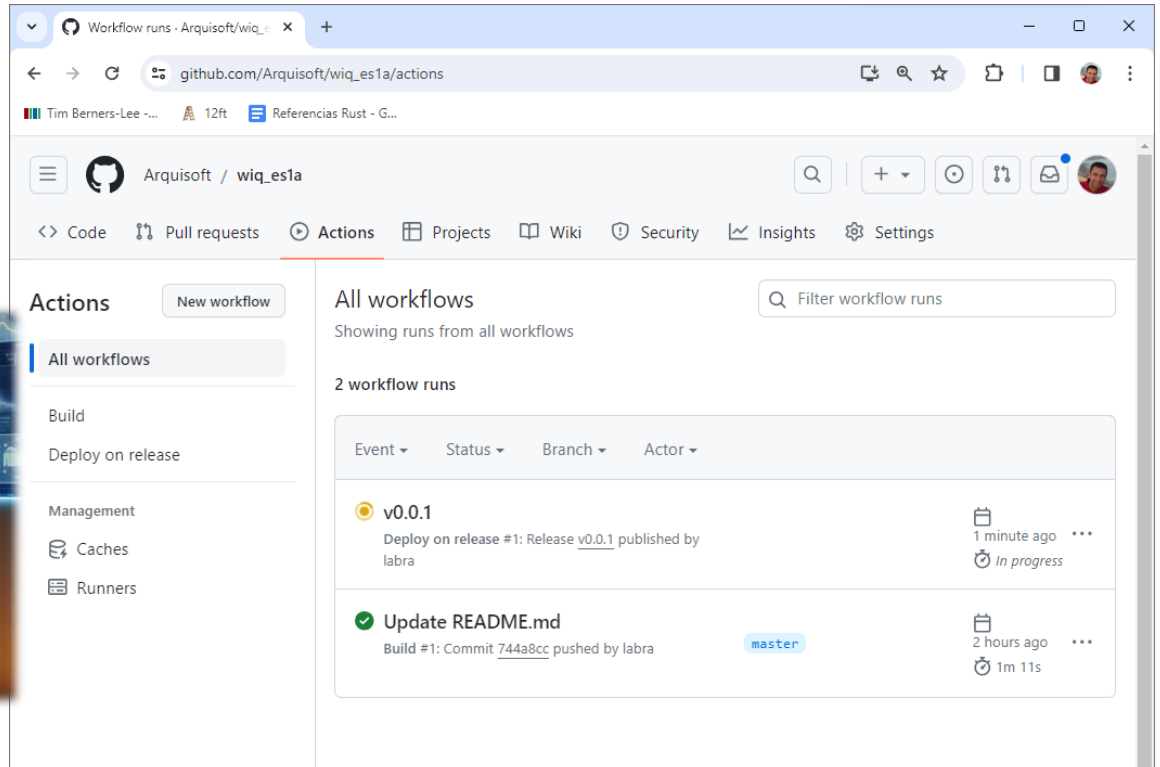
Steps

Create a tag and push to github

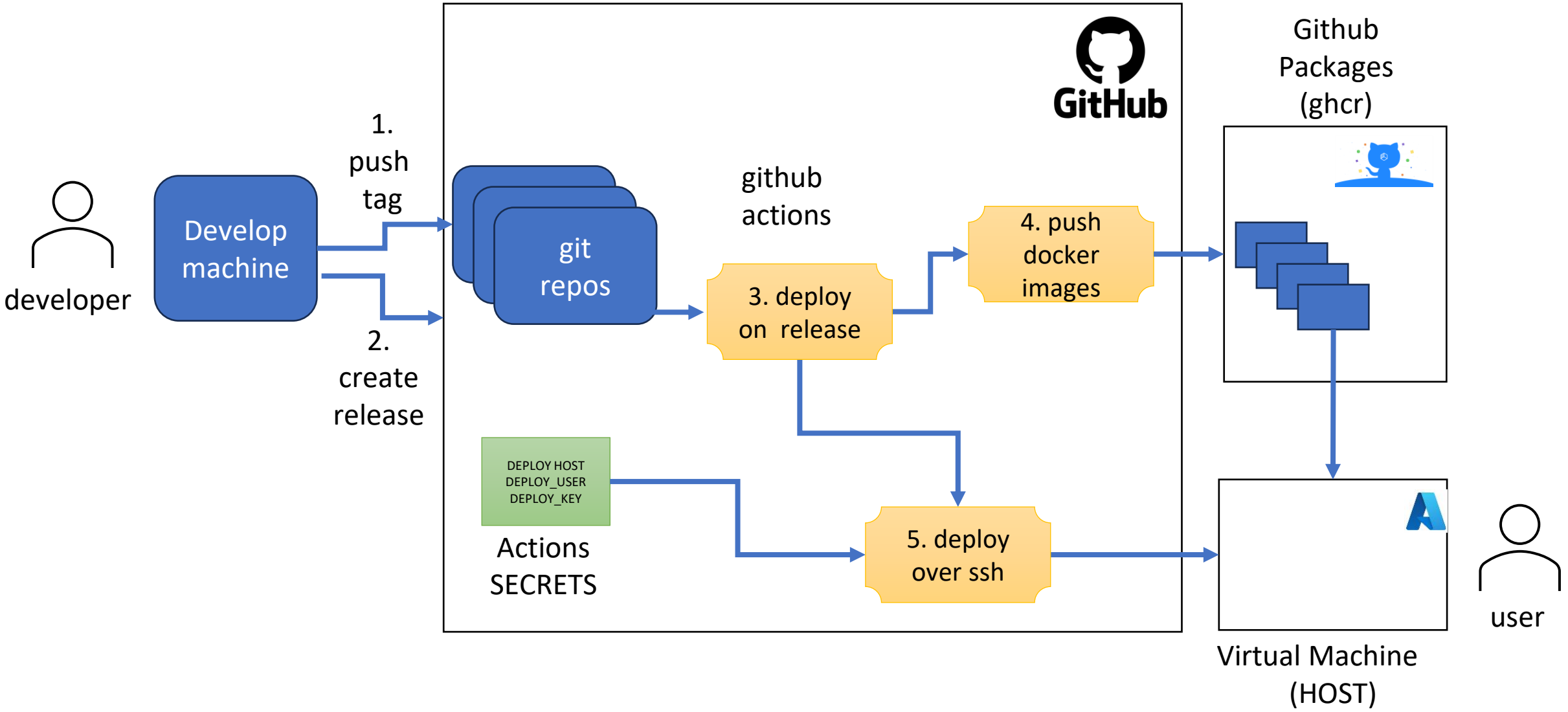
```
git tag -a v0.0.1 -m "v0.0.1"
git push origin v0.0.1
```

Create release from github

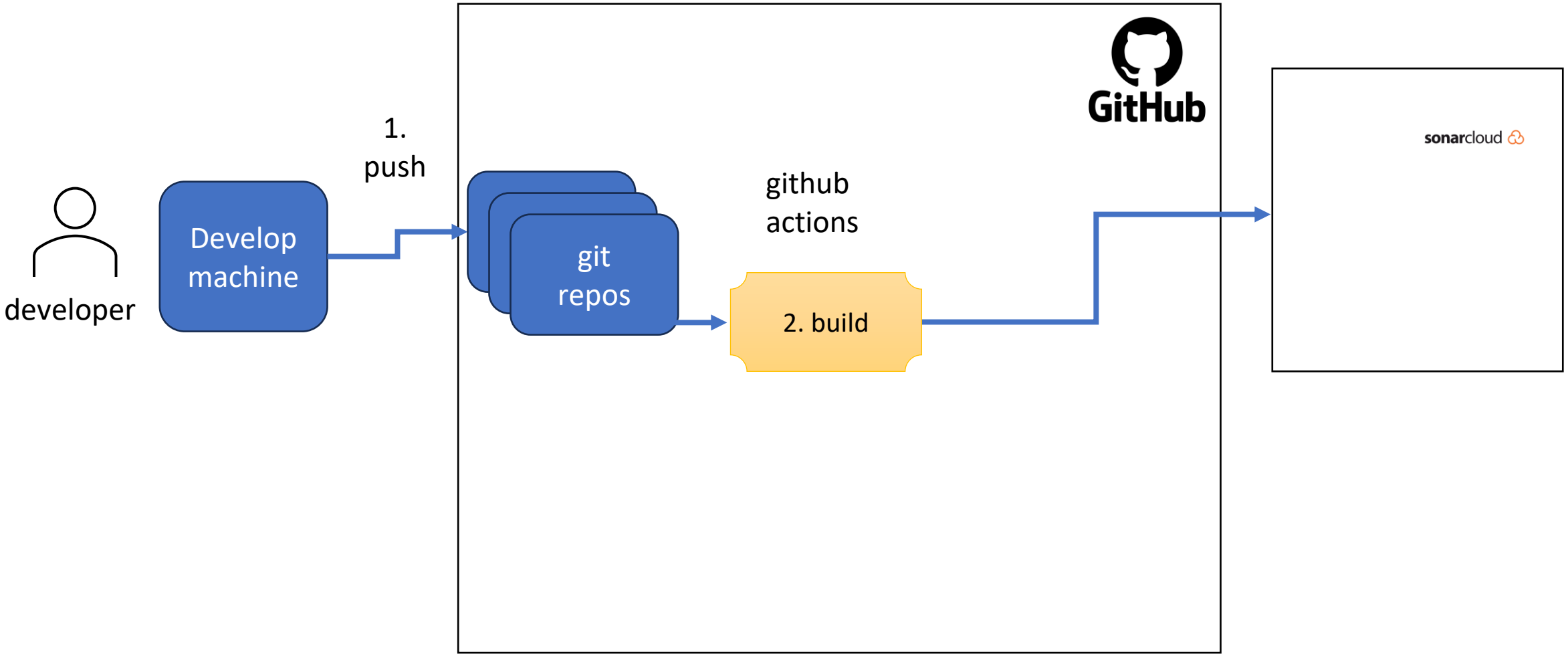
Watch automatic deployment



Deployment pipeline in yovi_xxx



Build pipeline in yovi_xxx



Extra information

Small repository with all the basic commands used in docker:

https://github.com/pglez82/docker_cheatsheet