Introduction to TEK2

3rd semester @ Erhvervsakademi København

Course Overview

Course description: https://katalog.kea.dk/course/3050352

Workload: 10 ECTS (14 hours per week - 3 hours lectures w/ exercises, 11 hours of self-study)

Projects: Full stack project, AI Project, Semester project

Exam: To attend the exam, you must have handed in and presented all projects

- 20 min oral presentation: approx. 9. - 13. january 2026
- Exam questions are known in advance

Guest lectures during the semester:

- CEO of punktum.dk

Tentative Plan:

- Docker + Docker Compose
- GitHub Actions and workflows
- Linux
- Cloud VM & CD
- DNS & HTTP(S)
- TCP/IP model

SSH keys, Docker

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Plan for today

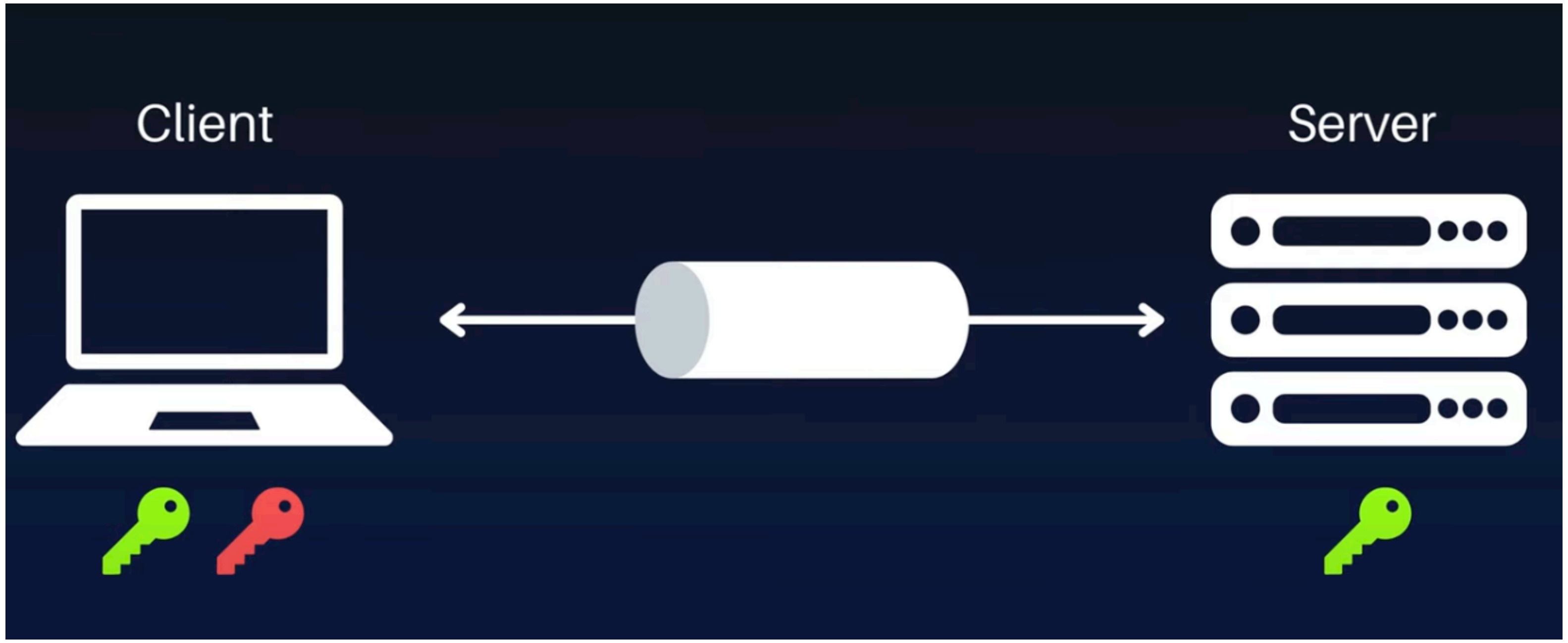
- GitHub Student Developer Pack
- Setup SSH keys
- Authenticate GitHub with SSH
- Installing Docker Desktop
- Docker commands and concepts
- Hands-on exercises with Docker

What is SSH?

- **SSH (Secure Shell)** is a protocol for securely accessing and managing remote systems over a network.
- We use **SSH** to connect to remote servers, execute commands, and transfer files securely.
- **SSH keys** are a pair of cryptographic keys used for authentication in SSH connections.

SSH keys:

- SSH uses a pair of keys:
  - **Public Key**: Shared with the server, allowing it to verify the identity of the client.
  - **Private Key**: Kept secret by the client, used to authenticate against the server.
- **The public key is stored on the server, while the private key remains on the client.**


Client
Server

How SSH Works

Assume that the client has the private key and the server has the public key.

1. When the client connects to the server, it sends a request to authenticate using the public key.
2. The server checks if the public key matches any in its `authorized_keys` file.
3. If a match is found, the server sends a challenge that can only be answered with the private key.
4. If the client responds with the correct answer, the server grants access.

Analogy:

Everybody can see the **public key** (like a lock), but only the owner has the **private key** (like a key to that lock).

Setting up SSH keys with GitHub

- We will generate a new SSH key pair on your local machine.
- The public key will be added to your GitHub account.
- This allows you to authenticate with GitHub without entering your username and password every time.
- This will allow you to clone, push, and pull repositories securely using your terminal.

Exercise: Generate SSH keys

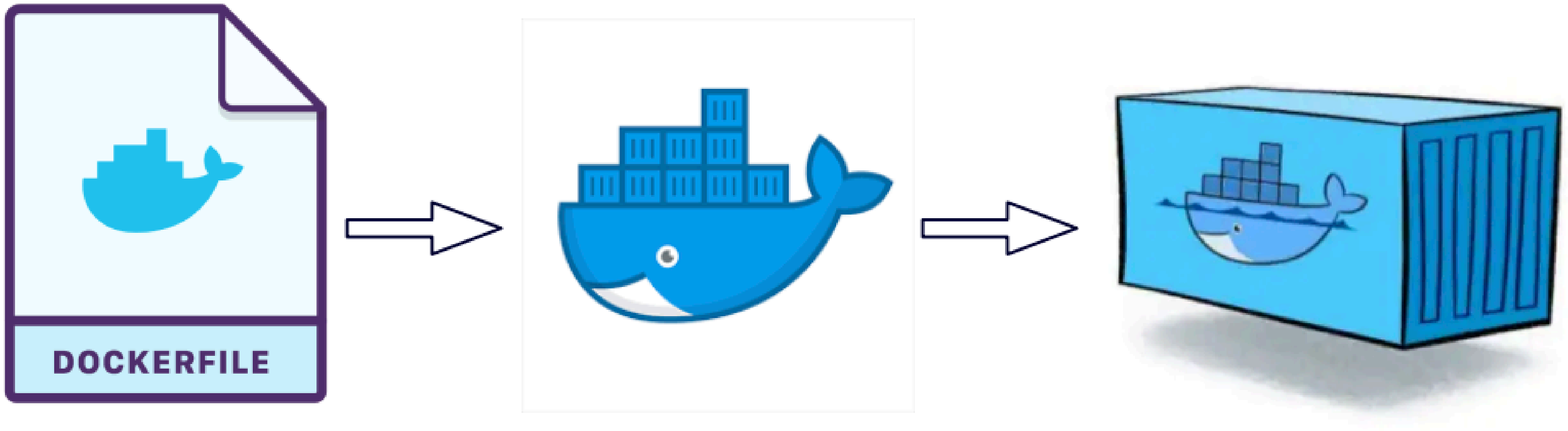
Docker

Why Docker?

Solves "works on my machine" by packaging app + dependencies into portable containers that run the same everywhere.

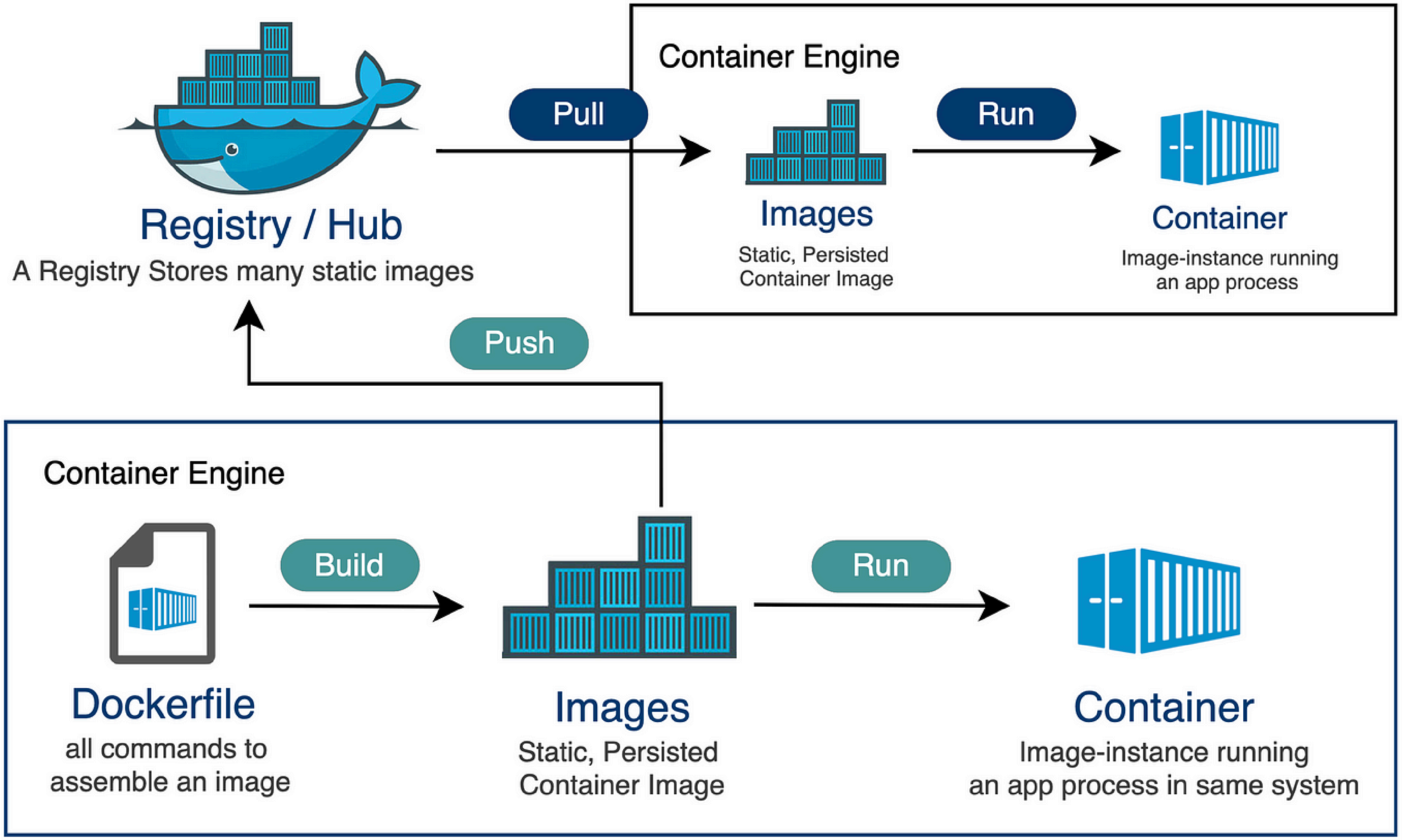
Docker 101

- **Dockerfile**:
  Instructions to build an image (base image, deps, config).
- **Docker Image**:
  A read-only template that contains the application code, libraries, and dependencies needed to run an application.
- **Docker Container**:
  A running instance of a Docker image. It includes everything needed to run the application.
- **Docker Engine**:
  The runtime that builds and runs containers.


DOCKERFILE
Docker file
Docker Image
Docker Container

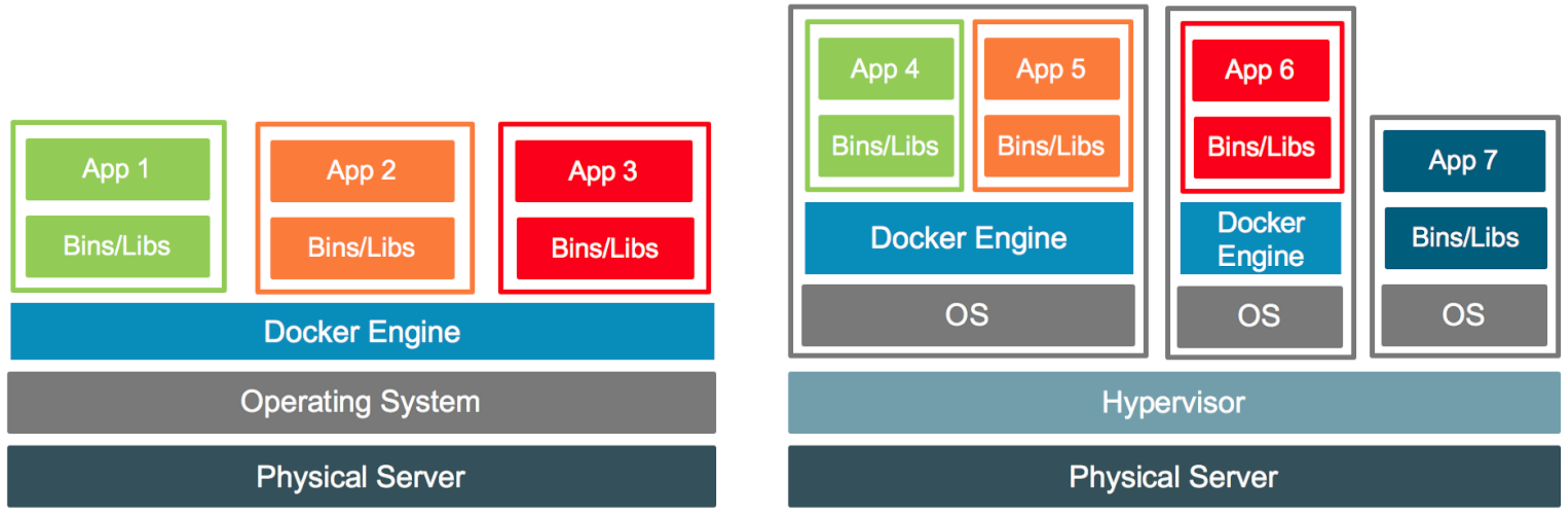
What is Docker?

- **Docker** is a platform for developing, shipping, and running applications in containers.
- **Containers** are lightweight, portable, and self-sufficient units that package an application and its dependencies.
- **Docker Engine** is the runtime that allows you to build and run containers.
- **Docker Hub** is a cloud-based registry for sharing and managing Docker images.


Registry / Hub
A Registry Stores many static images
Pull
Container Engine
Images
Static, Persisted Container Image
Run
Container
Image-instance running an app process
Push
Container Engine
Dockerfile
all commands to assemble an image
Build
Images
Static, Persisted Container Image
Run
Container
Image-instance running an app process in same system

Docker vs Virtual Machines

- **Docker**
  Virtualizes the OS, sharing the kernel and isolating processes. Much more lightweight and efficient than VMs.
- **Virtual Machines**
  Virtualizes the hardware, running a full OS with its own kernel.



Exercise: Docker install

Creating a Dockerfile

A **Dockerfile** is a text file that contains instructions to build a Docker image.

It defines the base image, installs dependencies, copies files, and sets up the environment for the application.

```
FROM ubuntu:latest

WORKDIR /app

RUN apt-get update && apt-get install -y curl dnsutils

CMD ["/bin/bash"]
```

Building a Docker Image

To build a Docker image from a Dockerfile, use the `docker build` command.

```
docker build -t <image-name> .
```

- The `-t` flag (same as `--tag`) tags the image with a name.
- The `.` at the end specifies the build context, which is the current directory.

Example:

```
docker build -t my-ubuntu-image .
```

Running a container

To run a Docker container from an image, use the following command:

```
docker run -it <image-name>
```

- The `-it` flags are used to run the container in interactive mode with a terminal attached.
- If the image does not exist locally, Docker will pull it from Docker Hub.

Example:

```
docker run -it my-ubuntu-image
```

From Dockerfile to running container

1. **Create a Dockerfile**: Write the instructions to build the image.
2. **Build the image**: Use `docker build -t <image-name> .`
3. **Run the container**: Use `docker run -it <image-name>`

Exercise: Dockerize a maven project

Networking: Port mapping

Port mapping allows you to expose a port on the host machine to a port in the Docker container.

This is useful for accessing services running inside the container, such as web servers or databases.

To map a port, use the `-p` option when running a container.

```
docker run -p <host-port>:<container-port> <image-name>
```

Example:

```
docker run -p 8080:80 nginx
```

Bind mounts

Bind mounts allow you to mount a directory from your host machine into a Docker container.

This is useful for development, as it allows you to edit files on your host machine and see the changes reflected in the container immediately.

To use a bind mount, you can use the `-v` option when running a container.

```
docker run -v /path/on/host:/path/in/container <image-name>
```

Exercise: Docker bind mount

Docker: Basic CLI Commands

- `docker build -t <image-name> .` : Builds a Docker image from a Dockerfile.
- `docker run <image-name>` : Runs a Docker container from an image.
- `docker ps` : Lists running containers.
- `docker ps -a` : Lists all containers, including stopped ones.
- `docker images` : Lists all Docker images on the system.
- `docker logs` : Displays logs from a running container.
- `docker exec` : Executes a command in a running container.
- `docker stop <container-id>` : Stops a running container.
- `docker rm <container-id>` : Removes a stopped container.
- `docker rmi <image-name>` : Removes a Docker image.