

Introduction to Docker Compose

INTERMEDIATE DOCKER



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What is Docker Compose?

- Additional command-line tool for Docker
- Define and manage multi-container applications
- Specify containers, networking, and storage volumes in a single file
 - `compose.yml` or `compose.yaml`
 - Older compose files may be named `docker-compose.yaml`
- Easy to share / demo applications

Example compose.yaml

```
# Define the services
services:
  # Define the container(s), by name
  webapp:
    image: "webapp"
    # Optionally, define the port forwarding
    ports:
      - "8000:5000"
  # Define any other containers required
  redis:
    image: "redis:alpine"
```

Starting an application

- `docker compose up`
 - On older systems, `docker-compose up`
 - `docker compose -f <yaml> up`
 - `docker compose up -d`

```
$ docker compose up
[+] Running 2/0
? Network composetest_default    Created
? Container composetest-redis-1  Created
? Container composetest-web-1    Created
Attaching to redis-1, web-1
redis-1 | 1:C 11 Mar 2024 04:09:51.754 * o000o000o000o Redis is starting o000o000o000o
web-1   | * Serving Flask app 'app.py'
web-1   | * Running on http://127.0.0.1:5000
```

Checking status of applications

- `docker compose ls`

```
$ docker compose ls
```

NAME	STATUS	CONFIG FILES
webapp	running (2)	/webapp/docker-compose.yml

Stopping an application

- `docker compose down`
 - `docker-compose down`
 - `docker compose -f <yaml> down`

```
$ docker compose down
```

```
[+] Running 3/3
```

```
? Container composetest-redis-1    Removed
```

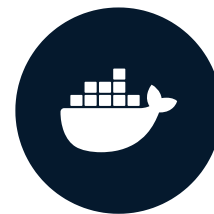
```
? Container composetest-web-1      Removed
```

```
? Network composetest_default      Removed
```

Let's practice!
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Creating compose.yaml files

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YAML

- Yet Another Markup Language
 - YAML Ain't Markup Language
- Text file, but spacing matters (like Python)
- Used in many development scenarios for configuration
- Rules can be tricky, mainly keep entries lined up as in examples

```
services:
  postgres:
    container_name: postgres
    image: postgres:latest
    ports:
      - "5432:5432"
    restart: always
  pgadmin:
    container_name: pgadmin
    image: dpage/pgadmin4:latest
    ports:
      - "5050:80"
    restart: always
```

Main sections

- Different sections handle different components
- `services:` list the containers to load
- `networks:` handles networking definitions
- `volumes:` controls any volume mounting
- `configs:` handles configuration options without custom images
- `secrets:` Provides options to handle passwords, tokens, API keys, etc

- Refer to the Docker Compose

[Documentation](https://docs.docker.com/compose/compose-file/) for more information

```
services:
    ... # Define containers
networks:
    ... # Define any networking details
volumes:
    ... # Define storage requirements
configs:
    ... # Define special config details
secrets:
    ... # Define passwords / etc
```

¹ <https://docs.docker.com/compose/compose-file/>

Services section

- Defines all required resources for the application
- Primarily specifies the containers and images to be used
- Extensive options available, but only apply to the individual container(s)
- Indentation is applied as needed
- First subsection is the name of each component, followed by the settings

Services example

```
services:
  # Resource name
  postgres:
    # Container name, otherwise random
    container_name: postgres
    # Container image to use
    image: postgres:latest
    # Any port mapping required
    ports:
      # Network details
      - "5432:5432"
  # Next resource
  pgadmin:
    ...
```

- Resource name
- `container_name:` , the assigned name of the container otherwise it's random
- `image:` , which container image to use
- `ports:` , contains a list of any port mapping required
- Followed by next resources required

Additional comments

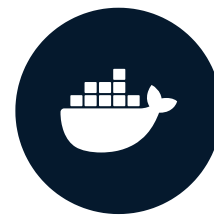
- `config.yaml` syntax is extensive
 - Covering very small portion of `compose.yaml` options
 - Review the documentation!
- It's typically not required to build a `compose.yaml` file from scratch

¹ <https://docs.docker.com/compose/compose-file/>

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Dependencies and troubleshooting in Docker Compose

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What are dependencies?

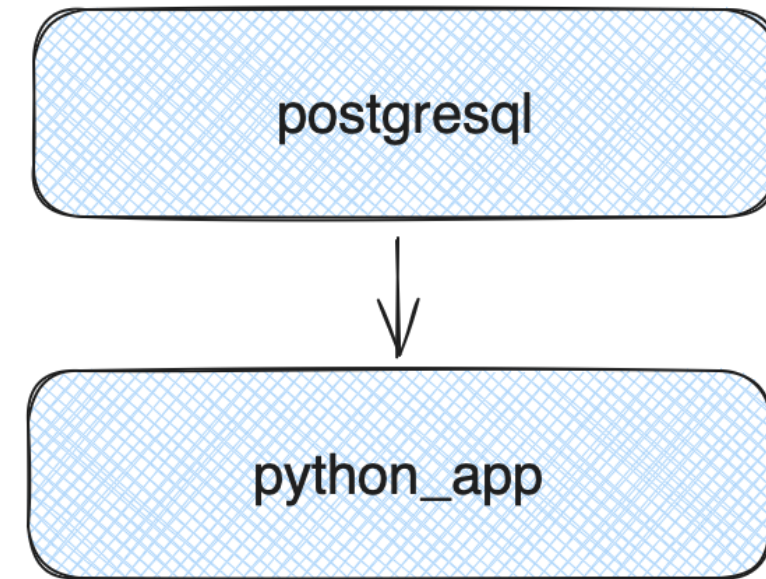
- Dependencies define the order of resource startup
- Resources (containers) may require other resources
- Example web application
 - Database container `postgresql` must start first



postgresql

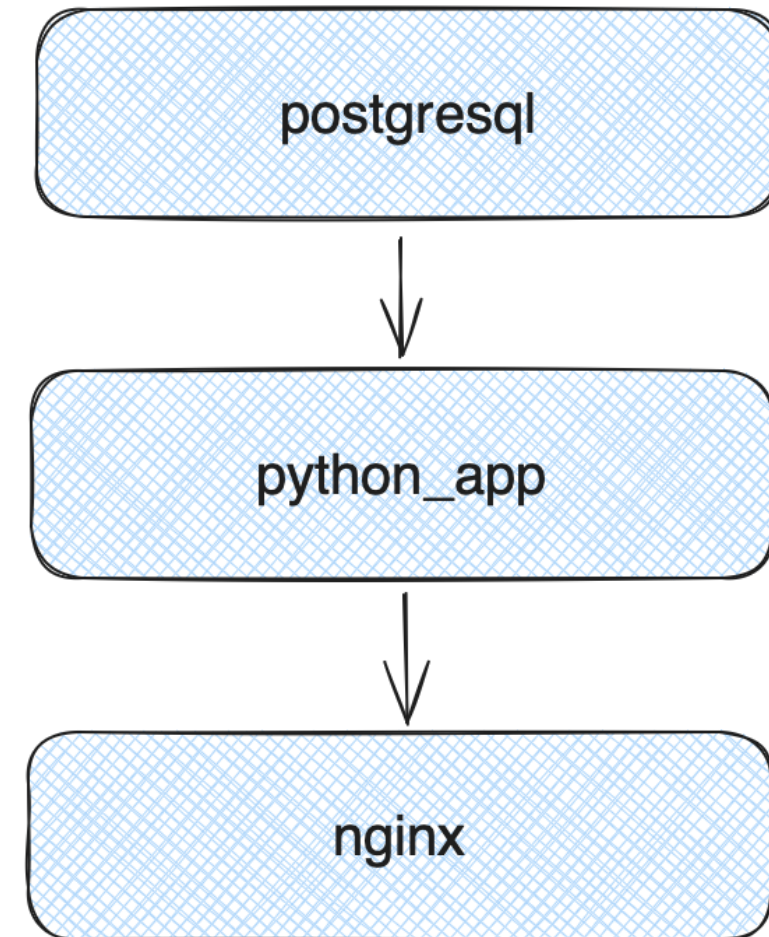
What are dependencies?

- Dependencies define the order of resources
- Resources (containers) may require other resources
- Example web application
 - Database container `postgresql` must start first
 - Then the `python_app`



What are dependencies?

- Dependencies define the order of resources
- Resources (containers) may require other resources
- Example web application
 - Database container `postgresql` must start first
 - Then the `python_app`
 - Finally, the `nginx` web server



depends_on

- Dependencies defined using the `depends_on` attribute
- Can chain dependencies as per example
- Or, can have multiple dependencies per resource if required
- Order of the `compose.yaml` file does not matter

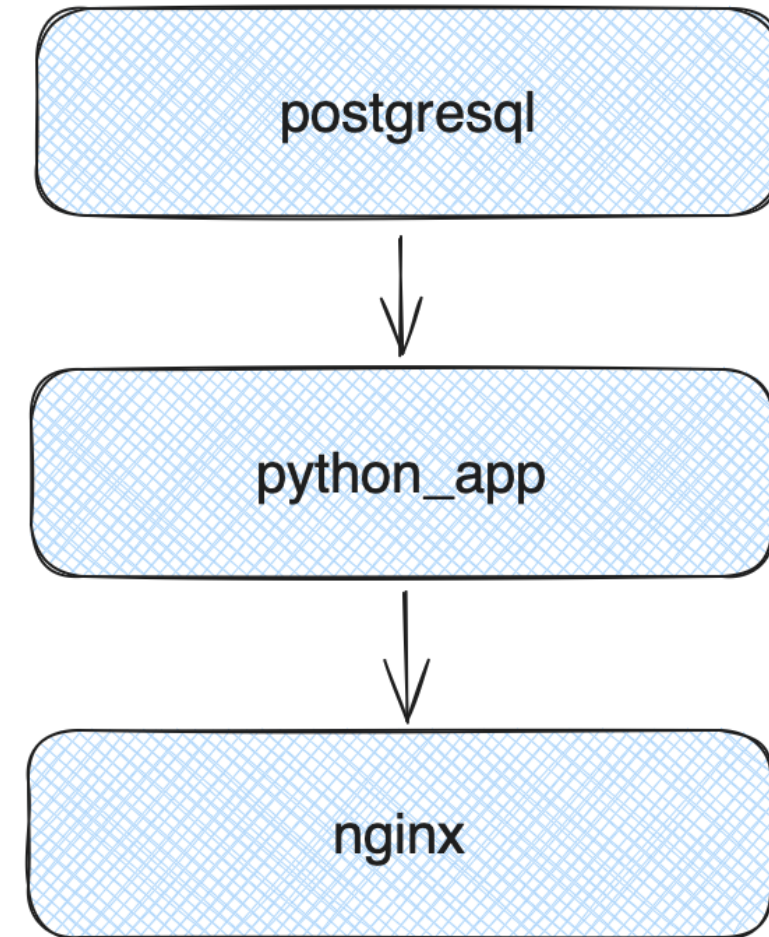
```
services:
  postgresql:
    image: postgresql:latest

  python_app:
    image: custom_app
    depends_on:
      - postgresql

  nginx:
    image: nginx/latest
    depends_on:
      - python_app
```

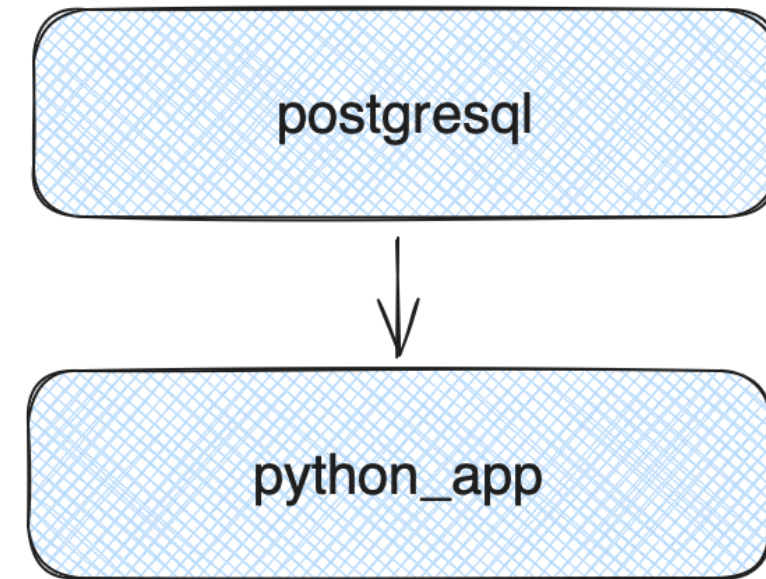
Shutting down applications

- Shutting down an application occurs in reverse order
- Stops `nginx` resource



Shutting down applications

- Shutting down an application occurs in reverse order
- Stops `nginx` resource
- Then stops the `python_app` resource



Shutting down applications

- Shutting down an application occurs in reverse order
- Stops `nginx` resource
- Then stops the `python_app` resource
- And finally the `postgresql` resource



postgresql

Other options

- Docker Compose provides other options for dependencies
- `condition:` defines how to decide when resource is ready.
 - `service_started` - Resource has started normally
 - Default behavior
 - `service_completed_successfully` - Resource ran to completion, such as a initial configuration / etc
 - `service_healthy` - Resource meets a criteria defined by `healthcheck`

```
services:
  nginx:
    image: nginx/latest
    depends_on:
      python_app:
        condition: service_started

python_app:
  image: custom_app
  depends_on:
    postgresql:
      condition: service_healthy
```

Docker Compose troubleshooting tools

- Docker Compose has additional troubleshooting tools
- `docker compose logs` - Gathers output from all resources in application

```
redis-1 | * o000o000o000o Redis is starting o000o000o000o
redis-1 | * Running mode=standalone, port=6379.
redis-1 | * Server initialized
redis-1 | * Ready to accept connections tcp
web-1   | * Serving Flask app 'app.py'
web-1   | * Running on all addresses (0.0.0.0)
web-1   | * Running on http://172.20.0.2:5000
web-1   | Press CTRL+C to quit
```

- `docker compose logs <resourcename>`

docker compose top

- `docker compose top` shows status of resources within an application

```
composetest-redis-1
```

UID	PID	PPID	C	STIME	TTY	TIME	CMD
999	2767	2726	0	01:16	?	00:03:27	redis-server *:6379

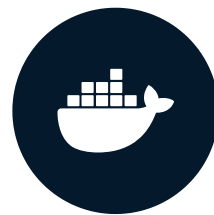
```
composetest-web-1
```

UID	PID	PPID	C	STIME	TTY	TIME	CMD
root	2768	2740	0	01:16	?	00:00:23	/usr/local/bin/python /usr/local/

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Creating a data service within Docker

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Data sharing

- `docker run -v <host directory>:<container directory>`
 - `-v ~/hostdata:/containerdata`

Data sharing in compose.yaml

- Also present in `compose.yaml` files

```
services:
  resource:
    name: resource1

# Section named volumes
volumes:
  - <host directory>:<container directory>
# Such as:
  - ~/hostdata:/containerdata
```

Networks

- `docker run --network <networkname>`
 - `docker run --network net1`
- In `compose.yaml` resources

```
services:  
  resource:  
    name: resource1  
  
  networks:  
    network_name:  
      # Such as:  
      net1:
```

Port mapping

- `docker run -p hostport:containerport`
 - `-p 8000:8000`
- Available in `compose.yaml` resources

```
services:  
  resource:  
    name: resource1  
  
  ports:  
    - hostport:containerport  
    # Such as:  
    - 8000:8000
```

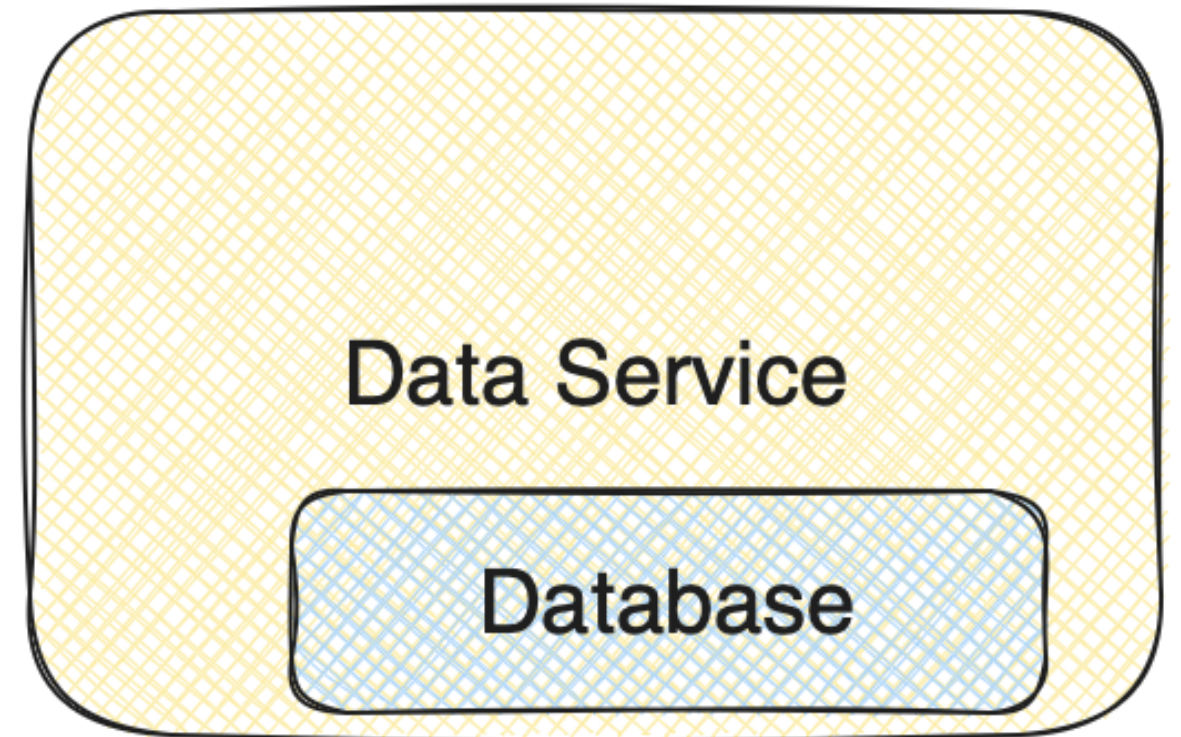
docker inspect

- Determine information about provisioned containers
 - `docker inspect <id / name>`
- Provides various levels of information
 - `Mounts` : Provides mounted data information
 - `NetworkSettings` : Network information
 - `NetworkSettings:Networks` : Shows the Docker network(s) connection details

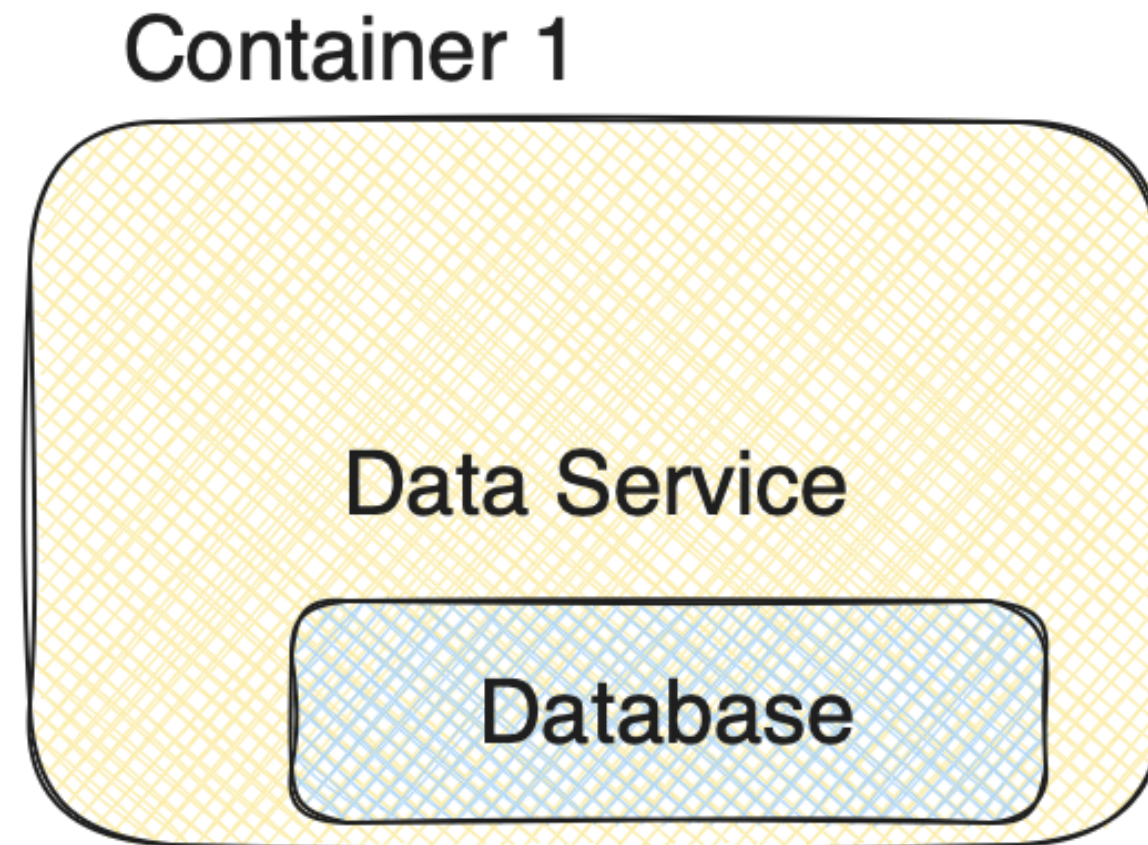
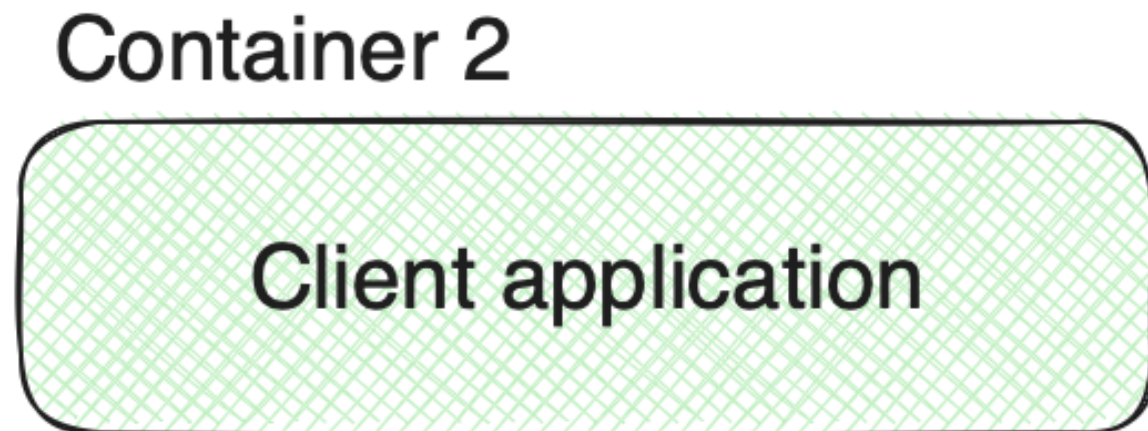
```
"Config": {  
  "Mounts": [...]  
  ...  
  "Networks": {  
    "network1": {  
      ...
```


Data service

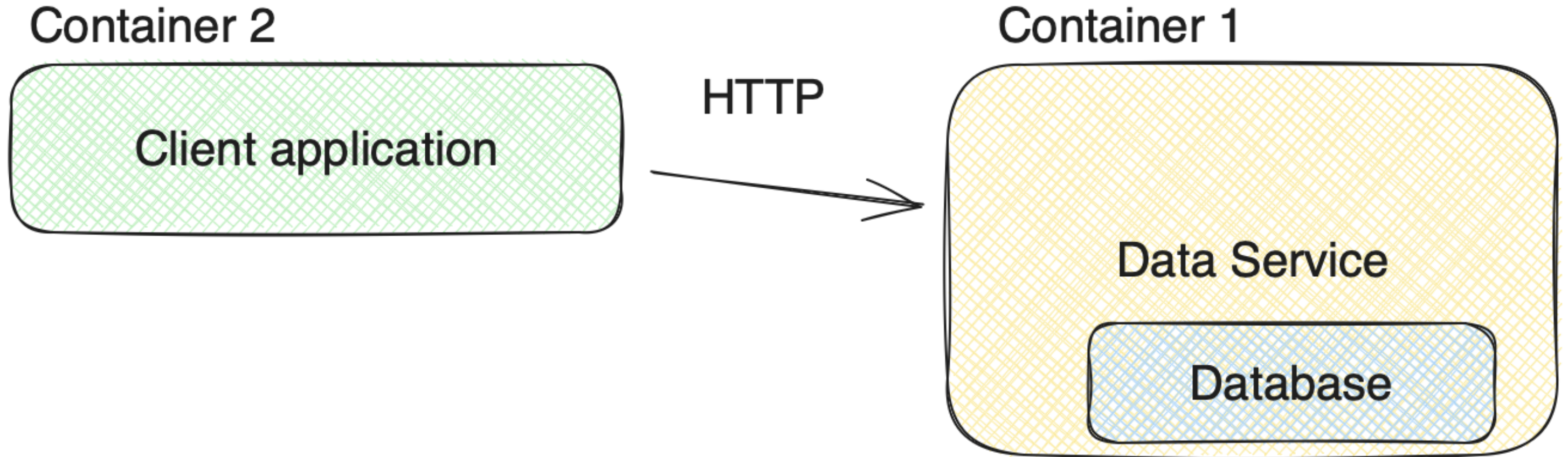
Container 1



Data service



Data service



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Course review

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Next steps

- Review Docker documentation docs.docker.com
- Containerize more applications
- Create custom repositories
- Docker Swarm
- Kubernetes
- CI/CD
- Mapping to host GPU hardware

Congratulations!

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