DOCKER COMPOSE

FUNDAMENTALS

About Me

My name is Kirk Patrick, and I have 17+ years of experience in the technology industry, including:

- 10 years as a Software Engineer
- 4 years as a DevOps Engineer
- 3 years as a Solution Architect

Academic Background

- Technical Degree in Accounting — Rui Barbosa School
- Bachelor's Degree in Systems Analysis and Development — FIAP
- Professional Baccalaureate in Data Science — Datatech Florida
- Postgraduate Degree in Machine Learning — FIAP
- Currently pursuing a Postgraduate Degree in Astronomy with an emphasis in Planetary Geology - FGE São Paulo / Space Today

Additional Information

- Speaker at Campus Party Brazil (Goiânia Edition), my hometown.
- Guest Mentor for NASA events in Brazil (NASA Space Apps Challenge)
- Certified Professional in AWS, Azure, and GCP (Google Cloud Platform).

Contact

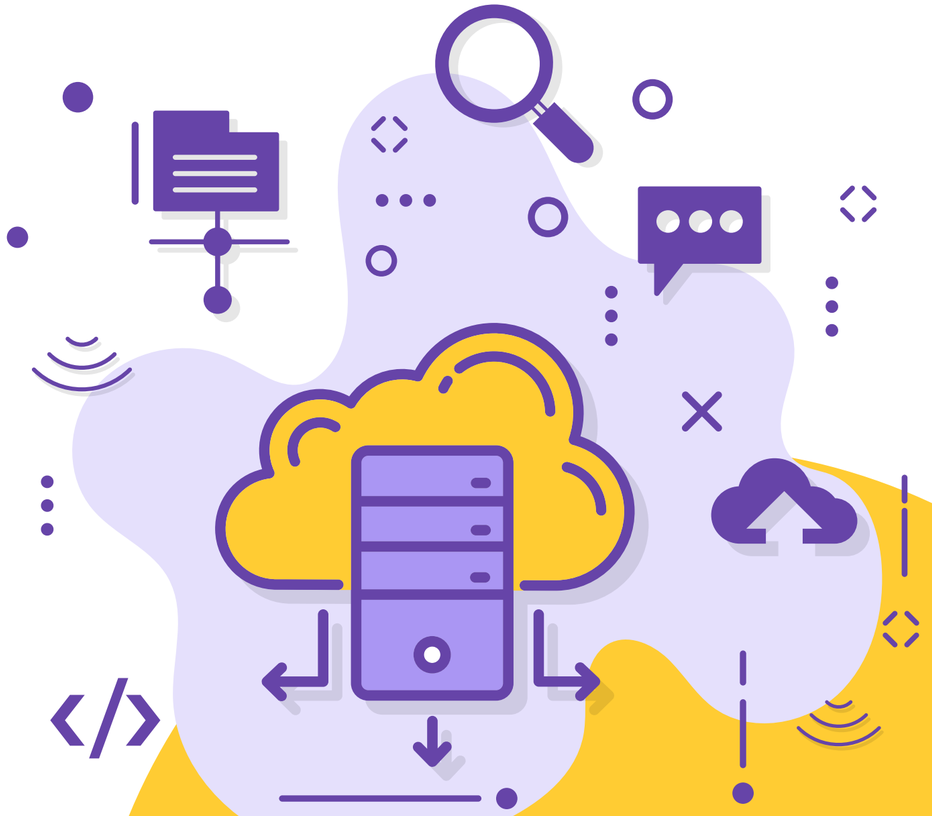
- LinkedIn → https://www.linkedin.com/in/kirkgo/

What is Docker Compose

Docker Compose is a tool for defining and running multi-container Docker applications. With Compose, you use a YAML file to configure your application's services, networks, and volumes. Then, with a single command, you create and start all the services from your configuration.

Why use it?

- *Simplicity*: Define your entire application stack in one file
- *Reproducibility*: Same environment every time, everywhere
- *Isolation*: Each component runs in its own container
- *Scalability*: Easy to scale services up or down
- *Maintainability*: Version control your infrastructure as code

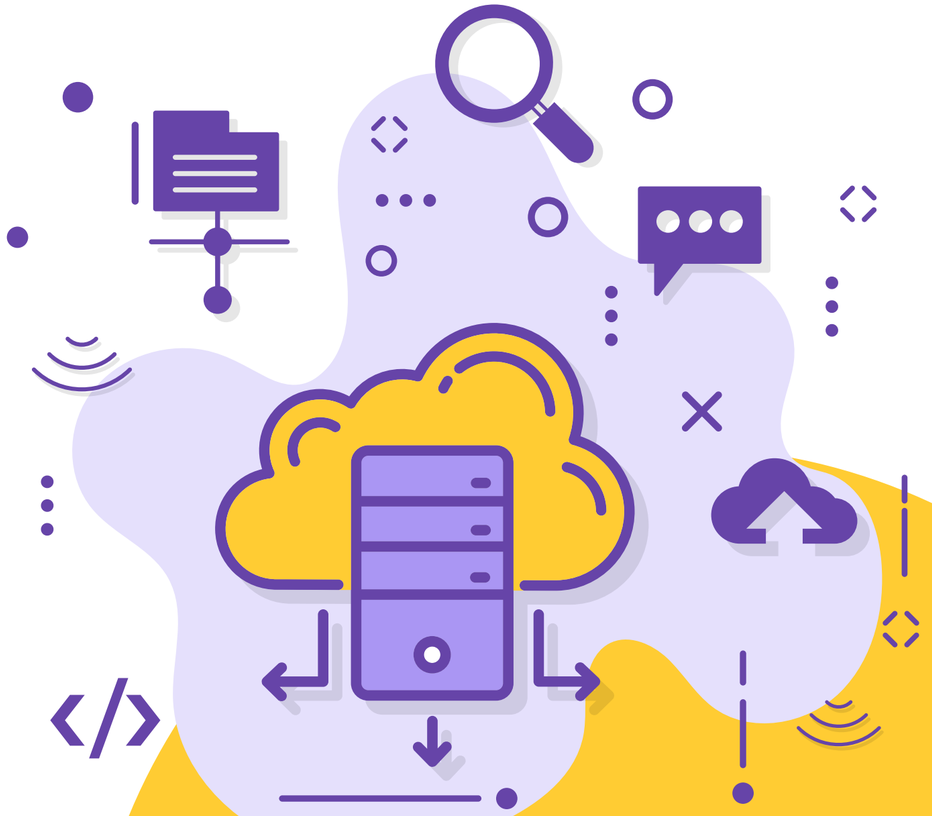


Docker vs Docker Compose

Key Differences:

- Docker: Manages individual containers
- Docker Compose: Orchestrates multiple containers as a single application

Think of Docker as managing single instruments, while Docker Compose conducts the entire orchestra



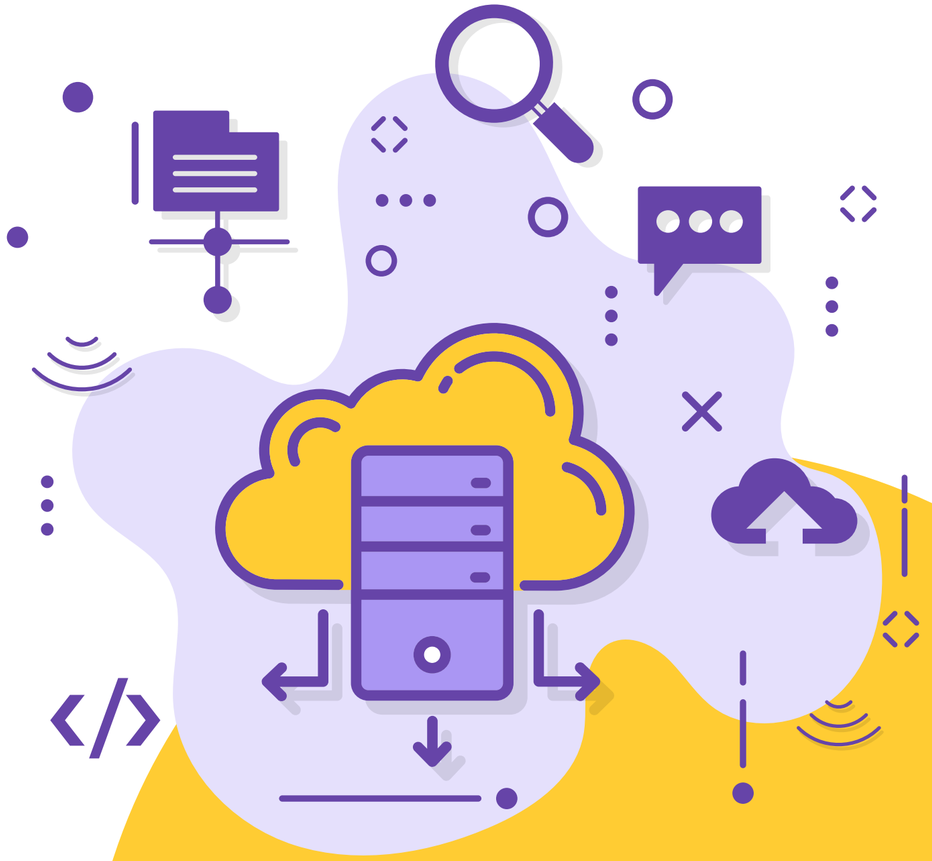
Installation and Setup

For Windows Users:

1. Install Docker Desktop for Windows from Docker's official website
2. Docker Compose is included with Docker Desktop for Windows
3. Verify installation by opening PowerShell or Command Prompt and running:
   - *docker-compose --version*

For Mac Users:

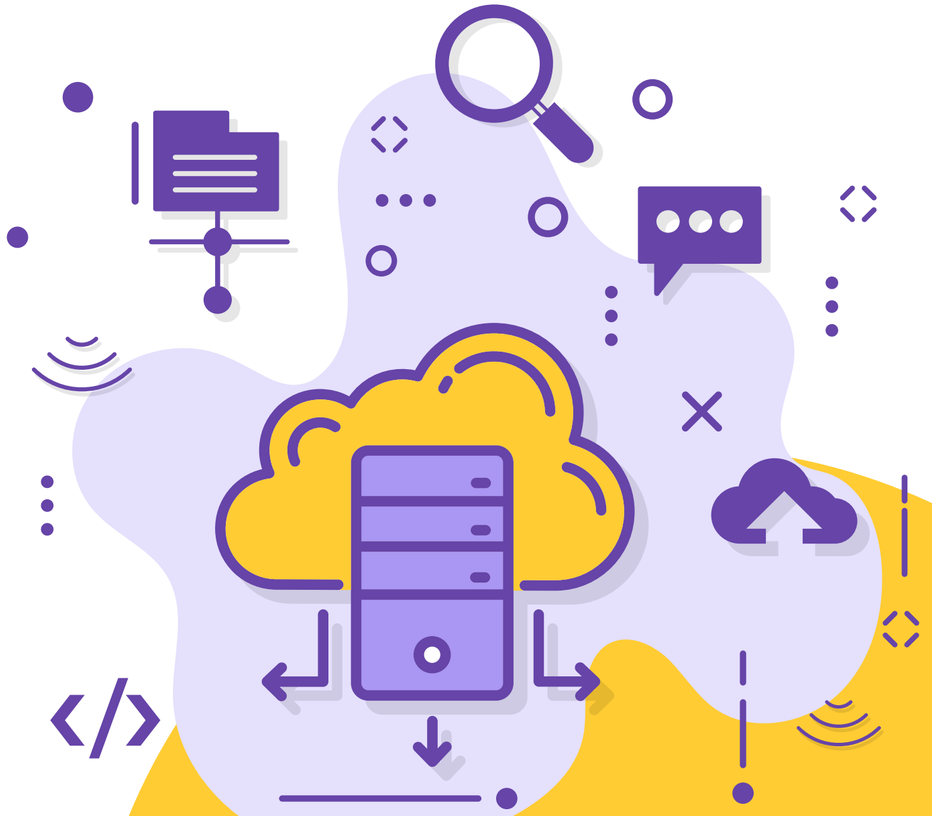
1. Install Docker Desktop for Mac from Docker's official website
2. Docker Compose is included with Docker Desktop for Mac
3. Verify installation by opening Terminal and running:
   - docker-compose --version



Installation and Setup

Note for Windows Users:

- Ensure virtualization is enabled in your BIOS
- Docker Desktop requires at least 4GB of RAM
- WSL 2 backend is recommended for Windows users



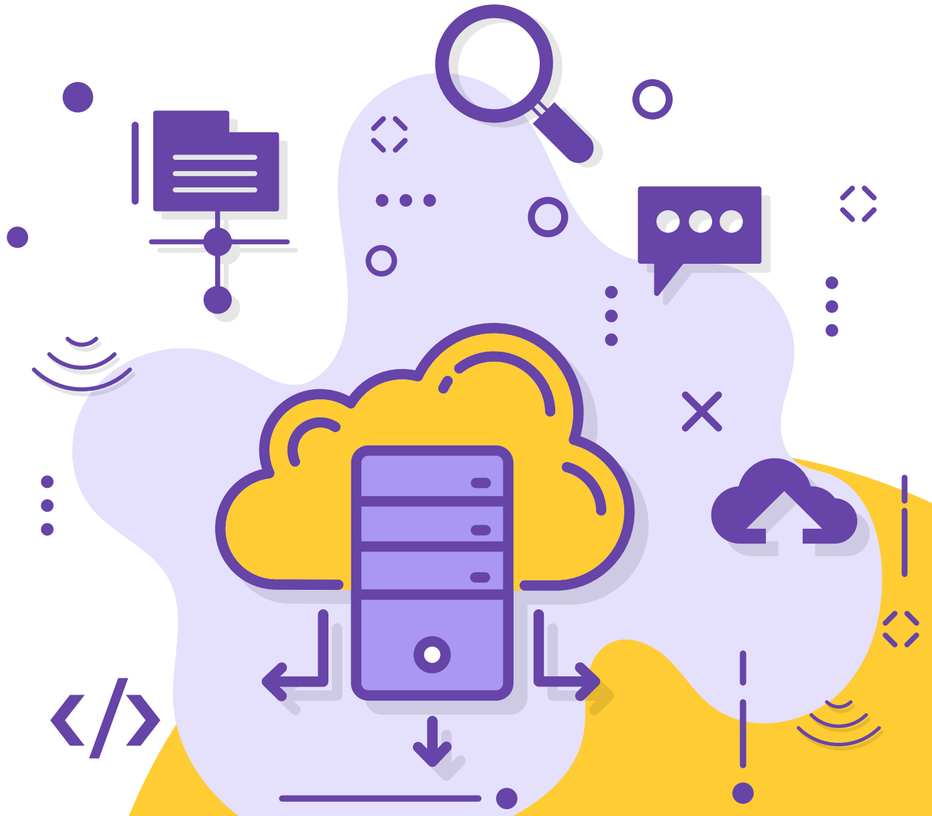
Core Concepts

Services

Services are the containers that make up your application. Each service runs a single image and can be configured with various options including environment variables, volumes, ports, and more.

Networks

Networks enable communication between your containers and with the outside world. Docker Compose creates a default network for your application, but you can define custom networks with specific drivers and options.



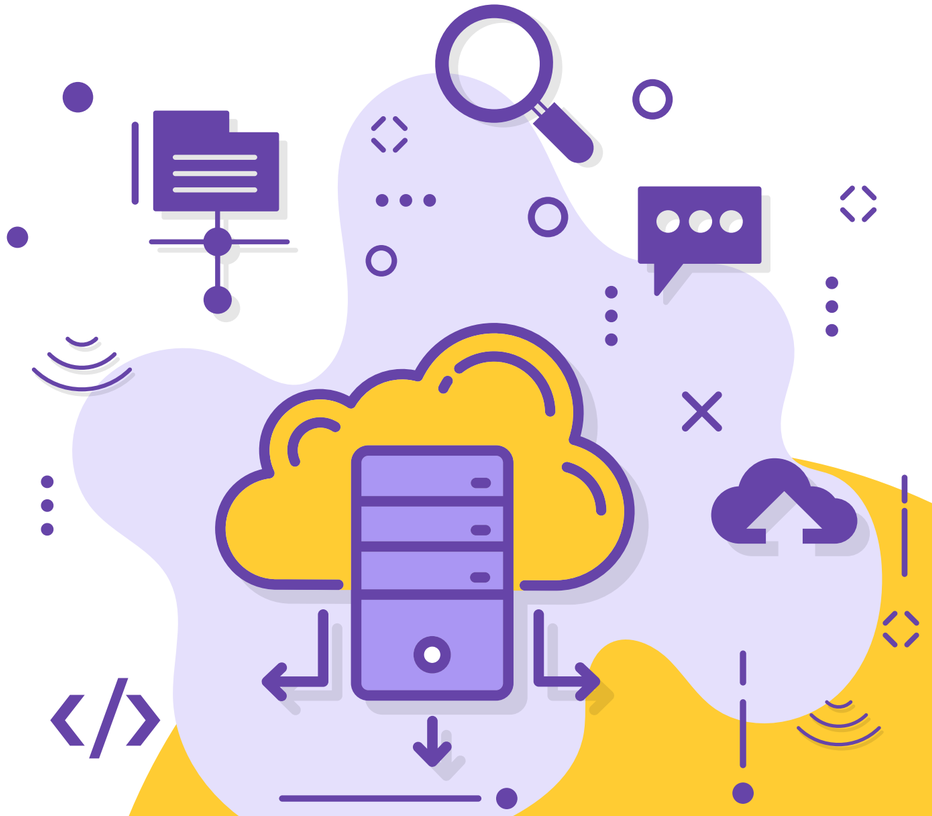
Core Concepts

Volumes

Volumes provide persistent storage for your containers. They can be used to share data between containers or to persist data even after a container is removed.

Dependencies

Dependencies allow you to specify the order in which services should start. This is useful when one service depends on another being available before it can function properly.



Docker Compose File Structure

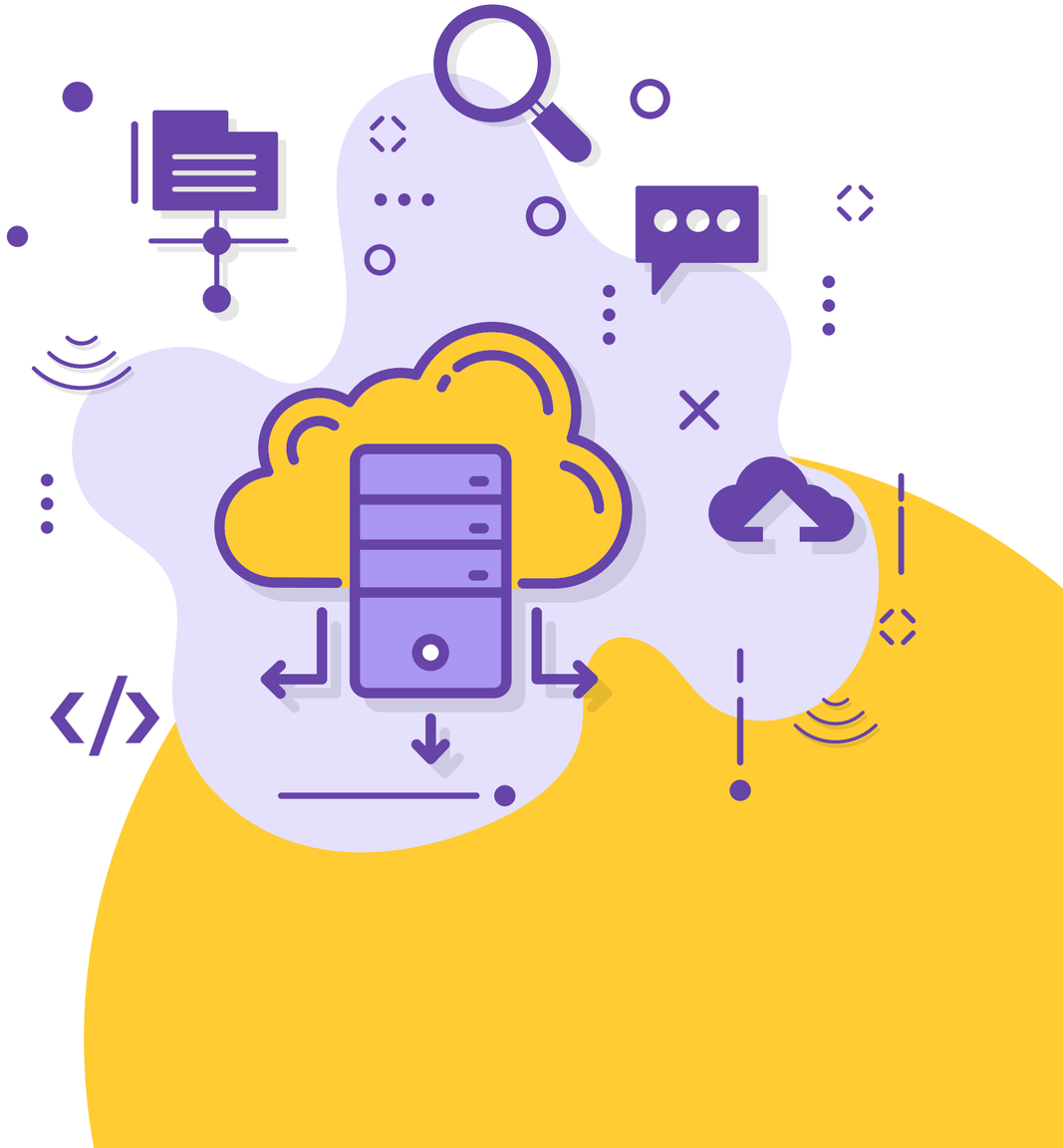
Docker Compose configurations are written in YAML format, typically in a file named ***docker-compose.yml***:

docker-compose.yml

001-first-compose > docker-compose.yml > ...

docker-compose.yml - The Compose specification establishes a standard for the definition of multi-

```yaml
version: '3'  # Compose file version

▷Run All Services
services:     # Container definitions
  ▷Run Service
  service1:   # First service
    image: nginx
    ports:
      - "8080:80"

  ▷Run Service
  service2:   # Second service
    build: ./app
    volumes:
      - ./app:/code
    depends_on:
      - service1

networks:     # Network definitions
  frontend:
  backend:

volumes:      # Volume definitions
  data:

```



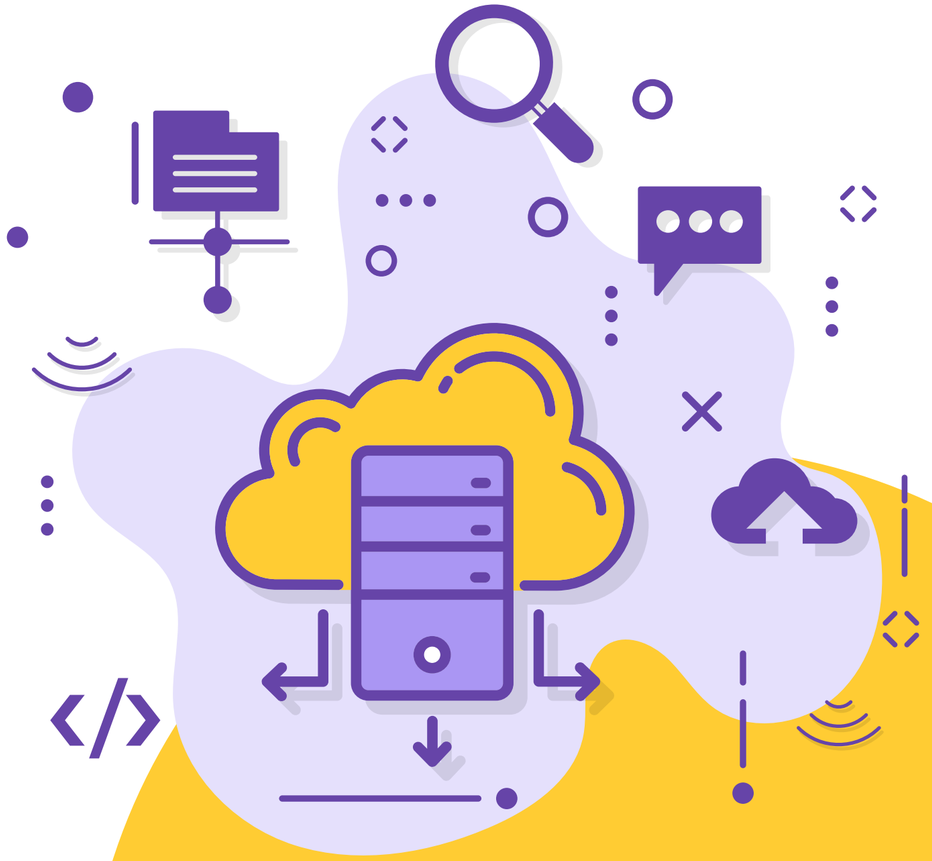
Docker Compose

Key Componentes of *docker-compose.yml* file:

- *version*: Specifies the Compose file format version
- *services*: Defines the containers you want to run
- *networks*: Configures networking for your application
- *volumes*: Defines persistent data storage
- *configs* and *secrets*: Manages configuration and sensitive data (in newer versions)

Additional Concepts:

- Services share the same default network, enabling them to communicate by service name.
- Configuration is declarative — Compose figures out what to do based on file state.



Hello Docker Compose

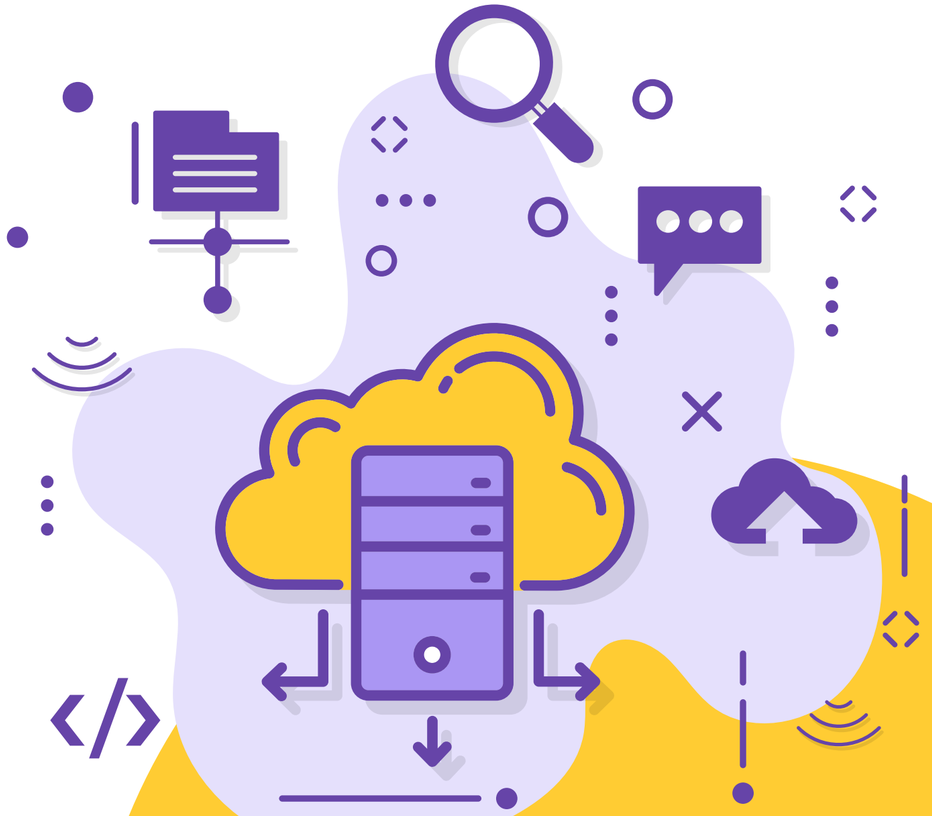
The *docker-compose.yml*:

docker-compose.yml

001-hello-compose > docker-compose.yml > YAML > {} services > {} web

docker-compose.yml - The Compose specification establishes a standard for the definition of multi-container pla

```yaml
version: '3'

▷Run All Services
services:
  ▷Run Service
  web:
    image: nginx:alpine
    ports:
      - "8080:80"
    volumes:
      - ./website:/usr/share/nginx/html
    restart: always
```



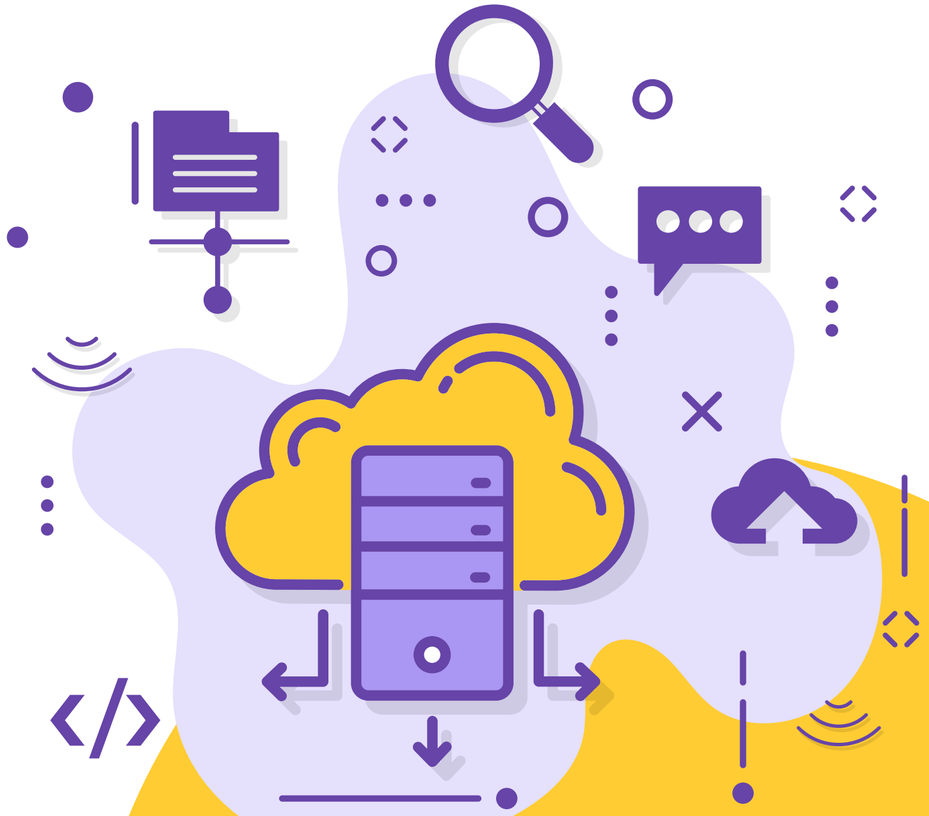
Hello Docker Compose

The *index.html* file:

index.html

001-hello-compose > website > index.html > html

```
<!DOCTYPE html>
<html lang="en">

<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Hello Docker Compose</title>
    <style>…
    </style>
</head>

<body>
    <div class="container">
        <h1>Hello Docker Compose!</h1>
        <p>This simple page is being served by Nginx running in a Docker container.</p>

        <div class="docker-info">
            <p><strong>Container:</strong> Nginx Alpine</p>
            <p><strong>Port:</strong> 8080:80</p>
            <p><strong>Status:</strong> Running</p>
        </div>

        <p>Congratulations! Your Docker Compose setup is working correctly.</p>
    </div>
</body>

</html>
```



What’s Happening?

When you run *docker-compose up -d*:

- Docker downloads the *nginx:alpine* image (if it's not already available locally)
- It creates a container based on that *image*
- It maps *port 8080* on your computer to *port 80* on the container
- It mounts your local "*website*" folder in the directory where Nginx serves the files
- It starts the container in detached mode (*-d flag*)

As a result, Nginx inside the container serves the *index.html* file and we can access it from the browser at *localhost:8080*.

Result of Hello Docker Compose

Hello Docker Compose!

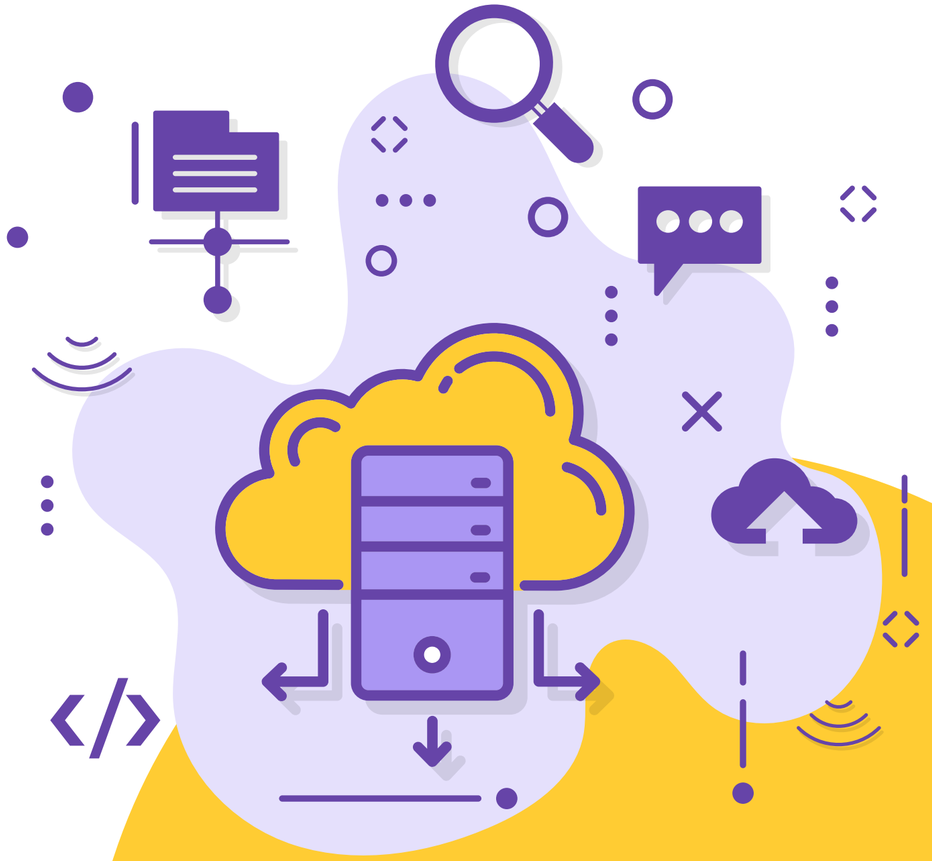
This simple page is being served by Nginx running in a Docker container.

Container: Nginx Alpine

Port: 8080:80

Status: Running

Congratulations! Your Docker Compose setup is working correctly.



Command Workflow & Lifecycle

Command Description:

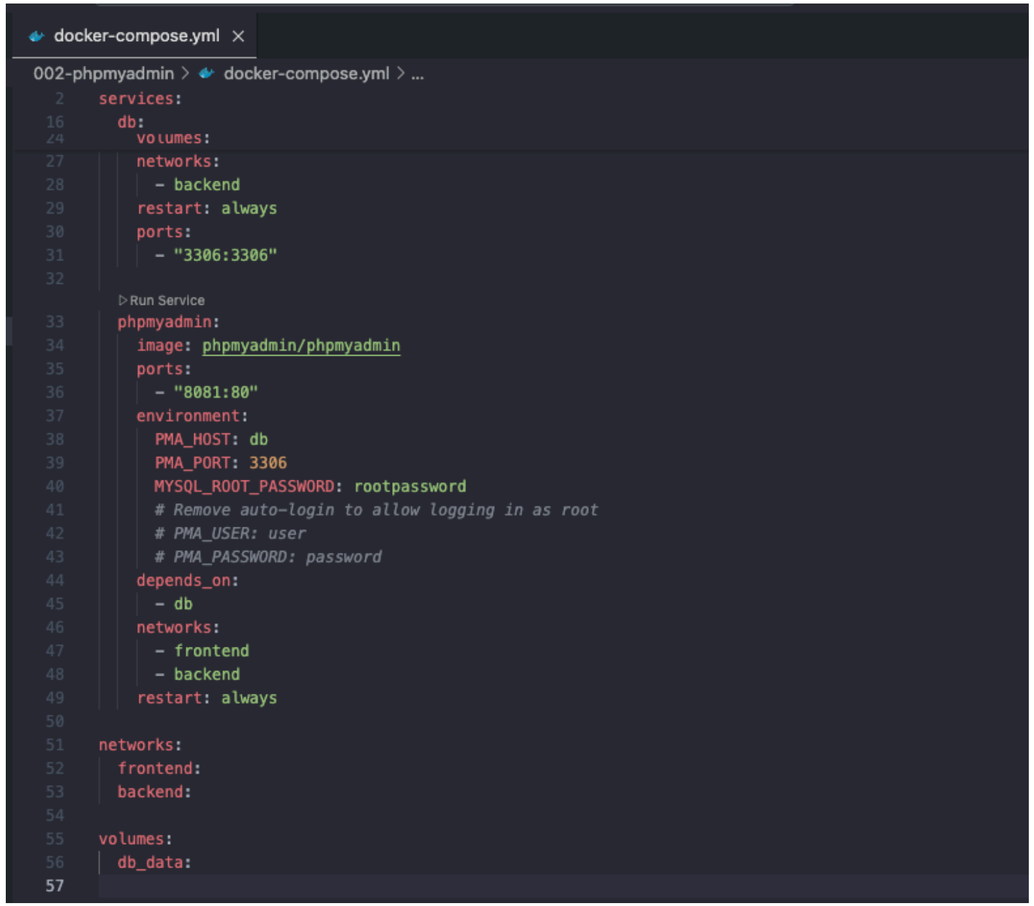
- *docker-compose up* → Builds (if needed) and starts the services
- *docker-compose up -d* → Runs services in the background (detached mode)
- *docker-compose down* → Stops and removes containers, networks, volumes
- *docker-compose ps* → Lists services and status
- *docker-compose logs -f* → Tails logs from all services
- *docker-compose exec <service> bash* → Executes a command in a running container

Behind the scenes Docker Compose creates:

- A custom bridge network
- Named volumes for persistence
- Container names prefixed with the project name

Updating Hello Docker Compose

New *docker-compose.yml*:



Updating Hello Docker Compose

mysql-init/grant_privileges.sql:

Updating Hello Docker Compose

Explanation of the New Docker Compose File

Version Declaration:

- *version*: *'3'* → This specifies the Docker Compose file format version. Version 3 is commonly used and supports most modern Docker features.

Services Section:

- This section defines three containers (services) that will work together:
  - Web Server (Nginx)
    - *image*: Uses the lightweight Alpine Linux version of Nginx
    - *ports*: Maps port 8080 on your host to port 80 in the container
    - *volumes*: Maps your local ./website folder to Nginx's web root
    - *depends_on*: Ensures the database starts before this service
    - *networks*: Connects to both frontend and backend networks
    - *restart*: Automatically restarts the container if it stops

Updating Hello Docker Compose

Services Section (continuation):

- Database Server (MySQL)
  - *image*: Uses MySQL version 8.0
  - *command*: Changes the authentication plugin to be compatible with more clients
  - *environment*: Sets up:
    - Root password
    - Initial database named "myapp"
    - A non-root user account with limited permissions
  - *volumes*:
    - db_data: A named volume to persist database files
    - ./mysql-init:/docker-entrypoint-initdb.d: For SQL initialization scripts
  - *networks*: Only on the backend network for security
  - *ports*: Exposes MySQL on port 3306 (optional, for external access)
  - *restart*: Automatically restarts if it fails

Updating Hello Docker Compose

Services Section (continuation):

- Database Management Tool (phpMyAdmin)
  - *image*: Uses the official phpMyAdmin image
  - *ports*: Maps port 8081 on your host to port 80 in the container
  - *environment*:
    - PMA_HOST: Tells phpMyAdmin which database server to connect to
    - PMA_PORT: The port MySQL is running on
    - MYSQL_ROOT_PASSWORD: Passes the root password to phpMyAdmin
    - The commented-out PMA_USER and PMA_PASSWORD lines are the key change
  - *depends_on*: Ensures the database starts before phpMyAdmin
  - *networks*: Connected to both networks
  - *restart*: Automatically restarts if it fails

Updating Hello Docker Compose

Network Section:

- Database Management Tool (phpMyAdmin)
  - *Creates two separate network spaces*:
    - *frontend*: *For external access to web servers*
    - *backend*: *For internal communication between services*

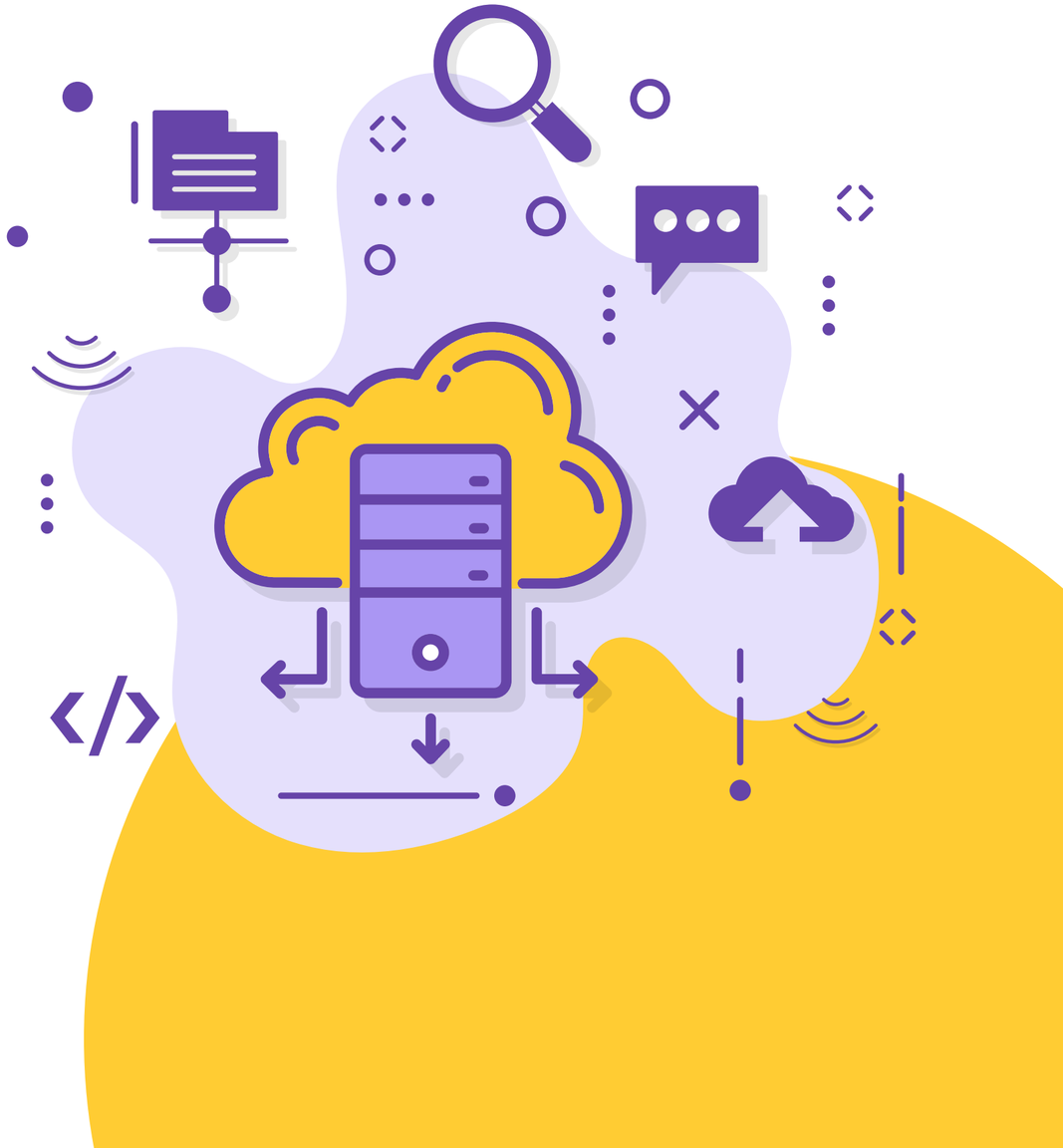
Volumes Section:

- Creates a named volume to store MySQL data persistently, even when containers are removed.

How to Access:

- Website: localhost:8080
- phpMyAdmin: localhost:8081
  - On the phpMyAdmin login screen, use:
    - Server: db (pre-filled)
    - Username: root
    - Password: rootpassword

Questions?



Learning More About Docker Compose

Official Documentation

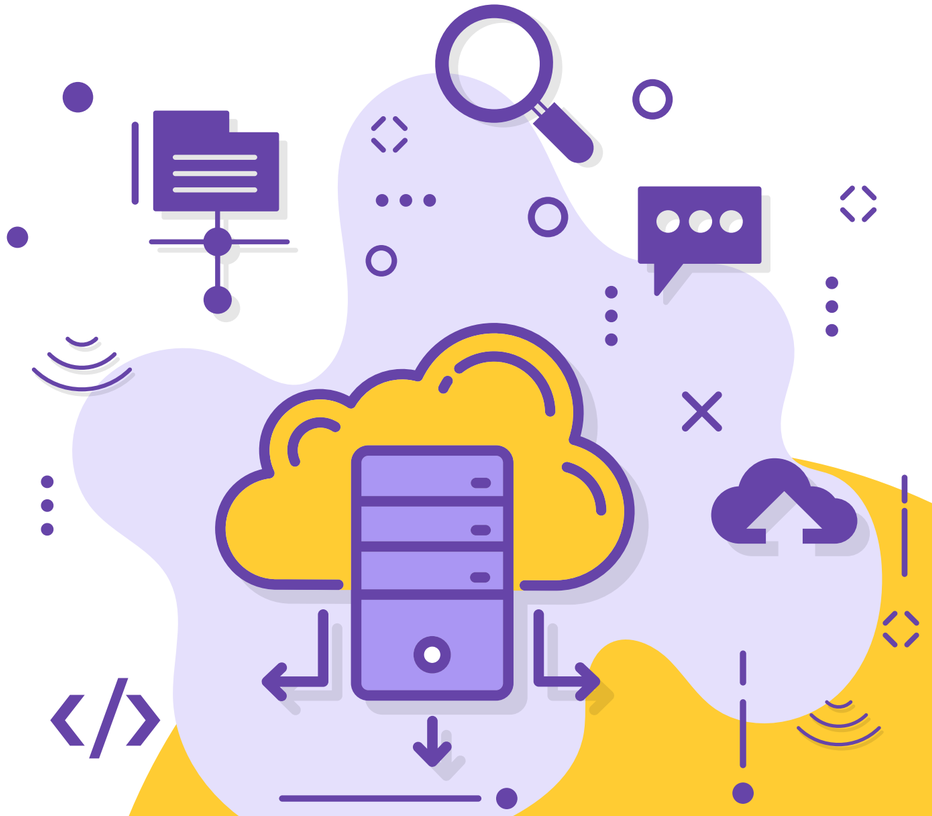
- Docker Compose Documentation
  - https://docs.docker.com/compose/

- Compose File Reference
  - https://docs.docker.com/compose/compose-file/

- Docker Compose CLI Reference
  - https://docs.docker.com/compose/reference/

Interactive Learning

- Play with Docker - Free online Docker playground
  - https://labs.play-with-docker.com/



THANK YOU