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Module 5: Continuous deployments

1. Docker Introduction

What is Docker?
Docker is a platform designed to help developers build, ship, and run applications inside lightweight, portable containers.

Why Use Docker?

- **Containerization**: Docker packages your application along with all its dependencies, libraries, and configuration files into a single unit called a container.
- **Portability**: Docker containers can run on any system that supports Docker, making deployment easy and consistent across different environments.
- **Speed**: Containers start quickly and use fewer resources than traditional virtual machines.
- **Consistency**: Ensures the application runs the same in development, testing, and production.

What is a Container?

A container is a lightweight, standalone, executable package that includes everything needed to run a piece of software, including the code, runtime, system tools, and libraries. Containers share the host system's OS kernel but remain isolated from each other.

Main Components of Docker

- **Dockerfile** – A text file with a set of instructions to create a Docker image.
- **Image** – A snapshot of the application and its environment.
- **Container** – A running instance of a Docker image.
- **Docker Hub** – A cloud-based registry where Docker images can be stored and shared.

Basic Docker Commands

- docker build – Builds a Docker image from a Dockerfile.
- docker run – Runs a container based on an image.
- docker ps – Lists running containers.
- docker stop – Stops a running container.

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2. Explore docker commands for content management

docker images

Shows a list of all the Docker images stored on your system.
Usage: To see available images you can use to create containers.

```
C:\Users\Admin>docker images
REPOSITORY    TAG      IMAGE ID       CREATED       SIZE
rupesh2       latest   660b386e06a2   6 days ago    117MB
rupesh        latest   61e48edead3d   6 days ago    117MB
ubuntu        latest   72297848456d   8 weeks ago   117MB
hello-world   latest   7e1a4e2d11e2   2 months ago  20.4kB
```

docker pull ubuntu

Downloads the **Ubuntu** image from Docker Hub to your local system.
Use case: To get a base image (like Ubuntu) for creating containers.

```
C:\Users\Admin>docker pull ubuntu
Using default tag: latest
latest: Pulling from library/ubuntu
Digest: sha256:72297848456d5d37d1262630108ab308d3e9ec7ed1c3286a32fe09856619a782
Status: Image is up to date for ubuntu:latest
docker.io/library/ubuntu:latest
```

docker ps

Lists only the containers that are currently running.
Use case: To check which containers are active at the moment.

```
C:\Users\Admin>docker ps
CONTAINER ID   IMAGE    COMMAND   CREATED   STATUS    PORTS    NAMES
```

docker ps -a

Lists all containers, including those that are stopped.
Use case: To see both running and exited containers.

```
C:\Users\Admin>docker ps -a
CONTAINER ID   IMAGE          COMMAND       CREATED      STATUS
    PORTS       NAMES
8b39ea7d9376   rupesh2        "/bin/bash"   6 days ago   Exited (0) 6 days ago           objective_mendel
79ad1c650484   rupesh         "/bin/bash"   6 days ago   Exited (255) 14 minutes ago     romantic_moore
9e9702b44f18   hello-world    "/hello"      6 days ago   Exited (0) 6 days ago           silly_bowman
2bdfc834ba84   hello-world    "/hello"      6 days ago   Exited (0) 6 days ago           adoring_turing
f00305599cb6   rupesh         "/bin/bash"   6 days ago   Exited (0) 6 days ago           charming_leakey
c46f4b271e0b   rupesh         "/bin/bash"   6 days ago   Exited (0) 6 days ago           sleepy_noether
7bfa9fd4ef63   ubuntu         "/bin/bash"   6 days ago   Exited (0) 6 days ago           elegant_golick
deb19fd7103a   ubuntu         "/bin/bash"   6 days ago   Exited (0) 6 days ago           elegant_beaver

C:\Users\Admin>
```

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```
C:\Users\Admin>docker images
REPOSITORY      TAG       IMAGE ID       CREATED        SIZE
rupesh2         latest    660b386e06a2   6 days ago     117MB
rupesh          latest    61e48edead3d   6 days ago     117MB
ubuntu          latest    72297848456d   8 weeks ago    117MB
hello-world     latest    7e1a4e2d11e2   2 months ago   20.4kB
```

docker run -it -d <imageId>

Runs a container from the specified image:

- -i: interactive mode
- -t: allocates a pseudo-TTY (terminal)
- -d: detached mode (runs in the background)
  Use case: To start a container in the background with terminal access.

```
C:\Users\Admin>docker run -it -d 660b386e06a2
0c7b6421f6616ef5b8fed4b8f67c9ceed7c7b1b9cb4cf7cc35a856dbf3acd153
```

docker start <container_id>

Starts a previously stopped container.
Use case: To resume a container without creating a new one.

```
C:\Users\Admin>docker start 79ad1c650484
79ad1c650484

C:\Users\Admin>docker exec -it 79ad1c650484 bash
root@79ad1c650484:/# ls
Rupesh  bin  boot  dev  etc  home  ironman  lib  lib64  media  mnt  opt  proc  root  run  sbin  srv  sys  tmp  usr  var
root@79ad1c650484:/# touch hello.txt
root@79ad1c650484:/# exit
exit

C:\Users\Admin>
```

docker diff <container_id>

Shows the changes made to the container's file system (added, modified, or deleted files).
Use case: To inspect what has changed inside a container.

```
C:\Users\Admin>docker diff 79ad1c650484
C /root
C /root/.bash_history
A /ironman
A /ironman/hello.txt
A /hello.txt

C:\Users\Admin>
```

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docker commit <container_id> <new_image_name>

Creates a new image from the current state of a container.
Use case: To save the modified container as a new image.

```
C:\Users\Admin>docker commit 79ad1c650484 patilraj/ubuntu
sha256:ad5ae028378d02f6da31e10ec3c984441b34080aa955552e3c175ff27db4138f

C:\Users\Admin>docker images
REPOSITORY         TAG       IMAGE ID       CREATED          SIZE
patilraj/ubuntu    latest    ad5ae028378d   16 seconds ago   117MB
rupesh2            latest    660b386e06a2   6 days ago       117MB
rupesh             latest    61e48edead3d   6 days ago       117MB
ubuntu             latest    72297848456d   8 weeks ago      117MB
hello-world        latest    7e1a4e2d11e2   2 months ago     20.4kB
```

docker restart <container_id>

Stops and then starts the container again.
Use case: To refresh the container or apply configuration changes.

```
C:\Users\Admin>docker restart 79ad1c650484
79ad1c650484

C:\Users\Admin>docker rename 79ad1c650484 patilraj
```

```
C:\Users\Admin>docker ps
CONTAINER ID   IMAGE          COMMAND       CREATED          STATUS          PORTS     NAMES
0c7b6421f661   660b386e06a2   "/bin/bash"   33 minutes ago   Up 33 minutes             bold_hypatia
79ad1c650484   rupesh         "/bin/bash"   6 days ago       Up 2 minutes              patilraj
```

docker rm <container_id>

Removes a stopped container.
Use case: To clean up containers you no longer need.

```
C:\Users\Admin>docker rm 2bdfc834ba84
2bdfc834ba84

C:\Users\Admin>docker rmi 7e1a4e2d11e2
```

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docker login

Logs into your Docker Hub account via the terminal.
Use case: Required before pushing images to your Docker Hub repository.

```
C:\Users\Admin>docker login
Authenticating with existing credentials...
Login Succeeded

C:\Users\Admin>docker logout
Removing login credentials for https://index.docker.io/v1/

C:\Users\Admin>
```

docker stop <container_id>

Stops a running container.
Use case: To safely terminate a container.

```
C:\Users\Admin>docker stop 79ad1c650484
79ad1c650484
```

docker kill <container_id>

Description:
This command **immediately stops** a running container by sending a **SIGKILL** signal to the main process inside the container.

Use case:
Use docker kill when you need to forcefully stop a container **right away**, especially if it's not responding to a normal docker stop (which uses a gentler SIGTERM signal).

```
C:\Users\Admin>docker start 79ad1c650484
79ad1c650484

C:\Users\Admin>docker kill 79ad1c650484
79ad1c650484
```
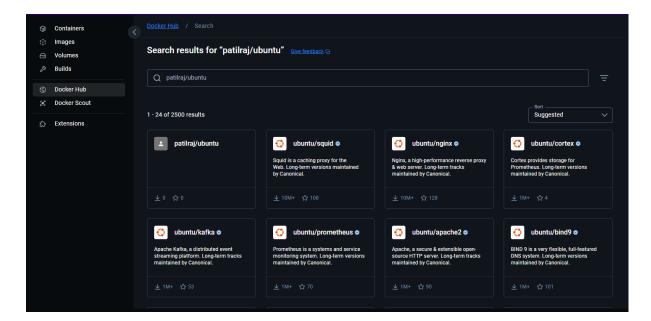
docker push <image_name>

Uploads a Docker image to Docker Hub.
Use case: To share your image with others or store it online for deployment.

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```
C:\Users\Admin>docker push patilraj/ubuntu
Using default tag: latest
The push refers to repository [docker.io/patilraj/ubuntu]
099f3b2a5c39: Pushed
5a7813e071bf: Mounted from library/ubuntu
6d4400bd5482: Pushed
latest: digest: sha256:ad5ae028378d02f6da31e10ec3c984441b34080aa955552e3c175ff27db4138f size: 960

C:\Users\Admin>
```
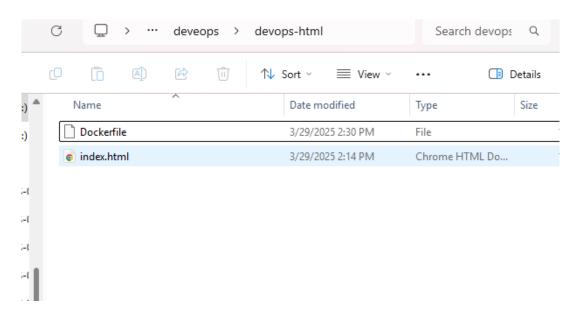
Image is uploaded on docker hub

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3. Develop a simple containerized application using Docker

Docker app

Index.html

<!DOCTYPE html>

<html>

<head>

<title>Page Title</title>

</head>

<body>

<h1>This is a Docker Html app </h1>

<p>This is a paragraph.</p>

</body>

</html>

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Dokerfile

FROM nginx:alpine

COPY . /usr/share/nginx/html

```
C:\ashish\deveops\devops-html>docker build -t my-docker-app .
[+] Building 19.2s (8/8) FINISHED                                        docker:desktop-linux
 => [internal] load build definition from Dockerfile                                    0.0s
 => => transferring dockerfile: 84B                                                     0.0s
 => [internal] load metadata for docker.io/library/nginx:alpine                        2.4s
 => [auth] library/nginx:pull token for registry-1.docker.io                           0.0s
 => [internal] load .dockerignore                                                       0.0s
 => => transferring context: 2B                                                         0.0s
 => [internal] load build context                                                       0.0s
 => => transferring context: 288B                                                       0.0s
 => [1/2] FROM docker.io/library/nginx:alpine@sha256:4ff102c5d78d254a6f0da062b3cf39eaf07f01eec0927fd21e219d0af8b  16.5s
 => => resolve docker.io/library/nginx:alpine@sha256:4ff102c5d78d254a6f0da062b3cf39eaf07f01eec0927fd21e219d0af8bc  0.0s
 => => sha256:0c7e4c092ab716c95e1a8840943549b4ac5e6c5d1a1cc74496528e1b03e1e67a 15.38MB / 15.38MB  16.1s
 => => sha256:6d79cc6084d434876ce0f038c675d20532f28e476283a29e7e63bc0bf13a4ed6 1.40kB / 1.40kB  1.0s
 => => sha256:ab3286a7346303a31b69a5189f63f1414cc1de44e397088dcd07edb322df1fe9 1.21kB / 1.21kB  1.1s
 => => sha256:8d27c072a58f81ecf2425172ac0e5b25010ff2d014f89de35b90104e462568eb 402B / 402B  1.4s
 => => sha256:43f2ec460bdf5babee56d7e13b060b308f42cbf2103f6665c349f0b98dac8962 627B / 627B  0.4s
 => => sha256:984583bcf083fa6900b5e7834795a9a57a9b4dfe7448d5350474f5d309625ece 955B / 955B  0.4s
 => => sha256:ccc35e35d420d6dd115290f1074afc6ad1c474b6f94897434e6befd33be781d2 1.79MB / 1.79MB  5.7s
 => => sha256:f18232174bc91741fdf3da96d85011092101a032a93a388b79e99e69c2d5c870 3.64MB / 3.64MB  6.8s
 => => extracting sha256:f18232174bc91741fdf3da96d85011092101a032a93a388b79e99e69c2d5c870  0.1s
 => => extracting sha256:ccc35e35d420d6dd115290f1074afc6ad1c474b6f94897434e6befd33be781d2  0.1s
 => => extracting sha256:43f2ec460bdf5babee56d7e13b060b308f42cbf2103f6665c349f0b98dac8962  0.0s
 => => extracting sha256:984583bcf083fa6900b5e7834795a9a57a9b4dfe7448d5350474f5d309625ece  0.0s
 => => extracting sha256:8d27c072a58f81ecf2425172ac0e5b25010ff2d014f89de35b90104e462568eb  0.0s
 => => extracting sha256:ab3286a7346303a31b69a5189f63f1414cc1de44e397088dcd07edb322df1fe9  0.0s
 => => extracting sha256:6d79cc6084d434876ce0f038c675d20532f28e476283a29e7e63bc0bf13a4ed6  0.0s
```

```
C:\ashish\deveops\devops-html>docker run -d -p 9090:80 my-docker-app
dbe86a12872665a13608ceee9a687750c332ac70f55a1287cbcc6ff2de10ed0f

C:\ashish\deveops\devops-html>
```
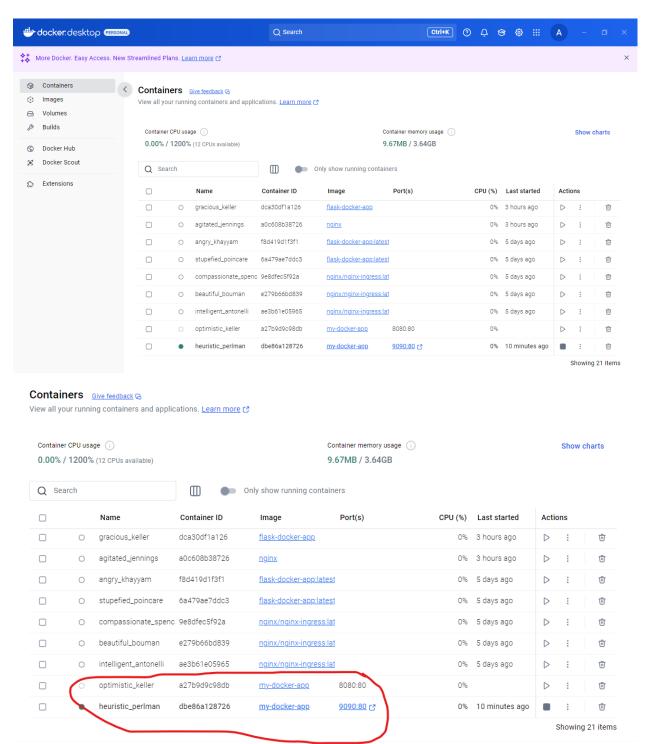
← → C ⓘ localhost:9090

This is a Docker Html app

This is a paragraph.

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Containers   Give feedback

View all your running containers and applications. Learn more

Container CPU usage   Container memory usage   Show charts
0.00% / 1200% (12 CPUs available)   9.67MB / 3.64GB

		Name	Container ID	Image	Port(s)	CPU (%)	Last started	Actions
☐	○	gracious_keller	dca30df1a126	flask-docker-app		0%	3 hours ago	▷ ⋮ 🗑
☐	○	agitated_jennings	a0c608b38726	nginx		0%	3 hours ago	▷ ⋮ 🗑
☐	○	angry_khayyam	f8d419d1f3f1	flask-docker-app:latest		0%	5 days ago	▷ ⋮ 🗑
☐	○	stupefied_poincare	6a479ae7ddc3	flask-docker-app:latest		0%	5 days ago	▷ ⋮ 🗑
☐	○	compassionate_spenc	9e8dfec5f92a	nginx/nginx-ingress:lat		0%	5 days ago	▷ ⋮ 🗑
☐	○	beautiful_bouman	e279b66bd839	nginx/nginx-ingress:lat		0%	5 days ago	▷ ⋮ 🗑
☐	○	intelligent_antonelli	ae3b61e05965	nginx/nginx-ingress:lat		0%	5 days ago	▷ ⋮ 🗑
☐	○	optimistic_keller	a27b9d9c98db	my-docker-app	8080:80	0%		▷ ⋮ 🗑
☐	●	heuristic_perlman	dbe86a128726	my-docker-app	9090:80	0%	10 minutes ago	■ ⋮ 🗑

Showing 21 items

4. Build, deploy and manage web/software application on Docker Engine.

python

```
PS C:\ashish\deveops\project-demo> mkdir my-pyhton-app1


    Directory: C:\ashish\deveops\project-demo


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----         3/29/2025   3:10 PM                my-pyhton-app1


PS C:\ashish\deveops\project-demo> cd my-pyhton-app1
PS C:\ashish\deveops\project-demo\my-pyhton-app1> notepad app.py
PS C:\ashish\deveops\project-demo\my-pyhton-app1> notepad Dockerfile
PS C:\ashish\deveops\project-demo\my-pyhton-app1> |
```

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app.py

  print("hello docker file")

Dockerfile

FROM python:3.10

Set the working directory inside the container

WORKDIR /app

Copy the application code to the container's /app directory

COPY app.py /app/

Run the Python application

CMD ["python", "app.py"]

```
C:\ashish\deveops\project-demo\my-pyhton-app1>docker build -t my-python-app .
[+] Building 312.1s (9/9) FINISHED                                          docker:desktop-linux
 => [internal] load build definition from Dockerfile                                        0.0s
 => => transferring dockerfile: 265B                                                        0.0s
 => [internal] load metadata for docker.io/library/python:3.10                              2.4s
 => [auth] library/python:pull token for registry-1.docker.io                               0.0s
 => [internal] load .dockerignore                                                           0.0s
 => => transferring context: 2B                                                             0.0s
 => [1/3] FROM docker.io/library/python:3.10@sha256:8ad0e578e1b733f2a496b41f179175679374191a9c7ab8c63156446094a  309.4s
 => => resolve docker.io/library/python:3.10@sha256:8ad0e578e1b733f2a496b41f179175679374191a9c7ab8c63156446094a9c  0.0s
 => => sha256:57161121b343e07415ad5fddf4d3b635176622126bab8ff18e653439c9619f29 21.38MB / 21.38MB  175.1s
 => => sha256:a90d73ac0e516c2cd69b099f3b5f957c2815844e088d741d737c95e7111d249c 249B / 249B         1.0s
 => => sha256:0c64566c7562a4e1405a59f7b95f25b2b74a9a630b8b4b5916d3829a81e90ab4 6.16MB / 6.16MB    10.0s
 => => sha256:353e14e5cc47664fba714a7da288001d90427c705494847ac773f5cc08199451 211.35MB / 211.35MB  305.6s
 => => sha256:255774e0027b72d2327719e78dbad5ad8c9cf446d055e45be7fc149418470bae 64.40MB / 64.40MB  193.8s
 => => sha256:091eb8249475f42de217265c501e0186f0a3ea7490ef7f51458c30db91fb3cac 24.01MB / 24.01MB   71.8s
 => => sha256:7cd785773db44407e20a679ce5439222e505475eed5b99f1910eb2cda51729ab 48.47MB / 48.47MB  106.5s
 => => extracting sha256:7cd785773db44407e20a679ce5439222e505475eed5b99f1910eb2cda51729ab           0.9s
 => => extracting sha256:091eb8249475f42de217265c501e0186f0a3ea7490ef7f51458c30db91fb3cac           0.3s
 => => extracting sha256:255774e0027b72d2327719e78dbad5ad8c9cf446d055e45be7fc149418470bae           1.1s
 => => extracting sha256:353e14e5cc47664fba714a7da288001d90427c705494847ac773f5cc08199451           3.1s
 => => extracting sha256:0c64566c7562a4e1405a59f7b95f25b2b74a9a630b8b4b5916d3829a81e90ab4           0.1s
 => => extracting sha256:57161121b343e07415ad5fddf4d3b635176622126bab8ff18e653439c9619f29           0.4s
 => => extracting sha256:a90d73ac0e516c2cd69b099f3b5f957c2815844e088d741d737c95e7111d249c           0.0s
 => [internal] load build context                                                           0.0s
 => => transferring context: 59B                                                            0.0s
 => [2/3] WORKDIR /app                                                                      0.1s
 => [3/3] COPY app.py /app/                                                                 0.0s
 => exporting to image                                                                      0.2s
 => => exporting layers                                                                     0.1s
 => => exporting manifest sha256:6f530407894931cf260eafb029bfe76fbec69c317cd6cbfc58613ca95cc91114   0.0s
 => => exporting config sha256:ffddac55a27a2c24b92464cad9562f789c2eef59b5bd835539c5dc07d627e068     0.0s
 => => exporting attestation manifest sha256:affb20988d9002e5995407f78aa743fcaabab29d3475a0df434cb7f221d4211b  0.0s
 => => exporting manifest list sha256:bc6504914ed2e1ab5527764d9ab0d428aa77d69f8efe14689883cafa69de5037  0.0s
 => => naming to docker.io/library/my-python-app:latest                                     0.0s
 => => unpacking to docker.io/library/my-python-app:latest                                  0.0s

View build details: docker-desktop://dashboard/build/desktop-linux/desktop-linux/g8esci1ozseg1gkas8b7zw2zx
```

```
View build details: docker-desktop://dashboard/build/desktop-linux/desktop-linux/g8esci1ozseg1gkas8b7zw2zx

C:\ashish\deveops\project-demo\my-pyhton-app1>docker run my-python-app
hello docker file

C:\ashish\deveops\project-demo\my-pyhton-app1>
```

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App.py

import time

while True:

  print("hello docker file")

  time.sleep(2)