BY LEARNSTACK

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Docker for Beginners Handbook

Containerize, Ship & Run Your Apps Anywhere

Containers | Dockerfile | Docker Compose | Volumes | Networking | DevOps | CI/CD

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About This Handbook

Docker for Beginners Handbook is a complete, beginner-friendly guide to containerizing real applications with Docker. It starts with your first container, then builds toward Dockerfiles, Docker Compose, image optimization, volumes, networking, CI/CD, and interview-ready troubleshooting.

- Covers Docker fundamentals from absolute beginner to production-minded workflows.
- Explains images, containers, registries, Dockerfiles, volumes, networks, Compose, and cleanup commands.
- Includes realistic terminal output, Dockerfile examples, Compose YAML, flag tables, tips, and caution boxes.
- Works as both a course and a lookup reference: read Chapters 1-7 first, then use Chapters 8 and 12 as command references.
- Designed for students, backend developers, DevOps/cloud aspirants, and interview candidates.

INFO
Learning path: Beginner -> Docker CLI user -> Dockerfile author -> Compose builder -> DevOps-ready practitioner.

TIP
Keep the cheat sheet pages near your desk. Docker confidence grows fastest when you repeatedly build, run, inspect, and fix containers yourself.

REAL WORLD
Real teams use Docker to reduce environment drift. When the app, runtime, libraries, and config are packaged together, onboarding becomes a repeatable command instead of a fragile setup document.

Table of Contents

How This Handbook Is Organized

The handbook is built as a progression. Chapters 1-4 help you understand why Docker matters and set up your machine. Chapters 5-7 teach the practical skills you will use every day. Chapters 8 and 12 are designed as dense references. Chapters 10 and 11 turn the knowledge into projects and interview answers.

Part	Best Use	What You Will Gain
Foundations	Read sequentially	Mental model of containers, images, registries, and Docker Engine
Hands-on skills	Practice at terminal	Build images, run containers, connect services, persist data
Reference chapters	Look up during work	Command syntax, flags, Dockerfile instructions, Compose keys
Projects and interviews	Revise before interviews	Debugging workflow and professional explanations

TIP
Do not memorize every command on day one. Learn the workflow: pull/build -> run -> inspect/logs -> exec/debug -> stop/remove -> repeat.

01 Introduction to Docker

1.1 What is Docker?

INFO
Docker is a platform for building, packaging, shipping, and running applications in containers. A container bundles an application with the files, libraries, runtime, and configuration it needs, so the app behaves consistently across machines.

Think of Docker like shipping containers at a port. A ship does not care whether a container holds shoes, phones, or books; every container has the same outside shape and handling rules. Docker gives software the same standardized packaging.

Concept	Beginner Analogy	Technical Meaning
Image	Recipe or class	Read-only package that contains app files, runtime, dependencies, and metadata
Container	Cooked dish or object instance	Running or stopped execution environment created from an image
Registry	App store / warehouse	Remote place where images are stored and shared
Docker Engine	Forklift + manager	Daemon that builds images and runs containers

REAL WORLD
Docker is used by teams to remove the classic sentence: "It works on my machine." The image becomes the contract between developer laptops, CI servers, staging, and production.

1.2 A Brief History

Docker began as technology inside dotCloud and was publicly launched in 2013. It popularized Linux containers by providing a developer-friendly workflow: write a Dockerfile, build an image, run a container, then push the image to a registry. The broader container world later standardized around the Open Container Initiative (OCI), which defines image and runtime specifications.

Year	Milestone	Why it matters
2013	Docker public launch	Containers became approachable for everyday developers
2015	OCI formed	Industry standardization for image/runtime behavior
2017+	Kubernetes mainstream	Containers became default packaging for cloud-native apps
Today	Compose, registries, scanners, CI/CD	Docker skills connect development, DevOps, and platform engineering

1.3 Why Docker Was Created

Before Docker, teams often wrote long setup documents: install Node version X, Python version Y, system library Z, database A, cache B, and environment variables C. One missed step could break the app. Docker turns that setup into repeatable files and commands.

```
terminal

$ docker run hello-world
Hello from Docker!
This message shows that your installation appears to be working correctly.
```

TIP
Docker does not replace understanding your application. It gives you a controlled, repeatable way to package and run it.

1.4 Current Ecosystem

Tool	What it does	Beginner takeaway
Docker Engine	Builds and runs containers	The core runtime on Linux servers
Docker Desktop	GUI + engine for Windows/macOS	Easiest local setup for beginners
Docker Hub	Public image registry	Where many official images live
Docker Compose	Runs multi-container apps from YAML	Use it for app + database + cache stacks
containerd	Container runtime component	Common runtime layer used in modern platforms

NUMBERS
Sources worth knowing: Docker Docs describe Compose as a way to manage services, networks, and volumes in a single YAML file; Docker Hub describes itself as a major container image registry; CNCF surveys track container and cloud-native adoption trends; Stack Overflow surveys track professional developer tool usage.

02 Why Learn Docker?

2.1 Key Advantages

- Consistency across machines: the same image runs on laptop, CI, staging, and production.
- Fast startup compared with full virtual machines because containers share the host kernel.
- Isolation between apps: dependencies for one app do not pollute another app.
- Portability: images can be pushed to registries and run on many hosts.
- Repeatability: infrastructure knowledge is encoded in Dockerfile and Compose files.

REAL WORLD
A new backend developer can clone a repo and run docker compose up instead of installing database servers, Redis, language runtimes, and system packages manually.

2.2 Job Market Demand

Docker is now a baseline skill in DevOps, SRE, cloud, platform, and backend roles. Recruiters rarely treat Docker as a separate specialty; they expect developers to understand images, containers, ports, volumes, logs, and Compose enough to debug local and CI environments.

INFO
Do not learn Docker as isolated commands. Learn the workflow employers care about: package an app, run it locally, connect it to a database, debug logs, shrink the image, and automate the build in CI/CD.

2.3 What You Can Build

Use case	Docker helps by	Typical command
Local dev environment	Starting app + database + cache in one step	docker compose up -d
Microservices	Running isolated services with separate dependencies	docker run --network appnet ...
CI testing	Testing against the same runtime every build	docker build && docker run
Demo apps	Shipping a reproducible demo to others	docker push / docker pull
Cloud deployment	Packaging apps as images for platforms	docker build -t registry/app:sha .

2.4 Docker vs Virtual Machines vs Podman

Feature	Docker Containers	Virtual Machines	Podman
Isolation	Process-level isolation	Full OS isolation	Container isolation similar to Docker
Startup speed	Seconds or less	Usually slower	Seconds or less
Image format	OCI images	VM disk images	OCI images
Best for	App packaging and dev/prod parity	Strong OS isolation	Rootless container workflows
Beginner ecosystem	Very large	Traditional infra	Growing
Compose support	Docker Compose first-class	Not applicable	Can use podman-compose / compatibility

TIP
Learn Docker first. Once the mental model is clear, Podman and Kubernetes become much easier to understand.

03 Career Paths

3.1 Roles That Use Docker

Docker is valuable because it sits at the boundary between application development and infrastructure. The same skill helps developers run dependencies, DevOps engineers build pipelines, and platform teams standardize deployments.

ROLE: DevOps Engineer What you will do: Build CI/CD pipelines, package apps, manage images, automate deployments. Avg salary: $95k-$145k/yr Docker skills: Dockerfiles, Compose, registries, image tagging, CI/CD	ROLE: Cloud Engineer What you will do: Run containerized apps on cloud platforms and managed services. Avg salary: $90k-$140k/yr Docker skills: Docker Engine, image registries, cloud container services
ROLE: SRE What you will do: Improve reliability, debugging, observability, and incident response. Avg salary: $110k-$170k/yr Docker skills: Logs, health checks, resource limits, networking, rollbacks	ROLE: Platform Engineer What you will do: Build internal developer platforms and golden paths. Avg salary: $115k-$180k/yr Docker skills: Base images, templates, security scanning, Kubernetes handoff
ROLE: Backend Developer What you will do: Containerize APIs and local service dependencies. Avg salary: $80k-$140k/yr Docker skills: Dockerfile, Compose, databases, environment variables	ROLE: Release Engineer What you will do: Version, tag, publish, and promote images across environments. Avg salary: $90k-$145k/yr Docker skills: Registries, semantic tags, immutable releases, SBOM/security
ROLE: Kubernetes Administrator What you will do: Operate clusters that run container images. Avg salary: $105k-$165k/yr Docker skills: Image basics, ports, volumes, registries, readiness concepts	ROLE: Containerization Consultant What you will do: Modernize legacy apps for container platforms. Avg salary: $100k-$170k/yr Docker skills: Migration strategy, image optimization, networking, volumes

TIP
Salary ranges vary heavily by country, company, and experience. Use the role cards as learning direction, not as a promise.

04 Setting Up the Environment

4.1 Installing Docker

Windows: Docker Desktop + WSL2

Install Docker Desktop from the official Docker site, enable the WSL2 backend, then verify from Windows Terminal or Ubuntu WSL.

terminal

```
$ docker --version
Docker version 27.x.x, build ...
```

terminal

```
$ docker compose version
Docker Compose version v2.x.x
```

macOS: Docker Desktop

Install the Apple Silicon or Intel build based on your Mac. Docker Desktop includes the Docker CLI and Compose plugin.

terminal

```
$ docker run hello-world
Hello from Docker!
This message shows that your installation appears to be working correctly.
```

Linux: Docker Engine

On Linux servers, install Docker Engine using your distribution package repository or Docker official repository. After install, start the service and verify.

terminal

```
$ sudo systemctl enable --now docker
Created symlink /etc/systemd/system/multi-user.target.wants/docker.service ->
  /lib/systemd/system/docker.service.
```

terminal

```
$ sudo docker run hello-world
Hello from Docker!
```

CAUTION
On Linux, permission denied errors often happen when your user is not in the docker group. Adding a user to the docker group grants root-equivalent power over the host, so do it only on trusted machines.

4.2 Recommended Tools

Tool	Best For	Platform	Free?
Docker Desktop	Beginner local setup and GUI	Windows/macOS/Linux	Free for many personal uses
Docker CLI	Professional daily workflow	All	Yes

Tool	Best For	Platform	Free?
Docker Compose	Multi-container local apps	All	Yes
Portainer	Web UI for managing Docker	All	Community edition available
Lazydocker	Terminal UI for containers/logs	All	Yes
VS Code Docker extension	Editing Dockerfiles and Compose files	All	Yes

4.3 Hello World Walkthrough

```terminal
$ docker run hello-world
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
Status: Downloaded newer image for hello-world:latest

Hello from Docker!
```

This command asked Docker Engine to run a container from the hello-world image. Docker did not find the image locally, so it pulled it from Docker Hub, created a container, ran the program, printed output, and exited.

4.4 Common Beginner Errors

CAUTION
Cannot connect to the Docker daemon: Docker Engine is not running, your CLI is pointing to the wrong context, or your user lacks permission.

CAUTION
Port already allocated: another process or container is already using the host port. Change the left side of -p, for example -p 8081:80.

CAUTION
Container exits immediately: the main process finished or crashed. Run docker ps -a and docker logs <container> first.

05 Core Concepts: Docker Fundamentals

INFO
Docker becomes easy when you understand five objects: images, containers, registries, volumes, and networks. Everything else is a workflow built on top of these.

5.1 Images vs Containers

Image	Container
Template/package: read-only layers	Runtime instance: writable layer on top
Built using Dockerfile or pulled from registry	Created using docker run or Compose
Can be tagged and pushed	Can be started, stopped, logged, inspected
Example: nginx:alpine	Example: web container running nginx

REAL WORLD
Class vs instance analogy: an image is like a class definition; a container is like an object created from that class. Multiple containers can run from the same image.

5.2 Docker Architecture

The Docker CLI sends commands to the Docker daemon. The daemon builds images, downloads from registries, creates networks, mounts volumes, and starts containers. The registry stores images.

architecture

```
Client CLI  -->  Docker Daemon / Engine  -->  Container runtime
     |                  |
     |                  +--> Images, containers, volumes, networks
     |
     +--> Registry: Docker Hub / private registry
```

5.3 Writing Your First Dockerfile

Dockerfile

```
FROM node:20-alpine
WORKDIR /app
COPY package*.json ./
RUN npm ci --only=production
COPY . .
EXPOSE 3000
CMD ["node", "server.js"]
```

Instruction	Purpose	Example
FROM	Base image	FROM node:20-alpine
WORKDIR	Set working directory	WORKDIR /app
COPY	Copy files into image	COPY . .
RUN	Execute build-time command	RUN npm ci
EXPOSE	Document container port	EXPOSE 3000
CMD	Default run command	CMD ["node","server.js"]

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