

AN OPENSOURCE EBOOK

# INTRODUCTION TO



docker<sup>®</sup>

---

Bobby Iliev

# Table of Contents

<b>About the book</b>	<b>4</b>
About the author	5
Sponsors	6
Ebook PDF Generation Tool	8
Book Cover	9
License	10
<b>Introduction to Docker</b>	<b>11</b>
What is a container?	13
What is a Docker image?	14
What is Docker Hub?	15
<b>Installing Docker</b>	<b>16</b>
<b>Working with Docker containers</b>	<b>19</b>
Pulling an image from Docker Hub	22
Stopping and restarting a Docker Container	25
Accessing a running container	26
Deleting a container	27
<b>What are Docker Images</b>	<b>28</b>
Working with Docker images	29
Modifying images ad-hoc	31
Pushing images to Docker Hub	33
Modifying images with Dockerfile	36
Docker images Knowledge Check	37

<b>What is a Dockerfile</b>	<b>38</b>
Dockerfile example	39
Docker build	42
Dockerfile Knowledge Check	44
 <b>Docker Network</b>	 <b>45</b>
Creating a Docker network	46
Inspecting a Docker network	47
Attaching containers to a network	48
 <b>What is Docker Swarm mode</b>	 <b>50</b>
Docker Services	51
Building a Swarm	52
 <b>Managing the cluster</b>	 <b>55</b>
Promote a worker to manager	57
Using Services	58
Scaling a service	60
Deleting a service	62
Docker Swarm Knowledge Check	63
 <b>Conclusion</b>	 <b>64</b>
Other eBooks	65

# About the book

- **This version was published on October 27 2021**

This is an open-source introduction to Docker guide that will help you learn the basics of Docker and how to start using containers for your SysOps, DevOps, and Dev projects. No matter if you are a DevOps/SysOps engineer, developer, or just a Linux enthusiast, you will most likely have to use Docker at some point in your career.

The guide is suitable for anyone working as a developer, system administrator, or a DevOps engineer and wants to learn the basics of Docker.

## About the author

My name is Bobby Iliev, and I have been working as a Linux DevOps Engineer since 2014. I am an avid Linux lover and supporter of the open-source movement philosophy. I am always doing that which I cannot do in order that I may learn how to do it, and I believe in sharing knowledge.

I think it's essential always to keep professional and surround yourself with good people, work hard, and be nice to everyone. You have to perform at a consistently higher level than others. That's the mark of a true professional.

For more information, please visit my blog at <https://bobbyiliev.com>, follow me on Twitter [@bobbyiliev\\_](#) and [YouTube](#).

## Sponsors

This book is made possible thanks to these fantastic companies!

### Materialize

The Streaming Database for Real-time Analytics.

Materialize is a reactive database that delivers incremental view updates. Materialize helps developers easily build with streaming data using standard SQL.

### DigitalOcean

DigitalOcean is a cloud services platform delivering the simplicity developers love and businesses trust to run production applications at scale.

It provides highly available, secure, and scalable compute, storage, and networking solutions that help developers build great software faster.

Founded in 2012 with offices in New York and Cambridge, MA, DigitalOcean offers transparent and affordable pricing, an elegant user interface, and one of the largest libraries of open source resources available.

For more information, please visit <https://www.digitalocean.com> or follow [@digitalocean](#) on Twitter.

If you are new to DigitalOcean, you can get a free \$100 credit and spin up your own servers via this referral link here:

[Free \\$100 Credit For DigitalOcean](#)

## **DevDojo**

The DevDojo is a resource to learn all things web development and web design. Learn on your lunch break or wake up and enjoy a cup of coffee with us to learn something new.

Join this developer community, and we can all learn together, build together, and grow together.

[Join DevDojo](#)

For more information, please visit <https://www.devdojo.com> or follow [@thedeveloper](#) on Twitter.

# Ebook PDF Generation Tool

This ebook was generated by [Ibis](#) developed by [Mohamed Said](#).

Ibis is a PHP tool that helps you write eBooks in markdown.



## Book Cover

The cover for this ebook was created with [Canva.com](https://www.canva.com).

If you ever need to create a graphic, poster, invitation, logo, presentation – or anything that looks good — give Canva a go.

# License

## MIT License

Copyright (c) 2020 Bobby Iliev

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

# Introduction to Docker

It is more likely than not that **Docker** and containers are going to be part of your IT career in one way or another.

After reading this eBook, you will have a good understanding of the following:

- What is Docker
- What are containers
- What are Docker Images
- What is Docker Hub
- How to installing Docker
- How to work with Docker containers
- How to work with Docker images
- What is a Dockerfile
- How to deploy a Dockerized app
- Docker networking
- What is Docker Swarm
- How to deploy and manage a Docker Swarm Cluster

I'll be using **DigitalOcean** for all of the demos, so I would strongly encourage you to create a **DigitalOcean** account follow along. You would learn more by doing!

To make things even better you can use my referral link to get a free \$100 credit that you could use to deploy your virtual machines and test the guide yourself on a few **DigitalOcean servers**:

**DigitalOcean \$100 Free Credit**

Once you have your account here's how to deploy your first

Droplet/server:

<https://www.digitalocean.com/docs/droplets/how-to/create/>

I'll be using **Ubuntu 21.04** so I would recommend that you stick to the same so you could follow along.

However you can run Docker on almost any operating system including Linux, Windows, Mac, BSD and etc.

## What is a container?

According to the official definition from the [docker.com](https://docker.com) website, a container is a standard unit of software that packages up code and all its dependencies so the application runs quickly and reliably from one computing environment to another. A Docker container image is a lightweight, standalone, executable package of software that includes everything needed to run an application: code, runtime, system tools, system libraries, and settings.

Container images become containers at runtime and in the case of Docker containers - images become containers when they run on Docker Engine. Available for both Linux and Windows-based applications, containerized software will always run the same, regardless of the infrastructure. Containers isolate software from its environment and ensure that it works uniformly despite differences for instance between development and staging.



## What is a Docker image?

A **Docker Image** is just a template used to build a running Docker Container, similar to the ISO files and Virtual Machines. The containers are essentially the running instance of an image. Images are used to share a containerized applications. Collections of images are stored in registries like [DockerHub](#) or private registries.



## What is Docker Hub?

DockerHub is the default **Docker image registry** where we can store our **Docker images**. You can think of it as GitHub for Git projects.

Here's a link to the Docker Hub:

<https://hub.docker.com>

You can sign up for a free account. That way you could push your Docker images from your local machine to DockerHub.

# Installing Docker

Nowadays you can run Docker on Windows, Mac and of course Linux. I will only be going through the Docker installation for Linux as this is my operating system of choice.

I'll deploy an **Ubuntu server on DigitalOcean** so feel free to go ahead and do the same:

[Create a Droplet DigitalOcean](#)

Once your server is up and running, SSH to the Droplet and follow along!

If you are not sure how to SSH, you can follow the steps here:

<https://www.digitalocean.com/docs/droplets/how-to/connect-with-ssh/>

The installation is really straight forward, you could just run the following command, it should work on all major **Linux** distros:

```
wget -qO- https://get.docker.com | sh
```

It would do everything that's needed to install **Docker on your Linux machine**.

After that, set up Docker so that you could run it as a non-root user with the following command:

```
sudo usermod -aG docker ${USER}
```



To test **Docker** run the following:

```
docker version
```

To get some more information about your Docker Engine, you can run the following command:

```
docker info
```

With the `docker info` command, we can see how many running containers that we've got and some server information.

The output that you would get from the `docker version` command should look something like this:

```
root@docker:~# docker version
Client:
 Version:           20.10.7
 API version:       1.41
 Go version:        go1.13.8
 Git commit:        20.10.7-0ubuntu1~21.04.2
 Built:             Fri Oct  1 03:50:45 2021
 OS/Arch:           linux/amd64
 Context:           default
 Experimental:      true

Server:
 Engine:
  Version:          20.10.7
  API version:      1.41 (minimum version 1.12)
  Go version:       go1.13.8
  Git commit:       20.10.7-0ubuntu1~21.04.2
  Built:            Fri Oct  1 02:50:01 2021
  OS/Arch:          linux/amd64
  Experimental:     false
 containerd:
  Version:          1.5.2-0ubuntu1~21.04.3
  GitCommit:
 runc:
  Version:          1.0.0~rc95-0ubuntu1~21.04.2
  GitCommit:
 docker-init:
  Version:          0.19.0
  GitCommit:
```

In case you would like to install Docker on your Windows PC or on your Mac, you could visit the official Docker documentation here:

<https://docs.docker.com/docker-for-windows/install/>

And:

<https://docs.docker.com/docker-for-mac/install/>

That is pretty much it! Now you have Docker running on your machine!

Now we are ready to start working with containers! We will pull a **Docker image** from the **DockerHub**, we will run a container, stop it, destroy it and more!

# Working with Docker containers

Once you have your **Ubuntu Droplet** ready, ssh to the server and follow along!

So let's run our first Docker container! To do that you just need to run the following command:

```
docker run hello-world
```

You will get the following output:

```
root@docker:~# docker run hello-world
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
1b930d010525: Pull complete
Digest: sha256:6540fc08ee6e6b7b63468dc3317e3303aae178cb8a45ed3123180328bcc1d20f
Status: Downloaded newer image for hello-world:latest

Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
1. The Docker client contacted the Docker daemon.
2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
   (amd64)
3. The Docker daemon created a new container from that image which runs the
   executable that produces the output you are currently reading.
4. The Docker daemon streamed that output to the Docker client, which sent it
   to your terminal.

To try something more ambitious, you can run an Ubuntu container with:
$ docker run -it ubuntu bash

Share images, automate workflows, and more with a free Docker ID:
https://hub.docker.com/

For more examples and ideas, visit:
https://docs.docker.com/get-started/

root@docker:~#
```

We just ran a container based on the **hello-world Docker Image**, as we did not have the image locally, docker pulled the image from the **DockerHub** and then used that image to run the container. All that happened was: the **container ran**, printed some text on the screen and then exited.

Then to see some information about the running and the stopped containers run:

```
docker ps -a
```

You will see the following information for your **hello-world container** that you just ran:

```
root@docker:~# docker ps -a
CONTAINER ID        IMAGE               COMMAND             PORTS
CREATED            STATUS
NAMES
62d360207d08       hello-world        "/hello"           5
minutes ago       Exited (0) 5 minutes ago
focused_cartwright
```

In order to list the locally available Docker images on your host run the following command:

```
docker images
```

## Pulling an image from Docker Hub

Let's run a more useful container like an **Apache** container for example.

First, we can pull the image from the docker hub with the **docker pull** command:

```
docker pull webdevops/php-apache
```

You will see the following output:

```
root@docker:~#  
[root@docker:~# docker pull webdevops/php-apache  
Using default tag: latest  
latest: Pulling from webdevops/php-apache  
35c102085707: Pull complete  
251f5509d51d: Pull complete  
8e829fe70a46: Pull complete  
6001e1789921: Pull complete  
258b5eb418c1: Pull complete  
631fa9e6fae0: Extracting [=====>] 360.4kB/2.613MB  
4b66173e7add: Download complete  
f83bf8c8025c: Download complete  
8a189afa963d: Download complete  
820adb2a2e9: Downloading [=====>] 76.83MB/81.82MB  
a6ed74e58632: Download complete  
797a96241110: Download complete  
953414d456f2: Download complete  
7d4e5514ff1b: Download complete  
█
```

Then we can get the image ID with the docker images command:

```
docker images
```

The output would look like this:

```
root@docker:~#  
root@docker:~# docker images  
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE  
webdevops/php-apache latest             fd4f7e58ef4b       8 hours ago        531MB  
hello-world          latest             fce289e99eb9       7 months ago       1.84kB  
root@docker:~#
```

Note, you do not necessarily need to pull the image, this is just for demo purposes. When running the **docker run** command, if the image is not available locally, it will automatically be pulled from Docker Hub.

After that we can use the **docker run** command to spin up a new container:

```
docker run -d -p 80:80 IMAGE_ID
```

Quick rundown of the arguments that I've used:

- **-d**: it specifies that I want to run the container in the background. That way when you close your terminal the container would remain running.
- **-p 80:80**: this means that the traffic from the host on port 80 would be forwarded to the container. That way you could access the Apache instance which is running inside your docker container directly via your browser.

With the **docker info** command now we can see that we have 1 running container.

And with the **docker ps** command we could see some useful information about the container like the container ID, when the container was started and etc.:

```
root@docker:~# docker ps
CONTAINER ID        IMAGE               COMMAND
CREATED            STATUS             PORTS
NAMES
7dd1d512b50e       fd4f7e58ef4b      "/entrypoint supervi..."
About a minute ago Up About a minute  443/tcp,
0.0.0.0:80->80/tcp, 9000/tcp  pedantic_murdock
```



## Stopping and restarting a Docker Container

Then you can stop the running container with the `docker stop` command followed by the container ID:

```
docker stop CONTAINER_ID
```

If you need to you can start the container again:

```
docker start CONTAINER_ID
```

In order to restart the container you can use the following:

```
docker restart CONTAINER_ID
```

## Accessing a running container

If you need to attach to the container and run some commands inside the container use the `docker exec` command:

```
docker exec -it CONTAINER_ID /bin/bash
```

That way you will get to a **bash shell** in the container and execute some commands inside the container itself.

Then to detach from the interactive shell press **CTRL+PQ** that way you will not stop the container but just detached from the interactive shell.

```
root@docker:~#
root@docker:~# docker exec -it 7dd1d512b50e /bin/bash
root@7dd1d512b50e:/# cat /etc/os-release
NAME="Ubuntu"
VERSION="18.04.3 LTS (Bionic Beaver)"
ID=ubuntu
ID_LIKE=debian
PRETTY_NAME="Ubuntu 18.04.3 LTS"
VERSION_ID="18.04"
HOME_URL="https://www.ubuntu.com/"
SUPPORT_URL="https://help.ubuntu.com/"
BUG_REPORT_URL="https://bugs.launchpad.net/ubuntu/"
PRIVACY_POLICY_URL="https://www.ubuntu.com/legal/terms-and-policies/privacy-policy"
VERSION_CODENAME=bionic
UBUNTU_CODENAME=bionic
root@7dd1d512b50e:/# read escape sequence
root@docker:~# docker stop 7dd1d512b50e
7dd1d512b50e
root@docker:~#
```

## Deleting a container

To delete the container run first make sure that the container is not running and then run:

```
docker rm CONTAINER_ID
```

If you would like to delete the container and the image all together, just run:

```
docker rmi IMAGE_ID
```

With that you now know how to pull Docker images from the **Docker Hub**, run, stop, start and even attach to Docker containers!

We are ready to learn how to work with **Docker images**!

# What are Docker Images

A Docker Image is just a template used to build a running Docker Container, similar to the ISO files and Virtual Machines. The containers are essentially the running instance of an image. Images are used to share a containerized applications. Collections of images are stored in registries like DockerHub or private registries.

## Working with Docker images

The `docker run` command downloads and runs images at the same time. But we could also only download images if we wanted to with the `docker pull` command. For example:

```
docker pull ubuntu
```

Or if you want to get a specific version you could also do that with:

```
docker pull ubuntu:14.04
```

Then to list all of your images use the `docker images` command:

```
docker images
```

You would get a similar output to:

```
root@docker:~# docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
webdevops/php-apache latest             fd4f7e58ef4b       8 hours ago        531MB
ubuntu               latest             a2a15febcd3        2 days ago         64.2MB
ubuntu               14.04             2c5e00d77a67       3 months ago       188MB
hello-world          latest             fce289e99eb9       7 months ago       1.84kB
root@docker:~#
```

The images are stored locally on your docker host machine.

To take a look at the docker hub, go to: <https://hub.docker.com> and you would be able to see where the images were just downloaded from.

For example, here's a link to the **Ubuntu image** that we've just downloaded:

[https://hub.docker.com/\\_/ubuntu](https://hub.docker.com/_/ubuntu)

There you could find some useful information.

As Ubuntu 14.04 is really outdated, to delete the image use the **docker rmi** command:

```
docker rmi ubuntu:14.04
```

This is a sample from "Introduction to Docker" by Bobby Iliev.

For more information, [Click here](#).