Docker Tutorial: Get Going From Scratch

By: Eric | June 29, 2021

Docker is a platform for packaging, deploying, and running applications. Docker applications run in containers that can be used on any system: a developer's laptop, systems on premises, or in the cloud.

Containerization is a technology that's been around for a long time, but it's seen new life with Docker. It packages applications as images that contain everything needed to run them: code, runtime environment, libraries, and configuration. Images run in containers, which are discrete processes that take up only as many resources as any other executable.

It's important to note that Docker containers don't run in their own virtual machines, but share a Linux kernel. Compared to virtual machines, containers use less memory and less CPU.

However, a Linux runtime is required for Docker. Implementations on non-Linux platforms such as macOS and Windows 10 use a single Linux virtual machine. The containers share this system.

Containerization has enjoyed widespread adoption because of its

Get Started with Docker

We'll start by installing the Docker desktop tools found here. Download the correct installer for your operating system and run the installation.

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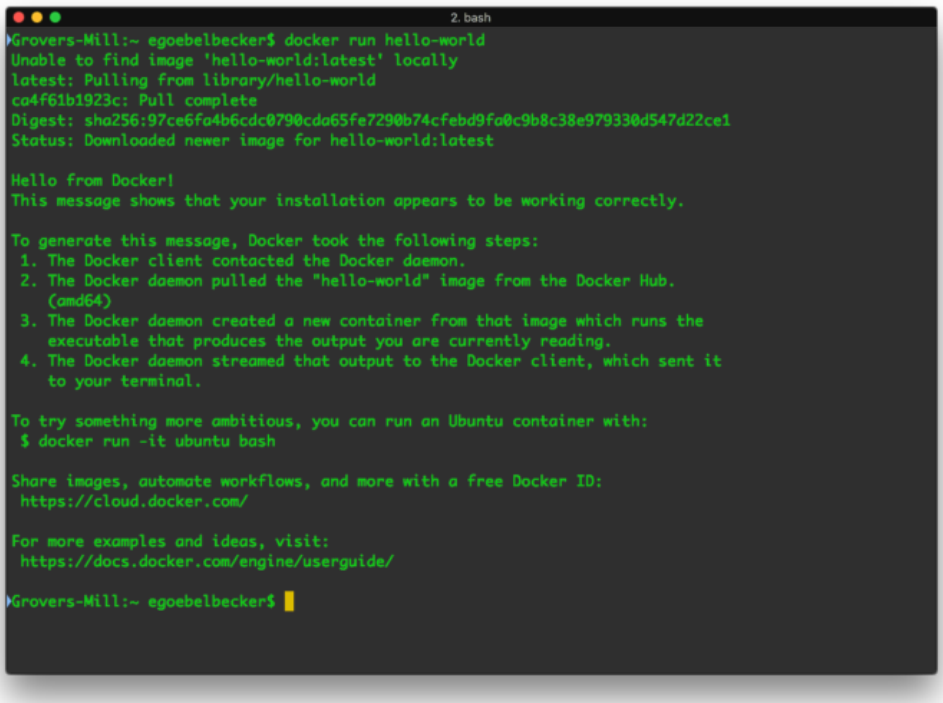
Running a container

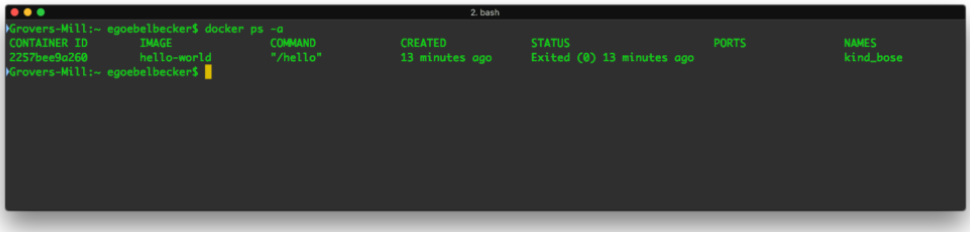
Once we install the tools, we can run a Docker image:



docker run hello-world does exactly what it sounds like. It runs an image named "hello-world."

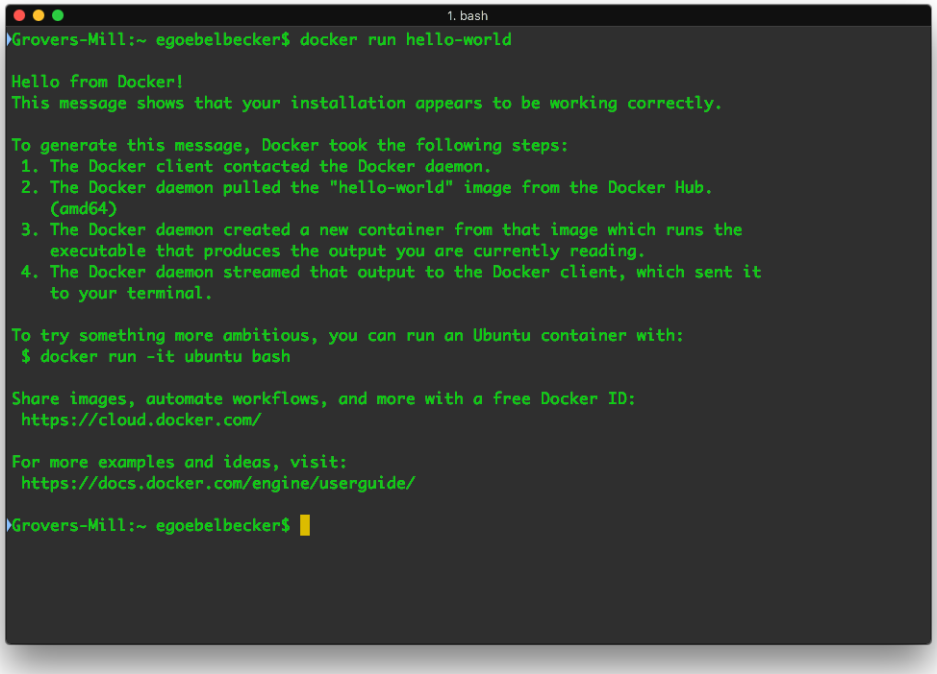
Docker looks for this image on our local system. When it can't find the image, Docker downloads it from Docker Hub for us.

docker ps -a lists the containers on our system:



From this, we can see that the hello-world container is still in memory. The **status** column tells us that it's exited. The **names** column has a name, **kind_bose**, that Docker assigned to the container for us. We'll cover container names below.

Let's run this image again with **docker run hello-world.** The output is almost the same…



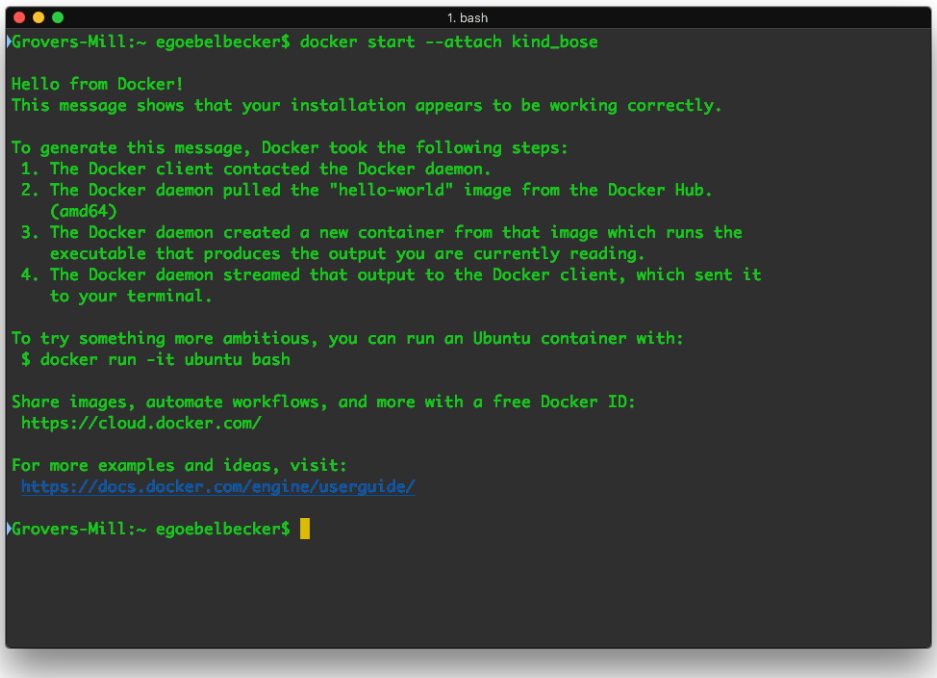
…except this time we don't see information about downloading the image. It was already available on our system.

But what does **docker ps -a** show us now?

names. Docker created an additional container. It didn't reuse the first. When we told Docker to run an image named hello-world, it did exactly that; it ran a new instance of the image. If we want to reuse a container, we refer to it by name.

Reuse a container

Let's try starting one of the stopped containers:



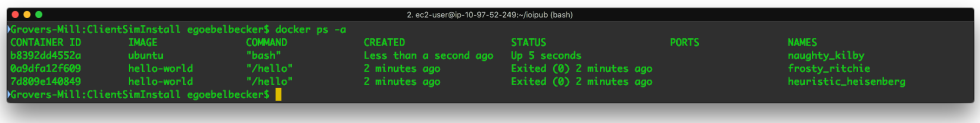
This time, we used **docker start –attach <container name>** instead of **docker run**. We use the **start** command, and rather than naming the image, we specify the name of a container that's already loaded. The **–attach** tells Docker to connect to the container output so we can see the results.

We stop containers with **docker stop <container name>** and remove them with **docker rm <container name>**. We'll take a look at that below when we work with applications designed to keep running in the background.

If we check **docker ps** again, we still see two containers.

With a single Docker command, **docker run -it ubuntu bash,** we downloaded an Ubuntu Linux image and started a login shell as root inside it. The **-it** flags allow us to interact with the shell.

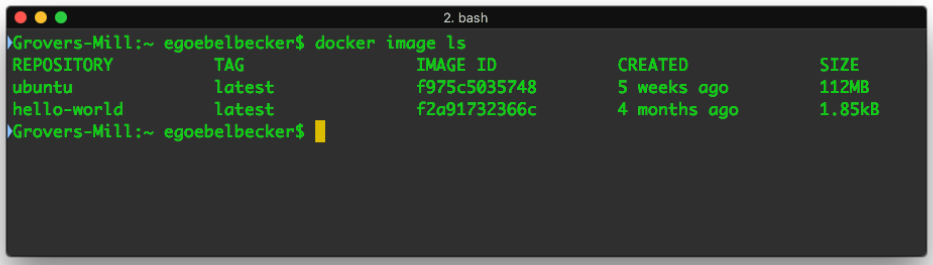
When we open another window and list containers, we see a different picture:



The Ubuntu container's status is **Up**. Let's see what's going on inside:

docker top looks inside the container and shows us the running processes. The Ubuntu container is running a single process—the root shell.

Let's look at one last Docker command before we create a container of our own:



Docker image ls produces a listing of images on our system. We see Ubuntu and the single hello-world image since we only needed that single image to run two containers.

Share system resources with a container

So far, we've run a couple of self-contained images. What happens when we want to share local resources from our host system with a container? Docker has the ability to share both the file system and the networking stack with containers.

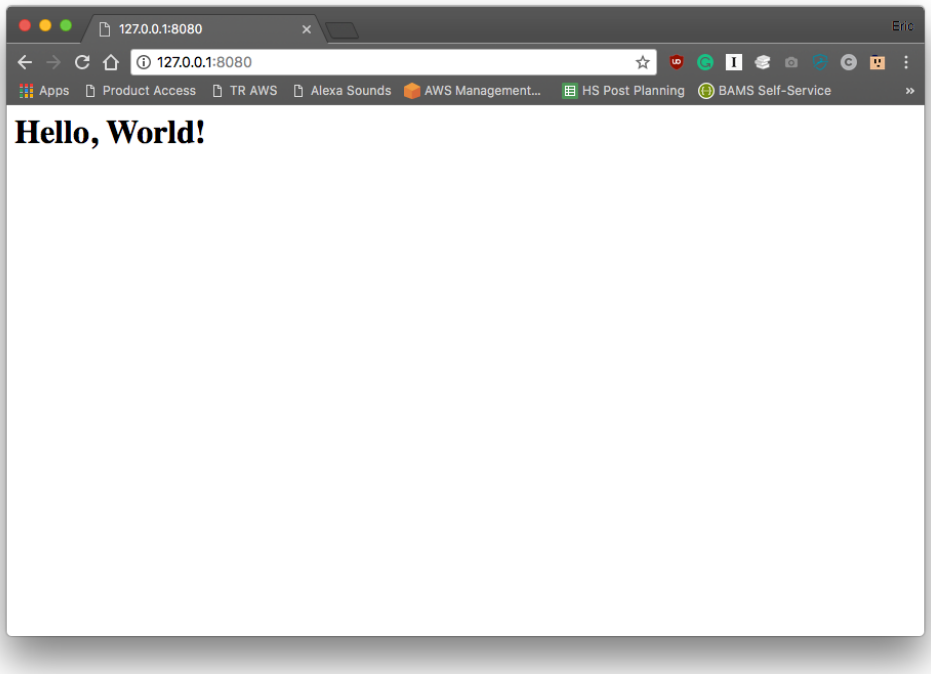
Let's create a web server that serves a web page from the local filesystem. We'll use a public **Nginx** image.

First, we need an HTML file to display when we connect to the web server. Start in an empty directory that we'll call **my-nginx** and create a single subdirectory named **html**. Inside **html**, create **index.html**:

Hello, World!

- **-v /full/path/to/html/directory:/usr/share/nginx/html:ro** maps the directory holding our web page to the required location in the image. The **ro** field instructs Docker to mount it in read-only mode. It's best to pass Docker the full paths when specifying host directories.
- **-p 8080:80** maps network service port 80 in the container to 8080 on our host system.
- **-d** detaches the container from our command line session. Unlike our previous two examples, we don't want to interact with this container.
- **nginx** is the name of the image.

After executing this command, we should be able to reach the web server on port 8080:



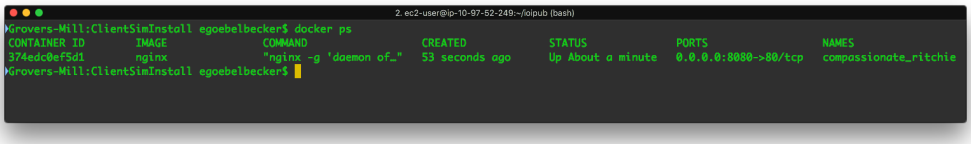
We see our test page! You can also access the page from our devices on your network using your host system's IP address.

Containers don't automatically have access to the host network. With our port mapping directive, the container can be accessed via the host network. Since we only mapped this port, no other network resources are available to the container.

This exercise illustrates one of Docker's key advantages: easy reuse of existing resources. We were able to create a web server in minutes with virtually no configuration.

Stop and remove a container

Our web server is still running:



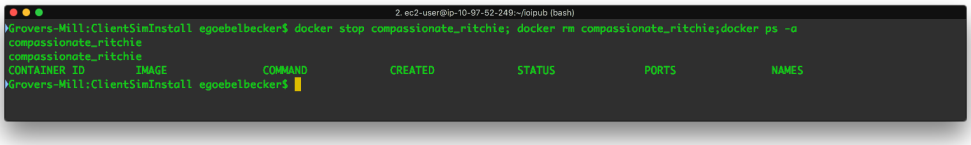
We can stop it with **docker stop**…

```
$ docker stop compassionate_ritchie
```

…and remove the container with **docker rm.**

```
$ docker rm compassionate_ritchie
```

After running these two commands, the container is gone:



Create a Docker image

Now let's build on this example to create an image of our own. We'll package the Nginx image with our **html** file.

Images are created with a Dockerfile, which lists the components and commands that make up an image.

and establishes the base image. Subsequent instructions are executed on the base image.

2. The second instruction, **COPY,** tells Docker to copy our file tree into the base image, overriding the contents of **/usr/share/nginx/html** in the base image.

Next, build the image:

```
$ docker build -t mynginx .

Sending build context to Docker daemon 3.584kB
Step 1/2 : FROM nginx
---> b175e7467d66
Step 2/2 : COPY html /usr/share/nginx/html
---> Using cache
---> a8b02c2e09a4
Successfully built a8b02c2e09a4
Successfully tagged mynginx:latest
```

We passed two arguments to **build**:

- **-t mynginx** gave Docker a tag for the image. Since we only supplied a name, we can see that Docker tagged this build as the latest in the last line of the build output. We'll look more closely at tagging below.
- The final argument, **dot (**or "."), told Docker to look for the Dockerfile in the current working directory.

The build output shows Docker using the **nginx** image and copying the contents of **html** into the new image.

When we list images, we can see **mynginx:**

Run a custom image

Next, we run our new image:

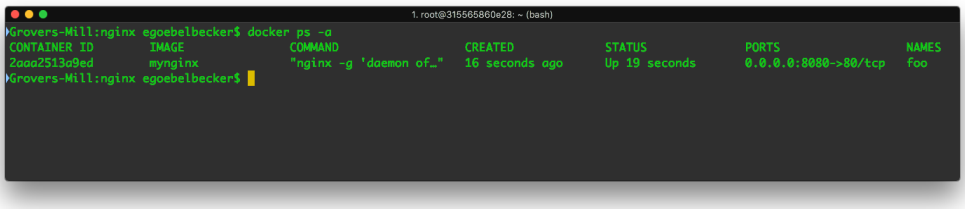
```
$ docker run --name foo -d -p 8080:80 mynginx
```

Let's break that command down.

- **–name foo** gives the container a name, rather than one of the randomly assigned names we've seen so far.
- **-d** detaches from the container, running it in the background, as we did in our previous run of Nginx.
- **-p 8080:80** maps network ports, as we did with the first example.
- Finally, the image name is always last.

Now point your browser at **http://127.0.0.1:8080** and you can see the test web page again.

While the web server is still running, let's take a look at **docker ps**:



We can see that the **ports** column has the mapping we used to start the container, and **names** displays the container name we used.

We've created a self-contained web server that could easily contain a complete set of web documents instead of only one. It can be deployed on any platform that supports Docker.

Create a more customized image

Each Docker image executes a command when it's run. In our Nginx Dockerfile, we didn't define one, so Docker used the command specified in the base image.

```
from flask import Flask
import os
import socket

app = Flask(__name__)
@app.route("/")

def hello():
    html = "<h3>Hello {name}!</h3> <b>Hostname:</b> {hostname}<br/>
    return html.format(name=os.getenv("NAME", "world"), hostname=so

if __name__ == "__main__":
    app.run(host='0.0.0.0', port=4000)
```

This script creates a web server listening on port 4000 and serves a small HTML document with a greeting and the container's hostname.

Next, we'll create a **Dockerfile**:

```
# Use an official Python runtime as a parent image
FROM python:2.7-slim
WORKDIR /app
ADD . /app
RUN pip install --trusted-host pypi.python.org Flask
ENV NAME World
CMD ["python", "app.py"]
```

This Dockerfile starts with an image that contains a Python runtime. We can see from the name that it provides version 2.7 in a slim configuration that contains a minimal number of Python packages.

Next, it establishes a **WORKDIR** (working directory) named **/app** and **ADD**s the current working directory to it.

After adding the script to the image, we need to install the **Flask** Python package, the library we use for the web server. The **RUN** instruction executes **pip install** for this. Dockerfiles can run commands as part of the image build process.

Let's build this image:

```
$ docker build -t mypyweb .

Sending build context to Docker daemon 4.096kB
Step 1/6 : FROM python:2.7-slim
---> b16fde09c92c
Step 2/6 : WORKDIR /app
---> Using cache
---> e8cfc6466e29
Step 3/6 : ADD . /app
---> Using cache
---> b0ed613be2d4
Step 4/6 : RUN pip install --trusted-host pypi.python.org Flask
---> Using cache
---> 255f51709816
Step 5/6 : ENV NAME World
---> Using cache
---> d79d78336885
Step 6/6 : CMD ["python", "app.py"]
---> Using cache
---> 687bc506dd46
Successfully built 687bc506dd46
Successfully tagged mypyweb:latest
```

Run our Python image

```
$ docker run --name webapp -p 8080:4000 mypyweb
```

Let's navigate to 8080 again with a browser:

We see our new web page. We've created another portable web server with just a few lines of Python!

Pass environment variables

Our Dockerfile set an environment variable…

```
ENV NAME World
```

…which the Python script uses in this greeting:

```
html = "
```

Hello {name}!

Hostname: {hostname}
"

We can override this variable from the command line:

```
$ docker run --name webapp -p 8080:4000 -e NAME="Dude" mypyweb
```

Then look at the web page again:

We can upload our own images to Docker Hub for distribution, too.

The first step is to create an account on Docker Cloud. If you don't already have an account, go and create one.

Next, we'll log in to the Docker registry:

```
$ docker login
Username: ericgoebelbecker
Password:
Login Succeeded
```

Before uploading **mypyweb** to Docker Hub, you should tag it. The format for Docker tags is **username/repository:tag**. Tags and repository names are effectively freeform.

```
$ docker tag mypyweb ericgoebelbecker/stackify-tutorial:1.00
```

If we list our images now, we see this tag:

```
REPOSITORY                              TAG         IMAGE ID       CREA
ericgoebelbecker/stackify-tutorial      1.00        0057736e26ce   Less
mypyweb                                 latest      0057736e26ce   Less
mynginx                                 latest      a8b02c2e09a4   41 h
nginx   .                               latest      b175e7467d66   4 da
python                                  2.7-slim    b16fde09c92c   3 we
```

Note that our image tag and **mypyweb** have the same image ID and size. Tags don't create new copies of images. They're pointers.

Now we can push the image to Docker Hub:

```
$ docker push ericgoebelbecker/stackify-tutorial:1.00

The push refers to repository [docker.io/ericgoebelbecker/stackify-
7d7bb0289fd8: Pushed
acfa7c4abdbb: Pushed
8d2f81f035b3: Pushed
d99e7ab4a34b: Mounted from library/python
332873801f89: Mounted from library/python
2ec65408eff0: Mounted from library/python
```

now repository, the image, and the tag.

If you look closely, you'll notice a size discrepancy. This is because the image on Docker Hub only contains the changes from the Python:2.7-slim image it's based on.

We can pull the Docker image down and run it **from any system**:

```
$ docker run -p 8080:4000 --name webapp -e NAME="Docker Hub" ericgo

Unable to find image 'ericgoebelbecker/stackify-tutorial:1.00' loca
1.00: Pulling from ericgoebelbecker/stackify-tutorial
b0568b191983: Pull complete
55a7da9473ae: Pull complete
422d2e7f1272: Pull complete
8fb86f1cff1c: Pull complete
```

built. Similar to the way we ran hello-world, we passed the image tag to **docker run.** And since the image was not available locally, Docker pulled it from Docker Hub and Python:2.7-slim, assembled the image and ran it.

We published the image, and it's now publicly available from Docker Hub.

Conclusion

Docker is a powerful platform for building, managing and running containerized applications. In this Docker tutorial, we installed the tools, downloaded and ran an off-the-shelf image and then built images of our own. We published an image to Docker Hub and demonstrated how it can be downloaded and run on any Docker-enabled host.

Now that you understand the basics, keep experimenting and see how you can use Docker to package and distribute your applications.

However, you don't have to go it alone. All superheroes need a sidekick, and developers are no exception. **Stackify by Netreo** works hard to make sure developers get all the help they need. We have developed tools such as Prefix, which helps you write better code by profiling and testing as you write it. If you need quality control for the big-picture moments, use Retrace to help you proactively and continuously improve and observe applications in production environments.

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