

Implement container management with Kubernetes/Docker

1.0 Running your first container

It's time to get your hands dirty! As with all things technical, a "hello world" app is good place to start. Type or click the code below to run your first Docker container:

```
docker container run hello-world
```

That's it: your first container. The *hello-world* container output tells you a bit about what just happened. Essentially, the Docker engine running in your terminal tried to find an **image** named *hello-world*. Since you just got started there are no images stored locally (*Unable to find image...*) so Docker engine goes to its default **Docker registry**, which is **Docker Hub**, to look for an image named "hello-world". It finds the image there, pulls it down, and then runs it in a container. And *hello-world*'s only function is to output the text you see in your terminal, after which the container exits.

Hello World: What Happened?

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```
#####
# WARNING!!!!
#
# This is a sandbox environment. Using personal credentials
# is HIGHLY! discouraged. Any consequences of doing so are
# completely the user's responsibilities.
#
# The PWD team.
#####
[node1] (local) root@192.168.0.13 ~
$ uname -a
Linux node1 4.4.0-210-generic #242-Ubuntu SMP Fri Apr 16 09:57:56 UTC 2021 x86_64
Linux
[node1] (local) root@192.168.0.13 ~
$ docker container run hello-world
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
c1ec31eb5944: Pull complete
Digest: sha256:d000bc569937abbe195e20322a0bde6b2922d805332fd6d8a68b19f524b7d21d
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.
```

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1.1 Docker Images

In this rest of this lab, you are going to run an **Alpine Linux** container. Alpine is a lightweight Linux distribution so it is quick to pull down and run, making it a popular starting point for many other images.

To get started, let's run the following in our terminal:

```
docker image pull alpine
```

The **pull** command fetches the **alpine image** from the **Docker registry** and saves it in our system. In this case the registry is **Docker Hub**. You can change the registry, but that's a different lab.

You can use the **docker image** command to see a list of all images on your system.

```
docker image ls
```

REPOSITORY	TAG	IMAGE ID	CREATED	VIRTUAL SIZE
alpine	latest	c51f86c28340	4 weeks ago	1.109 MB
hello-world	latest	690ed74de00f	5 months ago	960 B

1.1 Docker Container Run

Great! Let's now run a Docker **container** based on this image. To do that you are going to use the **docker container run** command.

```
docker container run alpine ls -l
```

```
total 48
drwxr-xr-x  2 root root    4096 Mar  2 16:20 bin
```

About

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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/>

```
[node1] (local) root@192.168.0.13 ~
$ docker image pull alpine
Using default tag: latest
latest: Pulling from library/alpine
4abcf2066143: Pull complete
Digest: sha256:c5b1261d6d3e43071626931fc004f70149baeba2c8ec672bd4f27761f8e1ad6b
Status: Downloaded newer image for alpine:latest
docker.io/library/alpine:latest
[node1] (local) root@192.168.0.13 ~
$ docker image ls
REPOSITORY TAG IMAGE ID CREATED SIZE
alpine latest 05455a08801e 6 weeks ago 7.38MB
hello-world latest d2c94e258dcb 10 months ago 13.3kB
[node1] (local) root@192.168.0.13 ~
$ docker container run alpine ls -l
total 8
drwxr-xr-x  2 root root    4096 Jan 26 17:53 bin
drwxr-xr-x  5 root root    340 Mar  9 07:58 dev
drwxr-xr-x  1 root root    66 Mar  9 07:58 etc
drwxr-xr-x  2 root root    6 Jan 26 17:53 home
```

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1.2 Container Isolation

In the steps above we ran several commands via container instances with the help of `docker container run`. The `docker container ls -a` command showed us that there were several containers listed. Why are there so many containers listed if they are all from the `alpine` image?

This is a critical security concept in the world of Docker containers! Even though each `docker container run` command used the same `alpine` *image*, each execution was a separate, isolated *container*. Each container has a separate filesystem and runs in a different namespace; by default a container has no way of interacting with other containers, even those from the same image. Let's try another exercise to learn more about isolation.

```
docker container run -it alpine /bin/ash
```

The `/bin/ash` is another type of shell available in the alpine image. Once the container launches and you are at the container's command prompt type the following commands:

```
echo "hello world" > hello.txt
ls
```

The first `echo` command creates a file called "hello.txt" with the words "hello world" inside it. The second command gives you a directory listing of the files and should show your newly created "hello.txt" file. Now type `exit` to leave this container.

To show how isolation works, run the following:

```
docker container run alpine ls
```

It is the same `ls` command we used inside the container's interactive ash shell, but this time, did you notice that your "hello.txt" file is missing? That's isolation! Your command ran in a new and separate *instance*, even though it is based on the same *image*. The 2nd instance has no way of interacting with the 1st instance because the Docker

If the commandline doesn't appear in the terminal, make sure popups are enabled or try resizing the browser window.

```
[node1] (local) root@192.168.0.13 ~
$ docker container run -it alpine /bin/ash
/ # echo "hello world" > hello.txt
/ # ls
bin          hello.txt    media        proc          sbin          tmp
dev          home         mnt          root          srv           usr
etc          lib          opt          run           sys          var

/ # docker container run alpine ls
/bin/ash: docker: not found
/ # exit
[node1] (local) root@192.168.0.13 ~
$ docker container run alpine ls
bin
dev
etc
home
lib
media
mnt
opt
proc
root
run
sbin
srv
sys
```

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users take their changes and move them up to production using this basic concept and the built-in capabilities of Docker Enterprise. We will explore more of that in later exercises.

Right now, the obvious question is "how do I get back to the container that has my 'hello.txt' file?"

Once again run the

```
docker container ls -a
```

command again and you should see output similar to the following:

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS
36171a5da744	alpine	"ls"	2 minutes ago	Exited (0) 2 minutes ago
3038c9c91e12	alpine	"/bin/ash"	5 minutes ago	Exited (0) 2 minutes ago
a6a9d46d0b2f	alpine	"echo 'hello from alp"	6 minutes ago	Exited (0) 6 minutes ago
ff0a5c3750b9	alpine	"ls -l"	8 minutes ago	Exited (0) 8 minutes ago
c317d0a9e3d2	hello-world	"/hello"	34 seconds ago	Exited (0) 12 minutes ago
		stupefied_mcclintock		

Graphically this is what happened on our Docker Engine:

Docker Container Isolation

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```
sbinsrvsystmpusrvar
$ docker container ls -a
CONTAINER ID    IMAGE    COMMAND    CREATED    STATUS
426b2bf7b936    alpine    "ls"       23 seconds ago    Exited (0) 23 seconds ago
82a6be230238    alpine    "/bin/ash" 2 minutes ago    Exited (127) 27 seconds ago
40ee14a7f5de    alpine    "/bin/sh"  3 minutes ago    Exited (0) 3 minutes ago
objective_chandra...
a5c378d89613    alpine    "/bin/sh"  3 minutes ago    Exited (0) 3 minutes ago
c306319ac60d    alpine    "echo 'hello from al..." 4 minutes ago    Exited (0) 4 minutes ago
e2ed6094a74b    alpine    "ls -l"    5 minutes ago    Exited (0) 5 minutes ago
02ce49bc7fe5    hello-world  "/hello"   7 minutes ago    Exited (0) 7 minutes ago
heuristic_kepler
[node1] (local) root@192.168.0.13 ~
$
```

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The container in which we created the "hello.txt" file is the same one where we used the `/bin/ash` shell, which we can see listed in the "COMMAND" column. The *Container ID* number from the first column uniquely identifies that particular container instance. In the sample output above the container ID is `3030c9c91e12`. We can use a slightly different command to tell Docker to run this specific container instance. Try typing:

```
docker container start <container ID>
```

- Pro tip:** Instead of using the full container ID you can use just the first few characters, as long as they are enough to uniquely ID a container. So we could simply use "3030" to identify the container instance in the example above, since no other containers in this list start with these characters.

Now use the `docker container ls` command again to list the running containers.

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS
3030c9c91e12	alpine	"/bin/ash"	2 minutes ago	Up 14 second
s		distracted_bhaskara		

Notice this time that our container instance is still running. We used the ash shell this time so the rather than simply exiting the way `/bin/sh` did earlier, ash waits for a command. We can send a command in to the container to run by using the `exec` command, as follows:

```
docker container exec <container ID> ls
```

This time we get a directory listing and it shows our "hello.txt" file because we used the container instance where we created that file.

If the commandline doesn't appear in the terminal, make sure popups are enabled or try resizing the browser window.

```
(node1) (local) root@192.168.0.13 ~
$ docker container start <82a6be230238>
bash: syntax error near unexpected token `newline'
(node1) (local) root@192.168.0.13 ~
$ docker container start 82a6be230238
82a6be230238
(node1) (local) root@192.168.0.13 ~
$ docker container ls
CONTAINER ID   IMAGE     COMMAND                  CREATED         STATUS         PORTS          NA
MES
82a6be230238   alpine    "/bin/ash"              8 minutes ago   Up 9 seconds   vi
gorous_antomelli
(node1) (local) root@192.168.0.13 ~
$ docker container exec 82a6be230238 ls
bin
dev
etc
hello.txt
home
lib
media
mnt
opt
proc
root
run
```

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create larger, more complex images in a simple, automated manner.

1.3 Terminology

In the last section, you saw a lot of Docker-specific jargon which might be confusing to some. So before you go further, let's clarify some terminology that is used frequently in the Docker ecosystem.

- Images** - The file system and configuration of our application which are used to create containers. To find out more about a Docker image, run `docker image inspect alpine`. In the demo above, you used the `docker image pull` command to download the `alpine` image. When you executed the command `docker container run hello-world`, it also did a `docker image pull` behind the scenes to download the `hello-world` image.
- Containers** - Running instances of Docker images — containers run the actual applications. A container includes an application and all of its dependencies. It shares the kernel with other containers, and runs as an isolated process in user space on the host OS. You created a container using `docker run` which you did using the alpine image that you downloaded. A list of running containers can be seen using the `docker container ls` command.
- Docker daemon** - The background service running on the host that manages building, running and distributing Docker containers.
- Docker client** - The command line tool that allows the user to interact with the Docker daemon.
- Docker Hub** - Store is, among other things, a [registry](#) of Docker images. You can think of the registry as a directory of all available Docker images. You'll be using this later in this tutorial.

If the commandline doesn't appear in the terminal, make sure popups are enabled or try resizing the browser window.

```
(node1) (local) root@192.168.0.13 ~
$ docker image inspect alpine
[
  {
    "Id": "sha256:05455a08881ea9cf0e752bc48e61bbd71a34c029bb13df01e40e3e70e0d007bd",
    "RepoTags": [
      "alpine:latest"
    ],
    "RepoDigests": [
      "alpine@sha256:c5b1261d6d3e43071626931fc004f70149baeba2c8ec672bd4f27761f8e1ad6b"
    ],
    "Parent": "",
    "Comment": "",
    "Created": "2024-01-27T00:30:48.743965523Z",
    "Container": "4189cbc534955765760c227f328ec1cdd52e8550681c2bf9f8f990b27b644f9c",
    "ContainerConfig": {
      "Hostname": "4189cbc53495",
      "Domainname": "",
      "User": "",
      "AttachStdin": false,
      "AttachStdout": false,
      "AttachStderr": false,
      "Tty": false,
```

Where do images get pulled from by default when not found locally?

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Where do images get pulled from by default when not found locally?

If the commandline doesn't appear in the terminal, make sure popups are enabled or try resizing the browser window.

```
(node1) (local) root@192.168.0.13 ~
$ docker image pull
"docker image pull" requires exactly 1 argument.
See 'docker image pull --help'.

Usage:  docker image pull [OPTIONS] NAME[:TAG|@DIGEST]

Download an image from a registry
(node1) (local) root@192.168.0.13 ~
$ docker container run hello-world

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
```

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Where do images get pulled from by default when not found locally?

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```
(node1) (local) root@192.168.0.13 ~
$ docker image pull
"docker image pull" requires exactly 1 argument.
See 'docker image pull --help'.

Usage:  docker image pull [OPTIONS] NAME[:TAG|@DIGEST]

Download an image from a registry
(node1) (local) root@192.168.0.13 ~
$ docker run
"docker run" requires at least 1 argument.
See 'docker run --help'.

Usage:  docker run [OPTIONS] IMAGE [COMMAND] [ARG...]

Create and run a new container from an image
(node1) (local) root@192.168.0.13 ~
$ docker container ls
CONTAINER ID   IMAGE     COMMAND                  CREATED         STATUS         PORTS          NAMES
82a6be230238   alpine    "/bin/ash"              14 minutes ago Up 6 minutes   v
igorous_antone
(node1) (local) root@192.168.0.13 ~
$
```

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