Get started with Docker Compose

Estimated reading time: 10 minutes

On this page you build a simple Python web application running on Docker Compose. The application uses the Flask framework and maintains a hit counter in Redis. While the sample uses Python, the concepts demonstrated here should be understandable even if you're not familiar with it.

Prerequisites

Make sure you have already installed both Docker Engine (https://docs.docker.com/install/) and Docker Compose (https://docs.docker.com/compose/install/). You don't need to install Python or Redis, as both are provided by Docker images.

Step 1: Setup

Define the application dependencies.

1. Create a directory for the project:

   ```
   $ mkdir composetest
   $ cd composetest
   ```

2. Create a file called `app.py` in your project directory and paste this in:

```
import time

import redis
from flask import Flask


app = Flask(__name__)
cache = redis.Redis(host='redis', port=6379)


def get_hit_count():
    retries = 5
    while True:
        try:
            return cache.incr('hits')
        except redis.exceptions.ConnectionError as exc:
            if retries == 0:
                raise exc
            retries -= 1
            time.sleep(0.5)


@app.route('/')
def hello():
    count = get_hit_count()
    return 'Hello World! I have been seen {} times.\n'.format(count)

if __name__ == "__main__":
    app.run(host="0.0.0.0", debug=True)
```

In this example, `redis` is the hostname of the redis container on the application's network. We use the default port for Redis, `6379` .

Handling transient errors

Note the way the `get_hit_count` function is written. This basic retry loop lets us attempt our request multiple times if the redis service is not available. This is useful at startup while the application comes online, but also makes our application more resilient if the Redis service needs to be restarted anytime during the app's lifetime. In a cluster, this also helps handling momentary connection drops between nodes.

3. Create another file called `requirements.txt` in your project directory and paste this in:

```
flask
redis
```

Step 2: Create a Dockerfile

In this step, you write a Dockerfile that builds a Docker image. The image contains all the dependencies the Python application requires, including Python itself.

In your project directory, create a file named `Dockerfile` and paste the following:

```
FROM python:3.4-alpine
ADD . /code
WORKDIR /code
RUN pip install -r requirements.txt
CMD ["python", "app.py"]
```

This tells Docker to:

- Build an image starting with the Python 3.4 image.
- Add the current directory `.` into the path `/code` in the image.
- Set the working directory to `/code` .
- Install the Python dependencies.
- Set the default command for the container to `python app.py` .

For more information on how to write Dockerfiles, see the Docker user guide (https://docs.docker.com/engine/tutorials/dockerimages/#building-an-image-from-a-dockerfile) and the Dockerfile reference (https://docs.docker.com/engine/reference/builder/).

Step 3: Define services in a Compose file

Create a file called `docker-compose.yml` in your project directory and paste the following:

```
version: '3'
services:
  web:
    build: .
    ports:
     - "5000:5000"
  redis:
    image: "redis:alpine"
```

This Compose file defines two services, `web` and `redis` . The `web` service:

- Uses an image that's built from the `Dockerfile` in the current directory.
- Forwards the exposed port 5000 on the container to port 5000 on the host machine. We use the default port for the Flask web server, `5000` .

The `redis` service uses a public Redis (https://registry.hub.docker.com/_/redis/) image pulled from the Docker Hub registry.

Step 4: Build and run your app with Compose

1. From your project directory, start up your application by running `docker-compose up` .

```
$ docker-compose up
Creating network "composetest_default" with the default driver
Creating composetest_web_1 ...
Creating composetest_redis_1 ...
Creating composetest_web_1
Creating composetest_redis_1 ... done
Attaching to composetest_web_1, composetest_redis_1
web_1    |  * Running on http://0.0.0.0:5000/ (Press CTRL+C to quit)
redis_1  | 1:C 17 Aug 22:11:10.480 # oO0OoO0OoO0Oo Redis is starting oO0OoO
redis_1  | 1:C 17 Aug 22:11:10.480 # Redis version=4.0.1, bits=64, commit=00
redis_1  | 1:C 17 Aug 22:11:10.480 # Warning: no config file specified, usin
web_1    |  * Restarting with stat
redis_1  | 1:M 17 Aug 22:11:10.483 * Running mode=standalone, port=6379.
redis_1  | 1:M 17 Aug 22:11:10.483 # WARNING: The TCP backlog setting of 511
web_1    |  * Debugger is active!
redis_1  | 1:M 17 Aug 22:11:10.483 # Server initialized
redis_1  | 1:M 17 Aug 22:11:10.483 # WARNING you have Transparent Huge Pages
web_1    |  * Debugger PIN: 330-787-903
redis_1  | 1:M 17 Aug 22:11:10.483 * Ready to accept connections
```

   Compose pulls a Redis image, builds an image for your code, and starts the services you defined. In this case, the code is statically copied into the image at build time.

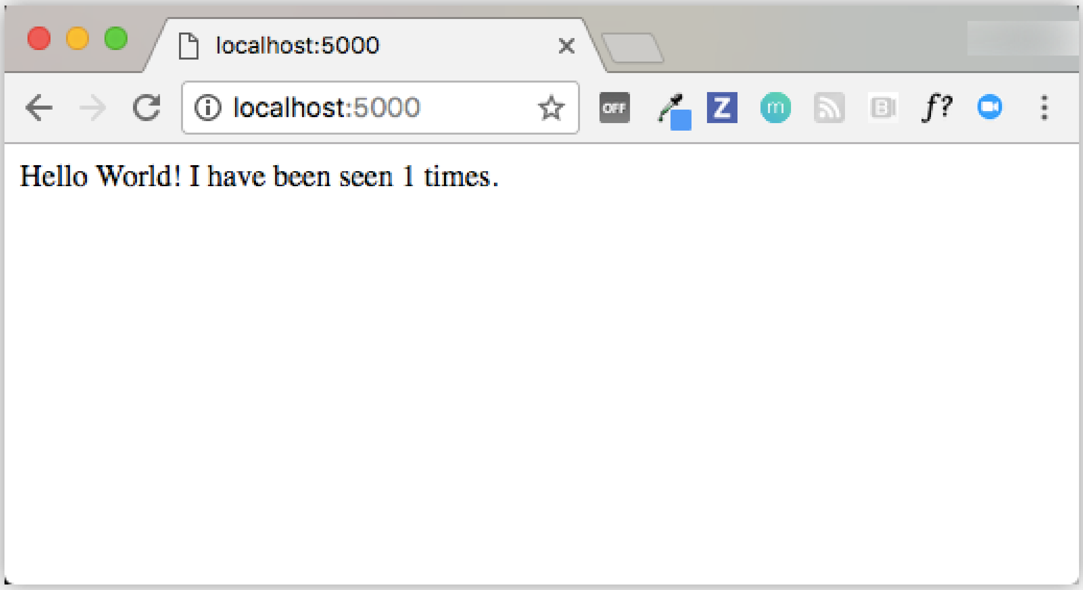
2. Enter `http://0.0.0.0:5000/` in a browser to see the application running.

   If you're using Docker natively on Linux, Docker Desktop for Mac, or Docker Desktop for Windows, then the web app should now be listening on port 5000 on your Docker daemon host. Point your web browser to `http://localhost:5000` to find the `Hello World` message. If this doesn't resolve, you can also try `http://0.0.0.0:5000` .

   If you're using Docker Machine on a Mac or Windows, use `docker-machine ip MACHINE_VM` to get the IP address of your Docker host. Then, open `http://MACHINE_VM_IP:5000` in a browser.

   You should see a message in your browser saying:

```
Hello World! I have been seen 1 times.
```

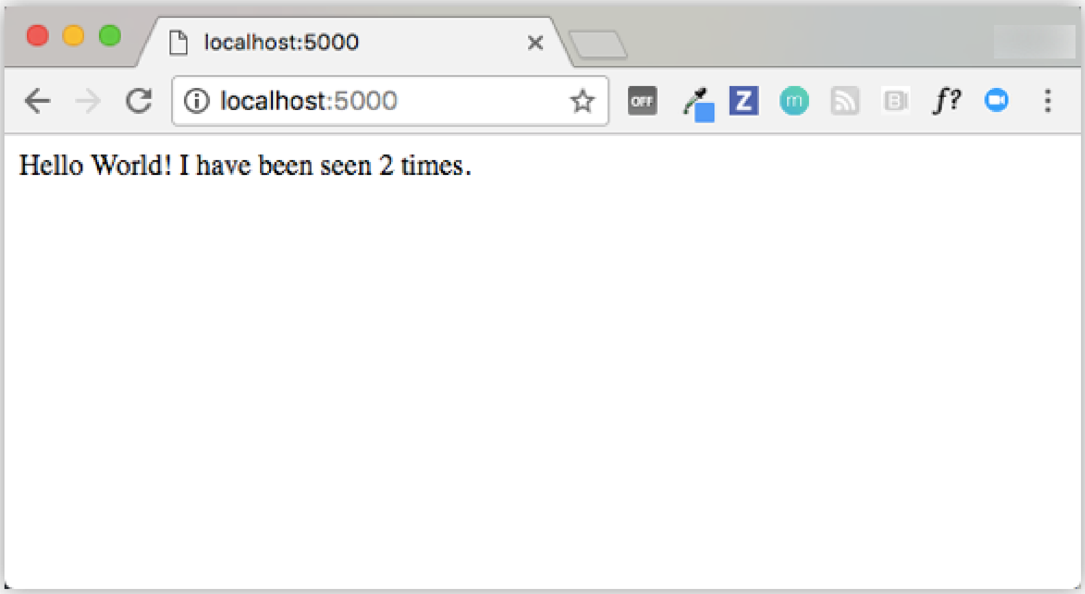


Hello World! I have been seen 1 times.

3. Refresh the page.

   The number should increment.

   ```
   Hello World! I have been seen 2 times.
   ```



Hello World! I have been seen 2 times.

4. Switch to another terminal window, and type `docker image ls` to list local images.

   Listing images at this point should return `redis` and `web` .

```
$ docker image ls
REPOSITORY          TAG                 IMAGE ID            CREATED
composetest_web     latest              e2c21aa48cc1        4 minutes ag
python              3.4-alpine          84e6077c7ab6        7 days ago
redis               alpine              9d8fa9aa0e5b        3 weeks ago
```

You can inspect images with `docker inspect <tag or id>` .

5. Stop the application, either by running `docker-compose down` from within your project directory in the second terminal, or by hitting CTRL+C in the original terminal where you started the app.

Step 5: Edit the Compose file to add a bind mount

Edit `docker-compose.yml` in your project directory to add a bind mount (https://docs.docker.com/engine/admin/volumes/bind-mounts/) for the `web` service:

```
version: '3'
services:
  web:
    build: .
    ports:
     - "5000:5000"
    volumes:
     - .:/code
  redis:
    image: "redis:alpine"
```

The new `volumes` key mounts the project directory (current directory) on the host to `/code` inside the container, allowing you to modify the code on the fly, without having to rebuild the image.

Step 6: Re-build and run the app with Compose

From your project directory, type `docker-compose up` to build the app with the updated Compose file, and run it.

```
$ docker-compose up
Creating network "composetest_default" with the default driver
Creating composetest_web_1 ...
Creating composetest_redis_1 ...
Creating composetest_web_1
Creating composetest_redis_1 ... done
Attaching to composetest_web_1, composetest_redis_1
web_1    |  * Running on http://0.0.0.0:5000/ (Press CTRL+C to quit)
...
```

Check the `Hello World` message in a web browser again, and refresh to see the count increment.

Shared folders, volumes, and bind mounts

- If your project is outside of the `Users` directory (`cd ~`), then you need to share the drive or location of the Dockerfile and volume you are using. If you get runtime errors indicating an application file is not found, a volume mount is denied, or a service cannot start, try enabling file or drive sharing. Volume mounting requires shared drives for projects that live outside of `C:\Users` (Windows) or `/Users` (Mac), and is required for *any* project on Docker Desktop for Windows that uses Linux containers (https://docs.docker.com/docker-for-windows/#switch-between-windows-and-linux-containers-beta-feature). For more information, see Shared Drives (https://docs.docker.com/docker-for-windows/#shared-drives) on Docker Desktop for Windows, File sharing (https://docs.docker.com/docker-for-mac/#file-sharing) on Docker for Mac, and the general examples on how to Manage data in containers (https://docs.docker.com/engine/tutorials/dockervolumes/).
- If you are using Oracle VirtualBox on an older Windows OS, you might encounter an issue with shared folders as described in this VB trouble ticket (https://www.virtualbox.org/ticket/14920). Newer Windows systems meet the requirements for Docker Desktop for Windows (https://docs.docker.com/docker-for-windows/install/) and do not need VirtualBox.

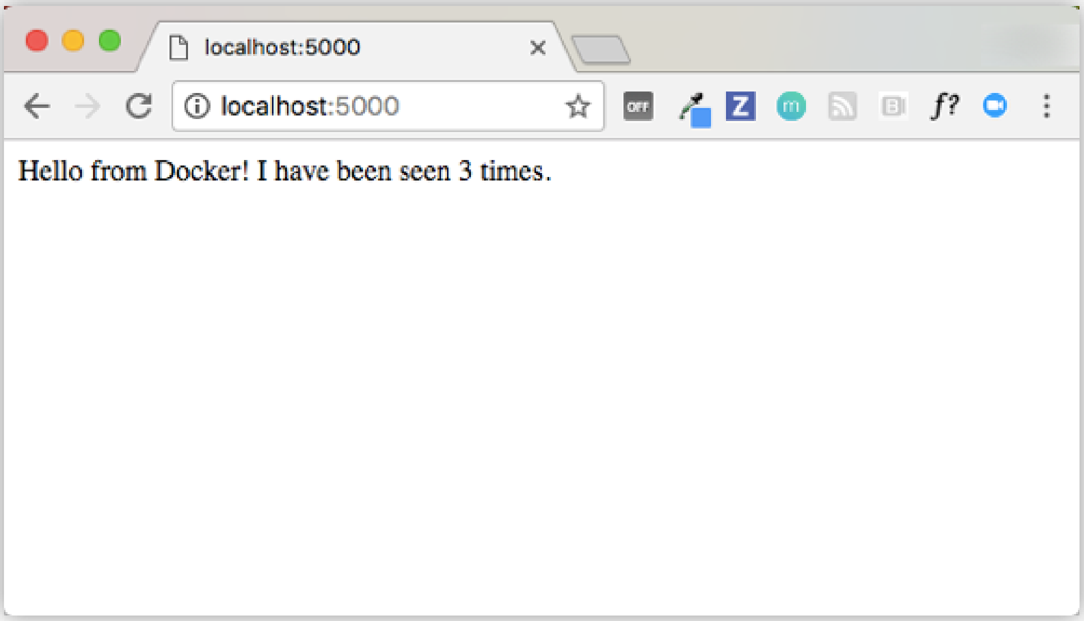
Step 7: Update the application

Because the application code is now mounted into the container using a volume, you can make changes to its code and see the changes instantly, without having to rebuild the image.

1. Change the greeting in `app.py` and save it. For example, change the `Hello World!` message to `Hello from Docker!` :

```
return 'Hello from Docker! I have been seen {} times.\n'.format(count)
```

2. Refresh the app in your browser. The greeting should be updated, and the counter should still be incrementing.



Hello from Docker! I have been seen 3 times.

Step 8: Experiment with some other commands

If you want to run your services in the background, you can pass the `-d` flag (for "detached" mode) to `docker-compose up` and use `docker-compose ps` to see what is currently running:

```
$ docker-compose up -d
Starting composetest_redis_1...
Starting composetest_web_1...

$ docker-compose ps
Name                 Command            State       Ports
-------------------------------------------------------------------
composetest_redis_1   /usr/local/bin/run         Up
composetest_web_1     /bin/sh -c python app.py   Up      5000->5000/tcp
```

The `docker-compose run` command allows you to run one-off commands for your services. For example, to see what environment variables are available to the `web` service:

```
$ docker-compose run web env
```

See `docker-compose --help` to see other available commands. You can also install command completion (https://docs.docker.com/compose/completion/) for the bash and zsh shell, which also shows you available commands.

If you started Compose with `docker-compose up -d`, stop your services once you've finished with them:

```
$ docker-compose stop
```

You can bring everything down, removing the containers entirely, with the `down` command. Pass `--volumes` to also remove the data volume used by the Redis container:

```
$ docker-compose down --volumes
```

At this point, you have seen the basics of how Compose works.

Where to go next

- Next, try the quick start guide for Django (https://docs.docker.com/compose/django/), Rails (https://docs.docker.com/compose/rails/), or WordPress (https://docs.docker.com/samples/library/wordpress/)
- Explore the full list of Compose commands (https://docs.docker.com/compose/reference/)
- Compose configuration file reference (https://docs.docker.com/compose/compose-file/)
- To learn more about volumes and bind mounts, see Manage data in Docker (https://docs.docker.com/engine/admin/volumes/)

documentation (https://docs.docker.com/glossary/?term=documentation), docs (https://docs.docker.com/glossary/?term=docs), docker (https://docs.docker.com/glossary/?term=docker), compose (https://docs.docker.com/glossary/?term=compose), orchestration (https://docs.docker.com/glossary/?term=orchestration), containers (https://docs.docker.com/glossary/?term=containers)