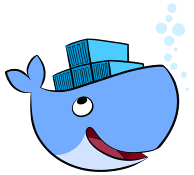
Docker for Python Developers

Fitter. Happier. More productive.



Presented by *Michael Herman* at dockercon 2018 SF

Note

These practices, from this presentation, can be used for any language. Examples are in Python, though - designed specifically for web developers and data scientists.

Agenda

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(1) Intro

1. About Me
2. Objectives
3. Why Docker?

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1. About Me
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3. Why Docker?

(2) Best Practices

1. Keep images slim with Alpine
2. Use multi-stage builds
3. Order Dockerfile commands
4. Minimize the number of layers
5. Version Docker images
6. Create a non-root user
7. Do not store secrets in an image

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Intro

About Michael

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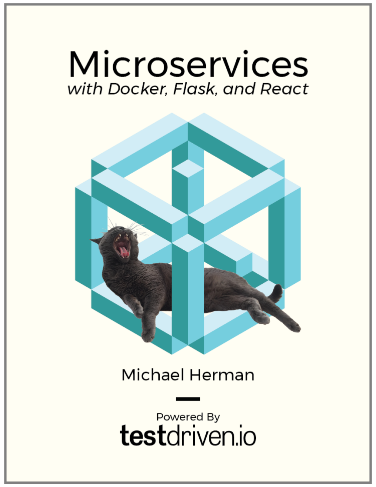
Also:

1. Co-founder/author of Real Python
2. 😍 - tech writing/education, open source, financial models, radiohead

TestDriven.io

Started Testdriven.io late 2017...



Microservices with Docker, Flask, and React

Learn how to build, test, and deploy microservices powered by Docker, Flask, and React!

- Test-driven Development (TDD)
- AWS ECS, RDS, and Lambda
- React
- Blue/Green Deploys
- CI/CD

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6. Run container processes as a **non-root user**
7. Explain the best practices for **managing secrets** at both build and run-times
8. Use **Docker Compose** to build, run, and connect multiple containers together

Why Docker?

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...so you can focus on the code and data analysis, etc.

Plus, it's much easier than dealing with virtual environments!

Best Practices

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Web development example

```
FROM python:3.6-alpine

WORKDIR /app

COPY requirements.txt /
RUN pip install -r /requirements.txt  # flask and gunicorn

COPY . /app
```

Size before: 702MB, Size after: 102MB

Keep images slim with Alpine (2)

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Data science example

```
FROM python:3.6-alpine

RUN apk --no-cache add --virtual build-dependencies \
                build-base \
                python3-dev \
        && pip3 install \
                jupyter \
                pandas

WORKDIR /notebooks
```

Size before: 929MB, Size after: 634MB

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Want to inspect an image from Docker Hub?
Check out MicroBadger.

Use multi-stage builds (1)

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Web development example

```
FROM python:3.6 as base
COPY requirements.txt /
RUN pip wheel --no-cache-dir --no-deps --wheel-dir /wheels -r requirements.txt

FROM python:3.6-alpine
COPY --from=base /wheels /wheels
COPY --from=base requirements.txt .
RUN pip install --no-cache /wheels/* # flask, gunicorn, pycrypto
WORKDIR /app
COPY . /app
```

Size before: 705MB, Size after: 103MB

Use multi-stage builds (2)

Data science example

```
FROM python:3.6 as base
RUN pip wheel --no-cache-dir --no-deps --wheel-dir /wheels jupyter pandas

FROM python:3.6-slim
COPY --from=base /wheels /wheels
RUN pip install --no-cache /wheels/*
WORKDIR /notebooks
```

Size before: 929MB, Size after: 365MB

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RUN pip install --no-cache /wheels/*
WORKDIR /notebooks
```

Size before: 929MB, Size after: 365MB

CI example

```
FROM python:3.6 as base
RUN pip wheel --no-cache-dir --no-deps --wheel-dir /wheels -r flask
COPY . /app
# What happens if the tests fail?
RUN py.test

FROM python:3.6-alpine
COPY --from=base /wheels /wheels
RUN pip install --no-cache /wheels/*
COPY . /app
```

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COPY sample.py /app

COPY requirements.txt /
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Move the `COPY sample.py /app` statement to the bottom!

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Combine `RUN` steps that are related to prevent caching (since each `RUN` step will create a new layer) and using unnecessary disc space.

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Finally...

Use multi-stage builds as much as possible!

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2. image ids
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Example

You could use both the git commit SHA1 hash (to associate the image back to a specific commit to help with debugging) along with and the environment name:

`/$PROJECT/$ENVIRONMENT:$SHA1`

```
$ docker build -t web/prod:a072c4e5d94b5a769225f621f08af3d4bf820a07 .
```

Create a non-root user

By default, Docker runs container processes as root inside of a container. This is a bad practice since attackers can gain root access to the Docker host if they manage to break out of the container.

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2. Data Science

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Verify

```
$ docker run -p 5000:5000 -i sample id
uid=100(app) gid=101(app) groups=101(app)

$ docker run -p 8888:8888 -i ds id
uid=100(app) gid=101(app) groups=101(app)
```

(The Linux `id` command displays info about the current user.)

Now, each containers' user and associated group are non-root users.

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Secret Management (build vs run time)

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At run-time (recommended!):

1. You can pass secrets in via env variables, but they will be visible in all child processes - i.e., linked containers, `docker inspect` - and logs. It's also difficult to update them.

   ```
   $ docker run -p 5000:5000 -d -e "foo=bar" -i sample \
   gunicorn -b 0.0.0.0:5000 sample:app

   f8650976bcb9a50257aa9c39114207bb07d42d89f9ae00f5f2ba36c68fc

   $ docker inspect f8650976bcb9a50257aa9c39114207bb07d42d89f9ae00f5f2ba36c68fc
   ```

2. Passing them in using a shared volume is a better solution, but they should be encrypted (via Vault or KMS) since they are saved to disc.

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At Build time:

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At Build time:

1. Never store secrets in a Docker image that will be pushed to a public repo.
2. You can pass secrets in at build-time using build-time args, but they will be visible to those who have access to the image via `docker history`.

   Dockerfile:

   ```
   FROM alpine
   ARG foo
   RUN echo "Hello, World!"
   ```

   Example:

   ```
   $ docker build --build-arg "foo=bar" -t hi .
   Successfully built f2bcff49ac09

   $ docker history f2bcff49ac09 | grep foo
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!!! Using Docker Swarm? Check out Docker Secrets. !!!

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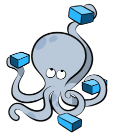
Docker Compose is an orchestration tool used for running multi-container apps. It helps streamline building, running, and connecting multiple containers together. To use Docker Compose, you'll need to define how to build your containers with YAML in a *docker-compose.yml* file.



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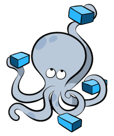

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https://realpython.com/offline-python-deployments-with-docker

That's it!

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Resources

1. Slides - http://mherman.org/presentations/dockercon-2018
2. Repo - https://github.com/testdrivenio/docker-python-devs
3. 7 best practices for building containers
4. How to Build 12 Factor Microservices on Docker
5. Docker Cheat Sheet
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7. From Docker:
    - Best practices for writing Dockerfiles
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Questions?

✌️