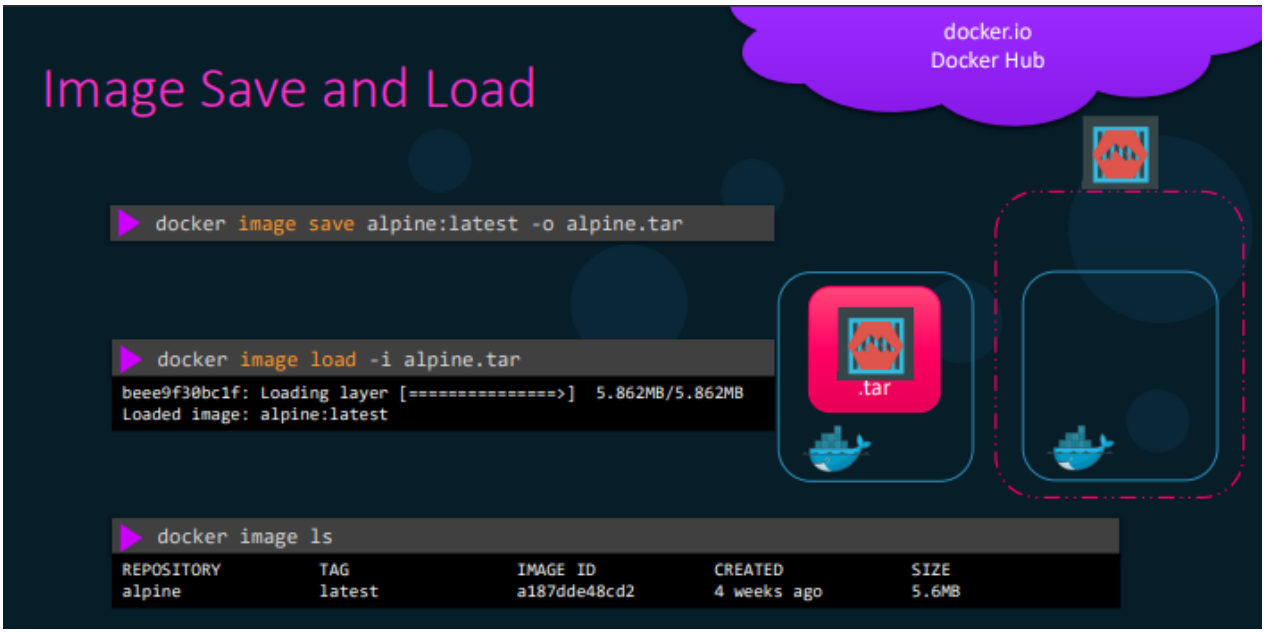
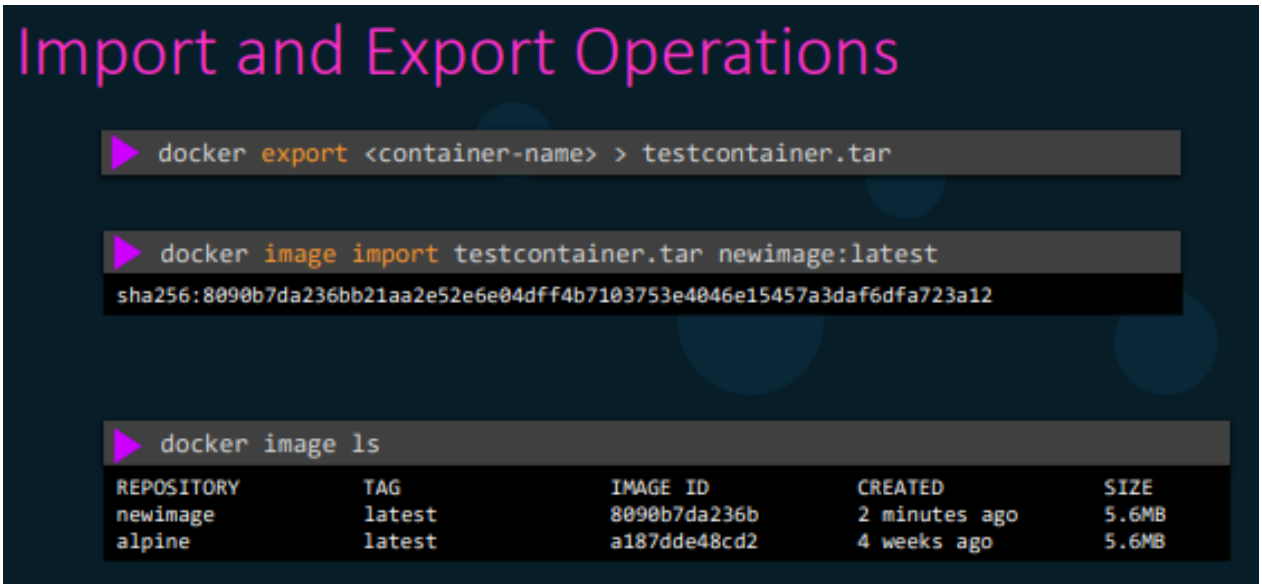
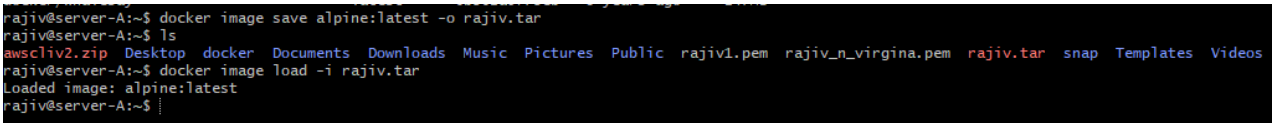
Image Save and Load





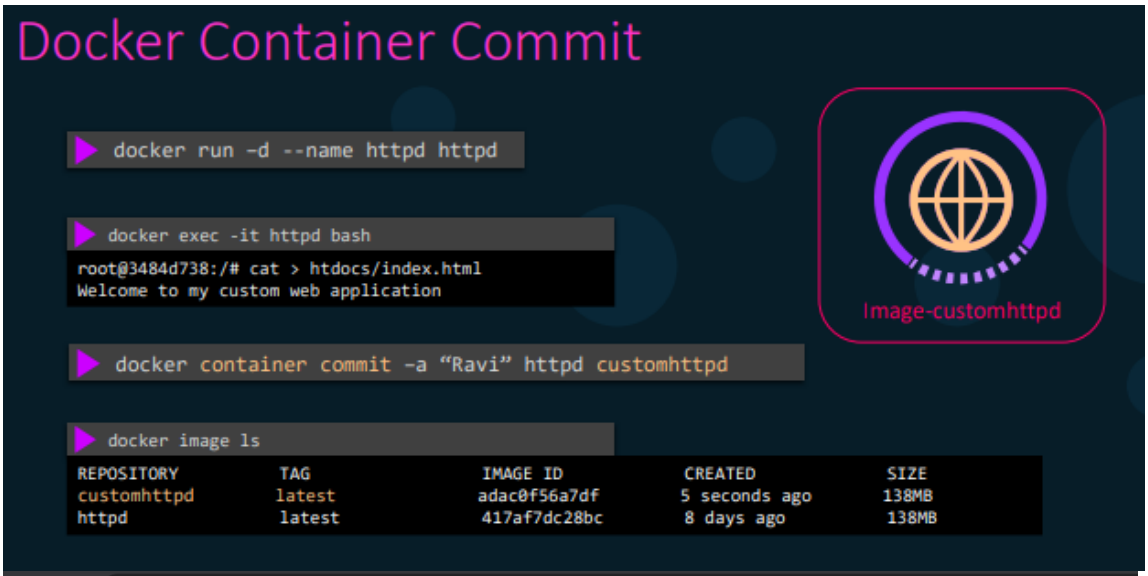
Lab: from image create tar file then from that tar file create a image

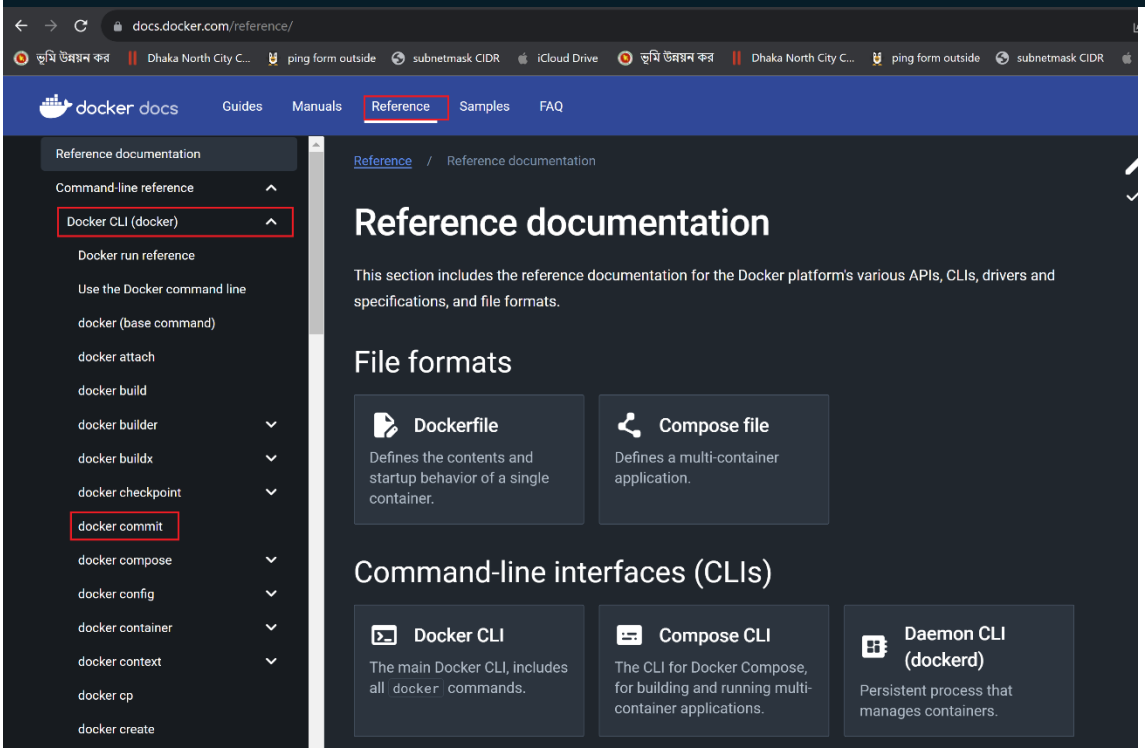


Lab: create a tar file from a container then launch a container from that tar file

```
rajiv@server-A:~$ docker container run -itd --name=test alpine
b7404c2d82bd21317ca14eaf2a028c967893fcc994d1d44e94d77d721cd14072
rajiv@server-A:~$ docker container ls -l
CONTAINER ID   IMAGE     COMMAND     CREATED          STATUS          PORTS     NAMES
b7404c2d82bd   alpine    "/bin/sh"   10 seconds ago   Up 10 seconds             test
rajiv@server-A:~$ docker export test >rajiv.tar
rajiv@server-A:~$ ls
awscliv2.zip  Desktop  docker  Documents  Downloads  Music  Pictures  Public  rajiv1.pem  rajiv_n_virgina.pem  rajiv.tar  snap  Templates  Videos
rajiv@server-A:~$ docker image import rajiv.tar rajiv:latest
sha256:f0b7a6a23e8beccc9f11ecca390b2d388df550e76fc1263e177aedeeaa3c9138
rajiv@server-A:~$ docker images
REPOSITORY                                  TAG         IMAGE ID       CREATED         SIZE
rajiv                                       latest      f0b7a6a23e8b   9 seconds ago   7.33MB
result-app                                  latest      14b88973d259   4 days ago      264MB
```

Building Images Using Commit





Lab: edit a website from a running container and then create a image and run a container

```
First
#docker image pull centos:7
#docker container create -it --name=rajivweb centos:7
#docker container ls -l
#docker container start rajivweb
#docker container ls -l
#docker container exec -it rajivweb /bin/bash
Now run some command in this container
```

```
yum update -y
yum install httpd -y
echo "Hello world" > /var/www/html/index.html
exit
```

```
#docker container ls
#docker container stop rajivweb
#docker container ls -l
#docker container commit -a "rajiv siddiqui" -c 'CMD ["httpd", "-D", "FOREGROUND"]'
rajivweb rajivweb2023:v1
#docker image ls
#docker container run -itd -p 80:80 rajivweb2023:v1
#docker container ls -l
```

Difference between Save vs Load vs Export vs Import vs commit

save= create a tar file form an image

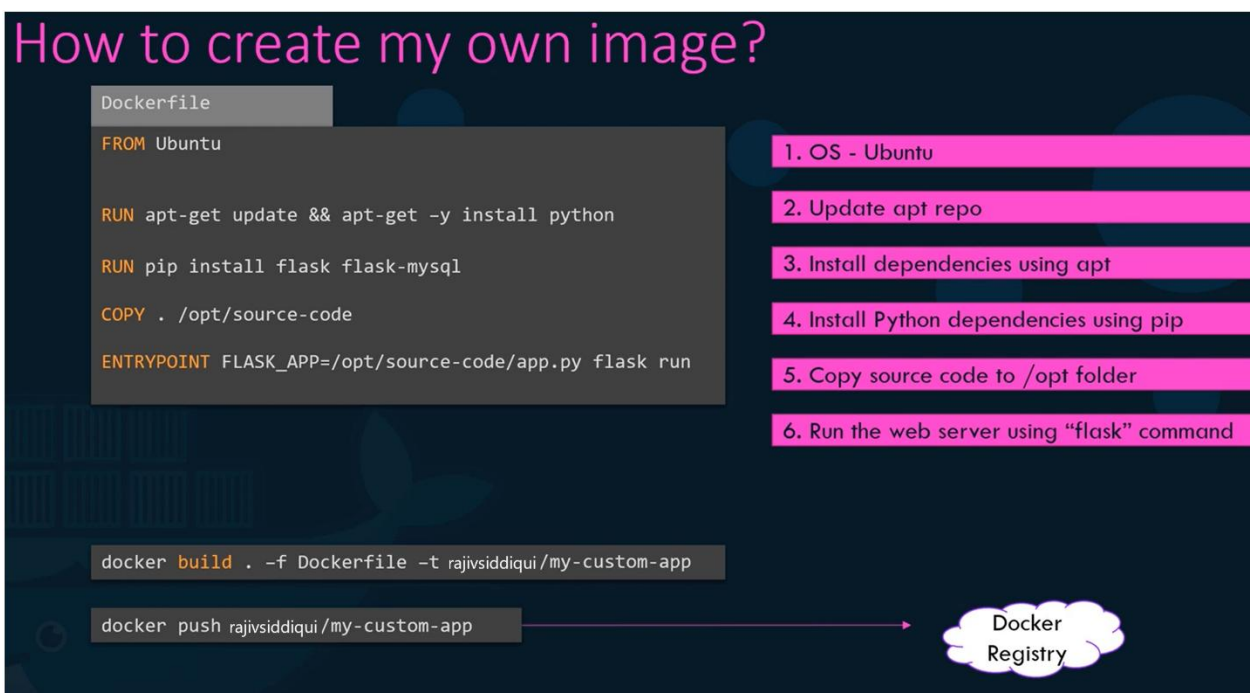
Load= create an image form that tar file

export= create an tar from a running container

import= create an image from a running container tar file

commit= edit a running container and create an image from that running container

Create our own images:



Dockerfile

INSTRUCTION | ARGUMENT

Dockerfile

```
FROM Ubuntu

RUN apt-get update && apt-get -y install python

RUN pip install flask flask-mysql

COPY . /opt/source-code

ENTRYPOINT FLASK_APP=/opt/source-code/app.py flask run
```

- FROM Ubuntu → Start from a base OS or another image
- RUN apt-get update && apt-get -y install python; RUN pip install flask flask-mysql → Install all dependencies
- COPY . /opt/source-code → Copy source code
- ENTRYPOINT FLASK_APP=/opt/source-code/app.py flask run → Specify Entrypoint

Layered architecture

```
docker build . -f Dockerfile -t   rajivsiddiqui/my-custom-app
```

Dockerfile

```
FROM Ubuntu

RUN apt-get update && apt-get -y install python

RUN pip install flask flask-mysql

COPY . /opt/source-code

ENTRYPOINT FLASK_APP=/opt/source-code/app.py flask run
```

Layer 1. Base Ubuntu Layer	120 MB
Layer 2. Changes in apt packages	306 MB
Layer 3. Changes in pip packages	6.3 MB
Layer 4. Source code	229 B
Layer 5. Update Entrypoint with “flask” command	0 B

```
root@osboxes:/root/simple-webapp-docker # docker history rajivsiddiqui/my-app
IMAGE          CREATED        CREATED BY                                      SIZE      COMMENT
1a45ba829f10   About an hour ago   /bin/sh -c #(nop)  ENTRYPOINT ["/bin/sh" "...   0B
37d37ed8fe99   About an hour ago   /bin/sh -c #(nop) COPY file:29b92853d73898...   229B
d6aaebf8ded0   About an hour ago   /bin/sh -c pip install flask flask-mysql        6.39MB
e4c055538e60   About an hour ago   /bin/sh -c apt-get update && apt-get insta...   306MB
ccc7a11d65b1   2 weeks ago         /bin/sh -c #(nop)  CMD ["/bin/bash"]            0B
<missing>      2 weeks ago         /bin/sh -c mkdir -p /run/systemd && echo '...   7B
<missing>      2 weeks ago         /bin/sh -c sed -i 's/^#\s*\(deb.*universe\...   2.76kB
<missing>      2 weeks ago         /bin/sh -c rm -rf /var/lib/apt/lists/*          0B
<missing>      2 weeks ago         /bin/sh -c set -xe   && echo '#!/bin/sh' >...   745B
<missing>      2 weeks ago         /bin/sh -c #(nop) ADD file:39d3593ea220e68...   120MB
```

Docker build output

```
root@osboxes:/root/simple-webapp-docker # docker build .
Sending build context to Docker daemon  3.072kB
Step 1/5 : FROM ubuntu
 ---> ccc7a11d65b1
Step 2/5 : RUN apt-get update && apt-get install -y python python-setuptools python-dev
 ---> Running in a7840dbfad17
Get:1 http://archive.ubuntu.com/ubuntu xenial InRelease [247 kB]
Get:2 http://security.ubuntu.com/ubuntu xenial-security InRelease [102 kB]
Get:3 http://archive.ubuntu.com/ubuntu xenial-updates InRelease [102 kB]
Get:4 http://security.ubuntu.com/ubuntu xenial-security/universe Sources [46.3 kB]
Get:5 http://archive.ubuntu.com/ubuntu xenial-backports InRelease [102 kB]
Get:6 http://security.ubuntu.com/ubuntu xenial-security/main amd64 Packages [440 kB]
Step 3/5 : RUN pip install flask flask-mysql
 ---> Running in a4a6c9190ba3
Collecting flask
  Downloading Flask-0.12.2-py2.py3-none-any.whl (83kB)
Collecting flask-mysql
  Downloading Flask_MySQL-1.4.0-py2.py3-none-any.whl
Removing intermediate container a4a6c9190ba3
Step 4/5 : COPY app.py /opt/
 ---> e7cdab17e782
Removing intermediate container faaaaf63c512
Step 5/5 : ENTRYPOINT FLASK_APP=/opt/app.py flask run --host=0.0.0.0
 ---> Running in d452c574a8bb
 ---> 9f27c36920bc
Removing intermediate container d452c574a8bb
Successfully built 9f27c36920bc
```

Build Cache

Build Cache

Dockerfile

```
FROM ubuntu

RUN apt-get update
RUN apt-get install -y python python3-pip

RUN pip3 install flask

COPY app.py /opt/source-code

ENTRYPOINT flask run
```

Layer 1. Base ubuntu Layer	120 MB
Layer 2. Update apt packages	22 MB
Layer 3. Install python and python pip	329 MB
Layer 4. Changes in pip packages	4.3 MB
Layer 5. Source code	229 B
Layer 6. Update Entrypoint with "flask" command	0 B

Lab: build a image from docker file and push it docker repository

Create 2 file

Dockerfile

index.html

Dockerfile

```
FROM centos:7
MAINTAINER Rajiv<rajivsiddiqui@gmail.com>
RUN yum update -y
RUN yum install httpd -y
COPY index.html /var/www/html/
ENTRYPOINT ["/usr/sbin/httpd","-D","FOREGROUND"]
```

index.html

```
Hello world
```

Now run the following command to build the image

```
#docker image build -t web2 .
#docker run -itd -p 82:80 web2
#docker image tag web2:latest rajivsiddiqui/web-httpd-centos
#docker images
#docker push rajivsiddiqui/web-httpd-centos
```

Use tomcat version as a argument variable

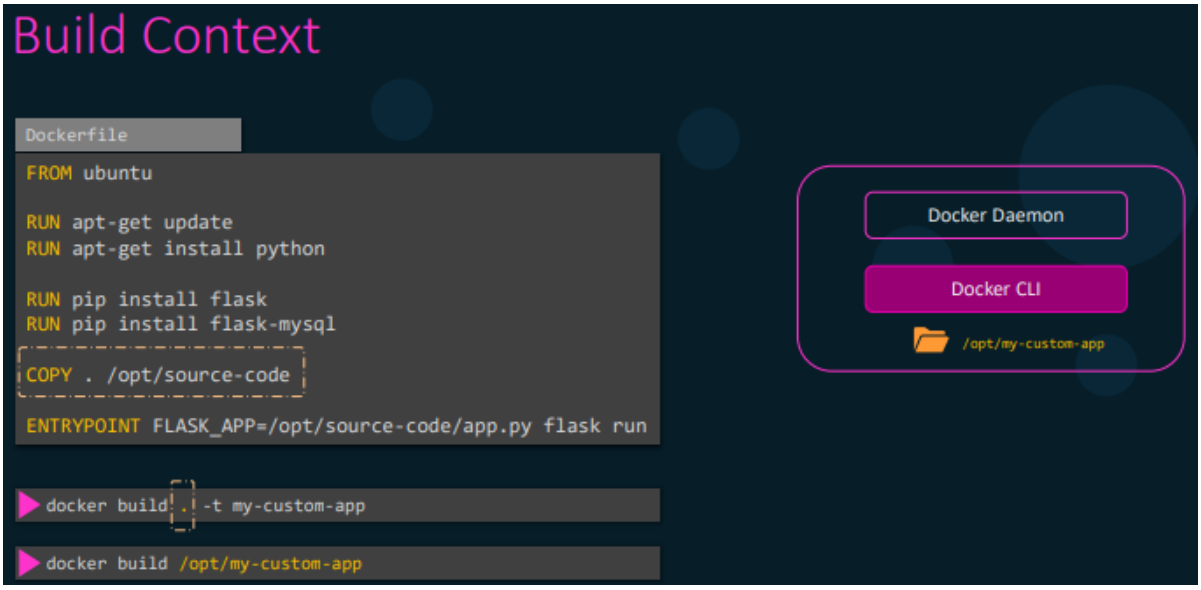
git lab url for this docker file

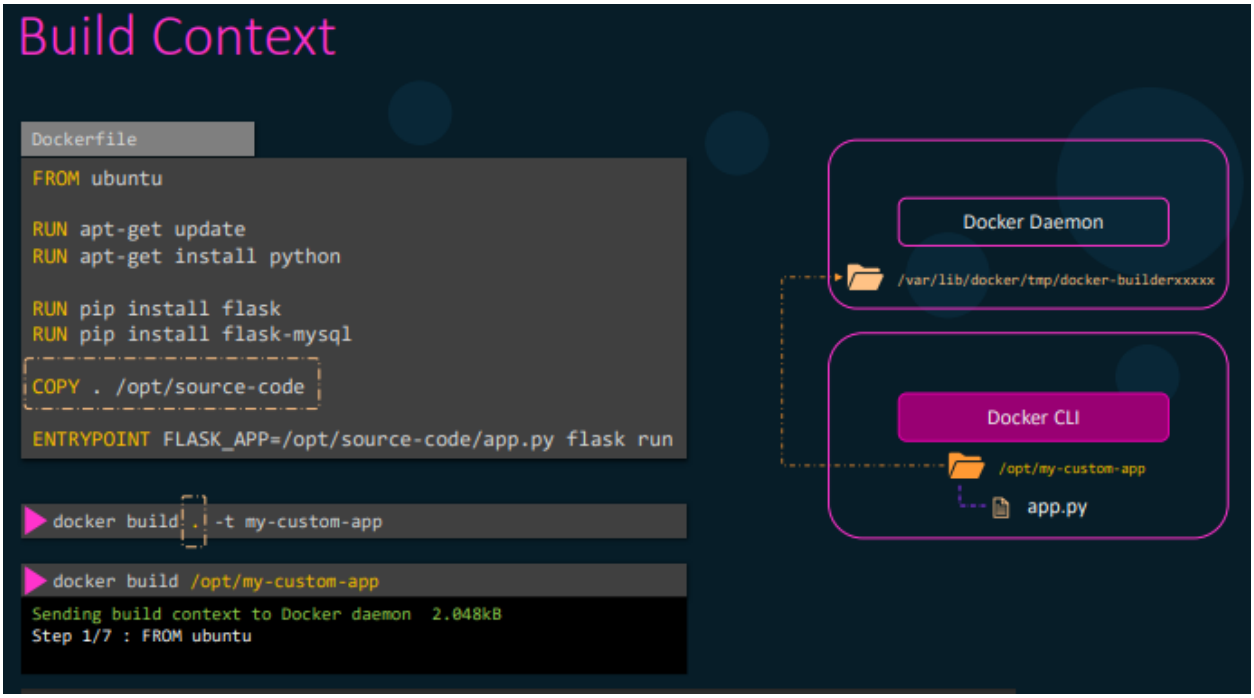
```
FROM centos:7
ARG tomcat_version=8.5.6
RUN  yum install -y epel-release java-1.8.0-openjdk.x86_64 wget
RUN groupadd tomcat && mkdir /opt/tomcat
RUN useradd -s /bin/nologin -g tomcat -d /opt/tomcat tomcat
WORKDIR /
RUN wget https://archive.apache.org/dist/tomcat/tomcat-
8/v$tomcat_version/bin/apache-tomcat-$tomcat_version.tar.gz
RUN tar -zxvf apache-tomcat-$tomcat_version.tar.gz -C /opt/tomcat --strip-
components=1
RUN cd /opt/tomcat && chgrp -R tomcat conf
RUN chmod g+rwx /opt/tomcat/conf && chmod g+r /opt/tomcat/conf/*
RUN chown -R tomcat /opt/tomcat/logs/ /opt/tomcat/temp /opt/tomcat/webapps
/opt/tomcat/work
RUN chgrp -R tomcat /opt/tomcat/bin && chgrp -R tomcat /opt/tomcat/lib && chmod
g+rwx /opt/tomcat/bin && chmod g+r /opt/tomcat/bin/*
```

```
WORKDIR /opt/tomcat/webapps
#RUN wget https://tomcat.apache.org/tomcat-7.0-doc/appdev/sample/sample.war
EXPOSE 8080
CMD ["/opt/tomcat/bin/catalina.sh","run"]
```

```
#docker image build -t rajivsiddiqui/tomcat:v2 --build-arg tomcat_version=8.5.8 .
```

Build Context





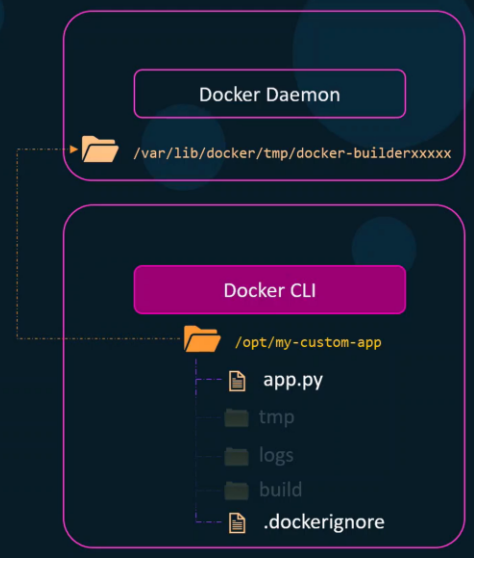
.dockerignore

.dockerignore

```
tmp
logs
build
```

```
docker build . -t my-custom-app
```

```
docker build /opt/my-custom-app
Sending build context to Docker daemon  2.048kB
Step 1/7 : FROM ubuntu
```



Build Context

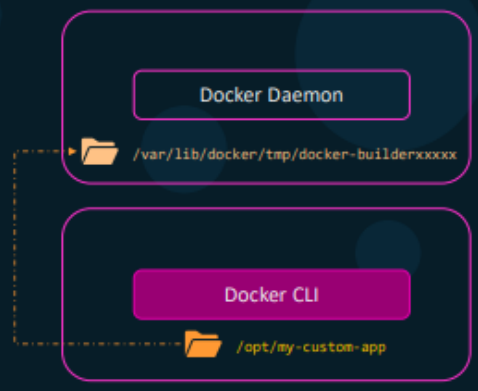
```
docker build . -t my-custom-app
```

```
docker build /opt/my-custom-app
Sending build context to Docker daemon  2.048kB
Step 1/7 : FROM ubuntu
```

```
docker build https://github.com/myaccount/myapp
```

```
docker build https://github.com/myaccount/myapp#<branch>
```

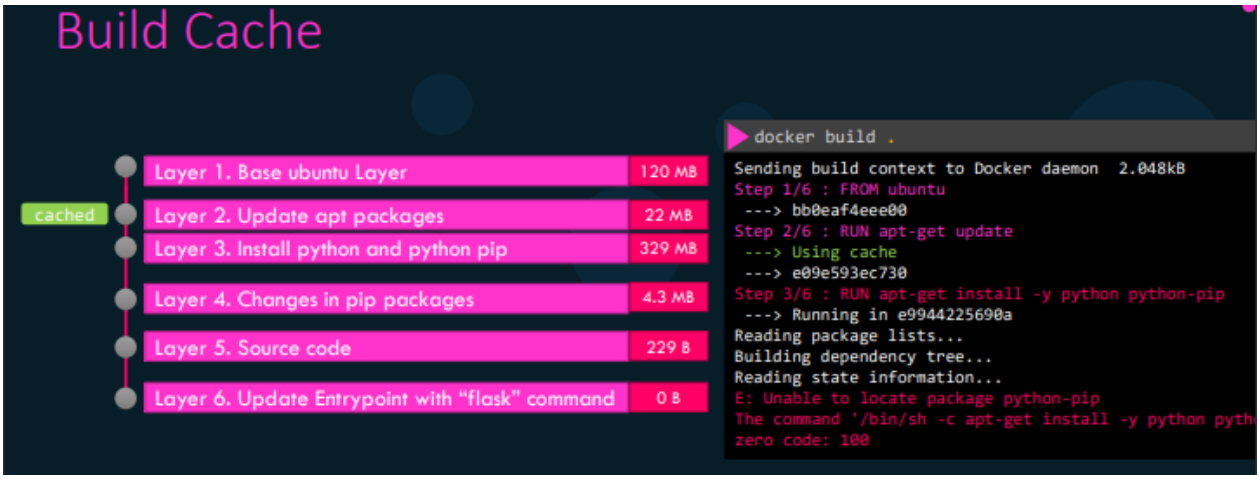
```
docker build https://github.com/myaccount/myapp:<folder>
```

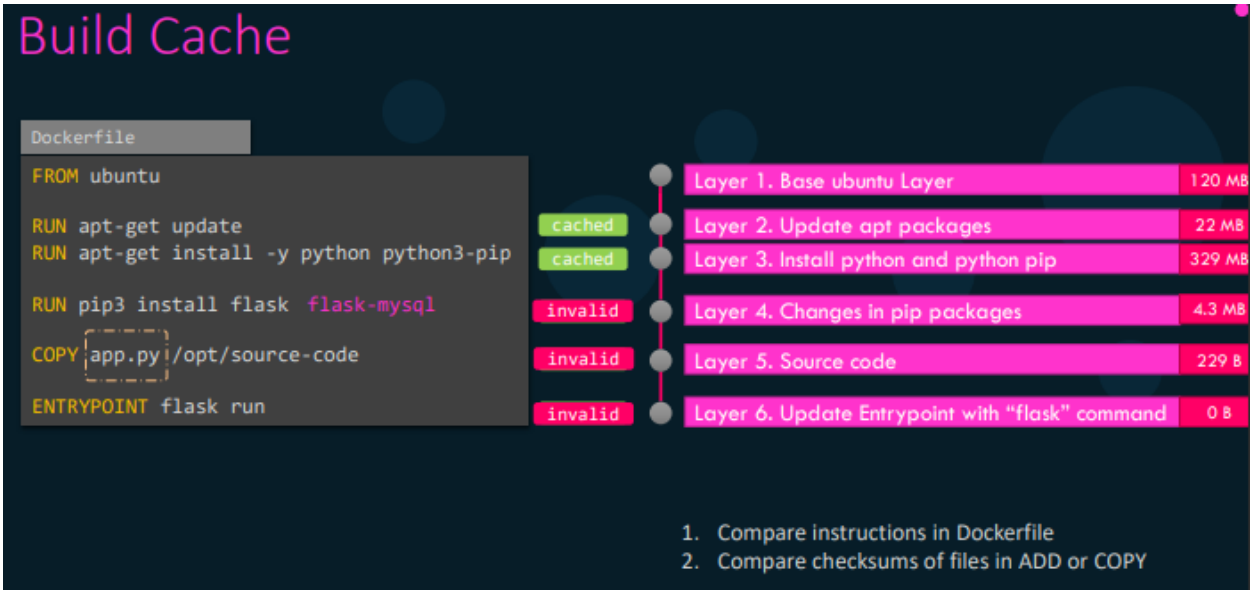



```
docker build -f Dockerfile.dev https://github.com/myaccount/myapp
```

Image Cache


Build Cache
Dockerfile
FROM ubuntu
RUN apt-get update
RUN apt-get install -y python python3-pip
RUN pip3 install flask
COPY app.py /opt/source-code
ENTRYPOINT flask run
Layer 1. Base ubuntu Layer
120 MB
Layer 2. Update apt packages
22 MB
Layer 3. Install python and python pip
329 MB
Layer 4. Changes in pip packages
4.3 MB
Layer 5. Source code
229 B
Layer 6. Update Entrypoint with "flask" command
0 B


Build Cache
cached
Layer 1. Base ubuntu Layer
120 MB
Layer 2. Update apt packages
22 MB
Layer 3. Install python and python pip
329 MB
Layer 4. Changes in pip packages
4.3 MB
Layer 5. Source code
229 B
Layer 6. Update Entrypoint with "flask" command
0 B
docker build .
Sending build context to Docker daemon 2.048kB
Step 1/6 : FROM ubuntu
---> bb0eaf4eee00
Step 2/6 : RUN apt-get update
---> Using cache
---> e09e593ec730
Step 3/6 : RUN apt-get install -y python python-pip
---> Running in e9944225690a
Reading package lists...
Building dependency tree...
Reading state information...
E: Unable to locate package python-pip
The command '/bin/sh -c apt-get install -y python pyth
zero code: 100


Build Cache
Dockerfile
FROM ubuntu
RUN apt-get update
RUN apt-get install -y python python3-pip
RUN pip3 install flask flask-mysql
COPY app.py /opt/source-code
ENTRYPOINT flask run
cached
cached
invalid
invalid
invalid
Layer 1. Base ubuntu Layer
120 MB
Layer 2. Update apt packages
22 MB
Layer 3. Install python and python pip
329 MB
Layer 4. Changes in pip packages
4.3 MB
Layer 5. Source code
229 B
Layer 6. Update Entrypoint with "flask" command
0 B
1. Compare instructions in Dockerfile
2. Compare checksums of files in ADD or COPY

Build Cache - Cache Busting

Dockerfile

```
FROM ubuntu

RUN apt-get update && apt-get install -y \
    python python3-pip python-dev

RUN pip3 install flask  flask-mysql

COPY app.py /opt/source-code

ENTRYPOINT flask run
```

- Layer 1. Base ubuntu Layer
- cached — Layer 2. Update & Install python and pyth
- invalid — Layer 3. Install python and python pip
- invalid — Layer 3. Changes in pip packages
- invalid — Layer 4. Source code
- invalid — Layer 5. Update Entrypoint with "flask" co

Build Cache - Version Pinning

Dockerfile

```
FROM ubuntu

RUN apt-get update && apt-get install -y \
    python      \
    python-dev  \
    python3-pip=20.0.2

RUN pip3 install flask  flask-mysql

COPY app.py /opt/source-code

ENTRYPOINT flask run
```

- Layer 1. Base ubuntu Layer
- cached — Layer 2. Update & Install python and pyth
- invalid
- invalid — Layer 3. Changes in pip packages
- invalid — Layer 4. Source code
- invalid — Layer 5. Update Entrypoint with "flask" co

Build Cache

Dockerfile

```
FROM ubuntu

RUN apt-get update && apt-get install -y \
    python      \
    python-dev  \
    python3-pip=20.0.2

RUN pip3 install flask flask-mysql

COPY app.py /opt/source-code

ENTRYPOINT flask run
```

cached

cached

invalid

Build Cache

Dockerfile

```
FROM ubuntu

COPY app.py /opt/source-code

RUN apt-get update && apt-get install -y \
    python      \
    python-dev  \
    python3-pip=20.0.2

RUN pip3 install flask flask-mysql


ENTRYPOINT flask run
```

invalid

invalid

invalid

Copy and ADD

Docker CMD vs Entrypoint

```
# Install Nginx.
RUN \
  add-apt-repository -y ppa:nginx/stable && \
  apt-get update && \
  apt-get install -y nginx && \
  rm -rf /var/lib/apt/lists/* && \
  echo "\ndaemon off;" >> /etc/nginx/nginx.conf && \
  chown -R www-data:www-data /var/lib/nginx

# Define mountable directories.
VOLUME ["/etc/nginx/sites-enabled", "/etc/nginx/certs", "/etc/nginx/cor

# Define working directory.
WORKDIR /etc/nginx

# Define default command.
CMD ["nginx"]
```

```
ARG MYSQL_SERVER_PACKAGE_URL=https://repo.mysql.com/yum/mysql-8.0-community/dock
ARG MYSQL_SHELL_PACKAGE_URL=https://repo.mysql.com/yum/mysql-tools-community/el/

# Install server
RUN rpmkeys --import https://repo.mysql.com/RPM-GPG-KEY-mysql \
  && yum install -y $MYSQL_SERVER_PACKAGE_URL $MYSQL_SHELL_PACKAGE_URL libpwqual
  && yum clean all \
  && mkdir /docker-entrypoint-initdb.d

VOLUME /var/lib/mysql

COPY docker-entrypoint.sh /entrypoint.sh
COPY healthcheck.sh /healthcheck.sh
ENTRYPOINT ["/entrypoint.sh"]
HEALTHCHECK CMD /healthcheck.sh
EXPOSE 3306 33060
CMD ["mysqld"]
```

```
# Pull base image.
FROM ubuntu:14.04

# Install.
RUN \
  sed -i 's/# \(.*multiverse$\)/\1/g' /etc/apt/sources.list && \
  apt-get update && \
  apt-get -y upgrade && \
  apt-get install -y build-essential && \
  apt-get install -y software-properties-common && \
  apt-get install -y byobu curl git htop man unzip vim wget && \
  rm -rf /var/lib/apt/lists/*

# Add files.
ADD root/.bashrc /root/.bashrc
ADD root/.gitconfig /root/.gitconfig
ADD root/.scripts /root/.scripts

# Set environment variables.
ENV HOME /root

# Define working directory.
WORKDIR /root

# Define default command.
CMD ["bash"]
```

```
docker run ubuntu [COMMAND]
```

```
docker run ubuntu sleep 5
```

```
FROM Ubuntu

CMD sleep 5
```

CMD command param1

CMD ["command", "param1"]

CMD sleep 5

CMD ["sleep", "5"] ✓

CMD ["sleep 5"] ✗

```
docker build -t ubuntu-sleeper .
```

```
docker run ubuntu-sleeper
```

FROM Ubuntu

CMD sleep 5

```
docker run ubuntu-sleeper sleep 10
```

Command at Startup: sleep 10

FROM Ubuntu

ENTRYPOINT [“sleep”]

```
docker run ubuntu-sleeper 10
```

Command at Startup: sleep 10

```
docker run ubuntu-sleeper
sleep: missing operand
Try 'sleep --help' for more information.
```

Command at Startup:sleep

FROM Ubuntu

ENTRYPOINT [“sleep”]

CMD [“5”]

```
docker run ubuntu-sleeper
sleep: missing operand
Try 'sleep --help' for more information.
```

Command at Startup: sleep 5

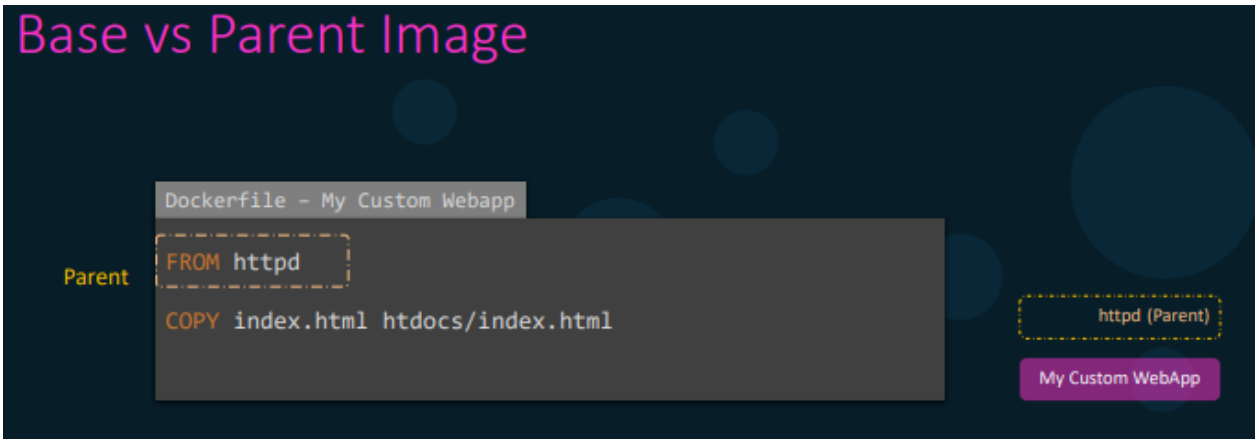
```
docker run ubuntu-sleeper 10
```

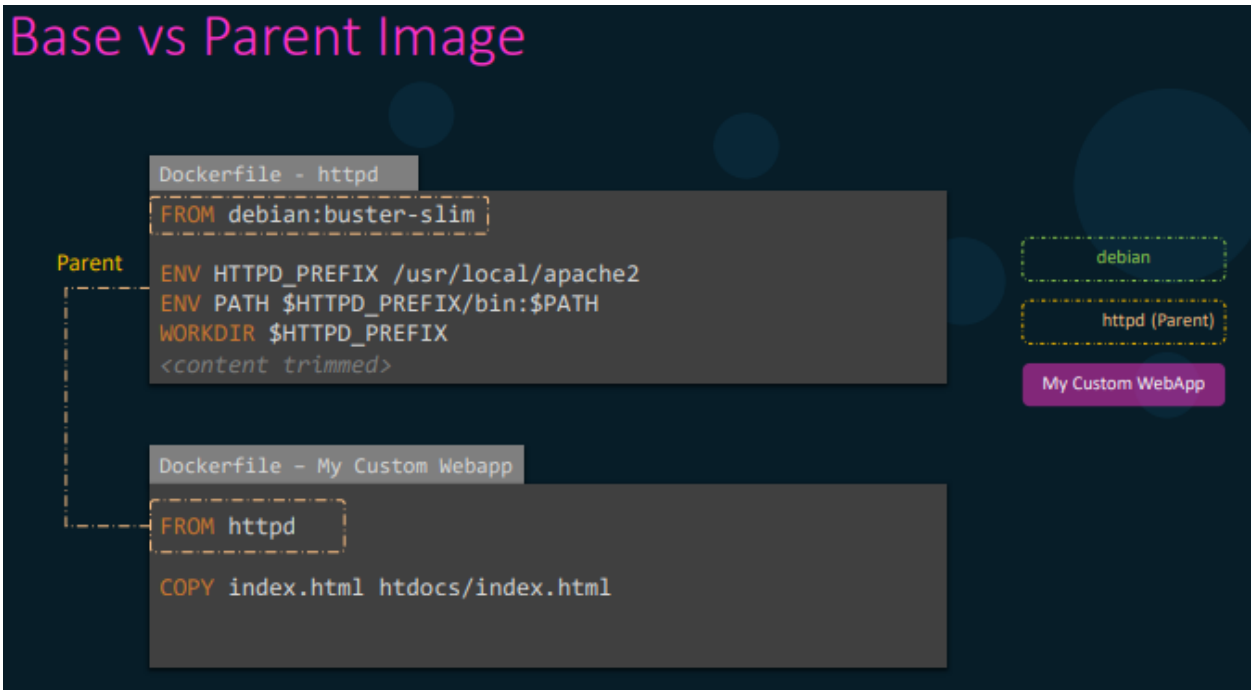
Command at Startup: sleep 10

```
docker run --entrypoint sleep2.0 ubuntu-sleeper 10
```

Command at Startup: sleep2.0 10

Docker Base Image





Base vs Parent Image

Base

Dockerfile - debian:buster-slim

```
FROM scratch
ADD rootfs.tar.xz /
CMD ["bash"]
```

Parent

Dockerfile - httpd

```
FROM debian:buster-slim

ENV HTTPD_PREFIX /usr/local/apache2
ENV PATH $HTTPD_PREFIX/bin:$PATH
WORKDIR $HTTPD_PREFIX
<content trimmed>
```

Dockerfile – My Custom Webapp

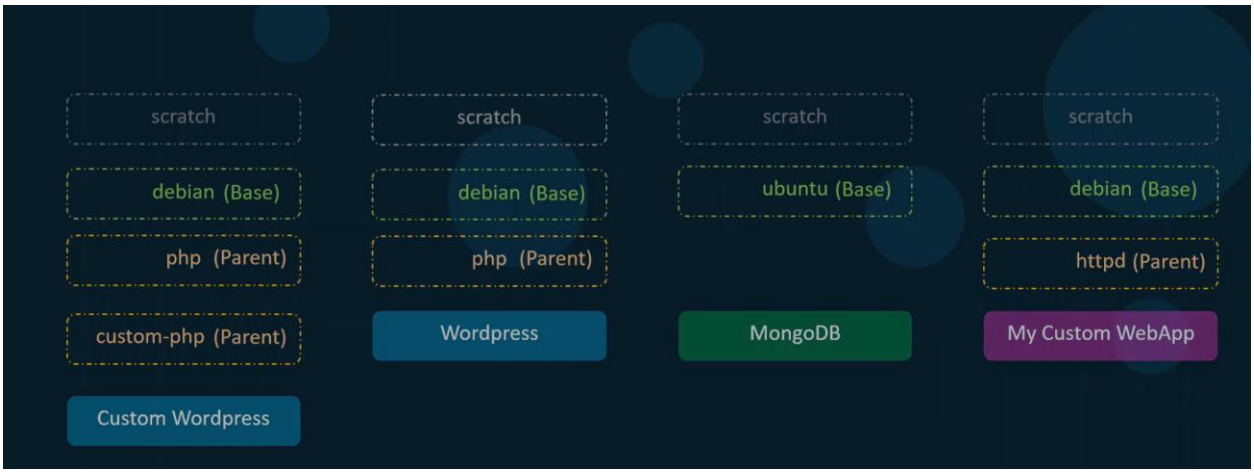
```
FROM httpd

COPY index.html htdocs/index.html
```

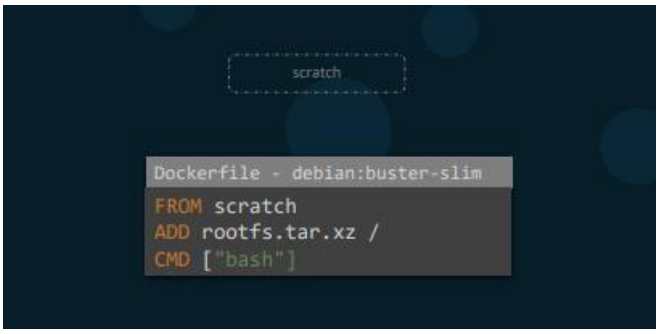
scratch

debian (Base)

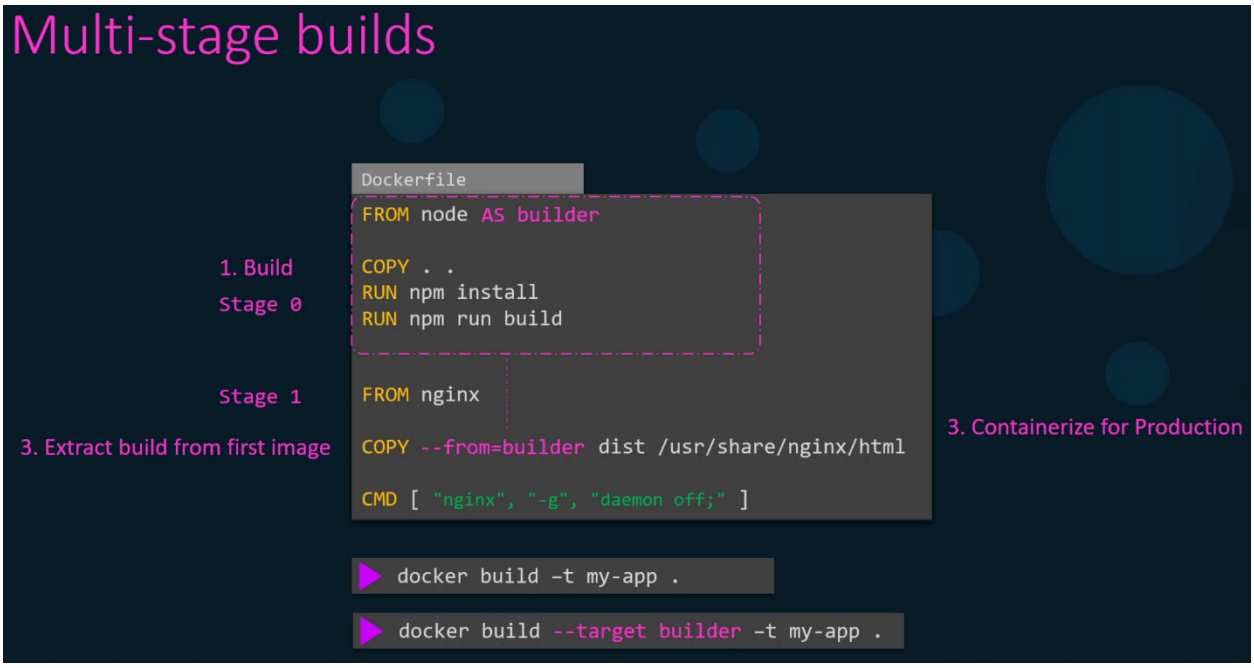
httpd (Parent)

My Custom WebApp

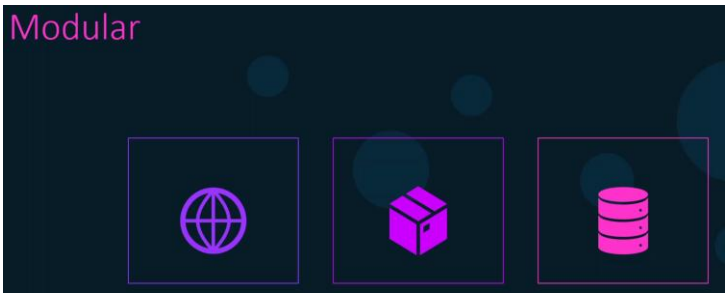


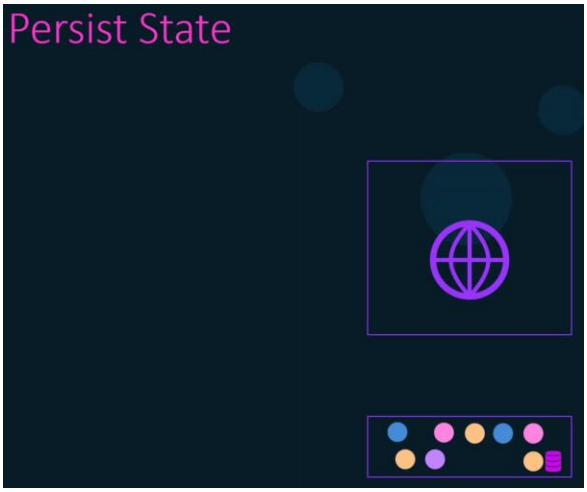


Multi Stage Build



Best practice when create an image





Slim/Minimal Images

1. Create slim/minimal images
2. Find an official minimal image that exists
3. Only install necessary packages
4. Maintain different images for different environments:
   - Development – debug tools
   - Production - lean
5. Use multi-stage builds to create lean production ready images.
6. Avoid sending unwanted files to the build context