How to create Docker Images with a Dockerfile

Docker is an operating-system-level virtualization mainly intended for developers and sysadmins. Docker makes it easier to create and deploy applications in an isolated environment. A **Dockerfile** is a script that contains collections of commands and instructions that will be automatically executed in sequence in the docker environment for building a new docker image.

On this page

In this tutorial, I will show you how to create your own docker image with a dockerfile. I will explain the dockerfile script in detail to enable you to build your own dockerfile scripts.

Prerequisite

- A Linux Server - I will use Ubuntu 16.04 as the host machine, and Ubuntu 16.04 as the docker base image.
- Root Privileges.
- Understanding Docker command

Introduction to the Dockerfile Command

A dockerfile is a script which contains a collection of dockerfile commands and operating system commands (ex: Linux commands). Before we create our first dockerfile, you should become familiar with the dockerfile command.

Below are some dockerfile commands you must know:

FROM

The base image for building a new image. This command must be on top of the dockerfile.

MAINTAINER

Optional, it contains the name of the maintainer of the image.

RUN

Used to execute a command during the build process of the docker image.

ADD

Copy a file from the host machine to the new docker image. There is an option to use an URL for the file, docker will then download that file to the destination directory.

ENV

Define an environment variable.

CMD

Used for executing commands when we build a new container from the docker image.

ENTRYPOINT

Define the default command that will be executed when the container is running.

WORKDIR

This is directive for CMD command to be executed.

USER

Set the user or UID for the container created with the image.

VOLUME

Enable access/linked directory between the container and the host machine.

Now let's stat to create our first dockerfile.

Step 1 - Installing Docker

Login to your server and update the software repository.

```
ssh root@192.168.1.248
apt-get update
```

Install docker.io with this apt command:

```
apt-get install docker.io
```

When the installation is finished, start the docker service and enable it to start at boot time:

```
systemctl start docker
systemctl enable docker
```

Docker has been installed and is running on the system.

Step 2 - Create Dockerfile

In this step, we will create a new directory for the dockerfile and define what we want to do with that dockerfile.

Create a new directory and a new and empty dockerfile inside that directory.

```
mkdir ~/myimages
cd myimages/
touch Dockerfile
```

Next, define what we want to do with our new custom image. In this tutorial, I will install Nginx and PHP-FPM 7 using an Ubuntu 16.04 docker image. Additionally, we need Supervisord, so we can start Nginx and PHP-FPM 7 both in one command.

Edit the 'Dockerfile' with vim:

```
vim Dockerfile
```

On the top of the file, add a line with the base image (Ubuntu 16.04) that we want to use.

```
#Download base image ubuntu 16.04
FROM ubuntu:16.04
```

Update the Ubuntu software repository inside the dockerfile with the 'RUN' command.

```
# Update Ubuntu Software repository
RUN apt-get update
```

Then install the applications that we need for the custom image. Install Nginx, PHP-FPM and Supervisord from the Ubuntu repository with apt. Add the RUN commands for Nginx and PHP-FPM installation.

```
# Install nginx, php-fpm and supervisord from ubuntu repository
RUN apt-get install -y nginx php7.0-fpm supervisor && \
    rm -rf /var/lib/apt/lists/*
```

At this stage, all applications are installed and we need to configure them. We will configure Nginx for handling PHP applications by editing the default virtual host configuration. We can replace it our new configuration file, or we can edit the existing configuration file with the 'sed' command.

In this tutorial, we will replace the default virtual host configuration with a new configuration by using the 'COPY' dockerfile command.

```
#Define the ENV variable
ENV nginx_vhost /etc/nginx/sites-available/default
ENV php_conf /etc/php/7.0/fpm/php.ini
ENV nginx_conf /etc/nginx/nginx.conf
ENV supervisor_conf /etc/supervisor/supervisord.conf

# Enable php-fpm on nginx virtualhost configuration
COPY default ${nginx_vhost}
RUN sed -i -e 's/;cgi.fix_pathinfo=1/cgi.fix_pathinfo=0/g' ${php_conf} && \
    echo "\ndaemon off;" >> ${nginx_conf}
```

Next, configure Supervisord for Nginx and PHP-FPM. We will replace the default Supervisord configuration with a new configuration by using the 'COPY' command.

```
#Copy supervisor configuration
COPY supervisord.conf ${supervisor_conf}
```

Now create a new directory for the php-fpm sock file and change the owner of the /var/www/html directory and PHP directory to www-data.

```
RUN mkdir -p /run/php && \
    chown -R www-data:www-data /var/www/html && \
    chown -R www-data:www-data /run/php
```

Next, define the volume so we can mount the directories listed below to the host machine.

```
# Volume configuration
VOLUME ["/etc/nginx/sites-enabled", "/etc/nginx/certs", "/etc/nginx/conf.d",
 "/var/log/nginx", "/var/www/html"]
```

Finally, setup the default container command 'CMD' and open the port for HTTP and HTTPS. We will create a new start.sh file for default 'CMD' command when container is starting. The file contains the 'supervisord' command, and we will copy the file to the new image with the 'COPY' dockerfile command.

```
# Configure Services and Port
COPY start.sh /start.sh
CMD ["./start.sh"]

EXPOSE 80 443
```

Save the file and exit.

Here is the complete Dockerfile in one piece:

```
#Download base image ubuntu 16.04
FROM ubuntu:16.04

# Update Software repository
RUN apt-get update

# Install nginx, php-fpm and supervisord from ubuntu repository
RUN apt-get install -y nginx php7.0-fpm supervisor && \
    rm -rf /var/lib/apt/lists/*

#Define the ENV variable
ENV nginx_vhost /etc/nginx/sites-available/default
ENV php_conf /etc/php/7.0/fpm/php.ini
ENV nginx_conf /etc/nginx/nginx.conf
ENV supervisor_conf /etc/supervisor/supervisord.conf
```

```
# Enable php-fpm on nginx virtualhost configuration
COPY default ${nginx_vhost}
RUN sed -i -e 's/;cgi.fix_pathinfo=1/cgi.fix_pathinfo=0/g' ${php_conf} && \
    echo "\ndaemon off;" >> ${nginx_conf}

#Copy supervisor configuration
COPY supervisord.conf ${supervisor_conf}

RUN mkdir -p /run/php && \
    chown -R www-data:www-data /var/www/html && \
    chown -R www-data:www-data /run/php

# Volume configuration
VOLUME ["/etc/nginx/sites-enabled", "/etc/nginx/certs", "/etc/nginx/conf.d",
 "/var/log/nginx", "/var/www/html"]

# Configure Services and Port
COPY start.sh /start.sh
CMD ["./start.sh"]

EXPOSE 80 443
```

Now inside our 'Dockerfile' directory, create a new configuration file for the virtual host named 'default', a supervisord configuration file 'supervisord.conf' and a service configuration script 'start.sh'.

```
vim default
```

Paste default virtual host configuration below:

```
server {
    listen 80 default_server;
    listen [::]:80 default_server;

    root /var/www/html;
    index index.html index.htm index.nginx-debian.html;

    server_name _;

    location / {
        try_files $uri $uri/ =404;
    }

    location ~ \.php$ {
        include snippets/fastcgi-php.conf;
        fastcgi_pass unix:/run/php/php7.0-fpm.sock;
    }

    # deny access to .htaccess files, if Apache's document root
    # concurs with nginx's one
    #
    #location ~ /\.ht {
```

```
    #    deny all;
    #}
}
```

Supervisord configuration file:

```
vim supervisord.conf
```

Paste configuration below:

```
[unix_http_server]
file=/dev/shm/supervisor.sock   ; (the path to the socket file)

[supervisord]
logfile=/var/log/supervisord.log ; (main log file;default $CWD/supervisord.lo
g)
logfile_maxbytes=50MB        ; (max main logfile bytes b4 rotation;default 50
MB)
logfile_backups=10           ; (num of main logfile rotation backups;default
 10)
loglevel=info                ; (log level;default info; others: debug,warn,tr
ace)
pidfile=/tmp/supervisord.pid ; (supervisord pidfile;default supervisord.pid)
nodaemon=false               ; (start in foreground if true;default false)
minfds=1024                  ; (min. avail startup file descriptors;default 1
024)
minprocs=200                 ; (min. avail process descriptors;default 200)
user=root             ;

; the below section must remain in the config file for RPC
; (supervisorctl/web interface) to work, additional interfaces may be
; added by defining them in separate rpcinterface: sections
[rpcinterface:supervisor]
supervisor.rpcinterface_factory = supervisor.rpcinterface:make_main_rpcinterf
ace

[supervisorctl]
serverurl=unix:///dev/shm/supervisor.sock ; use a unix:// URL  for a unix soc
ket

; The [include] section can just contain the "files" setting.  This
; setting can list multiple files (separated by whitespace or
; newlines).  It can also contain wildcards.  The filenames are
; interpreted as relative to this file.  Included files *cannot*
; include files themselves.

[include]
files = /etc/supervisor/conf.d/*.conf


[program:php-fpm7.0]
command=/usr/sbin/php-fpm7.0 -F
numprocs=1
autostart=true
```

```
autorestart=true

[program:nginx]
command=/usr/sbin/nginx
numprocs=1
autostart=true
autorestart=true
```

Start.sh file.

```
vim start.sh
```

Paste configuration below:

```
#!/bin/sh

/usr/bin/supervisord -n -c /etc/supervisor/supervisord.conf
```

Save and exit

Make start.sh executable with chmod command:

```
chmod +x start.sh
```

Save the file and exit.

Step 3 - Build New Docker Image and Create New Container Based on it

The Dockerfile and all required config files have been created, now we can build a new docker image based on Ubuntu 16.04 and our dockerfile with the docker command below:

```
docker build -t nginx_image .
```

When the command completed successfully, we can check the new image 'nginx_image' with the docker command below:

```
docker images
```

```
Step 14 : CMD ./start.sh
 ---> Using cache
 ---> ab533b5888ba
Step 15 : EXPOSE 80 443
 ---> Using cache
 ---> 7875e0fc8138
Successfully built 7875e0fc8138
root@natsuki:~/myimages# docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
nginx_image         latest              7875e0fc8138        5 minutes ago       266.8 MB
ubuntu              16.04               42118e3df429        2 weeks ago         124.8 MB
root@natsuki:~/myimages#
```

Then we can try to create a new container based on nginx_images. And before create new container, we can create new directory on the host machine for the webroot data.

```
mkdir -p /webroot
```

Now run the new container with command below:

```
docker run -d -v /webroot:/var/www/html -p 80:80 --name hakase nginx_image
```

Then we can check that the new container with name hakase based on 'nginx_image' is running:

```
docker ps
```

```
root@natsuki:~/myimages# mkdir -p /webroot
root@natsuki:~/myimages# docker run -d -v /webroot:/var/www/html -p 80:80 --name hakase nginx_image
7ddd15694ab6e6620c173f837d367039a6b1513c98511e0ea5e758035513be6a
root@natsuki:~/myimages# docker ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS                          NAMES
7ddd15694ab6        nginx_image         "./start.sh"        3 seconds ago       Up 2 seconds        0.0.0.0:80->80/tcp, 443/tcp    hakase
root@natsuki:~/myimages#
```

Note:

- --name hakase nginx_image = We create a new container with the name 'hakase', based on docker image 'nginx_images'.
- -p 80:80 = hakase container running on port 80 on the host machine.
- -v /webroot:/var/www/html = /webroot directory on the host machine rewrite the /var/www/html directory on the container.

The new container based on the nginx_image is running without error.

Step 4 - Testing Nginx and PHP-FPM in the Container

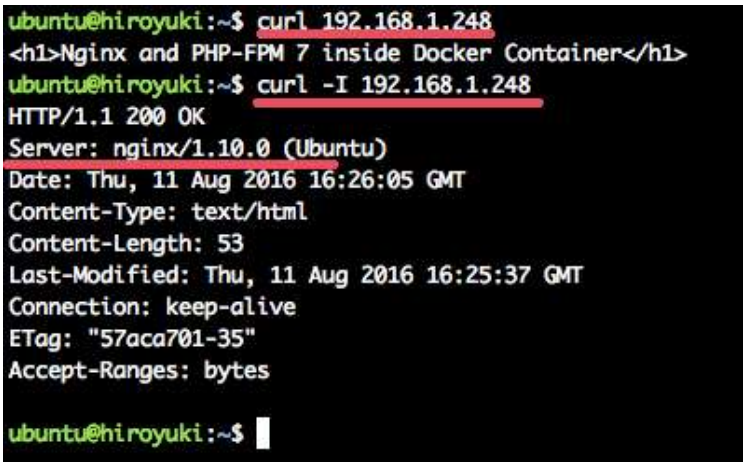
Try to create a new index.html file in the /webroot directory with echo:

```
echo '<h1>Nginx and PHP-FPM 7 inside Docker Container</h1>' > /webroot/inde
x.html
```

Testing with curl command by accessing the host machine ip address.

```
curl 192.168.1.250
curl -I 192.168.1.250
```

We will see results below.



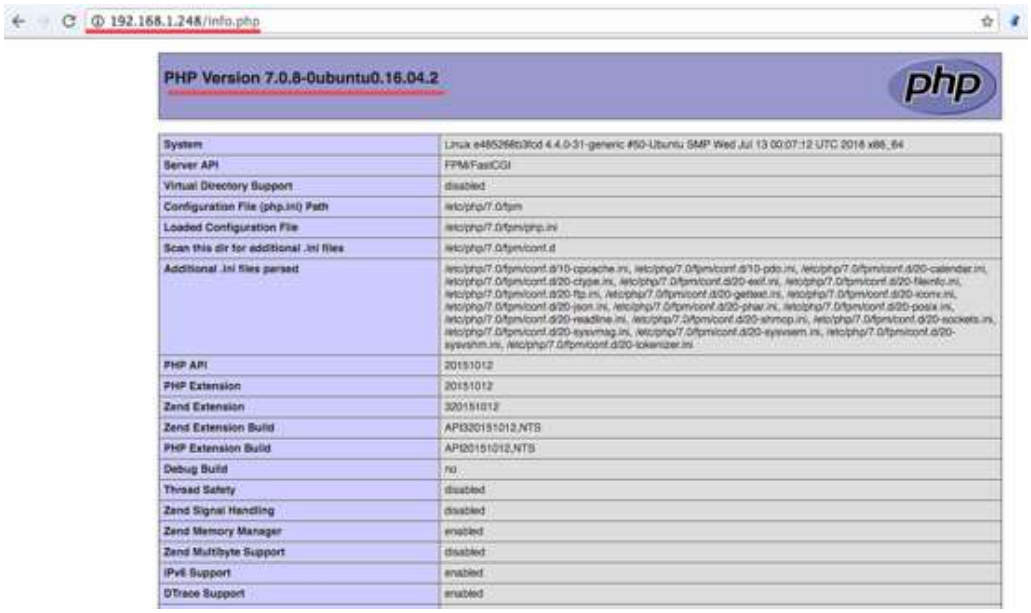
Next, test that PHP-FPM 7.0 is running by creating a new phpinfo file in the /webroot directory on the host machine.

```
echo '<?php phpinfo(); ?>' > /webroot/info.php
```

Open the web browser and type the host machine IP address:

http://192.168.1.248/info.php

Now you can see the output of the phpinfo file.



the new docker image 'nginx_image' has been successfully created, now we can create more containers based on that image.

Reference

- https://docs.docker.com/engine/reference/builder/
- https://github.com/ngineered/nginx-php-fpm
- https://github.com/docker-library/wordpress/

About Muhammad Arul

Muhammad Arul is a freelance system administrator and technical writer. He is working with Linux Environments for more than 5 years, an Open Source enthusiast and highly motivated on Linux installation and troubleshooting. Mostly working with RedHat/CentOS Linux and Ubuntu/Debian, Nginx and Apache web server, Proxmox, Zimbra Administration, and Website Optimization. Currently learning about OpenStack and Container Technology.

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Comments

By: Jigar **at:** *2016-12-28 14:54:14* Reply

is there an alternative then doing vi on docker container ? I mean copy-paste of many configurations is troublesome job.

By: wolf **at:** *2017-02-11 00:45:11* Reply

In your dockerfile you have multiple volumes in the [VOLUME] section, doesn't this mean that you should be referencing this in the run command when you first run off of your built image. Does there need to be a -v for each of the items in [VOLUME] in the run command?
docker run -d -v /webroot:/var/www/html -p 80:80 --name hakase nginx_image
Something like this: docker run -d -v /webroot:/var/www/html -v /ssl/certs:/etc/nginx/certs -v /etc/sites/etc:/etc/nginx/sites-enabled -p 80:80 -p 443:443 --name hakase nginx_image
Volume configuration
VOLUME ["/etc/nginx/sites-enabled", "/etc/nginx/certs", "/etc/nginx/conf.d", "/var/log/nginx", "/var/www/html"]

By: LittleWing **at:** *2017-08-22 04:58:30* Reply

For one want to run NGINX use TCP/IP 127.0.0.1:9000:
- Update default nginx vhost: change line with fastcgi_pass to fastcgi_pass 127.0.0.1:9000;- In Dockerfile update these line:
+ Add ENV variable refer to fpm pool.d/www.conf:
ENV fpm_pool_www /etc/php/7.0/fpm/pool.d/www.conf

+ Then use sed command to edit www.conf:
RUN sed -i 's/listen = \/run\/php\/php7.0-fpm.sock/listen = 127.0.0.1:9000/g' ${fpm_pool_www}

By: Ray **at:** *2017-12-16 14:39:55* Reply

I followed all the commands using a mac and tweaked where necessary. I was able to create the image and to run an instance. I pointed the host port to 8080 but I am getting an empty response when I visit http://host_ip:8080. This is my docker command: docker run -d -v ~/Sites/webroot:/var/www/html -p 8080:80 --name vhr_opencart nginx_image

By: TiTex **at:** *2018-02-22 19:26:28* Reply

i hope this tutorial is just a proof of concept , because otherwise is far from optimal from a best practices point of view

By: Patrick **at:** *2018-02-27 02:27:52* Reply

and what would be optimal have any examples

By: Brian **at:** *2018-03-15 01:41:11* Reply

curl 192.168.1.250curl -I 192.168.1.250
If I follow your instruction verbatim. The two above commands do not work.
Do you have to install nginx on the system?
There is something missing with your instructions.

By: Mahender Singh **at:** *2018-03-26 10:45:47* Reply

Thanks a lot for sharing step by step and explained docuement.
Reagards
Mahender

By: Michael Cooper **at:** *2018-06-15 09:21:45* Reply

Nicely done article, What if I want to create multiple server blocks? How would that look in this configuration?

Thanks,

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Tutorial Info

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linux, server, ubuntu, virtualization, web server

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