Docker Training

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Please note this Tutorial will be run on Linux

1 Creating Docker Files to create Docker Images

example 1 : Hello World Without Arguments

Step 1 : Create a folder for your Docker Image and open this folder:

hello-cpp0/

Step 2: Inside this folder create a file called: Dockerfile with this content:

```
FROM amytabb/docker_ubuntu16_essentials
COPY HelloWorld /HelloWorld
WORKDIR /HelloWorld/
RUN g++ -o HelloWorld helloworld.cpp
CMD ["./HelloWorld"]
```

Step 3: Inside this folder create a folder called HelloWorld

step 4: Inside this folder create a C++ file : helloworld.cpp with this content:

```
#include <iostream>
using namespace std;

int main()
{
  cout << "Hello world 0!" << endl;
  return 0;
}
```

Step 6: Run the following commands to create the Docker Image:

sudo docker pull amytabb/docker_ubuntu16_essentials

sudo docker build -t hello-cpp0 .

Step 7: Launch the Docker Image using Docker:

sudo docker run -it hello-cpp0

Example 2 : Hello World With Arguments

Step 1: Create a folder for your Docker Image and open this folder:
hello1/

Step 2: create a file called: Dockerfile with this content:

```
FROM amytabb/docker_ubuntu16_essentials
ENV NAME VAR1
ENV NAME VAR2
ENV NAME VAR3
COPY run_hello1.sh /run_hello1.sh
COPY HelloWorld /HelloWorld
WORKDIR /HelloWorld/
RUN g++ -o HelloWorld1 helloworld1.cpp
WORKDIR /
CMD ["/bin/sh", "/run_hello1.sh"]
```

Step 3: Inside this folder create a folder called HelloWorld
Step 4: Inside this folder create a C++ file : helloworld.cpp with this content:

```
#include <iostream>
#include <string>
using namespace std;

int main(int argc, char **argv)
{
  cout << "Hello world 1, with arguments!" << endl;

  string val;
  for (int i = 1; i < argc; i++){
          val = argv[i];
       cout << "Argument " << i << " " << val << endl;
  }
  return 0;
}
```

Step 5: Inside this folder create a shell script file: run_hello1.sh with this content:

```
#!/bin/sh
./HelloWorld/HelloWorld1 $VAR1 $VAR2 $VAR3
```

Step 6: Inside this folder run the following command:
chmod 775 run_hello1.sh

Step 7: Inside this folder run the following command:
cd ../

Step 8: Run the following commands to create the Docker Image:
sudo docker build -t hello1 .
sudo docker run -it -e VAR1='23' hello1

Example 3: Simple Java Hellow World

Step 1: Create a folder for your Docker Image and open this folder:
hello-java/

Step 2: Inside this folder create a Java file : HelloWorld.java with this content:

```
public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello, World");
    }
}
```

Step 3: Inside this folder run the following command to complie this Class:
javac HelloWorld.java

Step 4: Inside this folder run the following command to Pull the Alpine Docker Image from the Docker Repository
sudo docker pull alpine:latest

Step 5: Inside this folder create a file called: Dockerfile with this content:

```
FROM alpine:latest
ADD HelloWorld.class HelloWorld.class
RUN apk --update add openjdk8-jre
ENTRYPOINT ["java", "-Djava.security.egd=file:/dev/./urandom", "HelloWorld"]
```

Step 6: Inside this folder run the following commands to create the Docker Image:
sudo docker pull alpine:latest
sudo docker build --tag "docker-hello-world:latest" .

Step 7: Inside this folder run the following command to launch the Docker Image:
sudo docker run docker-hello-world:latest

Example 4 : Hello World Apache Webserver

Step 1: create a folder for your Docker Image and open this folder:

helloweb/

Step 2: Inside this folder create a HTML file : Index.html with this content:

<html>
<body>
<h1>Hellow World</h1>
</body>
</html>

Step 3: Inside this folder create a file called: Dockerfile with this content:

FROM centos:latest
MAINTAINER NewstarCorporation
RUN yum -y install httpd
COPY index.html /var/www/html/
CMD [“/usr/sbin/httpd”, “-D”, “FOREGROUND”]
EXPOSE 80

Step 4: Inside this folder run the following commands to create the Docker Image:
sudo docker pull centos:latest
sudo docker build -t webserver:v1 .

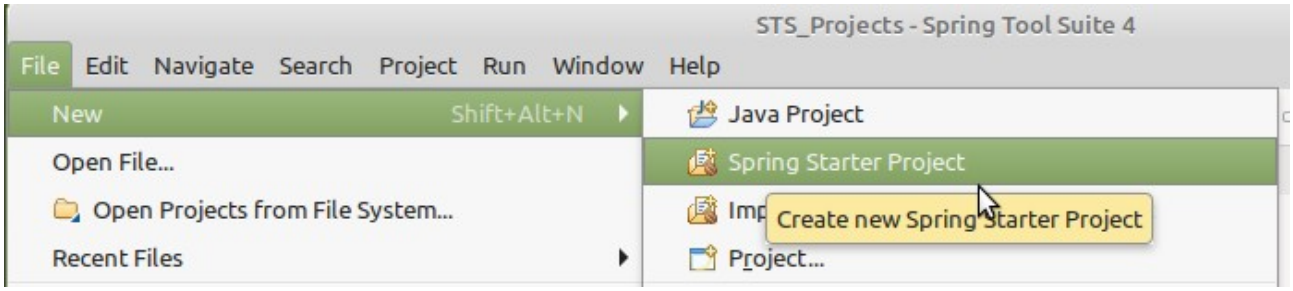
Step 5: Inside this folder run the following commands to launch the Docker Image using :
sudo docker run -dit -p 1234:80 webserver:v1

Step 6: Open your browser to :

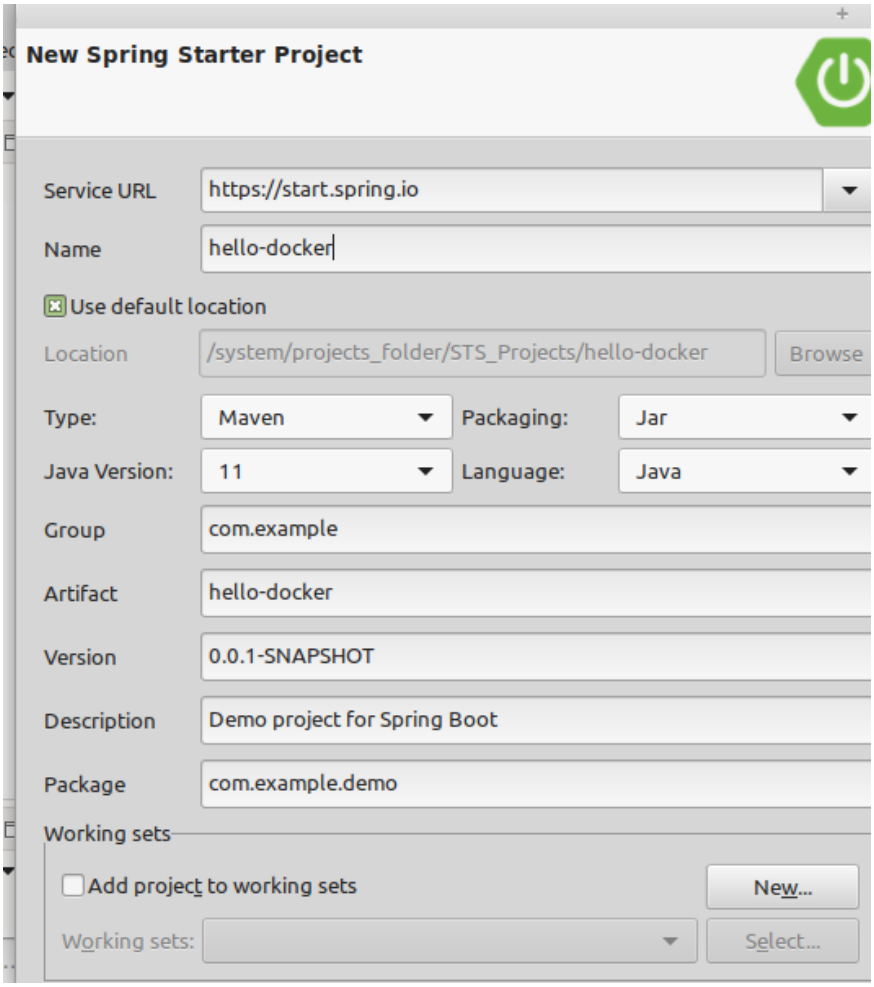
http://localhost:1234

Example 5: Java Spring Boot Microservice

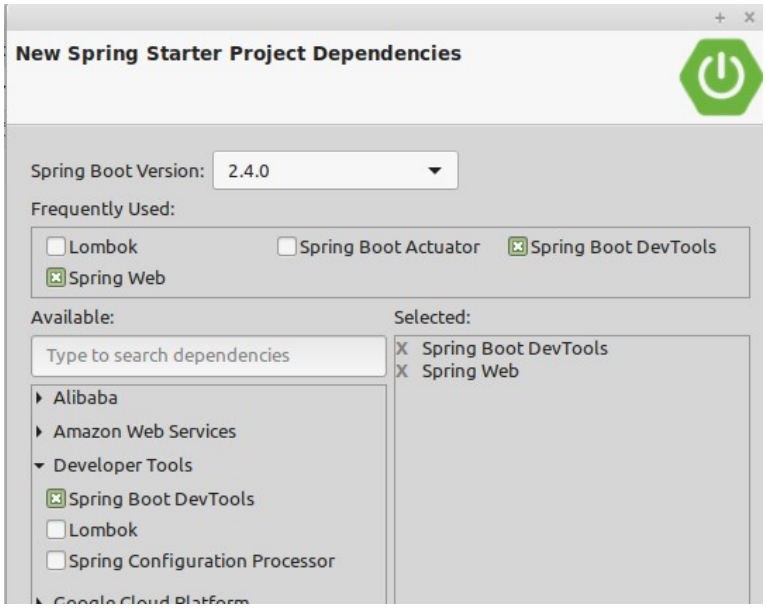
Step 1 : create a Spring Boot project that will generate JAR file: hello-docker.jar



and name it hello-docker and press the Next button



Select the Spring Boot version required
Expand Web and select SpringWeb and expand
DeveloperTools and select Spring Boot devTools
and press the Next button and then the Finish Button



Step 2 : Adding the Java code

Create a package : com.example.demo.controllers

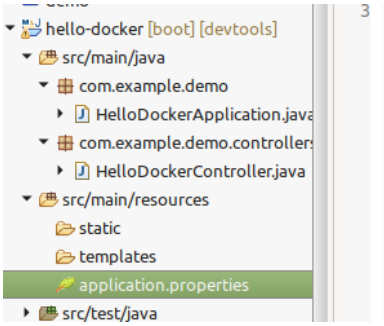
In this package create a class HelloDockerController and use the following Java Code:

```
package com.example.demo.controllers;

import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

@RestController
public class HelloDockerController {

	@RequestMapping("/greet")
	public String getGreeting() {
		return "HelloDocker";
	}

}
```

Step 3 : Make the following changes to the POM file:

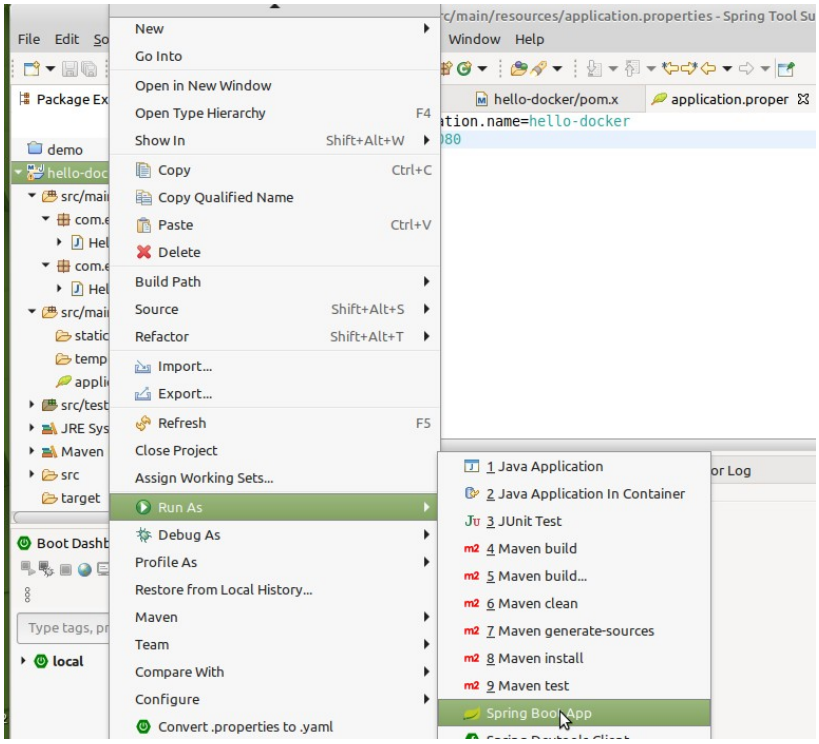
```
<dependencies>
	<!-- needed to fix issue with missing/invalid enum values -->
	<dependency>
		<groupId>com.sun.xml.bind</groupId>
		<artifactId>jaxb-impl</artifactId>
		<version>2.2.4</version>
	</dependency>
	<dependency>
		<groupId>org.apache.commons</groupId>
		<artifactId>commons-lang3</artifactId>
		<!-- <version>3.3.2</version> -->
	</dependency>
	<dependency>
		<groupId>commons-codec</groupId>
		<artifactId>commons-codec</artifactId>
		<version>1.11</version>
	</dependency>
	<dependency>
		<groupId>org.springframework.boot</groupId>
		<artifactId>spring-boot-starter-web</artifactId>
	</dependency>
	<dependency>
		<groupId>org.springframework.boot</groupId>
		<artifactId>spring-boot-starter-tomcat</artifactId>
		<scope>provided</scope>
	</dependency>

	<dependency>
		<groupId>org.springframework.boot</groupId>
		<artifactId>spring-boot-devtools</artifactId>
		<scope>runtime</scope>
		<optional>true</optional>
	</dependency>
	<dependency>
		<groupId>org.springframework.boot</groupId>
		<artifactId>spring-boot-starter-test</artifactId>
		<scope>test</scope>
	</dependency>
</dependencies>

<build>
	<finalName>${project.artifactId}</finalName>
	<plugins>
		<plugin>
			<groupId>org.springframework.boot</groupId>
			<artifactId>spring-boot-maven-plugin</artifactId>
		</plugin>
	</plugins>
</build>
```

Step 4: In the resources folder edit the applications.properties file



Now add this code there:
spring.application.name=hello-docker
server.port=8080

Step 5: Test this project
Right click the project and select Run As and select Spring Boot App



Open the browser to this URL: http://localhost:8080/greet
You should see : HelloDocker
Stop the Server running in the IDE or shut down the IDE

Step 6 Open the folder where your IDE saved this project
Now run the following maven command in a terminal in that folder:
nicm@nm-laptop:/system/projects_folder/STS_Projects/hello-docker$ **mvn clean package**
You should find the following file in the target folder : hello-docker.jar
You will need to copy it in the Docker folder in the next steps
Test this jar file : java -jar hello-docker.jar
Open the Browser here : http://localhost:8080/greet

Step 7: Building the Docker Project
Create a folder called:
Hellodocker/

Step 8: Inside this folder copy the JAR file from the previous step

Step 9: Inside this folder create a file called: Dockerfile with this content:

```
FROM alpine:latest
WORKDIR /
VOLUME /tmp
ADD hello-docker.jar hello-docker.jar
RUN apk --update add openjdk11-jre
EXPOSE 8080
CMD java -jar hello-docker.jar
```

Step 10: Inside this folder run the following commands to create the Docker Image:
sudo docker pull alpine:latest
sudo docker build -t hello-docker:v1 .

Step 11: Inside this folder run the following commands to launch the Docker Image using :
sudo docker run -it -p 1234:8080 hello-docker:v1

Step 12: Open your browser to :

http://localhost:1234
You should now see :
HelloDocker

2 Portainer

Now we will look at docker container management commands and manage then manage them in Portainer

Install Portainer running these commands in a terminal:

sudo docker volume create portainer_data

sudo docker run -d -p 8000:8000 -p 9000:9000 --name=portainer --restart=always -v /var/run/docker.sock:/var/run/docker.sock -v portainer_data:/data portainer/portainer-ce

Open the browser with thhis URL:
http://localhost:9000

Use the Following Credentials:
user:admin
password:adminadmin

3 Getting Familiar with docker commands

Running an Ubuntu Container and accessing it from the terminal
sudo docker run -it ubuntu bash

Now run these commands from the terminal
ls -l
pwd
whoami
more /etc/os-release
lscpu
top
uname -a

Listing docker Images

sudo docker images

Listing All Docker Containers

sudo docker container ls -a

Starting a listed container

(assuming a container was listed as: 0a0631eeea21)

sudo docker start -i 0a0631eeea21

Run and Delete a container afterwards

sudo docker run --rm -t ubuntu bash

Deleting all Docker Containers

(its dangerous but it give you back all the disk space used)
sudo docker container prune

Pulling (down) Docker containers

sudo docker pull ubuntu
sudo docker pull sonarqube
sudo docker pull postgres
sudo docker pull nginx
sudo docker pull ubuntu
sudo docker pull mariadb
sudo docker pull httpd
sudo docker pull centos

Show Details of Docker containers

sudo docker container ls

List all Containers

sudo docker container ls -l
sudo docker container ls -a
sudo docker container ls --all

List all Images

sudo docker images

Stopping a container

sudo docker stop ubuntu

Deleting a container

sudo docker stop hello-world
sudo docker rm hello-world
sudo docker stop 724a4081c966
sudo docker rm 724a4081c966

Deleting an Image (This is permanent)

sudo docker images
sudo docker rmi hello-world

Running containers :

sudo docker run hello-world
sudo docker run -it ubuntu bash

Launch a container in the interactive mode

sudo docker run -i -t ubuntu:latest /bin/bash

Attached Mode

In this mode, the console you are using to execute docker run will be attached to standard input, output and error.
That means your console is attached to the container's process.

Detached Mode

In detached mode, you can follow the standard output of your docker container with docker logs -f <container_ID>

Running Containers in Attached mode:

docker run -rm mongo ..... Mongo listens to port 27017
Ctrl C to stop it

Running Containers in Detached mode (as a service):

sudo docker run -d -p 80:80 gvelrajan/hello-world:v1.0
sudo docker run -d -p 8080:80 gvelrajan/hello-world:v1.0
sudo docker ps

Run and then delete the container:

sudo docker run --rm -t ubuntu bash

Running a webserver with internal port 80 and external port 4000 and 4001

sudo docker run --rm -it -p 4000:80 simple-webserver
sudo docker run --rm -it -p 4001:80 simple-webserver

You access the following webserver instances from the browser at:
http://localhost:4000
http://localhost:4001

Pruning Docker Containers Images and volumes

Pruning unused Docker Containers

The following removes all containers
sudo docker container prune

The following removes containers created more than 5 minutes ago:
sudo docker container prune --force --filter "until=5m"

Prune unused Docker Images

sudo docker image prune

Limiting images pruned to only images created more than 24 hours ago:

sudo docker image prune -a --filter "until=24h"

Prune Volumes (this is non recoverable)

sudo docker volume prune

Removing volumes which are not labelled with the keep label:

sudo docker volume prune --filter "label!=keep"

4 The Dockerfile Syntax

FROM centos // you are specify "Super - Container" usually the O/S web server or Database
MAINTAINER <author's detail>
COPY <src> ... <dst> // to copy files into the Image
ADD <src> ... <dst> // similar to add but handles tar commands
ENV <key> <value>
ENV DEBUG_LVL 3
ENV APACHE_LOG_DIR /var/log/apache
USER <UID>|<UName> // <UID> numerical user ID <UName> :valid user Name
WORKDIR <dirpath>
VOLUME <mountpoint>
EXPOSE <port>[/<proto>] [<port>[/<proto>]...]
EXPOSE 7373/udp 8080
RUN <command> // to run a command in the Image
CMD <command> // execute a shell command during launch of the container
ENTRYPOINT <command> // shell command executed during the launch of the container.
ONBUILD <INSTRUCTION>
ONBUILD ADD config /etc/appconfig

And Example of a Dockerfile :

```
##########################################
# Dockerfile to build an Apache2 image
##########################################
# Base image is Ubuntu
FROM ubuntu:14.04
# Author: James Bond
MAINTAINER James Bond <james.bond007@gmail.com>
# Install apache2 package
RUN apt-get update && \
apt-get install -y apache2 && \
apt-get clean
```

Running Containers with a Hard coded port
sudo docker container run --name mongo mongo -p 8081:271017 mongo
sudo docker container rm -f mongo .....manually deletes the container

Running Containers with Dynamically allocated port
sudo docker container run -d --name mongo -p 271017 mongo

Pausing/Unpausing a Docker Container
sudo docker run -i -t ubuntu:latest /bin/bash

5 Docker Swarms

Difference between Docker and Docker Swarm

As a platform, Docker has revolutionized the manner software was packaged.
Docker Swarm or simply Swarm is an open-source container orchestration platform and is the native clustering engine for and by Docker.
Swarm turns a pool of Docker hosts into a virtual, single host.

Worker Nodes

Worker nodes are also instances of Docker Engine whose sole purpose is to execute containers.

Create Swarm

docker swarm init ....do this on the first node to manage the swarm

Joining a swarm

docker swarm join --token SWMTKN-1-4zfe8c7vezompmxgnvr59z9fzj4dop9lggde6qk4qs71nytr97-03cjgmeh8yiun807y7adz6k79 10.154.2.105:2377

Creating workers

docker swarm join-token worker
.. it will display :
To add a worker to this swarm, run the following command:
sudo docker swarm join --token SWMTKN-1-4zfe8c7vezompmxgnvr59z9fzj4dop9lggde6qk4qs71nytr97-2srtr4qxcnvc9bqmr9nn6s76z 10.154.2.105:2377

Joining another node as a worker to this swarm

sudo docker swarm join --token SWMTKN-1-4zfe8c7vezompmxgnvr59z9fzj4dop9lggde6qk4qs71nytr97-2srtr4qxcnvc9bqmr9nn6s76z 10.154.2.105:2377