

WETHINKCODE_

DEV OPS

PROJECT III

Docker:

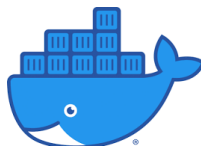
Now, you're thinkinking with containers...

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1 SUMMARY

Right now, you are probably developing a one-block app, with softwares and libraries installed directly in your development environment, or maybe in a virtual environment... **WeThinkCode_** has provided students with two options.

IMAGINE IF YOUR APPLICATION HAS TO BE DEPLOYED ALL OVER THE WORLD AND YOU HAVE TO RE- DEVELOP IT FOR ALL EXISTING PLATFORMS AND OS...

Docker was created to satisfy this need for unification and normalisation: it makes it possible to split an application into several microservices, light, adaptable, universal and scalable, and it also gives the system administrators a great flexibility to deploy and scale up the app. This suite of projects on Docker will help you better understand this specific tool, but also the various aspects of applications development using microservices.

The aim of the Docker-1 project is to make you handle docker and docker-machine, the bases to understand the idea of containerization of services. You can see this project as an initiation.

2 GETTING STARTED

2.1 Windows

Windows Installation*: Windows is trash[1]

2.2 Linux

Linux Installation**: Begin by ensuring that you have docker[2] installed on your system, if not type:

```
$ sudo snap install docker
```

2.3 MacOS

At the time of typing this document a Mac was not available to conduct testing but the documentation[3] does state that installation and

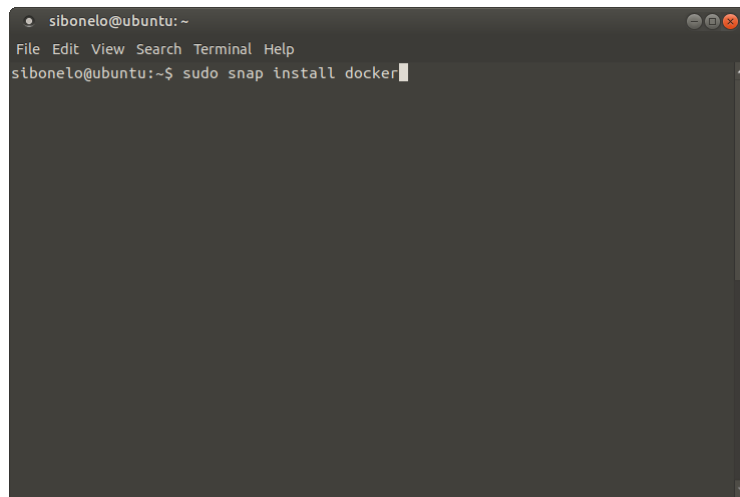


Figure 1: *sudo snap install*, of Docker on Ubuntu

setup occurs with a call to *Homebrew* or an installation of Docker Desktop.

3 OO_HOW_TO_DOCKER

3.1 Exercise 01 - 09

01 - Create docker-machine

`docker-machine create --driver=virtualbox Char`

This will begin the creation of the machine. Ensure that you have installed 'virtualbox' or an error will be received.

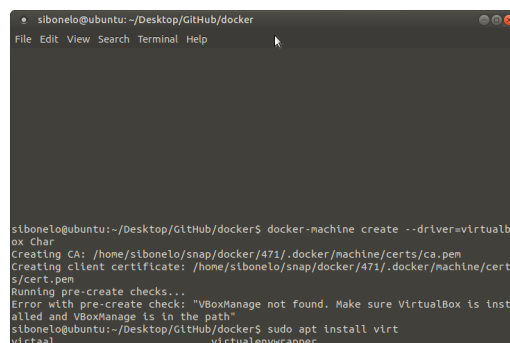


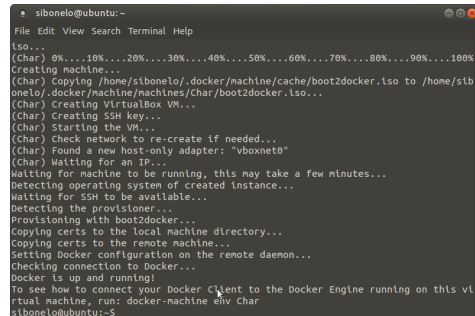
Figure 2: Install error *sudo user*, for VirtualBox

* Information provided is correct for current users configuration i.e Windows Home 10:2004, results may differ for other configurations

** Snap install is not available for all Linux Distros, this is expected to work on Ubuntu and Debian flavours

NB: The snap install will cause virtualbox and VBoxManage to not work, so rather uninstall it and use the official installation and instructions LinuxHint[4]

If everything is configured correctly, the terminal will begin downloading an ISO. Reference to Figure 3.



```

sibonelo@ubuntu:~$ docker-machine create --driver virtualbox char
iso...
(Char) 0%...10%...20%...30%...40%...50%...60%...70%...80%...90%...100%
Creating machine...
(Char) Copying /home/sibonelo/.docker/machine/cache/boot2docker.iso to /home/sibonelo/.docker/machine/machines/char/boot2docker.iso...
(Char) Creating VirtualBox VM...
(Char) Creating SSH key...
(Char) Starting the VM...
(Char) Check network to re-create if needed...
(Char) Found a new host-only adapter: "vboxnet0"
(Char) Waiting for an IP...
Waiting for machine to be running, this may take a few minutes...
Detecting operating system of created instance...
Waiting for SSH to be available...
Detecting the provisioner...
Provisioning with boot2docker...
Copying certs to the local machine directory...
Copying certs to the remote machine...
Setting Docker configuration on the remote daemon...
Checking connection to Docker...
Docker is up and running!
To see how to connect your Docker Client to the Docker Engine running on this virtual machine, run: docker-machine env char
sibonelo@ubuntu:~$

```

Figure 3: Install *success*, for Docker-Machine - Char

You have successfully created a Docker Machine named 'Char'.

02 - Get docker-machine IP

To get the ip address of the docker-machine '**Char**' that we have just created needs us to type:

```
docker-machine ip Char
```

The address that is returned for our current machine is:

```
192.168.99.100
```

At this point I would recommend running:

```
docker-machine ls
```

This will list all the docker-machines currently installed on your system and show you their status.

03 - Set Environment Variables

In order to set the env for your new machine, you can follow the links below. The reason for doing so, is to allow docker-compose to know what to load in the yaml file before running. This will all be explained later. ENV values are available to containers[5], but also RUN-style commands during the Docker build starting with the line where they are introduced.

This is best explained in the documentation[6] which can be found at <https://docs.docker.com/machine/get-started/>. The subsection is section 6,

connect your shell to the new machine

The command to set env for docker-machine 'Char'

```
eval "$(docker-machine_env_Char)"
```

04 - hello_world Image

Get the 'hello_world' image from Docker Hub[7] and pull it with this command:

```
docker pull hello-world
```

05 - Run Image

Launch the hello-world container:

```
docker run hello-world
```

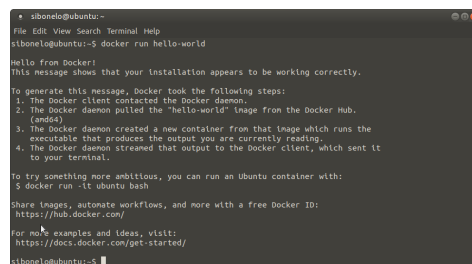


Figure 4: Running hello_world image

06 - Launch an Nginx container

To launch an NginX container, you first have to make sure you have it installed. Check if nginx is listed[8]:

```
docker image ls
```

If it is not listed, run:

```
docker pull nginx
```

After Nginx is installed as an image, run the below commands:

```
docker run -d -p 5000:80 --name overlord
--restart=always nginx
```

Explainer[9]:

- -d: Run in background
- -p: Set port (5000:80 is a configuration)

- `--name`: Set name to overlord
- `restart=always`: Tells docker to always try restart the container

Remember the IP address retrieved in Step 2, if setup has gone correctly visit the ip address and port.

For me this is: <http://192.168.99.100:5000/> Your browser should look like Figure 5

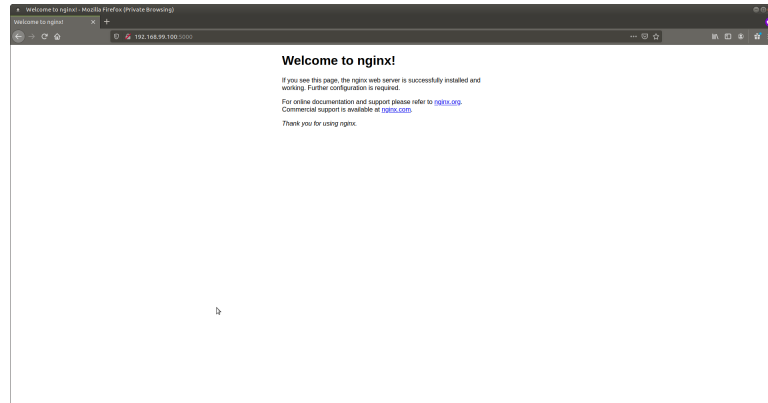


Figure 5: Running Nginx server image on <http://192.168.99.100:5000/>.

NB: Check if it is 'http' or 'https', I wasted quite a few minutes and the best of my curse words on that small discrepancy.

07 - Get the internal IP address of the overlord container

The network above allows you a **bridge** into the internal workings of Docker. The question now is, how do you address the internal Nginx server itself, more specifically... 'overlord':

```
docker network ls
```

is a good place to start. As explained on freecodecamp.org^[10], you will then proceed to use the inspect command. You must know the name of the object you wish to inspect.

```
docker inspect -f "{{_.NetworkSettings.IPAddress_}}"
overlord
```

`-f` = Format the output given the template

The extensive commandline is available here: <https://docs.docker.com/engine/reference/commandline/inspect/>

My returned ip-address is: 172.17.0.2

08 - Launch a shell from an alpine container

To launch an *Alpine* container, you first have to make sure you have it installed. Check if alpine is listed[8]:

```
docker image ls
```

If it is not listed, run:

```
docker pull alpine
```

After alpine is installed as an image, run the below commands:

```
docker run -i -t --rm alpine
```

Explainer

- d=false: Detached mode: Run container in the background, print new container id
- -i: Keep STDIN open even if not attached[11]
- -t: Allocate a pseudo-tty[11]
- --rm=false: Automatically remove the container when it exits[12]
- restart=always: Tells docker to always try restart the container

09 - From the shell of a debian container

To launch a *Debian* container, you first have to make sure you have it installed. Check if Debian is listed[8]:

```
docker image ls
```

If it is not listed, run:

```
docker pull debian
```

After debian is installed as an image, run the below commands:

```
docker run -i -t --rm debian
```

Run a nested call to update, upgrade and install gcc & git:

```
apt-get update -y && apt-get upgrade -y
&& apt-get install gcc -y &&
apt-get install git -y
```

This should provide your image the ability to compile C code and push to a git.

3.2 Exercise 10 - 19

10. Create a volume named hatchery

Creating a Volume in Docker is key to taking your applications to production[13] To do this one must run a volume create command.

```
docker volume create hatchery
```

'hatchery' is the name given to our volume that we created.

11. List all the Docker volumes created on the machine

To check if you were successful in creating your volume or to check all the volumes installed on your machine, run[13]:

```
docker volume ls
```

This shows **ONLY** volumes.

12. Launch a mysql container as a background task

This is quite challenging and needs an individual to be focused, not because the task is large but because of the details embedded within.

```
'spawning-pool' -> 'hatchery' -> 'mysql' -> 'zerglings' -> 'root:Kerrigan'
```

To launch a *mysql* container, you first have to make sure you have it installed. Check if MySQL is listed[8]:

```
docker image ls
```

If it is not listed, run:

```
docker pull mysql
```

After mysql is installed as an image, run the below commands:

```
docker run --name=spawning-pool -d
  --env="MYSQL_ROOT_PASSWORD=Kerrigan"
  --env="MYSQL_DATABASE=zerglings"
  --volume=hatchery:/var/lib/mysql
  --restart=on-failure mysql
```

Explainer[14]:[15]

- -d: Run in background
- -e: Set Environment Variables
- -v: Set Volume to use
- --name: Set name to desired [variable]

- `--restart=on-failure`: Tells docker to try restart the container if it fails

It is worth noting that this matter is only complex because of how the statement concatenates together. If you check the references posted above, it is taken step-by-step. The order I cannot stress this enough of the arguments is very important. At a minimum it will not build what you want, worst case is it builds unusable containers. Take caution! It will restart only on failure.

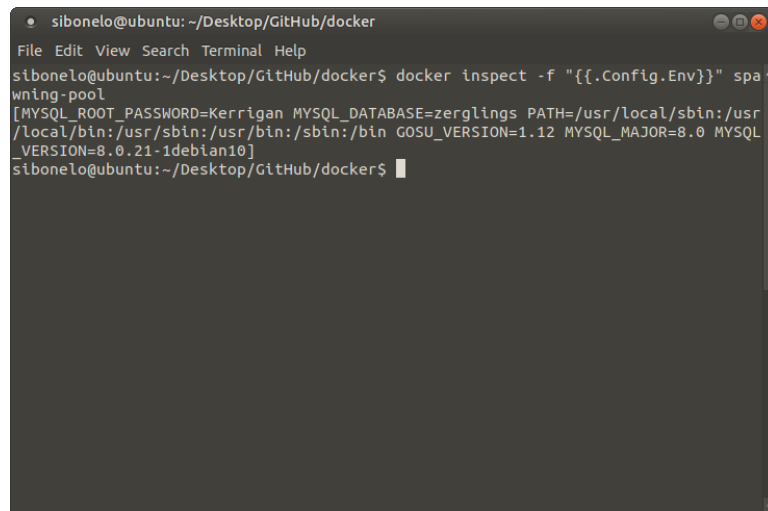
13. Print the environment variables of the spawning-pool

To see if everything worked correctly simply print its environment variables. To do this run:

```
docker inspect -f "{{.Config.Env}}" spawning-pool
```

If spawning-pool failed to set, you will receive an error container in one command, otherwise your output should be similar to Figure 6 to be sure that you have configured your container properly.

We used a similar 'inspect' method earlier. Please reference back to it if you are lost[5].



```
sibonelo@ubuntu: ~/Desktop/GitHub/docker
File Edit View Search Terminal Help
sibonelo@ubuntu:~/Desktop/GitHub/docker$ docker inspect -f "{{.Config.Env}}" spawning-pool
[MYSQL_ROOT_PASSWORD=Kerrigan MYSQL_DATABASE=zerglings PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin GOSU_VERSION=1.12 MYSQL_MAJOR=8.0 MYSQL_VERSION=8.0.21-1debian10]
sibonelo@ubuntu:~/Desktop/GitHub/docker$
```

Figure 6: Print out of MySQL container env variables

14. Launch a wordpress container as a background task

To launch a *wordpress* container, you first have to make sure you have it installed. Check if WordPress is listed[8]:

```
docker image ls
```

If it is not listed, run:

```
docker pull wordpress
```

After WordPress is installed as an image, run the below commands:

```
docker run -d -p 8080:80 --name lair
--link spawning-pool wordpress
```

We used a similar 'inspect' method earlier. Please reference back to it if you are lost[5].

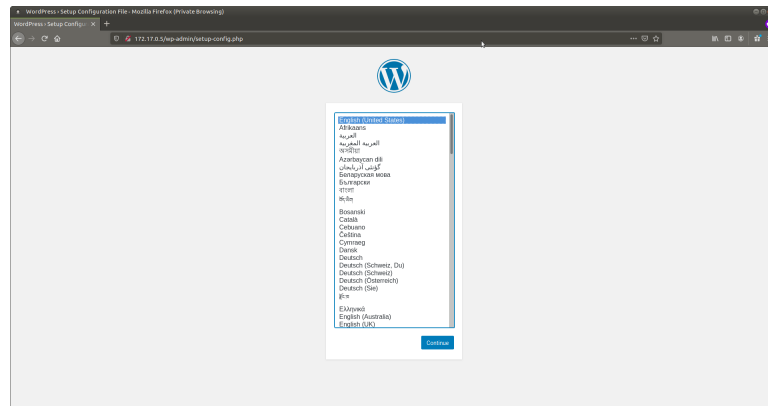


Figure 7: Running WordPress container linked to MySQL 'spawning-pool'

Explainer[16]

- -d: Run in background
- -p: Set port (8080:80 is a configuration)
- -link: Sets the two or more containers to be linked
- -name: Set name to desired [variable]

The name is then set to 'lair'. Run the command to get the IP of the container

`docker inspect -f "{{_.NetworkSettings.IPAddress_}}" lair`
and proceed to that address with the 8080 port appended.

15. Launch a phpmyadmin container as a background task

To launch a *phpmyadmin* container, you first have to make sure you have it installed. Check if `phpmyadmin` is listed[8]:

```
docker image ls
```

If it is not listed, run:

```
docker pull phpmyadmin
```

After phpmyadmin is installed as an image, run the below commands[17]:

```
docker run -d --name roach-warden -p 8081:80
--link spawning-pool:db phpmyadmin
```

Check for the ip address and visit the link with the port activated.
You should see a screen similar to Figure 8

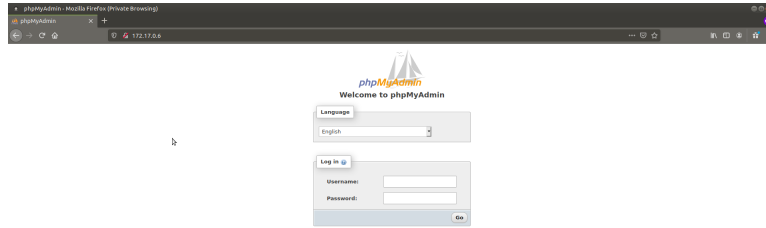


Figure 8: Running PHPMyAdmin container linked to MySQL DB 'spawning-pool'

16. Look up the spawning-pool container's logs

To see the log run:

```
docker logs -f spawning-pool
```

There are other variations that one can try though[\[18\]](#).

17. Display all the currently active containers on the Char virtual machine

To list the status of you containers run:

```
docker stats
```

expect an output similar as shown in Figure 9 on the following page

To list the active containers run:

```
docker ps
```

expect an output similar as shown in Figure 10 on the next page

18. Relaunch the overlord container

To restart a container needs you to tell docker to restart using the container's name e.g:

```
docker restart <container-name>
```

To restart overlord simply run:

```

sibonelo@ubuntu: ~/Desktop/GitHub/docker
File Edit View Search Terminal Help
CONTAINER ID   NAME          CPU %      BLOCK I/O  MEM USAGE / LIMIT
MEM %         NET I/O    PIDS
fb0f0b966914   roach-warden  0.01%      397kB / 0B  9.188MiB / 985.4MiB
0.93%         1.01kB / 0B  6
caf8bceb75ec   lair          0.01%      31.1MB / 0B  14.7MiB / 985.4MiB
1.49%         1.01kB / 0B  6
dc0f3127e73f   spawning-pool 1.80%      65MB / 299MB 319.6MiB / 985.4MiB
32.43%        1.08kB / 0B  38
aaf6ff3f8fe5   overlord      0.00%      10MB / 4.1kB 2.133MiB / 985.4MiB
0.22%         2.08kB / 0B  2

```

Figure 9: Running 'docker stats' to ascertain running containers

```

sibonelo@ubuntu: ~/Desktop/GitHub/docker
File Edit View Search Terminal Help
sibonelo@ubuntu:~/Desktop/GitHub/docker$ docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED
STATUS        PORTS         NAMES
fb0f0b966914   phpmyadmin     "/docker-entrypoint.s..." 16 minutes ago
Up 16 minutes  0.0.0.0:8081->80/tcp    roach-warden
caf8bceb75ec   wordpress      "docker-entrypoint.s..." 17 minutes ago
Up 17 minutes  0.0.0.0:8080->80/tcp    lair
dc0f3127e73f   mysql         "docker-entrypoint.s..." 30 minutes ago
Up 30 minutes  3306/tcp, 33060/tcp    spawning-pool
aaf6ff3f8fe5   nginx         "/docker-entrypoint.s..." 16 hours ago
Up 8 hours    0.0.0.0:5000->80/tcp    overlord
sibonelo@ubuntu:~/Desktop/GitHub/docker$

```

Figure 10: Running 'docker ps' to see container processes

```
docker restart overlord
```

You may notice that 'overload' now has a different uptime. It has gone from '8 hours' as shown in Figure 10 to a few seconds as shown in Figure 11 on the next page.

To learn more about the docker commandline please reference as before to the Docker Documentation[8].

19. Launch a container name Abathur

To launch a *python* container, you first have to make sure you have it installed. Check if python is listed[8]:

```
docker image ls
```

If it is not listed, run:

```

sibonelo@ubuntu: ~/Desktop/GitHub/docker
File Edit View Search Terminal Help
sibonelo@ubuntu:~/Desktop/GitHub/docker$ docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED
STATUS        PORTS          NAMES
fb0f0b966914   phpmyadmin     "/docker-entrypoint.s..." 47 minutes ago
Up 47 minutes  0.0.0.0:8081->80/tcp    roach-warden
caf8bceb75ec   wordpress      "docker-entrypoint.s..." 48 minutes ago
Up 48 minutes  0.0.0.0:8080->80/tcp    lair
dc0f3127e73f   mysql         "docker-entrypoint.s..." About an hour ago
Up About an hour 3306/tcp, 33060/tcp      spawning-pool
aaf6ff3f8fe5   nginx         "/docker-entrypoint.s..." 17 hours ago
Up 12 seconds   0.0.0.0:5000->80/tcp    overlord
sibonelo@ubuntu:~/Desktop/GitHub/docker$

```

Figure 11: Running 'docker restart overlord' to see the restart of 'overlord'

```
docker pull python
```

This will install a python image[19]. Note that the tutorial[20] uses a Dockerfile but we are expected to produce the commands instead, therefore follow closely. After python is installed as an image, run the below commands:

```
docker run -it -d --name Abathur -p 3000:3000
-v ~/home/sibonelo/./root python:2-slim
```

change sibonelo to whatever your home folder uses to recognise you. It is also worth noting that even though we pulled a python image, docker pulled another container for the 2-slim version.

Run the next command to install flask on your python container Abathur:

```
docker exec Abathur pip install Flask
```

20. Create a local swarm

, the Char virtual machine should be its manager.

4 01_DOCKERFILES

A Section or subsection covering extensively unit testing will be key either here or on it's own chapter

5 RESULTS AND DISCUSSION

6 CODE SNIPPET AS A FIGURE

Reference to Figure 12.

```
import { Button } from "@material-ui/core"
import React, { useState } from "react"
import GameCanvas from "../GameCanvas"

5 const Game = (props) => {
  const [gameOver, setGameOver] = useState(true)

  const handleStart = () => setGameOver(false)

10  return (
    <>
      {gameOver ? (
        <Button color="primary" onClick={handleStart}>
          start
15        </Button>
      ) : (
        <GameCanvas setGameOver={setGameOver} />
      )}
    </>
20  )
}

export default Game
```

Listing 1: Game Start Code.

Figure 12: Code Snippet from the game front-end to get it running *localhost* limitation, JSX Component, from <http://localhost:3000/>.

7 BIBLIOGRAPHY

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8 STUDENT HONESTY DECLARATION

Engaging in any cheating or dishonesty in any form of assessment, assignment, test or examination or other WeThinkCode_ prescribed work is considered cheating and is grounds for disciplinary action. Plagiarism, which is to present work (or a portion of work) as your own when it is not, is considered cheating and is not accepted at WeThinkCode_.

An evaluator can flag one for plagiarism on one of the following grounds :

- The evaluator (marker) identifies that the student does not understand all or part of the work they have submitted.
- If all or part of the work presented is plagiarised ,i.e. copied from another source without reference.

Cheating in group projects

The main purpose for a group project is to give students the experience of working in a team, by coming up with a solution to a problem together.

- Each member must be able to show which portion of the project they worked on.
- Failure to do so will result in the student being flagged for cheating which will be grounds for disciplinary action.
- This is to avoid single members doing the majority of the group project at the benefit of a member who is not contributing.
- In this way we are able to ensure fair assessment of each WTC student's competence.

Group projects can be approached in two ways.

1. Divide and conquer: This is usually preferred and advised when working on big projects. The project is divided into segments, in which each member of the group can accomplish. Once completed, the group will then integrate the segments to complete the project
2. One for all: This method is usually preferred and advised when a group is working on a small project. The group will work on the solution together from the start of the project until the end. This will require the members to move at a pace in which everyone in the team can keep up with.

NOTE: At the end of each group project, each member should have a general and basic understanding of the project and the solution found. This will include running, testing and explaining the solutions of the project.

DECLARATION

I hereby declare that the work submitted by me and/or my group members is:

- Original (not plagiarised)
- References listed
- Honest & in Good Faith
- Subject to WeThinkCode_policies

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