Docker

Introduction

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- Introduction

Docker commands

General

	Column Header
Version	docker --version
Pull image from Dockerhub	docker pull <image-name>
Start container from image	docker run <image-name>
List all running containers	docker ps
Stop container	docker stop <contId>
List all containers including stopped	docker ps -a
Delete container	docker rm <container-id>
Image List	docker images
Delete image	docker rmi <image-name>
Map container port to host port	docker run -p <host-port>:<container-port> myapp
Map container directory to host directory	docker run -v <host-dir> <cont-dir>
Inspect running container	docker inspect <image-name>
Execute command on container	

Run

	Column Header
Start a container	docker run hello-world
Start container in background	docker run -d hello-world
Start container with std in/out	docker run -i -t <image>

Port mapping

The following runs a container and maps port 80 on the container to port **4000** on the container host.

```
  docker run -d -p 4000:80 --name myapp2 aspnetapp
```

Docker logs

We can list the logs for the container using

```
docker logs <container-id>
```

The following shows a simple example

```
> docker logs 6ff

> Hosting environment: Production
> Content root path: /app/
> Now listening on: http://[::]:80
> Application started. Press Ctrl+C to shut down.
```

Docker Inspect

We can list the entire information for a container using. This also gives the container IP Address.

```
docker inspect <container-id>
```

Viewing the directory structure of running container

If the container is Linux based we can execute a shell to log on and see what is happening on a running container

```
  docker exec -i -t 7d bash
```

We now have a shell onto the container.

Building Images

CMD and ENTRYPOINT

To illustrate the difference between CMD and ENTRYPOINT we will use the following simple web application

Source Code

```
namespace ASPHelloWorld
{
    public class Program
    {
        public static void Main(string[] args)
        {
            string message = args.Length > 0 ? args[0] : "Hello";

            var webHost = new WebHostBuilder()
                .UseKestrel()
                .Configure(app =>
                {
                    app.Run(async ctx =>
                    {
                        await ctx.Response.WriteAsync(message);
                    });
                })
                .Build();

            webHost.Run();
        }
    }
}
```

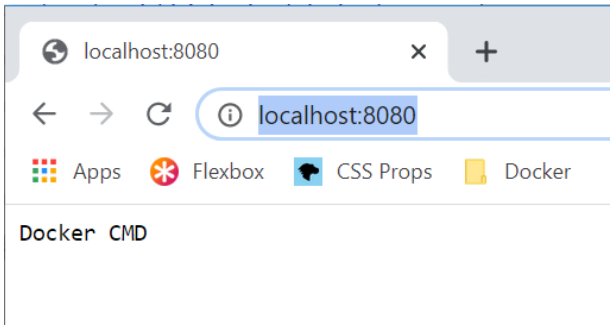
Dockerfile

```
FROM mcr.microsoft.com/dotnet/core/sdk:3.1 AS build

# WORKDIR sets the working directory for any RUN, CMD, ENTRYPOINT, COPY
and ADD
# instructions that follow it. If the workdir does not exist it is
created
WORKDIR /app

# copy .sln to /app/.sln
COPY *.sln .

# copy aspnetapp/*.csproj to /app/aspnetapp/*.csproj
COPY ASPHelloWorld/*.csproj ./ASPHelloWorld/

# Use NuGet to restore dependencies.
RUN dotnet restore

# copy everything else to /app/aspnetapp
COPY ASPHelloWorld/. ./ASPHelloWorld/

# Set the wordir
WORKDIR /app/ASPHelloWorld

# Compiles the application and publishes the results to a directory
RUN dotnet publish -c Release -o out

FROM mcr.microsoft.com/dotnet/core/aspnet:3.1 AS runtime
WORKDIR /app

# --from=build sets the source location to the previous step named build
COPY --from=build /app/ASPHelloWorld/out ./

ENTRYPOINT ["dotnet", "ASPHelloWorld.dll"]

CMD ["Docker CMD"]
```

We can build and run an instance of our web application as follows

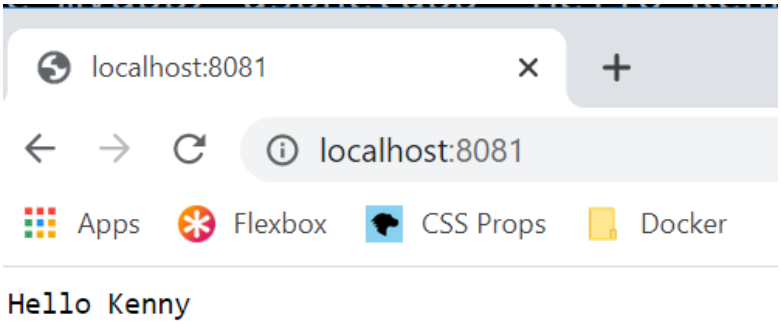
```
build -t aspnetapp .
docker run -d -p 8080:80 --name myapp aspnetapp
```

When we connect to our application from a browser we see the value of the CMD is returned



If we want to override the value of CMD we can do this from the command line. We create a second instance on a different port and with a different message

```
docker run -d -p 8081:80 --name myapp2 aspnetapp "Hello Kenny"
```



For ports see

https://stackoverflow.com/questions/48669548/why-does-aspnet-core-start-on-port-80-from-within-docker

Dockerize ASP.Net core

Basic Example

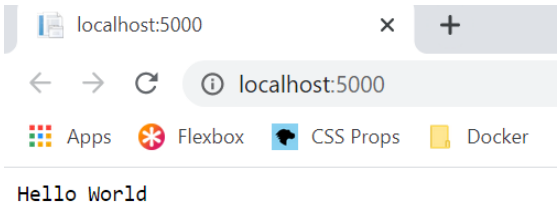
Consider a single file ASP.NET Core application. It is the simplest hello world application

```
public class Program
{
    public static void Main(string[] args)
    {
        var webHost = new WebHostBuilder()
            .UseKestrel()
            .Configure(app =>
            {
                app.Run(async ctx =>
                {
                    await ctx.Response.WriteAsync("Hello World");
                } );
            })
            .Build();

        webHost.Run();
    }
}
```

And a simple `launchSettings.json` as follows

```
{
  "profiles": {
    "ASPHelloWorld": {
      "commandName": "Project",
      "launchBrowser": true,
      "applicationUrl": "http://localhost:5000",
      "environmentVariables": {
        "ASPNETCORE_ENVIRONMENT": "Development"
      }
    }
  }
}
```

Running this application inside of Visual Studio and connecting to http://localhost:5000 gives the following.



DOCKERIZE

Create the Docker File

```
FROM mcr.microsoft.com/dotnet/core/sdk:3.0 AS build
WORKDIR /app

# copy csproj and restore as distinct layers
COPY *.sln .
COPY aspnetapp/*.csproj ./aspnetapp/
RUN dotnet restore

# copy everything else and build app
COPY aspnetapp/. ./aspnetapp/
WORKDIR /app/aspnetapp
RUN dotnet publish -c Release -o out

FROM mcr.microsoft.com/dotnet/core/aspnet:3.0 AS runtime
WORKDIR /app
COPY --from=build /app/aspnetapp/out ./
ENTRYPOINT ["dotnet", "aspnetapp.dll"]
```

Build an image

Run the following command

```
docker build -t aspnetapp .
```

Run a container from the image

```
docker run -d -p 8080:80 --name myapp aspnetapp
```

Note that the docker image runs in the container on port 80. The launchSettings.json is ignored. For this reason, we map port 80 on the container to port 8080 on the container host so we can access it from localhost

Mapping directory from docker container to host

Now consider the situation where our application logs to the container via Serilog. The configuration is as follows.

Serilog (appsettings.config)

```
"WriteTo": [
  {
    "Name": "File",
    "Args": {
      "path": "/var/tmp/logs/log.txt",
      "rollingInterval": "Day"
    }
  },
  {
    "Name": "Console"
  }
]
```

We create the directory `/var/tmp` in the Dockerfile.

Dockerfile

```
WORKDIR /app
COPY *.sln .
COPY ASPHelloWorld/*.csproj ./ASPHelloWorld/
RUN dotnet restore
COPY ASPHelloWorld/. ./ASPHelloWorld/

WORKDIR /app/ASPHelloWorld
RUN dotnet publish -c Release -o out

FROM mcr.microsoft.com/dotnet/core/aspnet:3.1 AS runtime
WORKDIR /app
RUN mkdir -p /var/tmp/logs
COPY --from=build /app/ASPHelloWorld/out ./

ENTRYPOINT ["dotnet", "ASPHelloWorld.dll"]
CMD ["Docker CMD"]
```

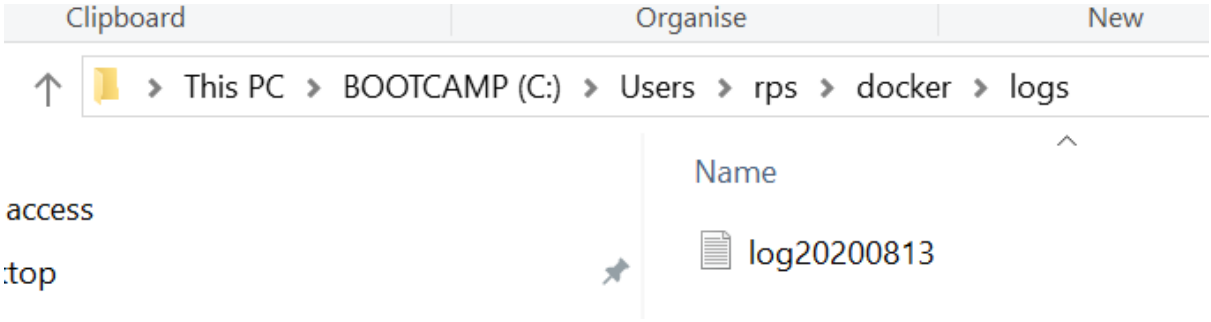
We now build the container

```
docker build -t aspdotnetapp .
```

Finally, we run the container and map the container log file `/var/tmp/logs` to the folder `C:\Users\rps\docker\logs` on the container host

```
docker run -d -p 8080:80 -v C:\Users\rps\docker\logs:/var/tmp/logs
aspdotnetapp
```

When we attach a browser to the port localhost:8080 we will see the log file shows up in the docker host filesystem in directory **`C:\Users\rps\docker\logs`**



We can also view the mount that maps the directory by running the docker inspect command on the running container

```
Docker inspect 7d
```

And inside the output we see

```
"Mounts": [
    {
        "Type": "bind",
        "Source": "/host_mnt/c/Users/rps/docker/logs",
        "Destination": "/var/tmp/logs",
        "Mode": "",
        "RW": true,
        "Propagation": "rprivate"
    }
],
```

A docker image captures the private filesystem that the that your containerized component will run in. The image contains just what the component needs. The image isolates all the dependencies your component needs.

A Dockerfile describes how to assemble a private filesystem for a container. This file provides step by step instructions on how to build up the image.

Docker Compose

Linking Containers

Consider a simple example where one container runs an instance of MongoDB and other container runs a script that uploads data. The upload container needs to have access to the MongoDB container IP address. The way we do this is with links. Consider the following. The bold pieces link together the containers for mongohost

docker-compose.yaml

```
version: '3'
services:
    mongohost:
        image: mongo

        ports:
            - 27010:27017
    mongo-load:
        build:
            context: MongoPopulate
            dockerfile: Dockerfile
        links:
            - mongohost
```

MongoPopulate/Dockerfile

```
FROM mongo
COPY myarchive /myarchive
COPY populate.sh /populate.sh
CMD "./populate.sh"
```

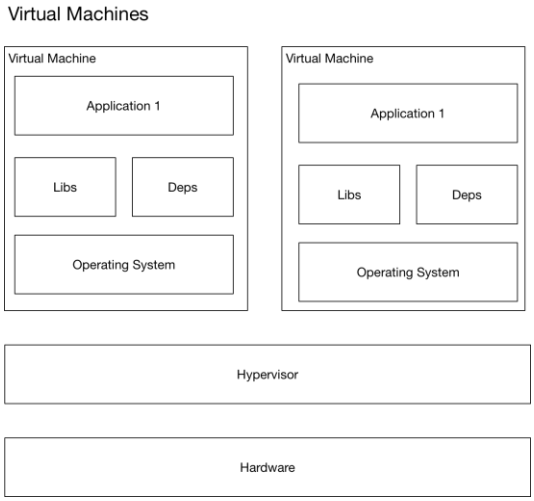
MongoPopulate/populate.sh

```
echo "Doing the load"
sleep 10
mongorestore --uri="mongodb://mongohost:27017" --drop --archive=myarchive
--gzip
echo "Finished"
```

Overviews

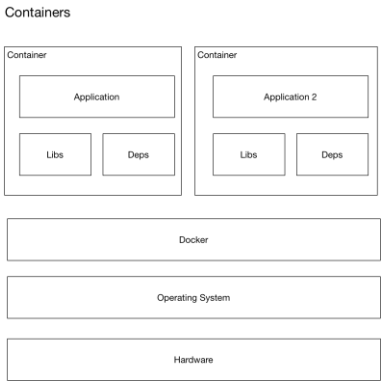
Compare Docker and Virtual Machines

Consider the following diagram that shows how virtualization works.



- Multiple virtual machines running on the same hardware
- Heavyweight solution
- Each virtual machine has its own operating system
- Each VM typically requires GB of desk space as it runs whole OS
- Complete Isolation
- High overhead
- Start-up time can be minutes as OS needs to start.

Now let us look at Docker.



- Lightweight solution
- Each container typically MB in size
- Starts up in second.
- Docker has less isolation as more resources are shared across containers (kernel)

Overview of Docker

Docker runs on the OS and manages multiple containers. Each container has its own set of libraries and other dependencies. These dependencies are used by the application that runs inside the container.

A docker image is a template that is used to create docker containers. Each container is hence an instance of the image. A container is created using the docker run command. Dockerhub is a public repository of images for applications such as MongoDB and Node.js. We can also create our own images

A container is a running process with some added features to keep it isolated from the host and from other containers. Each container has its own private filesystem. The filesystem is provided by the docker image.

Docker Run

TAGS

If you look up an image on Dockerhub.com is listed all supported tags for that image. We can specify versions using the tags

```
docker run redis:4.0
```

STDIN/STDOUT

By default docker containers run in non-interactive form. It does not listen to stdin. Its does not have a terminal to read input from. To provide input we must map stdin from our host to the docker container

```
docker run -i <image>
```

If we want a prompt and terminal, we need to add a terminal too.

```
docker run -i -t <image>
```

PORT MAPPING

Consider we run a simple webapp.

```
docker run kodekloud/webapp
```

If we want to know the IP of a docker container we run the command.

```
docker inspect --format='{{range .NetworkSettings.Networks}}{{.IPAddress}}{{end}}'
$INSTANCE_ID
```

If we want to map a port from our docker container to the docker host we run the command as follows

```
docker run -p80:5000  kodekloud/webapp
```

docker run image:tag	`Docker run redis:`	Show the version of docker installed

Docker Training

Why docker?

Multiple services require difference versions of the OS or different versions of dependencies. With docker each container can have its own dependencies, libraries, processes, networks and mounts.

The purpose of docker is to package and containerise applications so we can ship them and run them as many times as we need.

Many products are containerised on Dockerhub repository. Such products include OS versions, database versions etc.

All containers share the same OS kernel.

What is an image?

A template used to create containers

What are containers?

Running instances of containers that are isolated and have their own processes

How long does a container live?

As long as the process inside it

Commands

Containers are meant to run a specific task or process e.g. to host an instance of a web server or database. Once the task is complete the container exits. The container only lives as long as the process inside it is alive. Once a web server stops the container exits. We can instruct docker to run a command on our container

```
docker run ubuntu  sleep 120
```

Now we can execute a command on this ubuntu container while it is running

```
C:\Users\rps>docker exec ce55  cat /etc/hosts
127.0.0.1       localhost
::1     localhost ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
172.17.0.2      ce5539c1b552
```

Available Images

To see what kind of images are available go to

https://hub.docker.com/

Docker For Windows

I am installed Docker Community Edition for Windows.

https://hub.docker.com/editions/community/docker-ce-desktop-windows

There are two ways to use Docker on windows. Docker Toolbox is a legacy application so we only consider Docker desktop for windows.

Docker desktop for windows

Docker for windows uses the windows virtualization technology Hyper V. Because of this dependency Docker for Windows requires Windows Professional or Enterprise. The default option is to run Linux underneath. In this configuration all container are Linux containers.

There is now also an option for Windows Container where each container runs on windows.