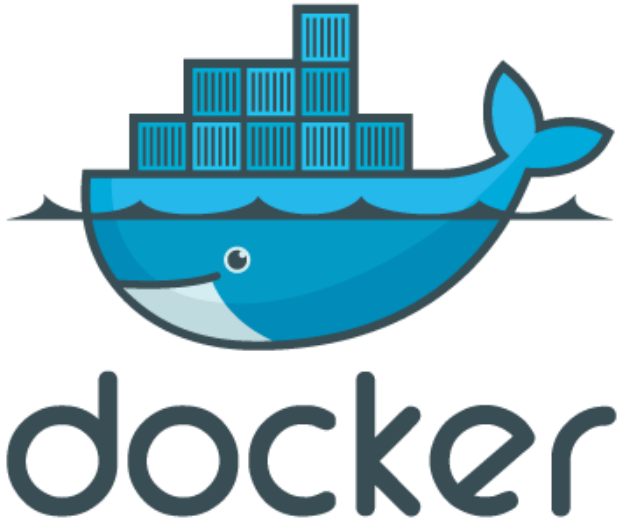

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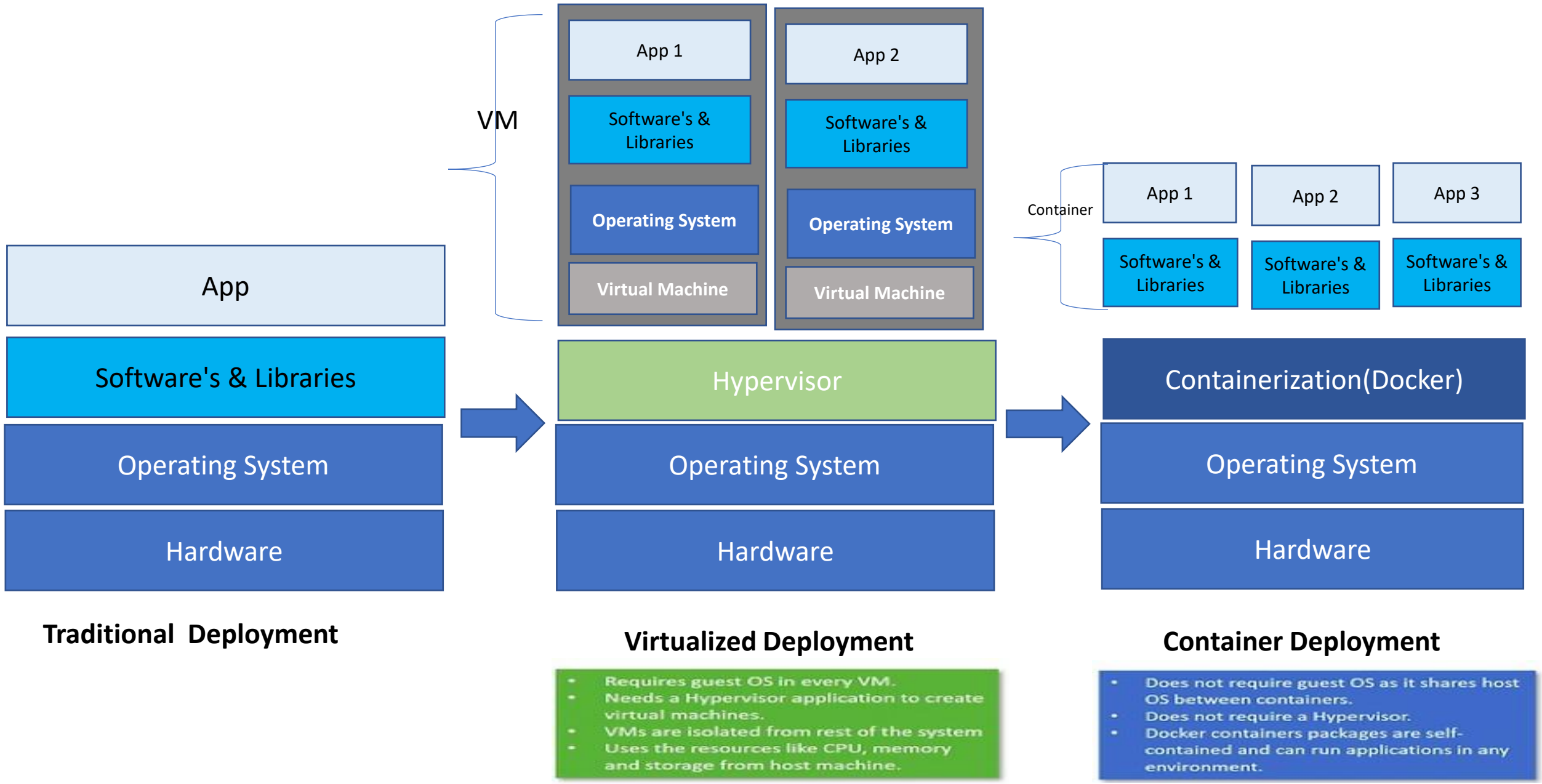
Program Agenda

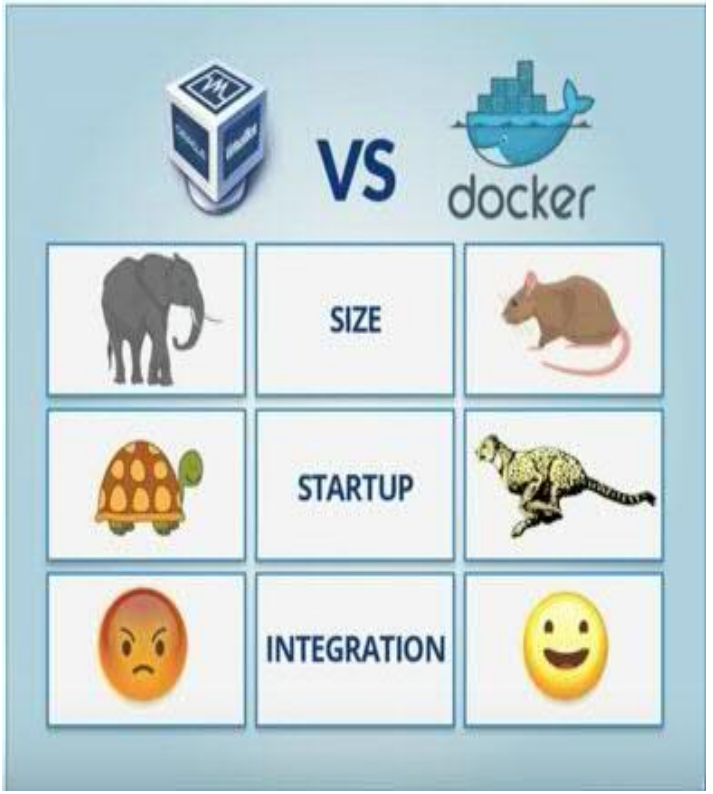
- Introduction
- Virtualization and Containerization
- Virtual Machine and Docker
- Installation
- Dockerfile, Docker Image and Docker Container
- Docker Commands
- Build the Dockerfile
- Create Docker Custom images and Containers, push to Docker Hub
- Docker Compose
- Docker Swarm

Past & Present Of Application Deployment Approach



Virtual Machines Vs Containers

Virtual Machine	*Container*
• Heavyweight	• Lightweight
• Limited performance	• Native performance
• Each VM runs in its own OS	• All containers share the host OS
• Hardware-level virtualization	• OS virtualization
• Startup time in minutes	• Startup time in milliseconds
• Allocates required memory	• Requires less memory space
• Fully isolated and hence more secure	• Process-level isolation, possibly less secure



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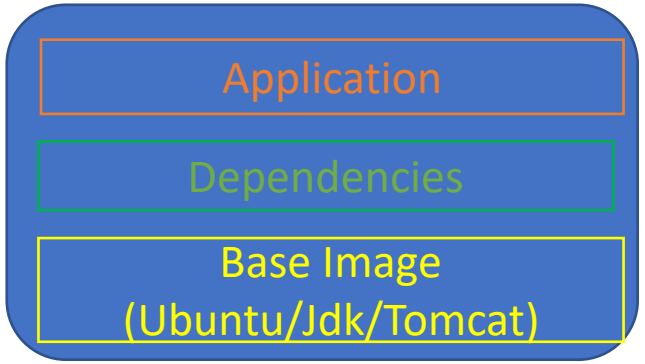
What is Docker

- Docker is a container management platform for developing, deploying and running applications.
- Docker enables you to separate your application with infrastructure.
- Docker is light weight in nature as it does not require a hypervisor
- Docker runs directly on host machine's kernel
- Docker is scalable, quick to deploy and easy to use

- *Docker is a containerisation platform which packages your app and its all dependencies together in the form of containers. so as to ensure that your application works seamlessly in any environment be it dev or test or prod.*
- *Docker is an open platform for developers and sysadmins to build, ship, and run distributed applications*
- *Docker is available in two editions: Community Edition (CE) and Enterprise Edition (EE).*

EX: Base Image + Configurations & Dependencies (Software's) + Application



Why Containers?

Developers care because:

- Quickly create ready-to-run packaged applications, low cost deployment and replay
- Automate testing, integration, packaging
- Reduce / eliminate platform compatibility issues (“It works in dev!”)
- Support next gen applications (microservices)

IT cares because:

- Improve **speed** and frequency of releases, reliability of deployments
- Makes app lifecycle efficient, consistent and repeatable – configure once, run many times
- Eliminate environment inconsistencies between development, test, production
- Improve production application resiliency and scale out / in on demand

Type	Containerization Tool
Vendor	Docker
Is Open Source?	Yes – Some extent
Operating system	Cross Platform
URL	https://www.docker.com/

Docker Installation

Docker For Linux

Docker For Windows

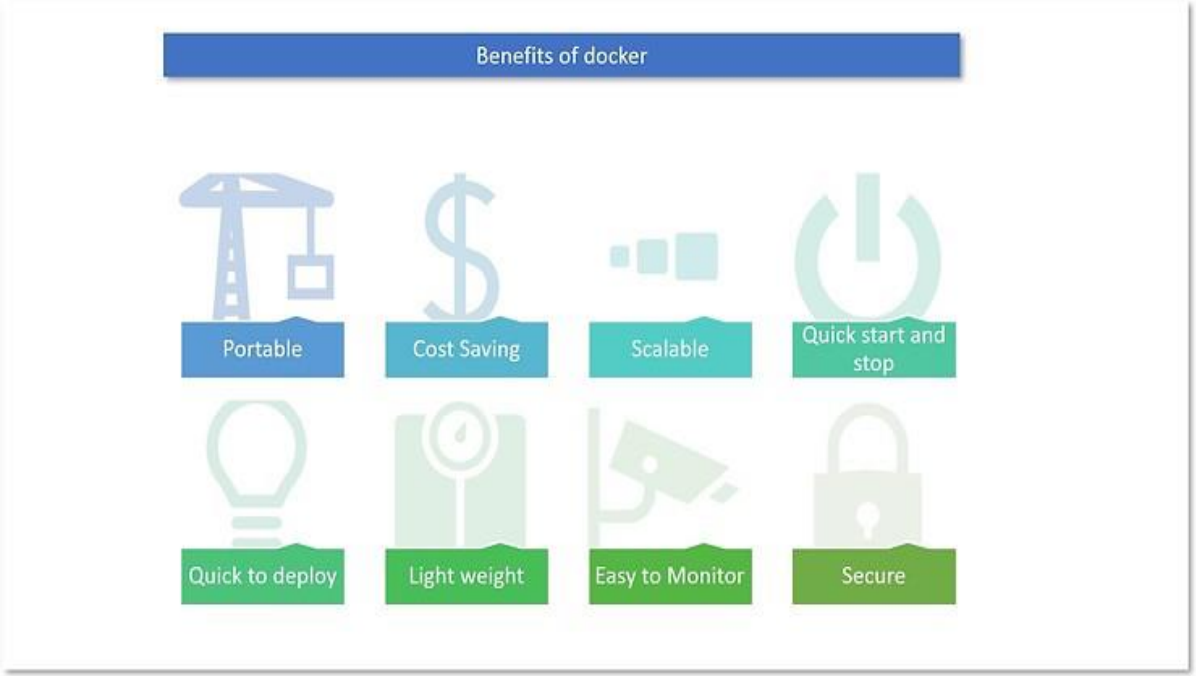
Windows 10 64-bit Home/Pro Only.
Hyper V Should be enabled.

Docker For Mac

https://docs.docker.com/engine/install/

Docker Hub Registry:

Register in https://hub.docker.com/



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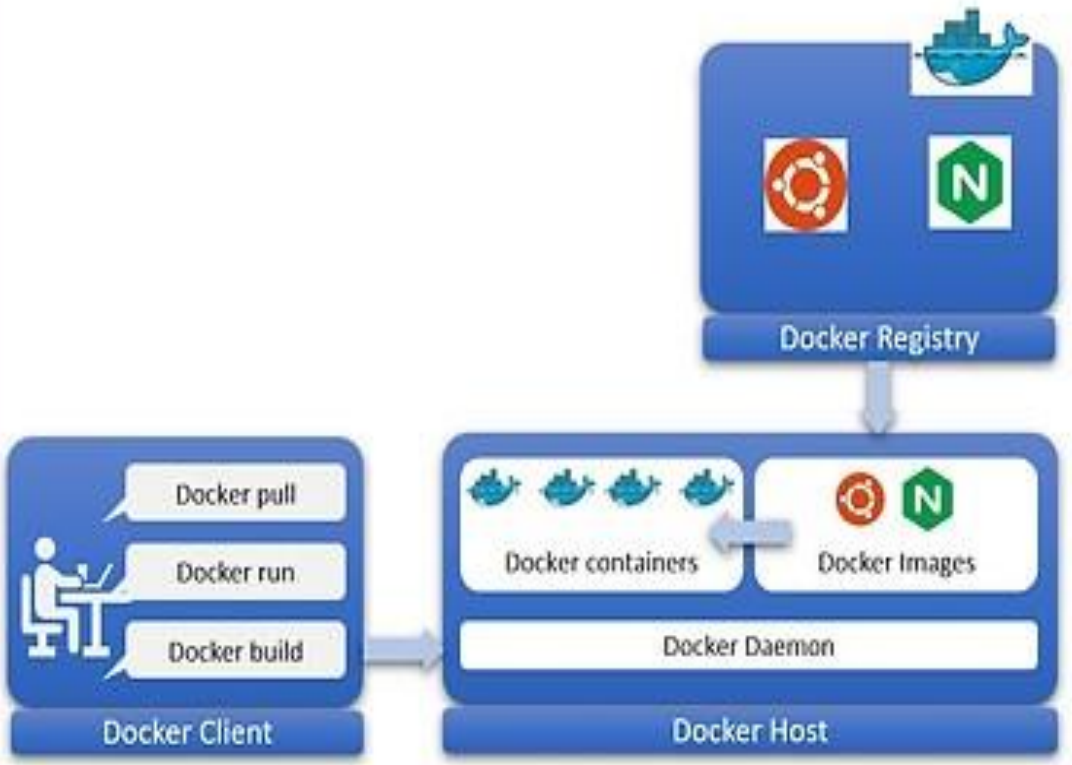
Architecture of Docker showing how it works

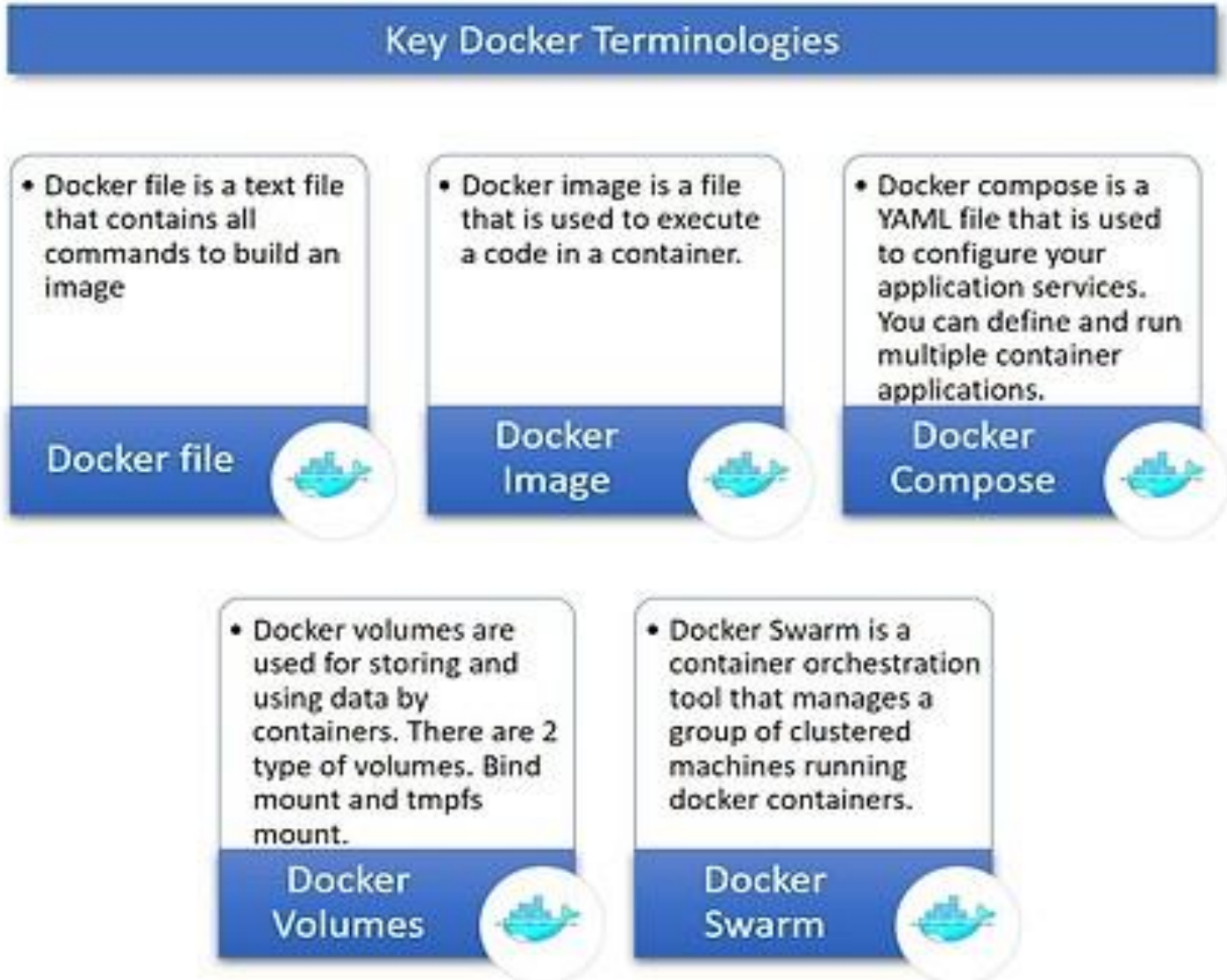
Docker Architecture

Docker consists of three major components

- **Docker Client**
  This is a command line interface (CLI) through which the user send the commands / instructions to docker.
- **Docker Daemon**
  Docker daemon executes the commands sent by the user. Commands may be installing an OS or pulling an image from registry or running a container etc.
- **Docker Registry**
  This is a central repository maintained by Docker and its called Docker Hub. This registry contains various public Images that can be used. Also, the user can create his own image and upload the image in registry either as public or private.



Docker Key Concepts

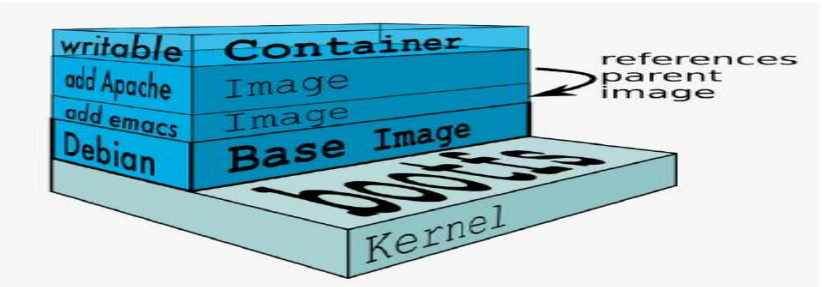


Dockerfile

- Dockerfile is a file, it will describe the steps in order to create an image quickly.
- The Docker daemon runs the instructions in the Dockerfile are processed from the top down, so you should order them accordingly.
- The Dockerfile is the source code of the Docker Image.

Docker Image

- An image is a lightweight, stand-alone, executable package that includes everything needed to run a piece of software, including the code, a runtime, libraries, environment variables, and config files.



Docker Flow

DockerFile

Build

$ docker build -t dockerhandson/java-web-app:1.0 .

NOTE: The "." references Dockerfile in local directory.

dockerhandson is repository (Public Docker hub username) name where we can upload images.

Image

$ docker run –d –name javaapp –p 8080:8080 dockerhandson/java-web-app:1.0

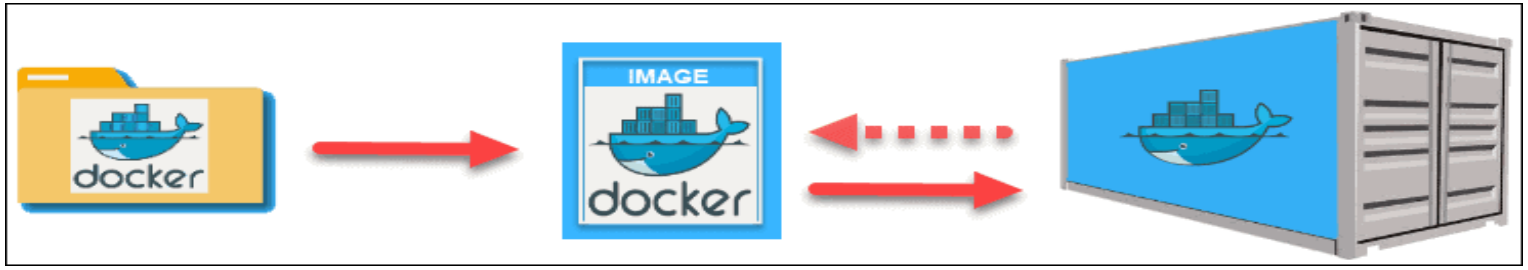
Run

Container

Container Operating System

Software

Application Code




```
# Default name of docker file is Dockerfile
FROM tomcat:8.0.20-jre8
COPY target/java-web-app*.war /usr/local/tomcat/webapps/java-web-app.war
```

Advantages of Docker

- ***Rapid application deployment*** *– containers include the minimal run time requirements of the application, reducing their size and allowing them to be deployed quickly.*

- ***Portability across machines*** *– an application and all its dependencies can be bundled into a single container that is independent from the host version of Linux kernel, platform distribution, or deployment model. This container can be transferred to another machine that runs Docker using it's docker image, and executed there without compatibility issues.*

- ***Version control and component reuse*** *– you can track successive versions of a images, roll-back to previous versions. Containers reuse components from the preceding layers(base images), which makes them noticeably lightweight.*

- ***Sharing*** *– you can use a remote repository to share your image with others. And it is also possible to configure your own private repository.*

- ***Lightweight footprint and minimal overhead*** *– Docker images are typically very small, which facilitates rapid delivery and reduces the time to deploy new application containers. Allowing for more efficient use of computing resources, both in terms of energy consumption and cost effectiveness.*

- ***Simplified maintenance*** *– Docker reduces effort and risk of problems with application dependencies. Multiple containerized apps on a single server don't mess up each other. If you update an app, you just build a new image, run fresh containers and don't have to worry about other ones on the machine breaking*

Advantages of Docker

- ***Self-sufficient***

  A Docker container contains everything it needs to run

  Minimal Base OS

  Libraries and frameworks

  Application code

  A Docker container should be able to run anywhere that Docker can run.

- ***Docker shines for microservices architecture.***

  NOTE: Containers aren't required to implement microservices, but they are perfectly suited to the microservices approach and to agile development processes generally.

Build & Deployment Process

To be more clear,
In 1990’S we had physical servers where apps are hosted and served.

In 2000’S we had Virtual Machines where apps are hosted and served ,running on top of the Physical servers. Virtualization started here.

In early 2013 the concept of Containerization picks up where we can package the application and its dependencies so that whatever a developer released will work regardless of which environment it runs under(DEV, QA & PROD).

Before Docker
Build

- A developer pushes a change to SCM tools.
- The CI sees that new code is available. It rebuilds the project, runs the tests and generates a application package(like jar/war/ear ..etc.)
- The CI saves application package as build artifacts into repositories.

Deployment

- Setup dependencies(Software's) and configuration files in App(Deployment) Servers(Physical/Virtual Machines).
- Download the application package
- Start the application

Build & Deployment Process

Cons:

- Packaging and deploying applications in multiple environments is a real and challenging job.
- Setup Environments before deploying an application.
- Applications may work in one environment which may not work in another environment. The reasons for this are varied; different operating system, different dependencies, different libraries, software versions.

After Docker

Build

- A developer pushes a change to SCM tools.
- The CI sees that new code is available it. It rebuilds the project, runs the tests and generates an application package(jar/war/ear ..etc) & and also we will create docker image(application code(jar/ear/war..etc), dependencies (Software's) and configuration files).
- CI Will push docker image to the docker repo(Public Repo(Docker Hub) or Private Repo(Nexus/JFrog/DTR. Etc.)).

Deployment

- Download the Docker image(package).
- Start the docker image which will create a container where our application will be running.

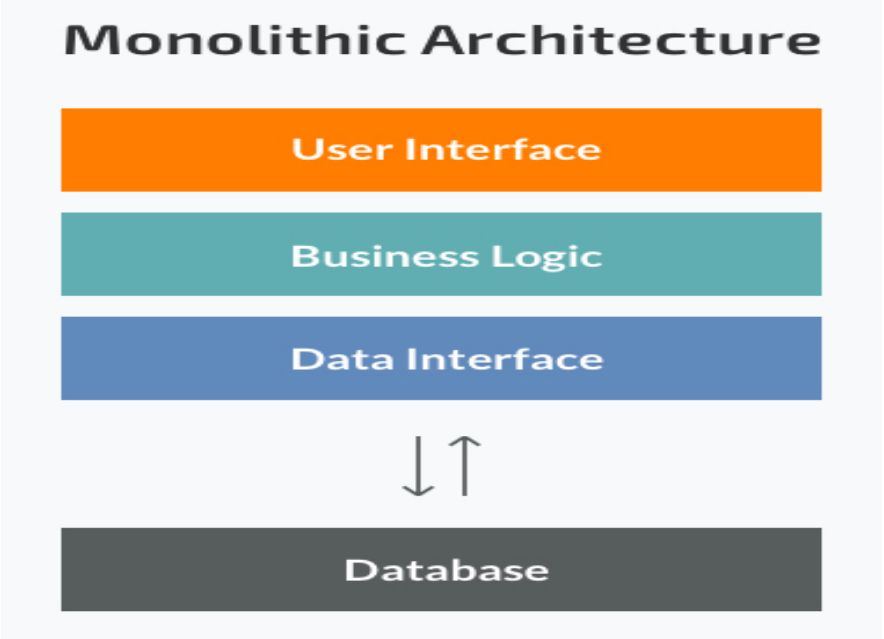
Advantages:

Application works seamlessly in any environment be it dev or test or prod.

Monolithic VS Microservices Architecture

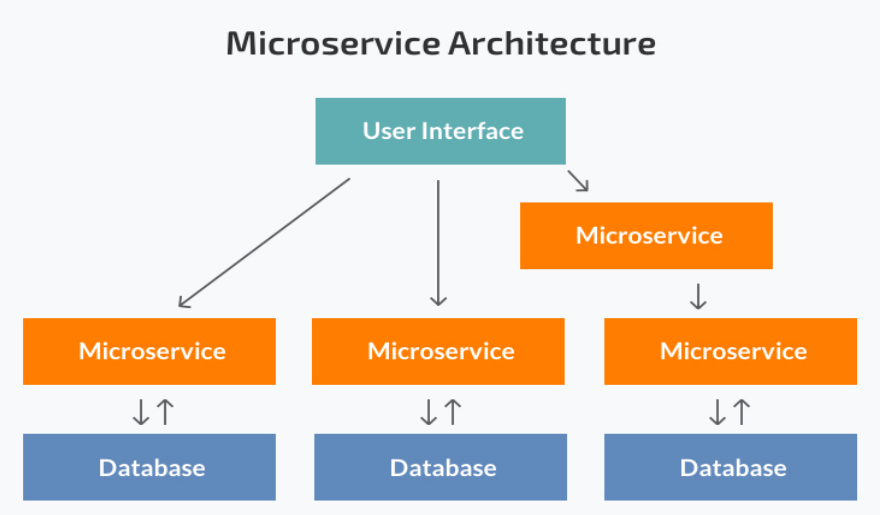
Monolithic Architecture

Monolithic application has single code base with multiple modules. Modules are divided as either for business features or technical features. It has single build system which build entire application and/or dependency. It also has single executable or deployable binary.



Microservices Architecture

Microservices are a software development technique that arranges an application as a collection of loosely coupled services. Which can be developed, deployed, and maintained independently. Each of these services is responsible for discrete task and can communicate with other services through simple APIs to solve a larger complex business problem.



Monolithic

Pros

- Simple to develop
- Simple to deploy single package(war/jar/ear,..etc.).
- Easy to debug & Error tracing.
- Simple to test.

Cons

- Difficult to understand and modify.
- Tightly coupled.
- Redeploy entire app on each update.
- Single bug can bring down entire application.
- Scaling the application is difficult. If we need to scale only few features/modules will end up scaling entire app as its single package.
- Changes on one section(module/features of the code can cause
- impact on the other section of the code as it's a single code base.

Micro Services

Pros

- Loosely coupled.
- Easy to understand & modify as it's small code base.
- Better deployments as each service(feature/module) can be deployed independently.
- Each service can be scaled independently as each service is a separate package.
- Each service can developed using any new technology as each service is a separate code base(Repository).

Cons

- **Communication between services is complex**: Since everything is now an independent service, you have to carefully handle requests traveling between your modules/services using Rest API's.
- **Integration testing is difficult**: Testing a microservices-based application can be cumbersome. In a monolithic approach, we would just need to launch our WAR on an application server and ensure its connectivity with the underlying database. With microservices, each dependent service needs to be deployed before testing can occur.
- **Debugging problems can be harder**: Each service has its own set of logs to go through. Log, logs, and more logs.
- **Deployment challengers**: The Application may need coordination among multiple services, which may not be as straightforward as deploying a WAR in a container.

Questions ?

Thank You