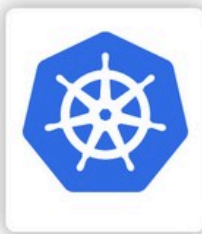
Master Microservices



1+ Million Students Upskilled

JAVA / Python

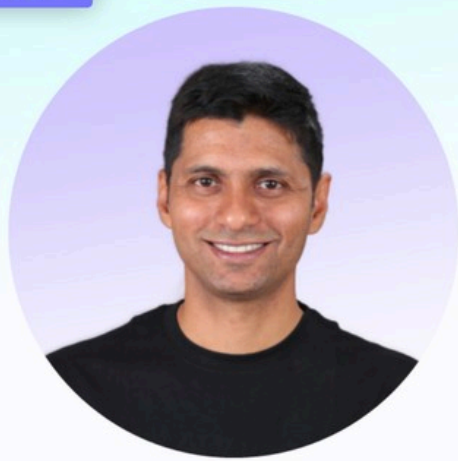
JAVA Microservices

DevOps

AWS

Azure

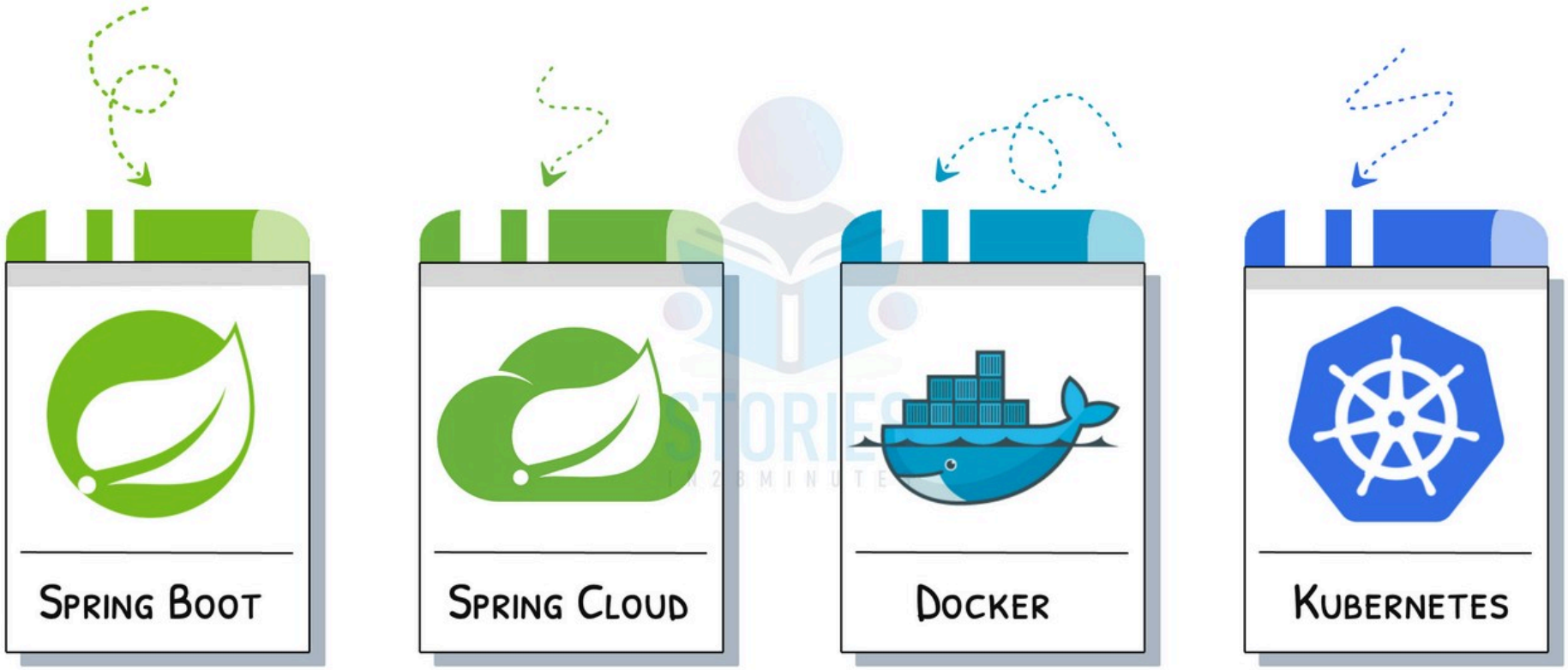
Google Cloud



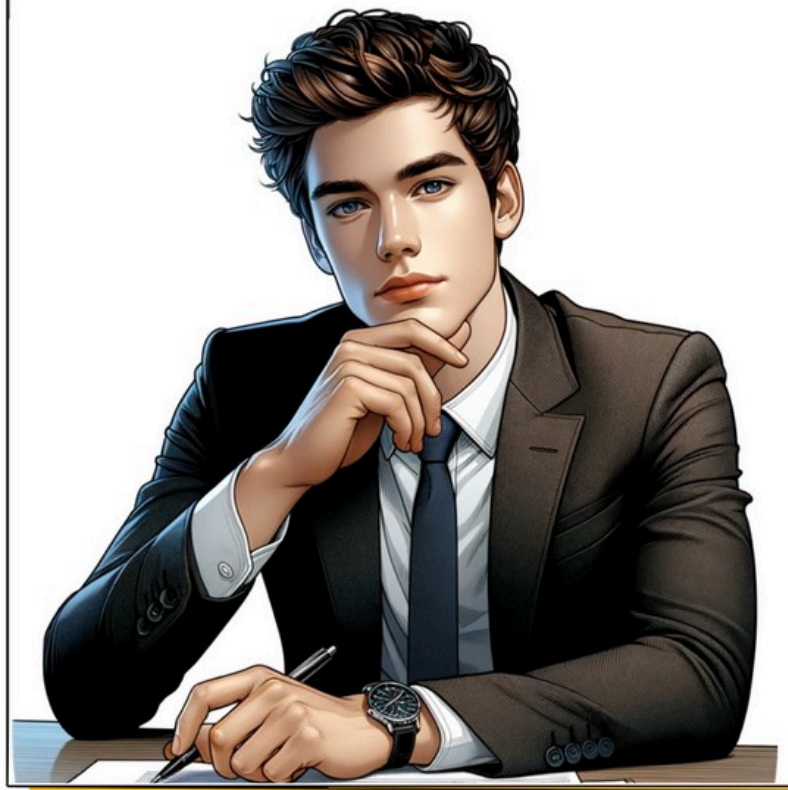
Ranga Karanam

Founder of in28minutes

TOP TOOLS FOR MICROSERVICES DEVELOPMENT



CHALLENGES IN LEARNING MICROSERVICES



Lots of Concepts

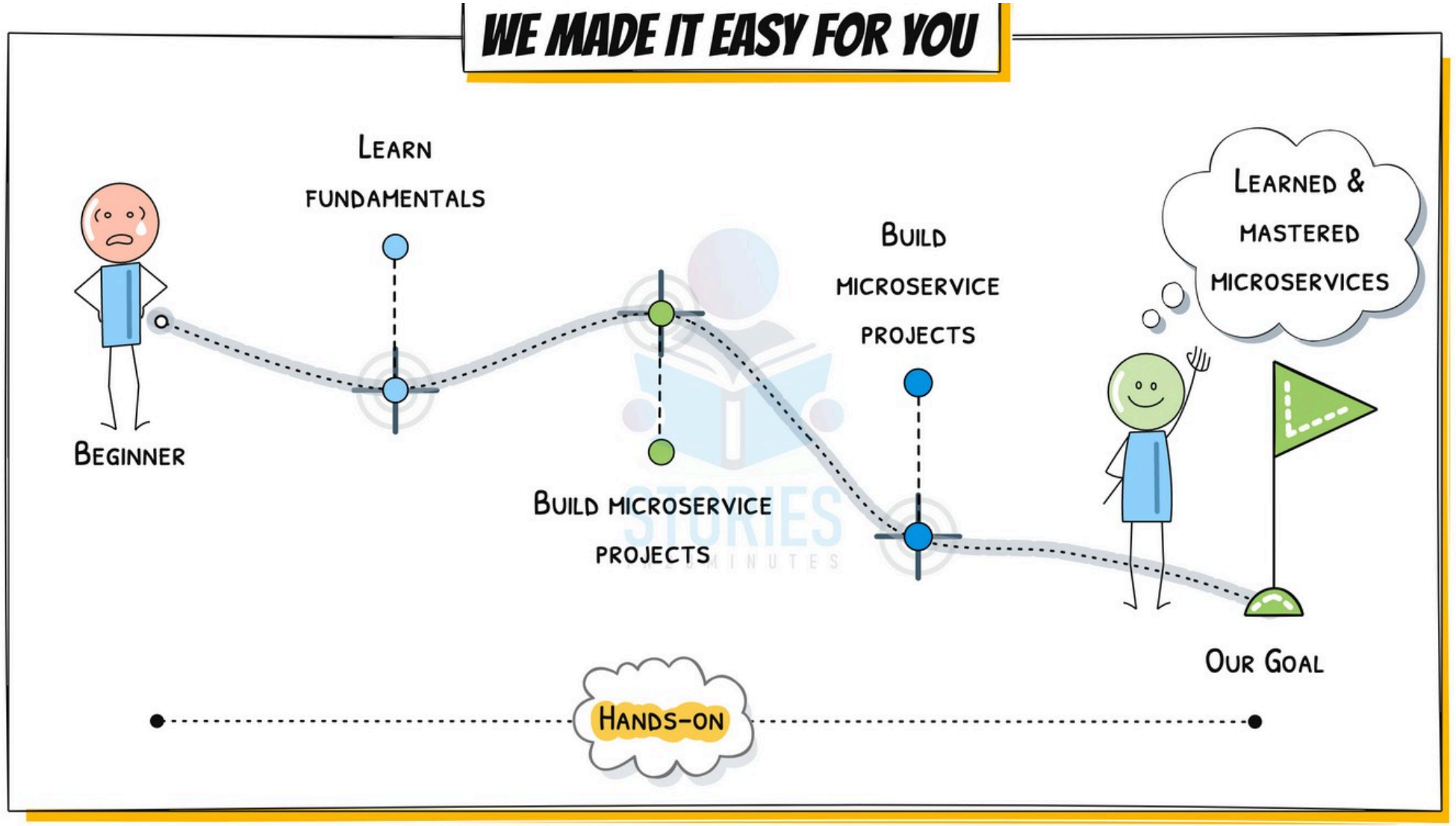
REST API, Service Discovery, API Gateway, Naming Server, Circuit Breakers, Load Balancing, Security...

Diverse Deployment Options

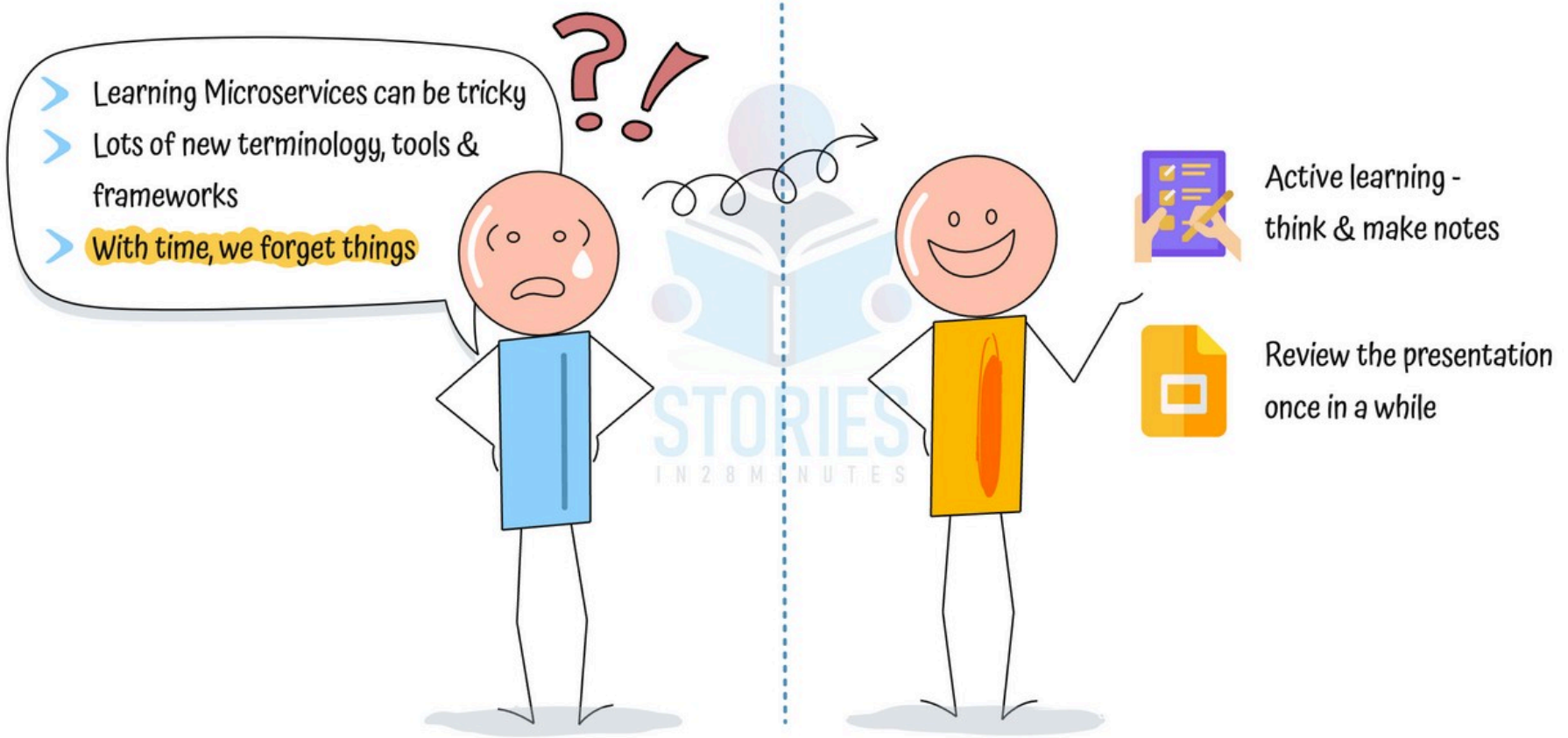
Containers, Orchestration, Cloud-native environments

Needs knowledge of tools & platforms

Spring Boot, Spring Cloud, Docker, Kubernetes, Cloud, and more


WE MADE IT EASY FOR YOU
LEARN
FUNDAMENTALS
BUILD
MICROSERVICE
PROJECTS
LEARNED &
MASTERED
MICROSERVICES
BEGINNER
BUILD MICROSERVICE
PROJECTS
OUR GOAL
HANDS-ON

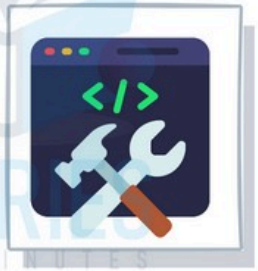
NAVIGATING THE TRICKY PATH OF MICROSERVICES



THE IN28MINUTES APPROACH

Understand The Fundamentals

Beautiful Presentations

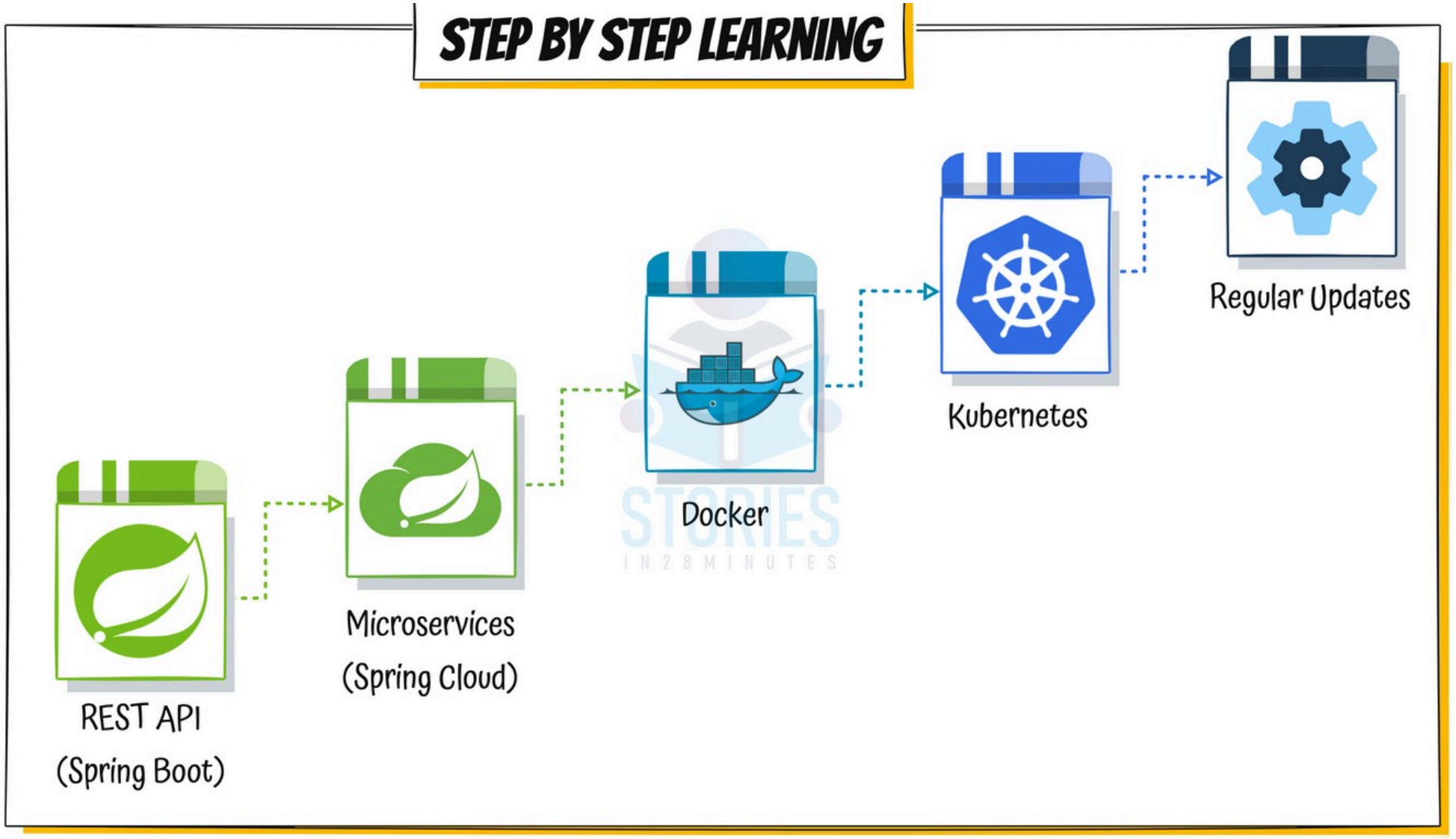


Hands-on Learning

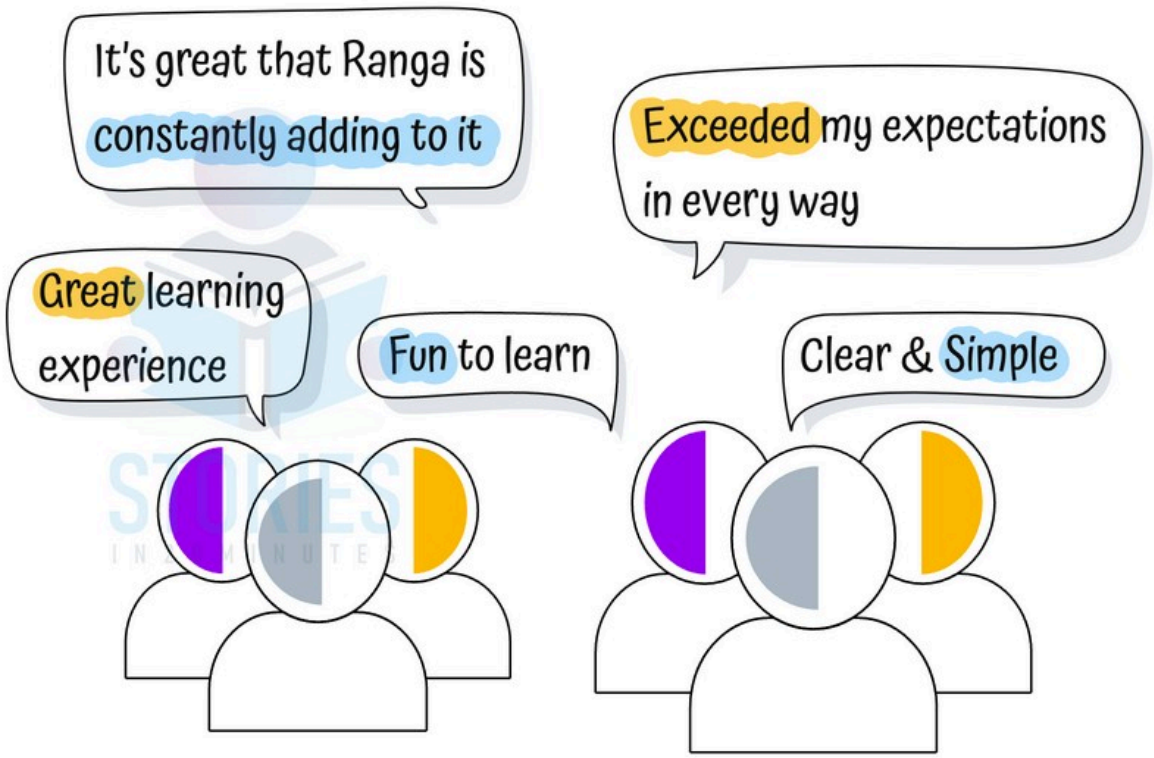
You Build Amazing Projects

Regular Review

Quizzes and Exercises


STEP BY STEP LEARNING
REST API
(Spring Boot)
Microservices
(Spring Cloud)
Docker
Kubernetes
Regular Updates
STORIES
IN28MINUTES

AMAZING FEEDBACK



FASTEST ROADMAPS

in28minutes.com

In28 Minutes

- Google Cloud Certifications
- Azure Certifications
- AWS Certifications
- DevOps
- Java Full Stack
- Java Microservices

Web Services

IS THIS A WEB SERVICE? - TRY 1

Service delivered over the web?

Is the Todo Web Application a Web Service?

- Delivers HTML output: Not consumable by other applications

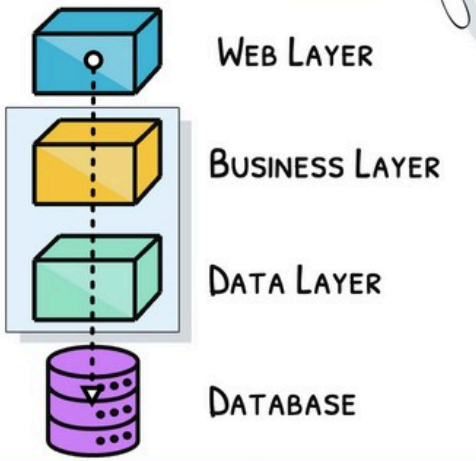
AWS	Update	Delete
DevOps	Update	Delete
React	Update	Delete

- Todo Web App is NOT a Web Service!
- Definition is NOT just a "Service delivered over the web"

IS THIS A WEB SERVICE? - TRY 2

What if I create and share a JAR?

- Needs Other Dependencies: Database, Queues, ..
- Communication of Changes: Needs a process to handle future updates to code
- Not Platform independent: What if the consumer is using .Net or Python or JS?

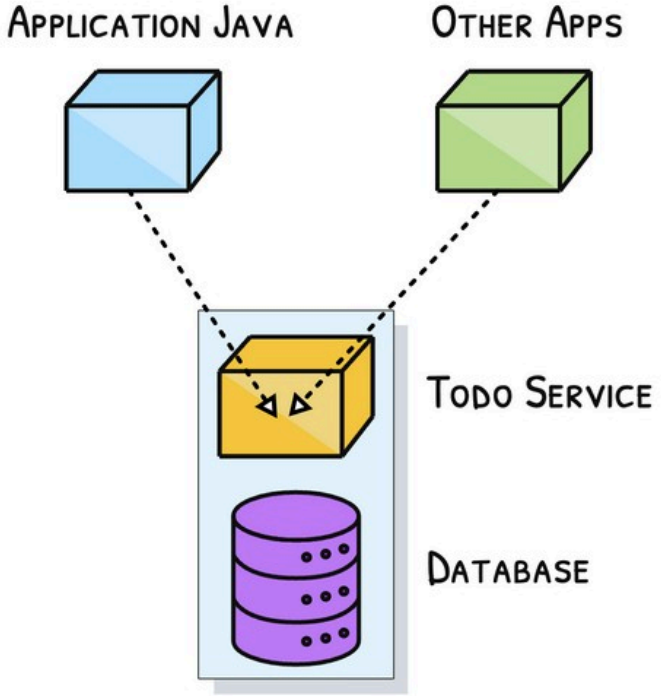


- NOT a Web Service: Sharing a JAR is NOT a web service approach!

IS THIS A WEB SERVICE? - TRY 3

WHAT IS A WEB SERVICE?

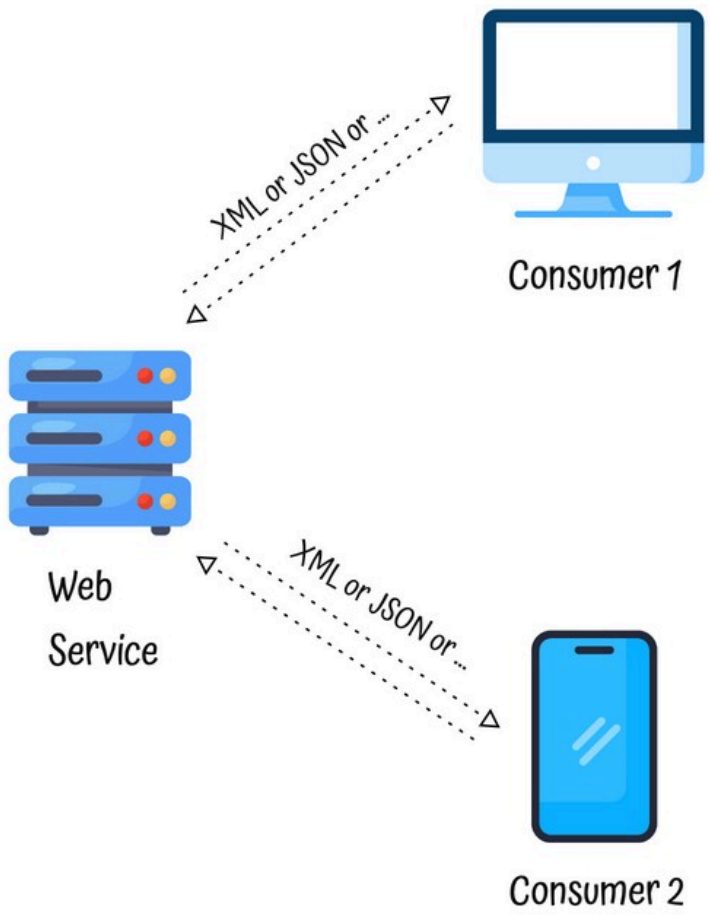
W3C definition: Software system designed to support interoperable machine-to-machine interaction over a network



3 Keys: All three are important

- Designed for machine-to-machine (or application-to application) interaction
- Should be interoperable (Not platform dependent)
- Should allow communication over a network

MAKING WEB SERVICES PLATFORM INDEPENDENT



- The communication (request and response) should be platform independent

- XML

something.xml

```
<getCourseDetailsRequest>
  <id>Course1</id>
</getCourseDetailsRequest>
```

- JSON

something.json

```
[
    {
        "id": 1,
        "name": "Even",
        "birthDate": "2017-07-10T07:52:48.270+0000"
    },
    {
        "id": 2,
        "name": "Abe",
        "birthDate": "2017-07-10T07:52:48.270+0000"
    }
]
```

KEY WEB SERVICES TERMINOLOGY

Request

XML or JSON or ...

Response

Web Service

Consumer

Request

Input to a web service

Service Provider (or Server)

Entity providing the web service

Response

Output from the web service

Service Consumer

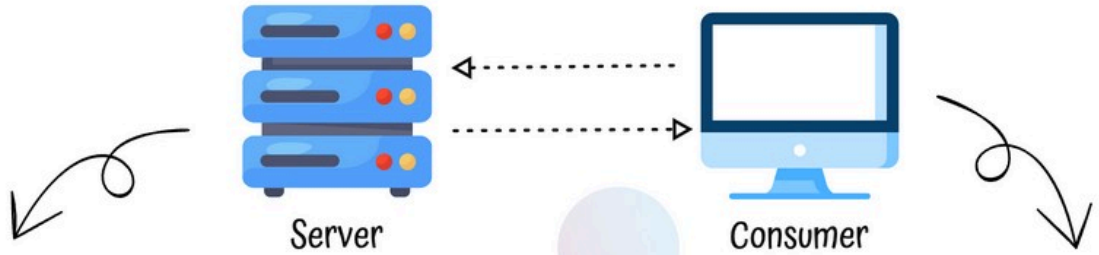
Entity consuming the web service

Message Exchange Format

The format used for communication

(XML, JSON, . etc)

TWO WEB SERVICES CATEGORIES



SOAP Web Services

- Use SOAP-XML as request and response format

SOAP_Request_Response_structure.xml

```
<SOAP-ENV: Envelope xmlns: SOAP-ENV="http://schemas.xmlsoap.org/
  <SOAP-ENV: Header/>
  <SOAP-ENV : Body>
      <ns2 : getCourseDetailsResponse xmlns:ns2="http://in28mi
          <ns2 :course>
              <ns2 : id>Course1
              </ns2:id>
              <ns2 : name>Spring</ns2 :name>
              <ns2 : description>10 Steps
              </ns2:description>
          </ns2 : course>
      </ns2 : getCourseDetailsResponse>
  </SOAP-ENV : Body>
</SOAP-ENV : Envelope>
```

REST Web Services

- Build on Top of HTTP. Use HTTP methods (GET, POST, DELETE, ..) for executing operations
  - Retrieve Todos for a User - GET /users/Ranga
  - Create a new User - POST /users
  - Delete a User - DELETE /users

In28 Minutes

Remaining this is word by word Same From 2024 Presentation.
First Few pages are changed
Microservices-y2024 File

Spring Boot
in 10(ish) Steps

Getting Started with Spring Boot

In 28 Minutes

- **WHY** Spring Boot?
  - You can build web apps & REST API WITHOUT Spring Boot
  - What is the need for Spring Boot?
- **WHAT** are the goals of Spring Boot?
- **HOW** does Spring Boot work?
- **COMPARE** Spring Boot vs Spring MVC vs Spring

Getting Started with Spring Boot - Approach

In 28 Minutes

- **1:** Understand the world before Spring Boot (10000 Feet)
- **2:** Create a Spring Boot Project
- **3:** Build a simple REST API using Spring Boot
- **4:** Understand the MAGIC of Spring Boot
  - Spring Initializr
  - Starter Projects
  - Auto Configuration
  - Developer Tools
  - Actuator
  - ...

World Before Spring Boot!

In28 Minutes

- Setting up Spring Projects **before Spring Boot was NOT easy**!
- We needed to configure a **lot of things** before we have a **production-ready** application

World Before Spring Boot - 1 - Dependency Management

In 28 Minutes

```
<dependency>
    <groupId>org.springframework</groupId>
    <artifactId>spring-webmvc</artifactId>
    <version>6.2.2.RELEASE</version>
</dependency>
<dependency>
    <groupId>com.fasterxml.jackson.core</groupId>
    <artifactId>jackson-databind</artifactId>
    <version>2.13.3</version>
</dependency>
<dependency>
    <groupId>log4j</groupId>
    <artifactId>log4j</artifactId>
    <version>1.2.17</version>
</dependency>
```

- Manage frameworks and versions
  - **REST API** - Spring framework, Spring MVC framework, JSON binding framework, ..
  - **Unit Tests** - Spring Test, Mockito, JUnit, ...

World Before Spring Boot - 2 - web.xml

In28 Minutes

```
<servlet>
    <servlet-name>dispatcher</servlet-name>
    <servlet-class>
        org.springframework.web.servlet.DispatcherServlet
    </servlet-class>
    <init-param>
        <param-name>contextConfigLocation</param-name>
        <param-value>/WEB-INF/todo-servlet.xml</param-value>
    </init-param>
    <load-on-startup>1</load-on-startup>
</servlet>

<servlet-mapping>
    <servlet-name>dispatcher</servlet-name>
    <url-pattern>/*</url-pattern>
</servlet-mapping>
```

- **Example**: Configure **DispatcherServlet** for Spring MVC

World Before Spring Boot - 3 - Spring Configuration

In28 Minutes

```
<context:component-scan base-package="com.in28minutes" />

<bean
    class="org.springframework.web.servlet.view.InternalResourceViewResolver">
    <property name="prefix">
        <value>/WEB-INF/views/</value>
    </property>
    <property name="suffix">
        <value>.jsp</value>
    </property>
</bean>
```

- Define your **Spring Configuration**
  - Component Scan
  - View Resolver
  - ....

World Before Spring Boot - 4 - NFRs

In28 Minutes

```
<plugin>
    <groupId>org.apache.tomcat.maven</groupId>
    <artifactId>tomcat7-maven-plugin</artifactId>
    <version>2.2</version>
    <configuration>
        <path>/</path>
        <contextReloadable>true</contextReloadable>
    </configuration>
</plugin>

<dependency>
    <groupId>log4j</groupId>
    <artifactId>log4j</artifactId>
    <version>1.2.17</version>
</dependency>
```

- Logging
- Error Handling
- Monitoring

World Before Spring Boot!

In28 Minutes

- Setting up Spring Projects **before Spring Boot was NOT easy**!
  - 1: Dependency Management (**pom.xml**)
  - 2: Define Web App Configuration (**web.xml**)
  - 3: Manage Spring Beans (**context.xml**)
  - 4: Implement Non Functional Requirements (NFRs)
- AND repeat this for every new project!
- Typically takes a **few days** to setup for each project (and countless hours to maintain)

Understanding Power of Spring Boot

In28 Minutes

```
// http://localhost:8080/courses
[
  {
    "id": 1,
    "name": "Learn AWS",
    "author": "in28minutes"
  }
]
```

- **1:** Create a Spring Boot Project
- **2:** Build a simple REST API using Spring Boot

What's the Most Important Goal of Spring Boot?

In28 Minutes

- Help you build **PRODUCTION-READY** apps **QUICKLY**
  - Build **QUICKLY**
    - Spring Initializr
    - Spring Boot Starter Projects
    - Spring Boot Auto Configuration
    - Spring Boot DevTools
  - Be **PRODUCTION-READY**
    - Logging
    - Different Configuration for Different Environments
      - Profiles, ConfigurationProperties
    - Monitoring (Spring Boot Actuator)
    - ...

Spring Boot
BUILD QUICKLY

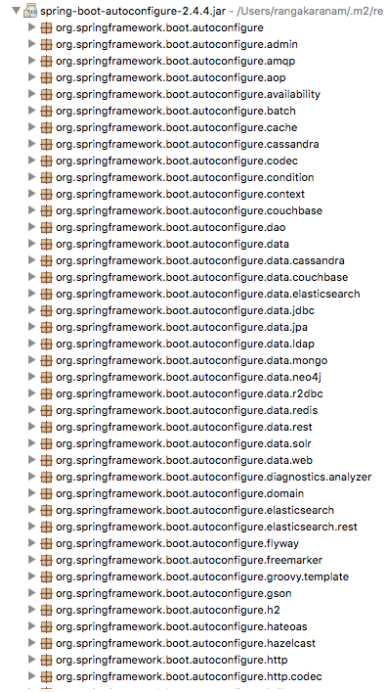
Exploring Spring Boot Starter Projects

- I need a lot of frameworks to build application features:
  - **Build a REST API**: I need Spring, Spring MVC, Tomcat, JSON conversion...
  - **Write Unit Tests**: I need Spring Test, JUnit, Mockito, ...
- How can I group them and make it easy to build applications?
  - **Starters**: Convenient **dependency descriptors** for diff. features
- **Spring Boot** provides variety of starter projects:
  - **Web Application & REST API** - Spring Boot Starter Web (spring-webmvc, spring-web, spring-boot-starter-tomcat, spring-boot-starter-json)
  - **Unit Tests** - Spring Boot Starter Test
  - **Talk to database using JPA** - Spring Boot Starter Data JPA
  - **Talk to database using JDBC** - Spring Boot Starter JDBC
  - **Secure your web application or REST API** - Spring Boot Starter Security

Exploring Spring Boot Auto Configuration

In 28 Minutes

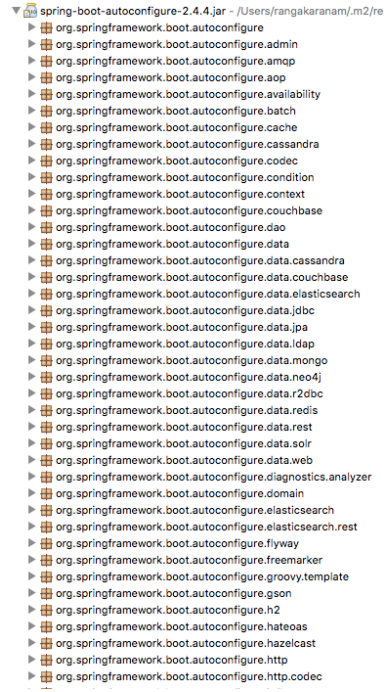
- I need **lot of configuration** to build Spring app:
  - Component Scan, DispatcherServlet, Data Sources, JSON Conversion, ...
- How can I simplify this?
  - **Auto Configuration**: **Automated configuration** for your app
    - **Decided** based on:
      - Which frameworks are in the Class Path?
      - What is the existing configuration (Annotations etc)?
- **Example**: Spring Boot Starter Web
  - Dispatcher Servlet (`DispatcherServletAutoConfiguration`)
  - Embedded Servlet Container - Tomcat is the default (`EmbeddedWebServerFactoryCustomizerAutoConfiguration`)
  - Default Error Pages (`ErrorMvcAutoConfiguration`)
  - Bean<->JSON (`JacksonHttpMessageConvertersConfiguration`)



Understanding the Glue - @SpringBootApplication

In 28 Minutes

- Questions:
  - Who is launching the Spring Context?
  - Who is triggering the component scan?
  - Who is enabling auto configuration?
- Answer: **@SpringBootApplication**
  - 1: **@SpringBootConfiguration**: Indicates that a class provides Spring Boot application @Configuration.
  - 2: **@EnableAutoConfiguration**: Enable auto-configuration of the Spring Application Context,
  - 3: **@ComponentScan**: Enable component scan (for current package, by default)



Build Faster with Spring Boot DevTools

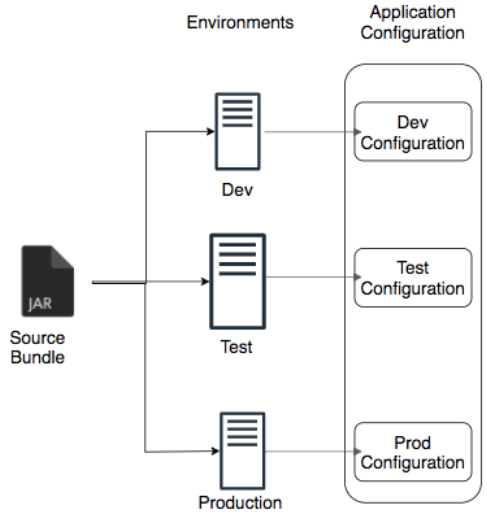
In28 Minutes

- Increase developer productivity
- Why do you need to restart the server **manually** for every code change?
- **Remember**: For pom.xml dependency changes, you will need to restart server **manually**

Spring Boot
PRODUCTION-READY

Managing App. Configuration using Profiles

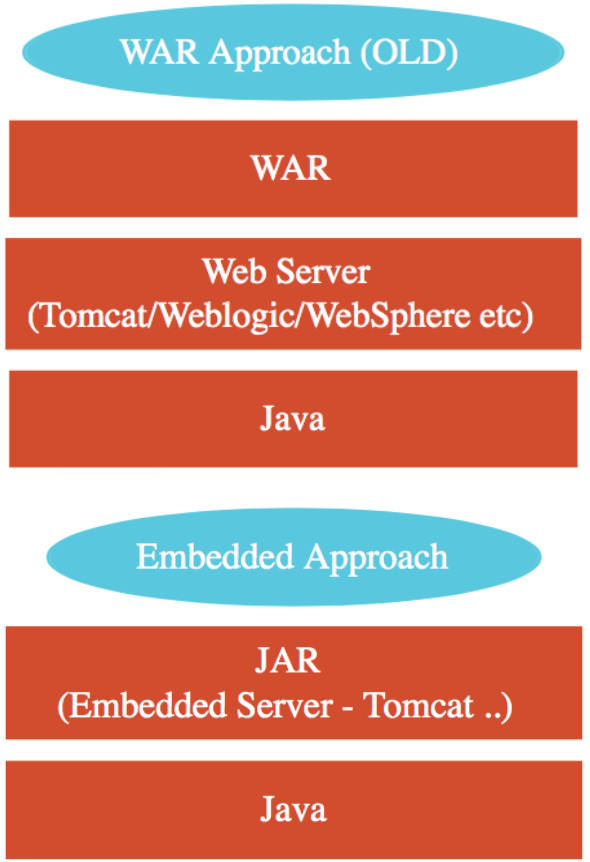
- Applications have different environments: **Dev, QA, Stage, Prod**, ...
- Different environments need **different configuration**:
  - Different Databases
  - Different Web Services
- How can you provide different configuration for different environments?
  - **Profiles**: Environment specific configuration
- How can you define externalized configuration for your application?
  - **ConfigurationProperites**: Define externalized configuration



Simplify Deployment with Spring Boot Embedded Servers

In 28 Minutes

- How do you deploy your application?
  - Step 1 : Install Java
  - Step 2 : Install Web/Application Server
    - Tomcat/WebSphere/WebLogic etc
  - Step 3 : Deploy the application WAR (Web ARchive)
    - This is the OLD **WAR** Approach
    - Complex to setup!
- **Embedded Server** - Simpler alternative
  - Step 1 : Install Java
  - Step 2 : Run **JAR** file
  - **Make JAR not WAR** (Credit: Josh Long!)
  - Embedded Server **Examples**:
    - spring-boot-starter-tomcat
    - spring-boot-starter-jetty
    - spring-boot-starter-undertow



Monitor Applications using Spring Boot Actuator

In 28 Minutes

- Monitor and manage your application in your production
- Provides a number of endpoints:
  - **beans** - Complete list of Spring beans in your app
  - **health** - Application health information
  - **metrics** - Application metrics
  - **mappings** - Details around Request Mappings

Understanding Spring Boot vs Spring MVC vs Spring

In28 Minutes

- **Spring Boot vs Spring MVC vs Spring**: What's in it?
  - **Spring Framework**: Dependency Injection
    - @Component, @Autowired, Component Scan etc..
    - Just Dependency Injection is NOT sufficient (You need other frameworks to build apps)
      - **Spring Modules and Spring Projects**: Extend Spring Eco System
        - Provide good integration with other frameworks (Hibernate/JPA, JUnit & Mockito for Unit Testing)
  - **Spring MVC** (Spring Module): Simplify building web apps and REST API
    - Building web applications with Struts was very complex
    - @Controller, @RestController, @RequestMapping("/courses")
  - **Spring Boot** (Spring Project): Build **PRODUCTION-READY** apps **QUICKLY**
    - **Starter Projects** - Make it easy to build variety of applications
    - **Auto configuration** - Eliminate configuration to setup Spring, Spring MVC and other frameworks!
    - Enable non functional requirements (NFRs):
      - **Actuator**: Enables Advanced Monitoring of applications
      - **Embedded Server**: No need for separate application servers!
      - Logging and Error Handling
      - Profiles and ConfigurationProperties

Spring Boot - Review

In 28 Minutes

- **Goal**: 10,000 Feet overview of Spring Boot
  - Help you understand the terminology!
    - Starter Projects
    - Auto Configuration
    - Actuator
    - DevTools
- **Advantages**: Get started quickly with production ready features!

In28 Minutes

Building REST API with Spring Boot

Building REST API with Spring Boot - Goals

In 28 Minutes

- **WHY** Spring Boot?
  - You can build REST API WITHOUT Spring Boot
  - What is the need for Spring Boot?
- **HOW** to build a great REST API?
  - Identifying Resources (/users, /users/{id}/posts)
  - Identifying Actions (GET, POST, PUT, DELETE, ...)
  - Defining Request and Response structures
  - Using appropriate Response Status (200, 404, 500, ..)
  - Understanding REST API Best Practices
    - Thinking from the perspective of your consumer
    - Validation, Internationalization - i18n, Exception Handling, HATEOAS, Versioning, Documentation, Content Negotiation and a lot more!

Building REST API with Spring Boot - Approach

In28 Minutes

- **1:** Build 3 Simple Hello World REST API
  - Understand the magic of Spring Boot
  - Understand fundamentals of building REST API with Spring Boot
    - @RestController, @RequestMapping, @PathVariable, JSON conversion
- **2:** Build a REST API for a Social Media Application
  - Design and Build a Great REST API
    - Choosing the right URI for resources (/users, /users/{id}, /users/{id}/posts)
    - Choosing the right request method for actions (GET, POST, PUT, DELETE, ..)
    - Designing Request and Response structures
    - Implementing Security, Validation and Exception Handling
  - Build Advanced REST API Features
    - Internationalization, HATEOAS, Versioning, Documentation, Content Negotiation, ...
- **3:** Connect your REST API to a Database
  - Fundamentals of JPA and Hibernate
  - Use H2 and MySQL as databases

What's Happening in the Background?

- Let's explore some **Spring Boot Magic**: Enable Debug Logging
  - **WARNING**: Log change frequently!
- **1:** How are our requests handled?
  - **DispatcherServlet** - Front Controller Pattern
    - `Mapping servlets: dispatcherServlet urls=[/]`
    - **Auto Configuration** (`DispatcherServletAutoConfiguration`)
- **2:** How does **HelloWorldBean** object get converted to JSON?
  - @ResponseBody + JacksonHttpMessageConverters
    - **Auto Configuration** (`JacksonHttpMessageConvertersConfiguration`)
- **3:** Who is configuring error mapping?
  - **Auto Configuration** (`ErrorMvcAutoConfiguration`)
- **4:** How are all jars available(Spring, Spring MVC, Jackson, Tomcat)?
  - **Starter Projects** - Spring Boot Starter Web (spring-webmvc, spring-web, spring-boot-starter-tomcat, spring-boot-starter-json)

Social Media Application REST API

In 28 Minutes

- Build a REST API for a Social Media Application
- **Key Resources**:
  - Users
  - Posts
- **Key Details**:
  - User: id, name, birthDate
  - Post: id, description

Request Methods for REST API

In 28 Minutes

- **GET** - Retrieve details of a resource
- **POST** - Create a new resource
- **PUT** - Update an existing resource
- **PATCH** - Update part of a resource
- **DELETE** - Delete a resource

localhost:8080/users


```
[
  {
    "id": 1,
    "name": "Adam",
    "birthDate": "2022-08-16"
  },
  {
    "id": 2,
    "name": "Eve",
    "birthDate": "2022-08-16"
  },
  {
    "id": 3,
    "name": "Jack",
    "birthDate": "2022-08-16"
  }
]
```

Social Media Application - Resources & Methods

In28 Minutes

- **Users REST API**
  - Retrieve all Users
    - **GET /users**
  - Create a User
    - **POST /users**
  - Retrieve one User
    - **GET /users/{id} -> /users/1**
  - Delete a User
    - **DELETE /users/{id} -> /users/1**
  - **Posts REST API**
    - Retrieve all posts for a User
      - **GET /users/{id}/posts**
    - Create a post for a User
      - **POST /users/{id}/posts**
    - Retrieve details of a post
      - **GET /users/{id}/posts/{post_id}**

Response Status for REST API

In28 Minutes

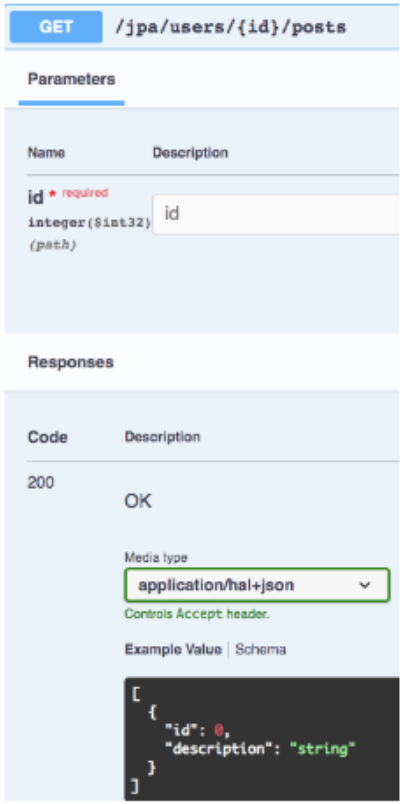
- Return the **correct response status**
  - Resource is not found => 404
  - Server exception => 500
  - Validation error => 400
- **Important Response Statuses**
  - **200** — Success
  - **201** — Created
  - **204** — No Content
  - **401** — Unauthorized (when authorization fails)
  - **400** — Bad Request (such as validation error)
  - **404** — Resource Not Found
  - **500** — Server Error

Advanced REST API Features

- Documentation
- Content Negotiation
- Internationalization - i18n
- Versioning
- HATEOAS
- Static Filtering
- Dynamic Filtering
- Monitoring
- ....

REST API Documentation

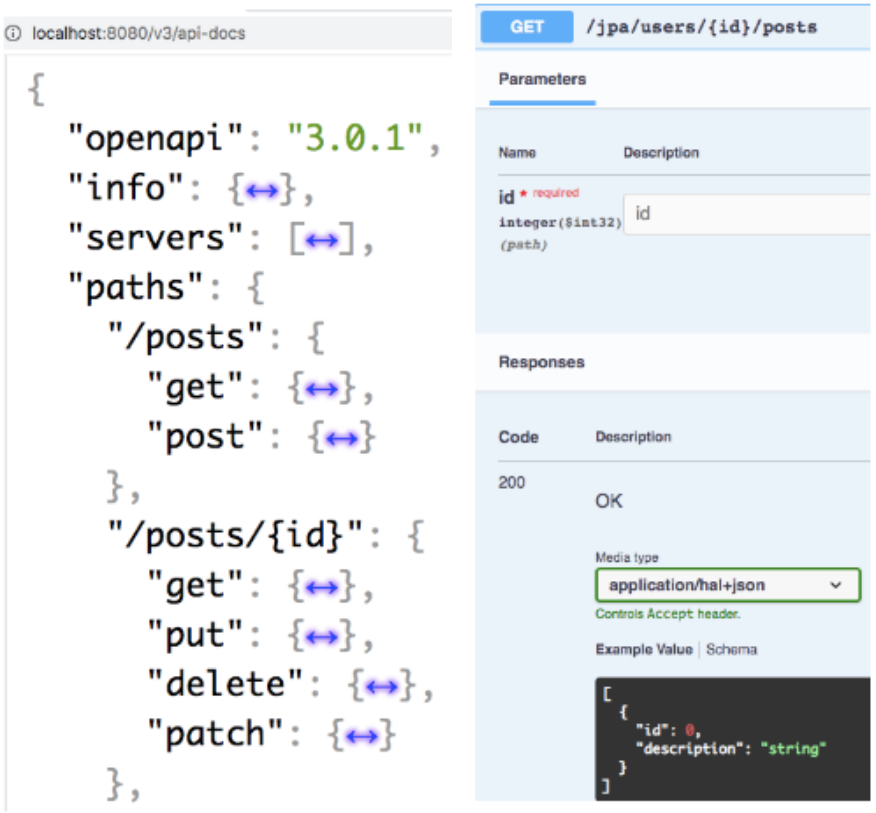
- Your REST API consumers need to understand your REST API:
  - Resources
  - Actions
  - Request/Response Structure (Constraints/Validations)
- **Challenges:**
  - Accuracy: How do you ensure that your documentation is upto date and correct?
  - Consistency: You might have 100s of REST API in an enterprise. How do you ensure consistency?
- **Options:**
  - **1**: Manually Maintain Documentation
    - Additional effort to keep it in sync with code
  - **2**: Generate from code



REST API Documentation - Swagger and Open API

In 28 Minutes

- **Quick overview:**
  - **2011:** Swagger Specification and Swagger Tools were introduced
  - **2016:** Open API Specification created based on Swagger Spec.
    - Swagger Tools (ex:Swagger UI) continue to exist
  - **OpenAPI Specification**: Standard, language-agnostic interface
    - Discover and understand REST API
    - Earlier called Swagger Specification
  - **Swagger UI**: Visualize and interact with your REST API
    - Can be generated from your OpenAPI Specification

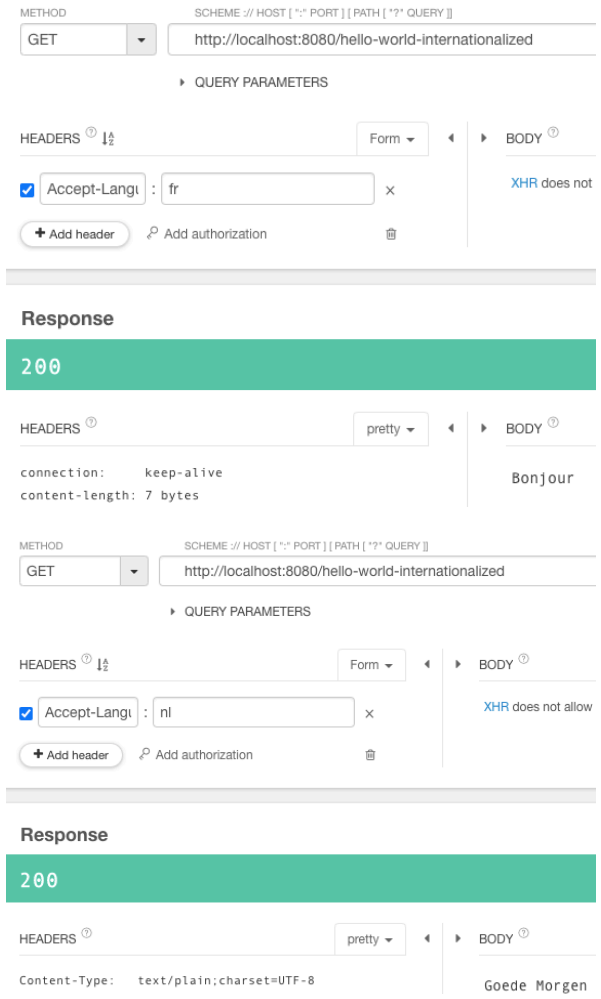


Content Negotiation

- **Same Resource** - Same URI
  - HOWEVER **Different Representations** are possible
    - Example: Different Content Type - XML or JSON or ..
    - Example: Different Language - English or Dutch or ..
- How can a consumer tell the REST API provider what they want?
  - **Content Negotiation**
- Example: Accept header (MIME types - application/xml, application/json, ..)
- Example: Accept-Language header (en, nl, fr, ..)

Internationalization - i18n

- Your REST API might have consumers from around the world
- How do you customize it to users around the world?
  - **Internationalization - i18n**
- Typically **HTTP Request Header - `Accept-Language`** is used
  - `Accept-Language` - indicates natural language and locale that the consumer prefers
  - Example: `en` - English (Good Morning)
  - Example: `nl` - Dutch (Goedemorgen)
  - Example: `fr` - French (Bonjour)



Versioning REST API

In 28 Minutes

- You have built an amazing REST API
  - You have 100s of consumers
  - You need to implement a breaking change
    - Example: Split name into firstName and lastName
- **SOLUTION**: Versioning REST API
  - **Variety of options**
    - URL
    - Request Parameter
    - Header
    - Media Type
  - **No Clear Winner!**

localhost:8080/v1/person

```
{
  "name": "Bob Charlie"
}
```

localhost:8080/v2/person

```
{
  "name": {
    "firstName": "Bob",
    "lastName": "Charlie"
  }
}
```

Versioning REST API - Options

- **URI Versioning** - Twitter
  - ***http://localhost:8080/v1/person***
  - ***http://localhost:8080/v2/person***
- **Request Parameter versioning** - Amazon
  - ***http://localhost:8080/person?version=1***
  - ***http://localhost:8080/person?version=2***
- **(Custom) headers versioning** - Microsoft
  - SAME-URL headers=[X-API-VERSION=1]
  - SAME-URL headers=[X-API-VERSION=2]
- **Media type versioning** (a.k.a "content negotiation" or "accept header") - GitHub
  - SAME-URL produces=application/vnd.company.app-v1+json
  - SAME-URL produces=application/vnd.company.app-v2+json

Versioning REST API - Factors

In28 Minutes

- **Factors to consider**
  - URI Pollution
  - Misuse of HTTP Headers
  - Caching
  - Can we execute the request on the browser?
  - API Documentation
  - **Summary**: No Perfect Solution
- **My Recommendations**
  - Think about versioning even before you need it!
  - One Enterprise - One Versioning Approach

URI Versioning - Twitter
- *http://localhost:8080/v1/person*
- *http://localhost:8080/v2/person*

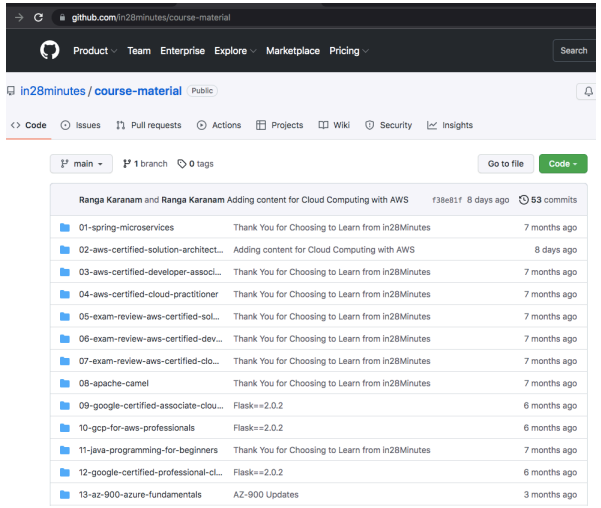
Request Parameter versioning - Amazon
- *http://localhost:8080/person?version=1*
- *http://localhost:8080/person?version=2*

(Custom) headers versioning - Microsoft
- SAME-URL headers=[X-API-VERSION=1]
- SAME-URL headers=[X-API-VERSION=2]

Media type versioning - GitHub
- SAME-URL produces=application/vnd.company.app-v1+json
- SAME-URL produces=application/vnd.company.app-v2+json

HATEOAS

- **Hypermedia as the Engine of Application State (HATEOAS)**
- Websites allow you to:
  - See **Data** AND Perform **Actions** (using links)
- How about enhancing your REST API to tell consumers how to perform subsequent actions?
  - **HATEOAS**
- **Implementation Options**:
  - **1:** Custom Format and Implementation
    - Difficult to maintain
  - **2:** Use Standard Implementation
    - **HAL (JSON Hypertext Application Language)**: Simple format that gives a consistent and easy way to hyperlink between resources in your API
    - **Spring HATEOAS**: Generate HAL responses with hyperlinks to resources




```
{
  "name": "Adam",
  "birthDate": "2022-08-16",
  "_links": {
    "all-users": {
      "href": "http://localhost:8080/users"
    }
  }
}
```

Customizing REST API Responses - Filtering and more..

In 28 Minutes

- **Serialization**: Convert object to stream (example: JSON)
  - Most popular JSON Serialization in Java: Jackson
- How about customizing the REST API response returned by Jackson framework?
- **1:** Customize field names in response
  - @JSONProperty
- **2:** Return only selected fields
  - **Filtering**
  - Example: Filter out Passwords
  - **Two types**:
    - **Static Filtering**: Same filtering for a bean across different REST API
      - @JsonIgnoreProperties, @JsonIgnore
    - **Dynamic Filtering**: Customize filtering for a bean for specific REST API
      - @JsonFilter with FilterProvider

localhost:8080/filtering-list


```
[
  {
    "field2": "value2",
    "field3": "value3"
  },
  {
    "field2": "value5",
    "field3": "value6"
  }
]
```


localhost:8080/filtering


```
{
  "field1": "value1",
  "field3": "value3"
}
```

Get Production-ready with Spring Boot Actuator

In 28 Minutes

- **Spring Boot Actuator**: Provides Spring Boot's production-ready features
  - Monitor and manage your application in your production
- **Spring Boot Starter Actuator**: Starter to add Spring Boot Actuator to your application
  - **spring-boot-starter-actuator**
- Provides a number of endpoints:
  - **beans** - Complete list of Spring beans in your app
  - **health** - Application health information
  - **metrics** - Application metrics
  - **mappings** - Details around Request Mappings
  - and a lot more .....

Explore REST API using HAL Explorer

In28 Minutes

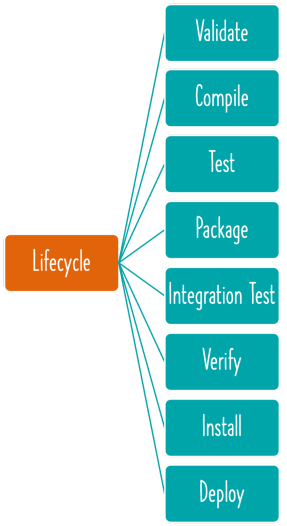
- 1: **HAL (JSON Hypertext Application Language)**
  - Simple format that gives a consistent and easy way to hyperlink between resources in your API
- 2: **HAL Explorer**
  - An API explorer for RESTful Hypermedia APIs using HAL
  - Enable your non-technical teams to play with APIs
- 3: **Spring Boot HAL Explorer**
  - Auto-configures HAL Explorer for Spring Boot Projects
  - spring-data-rest-hal-explorer

Maven

What is Maven?

In28 Minutes

- **Things you do** when writing code each day:
  - Create new projects
  - Manages **dependencies** and their versions
    - Spring, Spring MVC, Hibernate,...
    - Add/modify dependencies
  - **Build** a JAR file
  - Run your application locally in Tomcat or Jetty or ..
  - Run **unit tests**
  - Deploy to a test environment
  - and a lot more..
- Maven helps you do all these and more...



spring

Maven™

Exploring Project Object Model - pom.xml

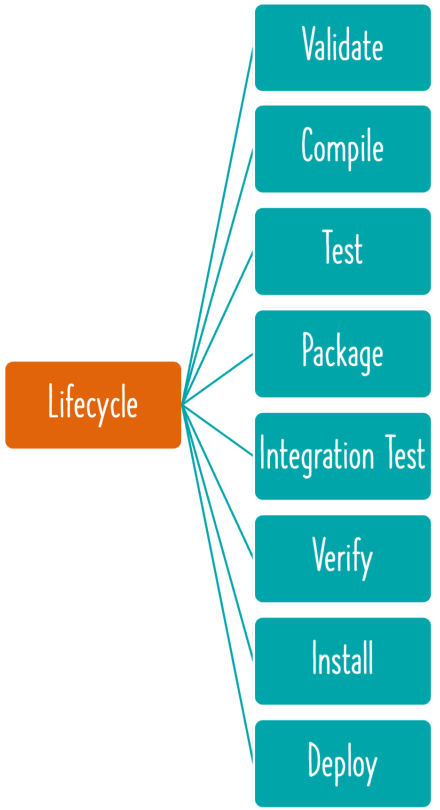
In 28 Minutes

- Let's explore Project Object Model - pom.xml
  - **1: Maven dependencies**: Frameworks & libraries used in a project
    - Ex: `spring-boot-starter-web` and `spring-boot-starter-test`
    - Why are there so many dependencies in the classpath?
      - Answer: Transitive Dependencies
      - (REMEMBER) Spring dependencies are DIFFERENT
  - **2: Parent Pom**: spring-boot-starter-parent
    - Dependency Management: `spring-boot-dependencies`
    - Properties: `java.version`, plugins and configurations
  - **3: Name of our project**: groupId + artifactId
    - **1:groupId**: Similar to package name
    - **2:artifactId**: Similar to class name
    - **Why is it important?**
      - Think about this: How can other projects use our new project?
- **Activity**: help:effective-pom, dependency:tree & Eclipse UI
  - Let's add a new dependency: spring-boot-starter-web

Exploring Maven Build Life Cycle

In28 Minutes

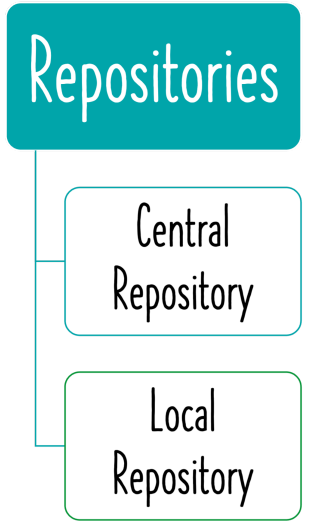
- When we run a maven command, maven build life cycle is used
- Build LifeCycle is a sequence of steps
  - Validate
  - Compile
  - Test
  - Package
  - Integration Test
  - Verify
  - Install
  - Deploy



How does Maven Work?

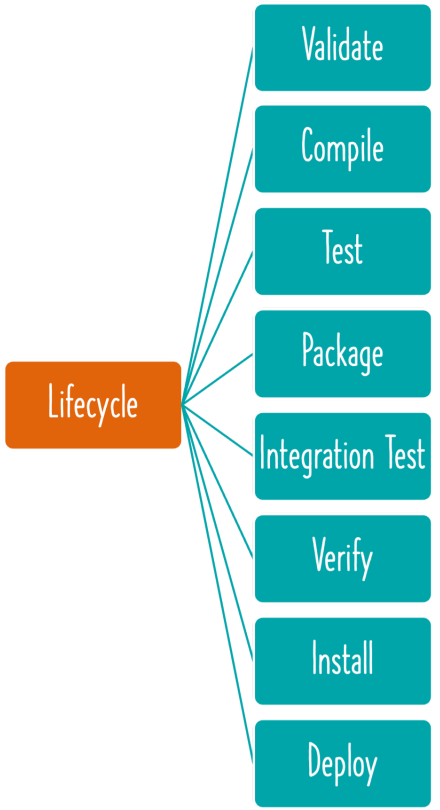
In28 Minutes

- Maven follows **Convention over Configuration**
  - Pre defined folder structure
  - Almost all Java projects follow **Maven structure** (Consistency)
- **Maven central repository** contains jars (and others) indexed by artifact id and group id
  - Stores all the versions of dependencies
  - repositories > repository
  - pluginRepositories > pluginRepository
- When a dependency is added to pom.xml, Maven tries to download the dependency
  - Downloaded dependencies are stored inside your maven local repository
  - **Local Repository** : a temp folder on your machine where maven stores the jar and dependency files that are downloaded from Maven Repository.



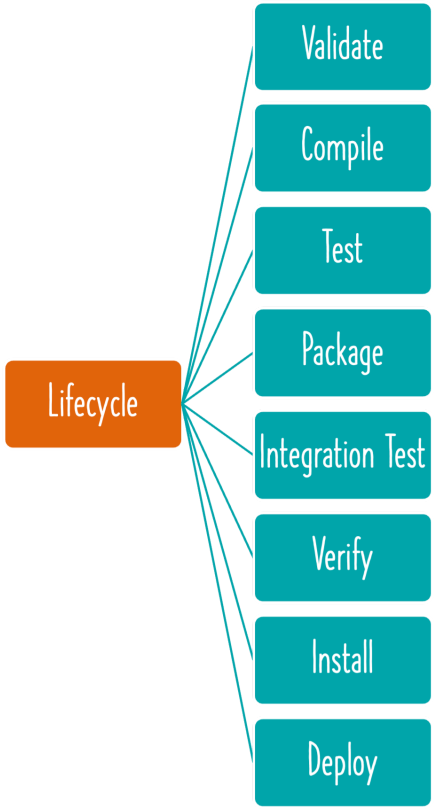
Important Maven Commands

- mvn --version
- mvn compile: Compile source files
- mvn test-compile: Compile test files
  - OBSERVCE CAREFULLY: This will also compile source files
- mvn clean: Delete target directory
- mvn test: Run unit tests
- mvn package: Create a jar
- mvn help:effective-pom
- mvn dependency:tree



Spring Boot Maven Plugin

- **Spring Boot Maven Plugin**: Provides Spring Boot support in Apache Maven
  - Example: Create executable jar package
  - Example: Run Spring Boot application
  - Example: Create a Container Image
- **Commands**:
  - mvn spring-boot:**repackage** (create jar or war)
    - Run package using `java –jar`
  - mvn spring-boot:**run** (Run application)
  - mvn spring-boot:**start** (Non-blocking - Ex:integration tests)
  - mvn spring-boot:**stop** (Stop application)
  - mvn spring-boot:**build-image** (Build a container image)



How are Spring Releases Versioned?

In28 Minutes

- **Version scheme** - MAJOR.MINOR.PATCH[-MODIFIER]
  - **MAJOR**: Significant amount of work to upgrade (10.0.0 to 11.0.0)
  - **MINOR**: Little to no work to upgrade (10.1.0 to 10.2.0)
  - **PATCH**: No work to upgrade (10.5.4 to 10.5.5)
  - **MODIFIER**: Optional modifier
    - **Milestones** - M1, M2, .. (10.3.0-M1,10.3.0-M2)
    - **Release candidates** - RC1, RC2, .. (10.3.0-RC1, 10.3.0-RC2)
    - **Snapshots** - SNAPSHOT
    - **Release** - Modifier will be ABSENT (10.0.0, 10.1.0)
- **Example versions in order:**
  - 10.0.0-SNAPSHOT, 10.0.0-M1, 10.0.0-M2, 10.0.0-RC1, 10.0.0-RC2, 10.0.0, ...
- **MY RECOMMENDATIONS:**
  - Avoid SNAPSHOTs
  - Use ONLY Released versions in PRODUCTION

Gradle

Gradle

- **Goal**: Build, automate and deliver better software, faster
  - **Build Anything**: Cross-Platform Tool
    - Java, C/C++, JavaScript, Python, ...
  - **Automate Everything**: Completely Programmable
    - Complete flexibility
    - Uses a DSL
      - Supports Groovy and Kotlin
  - **Deliver Faster**: Blazing-fast builds
    - Compile avoidance to advanced caching
    - Can speed up Maven builds by up to 90%
      - **Incrementality** — Gradle runs only what is necessary
        - Example: Compiles only changed files
      - **Build Cache** — Reuses the build outputs of other Gradle builds with the same inputs
- Same project layout as Maven
- IDE support still evolving

Gradle Plugins

In28 Minutes

- Top 3 Java Plugins for Gradle:
  - **1: Java Plugin**: Java compilation + testing + bundling capabilities
    - **Default Layout**
      - src/main/java: Production Java source
      - src/main/resources: Production resources, such as XML and properties files
      - src/test/java: Test Java source
      - src/test/resources: Test resources
    - **Key Task**: build
  - **2: Dependency Management**: Maven-like dependency management
    - `group:'org.springframework', name:'spring-core', version:'10.0.3.RELEASE'` OR
    - Shortcut: `org.springframework:spring-core:10.0.3.RELEASE`
  - **3: Spring Boot Gradle Plugin**: Spring Boot support in Gradle
    - Package executable Spring Boot jar, Container Image (bootJar, bootBuildImage)
    - Use dependency management enabled by spring-boot-dependencies
      - No need to specify dependency version
        - Ex: `implementation('org.springframework.boot:spring-boot-starter')`

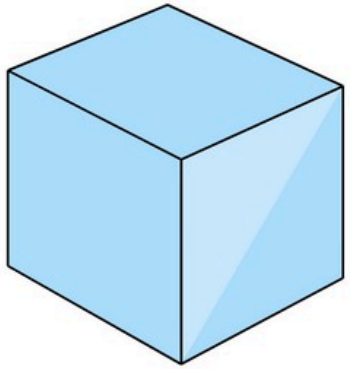
Maven vs Gradle - Which one to Use?

In28 Minutes

- Let's start with a few popular examples:
  - **Spring Framework** - Using Gradle since 2012 (Spring Framework v3.2.0)
  - **Spring Boot** - Using Gradle since 2020 (Spring Boot v2.3.0)
  - **Spring Cloud** - Continues to use Maven even today
    - Last update: Spring Cloud has no plans to switch
- **Top Maven Advantages**: Familiar, Simple and Restrictive
- **Top Gradle Advantages**: Faster build times and less verbose
- **What Do I Recommend**: I'm sitting on the fence for now
  - Choose whatever tool best meets your projects needs
  - If your builds are taking really long, go with Gradle
  - If your builds are simple, stick with Maven

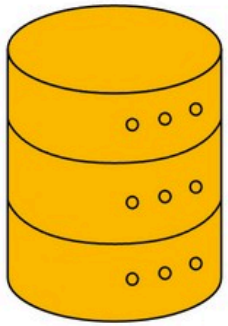
Microservices

WHAT IS A MONOLITH?



A large application

Movie Application



Large Database

Challenges

Deployment complexity

Minor updates need complete redeployment

Tightly coupled components

Changes in one part of can affect others => longer release cycles

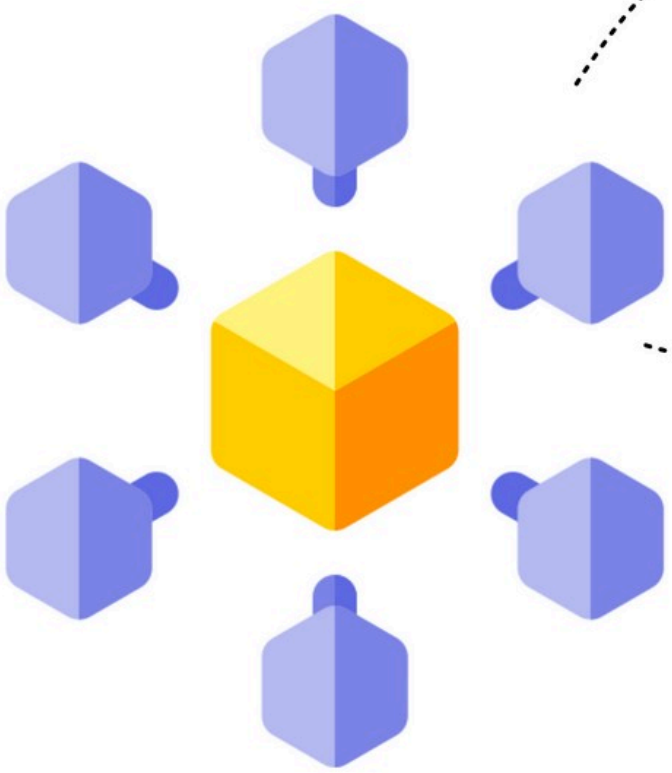
Scalability limitations

Scaling can be resource intensive. Entire app to be scaled even if only one part of it needs more capacity.

Technology lock-in

Entire app built on a single technology stack. Adopting new technologies is challenging.

GETTING STARTED WITH MICROSERVICES



Small autonomous services that work together

– Sam Newman

In short, the microservice architectural style is an approach to developing a single application as a suite of small services, each running in its own process and communicating with lightweight mechanisms, often an HTTP resource API. These services are built around business capabilities and independently deployable by fully automated deployment machinery. There is a bare minimum of centralized management of these services, which may be written in different programming languages and use different data storage technologies.

– James Lewis and Martin Fowler

MICROSERVICES - KEEPING IT SIMPLE!

MICROSERVICE A

MICROSERVICE B

MICROSERVICE C

THREE CRITICAL FOCUS AREAS

REST

Built following REST API Standards and Best Practices

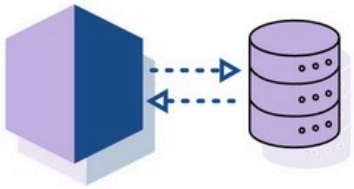
SMALL WELL CHOSEN DEPLOYABLE UNITS

Independently deployable units of small services

DYNAMIC SCALING

Possible to scale up and down independent of each other

Movie Booking Application: Key Microservices

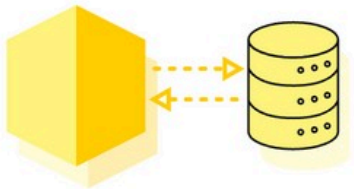


MovieService

Central service managing movie details, showtimes, and availability

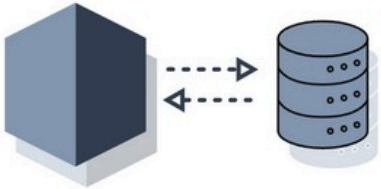
BookingService

Handles ticket booking, seat selection, and booking management



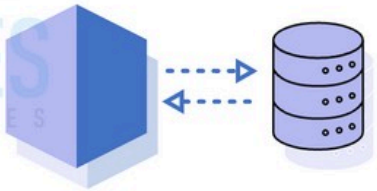
PricingService

Manages ticket pricing, discounts, and special offers



CustomerService

Manages customer profiles, authentication, and customer support



ReviewService

Allows users to submit and view reviews, ratings, and comments

MICROSERVICES - 3 KEY ADVANTAGES

New Technology & Process Adoption

Teams can adopt new technologies and processes for individual services

- **Flexibility:** Choose best frameworks, and languages for each service
- **Innovation:** Easier to experiment and use emerging technologies

Faster Release Cycles

Smaller, independent services can be developed, tested, and deployed more quickly

- **Agility:** Allows for more frequent updates and quicker response to market demands

Dynamic Scaling

Enable scaling of individual components based on demand

- **Efficiency:** Scale only the services that need it, reducing costs

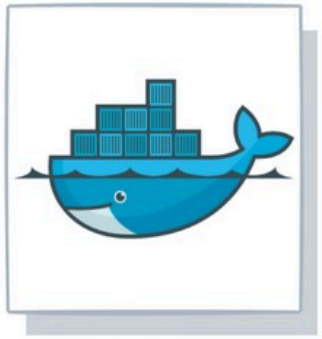
KEY MICROSERVICES SOLUTIONS

Spring Boot

Enables rapid development of REST API

Spring Cloud

Umbrella project that provides essential microservice needs



Docker

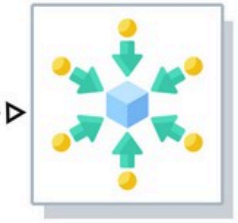
Consistent deployment approach for microservices. Programming language and environment independent.

Kubernetes

Orchestrate thousands of microservices with advanced features (Service Discovery, Load Balancing, Release Mgmt, ..)

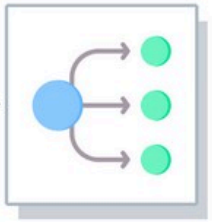
KEY MICROSERVICES SOLUTIONS

SPRING CLOUD



CENTRALIZED CONFIGURATION

Manage configuration for multiple microservices in central GIT repository



LOAD BALANCING

Distributes requests across active instances of microservices dynamically

SERVICE DISCOVERY

Enable automatic discovery of microservices

DISTRIBUTED TRACING

Trace requests across microservices

EDGE SERVER

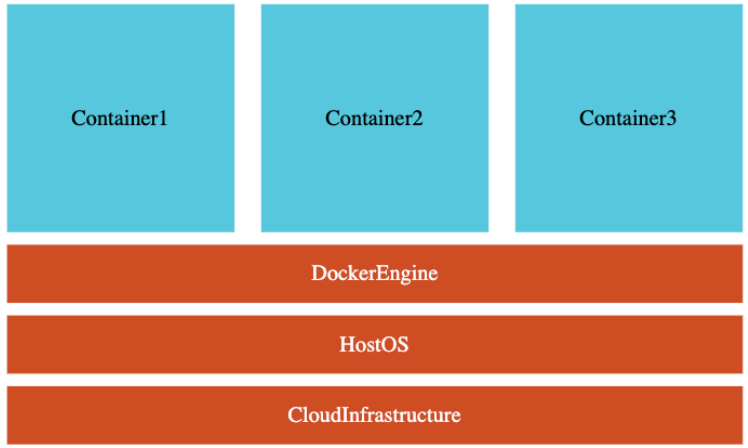
Single Entry Point: Implement common features like authentication

FAULT TOLERANCE

Ensure that failure in one microservice does not cascade and make other microservices to fail

Microservices - Evolution

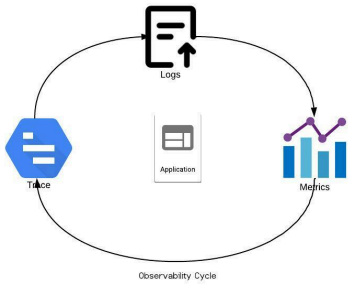
- **Goal**: Evolve with Microservices
  - **V1** - Spring Boot 2.0.0 to 2.3.x
  - **V2** - Spring Boot 2.4.0 to 3.0.0 to ...
    - Spring Cloud LoadBalancer (Ribbon)
    - Spring Cloud Gateway (Zuul)
    - Resilience4j (Hystrix)
    - NEW: Docker
    - NEW: Kubernetes
    - NEW: Observability
      - NEW: Micrometer (Spring Cloud Sleuth)
      - NEW: OpenTelemetry



Microservices - Spring Boot 2 vs Spring Boot 3

In28 Minutes

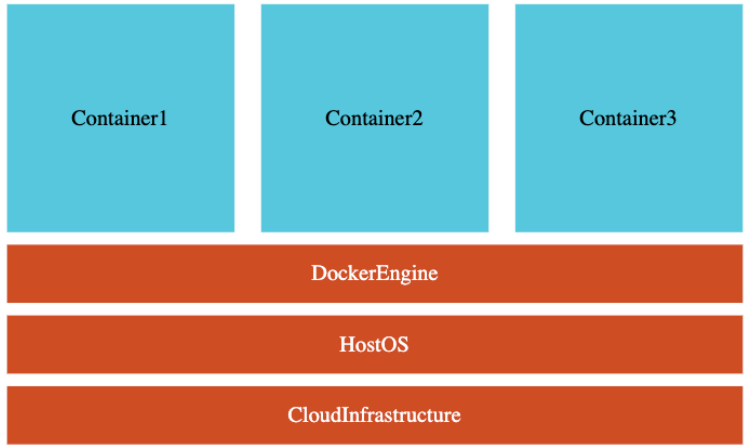
- **V1**(2.0.0 to 2.3.x)
- **V2** (2.4.x to 3.0.0 to ..)
- Spring Boot 2.4.0+
  - ***https://github.com/in28minutes/spring-microservices-v2***
- Spring Boot 3.0.0+
  - ***https://github.com/in28minutes/spring-microservices-v3***
  - Notes: v3-upgrade.md
  - Key Changes:
    - **Observability** - Ability of a system to measure its current state based on the generated data
      - Monitoring is reactive while Observability is proactive
      - **OpenTelemetry**: One Standard for Logs + Traces + Metrics



Microservices - V2 - What's New

In28 Minutes

- Microservices Evolve Quickly
- **V2** (Spring Boot - 2.4.x to 3.0.0 to LATEST)
  - **Spring Cloud LoadBalancer** instead of Ribbon
  - **Spring Cloud Gateway** instead of Zuul
  - **Resilience4j** instead of Hystrix
  - **Docker**: Containerize Microservices
    - Run microservices using Docker and Docker Compose
  - **Kubernetes**: Orchestrate all your Microservices with Kubernetes
  - **OpenTelemetry**: One Standard - Logs, Traces & Metrics
  - **Micrometer** (Replaces Spring Cloud Sleuth)

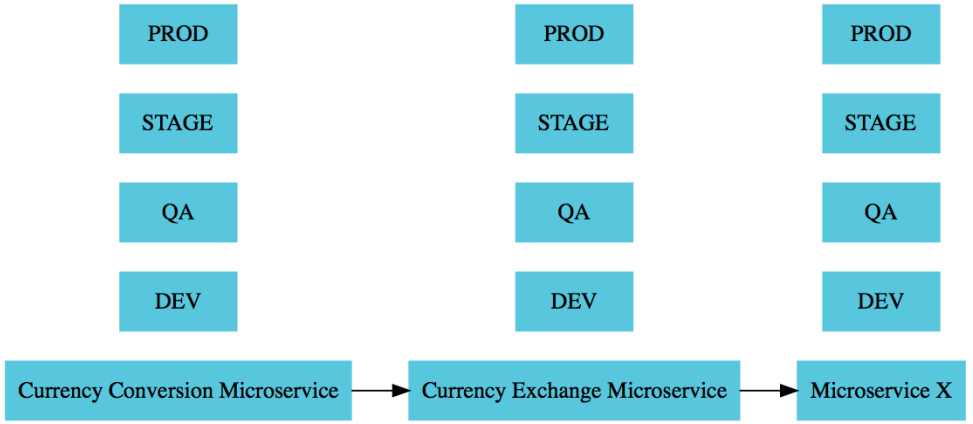


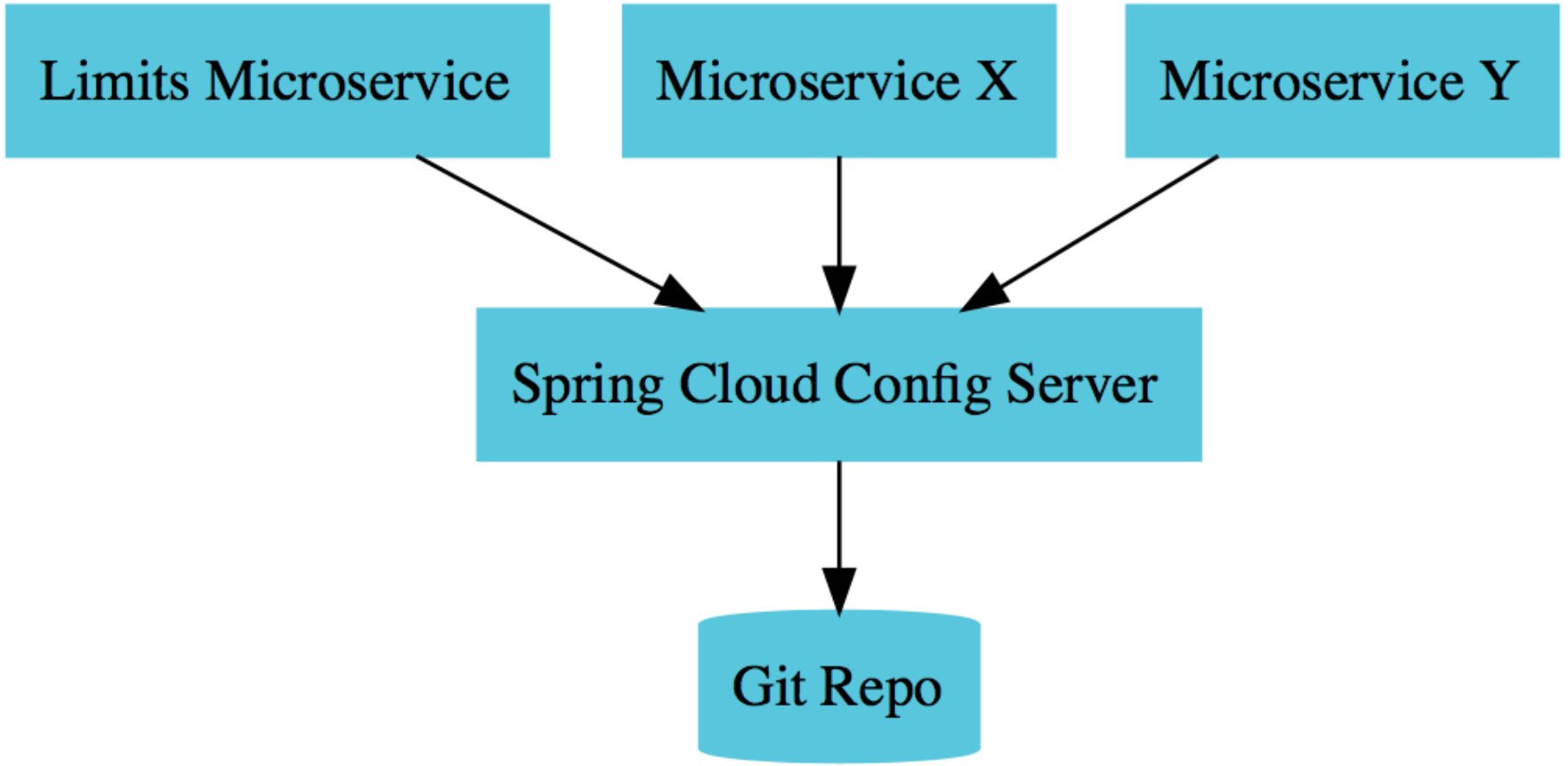
Ports Standardization

Application	Port
Limits Microservice	8080, 8081, ...
Spring Cloud Config Server	8888
Currency Exchange Microservice	8000, 8001, 8002, ..
Currency Conversion Microservice	8100, 8101, 8102, ...
Netflix Eureka Naming Server	8761
API Gateway	8765
Zipkin Distributed Tracing Server	9411

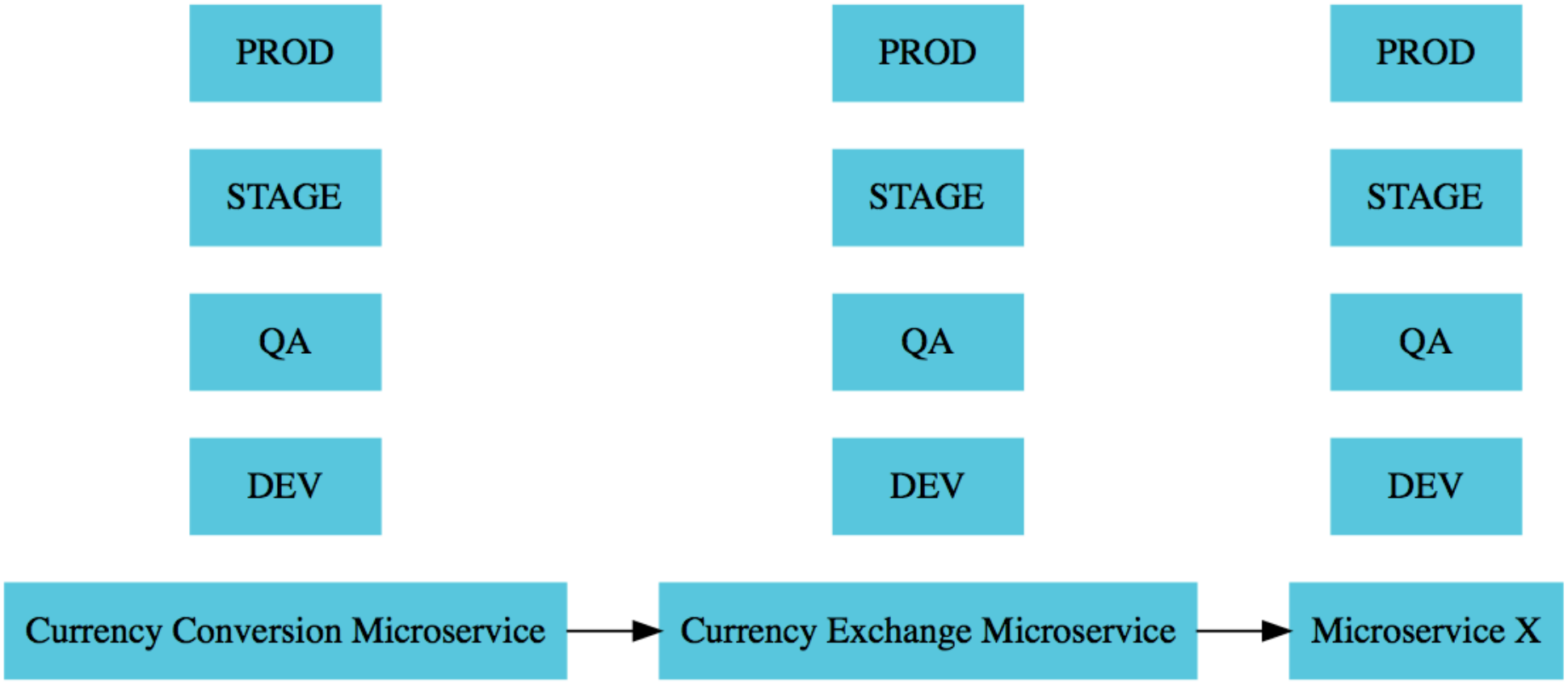
Need for Centralized Configuration

- Lot of configuration:
  - External Services
  - Database
  - Queue
  - Typical Application Configuration
- Configuration variations:
  - 1000s of Microservices
  - Multiple Environments
  - Multiple instances in each Environment
- How do you manage all this configuration?

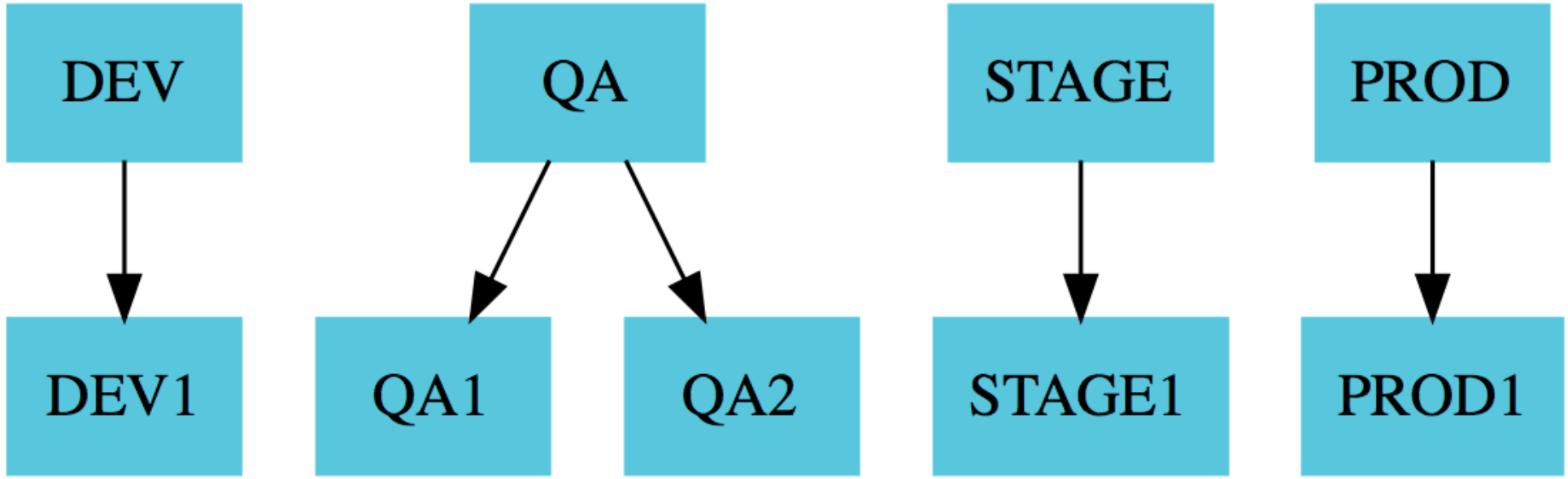




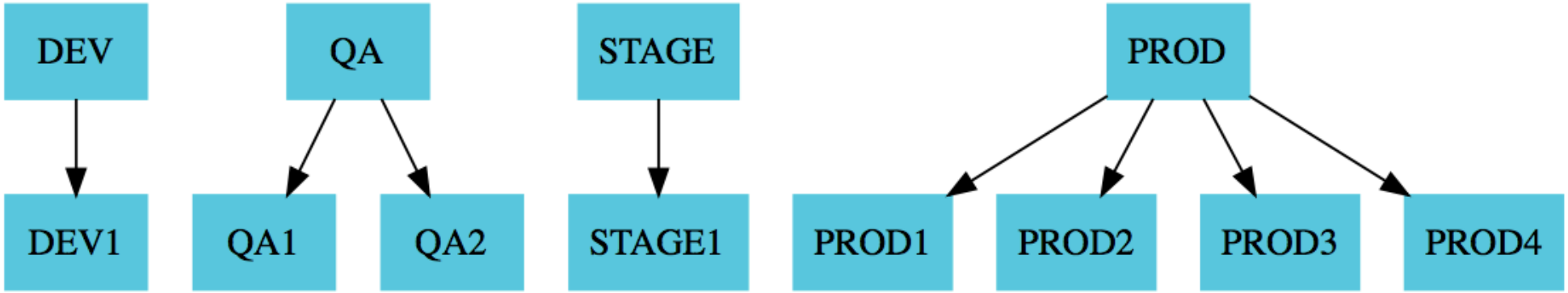
Config Server



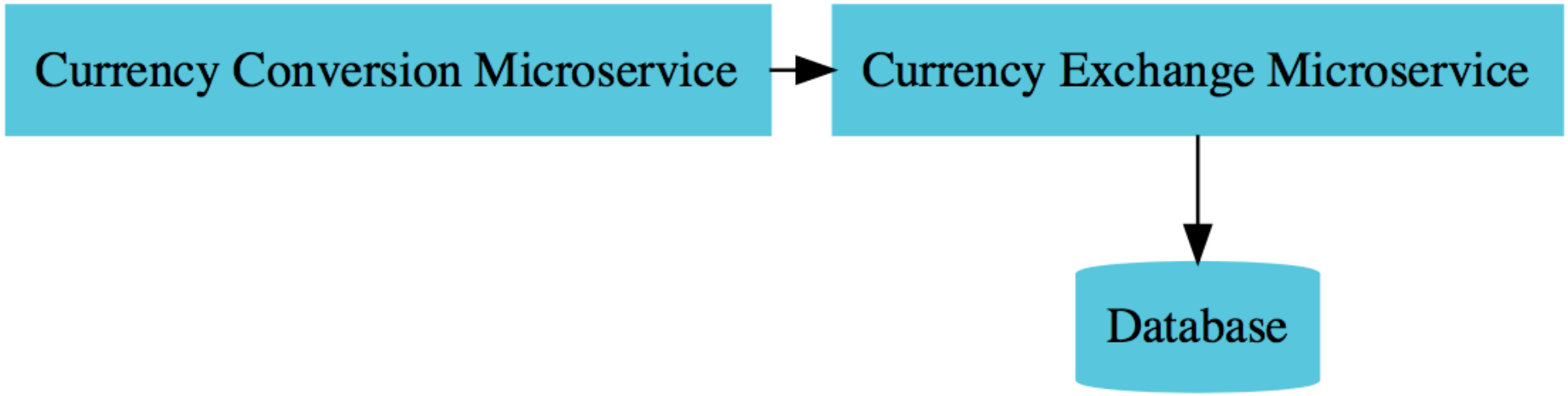
Environments



Environments



Environments



Microservices Overview

Currency Exchange Microservice

In28 Minutes

What is the exchange rate of one currency in another?

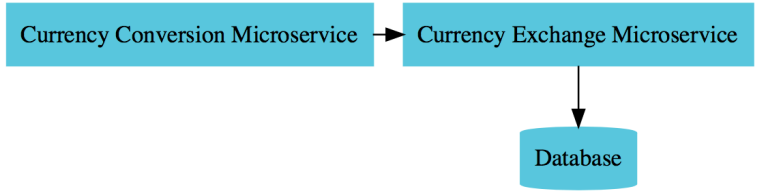
```
http://localhost:8000/currency-exchange/from/USD/to/INR

{
   "id":10001,
   "from":"USD",
   "to":"INR",
   "conversionMultiple":65.00,
   "environment":"8000 instance-id"
}
```

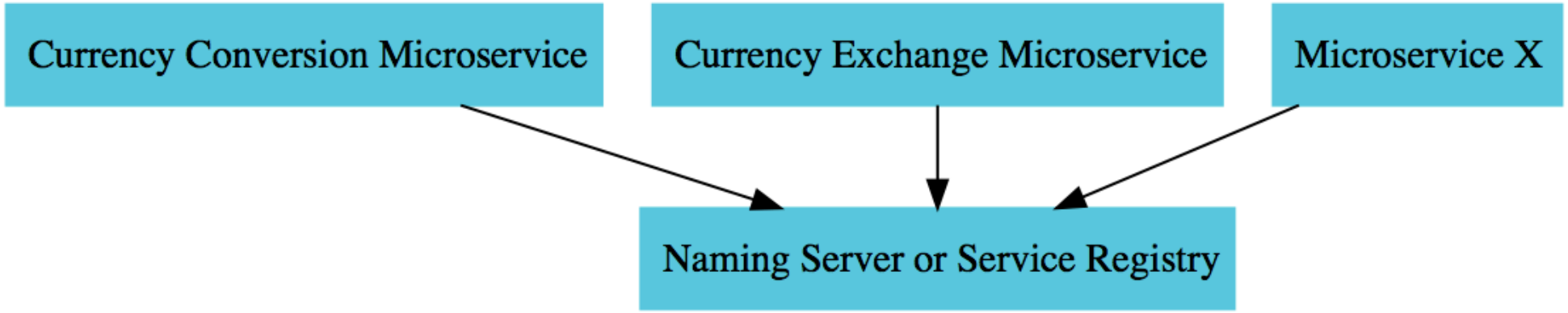
Currency Conversion Microservice

In28 Minutes

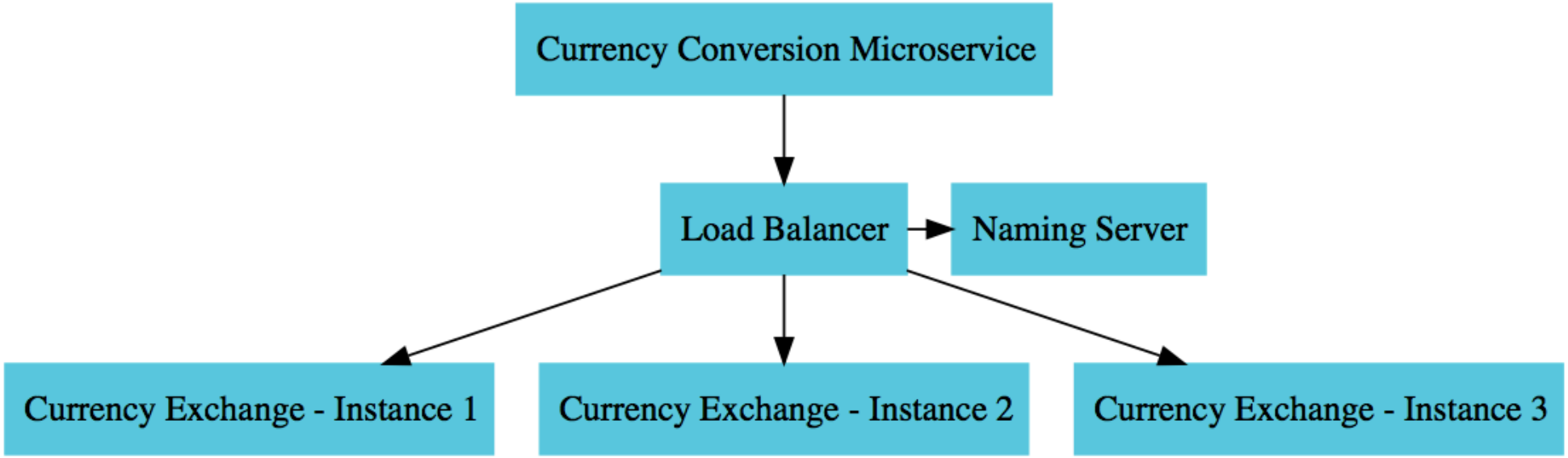
Convert 10 USD into INR

```
http://localhost:8100/currency-conversion/from/USD/to/INR/quantity/10

{
  "id": 10001,
  "from": "USD",
  "to": "INR",
  "conversionMultiple": 65.00,
  "quantity": 10,
  "totalCalculatedAmount": 650.00,
  "environment": "8000 instance-id"
}
```





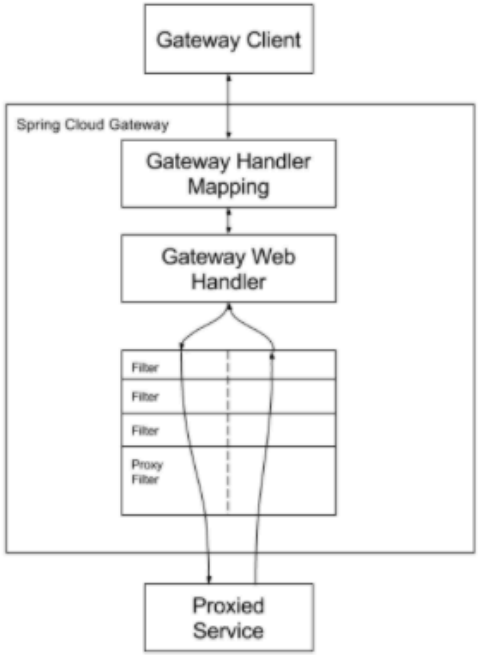
Naming Server



Load Balancing

Spring Cloud Gateway

- Simple, yet effective way to route to APIs
- Provide cross cutting concerns:
  - Security
  - Monitoring/metrics
- Built on top of Spring WebFlux (Reactive Approach)
- Features:
  - Match routes on any request attribute
  - Define Predicates and Filters
  - Integrates with Spring Cloud Discovery Client (Load Balancing)
  - Path Rewriting



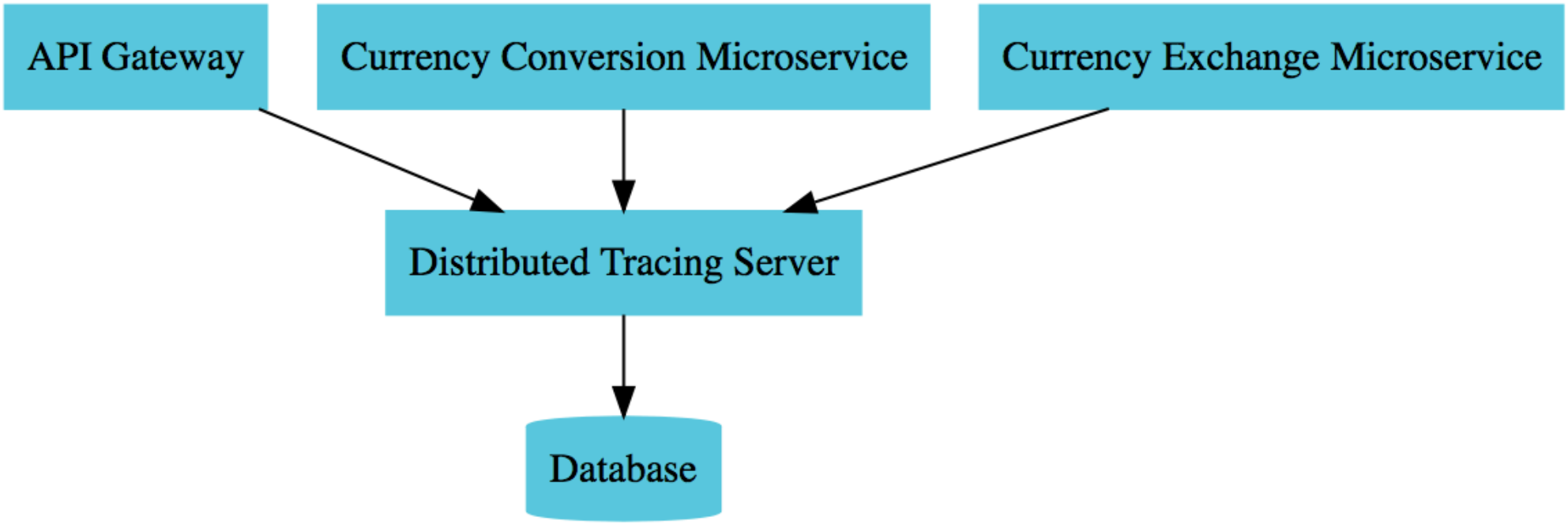
From *https://docs.spring.io*

Circuit Breaker

- What if one of the services is down or is slow?
  - Impacts entire chain!
- Questions:
  - Can we return a fallback response if a service is down?
  - Can we implement a Circuit Breaker pattern to reduce load?
  - Can we retry requests in case of temporary failures?
  - Can we implement rate limiting?
- Solution: Circuit Breaker Framework - Resilience4j

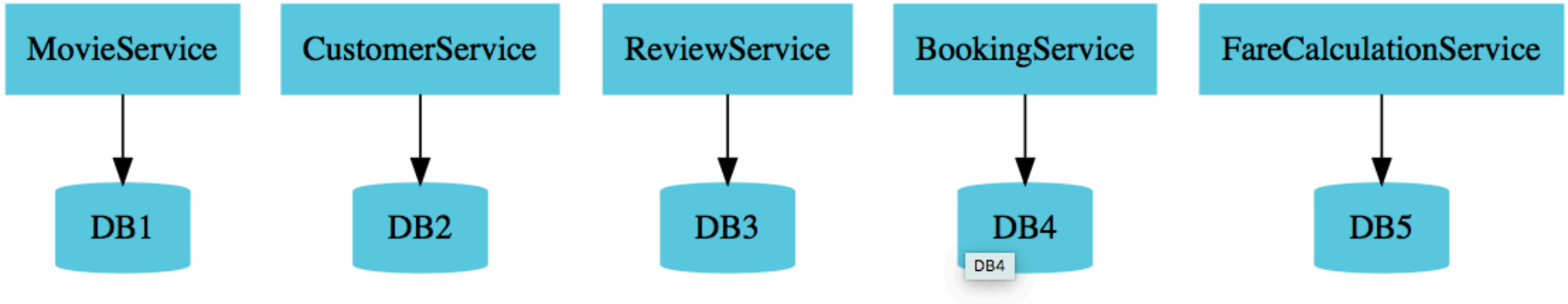
Distributed Tracing

- Complex call chain
- How do you debug problems?
- How do you trace requests across microservices?
- Enter Distributed Tracing



Distributed Tracing

Microservices



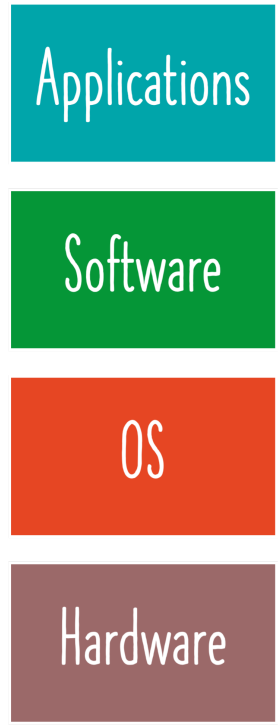
- Enterprises are heading towards microservices architectures
  - Build small focused microservices
  - **Flexibility to innovate** and build applications in different programming languages (Go, Java, Python, JavaScript, etc)
  - BUT **deployments become complex**!
  - How can we have **one way of deploying** Go, Java, Python or JavaScript .. microservices?
    - Enter **containers**!

Docker
Getting Started

How does Traditional Deployment work?

In28 Minutes

- Deployment process **described in a document**
- Operations team **follows steps** to:
  - Setup Hardware
  - Setup OS (Linux, Windows, Mac, ...)
  - Install Software (Java, Python, NodeJs, ...)
  - Setup Application Dependencies
  - Install Application
- **Manual approach**:
  - Takes a lot of time
  - High chance of making mistakes



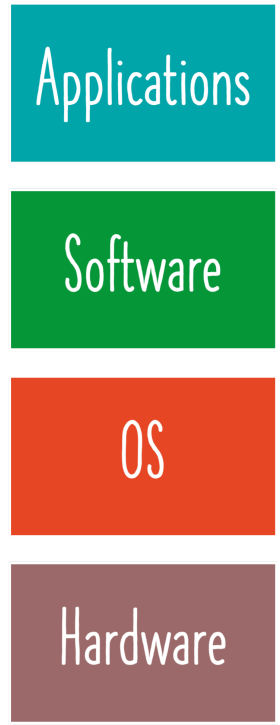
Understanding Deployment Process with Docker

In28 Minutes

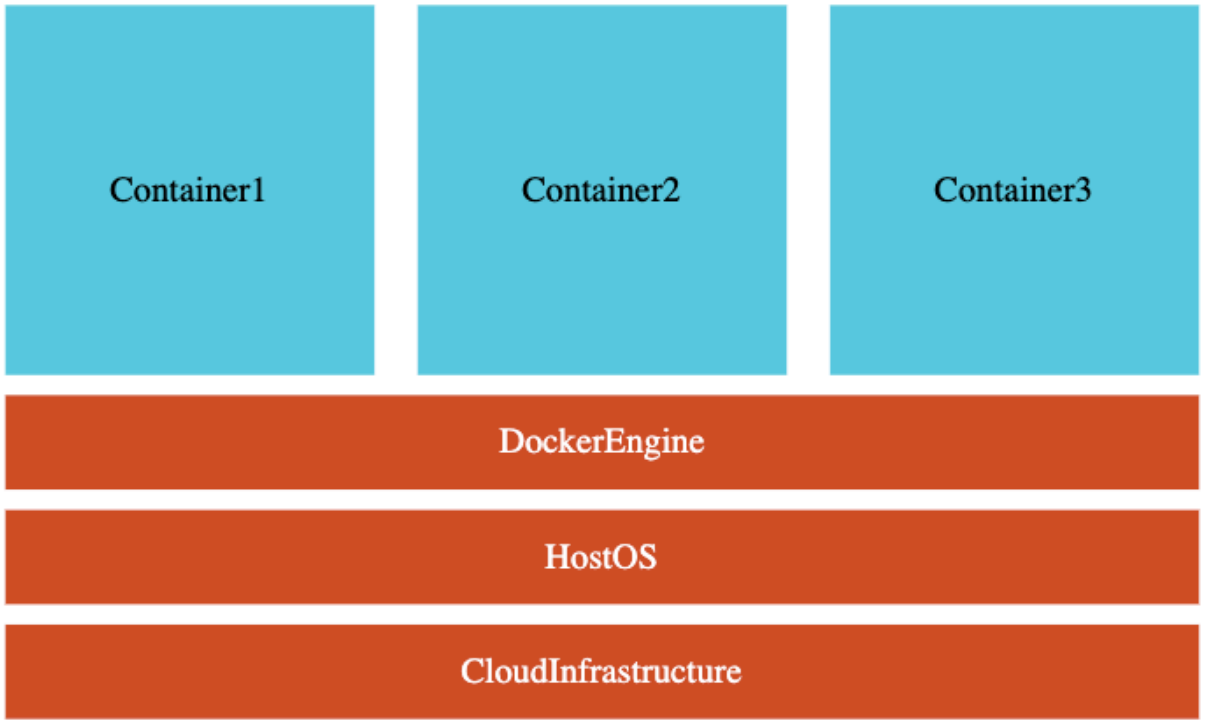
- **Simplified** Deployment Process:
  - OS doesn't matter
  - Programming Language does not matter
  - Hardware does not matter
- **01:** Developer creates a Docker Image
- **02:** Operations run the Docker Image
  - Using a very simple command
- **Takeaway**: Once you have a Docker Image, irrespective of what the docker image contains, you run it the same way!
  - Make your operations team happy

How does Docker Make it Easy?

- Docker image **has everything you need to run your application**:
  - Operating System
  - Application Runtime (JDK or Python or NodeJS)
  - Application code and dependencies
- You can run a Docker container **the same way** everywhere:
  - Your local machine
  - Corporate data center
  - Cloud



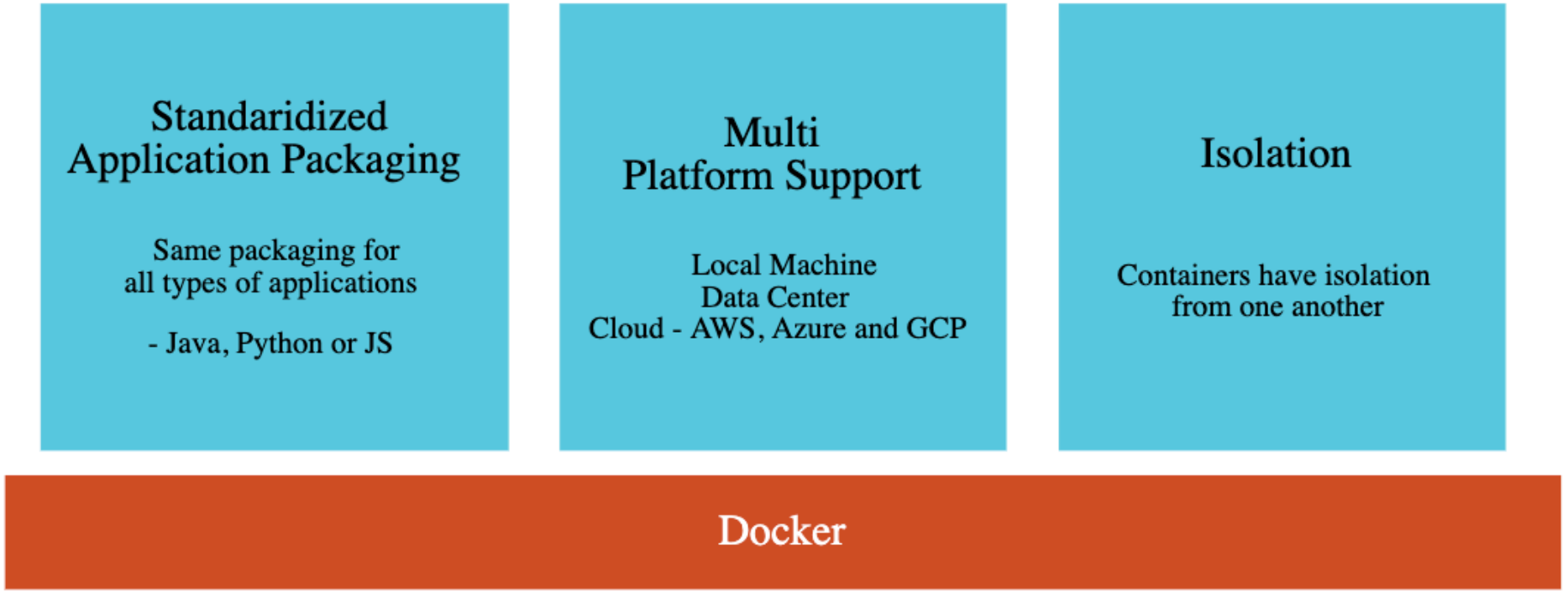
Run Docker Containers Anywhere



- All that you need is a Docker Runtime (like Docker Engine)

Why is Docker Popular?

In28 Minutes



What's happening in the Background?

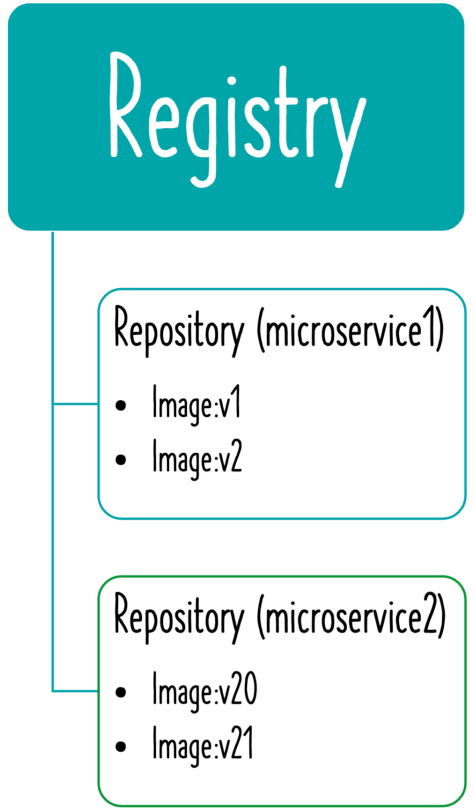

```
docker container run -d -p 5000:5000 in28min/hello-world-nodejs:0.0.1.RELEASE
```

- **Docker image** is downloaded from Docker Registry (Default: Docker Hub)
  - ***https://hub.docker.com/r/in28min/hello-world-nodejs***
  - **Image** is a set of bytes
  - **Container**: Running Image
  - **in28min/hello-world-nodejs**: Repository Name
  - **0.0.1.RELEASE**: Tag (or version)
  - **-p hostPort:containerPort**: Maps internal docker port (container port) to a port on the host (host port)
    - By default, Docker uses its own internal network called bridge network
    - We are mapping a host port so that users can access your application
  - **-d**: Detatched Mode (Don't tie up the terminal)

Understanding Docker Terminology

In28 Minutes

- **Docker Image**: A package representing specific version of your application (or software)
  - Contains everything your app needs
    - OS, software, code, dependencies
- **Docker Registry**: A place to store your docker images
- **Docker Hub**: A registry to host Docker images
- **Docker Repository**: Docker images for a specific app (tags are used to differentiate different images)
- **Docker Container**: Runtime instance of a docker image
- **Dockerfile**: File with instructions to create a Docker image



Dockerfile - 1 - Creating Docker Images

In28 Minutes

```
FROM openjdk:18.0-slim
COPY target/*.jar app.jar
EXPOSE 5000
ENTRYPOINT ["java","-jar","/app.jar"]
```

- Dockerfile contains instruction to create Docker images
  - **FROM** - Sets a base image
  - **COPY** - Copies new files or directories into image
  - **EXPOSE** - Informs Docker about the port that the container listens on at runtime
  - **ENTRYPOINT** - Configure a command that will be run at container launch
- docker build -t in28min/hello-world:v1 .

Dockerfile - 2 - Build Jar File - Multi Stage

In28 Minutes

```
FROM maven:3.8.6-openjdk-18-slim AS build
WORKDIR /home/app
COPY . /home/app
RUN mvn -f /home/app/pom.xml clean package

FROM openjdk:18.0-slim
EXPOSE 5000
COPY --from=build /home/app/target/*.jar app.jar
ENTRYPOINT [ "sh", "-c", "java -jar /app.jar" ]
```

- Let build the jar file as part of creation of Docker Image
- Your build does NOT make use of anything built on your local machine

Dockerfile - 3 - Improve Layer Caching

In 28 Minutes

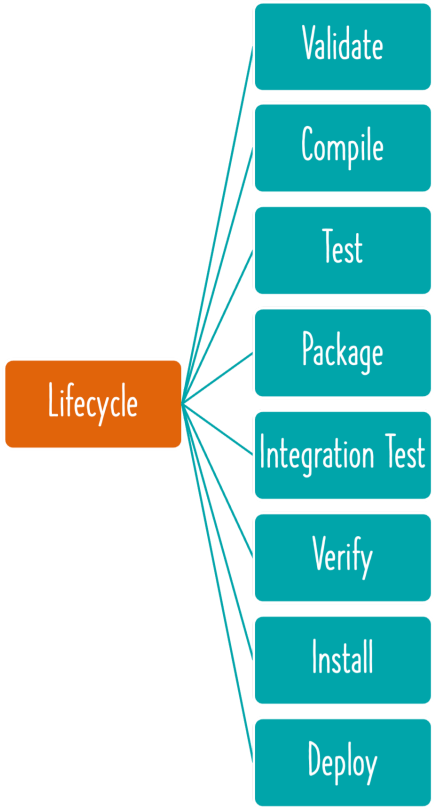
```
FROM maven:3.8.6-openjdk-18-slim AS build
WORKDIR /home/app

COPY ./pom.xml /home/app/pom.xml
COPY ./src/main/java/com/example/demodocker/DemoDockerApplication.java /
    /home/app/src/main/java/com/example/demodocker/DemoDockerApplication.java

RUN mvn -f /home/app/pom.xml clean package

COPY . /home/app
RUN mvn -f /home/app/pom.xml clean package

FROM openjdk:18.0-slim
EXPOSE 5000
COPY --from=build /home/app/target/*.jar app.jar
ENTRYPOINT [ "sh", "-c", "java -jar /app.jar" ]
```

- Docker caches every layer and tries to reuse it
- Let's make use of this feature to make our build efficient

Spring Boot Maven Plugin - Create Docker Image

In28 Minutes

- **Spring Boot Maven Plugin**: Provides Spring Boot support in Apache Maven
  - Example: Create executable jar package
  - Example: Run Spring Boot application
  - Example: Create a Container Image
  - **Commands**:
    - mvn spring-boot:**repackage** (create jar or war)
      - Run package using `java -jar`
    - mvn spring-boot:**run** (Run application)
    - mvn spring-boot:**start** (Non-blocking. Use it to run integration tests.)
    - mvn spring-boot:**stop** (Stop application started with start command)
    - mvn spring-boot:**build-image** (Build a container image)



Creating Docker Images - Dockerfile

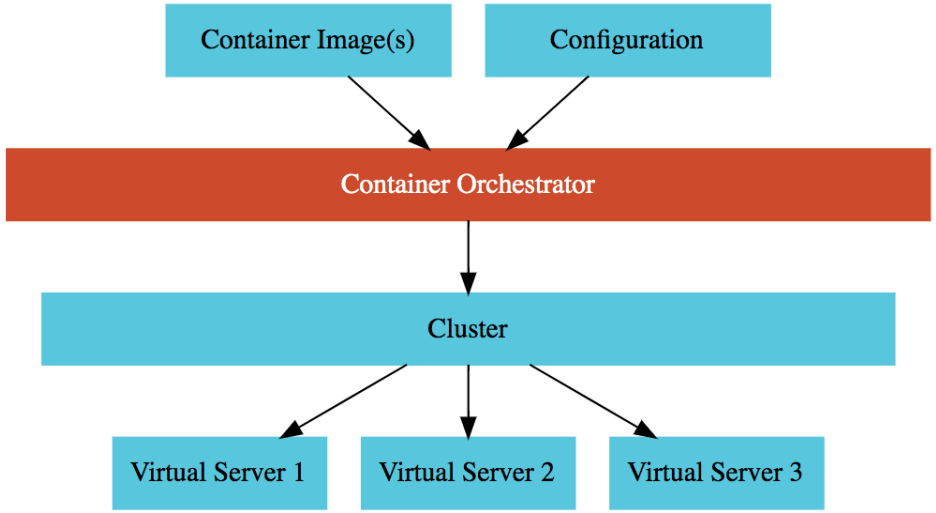
In28 Minutes

```
FROM node:8.16.1-alpine
WORKDIR /app
COPY . /app
RUN npm install
EXPOSE 5000
CMD node index.js
```

- Dockerfile contains instruction to create Docker images
  - **FROM** - Sets a base image
  - **WORKDIR** - sets the working directory
  - **RUN** - execute a command
  - **EXPOSE** - Informs Docker about the port that the container listens on at runtime
  - **COPY** - Copies new files or directories into image
  - **CMD** - Default command for an executing container

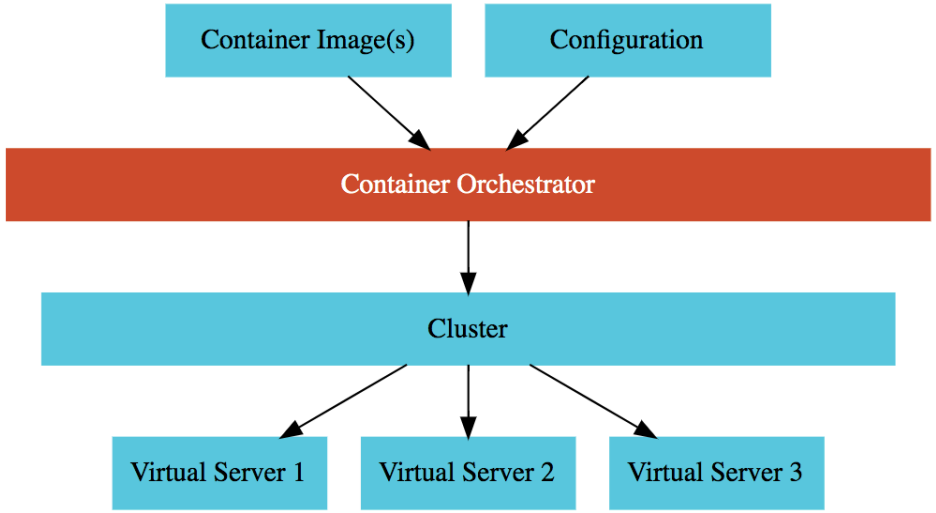
Container Orchestration

- **Requirement** : I want 10 instances of Microservice A container, 15 instances of Microservice B container and ....
- Typical Features:
  - **Auto Scaling** - Scale containers based on demand
  - **Service Discovery** - Help microservices find one another
  - **Load Balancer** - Distribute load among multiple instances of a microservice
  - **Self Healing** - Do health checks and replace failing instances
  - **Zero Downtime Deployments** - Release new versions without downtime



Container Orchestration Options

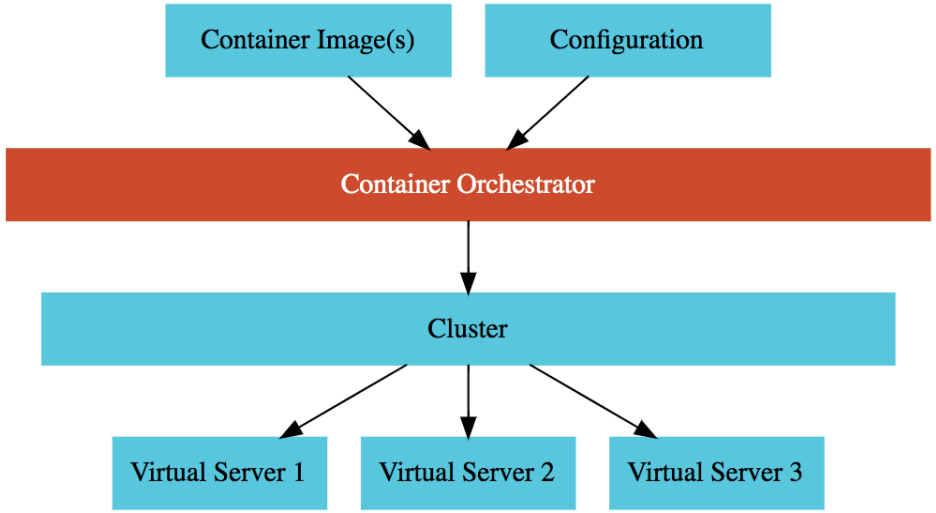
- **AWS Specific**
  - AWS Elastic Container Service (ECS)
  - AWS Fargate : Serverless version of AWS ECS
- **Cloud Neutral** - Kubernetes
  - AWS - Elastic Kubernetes Service (EKS)
  - Azure - Azure Kubernetes Service (AKS)
  - GCP - Google Kubernetes Engine (GKE)
  - EKS/AKS does not have a free tier!
    - We use GCP and GKE!



Kubernetes

Kubernetes

- Most popular open source container orchestration solution
- Provides Cluster Management (including upgrades)
  - Each cluster can have different types of virtual machines
- Provides all important container orchestration features:
  - **Auto Scaling**
  - **Service Discovery**
  - **Load Balancer**
  - **Self Healing**
  - **Zero Downtime Deployments**



Google Kubernetes Engine (GKE)

In28 Minutes

- **Managed** Kubernetes service
- Minimize operations with **auto-repair** (repair failed nodes) and **auto-upgrade** (use latest version of K8S always) features
- Provides **Pod and Cluster Autoscaling**
- Enable **Cloud Logging** and **Cloud Monitoring** with simple configuration
- Uses **Container-Optimized OS**, a hardened OS built by Google
- Provides support for **Persistent disks** and **Local SSD**

Kubernetes Engine

Kubernetes - A Microservice Journey - Getting Started

In28 Minutes

- **Let's Have Some Fun**: Let's get on a journey with Kubernetes:
  - Let's create a cluster, deploy a microservice and play with it in **13 steps**!

- **1:** Create a Kubernetes cluster with the default node pool
  - *gcloud container **clusters create*** or use cloud console
- **2:** Login to Cloud Shell
- **3:** Connect to the Kubernetes Cluster
  - *gcloud container **clusters get-credentials** my-cluster --zone us-central1-a --project solid-course-258105*

Kubernetes - A Microservice Journey - Deploy Microservice

In28 Minutes

- **4:** Deploy Microservice to Kubernetes:
  - Create deployment & service using kubectl commands
    - *kubectl **create deployment** hello-world-rest-api --image=in28min/hello-world-rest-api:0.0.1.RELEASE*
    - *kubectl **expose deployment** hello-world-rest-api --type=LoadBalancer --port=8080*

- **5:** Increase number of instances of your microservice:
  - *kubectl **scale deployment** hello-world-rest-api --replicas=2*
- **6:** Increase number of nodes in your Kubernetes cluster:
  - *gcloud container clusters resize **my-cluster --node-pool my-node-pool --num-nodes 5***
  - You are NOT happy about manually increasing number of instances and nodes!

Kubernetes - A Microservice Journey - Auto Scaling and ..

In28 Minutes

- **7:** Setup auto scaling for your microservice:
  - *kubectl **autoscale deployment** hello-world-rest-api --max=10 --cpu-percent=70*
    - Also called horizontal pod autoscaling - HPA - *kubectl get hpa*

- **8:** Setup auto scaling for your Kubernetes Cluster
  - *gcloud **container clusters update** cluster-name --enable-autoscaling --min-nodes=1 --max-nodes=10*
- **9:** Add some application configuration for your microservice
  - Config Map - *kubectl **create configmap** todo-web-application-config --from-literal=RDS_DB_NAME=todos*
- **10:** Add password configuration for your microservice
  - Kubernetes Secrets - *kubectl **create secret** generic todo-web-application-secrets-1 --from-literal=RDS_PASSWORD=dummytodos*

Kubernetes Deployment YAML - Deployment

In28 Minutes

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    app: hello-world-rest-api
  name: hello-world-rest-api
  namespace: default
spec:
  replicas: 3
  selector:
    matchLabels:
      app: hello-world-rest-api
  template:
    metadata:
      labels:
        app: hello-world-rest-api
    spec:
      containers:
      - image: in28min/hello-world-rest-api:0.0.3.RELEASE
        name: hello-world-rest-api
```

Kubernetes Deployment YAML - Service

In28 Minutes

```yaml
apiVersion: v1
kind: Service
metadata:
  labels:
    app: hello-world-rest-api
  name: hello-world-rest-api
  namespace: default
spec:
  ports:
  - port: 8080
    protocol: TCP
    targetPort: 8080
  selector:
    app: hello-world-rest-api
  sessionAffinity: None
  type: LoadBalancer
```

Kubernetes - A Microservice Journey - The End!

In28 Minutes

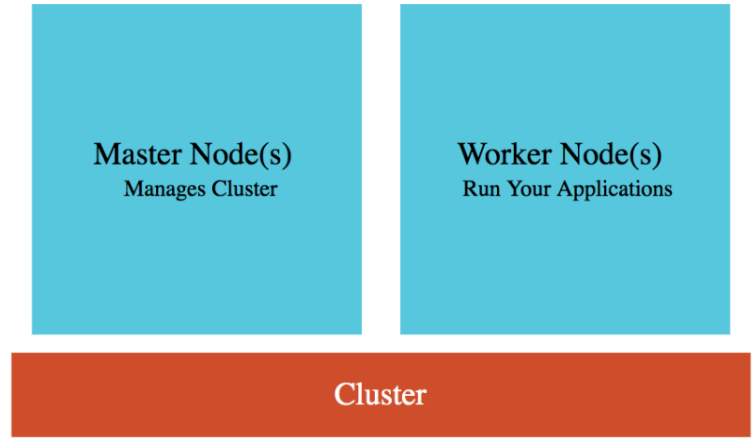
- **11:** Deploy a new microservice which needs nodes with a GPU attached
  - Attach a new node pool with GPU instances to your cluster
    - gcloud **container node-pools create** POOL_NAME --cluster CLUSTER_NAME
    - gcloud container node-pools list --cluster CLUSTER_NAME
  - Deploy the new microservice to the new pool by setting up `nodeSelector` in the `deployment.yaml`
    - nodeSelector: cloud.google.com/gke-nodepool: POOL_NAME
- **12:** Delete the Microservices
  - Delete service - *kubectl **delete service***
  - Delete deployment - *kubectl **delete deployment***
- **13:** Delete the Cluster
  - *gcloud container **clusters delete***

Kubernetes Engine

Google Kubernetes Engine (GKE) Cluster

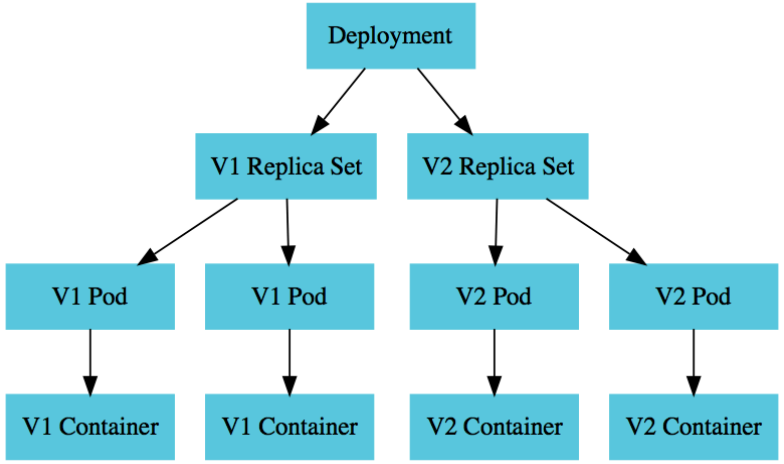
In28 Minutes

- **Cluster** : Group of Compute Engine instances:
  - **Master Node(s)** - Manages the cluster
  - **Worker Node(s)** - Run your workloads (pods)
- **Master Node** (Control plane) components:
  - **API Server** - Handles all communication for a K8S cluster (from nodes and outside)
  - **Scheduler** - Decides placement of pods
  - **Control Manager** - Manages deployments & replicasets
  - **etcd** - Distributed database storing the cluster state
- **Worker Node** components:
  - Runs your pods
  - **Kubelet** - Manages communication with master node(s)



Kubernetes - Pods

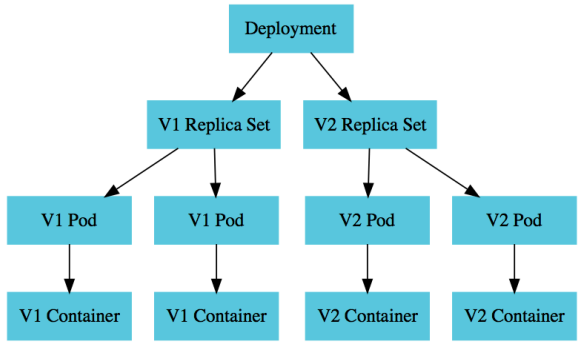
- Smallest deployable unit in Kubernetes
- A Pod contains **one or more containers**
- Each Pod is assigned an ephemeral **IP address**
- All containers in a pod share:
  - Network
  - Storage
  - IP Address
  - Ports and
  - Volumes (Shared persistent disks)
- POD statuses : Running /Pending /Succeeded /Failed /Unknown



Kubernetes - Deployment vs Replica Set

In28 Minutes

- A **deployment** is created for each microservice:
  - `kubectl create deployment m1 --image=m1:v1`
  - Deployment represents a microservice (with all its releases)
  - Deployment manages new releases ensuring zero downtime
- **Replica set** ensures that a specific number of pods are running for a specific microservice version
  - `kubectl scale deployment m2 --replicas=2`
  - Even if one of the pods is killed, replica set will launch a new one
- Deploy V2 of microservice - Creates a new replica set
  - `kubectl set image deployment m1 m1=m1:v2`
  - V2 Replica Set is created
  - Deployment updates V1 Replica Set and V2 Replica Set based on the release strategies



Kubernetes - Service

In28 Minutes

- Each Pod has its **own IP address:**
  - How do you ensure that external users are not impacted when:
    - A pod fails and is replaced by replica set
    - A new release happens and all existing pods of old release are replaced by ones of new release
- Create **Service**
  - *kubectl expose deployment name --type=LoadBalancer --port=80*
    - Expose PODs to outside world using a stable IP Address
    - Ensures that the external world does not get impacted as pods go down and come up
- Three Types:
  - **ClusterIP**: Exposes Service on a cluster-internal IP
    - Use case: You want your microservice only to be available inside the cluster (Intra cluster communication)
  - **LoadBalancer**: Exposes Service externally using a cloud provider's load balancer
    - Use case: You want to create individual Load Balancer's for each microservice
  - **NodePort**: Exposes Service on each Node's IP at a static port (the NodePort)
    - Use case: You DO not want to create an external Load Balancer for each microservice (You can create one Ingress component to load balance multiple microservices)

Kubernetes - Liveness and Readiness Probes

- Kubernetes uses probes to check the health of a microservice:
  - If readiness probe is not successful, no traffic is sent
  - If liveness probe is not successful, pod is restarted
- Spring Boot Actuator (>=2.3) provides inbuilt readiness and liveness probes:
  - /health/readiness
  - /health/liveness

What Next?

FASTEST ROADMAPS

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- Azure Certifications
- AWS Certifications
- DevOps
- Java Full Stack
- Java Microservices