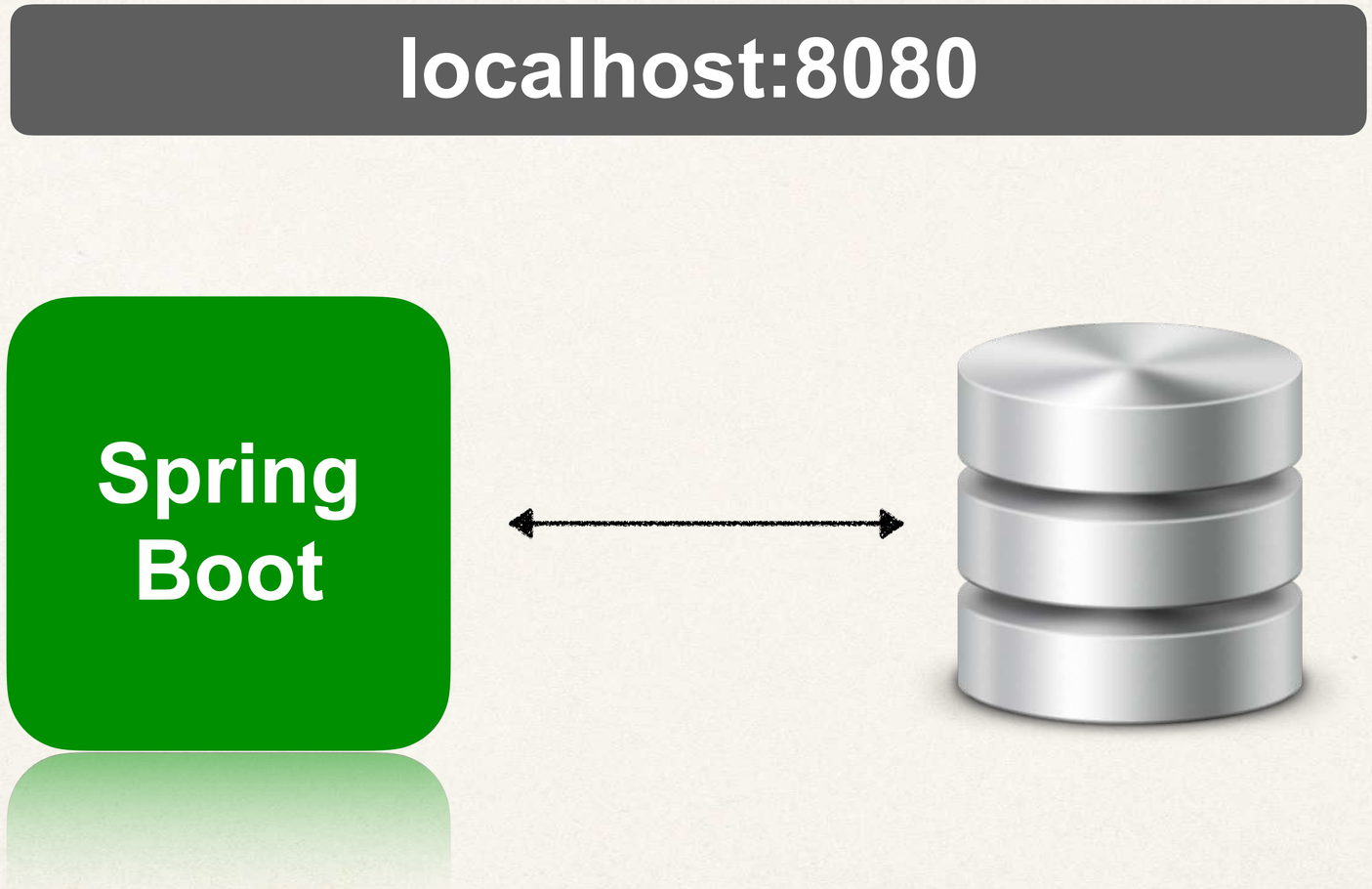
Course Introduction

Local Development



<< your domain name >>

Main Objectives

- Learn how to deploy your Spring Boot application online
- Live Internet access for your Spring Boot application
- Great way to showcase your skills to the hiring manager

Cloud Hosting

- We will use Amazon Web Services (AWS) for cloud hosting
- Free developer account for 6 months
- No prior experience with AWS is required
- I will give an overview in later videos :-)

Course Road Map

- Amazon Web Services (AWS) Overview
- Create a free AWS Developer Account
- Deploy Spring Boot app on AWS Cloud
- Add database support on AWS Cloud
- Register a custom domain name

www.myspringbootapp.com

Prerequisites

- You should have basic Spring Boot experience: Spring MVC + DB

- Should have these dev tools installed:
  - Java IDE (IntelliJ, VS Code, Eclipse etc …)
  - MySQL Workbench

Source Code

- Our classroom Spring Boot app is **already developed** and can run locally
- No major coding is involved in this course
- The focus of this course is **deploying code** … not developing it

Source Code and PDFs

All source code is available for download

All PDFs of slides are available for download

Questions / Help

If you have questions or need help…

Post the question in the classroom discussion forum

AWS Overview

What is Amazon Web Services (AWS)?

- At a high-level, you can think of AWS as
  - Online hosting service
  - Deploy web applications
  - Deploy databases

- Once deployed, your apps are available online!

What is Amazon Web Services (AWS)?

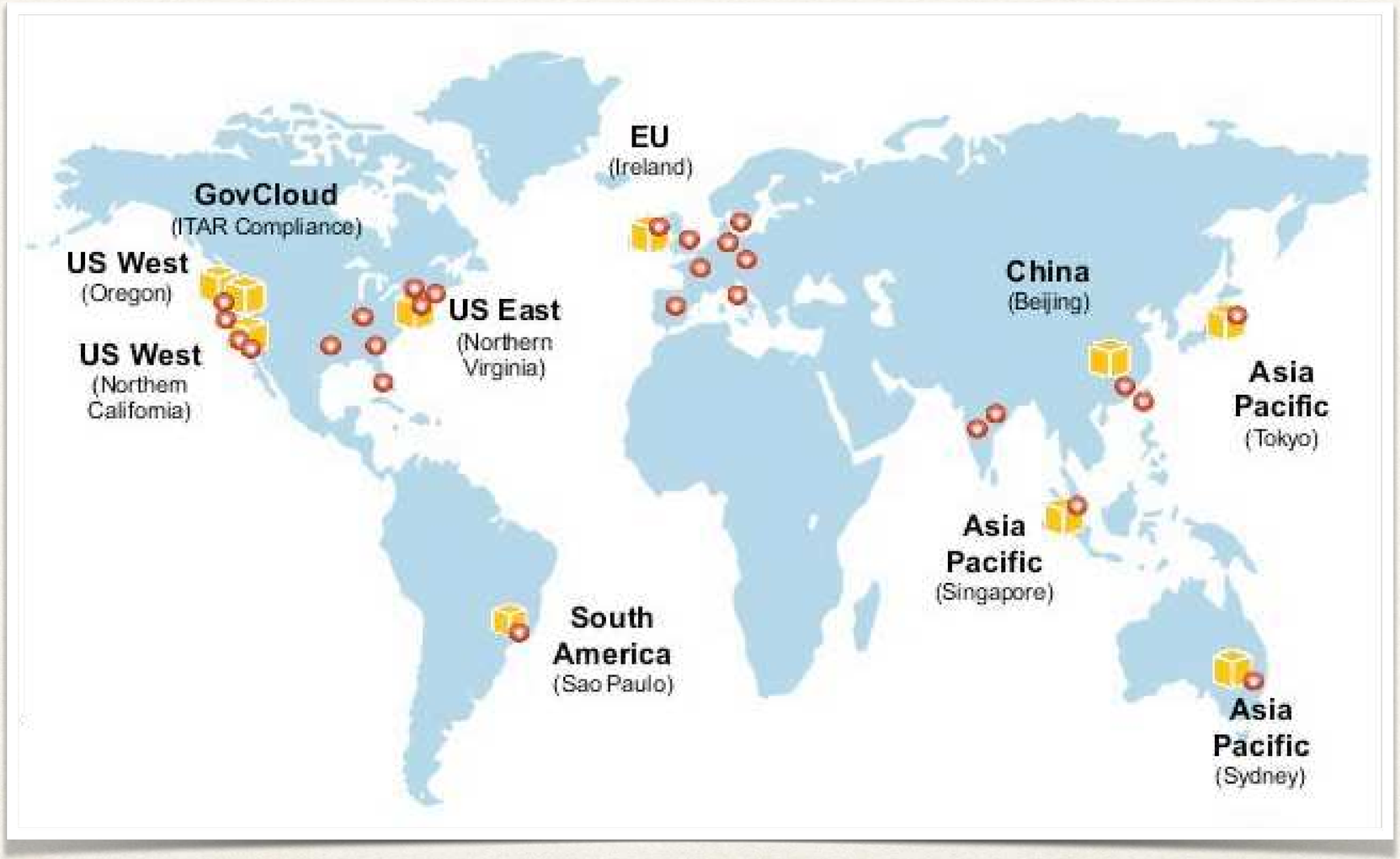
AWS is a full service cloud platform

Over 90+ services!

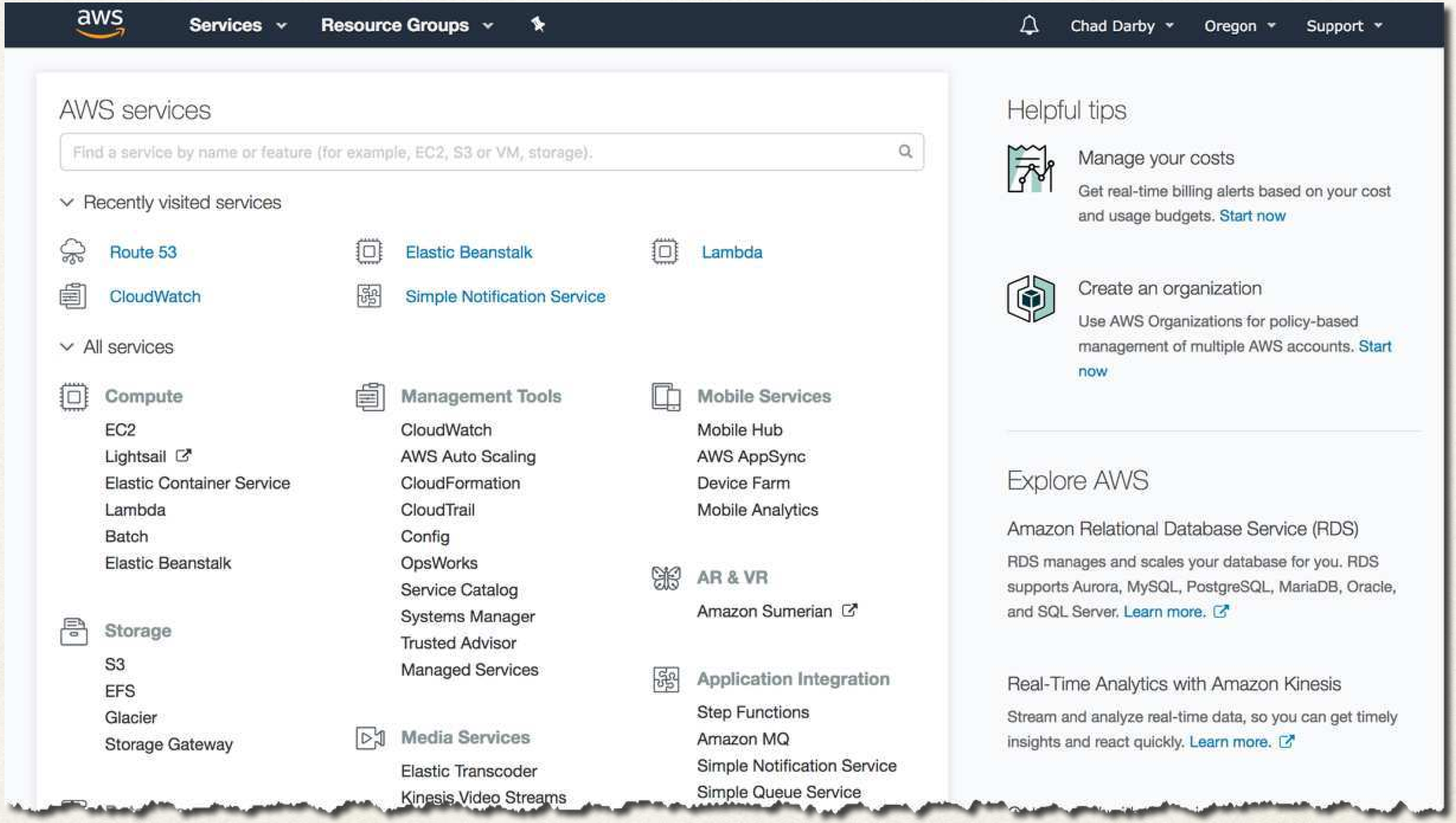
With AWS Cloud - you get …

- On-demand delivery of IT resources via the Internet
  - Spin up servers on-demand (choose your OS etc)
  - Deploy databases in the cloud (choose your DB)
- Pay-as-you-go pricing (**FREE** developer accounts available!)

Go Global in Minutes - Data Centers Worldwide



Select your Services … then Deploy!



AWS Free Tier

- For developers, six months FREE

- Enough resources for us to deploy Spring App and DB for FREE

https://aws.amazon.com/free/

Practical Results

- Cover the essential AWS services to deploy our Spring App online

- Not an A to Z reference of AWS … for that, you can see the **AWS Documentation**

https://aws.amazon.com/documentation/

AWS Resources

- AWS YouTube Videos (official)

https://www.youtube.com/user/AmazonWebServices

- Plenty of AWS courses on udemy.com
  - Search for **AWS** and review the courses with **Best Seller** tag

AWS Key Services

AWS Key Services

Elastic Cloud Compute (EC2)

Remote VM

Elastic Beanstalk

Deploy web applications

Relational Database Service (RDS)

Database in the cloud

Route 53

Route custom domain names

Elastic Cloud Compute (EC2)

- Remote virtual machine based on your specs
- Select the Operating System (MS Windows or Linux)
- You get the Operating System pre-installed … that's it
- Manually install your own apps on top of OS (Tomcat, DB, etc …)

Can also use custom Amazon "Images"

Elastic Beanstalk

- Quickly deploy web applications with Elastic Beanstalk

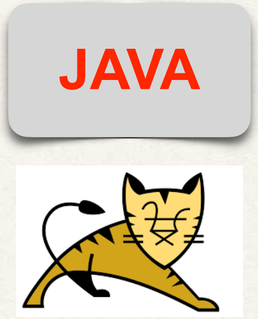
- Select pre-configured virtual machine for your web app stack

- No software to install on virtual machine

- Just deploy your code (zip, war etc)

Java on AWS

- You can use regular Java EE APIs
- Can use 3rd-party frameworks: Spring, Hibernate etc
- All based on standard Java



THERE ARE NO PROPRIETARY AMAZON HOOKS

Java Web Application Archive (WAR)

- Java Web App specification defines standard deployment file
  - **W**eb Application **AR**chive (WAR file)
- Zipped archive of your web app with **`.war`** extension
- Create the WAR file using your IDE or Maven
- Deploy your WAR file to Elastic Beanstalk

mycoolwebapp.war

- **`src/main/webapp`**
  - **`WEB-INF`**
  - **`WEB-INF/classes`**
  - **`WEB-INF/lib`**

Relational Database Service (RDS)

- Quickly deploy a relational database in the cloud

- You can manage it using normal admin tool:
  - MySQL Workbench
  - Oracle SQL Developer, etc …

- AWS also has support for NoSQL databases
  - MongoDB, etc …

MySQL

Oracle

MariaDB

Microsoft SQL Server

PostgreSQL

Amazon Aurora

Route 53

- Routes your custom domain name to your app on AWS
- Configure Route 53 to send www.myspringbootapp.com to your AWS app
- This is the AWS Domain Name System (DNS)
- We'll use it later in the course for our custom domain name :-)

Comparing EC2 to Elastic Beanstalk

- **EC2** is a Do-It-Yourself solution

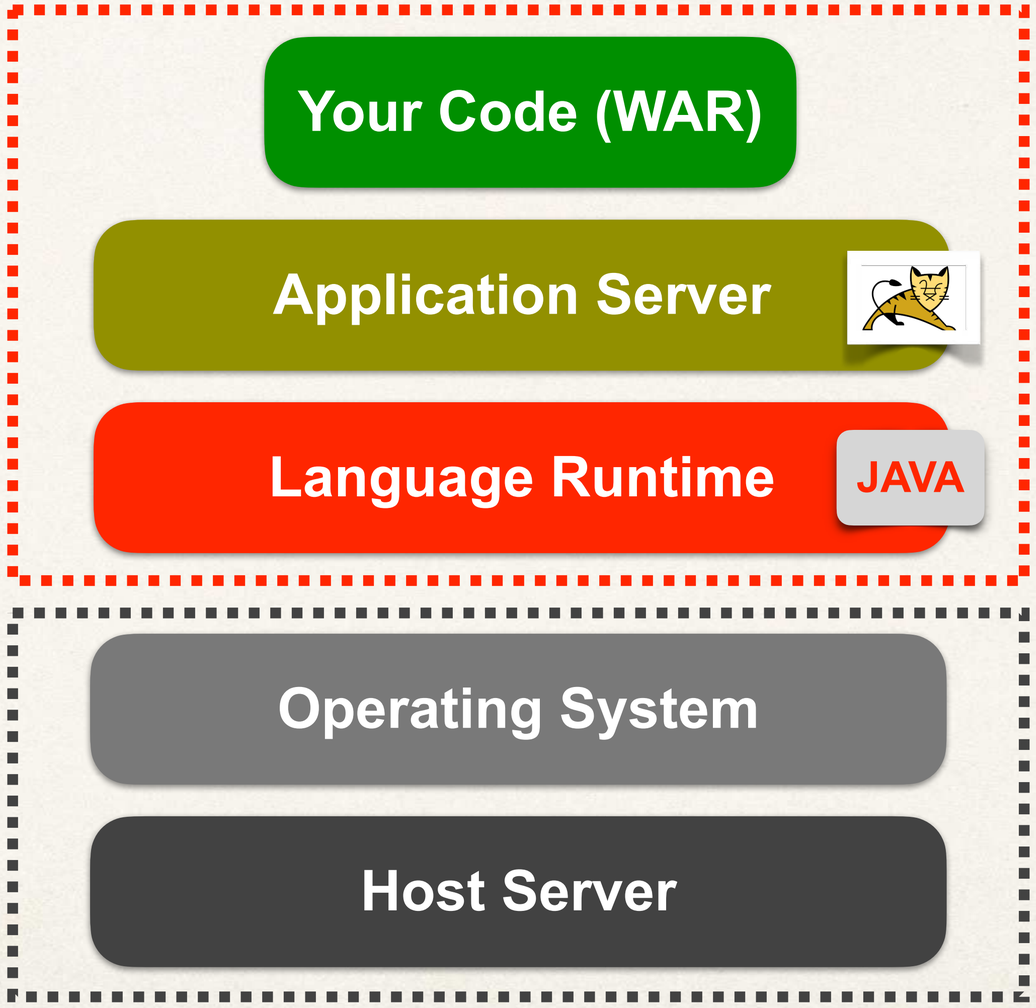
- All you get is the operating system
  - MS Windows or Linux

- If you want other apps
  - You have to manually install them
  - JDK, Tomcat, MySQL etc …

Elastic Cloud Compute (EC2)

Developer responsible for this

EC2 provides this



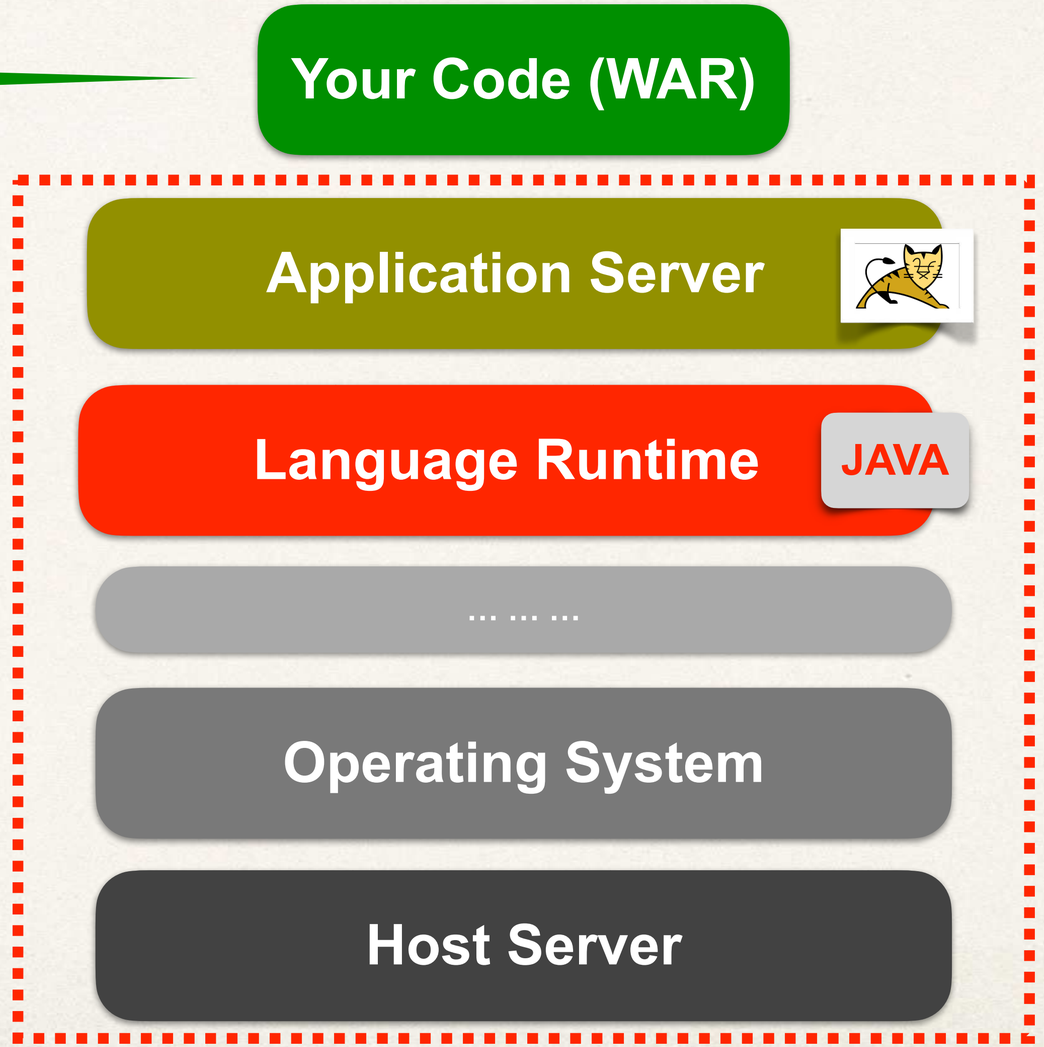
Comparing EC2 to Elastic Beanstalk

- **Elastic Beanstalk** is a pre-packaged platform
  - Ideal for deployments on a web stack
  - Simply select the services you need
- Known as Platform-as-a-Service (PaaS)
- All you have to deploy is **Your Code**

Elastic Beanstalk

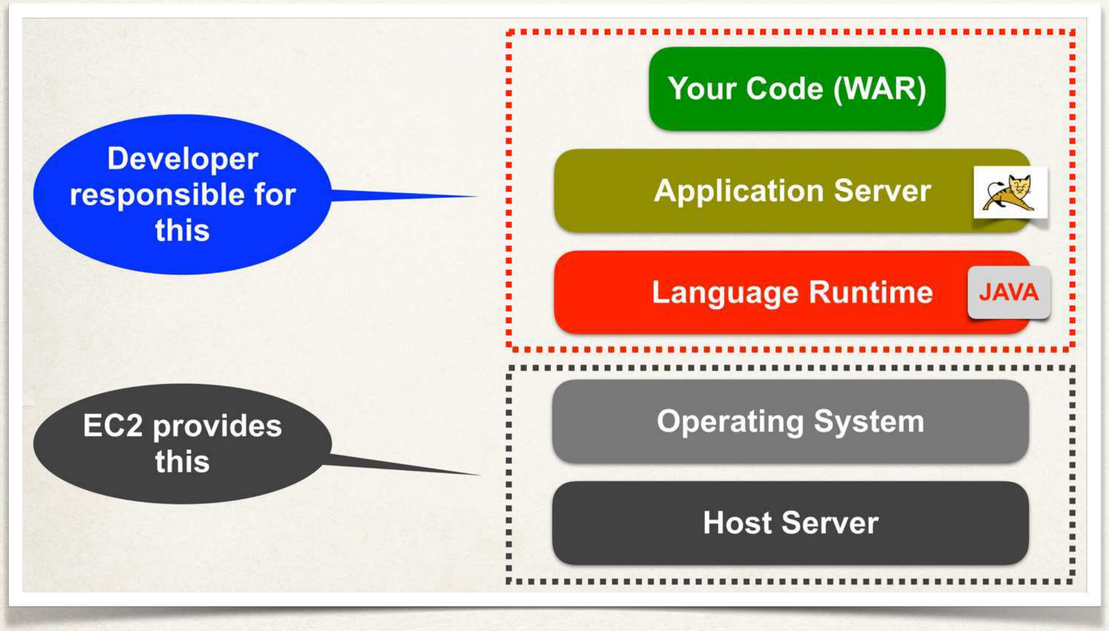
Developer responsible for this

Elastic Beanstalk provides this

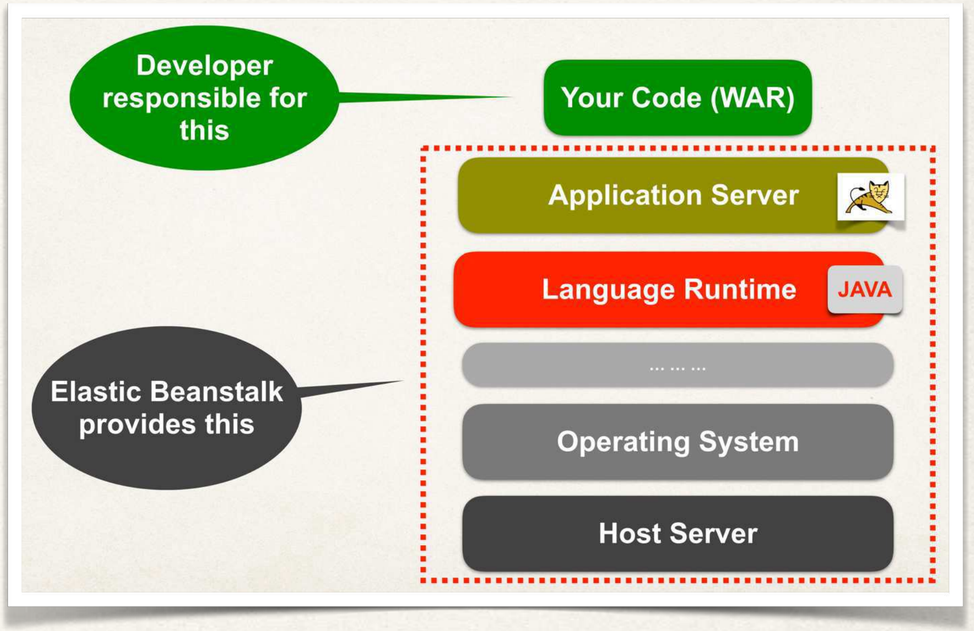


EC2 vs Elastic Beanstalk

EC2



Elastic Beanstalk



Spring Boot JAR - includes embedded Tomcat

Developer responsible for this

Your Spring Boot App (JAR)

Elastic Beanstalk provides this

Language Runtime

JAVA

... ...

Operating System

Host Server

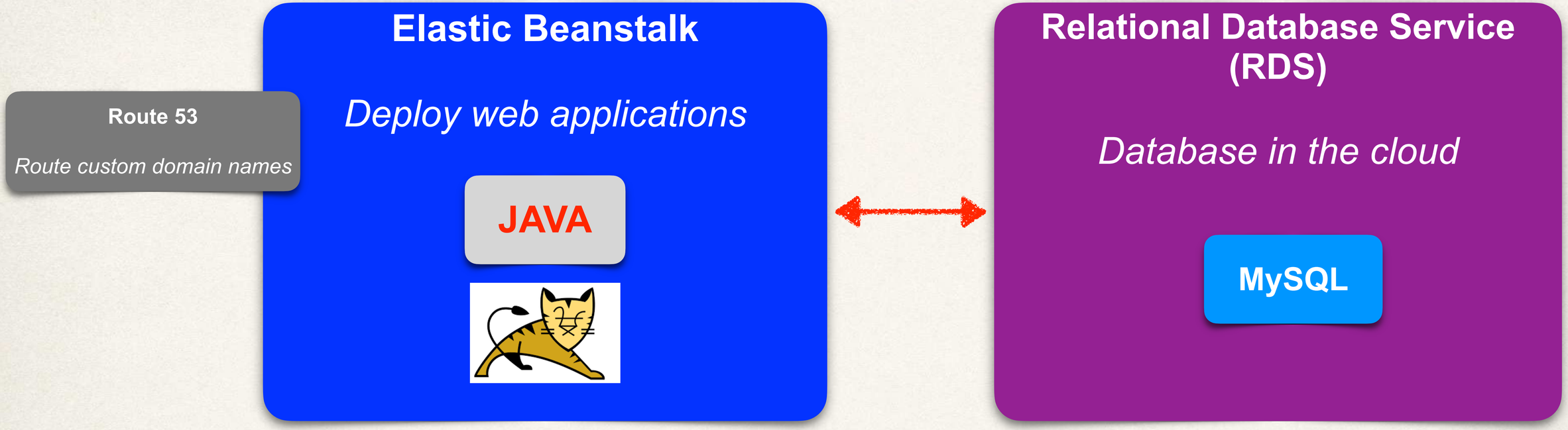
Use Case

- For your apps, start with Elastic Beanstalk 
  - Quickly get started with deploying your apps
  - Leverage pre-configured web stacks

- Use EC2 if you need low-level control 
  - You want to deploy using a different version of Java not supported by Elastic Beanstalk
  - You want to use a different Java app server (WebLogic, WebSphere etc …)
  - Any other OS specific customizations you need to make

Can also create custom Elastic Beanstalk "templates"

Our App Architecture



<< your domain name >>

More Cool Features of Elastic Beanstalk

- Capacity provisioning
- Load balancing
- Auto scaling
- Health monitoring, alarms and notifications
- Many more ….

AWS Documentation

https://aws.amazon.com/documentation/

Service	Docs
Elastic Cloud Compute (EC2)	https://aws.amazon.com/documentation/ec2/
Elastic Beanstalk	https://aws.amazon.com/documentation/elastic-beanstalk/
Relational Database Service (RDS)	https://aws.amazon.com/documentation/rds/
Route 53	https://aws.amazon.com/documentation/route53/

Create a Free AWS Account

Deploy HelloWorld Spring Boot App

HelloWorld - Spring Boot

Spring Boot

Spring Boot - HelloWorld

- As Proof-of-Concept, deploy HelloWorld Spring Boot app on Elastic Beanstalk
- Simple Spring Boot app
- Focus on the deployment process to Elastic Beanstalk

We'll do advanced Spring Boot with Database CRUD in later videos …

Development Process

Step-By-Step

1. Download the app and import into Java IDE
2. Package the application using Maven
3. Create a new application in Elastic Beanstalk
4. Upload the JAR file to Elastic Beanstalk

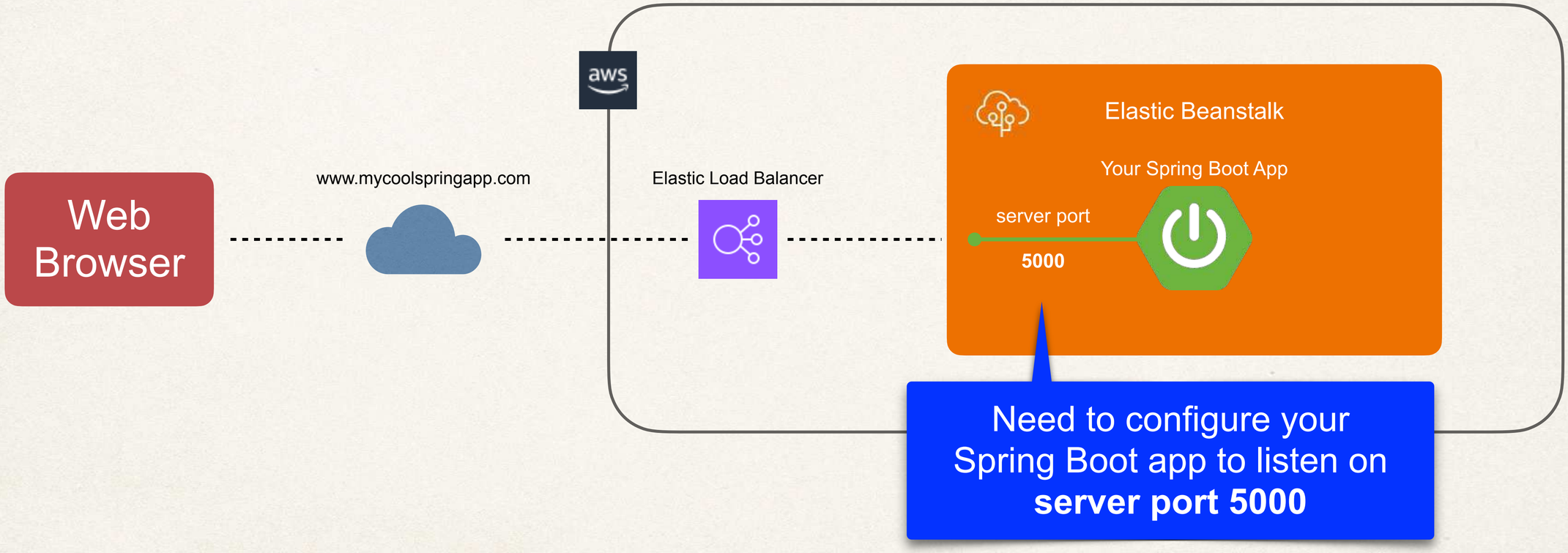
Spring Boot - REST API Deployment

- We'll use MVC app in this course, but we can also deploy REST API
- For REST API … we can follow the exact same deployment steps
- This works the same for @RestController … just like @Controller

Same deployment steps!

Server Port 5000

- Elastic Beanstalk expects for your **Spring Boot app** to listen on **server port 5000**



Server Port 5000

- Elastic Beanstalk expects for your app to listen on server port 5000
- Two options
  - Option 1: Set **environment variable** in Elastic Beanstalk
  - **`SERVER_PORT=5000`**

We'll cover Option 1 for first deployment: HelloWorld

We'll cover Option 2 for second deployment: CRUD MVC

  - Option 2: Set property in **application.properties**
  - **`server.port=5000`**

Can also use Spring profiles

AWS Free Tier and Budgets

AWS Free Tier

- Six months free available to new AWS customers
  - Specific limitations on service and instance type

http://aws.amazon.com/free

AWS Free Tier

- Six months free does not give you unlimited access
- You can not run unlimited number of apps for free for six months

http://aws.amazon.com/free

AWS Free Tier

- Based on free tier limits, you can safely run
  - 1 Spring Boot app on Elastic Beanstalk
  - 1 Database instance on Amazon Relational Database Service (RDS)

- Run this scenario for free for six months - 24/7

AWS Free Tier

- You can experiment with other services
- However, if you are not actively using the services
  - You should stop/delete the services
- If you don't stop /delete the services
  - You will be charged if usage exceeds free tier limits

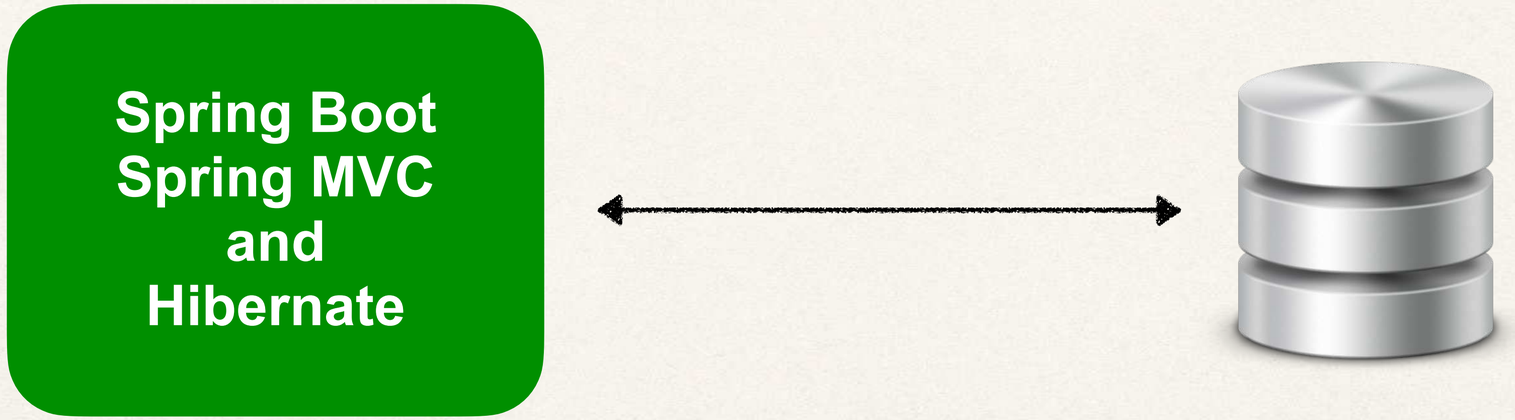
Budget Alerts

- To help monitor charges, you can set up **Budget Alerts**
- Helps keep you in the Free Tier
- AWS will send an email before you exceed capacity / usage
- Normally sends the alert when you are at 75% capacity / usage
- Gives you a chance to stop the services before charges are incurred

Deploy Spring Boot Spring MVC CRUD App

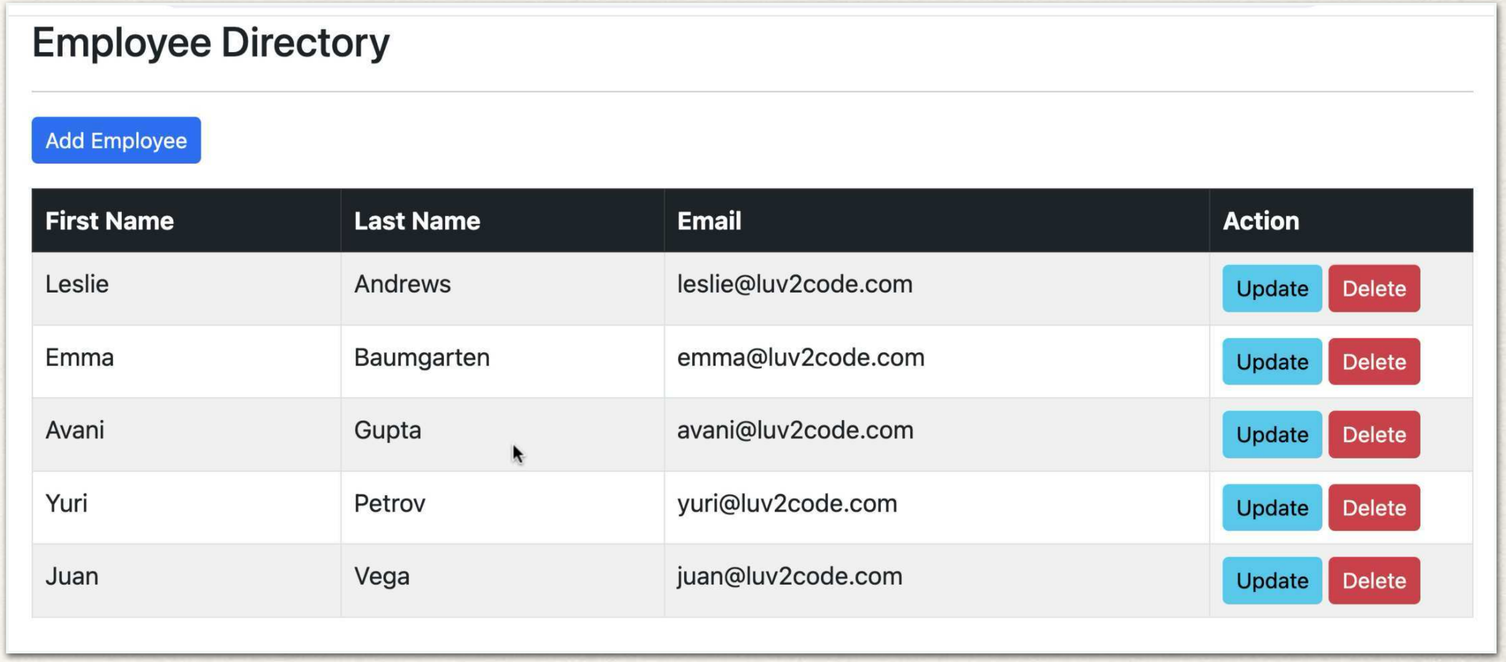
Spring Boot - Spring MVC CRUD Project

Spring Boot - Spring MVC and JPA/Hibernate application that connects to a database



Employee Directory

- List Employees
- Add a new Employee
- Update an Employee
- Delete an Employee



About the code

- All of the coding is complete … we'll focus on deployment
- We'll download the full source code for this app
- Run the app locally using a local database

Create a database on AWS

- Once we have app running locally, then in following videos
  - Create a database on AWS
  - Configure the app to talk our database deployed in AWS
  - Deploy the app to AWS Elastic Beanstalk
- We'll do that later … at the moment, let's focus on running the app locally

Two Database Scripts

1. Folder: **sql-scripts**
   - **01-create-user.sql**
   - **02-employee-directory.sql**

Details on downloading the SQL file provided in next section

About: 01-create-user.sql

1. Create a new MySQL user for our application

- user id: **springstudent**
- password: **springstudent**

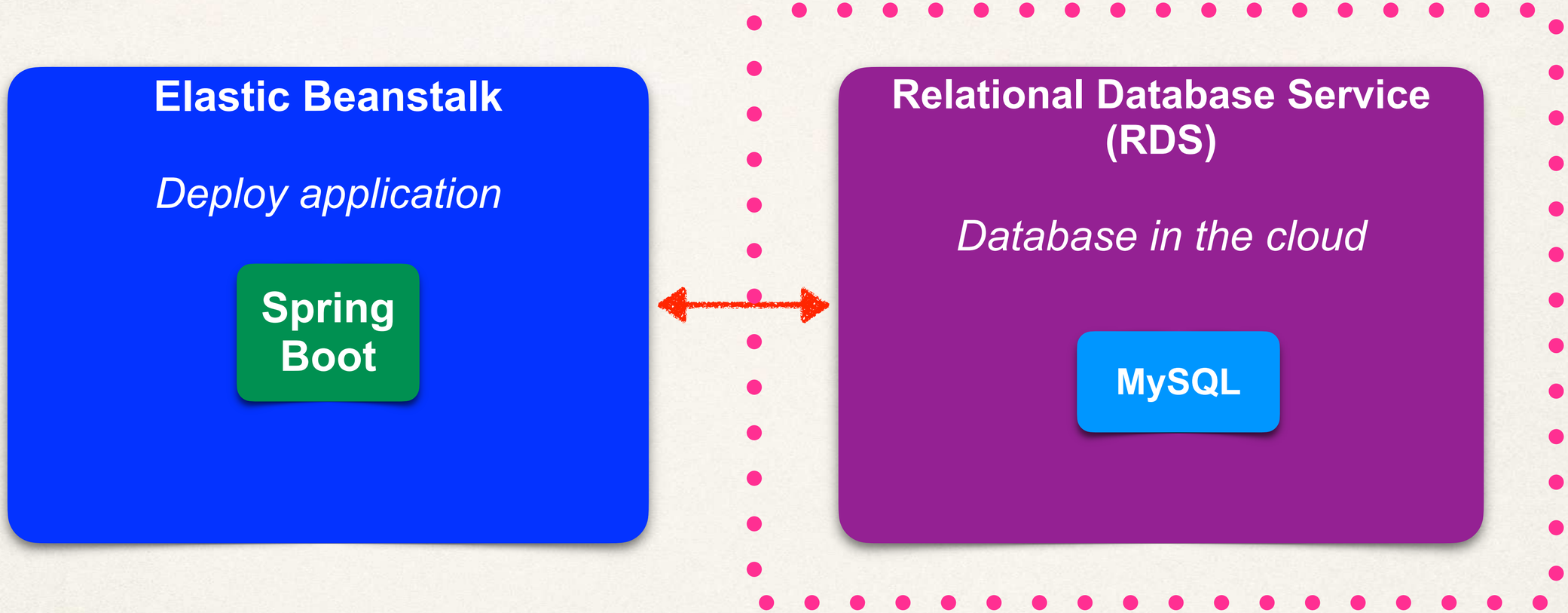
About: 02-employee-directory.sql

1. Create a new database table: **employee**

2. Load table with sample data

Deploy
Relational Database Service (RDS)

Our App Architecture



Relational Database Service (RDS)

- Quickly deploy a relational database in the cloud

- You can manage it using normal admin tool:
  - MySQL Workbench
  - Oracle SQL Developer, etc …

- AWS also has support for NoSQL databases
  - MongoDB, etc …

MySQL

Oracle

MariaDB

Microsoft SQL Server

PostgreSQL

Amazon Aurora

RDS Documentation

https://aws.amazon.com/documentation/rds

Our Game Plan

- Deploy MySQL database instance in AWS Cloud
- Once deployed, we will have our database hostname, userid & password
- Connect to our database with MySQL Workbench to verify connectivity

Development Process

Step-By-Step

1. Select Engine

2. Choose Use Case

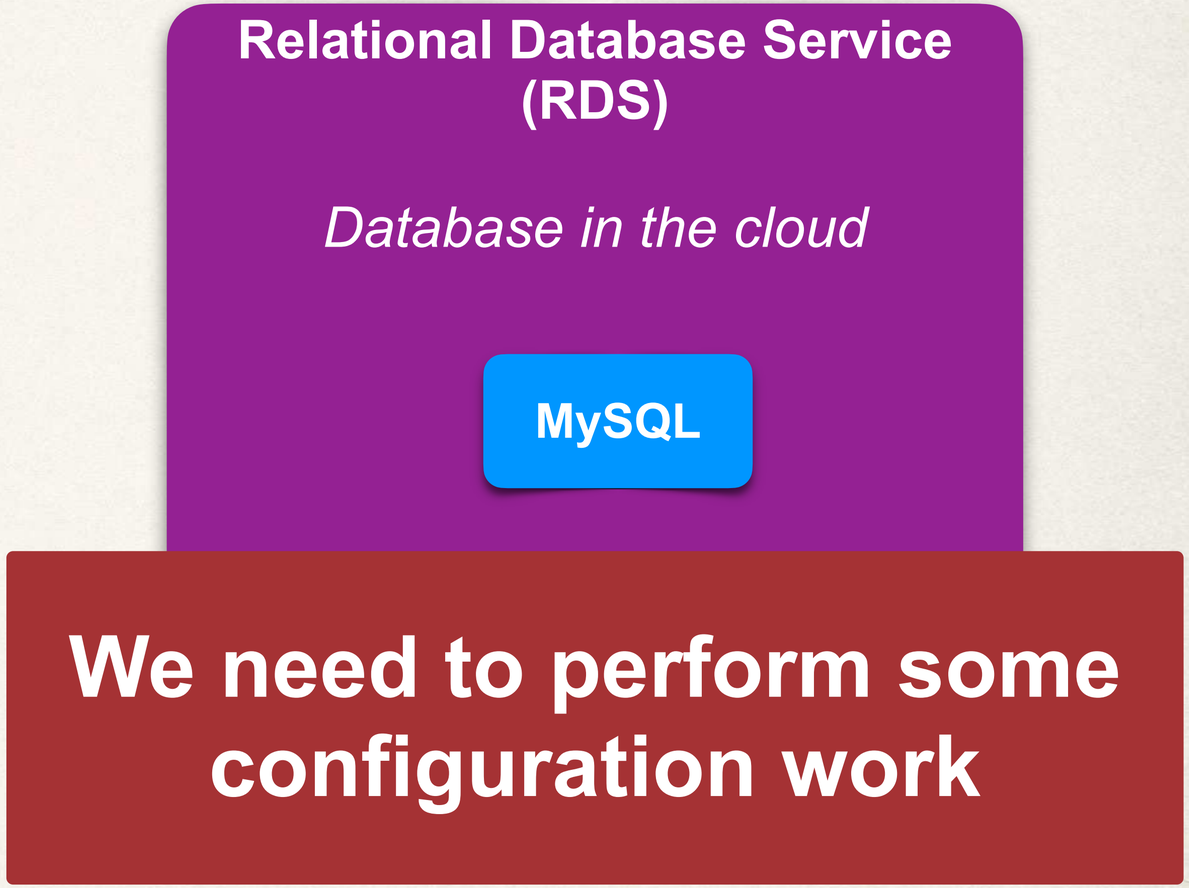
3. Specify Database Details

4. Configure Advanced Settings

Configure
Relational Database Service (RDS)

Current Status - Database in the Cloud

- We created a database server instance …
- But that's it … it is empty
- No database schema, no tables …
- No nothing … LOL!



Development Process

Step-By-Step

1. Configure security for Inbound Connection Rules

2. Test database connection with MySQL Workbench

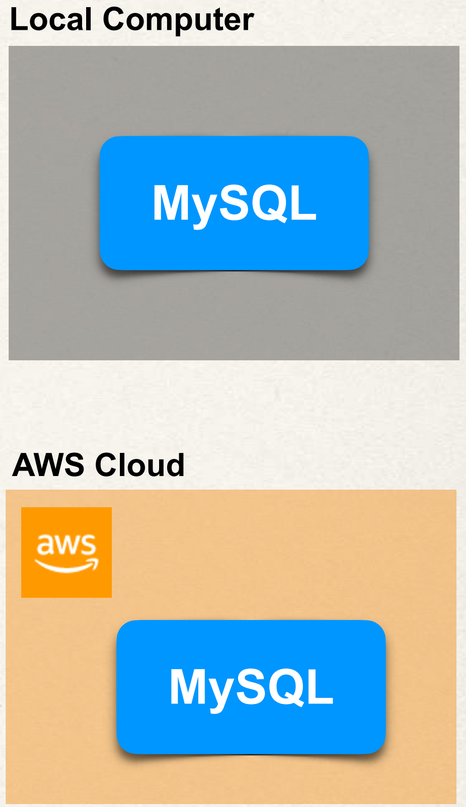
3. Run SQL Scripts to create table and load sample data

Application Properties with Spring Profiles

The Challenge - Multiple Environments

- Currently, we have multiple databases running
  - A local MySQL database
  - A remote MySQL database in AWS cloud

- Which one will our application connect to???

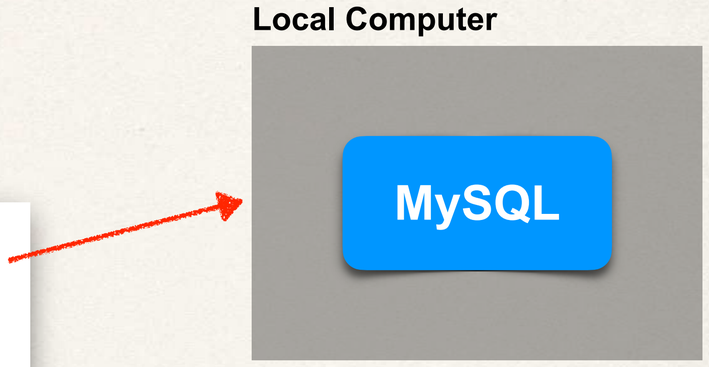


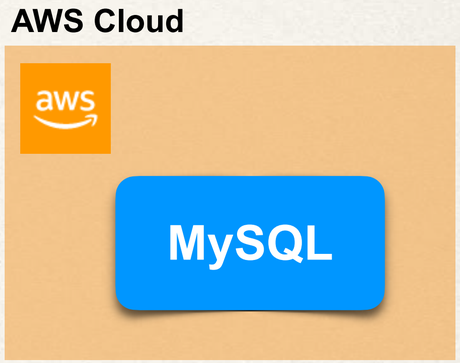
The Challenge - Multiple Environments

- Our database configuration is in our config file

File: application.properties

```
spring.datasource.url=jdbc:mysql://localhost:3306/employee_directory
spring.datasource.username=springstudent
spring.datasource.password=springstudent
```

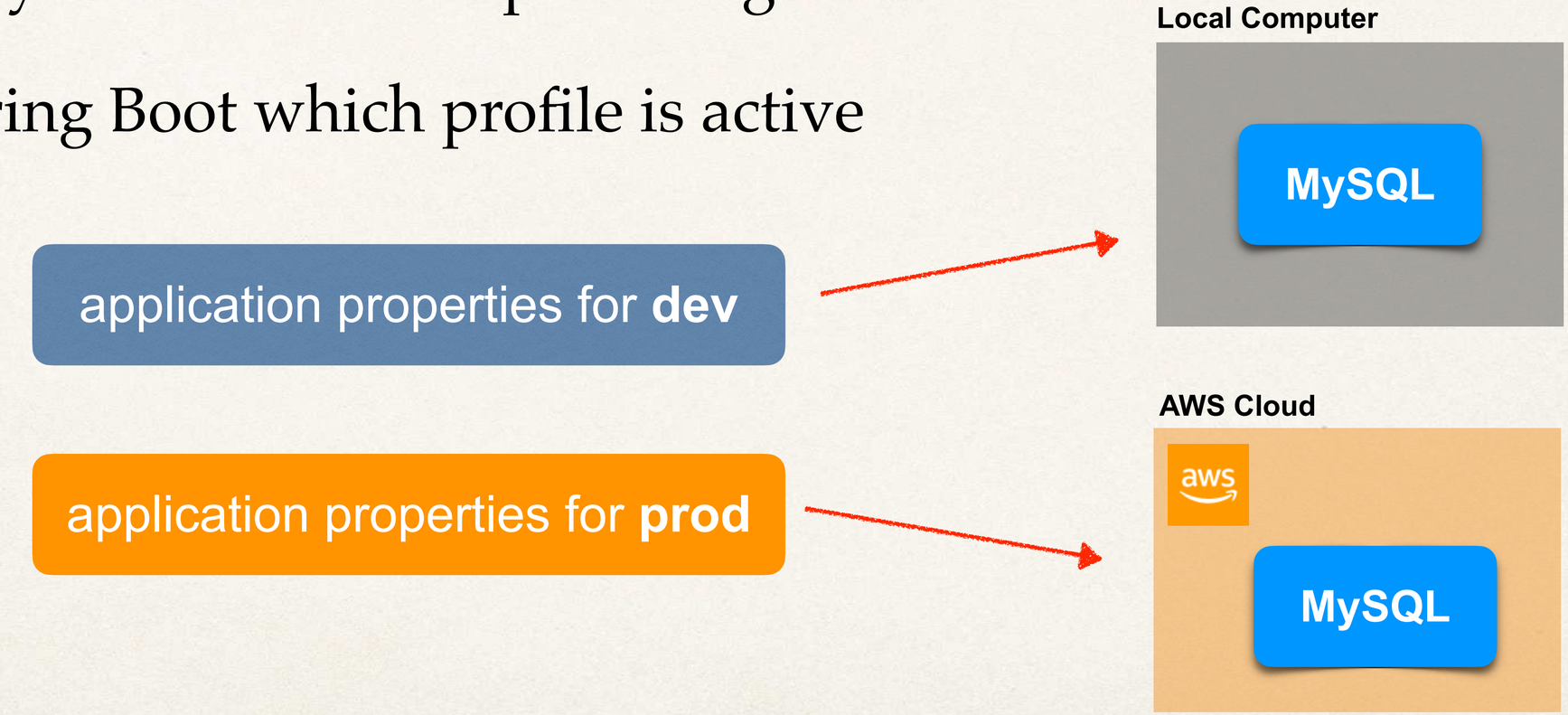




- The AWS database will have different **url, username and password**
- Wouldn't it be great if I could have multiple config files??
- Just tell Spring Boot which one to use???

The Solution

- Spring Boot has support for **Profiles**
  - Allows you to have multiple configurations
  - Tell Spring Boot which profile is active



Profiles

- You can have as many profiles as you need
- You can give the profiles any name

application properties for **dev**

application properties for **qa**

application properties for **qa-fun-test**

application properties for **prod**

You can give any name for profiles

Profiles - Naming Convention

- **application-<profile name>.properties**

application-**dev**.properties

application-**qa**.properties

application-**qa-fun-test**.properties

application-**prod**.properties

You can give any name for profiles

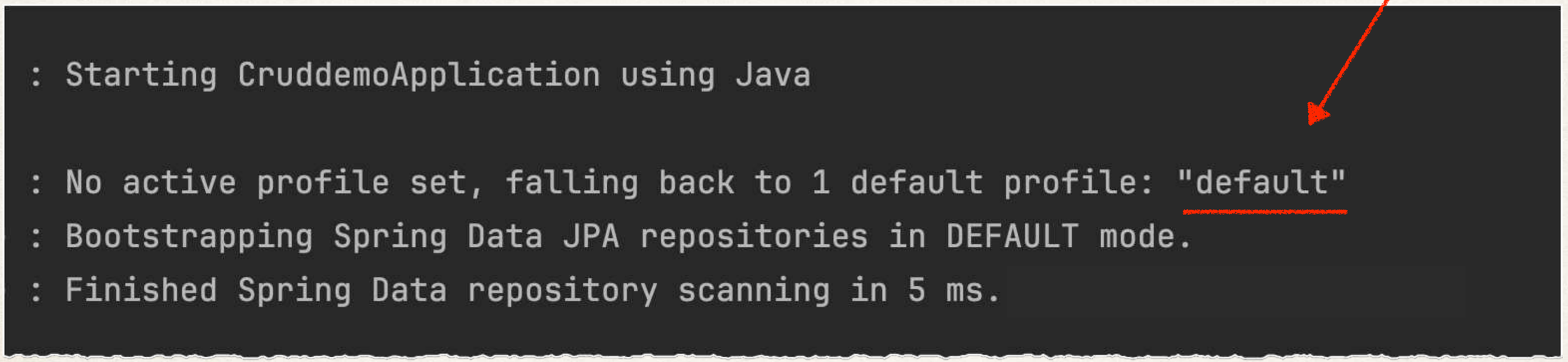
YAML files are also supported

Profiles - the default profile

File: application.properties

```
spring.datasource.url=jdbc:mysql://localhost:3306/employee_directory
spring.datasource.username=springstudent
spring.datasource.password=springstudent
```

Since no profile given, this is the **default** profile



Profiles - the files

Naming convention
application-<profile name>.properties

File: application.properties

```
spring.datasource.url=jdbc:mysql://localhost:3306/employee_directory
spring.datasource.username=springstudent
spring.datasource.password=springstudent
```

Since no profile given, this is the **default** profile

File: application-qa.properties

```
spring.datasource.url=jdbc:mysql://testing.example.com:3306/employee_directory
spring.datasource.username=qateam
spring.datasource.password=testsquad
```

File: application-qa-fun-test.properties

```
spring.datasource.url=jdbc:mysql://190.167.139.61:3306/employee_directory
spring.datasource.username=demo
spring.datasource.password=demo123
```

Notice, each config file can have different values based on the profile / environment

For example: spring.datasource.url = …

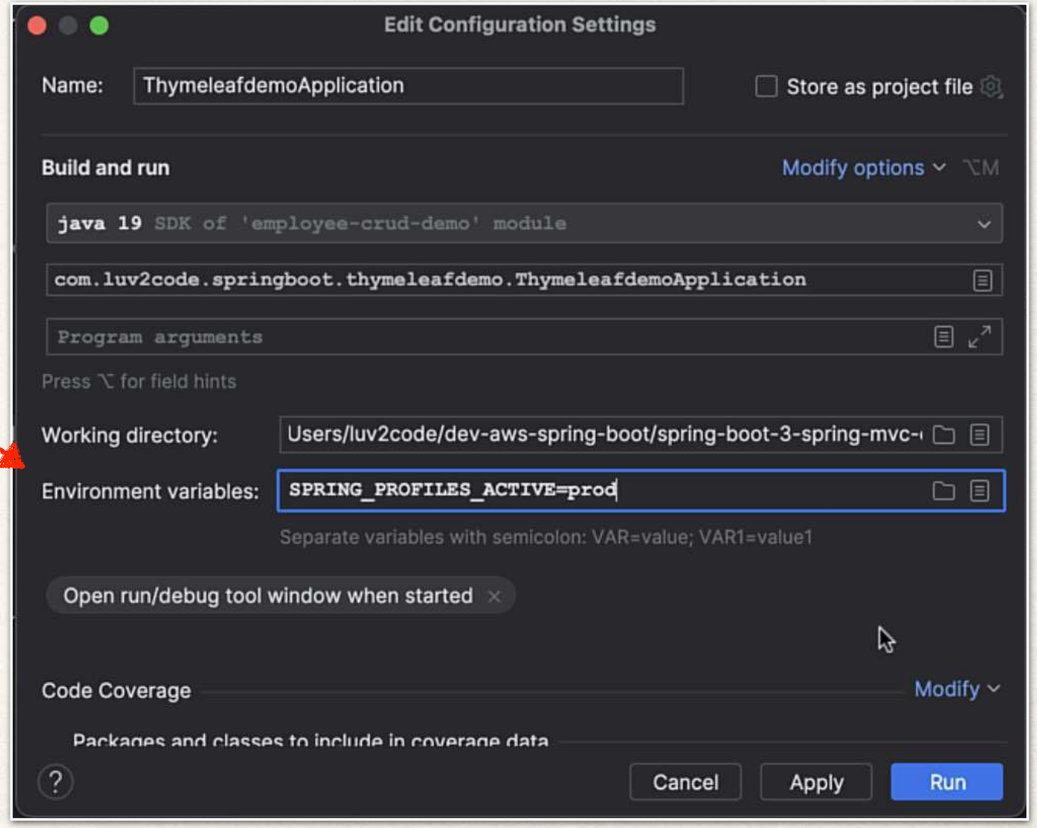
File: application-prod.properties

```
spring.datasource.url=jdbc:mysql://useast2-ohio.aws.amazon.com:3306/employee_directory
spring.datasource.username=springstudent
spring.datasource.password=SuperTopSecret123#
```

Tell Spring Boot which Profile to use

- One option, set an environment variable: **SPRING_PROFILES_ACTIVE**
- IntelliJ Runtime configuration settings

```
SPRING_PROFILES_ACTIVE=prod
```



Tell Spring Boot which Profile to use

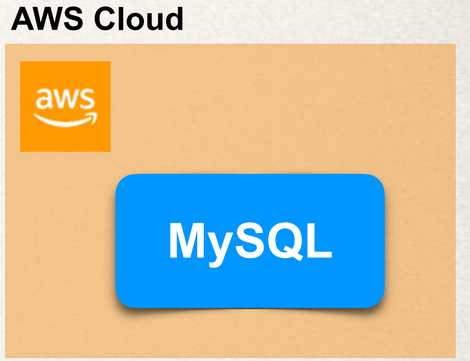
- One option, set an environment variable: **SPRING_PROFILES_ACTIVE**
- IntelliJ Runtime configuration settings

```
SPRING_PROFILES_ACTIVE=prod
```

File: application-prod.properties

```
spring.datasource.url=jdbc:mysql://useast2-ohio.aws.amazon.com:3306/employee_directory
spring.datasource.username=springstudent
spring.datasource.password=SuperTopSecret123#
```

Naming convention
application-<profile name>.properties



Profiles - Advanced Features

- Can have multiple profiles active
  - Define common properties in default profile: app title etc
  - Define environment specific info in profiles: jdbc url etc

- If multiple profiles define **same property**, last one wins
  - Profiles listed as environment variable, left to right (last one wins)

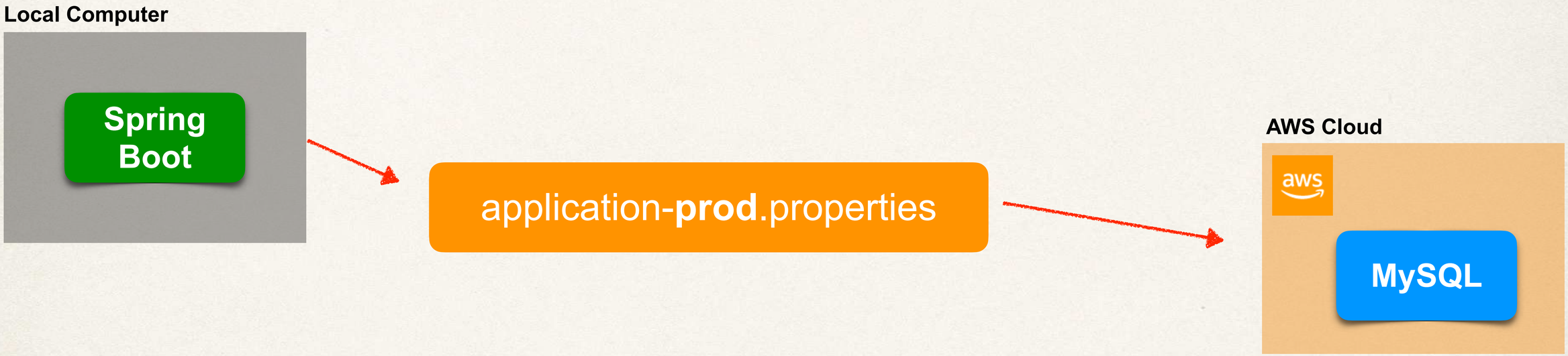
```
SPRING_PROFILES_ACTIVE=dev,qa,prod
```

Profiles - Advanced Features

http://www.luv2code.com/spring-boot-profiles

Our Game Plan

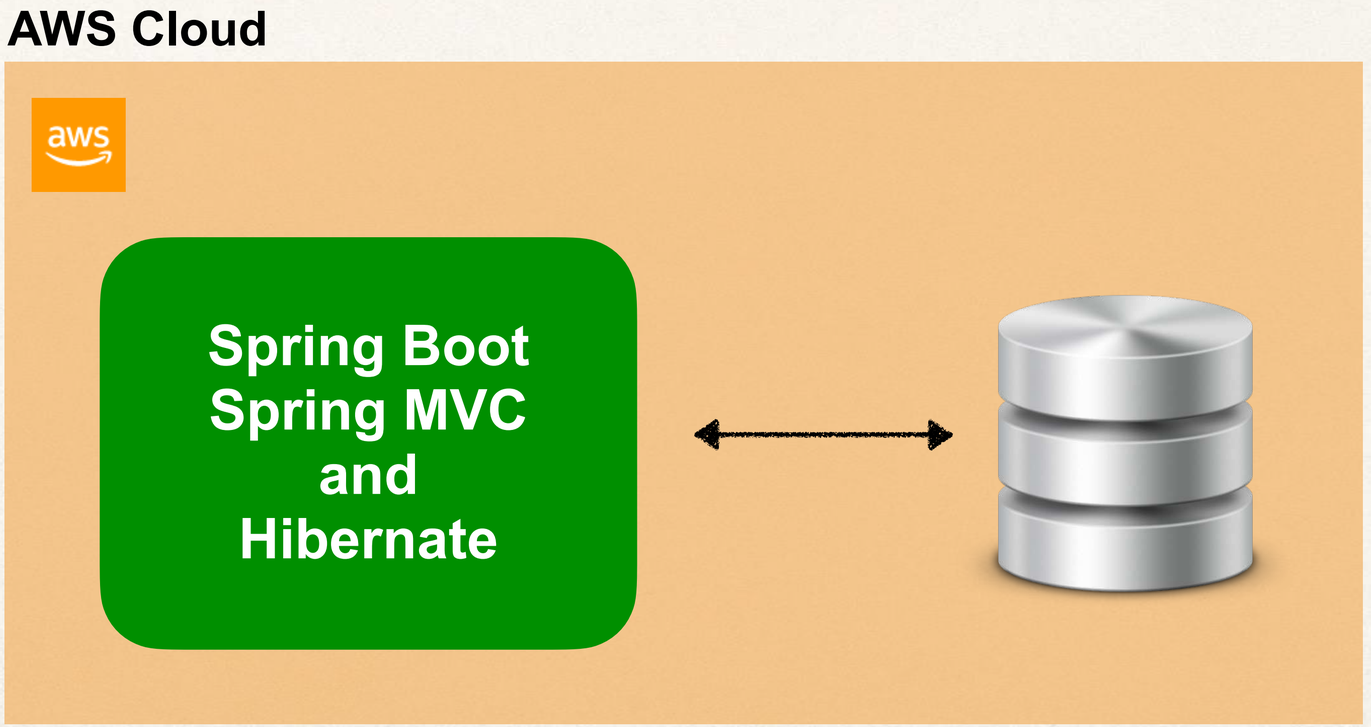
- Run our app locally … and connect to AWS database in the cloud



Deploy Spring Boot app on AWS

Application Set Up

- Our database is already deployed in the AWS Cloud
- Now, let's deploy our Spring Boot app in the AWS Cloud



Development Process

Step-By-Step

1. Package the Spring Boot app using Maven
2. Create a new application in Elastic Beanstalk
3. Upload the Spring Boot JAR file to Elastic Beanstalk
4. Set Environment variables in AWS
   - **`SERVER_PORT=5000`**
   - **`SPRING_PROFILES_ACTIVE=prod`**

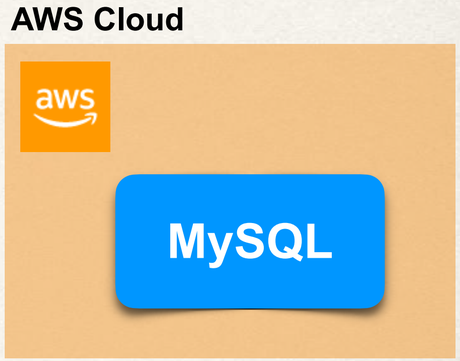
Use **prod** profile to load application-**prod**.properties to connect to AWS database

Environment Properties in AWS

We have a little problem …

File: application-prod.properties

```
spring.datasource.url=jdbc:mysql://useast2-ohio.aws.amazon.com:3306/employee_directory
spring.datasource.username=springstudent
spring.datasource.password=SuperTopSecret123#
```



- We have PRODUCTION database info in our props file :-(
- What if a developer accidentally checked this into the git repo??
- This data is not secure … not good!!!

The Solution

- Remove database connection info from application-prod.properties
- Use Environment Properties / Environment Variables in AWS

Environment Properties

- Spring Boot can read appropriate environment properties

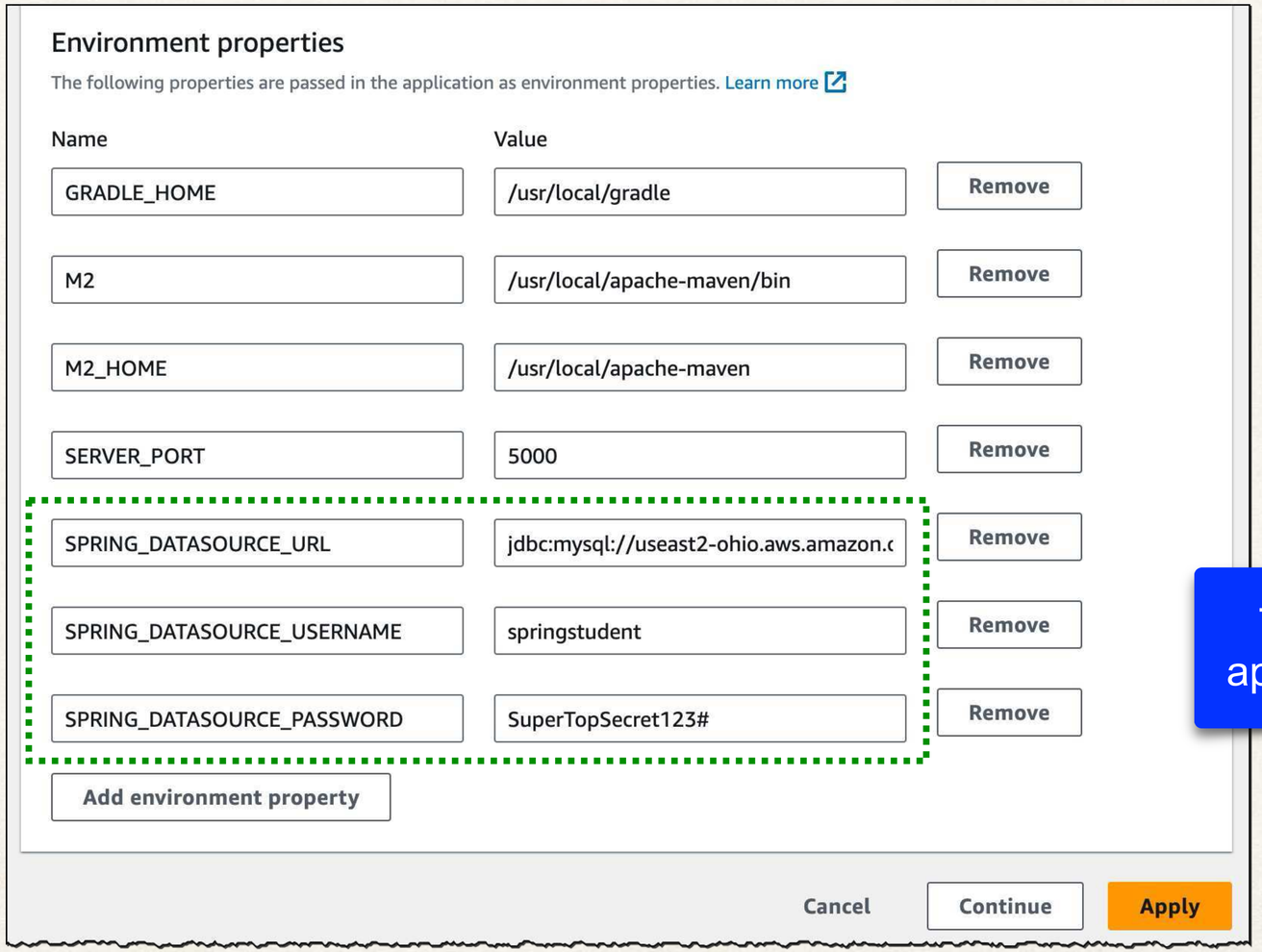
Defined in AWS

application.properties	Environment Property
`spring.datasource.url` →	SPRING_DATASOURCE_URL
`spring.datasource.username` →	SPRING_DATASOURCE_USERNAME
`spring.datasource.password` →	SPRING_DATASOURCE_PASSWORD

To convert props name: Make all caps and replace “.” With “_”

Environment Properties

Defined in AWS



Database Connection Configs

This info is no longer in application-prod.properties

Environment Properties - Higher Priority

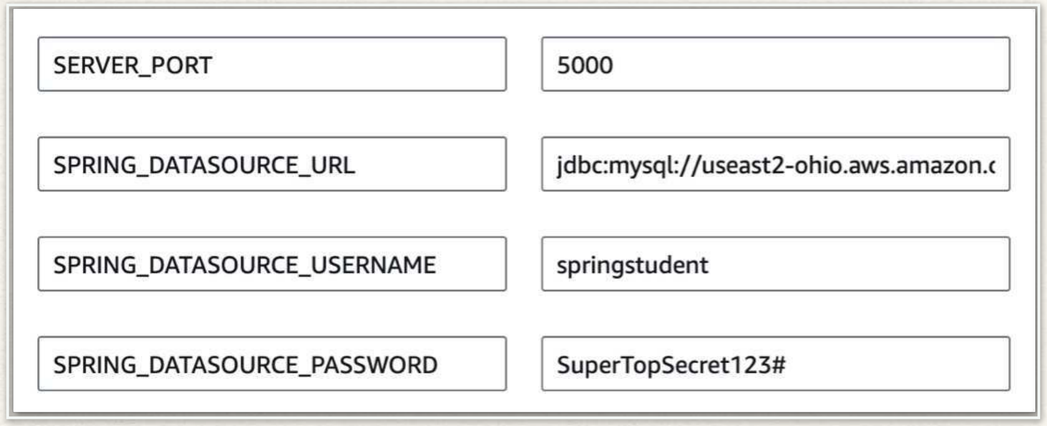
- What if property is defined twice??
  - Property defined in application-<profile>.properties
  - AWS environment property is set

- The environment property has higher priority and will override

Development Process

Step-By-Step

1. Set Environment properties in AWS



2. Remove the application-prod.properties file from Spring Boot app

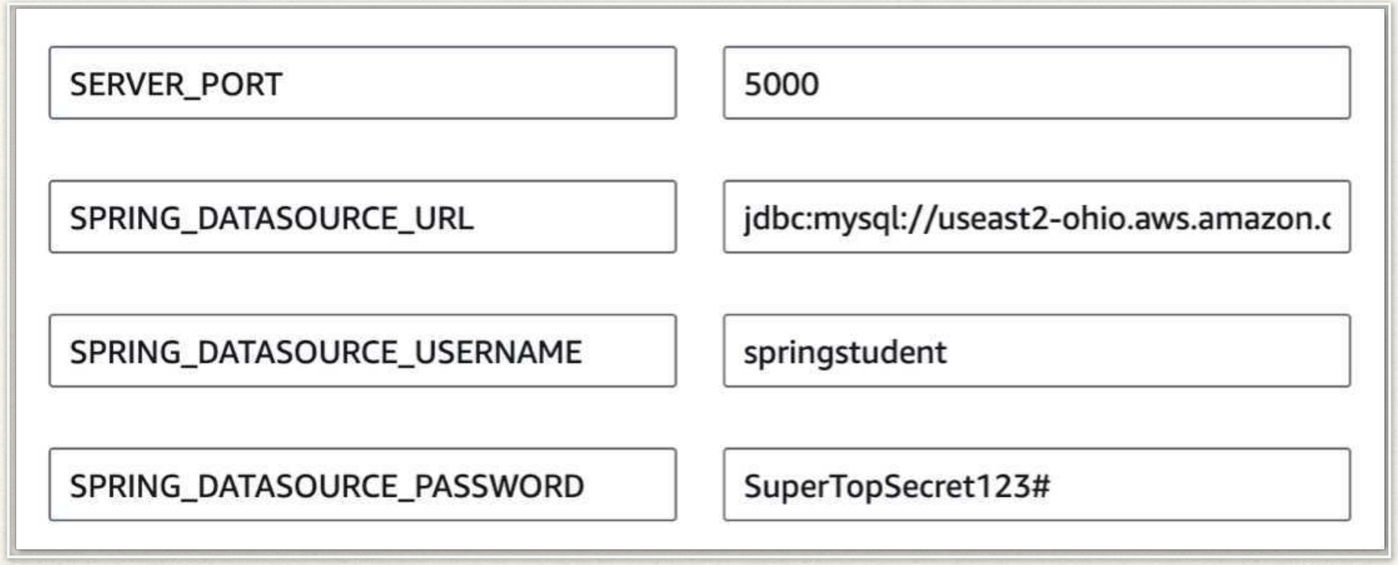
3. Package the Spring Boot app using Maven

4. Upload the Spring Boot JAR file to Elastic Beanstalk

Encrypted Environment Properties in AWS

AWS Environment Properties

- The environment properties are NOT encrypted at rest
- Stored as plain text



Security Requirements

- Database connection info should be
  - Encrypted at rest
  - Stored in an encrypted format
- This applies to database URL, username and password

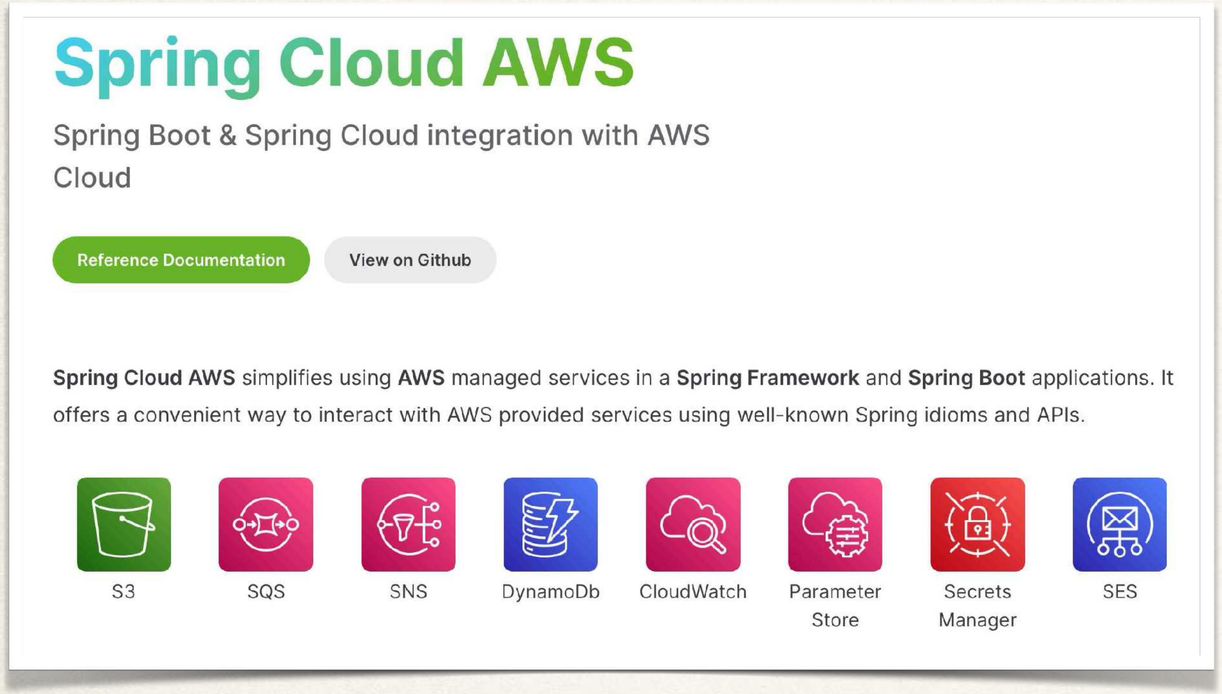
Solution: AWS Systems Manager Parameter Store

- Provides secure solution for storing configuration data
- Supports storing data as plain text or encrypted data
- Adds auditing and security controls for accessing data
- Centralized solution for managing configuration data

Free service

- Note: Official service name is **AWS Systems Manager Parameter Store**
  - I'll just call it **AWS Parameter Store** … most developers use the short name

Spring Cloud AWS



- Open-source project provides integration with AWS Cloud
- Simplifies using AWS services in Spring Boot applications
- We'll use Spring Cloud AWS for easy integration with AWS Parameter Store

https://awspring.io/

Development Process

Step-By-Step

1. Create parameters in AWS Parameter Store

2. Attach policy to AWS role: AmazonSSMReadOnlyAccess

3. Edit application-prod.properties file in Spring Boot app

4. Update Maven pom.xml to support Parameter Store

5. Package the Spring Boot app using Maven

6. Update AWS Environment Properties

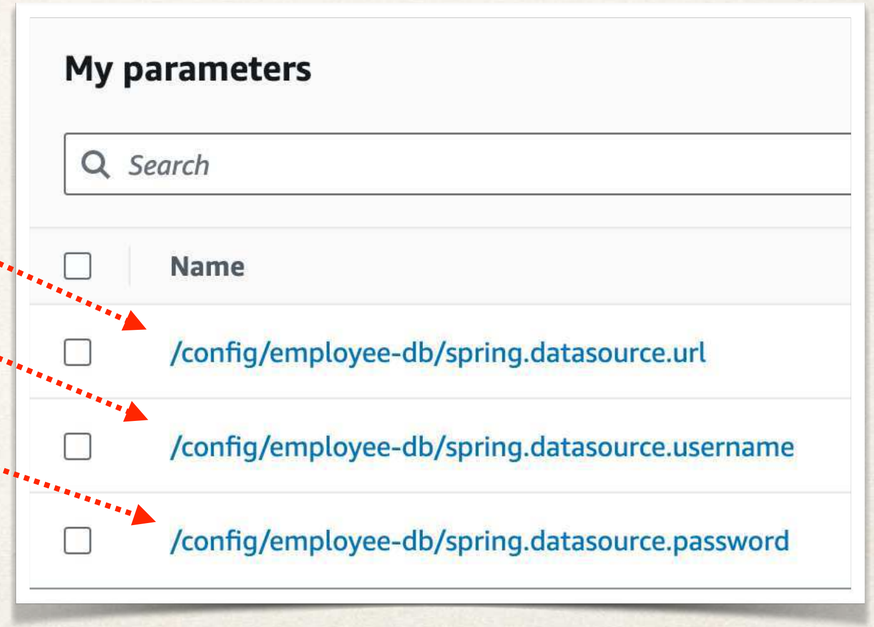
7. Upload the Spring Boot JAR file to Elastic Beanstalk

Step 1: Create parameters in AWS Parameter Store

- We can define a path to our parameters: `/config/employee-db`

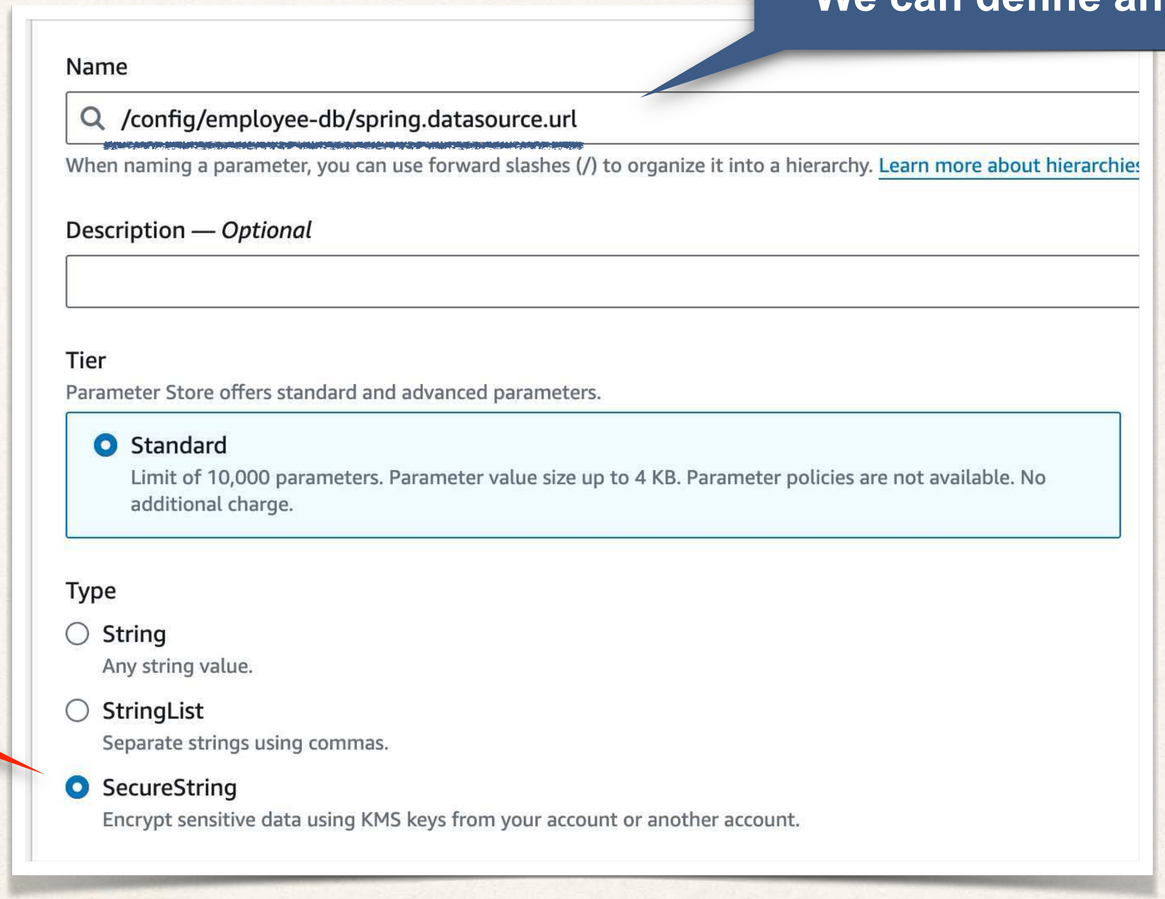
We can define any path

- Use the standard property names for Spring Boot
  - `spring.datasource.url`
  - `spring.datasource.username`
  - `spring.datasource.password`



Step 1: Create parameters in AWS Parameter Store

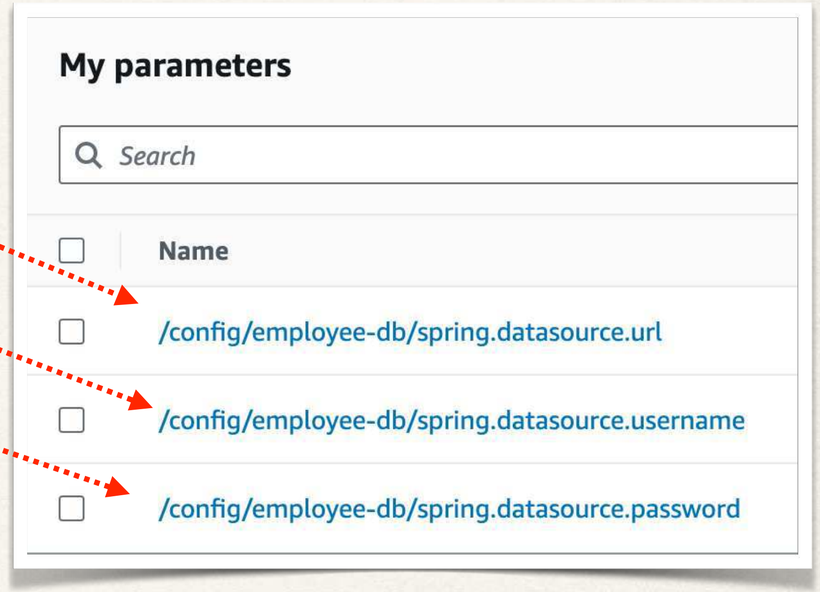
We can define any path and property name



For encrypting the data
Very important!

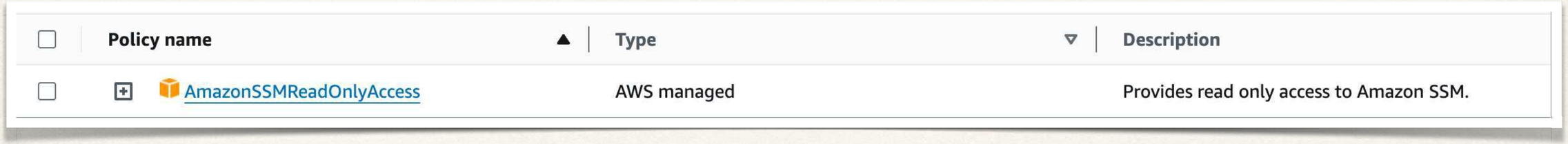
Step 1: Create parameters in AWS Parameter Store

- Repeat the process for standard property names for Spring Boot
  - `spring.datasource.url`
  - `spring.datasource.username`
  - `spring.datasource.password`

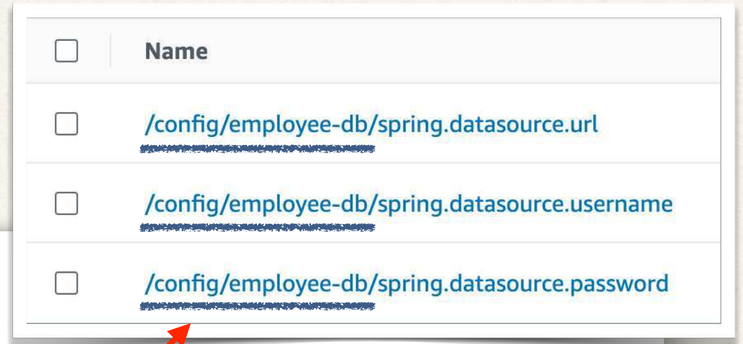


Step 2: Attach policy to AWS role: AmazonSSMReadOnlyAccess

- Allow our app to read config data from AWS Parameter Store



Step 3: Edit application-prod.properties file in Spring Boot app



File: application-prod.properties

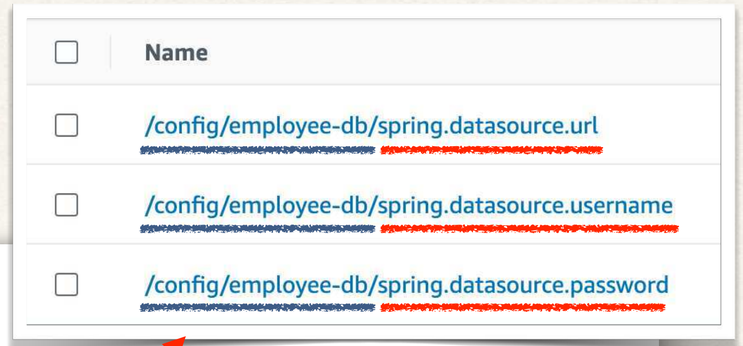
```
#
# Load Spring DataSource properties
# from AWS Parameter Store
#
spring.config.import=aws-parameterstore:/config/employee-db
```

For importing additional configuration

Fetch additional configuration from AWS Parameter Store via Spring Cloud AWS libraries

Path to your parameters

Step 3: Edit application-prod.properties file in Spring Boot app



File: application-prod.properties

```
#
# Load Spring DataSource properties
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#
spring.config.import=aws-parameterstore:/config/employee-db
```

For importing additional configuration

Fetch additional configuration from AWS Parameter Store via Spring Cloud AWS libraries

Path to your parameters

Step 4: Update Maven pom.xml to support Parameter Store

- We will use the Bill of Materials (BOM) for Spring Cloud AWS
  - Defines the recommend versions for each dependency in Spring Cloud AWS
  - Similar concept to Spring Boot Starter Parent

File: pom.xml

```
<dependencyManagement>
   <dependencies>
      <dependency>
         <groupId>io.awspring.cloud</groupId>
         <artifactId>spring-cloud-aws-dependencies</artifactId>
         <version>3.1.0</version>
         <type>pom</type>
         <scope>import</scope>
      </dependency>
   </dependencies>
</dependencyManagement>
```

Note: This entry is in <dependencyManagement> section … not regular <dependencies> section

Step 4: Update Maven pom.xml to support Parameter Store

- Add dependency entry for Spring Cloud AWS Starter: Parameter Store
- No need to list version number
  - Since it is defined in Spring Cloud AWS Bill of Materials entry from previous slide

File: pom.xml

Regular <dependencies> section

```
<dependencies>

    <dependency>
      <groupId>io.awspring.cloud</groupId>
      <artifactId>spring-cloud-aws-starter-parameter-store</artifactId>
    </dependency>
    …
</dependencies>
```

Easy step ….

5. Package the Spring Boot app using Maven

Step 6: Update AWS Environment Properties

- Set Environment property in AWS
  - **SPRING_PROFILES_ACTIVE=prod**

Use **prod** profile to load
application-**prod**.properties
to access
AWS Systems Manager Parameter Store

File: application-prod.properties

```
#
# Load Spring DataSource properties
# from AWS Parameter Store
#
spring.config.import=aws-parameterstore:/config/employee-db
```

Easy step ....

7. Upload the Spring Boot JAR file to Elastic Beanstalk

Options

We'll use the free service

- **AWS Parameter Store**
  - Provides support for encrypted storage of configuration data
  - This service is **free** for storing up to 10,000 parameters / per region / per account

- **AWS Secrets Manager**
  - This is a **paid** service (not eligible for free tier)
  - Rotate secrets automatically based on your compliance policy
  - Replicate secrets to handle disaster recovery and applications spanning multiple regions
  - Monitor and audit the use of secrets
  - *more …*

Create a Custom Domain Name

Following steps are optional

- We create a custom domain name which requires a purchase ($13 USD)

At the time of this recording

- This is optional, if you don't want to purchase custom domain name
  - Share the **generated** AWS domain name with friends / employers
  - **Generated** AWS domain name is free … no charge

employee-crud-demo.xxx.us-east-yyy.elasticbeanstalk.com

AWS generated
Domain name

employee-crud-demo.xxx.us-east-yyy.elasticbeanstalk.com

We want our own
custom domain name …
not the generated name

<< your domain name >>

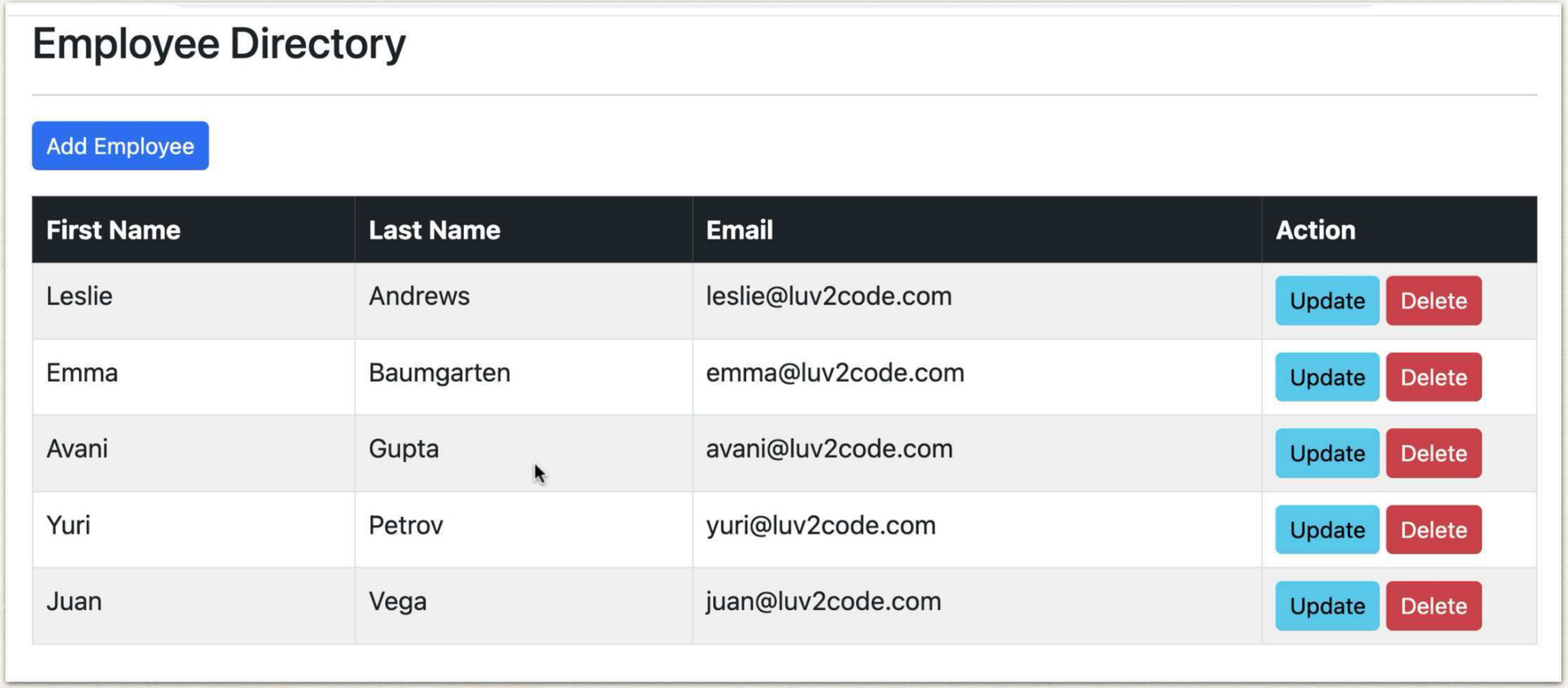
We want our own
custom domain name …
not the generated name

myspringbootapp.com

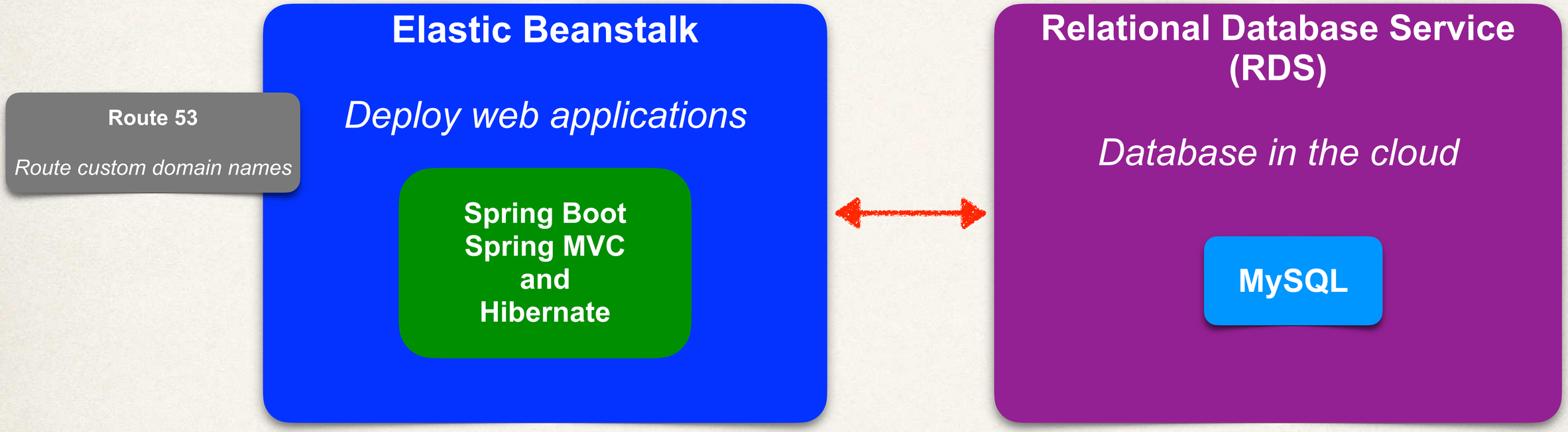
We want our own
custom domain name …
not the generated name

Our own
custom domain name

www.myspringbootapp.com



Our App Architecture



Route 53

- Routes your custom domain name to your app on AWS
- Send `www.myspringbootapp.com` to your AWS app
- This is the AWS Domain Name System (DNS)
- Trivia: Why the number 53? It is the default port # for name servers :-)

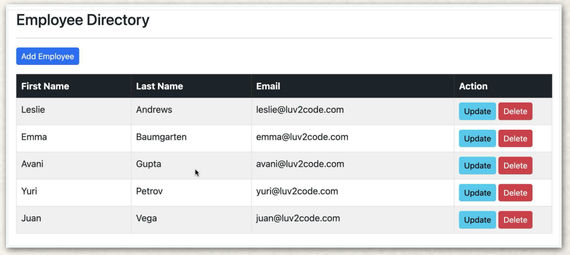
User enters this in web browser

www.myspringbootapp.com

53

Route 53 has an alias for our Elastic Beanstalk app

employee-crud-demo.xxx.us-east-yyy.elasticbeanstalk.com



Route 53 Documentation

https://aws.amazon.com/documentation/route53

Development Process

Step-By-Step

1. Register your domain name on AWS - $13 USD annually

2. AWS will perform the registration … can take up to 3 days

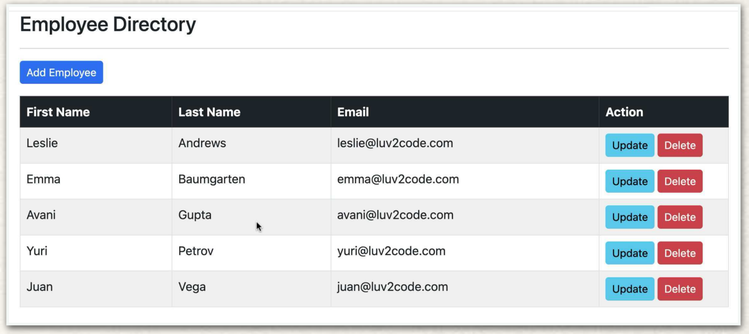
3. Configure domain name to point to your Elastic Beanstalk app

myspringbootapp.com

An alias to redirect to our www. domain

www.myspringbootapp.com

53



employee-crud-demo.xxx.us-east-yyy.elasticbeanstalk.com

Course Summary

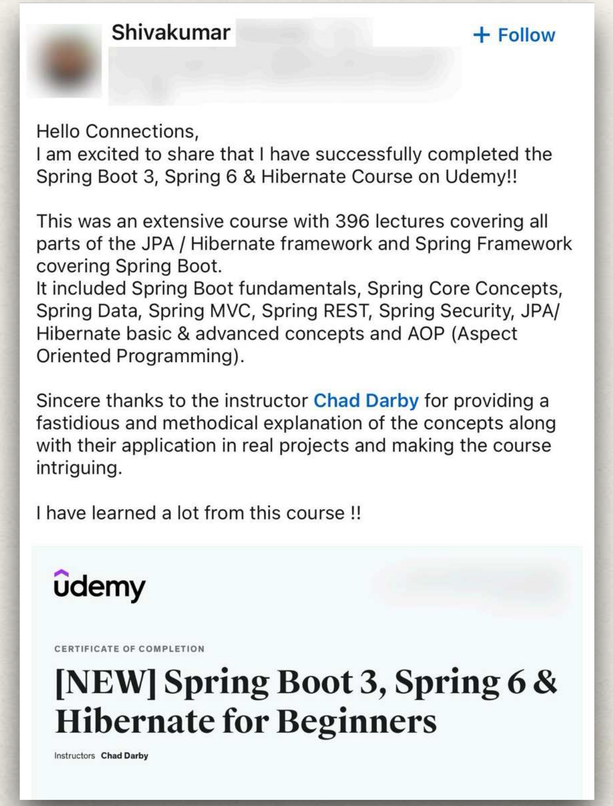
Accomplishments

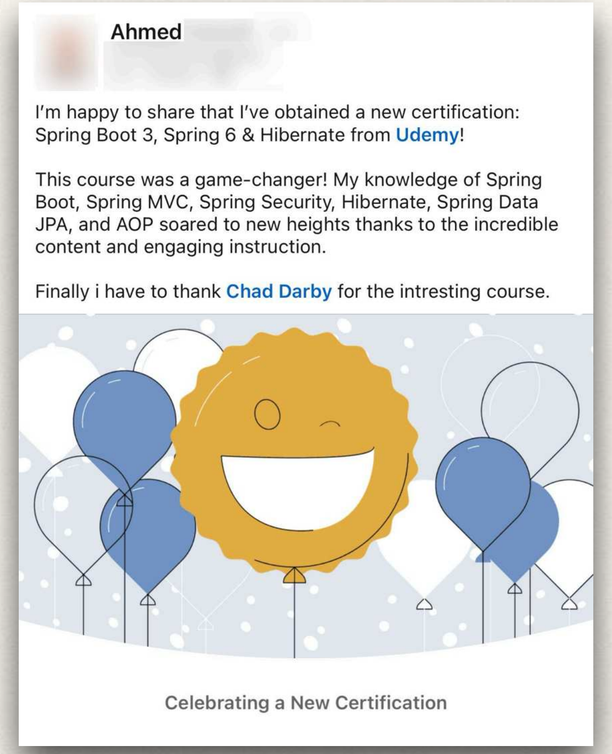
- Deployed Spring Boot app on AWS Cloud
- Added database support on AWS Cloud
- Registered a custom domain name

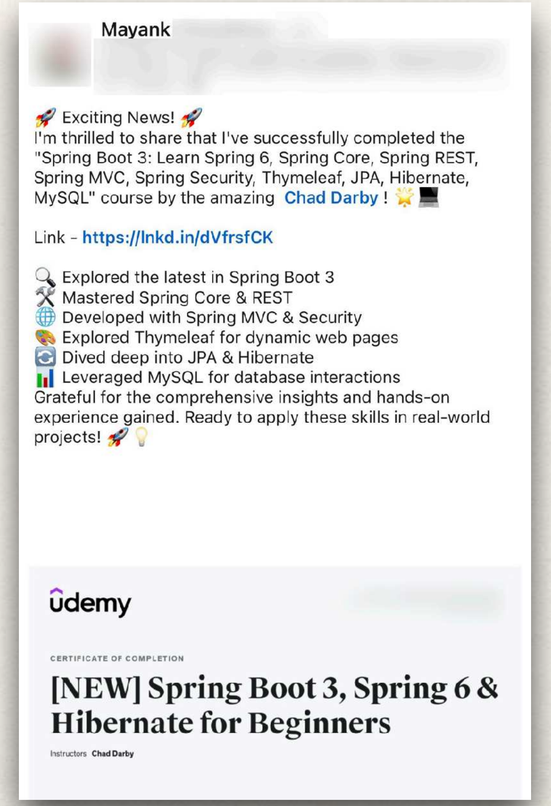
www.myspringbootapp.com

Share Your Accomplishment

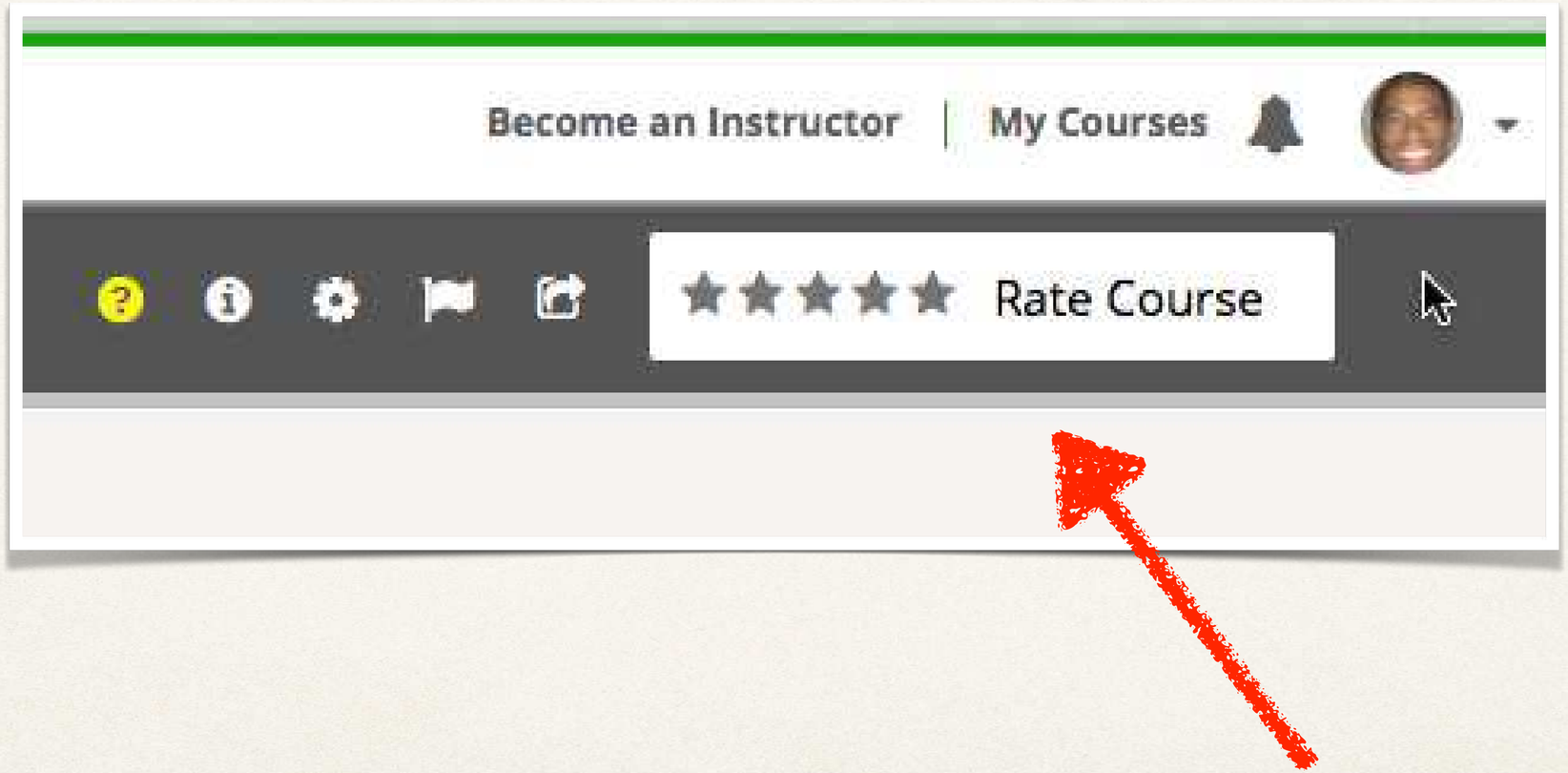
- Download your course certificate and share it on social media!







Please Rate the Course



Contact Me

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