



# Spring Boot with React and AWS

Learn to Deploy a Full Stack Spring  
Boot React Application to AWS

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Ravi Kant Soni  
Namrata Soni

Apress®

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## ***Spring Boot with React and AWS: Learn to Deploy a Full Stack Spring Boot React Application to AWS***

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Printed on acid-free paper

*To my beloved father,  
the late Ras Bihari Prasad*

*We miss you and love you, Papa. A strong and gentle  
soul who taught us to trust God and to believe in ourselves  
and our dreams.*

*To my beloved mother,  
Smt. Manorma Devi*

*We love you, Maa. We could never have completed this  
book without your true love, warmest support, and  
constant encouragement.*

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Finally, this book is based on the innovative work of many people in our industry who have become my idols. I am thankful to everyone who supported me in one way or another in writing this book.

Welcome to *Spring Boot with React and AWS.*

—Ravi Kant Soni

## CHAPTER 1

# An Introduction to Amazon Web Services (AWS)

When you hear the word *amazon*, you likely first think of [Amazon.com](#), which is one of the biggest and most successful online stores. While Amazon built its brand on developing online retail services, it has also branched out into alternative industries, among them the web services industry, where they have the eponymous Amazon Web Service (AWS), a form of cloud-computing that assists users develop software, database, and other programs that need heavy-duty computing resources.

This chapter overviews Amazon Web Services (AWS), including several AWS key services, such as Amazon Elastic Compute Cloud (Amazon EC2), AWS Elastic Beanstalk, Amazon Relational Database Service (Amazon RDS), and Amazon Route 53. It covers creating a free AWS account for developers, creating an Elastic Beanstalk server, creating a HelloWorld JSP application, building a WAR file with Maven, and uploading it to Elastic Beanstalk.

# Introduction to Amazon Web Services

*What precisely is Amazon Web Services (AWS)?* At a really high level, AWS is a web-hosting service offered by Amazon, where you can deploy your web applications and conjointly deploy your databases. Once it's deployed, your apps are out there online. Anyone can simply enter your URL (Universal Resource Locator) in their web browser to access your application. The web connects everybody. You can deploy your application online within the cloud, so that anyone can access it. It's not only running locally; it's now running online.

AWS is a full-service cloud platform. It is more than just an application hosting platform. There are plenty of belongings you do with AWS.

- On-demand delivery of IT resources via the web
  - You can spin up servers on-demand, and you can choose your operating system.
  - You can even deploy databases within the cloud, and you get more options for the database as you wish.
- Pay-as-you-go pricing model
  - This book uses free developer accounts. You can get a free developer account for 12 months.

And, the nice thing about using the Amazon Web Services cloud is that you can be global within minutes because Amazon has worldwide data centers, as shown in Figure 1-1.



**Figure 1-1.** Amazon data center

You'll be able to deploy your application to a single data center; otherwise, you'll deploy it to multiple data centers. Also, there are no restrictions on which data center you'll be able to deploy to.

If you're based mostly within the United States, however, you can deploy applications to the data center in South America, China, or the Asia Pacific. It's completely up to you. The user can select the regions based on the application usage so that latency is low. There's no restriction as such on it.

Once you're logged in to the Amazon console, then essentially, you choose the services that you simply wish to use. You need to only deploy your applications to have a pleasant web admin console where you only configure your environment, configure your servers, then reasonably push-button deploy. Figure 1-2 shows the AWS services on AWS Management Console.

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)

The screenshot shows the AWS Management Console navigation bar. At the top left is the "AWS services" logo. Below it is a search bar with the placeholder text "Example: Relational Database Service, database, RDS". Under the search bar, there are two recently visited service links: "Elastic Beanstalk" and "EC2". A dropdown menu titled "Recently visited services" is open. Below this, a larger section titled "All services" is expanded, showing various service categories with their respective icons and names:

- Compute**: EC2, Elastic Container Service, Lambda, Elastic Beanstalk, ECR
- Storage**: S3, Glacier, Storage Gateway
- Database**: RDS, DynamoDB, ElastiCache, Amazon Redshift
- Migration**: Database Migration Service, Server Migration Service, Snowball
- Networking & Content Delivery**: VPC, API Gateway, Direct Connect
- Developer Tools**: CodeDeploy
- Management Tools**: CloudWatch, CloudFormation, CloudTrail, Config, Systems Manager, Trusted Advisor
- Machine Learning**: Amazon SageMaker, Amazon Polly, Rekognition, Amazon Translate
- Analytics**: EMR, Elasticsearch Service, Kinesis
- Security, Identity & Compliance**: IAM, GuardDuty, Inspector, Certificate Manager, CloudHSM, Directory Service
- Application Integration**: Step Functions, Simple Notification Service, Simple Queue Service, SWF
- Internet of Things**: IoT Core, IoT Device Management

**Figure 1-2.** AWS

This was all about an introduction to Amazon Web Services. Let's dig into some of the AWS key Services.

## AWS Key Services

AWS offers a wide range of services underneath different categories. This section explores several AWS key services (see Figure 1-3). First, let's look at Amazon Elastic Compute Cloud (Amazon EC2), which may include remote VMs (virtual machines). Next, you briefly look at AWS Elastic

Beanstalk, which allows developers to deploy web applications. Then, you move on to the Amazon Relational Database Service (Amazon RDS), which is a database within the cloud. Finally, you look at Amazon Route 53, which routes custom domain names to your application.

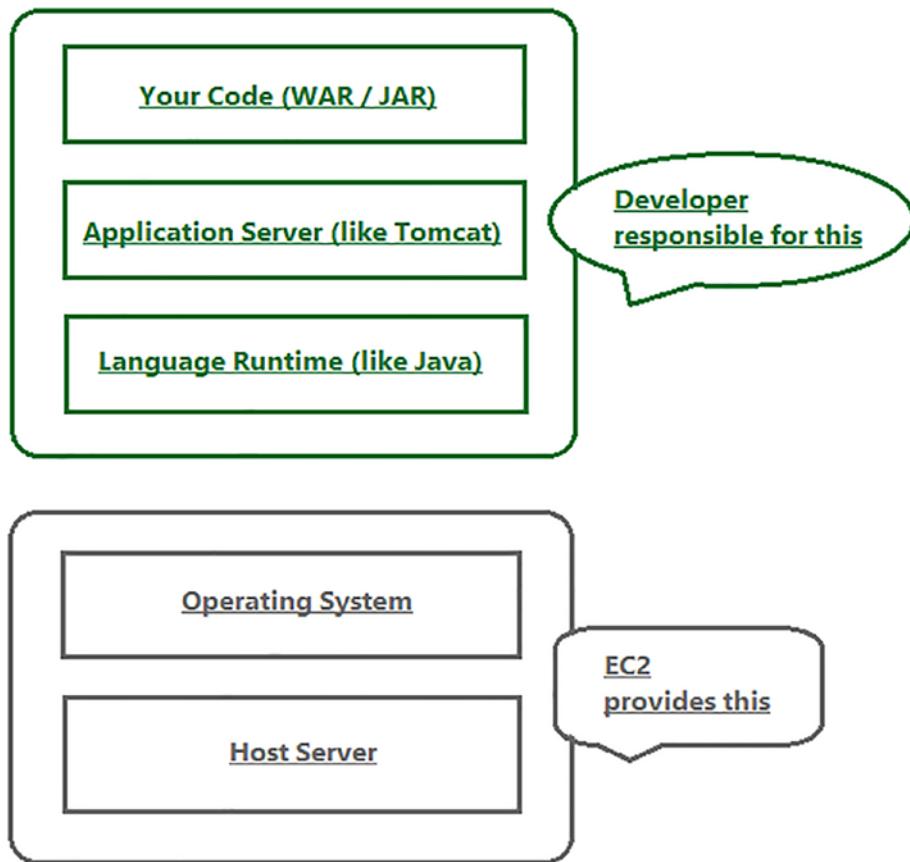


**Figure 1-3.** AWS key services

## Elastic Cloud Compute (EC2)

Elastic Cloud Compute (EC2) is one of the first web service interfaces when AWS was released, allowing users to create and configure compute machines within the cloud. EC2 allows users to create VM (virtual machine) on the Amazon cloud for running applications that can be accessed via the Internet.

The software can be configured on cloud servers based on your specifications. You select the operating system (i.e., Microsoft Windows or Linux) best suited to your requirements or applications, and you get the operating system pre-installed. EC2 provides the actual host server and operating system. Figure 1-4 shows how it is set up.

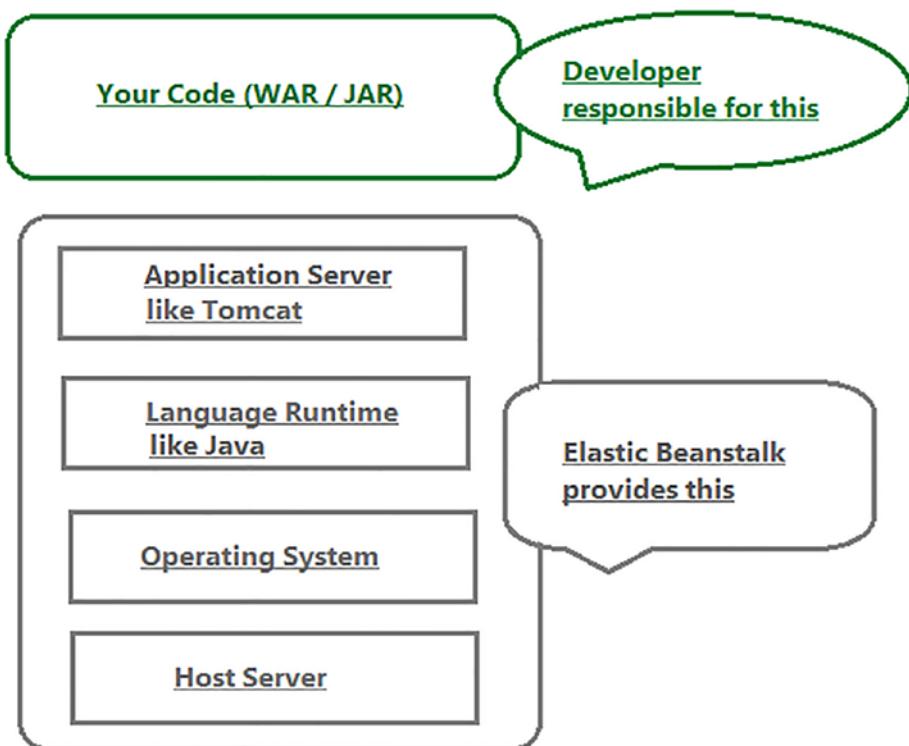


**Figure 1-4.** How EC2 is set up

If you want any additional software, you must manually install it on top of the OS as a developer. So, if you want JDK (Java Development Kit), you can install Java. You can also install Tomcat, a database, and so on. It's almost like getting a brand-new laptop that only has the operating system, and you need to install your tools on top of it.

## Elastic Beanstalk

Elastic Beanstalk is a pre-packaged platform, allowing you to quickly deploy and handle your web applications without worrying about the infrastructure. You select a pre-configured virtual machine for your given web stack, like Java and Tomcat. And, there is no need to install any additional software's on the virtual machine. You simply upload the application's deployable file, and then you are out there and ready to go. Elastic Beanstalk automatically provides the application server, language runtime, operating server, and the host server, as shown in Figure 1-5.



**Figure 1-5.** Elastic Beanstalk

It also has support for .NET, Node.js, PHP, Docker, and so on. You can choose the web stack that gives you all the software's pre-installed, pre-configured, and you simply deploy your code.

It's great for deployment on a web stack, you simply select the services that you need, and it is set up for you. This is known as *platform as a service*, or PaaS. All you have to do is deploy your code.

Now, when you develop Java applications on AWS, you can use your regular Java EE APIs. You can also use third-party frameworks like Spring Boot, Hibernate, and anything in standard Java. Whatever you can run on Tomcat locally, you can run that same code on Amazon. So, there are no code changes you need to make and no special Amazon JAR files or anything.

## Relational Database Service (RDS)

AWS Relational Database Service (RDS) is your relational database in the cloud. This allows you to quickly deploy a relational database in the cloud. It has support for a wide range of databases to choose from, including MySQL, Oracle, Microsoft SQL Server, and so on.

You can manage these tools using your normal admin tools. If you are using MySQL, you can use MySQL Workbench. If you are using the Oracle Database, you can use Oracle SQL Developer, and the list goes on.

AWS also has support for NoSQL databases such as MongoDB. So, all major database feature's that you need can be found in AWS with the support of the relational Database Service.

## Route 53

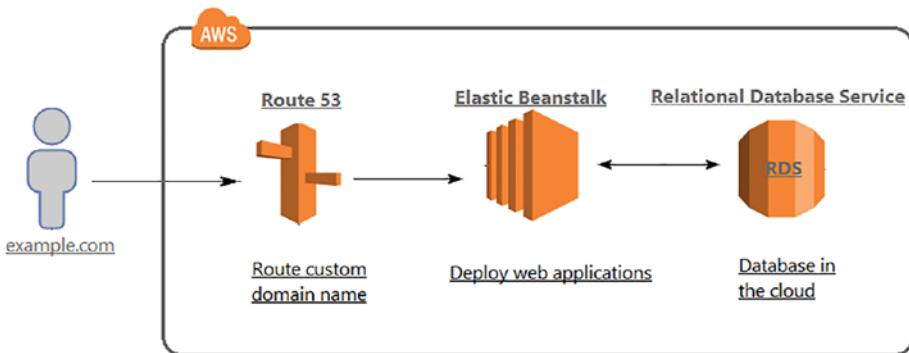
Amazon Route 53 is a Domain Name System (DNS), which allows you to route your custom domain names to your actual application on AWS. So, you configure Route 53 to send requests from the browser to your AWS application. The AWS DNS sets up your custom domain name.

## Use Case: AWS Application Architecture

For your apps, start with AWS Elastic Beanstalk because you can quickly get started with deploying your application by leveraging those pre-configured web stacks out of the box.

Use EC2 if you need some low-level control. For example, you may want to use a version of Java that Elastic Beanstalk does not support, or you may want to use a Java application server like WebLogic or make another OS-specific customization.

Figure 1-6 shows that the architecture uses Elastic Beanstalk to deploy the web application. The Java application runs on Tomcat. RDS is the database in the cloud using MySQL. Route 53 routes your custom domain name to your application hosted on AWS.



**Figure 1-6.** AWS application architecture

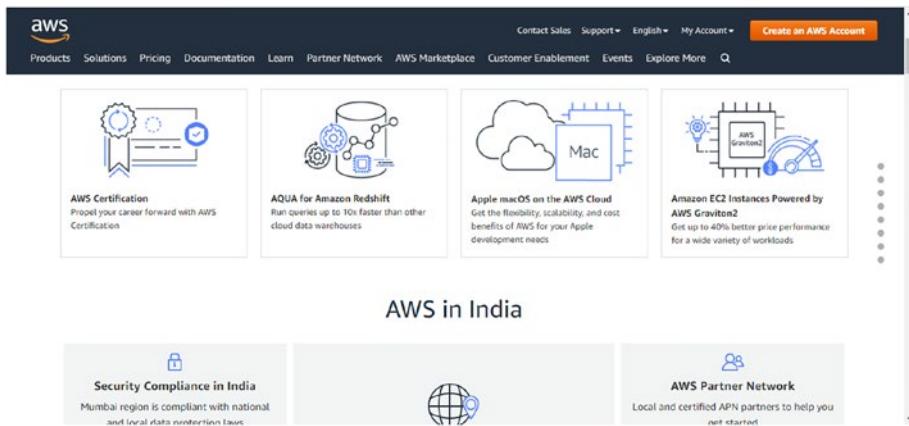
## Create a Free AWS Account for Developer

To access Amazon Web Services, you need to create an AWS account. First, let's talk about the AWS free tier, where developers get a free 12 months trial period and enough resources to deploy your application and database for free. There is also a smaller version of AWS servers that you can use for free.

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)

If you need to have some more advanced features, then you must pay and get access. This book uses the free tier. If you would like more information on the free tier, go to <https://aws.amazon.com/free/>.

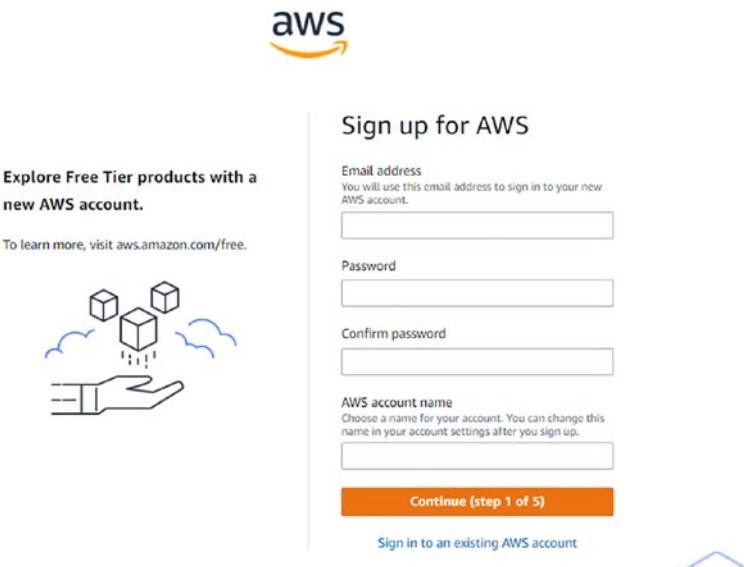
In your web browser, go to <https://aws.amazon.com> to open the Amazon Web Services home page (see Figure 1-7; this screenshot may be different on your screen due to any updates by Amazon).



**Figure 1-7.** AWS main page

To create an AWS account, you need to provide your contact information, including your address, and a valid debit or credit card. Even though you are using a free account, Amazon needs your credit or debit card information. So, have it handy when creating your AWS account.

On the top right of the main page, click the **Create an AWS Account** button. You are redirected to the sign up for the AWS page, as shown in Figure 1-8.



**Figure 1-8.** Sign up for AWS

Enter your email address, password (choose a strong password to prevent getting hacked), and the AWS account name that you want for this account. You must be sure that the account information you enter is correct, especially your email address. If you enter an incorrect email address, you can't access your account.

Click the Continue button to enter your contact information, as shown in Figure 1-9.

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)

The screenshot shows the 'Sign up for AWS' page. On the left, there's a section titled 'Free Tier offers' listing three options: 'Always free' (never expires), '12 months free' (starts from initial sign-up date), and 'Trials' (starts from service activation date). The main right section is titled 'Contact Information' and contains fields for full name, phone number, country or region, address, city, state, province, or region, and postal code. At the bottom, there's a checkbox for agreeing to the AWS Customer Agreement and a large orange 'Continue (step 2 of 5)' button.

### Sign up for AWS

#### Contact Information

How do you plan to use AWS?

Business - for your work, school, or organization

Personal - for your own projects

Who should we contact about this account?

Full Name  
[Text Input Field]

Phone Number  
Enter your country code and your phone number.  
+1 222-333-4444  
[Text Input Field]

Country or Region  
United States ▾

Address  
[Text Input Field]  
Apartment, suite, unit, building, floor, etc.  
[Text Input Field]

City  
[Text Input Field]

State, Province, or Region  
[Text Input Field]

Postal Code  
[Text Input Field]

I have read and agree to the terms of the AWS Customer Agreement [\(View\)](#).

**Continue (step 2 of 5)**

**Figure 1-9.** Contact information

First, select the Personal account type. (A business account is associated with an organization, and a personal account is associated with an individual.) Enter your full name, phone number, country, address, city, state, and postal code.

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)

Finally, select the little check box at the bottom to show that you have read and agree to the terms of the AWS Customer Agreement, and then click the Continue button.

You receive an email from AWS to confirm that your AWS account has been created. You can sign in to your new account using the email address and password you registered with. However, you can't use AWS services until you finish your account activation.

Billing information is where you must enter your credit or debit card number and so forth, as shown in Figure 1-10. It is used for verification purposes.

The screenshot shows the 'Sign up for AWS' process at step 3 of 5. The top right features the AWS logo. The left sidebar has a 'Secure verification' section with a note about holding INR 2 for identity verification. Below it is a shield icon with a checkmark. The main form area is titled 'Billing Information'. It includes fields for 'Credit or Debit card number' (with a placeholder box), 'Expiration date' (with dropdown menus for Month and Year), 'Cardholder's name' (placeholder box), 'CVV' (placeholder box), and 'Billing address'. Under 'Billing address', the 'Use my contact address' option is selected, showing 'my address bangalore karnataka 560013 IN'. There is also an option to 'Use a new address'. A 'Do you have a PAN?' section explains what a PAN is and asks if the user has one ('Yes' or 'No'). A note says users can update PAN info on the Tax Settings Page. At the bottom is a large orange 'Verify and Continue (step 3 of 5)' button.

**Figure 1-10.** Billing information

Amazon does not charge your card unless your usage exceeds AWS Free Tier limits. In this book, everything that we show you is within the Free Tier limits.

AWS requires phone number verification, as shown in Figure 1-11. Choose your country or region code from the list, enter a phone number where you can be immediately reached, and enter the characters displayed in Security Check.

AWS will call you immediately using an automated system. When prompted, enter the 4-digit number from the AWS website on your phone keypad.

**Provide a telephone number**

Please enter your information below and click the "Call Me Now" button.

Country/Region code

India (+91) ▾

Phone number Ext

[REDACTED] [REDACTED]

Security Check

w7waze

Speaker icon  
Refresh icon

Please type the characters as shown above

Call Me Now

**Figure 1-11.** Phone number verification

Once you type the security check characters, click the Call Me Now button. A verification code is displayed on the screen, and at the same time, you get a call from Amazon to verify your registered phone number. You must enter the PIN you received and choose to continue. Once your identity has been successfully verified, you can see on the window that your phone is verified, and you are redirected to the next screen to choose your support plan, as shown in Figure 1-12.

## Select a Support Plan

AWS offers a selection of support plans to meet your needs. Choose the support plan that best aligns with your AWS usage. [Learn more](#)



**Basic Plan**



**Developer Plan**



**Business Plan**

**Free**

**From \$29/month**

**From \$100/month**

- Included with all accounts
  - 24/7 self-service access to forums and resources
  - Best practice checks to help improve security and performance
  - Access to health status and notifications
- For early adoption, testing and development
  - Email access to AWS Support during business hours
  - 1 primary contact can open an unlimited number of support cases
  - 12-hour response time for nonproduction systems
- For production workloads & business-critical dependencies
  - 24/7 chat, phone, and email access to AWS Support
  - Unlimited contacts can open an unlimited number of support cases
  - 1-hour response time for production systems

### Need Enterprise level support?

Contact your account manager for additional information on running business and mission critical workloads on AWS (starting at \$15,000/month). [Learn more](#)

**Figure 1-12.** Support plan

Choose the support plan that meets your needs. Select the Basic Plan for free support. Click the Free button, and you are redirected to the AWS Registration Confirmation page.

Now you can *sign in to the AWS Management Console*. Go to <https://console.aws.amazon.com> to start using AWS.

Select **Root user**, enter your AWS account email address, and click the Next button, as shown in Figure 1-13.



## Sign in

**Root user**  
Account owner that performs tasks requiring unrestricted access. [Learn more](#)

**IAM user**  
User within an account that performs daily tasks.  
[Learn more](#)

**Root user email address**

username@example.com

**Next**

By continuing, you agree to the [AWS Customer Agreement](#) or other agreement for AWS services, and the [Privacy Notice](#). This site uses essential cookies. See our [Cookie Notice](#) for more information.

**Figure 1-13.** Sign in to the console

Next, enter your AWS account password, and click **Sign in**, as shown in Figure 1-14.

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)



### Root user sign in ?

Email: ravikantsoni.author@gmail.com

Password

[Forgot password?](#)

**Sign in**

[Sign in to a different account](#)

[Create a new AWS account](#)

**Figure 1-14.** Sign-in password

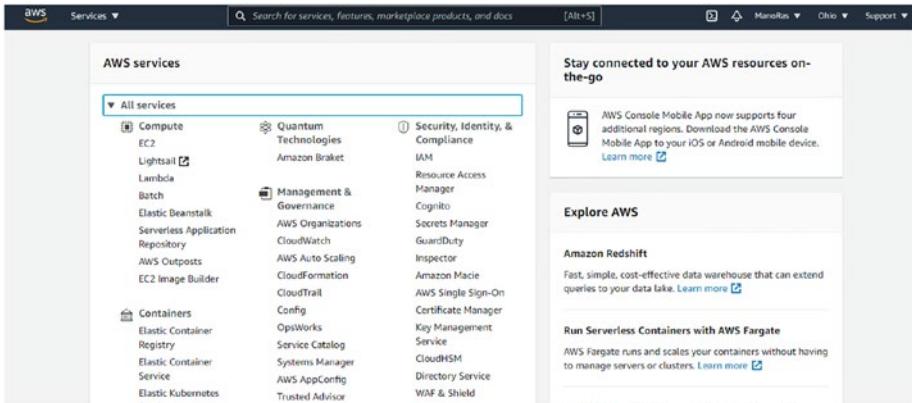
The AWS Management Console is shown in Figure 1-15.

A screenshot of the AWS Management Console homepage. At the top, there's a navigation bar with links for 'Services', a search bar, and account information for 'ManoRaS' and 'Ohio'. Below the header, the title 'AWS Management Console' is displayed. On the left, there's a sidebar with sections for 'AWS services' (with a 'All services' link), 'Build a solution' (with a 'Launch a virtual machine' section for EC2), and 'Explore AWS' (with a 'Amazon Redshift' section). The main content area features three large cards: 'Launch a virtual machine' (With EC2, 2-3 minutes, icon of a server), 'Build a web app' (With Elastic Beanstalk, 6 minutes, icon of a cloud), and 'Build using virtual servers' (With Lightsail, 1-2 minutes, icon of a server with a lightbulb). A sidebar on the right promotes the 'AWS Console Mobile App'.

**Figure 1-15.** AWS Management Console

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)

This is where you can find all the different services that are available and provided, but they are grouped by category, as shown in Figure 1-16.



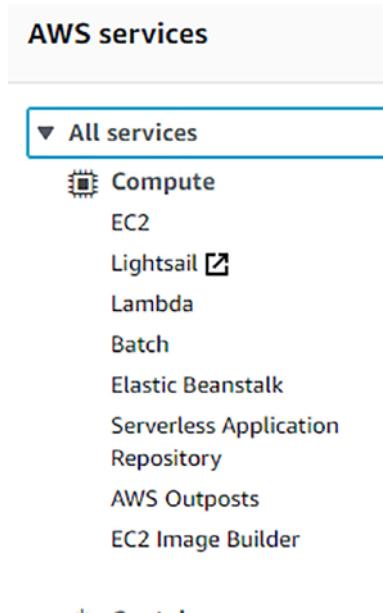
**Figure 1-16.** AWS services by category

The next section uses the Elastic Beanstalk service to begin building a web application. Tomcat is running in the AWS cloud.

## Explore and Create an AWS Elastic Beanstalk Server

On the **AWS services** page, scroll down to the Compute section and select Elastic Beanstalk, as shown in Figure 1-17. It allows you to run and manage your web application.

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)



**Figure 1-17.** Elastic Beanstalk under Compute section

The AWS Elastic Beanstalk page is shown in Figure 1-18.

The screenshot shows the AWS Elastic Beanstalk landing page. At the top, there's a navigation bar with the AWS logo, a search bar, and links for 'Services', 'Compute', 'Managers', 'Ohio', and 'Support'. On the left, a sidebar has 'Elastic Beanstalk' selected and links for 'Environments', 'Applications', and 'Change history'. The main content area has a title 'AWS Elastic Beanstalk' with the subtitle 'End-to-end web application management.' It features a 'Get started' button and a 'Create Application' button. Below this, there's a 'How it works' section with a note about automatic deployment and scaling, and a 'Pricing' section stating there's no additional charge. The URL in the address bar is 'https://console.aws.amazon.com/elasticbeanstalk/home?region=us-east-1#/'.

**Figure 1-18.** AWS Elastic Beanstalk

Elastic Beanstalk is the simplest way to deploy and run your web application on AWS. Elastic Beanstalk automatically handles the deployment details of capacity provisioning, load balancing, automatic scaling, and web application health monitoring.

Here, you select a platform, upload an application, or use a sample, and then run it. This chapter used a sample, and Tomcat is the platform for deploying the application code.

Click the Create Application button. This takes you to the **Create a web app** page shown in Figure 1-19.

The screenshot shows the 'Create a web app' page. At the top, there's a brief description: 'Create a new application and environment with a sample application or your own code. By creating an environment, you allow AWS Elastic Beanstalk to manage AWS resources and permissions on your behalf. [Learn more](#)'.

**Application information**

Application name:  Up to 100 Unicode characters, not including forward slash (/).

**Application tags**

Apply up to 50 tags. You can use tags to group and filter your resources. A tag is a key-value pair. The key must be unique within the resource and is case-sensitive. [Learn more](#)

Key:  Value:  Remove tag

Add tag

50 remaining

**Platform**

Platform:

Platform branch:

**Figure 1-19.** Create a web app

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)

Name the application **My First Elastic Beanstalk Application**, as shown in Figure 1-20.

The screenshot shows a form titled "Application information". Under the "Application name" section, there is a text input field containing "My First Elastic Beanstalk Application". Below the input field, a note says "Up to 100 Unicode characters, not including forward slash (/).".

**Figure 1-20.** Application name under Application information

Next, select the platform from the drop-down list. Choose Tomcat, as shown in Figure 1-21.

The screenshot shows a form titled "Platform". Under the "Platform" section, there is a dropdown menu with the placeholder "Choose a platform". The menu lists several options: ".NET on Windows Server", "Docker", "GlassFish", "Go", "Java", "Node.js", "PHP", "Python", "Ruby", and "Tomcat". The "Tomcat" option is highlighted. At the bottom of the form, there is a checkbox labeled "Upload your code".

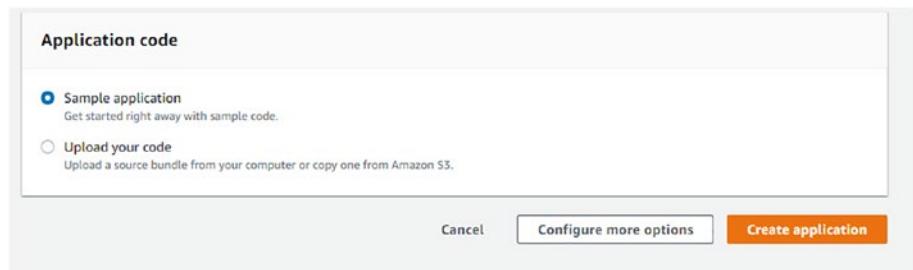
**Figure 1-21.** Platform under Application information

Select the default Tomcat branch and version, as shown in Figure 1-22.



**Figure 1-22.** Platform details on selecting platform under Application information

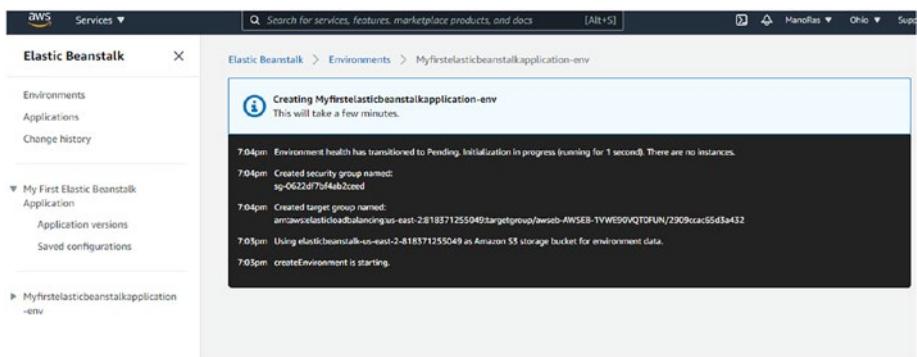
Under Application code, select **Sample** application, as shown in Figure 1-23, and then click the **Create** application button.



**Figure 1-23.** Application code

At this point, AWS provisions a server for you, as shown in Figure 1-24. It has Java installed, running on Linux, and Tomcat is already pre-installed.

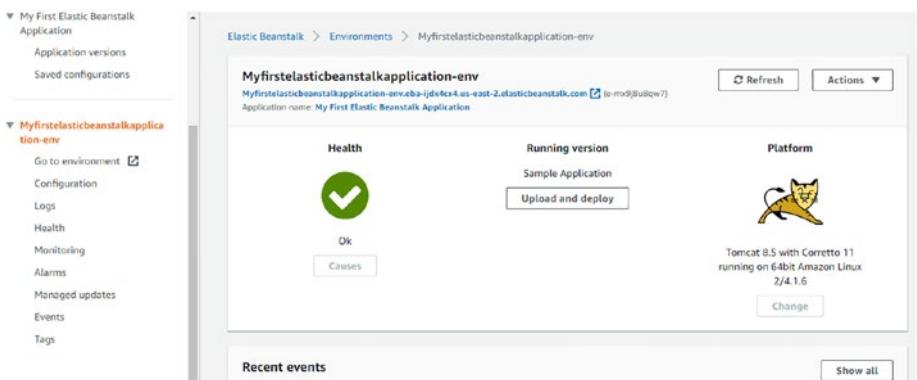
## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)



**Figure 1-24.** Environment details

You see diagnostics on the screen while the work is going on in the background.

Eventually, your application is deployed successfully, and the health status is OK, as shown in Figure 1-25. The link to your application appears in the top-left of the window. So, if you click the link, you see your application up and running.



**Figure 1-25.** Health OK

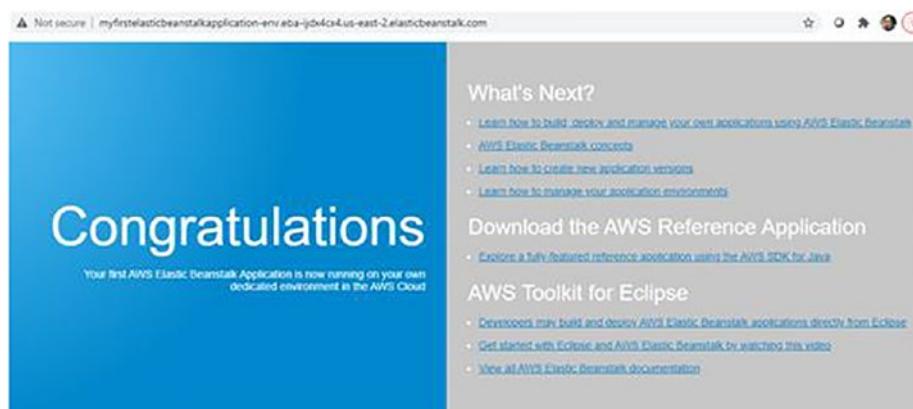
This will start the sample application and configuring Linux, Tomcat, and Java. The logs shown in the following Figure 1-26 inform that the environment launched successfully.

The screenshot shows the AWS CloudWatch Logs interface for the environment 'Myfirstelasticbeanstalkapplication-env'. On the left, there's a sidebar with options like Go to environment, Configuration, Logs, Health, Monitoring, Alarms, Managed updates, Events, and Tags. The main area is titled 'Recent events' and contains a table with four rows of log entries. The columns are Time, Type, and Details.

Time	Type	Details
2021-03-24 19:08:14 UTC+0530	INFO	Environment health has transitioned from Warning to Ok. Initialization completed 52 seconds ago and took 3 minutes.
2021-03-24 19:07:43 UTC+0530	INFO	Successfully launched environment: Myfirstelasticbeanstalkapplication-env
2021-03-24 19:07:43 UTC+0530	INFO	Application available at Myfirstelasticbeanstalkapplication-env.eba-ijdx4cx4.us-east-2.elasticbeanstalk.com.
2021-03-24 19:07:14	WARN	Environment health has transitioned from Pending to Warning. Initialization completed 12 seconds ago

**Figure 1-26.** Logs

Figure 1-27 shows the Congratulations screen.



**Figure 1-27.** Congratulations screen

Your app is now running on the AWS cloud, and its URL is live on the Internet. Tomcat is running on your dedicated environment in the AWS cloud.

Right now, you are simply using the sample application, but later, you upload your applications and run them in the AWS cloud. You can add a custom domain name to the URL.

## Create a HelloWorld JSP Application, Build WAR with Maven, and Upload WAR to Elastic Beanstalk

As a proof of concept, let's deploy the HelloWorld JSP application on Elastic Beanstalk. It's just a simple application on the Java side, which allows you to focus on the Elastic Beanstalk deployment process.

Advanced Spring Boot and database CRUD operations are covered later.

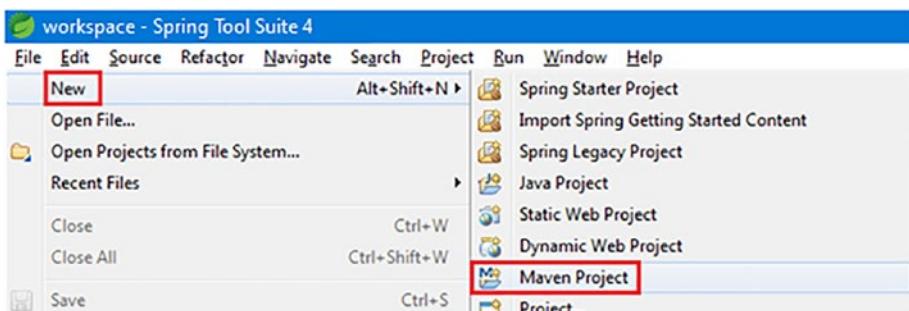
To understand the mechanics of how to deploy, let's look at the step-by-step development process.

1. Create the HelloWorld JSP application in Spring Tool Suite (STS).
2. Package the WAR file using Maven.
3. Create a new application in Elastic Beanstalk.
4. Upload the WAR file to Elastic Beanstalk.

### Create a HelloWorld JSP Application

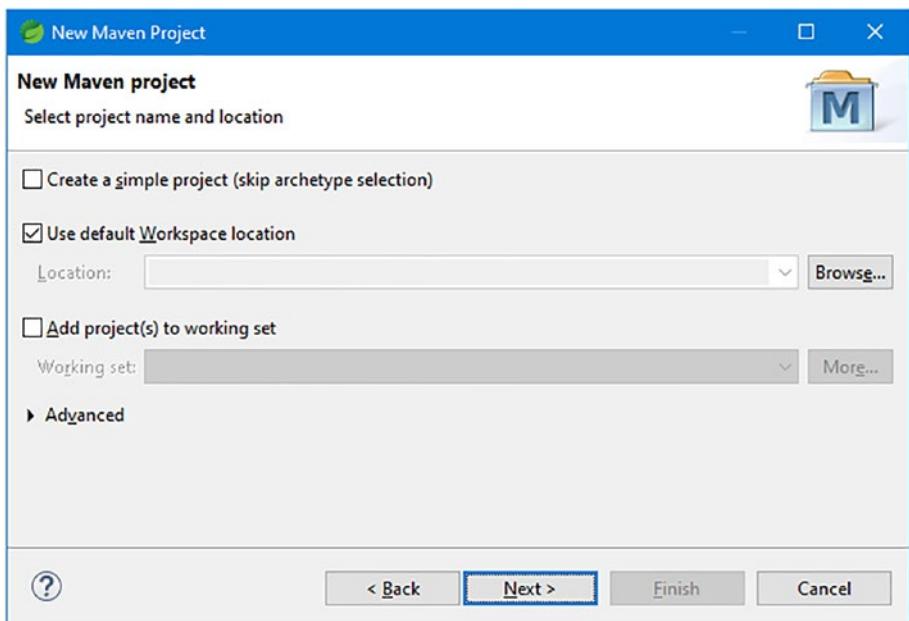
Create a Maven web application project using STS or any IDE of your choice.

First, open Spring Tool Suite, select File menu ► New ► Maven Project, as shown in Figure 1-28.



**Figure 1-28.** Select Maven Project

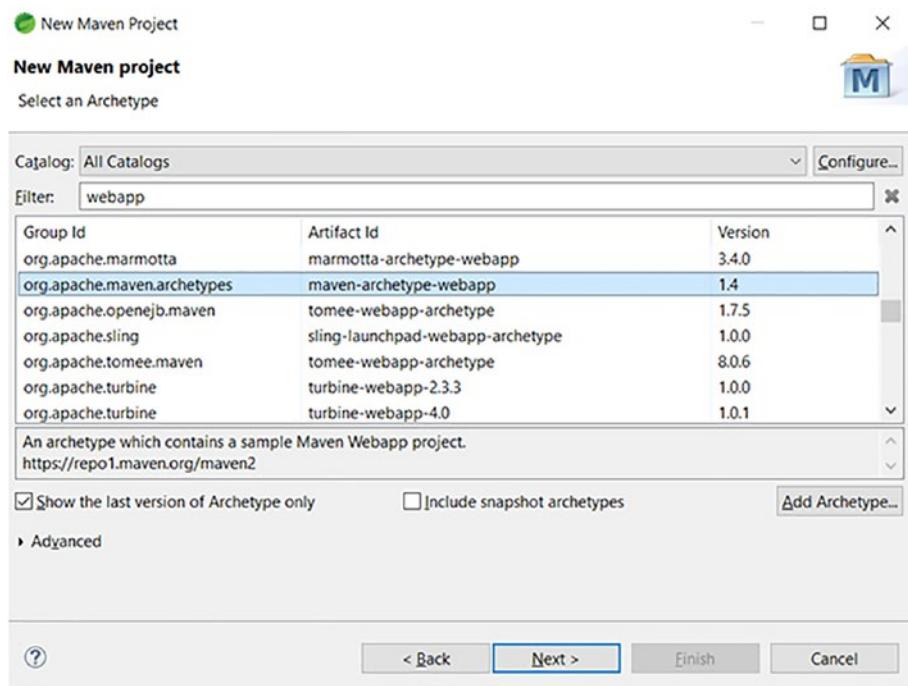
Figure 1-29 shows the New Maven Project wizard. Select the default location, and click Next.



**Figure 1-29.** New Maven Project wizard

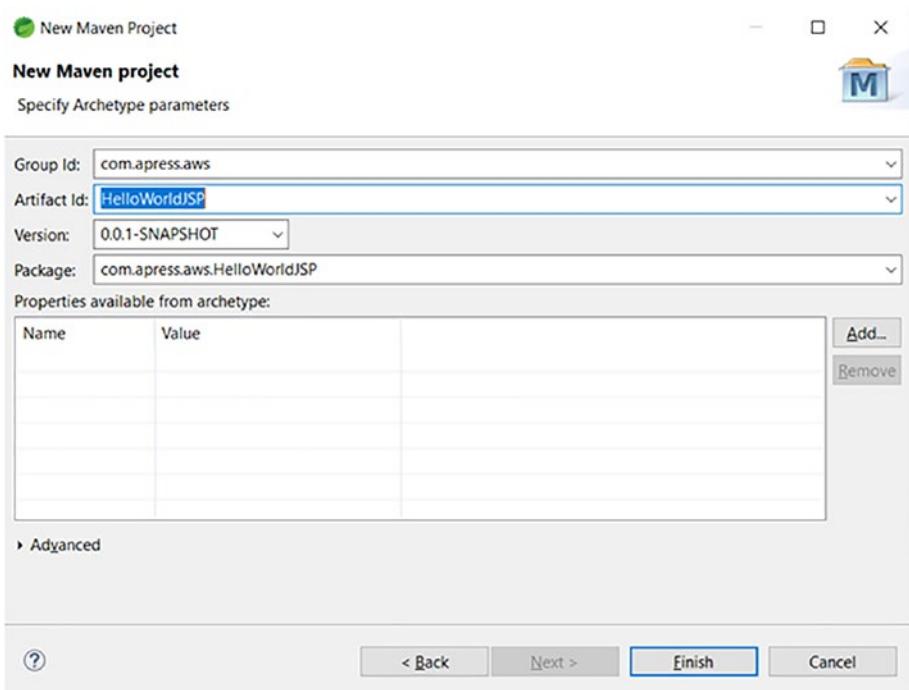
## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)

Then, select maven-archetype-webapp and click Next, as shown in Figure 1-30.



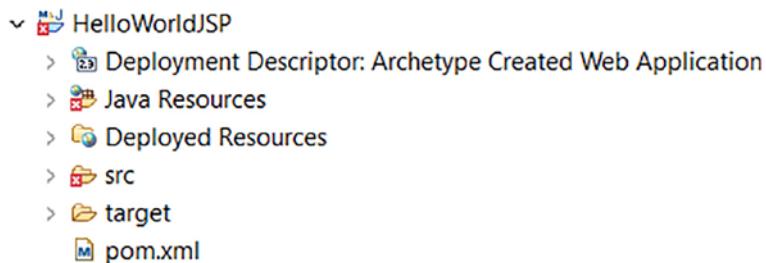
**Figure 1-30.** Select an archetype

Next, provide the group ID, artifact ID, and package information, and then hit the Finish button, as shown in Figure 1-31.



**Figure 1-31.** Specify archetype parameters

A project directory is created, as shown in Figure 1-32.

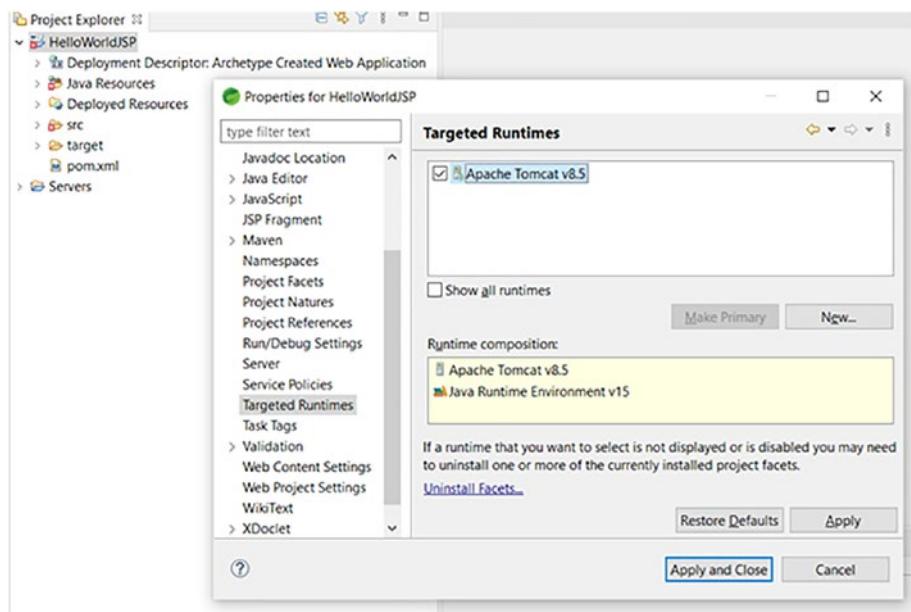


**Figure 1-32.** HelloWorldJSP project directory

If you look in the problem's view in IDE, the error shown is “The superclass javax.servlet.http.HttpServlet was not found on the Java Build Path”. This error indicates that an HTTP servlet is not available in the project classpath.

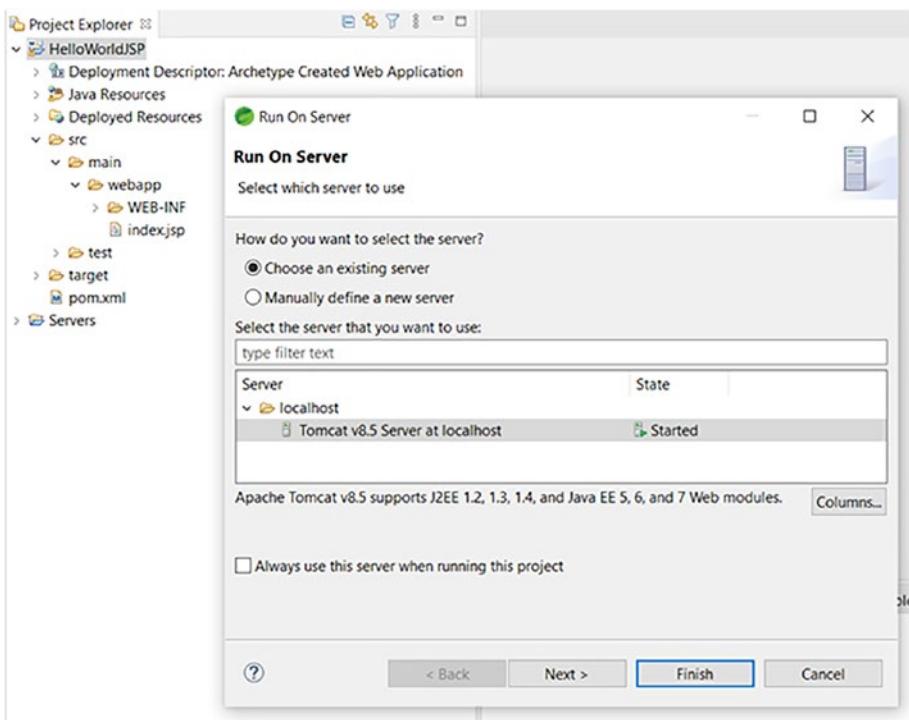
Once you add a target runtime to the project, an HTTP servlet is available in the project classpath. Errors are resolved after configuring the runtime server, such as the Tomcat server.

To configure the Tomcat server, right-click the project and select Properties. Select Targeted Runtimes, and then select Apache Tomcat v8.5, as shown in Figure 1-33. Then, click the Apply and Close button.



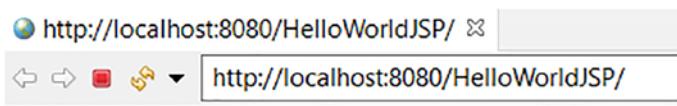
**Figure 1-33.** Targeted runtimes

To run the application on the local Tomcat server, right-click the project, select Run As and Run On Server. Select the Tomcat server in the window, and click the Finish button (see Figure 1-34).



**Figure 1-34.** Run On Server

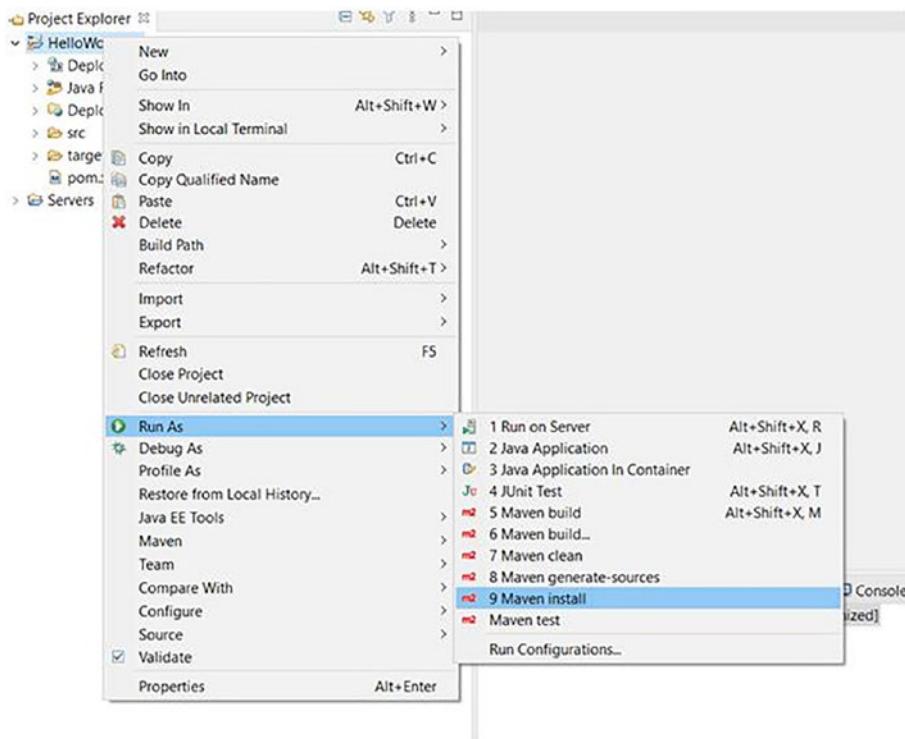
Type `http://localhost:8080/HelloWorldJSP/` in your favorite web browser to see the “Hello World!” message, as shown in Figure 1-35.



**Figure 1-35.** Hello World! in browser

## Package a WAR File Using Maven

Now, let's package a WAR file using Maven in STS. Right-click the project and select **Run As > Maven install**, as shown in Figure 1-36.



**Figure 1-36.** Run As Maven install

Once the build is successful, you can validate it with a success message in the console, as shown in Figure 1-37. This generates a WAR file.

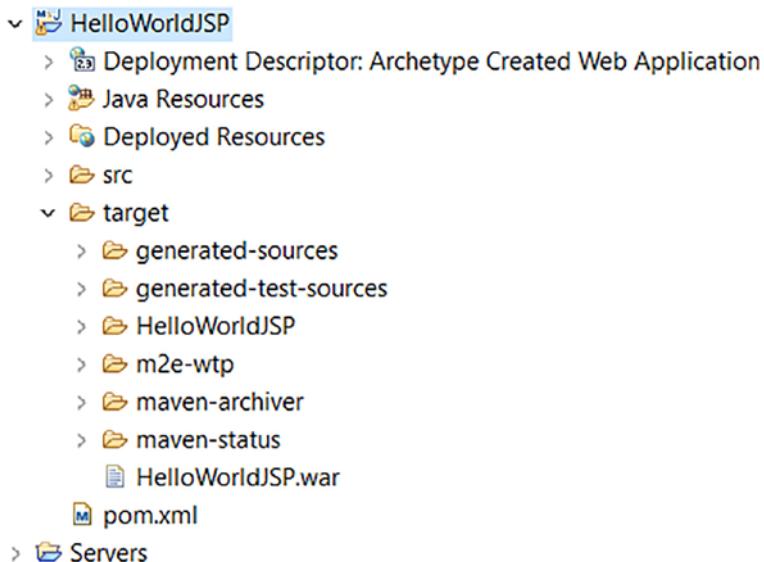
## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)



```
[Markers] [Properties] [Servers] [Snippets] [Console]
<terminated> D:\Learning\software\sts-4.0.0.RELEASE\plugins\org.eclipse.jst\openjdkhotspot\jre\full\win32\x86_64_15.0.1.v20201027-0507\jre\bin\java.exe
[INFO] Downloaded from : https://repo.maven.apache.org/maven2/org/apache/maven/surefire/surefire-booter/2.22.1/surefire-booter-2.22.1.jar
[INFO] Downloaded from : https://repo.maven.apache.org/maven2/org/apache/maven/surefire/surefire-common/2.22.1/surefire-common-2.22.1.jar
[INFO] ...
[INFO] --- maven-war-plugin:3.2.2:war (default-war) @ HelloWorldJSP ---
[INFO] Packaging webapp
[INFO] Assembling webapp [HelloWorldJSP] in [D:\Learning\book\Apress\workspace\HelloWorldJSP\target\HelloWorldJSP]
[INFO] Processing war project
[INFO] Copying webapp resources [D:\Learning\book\Apress\workspace\HelloWorldJSP\src\main\webapp]
[INFO] Webapp assembled in [22 secs]
[INFO] Building war: D:\learning\book\Apress\workspace\HelloWorldJSP\target\HelloWorldJSP.war
[INFO] ...
[INFO] --- maven-install-plugin:2.5.2:install (default-install) @ HelloWorldJSP ---
[INFO] Installing D:\learning\book\Apress\workspace\HelloWorldJSP\target\HelloWorldJSP.war to C:\Users\namra\.m2\repository\com\apress\HelloWorldJSP\1.0-SNAPSHOT\HelloWorldJSP-1.0-SNAPSHOT.war
[INFO] Installing D:\learning\book\Apress\workspace\HelloWorldJSP\pom.xml to C:\Users\namra\.m2\repository\com\apress\HelloWorldJSP\1.0-SNAPSHOT\HelloWorldJSP-1.0-SNAPSHOT.pom
[INFO] ...
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 16.086 s
[INFO] Finished at: 2021-03-24T22:59:30+05:30
[INFO] -----
```

**Figure 1-37.** Build success

Refresh the project folder structure and expand the target folder, where you find a WAR file named HelloWorldJSP.war, as shown in Figure 1-38.

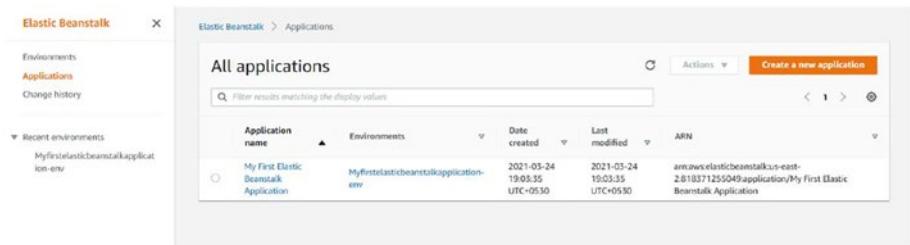


**Figure 1-38.** Generated WAR file in the target folder

## Upload WAR to Elastic Beanstalk

Now, let's create a new application in Elastic Beanstalk and then upload the WAR file to it.

On the AWS console, go to the Elastic Beanstalk page. Figure 1-39 shows the application named My First Elastic Beanstalk Application.



The screenshot shows the AWS Elastic Beanstalk interface. On the left, there is a sidebar with links for 'Environments', 'Applications' (which is selected), and 'Change history'. Below these are sections for 'Recent environments' and 'Recent applications', each listing one item: 'Myfirstelasticbeanstalkapplication-env' and 'MyFirstElasticBeanstalkApplication' respectively. The main content area is titled 'All applications' and contains a table with the following data:

Application name	Environments	Date created	Last modified	ARN
My First Elastic Beanstalk Application	MyFirstElasticBeanstalkApplication-env	2021-05-24 19:03:35 UTC+0530	2021-05-24 19:03:35 UTC+0530	arn:aws:elasticbeanstalk:us-east-2:818371255049:application/My First Elastic Beanstalk Application

**Figure 1-39.** Elastic Beanstalk application

Now let's create a brand-new application by clicking the **Create a new application** button. Enter the application name as **helloworld**, as shown in Figure 1-40. Then, click the Create button.

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)

Application information

Application name

helloworld

Maximum length of 100 characters, not including forward slash (/).

Description

Tags

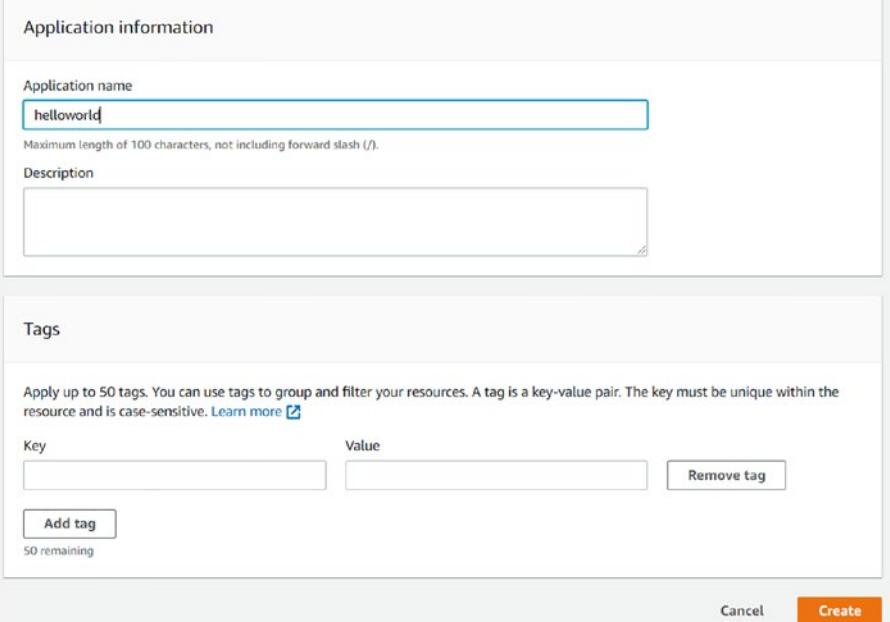
Apply up to 50 tags. You can use tags to group and filter your resources. A tag is a key-value pair. The key must be unique within the resource and is case-sensitive. [Learn more](#)

Key Value Remove tag

Add tag

50 remaining

Cancel Create



**Figure 1-40.** Application information

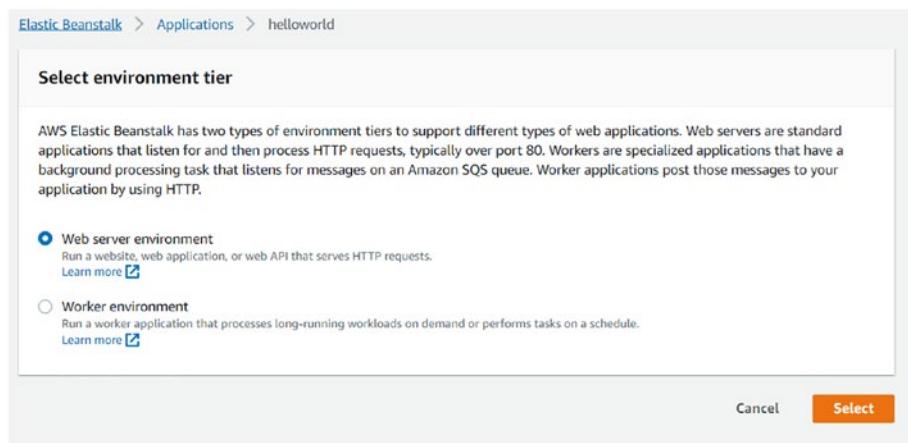
There is no environment that's already set up, as shown in Figure 1-41.

Application 'helloworld' environments										<a href="#">Actions</a>
Environment name	Health	Date created	Last modified	URL	Running versions	Platform	Platform state	Tier name		<a href="#">Create a new environment</a>
No environments currently exist for this application. <a href="#">Create one now.</a>										

**Figure 1-41.** Application environments

Create an environment by clicking Create one now to select the environment tier, as shown in Figure 1-41.

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)



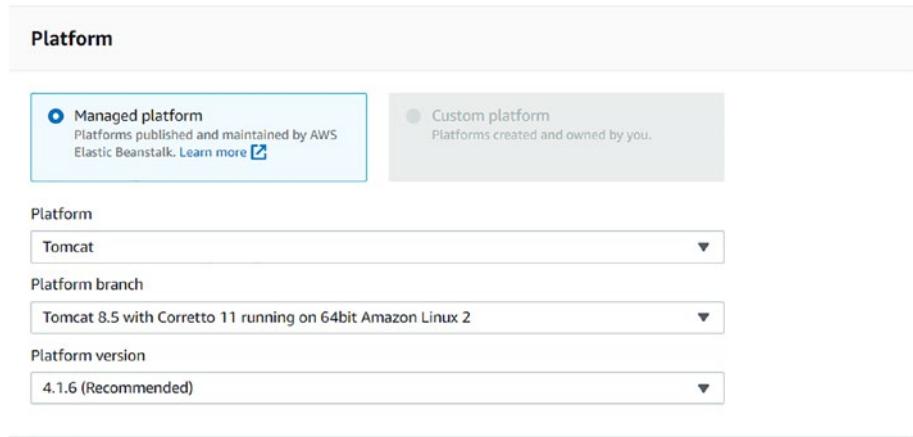
**Figure 1-42.** AWS grouped by category

For the environment tier, let's use a web server environment to run a web application. Elastic Beanstalk creates the server for us. Next, click the Select button. Now, you need to provide the environment information, as shown in Figure 1-43.

The screenshot shows the 'Environment information' configuration step in the AWS Elastic Beanstalk setup process. The breadcrumb navigation at the top reads 'Elastic Beanstalk > Applications > helloworld'. The title 'Environment information' is displayed. A note says 'Choose the name, subdomain, and description for your environment. These cannot be changed later.' Below this, there are input fields: 'Application name' containing 'helloworld', 'Environment name' containing 'Helloworld-env', 'Domain' containing 'awshelloworldjsp.us-east-2.elasticbeanstalk.', and a 'Check availability' button which has a green checkmark and the text 'awshelloworldjsp.us-east-2.elasticbeanstalk.com is available.'. There is also a 'Description' field with an empty text area.

**Figure 1-43.** Environment information

Here, you need to provide details like a name for the environment and domain. Make sure that the environment URL is unique; here, name it **awshelloworldjsp**, which indicates that it is available for use. Then choose the platform details for the server, as shown in Figure 1-44.



**Figure 1-44.** Platform for server

Here, select Managed platform, which is published and managed by AWS Elastic Beanstalk, and from the Platform drop-down list, choose Tomcat. So, Elastic Beanstalk creates a Tomcat server for you when it's spinning up the environment.

Now, you need to upload the WAR file to Elastic Beanstalk. Click Choose **file**, and select the HelloWorldJSP.war file from the local system, as shown in Figure 1-45.

## CHAPTER 1 AN INTRODUCTION TO AMAZON WEB SERVICES (AWS)

The screenshot shows the 'Application code' configuration step in the AWS Elastic Beanstalk environment creation wizard. It includes fields for selecting a sample application or existing version, choosing a version, uploading code from a local file, setting a version label, and specifying a source code origin. The 'Local file' option is selected, and a WAR file has been successfully uploaded. The 'Create environment' button is visible at the bottom.

**Application code**

Sample application  
Get started right away with sample code.

Existing version  
Application versions that you have uploaded for helloworld.

-- Choose a version --

**Upload your code**  
Upload a source bundle from your computer or copy one from Amazon S3.

**Version label**  
Unique name for this version of your application code.  
helloworld-source

Source code origin  
Maximum size 512 MB

Local file

Public S3 URL

File name : HelloWorldJSP.war  
File successfully uploaded

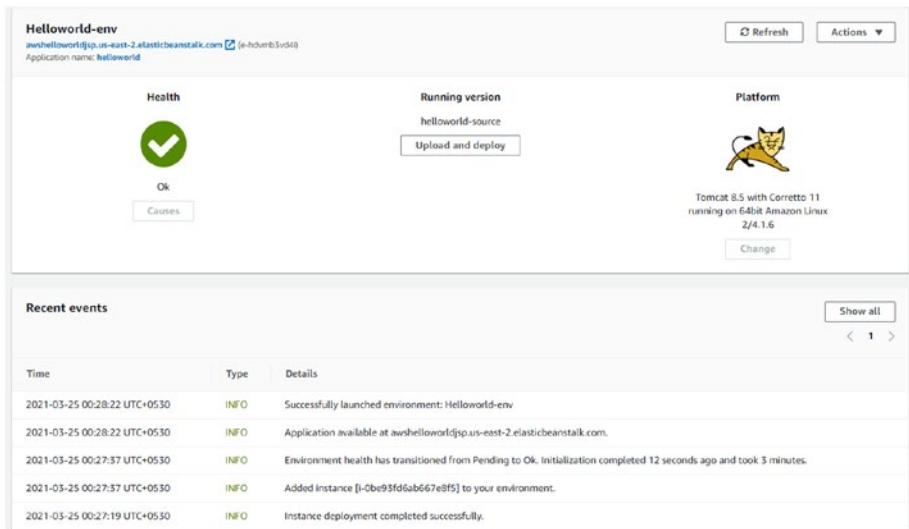
▶ Application code tags

Cancel      Configure more options      **Create environment**

**Figure 1-45.** Application code

Once the file successfully uploads to Elastic Beanstalk, hit the Create environment button.

Behind the scenes, Amazon provisions a server to use with the operating system. They install Java and Tomcat and deploy your WAR file to the Tomcat environment. You get a green checkbox indicating success when everything is done, as shown in Figure 1-46. Here, the logs confirm that the environment successfully launched.



**Figure 1-46.** Health OK and Recent events

Click the application's link. The page opens in the browser displaying "Hello World!" (see Figure 1-47).



**Figure 1-47.** Accessing application from browser by hitting URL

This is your new application. The WAR file is deployed on the Amazon cloud in Elastic Beanstalk, and it's up and running.

Make sure to stop any unused AWS Elastic Beanstalk apps that you don't need. This helps prevent any overuse charges from Amazon.

## Summary

This chapter overviewed Amazon Web Services (AWS). You learned about some AWS key services, such as EC2, Elastic Beanstalk, Amazon RDS, and Amazon Route 53. You created a free AWS account, a server, A HelloWorld JSP application, a WAR file with Maven, and uploaded the file to Elastic Beanstalk. Finally, you accessed your application in the browser to see the “Hello World!” message.

The next chapter deploys a Spring Boot application as a REST API in AWS.

## CHAPTER 2

# Deploy a Spring Boot Application as a REST API in AWS

The previous chapter provided an overview of Amazon Web Services (AWS), including services like Amazon Elastic Compute Cloud (Amazon EC2), AWS Elastic Beanstalk, Amazon Relational Database Service (Amazon RDS), and Amazon Route 53. First, you created a free AWS account for developers, explored Elastic Beanstalk, and created a server. Then, you created the HelloWorld JSP application. Finally, you built a WAR file with Maven and uploaded WAR to Elastic Beanstalk.

In this chapter, you create a Spring Boot application as a REST API in your local system. Then, you build the JAR using Maven for our Spring Boot application and deploy this JAR in Elastic Beanstalk so that anyone can access the REST API on the Internet. Finally, you explore logs from Elastic Beanstalk.

# Build a Spring Boot Application as a REST API

Why use Spring Boot as a back-end framework? There are many frameworks available for developing web applications, and Spring Boot is just one among them. But, if you wish to build something fast, Spring Boot may be the primary choice as a web application development framework.

*Working with Spring Boot is like pair programming with the Spring developers.*

—Josh Long @starbuxman

Spring Boot provides production-ready applications and services that anyone can run with minimum fuss. Spring Boot is *opinionated*, which suggests ensuring decisions for developers and supporting ranges of nonfunctional features that are common in enterprise applications (embedded servers, security, health checks, metrics, and externalized configuration).

In this section, you develop your Spring Boot application, step by step. If you're already acquainted with this build process, you can skip to the end of this section to see how it all fits together. Spring offers different options for starting a brand-new project. For more information, refer to <https://spring.io/>.

## Introduction to REST

*Representational state transfer* (REST) is an architectural style that describes how one system communicates or shares its state with another system. HTTP (Hypertext Transfer Protocol) may be a commonly used protocol to support a RESTful architecture. Standard HTTP methods like POST, GET, PUT, and DELETE access and manipulate RESTful web resources.

- The POST method performs a create operation by sending data to a server.
- The GET method retrieves data from a specified resource.
- The PUT method performs an update operation by sending data to a server.
- The DELETE method performs the delete operation.

A meaningful HTTP response status code always helps clients to utilize RESTful API. Table 2-1 describes several HTTP status codes that may be returned as the server response when calling a RESTful API.

**Table 2-1.** *HTTP Response Status Codes*

Code	Message	Description
200	OK	Successful response. The request has succeeded. (This is a standard HTTP response status code for a successful HTTP request.)
201	Created	Successful response. This is typically the HTTP response sent after POST or PUT requests are fulfilled, and a new resource has been created as a result.
204	Not Content	Successful response. This HTTP response code means that the request has been processed successfully but is not returning any content for this request.
400	Bad Request	Client error response. The request could not be fulfilled due to invalid syntax.
401	Unauthorized	Client error response. The request requires user authorization to get the requested response.

*(continued)*

**Table 2-1.** (continued)

<b>Code</b>	<b>Message</b>	<b>Description</b>
403	Forbidden	Client error response. The server refuses to fulfill the request because the client does not have access rights to the requested content.
404	Not Found	Client error response. The requested resource could not be found by the server.
409	Conflict	Client error response. The request cannot be completed because of a resource conflict with the current state of the server.

## System Requirements

Spring Boot 2.0.3.RELEASE requires (at least) Java 8. So, the first thing that is required is the Java 8 SDK. If you have already set up the JDK in your system, you should check the current version of Java installed on your system before you begin.

```
$ java -version
java version "1.8.0_101"
Java(TM) SE Runtime Environment (build 1.8.0_101-b13)
Java HotSpot(TM) 64-Bit Server VM (build 25.101-b13, mixed mode)
```

Spring offers the following three approaches to create a brand-new Spring Boot application.

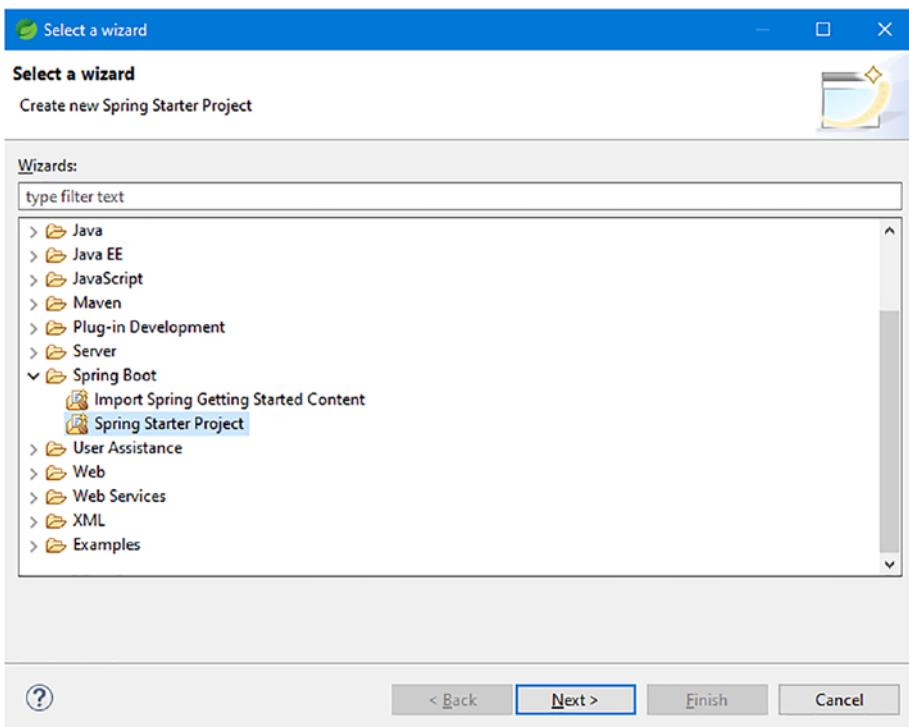
- Use the Spring Boot **CLI** tool
- Use the Spring **STS** IDE
- Use Spring **Initializr** (<http://start.spring.io/>)

## Create Spring Boot Application Using Spring Tool Suite

In this chapter, you build a RESTful application called HelloSpringBoot with REST endpoints, using STS IDE. The REST API layer is responsible for handling client requests and generating a response.

You create HelloSpringBoot by generating a Spring Boot application using Spring Tool Suite (STS). STS comes as a ready-to-use distribution of the latest Eclipse releases with pre-installed Spring IDE components.

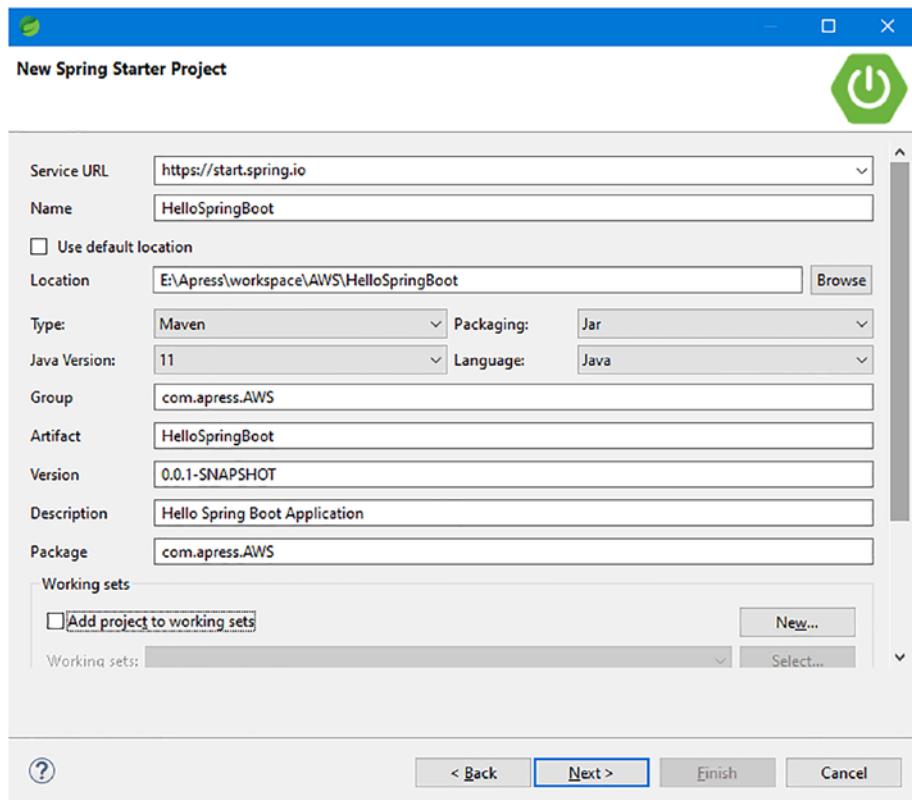
Use a Spring Starter Project wizard to create a Spring Boot application, as shown in Figure 2-1. By default, the Spring Boot application runs on port 8080.



**Figure 2-1.** The wizard to create a Spring Boot application

## CHAPTER 2 DEPLOY A SPRING BOOT APPLICATION AS A REST API IN AWS

Spring Boot provides *starters*. You need to provide project-related information, as shown in Figure 2-2.

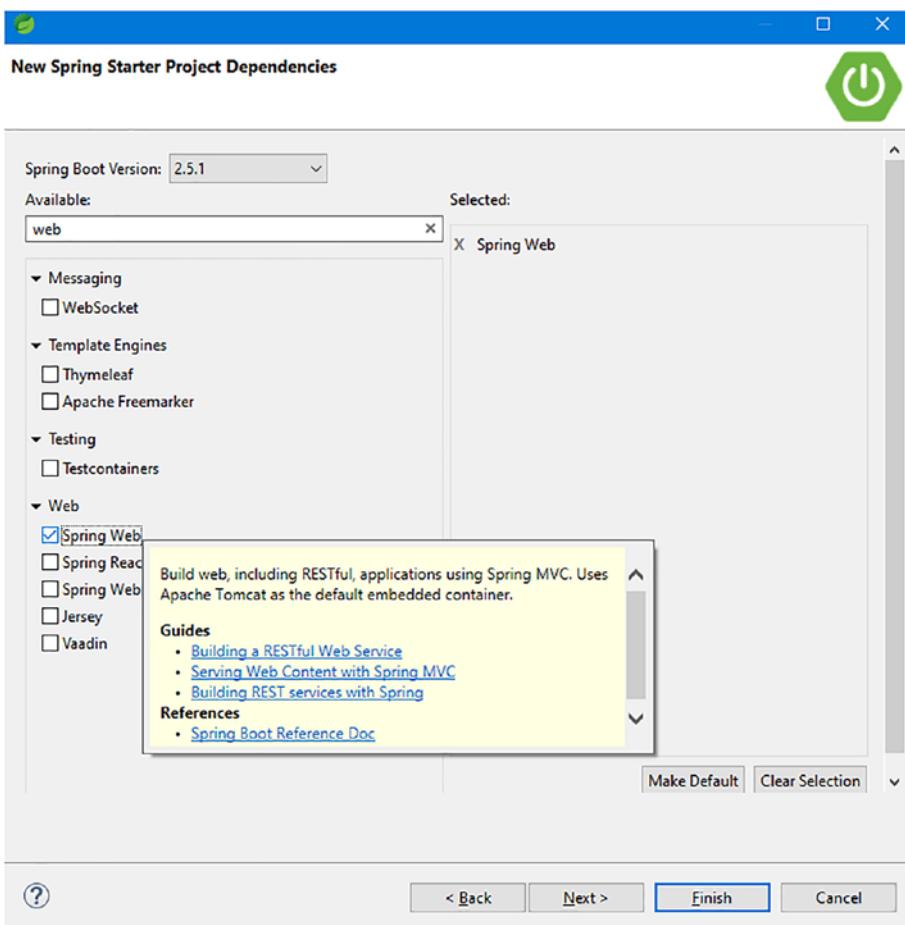


**Figure 2-2.** Creating HelloSpringBoot using Spring Starter Project

A starter in Spring Boot is a set of classpath dependencies that autoconfigure an application and enables a developer to build an application without any configuration.

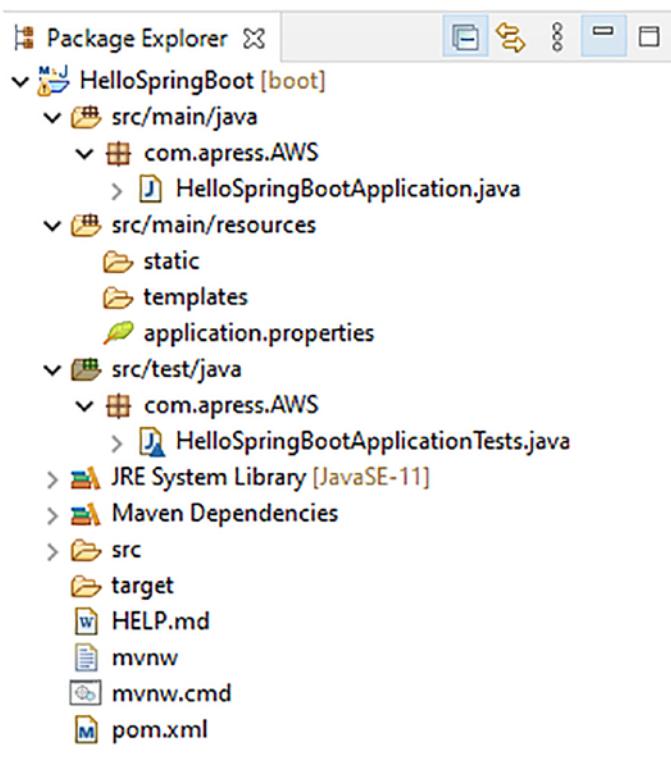
In this chapter, you pick the web dependencies to build a simple HelloSpringBoot RESTful service, as shown in Figure 2-3.

## CHAPTER 2 DEPLOY A SPRING BOOT APPLICATION AS A REST API IN AWS



**Figure 2-3.** Selecting a web dependency in the Spring starter

Clicking the Finish button generates a workspace to create a new package, class, and static files in your resources. The final structure of the project looks like Figure 2-4.



**Figure 2-4.** Project structure

Let's go through the code in the next section.

## A Walk-Through

Let's walk through the code by going through the `pom.xml` file and the Java class files. Let's start with `pom.xml`.

### **pom.xml**

When creating a Spring Boot application, all the dependencies that you select in the starter dialog are available in `pom.xml`, as shown in Listing 2-1. The `pom.xml` file is the recipe that builds your project.

***Listing 2-1.*** pom.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
  https://maven.apache.org/xsd/maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <parent>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-parent</artifactId>
    <version>2.5.1</version>
    <relativePath/>
  </parent>
  <groupId>com.apress.AWS</groupId>
  <artifactId>HelloSpringBoot</artifactId>
  <version>0.0.1-SNAPSHOT</version>
  <name>HelloSpringBoot</name>
  <description>Hello Spring Boot Application</description>
  <properties>
    <java.version>11</java.version>
  </properties>
  <dependencies>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-web</artifactId>
    </dependency>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-test</artifactId>
      <scope>test</scope>
    </dependency>
```

```
</dependencies>
<build>
    <plugins>
        <plugin>
            <groupId>org.springframework.boot</groupId>
            <artifactId>spring-boot-maven-plugin</
                artifactId>
        </plugin>
    </plugins>
</build>
</project>
```

Note the following about Listing 2-1.

- The `<parent>` element specifies the parent POM of Spring Boot, which contains definitions for common components.
- The `<dependency>` element on `spring-boot-starter-web` tells Spring Boot that this is a web application and lets Spring Boot to form its opinions accordingly.

Before going further, let's look at Spring Boot's opinions and how it uses a starter like `spring-boot-starter-web` to form its configuration opinions.

The HelloSpringBoot application has used `spring-boot-starter-web` as Spring Boot's web application starter. And, based on this starter, Spring Boot has formed the following opinions.

- Spring web MVC for the REST framework
- Apache Jackson for the JSON binding
- Tomcat embedded web server container

After Spring Boot forms an opinion about the kind of application you plan to build, it delivers a collection of Maven dependencies supporting the POM contents and starter specified for the HelloSpringBoot application.

## Write the Code

To bootstrap a Spring Boot application, you can start from a `main(...)` method. Most likely, you can delegate to the static `SpringApplication.run()` method, as shown in Listing 2-2.

***Listing 2-2.*** \src\main\java\com\apress\AWS\  
HelloSpringBootApplication.java

```
package com.apress.AWS;

import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

/**
 * @author RaviKantSoni
 *
 */
@SpringBootApplication
@RestController
public class HelloSpringBootApplication {

    public static void main(String[] args) {
        SpringApplication.run(HelloSpringBootApplication.class, args);
    }
}
```

```
@RequestMapping("/greeting")
public String greetingMessage() {
    return "Welcome to Hello Spring Boot Application!";
}

}
```

Let's step through the important parts.

## **@SpringBootApplication Annotation**

The first annotation in the `HelloSpringBootApplication` class is `@SpringBootApplication`, introduced in Spring Boot 1.2.0. It adds the following annotations.

- **@Configuration:** A class annotated with the `@Configuration` annotation can be used by the Spring Boot container as a source of Spring Bean definitions, which is not specific to Spring Boot. This class may contain one or more Spring Bean declarations by annotated methods with the `@Bean` annotation.
- **@EnableAutoConfiguration:** This annotation is part of the Spring Boot project that tells Spring Boot to start adding beans using classpath definitions. Autoconfiguration intelligently guesses and automatically creates and registers beans that you are likely to run with the application, thus simplifying the developer's work.
- **@ComponentScan:** This annotation tells Spring Boot to look for specific packages to scan for annotated components, configurations, and services.

## @RestController and @RequestMapping Annotations

@RestController is another annotation in the HelloSpringBootApplication class. It is a stereotype annotation. The @RequestMapping annotation provides “routing” information and tells Spring Boot that any HTTP request with the path /greeting should be mapped to the greetingMessage() method.

The @RestController and @RequestMapping annotations come from Spring MVC (these annotations are not specific to Spring Boot).

## The main Method

The most important part of the HelloSpringBootApplication class is the main(...) method. The application developed using Spring Boot contains the main method, which internally calls Spring Boot’s SpringApplication.run() method to launch an application. The class that contains a main method is the main class and is annotated with the @SpringBootApplication annotation.

## Run a Spring Boot Application in STS

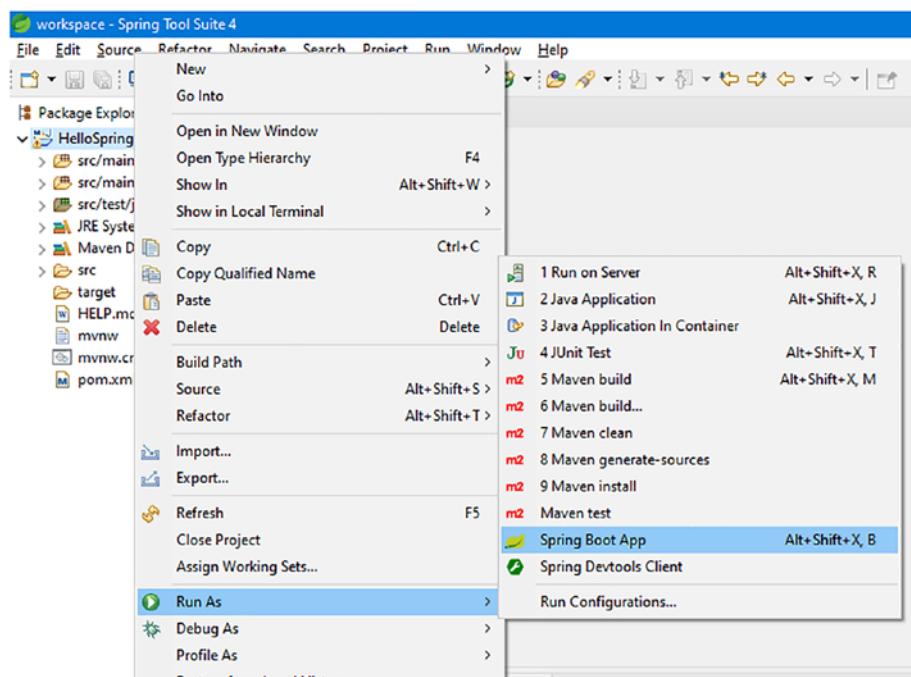
Spring Boot application created using the Spring Starter Project wizard comes in two flavors: WAR and JAR. This wizard allows you to choose between WAR and JAR in its packaging option.

*As Josh Long said in one of his talks in the Spring IO, “Make JAR, not WAR.”*

—[https://twitter.com/springcentral/  
status/598910532008062976](https://twitter.com/springcentral/status/598910532008062976)

Spring Boot favors JAR over WAR by allowing you to easily create stand-alone JAR packaged projects that add an embedded web server (Apache Tomcat is the default web server) inside the created artifact. It helps developers reduce the overhead of setting up local or remote Tomcat servers, WAR packaging, and deploying.

You don't need any special tooling from STS to run your Spring Boot application locally. You can run it by selecting **Run As > Java Application**, either from the standard Eclipse Java debugging tools or STS. The benefits of using STS over other IDEs are that it provides a dedicated launcher, which does the same thing as other IDEs do, but STS adds a few useful bells and whistles on the top of it. So, let's use STS to run the Spring Boot application, as shown in Figure 2-5. Simply right-click the HelloSpringBoot project, and then select **Run As > Spring Boot App**.



**Figure 2-5.** Wizard in STS to run the application

## CHAPTER 2 DEPLOY A SPRING BOOT APPLICATION AS A REST API IN AWS

The Spring Boot application starts with output in the console, as shown in Figure 2-6.



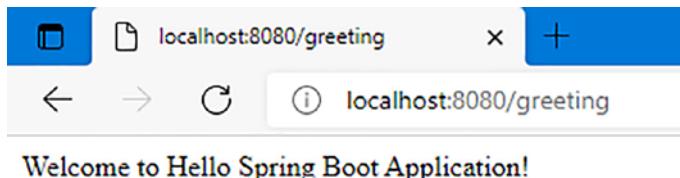
The screenshot shows the STS IDE interface with the 'Console' tab selected. The output window displays the startup logs of a Spring Boot application named 'HelloSpringBootApplication'. The logs include information about Java version, PID, and the configuration of Tomcat and Spring embedded web servers. The final line of the log indicates successful startup: 'Started HelloSpringBootApplication in 6.879 seconds (JVM running for 8.99)'.

```
2021-06-24 22:56:49.589 INFO 3712 --- [           main] c.apress.AWS.HelloSpringBootApplication : Starting HelloSpringBootApplication using Java 15.0.1 on DESKTOP-VVK28ID with PID 3712 (:E:\Apress\workspace\AWSHelloSpringBoot\target\classes started by RavikantSoni in E:\Apress\workspace\AWSHelloSpringBoot)
2021-06-24 22:56:49.596 INFO 3712 --- [           main] c.apress.AWS.HelloSpringBootApplication : No active profile set, falling back to default profiles: default
2021-06-24 22:56:54.243 INFO 3712 --- [           main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat initialized with port(s): 8080 (http)
2021-06-24 22:56:54.273 INFO 3712 --- [           main] o.apache.catalina.core.StandardService : Starting service [Tomcat]
2021-06-24 22:56:54.274 INFO 3712 --- [           main] org.apache.catalina.core.StandardEngine : Starting Servlet engine: [Apache Tomcat/9.0.46]
2021-06-24 22:56:54.643 INFO 3712 --- [           main] o.a.c.c.C.[Tomcat].[localhost].[/] : Initializing Spring embedded WebApplicationContext
2021-06-24 22:56:54.643 INFO 3712 --- [           main] w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext: initialization completed in 4855 ms
2021-06-24 22:56:55.569 INFO 3712 --- [           main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat started on port(s): 8080 (http) with context path ''
2021-06-24 22:56:55.595 INFO 3712 --- [           main] c.apress.AWS.HelloSpringBootApplication : Started HelloSpringBootApplication in 6.879 seconds (JVM running for 8.99)
```

**Figure 2-6.** Output on the STS console

If the Spring Boot application runs successfully, the last line on the console states, Started HelloSpringBootApplication.

Congratulations! You have successfully set up and run the application using Spring Boot. Now it's time to visit <http://localhost:8080/greeting> in the browser to see the web page, as shown in Figure 2-7.



**Figure 2-7.** Accessing the REST endpoint from the browser

# Add Swagger UI to a Spring Boot Application

Nowadays, front-end components and back-end components usually isolate a web application. Building a back-end API layer introduces new challenges that have gone beyond implementing endpoints. Usually, you expose REST APIs as a back-end component for the front-end component or any third-party app integrations.

Thus, your REST API documentation becomes more fragile. REST API documentation should be well structured so that it's informative, concise, and easy to read. In such a scenario, it is essential to have a proper specification for the back-end REST API. Moreover, reference API documentation should simultaneously describe each change in the API. Fulfilling this manually is a time-consuming and tedious exercise, so automation of this process was inevitable.

Swagger supports generating the API documentation automatically, and it also ensures that any changes made to the API are available to the customer immediately. In this section, you learn how to use Swagger 2 in a Spring Boot application to generate REST API documentation.

## Introduction to Swagger 2

Swagger 2 is an open source project that documents RESTful APIs. It is language-agnostic and is extensible to new technologies and protocols beyond HTTP protocol.

This Swagger 2 version defines a set of HTML (HyperText Markup Language), JavaScript, and CSS assets to dynamically generate documentation from a Swagger-compliant API. The Swagger UI project bundled these sets of files to display the API on the browser, and it returns response data in the JSON format. Besides rendering documentation, Swagger UI also allows other API developers or API consumers to interact

with the API's resources without having any of the API implementation logic in place.

The Swagger 2 specification, which is understood as the OpenAPI specification, has several implementations. Springfox has recently replaced Swagger-SpringMVC (Swagger 1.2 and older) and is popular for Spring Boot applications. Springfox supports both Swagger 1.2 and 2.0.

Let's use Swagger 2 for our Spring Boot REST web service, using the Springfox implementation of the Swagger 2 specification.

## Add Dependency in a Maven POM

Let's use the Springfox implementation of the Swagger specification. Its latest version can be found on Maven Central. To add it to our Spring Boot-based projects, you need to add a single `springfox-boot-starter` dependency, as shown in Listing 2-3.

***Listing 2-3.*** Add Springfox Dependency in pom.xml

```
<dependency>
    <groupId>io.springfox</groupId>
    <artifactId>springfox-boot-starter</artifactId>
    <version>3.0.0</version>
</dependency>
```

## Configure Swagger 2 into a Project

The configuration of Swagger 2 mainly focused on the Docket bean. For our Spring Boot application, let's create a Docket bean in a Spring Boot configuration class file to configure Swagger 2 for our application. A Springfox Docket instance provides the primary API configuration with default methods for configuration. Listing 2-4 shows our Spring Boot `SwaggerConfig` configuration class.

***Listing 2-4.*** \src\main\java\com\apress\AWS\config\SwaggerConfig.java

```
package com.apress.AWS.config;

import org.springframework.context.annotation.Bean;
import org.springframework.context.annotation.Configuration;

import springfox.documentation.builders.PathSelectors;
import springfox.documentation.builders.
RequestHandlerSelectors;
import springfox.documentation.spi.DocumentationType;
import springfox.documentation.spring.web.plugins.Docket;
import springfox.documentation.swagger2.annotations.
EnableSwagger2;

/**
 * @author RaviKantSoni
 *
 */
@Configuration
@EnableSwagger2
public class SwaggerConfig {
    @Bean
    public Docket productApi() {
        return new Docket(DocumentationType.SWAGGER_2)
            .select()
            .apis(RequestHandlerSelectors.any())
            .paths(PathSelectors.any())
            .build();
    }
}
```

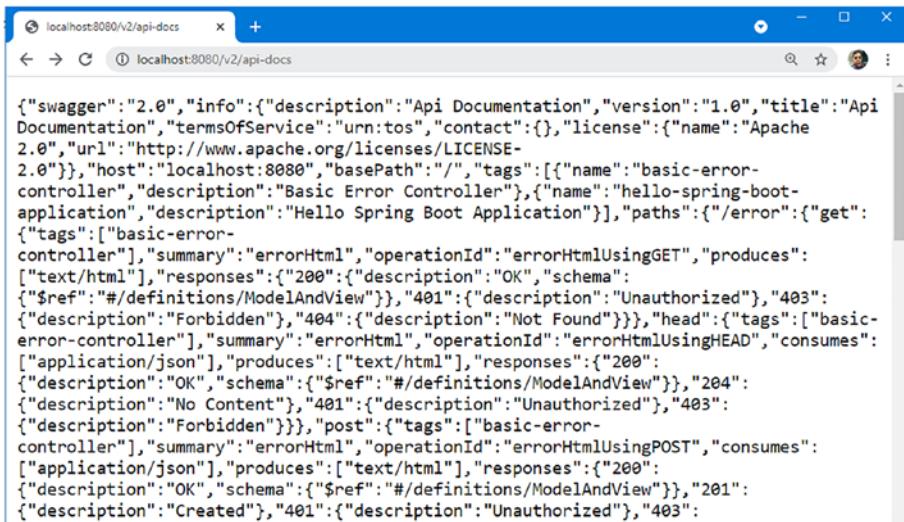
In this `SwaggerConfig` configuration class, the `@EnableSwagger2` annotation enables Swagger support in the class. The `select()` method called on the `Docket` bean instance returns an `ApiSelectorBuilder`, which provides a way to control the endpoints exposed by Swagger.

In the code, the `RequestHandlerSelectors` and `PathSelectors` use `any()` to make documentation for our entire API available through Swagger.

## Configuration Verification

At this point, you should be able to test the Swagger configuration by restarting the application and go to `http://localhost:8080/v2/api-docs`.

As shown in Figure 2-8, the result is a JSON response with a large number of key/value pairs, which is not very human-readable.



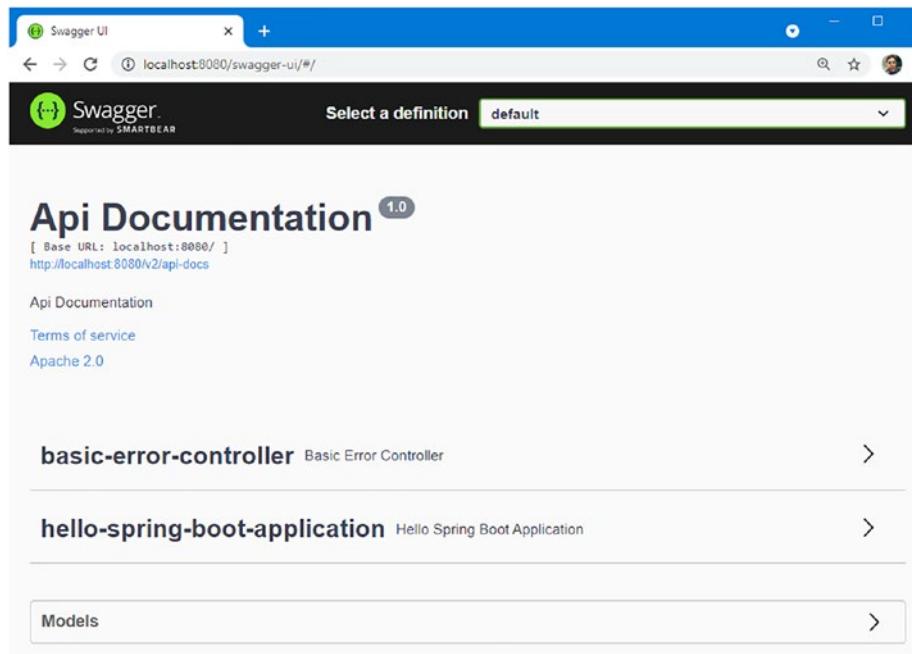
```
{"swagger":"2.0","info":{"description":"Api Documentation","version":"1.0","title":"Api Documentation","termsOfService":"urn:tos","contact":{},"license":{"name":"Apache 2.0"},"url":"http://www.apache.org/licenses/LICENSE-2.0"},"host":"localhost:8080","basePath":"/","tags":[{"name":"basic-error-controller","description":"Basic Error Controller"}, {"name":"hello-spring-boot-application","description":"Hello Spring Boot Application"}],"paths":{"/error":{"get":{"tags":["basic-error-controller"],"summary":"errorHtml","operationId":"errorHtmlUsingGET","produces":["text/html"],"responses":{"200":{"description":"OK","schema":{$ref:"#/definitions/ModelAndView"}}, "401":{"description":"Unauthorized"}, "403":{"description":"Forbidden"}, "404":{"description":"Not Found"}}, "head":{"tags":["basic-error-controller"],"summary":"errorHtml","operationId":"errorHtmlUsingHEAD","consumes":["application/json"],"produces":["text/html"],"responses":{"200":{"description":"OK","schema":{$ref:"#/definitions/ModelAndView"}}, "401":{"description":"Unauthorized"}, "403":{"description":"Forbidden"}}}, "post":{"tags":["basic-error-controller"],"summary":"errorHtml","operationId":"errorHtmlUsingPOST","consumes":["application/json"],"produces":["text/html"],"responses":{"200":{"description":"OK","schema":{$ref:"#/definitions/ModelAndView"}}, "201":{"description":"Created"}, "401":{"description":"Unauthorized"}, "403":{}}}}}}
```

**Figure 2-8.** Swagger JSON output

## Swagger UI

You want human-readable structured documentation. Swagger UI is a built-in solution that makes user interaction with the Swagger-generated API documentation much easier. In your browser, go to `http://localhost:8080/swagger-ui/`.

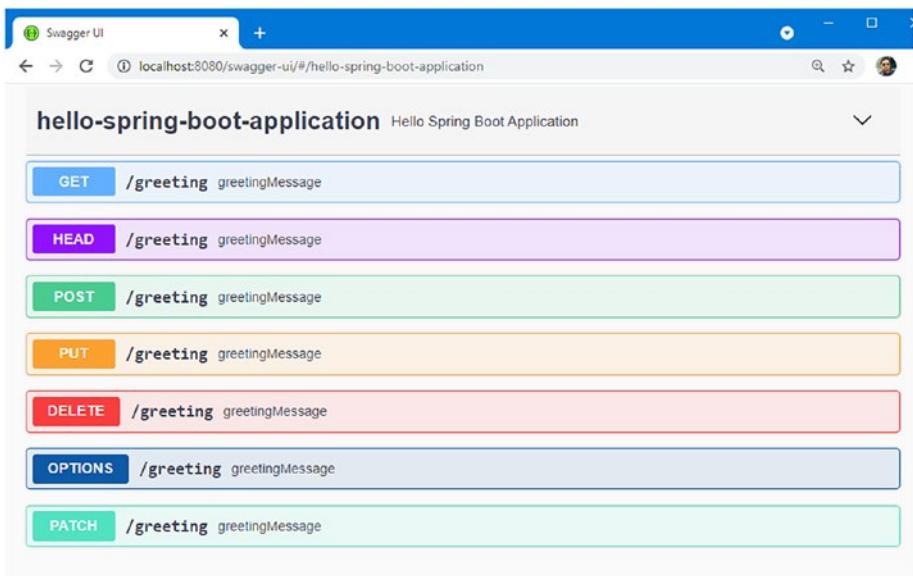
You see the generated documentation rendered by Swagger UI, as shown in Figure 2-9.



**Figure 2-9.** The Swagger API documentation page

The Basic Error Controller is the API that comes with Spring MVC. Models show all the Model objects.

Within Swagger's response is a list of all controllers defined in our application. Clicking any of them lists the operation endpoints with valid HTTP methods (DELETE, GET, HEAD, OPTIONS, PATCH, POST, PUT), as shown in Figure 2-10.



**Figure 2-10.** Swagger UI lists REST endpoints

For more information on Swagger, refer to the official documentation page at <https://swagger.io/docs/specification/2-0/basic-structure/>.

## Configure the Server Port for a Spring Boot Project

The default Port with which the Spring Boot application has been configured is 8080, which means a Spring Boot application starts with an embedded Tomcat server at a default port 8080. You can change this default embedded server port to any other port.

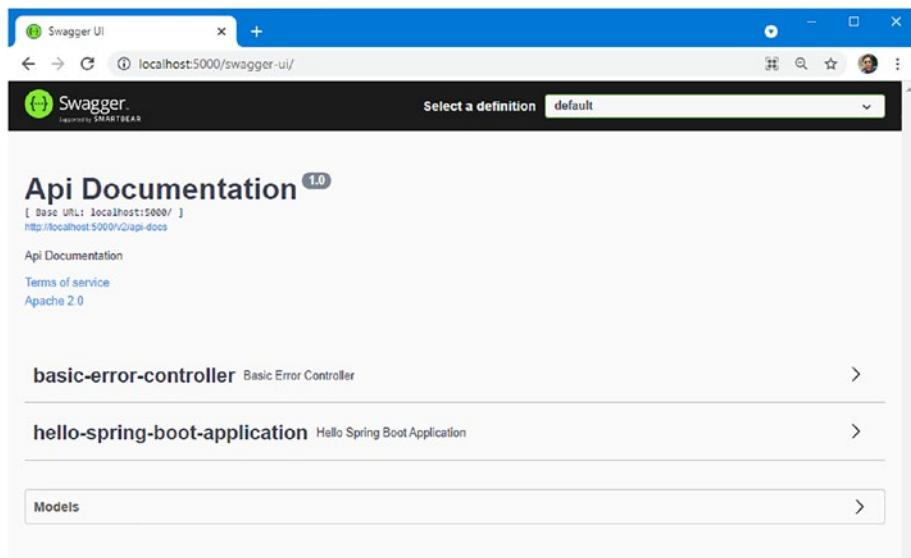
AWS Elastic Beanstalk assumes that the Spring Boot application listens on port 5000. You can change the default port by simply making an entry in the `application.properties` file in your Spring Boot application, as shown in Listing 2-5.

***Listing 2-5.*** \src\main\resources\application.properties

```
server.port=5000
```

Let's build and run our Spring Boot application in another port and then open the browser to access our application. This time, you are not using default port 8080 in the browser; rather, port 5000. In your browser, go to `http://localhost:5000/swagger-ui/`.

Figure 2-11 shows the generated documentation rendered by Swagger UI.



***Figure 2-11.*** URI with port 5000

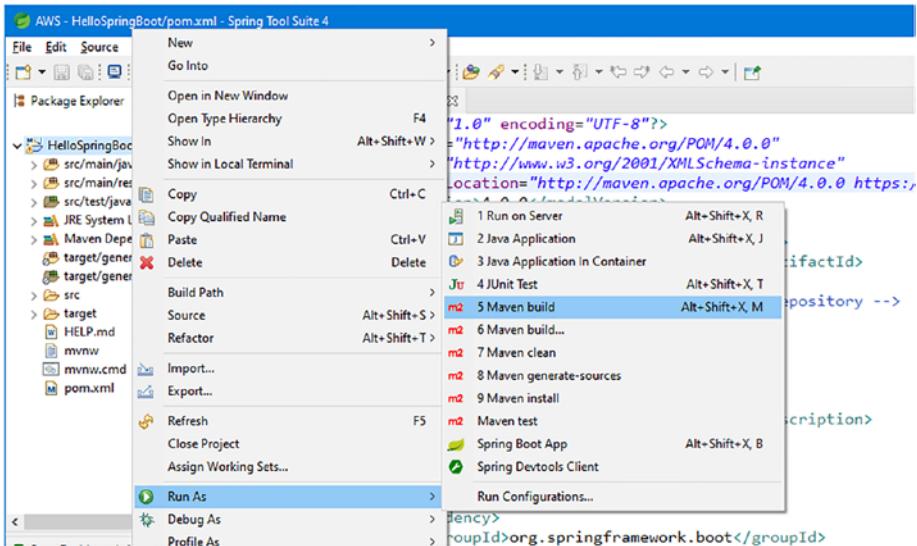
# Build a JAR for a Spring Boot Application

Since you have successfully created a Spring Boot application as a REST API, let's deploy it to AWS Elastic Beanstalk. To achieve this goal, you need a deployable unit of our project.

Before starting the actual process, make sure that you have Apache Maven (a command-line tool for building and managing any Java-based project) installed in your local system. If you do not already have Maven installed, you can follow the instructions at [maven.apache.org](http://maven.apache.org).

A Spring Boot application's default mode packages executable JARs (also known as *fat JARs*). So, a JAR is used as a deployable unit for this project. To build a JAR, you can either use STS or the command prompt.

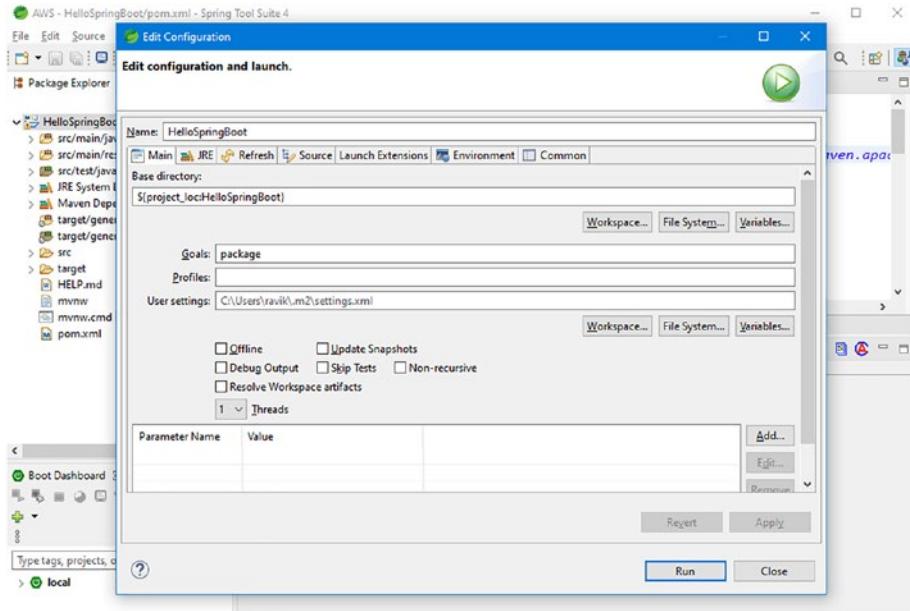
From STS, right-click the HelloSpringBoot project, and then select **Run As > Maven build**, as shown in Figure 2-12.



**Figure 2-12.** Maven build using STS

## CHAPTER 2 DEPLOY A SPRING BOOT APPLICATION AS A REST API IN AWS

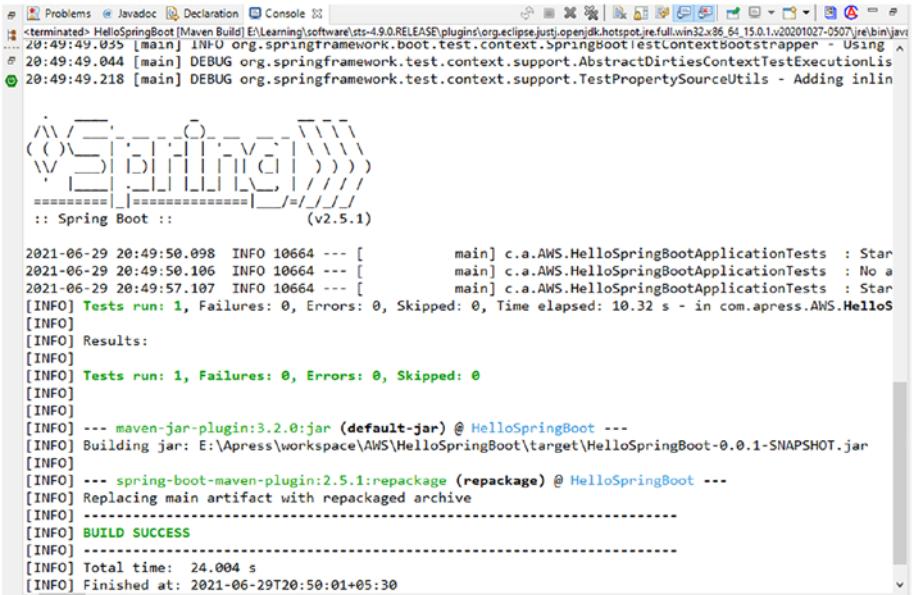
This opens the Edit Configuration window. Enter **package** in the Goals text box. Click Apply, and then click Run, as shown in Figure 2-13.



**Figure 2-13.** Edit configuration window

The HelloSpringBoot application starts building. You see that the entire Maven build runs, as shown in Figure 2-14.

## CHAPTER 2 DEPLOY A SPRING BOOT APPLICATION AS A REST API IN AWS



```


 HelloSpringBoot [ Maven Build ] E:\Learning\software\sts-4.9.0.RELEASE\plugins\org.eclipse.jdt\openjdk.hotspot.jre.full.win32.v86_64_15.0.1.v20201027-0507\jre\bin\java
20:49:49.035 [main] INFO org.springframework.boot.test.context.SpringBootTestTestContextBootstrapper - Using ^
20:49:49.044 [main] DEBUG org.springframework.test.context.support.AbstractDirtiesContextTestExecutionList
20:49:49.218 [main] DEBUG org.springframework.test.context.support.TestPropertySourceUtils - Adding inlin

```
  \ \ / \
  ( ) ( ) . - - . - - / \ \ \
  \| \| | | | | | | | | | | | | | |
    ' | | | | | | | | | | | |
=====|_|=====|_|=====|_|=====|_|=====|_
:: Spring Boot ::                    (v2.5.1)

2021-06-29 20:49:50.098 INFO 10664 --- [           main] c.a.AWS.HelloSpringBootApplicationTests : Star
2021-06-29 20:49:50.106 INFO 10664 --- [           main] c.a.AWS.HelloSpringBootApplicationTests : No a
2021-06-29 20:49:57.107 INFO 10664 --- [           main] c.a.AWS.HelloSpringBootApplicationTests : Star
[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 10.32 s - in com.apress.AWS.HelloS
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO]
[INFO] --- maven-jar-plugin:3.2.0:jar (default-jar) @ HelloSpringBoot ---
[INFO] Building jar: E:\Apress\workspace\AWS\HelloSpringBoot\target\HelloSpringBoot-0.0.1-SNAPSHOT.jar
[INFO]
[INFO] --- spring-boot-maven-plugin:2.5.1:repackage (repackage) @ HelloSpringBoot ---
[INFO]Replacing main artifact with repackaged archive
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 24.004 s
[INFO] Finished at: 2021-06-29T20:50:01+05:30


```

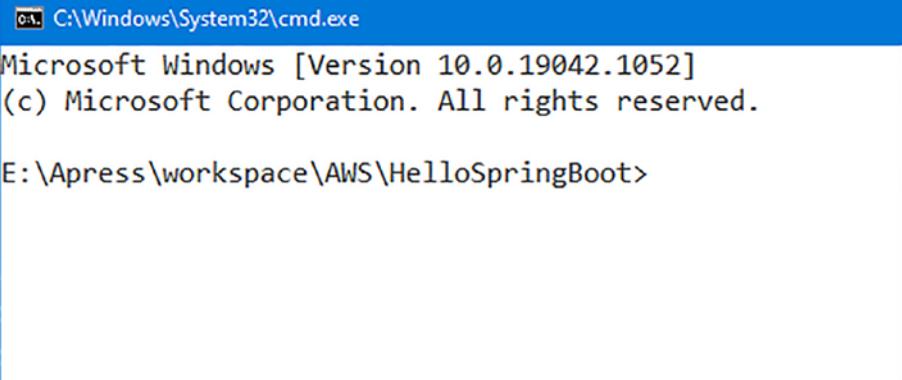
**Figure 2-14.** Build output on console in STS

A JAR named HelloSpringBoot-0.0.1-SNAPSHOT.jar has been created in the project's target folder.

Building jar: E:\Apress\workspace\AWS\HelloSpringBoot\target\HelloSpringBoot-0.0.1-SNAPSHOT.jar

To build a JAR using the command prompt, go to your project directory (where you have created the Spring Boot project) and copy the path.

Change the working directory to the project path on the command prompt, as shown in Figure 2-15.



```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.19042.1052]
(c) Microsoft Corporation. All rights reserved.

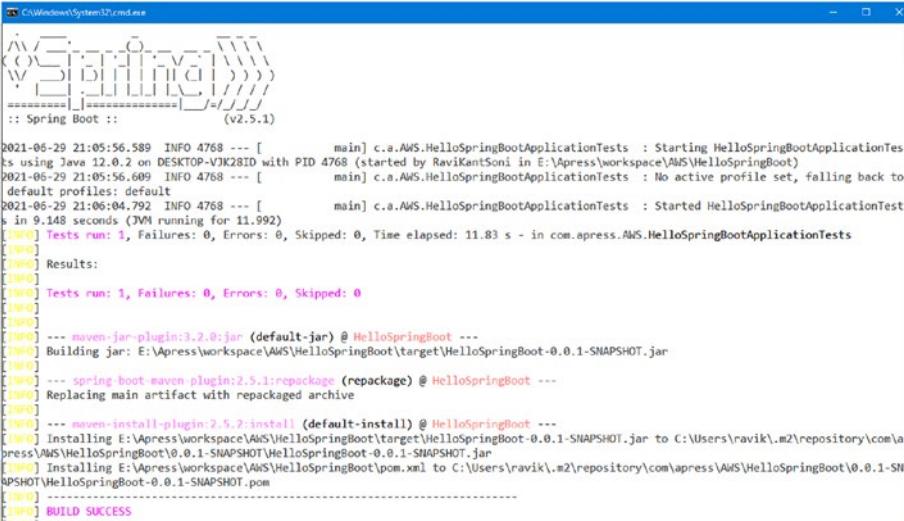
E:\Apress\workspace\AWS\HelloSpringBoot>
```

**Figure 2-15.** Directory to the project path on the command prompt

Build the project using the following command in the command prompt.

```
E:\Apress\workspace\AWS\HelloSpringBoot>mvn clean install
```

This starts building the application. The JAR file named `HelloSpringBoot-0.0.1-SNAPSHOT.jar` has been created, as shown in Figure 2-16.



```

C:\Windows\System32\cmd.exe
:: Spring Boot :: (v2.5.1)

2021-06-29 21:05:56.589 INFO 4768 --- [           main] c.a.AWS.HelloSpringBootApplicationTests : Starting HelloSpringBootApplicationTests using Java 12.0.2 on DESKTOP-VNK28ID with PID 4768 (started by RaviKantSoni in E:\Apress\workspace\AWS\HelloSpringBoot)
2021-06-29 21:05:56.609 INFO 4768 --- [           main] c.a.AWS.HelloSpringBootApplicationTests : No active profile set, falling back to default profiles: default
2021-06-29 21:06:04.792 INFO 4768 --- [           main] c.a.AWS.HelloSpringBootApplicationTests : Started HelloSpringBootApplicationTests in 9.148 seconds. (JVM running for 11.992)
[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 11.83 s - in com.apress.AWS.HelloSpringBootApplicationTests
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO] --- maven-jar-plugin:3.2.0:jar (default-jar) @ HelloSpringBoot ---
[INFO] Building jar: E:\Apress\workspace\AWS\HelloSpringBoot\target\HelloSpringBoot-0.0.1-SNAPSHOT.jar
[INFO]
[INFO] --- spring-boot-maven-plugin:2.5.1:repackage (repackage) @ HelloSpringBoot ---
[INFO] Replacing main artifact with repackaged archive
[INFO]
[INFO] --- maven-install-plugin:2.5.2:install (default-install) @ HelloSpringBoot ---
[INFO] Installing E:\Apress\workspace\AWS\HelloSpringBoot\target\HelloSpringBoot-0.0.1-SNAPSHOT.jar to C:\Users\ravik\.m2\repository\com\apress\AWS\HelloSpringBoot\0.0.1-SNAPSHOT>HelloSpringBoot-0.0.1-SNAPSHOT.jar
[INFO] Installing E:\Apress\workspace\AWS\HelloSpringBoot\pom.xml to C:\Users\ravik\.m2\repository\com\apress\AWS\HelloSpringBoot\0.0.1-SNAPSHOT>HelloSpringBoot-0.0.1-SNAPSHOT.pom
[INFO]
[INFO] BUILD SUCCESS
[INFO]

```

**Figure 2-16.** Build success in command prompt

You need to pick up and deploy the generated JAR file to AWS Elastic Beanstalk.

## Deploy a Spring Boot Application in AWS Elastic Beanstalk

You have locally created and run the HelloSpringBoot REST API and created a JAR file in the target folder. Now, let's deploy to AWS Elastic Beanstalk.

Sign in to the AWS Management Console using AWS credentials, and select Elastic Beanstalk as the service. There are already two applications, named My First Elastic Beanstalk Application and helloworld, created in Chapter 1 (see Figure 2-17).

## CHAPTER 2 DEPLOY A SPRING BOOT APPLICATION AS A REST API IN AWS

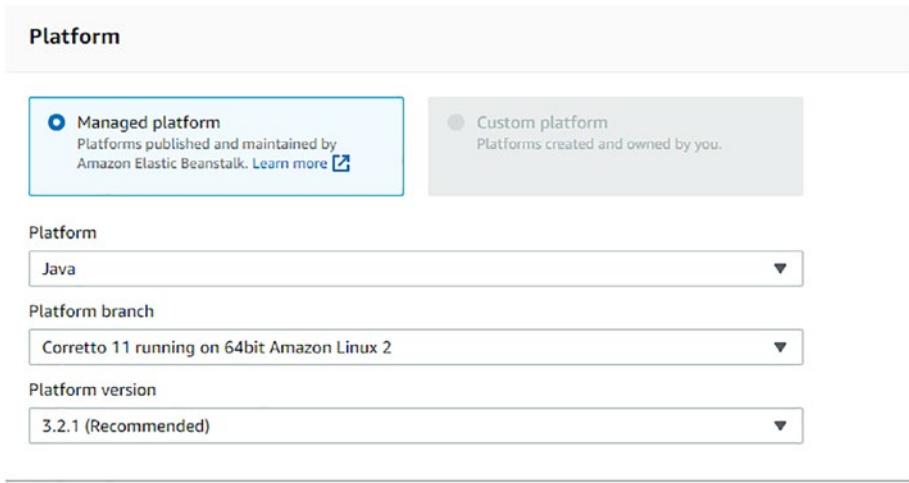
The screenshot shows the AWS Elastic Beanstalk Applications page. At the top, there's a navigation bar with 'Elastic Beanstalk > Applications'. Below it, a search bar says 'Filter results matching the display values'. The main area is titled 'All applications' and contains a table with the following data:

| Application name                       | Environments                           | Date created                    | Last modified                   | ARN                                                                                                |
|----------------------------------------|----------------------------------------|---------------------------------|---------------------------------|----------------------------------------------------------------------------------------------------|
| helloworld                             | Helloworld-env                         | 2021-06-29<br>22:59:57 UTC+0530 | 2021-06-29<br>22:59:57 UTC+0530 | arn:aws:elasticbeanstalk:us-east-2:818371255049:application/helloworld                             |
| My First Elastic Beanstalk Application | Myfirstelasticbeanstalkapplication-env | 2021-06-29<br>22:53:39 UTC+0530 | 2021-06-29<br>22:53:39 UTC+0530 | arn:aws:elasticbeanstalk:us-east-2:818371255049:application/My First Elastic Beanstalk Application |

**Figure 2-17.** Elastic Beanstalk application

Now let's create a brand-new application for our Spring Boot REST API. First, click the **Create a new application** button, and enter **HelloSpringBoot** the application name. Next, click the Create button to create a new environment for the application. Then, click the **Create one now** link. Select **Web server environment** as the environment tier, and then click the Select button.

On the environment information page, name the domain **HelloSpringBoot**, and check for availability. Then, select Java as the managed platform, as shown in Figure 2-18.

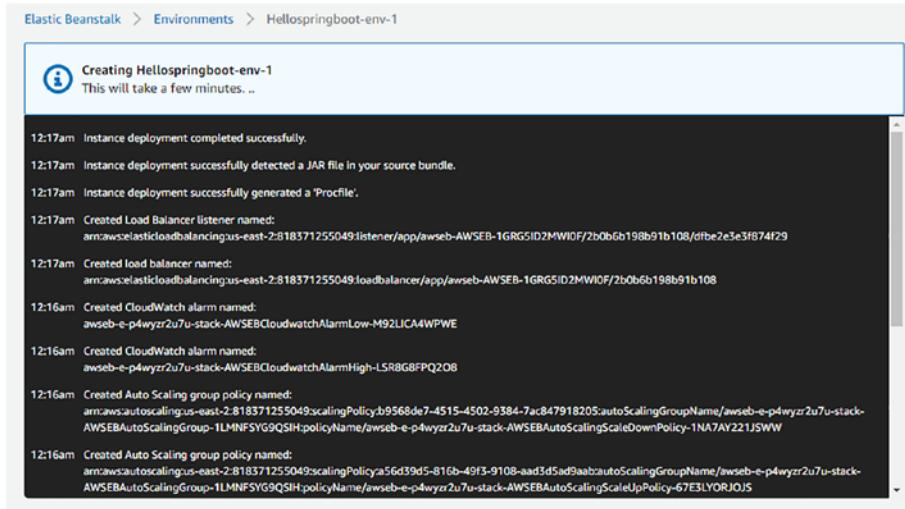


**Figure 2-18.** Platform as Java

Finally, upload your code by selecting the JAR file from the target folder (e.g., in the authors' local it is E:\Apress\workspace\AWS\HelloSpringBoot\target\HelloSpringBoot-0.0.1-SNAPSHOT.jar) of the project, and then click the **Create environment** button.

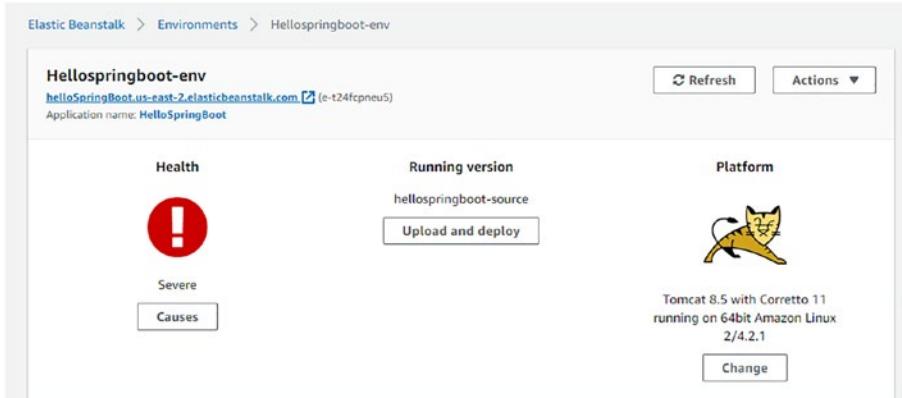
Elastic Beanstalk coordinates the creation and deployment of all AWS resources required to support the environment during the launch process. This includes, but is not limited to, launching two EC2 instances, creating a load balancer, and creating a security group, as shown in Figure 2-19.

## CHAPTER 2 DEPLOY A SPRING BOOT APPLICATION AS A REST API IN AWS



**Figure 2-19.** Creating HelloSpringboot-env in Elastic Beanstalk

Once the environment has been created and the resources have been deployed, notice that Health is reported as severe (see Figure 2-20). This is because the Spring Boot application still needs some configuration.

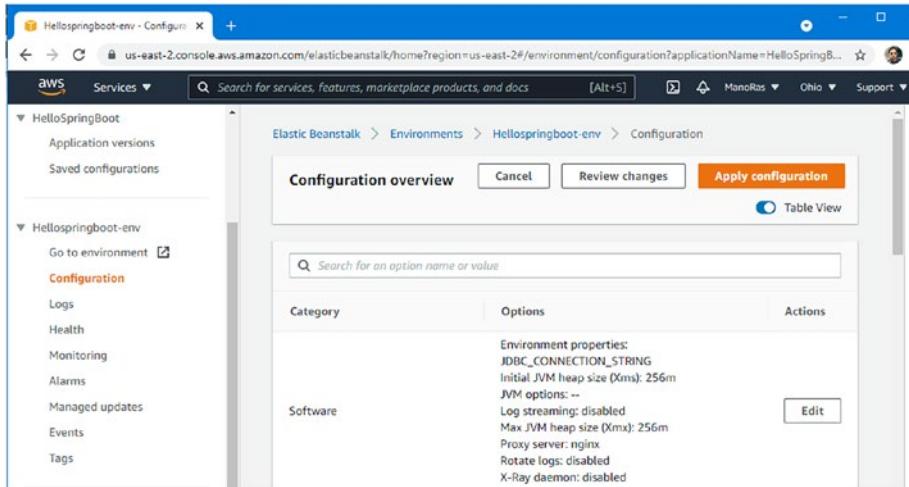


**Figure 2-20.** Severe health of Spring Boot application

## CHAPTER 2 DEPLOY A SPRING BOOT APPLICATION AS A REST API IN AWS

AWS Elastic Beanstalk assumes that the application listens on port 5000. To fix the discrepancy, change the port the Spring Boot application listens on. So, you need to specify the SERVER\_PORT environment variable in the Elastic Beanstalk environment and set the value to 5000.

Go to the Configuration page in your environment. Under Configuration, click the Edit icon, as shown in Figure 2-21.



**Figure 2-21.** Spring Boot application severe health

In the Environment properties, you see that there are already some environment variables set by Elastic Beanstalk when it is configured to use the Java platform.

To change the port that the Spring Boot application listens on, add a new environment variable, SERVER\_PORT, with a value of 5000, as shown in Figure 2-22.

## CHAPTER 2 DEPLOY A SPRING BOOT APPLICATION AS A REST API IN AWS

The screenshot shows the AWS Elastic Beanstalk environment properties configuration page. On the left, there's a sidebar with navigation links like 'Environments', 'Applications', 'Change history', 'HelloSpringBoot' (with 'Application versions' and 'Saved configurations'), 'Hellospringboot-env-1' (with 'Go to environment', 'Logs', 'Health', 'Monitoring', 'Alarms', and 'Managed updates'), and a 'Configuration' section. The main area is titled 'Environment properties' with a sub-instruction: 'The following properties are passed in the application as environment properties. Learn more'. It contains a table with five rows:

| Name        | Value                                       |
|-------------|---------------------------------------------|
| GRADLE_HOME | /usr/local/gradle                           |
| JAVA_HOME   | /usr/lib/jvm/java-11-amazon-corretto.x86_64 |
| M2          | /usr/local/apache-maven/bin                 |
| M2_HOME     | /usr/local/apache-maven                     |
| SERVER_PORT | 5000                                        |

At the bottom right are 'Cancel', 'Continue', and 'Apply' buttons.

**Figure 2-22.** Environment properties on software configuration

As soon as you click Apply, the configuration change propagates to the application servers. The application restarts. When it restarts, it picks up the new configuration through the environment variables. After a minute, you see a healthy application on the dashboard, as shown in Figure 2-23.

The screenshot shows the AWS Elastic Beanstalk environment health status for 'Hellospringboot-env-1'. The top bar shows the path 'Elastic Beanstalk > Environments > Hellospringboot-env-1'. The main card displays the following information:

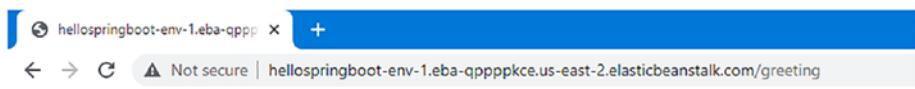
- Health:** Shows a green circle with a checkmark, labeled 'Ok' and 'Causes'.
- Running version:** 'hellospringboot-source-1' with a 'Upload and deploy' button.
- Platform:** 'Corretto 11 running on 64bit Amazon Linux 2/3.2.1' with a 'Change' button.

**Figure 2-23.** Health OK

# Test a Spring Boot Application as a REST API in the Cloud

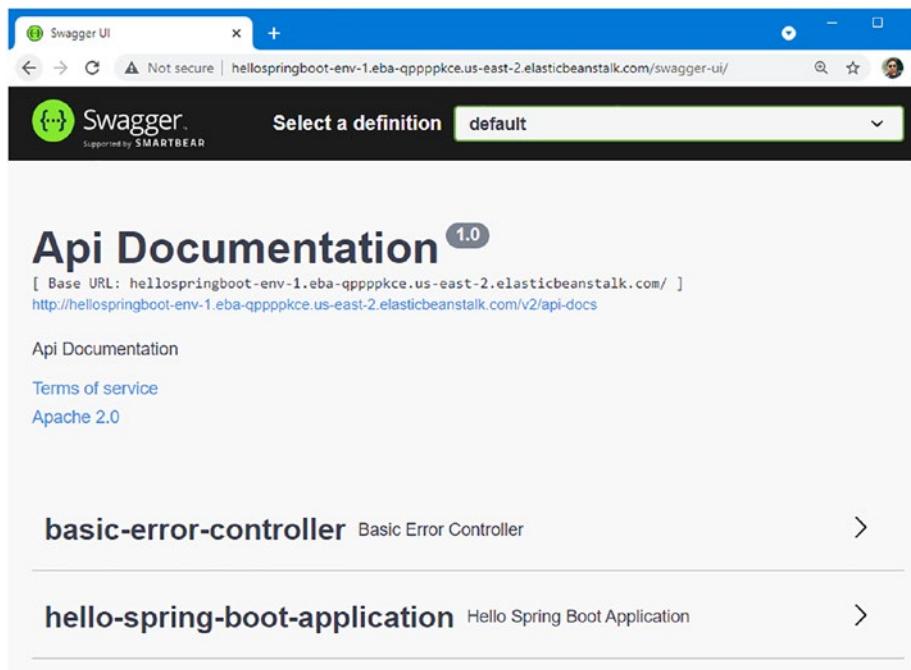
Now, let's test the deployed REST API endpoint in AWS. Use the URL you configured in the environment to access the service. For this example, the specified URL is <http://hellospringboot-env-1.eba-qpppkce.us-east-2.elasticbeanstalk.com>.

For the first test, from the browser, use an HTTP GET on the greeting URI at <http://hellospringboot-env-1.eba-qpppkce.us-east-2.elasticbeanstalk.com/greeting>. The service responds with a welcome greeting message, as shown in Figure 2-24.



**Figure 2-24.** Accessing REST API deployed on the cloud from browser

Next, access the Swagger UI dashboard at <http://hellospringboot-env-1.eba-qpppkce.us-east-2.elasticbeanstalk.com/swagger-ui/> from your browser, as shown in Figure 2-25.

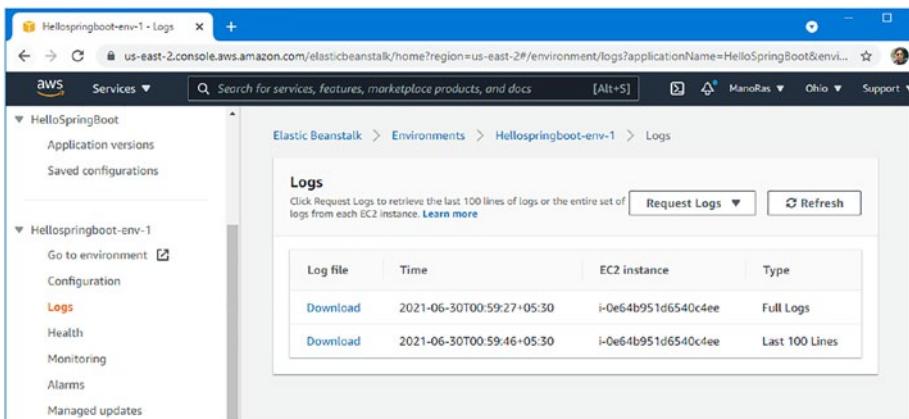


**Figure 2-25.** Accessing Swagger-UI dashboard from browser

## Explore Logs from Elastic Beanstalk

You can explore the Spring Boot logs from Elastic Beanstalk. Select **Logs > Request Logs** to retrieve the last 100 lines of a log or the entire set of logs from each EC2 instance, as shown in Figure 2-26.

## CHAPTER 2 DEPLOY A SPRING BOOT APPLICATION AS A REST API IN AWS



**Figure 2-26.** AWS Elastic Beanstalk logs

Once you click Download, you see that the entire Spring Boot log is visible.

## Summary

In this chapter, you deployed a REST API to Elastic Beanstalk. You created a Spring Boot project application as a REST API and then generated a JAR file for the project. You deployed this JAR to Elastic Beanstalk, resolved server issues in AWS. And finally, you accessed the deployed application in the cloud.

In the next chapter, you deploy a MySQL database in AWS with RDS.

## CHAPTER 3

# Deploy MySQL as a Database in AWS with RDS

In Chapter 2, you deployed the REST API to AWS Elastic Beanstalk. You created a Spring Boot application as REST API, and then you generated a JAR file of our project. You were able to deploy the JAR file to Elastic Beanstalk and resolved the server issue on AWS to make the application. And finally, you were able to access the application deployed on the AWS cloud.

Amazon RDS makes it easy to set up and operate a MySQL database and easy to scale MySQL deployment in the Amazon cloud. Self-managing a database offers a lot of challenges and takes upkeep. This chapter introduces Amazon Relational Database Service (RDS), and you learn how to deploy it.

If you look at the application architecture from Chapter 2, Elastic Beanstalk is where our Java-based Spring Boot application was deployed. Now let's use the Amazon RDS, which is a database in the cloud. MySQL runs on AWS. An instance of a MySQL database is created and configured in AWS. Tables are also created in the MySQL database.

## Introduction to Amazon RDS (Amazon Relational Database Service)

Data can be understood as a collection of the distinct unit of information that can be translated into a required form for efficient movement and processing. A database can be defined as an organized collection of structured data so that it can be easily accessed, managed, and updated. In simple words, a database is where the data is stored.

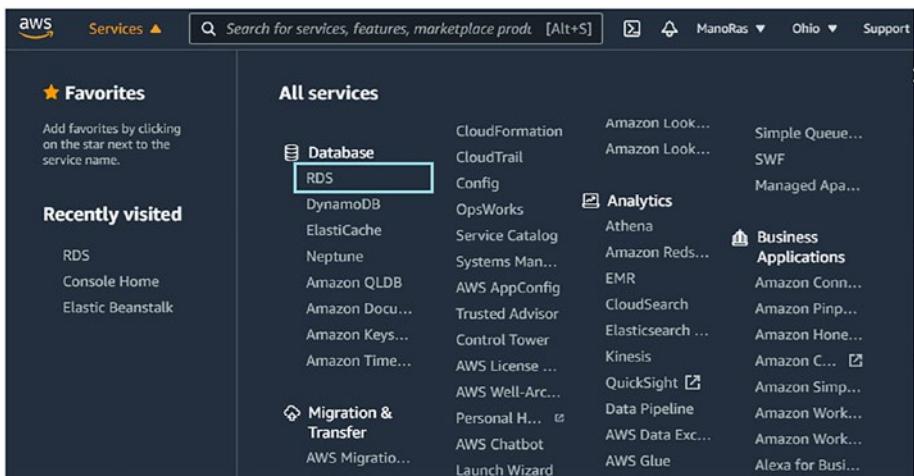
Amazon RDS is a web service that allows you to quickly deploy and scale a relational database on the Amazon cloud. Once you have deployed your database, you can manage it using a normal admin tool like MySQL Workbench, Oracle SQL Developer, or another admin tool. AWS also supports NoSQL databases like MongoDB.

For more information on Amazon RDS, refer to <https://docs.aws.amazon.com/AmazonRDS/latest/UserGuide>Welcome.html>.

## Create an Instance of the RDS Database in AWS

Let's begin configuring the RDS MySQL environment by signing up on AWS Management Console. Select RDS under the Database section in All Services, as shown in Figure 3-1.

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS



**Figure 3-1.** RDS under Database section in All Services

You are redirected to the Amazon RDS dashboard page, as shown in Figure 3-2. This page gives information about the resources you are using. Let's create an instance of Amazon Relational Database by clicking the **Create database** button.

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS

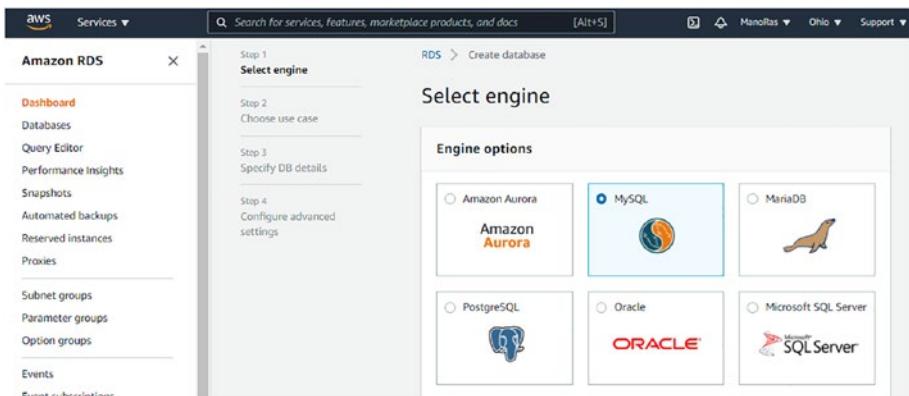
The screenshot shows the Amazon RDS dashboard. On the left sidebar, there's a navigation menu with links like Dashboard, Databases, Query Editor, Performance Insights, Snapshots, Automated backups, Reserved instances, Proxies, Subnet groups, Parameter groups, Option groups, Events, Event subscriptions, Recommendations, and Certificate update. The main content area is titled 'Resources' and displays usage statistics for various Amazon RDS resources in the US East (Ohio) region. It includes sections for DB Instances (0/40), DB Clusters (0/40), Reserved instances (0/40), Snapshots (0), Recent events (0), and Event subscriptions (0/20). To the right of these are links for Parameter groups (0), Option groups (0), Subnet groups (0/50), and Supported platforms VPC (Default network vpc-b8fa74d3). Below this is a 'Create database' section with a note about setting up a relational database in the cloud, a 'Restore from S3' button, and a prominent orange 'Create database' button. A note at the bottom states: 'Note: your DB instances will launch in the US East (Ohio) region'.

**Figure 3-2.** Amazon RDS dashboard

A new page opens, where you can define the database creation method and other options. Let's start creating a database.

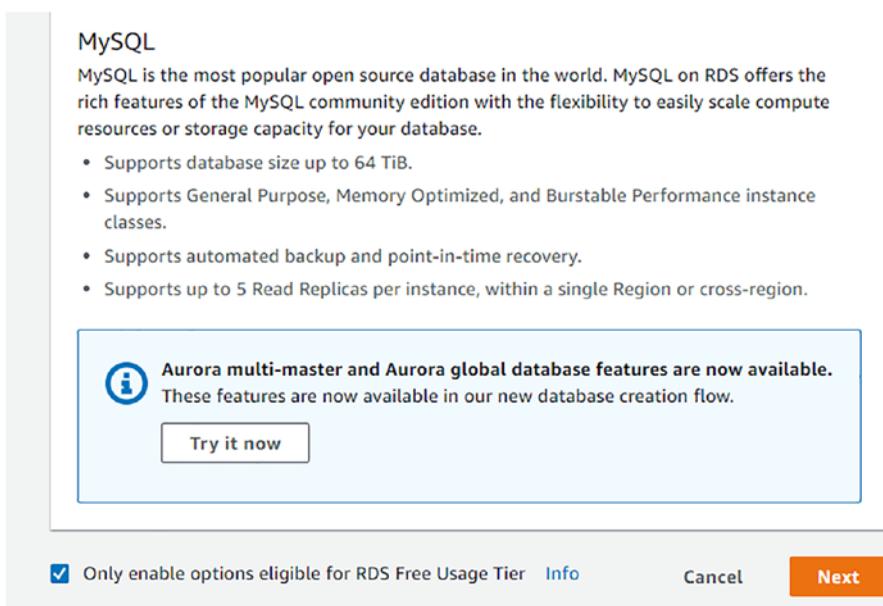
First, select the database engine from the **Engine options**, as shown in Figure 3-3. There are a lot of options available, but let's use the MySQL database engine. MySQL is a widely-used open source relational database management system. MySQL is mostly used for web databases.

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS



**Figure 3-3.** Engine options to select

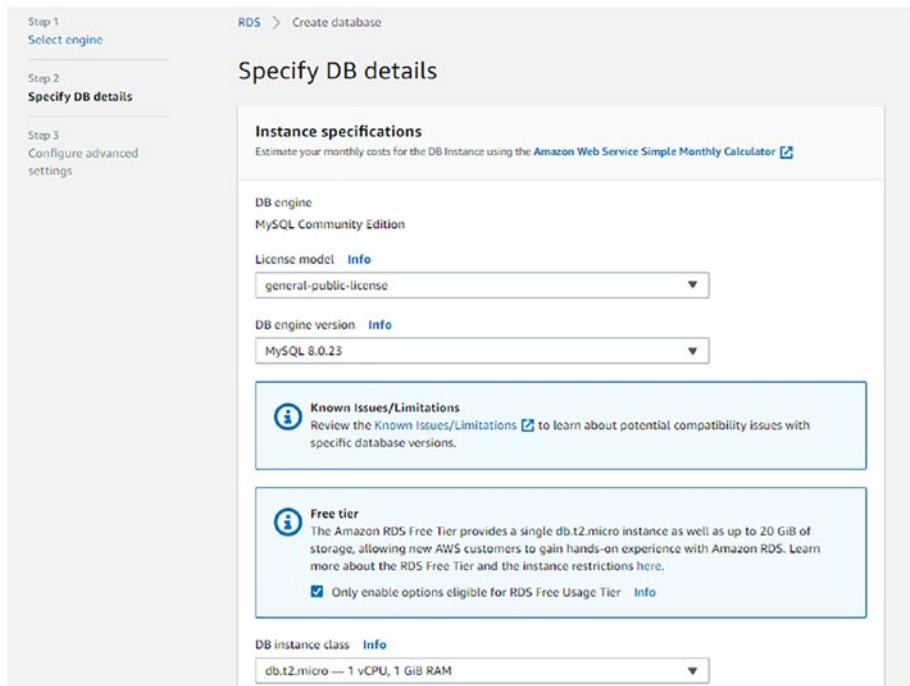
As shown in Figure 3-4, click the check box to only enable options for the RDS Free Usage Tier, which allows you to use a database for free in the AWS cloud. And then click the Next button.



**Figure 3-4.** RDS Free Usage Tier

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS

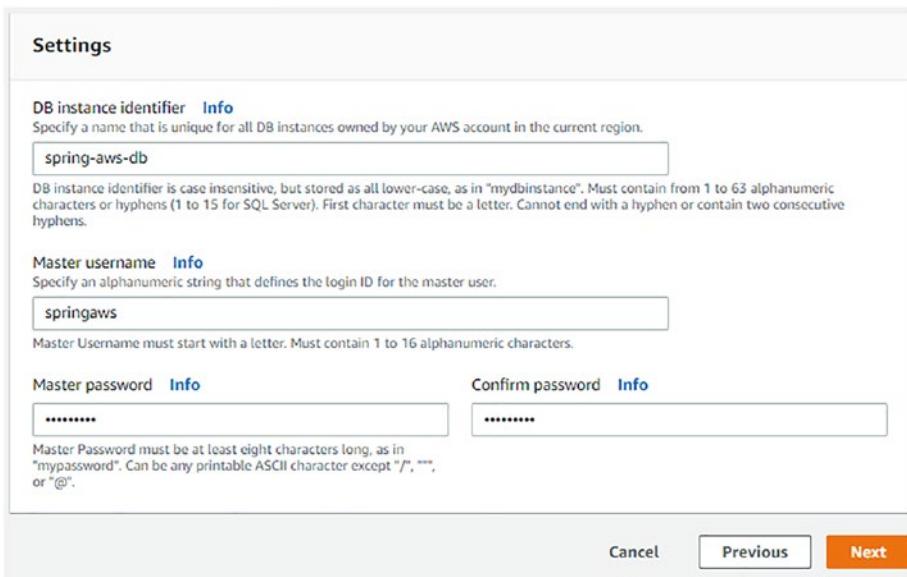
Next, specify the database details, as shown in following Figure 3-5.



**Figure 3-5.** *Specify DB details*

Keep the defaults for the license model and DB engine version. Check the box to only enable the option for the RDS free tier. In the DB instance class, keep the default selected value, db.t2.micro, for the free tier.

The database instance identifier is a unique name that you create to find or reference a database instance. Next, provide a suitable name for the database; let's use `spring-aws-db`, as shown in Figure 3-6.

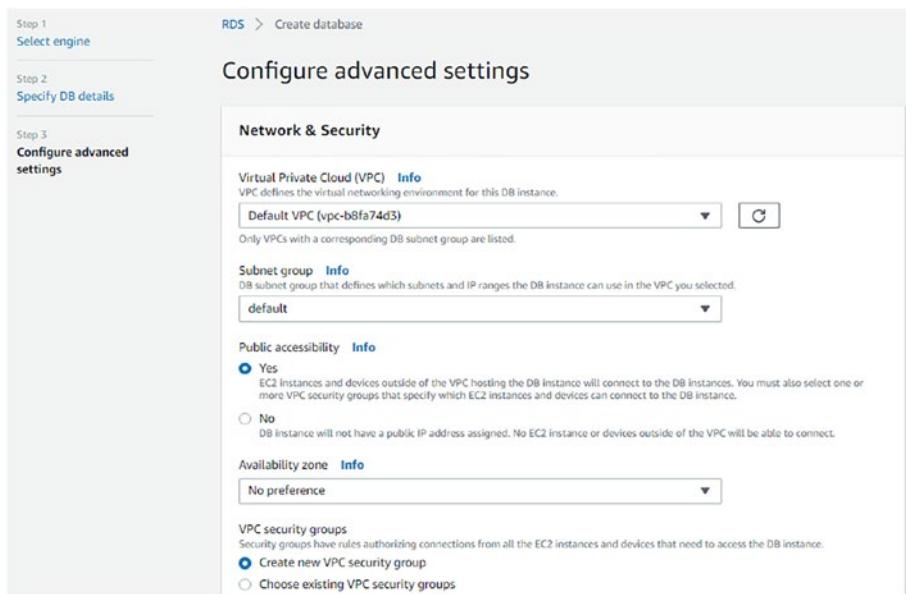


**Figure 3-6.** Setting database details

Similarly, provide the master username and password. We used `springaws` for both to keep things simple, but you can use any value you want. You can connect to the MySQL instance using this username and password later, so keep these credentials safe. And then click the Next button.

Finally, you need to configure some advanced settings that are essential to setting up an RDS MySQL environment, as shown in Figure 3-7.

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS



**Figure 3-7.** Configure advanced settings

Keep all the defaults in the Network & Security section. Make sure the public accessibility of the DB instance is Yes. This allows the database instance to be available on the Internet and connect with other hosts.

Next, the database options include the name, port, and so on, as shown in Figure 3-8. Keep all the defaults as they are. The port number is 3306, which is the default port. Other options are also available.

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS

**Database options**

Database name [Info](#)

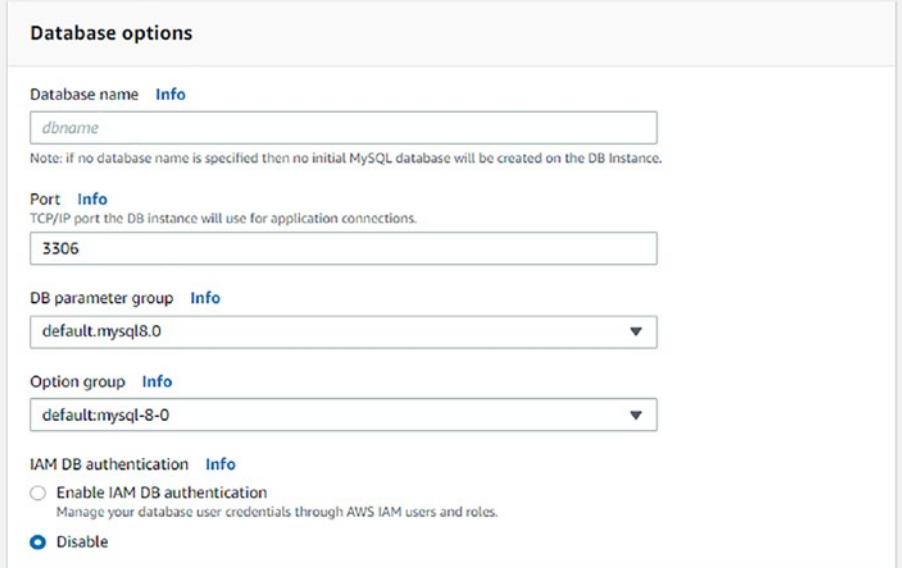
Note: if no database name is specified then no initial MySQL database will be created on the DB Instance.

Port [Info](#)  
TCP/IP port the DB instance will use for application connections.

DB parameter group [Info](#)

Option group [Info](#)

IAM DB authentication [Info](#)  
 Enable IAM DB authentication  
Manage your database user credentials through AWS IAM users and roles.  
 Disable



**Figure 3-8.** Database options

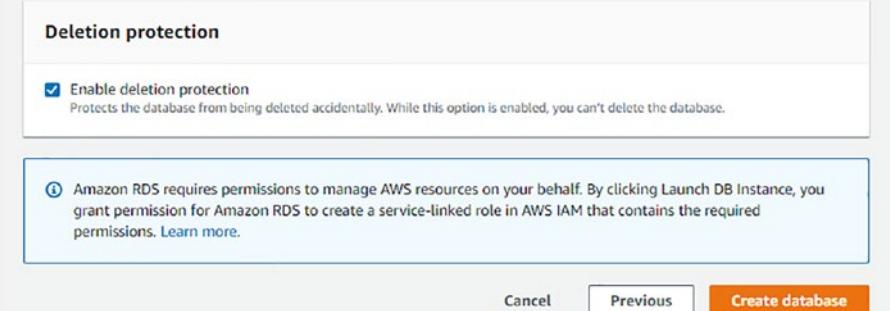
Click the **Create database** button to launch the Amazon RDS database instance, as shown in Figure 3-9.

**Deletion protection**

Enable deletion protection  
Protects the database from being deleted accidentally. While this option is enabled, you can't delete the database.

**Amazon RDS requires permissions to manage AWS resources on your behalf. By clicking Launch DB Instance, you grant permission for Amazon RDS to create a service-linked role in AWS IAM that contains the required permissions. [Learn more.](#)**

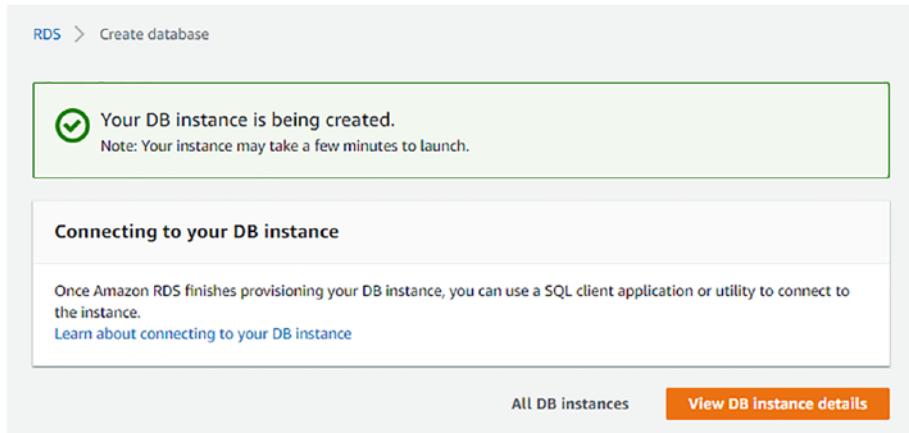
[Cancel](#) [Previous](#) [Create database](#)



**Figure 3-9.** Launch the Amazon RDS database instance

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS

You see that your database instance is being created, as shown in Figure 3-10.



**Figure 3-10.** Amazon RDS DB instance creation status

Your DB instance normally takes a few minutes to launch.

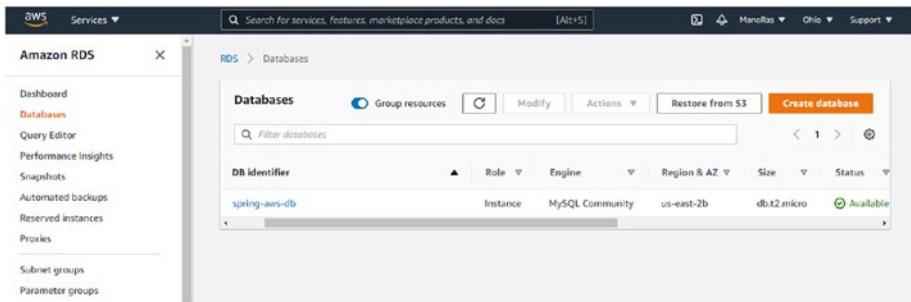
## Configure Amazon RDS

The current status shows that you have a database instance available in the AWS cloud, which you created as an instance of the RDS database server. Unfortunately, this database instance is empty because there's no database schema, tables, or data available in the RDS database instance.

You need to do some configuration work for the relational database service, connect it to MySQL Workbench, and access it. As a development process, the first thing is to configure security for inbound connection rules. And, then you need to test the database connectivity with MySQL Workbench.

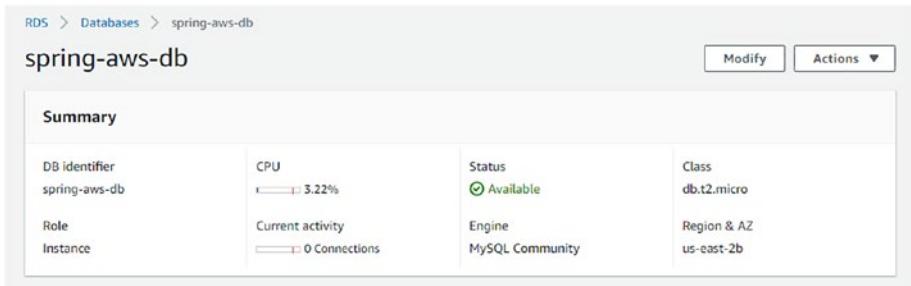
Before going ahead, let's check the Amazon RDS database instance status. Click **Databases** under Amazon RDS, as shown in Figure 3-11.

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS



**Figure 3-11.** Database instance status

Here, you can see that the database instance `spring-aws-db` is added to the list. Its status is available, which indicates that the database has been created and is available for use. Click the `spring-aws-db` link in the Databases table. Figure 3-12 shows the summary.



**Figure 3-12.** Amazon RDS database instance summary

Here, you can see the information on the `spring-aws-db` database instance. The class is `db.t2.micro`, the engine is MySQL Community, and the status is available.

## Step 1. Configure Security for Inbound Connection Rules

First, you need to configure the security group rules for the inbound connection rules. Scroll down to the **Security group rules** section, as shown in Figure 3-13.

| Security group rules (2)                 |                    |                 |
|------------------------------------------|--------------------|-----------------|
| Security group                           | Type               | Rule            |
| rds-launch-wizard (sg-082174a08066db6d8) | CIDR/IP - Inbound  | 59.99.65.121/32 |
| rds-launch-wizard (sg-082174a08066db6d8) | CIDR/IP - Outbound | 0.0.0.0/0       |

**Figure 3-13.** Security group rules

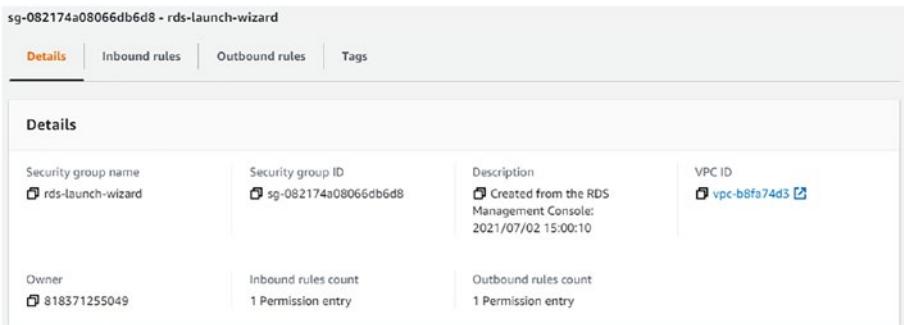
The inbound rule defines the traffic allowed on the server and who can connect to the database instance. Click rds-launch-wizard for CIDR/IP - Inbound, which redirects you to the Security Groups Info page, as shown in Figure 3-14.

| Security Groups (1/1) <a href="#">Info</a>                    |                      |                     |              |                        |  |
|---------------------------------------------------------------|----------------------|---------------------|--------------|------------------------|--|
| <a href="#">Actions</a> <a href="#">Create security group</a> |                      |                     |              |                        |  |
| <a href="#">Filter security groups</a>                        |                      |                     |              |                        |  |
| <a href="#">Clear filters</a>                                 |                      |                     |              |                        |  |
| Name                                                          | Security group ID    | Security group name | VPC ID       | Description            |  |
| rds-launch-wizard                                             | sg-082174a08066db6d8 | rds-launch-wizard   | vpc-b8fa74d3 | Created from the RDS . |  |

**Figure 3-14.** Security groups

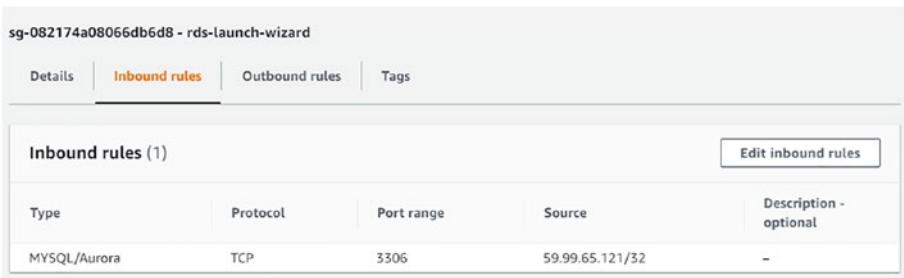
At the bottom of this page, you see tabs named Details, Inbound rules, Outbound rules, and Tags, as shown in Figure 3-15.

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS



**Figure 3-15.** rds-launch-wizard

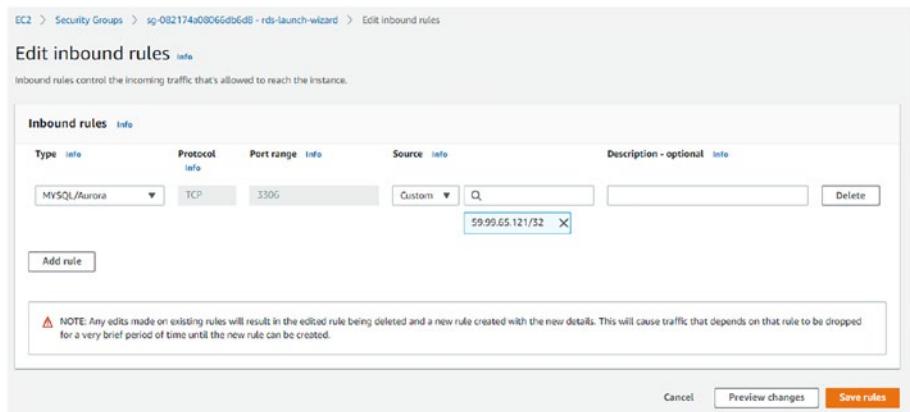
Click the **Inbound rules** tab, as shown in Figure 3-16.



**Figure 3-16.** Inbound rules

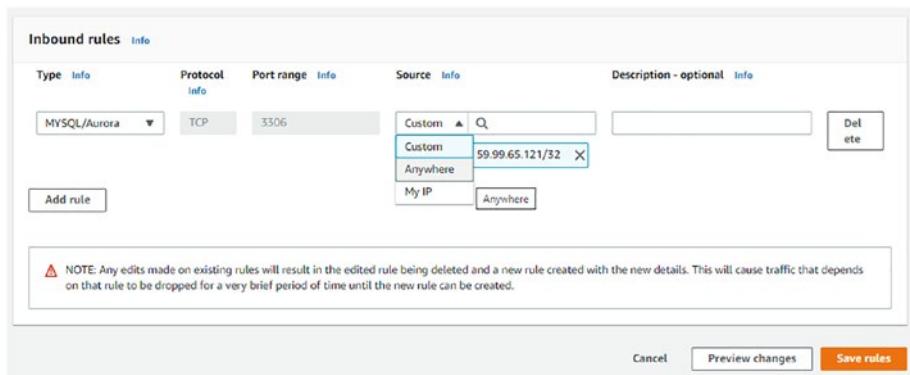
You see that the database is only accessible from the IP address 59.99.65.121/32. You need to make some modifications here. Click the **Edit inbound rules** button, which redirects to the **Edit inbound rules** page. Here you can edit the IP address that has access to the Amazon RDS MySQL database instance, as shown in Figure 3-17.

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS



**Figure 3-17.** Edit inbound rules

You can determine the traffic that can reach the database instance. From the Source drop-down list, select the Anywhere option, as shown in Figure 3-18.



**Figure 3-18.** Select Anywhere from Source drop-down list

Now, anyone can find the database instance or connect to it, but they still have to provide a correct user ID and password. The Anywhere source option is good for dev and testing, but it is recommended to only allow access from the Elastic Beanstalk app IP address for production.

Click the **Save rules** button. Now you can see that the inbound rule has been set up, as shown in Figure 3-19.

The screenshot shows the AWS RDS Launch Wizard interface for a security group named 'sg-082174a08066db6d8'. The 'Inbound rules' tab is selected. There are two entries in the table:

| Type         | Protocol | Port range | Source    | Description - optional |
|--------------|----------|------------|-----------|------------------------|
| MySQL/Aurora | TCP      | 3306       | 0.0.0.0/0 | -                      |
| MySQL/Aurora | TCP      | 3306       | ::/0      | -                      |

**Figure 3-19.** Updated source in Inbound rules

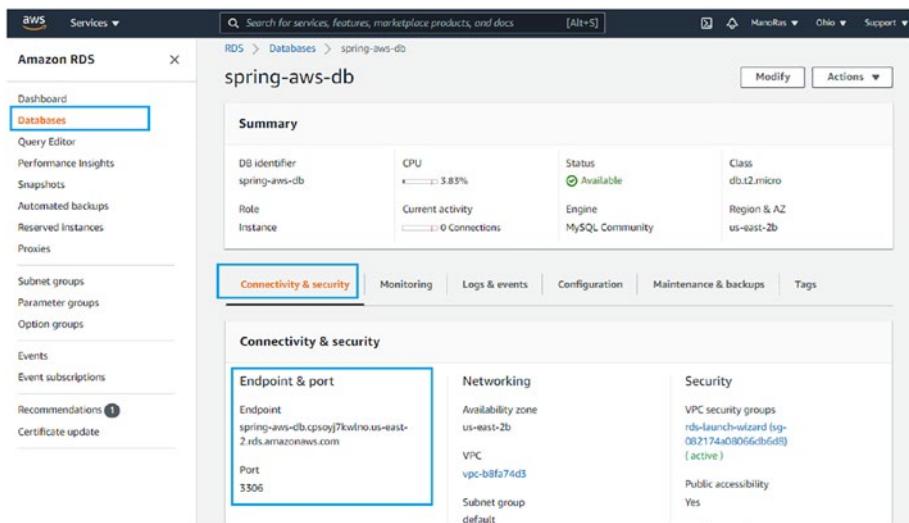
These updated Inbound rules allow connection from anywhere.

## Step 2. Test an Amazon RDS Database Instance Connection with MySQL Workbench

Once you have successfully created the Amazon RDS MySQL database instance and all the necessary configurations are done, the second step is to test the RDS database instance connection with MySQL Workbench.

Return to the previous page in the browser. In the Databases section, click the **Connectivity & security** tab, as shown in Figure 3-20.

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS



**Figure 3-20.** Updated source in Inbound rules

In the Connectivity & Security tab, there is a section called **Endpoint & port**. The endpoint indicates the hostname of the database instance, which you can use in MySQL Workbench to connect to the RDS database instance. In this case, it is

`spring-aws-db.cpsoyj7kwlno.us-east-2.rds.amazonaws.com`

---

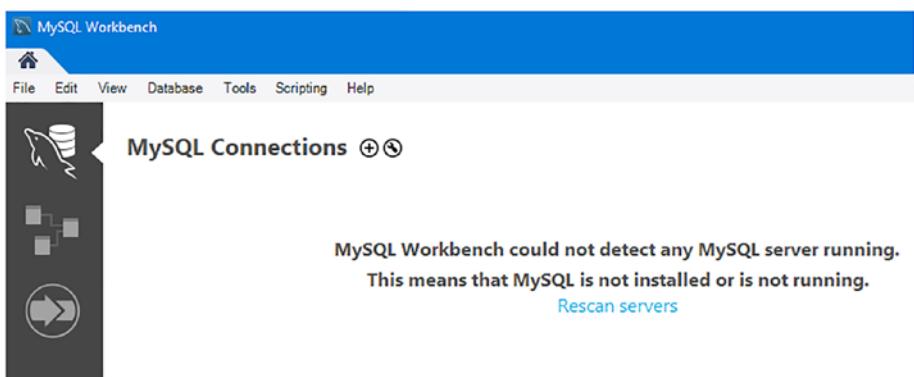
**Note** Refer to Appendix A for the MySQL Workbench installation guide.

---

## Connect MySQL Workbench to an Amazon RDS MySQL Database Instance

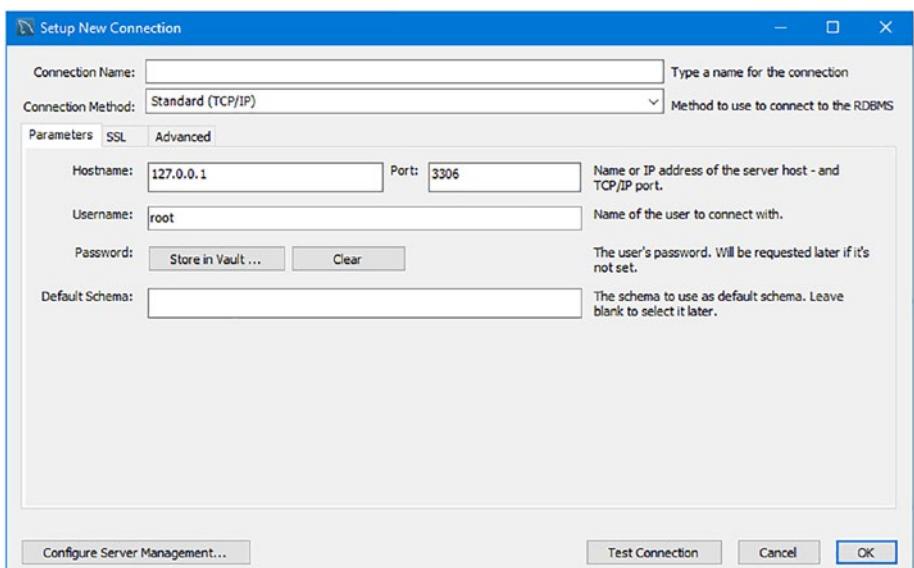
Open MySQL Workbench in your local system. Then, click the + icon to create a MySQL connection, as shown in Figure 3-21.

## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS



**Figure 3-21.** MySQL Workbench

This opens the Setup New Connection wizard, as shown in Figure 3-22.



**Figure 3-22.** Setup New Connection wizard

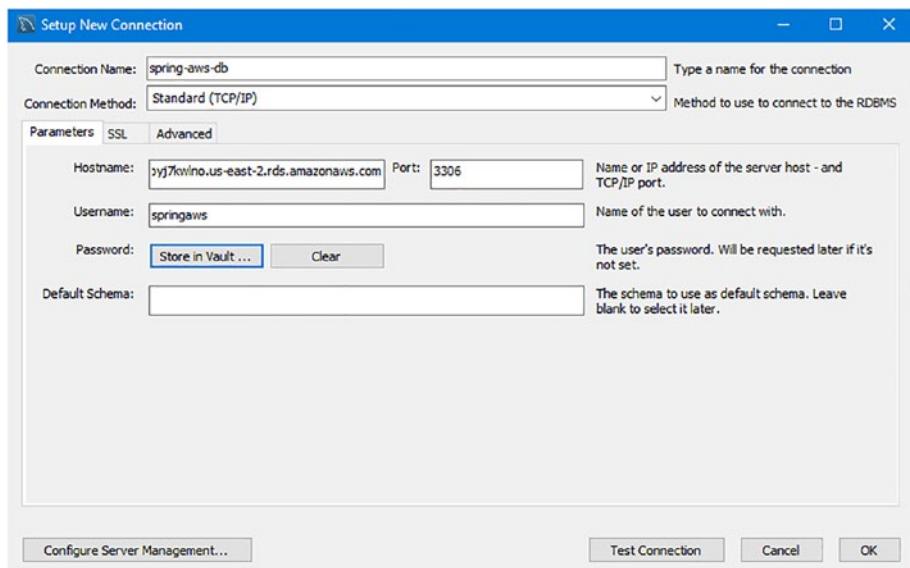
## CHAPTER 3 DEPLOY MYSQL AS A DATABASE IN AWS WITH RDS

For the connection name, enter the value as **spring-aws-db**. In the hostname field, the default value is 127.0.0.1, which is known as the localhost. Replace the default IP address with the following RDS database instance hostname from AWS Management Console.

`spring-aws-db.cpsoyj7kwlno.us-east-2.rds.amazonaws.com`

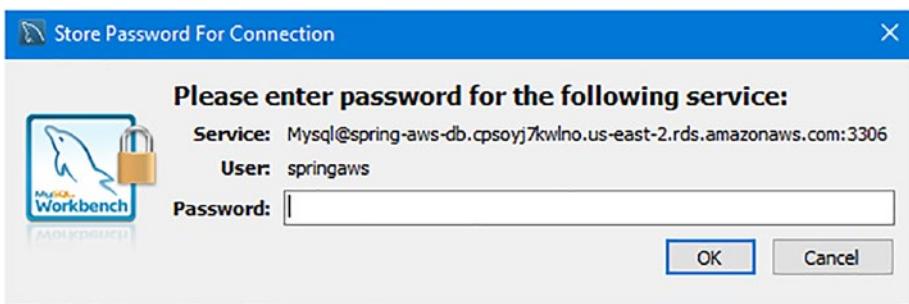
Leave the port number as it is because 3306 is the port for the database instance from the AWS console.

Use the same username and password that you created for the RDS database instance. So, enter **springaws** as the username, as shown in Figure 3-23. Click the **Store in Vault** button for password.



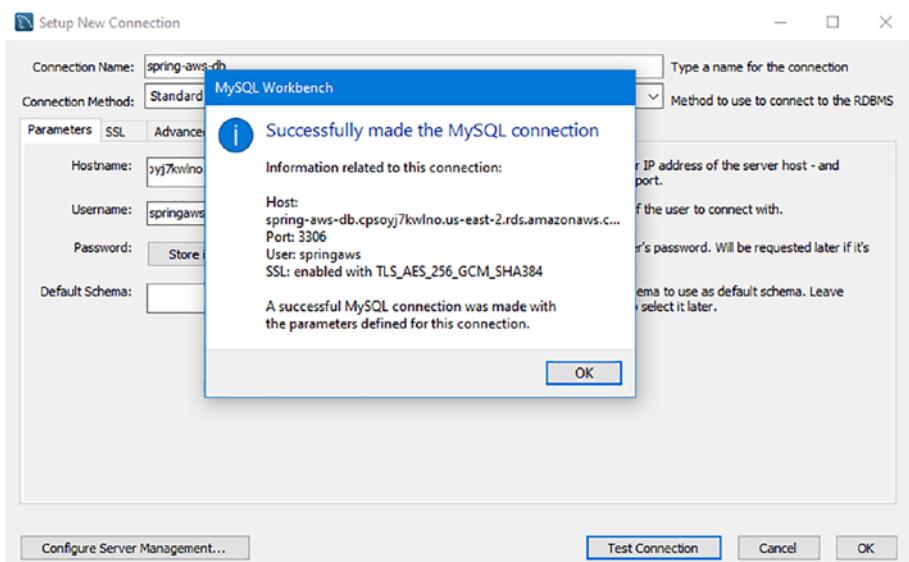
**Figure 3-23.** Updated value in Setup New Connection wizard

Enter **springaws**, and then click OK, as shown in Figure 3-24.



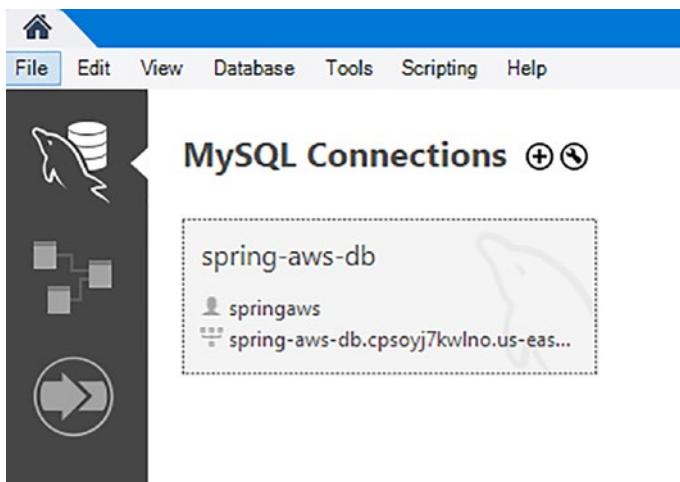
**Figure 3-24.** Store password for connection

Click the Test Connection button. You should receive a notification saying you have successfully made the MySQL connection, as shown in Figure 3-25.



**Figure 3-25.** Successfully made the MySQL connection

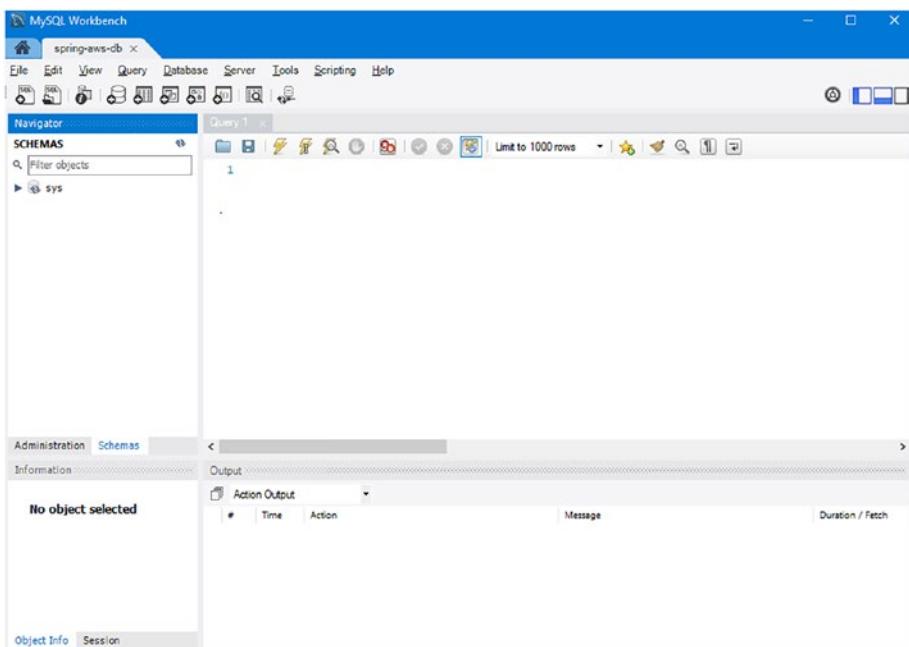
That's how you know that the database instance is available and running in the AWS cloud. You can use your local MySQL Workbench to connect to it. Click the OK button in the Connection wizard, which lets Workbench list the database connection details, as shown in Figure 3-26.



**Figure 3-26.** MySQL Workbench with Amazon RDS db connection details

## Create a Table Inside an RDS Database Instance

MySQL is set up correctly. You can access the remote RDS database instance by clicking `spring-aws-db`, which opens in the SQL editor, as shown in Figure 3-27.



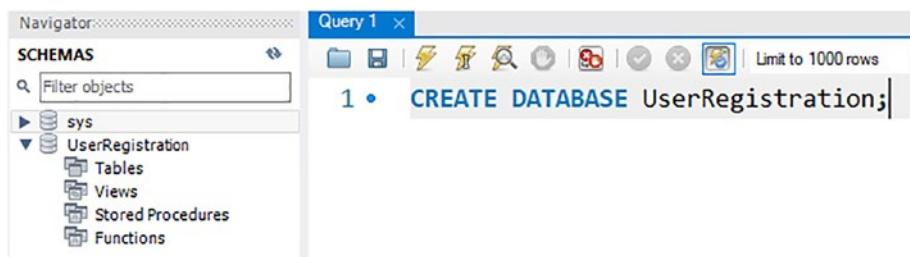
**Figure 3-27.** SQL editor instance for *spring-aws-db*

Currently, there is no database, table, or data available for our RDS database instance. You need to run some scripts to provide anything that you can query.

First, let's create a database using the `CREATE DATABASE` command. The syntax to create a new database is `CREATE DATABASE DB_NAME`, where `DB_NAME` is the database name that you want to create. For example, to create a database named `UserRegistration`, type the following query into the Query tab and run it.

```
CREATE DATABASE UserRegistration;
```

Once the query is executed successfully, the Schema tab should display the `UserRegistration` database, as shown in Figure 3-28.



**Figure 3-28.** Database created

Now, let's create a user table in the UserRegistration database. A table displays and stores the records in a structured format. The CREATE TABLE command creates a new table into the existing database. The syntax to create a MySQL table is shown in Listing 3-1.

#### **Listing 3-1.** Syntax to Create MySQL Table

```
CREATE TABLE [IF NOT EXISTS] table_name(  
    column_1 datatype(size) [NULL | NOT NULL],  
    column_2 datatype(size) [NULL | NOT NULL],  
    column_3 datatype(size) [NULL | NOT NULL],  
    .......,  
    column_N datatype(size) [NULL | NOT NULL],  
    table_constraints  
);
```

table\_name is the name of the table, which should always be unique in a MySQL database. The IF NOT EXISTS clause helps prevent errors when the same table name already exists in the database.

column\_ specifies the column name. datatype specifies the type of data for that column, and columns are separated using a comma operator.

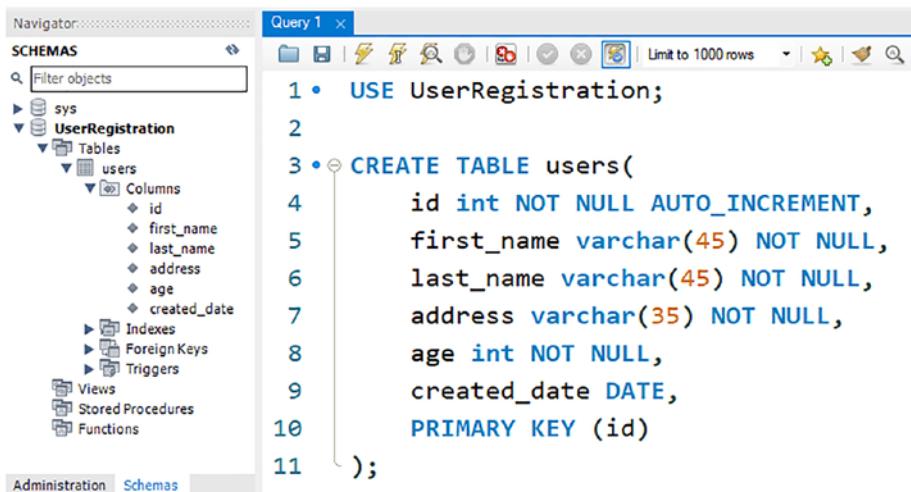
table\_constraints specifies the table's constraints, such as primary key, foreign key, and unique key. For example, to create a table called users, enter the query shown in Listing 3-2 in the Query tab and run it.

***Listing 3-2.*** Create Users Table in UserRegistration Database

```
use UserRegistration;

CREATE TABLE [IF NOT EXISTS] users(
    id int NOT NULL AUTO_INCREMENT,
    first_name varchar(45) NOT NULL,
    last_name varchar(45) NOT NULL,
    address varchar(35) NOT NULL,
    age int NOT NULL,
    created_date DATE,
    PRIMARY KEY (id)
);
```

Here, the use UserRegistration command selects the database under which the table is created. Once the query is executed successfully, the UserRegistration database should display the users table, as shown in Figure 3-29.



**Figure 3-29.** Table created

Now, let's insert some data into the users table. The `INSERT INTO` command adds or stores data in a table. The syntax to insert data into a table is shown in Listing 3-3.

***Listing 3-3.*** Syntax to Insert Data into the Table

```
INSERT INTO DATABASE.table_name (column_1, column_2,... column_N)
VALUES
( value_1, value_2,...value_N );
```

First, specify the database name followed by a dot (.), followed by the table name, and then a list of comma-separated columns. Next, provide the list of values corresponding to the column's name after the `VALUES` clause. For example, to insert data in the `users` table, type the query shown in Listing 3-4 in the Query tab, and then run it.

***Listing 3-4.*** Insert Data in `users` Table in `UserRegistration` Database

```
INSERT INTO UserRegistration.users (first_name, last_name,
address, age, created_date)
VALUES
('Ravi', 'Soni', 'Sasaram-Bihar-India', 34, '2021-07-04');
```

The default date format in MySQL is YYYY-MM-DD, where YYYY represents the year in four digits, MM represents the month in two digits, and DD represents the day in two digits.

Once the insert query is executed successfully, you can use the `SELECT` command to fetch data from the MySQL database. The data returned from the database is stored in a result table, called `result-set`. The `SELECT` command syntax to fetch data from a MySQL table is shown in Listing 3-5.

***Listing 3-5.*** Syntax of SELECT Command to Fetch Data from Database

```
SELECT column_1, column_2, ...
FROM
DATABASE.table_name;
```

For example, to fetch data from the users table, type the query shown in Listing 3-6 into the Query tab, and then run it.

***Listing 3-6.*** Fetch Data from UserRegistration Database

```
SELECT first_name, last_name, address, age, created_date
FROM
UserRegistration.users;
```

Once the SELECT query is executed successfully, the result appears as shown in Figure 3-30.



**Figure 3-30.** Table created

## Summary

This chapter introduced Amazon RDS. First, you created a MySQL database instance in AWS and configured the database. Then, you created a table in the database and inserted data into it using MySQL Workbench.

The next chapter overviews CRUD operations in a Spring Boot application, and you deploy Spring Boot application that talks to MySQL in AWS.

## CHAPTER 4

# Deploy a Spring Boot Application Talking to MySQL in AWS

Chapter 3 introduced Amazon RDS, and you learned how to deploy it on the Amazon cloud. You created an instance of an Amazon RDS MySQL database in AWS and configured the database. You also created tables in this database and inserted data into it using MySQL Workbench.

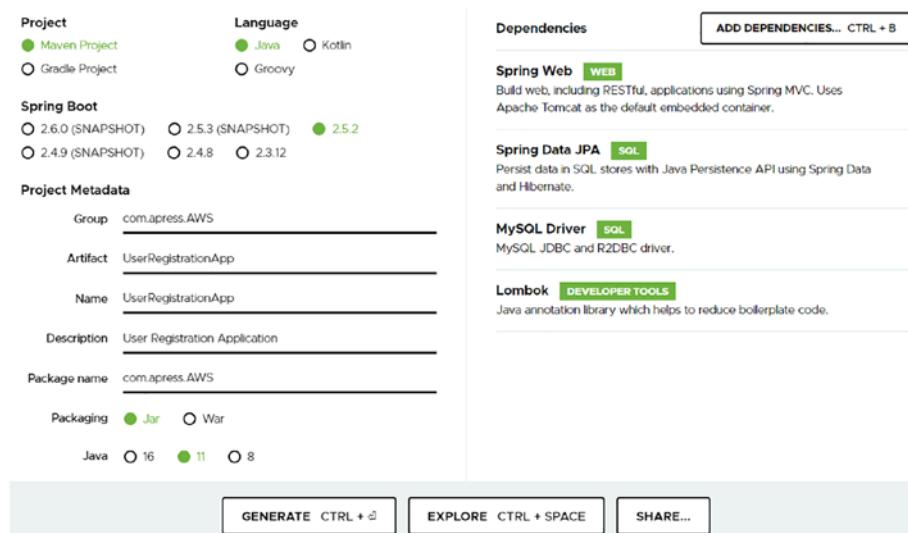
In Chapter 2, you created and deployed a Spring Boot REST API containing some endpoints to AWS Elastic Beanstalk. However, that's not how real applications run. The real application uses a real-time database to perform CRUD operations.

This chapter creates a Spring Boot application as a REST API talking to an Amazon RDS MySQL database from your local system.

## Create Spring Boot UserRegistrationApp Talking to MySQL Database

In this section, you create the UserRegistrationApp Spring Boot application using Spring Initializr (<http://start.spring.io/>). Here, you select Web, JPA, MySQL, and Lombok as dependencies, as shown in Figure 4-1.

## CHAPTER 4 DEPLOY A SPRING BOOT APPLICATION TALKING TO MYSQL IN AWS



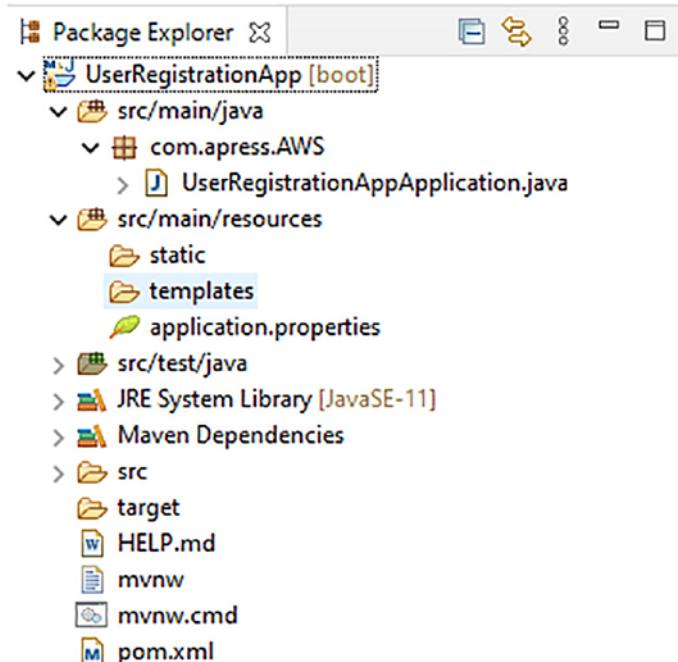
**Figure 4-1.** Creating UserRegistrationApp using Spring Initializr

Table 4-1 lists all the UserRegistrationApp settings.

**Table 4-1.** Project-Related Details

| Field        | Value                         |
|--------------|-------------------------------|
| Group        | com.apress.AWS                |
| Artifact     | UserRegistrationApp           |
| Name         | UserRegistrationApp           |
| Description  | User registration application |
| Package Name | com.apress.AWS                |
| Packaging    | JAR                           |
| Java Version | 11                            |
| Language     | Java                          |
| Project      | Maven                         |

After entering the project metadata, click the Generate button to download the `UserRegistrationApp.zip` file. Unzip it, and import it as a Maven project into the Spring Source Tool (STS) IDE. The initial project structure looks like what's shown in Figure 4-2.



**Figure 4-2.** Project structure

Let's walk through the code for more information and explore Maven dependencies defined in `pom.xml`.

## Maven Dependency in `pom.xml`

All the required dependencies you selected in Spring Initializr when creating the Spring Boot application are available in `pom.xml`, as shown in Listing 4-1. The `pom.xml` file is the recipe that builds the Spring Boot application.

***Listing 4-1.*** pom.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
  https://maven.apache.org/xsd/maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <parent>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-parent</artifactId>
    <version>2.5.2</version>
    <relativePath/>
  </parent>
  <groupId>com.apress.AWS</groupId>
  <artifactId>UserRegistrationApp</artifactId>
  <version>0.0.1-SNAPSHOT</version>
  <name>UserRegistrationApp</name>
  <description>User Registration Application</description>
  <properties>
    <java.version>11</java.version>
  </properties>
  <dependencies>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-web
      </artifactId>
    </dependency>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-data-jpa
      </artifactId>
    </dependency>
  </dependencies>

```

```
<dependency>
    <groupId>mysql</groupId>
    <artifactId>mysql-connector-java</artifactId>
    <scope>runtime</scope>
</dependency>
<dependency>
    <groupId>org.projectlombok</groupId>
    <artifactId>lombok</artifactId>
    <optional>true</optional>
</dependency>
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-test
    </artifactId>
    <scope>test</scope>
</dependency>
</dependencies>
<build>
    <plugins>
        <plugin>
            <groupId>org.springframework.boot
            </groupId>
            <artifactId>spring-boot-maven-plugin
            </artifactId>
            <configuration>
                <excludes>
                    <exclude>
                        <groupId>org.project
                            lombok</groupId>
                        <artifactId>lombok
                        </artifactId>
                    </exclude>
                </excludes>
            </configuration>
        </plugin>
    </plugins>

```

```
        </excludes>
    </configuration>
</plugin>
</plugins>
</build>
</project>
```

Also, update pom.xml with a Springfox dependency for the Swagger UI, as shown in Listing 4-2.

***Listing 4-2.*** Add Springfox Dependency in pom.xml

```
<dependency>
    <groupId>io.springfox</groupId>
    <artifactId>springfox-boot-starter</artifactId>
    <version>3.0.0</version>
</dependency>
```

## Project Lombok

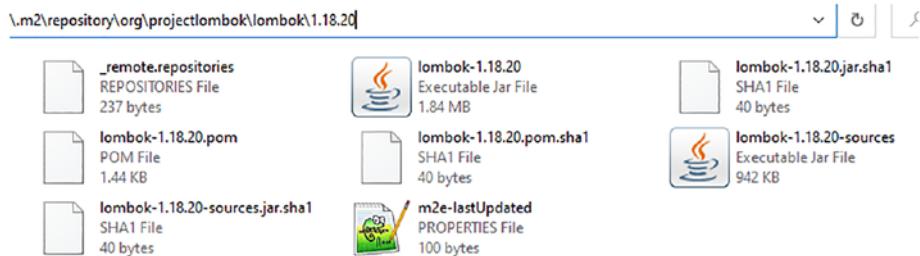
You selected Lombok dependency while creating the project. Let's look at the main objective of Project Lombok. “Project Lombok is a small Java library that plugs into your IDE like Eclipse, IntelliJ, STS, etc. Also, it can plug into build tools like Maven, Ant, etc. [The] Lombok library reduces the amount of boilerplate Java code by [preventing you from writing] another getter, setter, `toString`, or `equals` method again. And this implementation is automatically done during compile time.” (<https://projectlombok.org>)

Project Lombok automatically generates the getter, setter, `toString`, and `equals` method for the object by using the `@Data` Lombok. The following are the steps to plug in the Lombok Java library to the STS IDE.

1. For the STS IDE, get the Lombok executable JAR file.

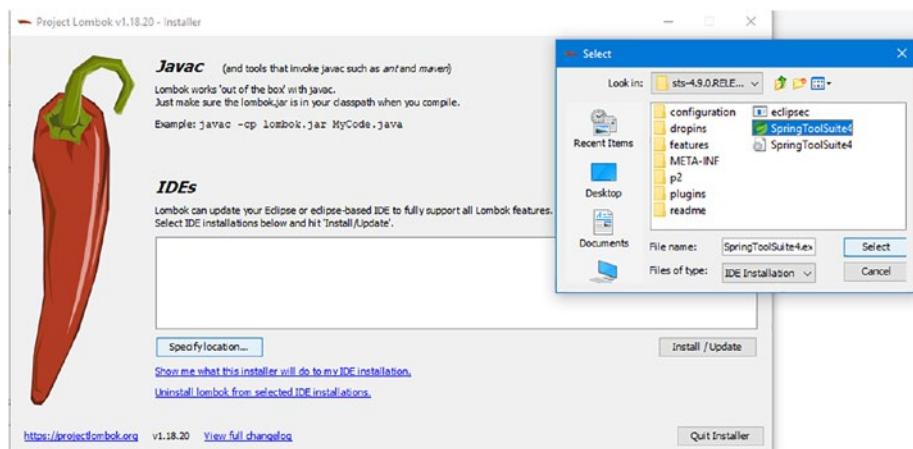
## CHAPTER 4 DEPLOY A SPRING BOOT APPLICATION TALKING TO MYSQL IN AWS

2. Do Maven build in the Spring Boot project. Figure 4-3 shows the Lombok JAR is at `.\.m2\repository\org\projectlombok\lombok\1.18.20\`.



**Figure 4-3.** Lombok JAR file under `.m2` directory

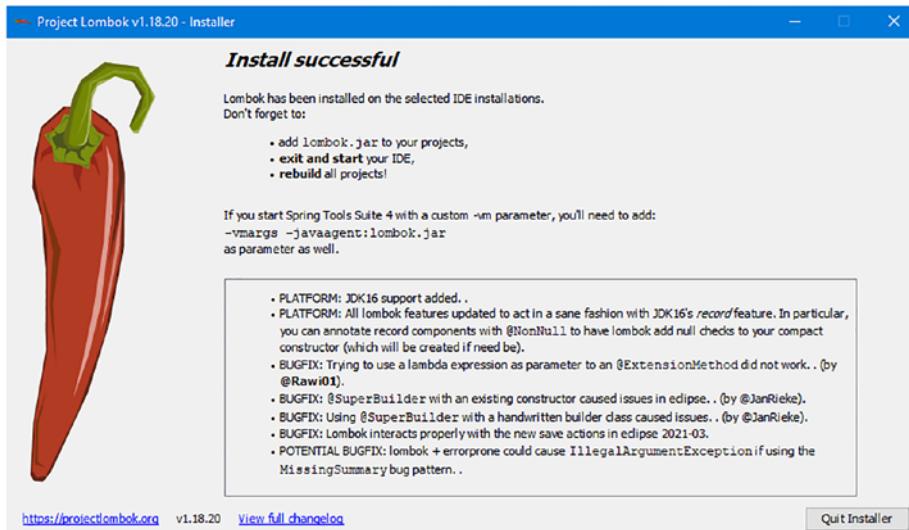
3. Double-click Lombok.jar to open the installer UI. Specify the location of the STS.exe path, and then click the Install/Update button, as shown in Figure 4-4.



**Figure 4-4.** Lombok Installer UI

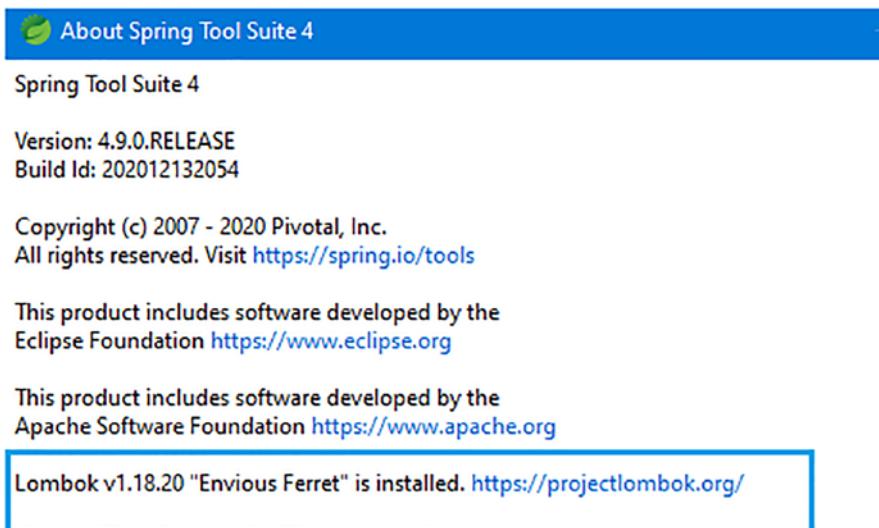
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4. You should see a “Install successful” message, as shown in Figure 4-5. Click the Quit Installer button to exit the installer.



**Figure 4-5.** Lombok installation success

5. Restart the STS IDE to ensure that Lombok is correctly configured. Verify this in STS by going to the Help option and clicking the About option, as shown in Figure 4-6.



**Figure 4-6.** Spring Tool Suite with Lombok details

## Application Properties

You need to configure how you can connect to the Amazon RDS MySQL database. In Chapter 3, you captured the MySQL database information, such as URL, username, and password, which you used in the MySQL Workbench connection with the Amazon RDS MySQL database instance.

Let's add code to the `/src/main/resources/application.properties` file, as shown in Listing 4-3.

**Listing 4-3.** `/src/main/resources/application.properties`

```
server.port=5000
# MySQL database settings
spring.datasource.url=jdbc:mysql://spring-aws-db.cpsoyj7kwlno.us-east-2.rds.amazonaws.com:3306/UserRegistration
spring.datasource.username=springaws
spring.datasource.password=springaws
# db-creation settings
```

```
spring.jpa.hibernate.ddl-auto=update  
spring.jpa.show-sql=true  
spring.jpa.properties.hibernate.format_sql=true
```

Here, you configure the datasource URL, username, and the corresponding password that you want to connect to the MySQL database. `spring.jpa.hibernate.ddl-auto` can be none, update, create, or create-drop.

- `none` is the default for MySQL. It indicates that there are no changes made to the database structure.
- `update` instructs Hibernate to change the database according to the given entity structures.
- `create` instructs Hibernate to create the database every time the application restarts but does not drop it when `SessionFactory` closes.
- `create-drop` instructs Hibernate to create the database every time the application restarts and drops it when `SessionFactory` closes.

In the `application.properties` file, configure `ddl-auto = update` to make sure that whenever the application is restarted, Hibernate compares the tables in the database with the entities declared in the class. If there are any changes in the entity structure, those changes are updated in the database.

## Domain Implementation: UserDTO Entity Class

In the `UserRegistrationApp` project, you create a DTO (data transfer object) class named `UserDTO` corresponding to the user domain's object inside a `com.apress.AWS.dto` subpackage. The `UserDTO` class contains only data. It transfers data between different layers of the application when there is a separation of concerns.

You can annotate the UserDTO class with JPA (Java Persistence API) annotations, which allow it to be easily persisted and retrieved using the JPA technology. A formal overview of JPA is beyond the scope of this book.

Let's implement the UserDTO entity class, as shown in Listing 4-4.

***Listing 4-4.*** \src\main\java\com\apress\AWS\ dto\UserDTO.java

```
package com.apress.AWS.dto;

import java.time.LocalDateTime;

import javax.persistence.Column;
import javax.persistence.Entity;
import javax.persistence.GeneratedValue;
import javax.persistence.GenerationType;
import javax.persistence.Id;
import javax.persistence.Table;

import lombok.Data;

@Entity
@Table(name = "users")
@Data
public class UserDTO {

    @Id
    @GeneratedValue(strategy = GenerationType.AUTO)
    @Column(name = "id", nullable = false)
    private Long id;
    @Column(name = "first_name")
    private String firstName;
    @Column(name = "last_name")
    private String lastName;
    @Column(name = "address")
    private String address;
```

```

    @Column(name = "age")
    private Integer age;
    @Column(name = "created_date")
    private LocalDateTime createdDate;

}

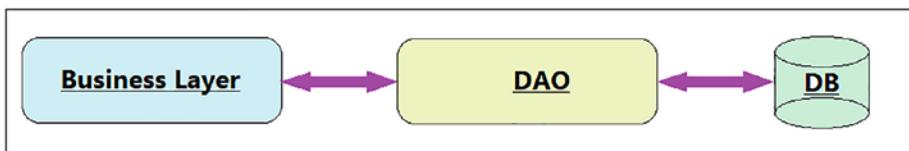
```

The UserDTO class has six attributes: id, firstName, lastName, address, age, and createdDate. The UserDTO class is annotated with the @Entity annotation to make it a JPA entity. This entity class is also annotated with the @Table annotation to define the table name as Users. The id property in UserDTO is annotated with the @Id annotation to make it the primary key. The id attribute has been annotated with the @GeneratedValue annotation to indicate that the ID value should be generated automatically. The id attribute is annotated with the @Column annotation to specify the details of the column to which a field or property is mapped. The other five properties are annotated with the @Column annotation.

The @Data Lombok annotation is used, so you don't have to create a getter and setter for attributes, and at the compile, it is automatically generated. The next step is to provide the repository implementation.

## Repository Implementation: UserJpaRepository

The Data Access Object (DAO) design pattern supports separation of concern by providing separation between business layer (services) and data access operation, as shown in Figure 4-7.



**Figure 4-7.** Separation of concern

The DAO layer sits between the business layer and the database and performs CRUD (create, retrieve, update, delete) operations in the database. To support `JpaRepository`, you need to add the Spring Data JPA dependency shown in Listing 4-5 to the `pom.xml` file.

#### ***Listing 4-5.*** Spring Data JPA Dependency

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-data-jpa</artifactId>
</dependency>
```

Listing 4-6 creates a repository interface named `UserJpaRepository` by extending the `org.springframework.data.jpa.repository.JpaRepository` interface that helps in persisting the `UserDTO` domain object into a relational database.

#### ***Listing 4-6.*** \src\main\java\com\apress\AWS\repository\UserJpaRepository.java

```
package com.apress.AWS.repository;

import org.springframework.data.jpa.repository.JpaRepository;
import org.springframework.stereotype.Repository;

import com.apress.AWS.dto.UserDTO;

@Repository
public interface UserJpaRepository extends JpaRepository<UserDTO, Long> {
}
```

In Listing 4-6, the `JpaRepository` interface takes a domain object. The domain object's identifier field is `UserDTO` and `Long`. Its generic parameters are `T` and `ID`. The `UserJpaRepository` interface inherits all the CRUD methods provided by `JpaRepository`.

Next, let's create a Service class that autowires `UserJpaRepository`.

## Service Implementation: `UserService`

Let's begin the service implementation by creating a Service class named `UserService`, as shown in Listing 4-7, where you call the CRUD methods of the `UserJpaRepository` interface to handle SQL operations.

***Listing 4-7.*** \src\main\java\com\apress\AWS\service\  
`UserService.java`

```
package com.apress.AWS.service;

import java.util.List;
import javax.transaction.Transactional;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Service;

import com.apress.AWS.dto.UserDTO;
import com.apress.AWS.repository.UserJpaRepository;

@Service
@Transactional
public class UserService {

    @Autowired
    private UserJpaRepository useRepository;
```

```
public List<UserDTO> listAll() {  
    return useRepository.findAll();  
}  
  
public void save(UserDTO user) {  
    useRepository.save(user);  
}  
  
public UserDTO get(Long id) {  
    return useRepository.findById(id).get();  
}  
  
public void delete(Long id) {  
    useRepository.deleteById(id);  
}  
}
```

This UserService class uses the @Autowired annotation that autowires UserJpaRepository.

Next, let's create a REST controller class to define different REST endpoints to retrieve and manipulate the UserDTO domain object.

## REST Controller Implementation: UserRegistrationController

Let's create a Spring REST controller named UserRegistrationController and implement different REST API endpoints to perform CRUD operations. Listing 4-8 is the code implementation for the UserRegistrationController class.

***Listing 4-8.*** \src\main\java\com\apress\AWS\controller\ UserRegistrationController.java

```
package com.apress.AWS.controller;

import java.util.List;
import java.util.NoSuchElementException;

import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.http.HttpStatus;
import org.springframework.http.ResponseEntity;
import org.springframework.web.bind.annotation.DeleteMapping;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.PathVariable;
import org.springframework.web.bind.annotation.PostMapping;
import org.springframework.web.bind.annotation.RequestBody;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

import com.apress.AWS.dto.UserDTO;
import com.apress.AWS.service.UserService;

import lombok.extern.slf4j.Slf4j;

@Slf4j
@RestController
@RequestMapping("/api/")
public class UserRegistrationController {

    @Autowired
    private UserService userService;

    // URI - /api/users
    @GetMapping(value = "users")
    public ResponseEntity<List<UserDTO>> getAllUsers() {
```

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```
        List<UserDTO> users = this.userService.listAll();
        return new ResponseEntity<List<UserDTO>>(users,
        HttpStatus.OK);
    }

// URI - /api/user/id/1
@GetMapping("user/id/{id}")
public ResponseEntity<UserDTO> getUserById(
@PathVariable(name = "id") final Long userId) {
    try {
        final UserDTO user = this.userService.
        get(userId);
        return new ResponseEntity<UserDTO>
        (user, HttpStatus.OK);
    } catch (NoSuchElementException e) {
        return new ResponseEntity<UserDTO>
        (HttpStatus.NOT_FOUND);
    }
}

// URI - /api/user/save
@PostMapping(value = "user/save")
public ResponseEntity<UserDTO> save(@RequestBody UserDTO
user) {
    this.userService.save(user);
    return new ResponseEntity<UserDTO>(user,
    HttpStatus.CREATED);
}

// URI - /api/user/delete/id/1
@DeleteMapping("user/delete/id/{id}")
public ResponseEntity<UserDTO> delete(@PathVariable
(name = "id") final Long userId) {
```

```

        this.userService.delete(userId);
        return new ResponseEntity<UserDTO>(HttpStatus.
NO_CONTENT);
    }
}

```

Here, the `UserRegistrationController` class was annotated with `@RestController` annotation. `@RequestMapping("/api")` was defined, which indicates that all REST API endpoint URLs start with `/api`, and it maps incoming HTTP requests to handler methods!

The `@Autowired` annotation autowires `UserService` to the RESTful controller. Table 4-2 explores the different REST endpoints defined in the `UserRegistrationController` class to retrieve and manipulate `UserDTO`.

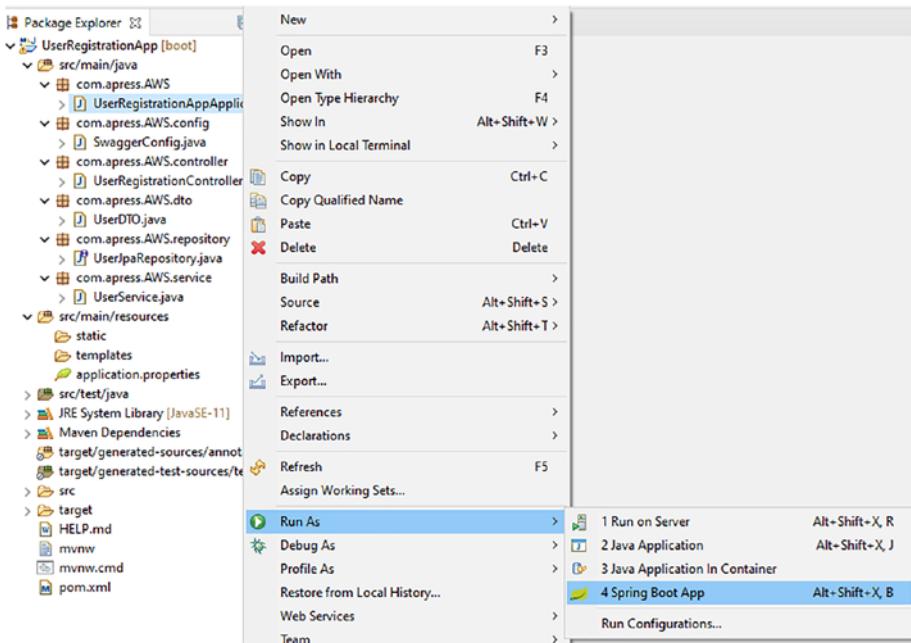
**Table 4-2.** REST Endpoints Defined in the `UserRegistrationController` Class

Annotation	URI	Description
<code>@GetMapping</code>	<code>/api/users</code>	Retrieve all users available in database
<code>@PostMapping</code>	<code>/api/user/save</code>	Create a new user in database
<code>@GetMapping ("/{id}")</code>	<code>/api/user/id/{id}</code>	Retrieve an individual user based on ID
<code>@DeleteMapping</code>	<code>/api/user/delete/id/{id}</code>	Delete an individual user based on ID

Now, build the `UserRegistrationApp` using a Maven build and run it locally to test defined REST endpoints.

## Run and Test UserRegistrationApp Locally

To run the UserRegistrationApp using the STS IDE in a local system, right-click the UserRegistrationAppApplication.java class under the com.apress.AWS package, and then click **Run As > Spring Boot App**, as shown in Figure 4-8.



**Figure 4-8.** Run the UserRegistrationApp using STS IDE

Once UserRegistrationApp started successfully, the last line in the STS console should state, Started UserRegistrationAppApplication, as shown in Figure 4-9.

## CHAPTER 4 DEPLOY A SPRING BOOT APPLICATION TALKING TO MYSQL IN AWS

```
\\_ _\\
 \\_ _\\
 \\_ _\\
 \\_ _\\
 \\_ _\\
 \\_ _\\
 :: Spring Boot ::      (v2.5.2)

2021-07-07 00:09:19.188 INFO 5256 --- [           main] c.a.AHS.UserRegistrationAppApplication : Starting UserRegistrationAppApplication
2021-07-07 00:09:19.214 INFO 5256 --- [           main] c.a.AHS.UserRegistrationAppApplication : No active profile set, falling back to
2021-07-07 00:09:22.358 INFO 5256 --- [           main] .s.d.r.c.RepositoryConfigurationDelegate : Bootstrapping Spring Data JPA repository
2021-07-07 00:09:22.501 INFO 5256 --- [           main] .s.d.r.c.RepositoryConfigurationDelegate : Finished Spring Data repository scanning
2021-07-07 00:09:24.369 INFO 5256 --- [           main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat initialized with port(s): 5000 (-
2021-07-07 00:09:24.411 INFO 5256 --- [           main] o.apache.catalina.core.StandardService : Starting service [Tomcat]
2021-07-07 00:09:24.417 INFO 5256 --- [           main] org.apache.catalina.core.StandardEngine : Starting Servlet engine: [Apache Tomcat/9.0.52]
2021-07-07 00:09:24.682 INFO 5256 --- [           main] o.a.c.c.C.[Tomcat].[localhost].[/] : Initializing Spring embedded WebAppli-
2021-07-07 00:09:24.682 INFO 5256 --- [           main] w.s.c.ServletServerApplicationContext : Root WebApplicationContext: initialize-
2021-07-07 00:09:25.492 INFO 5256 --- [           main] o.hibernate.jpa.internal.util.LogHelper : HHH0000204: Processing PersistenceUnitIn-
2021-07-07 00:09:25.812 INFO 5256 --- [           main] org.hibernate.Version : HHH0000412: Hibernate ORM core version 5
2021-07-07 00:09:26.561 INFO 5256 --- [           main] o.hibernate.annotations.common.Version : HCANN000001: Hibernate Commons Annotati-
2021-07-07 00:09:26.940 INFO 5256 --- [           main] com.zaxxer.hikari.HikariDataSource : HikariPool-1 - Starting...
2021-07-07 00:09:32.239 INFO 5256 --- [           main] com.zaxxer.hikari.HikariDataSource : HikariPool-1 - Start completed.
2021-07-07 00:09:32.375 INFO 5256 --- [           main] org.hibernate.dialect.Dialect : HHH0000400: Using dialect: org.hibernate.dialect.
2021-07-07 00:09:34.187 INFO 5256 --- [           main] o.h.e.t.j.p.i.JtaPlatformInitiator : HHH0000400: Using JtaPlatform implemen-
2021-07-07 00:09:34.212 INFO 5256 --- [           main] j.LocalContainerEntityManagerFactoryBean : Initialized JPA EntityManagerFactory fo-
2021-07-07 00:09:35.343 INFO 5256 --- [           main] JpaBaseConfiguration$JpaWebConfiguration : spring.jpa.open-in-view is enabled by d
2021-07-07 00:09:36.343 INFO 5256 --- [           main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat started on port(s): 5000 (http)
2021-07-07 00:09:36.916 INFO 5256 --- [           main] c.a.AHS.UserRegistrationAppApplication : Started UserRegistrationAppApplication
```

**Figure 4-9.** Output on the STS console

Now, it's time to test the REST API using Postman ([www.postman.com](https://www.postman.com)). You added data to the database using MySQL Workbench in Chapter 3. You should get that data during the REST API call.

## Retrieve All Users: /api/users

Let's test the first REST endpoint to retrieve all users. Launch the Postman tool in your local system, select GET as the request type, and enter **http://localhost:5000/api/users** to retrieve and display all user data. You should see a 200 OK HTTP status, as shown in Figure 4-10.

The screenshot shows the Postman interface with a successful API call. The URL is `http://localhost:5000/api/users`. The response body is a JSON object:

```
1  {
2   "id": 1,
3   "last_name": "Ravi",
4   "first_name": "Soni",
5   "address": "Sasaram-Bihar-India",
6   "age": 34,
7   "created_date": "2021-07-04T00:00:00"
8 }
9
10 ]
```

Figure 4-10. Retrieve all users

## Retrieve an Individual User: /api/user/id/{id}

Now, let's test another REST endpoint to retrieve an individual user based on id. To test this REST endpoint, launch Postman, select GET as the request type, and enter the URL (`http://localhost:5000/api/user/id/1`) to retrieve and display individual user data. You should see a 200 OK HTTP status, as shown in Figure 4-11.

The screenshot shows the Postman interface with a GET request to `http://localhost:5000/api/user/id/1`. The response status is `200 OK`. The response body is a JSON object:

```

1
2   "id": 1,
3   "last_name": "Ravi",
4   "first_name": "Soni",
5   "address": "Sasaram-Bihar-India",
6   "age": 34,
7   "created_date": "2021-07-04T00:00:00"
8

```

**Figure 4-11.** Retrieving an individual user

## Create a New User: /api/user/save

Next, let's test the REST endpoint to create a new user in the database. Launch Postman, select POST as the request type, and enter `http://localhost:5000/api/user/save`. Click the Body radio button, and then select raw. From the drop-down list, select JSON (application/json) as the content-type header. Use the JSON data in the request body as shown in Listing 4-9, and hit Send.

**Listing 4-9.** JSON Data in the Body to Create a New User

```
{
  "last_name": "Soni",
  "first_name": "Namrata",
  "address": "Bangalore-India",
```

```
"age": 25,  
"createdDate": "2021-07-04T00:00:00"  
}
```

On successful completion of the POST request, a new user is created in the database, and the response HTTP status is 201 Created, as shown in Figure 4-12.

The screenshot shows the Postman application interface. At the top, it says "POST" and the URL "http://localhost:5000/api/user/save". Below the URL, there are tabs for "Params", "Authorization", "Headers (8)", "Body" (which is selected), "Pre-request Script", "Tests", and "Settings". Under "Body", the content type is set to "form-data". The body content is a JSON object:

```
1 {"  
2   "last_name": "Soni",  
3   "firstName": "Namrata",  
4   "address": "Bangalore-India",  
5   "age": 25,  
6   "createdDate": "2021-07-04T00:00:00"  
7 }
```

Below the body, there are tabs for "Body", "Cookies", "Headers (5)", and "Test Results". The "Test Results" tab shows a status of "201 Created". At the bottom, there are buttons for "Pretty", "Raw", "Preview", "Visualize", and "JSON". The "JSON" button is selected, and the response body is displayed:

```
1 {"  
2   "id": 2,  
3   "last_name": "Soni",  
4   "firstName": "Namrata",  
5   "address": "Bangalore-India",  
6   "age": 25,  
7   "createdDate": "2021-07-04T00:00:00"  
8 }
```

**Figure 4-12.** Creating a new user

## Delete an Existing User: /api/user/delete/id/{id}

The last endpoint to test deletes an existing user from the database based on ID. To test this REST endpoint, launch Postman, select DELETE as the request type, and enter the URL (<http://localhost:5000/api/user/id/2>) to delete the existing user with id=1. On successful completion of the DELETE request, this user is deleted from the database. The response HTTP status after deleting the user is 204 No Content, as shown in Figure 4-13.

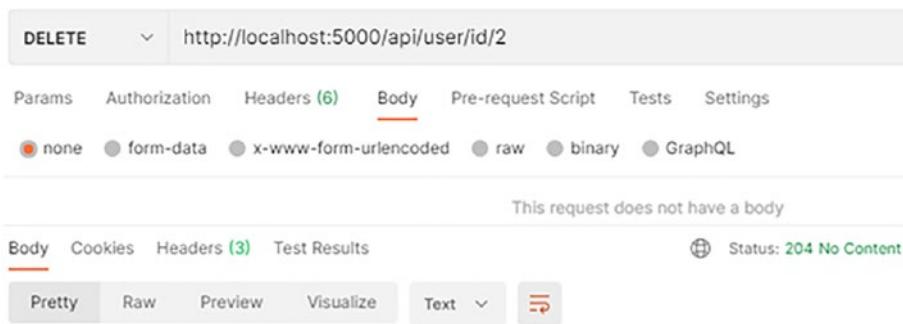
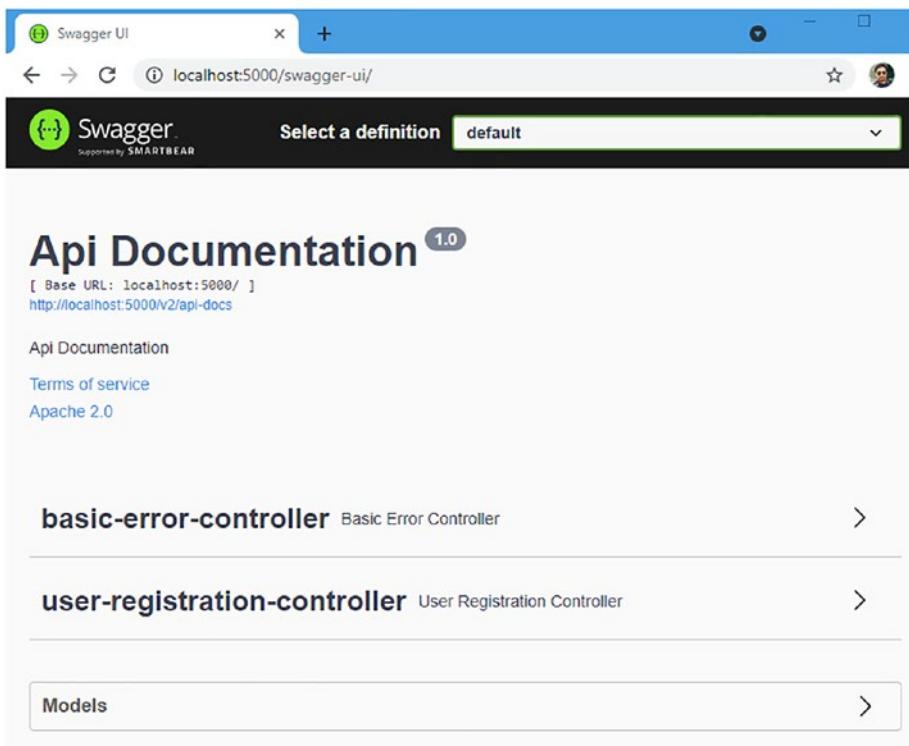


Figure 4-13. Delete an existing user

## Swagger UI: API Documentation

In a browser, open the Swagger UI page at <http://localhost:8080/swagger-ui/>. You see the generated API documentation, as shown in Figure 4-14.



**Figure 4-14.** Swagger API documentation page

user-registration-controller is defined in the application. Clicking it lists the REST endpoints and their valid HTTP methods. Clicking Models displays the model structure. Figure 4-15 shows the defined REST endpoints and the UserDTO model structure.

The screenshot shows the Swagger UI interface. At the top, there is a header for the 'user-registration-controller' which is described as a 'User Registration Controller'. Below this, there are four colored boxes representing different HTTP methods and their corresponding endpoints:

- A red box for **DELETE** with the endpoint `/api/user/delete/{id}` and the action `delete`.
- A blue box for **GET** with the endpoint `/api/user/id/{id}` and the action `getUserById`.
- A green box for **POST** with the endpoint `/api/user/save` and the action `save`.
- A light blue box for **GET** with the endpoint `/api/users` and the action `listAllUsers`.

Below these endpoints, there is a section titled 'Models' which contains a 'UserDTO' definition:

```
UserDTO {
    address      string
    age          integer($int32)
    createdDate string($date-time)
    firstName    string
    id           integer($int64)
    last_name    string
}
```

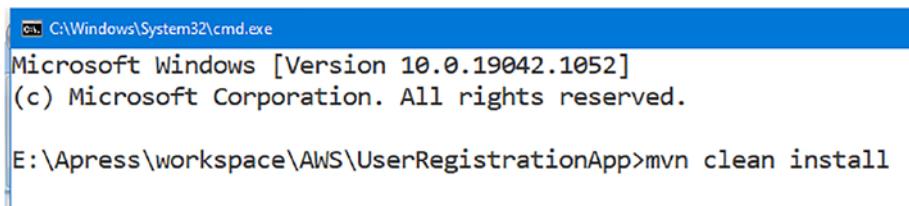
At the bottom of the 'Models' section, there is a 'View' link.

**Figure 4-15.** Swagger UI lists REST endpoints

## Build a JAR for a Spring Boot Application

To build JAR for the Spring Boot application from a command prompt, go to the project directory where you created the Spring Boot project and copy the project path. Now, change the working directory to the project path on the command prompt. Build the project using the following command executed in the command prompt, as shown in Figure 4-16.

```
E:\Apress\workspace\AWS\UserRegistrationApp>mvn clean install
```

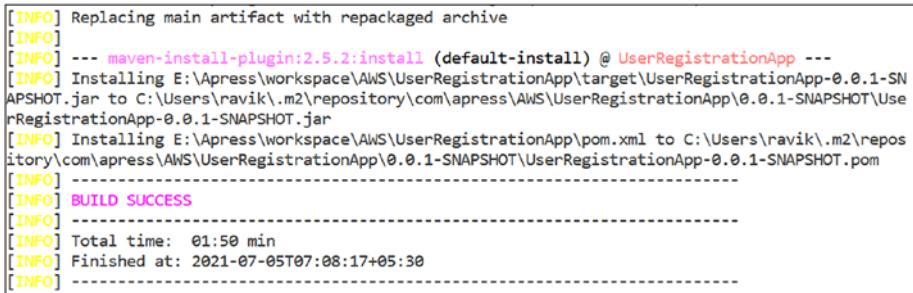


```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.19042.1052]
(c) Microsoft Corporation. All rights reserved.

E:\Apress\workspace\AWS\UserRegistrationApp>mvn clean install
```

**Figure 4-16.** Build JAR from the command prompt

This starts building the UserRegistrationApp project. Once the build is successful, you are informed that the JAR file named UserRegistrationApp-0.0.1-SNAPSHOT.jar has been created, as shown in Figure 4-17.



```
[INFO] Replacing main artifact with repackaged archive
[INFO]
[INFO] --- maven-install-plugin:2.5.2:install (default-install) @ UserRegistrationApp ---
[INFO] Installing E:\Apress\workspace\AWS\UserRegistrationApp\target\UserRegistrationApp-0.0.1-SNAPSHOT.jar to C:\Users\ravik\.m2\repository\com\apress\AWS\UserRegistrationApp\0.0.1-SNAPSHOT\UserRegistrationApp-0.0.1-SNAPSHOT.jar
[INFO] Installing E:\Apress\workspace\AWS\UserRegistrationApp\pom.xml to C:\Users\ravik\.m2\repository\com\apress\AWS\UserRegistrationApp\0.0.1-SNAPSHOT\UserRegistrationApp-0.0.1-SNAPSHOT.pom
[INFO]
[INFO] BUILD SUCCESS
[INFO]
[INFO] Total time: 01:50 min
[INFO] Finished at: 2021-07-05T07:08:17+05:30
[INFO]
```

**Figure 4-17.** Build success

You need to deploy the generated JAR file into Elastic Beanstalk.

## Deploy the UserRegistrationApp Spring Boot Application in AWS Elastic Beanstalk

Since you have successfully created a JAR file for the UserRegistrationApp application in your local system, now, you must deploy this JAR file to Elastic Beanstalk.

Let's sign in to the AWS Management Console using your AWS credentials and select service as Elastic Beanstalk. Figure 4-18 shows that three applications are already available: My First Elastic Beanstalk Application, helloworld, and HelloSpringBoot. You created them in previous chapters.

The screenshot shows the AWS Elastic Beanstalk Applications page. At the top, there is a breadcrumb navigation: Elastic Beanstalk > Applications. Below the breadcrumb, the title "All applications" is displayed. To the right of the title are buttons for "Actions" and "Create a new application". A search bar with the placeholder "Filter results matching the display values" is located below the title. Below the search bar is a table with the following columns: Application name, Environments, Date created, Last modified, and ARN. The table contains three rows, each representing an application:

Application name	Environments	Date created	Last modified	ARN
HelloSpringBoot		2021-06-30 00:14:46 UTC+0530	2021-06-30 00:14:46 UTC+0530	arn:aws:elasticbeanstalk:us-east-2:818371255049:application/HelloSpringBoot
helloworld		2021-06-29 22:59:57 UTC+0530	2021-06-29 22:59:57 UTC+0530	arn:aws:elasticbeanstalk:us-east-2:818371255049:application/helloworld
My First Elastic Beanstalk Application		2021-06-29 22:53:39 UTC+0530	2021-06-29 22:53:39 UTC+0530	arn:aws:elasticbeanstalk:us-east-2:818371255049:application/My First Elastic Beanstalk Application

**Figure 4-18.** List of all applications available in Elastic Beanstalk

Next, let's create a new application for UserRegistrationApp Spring Boot application talking to the MySQL database. Click the **Create a new application** button, enter the application name as **UserRegistrationApp**, and click the Create button.

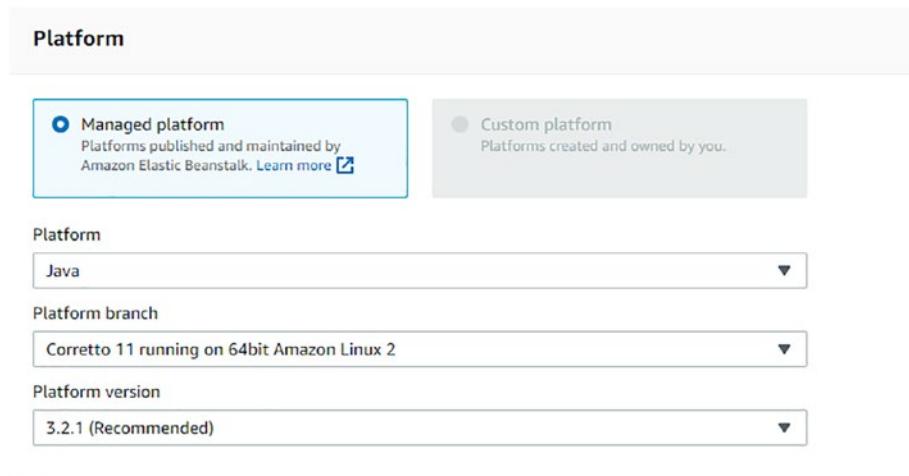
Next, create a new environment for this application by clicking the **Create one now** link. Select **Web server environment** as the environment tier, and then click the Select button.

On the **Environment information** page, enter **userregistration** as the domain name, and check for domain availability (see Figure 4-19).

The screenshot shows the 'Environment information' configuration page in the AWS Elastic Beanstalk console. The top navigation bar shows 'Elastic Beanstalk > Applications > UserRegistrationApp'. The main section is titled 'Environment information' with the sub-instruction 'Choose the name, subdomain, and description for your environment. These cannot be changed later.' Below this, there are four input fields: 'Application name' (UserRegistrationApp), 'Environment name' (Userregistrationapp-env), 'Domain' (userregistration.us-east-2.elasticbeanstalk.com), and a 'Check availability' button. A green success message indicates that the domain is available. There is also a large empty 'Description' field.

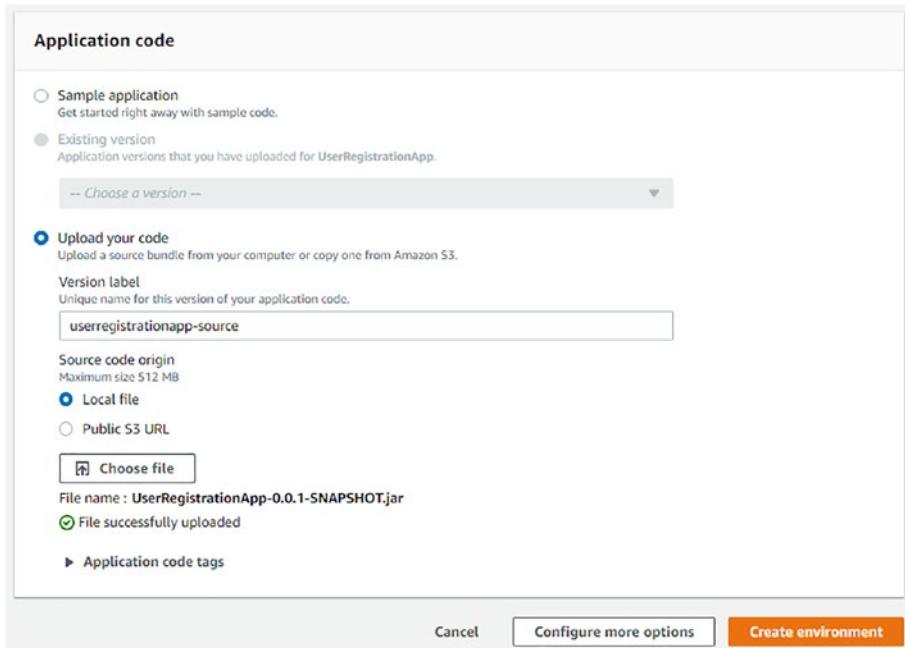
**Figure 4-19.** Environment information

Next, select Java as the managed platform, as shown in Figure 4-20.



**Figure 4-20.** Java is the managed platform

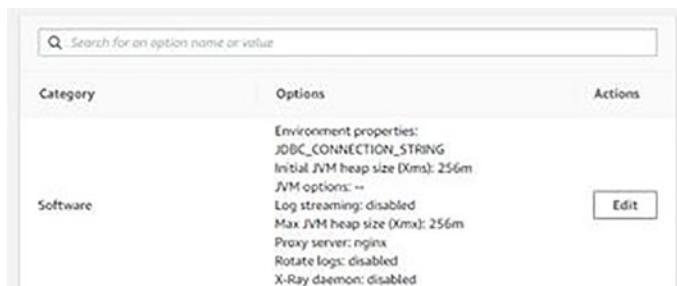
Finally, upload the code by selecting the JAR file from the project's target folder (e.g., in the authors' local system, it is E:\Apress\workspace\AWS\UserRegistrationApp\target\UserRegistrationApp-0.0.1-SNAPSHOT.jar), and then click the **Create environment** button, as shown in Figure 4-21.



**Figure 4-21.** Upload application code

Once the environment has been created, and the resources have been deployed, change the server port the Spring Boot application listens on. So, you need to specify the SERVER\_PORT environment variable in the Elastic Beanstalk environment and set the value to 5000.

On the Configuration page in your environment, under Software, click the Edit icon, as shown in Figure 4-22.



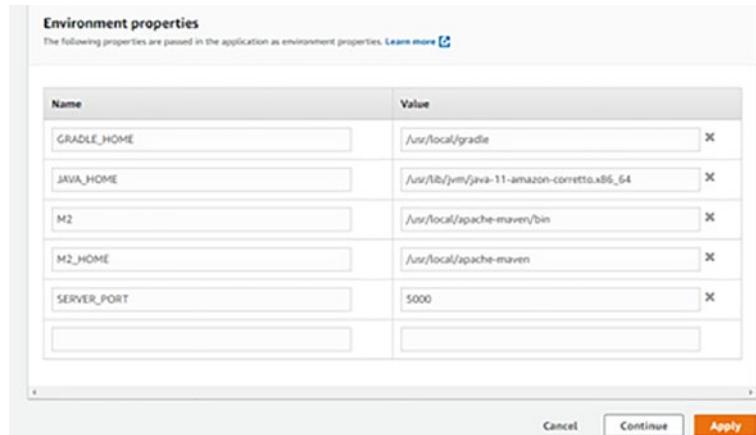
A screenshot of the AWS Lambda configuration interface. At the top is a search bar labeled "Search for an option name or value". Below it is a table with three columns: "Category", "Options", and "Actions". In the "Category" column, there is one entry: "Software". The "Options" column contains several environment variables and their values:

- Environment properties: JDBC\_CONNECTION\_STRING
- Initial JVM heap size (Xms): 256m
- JVM options: --
- Log streaming: disabled
- Max JVM heap size (Xmx): 256m
- Proxy server: nginx
- Rotate logs: disabled
- X-Ray daemon: disabled

In the "Actions" column, there is a single "Edit" button next to the "Software" row.

**Figure 4-22.** Edit software configuration

And then add a new environment variable SERVER\_PORT, with a value 5000 to change the port that the Spring Boot application listens on, as shown in Figure 4-23.



A screenshot of the AWS Lambda configuration interface showing the "Environment properties" section. The title is "Environment properties" and a note says "The following properties are passed in the application as environment properties. Learn more". Below is a table with two columns: "Name" and "Value". A new row has been added for "SERVER\_PORT":

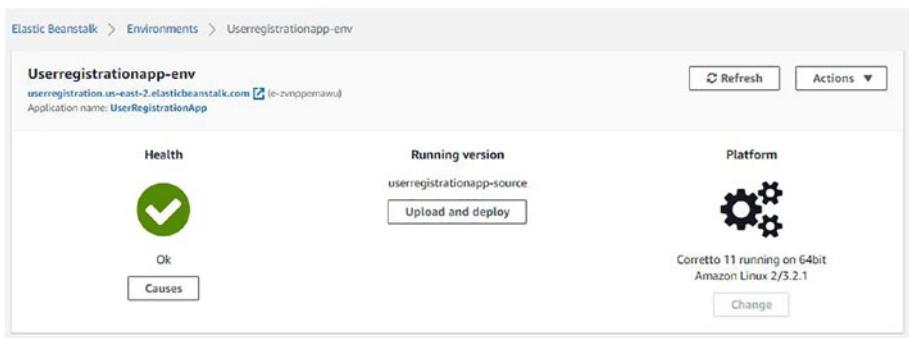
Name	Value
GRADLE_HOME	/usr/local/gradle
JAVA_HOME	/usr/lib/jvm/java-11-amazon-corretto.x86_64
M2	/usr/local/apache-maven/bin
M2_HOME	/usr/local/apache-maven
SERVER_PORT	5000

At the bottom are "Cancel", "Continue", and "Apply" buttons. The "Apply" button is highlighted.

**Figure 4-23.** Environment properties in software configuration

As soon as you click the Apply button, the configuration changes are propagated to the application servers, and the application is restarted.

When it restarts the application, it picks up the new configuration through the environment variables. And, in about a minute, you see a healthy application on the dashboard, as shown in Figure 4-24.



**Figure 4-24.** Health OK

You are now ready to test the UserRegistrationApp application deployed in the Amazon cloud.

## Test Deployed REST API in AWS Using Swagger UI

Now, it's time to test the deployed REST API endpoints in AWS. Use the URL that you configured on the AWS environment to access the service. For this example, the specified URL is <http://userregistration.us-east-2.elasticbeanstalk.com>.

Let's open the Swagger UI page in the browser at <http://userregistration.us-east-2.elasticbeanstalk.com/swagger-ui/>. You see the generated API documentation, as shown in Figure 4-25.

The screenshot shows a web browser window displaying the Swagger UI for a Spring Boot application. The title bar says "Swagger UI". The address bar shows "Not secure | userregistration.us-east-2.elasticbeanstalk.com/swagger-ui/" with a warning icon. The main content area has a dark header with "Swagger" and "Select a definition default". Below this, it says "Api Documentation 1.0" and "[ Base URL: userregistration.us-east-2.elasticbeanstalk.com/ ]". It also lists "http://userregistration.us-east-2.elasticbeanstalk.com/v2/api-docs". There are links for "Api Documentation", "Terms of service", and "Apache 2.0". The main content area lists three sections: "basic-error-controller Basic Error Controller", "user-registration-controller User Registration Controller", and "Models". Each section has a right-pointing arrow indicating it can be expanded.

**Figure 4-25.** *Swagger API documentation page*

Here, clicking **user-registration-controller** shows the list of defined REST endpoints, and by clicking the **Models** display domain model structure, as shown in Figure 4-26.

The screenshot shows the Swagger UI interface for a Spring Boot application. At the top, it displays the title "user-registration-controller" and the subtitle "User Registration Controller". Below this, there are four API endpoints listed:

- DELETE /api/user/delete/{id}** delete
- GET /api/user/{id}** getUserById
- POST /api/user/save** save
- GET /api/users** getAllUsers

Below the endpoints, under the "Models" section, the "UserDTO" class is defined with the following fields:

```
UserDTO {
    address      string
    age          integer($int32)
    createdDate string($date-time)
    firstName    string
    id           integer($int64)
    last_name    string
}
```

**Figure 4-26.** Swagger UI lists REST endpoints and model structure

Using Swagger, let's test the REST Endpoints deployed on AWS.

## List All Users: /api/users

On the Swagger UI page, expand GET /api/users, and click the Try It Out button. And then, click the Execute button to call this REST endpoint. Figure 4-27 shows that the HTTP status response code should be 200 OK, and the response body should contain the list of users.

## CHAPTER 4 DEPLOY A SPRING BOOT APPLICATION TALKING TO MYSQL IN AWS

The screenshot shows the Swagger UI interface for a Spring Boot application. At the top, a blue button labeled "GET" is followed by the URL "/api/users" and the operation name "listAllUsers". Below this, a "Parameters" section indicates "No parameters". On the right, a red "Cancel" button is visible. In the center, there are two buttons: "Execute" (blue) and "Clear" (white). Below these buttons, the "Responses" section is selected. To its right, the "Response content type" dropdown is set to "JSON". Under the "Responses" section, there is a "Curl" block containing the command: "curl -X GET \"http://userregistration.us-east-2.elasticbeanstalk.com/api/users\" -H \"accept: \*/\*\"". Below the "Responses" section, the "Request URL" is shown as "http://userregistration.us-east-2.elasticbeanstalk.com/api/users". The "Server response" section is expanded, showing the "Code" (200) and "Details" tabs. The "Code" tab is selected, displaying the "Response body" which contains a JSON array of user objects. One object is shown in detail: { "id": 1, "last\_name": "Ravi", "first\_name": "Soni", "address": "Sasaram-Bihar-India", "age": 34, "created\_date": "2021-07-04T00:00:00" }. A "Download" button is located to the right of this JSON snippet. The "Response headers" section lists the following: connection: keep-alive, content-type: application/json, date: Mon, 05 Jul 2021 03:30:11 GMT, server: nginx/1.20.0, transfer-encoding: chunked.

**Figure 4-27.** List all users using Swagger UI

## Create New Users: /api/users

On the Swagger UI page, expand POST /api/user/save, and click the Try It Out button. Next, enter the user JSON data shown in Listing 4-10 in the request body input box, and select **application/json** as the content-type parameter.

***Listing 4-10.*** User JSON Data

```
{  
    "last_name": "Soni",  
    "firstName": "Namrata",  
    "address": "Bangalore-India",  
    "age": 25,  
    "createdDate": "2021-07-04T00:00:00"  
}
```

Next, click the Execute button to call this REST endpoint. As shown in Figure 4-28, the response HTTP status code should be 201 Created.

## CHAPTER 4 DEPLOY A SPRING BOOT APPLICATION TALKING TO MYSQL IN AWS

The screenshot shows the Swagger UI interface for a Spring Boot application. The top navigation bar has 'POST' selected for the method and '/api/user/save' for the endpoint. Below this, there's a 'Parameters' section with a 'Cancel' button. The main body contains a table for parameters:

Name	Description
<b>user</b> * required	USER object (body)

The 'user' parameter is defined as a JSON object with fields: last\_name, first\_name, address, age, and createdDate. The value is set to a JSON object with these fields and their values. Below the table is another 'Cancel' button. A 'Parameter content type' dropdown is set to 'application/json'. At the bottom of the main area are 'Execute' and 'Clear' buttons.

Below the main area, under 'Responses', is a 'Responses' section with a 'Response content type' dropdown set to '\*/\*'. It also includes a 'Curl' code block and a 'Request URL' input field containing 'http://userregistration.us-east-2.elasticbeanstalk.com/api/user/save'. Under 'Server response', there's a 'Code' dropdown set to '201' and a 'Details' section for the response body. The response body is a JSON object with fields: id, last\_name, first\_name, address, age, and createdDate. There's a 'Download' button next to the response body. Below the response body is a 'Response headers' section with the following content:

```
connection: keep-alive
content-type: application/json
date: Mon, 05 Jul 2021 03:47:52 GMT
server: nginx/1.20.0
transfer-encoding: chunked
```

Figure 4-28. Create a new user using Swagger UI

# Summary

In this chapter, you created UserRegistrationApp Spring Boot REST API talking to an Amazon RDS MySQL database. You explored different Maven dependencies that have been used in the `pom.xml` file, such as Lombok, JPA, and so on. You learned how to configure Project Lombok to STS IDE. You updated the `application.properties` file with database details such as URL, username, and password, and many more. And then, you created an Entity class using JPA annotation, a repository interface that extends the `JpaRepository` interface, a service class for CRUD methods, and a REST controller to define different REST endpoints.

First, you tested the UserRegistrationApp application locally using Postman. Then you built a JAR that you deployed in Elastic Beanstalk. Finally, you tested the deployed REST endpoints to the AWS cloud using the Swagger UI.

The next chapter explores how to deploy a full stack Spring Boot React application in AWS and S3.

## CHAPTER 5

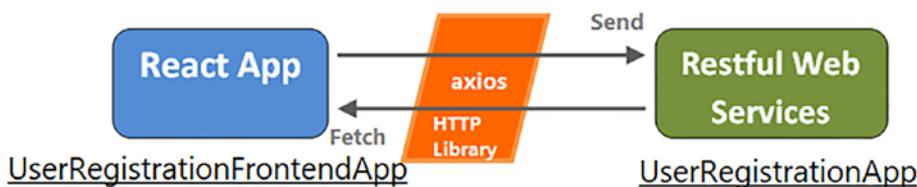
# Deploy a Full Stack Spring Boot React Application in AWS and S3

In Chapter 4, you created the `UserRegistrationApp` Spring Boot RESTful web service that talks to the Amazon RDS MySQL database to perform CRUD operations. You learned how to configure Project Lombok to STS IDE. You created an Entity class using JPA annotation, a repository interface that extends the `JpaRepository` interface, a Service class for CRUD methods, and a REST controller to define different REST endpoints. Afterward, you tested the `UserRegistrationApp` application locally using Postman. Then you built an executable JAR that was deployed in AWS Elastic Beanstalk. Finally, you tested the deployed REST endpoints using Swagger UI.

The world sees the front end, including the design using some languages such as HTML and CSS. The main aim of the front end is to present data in a well-defined style and allows interaction with the client to perform CRUD operations. There are so many amazing JavaScript libraries available that can develop front-end applications.

React is an open source, front-end JavaScript library for building single-page applications. React is a perfect solution for a client-side library for a clean and structured approach.

This chapter introduces React as a front-end framework and its major components. You can develop a single-page application using React as the front end to consume APIs exposed by the UserRegistrationApp back-end application developed using Spring Boot, as shown in Figure 5-1.



**Figure 5-1.** Full stack application overview

You set up a development environment to develop your React front-end application. In this chapter, you learn the following.

- How to develop and run React as a local front-end application
- How to deploy the React front end to AWS S3

This front-end application has a home page, an Add New User page, and a List All Users page with a Delete option. You make an API call to AWS, where you have already deployed the back-end RESTful services named UserRegistrationApp. You are introduced to AWS S3 (Simple Storage Service), where you deploy the React front-end application. And, finally, you verify successful deployment of the React front-end application.

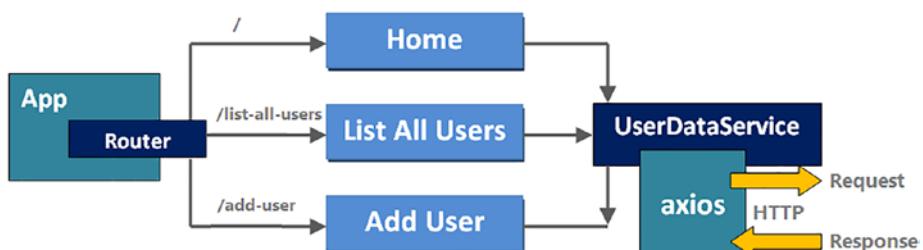
# Develop and Run React as a Front-End Application

Let's start developing and running the interactive front-end application with React in the local system. We assume that you have good knowledge of JavaScript, HTML5, CSS, and React. If you want an in-depth understanding of React, refer to <https://reactjs.org>.

## Introducing React as a Front-end Framework

React is an open source, component-based JavaScript library for building fast and interactive UI (user interface) components. It was created in 2011 by a Facebook software engineer named Jordan Walke. Initially, it was developed and maintained by Facebook. React application is made up of independent, isolated, and reusable components, which are the heart of React application, and each component is responsible for building complex and reusable user interfaces. Every React application has at least one component known as the *root component*. This root component represents the internal application and contains other child components.

You build a user registration front-end app using React with CRUD features. This React application has different components, as shown in Figure 5-2.



**Figure 5-2.** React components with Router and Axios

- The App component is a root component that contains react-router. This also contains a navbar that links to the route's paths.
- The Home component displays a welcome message.
- The ListAllUsers component displays a list of all users with a Delete option.
- The AddUser component has a form for new user submission.

All these components call required methods in `UserDataService`, which internally uses the Axios HTTP library to make HTTP requests and receive responses.

## React Components

In React, a component is considered as the core part of the user interface. Each component has its own structure and is independent of other components, and when all the components merge in a parent component results in the final UI of the application. A component is typically implemented as a JavaScript class with some state and a render method, as shown in Listing 5-1.

***Listing 5-1.*** Structure of Component with State and Render Method

```
class UserClass {  
    state = {};  
    render() {  
    }  
}
```

There are mainly two types of components in React.

- Stateless functional components
  - These are JavaScript functions that don't have their own state and return HTML to describe UI.
- Stateful class components
  - These are regular ES6 classes that extend the Component class from the React library. They must contain a render method, which in turn returns React elements or HTML. They manage the local state.

## React State

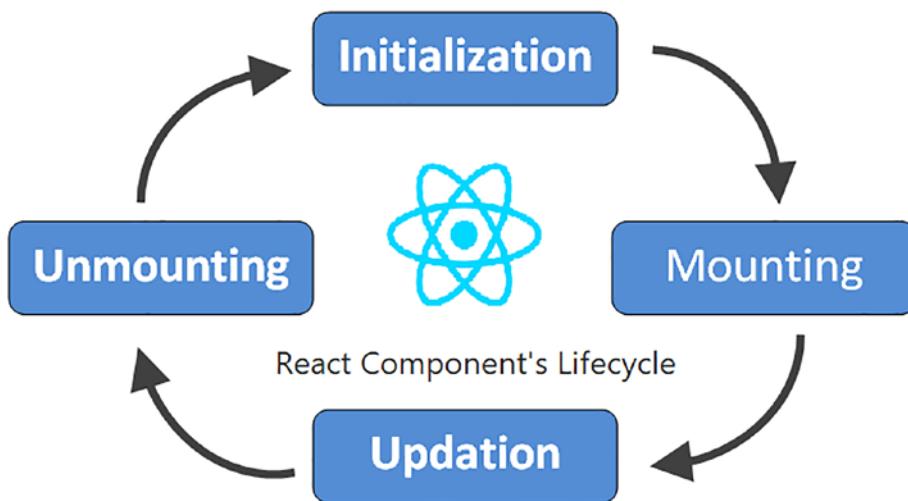
The state is an updatable structure that is managed within the component. A Stateful component has a state responsible for making the user interface dynamic and interactive. You need to declare some default set of values to define the initial state of components. A state can be set or changed using a `setState` method.

## Constructor

In React, the constructor initializes an object's state of a class. This constructor is called automatically during the object creation of the class. It is called before the component is mounted. You need to call the `super(props)` method before any other statement in a constructor. Also, in React, the constructor binds the event handler method.

## A React Component's Life Cycle

Let's explore the React component's life cycle. It primarily consists of four phases, as shown in Figure 5-3.



**Figure 5-3.** React component's life cycle

The different phases of the React component's life cycle provide different methods. React calls the life cycle method according to the component phase.

- Initialization is the birth phase of React components, where they start their journey by setting up the initial state and default props. This is done in the component's constructor.
- Mounting is the phase where the React component mounts (created and inserted) on the Document Object Model (DOM). After completing the initialization phase, the React component renders for the first time in this mounting phase.
- Updation is the third phase of a React component's life cycle. It is the state of the created component change. The React component data (e.g., props and state) is updated in response to user events like typing, clicking, and so on.

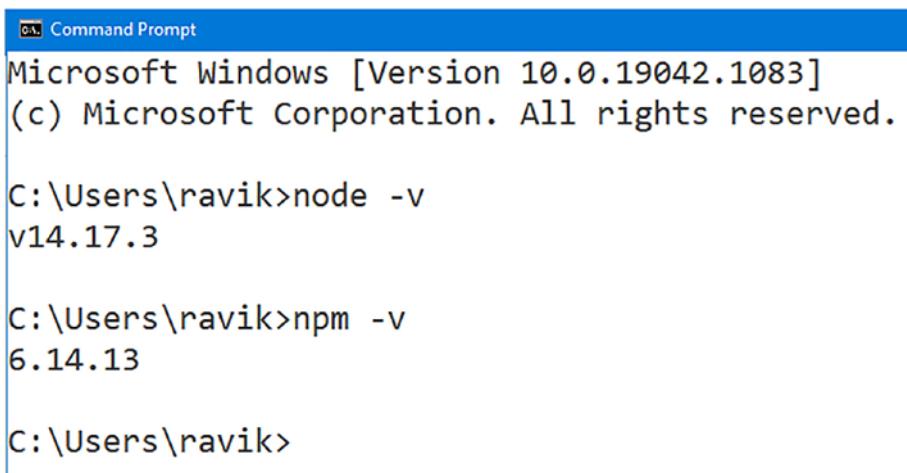
- Unmounting is the last phase in this life cycle.  
The React component instance is destroyed and unmounted from the DOM.

## Set up a Development Environment

The following tools are needed to run any React application.

- A **code editor**, such as Visual Studio, to work with the project files. You can download it from <https://code.visualstudio.com>.
- Go to <https://nodejs.org> to download and install the latest version of **Node.js**, which is a JavaScript runtime environment.
- A package manager called **npm**, which downloads and runs JavaScript packages built on Node.js. It's automatically included in your installation of Node.js.

To check the Node.js and npm versions, run the `node -v` and `npm -v` commands in your terminal, as shown in Figure 5-4.



Microsoft Windows [Version 10.0.19042.1083]  
(c) Microsoft Corporation. All rights reserved.

```
C:\Users\ravik>node -v
v14.17.3

C:\Users\ravik>npm -v
6.14.13

C:\Users\ravik>
```

**Figure 5-4.** Node.js and npm version in PC

## Cross-Origin Resource Sharing (CORS) Error

When you work on a front-end application in React that connects to a RESTful web service written in Spring Boot, you may get a CORS error whenever you make the request in your browser. Basically, this error means that the user agent (<http://localhost:3000>) doesn't have sufficient required permissions to access Spring Boot resources (<http://localhost:5000>).

The solution to this error required an update in the Spring Boot application to enable cross-origin requests for a RESTful web service. You must annotate the Controller class with `@CrossOrigin` annotation to support global CORS configuration, as shown in Listing 5-2. And, by default, all origins and the GET, HEAD, and POST HTTP methods are allowed.

***Listing 5-2.*** \src\main\java\com\apress\AWS\controller\UserRegistrationController.java

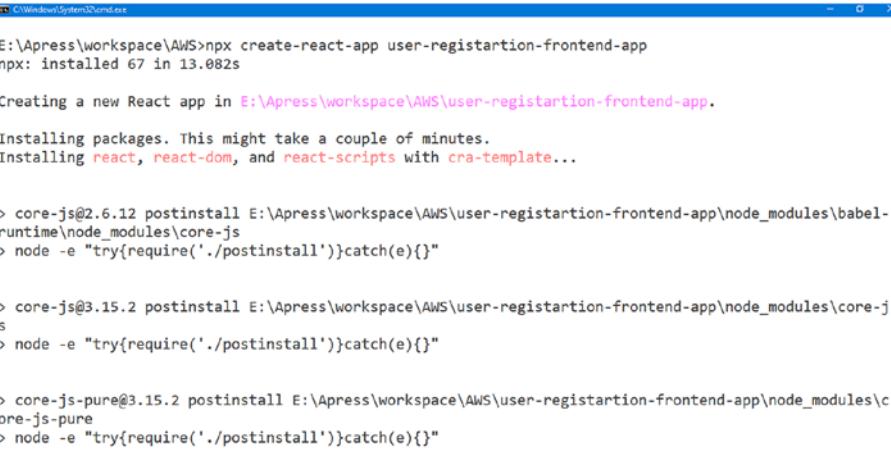
```
@CrossOrigin  
@RestController  
@RequestMapping("/api/")  
public class UserRegistrationController {
```

After updating the Controller class, Maven builds and runs the `UserRegistrationApp` Spring Boot application. And, also make sure that `UserRegistrationApp` should always be running when developing the front-end application using React.

## Developing React Front-End Application with `create-react-app`

The `create-react-app` package makes developing React front-end applications a breeze. To create a React app using `create-react-app`, open a command prompt in the folder where you want to save the project folder and run the following `npx` command (see Figure 5-5).

```
npx create-react-app user-registartion-frontend-app
```



```
C:\Windows\System32\cmd.exe  
E:\Apress\workspace\AWS>npx create-react-app user-registartion-frontend-app  
npx: installed 67 in 13.082s  
  
Creating a new React app in E:\Apress\workspace\AWS\user-registartion-frontend-app.  
  
Installing packages. This might take a couple of minutes.  
Installing react, react-dom, and react-scripts with cra-template...  
  
> core-js@2.6.12 postinstall E:\Apress\workspace\AWS\user-registartion-frontend-app\node_modules\babel-runtime\node_modules\core-js  
> node -e "try{require('./postinstall')}catch(e){}"  
  
> core-js@3.15.2 postinstall E:\Apress\workspace\AWS\user-registartion-frontend-app\node_modules\core-js  
> node -e "try{require('./postinstall')}catch(e){}"  
  
> core-js-pure@3.15.2 postinstall E:\Apress\workspace\AWS\user-registartion-frontend-app\node_modules\core-js-pure  
> node -e "try{require('./postinstall')}catch(e){}"
```

**Figure 5-5.** *npx command to create a React app using `create-react-app`*

Once the `npx` command has run successfully, a folder named `user-registration-frontend-app` is created, as shown in Figure 5-6; all the required packages are automatically installed.

## CHAPTER 5 DEPLOY A FULL STACK SPRING BOOT REACT APPLICATION IN AWS AND S3

```
C:\Windows\System32\cmd.exe
Success! Created user-registartion-frontend-app at E:\Apress\workspace\AWS\user-registartion-frontend-a
pp
Inside that directory, you can run several commands:

npm start
  Starts the development server.

npm run build
  Bundles the app into static files for production.

npm test
  Starts the test runner.

npm run eject
  Removes this tool and copies build dependencies, configuration files
  and scripts into the app directory. If you do this, you can't go back!

We suggest that you begin by typing:

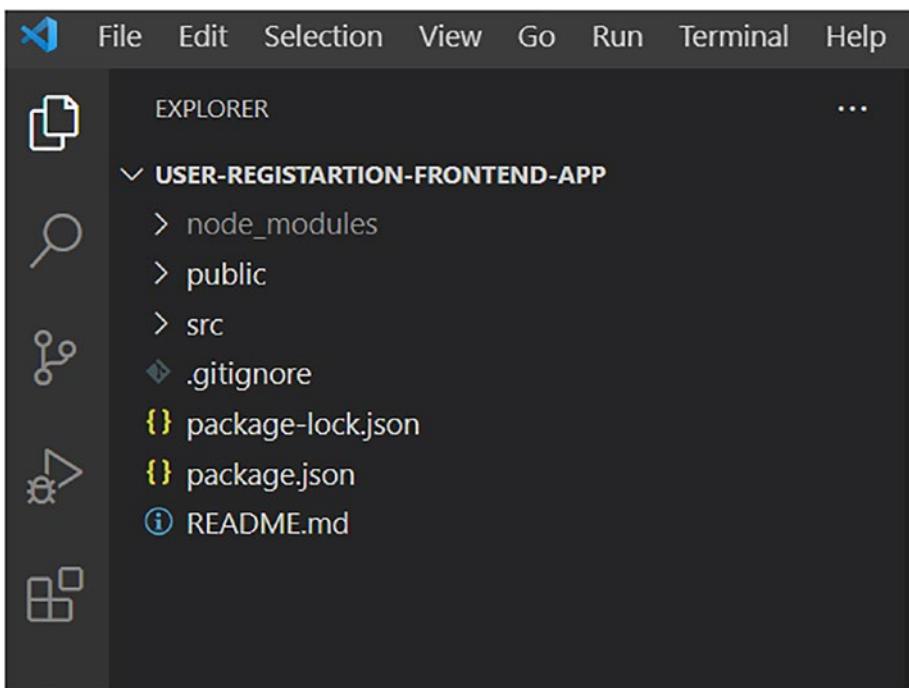
cd user-registartion-frontend-app
npm start

Happy hacking!
E:\Apress\workspace\AWS>
```

**Figure 5-6.** Successfully created user-registration-frontend-app

## Review the Project Structure

Once the React project has been created and all the required dependencies have been installed, open the project in Visual Studio. The project structure should look like as shown in Figure 5-7.



**Figure 5-7.** Project structure in Visual Studio

The project structure contains the following files and folders.

- The README.md file is a markdown file that includes a lot of helpful information.
- The package.json file manages the app's required dependencies and the scripts needed to run it.
- The .gitignore file excludes desired files and folders from being tracked by Git. Generally, you exclude large folders like the node\_modules folder.
- The src folder contains React-related source code and all the components that you develop.

- The `App.js` file in the `src` folder is a root component of the React application.
- The `index.js` file is the top render file of the React application. You import App components using the `ReactDOM.render()` method in the `index.js` file.
- The `public` folder stores static assets, such as fonts and images, for the React app.
  - The `index.html` file is in the `public` folder. The React application uses this single file to render all the components. This supports the principle of a single-page application.
- The `node_modules` folder contains all the packages installed with Node.js and npm.

## Run a React App

To build the React app, the following files must exist with the exact filenames.

- `public/index.html` is the only HTML file in the entire project. This HTML file is a template, and it is loaded first when the application starts.
  - Only those files which are there in the `public` folder can be used from `public/index.html`.
  - This file contains a line of code `<div id="root"></div>`, which signifies that all the React app components are loaded into this div.
- `src/index.js` is the JavaScript entry point.
- The `src/App.js` is the `App` component, which is the main component in React; it acts as a container for all the other components.

To start the React app, open the command prompt at `user-registration-frontend-app`, which is a newly created folder, and run the `npm start` command, as shown in Figure 5-8.



```
Microsoft Windows [Version 10.0.19042.1083]
(c) Microsoft Corporation. All rights reserved.

E:\Apress\workspace\AWS\user-registartion-frontend-app>npm start
> user-registartion-frontend-app@0.1.0 start E:\Apress\workspace\AWS\user-registartion-frontend-app
> react-scripts start
```

**Figure 5-8.** *npm start command to start React app*

A success message should appear in the command prompt, as shown in Figure 5-9.



```
Windows PowerShell
Compiled successfully!

You can now view user-registartion-frontend-app in the browser.

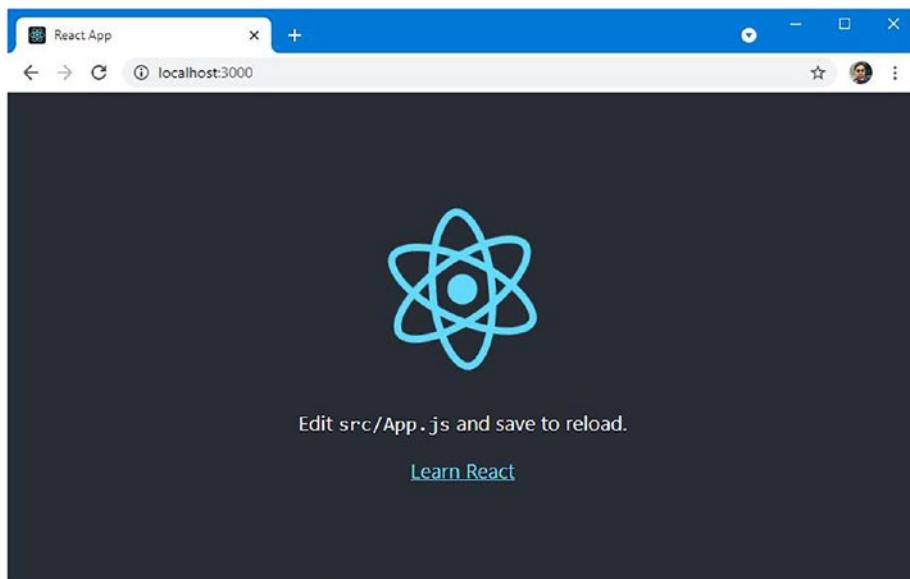
Local:          http://localhost:3000
On Your Network:  http://192.168.1.2:3000

Note that the development build is not optimized.
To create a production build, use npm run build.
```

**Figure 5-9.** *Compiled success message on command prompt*

This started the development server on `localhost:3000`. The great thing about this development server is that the server automatically refreshes to reflect the changes, and there is no need to refresh the browser manually.

You can view the application in the browser by hitting the URL (`http://localhost:3000`), as shown in Figure 5-10.



**Figure 5-10.** Home page for React app

Congratulations! You have successfully created a base source code for the React application to add more components as needed. This app content comes from the `src/App.js` file, which contains the code shown in Listing 5-3.

**Listing 5-3.** `src/App.js`

```
import logo from './logo.svg';
import './App.css';

function App() {
  return (
    <div className="App">
      <header className="App-header">
        <img src={logo} className="App-logo" alt="logo" />
        <p>
```

```
        Edit <code>src/App.js</code> and save to reload.  
</p>  
<a  
    className="App-link"  
    href="https://reactjs.org"  
    target="_blank"  
    rel="noopener noreferrer"  
>  
    Learn React  
</a>  
</header>  
</div>  
)  
}  
  
export default App;
```

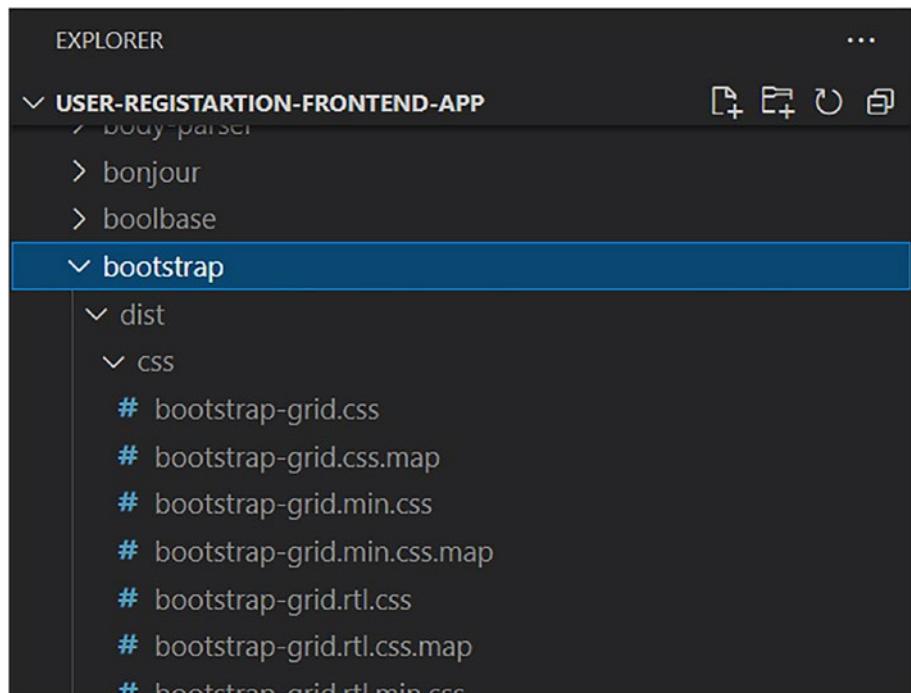
To support CRUD operation, let's create the following additional files in the React application.

- `src/services/user-registration.service.js`
- `src/components/add-user.component.js`
- `src/components/home.component.js`
- `src/components/list-users.component.js`

## Add Twitter Bootstrap to Style the React App with CSS

By default, `create-react-app` comes with CSS support by providing an `App.css` file in the `src` folder, where you can add some style to improve appearance. Twitter Bootstrap is a front-end CSS framework that can style a website's contents.

Open the command prompt, and run the `npm install bootstrap` command, which installs Bootstrap in the `node_modules` folder, as shown in Figure 5-11.



**Figure 5-11.** Bootstrap installed in `node_modules` folder

To import Twitter Bootstrap into the React app, open the `src/App.js` file and modify the code, as shown in Listing 5-4.

***Listing 5-4.*** src/App.js

```
import './App.css';
import 'bootstrap/dist/css/bootstrap.min.css'

function App() {
    // ...
}
```

## Add a Navbar

Let's add a navbar to the App component, which is the root container for the React application. Update the `src/App.js` file with the code shown in Listing 5-5.

***Listing 5-5.*** src/App.js

```
import './App.css';
import 'bootstrap/dist/css/bootstrap.min.css'

function App() {
    return (
        <div className="App">
            <header className="App-header1">
                <div class="page-header text-center">
                    <h2>User Registration App</h2>
                </div>
            </header>
            <div class="container-fluid">
                <nav class="navbar bg-primary justify-content-center">
                    <div class="col-sm"></div>
                    <a href="/" class="col-sm btn btn-outline-light">
```

```
        role="button">
Home
</a>
<div class="col-sm"></div>
<a href="/list-all-users"
    class="col-sm btn btn-outline-light"
    role="button">
List All Users
</a>
<div class="col-sm"></div>
<a href="/add-user"
    class="col-sm btn btn-outline-light"
    role="button">
Add User
</a>
<div class="col-sm"></div>
</nav>
</div>
</div>
);
}

export default App;
```

## Add react-router

Routing is a process that redirects users to different pages based on their request or action. The react-router package is a standard library system built on top of React and defines multiple routes using react-router in single-page web applications. When a user enters a specific URL in a browser, and the URL path matches a defined route, the user is routed to it.

By default, React doesn't come with routing. And, you need to add a react-router library in the project to enable routing. Open the command prompt and run the following command to install react-router.

```
npm install react-router-dom
```

Since you have successfully installed react-router, let's use it in the application.

## BrowserRouter Object to Enable Routing

BrowserRouter uses the HTML5 history API to keep your user interface in sync with the URL. It is used in client-side routing with URL segments.

First, you need to import BrowserRouter from react-router-dom to enable routing in the project. Open and update `src/index.js` to wrap app components with the BrowserRouter object, as shown in Listing 5-6.

### ***Listing 5-6.*** `src/index.js`

```
import React from 'react';
import ReactDOM from 'react-dom';
import './index.css';
import App from './App';
import reportWebVitals from './reportWebVitals';
import { BrowserRouter } from "react-router-dom";

ReactDOM.render(
  <BrowserRouter>
    <App />
  </BrowserRouter>,
  document.getElementById('root')
);
reportWebVitals();
```

## Switch and Route to Render Routes

Switch renders a route exclusively and helps with switching between pages without reloading it. Every route that matches the component and path renders inclusively.

The path property defines the path of the route; for example, / defines the path of the home page. Route loads the defined component; for example, it loads the home component. Update the src/App.js file with the source code shown in Listing 5-7.

**Listing 5-7.** Update src/App.js with react-router

```
import './App.css';
import React, {components} from 'react';
import { Switch, Route } from 'react-router-dom';
import 'bootstrap/dist/css/bootstrap.min.css'

import ListUsers from './components/list-users.component';
import Home from './components/home.component';
import AddUser from './components/add-user.component';

function App() {
  return (
    <div className="App">
      <header className="App-header1">
        <div class="page-header text-center">
          <h2>User Registration App</h2>
        </div>
      </header>
      <br/>
      <div class="container-fluid">
        <nav class="navbar bg-primary justify-content-center">
          <div class="col-sm"></div>
          <a href="/"
```

```
        class="col-sm btn btn-outline-light"
        role="button">
    Home
  </a>
<div class="col-sm"></div>
<a href="/list-all-users"
    class="col-sm btn btn-outline-light"
    role="button">
    List All Users
  </a>
<div class="col-sm"></div>
<a href="/add-user"
    class="col-sm btn btn-outline-light"
    role="button">
    Add User
  </a>
<div class="col-sm"></div>
</nav>
<br/>
<div className="container mt-3">
  <Switch>
    <Route exact path={["/"]} component={Home} />
    <Route exact path={["/list-all-users"]}
      component={ListUsers} />
    <Route exact path={["/add-user"]}
      component={AddUser} />
  </Switch>
</div>
</div>
</div>
);
}

export default App;
```

Three routes are defined in the React application.

- / for the home page
- /list-all-users for the List All Users page
- /add-user for the Add User page

## Initialize Axios for a REST API Call

React is a JavaScript library that builds user interfaces. It is not concerned with HTTP. To make HTTP or REST API calls, you need to use a third-party HTTP library. Here, you use the Axios HTTP library.

Axios is a promise-based HTTP client that allows you to make an HTTP request to a given endpoint and has good defaults to work with JSON. To set up Axios with React, you need to install Axios with npm. Open the command prompt and run the `npm install axios` command. Let's create an `http-common.js` file in the `src` folder, as shown in Listing 5-8.

### ***Listing 5-8.*** src/http-common.js

```
import axios from "axios";

export default axios.create({
  baseURL: "http://localhost:5000/api/",
  headers: {
    "Content-type": "application/json"
  },
});
```

Depending on the URL of REST API, you can update `baseURL` in the file.

## Data Service to Send an HTTP Request

Next, create a data service that uses Axios to send HTTP requests to the REST API. Let's create a service folder in the `src` folder and a `user-registration.service.js` file in that folder, as shown in Listing 5-9.

***Listing 5-9.*** `src/user-registration.service.js`

```
import http from '../http-common';

class UserDataService {

    getAllUsers() {
        return http.get("/users");
    }

    createUser(user) {
        return http.post("/user/save", user);
    }

    deleteUser(id) {
        return http.delete(`/user/delete/id/${id}`);
    }
}

export default new UserDataService();
```

`UserDataService` defines three methods: `getAllUsers`, `createUser`, and `deleteUser`. The Axios `get`, `post`, and `delete` methods are called corresponding to the HTTP GET, POST, and DELETE methods to make a CRUD operation.

## Create React Components Corresponding to Routes

Create three components corresponding in the `src/components` subfolder to the three routes defined before.

## Home Component

Let's create the Home component, which displays welcome messages along with a navigation bar. Listing 5-10 shows the code for the home component.

**Listing 5-10.** src/components/home.component.js

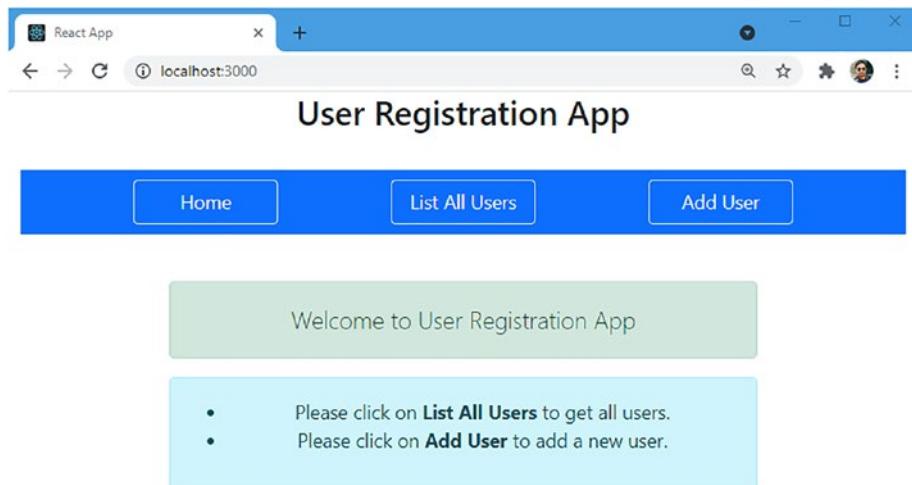
```
import React, { Component } from "react";

export default class Home extends Component {
  render() {
    return (
      <div class="container">
        <div class="panel panel-default">
          <div class="alert alert-success">
            <span class="lead">
              Welcome to User Registration App
            </span>
          </div>
          <div class="panel-body ">
            <div class="alert alert-info">
              <ul>
                <li>
                  Please click on
                  <strong> List All Users </strong>
                  to get all users.
                </li>
                <li>
                  Please click on
                  <strong> Add User </strong>
                  to add a new user.
                </li>
              </ul>
            </div>
          </div>
        </div>
      </div>
    );
  }
}
```

```
        </li>
      </ul>
    </div>
  </div>
</div>
);
}
}
```

In this component, you create a Home class that extends the Component class, which contains a render() method that returns HTML code containing a welcome message.

When you save this home component file, the content on the browser is automatically refreshed. The result in the browser is shown in Figure 5-12.



**Figure 5-12.** User registration app home page

## Add Users Component

Let's create another component to add a new user in the components. This component has a form to submit a new user with four fields: First Name, Last Name, Age, and Address. Listing 5-11, 5-12, 5-13 and 5-14 shows the pieces of code for the add-user component.

***Listing 5-11.*** Imports in src/components/add-user.component.js

```
import React, { Component } from "react";
import userRegistrationService from "../services/user-
registration.service";
```

Here, we have imported React and Component from "react" and user-registration-service.

***Listing 5-12.*** Constructor and State in AddUser Class in src/components/add-user.component.js

```
export default class AddUser extends Component {

  constructor(props) {
    super(props);

    this.onChangeFirstName = this.onChangeFirstName.
      bind(this);
    this.onChangeLastName = this.onChangeLastName.bind(this);
    this.onChangeAge = this.onChangeAge.bind(this);
    this.onChangeAddress = this.onChangeAddress.bind(this);
    this.handleSubmit = this.handleSubmit.bind(this);
    this.newUser = this.newUser.bind(this);

    this.state = {
      id: null,
      firstName: "",
```

```
    lastName: "",  
    age: "",  
    address: "",  
    createdDate: ""  
};  
}
```

In the preceding code, the `AddUser` class extends `components`. The constructor of this class sets the initial state for `id`, `firstName`, `lastName`, `age`, `address`, and `createdDate` with a default value. Also, we bound it to different events, such as `onChangeFirstName`, `handleSubmit`, and so on.

***Listing 5-13.*** Functions in `AddUser` Class in `src/components/add-user.component.js`

```
onChangeFirstName(event) {  
    this.setState({  
        firstName: event.target.value  
    });  
}  
  
onChangeLastName(event) {  
    this.setState({  
        lastName: event.target.value  
    });  
}  
  
onChangeAge(event) {  
    this.setState({  
        age: event.target.value  
    });  
}
```

```
onChangeAddress(event) {
    this.setState({
        address: event.target.value
    });
}

handleSubmit(event) {
    console.log(this.state)

    var data = {
        firstName: this.state.firstName,
        lastName: this.state.lastName,
        age: this.state.age,
        address: this.state.address
    };

    event.preventDefault();

userRegistrationService.createUser(data)
    .then(response => {
        alert('You submitted successfully! ' + data.
        firstName + ' User is created');
        this.setState({
            id: response.data.id,
            firstName: response.data.firstName,
            lastName: response.data.lastName,
            age: response.data.age,
            address: response.data.address
        });
        this.props.history.push("/list-all-users");
    })
}
```

```
.catch(e => {
    console.log(e);
});
}

newUser() {
    this.setState({
        id: null,
        firstName: "",
        lastName: "",
        age: "",
        address: "",
        createdDate: ""
    });
}
}
```

Four functions (`onChangeFirstName`, `onChangeLastName`, `onChangeAge`, `onChangeAddress`) are created to track the input value and set the state for changes. A function named `handleSubmit` is defined to get the value of the form (state) and call the `createUser()` method of `userRegistrationService`, which internally sends HTTP POST requests to the REST API.

***Listing 5-14.*** Render Method to Return HTML Code

```
render() {
    return (
        <div className="submit-form">
            <div className="form-group">
                <label htmlFor="firstName">First Name
                </label>
                <input
                    type="text"

```

```
        className="form-control"
        id="firstName"
        required
        value={this.state.firstName}
        onChange={e => this.
        onChangeFirstName(e)}
        name="firstName"

    />
</div>

<div className="form-group">
    <label htmlFor="lastName">Last Name</label>
    <input
        type="text"
        className="form-control"
        id="lastName"
        required
        value={this.state.lastName}
        onChange={e => this.
        onChangeLastName(e)}
        name="lastName"

    />
</div>

<div className="form-group">
    <label htmlFor="age">Age</label>
    <input
        type="text"
        className="form-control"
        id="age"
        required
        value={this.state.age}
```

## CHAPTER 5 DEPLOY A FULL STACK SPRING BOOT REACT APPLICATION IN AWS AND S3

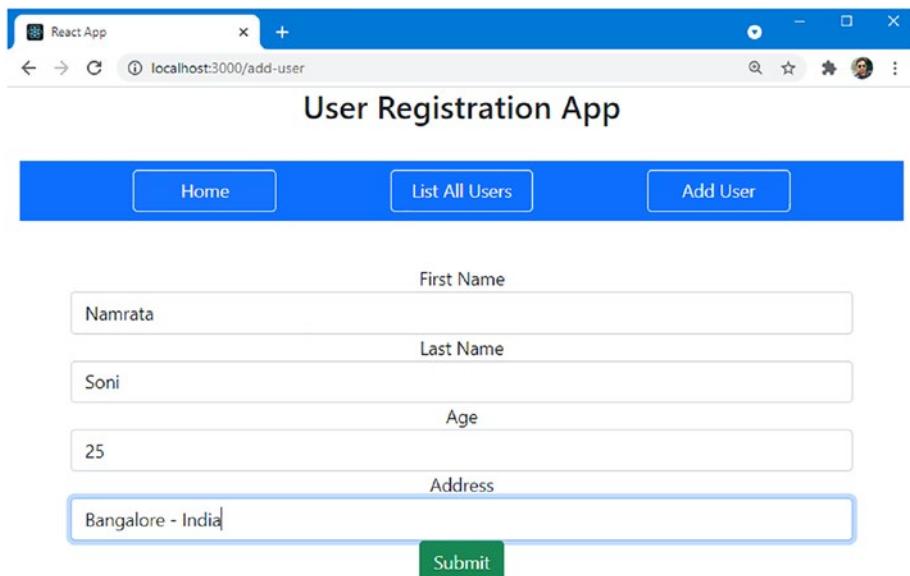
```
        onChange={e => this.onChangeAge(e)}
        name="age"
    />
</div>

<div className="form-group">
    <label htmlFor="address">Address</label>
    <input
        type="text"
        className="form-control"
        id="address"
        required
        value={this.state.address}
        onChange={e => this.onChangeAddress(e)}
        name="address"
    />
</div>

<button onClick={this.handleSubmit}
    className="btn btn-success">
    Submit
</button>
</div>
)
}

}
```

Here, the render method results in UI. AddUser contains input boxes for the first name, last name, age, and address, and it contains the Submit button for creating a new user, as shown in Figure 5-13.



**Figure 5-13.** Page to add new user

## List All Users Component

Let's create another component to list all the users in the components subfolder. This component has a *user array* to display a list of users in the table, and each row has a Delete button to delete specific users from the list. Listing 5-15 and 5-16 shows the pieces of code for the list-user component.

**Listing 5-15.** Imports, Constructor, State, and Functions in UsersList Class in src/components/list-users.component.js

```
import React, { Component } from "react";
import UserDataService from '../services/user-registration.
service';

export default class UsersList extends Component {
  constructor(props) {
    super(props);
```

## CHAPTER 5 DEPLOY A FULL STACK SPRING BOOT REACT APPLICATION IN AWS AND S3

```
    this.retrieveUsers = this.retrieveUsers.bind(this);
    this.deleteUser = this.deleteUser.bind(this);
    this.state = {
      users: []
    };
}

componentDidMount() {
  this.retrieveUsers();
}

retrieveUsers() {
  UserDataService.getAllUsers()
    .then(response => {
      this.setState({
        users: response.data
      });
      console.log(response.data);
    })
    .catch(e => {
      console.log(e.target);
    });
}

deleteUser(user, index) {
  UserDataService.deleteUser(user.id)
    .then(response => {
      alert('Deleted successfully! ' + user.
        firstName);
      this.retrieveUsers();
    })
}
```

```
    .catch(e => {
      console.log(e.target);
    });
}
```

The `UsersList` class extends the `Components` class. `React`, `Component`, and `user-registration-service` import as `UserDataService`. We defined the constructor of this class that sets the initial state for the `users` array. Also, we bound this to the different events such as `retrieveUsers` and `deleteUser`.

The `retrieveUsers` function is defined to get the list of users by calling the `getAllUsers()` method of `UserDataService`, which internally sends HTTP GET requests to the REST API. A function named `deleteUser` is defined to delete users by calling the `deleteUser()` method of `UserDataService`, which internally sends HTTP DELETE requests to the REST API. The `componentDidMount()` method immediately executes the React code after a component is mounted (placed in the DOM).

#### ***Listing 5-16.*** Render Method to Return HTML Code

```
render() {
  const { users } = this.state;

  return (
    <table class="table table-hover">
      <caption>List of users</caption>
      <thead class="thead-dark">
        <tr>
          <th scope="col">#</th>
          <th scope="col">First Name</th>
          <th scope="col">Last Name</th>
          <th scope="col">Age</th>
          <th scope="col">Address</th>
          <th scope="col">Delete</th>
        </tr>
      <tbody>
        {users.map(user => (
          <tr>
            <td>{user.id}</td>
            <td>{user.firstName}</td>
            <td>{user.lastName}</td>
            <td>{user.age}</td>
            <td>{user.address}</td>
            <td>
              <a href="#" onClick={() => this.deleteUser(user.id)}>Delete</a>
            </td>
          </tr>
        ))}
      </tbody>
    </table>
  );
}
```

```
</tr>
</thead>
<tbody>
{users && users.map((user, index) => (
  <tr>
    <th scope="row">{index+1}</th>
    <td>{user.firstName}</td>
    <td>{user.lastName}</td>
    <td>{user.age}</td>
    <td>{user.address}</td>
    <td>
      <button type="button"
        onClick={() => this.
          deleteUser(user,
          index)}
        class="btn btn-danger
        custom-width"
        key={index}
      >
        <span class="glyphicon
        glyphicon-remove">
          Delete
        </span>
      </button>
    </td>
  </tr>
))
);
</tbody>
</table>
);
}
}
```

The render method results in a UI. The List of Users page displays a user list in a table. It also contains a Delete button for each user's row in a table, as shown in Figure 5-14.

#	First Name	Last Name	Age	Address	Delete
1	Ravi	Soni	34	Sasaram-Bihar-India	<button>Delete</button>
2	Namrata	Soni	25	Bangalore - India	<button>Delete</button>

**Figure 5-14.** List all users along with a delete user option

Even though you added only one user in the previous section, the list shows two users. It's because the database already contains one user that was added in Chapter 4.

Here, clicking the Delete button deletes a specific user, as shown in Figure 5-15.

## CHAPTER 5 DEPLOY A FULL STACK SPRING BOOT REACT APPLICATION IN AWS AND S3

The screenshot shows a browser window titled "React App" with the URL "localhost:3000/list-all-users". A modal dialog box is displayed in the center, containing the message "localhost:3000 says Deleted successfully! Ravi" with an "OK" button. Below the modal, there is a table titled "List of users" with two rows of data. The first row has a "Delete" button, and the second row also has a "Delete" button.

#	First Name	Last Name	Age	Address	Delete
1	Ravi	Soni	34	Sasaram-Bihar-India	<button>Delete</button>
2	Namrata	Soni	25	Bangalore - India	<button>Delete</button>

**Figure 5-15.** Delete an existing user

After successfully deleting a specific user, the table displays an updated user list, as shown in Figure 5-16.

The screenshot shows a browser window titled "React App" with the URL "localhost:3000/list-all-users". The title bar of the browser says "User Registration App". A modal dialog box is displayed in the center, containing the message "localhost:3000 says Deleted successfully! Ravi" with an "OK" button. Below the modal, there is a table titled "List of users" with one row of data. The row has a "Delete" button.

#	First Name	Last Name	Age	Address	Delete
1	Namrata	Soni	25	Bangalore - India	<button>Delete</button>

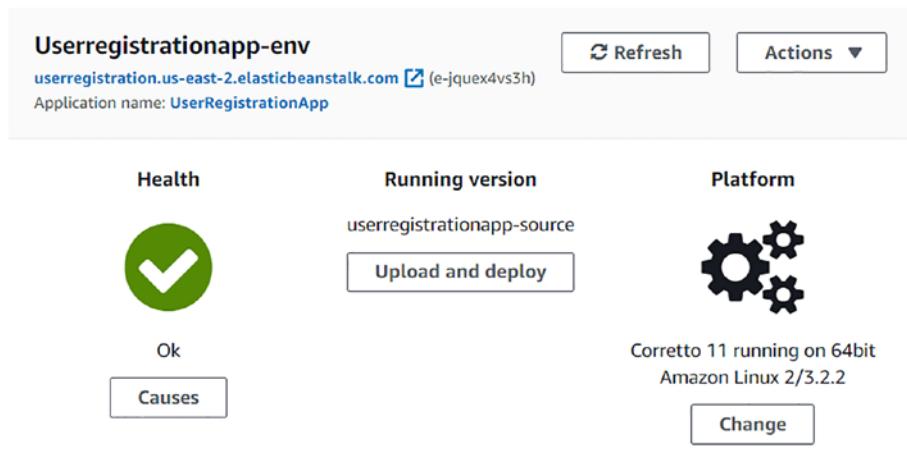
**Figure 5-16.** Updated user list after the delete operation

# Build React Code as a Front-end Application for AWS

You have successfully developed and run a user registration front-end app using React with CRUD features in your local system that consumes data from UserRegistrationApp RESTful web services that also run in the local system. To deploy the React app to AWS, you need to build React code.

## Verify the AWS Elastic Beanstalk Environment Is Up

You have updated the Spring Boot application, which should be deployed to Elastic Beanstalk. You already learned about the deployment process of the back-end application, so you need to follow the same here to complete the deployment of the UserRegistrationApp Spring Boot application. Once you have successfully deployed the updated code, you need to verify that the Elastic Beanstalk environment is up, as shown in Figure 5-17.



**Figure 5-17.** Verify that the Elastic Beanstalk environment is up

## Update BaseURL in a React App with an AWS Elastic Beanstalk Environment URL

We provided the localhost URL of the RESTful app in the React front-end app in the `src/http-common.js` file so that Axios can make a REST API call from the front end to the back end.

Now, the React front-end app should interact with the RESTful web services deployed in Elastic Beanstalk. To achieve this, open the `src/http-common.js` file and update the base URL with the Elastic Beanstalk environment URL, as shown in Listing 5-17.

***Listing 5-17.*** `src/http-common.js`

```
import axios from "axios";

export default axios.create({
  //baseURL: "http://localhost:5000/api/",
  baseURL: "http://userregistration.us-east-2.elasticbeanstalk.
  com/api/",
  headers: {
    "Content-type": "application/json"
  },
});
```

Before building, let's verify the changes locally. Once you access the List All Users page in the browser, you can see the result from AWS, as shown in Figure 5-18.

## CHAPTER 5 DEPLOY A FULL STACK SPRING BOOT REACT APPLICATION IN AWS AND S3

The screenshot shows a browser window titled "React App" with the URL "localhost:3000/list-all-users". The page title is "User Registration App". Below the title is a navigation bar with three buttons: "Home", "List All Users" (which is active), and "Add User". The main content area displays a table of user data:

#	First Name	Last Name	Age	Address	Delete
1	Namrata	Soni	25	Bangalore - India	<button>Delete</button>
2	Manorma	Devi	52	Sasaram - Rohtas -Bihar - India	<button>Delete</button>

Below the table, the text "List of users" is displayed.

**Figure 5-18.** React app interact with RESTful web services deployed in Elastic Beanstalk

To cross verify the changes, open Developers Tools in a browser and validate the request URL, as shown in Figure 5-19, for the POST method to create a new user.

The screenshot shows the "General" tab of browser developer tools with the following details:

- Request URL: `http://userregistration.us-east-2.elasticbeanstalk.com/api/user/save`
- Request Method: POST
- Status Code: 200
- Remote Address: 3.139.48.80:80
- Referrer Policy: strict-origin-when-cross-origin

Below these details are sections for "Response Headers" (10) and "Request Headers" (10). Under "Request Payload", the JSON data sent to the server is shown:

```
{firstName: "Manorma", lastName: "Devi", age: "52", address: "Sasaram - Rohtas -Bihar - India"}  
address: "Sasaram - Rohtas -Bihar - India"  
age: "52"  
firstName: "Manorma"  
lastName: "Devi"
```

**Figure 5-19.** Validate the Request URL in browser Developer Tools

## Build React Code for AWS Deployment

You have made the required changes in the React app and verified those changes to confirm that the React app interacts with RESTful web services deployed in AWS. Now, you would like to deploy this React front-end app to the AWS server. You need to create a build for the React app.

To create a build, you need to stop the React app and execute the following `npm` command in the command prompt.

```
E:\Apress\workspace\AWS\user-registartion-frontend-app>npm run build
```

Once you run the build command, a folder named `build` is created in the React app, and it is populated with an optimized production build, as shown in Figure 5-20.

## CHAPTER 5 DEPLOY A FULL STACK SPRING BOOT REACT APPLICATION IN AWS AND S3

```
C:\Windows\System32\cmd.exe
E:\Apress\workspace\AWS\user-registartion-frontend-app>npm run build
> user-registartion-frontend-app@0.1.0 build E:\Apress\workspace\AWS\user-registartion-frontend-app
> react-scripts build

Creating an optimized production build...
Compiled with warnings.

src\App.js
  Line 1:8:  'logo' is defined but never used      no-unused-vars
  Line 4:16: 'components' is defined but never used no-unused-vars

Search for the keywords to learn more about each warning.
To ignore, add // eslint-disable-next-line to the line before.

File sizes after gzip:

 54.7 KB  build\static\js\2.ca8d8efc.chunk.js
 22.53 KB build\static\css\2.4be38407.chunk.css
  2.04 KB  build\static\js\main.97751018.chunk.js
  1.64 KB  build\static\js\3.22a24324.chunk.js
  1.18 KB  build\static\js\runtime-main.6fb86437.js
   556 B    build\static\css\main.a617e044.chunk.css

The project was built assuming it is hosted at /.
You can control this with the homepage field in your package.json.

The build folder is ready to be deployed.
You may serve it with a static server:

  npm install -g serve
  serve -s build

Find out more about deployment here:
  https://cra.link/deployment

E:\Apress\workspace\AWS\user-registartion-frontend-app>
```

**Figure 5-20.** Build React app using npm command

So, now the build folder is ready. It contains a static folder and the asset-manifest.json, favicon.ico, index.html, manifest.json, logo.png, and robots.txt files, as shown in Figure 5-21.

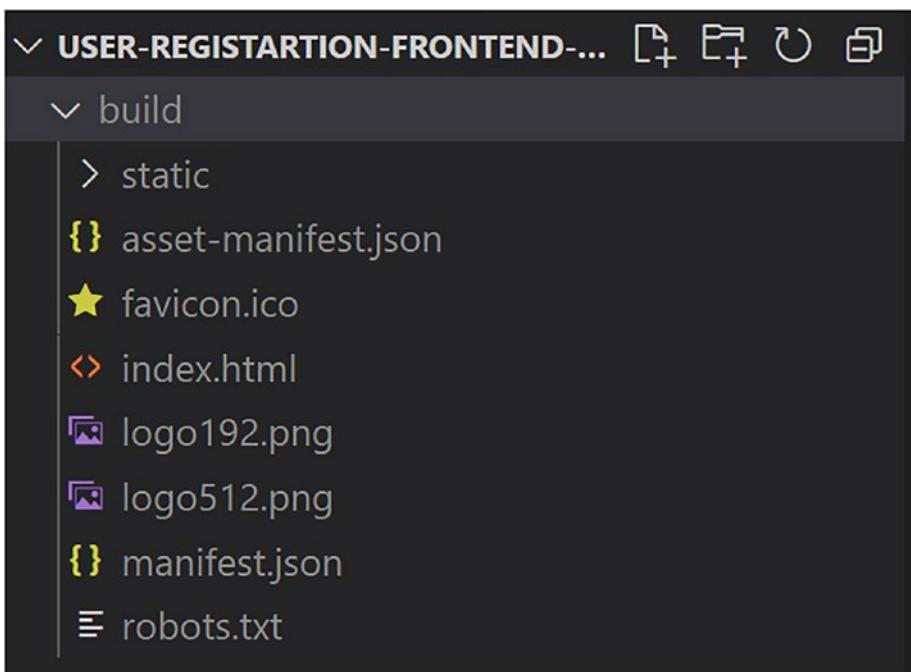


Figure 5-21. The build folder in React app

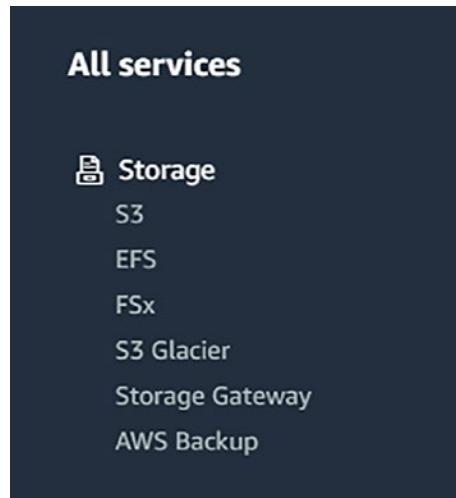
## Deploy a React Front-End to AWS S3: Hosting a Static Website

In the previous section, you built a React front-end app that you want to deploy in AWS S3.

### Introduction to S3: Simple Storage Service in AWS

S3 stands for Simple Storage Service, which is scalable storage in the cloud. S3 is basically an object-store.

Log in to AWS Console Management, and click the **All service** hyperlink at the top, and you find S3 under the Storage category, as shown in Figure 5-22.



**Figure 5-22.** S3 service under Storage category on AWS

Clicking S3 brings you to the page containing the bucket's details, as shown in Figure 5-23.

A screenshot of the Amazon S3 'Buckets' page. At the top left is the 'Amazon S3' logo. In the top right are buttons for 'View Storage Lens dashboard' and 'Create bucket'. Below this is a 'Account snapshot' section with a link to 'Storage lens provides visibility into storage usage and activity trends. Learn more'. On the far right of the top bar are buttons for 'Copy ARN', 'Empty', 'Delete', and 'Create bucket'. The main area shows a table of buckets. The first row is a header with columns: 'Name', 'AWS Region', 'Access', and 'Creation date'. Below it is a single data row for a bucket named 'elasticbeanstalk-us-east-2-818371255049'. The 'Name' column shows a radio button icon, the 'AWS Region' column shows 'US East (Ohio) us-east-2', the 'Access' column shows 'Objects can be public', and the 'Creation date' column shows 'March 24, 2021, 19:03:55 (UTC+05:30)'. To the left of the table is a search bar with the placeholder 'Find buckets by name' and navigation icons for 'Find', 'Copy ARN', 'Empty', 'Delete', and 'Create bucket'.

**Figure 5-23.** Buckets details on Amazon S3

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A *bucket* is a collection of objects that are files belonging to that container. Figure 5-23 shows that a bucket is available in Amazon S3.

Figure 5-24 shows that this bucket contains all the JARS that you deployed in previous chapters, as shown in.

The screenshot shows the Amazon S3 console interface. At the top, it displays the path "Amazon S3 > elasticbeanstalk-us-east-2-818371255049". Below this, the bucket name "elasticbeanstalk-us-east-2-818371255049" is shown with a "Info" link. A navigation bar below the bucket name includes tabs for "Objects" (which is selected), "Properties", "Permissions", "Metrics", "Management", and "Access Points".

The main area is titled "Objects (9)". It contains a table with the following data:

	Name	Type	Last modified	Size	Storage class
<input type="checkbox"/>	.elasticbeanstalk	elasticbeanstalk	March 24, 2021, 19:03:49 (UTC+05:30)	0 B	Standard
<input type="checkbox"/>	20210841VS-awsSpringBoot-0.0.1-SNAPSHOT.jar	jar	March 25, 2021, 17:45:57 (UTC+05:30)	16.3 MB	Standard
<input type="checkbox"/>	2021180gqa-HelloSpringBoot-0.0.1-SNAPSHOT.jar	jar	June 30, 2021, 00:13:03 (UTC+05:30)	24.4 MB	Standard

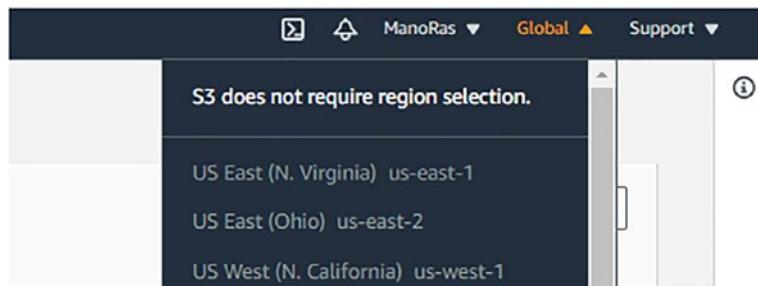
Below the table, there are several buttons: "Upload" (orange), "Copy S3 URI", "Copy URL", "Download", "Open", "Delete", "Actions", and "Create folder". There is also a search bar labeled "Find objects by prefix" and some pagination controls.

**Figure 5-24.** Bucket contains JARs

AWS fetches all the required JARs from S3, which you can think of as primarily a storage service in AWS. If you want to store something like a backup file, archival file, data staging, or logs file, you use S3 in AWS.

S3 can also serve static websites, and that is the feature which you deploy React applications. S3 provides high durability and high availability.

While buckets are associated with regions, when you use S3, you are in a global space that means a global service, and you are not really selecting a region, as shown in Figure 5-25.



**Figure 5-25.** Selecting S3 means global service

Next, you deploy the React app in AWS S3.

## Create a Bucket

Open the **Create bucket** page, as shown in Figure 5-26.

A screenshot of the "Create bucket" page in the AWS S3 console. The URL is "Amazon S3 > Create bucket".

**Create bucket** Info  
Buckets are containers for data stored in S3. [Learn more](#)

**General configuration**

**Bucket name**  
 Bucket name must be unique and must not contain spaces or uppercase letters. [See rules for bucket naming](#)

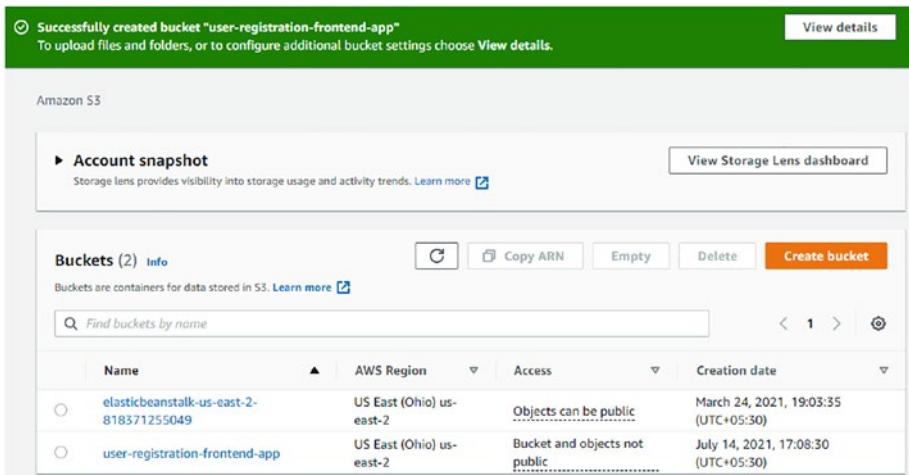
**AWS Region**

**Copy settings from existing bucket - optional**  
Only the bucket settings in the following configuration are copied.

**Figure 5-26.** Creating UserRegistrationApp using Spring Initializr

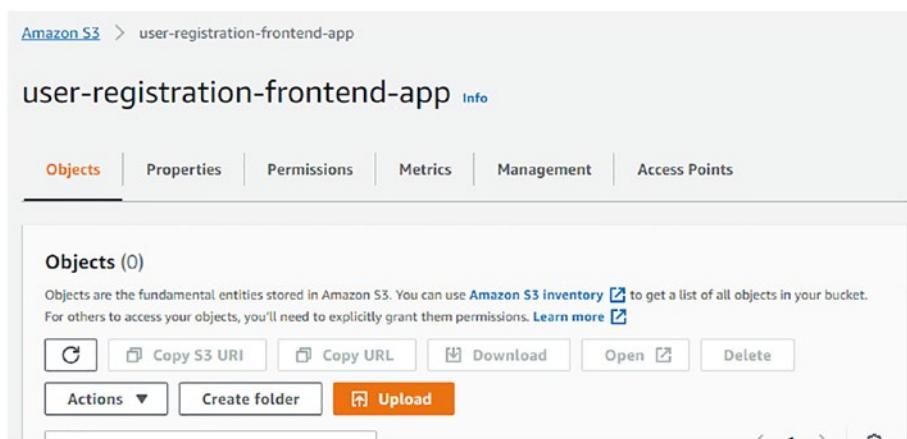
## CHAPTER 5 DEPLOY A FULL STACK SPRING BOOT REACT APPLICATION IN AWS AND S3

Here, you need to provide general configuration information. While entering the bucket name, across AWS, the Bucket name should be globally unique. Enter **user-registration-frontend-app** in Bucket name, leave the other options on the page as is, and then click the **Create bucket** button. You should get a success message, as shown in Figure 5-27.



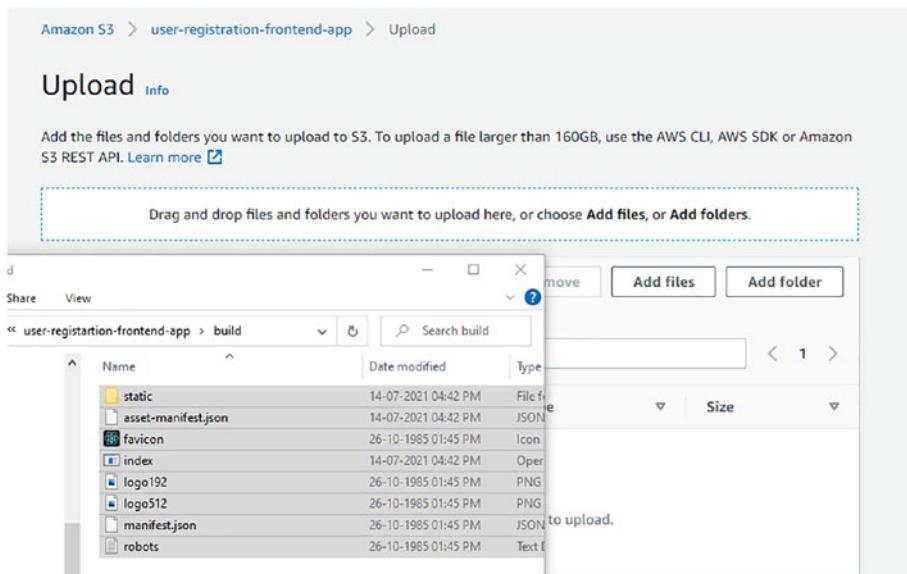
**Figure 5-27.** Creating UserRegistrationApp using Spring Initializr

Here, you can see that two buckets were created in AWS S3. Click the newly created bucket named **user-registration-frontend-app**, which takes you to **user-registration-frontend-app**, as shown in Figure 5-28.



**Figure 5-28.** user-registration-frontend-app with object details

Here, the objects are empty because it is a newly created bucket. Click the Upload button to upload all the content from the local system in the build folder, as shown in Figure 5-29.



**Figure 5-29.** Upload files in build folder to S3 bucket

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Next, click the Upload button at the bottom of the page. Once the files are uploaded successfully, you get a success message, as shown in Figure 5-30.

The screenshot shows the AWS S3 console interface. At the top, a green banner displays the message "Upload succeeded" and "View details below". Below the banner, there are two tabs: "Files and folders" (selected) and "Configuration". The main area is titled "Files and folders (21 Total, 1.3 MB)" and contains a search bar labeled "Find by name". A table lists the uploaded files and folders:

Name	Folder	Type	Size	Status
2.4be38407.chunk.css	static/css/	text/css	155.0 KB	Succeeded
2.4be38407.chunk.css.map	static/css/	-	416.9 KB	Succeeded
2.ca8d8efc.chunk.js	static/js/	text/javascript	170.9 KB	Succeeded
2.ca8d8efc.chunk.js.LICENSE.txt	static/js/	text/plain	1.3 KB	Succeeded
2.ca8d8efc.chunk.js.map	static/js/	-	515.3 KB	Succeeded
3.22a24324.chunk.js	static/js/	text/javascript	4.3 KB	Succeeded
3.22a24324.chunk.js.map	static/js/	-	9.4 KB	Succeeded
asset-manifest.json	-	application/json	1.3 KB	Succeeded
favicon.ico	-	image/x-icon	3.8 KB	Succeeded
index.html	-	text/html	3.1 KB	Succeeded

**Figure 5-30.** Uploaded files and folder to AWS S3

Now, under the Objects tab, you see all the objects present in the user-registration-frontend-app bucket. Figure 5-31 shows the static folder and all the files you have uploaded to the bucket.

The screenshot shows the AWS S3 Objects tab. At the top, there is a search bar labeled "Find objects by prefix" and a toolbar with icons for upload, download, and other actions. The main table lists the uploaded files and folders:

Name	Type	Last modified	Size	Storage class
asset-manifest.json	json	July 14, 2021, 17:15:27 (UTC+05:30)	1.3 KB	Standard
favicon.ico	ico	July 14, 2021, 17:15:28 (UTC+05:30)	3.8 KB	Standard
index.html	html	July 14, 2021, 17:15:21 (UTC+05:30)	3.1 KB	Standard
logo192.png	png	July 14, 2021, 17:15:22 (UTC+05:30)	5.2 KB	Standard
logo512.png	png	July 14, 2021, 17:15:23 (UTC+05:30)	9.4 KB	Standard
manifest.json	json	July 14, 2021, 17:15:24 (UTC+05:30)	492.0 B	Standard
robots.txt	txt	July 14, 2021, 17:15:26 (UTC+05:30)	67.0 B	Standard
static/	Folder	-	-	-

**Figure 5-31.** Creating UserRegistrationApp using Spring Initializer

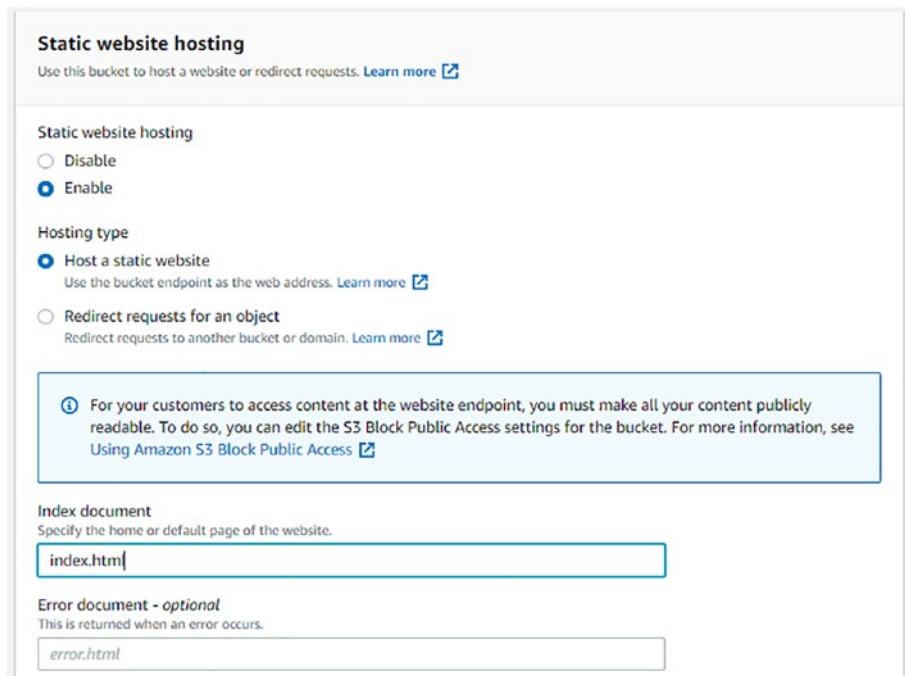
## CHAPTER 5 DEPLOY A FULL STACK SPRING BOOT REACT APPLICATION IN AWS AND S3

To host a website, go to the Properties tab, scroll down to **Static website hosting**, and then click Edit, as shown in Figure 5-32.



**Figure 5-32.** Static website hosting

Next, select **Enable** for static website hosting, select **Host a static website** as the hosting type, and enter index.html as the index document, as shown in Figure 5-33.



**Figure 5-33.** Update static website hosting details

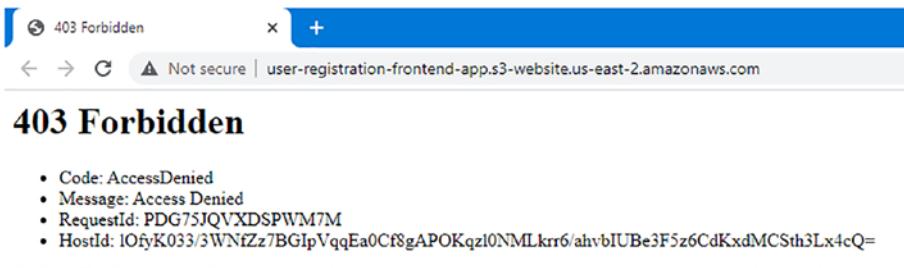
## CHAPTER 5 DEPLOY A FULL STACK SPRING BOOT REACT APPLICATION IN AWS AND S3

The index.html file was uploaded to the S3 bucket. Save the changes. Now you can find the bucket website endpoint URL in the Properties tab, as shown in Figure 5-34.



**Figure 5-34.** Bucket website endpoint URL

Clicking the bucket website endpoint URL gives a 403 Forbidden error, as shown in Figure 5-35.



**Figure 5-35.** Creating UserRegistrationApp using Spring Initializer

The Access Denied error is due to S3 security issues. By default, all the objects you have uploaded have **Block public access** in the Permissions tab, as shown in Figure 5-36.

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The screenshot shows the AWS S3 Bucket Settings page. At the top, there's a note about blocking public access for buckets and objects. Below it, the 'Edit' button is visible. The 'Block all public access' section is expanded, showing four sub-options, each with an 'On' checkbox checked. Underneath is the 'Bucket policy' section, which includes a note about bucket policies, an 'Edit' button, and a 'Delete' button.

**Block public access (bucket settings)**

Public access is granted to buckets and objects through access control lists (ACLs), bucket policies, access point policies, or all. In order to ensure that public access to all your S3 buckets and objects is blocked, turn on Block all public access. These settings apply only to this bucket and its access points. AWS recommends that you turn on Block all public access, but before applying any of these settings, ensure that your applications will work correctly without public access. If you require some level of public access to your buckets or objects within, you can customize the individual settings below to suit your specific storage use cases. [Learn more](#)

**Edit**

**Block all public access**

On

- Block public access to buckets and objects granted through *new* access control lists (ACLs)  
 On
- Block public access to buckets and objects granted through *any* access control lists (ACLs)  
 On
- Block public access to buckets and objects granted through *new* public bucket or access point policies  
 On
- Block public and cross-account access to buckets and objects through *any* public bucket or access point policies  
 On

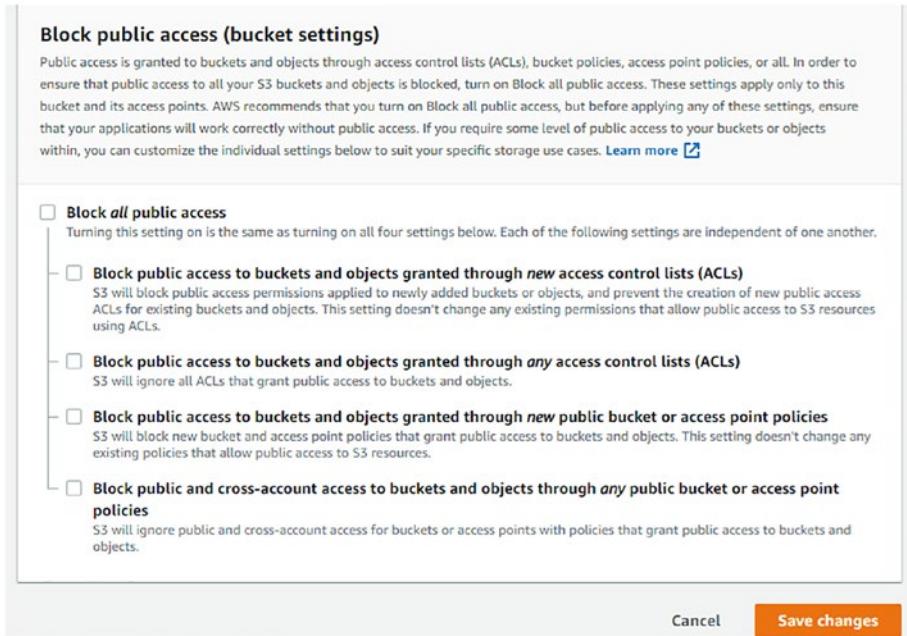
**Bucket policy**

The bucket policy, written in JSON, provides access to the objects stored in the bucket. Bucket policies don't apply to objects owned by other accounts. [Learn more](#)

**Edit** **Delete**

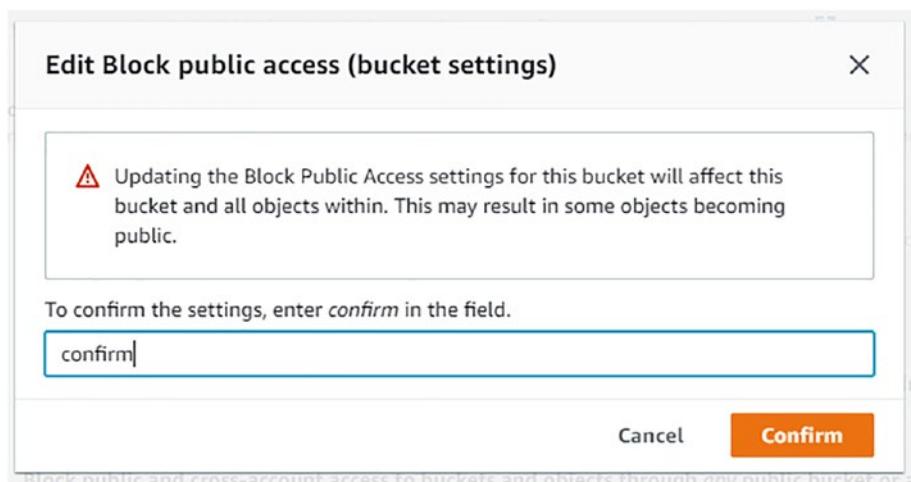
**Figure 5-36.** By default, all objects block public access

To make all the bucket's content public so that it is accessible on the Internet, click **Block public access**, uncheck **Block all public access**, and click **Save changes**, as shown in Figure 5-37.



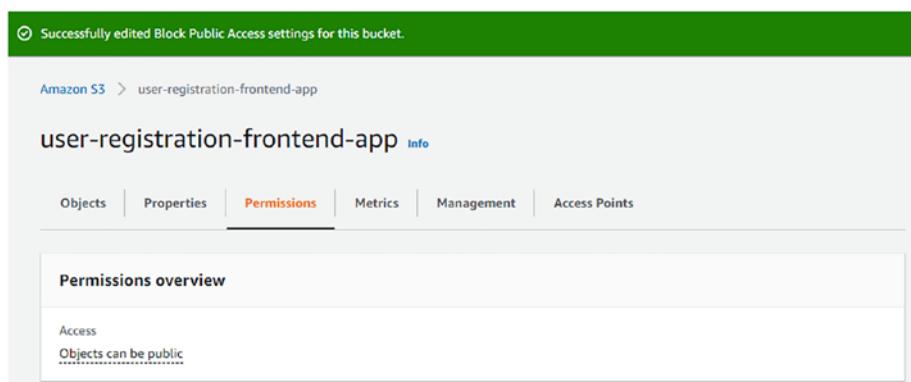
**Figure 5-37.** Creating UserRegistrationApp using Spring Initializr

A confirmation screen pops up to confirm the settings. You need to enter **confirm** in the input box and click the Confirm button, as shown in Figure 5-38.



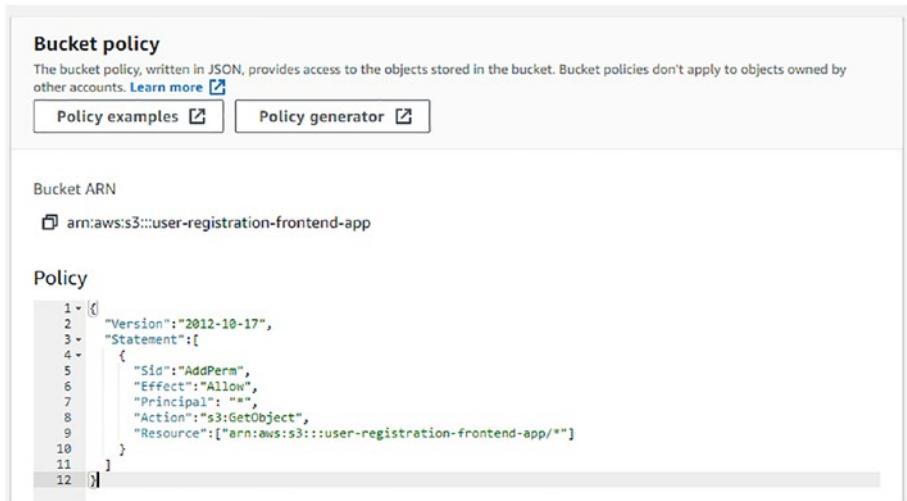
**Figure 5-38.** To confirm the settings, enter *confirm* in the field

A success message should appear, as shown in Figure 5-39.



**Figure 5-39.** Successfully edited Block Public Access settings for bucket

Now, you need to edit the bucket policy, which is written in JSON. It provides access to the objects stored in the bucket. To edit bucket policy, in the Permissions tab, scroll down to the **Bucket policy** section, and click the Edit button, and enter the JSON under Policy, as shown in Figure 5-40.



**Figure 5-40.** Update bucket policy

Listing 5-18 shows the JSON for a bucket policy.

**Listing 5-18.** JSON for Bucket Policy

```
{  
  "Version": "2012-10-17",  
  "Statement": [  
    {  
      "Sid": "AddPerm",  
      "Effect": "Allow",  
      "Principal": "*",  
      "Action": "s3:GetObject",  
      "Resource": ["arn:aws:s3:::user-registartion-frontend-  
app/*"]  
    }  
  ]  
}
```

Resource contains the bucket name, which is user-registration-frontend-app, to identify the resource for the bucket policy. This JSON specifies a specific version. GetObject in Action allows access to all principals. All users can execute GetObject on user-registration-frontend-app.

Next, save the changes, which prompts a message stating, “This bucket has public access.” Refresh the browser with the bucket website endpoint URL. You can now access your home page, as shown in Figure 5-41.



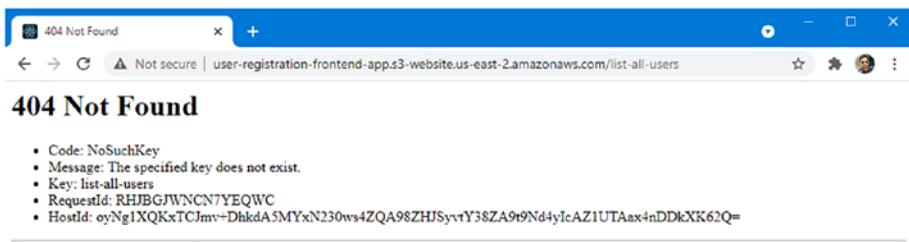
**Figure 5-41.** Bucket website endpoint URL in home page

Congratulations! You have successfully hosted your static React app in AWS S3 and can access the home page.

## Verify the Successful Deployment of a React Front-end Application: Resolve a 404 Error

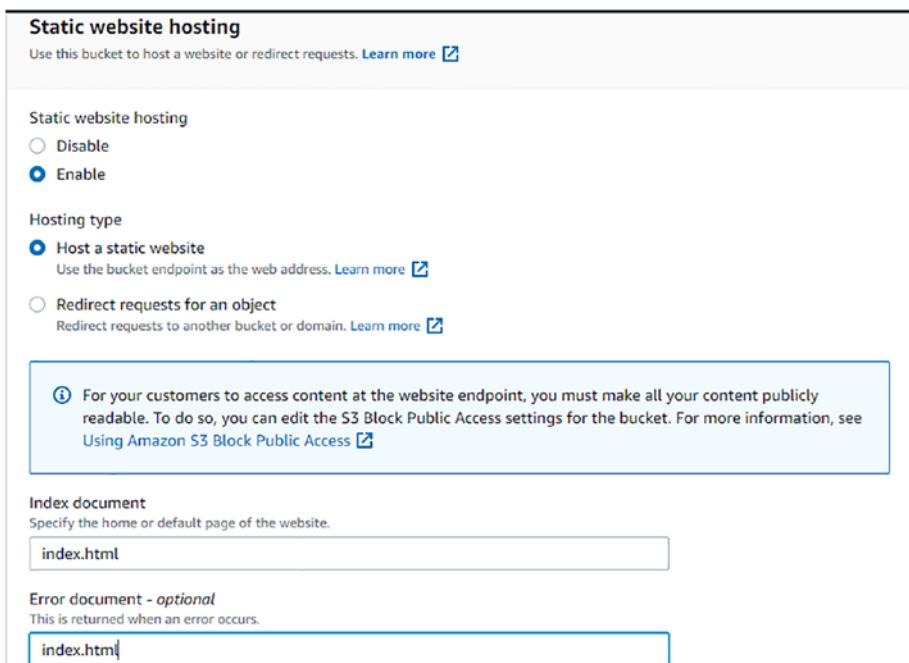
Click the List All Users button in the navigation bar on the home page. You get 404 Not Found errors, as shown in Figure 5-42.

## CHAPTER 5 DEPLOY A FULL STACK SPRING BOOT REACT APPLICATION IN AWS AND S3



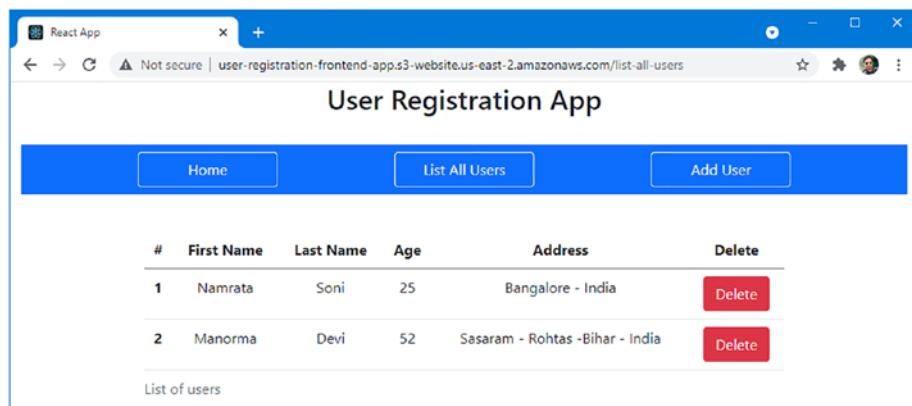
**Figure 5-42.** List All Users page throws 404 error

To resolve this issue, you need to update the **Error document** box to index.html. To make these changes, you need to go to the Properties tab under the bucket. Scroll down to **Static website hosting**, click Edit, and update the error document, as shown in Figure 5-43.



**Figure 5-43.** Update Error document in Static Website Hosting

This is the way react-router works. It handles the requests from the front-end and routes users to other routes. Save the changes and refresh the browser to view the List All Users page, as shown in Figure 5-44.



**Figure 5-44.** Access *list-all-users* page hosted on AWS S3

## Summary

This chapter introduced React as a front-end framework and its major components to develop a single-page application using React as the front end to consume the API exposed by the back-end application. You set up a development environment to develop a React front-end application and were introduced to S3 in AWS, where you deployed a React front-end application.

## APPENDIX A

# Install MySQL Workbench on Windows 10

MySQL Workbench is a visual database designing and modeling access tool used to add functionality and ease to SQL development work. MySQL Workbench facilitates creating new physical data models or modifying existing MySQL databases and provides data modeling, SQL development, and various administration tools for configuration. It also offers a graphical interface to work with MySQL databases in a structured way.

## Step 1. Download Workbench

Go to the official MySQL Workbench download site (<https://dev.mysql.com/downloads/workbench/>). You see the options to download

## APPENDIX A INSTALL MYSQL WORKBENCH ON WINDOWS 10

Workbench, as shown in Figure A-1. The MySQL Workbench version that was available when writing this tutorial was 8.0.25.

The screenshot shows the MySQL Workbench 8.0.25 download page. At the top, there are tabs for 'General Availability (GA) Releases' (which is selected), 'Archives', and a user icon. Below the tabs, the title 'MySQL Workbench 8.0.25' is displayed. A dropdown menu labeled 'Select Operating System:' shows 'Microsoft Windows' as the current selection. Under 'Recommended Download:', there is a section for 'MySQL Installer for Windows' which includes a thumbnail showing various MySQL icons and the text 'All MySQL Products. For All Windows Platforms. In One Package.' Below this, a note states 'Starting with MySQL 5.6 the MySQL Installer package replaces the standalone MSI packages.' To the right of the installer section is a large blue button labeled 'Go to Download Page >'. Under 'Other Downloads:', there is a table for the 'Windows (x86, 32 & 64-bit), MySQL Installer MSI' package, showing version 8.0.25, file size 42.2M, and a 'Download' button. The download link is '(mysql-workbench-community-8.0.25-winx64.msi)' and the MD5 hash is 'MD5: 4220a115ad93e4caa7e9bcbd7b08906e | Signature'.

Windows (x86, 32 & 64-bit), MySQL Installer MSI	8.0.25	42.2M	<a href="#">Download</a>
(mysql-workbench-community-8.0.25-winx64.msi)			MD5: 4220a115ad93e4caa7e9bcbd7b08906e   <a href="#">Signature</a>

**Figure A-1.** MySQL Workbench

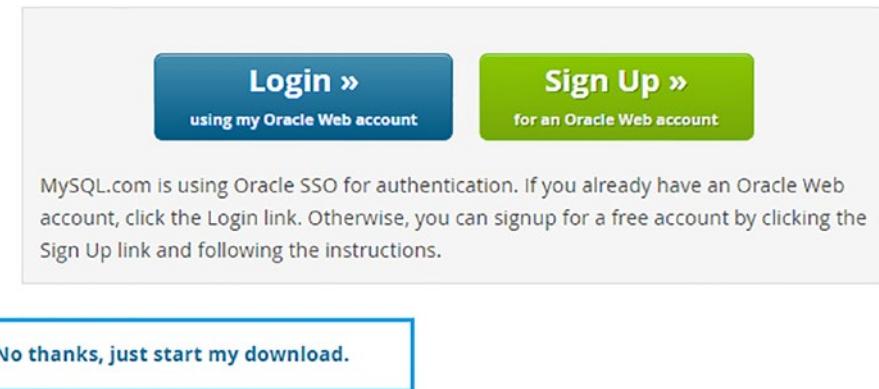
Clicking the Download button takes you to the next page, which asks you to either log in to download or download directly, as shown in Figure A-2.

## ④ MySQL Community Downloads

[Login Now](#) or [Sign Up](#) for a free account.

An Oracle Web Account provides you with the following advantages:

- Fast access to MySQL software downloads
- Download technical White Papers and Presentations
- Post messages in the MySQL Discussion Forums
- Report and track bugs in the MySQL bug system

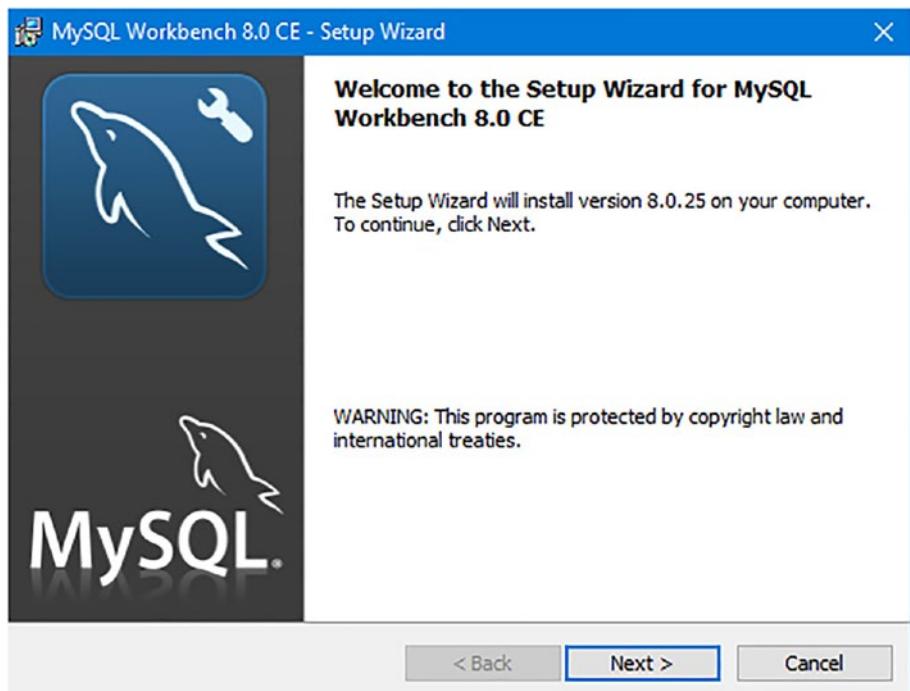


**Figure A-2.** MySQL community download

Complete the MySQL installer download by following either of the approaches.

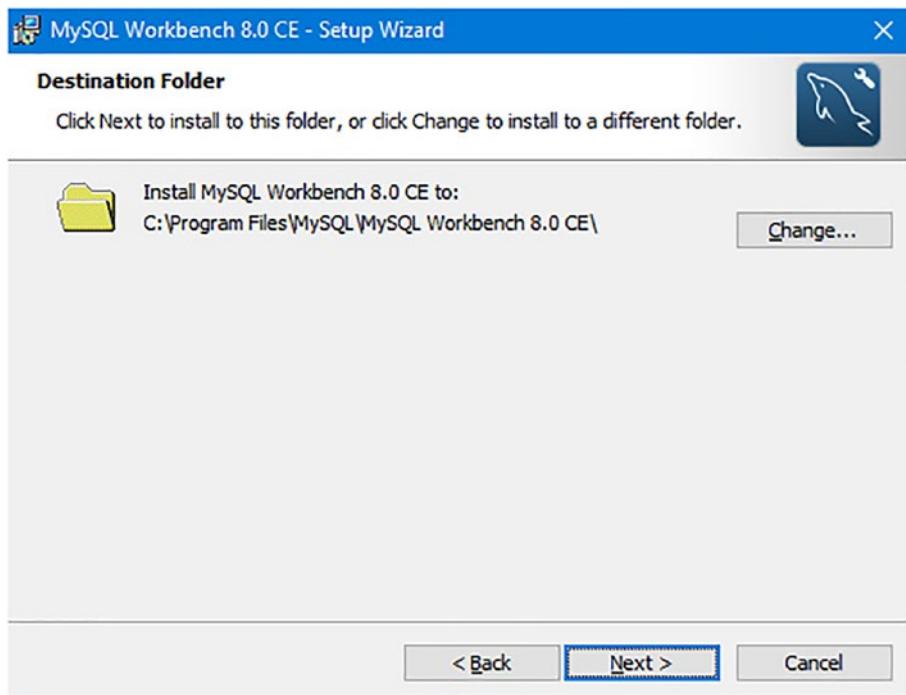
## Step 2. Install Workbench

Double-click the downloaded MySQL Workbench installer to execute it. It shows a “Welcome to the Setup Wizard” screen, as shown in Figure A-3.



**Figure A-3.** Welcome screen

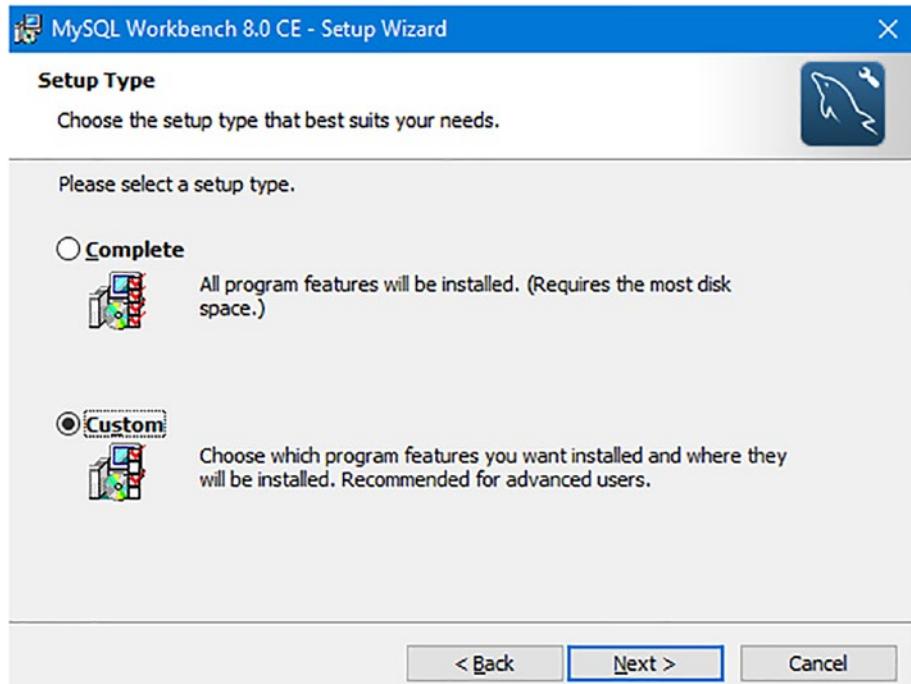
Click the Next button to continue the MySQL Workbench installation. The following screen asks you for the destination folder, as shown in Figure A-4.



**Figure A-4.** Destination folder

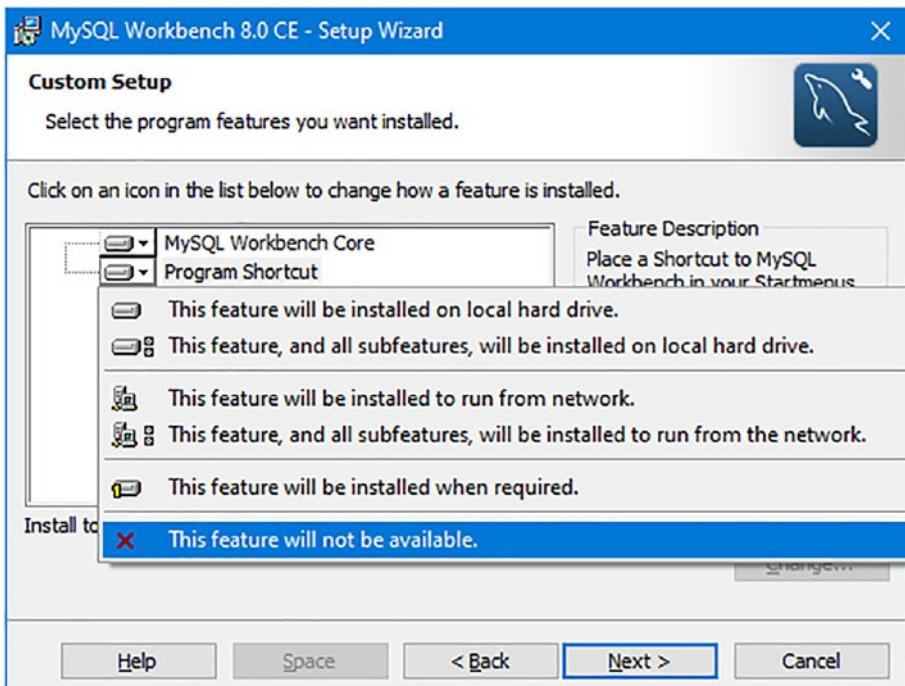
## APPENDIX A INSTALL MYSQL WORKBENCH ON WINDOWS 10

Change the path if required and then click the Next button. The next screen offers the setup type options, as shown in Figure A-5.



**Figure A-5.** Destination folder

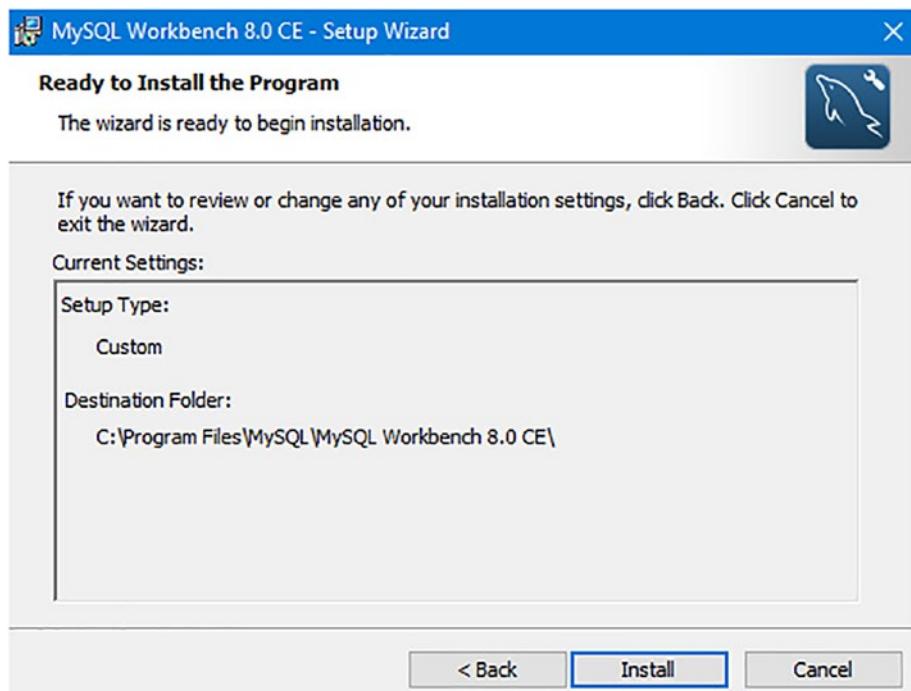
Select the Custom setup type to make changes. Then, click the Next button to view the custom options, as shown in Figure A-6.



**Figure A-6.** Custom setup

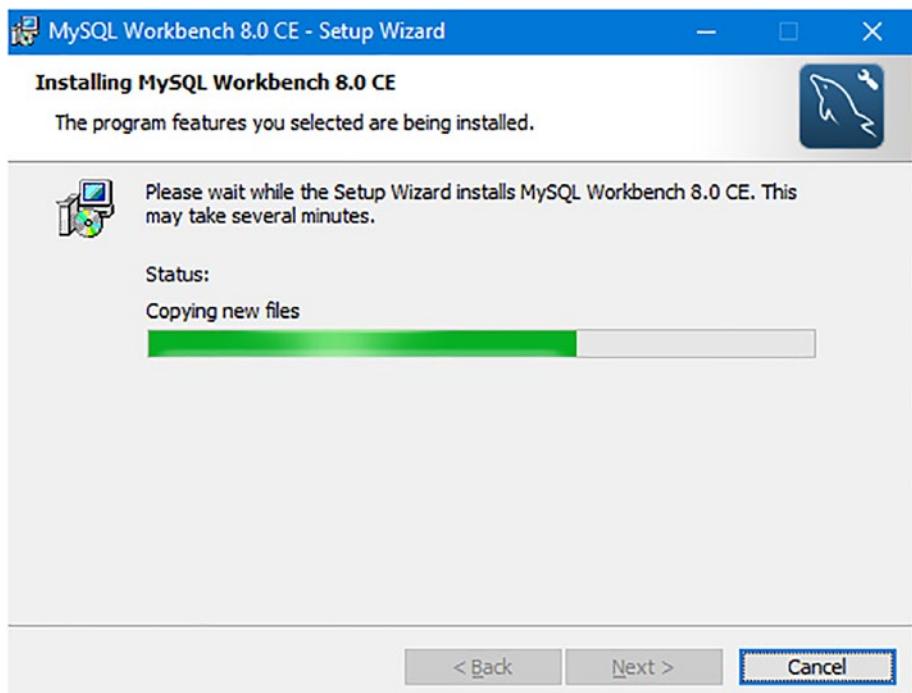
## APPENDIX A INSTALL MYSQL WORKBENCH ON WINDOWS 10

You can omit Program Shortcut by clicking it and selecting **This feature will not be available** (if required). Then, click the Next button to confirm MySQL Workbench installation, as shown in Figure A-7.



**Figure A-7.** Ready to install

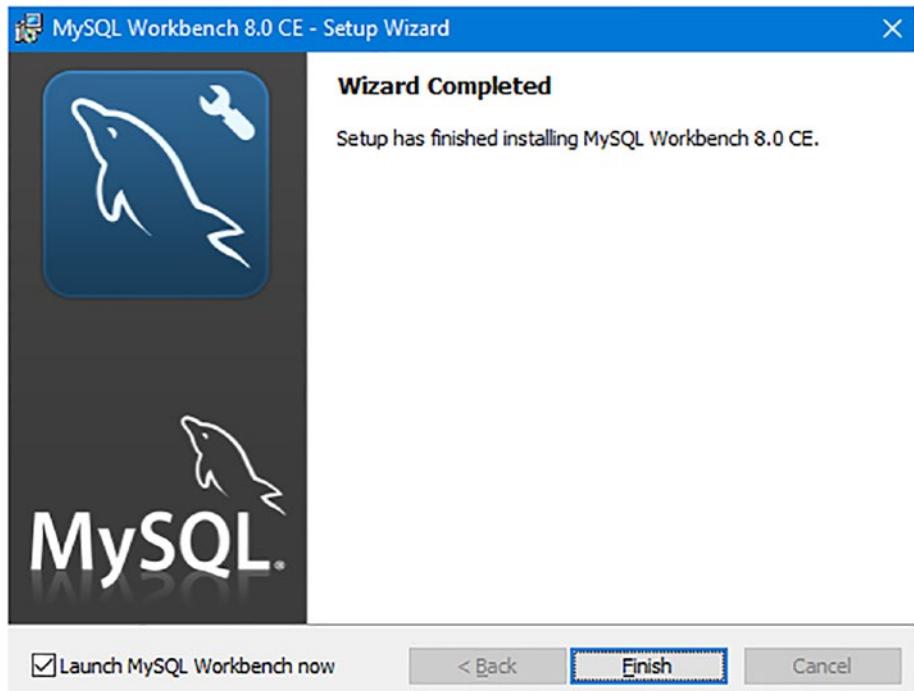
Click the Install button to start the installation. The installer asks for your system's permission. Grant the permissions to allow the installation process. It displays the progress, as shown in Figure A-8.



**Figure A-8.** Copying new files

## APPENDIX A INSTALL MYSQL WORKBENCH ON WINDOWS 10

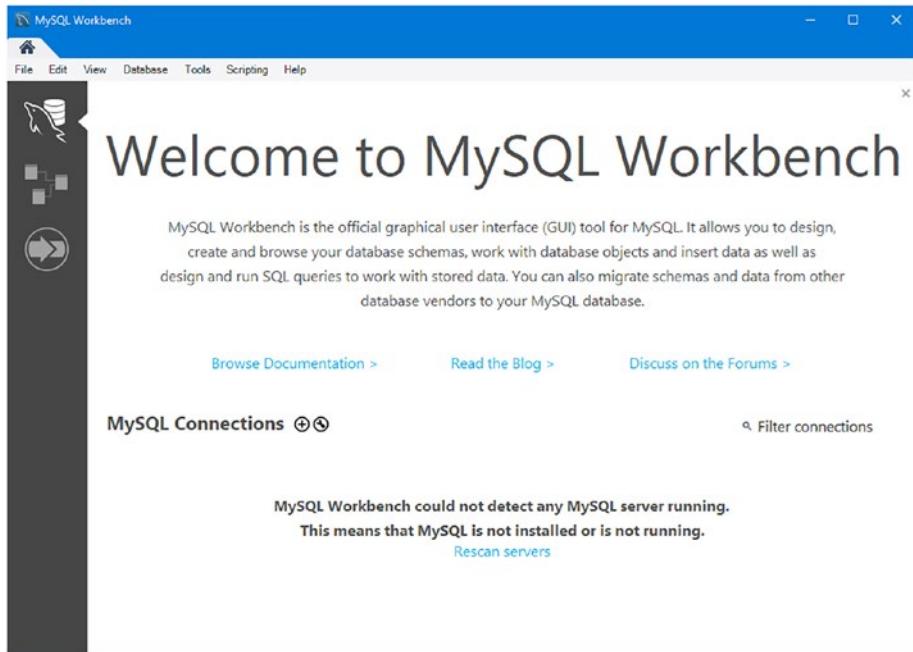
After completing the installation, a Wizard Completed success screen is displayed, as shown in Figure A-9.



**Figure A-9.** Wizard completed

## APPENDIX A INSTALL MYSQL WORKBENCH ON WINDOWS 10

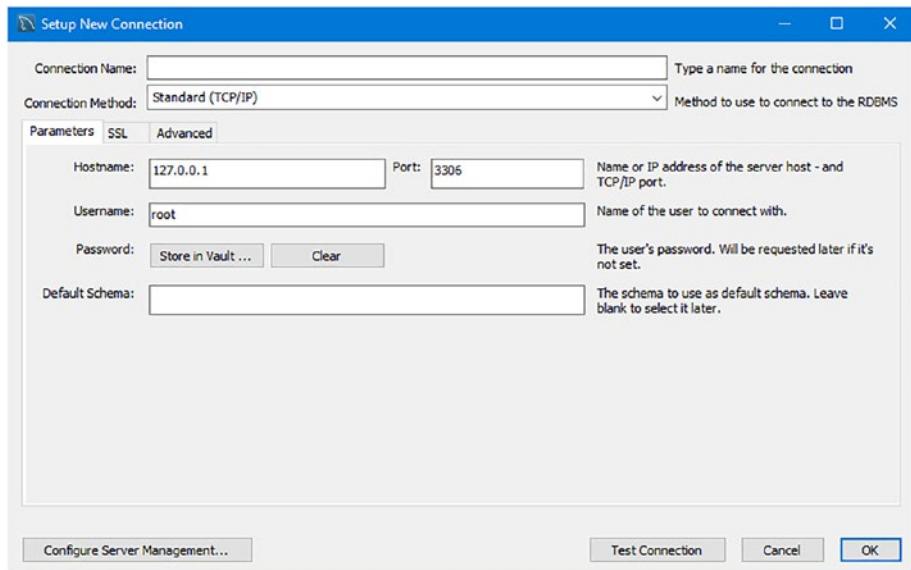
Once you click the Finish button, the installer starts MySQL Workbench. The default window looks like the one shown in Figure A-10.



**Figure A-10.** Welcome to MySQL Workbench

## APPENDIX A INSTALL MYSQL WORKBENCH ON WINDOWS 10

Your MySQL server connection contains information about the target database server, including how to connect to it. Click the **+** icon on the MySQL Workbench home window to open the **Setup New Connection** wizard, as shown in Figure A-11.



**Figure A-11.** Setup New Connection wizard

## APPENDIX B

# AWS Command-Line Interface (CLI)

The AWS Command Line Interface (CLI) manages AWS services from a terminal session that allows you to configure and control multiple AWS services by implementing a level of automation without logging in to the AWS Management Console.

Many popular tools, like Terraform, Jenkins, and Python scripts, support CLI access to create infrastructure as code (IAC), which creates the entire infrastructure. For example, if you want to create an S3 bucket in AWS, you don't have to log in to the AWS Management Console and visit different-different pages on AWS to enter lots of details for this bucket creation. Instead, create some code with the required information, like the bucket name and so on, and run that code, which creates the S3 bucket automatically.

Let's explore how to install AWS CLI in Windows and how to use the AWS CLI.

## Step 1. Download and Install the AWS CLI on a Windows Operating System

First, you need to download the AWS CLI (<https://aws.amazon.com/cli/>), which asks you to save the MSI standalone package in your local system. Once downloaded, run it, and follow the steps by clicking the Next buttons and the Finish button.

Once installation is completed, the program files are stored at C:\Program Files\Amazon\AWSCLIV2.

## Step 2. Create an Access Key

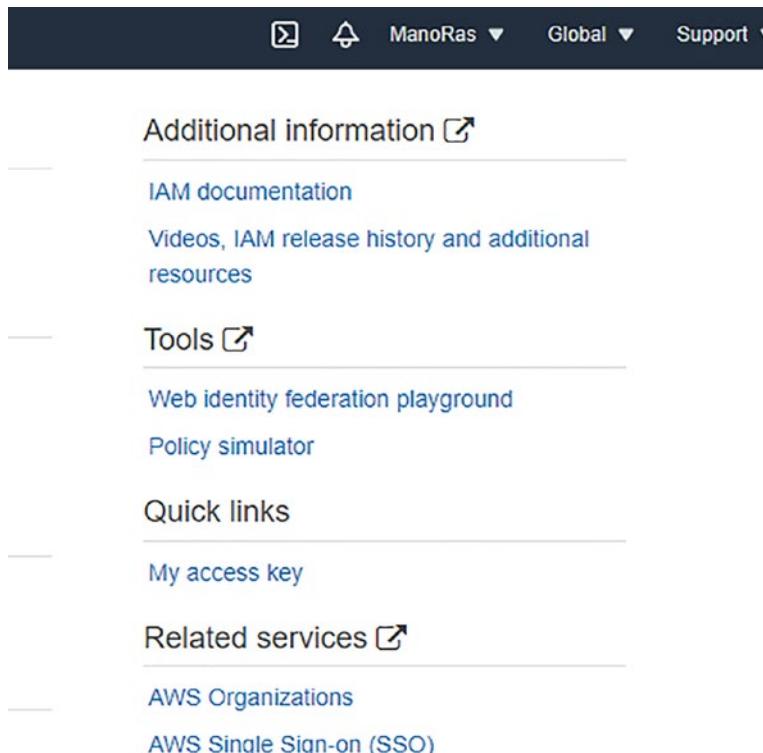
When you create an AWS account using AWS Management Console, AWS creates a root user who has administrative rights to perform many tasks in AWS. You need to create an IAM user in your AWS account to provide the necessary rights.

Log in to AWS Management Console, and in All Services, you can find IAM under the Security, Identity, & Compliance category, as shown in Figure B-1.



**Figure B-1.** IAM under Security, Identity, & Compliance

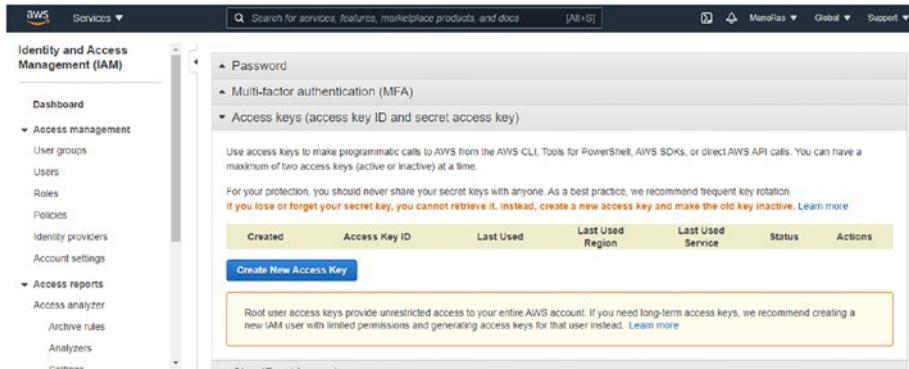
Clicking IAM takes you to the IAM page, where you find the **My access key** link, as shown in Figure B-2.



**Figure B-2.** My access key

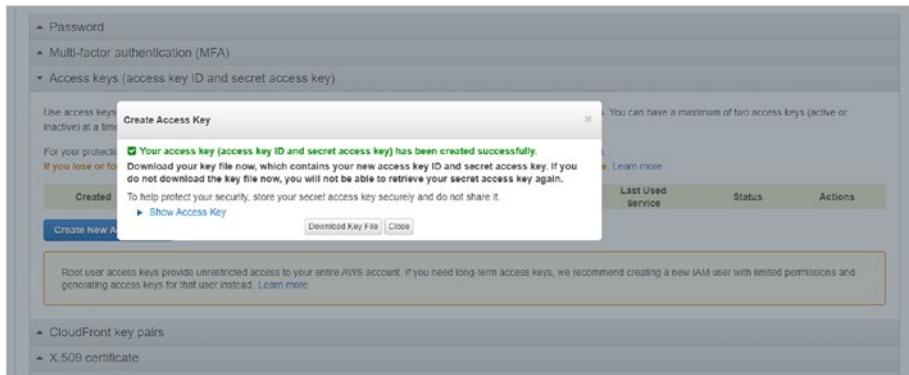
Clicking **My access key** gives you the Create New Access Key option, as shown in Figure B-3.

## APPENDIX B AWS COMMAND-LINE INTERFACE (CLI)



**Figure B-3.** Create a new access key

Clicking the Create New Access Key button opens a Create Access Key popup, with a Download Key File option and a Show Access Key option, as shown in Figure B-4.

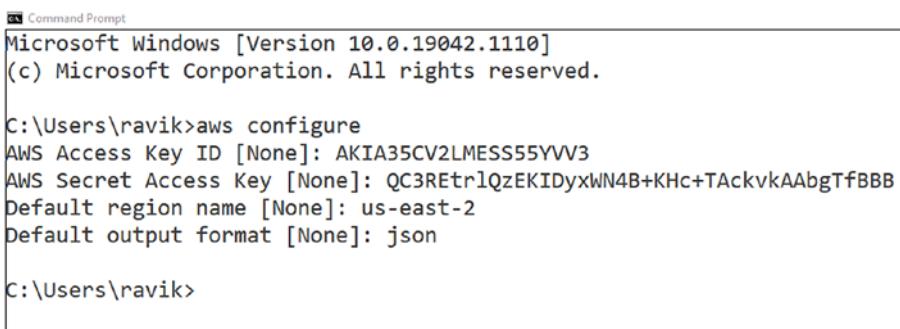


**Figure B-4.** Create access key

Download the file for future reference.

## Configure AWS CLI

Once you have successfully installed the AWS CLI, you need to configure the application to connect to your AWS account. To achieve this, open the command prompt, and enter the `aws configure` command, which prompts you for four pieces of information, as shown in Figure B-5.



```
Microsoft Windows [Version 10.0.19042.1110]
(c) Microsoft Corporation. All rights reserved.

C:\Users\ravik>aws configure
AWS Access Key ID [None]: AKIA35CV2LMESS55YVW3
AWS Secret Access Key [None]: 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
Default region name [None]: us-east-2
Default output format [None]: json

C:\Users\ravik>
```

**Figure B-5.** AWS *configure*

Copy the access key ID and the secret access key from the downloaded key file, which authenticates your AWS account. The region name defines the region where the request from CLI is sent to. The output format specifies the result format: JSON, YAML, text, or table.

## Example Commands That Work with S3

1. List all the S3 buckets in your AWS account.  
`aws s3 ls`

## APPENDIX B AWS COMMAND-LINE INTERFACE (CLI)

```
C:\Users\ravik>aws s3 ls
2021-03-24 19:03:57 elasticbeanstalk-us-east-2-818371255049
2021-07-14 17:57:15 user-registration-frontend-app

C:\Users\ravik>
```

2. Create a bucket.

```
aws s3 mb s3://user-registration-backup
```

```
C:\Users\ravik>aws s3 ls
2021-03-24 19:03:57 elasticbeanstalk-us-east-2-818371255049
2021-07-14 17:57:15 user-registration-frontend-app

C:\Users\ravik>aws s3 mb s3://user-registration-backup
make_bucket: user-registration-backup

C:\Users\ravik>aws s3 ls
2021-03-24 19:03:57 elasticbeanstalk-us-east-2-818371255049
2021-07-19 12:32:22 user-registration-backup
2021-07-14 17:57:15 user-registration-frontend-app

C:\Users\ravik>
```

3. Verify in AWS Management Console.

Buckets (3) <a href="#">Info</a>					
Buckets are containers for data stored in S3. <a href="#">Learn more</a> 					
<input type="text" value="Find buckets by name"/> <span style="float: right;">&lt; 1 &gt; </span>					
Name	AWS Region	Access	Creation date		
elasticbeanstalk-us-east-2-818371255049	US East (Ohio) us-east-2	Objects can be public	March 24, 2021, 19:03:55 (UTC+05:30)		
user-registration-backup	US East (Ohio) us-east-2	Objects can be public	July 19, 2021, 12:32:22 (UTC+05:30)		
user-registration-frontend-app	US East (Ohio) us-east-2	⚠️ Public	July 14, 2021, 17:08:30 (UTC+05:30)		

4. Refer to the folder at C:\Program Files\Amazon\AWSCLIV2\awscli\examples for an example with a command that you can use based on your requirements.

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