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Introduction

This exercise is aimed at introducing you to a couple of important topics in the Data space, if you are not already familiar with them. **Cloud computing** and **Relational Databases**. There are a variety of options available in the market for these, provided by different vendors. For this class particularly, we are going to use Amazon's Cloud offering "AWS" (Amazon Web Services) and MySQL database that runs in Amazon's cloud (Amazon cloud, in simple terms, is nothing but a really big Data Center, with a ton of computers, that belongs to Amazon). Amazon calls their managed service for Relational Databases as RDS (Relational Database Service). Amazon offers a bunch of other services in the cloud as part of AWS.

AWS Account creation

1. Create an AWS Personal account at http://aws.amazon.com/
2. Provide credit card info. (**Note**: AWS uses your payment information to verify your identity and only for usage in excess of the AWS Free Tier Limits. AWS will not charge you for usage below the AWS Free Tier Limits.) *For this assignment make sure to ONLY use free tier options when launching any new AWS resources.
3. Choose "Basic Plan" (FREE)

Launching a MySQL Database Instance in your AWS account

1. Sign-in to the management console from https://aws.amazon.com/ (My Account -> AWS Management Console)
2. Find services –> RDS (Managed Relational Database Service)
3. Create database
4. **Creation method=Standard create, Engine=MySQL, Template=Free tier,**

Free Tier

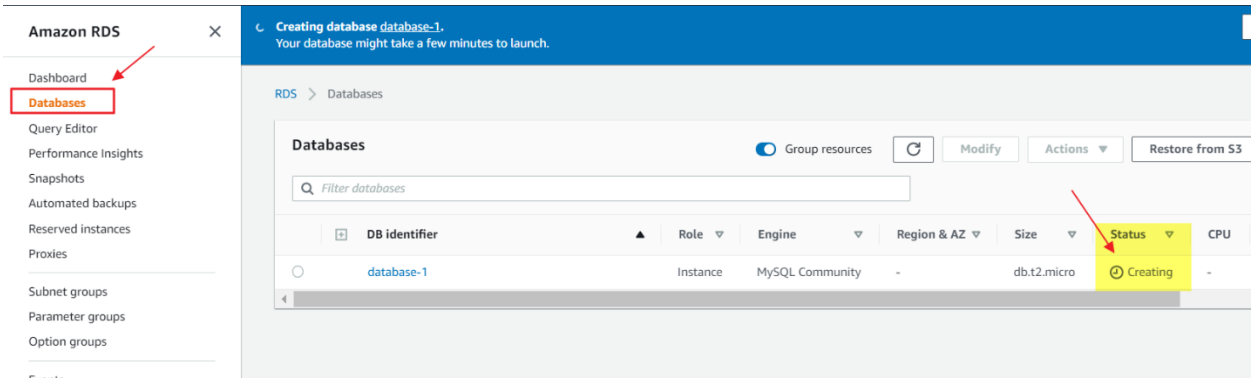
The Amazon RDS Free Tier is available to you for 12 months. Each calendar month, the free tier will allow you to use the Amazon RDS resources listed below for free:

- 750 hrs of Amazon RDS in a Single-AZ db.t2.micro Instance.
- 20 GB of General Purpose Storage (SSD).
- 20 GB for automated backup storage and any user-initiated DB Snapshots.

Learn more about AWS Free Tier.

When you free usage expires or if your application use exceeds the free usage tiers, you simply pay standard, pay-as-you-go service rates as described in the Amazon RDS Pricing page.

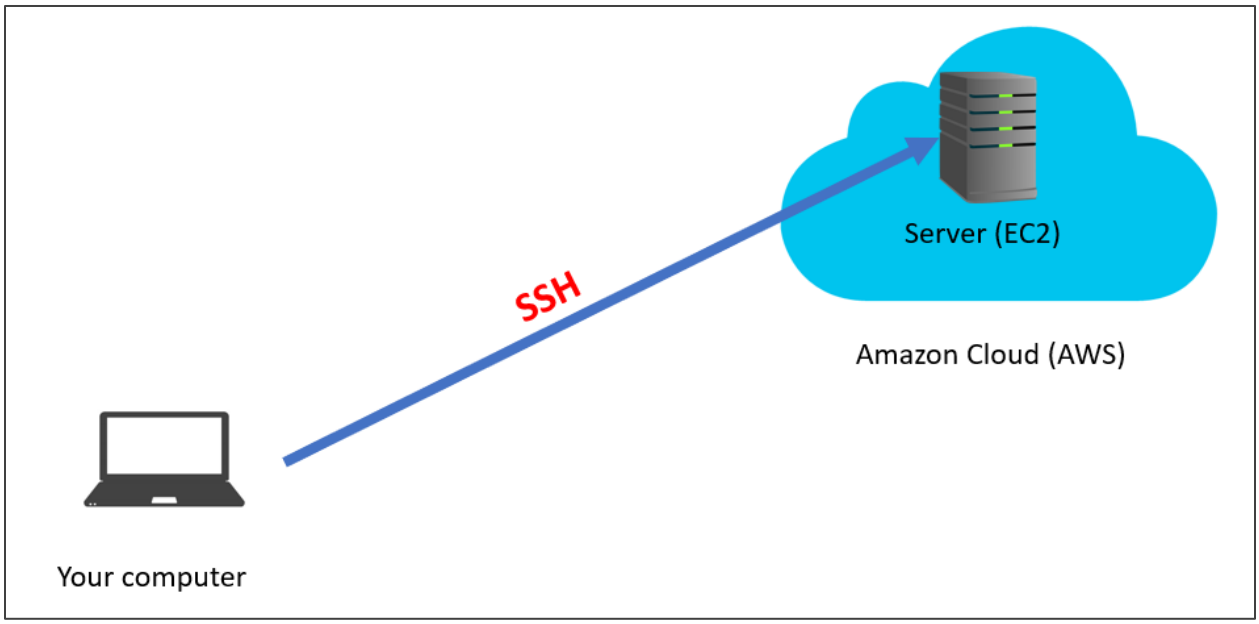
5. Fill out the settings for DB Instance identified and master password
6. Leave everything else as the default settings proposed by AWS. Changing any of those settings may impact the free tier usage and cost you money.
7. Click create database.



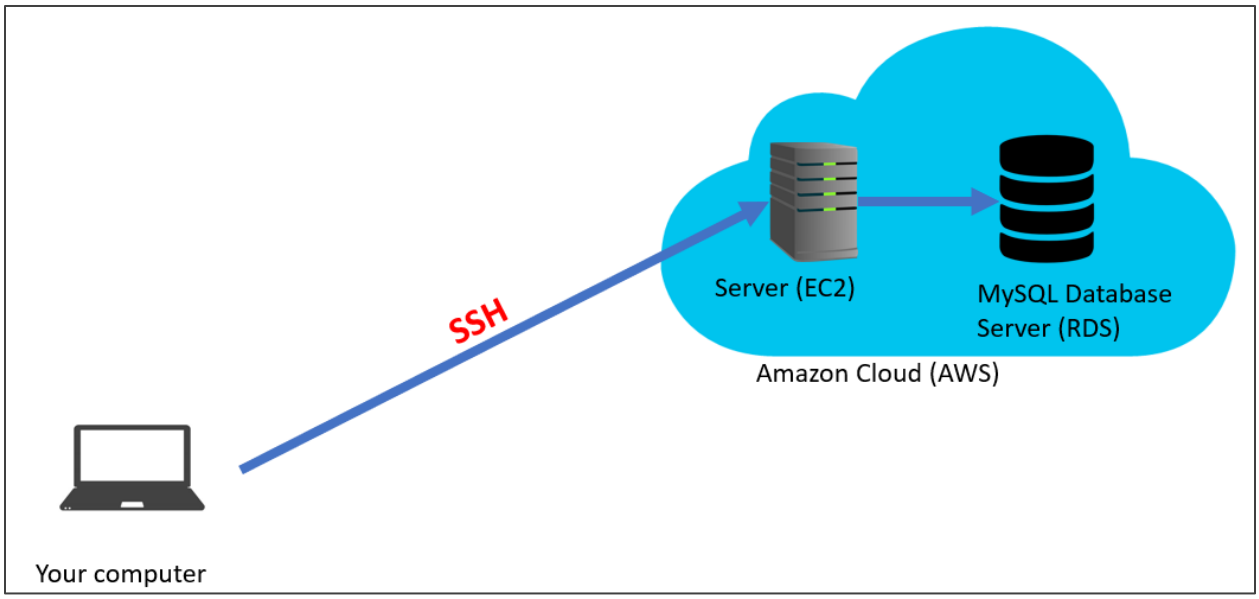
So, you have just launched a MySQL Database Server in the Amazon Cloud. Note that Amazon offers a lot of other services than just Relational Databases, such as Web Servers, Application servers, Hadoop Clusters, Storage services etc. just to name a few. With simple clicks of buttons on the Amazon Website (console) you can launch any of these services from your computer, these services run on Amazon's hardware, Amazon takes care of maintaining that hardware and also the software, you just pay for the usage.

But how do you connect to this Database if you want to do anything on it?
Well, how do you connect to anything that runs in AWS?
If you are running a server (like a web server or an app server) on AWS, then you can remotely connect to it using SSH (please read more about this online if you are interested).
In simple words, with SSH you basically type commands on the command line on your computer, but they execute on the remote AWS server.

By the way, the Amazon service for servers is called EC2.



So, can you SSH from your computer to RDS then? Well, AWS doesn't allow direct SSH to RDS instances. You will have to first SSH to an EC2 instance and then "jump" from that EC2 to RDS via a feature in SSH called local port forwarding (do not worry too much about these concepts, you only need to know the correct SSH commands for this and need not understand the underlying concepts).



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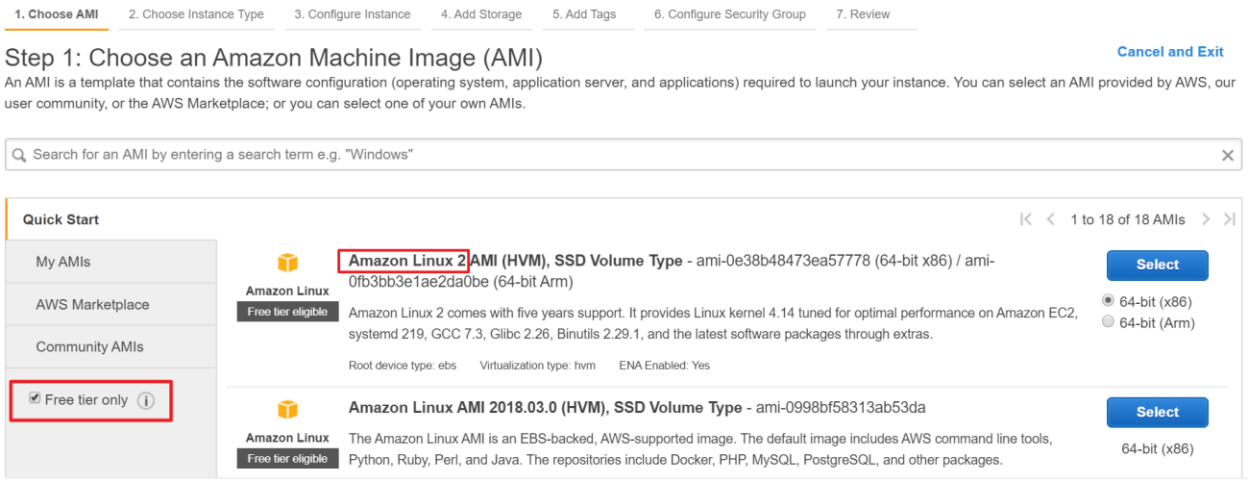
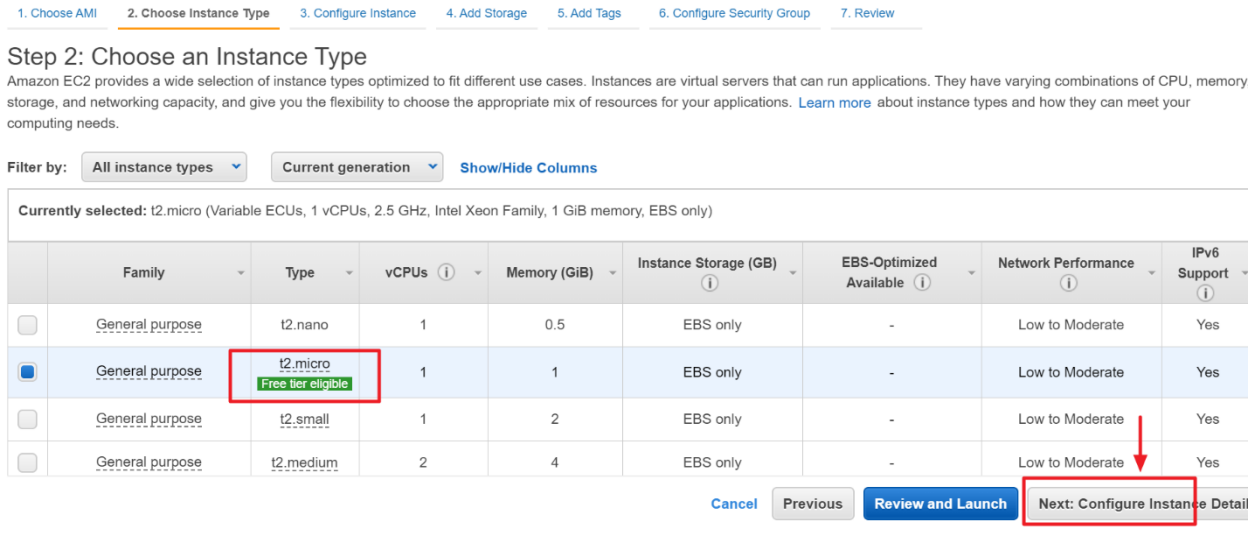
Launching an EC2 instance

1. Sign-in to the management console from https://aws.amazon.com/ (My Account -> AWS Management Console)
2. Find services –> EC2
3. Instances (on the left menu) -> Launch Instance



Pick the latest Amazon Linux instance (in the above example it is Amazon Linux 2 AMI (HVM), SSD Volume Type - ami-0e38b48473ea57778 (64-bit x86) / ami-0fb3bb3e1ae2da0be (64-bit Arm)).

4. Make sure to choose the Free tier option and keep clicking on the "Next" step until the end. You don't have to change any settings, just keep hitting Next.



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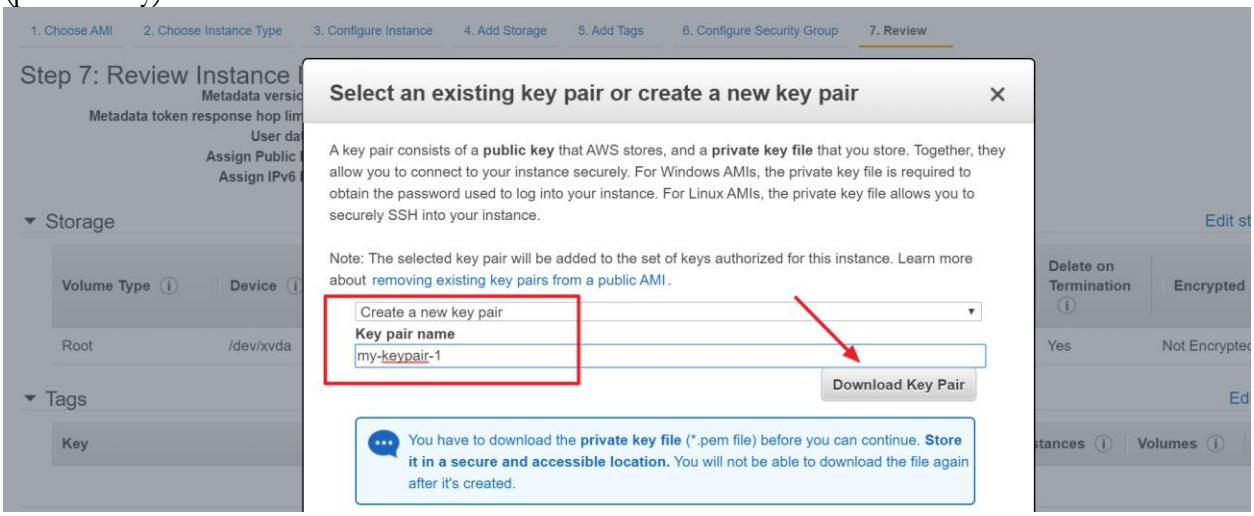
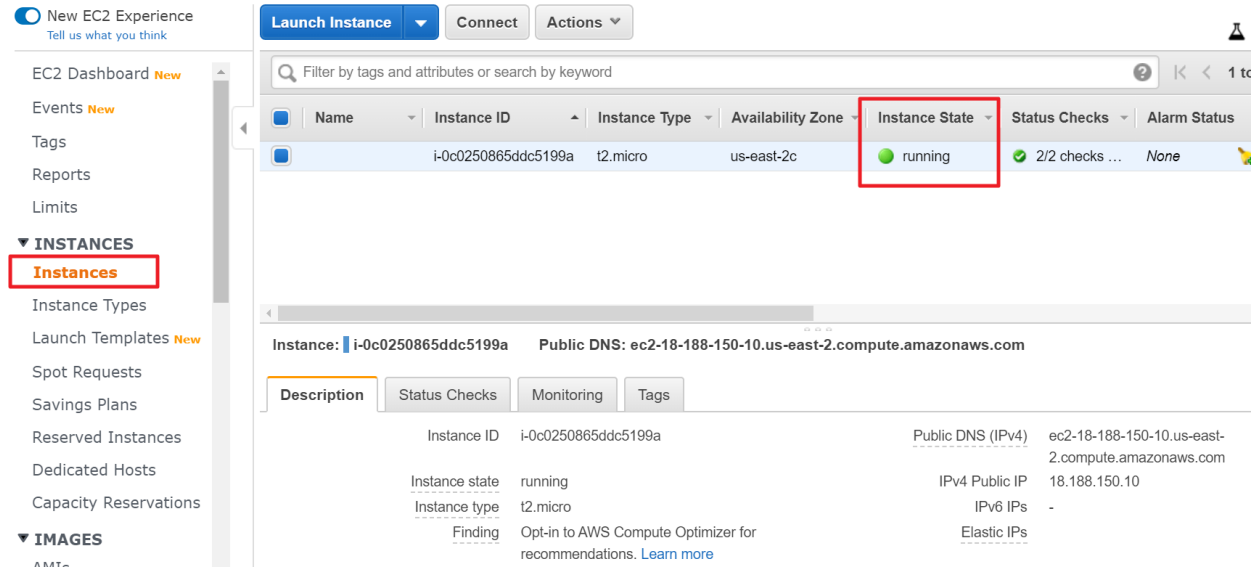
5. Once you reach the last step and click on "Launch" you will be asked for a "Key Pair". Choose the option to create a new one. You will need to download the ".pem file" for your key pair and store it securely. The .pem file is the private key. Remember we said you can SSH into an EC2 server from within your computer? We need the .pem file (private key) in order to SSH into the EC2 instance.



6. Once it is launched you can see it from the Instances menu on the left.



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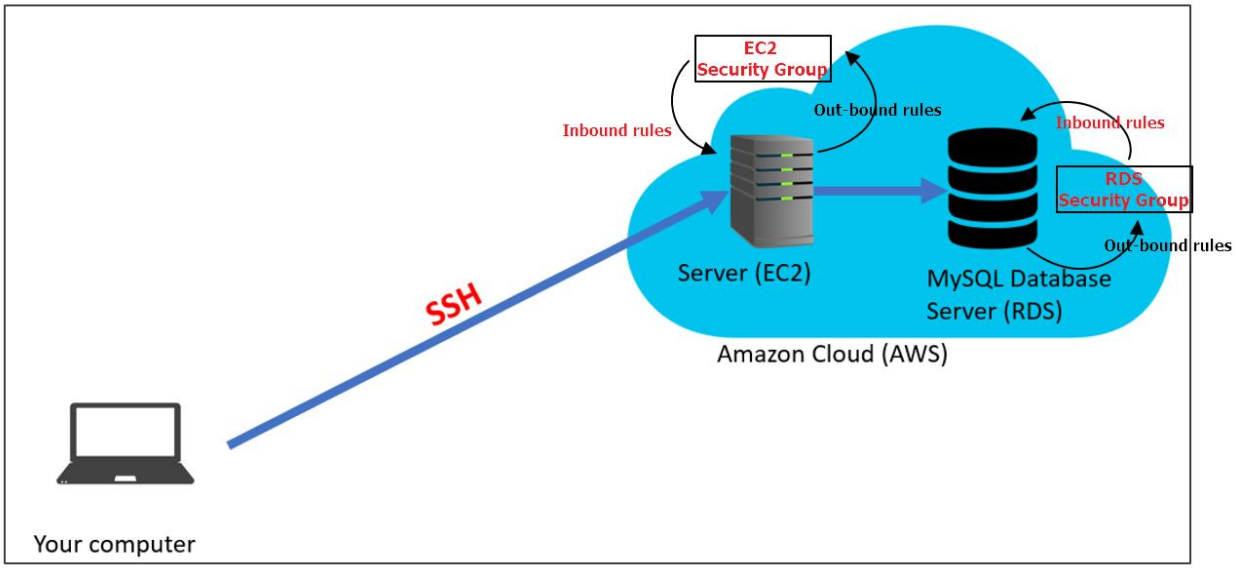
Connecting to EC2 instance via SSH

Before we learn how to connect to an EC2 instance via SSH, let's think about security for a moment. Can anyone in the world with a computer connect to your server by default? If the answer is yes then that is a big security hole, we do NOT want that. Instead we want the ability to restrict what computers can connect to your server. For this purpose, AWS has a concept of **Security Groups**. Without going too much into detail, just know that a Security group is a set of rules that define what computers (IP addresses) can connect to your instance. These are "in-bound" rules. Similarly, security groups also have "outbound" rules. The outbound traffic is by default set to "un-restricted" (represented by IP address 0.0.0.0/0). This is because you want to access the internet from within your server.

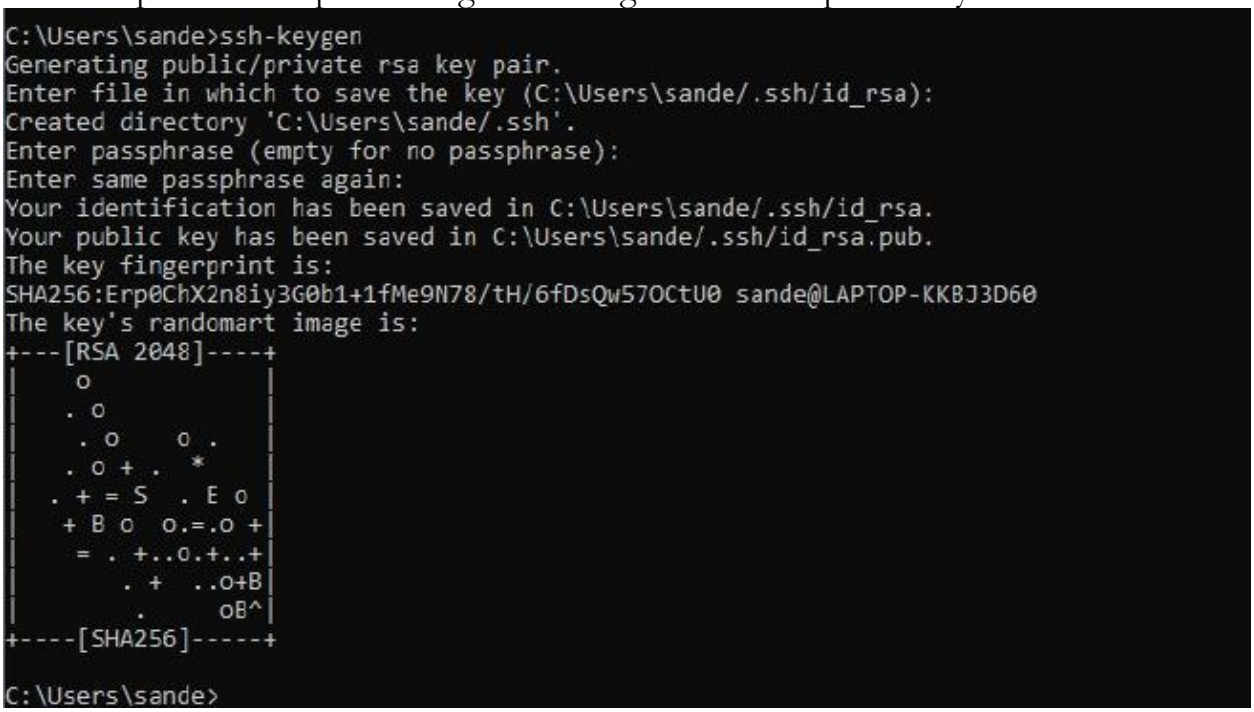
Both EC2 and RDS instances will have Security Groups to filter traffic coming into and out of them.



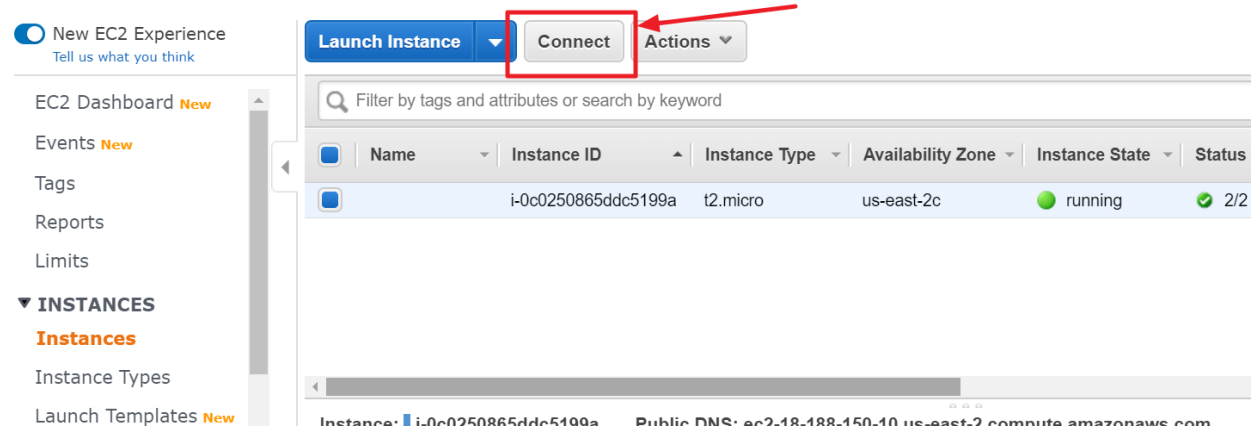
For this exercise, for simplicity sake, we are going to allow everything in-bound and out-bound for both EC2 and RDS.
When you create the EC2 and RDS instances the corresponding security groups will automatically get created. The good thing is the EC2 security group

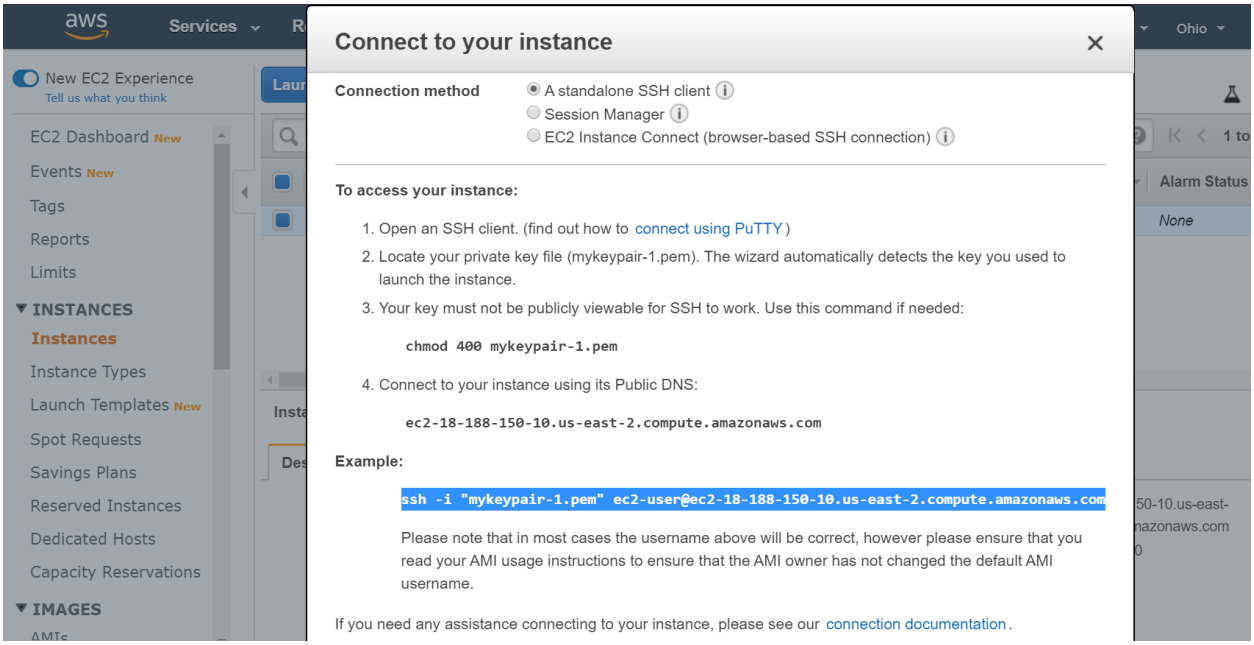
will already be created with the correct settings we need, so there is no need to touch it. For RDS security group though, we will need to make a small change which we will see in the later section about connecting to RDS.

1. Open command prompt on your computer.
2. For windows, type ssh-keygen, keep clicking enter like in the screenshot below. For Mac please lookup on Google how to generate SSH public key.



3. In Windows 10 typically the SSH home folder will be C:\Users\<username>\.ssh (it's the same path where your public key gets generated when you run ssh-keygen)
4. Paste the .pem file that you downloaded during EC2 launch (step 5 in the above section) in that location.
5. You can get the correct SSH command to connect to the EC2 from the AWS console (EC2 -> Instances -> Select the instance you need to connect to -> Click on the Connect button)

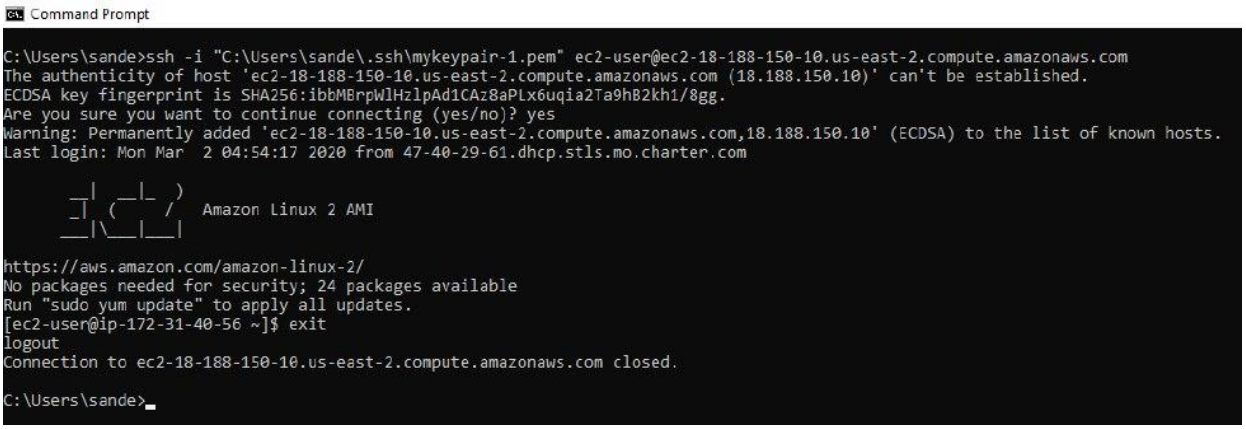




6. Copy that command and paste it into the command line on your computer. Note that you will need to specify the correct path for the part that says "mykeypair-1.pem"
   In my case the SSH command is:

   ssh -i "C:\Users\sande\.ssh\mykeypair-1.pem" ec2-user@ec2-18-188-150-10.us-east-2.compute.amazonaws.com

7. As you can see in the screenshot below, the SSH connection to the remote server was successful. (To disconnect use the exit command)



Note that in the screenshot above I simply connected to the remote EC2 server and immediately exit-ed. But in general, you would connect to the remote server and run commands, like for example, installing a software on the server or copying files to the server etc.

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Connecting to the Database in AWS from your computer (via EC2) to interact with it using SQL

1. Unlike connecting to an EC2 server where you can do so using the command line interface, you will need a tool/software to connect to a database. (Although it is technically possible to interact with a database from the command line it is recommended to use a tool that gives you a graphical/visual view of the stuff in the database).
2. There are multiple client tools available to connect to a MySQL Database. For ease of use we recommend **MySQL Workbench**. You can download it from https://dev.mysql.com/downloads/workbench/
   I tested "mysql-workbench-community-8.0.12-winx64" on my Windows 10 computer and it works.
   Note: If downloading this requires an Oracle account, please create one. It's free.
3. Change the RDS's security group inbound rule to allow traffic from everywhere. (Technically we just need to allow connectivity from our EC2 instance but for simplicity sake let's just allow everything). See below.

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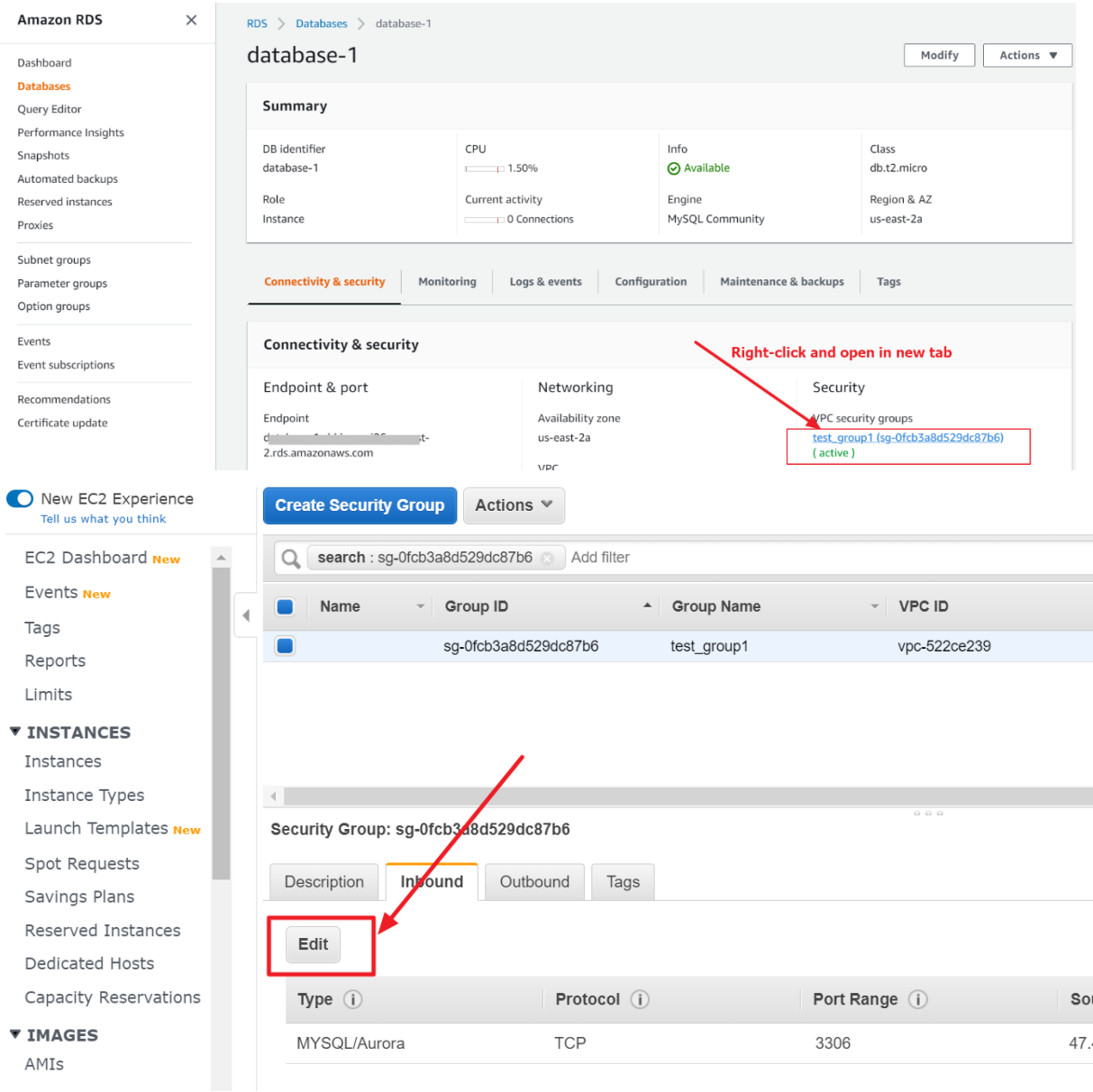

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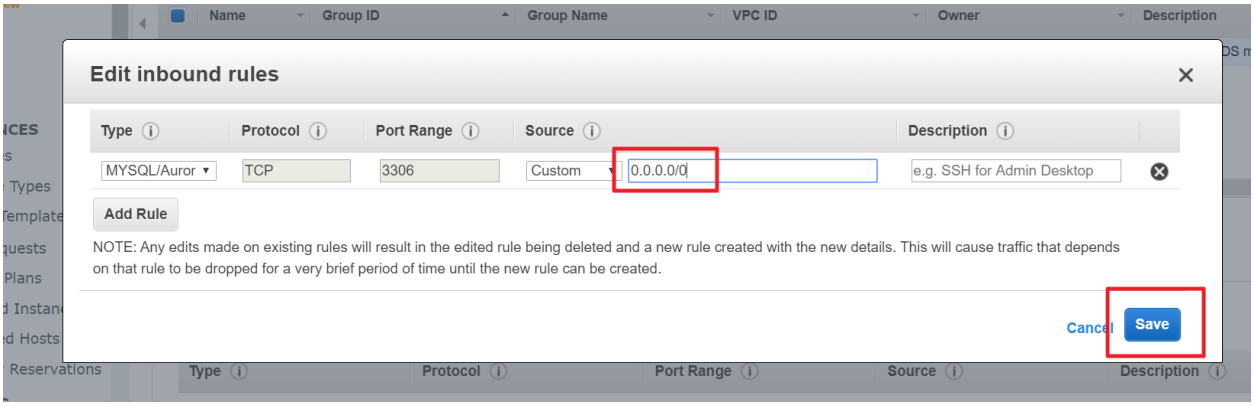
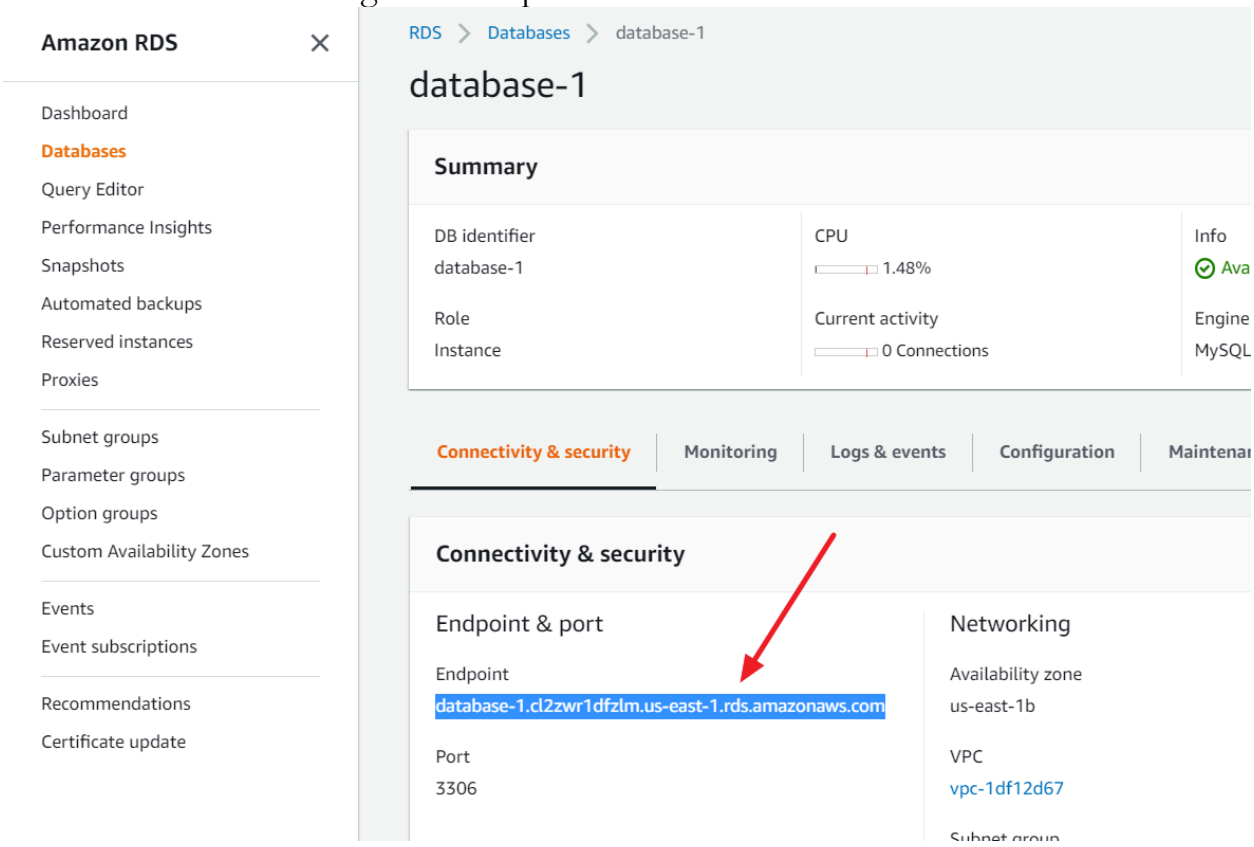


4. Now you need to do the SSH port forwarding. For that you first need to get the RDS "endpoint".
   See screenshot below to get the endpoint:



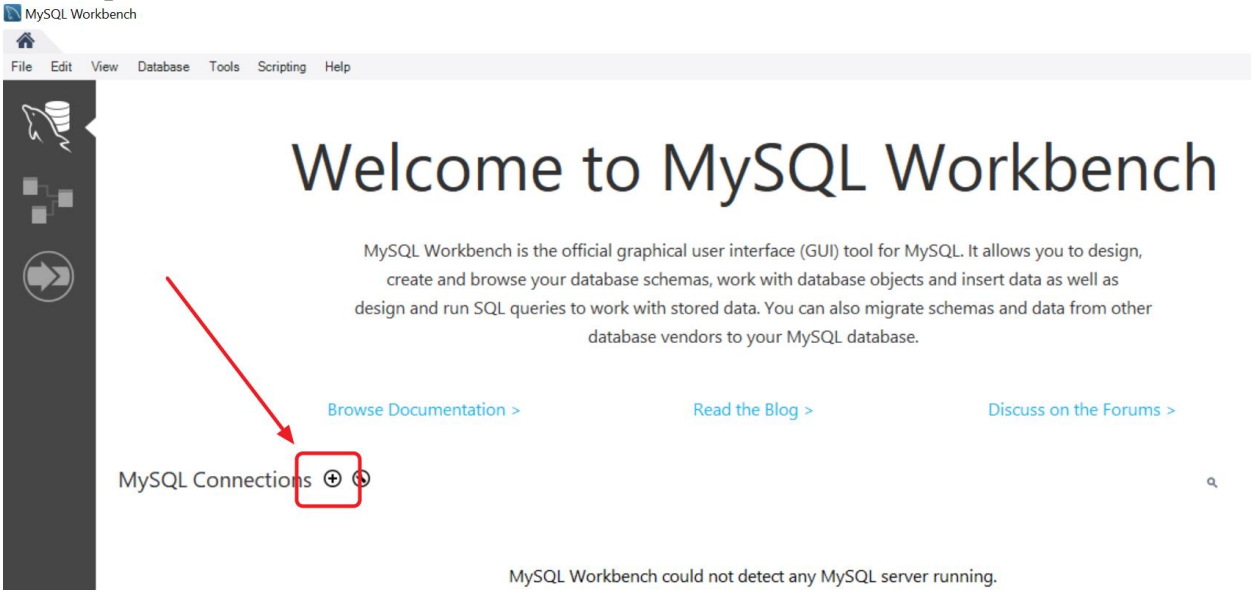
The syntax for the SSH command is as follows (replace the variables

highlighted in different colors below with the actual values)
ssh -N -L localPort:rdsHost:remotePort user@remoteEC2Host -i ~/path/to/key

Below is the SSH command I used. Change it accordingly for your use. Just type it in the command prompt and hit enter.

```
ssh -N -L 3306:database-1.cl2zwr1dfzlm.us-east-1.rds.amazonaws.com:3306
ec2-user@ec2-18-188-150-10.us-east-2.compute.amazonaws.com -i
"C:\Users\sande\.ssh\mykeypair-1.pem"
```

5. Now open the SQL Workbench



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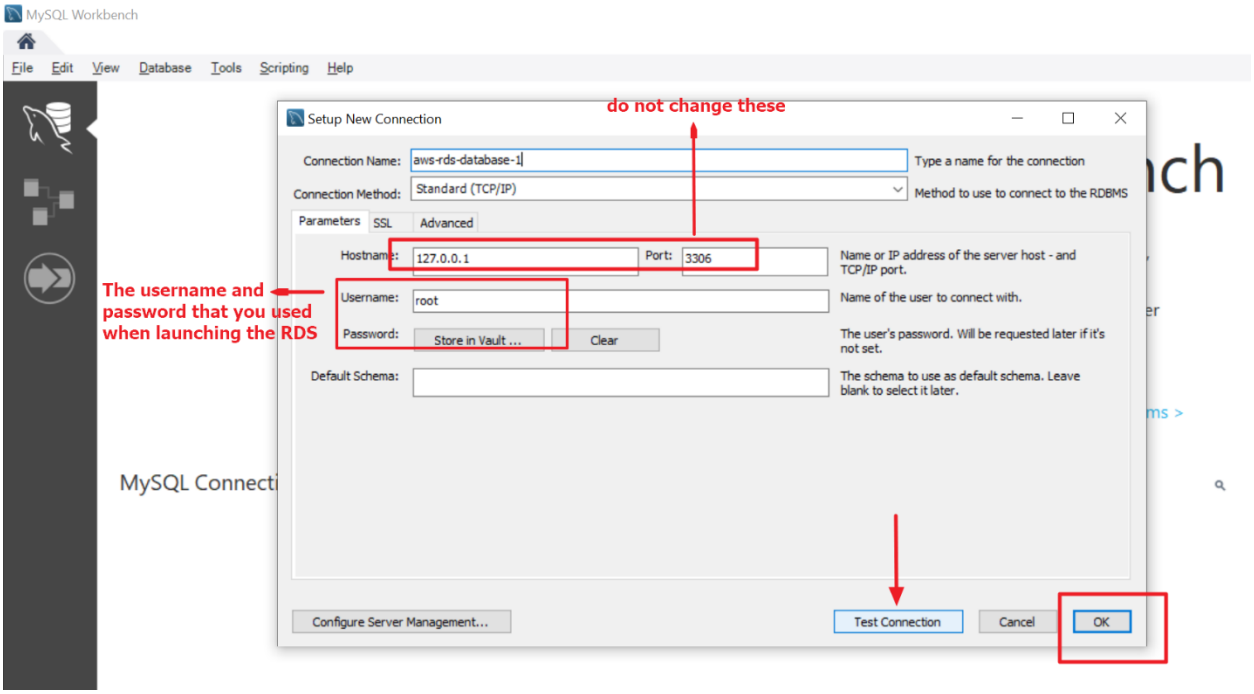

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Practice SQL

Go through the tutorial in the following link and practice SQL statements in your Database.
https://www.w3schools.com/sql/default.asp
Here is an example:
Step 1: Create a Database schema:

```
CREATE DATABASE testDB;
```

Step 2: Create a Database Table in the schema you created above:

```
CREATE TABLE testDB.Persons (
    PersonID int,
    LastName varchar(255),
    FirstName varchar(255),
    Address varchar(255),
    City varchar(255)
);
```

Step 3: Inserts records into the table:

```
INSERT INTO testDB.Persons(PersonID, LastName, FirstName, Address, City) VALUES (1, 'Ericson', 'Tom', '4006 Some Street', 'Saint Louis');
```

Insert more records using INSERT statements like above

Step 4: Select records from the table:

```
SELECT * FROM testDB.Persons;
```

Note:
If you stuck and need assistance on any of the steps, don't hesitate to reach out to our Data Architect Sai at 734-927-2427, Sai@archtalents.com