Database Week

Hands-On Lab: Getting Started with Amazon RDS

October 2019

Table of Contents

Overview

Amazon RDS is a web service that makes it easy to set up, operate, and scale a relational database in the cloud. It provides cost-efficient and resizable capacity while managing time-consuming database administration tasks, freeing you up to focus on your applications and business.

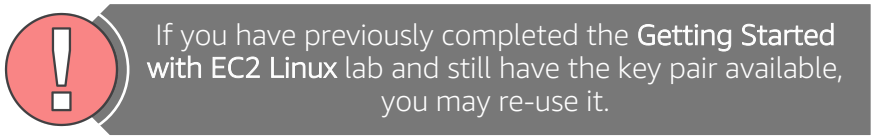
In this hands-on lab, we will create an Amazon RDS database instance, connect to it using an example web application and learn how to perform basic operations such as snapshots and scaling compute.

The lab includes a few setup steps to ensure all prerequisites are met for you to be able to successfully launch the database instance.

Prerequisites

In order to successfully provision and use a DB instance there are a few minimum prerequisite configurations and resources that you need to set up.

Create an EC2 Key Pair

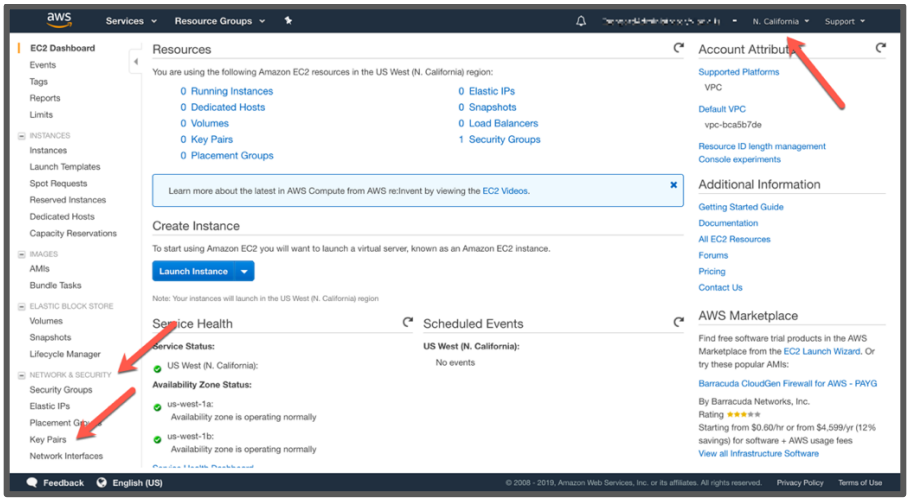


EC2 Key Pairs are used to connect securely to your EC2 Linux-based instances using SSH.

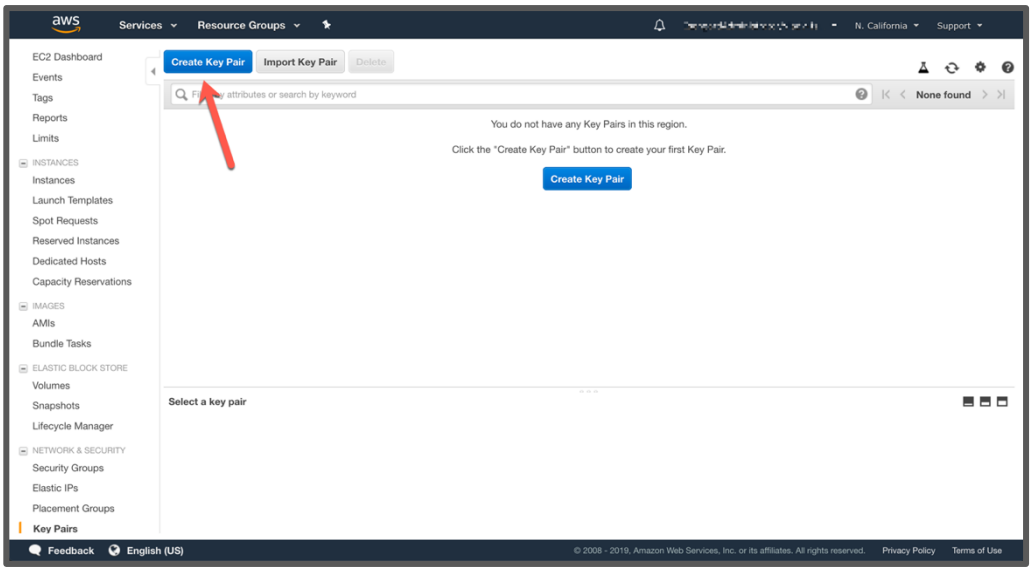
Sign into the AWS Management Console and open the Amazon EC2 console at https://console.aws.amazon.com/ec2.

In the upper-right corner of the AWS Management Console, confirm you are in the desired AWS region (e.g., Oregon).

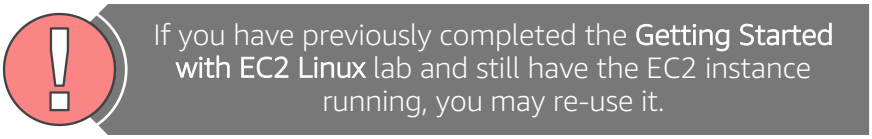
Click on **Key Pairs** in the **NETWORK & SECURITY** section near the bottom of the left-hand menu. This will display a page to manage your SSH key pairs.



Click Create Key Pair.



Name the key pair "dbweek", or another memorable name, then click **Create** and download the file with the same name (e.g. **dbweek.pem**) to your computer, save it in a memorable location like your desktop.



In this section we will launch an Amazon Linux 2 EC2 instance, bootstrap Apache/PHP, and install a basic web application.

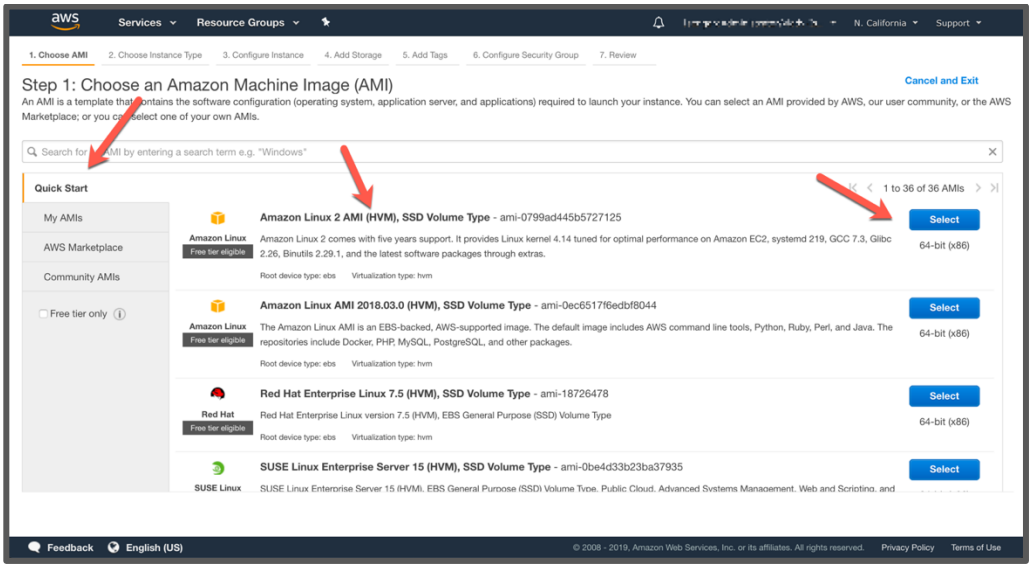
EC2 instances are launched within a virtual private network (VPC), configured with the correct topology in terms of network subnets, routing tables, gateways and other network resources. Setting up a VPC is beyond the scope of this exercise. Each AWS account is automatically created with a **Default VPC** in each region, containing a basic network configuration, where resources can be provisioned in any of that region's availability zones, and can have direct access to the Internet. In rare circumstances, customers can re-purpose these default VPCs, or delete them entirely. If you cannot find the default VPC in your account and region while following the steps in this section, please contact a lab assistant.

Sign into the AWS Management Console and open the Amazon EC2 console at https://console.aws.amazon.com/ec2, if the console is not already open

In the upper-right corner of the AWS Management Console, confirm you are in the desired AWS region (e.g., Oregon).

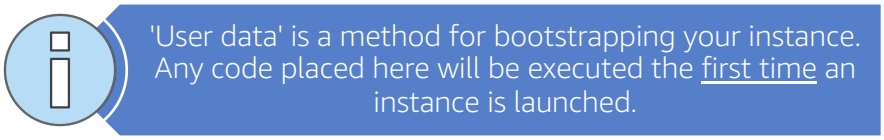
Navigate in the left-hand menu to **EC2 Dashboard** or **Instances**, then click **Launch Instance**.

In the Quick Start section of Step 1: Choose an Amazon Machine Image (AMI), select the first Amazon Linux 2 AMI (HVM), SSD Volume Type option and click Select.



On the **Step 2: Choose Instance Type** screen, select the **t2.micro** instance size and click **Next: Configure Instance Details** in the bottom right corner.

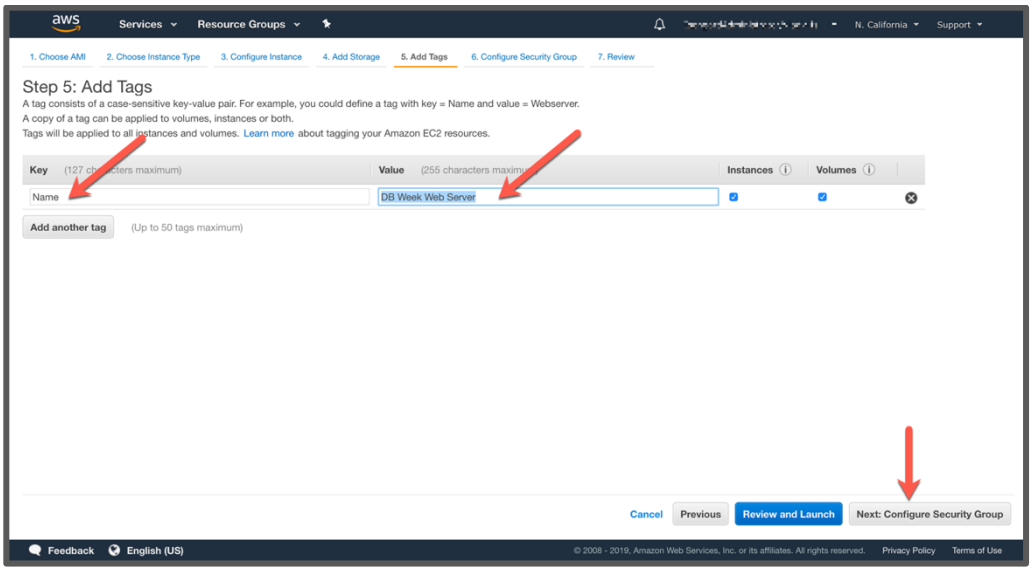
On the **Step 3: Configure Instance Details** screen, accept the defaults, but scroll down and expand the **Advanced Details** section. Copy/paste the script below into the **User Data** field (this shell script will install Apache & PHP, start the web service, and deploy a simple web page). Click **Next: Add Storage** in the bottom right corner.




```
#include
https://s3.amazonaws.com/immersionday-labs/bootstrap.sh
```

On the **Step 4: Add Storage** screen, you have the ability to modify or add storage and disk drives to the instance. For this lab, we will simply accept the storage defaults and click **Next: Add Tags** in the bottom right corner.

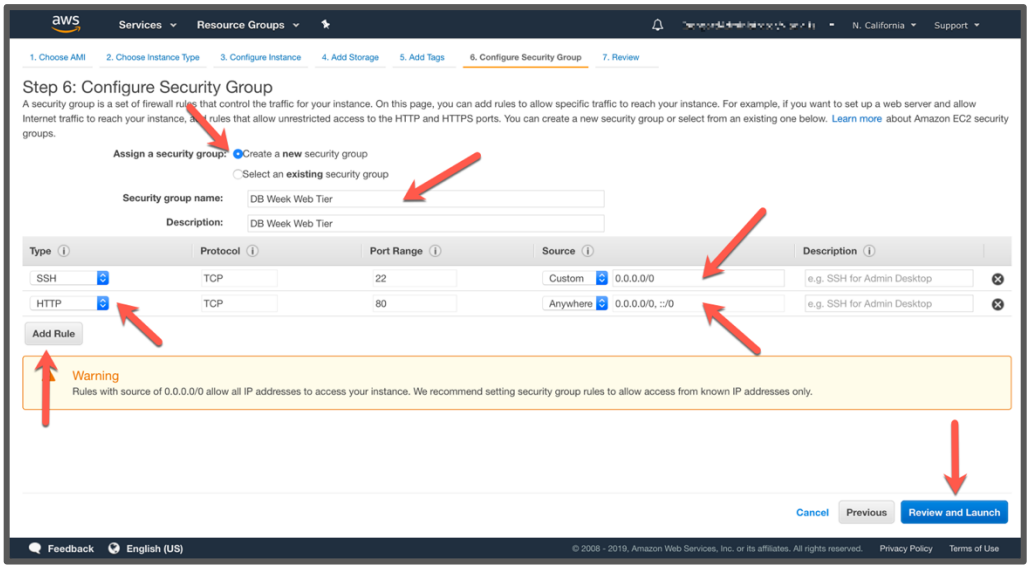
On the **Step 5: Add Tags** screen, you can name your EC2 instance by creating a **Name** tag. This Name will appear in the Management Console once the instance launches. It makes it easy to keep track of running machines in a complex environment. Click the **Add Tag** button, write **Name** under the **Key** column,and write a memorable name like "`DB Week Web Server`" in the **Value** column. Click **Next: Configure Security Group** in the bottom right corner.



On the **Step 6: Configure Security** Group screen, you will be prompted to create a new **Security Group**, which will contain your firewall rules. Since we are building out a Web server, name your new security group "`DB Week Web Tier`" or a similarly memorable name, and confirm an existing SSH rule exists which allows TCP port 22 from Anywhere (or 0.0.0.0/0). Click the **Add Rule** button, to add

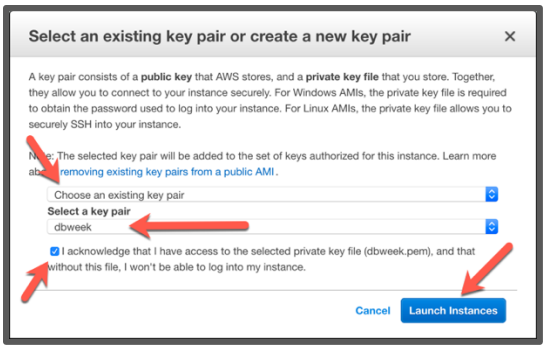
an additional rule.

Select **HTTP** from the **Type** dropdown menu, and confirm **TCP** port **80** is allowed from **Anywhere** *(you'll notice, that "Anywhere is the same as '0.0.0.0/0').* Click **Review and Launch** in the bottom right corner.



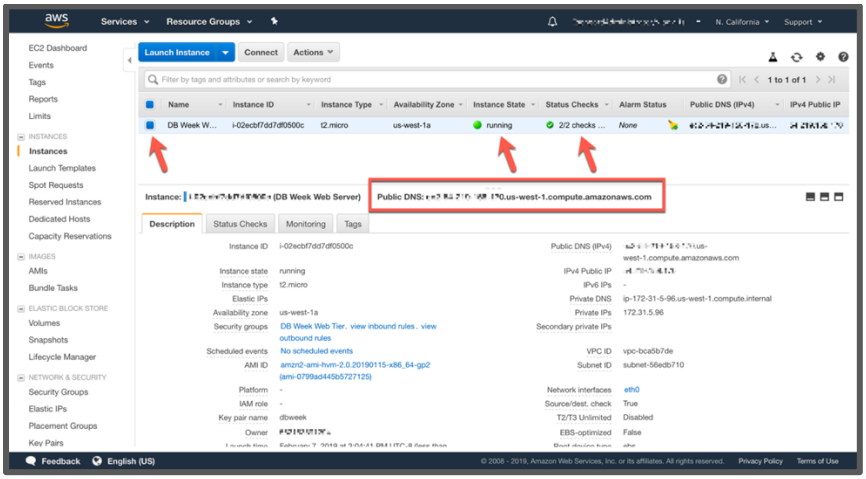
Review your cofiguration and choices, and then click **Launch** in the bottom right corner.

At the **Select an existing key pair…** prompt make sure to choose the option **Choose and existing key pair** in the first dropdown. Select the key pair that you created in the beginning of this lab from the second drop-down and check the "I acknowledge […]" checkbox. Then click the **Launch Instances** button.



Click the **View Instances** button in the lower righthand portion of the screen to view the list of EC2 instances. Once your instance has launched, you will see your web server as well as the Availability Zone the instance is in, and the publicly routable DNS name.

Click the checkbox next to your web server to view details about this EC2 instance.



Wait for the **Instance state** to change to **running** and to show **2/2 checks passed** in the **Status Checks** column.

Open a new browser tab and navigate to the web server interfaces by entering the EC2 instance's **Public DNS** name into the browser. The EC2 instance's Public DNS name can be found in the console by reviewing the Public DNS name line highlighted in the preceding screenshot. You should see a website that looks like the example below:

Create VPC Security Group for the DB Instance

The RDS servers have the same security model as Amazon EC2: trust nothing. A common use of an RDS instance in a VPC is to share data with an application server running in an EC2 instance in the same VPC. In this lab, the web server EC2 instance you just created, can be accessed directly over the Internet, and that web server will then initiate database connections to the RDS DB instance.

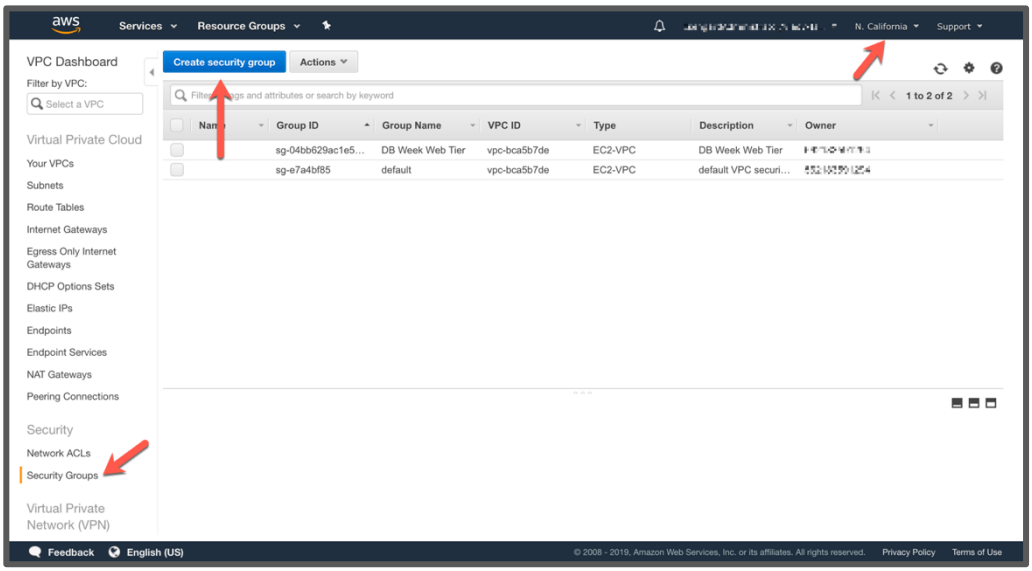
To this end, we'll need to utilize a VPC security group to permit the EC2 instance to access the RDS DB instance. Because workloads in AWS are elastic, and the number of actual EC2 instances typically can change, we will reference the security group of the web server as a permitted source of traffic to the database, instead of the IP address of the web server itself. This ensures that if we decide later to add more web server EC2 instances (or remove some), and we configure them to use the same web tier security group, we do not have to change the database security group to allow access. Access will be granted automatically by the membership in the web tier security group.

Let's create a new VPC security group for our database tier that only allows traffic from our web server (the EC2 instance we created previously).

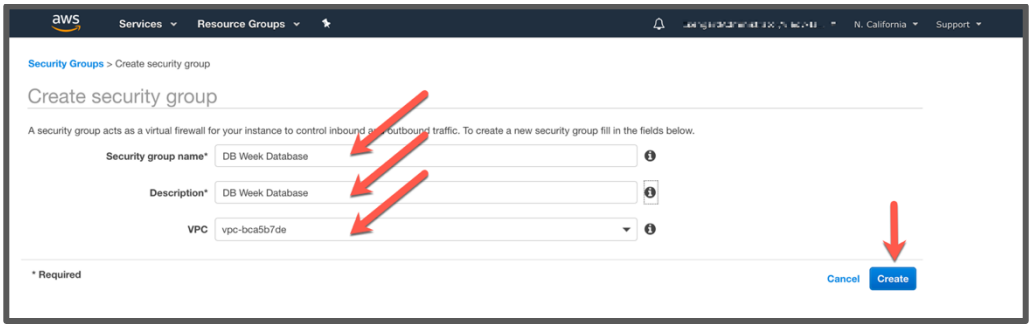
Sign into the AWS Management Console and open the Amazon VPC console at https://console.aws.amazon.com/vpc, if the console is not already open, or showing a different service console.

In the upper-right corner of the AWS Management Console, confirm you are in the desired AWS region (e.g., Oregon).

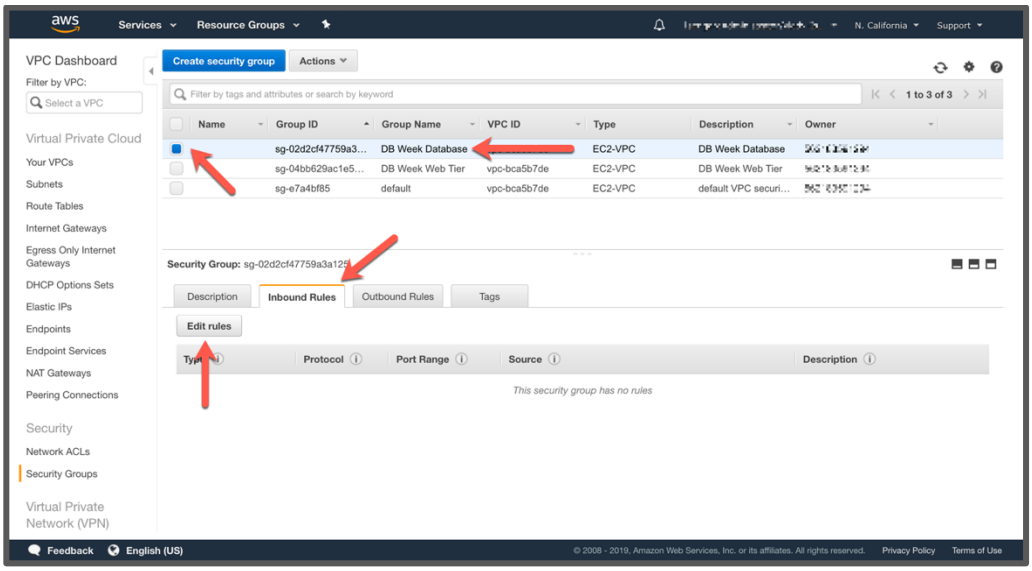
In the VPC dashboard, click **Security Groups**, then the **Create Security Group** button.



Set the **Security group name** and **Description** to a memorable name "`DB Week Database`". Under **VPC**, keep the VPC setting to the same VPC you've launched your EC2 instance in (typically the *Default VPC* which may be unnamed). Then click **Create**.

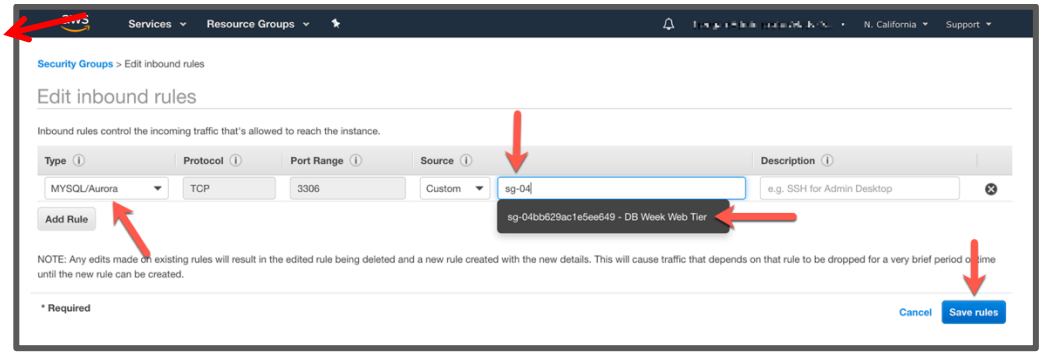


After your VPC security group is created (click **Close** on the confirmation screen), you'll see it listed along with the other security groups in your account. Check the box next to it, to see the details of it in the lower pane on the screen.



Click **Inbound Rules**, then the **Edit rules** button in that lower pane.

Add a new inbound rule for the EC2 server(s) in our web tier by clicking the **Add Rule** button. The **Type** should be **MySQL/Aurora (3306)** which auto-selects protocol **TCP** and port **3306**. In the **Source** text box, start typing "sg-", while you're typing, a list of security group(s) that match should be presented to you. Select your web tier security group, then click the **Save rules** button.



Click **Close** on the confirmation screen.

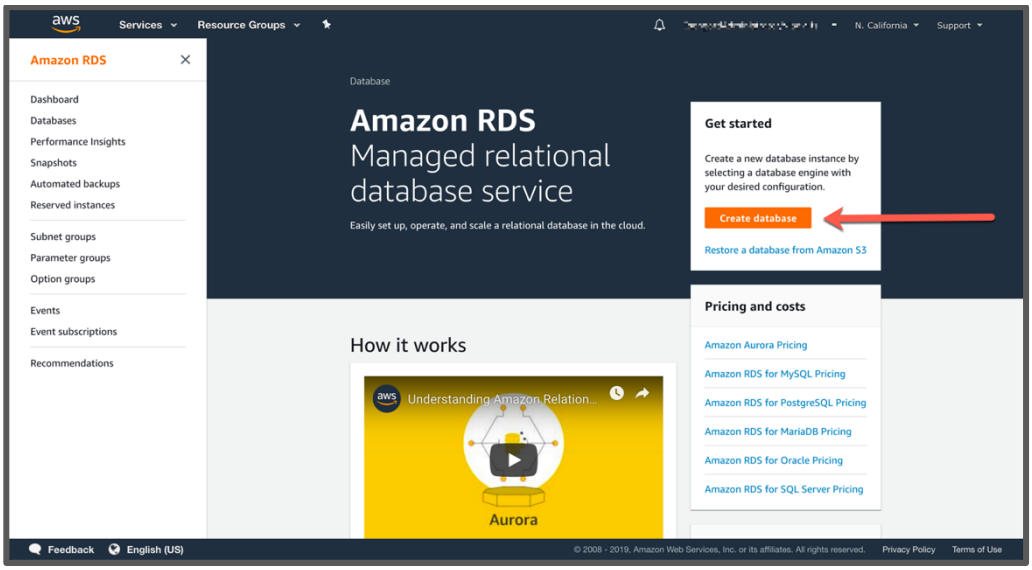
Launch an RDS DB Instance

Now that all prerequisites are met, you can configure and launch a MySQL RDS DB Instance. For the purposes of this lab, you will use the default configurations where possible.

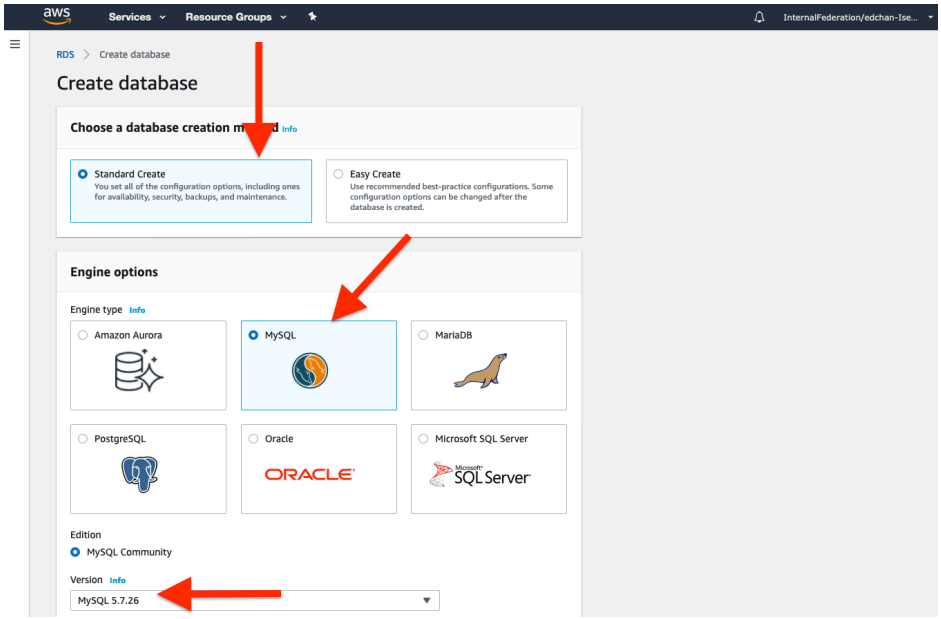
Sign into the AWS Management Console and open the Amazon RDS console at https://console.aws.amazon.com/rds, if the console is not already open, or showing a different service console.

In the upper-right corner of the AWS Management Console, confirm you are in the desired AWS region (e.g., Oregon).

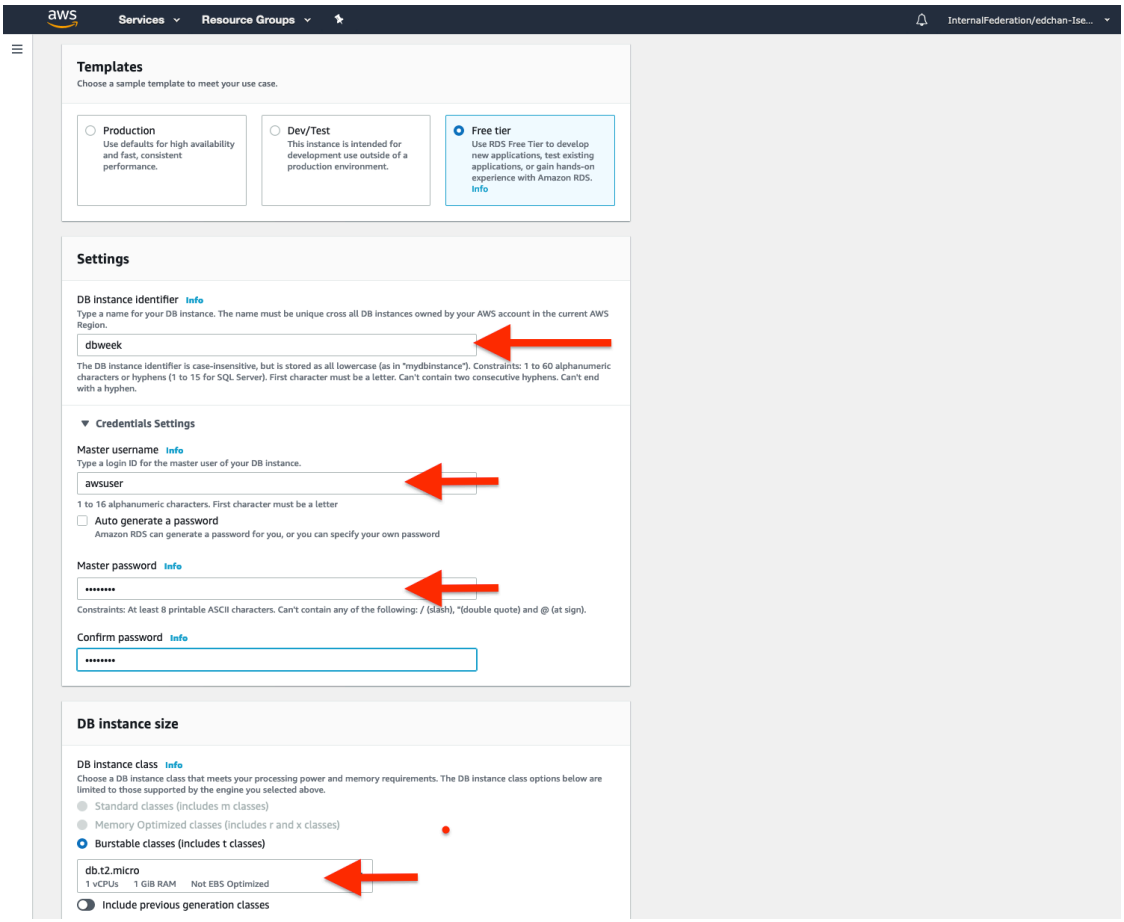
1. Click on **Create database**.



At **Create Database** page**,** choose Standard Create to see most options for the purpose of this workshop. Under Engine options, select **MySQL** from the available engine types. Select MySQL 5.7.26 for Engine Version.



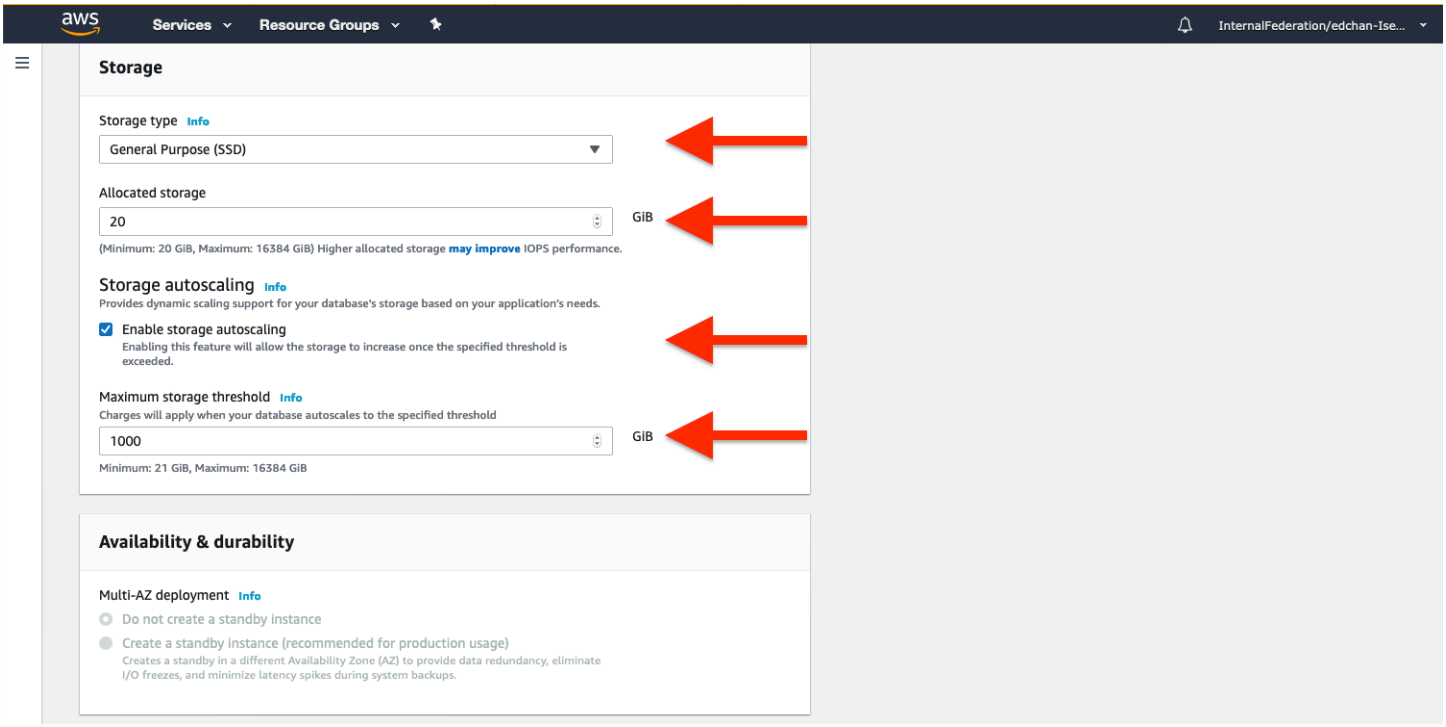
Continue to scroll down**,** Under Templates, select **Free Tier** (normally you would select Production or Dev/Test to prefill some additional options). Free Tier will disable options such as Multi-AZ deployments or read replicas, but it is safe for the purposes of this lab. The Free Tier will also bound your instance to ***db.t2.micro*** for DB instance size.

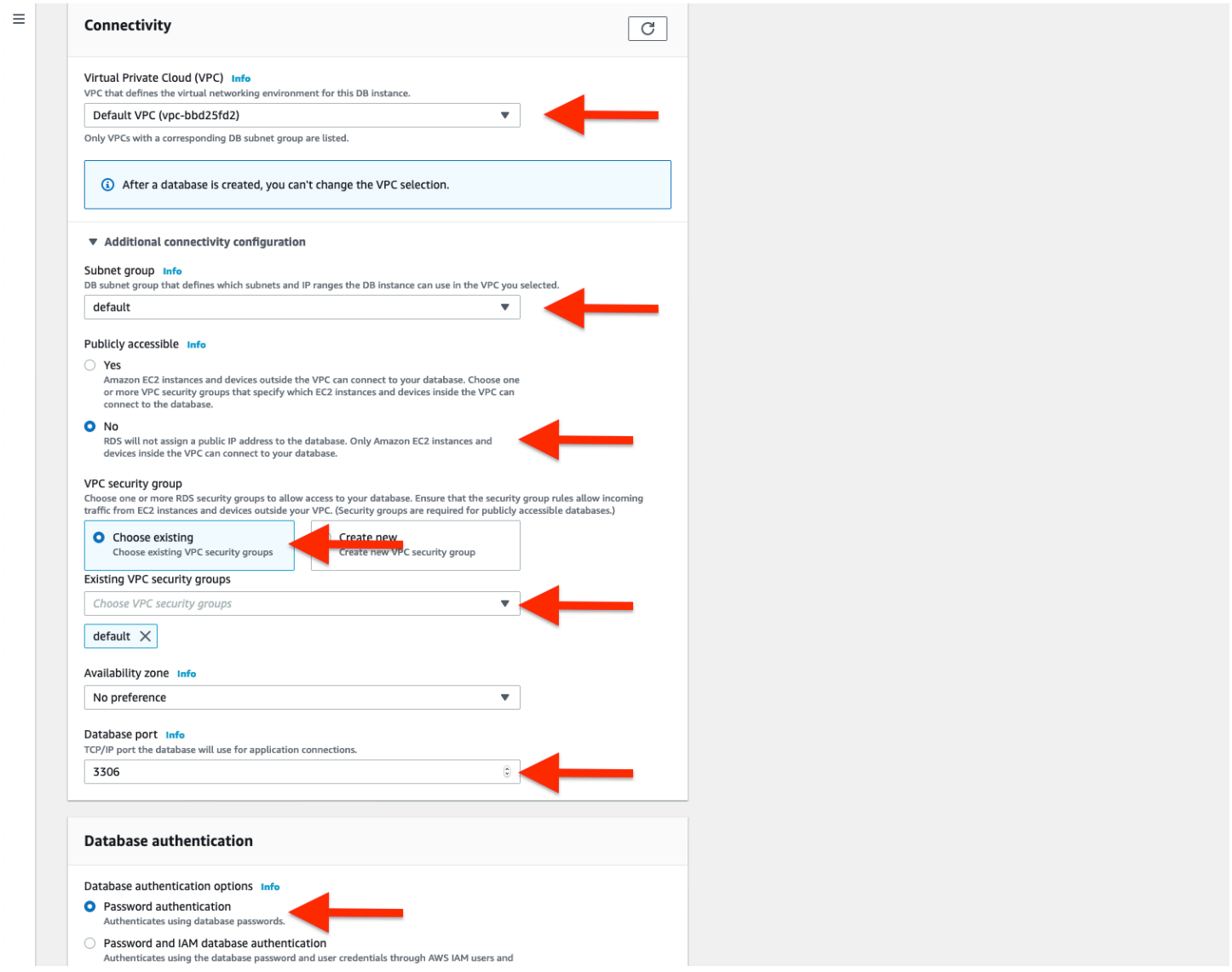


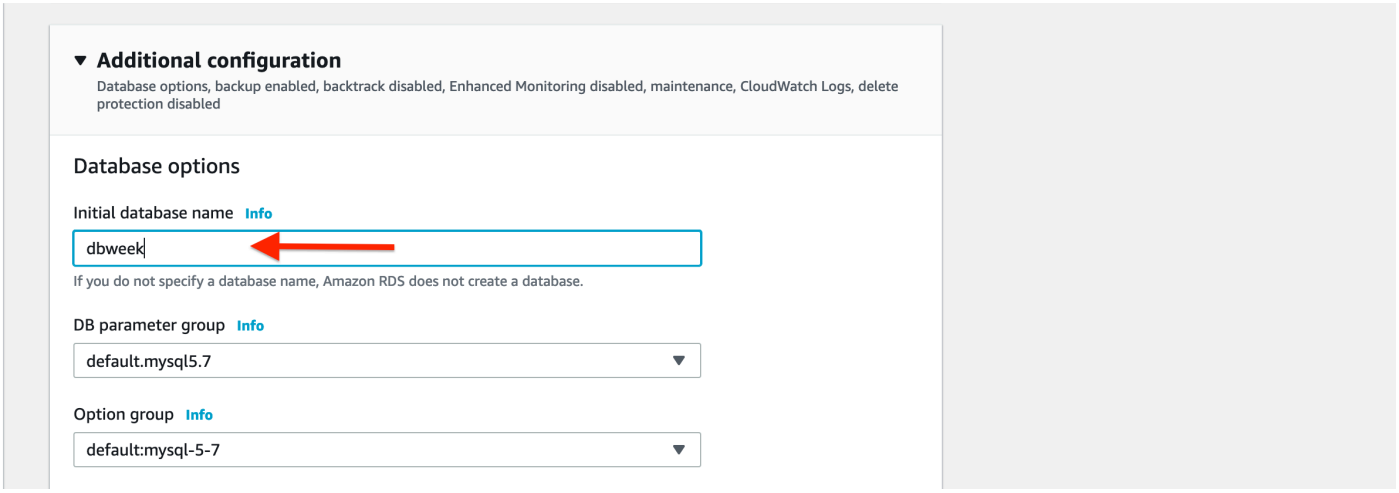
Set Storage to **General Purpose (SSD)** for Storage Type, and leave the defaults of **20GiB** Allocation Storage and Maximum threshold of **1000GiB**, and check **Enable storage autoscaling** on. As Free Tier is being used, this database instance will be forced to disable Multi-AZ deployment (**Do not create a standby instance**) under Availability & durability. In a real world production environment, Multi-AZ is highly recommended for additional resiliency and automatic failover.

Under Connectivity, select the **Default VPC**. Then click on **Additional connectivity configuration** to expand more options. Ensure that **Publicly accessible** is set to **No**, in order to disable a public IP from being assigned and remove public connectivity. Under **VPC security group**, we will select the previously-created security group named ***DBweek Database*** and remove the ***default*** security group with the X button next to it. Set Availability zone to **No Preference**, and Database port as default value of **3306**, and utilize Password authentication for database authentication.

Expand on **Additional Configuration**. Create an **Initial Database Name** called ***dbweek*** (as the simple web application will look for this database name for initial population SQL script). Use the default settings for other Additional configuration settings such as the Parameter Group, Encryption, Backup, Backtrack, Enhanced Monitoring, Logs, Maintenance and Delete protection sections


aws
Services
Resource Groups
InternalFederation/edchan-Ise...
Storage
Storage type Info
General Purpose (SSD)
Allocated storage
20
GiB
(Minimum: 20 GiB, Maximum: 16384 GiB) Higher allocated storage may improve IOPS performance.
Storage autoscaling Info
Provides dynamic scaling support for your database's storage based on your application's needs.
Enable storage autoscaling
Enabling this feature will allow the storage to increase once the specified threshold is exceeded.
Maximum storage threshold Info
Charges will apply when your database autoscales to the specified threshold
1000
GiB
Minimum: 21 GiB, Maximum: 16384 GiB
Availability & durability
Multi-AZ deployment Info
Do not create a standby instance
Create a standby instance (recommended for production usage)
Creates a standby in a different Availability Zone (AZ) to provide data redundancy, eliminate I/O freezes, and minimize latency spikes during system backups.


Connectivity
Virtual Private Cloud (VPC) Info
VPC that defines the virtual networking environment for this DB instance.
Default VPC (vpc-bbd25fd2)
Only VPCs with a corresponding DB subnet group are listed.
After a database is created, you can't change the VPC selection.
Additional connectivity configuration
Subnet group Info
DB subnet group that defines which subnets and IP ranges the DB instance can use in the VPC you selected.
default
Publicly accessible Info
Yes
Amazon EC2 instances and devices outside the VPC can connect to your database. Choose one or more VPC security groups that specify which EC2 instances and devices inside the VPC can connect to the database.
No
RDS will not assign a public IP address to the database. Only Amazon EC2 instances and devices inside the VPC can connect to your database.
VPC security group
Choose one or more RDS security groups to allow access to your database. Ensure that the security group rules allow incoming traffic from EC2 instances and devices outside your VPC. (Security groups are required for publicly accessible databases.)
Choose existing
Choose existing VPC security groups
Create new
Create new VPC security group
Existing VPC security groups
Choose VPC security groups
default
Availability zone Info
No preference
Database port Info
TCP/IP port the database will use for application connections.
3306
Database authentication
Database authentication options Info
Password authentication
Authenticates using database passwords.
Password and IAM database authentication
Authenticates using the database password and user credentials through AWS IAM users and

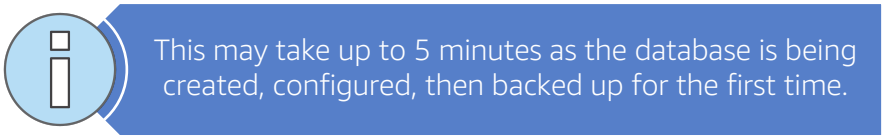


Your input values should resemble these values:

- Database creation method: Standard Create
- Engine type/edition: MySQL / MySQL Community
- DB engine version: MySQL 5.7.26 (or newer 5.7 minor version)
- Templates: Free Tier
- DB instance identifier: `dbweek`
- Master username: `awsuser` (or another memorable username)
- Master password / Confirm: DBweek19 (or another memorable password)
- DB instance class: `db.t2.micro` (Automatically Selected)
- Storage type: `General Purpose (SSD)`
- Allocated storage: `20 GiB`
- Storage Autoscaling: On
- Maximum storage threshold: `1000 GiB`
- Multi-AZ: Do not create a standby instance
- Virtual Private Cloud (VPC): *Select the one named* **`Default VPC`**
- Subnet group: `default`
- Public accessibility: No
- Availability zone: `No preference`
- Database port: 3306
- VPC security groups: *Select the one named* **`DB Week Database`**; *remove* **`Default`**
- Database authentication: Password authentication
- Initial Database Name: `dbweek`

Review your settings and click **Create database** in the bottom right area of the screen.

This will bring you back to the main RDS console Databases page and you can monitor the creation process of your RDS database instance.

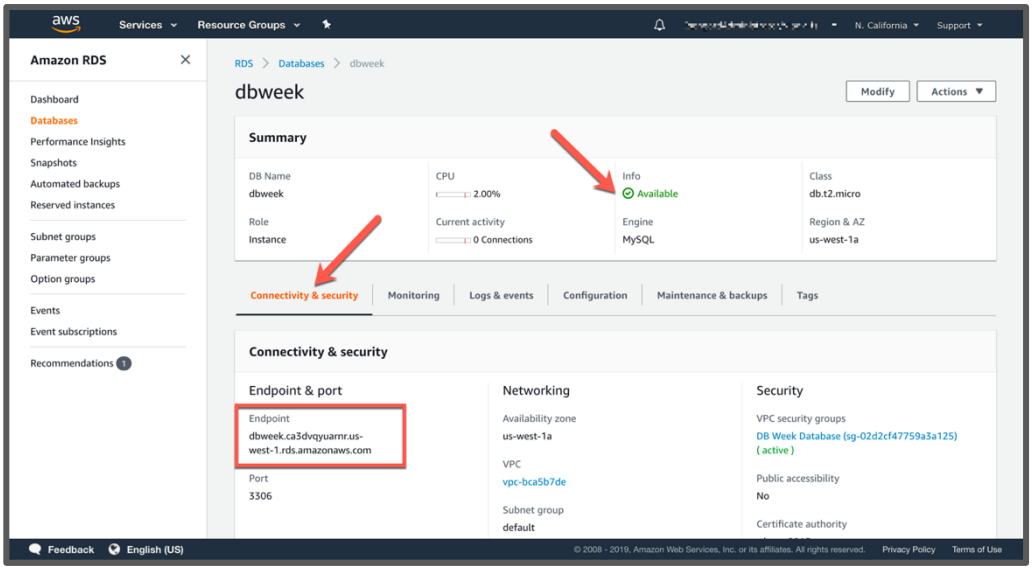


Connect the RDS DB Instance to the Web Server

The web server previously created contains a script to deploy an example database table and sample data for creating a simple address book. Next, you will connect the web server to the RDS DB instance and deploy that example.

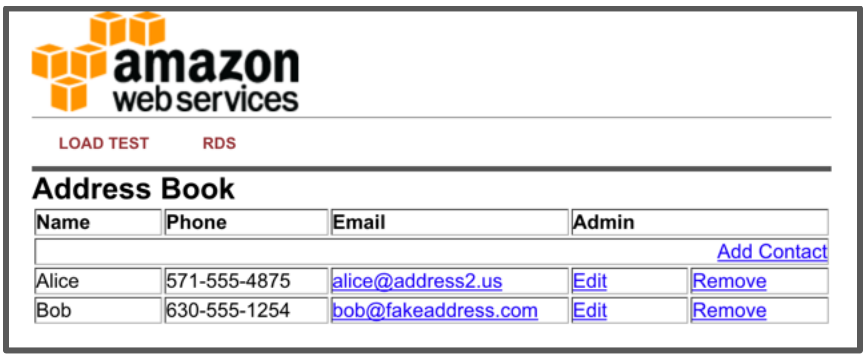
While still on the DB instance detail page of the database we recently created, refresh the browser window to ensure the DB instance status is listed as **Available.**

Click on the **Connectivity & security** tab if it is not already selected, and check the value under **Endpoint**. This is the DNS name of your database, and you will need it to connect to the database from clients. Copy that value, as you will need it shortly.



Navigate to the browser tab or window where you have the web server interface previously created open. Click on the **RDS** link**.**
You should see a prompt to enter the DB endpoint previously copied (do NOT include :3306 at the end of the DB endpoint), as well as the database "dbweek", username "awsuser" and password "DBweek19", or the custom values you specified when creating the database. Click the **Submit** button.

When complete, you will be redirected to a simple page displaying all of the information from the database you just created.



This is a very basic example of a simple address book interacting with a MySQL database managed by AWS. RDS can support much more complicated relational database scenarios, but we hope this simple example will suffice to demonstrate the point.

Feel free to play around with the address book and add/edit/remove content from your RDS database by using the **Add Contact**, **Edit**, and **Remove** links in the Address Book.

Working with RDS DB Instances

Backup and Restore using RDS Snapshots

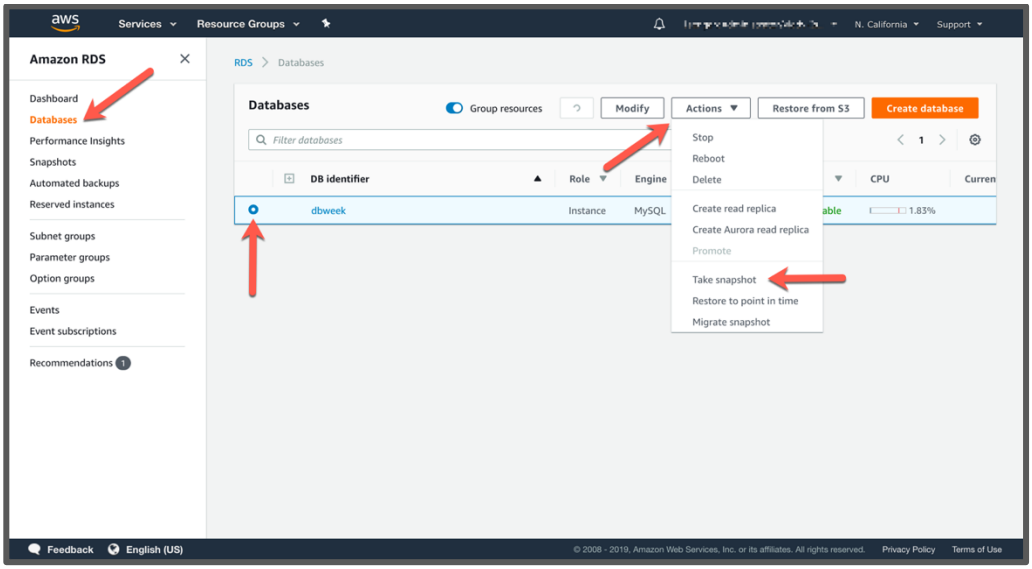
Now is a good time to take a snapshot of your RDS database. Taking a snapshot enables you to back up your DB Instance in a known state as frequently as you wish, and then restore to that specific state at any time.

Sign into the AWS Management Console and open the Amazon RDS console at https://console.aws.amazon.com/rds, if the console is not already open, or showing a different service console.

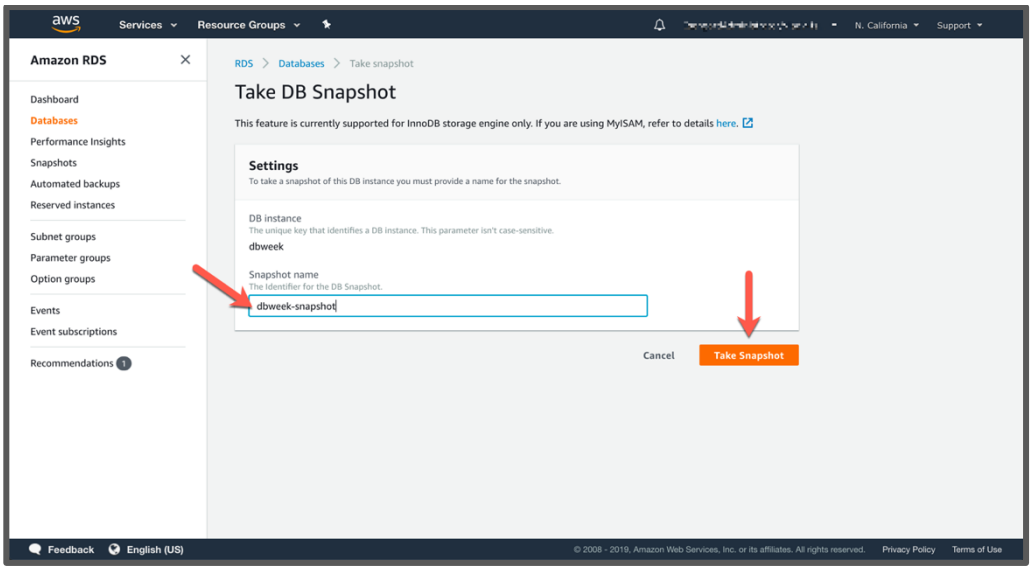
In the upper-right corner of the AWS Management Console, confirm you are in the desired AWS region (e.g., Oregon).

In the left-hand side navigation panel (the panel may be collapsed, click the three horizontal bars at the top of it to expand it), click on **Databases,** then select the radio box of the row corresponding to your DB instance.

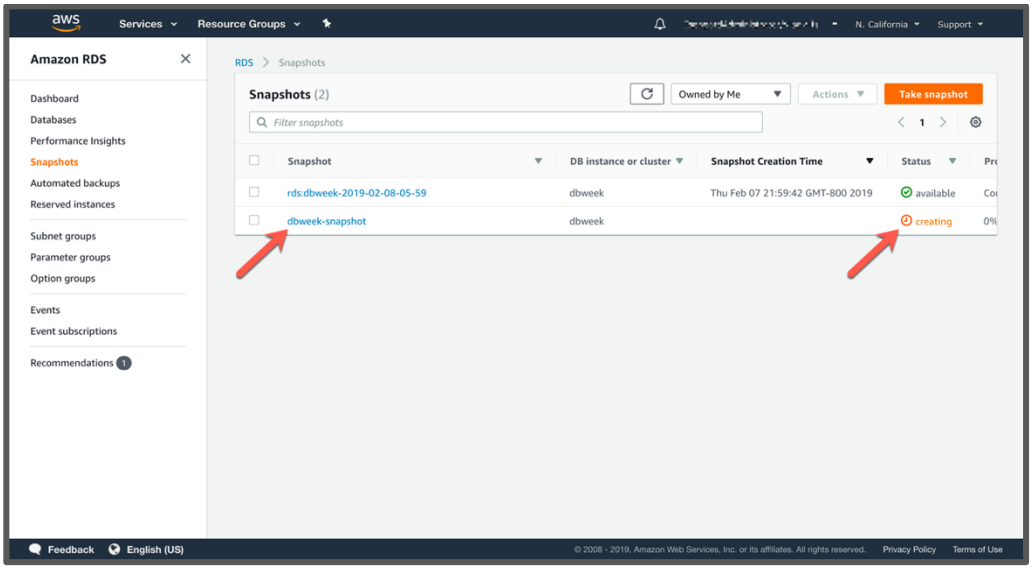
From the **Actions** menu button at the top of the DB instance listing, choose **Take snapshot**.



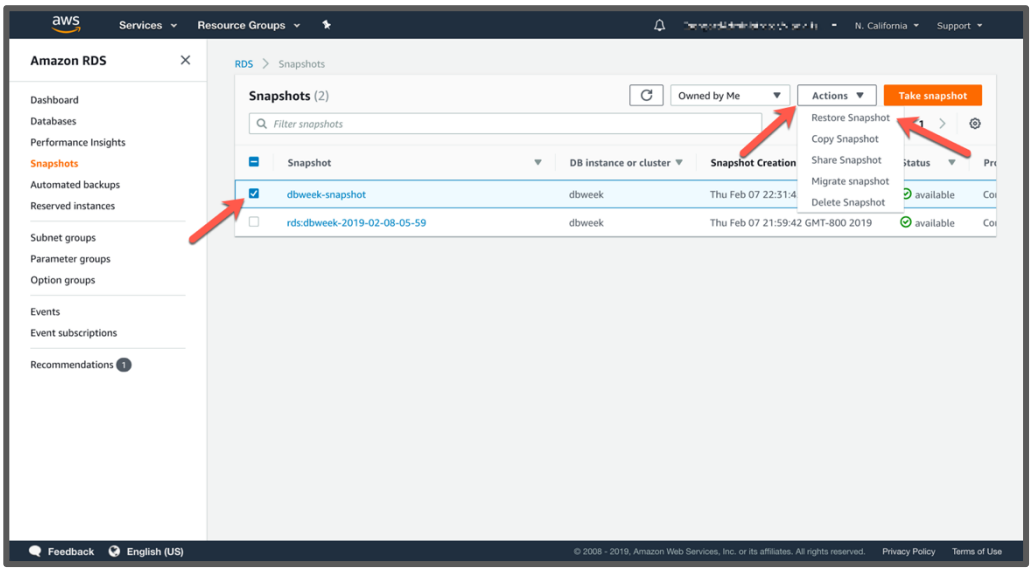
Give the snapshot a memorable name, such as "*dbweek-snapshot*" and click **Take Snapshot**.



You can track the backup progress in the **Snapshots** section of the RDS console. When the snapshot completes it will be listed as **available**. Notice the automated snapshot in the listing. It was enabled automatically when the default of 7 days backup retention was configured at DB instance launch time. You can leverage the automated backups to execute point in time restore operations, up to the last 5 minutes prior to the present time.



Once available, you can use that snapshot to restore the database. RDS does not replace your existing DB instance with the restored one, instead it will create a new DB instance using the data set of the snapshot. To initiate a restore operation, select the desired snapshot, then from the **Action** menu button at the top of the snapshot listing. Choose **Restore Snapshot** then follow the configuration screens. Notice that you can easily launch new RDS instances from any previous snapshot!



Launching a new DB instance from a snapshot may incur additional costs beyond the Free Tier.

Scale up the Compute Capacity for an RDS DB Instance

Scaling up and down with RDS is simple via the AWS Management Console. You can change the underlying server size, by selecting a new DB instance class, and you can modify the storage characteristics, by changing the storage type and growing the size of the storage to accommodate usage growth. You cannot

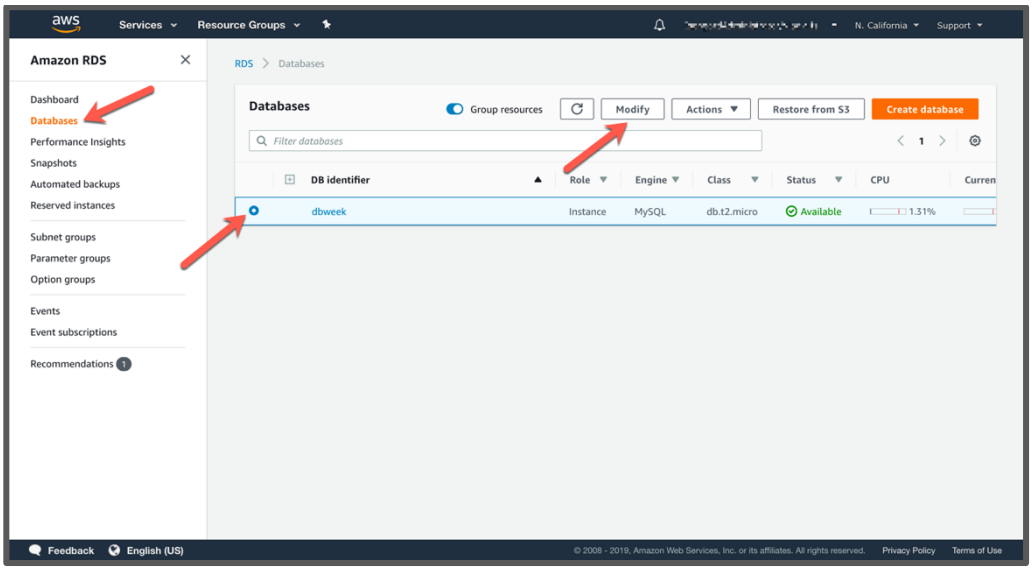
shrink the size of the storage, however, if it turns out you have overprovisioned it. It is always recommended to start with the right amount of storage you need in the immediate future, and scale the storage as your workload grows.

Sign into the AWS Management Console and open the Amazon RDS console at https://console.aws.amazon.com/rds, if the console is not already open, or showing a different service console.

In the upper-right corner of the AWS Management Console, confirm you are in the desired AWS region (e.g., Oregon).

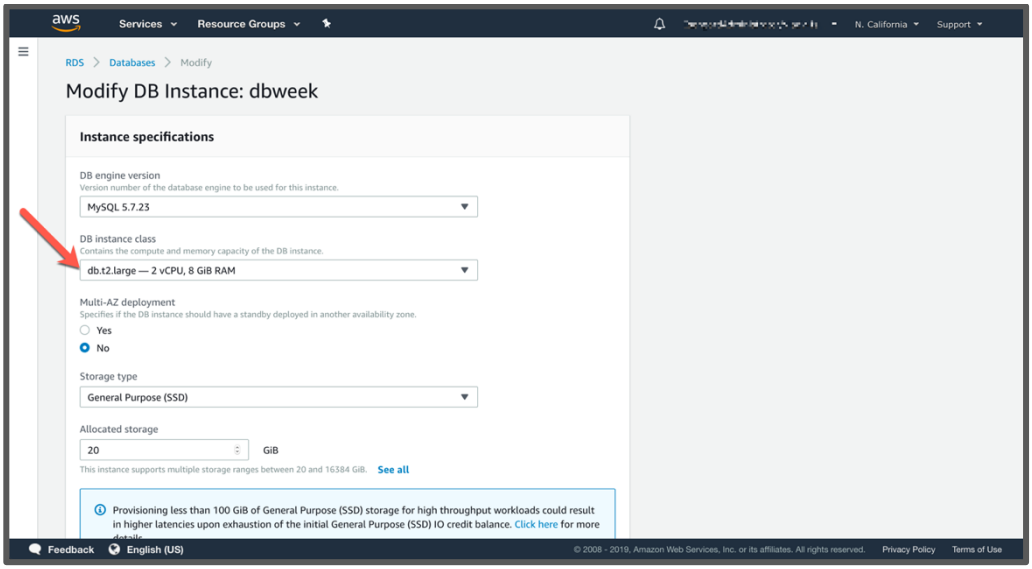
In the left-hand side navigation panel (the panel may be collapsed, click the three horizontal bars at the top of it to expand it), click on **Databases,** then select the radio box of the row corresponding to your DB instance.

Click the **Modify** button at the top of the DB instance listing.

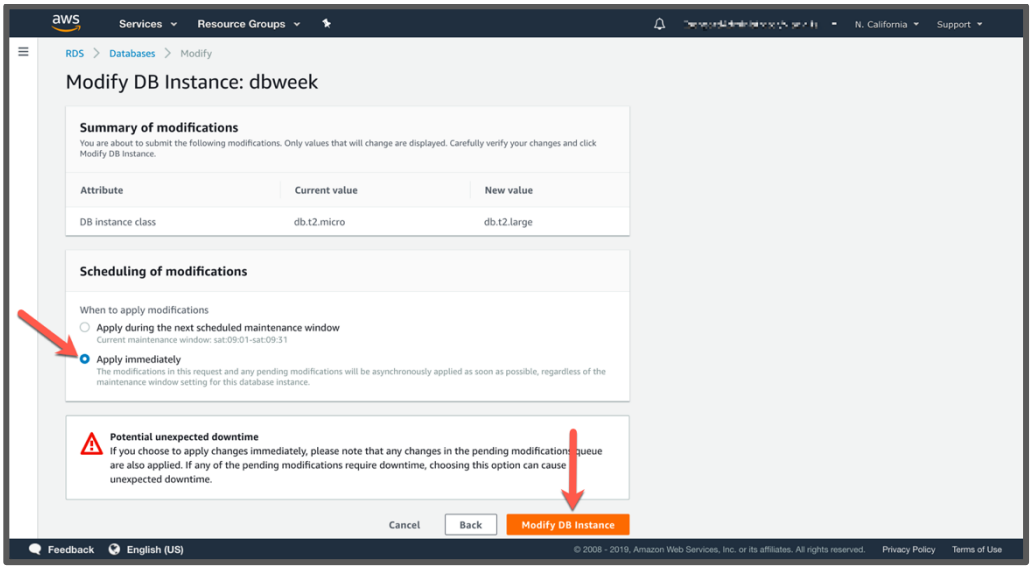


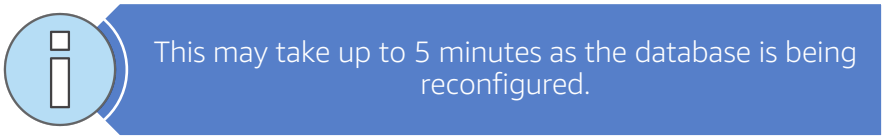
On the **Modify DB Instance** screen, try changing to a **t2.large** DB instance class, and if you want, also grow the database allocated storage at the same time to 40GiB. Click **Next**.

Changing the DB instance class to a larger one, or allocating more storage may incur additional costs beyond the Free Tier.

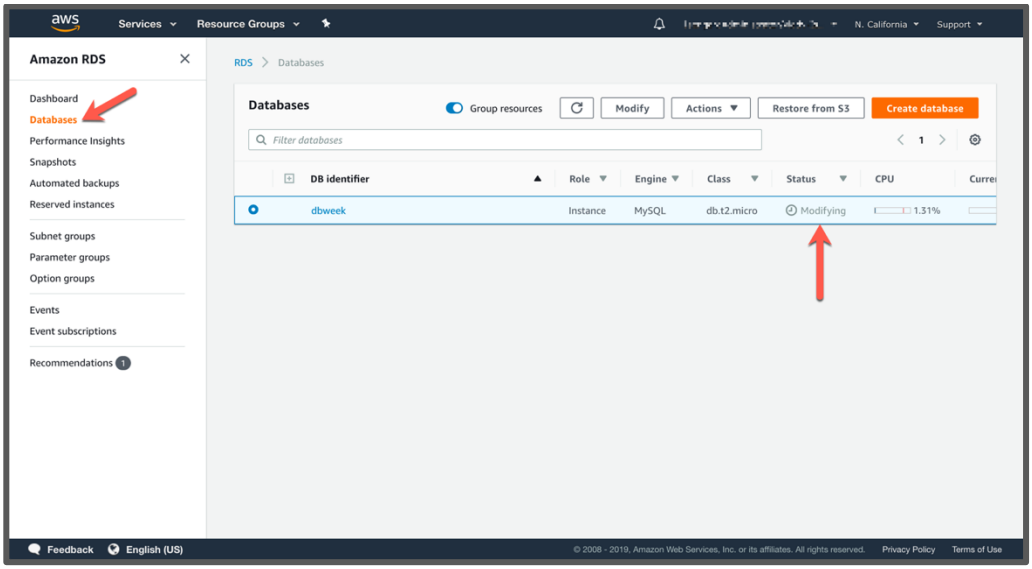


On the next screen, don't forget to choose **Apply immediately.** Then click **Modify DB Instance**. Otherwise changes will be scheduled to be applied during the next maintenance window. Scheduling changes is preferred for production workloads, as some modifications, like changing the DB instance class, require a restart (or failover in case of Multi-AZ DB instances). Applying such changes during a period of low utilization mitigates the corresponding temporary loss of availability.





Back on the **Databases** listing page in the console, you can track the status of the operation. While the changes are performed, your DB instance will be listed in a **Modifying** state.



Monitoring RDS DB Instances

You can monitor the health and performance of your RDS DB instances directly from the console. Amazon RDS leverages Amazon CloudWatch to expose various relevant health and performance metrics. You can use these metrics to monitor, create alarms, troubleshoot or make capacity planning decisions.

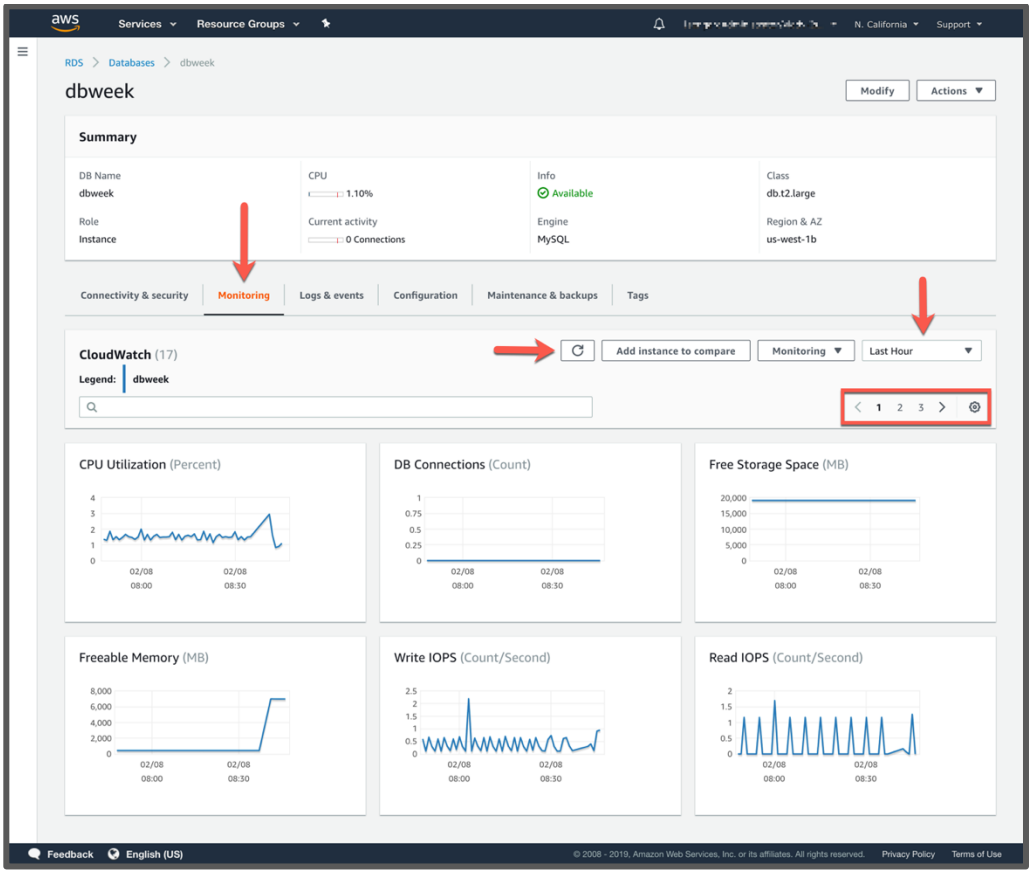
Sign into the AWS Management Console and open the Amazon RDS console at https://console.aws.amazon.com/rds, if the console is not already open, or showing a different service console.

In the upper-right corner of the AWS Management Console, confirm you are in the desired AWS region (e.g., Oregon).

In the left-hand side navigation panel (the panel may be collapsed, click the three horizontal bars at the top of it to expand it), click on **Databases,** then select the radio box of the row corresponding to your DB instance.

Click on the **DB identifier** of the desired database in the list.

Click on the **Monitoring** tab on the database detail page.



Use the **Refresh** button (circle with arrow) to repopulate the graphs with new data. You can also change the time period of the graphs from **Last Hour** to other relevant ones.

Monitoring metrics are paginated due to the large number of options, use the pagination controls to cycle through them, or change the number of graphs displayed on one page.

Extra Credit

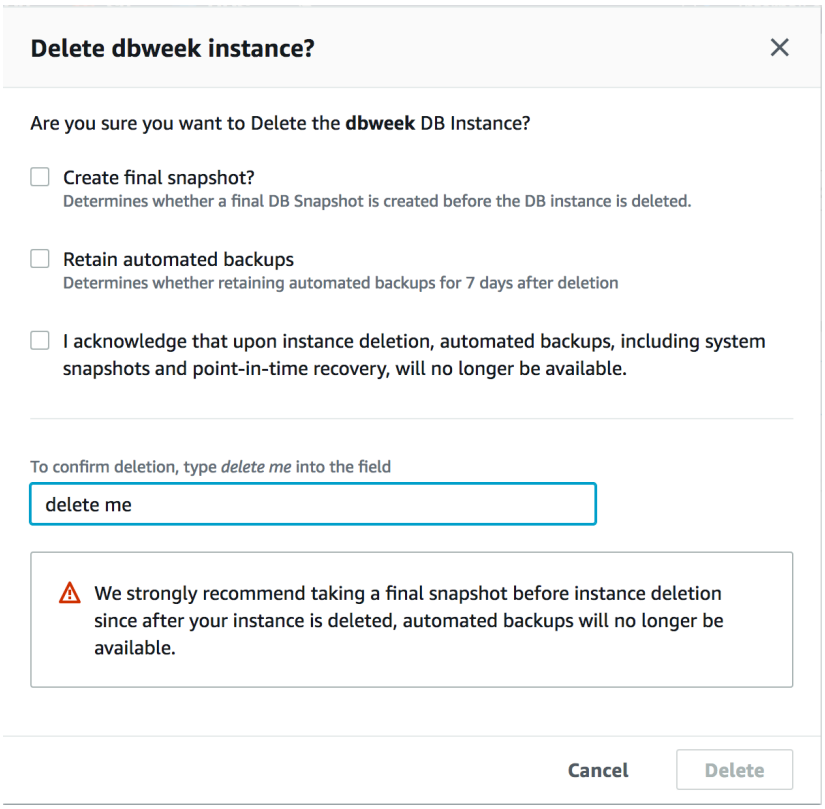
If you have additional time, try to do the following:

- Modify your original database instance size to **db.m5.large** ($0.171/hr; scaling operation to take about 10 minutes and will result in downtime), enable **Performance Insights**. Once turned on, return to the web app interface to insert, update, or delete records. Wait a few minutes and take a peek into RDS Performance Insights for metrics on database level performance. Click on the settings (gear icon) and add additional metrics like `Select_scan`, `Innodb_rows_read`, `Innodb_rows_updated`, and `Innodb_rows_deleted`. What do you see within the Performance Insights metrics?

Cleaning Up

Once finished, cleanup your resources created during this workshop to avoid incurring any running charges. Remember all running EC2 and RDS resources will incur an hourly on-demand charge.

1. Delete all RDS database instances created during the workshop. In the RDS Console, for each of the databases created, click on **Actions**, then **Delete**. Uncheck "**Create final snapshot**" and "**Retain automated backups**" (Normally for an actual database you might want to create the final snapshot in the event you need to restore the database). Click on "**I acknowledge**" checkbox and type in "**delete me**" in the field. Then press the **Delete** button.



2. Delete the EC2 instance created during the workshop. In the EC2 Console main page, click on **Running Instances**; or click on **Instances** on the left menu. Click on the checkbox next to the EC2 instance created for the web app. Then click on **Actions**, then **Instance State,** then **Terminate**.

Confirm on **Yes, Terminate** when prompted.

3. Delete the EC2 keypair. Click on **Key Pairs** on the left menu under the EC2 Console. Click on the checkbox next to the keypair created. Then **Delete**.

4. Delete the VPC Security Groups. Click on **Security Group** on the left menu under the EC2 Console. Highlight all the Security Groups created during the workshop (they should start with *dbweek** if you followed the naming conventions in the instructions) and then click on **Delete Security Group**.