

Migration Guide: Amazon RDS to MySQL HeatWave on Amazon Web Services (AWS)

Purpose statement

This document provides an overview of the steps to migrate to MySQL HeatWave.

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What is MySQL HeatWave

MySQL HeatWave is a fully managed database service, powered by the integrated HeatWave in-memory query accelerator. It's the only cloud database service that combines transactions, analytics, and machine learning services into one MySQL Database, delivering real-time, secure analytics without the complexity, latency, and cost of extract, transform, and load (ETL) duplication. It's available on Oracle Cloud Infrastructure (OCI), Amazon Web Services (AWS), and Microsoft Azure.

MySQL HeatWave on AWS delivers price performance that is 7X better than Amazon Redshift and 10X better than Snowflake. On a [10 GB TPC-C workload](#), MySQL HeatWave offers up to 10X higher and sustained throughput compared to Amazon RDS at high concurrency. With MySQL HeatWave ML, developers and data analysts can build, train, deploy, and explain machine learning models in MySQL HeatWave without moving data to a separate machine learning service. For machine learning, MySQL HeatWave on AWS is 25X faster than Redshift ML.

[Learn more about MySQL HeatWave](#)

Before you start

1. Using the method outlined in this migration guide, where you export your source database and then import it into MySQL HeatWave, there will be some downtime involved. The length of the downtime will mostly depend on the size of your database and checks you may want to perform before bringing your database back online.
2. You must have an account on Oracle Cloud Infrastructure (OCI) and be able to log in to it at <https://cloud.oracle.com/>
 - If you do not have an account on OCI, you can create one at <https://www.oracle.com/mysql/free/>
3. You must have enabled "MySQL HeatWave on AWS service" from the OCI Console.
 - For instructions on how to enable MySQL HeatWave on AWS from OCI, refer to the documentation <https://dev.mysql.com/doc/heatwave-aws/en/heatwave-aws-sign-up.html>

I. Preparing your AWS environment

Section A: Prerequisites

1. To migrate using the method that is shown in this guide, you will need a source RDS MySQL instance that is running MySQL 5.7 or above. For this guide, we have chosen an Amazon RDS MySQL 5.7.33 (when applicable, you should always execute the commands shown in this guide as a root/admin user). You can view the Amazon RDS MySQL version that is being used for this guide in the image below:

```
MySQL database-1 t-1.rds.amazonaws.com SQL > SELECT @@VERSION;
+-----+
| @@VERSION |
+-----+
| 5.7.33    |
+-----+
1 row in set (0.0010 sec)
```

You can check the version of MySQL you are using by logging into your Amazon RDS MySQL Server and running the following command:

```
mysql> SELECT @@VERSION;
```

2. For this guide, we have some data pre-loaded on our Amazon RDS MySQL database. The sample data being used for this example is called the 'world' database, which can be downloaded from here: <https://dev.mysql.com/doc/index-other.html>.

To view a list of the databases on your Amazon RDS MySQL Server and the tables in the world database that you will be exporting from Amazon RDS MySQL to MySQL HeatWave on AWS, run the following commands:

```
mysql> SHOW DATABASES;
mysql> SHOW TABLES IN world;
```

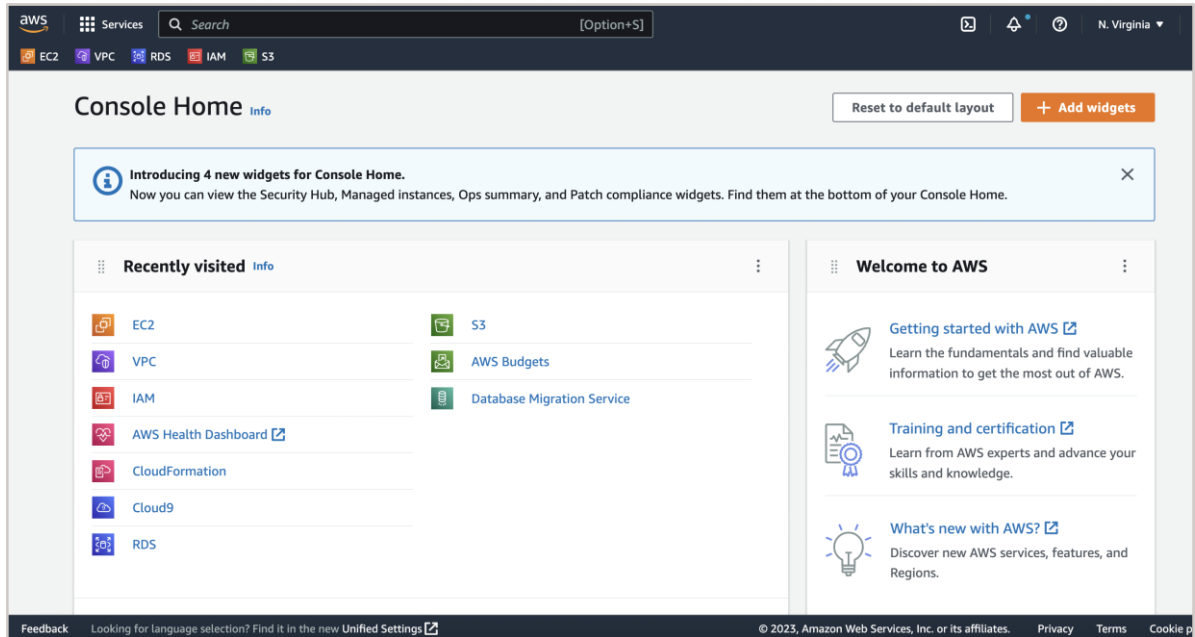
```
MySQL database-1.c1 i-east-1.rds.amazonaws.com world SQL > SHOW SCHEMAS;
+-----+
| Database |
+-----+
| information_schema |
| mysql         |
| performance_schema |
| sys          |
| world        |
+-----+
5 rows in set (0.0018 sec)

MySQL database-1. i-east-1.rds.amazonaws.com world SQL > SHOW TABLES IN world;
+-----+
| Tables_in_world |
+-----+
| city             |
| country         |
| countrylanguage |
+-----+
3 rows in set (0.0013 sec)
```

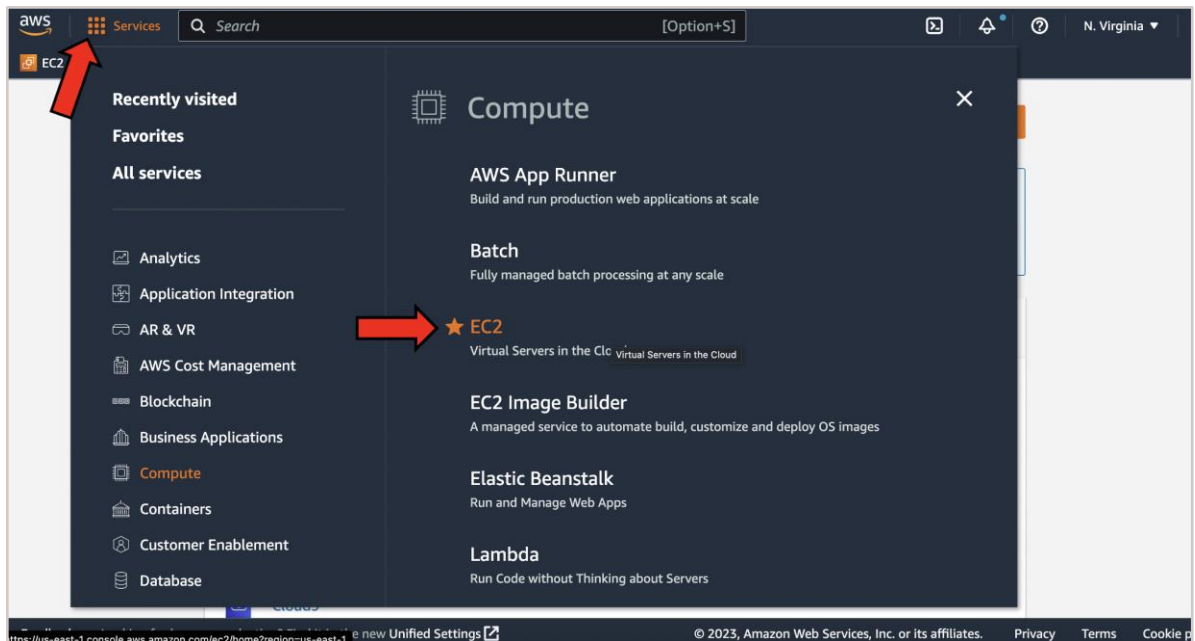
Section B: Create an EC2 Instance and configure your SSH keys

3. Login to your AWS account.

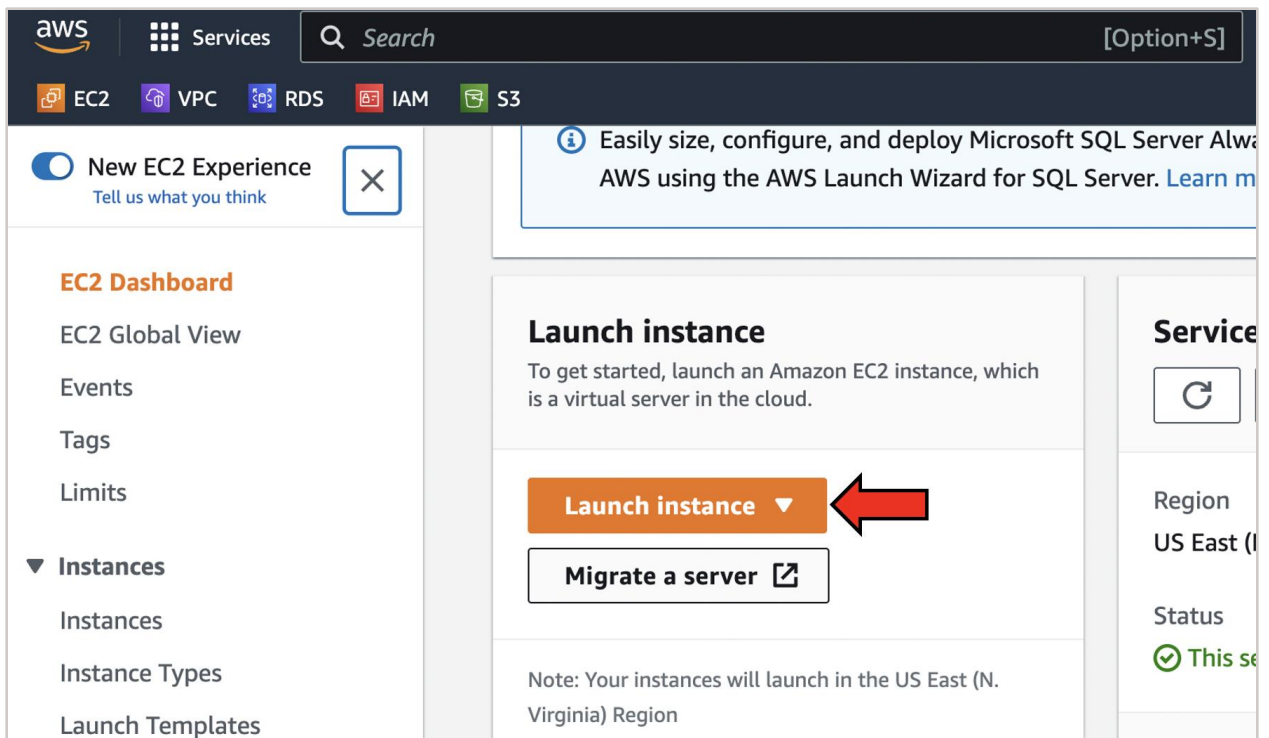
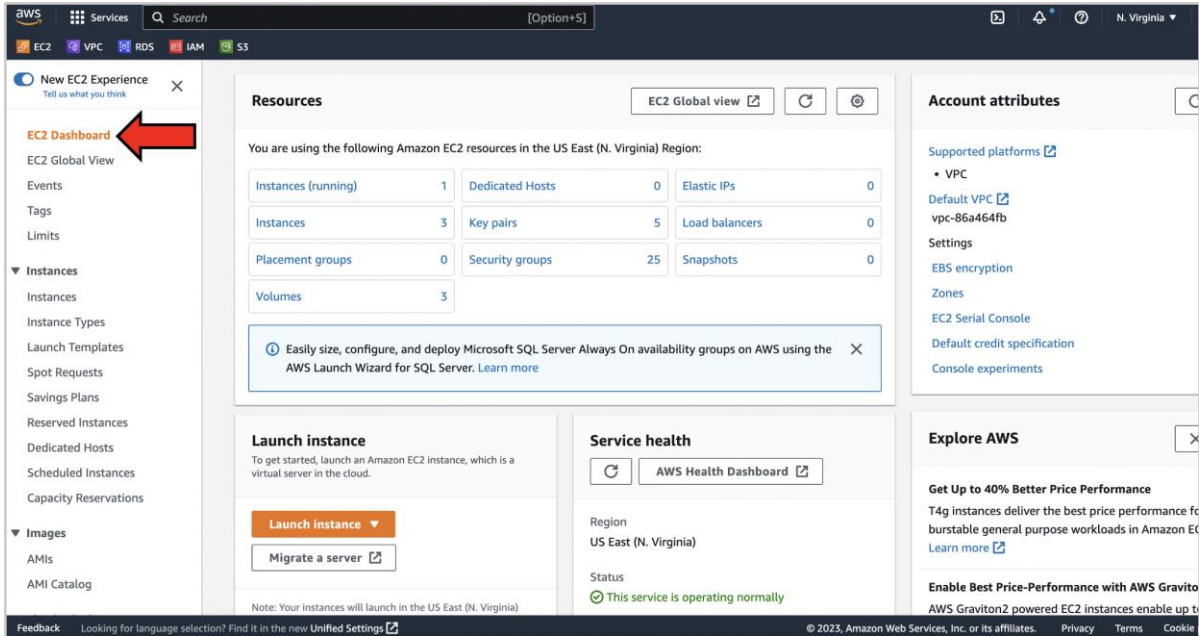
<https://aws.amazon.com/>



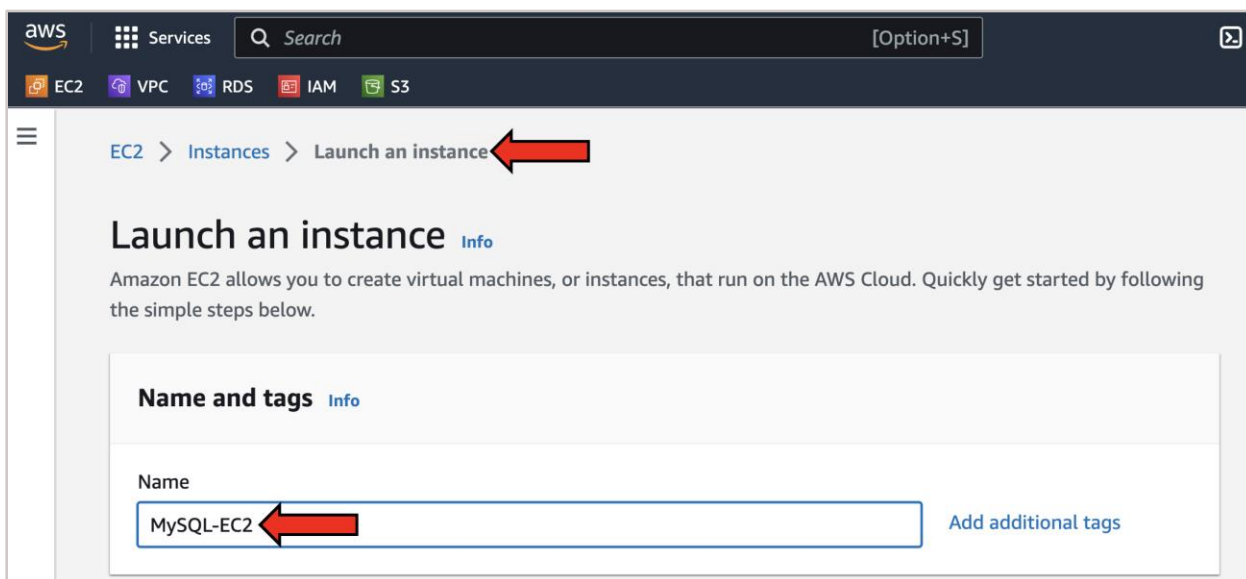
4. Click on the “Services” menu and go to “Compute” > “EC2”



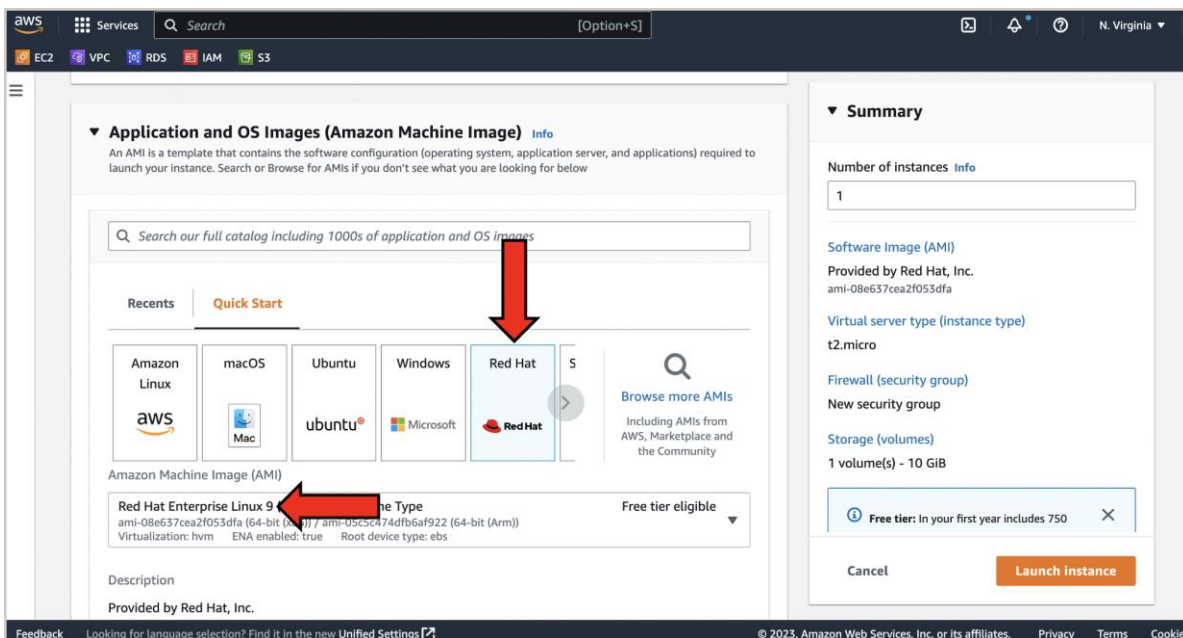
5. When on the “EC2 Dashboard” page, locate the “Launch instance” button



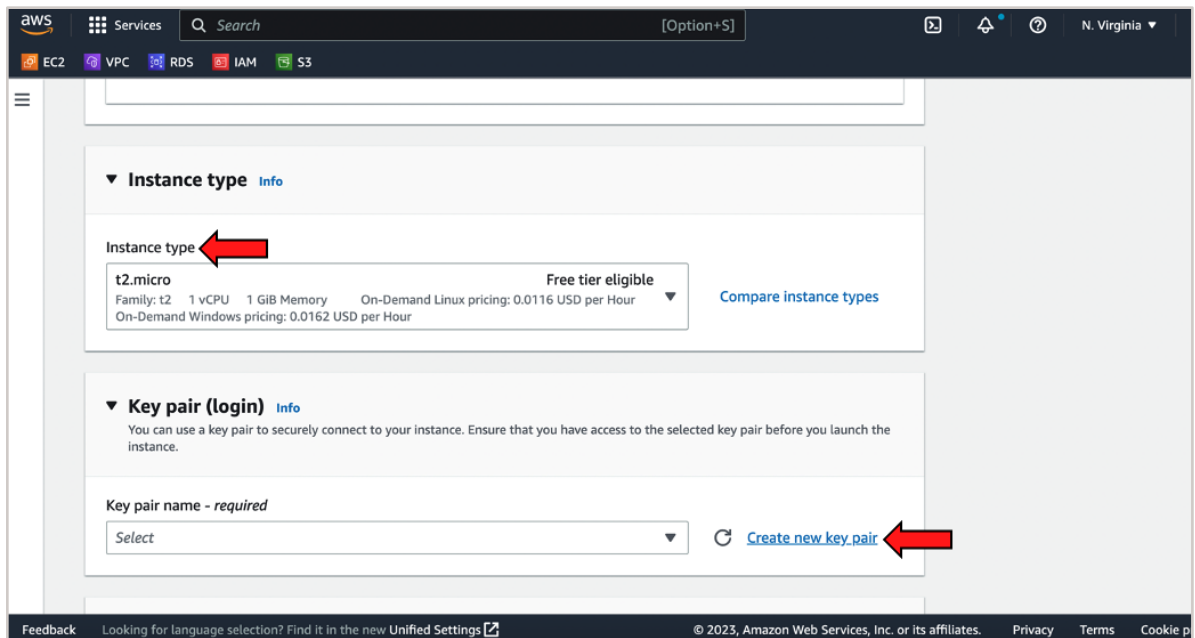
- Click “Launch instance”. When the “Launch an instance” page opens, enter a name for your EC2 Instance. For this guide, we have chosen “MySQL-EC2”



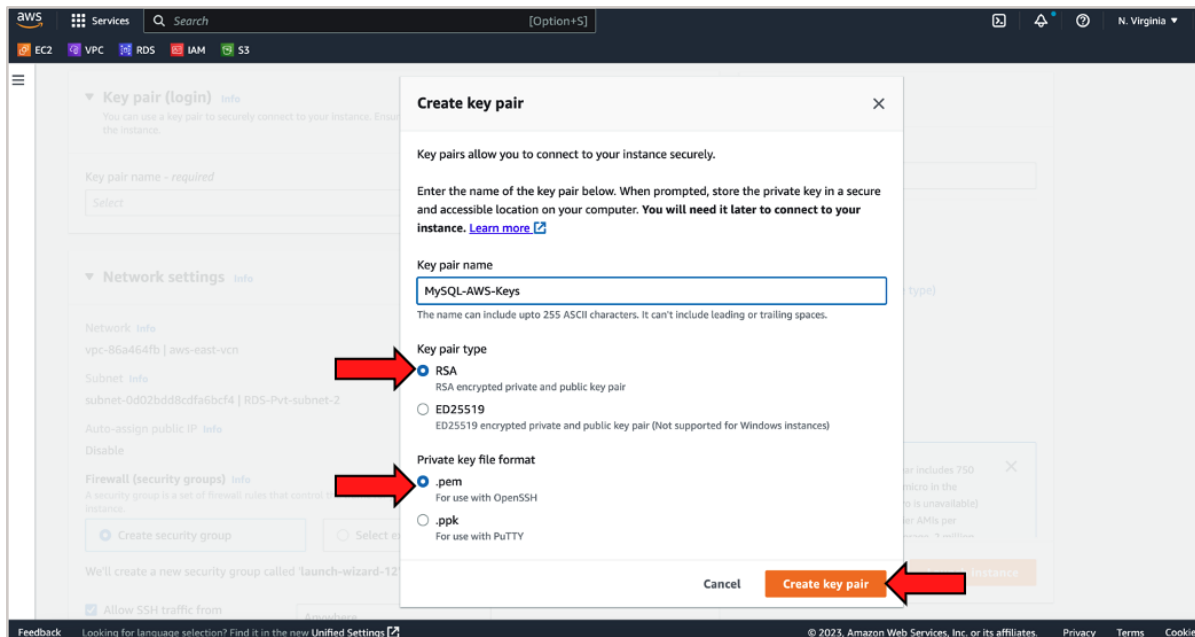
- For the Amazon Machine Image, choose “Red Hat” either version “Linux 8 or 9”, here we have chosen Linux 9



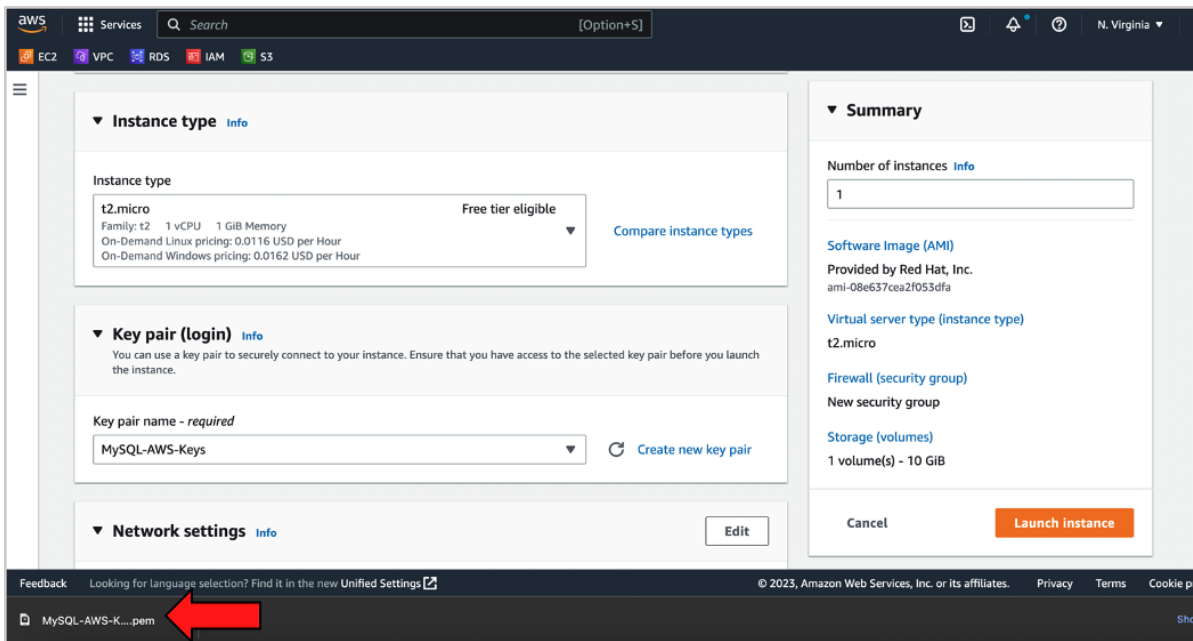
- For “Instance type”, select one that suits your needs. Afterwards for the “Key pair” section, click on “Create new key pair”. You can also use your existing keys here



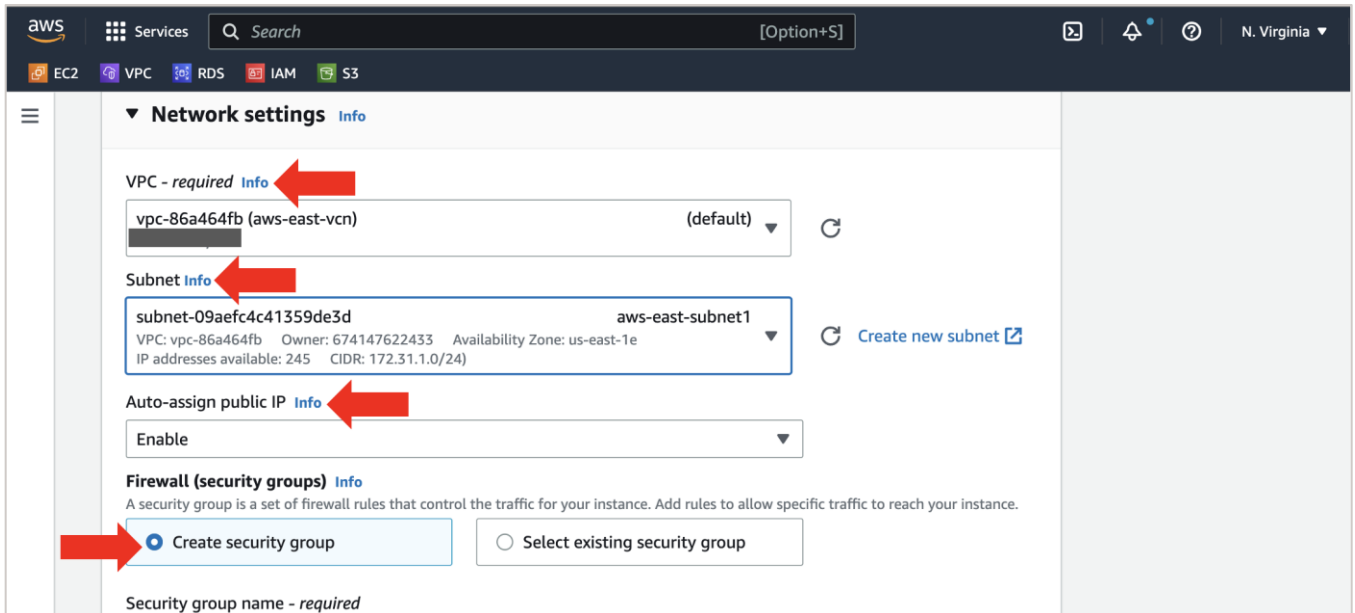
When you click “Create new key pair”, a popup will appear asking you to “Create key pair”. Here, give a name for your Key pair and make sure “RSA” is selected under the “Key pair type”. Under “Private key file format”, select “.pem”.

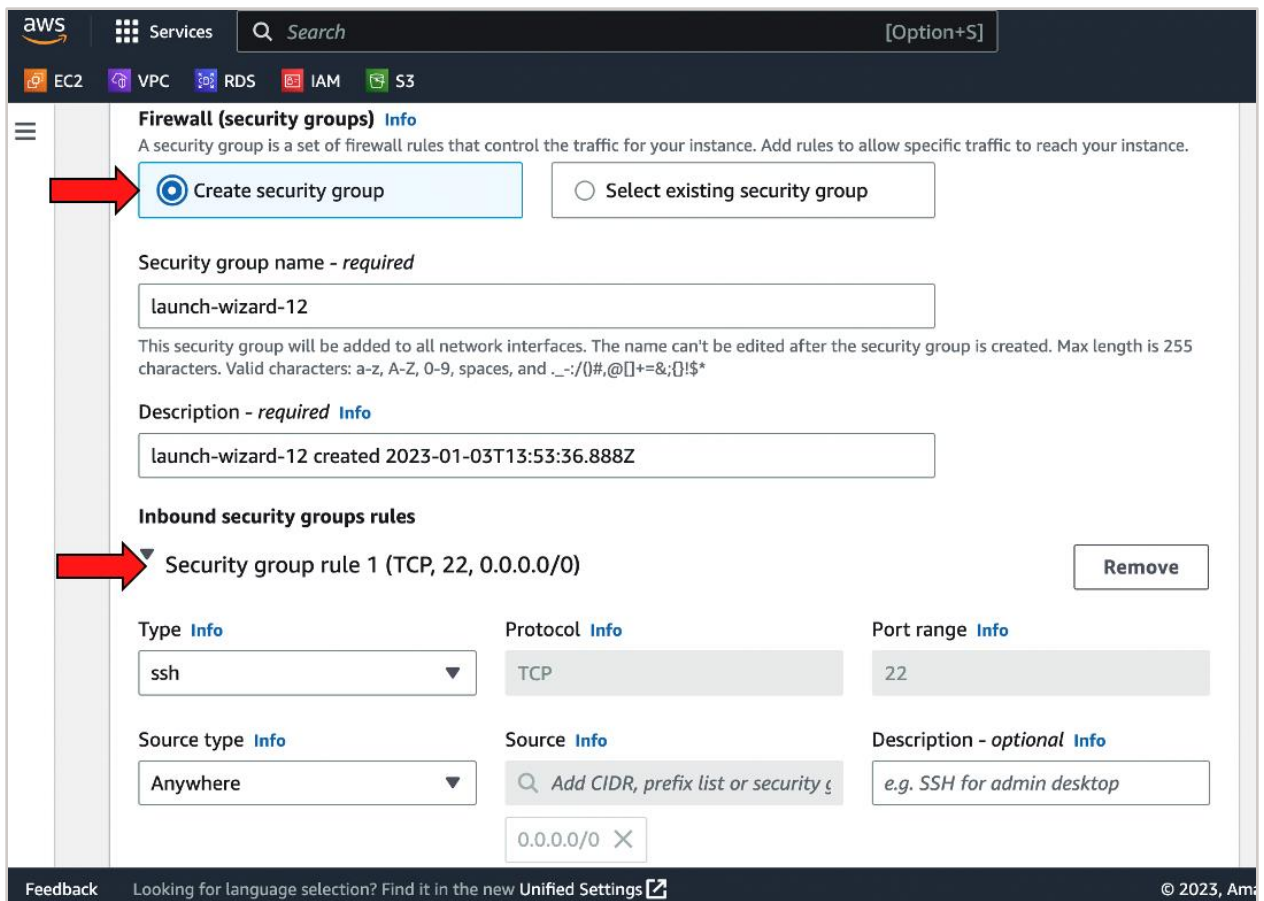


- Note: click “Create key pair” afterwards. This will close the “Create key pair” popup and will download a private SSH Key. See below:

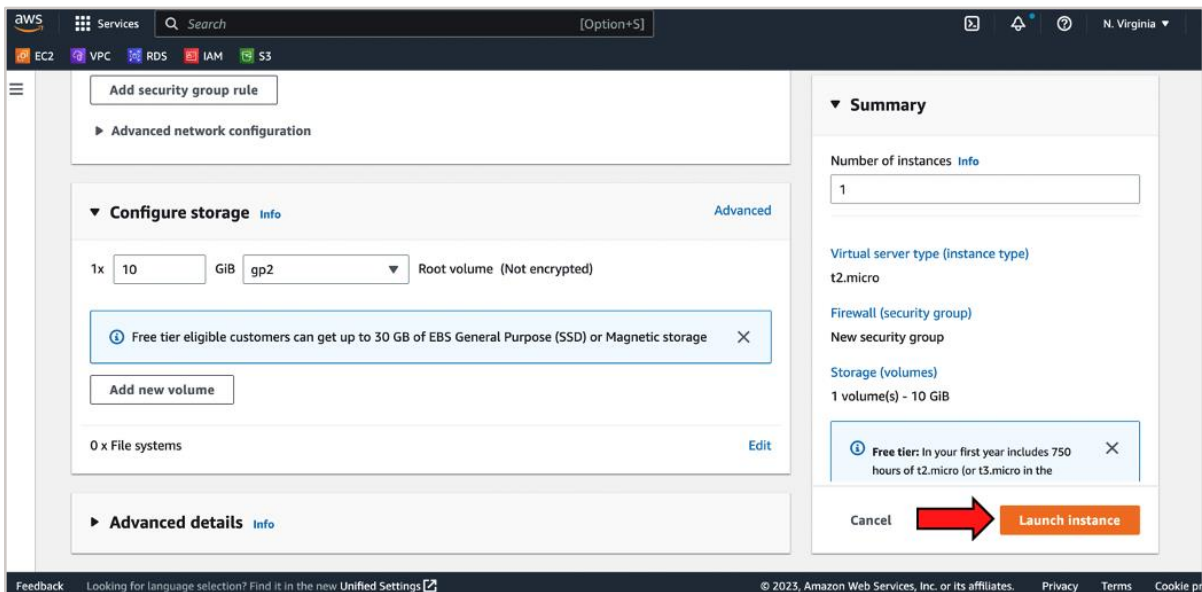


- Next for your “Network settings”, select your appropriate “VPC” and “Subnet”. For “Auto-assign public IP” select “Enable”. Under the “Firewall (security groups)” tab, choose “Create security group” and have an “Inbound security group rules” like the below one which allows SSH from anywhere.

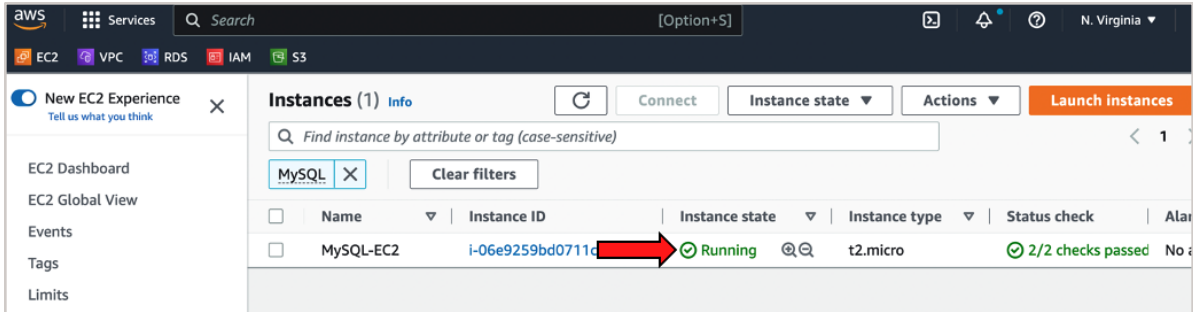




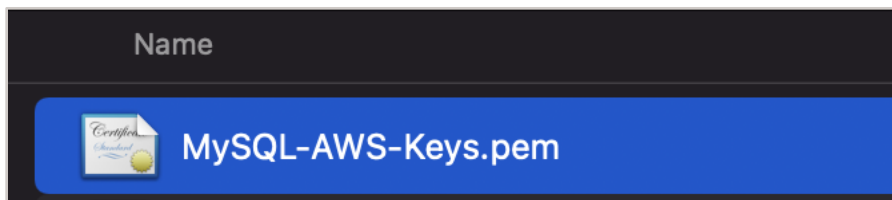
10. After the above step is performed, leave everything default and click “Launch instance”



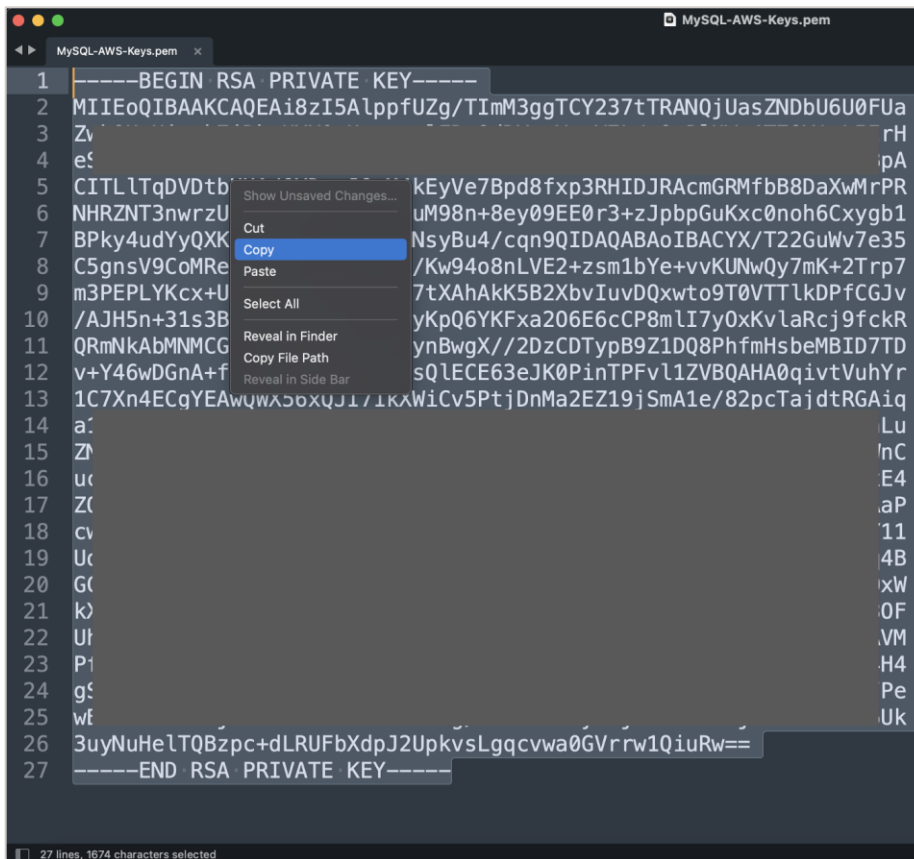
11. Wait until your MySQL-EC2 “Instance state” is in “Running” to connect to it.



12. Once your EC2 instance is in a “Running” state, open the Private SSH Key that we downloaded in Step 8 in a text editor of your choice.



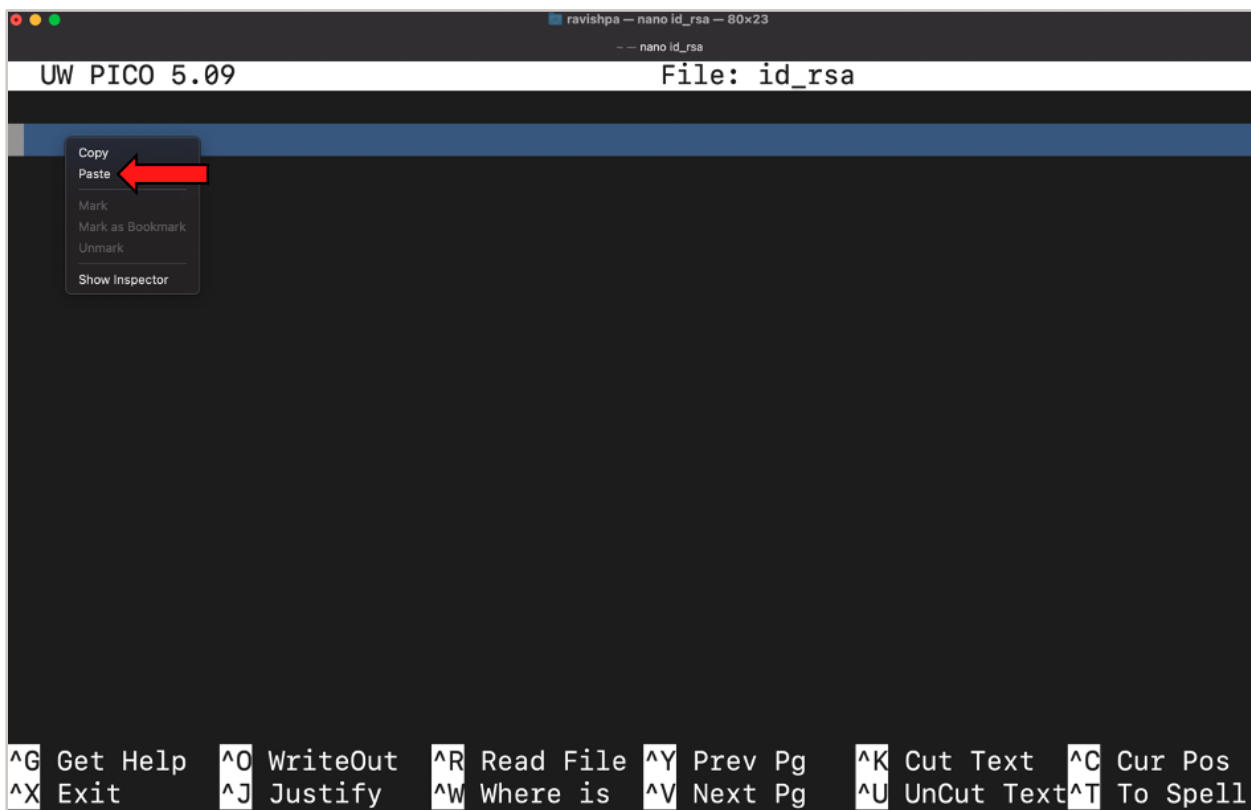
13. Once you have opened your Private SSH Key in a text editor, copy the contents of the entire file as shown below:



14. After copying the contents, to connect to your EC2 instance, go to your terminal where you will be accessing EC2 from. There, create a new file called `id_rsa` inside your home directory. The guide uses “nano” text editor, use a text editor of your own choice.

```
$ cd  
$ nano id_rsa
```

```
ra [REDACTED] pa-mac ~ % cd  
ra [REDACTED] pa-mac ~ %  
ra [REDACTED] pa-mac ~ % nano id_rsa
```



15. After pasting the contents of the private SSH key into the `id_rsa` file, save and close the file. If you are using nano,

- to paste the copied content: `command + V`
- to save the file: `control + O`
- to exit the file: `control + X`

```
UW PICO 5.09 File: id_rsa
-----BEGIN RSA PRIVATE KEY-----
MIIEoQIBAAKCAQEAi8zI5A1ppfUZg/TImM3ggTCY237tTRANQjUasZNDbU6U0FUa
ZrH
e: pA
C: PR
NI: b1
BI: 35
C: p7
m: Jv
/ /: kR
QI: TD
v: Yr
10: iq
a: Lu
ZI: /nC
u: E4
Z0: aP
cv: '11
Uc: j4B
G0: )xW
k: 0F
UI: VM
P: H4
g: 'Pe
wl: oUk
3uyNuHe1TQBzpc+dLRUFbXdpJ2UpkvsLgqcvwa0GVrrw1QiuRw==
-----END RSA PRIVATE KEY-----
```

16. After you have saved the private SSH Key on your terminal, grab the file path of the `id_rsa`. To get the file path of your current working directory where you have the `id_rsa`, execute:

```
$ ls
$ pwd

r [redacted] -mac ~ % ls
id_rsa
r [redacted] -mac ~ % pwd
/Users/r [redacted] ←
r [redacted] -mac ~ % █
```

- Note: by looking at the above image, the `id_rsa` location for this guide will hence be `/Users/ravishpa/id_rsa`

17. Once you have your SSH Key copy and pasted, make sure to change the Private SSH key's permission by running the following command:

```
$ chmod 400 id_rsa
```

```
r [redacted] mac ~ % chmod 400 id_rsa
```

18. Now connect to the EC2 Instance you created earlier by running the following command from your terminal window where you have the SSH keys

```
ssh -i <path/to/you-private-ssh-key> ec2-user@<ec2-Public-DNS>
```

```
[redacted]-mac ~ % ssh -i id_rsa ec2-user@[redacted].compute-1.amazonaws.com
Register this system with Red Hat Insights: insights-client --register
Create an account or view all your systems at https://red.ht/insights-dashb
oard
Last login: Fri Jan 27 15:48:41 2023 from [redacted]
[ec2-user@[redacted]]$
```

- Note: after running the above SSH command, when prompted “Are you sure you want to continue connecting (yes/no/[fingerprint])?”, type “yes”.

19. You have now successfully connected to the EC2 instance.

Section C: Connect to your EC2 Instance and install MySQL Shell

20. Once you have identified your Amazon RDS MySQL version and the data you want to migrate, go to your AWS environment, and connect to the EC2 instance we created in Section B. It is now time to install MySQL Shell on the EC2 instance. We will be using MySQL Shell to export the world database and import it into MySQL HeatWave. (MySQL Shell is an advanced client and code editor for MySQL. To learn more about MySQL Shell, visit: <https://dev.mysql.com/doc/mysql-shell/8.0/en/>)

Installing MySQL Shell on Microsoft Windows:

To install MySQL Shell on Microsoft Windows using the MSI Installer, do the following:

- a) Download the Windows (x86, 64-bit), MSI Installer package from <http://dev.mysql.com/downloads/shell/>
- b) When prompted, click Run.
- c) Follow the steps in the Setup Wizard.

Installing MySQL Shell on Linux:

To install MySQL Shell on Linux, run the following command:

```
sudo yum install mysql-shell
```

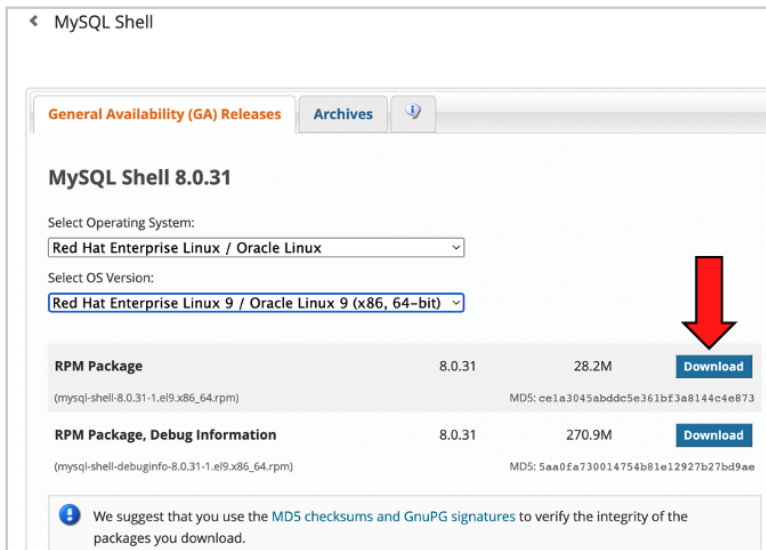
For other Linux installation options, visit: <https://dev.mysql.com/doc/mysql-shell/8.0/en/mysql-shell-install-linux-quick.html>

Installing MySQL Shell on macOS:

To install MySQL Shell on macOS, do the following:

- a) Download the package from <http://dev.mysql.com/downloads/shell/>.
- b) Double-click the downloaded DMG to mount it. Finder opens.
- c) Double-click the .pkg file shown in the Finder window.
- d) Follow the steps in the installation wizard.
- e) When the installer finishes, eject the DMG (It can be deleted).

This is how the guide installed MySQL Shell, visit: <https://dev.mysql.com/downloads/shell/>. Select the latest version of the MySQL Shell and select the appropriate OS System and Version. For this guide, Red Hat Enterprise Linux 9 server is being used for the EC2 instance.



- Note: the RPM Package (28.2M), without the debug information was chosen for this guide. Once you have identified which MySQL Shell version you want to download, click on the “Download” button shown in the above image. A new page will popup which is shown in the next step.

21. When you click “Download” as shown in Step 20, this page will come up. Right click on “No thanks, just start my download.” and select “Copy Link Address”



22. Go back to your AWS EC2 instance and download MySQL Shell via `wget` by pasting the link copied in the previous step. But first, download `wget` itself

```
$ sudo yum install wget -y
$ wget https://dev.mysql.com/get/Downloads/MySQL-Shell/mysql-shell-8.0.31-1.el8.x86_64.rpm
```

```
[ec2-user@ip-~]$ sudo yum install wget -y
```

```
[ec2-user@ip-~]$ wget https://dev.mysql.com/get/Downloads/MySQL-Shell/mysql-shell-8.0.31-1.el8.x86_64.rpm
--2023-01-27 15:53:49-- https://dev.mysql.com/get/Downloads/MySQL-Shell/mysql-shell-8.0.31-1.el8.x86_64.rpm
Resolving dev.mysql.com (dev.mysql.com)... 96.7.17.219, 2600:1408:c400:1881::2e31, 2600:1408:c400:188c::2e31
Connecting to dev.mysql.com (dev.mysql.com)|96.7.17.219|:443... connected.
HTTP request sent, awaiting response... 302 Moved Temporarily
Location: https://cdn.mysql.com//Downloads/MySQL-Shell/mysql-shell-8.0.31-1.el8.x86_64.rpm [following]
--2023-01-27 15:53:49-- https://cdn.mysql.com//Downloads/MySQL-Shell/mysql-shell-8.0.31-1.el8.x86_64.rpm
Resolving cdn.mysql.com (cdn.mysql.com)... 23.56.12.246
Connecting to cdn.mysql.com (cdn.mysql.com)|23.56.12.246|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 30061380 (29M) [application/x-redhat-package-manager]
Saving to: 'mysql-shell-8.0.31-1.el8.x86_64.rpm'

mysql-shell-8.0.31-1 100%[=====] 28.67M 20.7MB/s in 1.4s

2023-01-27 15:53:51 (20.7 MB/s) - 'mysql-shell-8.0.31-1.el8.x86_64.rpm' saved [30061380/30061380]

[ec2-user@ip-~]$
```

- Note: download and install MySQL Shell by using the proper commands/files/methods required for your own Operating System.

23. Once the MySQL Shell RPM file is downloaded on your your EC2 instance, extract it using

```
sudo rpm -ivh <file-name>
```

```
[ec2-user@ip-~]$ sudo rpm -ivh mysql-shell-8.0.31-1.el8.x86_64.rpm
warning: mysql-shell-8.0.31-1.el8.x86_64.rpm: Header V4 RSA/SHA256 Signature, key ID 3a79bd29: NOKEY
error: Failed dependencies:
    libcrypto.so.1.1()(64bit) is needed by mysql-shell-8.0.31-1.el8.x86_64
    libcrypto.so.1.1(OPENSSSL_1_1_0)(64bit) is needed by mysql-shell-8.0.31-1.el8.x86_64
    libcrypto.so.1.1(OPENSSSL_1_1_1)(64bit) is needed by mysql-shell-8.0.31-1.el8.x86_64
    libssl.so.1.1()(64bit) is needed by mysql-shell-8.0.31-1.el8.x86_64
    libssl.so.1.1(OPENSSSL_1_1_0)(64bit) is needed by mysql-shell-8.0.31-1.el8.x86_64
    libssl.so.1.1(OPENSSSL_1_1_1)(64bit) is needed by mysql-shell-8.0.31-1.el8.x86_64
[ec2-user@ip-~]$
```

- Note: there were missing dependences when the `rpm` command was executed

24. To resolve the above dependency, we executed

```
sudo yum install compat-openssl11
```

25. Once all the required dependencies are installed, execute the same rpm command from Step 23

```
sudo rpm -ivh <file-name>
```

```
[ec2-user@ip-10.132.1.100]$ sudo rpm -ivh mysql-shell-8.0.31-1.el8.x86_64.rpm
warning: mysql-shell-8.0.31-1.el8.x86_64.rpm: Header V4 RSA/SHA256 Signature, key ID 3a7
9bd29: NOKEY
Verifying... ##### [100%]
Preparing... ##### [100%]
Updating / installing...
 1:mysql-shell-8.0.31-1.el8 ##### [100%]
[ec2-user@ip-10.132.1.100]$
```

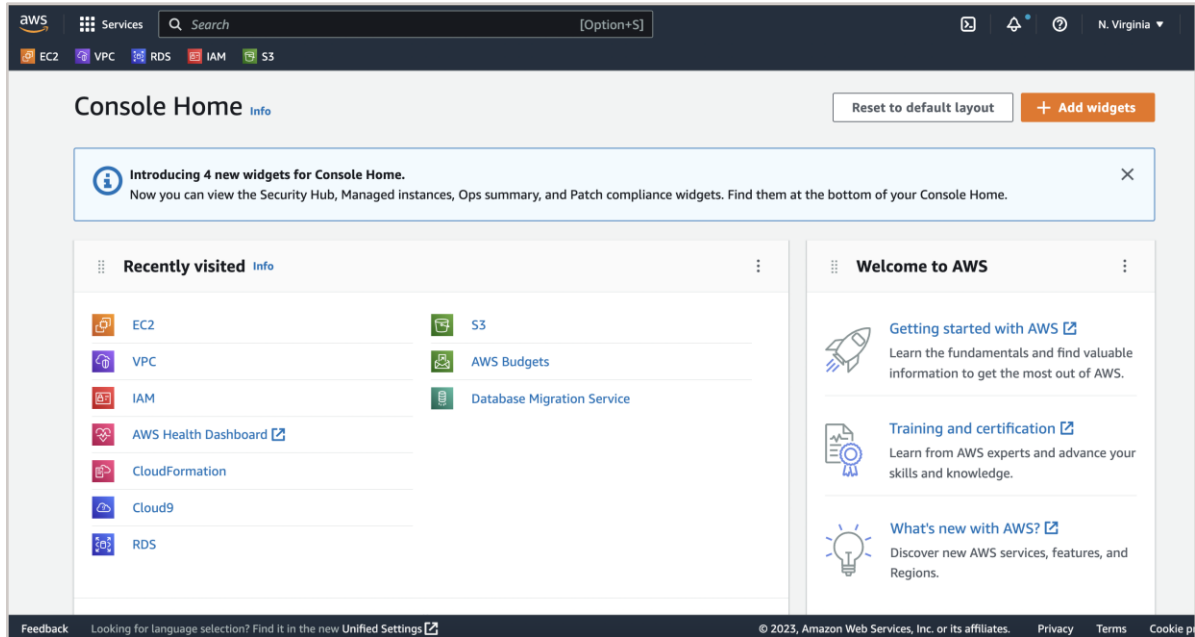
- Note: MySQL Shell was properly installed after all the dependencies were solved

II. Exporting the database

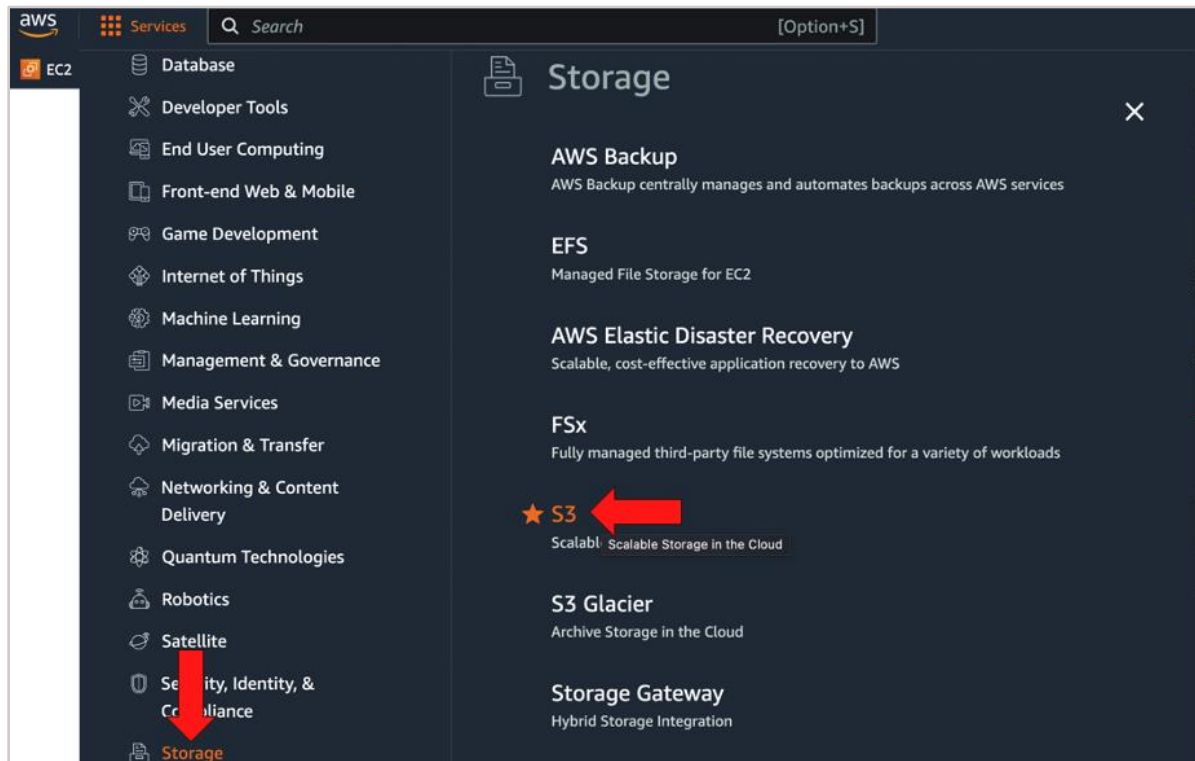
Section D: In AWS, create an S3 Storage Bucket

26. Login to your AWS account.

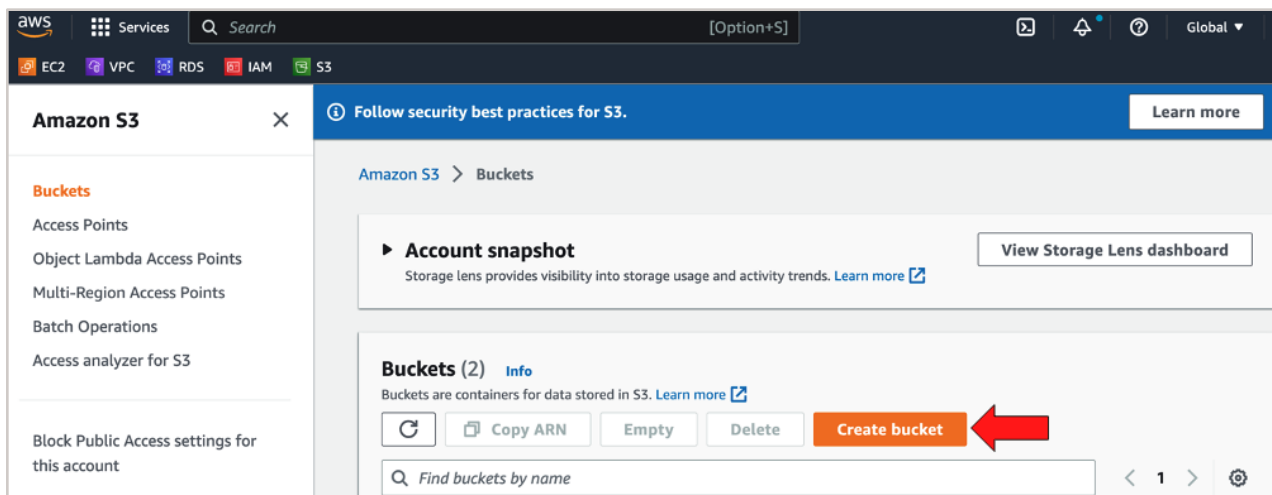
<https://aws.amazon.com/>



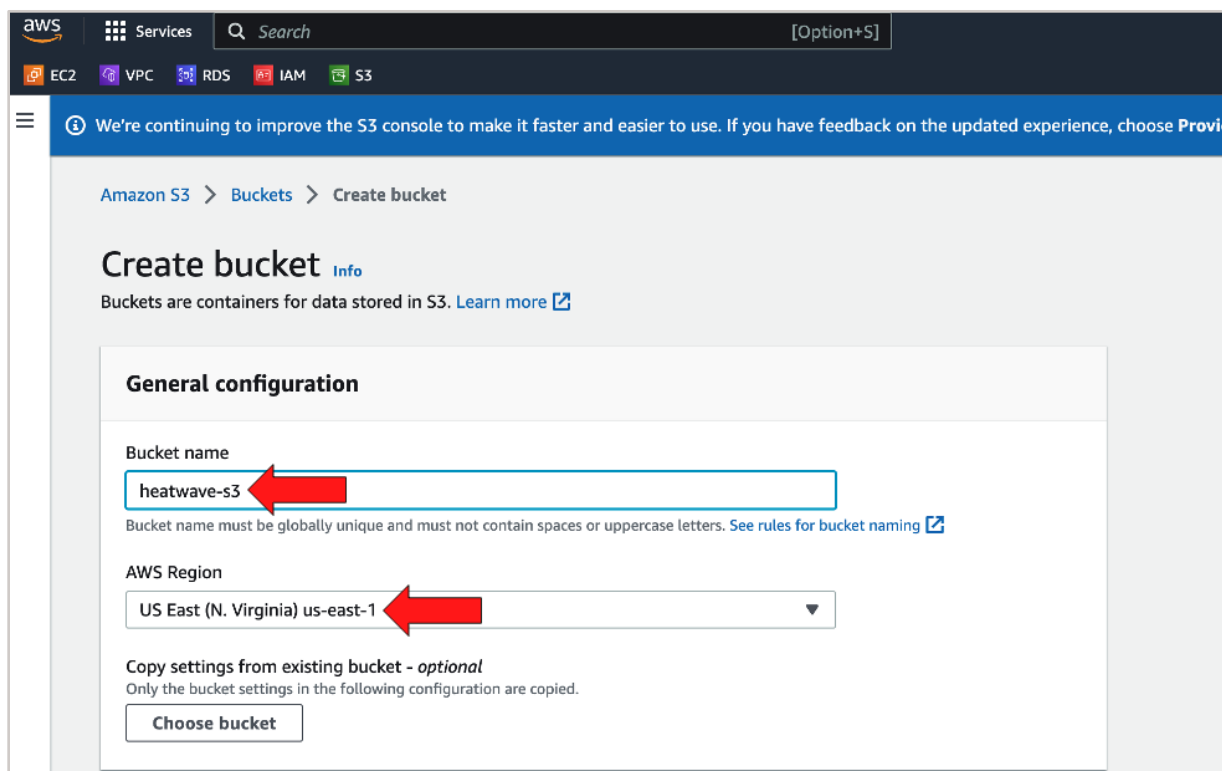
27. Click the 'Services' menu on the top-left corner. From there, navigate to 'Storage' and click on "S3"



28. Once you are on the 'S3' Buckets page, click the "Create bucket" button. In a later step, you will export your Amazon RDS MySQL database to AWS in this bucket.



29. On the 'Create bucket' page, give a name for your bucket and select "US East (N. Virginia)" as the 'AWS Region'



30. Leave the other fields as-is and click the “Create bucket” button.

▼ Advanced settings

Object Lock
Store objects using a write-once-read-many (WORM) model to help you prevent objects from being deleted or overwritten for a fixed amount of time or indefinitely. [Learn more](#)

Disable

Enable
Permanently allows objects in this bucket to be locked. Additional Object Lock configuration is required in bucket details after bucket creation to protect objects in this bucket from being deleted or overwritten.

Object Lock works only in versioned buckets. Enabling Object Lock automatically enables Bucket Versioning.

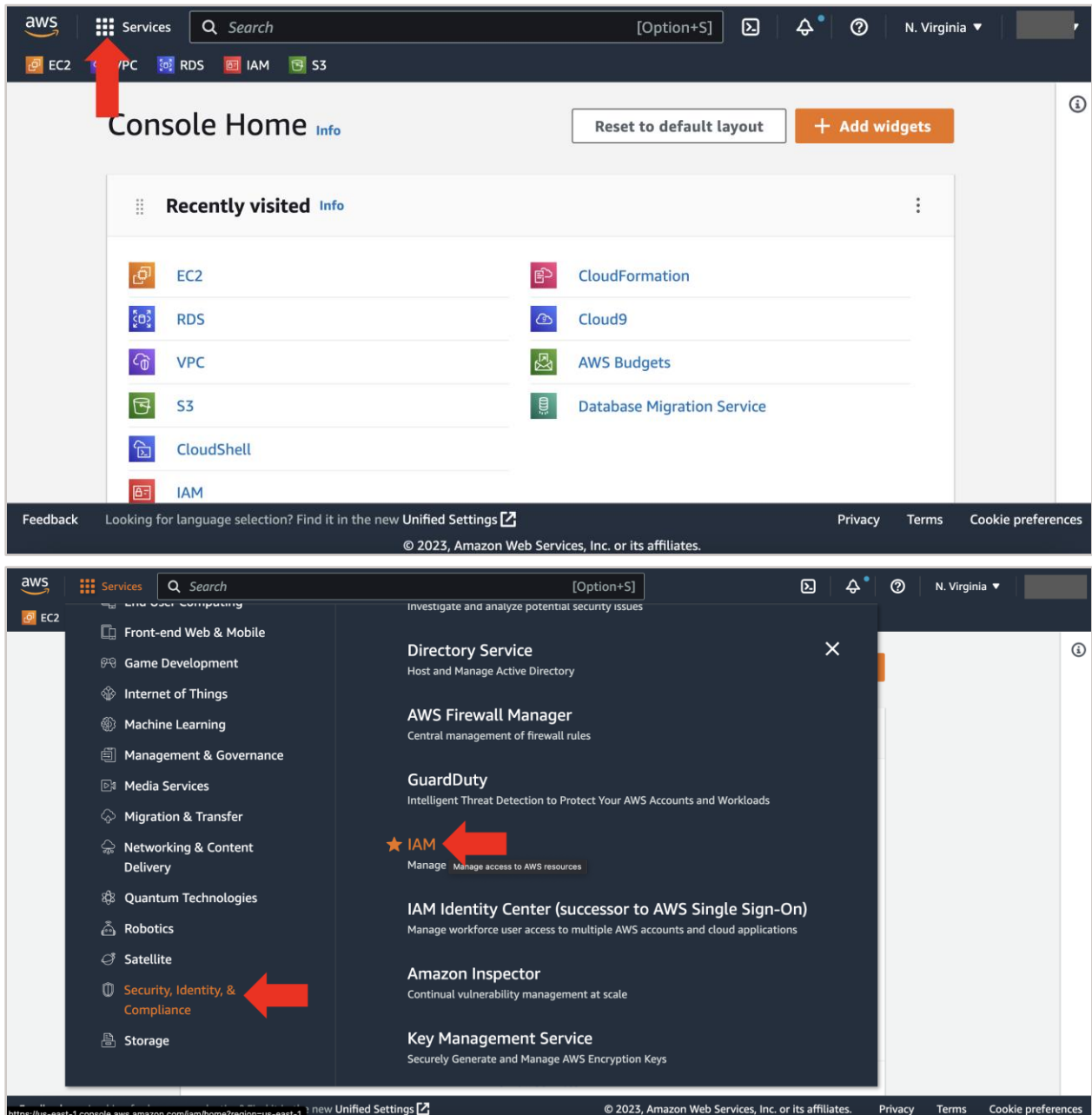
After creating the bucket you can upload files and folders to the bucket, and configure additional bucket settings.

Cancel **Create bucket**

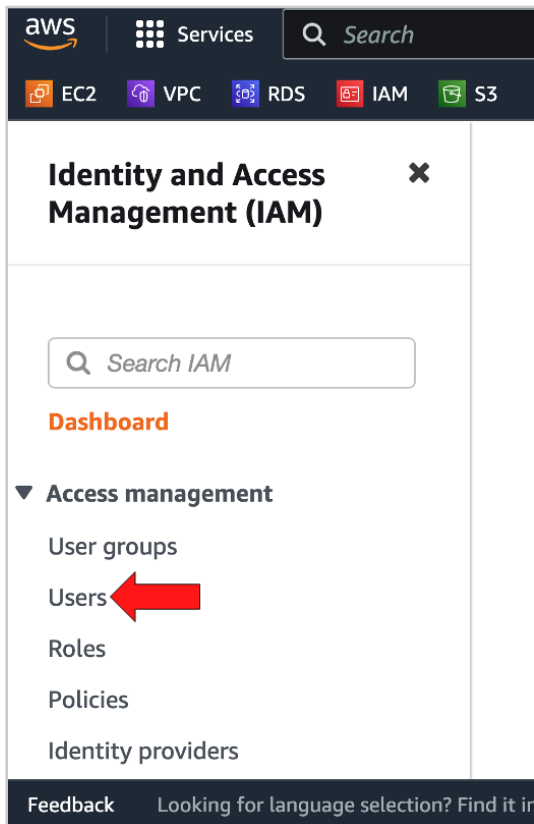
- Note: once the S3 bucket is created, save the bucket name in a notepad for later use.

Section E: Add an IAM user and download the .csv file

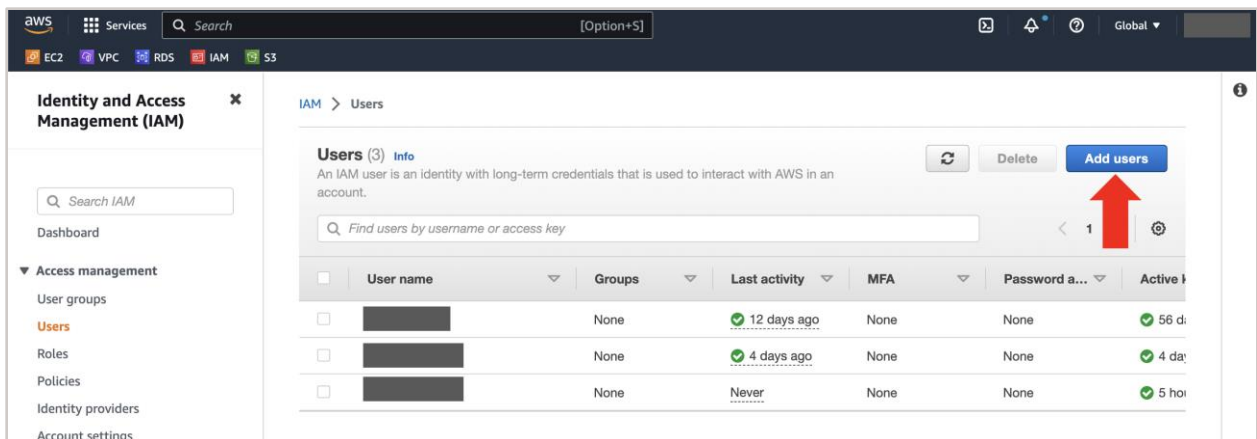
31. From the AWS Console, navigate to the 'Services' menu. From there, navigate to 'Security, Identity, & Compliance' and look for "IAM"



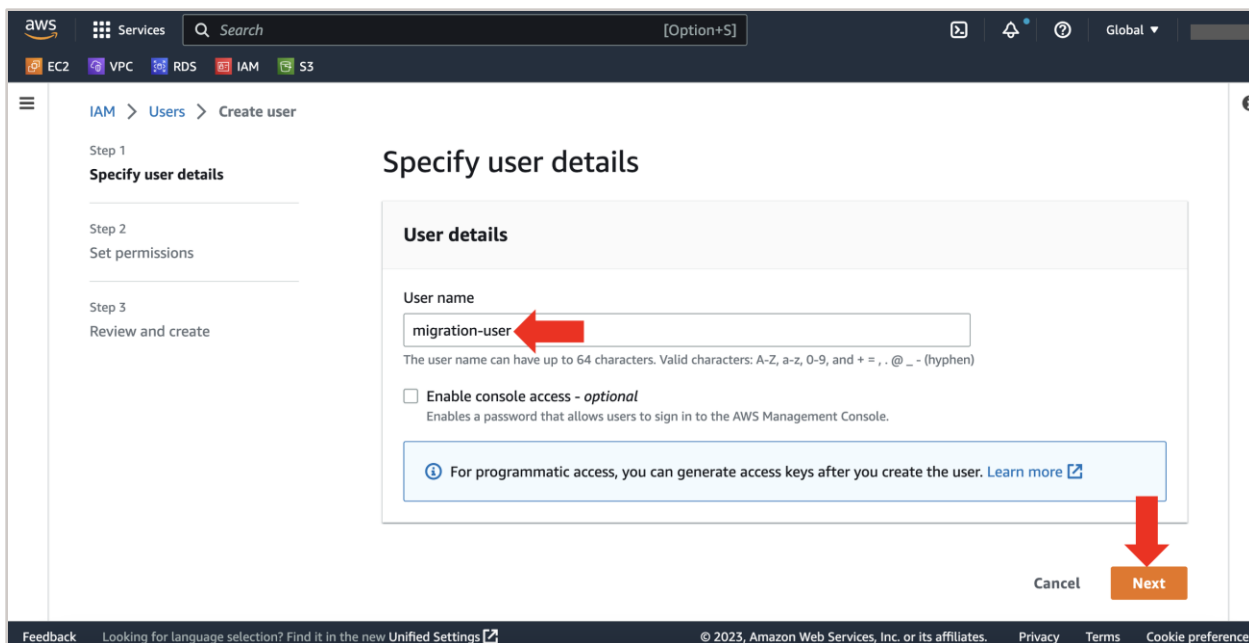
32. From the 'Identity and Access Management (IAM)' dashboard page, click on "Users" under 'Access management'



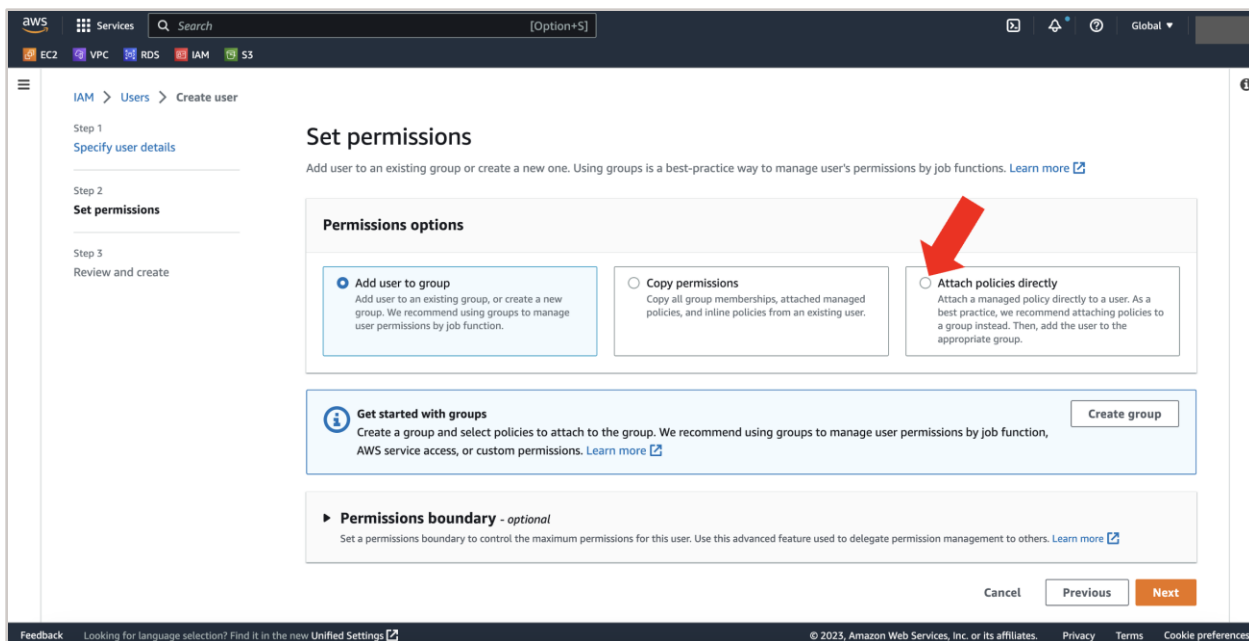
33. After landing on the 'Users' page, click "Add users"



34. On Step 1 of 'Create user', enter a 'User name'. Click "Next" afterwards.



35. On Step 2, click "Attach policies directly" and select the 'AdministratorAccess' policy. Leave everything as it is and click "Next" afterwards



Set permissions

Add user to an existing group or create a new one. Using groups is a best-practice way to manage user's permissions by job functions. [Learn more](#)

Permissions options

- Add user to group
Add user to an existing group, or create a new group. We recommend using groups to manage user permissions by job function.
- Copy permissions
Copy all group memberships, attached managed policies, and inline policies from an existing user.
- Attach policies directly
Attach a managed policy directly to a user. As a best practice, we recommend attaching policies to a group instead. Then, add the user to the appropriate group.

Permissions policies (1/1039)

Choose one or more policies to attach to your new user.

Filter distributions by text, property or value

<input type="checkbox"/>	Policy name	Type	Attached entities
<input type="checkbox"/>	AccessAnalyzerServiceRolePolicy	AWS managed	0
<input checked="" type="checkbox"/>	AdministratorAccess	AWS managed - job function	3
<input type="checkbox"/>	AdministratorAccess-Amplify	AWS managed	0

<input type="checkbox"/>	AlexaForBusinessNetworkProfileSer...	AWS managed	0
<input type="checkbox"/>	AlexaForBusinessPolyDelegatedAcc...	AWS managed	0
<input type="checkbox"/>	AlexaForBusinessReadOnlyAccess	AWS managed	0
<input type="checkbox"/>	AmazonAPIGatewayAdministrator	AWS managed	0
<input type="checkbox"/>	AmazonAPIGatewayInvokeFullAccess	AWS managed	0
<input type="checkbox"/>	AmazonAPIGatewayPushToCloudW...	AWS managed	0
<input type="checkbox"/>	AmazonAppFlowFullAccess	AWS managed	0
<input type="checkbox"/>	AmazonAppFlowReadOnlyAccess	AWS managed	0
<input type="checkbox"/>	AmazonAppStreamFullAccess	AWS managed	0
<input type="checkbox"/>	AmazonAppStreamPCAAccess	AWS managed	0
<input type="checkbox"/>	AmazonAppStreamReadOnlyAccess	AWS managed	0
<input type="checkbox"/>	AmazonAppStreamServiceAccess	AWS managed	0

Permissions boundary - optional

Set a permissions boundary to control the maximum permissions for this user. Use this advanced feature used to delegate permission management to others. [Learn more](#)

Cancel Previous **Next**

36. On Step 3, review all the information for accuracy. Click the “Create user” button afterwards.

The screenshot shows the AWS IAM console interface for creating a user. The breadcrumb navigation is IAM > Users > Create user. The left sidebar shows three steps: Step 1 (Specify user details), Step 2 (Set permissions), and Step 3 (Review and create). The main content area is titled 'Review and create' and includes a sub-header 'Review your choices. After you create the user, you can view and download the autogenerated password, if enabled.'

User details

User name migration-user	Console password type None	Require password reset No
-----------------------------	-------------------------------	------------------------------

Permissions summary

< 1 >

Name	Type	Used as
AdministratorAccess	AWS managed - job function	Permissions policy

Tags - optional

Tags are key-value pairs you can add to AWS resources to help identify, organize, or search for resources. Choose any tags you want to associate with this user.

No tags associated with the resource.

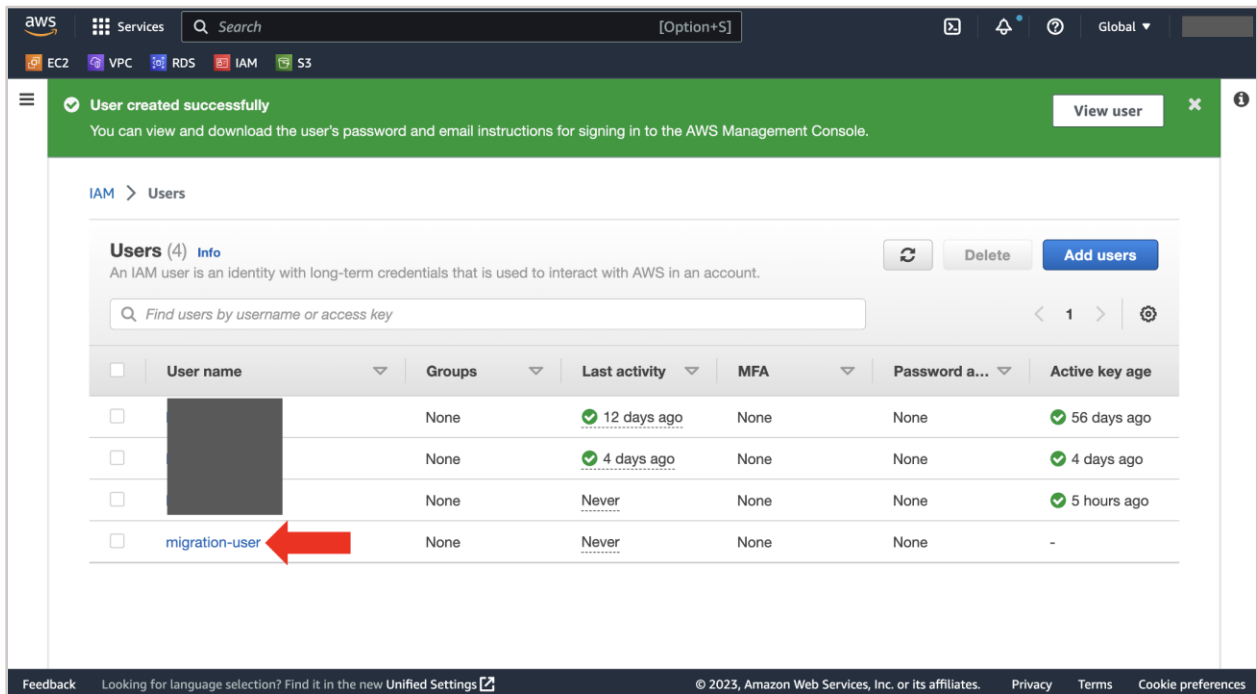
[Add new tag](#)

You can add up to 50 more tags.

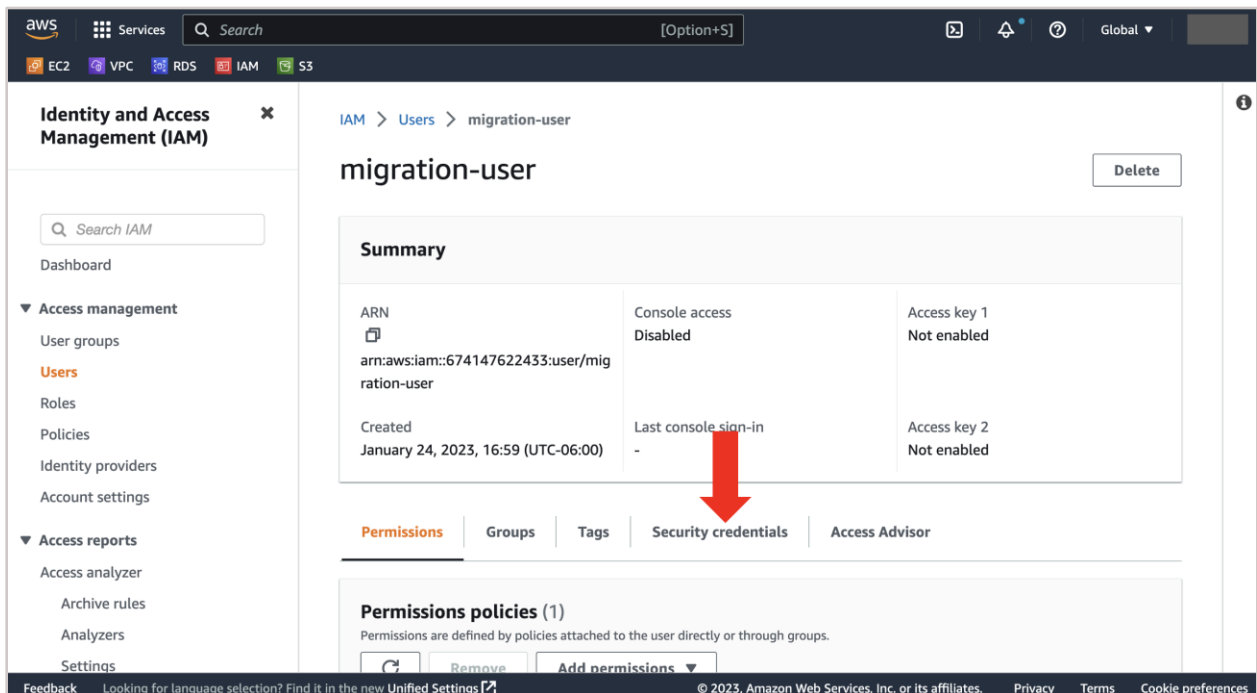
At the bottom right, there are three buttons: 'Cancel', 'Previous', and 'Create user'. A large red arrow points down to the 'Create user' button.

Footer: Feedback, Looking for language selection? Find it in the new Unified Settings, © 2023, Amazon Web Services, Inc. or its affiliates. Privacy, Terms, Cookie preferences

37. Once the User has been created, from the 'Users' page of IAM, click on the User we just created in the previous step



38. After your User page opens for the User that was just created, click on "Security credentials" and scroll down until you see "Access keys"



The screenshot shows the AWS IAM console for the user 'migration-user'. The 'Security credentials' tab is active. A red arrow points to the 'Last console sign-in' field, which is currently empty. The 'Console sign-in' section below has an 'Enable console access' button.

Summary		
ARN arn:aws:iam::674147622433:user/migration-user	Console access Disabled	Access key 1 Not enabled
Created January 24, 2023, 16:59 (UTC-06:00)	Last console sign-in -	Access key 2 Not enabled

The screenshot shows the 'Access keys' section of the AWS IAM console. A red arrow points to the 'Create access key' button. The section includes a warning about using long-term credentials like access keys.

Access keys (0)
Use access keys to send programmatic calls to AWS from the AWS CLI, AWS Tools for PowerShell, AWS SDKs, or direct AWS API calls. You can have a maximum of two access keys (active or inactive) at a time. [Learn more](#)

[Create access key](#)

No access keys
As a best practice, avoid using long-term credentials like access keys. Instead, use tools which provide short term credentials. [Learn more](#)

[Create access key](#)

- Note: when you locate the 'Access keys' section, click on "Create access key"

39. On Step 1 of 'Create access key', locate and select "Other". Click "Next" afterwards

The image displays two screenshots of the AWS IAM console during the 'Create access key' process.

Top Screenshot: Shows Step 1 of the wizard, titled 'Access key best practices & alternatives'. The breadcrumb navigation is IAM > Users > migration-user > Create access key. The left sidebar shows the progress: Step 1 (selected), Step 2 - optional (Set description tag), and Step 3 (Retrieve access keys). The main content area lists five use cases, each with a radio button:

- Command Line Interface (CLI)**
You plan to use this access key to enable the AWS CLI to access your AWS account.
- Local code**
You plan to use this access key to enable application code in a local development environment to access your AWS account.
- Application running on an AWS compute service**
You plan to use this access key to enable application code running on an AWS compute service like Amazon EC2, Amazon ECS, or AWS Lambda to access your AWS account.
- Third-party service**
You plan to use this access key to enable access for a third-party application or service that monitors or manages your AWS resources.
- Application running outside AWS**
You plan to use this access key to enable an application running on an on-premises host, or to use a local AWS client or third-party AWS plugin.

Bottom Screenshot: Shows the same wizard with the 'Other' option selected. A red arrow points to the 'Other' radio button. Below it, an information box provides best practices:

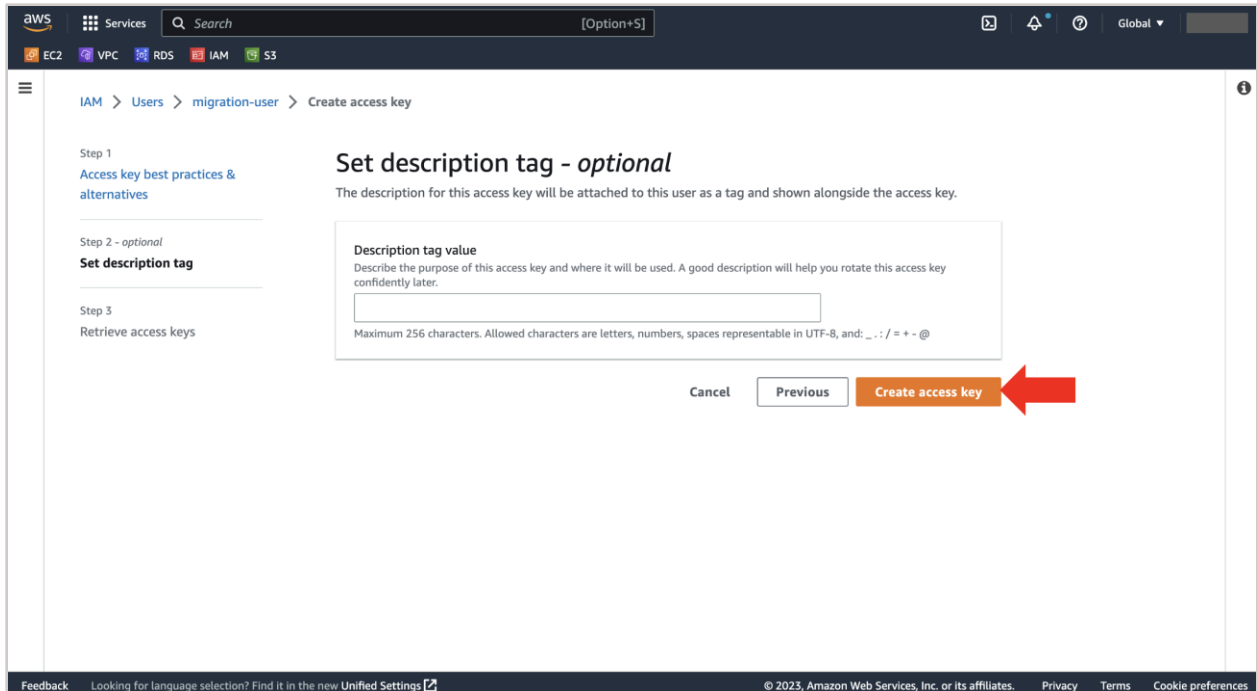
It's okay to use an access key for this use case, but follow the best practices:

- Never store your access key in plain text, in a code repository, or in code.
- Disable or delete access keys when no longer needed.
- Enable least-privilege permissions.
- Rotate access keys regularly.

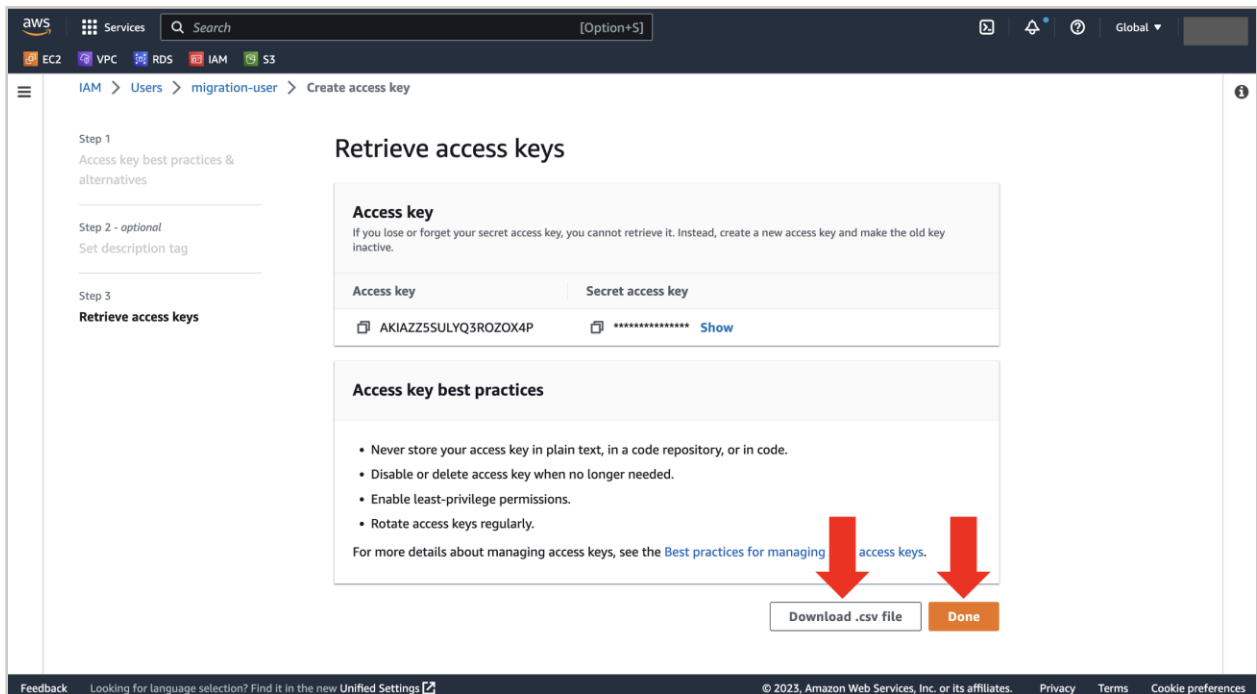
For more details about managing access keys, see the [Best practices for managing AWS access keys](#).

At the bottom right, there are 'Cancel' and 'Next' buttons. A red arrow points to the 'Next' button.

40. On Step 2, leave the values blank and click the “Create access key” button



41. On Step 3, your “Access key” will be created alongside the “Secret access key”. Save these two keys in a notepad for later use. Click “Download .csv file” to save the Access key and Secret access key in a .csv file. Click “Done” after downloading the .csv file



Section F: Create a credentials file in your EC2 instance

42. After creating the bucket and adding a user in AWS, go back to your EC2 instance where you have MySQL Shell installed.

On the EC2 instance where MySQL Shell is installed, create a new directory called “.aws” inside your home directory. Next, go into the “.aws” directory and create a file called “credentials”. After the file is created, copy and paste the below contents in that “credentials” file.

```
[default]
aws_access_key_id=
aws_secret_access_key=
region=
```

The commands used to achieve this step for the guide, are listed below:

```
ec2-user $ mkdir ~/.aws
ec2-user $ cd .aws
ec2-user $ nano credentials
```

```
[ec2-user@ip-... ~]$ mkdir ~/.aws
[ec2-user@ip-... ~]$
[ec2-user@ip-... ~]$ cd .aws
[ec2-user@ip-... .aws]$
[ec2-user@ip-... .aws]$ nano credentials
```

- Note: to download nano, execute `sudo yum install nano -y`

43. After pasting the “credentials” file contents from Step 42, below is how your “credentials” file should look like

```
GNU nano 2.9.8 credentials Mod
[default]
aws_access_key_id=
aws_secret_access_key=
region=
^G Get Help      ^O Write Out    ^W Where Is    ^K Cut Text    ^J Justify
^X Exit         ^R Read File    ^\ Replace     ^U Uncut Text  ^T To Spell
```


44. Inside the 'credentials' file, for the "aws_access_key_id" and "aws_secret_access_key" fields, fill them using the .csv file we downloaded in Step 41. For "region", since we have a Bucket created in us-east-1 and that the MySQL HeatWave system that we will create in the later steps will also be in the same region, enter

```
us-east-1
```

After filling all the information for your credentials file, you should see:

```
GNU nano 2.9.8 credentials
[default]
aws_access_key_id=AKI[REDACTED]
aws_secret_access_key=OtpEef[REDACTED]
region=us-east-1
[ Read 4 lines ]
^G Get Help      ^O Write Out    ^W Where Is    ^K Cut Text    ^J Justify
^X Exit          ^R Read File   ^\ Replace     ^U Uncut Text  ^T To Spell
```

- Note: save the "credentials" file after filling all the missing fields. If you are using nano,
- to paste the copied content: `command + v`
- to save the file: `control + O`
- to exit the file: `control + X`

Section G: Connect to your Amazon RDS MySQL Server using MySQL Shell and execute the `util.dumpInstance()` utility

45. Using MySQL Shell installed on your EC2 instance, connect to your Amazon RDS MySQL Server by executing (account with Root privilege necessary):

```
ec2-user $ mysqlsh <username>@<localhost/ip>
```

or

```
ec2-user $ mysqlsh -u <username> -h <localhost/ip> -P <portnumber> -p
```

```
[ec2-user@ip-... ~]$ mysqlsh root@database-1.rds.amazonaws.com
Please provide the password for 'root@database-1.rds.amazonaws.com': **
*****
Save password for 'root@database-1.rds.amazonaws.com'? [Y]es/[N]o/[e]xit
er (default No):
MySQL Shell 8.0.31

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Other names may be trademarks of their respective owners.

Type '\help' or '\?' for help; '\quit' to exit.
Creating a session to 'root@database-1.rds.amazonaws.com'
Fetching schema names for auto-completion... Press ^C to stop.
Your MySQL connection id is 11
Server version: 5.7.33 Source distribution
No default schema selected; type \use <schema> to set one.
MySQL database-1.rds.amazonaws JS >
```

- Note: anytime you login using MySQL Shell, MySQL Shell will display the MySQL Shell version and MySQL Server version currently being used. You can see this in the image above.

46. Once you are inside MySQL Shell, you can interact in three different modes. The default is JavaScript, the other ones you can choose from are SQL and Python. Once inside MySQL Shell:

- to switch to JavaScript mode, execute: `\js`
- to switch to SQL mode, execute: `\sql`
- to switch to Python mode, execute: `\py`

47. Make sure you are in JavaScript mode by typing `\js` and execute the `dumpInstance` utility to export the dump data into the AWS S3 Storage bucket.

```
MySQL JS> \js
MySQL JS> util.dumpInstance("sampledump",{s3bucketName: "heatwave-s3",
ocimds: "true", compatibility: ["strip_restricted_grants", "strip_definers",
"ignore_missing_pks"], users: "true", dryRun: "true"})
MySQL database-1. rds.amazonaws JS > util.dumpInstance("sampledump",{
s3bucketName: "heatwave-s3", ocimds: "true", compatibility: ["strip_restricted_grants", "strip_
definers", "ignore_missing_pks"], users: "true", dryRun: "true"})
dryRun enabled, no locks will be acquired and no files will be created.
NOTE: Backup lock is not supported in MySQL 5.7 and DDL changes will not be blocked. The dump
may fail with an error if schema changes are made while dumping.
Acquiring global read lock
WARNING: The current user lacks privileges to acquire a global read lock using 'FLUSH TABLES W
ITH READ LOCK'. Falling back to LOCK TABLES...
ERROR: The current user does not have required privileges to execute FLUSH TABLES WITH READ LO
CK.
Backup lock is not supported in MySQL 5.7 and DDL changes cannot be blocked.
The gtid_mode system variable is set to OFF or OFF_PERMISSIVE.
The log_bin system variable is set to OFF or the current user does not have required privi
leges to execute SHOW MASTER STATUS.
The consistency of the dump cannot be guaranteed.
ERROR: Unable to acquire global read lock neither table read locks.
Global read lock has been released
Util.dumpInstance: While 'Initializing': Unable to lock tables: Consistency check has failed.
(MYSQLSH 52002)
MySQL database-1. rds.amazonaws JS >
```

Note:

- The `util.dumpInstance()` utility will take a dump of all the databases except “mysql, sys, performance schema, and information schema”. The dump comprises of DDL files for the schema structure and tab-separated .tsv files containing the actual data. Additionally, you can also use `util.dumpSchemas()` or `util.dumpTables()` if you only want to dump specific schemas or tables. The three dump utilities can export the data into:
 - a) Object Storage bucket in Oracle Cloud
 - b) S3-compatible buckets
 - c) local filesystem
- This guide showcases option b). For more information, refer: <https://dev.mysql.com/doc/mysql-shell/8.0/en/mysql-shell-utilities-dump-instance-schema.html#mysql-shell-utilities-dump-opt-run>
- The `dryRun` option runs the export command but does not generate any output export file. It displays information about what would be dumped with the specified set of options, and about the results of MySQL HeatWave compatibility checks (if the `ocimds` option is specified, which is required for this guide), but does not proceed with the dump. Setting this option enables you to list out all the compatibility issues before starting the dump. The default is false. You can read more about the utility options at <https://dev.mysql.com/doc/mysql-shell/8.0/en/mysql-shell-utilities-dump-instance-schema.html#mysql-shell-utilities-dump-opt-control>
- In the command above, `sampledump` is the prefix under which all the exported dump files will be stored in S3 Storage bucket in AWS.
- Change the `s3bucketName` to match with what you have when you created your bucket in AWS in Step 30.
- Setting the `ocimds: true` option ensures compatibility of the export dump with MySQL HeatWave.
- Primary keys are required on every table for using MySQL HeatWave.

- If you can't seem to solve an error during the `dryRun`, contact a MySQL Solution Engineer for guidance: <https://go.oracle.com/LP=132857?src1=:ow:o:s:po::&intcmp=:ow:o:s:po::>
- To understand the `dumpInstance()`, `dumpSchemas()`, or `dumpTables()` utility in more detail, refer to this website: <https://dev.mysql.com/doc/mysql-shell/8.0/en/mysql-shell-utilities-dump-instance-schema.html>

48. Running the above Step 47 command may generate “Errors” regarding “table locks” (see Step 47 image). If you do encounter such problem (if and only if) execute the same command but this time add an additional option “consistent: false”

```
MySQL JS> util.dumpInstance("sampledump",{s3bucketName: "heatwave-s3",
ocimds: "true", compatibility: ["strip_restricted_grants", "strip_definers",
"ignore_missing_pks"], users: "true", dryRun: "true", consistent: "false"})

MySQL database-1. rds.amazonaws JS > util.dumpInstance("sampledump",{s
3bucketName: "heatwave-s3", ocimds: "true", compatibility: ["strip_restricted_grants", "strip_
definers", "ignore_missing_pks"], users: "true", dryRun: "true", consistent: "false"})
dryRun enabled, no locks will be acquired and no files will be created.
Initializing - done
2 out of 6 schemas will be dumped and within them 3 tables, 0 views.
2 out of 4 users will be dumped.
Gathering information - done
WARNING: The dumped value of gtid_executed is not guaranteed to be consistent
Checking for compatibility with MySQL Database Service 8.0.31
NOTE: MySQL Server 5.7 detected, please consider upgrading to 8.0 first.
Checking for potential upgrade issues.
The MySQL server at database-1.rds.amazonaws.com:3306,
version 5.7.33 - Source distribution, will now be checked for compatibility
issues for upgrade to MySQL 8.0.31...

1) MySQL 8.0 syntax check for routine-like objects
No issues found

16) Check for invalid table names and schema names used in 5.7
No issues found

Errors: 0
Warnings: 1
Notices: 0

NOTE: No fatal errors were found that would prevent an upgrade, but some potential issues were
detected. Please ensure that the reported issues are not significant before upgrading.
NOTE: User 'rdsadmin'@'localhost' had restricted privileges (CREATE TABLESPACE, FILE, RELOAD,
SHUTDOWN, SUPER) removed
NOTE: User 'root'@'%' had restricted privilege (RELOAD) removed
Compatibility issues with MySQL Database Service 8.0.31 were found and repaired. Please review
the changes made before loading them.
Validating MDS compatibility - done
Writing global DDL files
Writing users DDL
Writing DDL - done
Starting data dump
0% (0 rows / ~5.27K rows), 0.00 rows/s, 0.00 B/s uncompressed, 0.00 B/s compressed
MySQL database-1. rds.amazonaws JS >
```

49. Once you have executed the command in Step 47/48 and did not see any errors or warnings, execute the same Step 47/48 command. Although, this time change the dryRun option to false

```
MySQL JS> util.dumpInstance("sampledump",{s3bucketName: "heatwave-s3",
ocimds: "true", compatibility: ["strip_restricted_grants", "strip_definers",
"ignore_missing_pks"], users: "true", dryRun: "false", consistent: "false"})
```

```
MySQL database-1 rds.amazonaws JS > util.dumpInstance("sampledump",{s
3bucketName: "heatwave-s3", ocimds: "true", compatibility: ["strip_restricted_grants", "strip_
definers", "ignore_missing_pks"], users: "true", dryRun: "false", consistent: "false"})
Initializing - done
2 out of 6 schemas will be dumped and within them 3 tables, 0 views.
2 out of 4 users will be dumped.
Gathering information - done
WARNING: The dumped value of gtid_executed is not guaranteed to be consistent
Checking for compatibility with MySQL Database Service 8.0.31
NOTE: MySQL Server 5.7 detected, please consider upgrading to 8.0 first.
Checking for potential upgrade issues.
The MySQL server at database-1.rds.amazonaws.com:3306,
version 5.7.33 - Source distribution, will now be checked for compatibility
issues for upgrade to MySQL 8.0.31...

1) MySQL 8.0 syntax check for routine-like objects
```

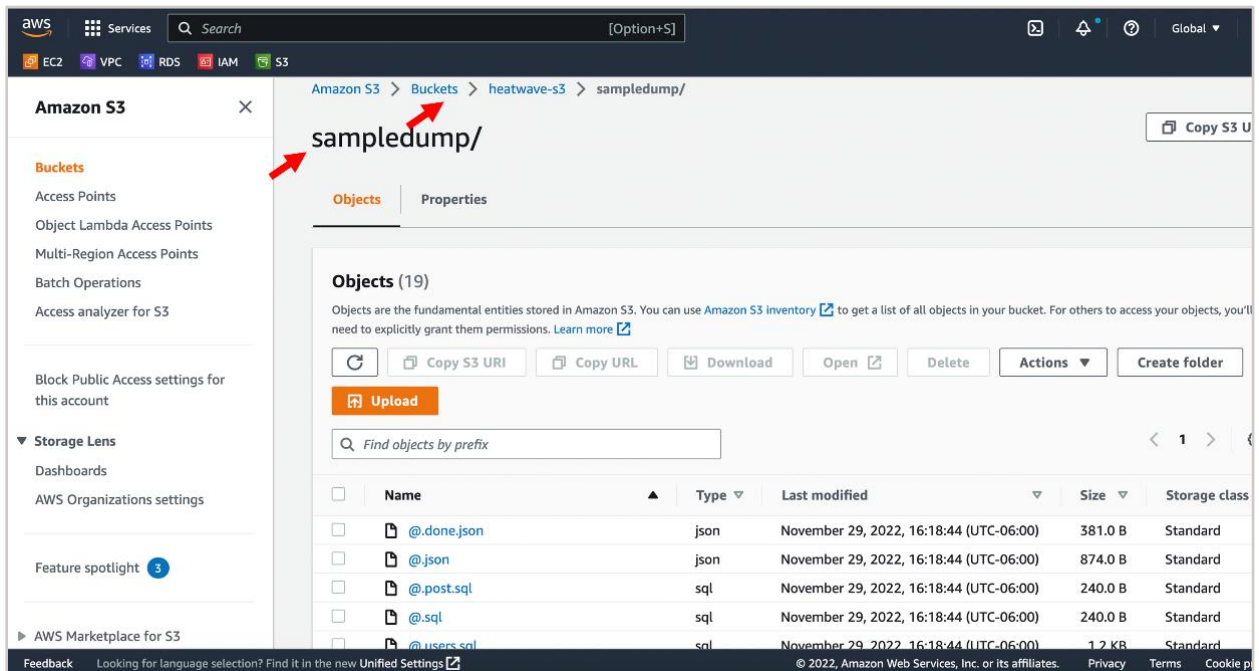
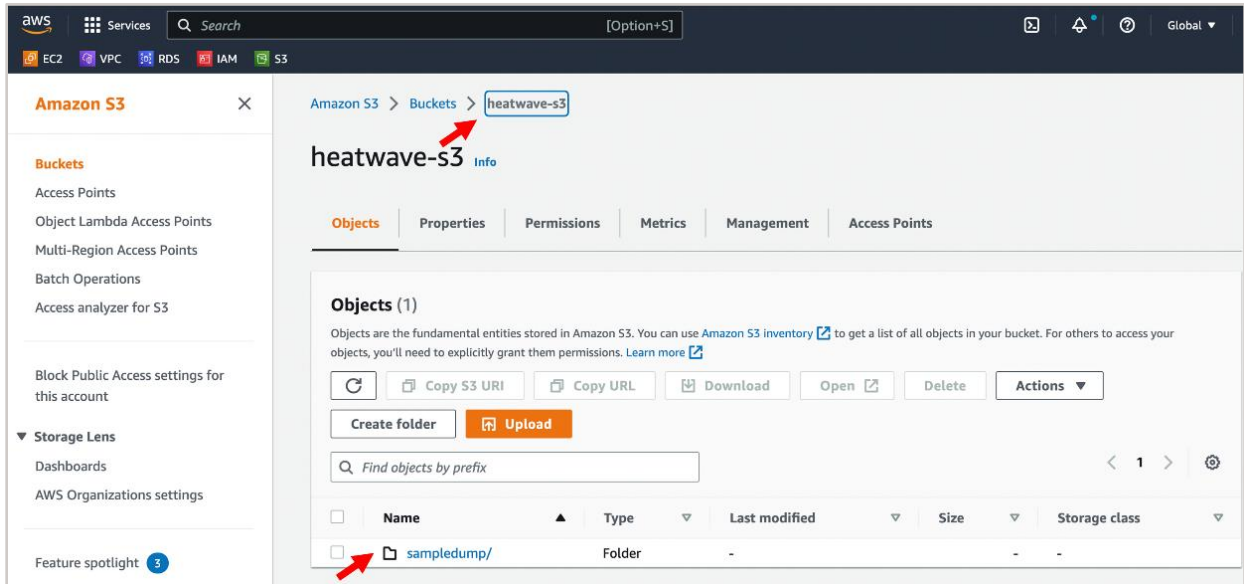
```
Validating MDS compatibility - done
Writing global DDL files
Writing users DDL
Running data dump using 4 threads.
NOTE: Progress information uses estimated values and may not be accurate.
Writing schema metadata - done
Writing DDL - done
Writing table metadata - done
Starting data dump
100% (5.30K rows / ~5.27K rows), 0.00 rows/s, 0.00 B/s uncompressed, 0.00 B/s compressed
Dump duration: 00:00:00s
Total duration: 00:00:01s
Schemas dumped: 2
Tables dumped: 3
Uncompressed data size: 194.62 KB
Compressed data size: 91.71 KB
Compression ratio: 2.1
Rows written: 5302
Bytes written: 91.71 KB
Average uncompressed throughput: 194.62 KB/s
Average compressed throughput: 91.71 KB/s
MySQL database-1 rds.amazonaws JS >
```

- Note: once the dump process is complete, MySQL Shell will display a summary of the dump process like the one shown in the image above.

III. Importing the database

Section H: Navigate to the S3 Storage bucket to confirm if the dump was successful

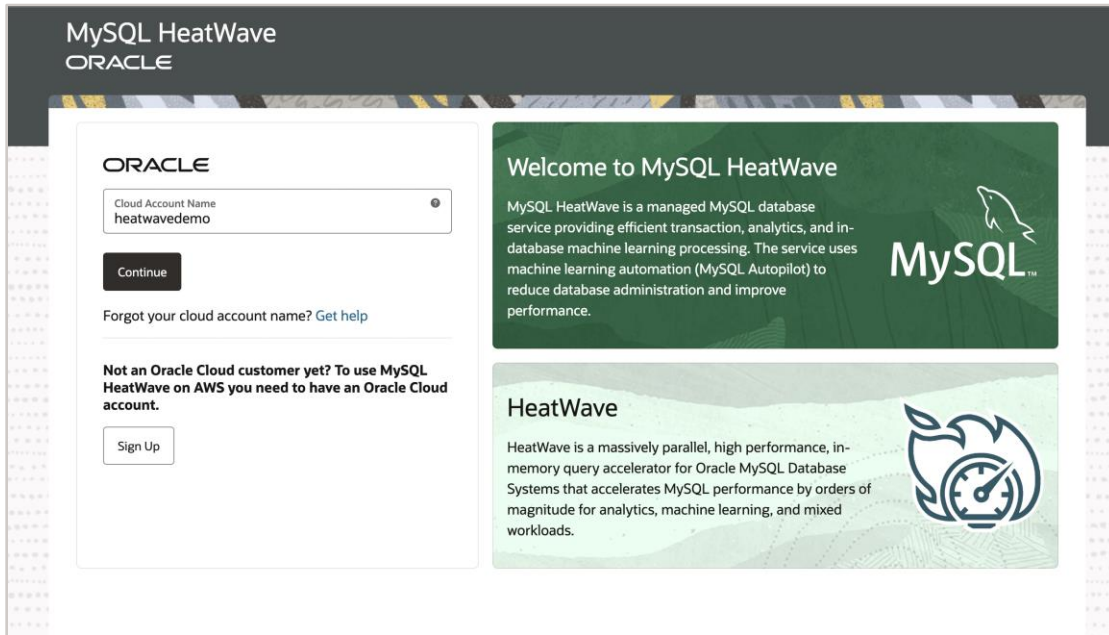
50. Once the export dump operation has completed, go back to your AWS S3 Storage bucket created in Step 30 and locate the dump files under the `samp1edump` prefix



Section I: Create a MySQL HeatWave System

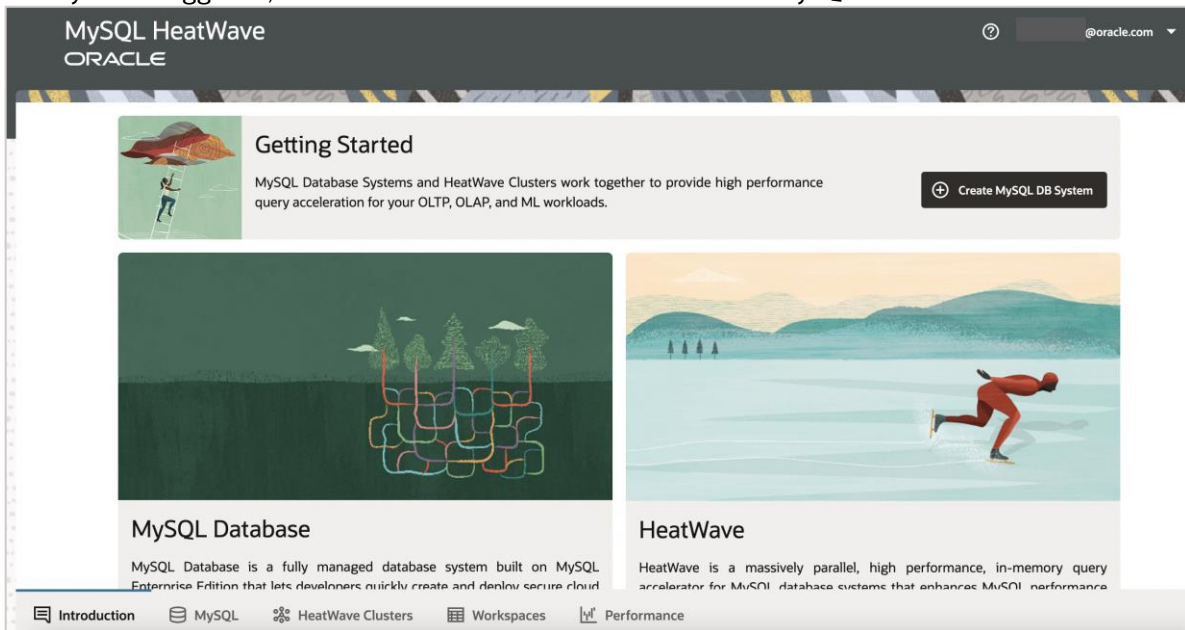
51. After completing all the above Steps, navigate to “cloud.mysql.com” to provision your MySQL HeatWave on AWS instance (assuming you have enabled MySQL HeatWave on AWS from OCI)

cloud.mysql.com

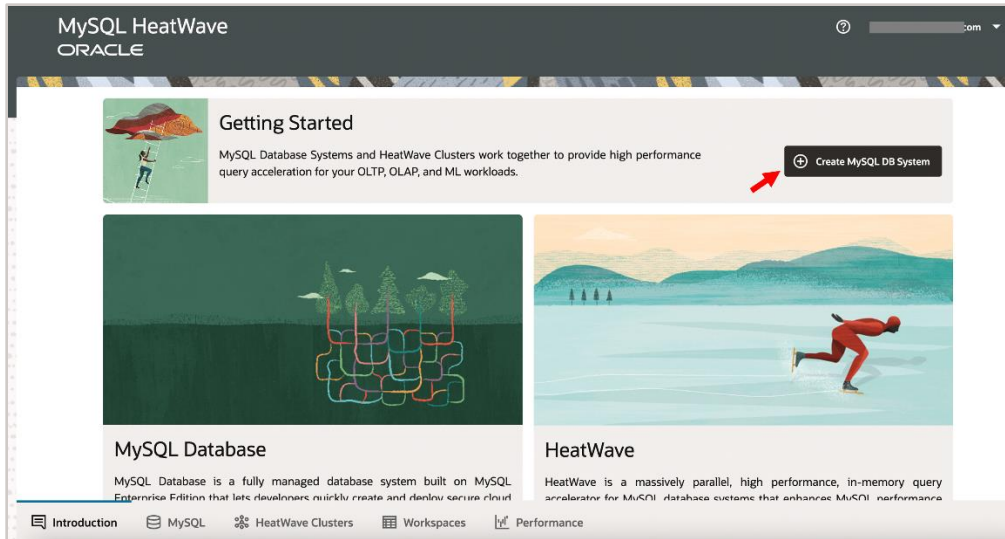


- Note: on the above page, enter your OCI Account Name and click “Continue”. Afterwards, you will be prompted to enter your Oracle Cloud ‘User Name’ and ‘Password’.

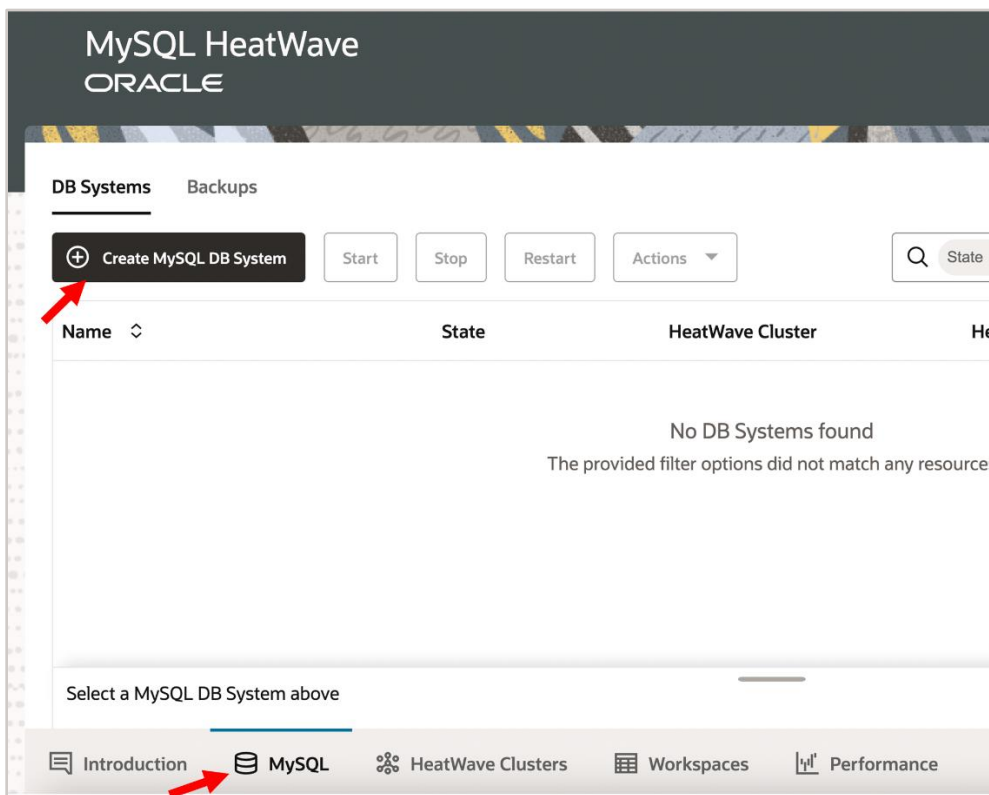
52. Once you are logged in, this is what the home screen looks like: the MySQL HeatWave on AWS Console



53. Click the “Create MySQL DB System” button



- Note: You can also perform the same action by clicking the 'MySQL' tab at the bottom of the page and then clicking the 'Create MySQL DB System' button



54. After clicking on “Create MySQL DB System”, enter a name for your MySQL DB system. Then, create an Admin ‘Username’ and ‘Password’.

The screenshot shows the Oracle MySQL HeatWave console interface. On the left, there is a sidebar with 'DB Systems' and 'Backups' tabs. Below these, there are buttons for 'Create MySQL DB System', 'Start', 'Stop', 'Restart', and 'Actions'. A table with columns 'Name', 'State', and 'HeatWave' is visible, but it is empty. The main content area is titled 'Create MySQL DB System and HeatWave Cluster'. It features a progress indicator with two steps: '1 MySQL DB System' and '2 HeatWave Cluster'. The 'Basic information' section includes a 'Display name' field with the value 'HWonAWS' and a 'Description' field with the text 'Testing migration to HeatWave on AWS'. The 'Administrator credentials' section has three fields: 'Username' with the value 'root', 'Password' (masked with dots), and 'Confirm password' (also masked with dots). At the bottom right, there are 'Cancel' and 'Next' buttons.

55. Scroll down and choose the appropriate ‘Hardware configuration’ and ‘Data storage size’. The minimum storage size you can select is 32 GB. The maximum storage size is 65 TB. For your InnoDB storage, if it is greater than 1 TB, we recommend you switch to the 32.256GB shape. Leave the ‘Maintenance window’ and ‘Availability zone’ as-is.

The screenshot shows the Oracle MySQL HeatWave console interface, specifically the 'Create MySQL DB System and HeatWave Cluster' wizard. It is at step 1, 'MySQL DB System'. The 'Hardware configuration' section has four buttons: 'MySQL.2.16GB' (selected), 'MySQL.4.32GB', 'MySQL.8.64GB', and 'MySQL.32.256GB'. Below this is a 'Data storage size (GiB)' dropdown menu with the value '32'. The 'Database version' section has a button for '8.0.31'. The 'Maintenance window' section has a title with an information icon and two radio buttons: 'Automatic' (selected) and 'Manual'. At the bottom, there is a 'Select start time' label.

56. Under 'Networking' and 'Allowed client addresses', enter the Public IP address of your EC2 Compute Instance that we created in the earlier step, followed by a '/32'.

Networking

Allowed client addresses
6/32

Enter semicolon-separated IP address ranges in CIDR notation (e.g. 1.2.3.4/32)

Port

X Plugin Port

Cancel Next

- Note: click "Next" after you have entered at least one client address under the 'Allowed client addresses'

57. After clicking Next, you will be taken to Page 2 where you will create a HeatWave Cluster. Name your HeatWave Cluster as you want and chose the appropriate "HeatWave Cluster Configuration". For the "Shape", you can either choose a Cluster Node of 16 GB (can handle ~25 GB of data) or a Cluster Node of 256 GB (can handle ~400 GB of data). The "Cluster Size" can go from 1 to 128. Here we will use the "HWonAWS-Cluster" name, 16GB Shape and Cluster Size of 1

Create MySQL DB System and HeatWave Cluster

1 MySQL DB System 2 HeatWave Cluster

Basic information

Display name
HWonAWS-Cluster

Description

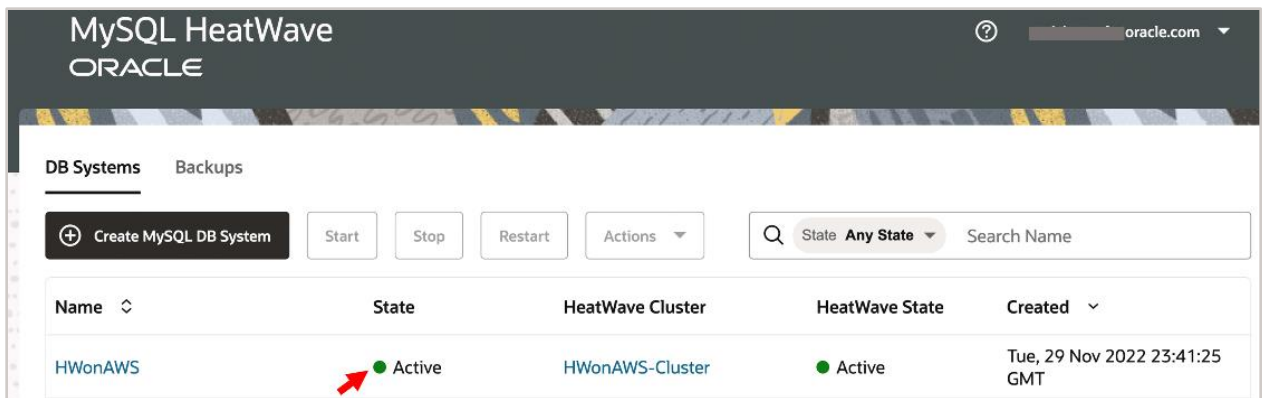
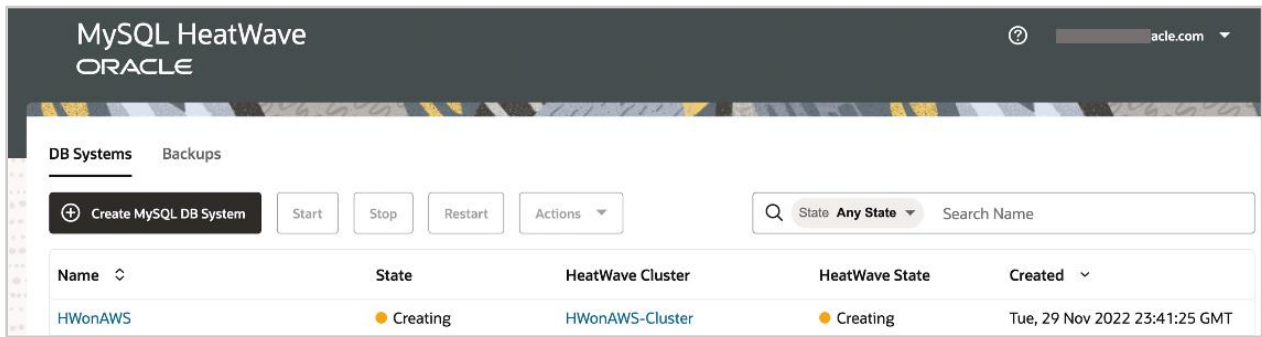
HeatWave Cluster Configuration

Shape
HeatWave.16GB HeatWave.256GB

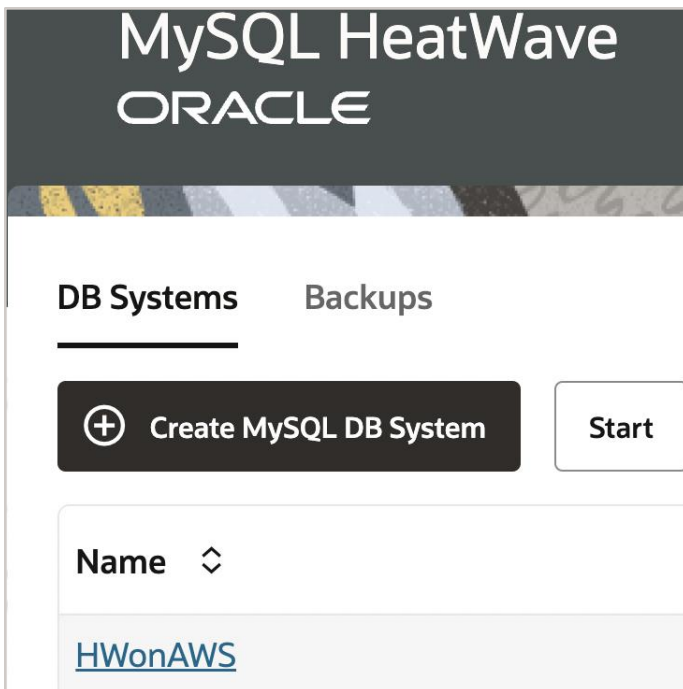
Cluster Size
1

Cancel Back Create

58. Click “Create” as shown in the above image, once you are done with everything. After a few minutes, your MySQL HeatWave System will be created and will be in an “Active” State



59. Once the System is created, click on the “Name” of your system. This will take us to the “DB Systems Details” page where we can view a variety of information regarding your MySQL HeatWave System.



60. You will land on the below “DB Systems Details” page

MySQL HeatWave
ORACLE

MySQL » DB Systems » Details

HWonAWS

Create Backup Edit DB System Start Stop Restart Delete

Summary

State ● Active

Shape
MySQL2.16GB

Resource ID	Host Name
[REDACTED]	m.us-east-1.aws.cloud.mysql.com

DB System Information Backups

General Information DB System Configuration

Description Storage Size

Introduction MySQL HeatWave Clusters Workspaces HeatWave ML Performance

- Note: here, copy the “Host Name” for later use

Section J: Import the dumped data using the util.loadDump() utility

61. After noting down the Host Name, log back into your EC2 instance where we have the 'credentials' file and MySQL Shell installed. Using MySQL Shell, log in to your MySQL HeatWave instance (the EC2 instance whose IP you entered in 'Allowed Client Addresses' in Step 56)

```
ssh -i <path/to/you-private-ssh-key> ec2-user@<ec2-Public-DNS>
```

then

```
$ mysqlsh <username>@<hostname>
```

or

```
$ mysqlsh -u <username> -h <hostname> -P <portnumber> -p
```

```
r [redacted] -mac ~ % ssh -i id_rsa ec2-user@ [redacted].compute-1.amazonaws.com
Register this system with Red Hat Insights: insights-client --register
Create an account or view all your systems at https://red.ht/insights-dashboard
Last login: Thu Jan 26 18:02:59 2023 from [redacted]
[ec2-user@ip [redacted] ~]$
[ec2-user@ip [redacted] ~]$ mysqlsh root@[redacted].dbsystem.us-east-1.aws.cloud.mysql.com
Please provide the password for 'root@[redacted].dbsystem.us-east-1.aws.cloud.mysql.com': *****
Save password for 'root@[redacted].dbsystem.us-east-1.aws.cloud.mysql.com'? [Y]es/[N]o/[e]xit (default No):
MySQL Shell 8.0.31

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Other names may be trademarks of their respective owners.

Type '\help' or '\?' for help; '\quit' to exit.
Creating a session to 'root@[redacted].dbsystem.us-east-1.aws.cloud.mysql.com'
Fetching schema names for auto-completion... Press ^C to stop.
Your MySQL connection id is 41 (X protocol)
Server version: 8.0.31-u3-cloud MySQL Enterprise - Cloud
No default schema selected; type \use <schema> to set one.
MySQL [redacted].dbsystem JS >
```

62. Now that you are logged in to the MySQL HeatWave on AWS System, it is time to load our Amazon RDS MySQL Server data from S3 into this newly created MySQL HeatWave System. Make sure you are in JavaScript mode of MySQL Shell by executing `\js` and then execute the MySQL Shell Load command

```
MySQL JS> \js
MySQL JS> util.loadDump("sampledump", {s3BucketName: "heatwave-s3",
progressFile: "/home/ec2-user/progressfile.json", ignoreVersion:true,
loadUsers:true, dryRun:true})

MySQL .dbssystem.us-east-1.aws JS > util.loadDump("sample
dump", {s3BucketName: "heatwave-s3", progressFile: "/home/ec2-user/progressfile.json", ignoreV
ersion:true, loadUsers:true, dryRun:true})
Loading DDL, Data and Users from AWS S3 bucket=heatwave-s3, prefix='sampledump' using 4 thread
s.
Opening dump...
dryRun enabled, no changes will be made.
Target is MySQL 8.0.31-u3-cloud (MySQL Database Service). Dump was produced from MySQL 5.7.33
WARNING: Destination MySQL version is newer than the one where the dump was created. Loading d
umps from different major MySQL versions is not fully supported and may not work. The 'ignoreV
ersion' option is enabled, so loading anyway.
Fetching dump data from remote location...
Listing files - done
Scanning metadata - done
Checking for pre-existing objects...
Executing common preamble SQL
Executing DDL - done
Executing view DDL - done
Starting data load
Executing user accounts SQL...
NOTE: Skipping CREATE/ALTER USER statements for user 'root'@'%'
NOTE: Filtered statement with restricted grants: GRANT SELECT,INSERT,UPDATE,DELETE,CREATE,DROP
,PROCESS,REFERENCES,INDEX,ALTER,SHOW DATABASES,CREATE TEMPORARY TABLES,LOCK TABLES,EXECUTE,REP
PLICATION SLAVE,REPLICATION CLIENT,CREATE VIEW,SHOW VIEW,CREATE ROUTINE,ALTER ROUTINE,CREATE US
ER,EVENT,TRIGGER ON *.* TO 'rdsadmin'@'localhost' WITH GRANT OPTION; -> GRANT SELECT, INSERT,
UPDATE, DELETE, CREATE, DROP, PROCESS, REFERENCES, INDEX, ALTER, SHOW DATABASES, CREATE TEMPOR
ARY TABLES, LOCK TABLES, EXECUTE, REPLICATION SLAVE, REPLICATION CLIENT, CREATE VIEW, SHOW VIE
W, CREATE ROUTINE, ALTER ROUTINE, CREATE USER, EVENT, TRIGGER ON *.* TO 'rdsadmin'@'localhost'
WITH GRANT OPTION;
NOTE: Skipping GRANT statements for user 'root'@'%'
Executing common postamble SQL
0% (0 bytes / 194.62 KB), 0.00 B/s, 3 / 3 tables done
Recreating indexes - done
No data loaded.
0 warnings were reported during the load.
MySQL .dbssystem.us-east-1.aws JS >
```

- Note:
 - The `util.loadDump()` utility will use the DDL files and tab-separated `.tsv` data files to set up the server instance or schema in the target MySQL instance, then loads the data. For more information, refer to: <https://dev.mysql.com/doc/mysql-shell/8.0/en/mysql-shell-utilities-load-dump.html>
 - Change the prefix and `s3BucketName` to match with what you have.

63. Once you have executed the command in Step 62 and did not see any errors or warnings, execute the same Step 62 command. Although, this time change the dryRun option to false

```
MySQL JS> util.loadDump("sampledump", {s3BucketName: "heatwave-s3",
progressFile: "/home/ec2-user/progressfile.json", ignoreVersion:true,
loadUsers:true, dryRun:false})

MySQL .dbssystem.us-east-1.aws JS > util.loadDump("sample
dump", {s3BucketName: "heatwave-s3", progressFile: "/home/ec2-user/progressfile.json", ignoreV
ersion:true, loadUsers:true, dryRun:false})
Loading DDL, Data and Users from AWS S3 bucket=heatwave-s3, prefix='sampledump' using 4 thread
s.
Opening dump...
Target is MySQL 8.0.31-u3-cloud (MySQL Database Service). Dump was produced from MySQL 5.7.33
WARNING: Destination MySQL version is newer than the one where the dump was created. Loading d
umps from different major MySQL versions is not fully supported and may not work. The 'ignoreV
ersion' option is enabled, so loading anyway.
Fetching dump data from remote location...
Listing files - done
Scanning metadata - done
Checking for pre-existing objects...
Executing common preamble SQL
Executing DDL - done
Executing view DDL - done
Starting data load
Executing user accounts SQL...
NOTE: Skipping CREATE/ALTER USER statements for user 'root'@'%'
NOTE: Filtered statement with restricted grants: GRANT SELECT,INSERT,UPDATE,DELETE,CREATE,DROP
,PROCESS,REFERENCES,INDEX,ALTER,SHOW DATABASES,CREATE TEMPORARY TABLES,LOCK TABLES,EXECUTE,REP
PLICATION SLAVE,REPLICATION CLIENT,CREATE VIEW,SHOW VIEW,CREATE ROUTINE,ALTER ROUTINE,CREATE US
ER,EVENT,TRIGGER ON *.* TO 'rdsadmin'@'localhost' WITH GRANT OPTION; -> GRANT SELECT, INSERT,
UPDATE, DELETE, CREATE, DROP, PROCESS, REFERENCES, INDEX, ALTER, SHOW DATABASES, CREATE TEMPOR
ARY TABLES, LOCK TABLES, EXECUTE, REPLICATION SLAVE, REPLICATION CLIENT, CREATE VIEW, SHOW VIE
W, CREATE ROUTINE, ALTER ROUTINE, CREATE USER, EVENT, TRIGGER ON *.* TO 'rdsadmin'@'localhost'
WITH GRANT OPTION;
NOTE: Skipping GRANT statements for user 'root'@'%'
Executing common postamble SQL
100% (194.62 KB / 194.62 KB), 100.27 KB/s, 3 / 3 tables done
Recreating indexes - done
3 chunks (5.30K rows, 194.62 KB) for 3 tables in 2 schemas were loaded in 2 sec (avg throughpu
t 194.62 KB/s)
0 warnings were reported during the load.
MySQL .dbssystem.us-east-1.aws JS >
```

- Note: once the load process is complete, MySQL Shell will display a summary of the dump process like the one shown in the image above.

64. After your import command has completed successfully in the previous step, you can verify the schemas and tables imported by running the following commands in `\sql` mode of MySQL Shell:

```
MySQL JS> \sql
MySQL SQL> SHOW SCHEMAS;
MySQL SQL> SHOW TABLES IN world;
```

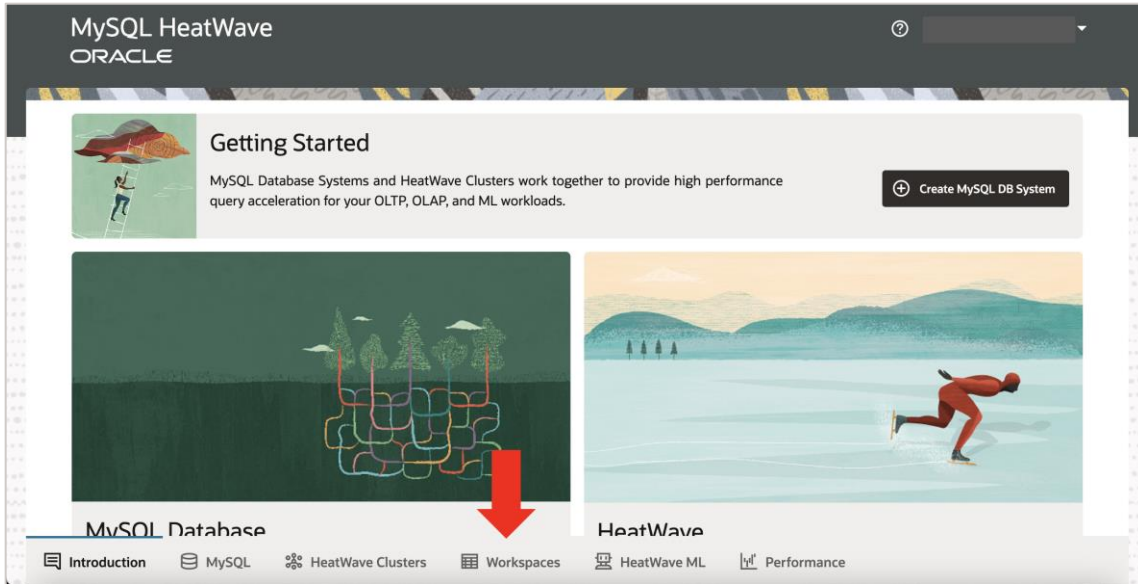
```
MySQL .dbsystem.us-east-1.aws.cloud JS > \sql
Switching to SQL mode... Commands end with ;
MySQL .dbsystem.us-east-1.aws.cloud.mysql SQL > SHOW SCHEMAS;
+-----+
| Database |
+-----+
| information_schema |
| mysql |
| mysql_autopilot |
| performance_schema |
| sys |
| world |
+-----+
6 rows in set (0.0015 sec)
MySQL .dbsystem.us-east-1.aws.cloud.mysql SQL > SHOW TABLES IN world;
+-----+
| Tables_in_world |
+-----+
| city |
| country |
| countrylanguage |
+-----+
3 rows in set (0.0018 sec)
MySQL .dbsystem.us-east-1.aws.cloud.mysql SQL >
```


IV. Loading data into MySQL HeatWave

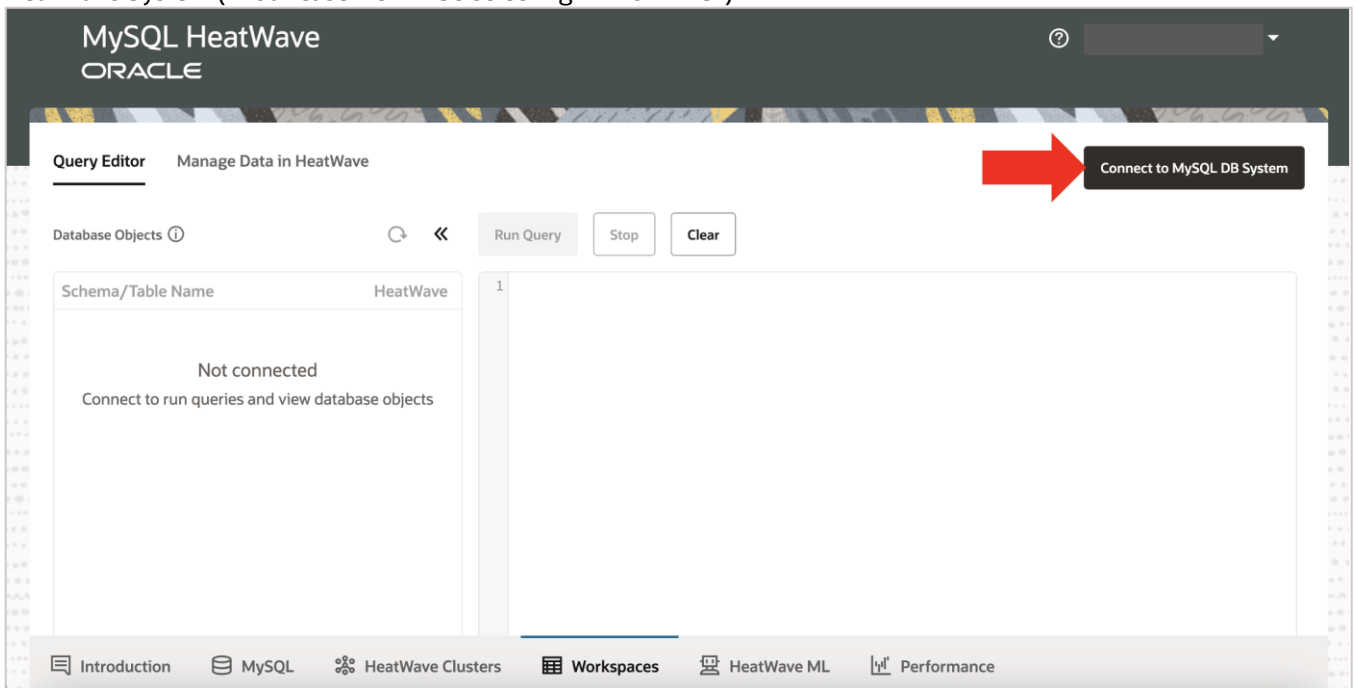
Section K: Load data into the HeatWave Cluster

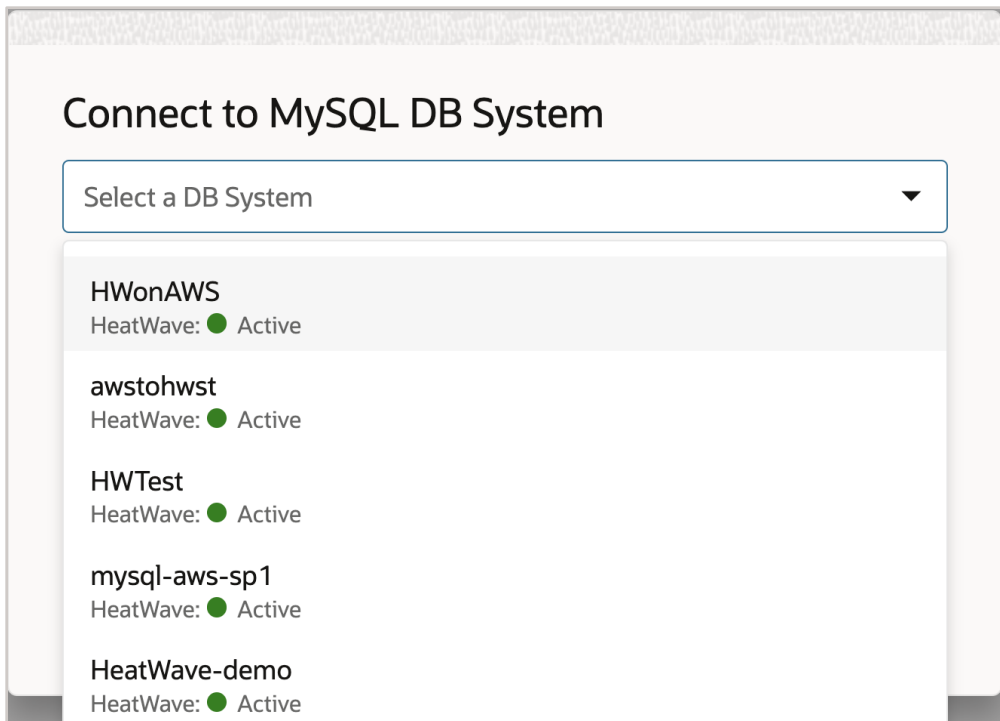
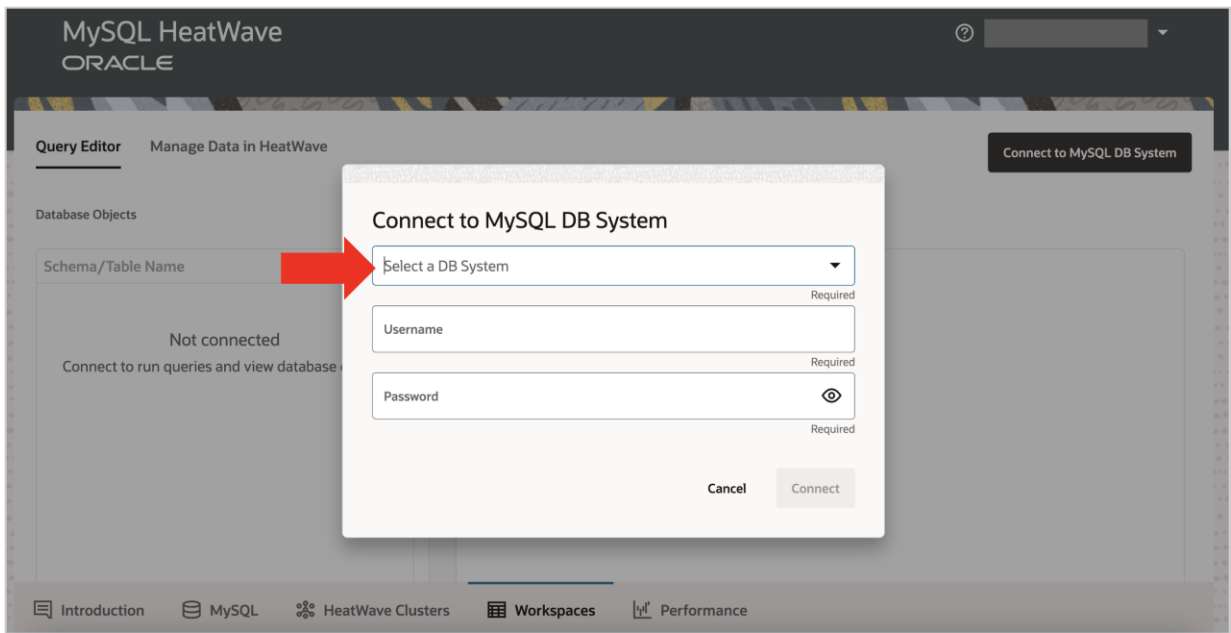
To make use of MySQL HeatWave's in-memory query engine and query acceleration capabilities, you need to attach a HeatWave cluster to your MySQL database.

65. Login to your MySQL HeatWave on AWS Console and navigate to the 'Workspaces' tab



66. From the 'Workspaces' tab, click the "Connect to MySQL DB System" button and then, select your MySQL HeatWave System (in our case we will be selecting "HWonAWS")





67. After selecting the appropriate MySQL DB System, enter the DB Username and Password. Click “Connect” afterwards

Connect to MySQL DB System

HWonAWS

Username
root

Password
.....

Cancel Connect

68. Once you connect, your MySQL DB System name alongside the username that was used to connect will be displayed on the top right. You can also view all the “Schemas” that are currently in the MySQL InnoDB Storage engine under the “Database Objects”

MySQL HeatWave
ORACLE

Query Editor Manage Data in HeatWave

HeatWave Cluster Active MySQL DB System HWonAWS Username root Disconnect

Database Objects

Schema/Table Name	HeatWave
world	0 of 3

Run a query

Introduction MySQL HeatWave Clusters Workspaces HeatWave ML Performance

69. On the 'Workspaces' tab, switch to "Manage Data in HeatWave" from 'Query Editor'

<input type="checkbox"/> Name	Loaded	Warnings	Rows Estimate	Memory Size Estimate (GiB)
<input type="checkbox"/> world	0 of 3	0	5,258	0.009
<input type="checkbox"/> city	0	-	4,035	0.003
<input type="checkbox"/> country	0	-	239	0.003
<input type="checkbox"/> countrylanguage	0	-	984	0.003

0.0 % Cluster memory usage ⓘ

16.0 GiB Free cluster memory ⓘ

0.0 GiB Size of tables to load ⓘ

0.0 GiB Size of tables to unload ⓘ

70. This screen will show a list of the schemas and tables that are loaded in the MySQL DB System. From this screen, you can select the schemas and tables to load into the HeatWave in-memory engine. Select the databases/tables you want to load by checking the box next to the appropriate database(s)/table(s). For this guide, instead of loading the whole "world" database, we will only load the "city" table and "countrylanguage" table.

<input type="checkbox"/> Name	Loaded	Warnings	Rows Estimate	Memory Size Estimate (GiB)
<input type="checkbox"/> world	0 of 3	0	5,258	0.009
<input type="checkbox"/> city	0	-	4,035	0.003
<input type="checkbox"/> country	0	-	239	0.003
<input type="checkbox"/> countrylanguage	0	-	984	0.003

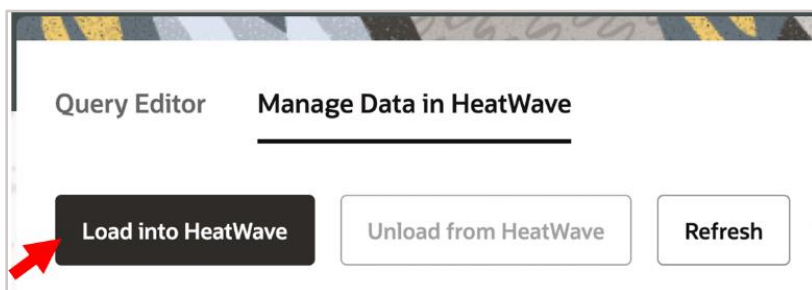
0.0 % Cluster memory usage ⓘ

16.0 GiB Free cluster memory ⓘ

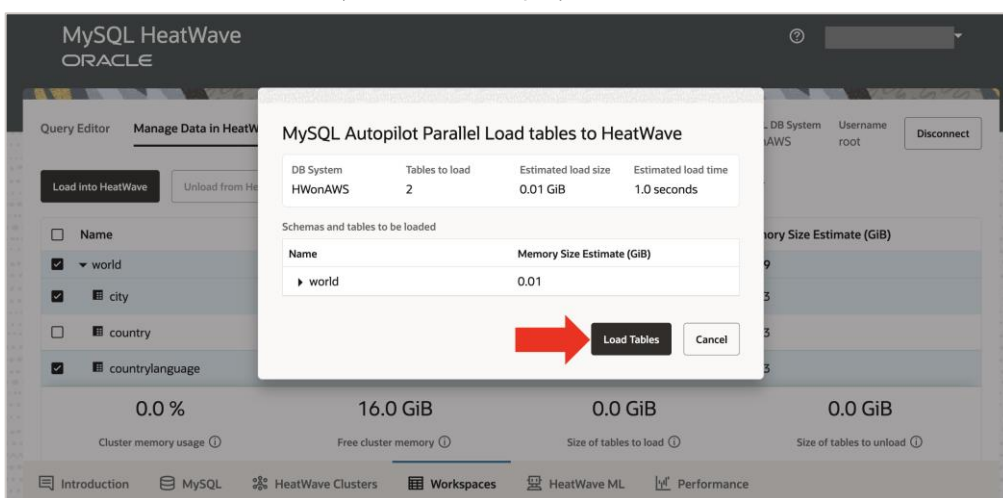
0.0 GiB Size of tables to load ⓘ

0.0 GiB Size of tables to unload ⓘ

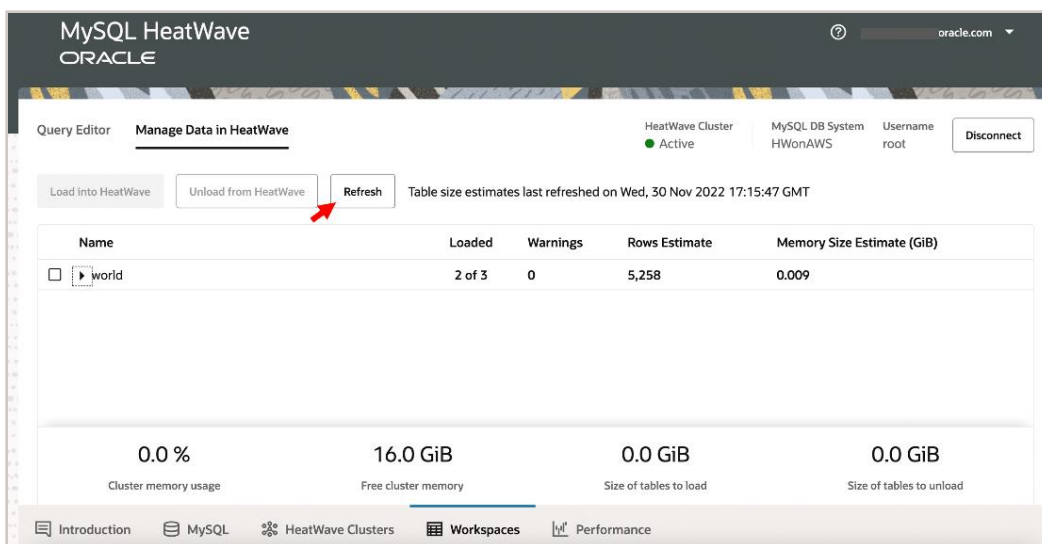
- After you have selected all the tables you want to load into HeatWave, click the 'Load into HeatWave' button on the top left.



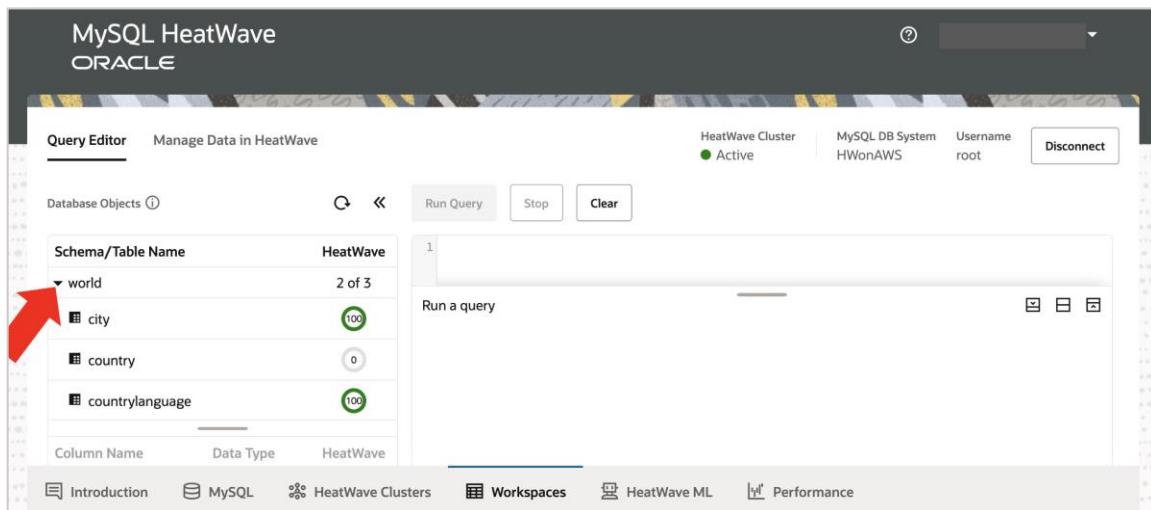
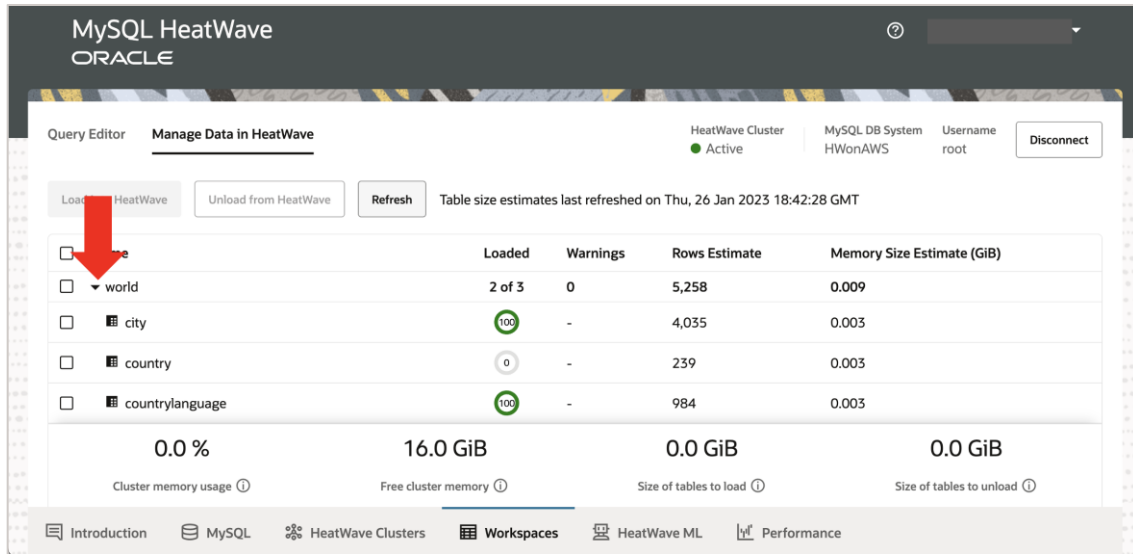
- After you've clicked the 'Load into HeatWave' button, a popup will appear, which will show you information about the tables that will be loaded and how much memory HeatWave will consume. Estimated time required to load the tables into memory will also be displayed. Click "Load Tables" when the below popup appears



- You can click the 'Refresh' button to view the progress of how much data has been loaded into HeatWave. Depending on the size of your data, it may take a few minutes to complete the load.



74. To confirm if your data is 100% loaded, expand the schema by clicking the tiny arrow next to the Schema name from either the “Query Editor” or “Manage Data in HeatWave” on the ‘Workspaces’ tab



75. You now have a complete MySQL HeatWave cluster.

76. Congratulations, you’ve now successfully migrated your data from Amazon RDS MySQL to MySQL HeatWave on AWS!

To learn more about using HeatWave, please visit [our documentation](#).

V. Appendix

Section L: Performing the `util.dumpInstance()` and `util.loadDump()` utility to and from a local filesystem

77. For relatively small databases, you can create the dump files on your local system. Although, you need to transfer them to the AWS EC2 instance using the copy utility of your choice, depending on the operating system you chose for your EC2 instance. (MySQL Shell must be installed on the systems from where you intend to run the `util.dumpInstance()` and `util.loadDump()` utility, setting up the `credentials` file is not required here)
78. In this Section, we will showcase how to perform the `dumpInstance()` utility from the Amazon RDS MySQL instance into a local filesystem. The local filesystem used for the `dumpInstance()` in this guide is the AWS EC2 instance that was shown in Step 11.
79. Connect to your Amazon RDS MySQL Server using MySQL Shell

```
ec2-user $ mysqlsh <username>@<localhost/ip>
```

or

```
ec2-user $ mysqlsh -u <username> -h <localhost/ip> -P <portnumber> -p
```

```
[ec2-user@ip-10.0.0.1 ~]$ mysqlsh root@database-1.rds.amazonaws.com
Please provide the password for 'root@database-1.rds.amazonaws.com': **
*****
Save password for 'root@database-1.rds.amazonaws.com'? [Y]es/[N]o/[e]xit
er (default No):
MySQL Shell 8.0.31

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Type '\help' or '\?' for help; '\quit' to exit.
Creating a session to 'root@database-1.rds.amazonaws.com'
Fetching schema names for auto-completion... Press ^C to stop.
Your MySQL connection id is 11
Server version: 5.7.33 Source distribution
No default schema selected; type \use <schema> to set one.
MySQL database-1.rds.amazonaws JS >
```

80. Make sure you are in JavaScript mode by typing `\js` and execute the `dumpInstance` utility to export the dump data into your local filesystem

```
MySQL JS> \js
MySQL JS> util.dumpInstance("/home/ec2-user/sampledump", {"ocimds": "true",
"compatibility": ["strip_restricted_grants", "strip_definers"], users:
"true", dryRun:"true", consistent: "false"})
```

```
MySQL database-1. rds.amazonaws.com JS > util.dumpInstance("/home/ec2-user
/sampledump", {"ocimds": "true", "compatibility": ["strip_restricted_grants", "strip_definers"
], users: "true", dryRun:"true", consistent: "false"})
dryRun enabled, no locks will be acquired and no files will be created.
Initializing - done
2 out of 6 schemas will be dumped and within them 3 tables, 0 views.
2 out of 4 users will be dumped.
Gathering information - done
WARNING: The dumped value of gtid_executed is not guaranteed to be consistent
Checking for compatibility with MySQL Database Service 8.0.31
NOTE: MySQL Server 5.7 detected, please consider upgrading to 8.0 first.
Checking for potential upgrade issues.
The MySQL server at database-1. rds.amazonaws.com:3306,
version 5.7.33 - Source distribution, will now be checked for compatibility
issues for upgrade to MySQL 8.0.31...

1) MySQL 8.0 syntax check for routine-like objects
```

```
16) Check for invalid table names and schema names used in 5.7
No issues found

Errors: 0
Warnings: 1
Notices: 0

NOTE: No fatal errors were found that would prevent an upgrade, but some potential issues were
detected. Please ensure that the reported issues are not significant before upgrading.
NOTE: User 'rdsadmin'@'localhost' had restricted privileges (CREATE TABLESPACE, FILE, RELOAD,
SHUTDOWN, SUPER) removed
NOTE: User 'root'@'%' had restricted privileges (INVOKE COMPREHEND, INVOKE LAMBDA, INVOKE SAGE
MAKER, LOAD FROM S3, RELOAD, SELECT INTO S3) removed
Compatibility issues with MySQL Database Service 8.0.31 were found and repaired. Please review
the changes made before loading them.
Validating MDS compatibility - done
Writing global DDL files
Writing users DDL
Writing DDL - done
Starting data dump
0% (0 rows / ~5.30K rows), 0.00 rows/s, 0.00 B/s uncompressed, 0.00 B/s compressed
MySQL database-1. -east-1.rds.world JS >
```

- Note:
 - `dumpInstance` SYNTAX: `util.dumpInstance(outputUrl[, options])`
 - `/home/opc/sampledump` is the `outputUrl`. Here, you can specify an absolute path or a path relative to the current working directory for your local filesystem.
 - `sampledump` is the directory under which all the exported dump files will be stored in EC2. The `sampledump` directory must not exist or if it does, the directory should be empty
 - Add the `consistent: false` option, if and only if, your `dump` utility produces “Errors” regarding “table locks” (MySQLSH 52002: See Steps 47/48 for more information)
 - The `util.dumpInstance()` utility will take a dump of all the databases except “mysql, sys, performance schema, and information schema”. The dump comprises of DDL files for the schema structure and tab-separated `.tsv` files containing the actual data. Additionally, you can also use

`util.dumpSchemas()` or `util.dumpTables()` if you only want to dump specific schemas or tables. The three dump utilities can export the data into:

- a) Object Storage bucket in Oracle Cloud
- b) S3-compatible buckets
- c) local filesystem
- This Section showcases option c). For more information, refer: <https://dev.mysql.com/doc/mysql-shell/8.0/en/mysql-shell-utilities-dump-instance-schema.html#mysql-shell-utilities-dump-opt-run>
- The `dryRun` option runs the export command but does not generate any output export file. It displays information about what would be dumped with the specified set of options, and about the results of MySQL HeatWave compatibility checks (if the `ocimds` option is specified, which is required for this guide), but does not proceed with the dump. Setting this option enables you to list out all the compatibility issues before starting the dump. The default is false. You can read more about the utility options at <https://dev.mysql.com/doc/mysql-shell/8.0/en/mysql-shell-utilities-dump-instance-schema.html#mysql-shell-utilities-dump-opt-control>
- Setting the `ocimds: true` option ensures compatibility of the export dump with MySQL HeatWave.
- Primary keys are required on every table for using MySQL HeatWave.
- If you can't seem to solve an error during the `dryRun`, contact a MySQL Solution Engineer for guidance: <https://go.oracle.com/LP=132857?src1=:ow:o:s:po:::&intcmp=:ow:o:s:po:::>
- To understand the `dumpInstance()`, `dumpSchemas()`, or `dumpTables()` utility in more detail, refer to this website: <https://dev.mysql.com/doc/mysql-shell/8.0/en/mysql-shell-utilities-dump-instance-schema.html>

81. Once you have executed the command in Step 80 and did not see any additional errors or warnings, execute the same Step 80 command. Although, this time change the `dryRun` option to `false`

```
MySQL JS> util.dumpInstance("/home/ec2-user/sampledump", {"ocimds": "true",
"compatibility": ["strip_restricted_grants", "strip_definers"], users:
"true", dryRun:"false", consistent: "false"})
```

```
MySQL database-1. rds.amazonaws.com JS > util.dumpInstance("/home/ec2-user
/sampledump", {"ocimds": "true", "compatibility": ["strip_restricted_grants", "strip_definers"
], users: "true", dryRun:"false", consistent: "false"})
Initializing - done
2 out of 6 schemas will be dumped and within them 3 tables, 0 views.
2 out of 4 users will be dumped.
Gathering information - done
WARNING: The dumped value of gtid_executed is not guaranteed to be consistent
Checking for compatibility with MySQL Database Service 8.0.31
NOTE: MySQL Server 5.7 detected, please consider upgrading to 8.0 first.
Checking for potential upgrade issues.
The MySQL server at database-1. rds.amazonaws.com:3306,
version 5.7.33 - Source distribution, will now be checked for compatibility
issues for upgrade to MySQL 8.0.31...

1) MySQL 8.0 syntax check for routine-like objects
```

```
NOTE: Progress information uses estimated values and may not be accurate.
Writing schema metadata - done
Writing DDL - done
Writing table metadata - done
Starting data dump
100% (5.30K rows / ~5.30K rows), 0.00 rows/s, 0.00 B/s uncompressed, 0.00 B/s compressed
Dump duration: 00:00:00s
Total duration: 00:00:00s
Schemas dumped: 1
Tables dumped: 3
Uncompressed data size: 194.62 KB
Compressed data size: 91.71 KB
Compression ratio: 2.1
Rows written: 5302
Bytes written: 91.71 KB
Average uncompressed throughput: 194.62 KB/s
Average compressed throughput: 91.71 KB/s
MySQL database-1.c -east-1.rds world JS >
```

- Note: once the dump process is complete, MySQL Shell will display a summary of the dump process like the one shown in the image above.

82. Go back to your local filesystem and locate the dump files under the `sampledump` directory, to confirm if the dump was successful (in our case, the EC2 instance).

```
[ec2-user@ip-... ~]$
[ec2-user@ip-... ~]$ ls
mysql-shell-8.0.31-1.el8.x86_64.rpm  privapikey.pem  sampledump  world-db  world-db.zip
[ec2-user@ip-... ~]$
[ec2-user@ip-... ~]$ cd sampledump
[ec2-user@ip-... sampledump]$
[ec2-user@ip-... sampledump]$ ls
@.done.json          world@city.json          world@countrylanguage.json
@.json              world@city.sql          world@countrylanguage.sql
@.post.sql          world@country@@0.tsv.zst world@country.sql
@.sql               world@country@@0.tsv.zst.idx world.json
@.users.sql        world@country.json      world.sql
world@city@@0.tsv.zst world@countrylanguage@@0.tsv.zst
world@city@@0.tsv.zst.idx world@countrylanguage@@0.tsv.zst.idx
[ec2-user@ip-... sampledump]$
```

83. Now, transfer the `sampLEDump` directory to the AWS EC2 instance using the copy utility of your choice, depending on the operating system you chose for your EC2 instance. One way to do this is to use the `scp` command.

84. After you have copied over your `sampLEDump` directory to the AWS EC2 instance, login to that EC2 instance and retrieve the path to the `sampLEDump` directory.

```
ssh -i <path/to/you-private-ssh-key> ec2-user@<ec2-Public-DNS>
```

```
[ec2-user@ip-██████████ ~]$ ls
privapikey.pem  sampLEDump
[ec2-user@ip-██████████ ~]$ pwd
/home/ec2-user
[ec2-user@ip-██████████ ~]$ █
```

- Note: by looking at the above image, the `sampLEDump` directory location for this guide will hence be `/home/ec2-user/sampLEDump`

85. Make sure you are logged in to that EC2 instance, and then login to your MySQL HeatWave instance using MySQL Shell to load those dump files.

```
ssh -i <path/to/you-private-ssh-key> ec2-user@<ec2-Public-DNS>
```

then,

```
$ mysqlsh <username>@<hostname>
```

or

```
$ mysqlsh -u <username> -h <hostname> -P <portnumber> -p
```

```
r ██████████ -mac ~ % ssh -i id_rsa ec2-user@ ██████████.compute-1.amazonaws.com
Register this system with Red Hat Insights: insights-client --register
Create an account or view all your systems at https://red.ht/insights-dashboard
Last login: Thu Jan 26 18:02:59 2023 from ██████████
[ec2-user@ip-██████████ ~]$
[ec2-user@ip-██████████ ~]# mysqlsh root@██████████.dbsystem.us-east-1.aws.cloud.mysql.com
Please provide the password for 'root@██████████.dbsystem.us-east-1.aws.cloud.mysql.com': *****
Save password for 'root@██████████.dbsystem.us-east-1.aws.cloud.mysql.com'? [Y]es/[N]o/[Ne]ver (default No):
MySQL Shell 8.0.31

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Type '\help' or '\?' for help; '\quit' to exit.
Creating a session to 'root@██████████.dbsystem.us-east-1.aws.cloud.mysql.com'
Fetching schema names for auto-completion.. Press ^C to stop.
Your MySQL connection id is 41 (X protocol)
Server version: 8.0.31-u3-cloud MySQL Enterprise – Cloud
No default schema selected; type \use <schema> to set one.
MySQL : ██████████.dbsystem JS >
```

86. It is now time to load our sample database “world”, that was dumped from our Amazon RDS MySQL instance to the local filesystem, which we later transferred to the AWS EC2 instance using the copy utility of your choice. Inside MySQL Shell, make sure you are in JavaScript mode of MySQL Shell by executing `\js` and then, execute the `loadDump` utility to import the dumped data from AWS EC2 instance into MySQL HeatWave.

```
MySQL SQL> \js
MySQL JS> util.loadDump("/home/ec2-user/sampledump", {progressFile:
"/home/ec2-user/progressfile.json", ignoreVersion: "true", loadUsers: "true",
dryRun: "true"})
```

```
MySQL .dbsystem.us-east-1.aws JS > util.loadDump("/home/
ec2-user/sampledump", {progressFile: "/home/ec2-user/progressfile.json", ignoreVersion: "true"
, loadUsers: "true", dryRun: "true"})
Loading DDL, Data and Users from '/home/ec2-user/sampledump' using 4 threads.
Opening dump...
dryRun enabled, no changes will be made.
Target is MySQL 8.0.31-u3-cloud (MySQL Database Service). Dump was produced from MySQL 5.7.33
WARNING: Destination MySQL version is newer than the one where the dump was created. Loading d
umps from different major MySQL versions is not fully supported and may not work. The 'ignoreV
ersion' option is enabled, so loading anyway.
Scanning metadata - done
Checking for pre-existing objects...
Executing common preamble SQL
Executing DDL - done
Executing view DDL - done
Starting data load
Executing user accounts SQL...
NOTE: Skipping CREATE/ALTER USER statements for user 'root'@%'
NOTE: Filtered statement with restricted grants: GRANT SELECT,INSERT,UPDATE,DELETE,CREATE,DROP
,PROCESS,REFERENCES,INDEX,ALTER,SHOW DATABASES,CREATE TEMPORARY TABLES,LOCK TABLES,EXECUTE,REP
PLICATION SLAVE,REPLICATION CLIENT,CREATE VIEW,SHOW VIEW,CREATE ROUTINE,ALTER ROUTINE,CREATE US
ER,EVENT,TRIGGER ON *.* TO 'rdsadmin'@'localhost' WITH GRANT OPTION; -> GRANT SELECT, INSERT,
UPDATE, DELETE, CREATE, DROP, PROCESS, REFERENCES, INDEX, ALTER, SHOW DATABASES, CREATE TEMPOR
ARY TABLES, LOCK TABLES, EXECUTE, REPLICATION SLAVE, REPLICATION CLIENT, CREATE VIEW, SHOW VIE
W, CREATE ROUTINE, ALTER ROUTINE, CREATE USER, EVENT, TRIGGER ON *.* TO 'rdsadmin'@'localhost'
WITH GRANT OPTION;
NOTE: Skipping GRANT statements for user 'root'@%'
Executing common postamble SQL
0% (0 bytes / 194.62 KB), 0.00 B/s, 3 / 3 tables done
Recreating indexes - done
No data loaded.
0 warnings were reported during the load.
MySQL .dbsystem.us-east-1.aws JS >
```

- Note:
 - `loadDump` SYNTAX: `util.loadDump(url[, options])`
 - `/home/opc/sampledump` is the `url`. Here, you can specify the path to a local directory containing the dump files
 - The `util.loadDump()` utility will use the DDL files and tab-separated `.tsv` data files to set up the server instance or schema in the target MySQL instance, then loads the data. For more information, refer to: <https://dev.mysql.com/doc/mysql-shell/8.0/en/mysql-shell-utilities-load-dump.html>
 - Change the filesystem path to match with what you have.

87. Once you have executed the command in Step 86 and did not see any errors or warnings, execute the same Step 86 command. Although, this time change the dryRun option to false

```
MySQL JS> util.loadDump("/home/ec2-user/sampledump", {progressFile:
"/home/ec2-user/progressfile.json", ignoreVersion: "true", loadUsers: "true",
dryRun: "false"})
```

```
MySQL .dbsystem.us-east-1.aws JS > util.loadDump("/home/
ec2-user/sampledump", {progressFile: "/home/ec2-user/progressfile.json", ignoreVersion: "true"
, loadUsers: "true", dryRun: "false"})
Loading DDL, Data and Users from '/home/ec2-user/sampledump' using 4 threads.
Opening dump...
Target is MySQL 8.0.31-u3-cloud (MySQL Database Service). Dump was produced from MySQL 5.7.33
WARNING: Destination MySQL version is newer than the one where the dump was created. Loading d
umps from different major MySQL versions is not fully supported and may not work. The 'ignoreV
ersion' option is enabled, so loading anyway.
Scanning metadata - done
Checking for pre-existing objects...
Executing common preamble SQL
Executing DDL - done
Executing view DDL - done
Starting data load
Executing user accounts SQL...
NOTE: Skipping CREATE/ALTER USER statements for user 'root'@%'
NOTE: Filtered statement with restricted grants: GRANT SELECT,INSERT,UPDATE,DELETE,CREATE,DROP
,PROCESS,REFERENCES,INDEX,ALTER,SHOW DATABASES,CREATE TEMPORARY TABLES,LOCK TABLES,EXECUTE,REP
PLICATION SLAVE,REPLICATION CLIENT,CREATE VIEW,SHOW VIEW,CREATE ROUTINE,ALTER ROUTINE,CREATE US
ER,EVENT,TRIGGER ON *.* TO 'rdsadmin'@'localhost' WITH GRANT OPTION; -> GRANT SELECT, INSERT,
UPDATE, DELETE, CREATE, DROP, PROCESS, REFERENCES, INDEX, ALTER, SHOW DATABASES, CREATE TEMPOR
ARY TABLES, LOCK TABLES, EXECUTE, REPLICATION SLAVE, REPLICATION CLIENT, CREATE VIEW, SHOW VIE
W, CREATE ROUTINE, ALTER ROUTINE, CREATE USER, EVENT, TRIGGER ON *.* TO 'rdsadmin'@'localhost'
WITH GRANT OPTION;
NOTE: Skipping GRANT statements for user 'root'@%'
Executing common postamble SQL
100% (194.62 KB / 194.62 KB), 0.00 B/s, 3 / 3 tables done
Recreating indexes - done
3 chunks (5.30K rows, 194.62 KB) for 3 tables in 2 schemas were loaded in 0 sec (avg throughpu
t 194.62 KB/s)
0 warnings were reported during the load.
MySQL .dbsystem.us-east-1.aws JS >
```

- Note: once the load process is complete, MySQL Shell will display a summary of the dump process like the one shown in the image above.

88. After your import command has completed successfully in the previous step, you can verify the schemas and tables imported by running the following commands in \sql mode:

```
MySQL JS> \sql
MySQL SQL> SHOW SCHEMAS;
MySQL SQL> SHOW TABLES IN world;
```

```
MySQL .dbsystem.us-east-1.aws.cloud JS > \sql
Switching to SQL mode... Commands end with ;
MySQL .dbsystem.us-east-1.aws.cloud.mysql SQL > SHOW SCHEMAS;
+-----+
| Database |
+-----+
| information_schema |
| mysql |
| mysql_autopilot |
| performance_schema |
| sys |
| world |
+-----+
6 rows in set (0.0015 sec)
MySQL .dbsystem.us-east-1.aws.cloud.mysql SQL > SHOW TABLES IN world;
+-----+
| Tables_in_world |
+-----+
| city |
| country |
| countrylanguage |
+-----+
3 rows in set (0.0018 sec)
MySQL .dbsystem.us-east-1.aws.cloud.mysql SQL >
```

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