EXPERIMENT 5

Aim: To study and Implement Database as a Service on SQL/NOSQL databases like AWS RDS, AZURE SQL/ MongoDB Lab/ Firebase.

Objective:

- Describe key database concepts.
- Compare and contrast relational and nonrelational databases.
- Identify the AWS database services.
- Discuss the features and concepts of Amazon RDS.
- Describe the benefits and use cases of Amazon RDS.
- Describe how to set up an RDS instance using the console.
- Identify how to connect to the database instance.
- Discuss how to use SQL commands to read and write to the database.

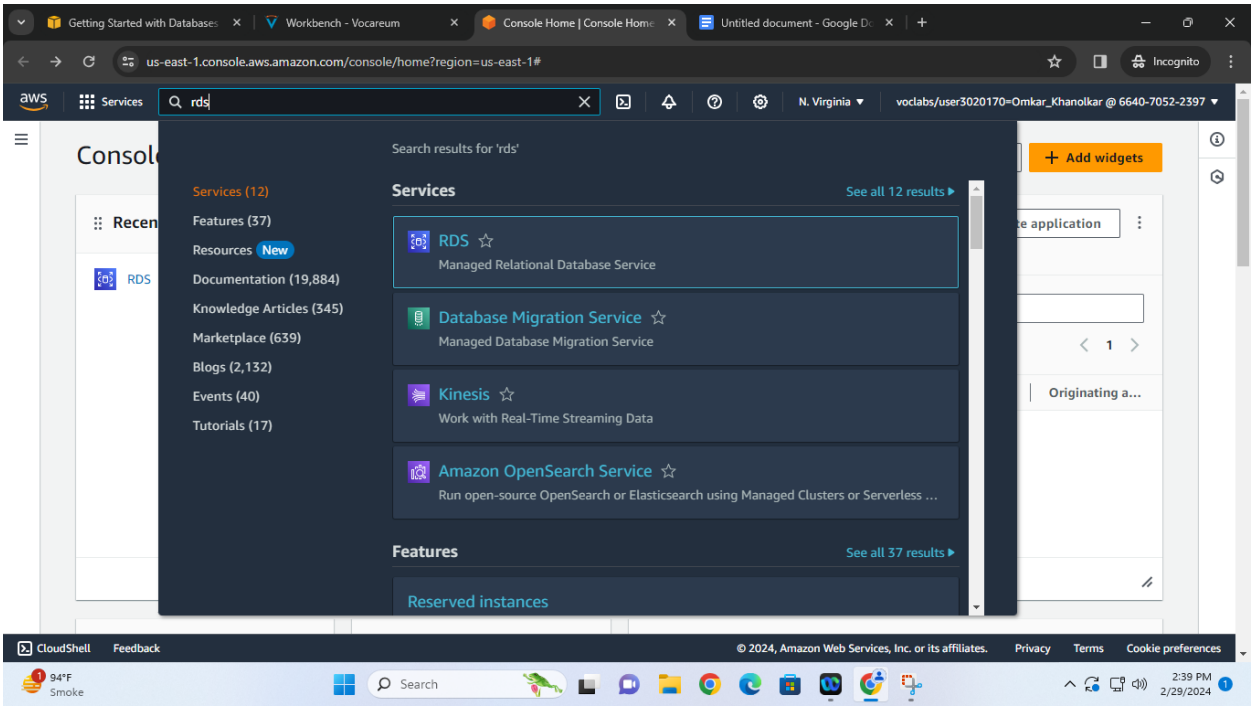
Theory: To embark on a study and implementation of Database as a Service (DBaaS) using SQL/NOSQL databases like AWS RDS, Azure SQL, MongoDB, or Firebase, it's crucial to grasp the foundational concepts and functionalities inherent in these cloud database platforms. DBaaS offers managed database services that eliminate the complexity of database administration tasks, such as provisioning, patching, backups, and scaling, allowing users to focus on application development and data management. The theory behind this endeavor revolves around understanding the core components and features of DBaaS offerings provided by AWS, Azure, MongoDB, and Firebase. These platforms offer a variety of database options, including relational databases like MySQL, PostgreSQL, SQL Server, and non-relational databases like MongoDB, Firestore, and Firebase Realtime Database. Key concepts include selecting the appropriate database service based on data model requirements, performance considerations, scalability needs, and cost constraints. Additionally, understanding database security, data integrity, backup and recovery mechanisms, and data migration strategies are essential aspects of studying and implementing DBaaS. By leveraging services like AWS RDS, Azure SQL Database, MongoDB Atlas, or Firebase, participants gain practical experience in provisioning, configuring, and managing databases in the cloud, ensuring high availability, reliability, and scalability for their applications. This experiment serves as a hands-on exploration of modern database technologies and equips participants with the knowledge and skills to leverage DBaaS effectively for building resilient and scalable data solutions in the cloud.

Implementation And Output:

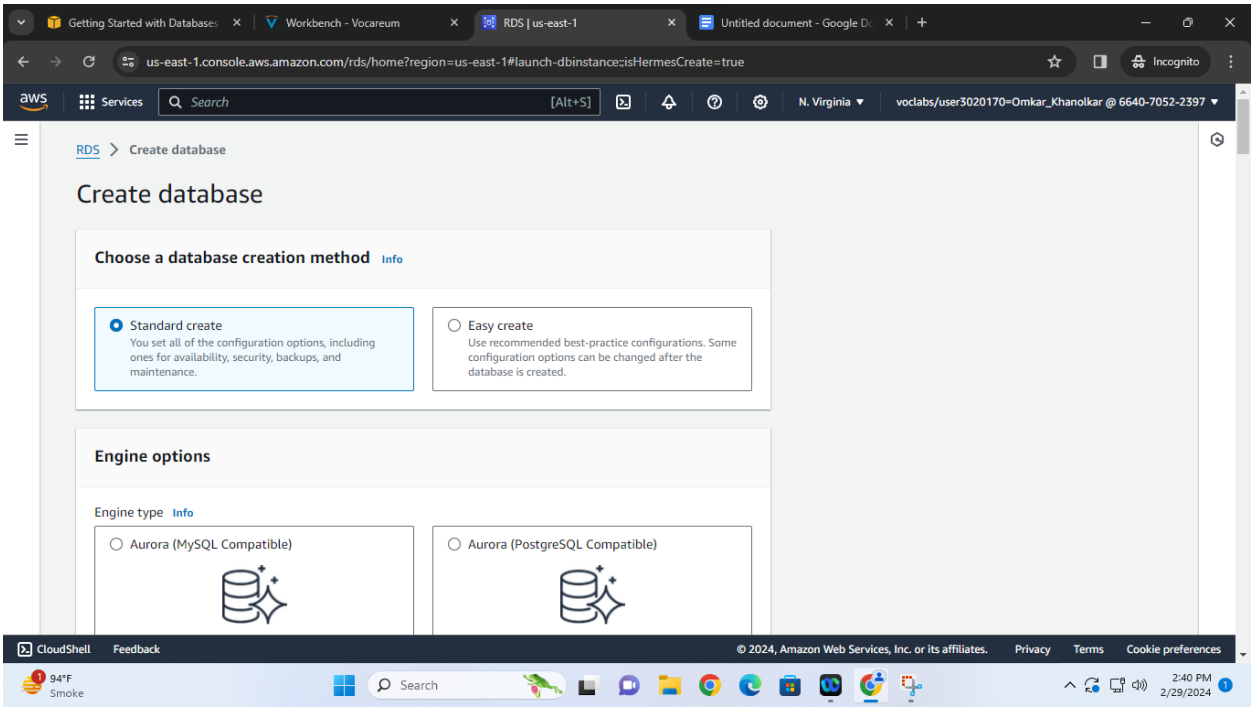
Task 1: Creating an Amazon RDS database

In this task, you create a MySQL database in your virtual private cloud (VPC). MySQL is a popular open-source relational database management system (RDBMS), so there are no software licensing fees.

1. On the **Services** menu, choose **RDS**.



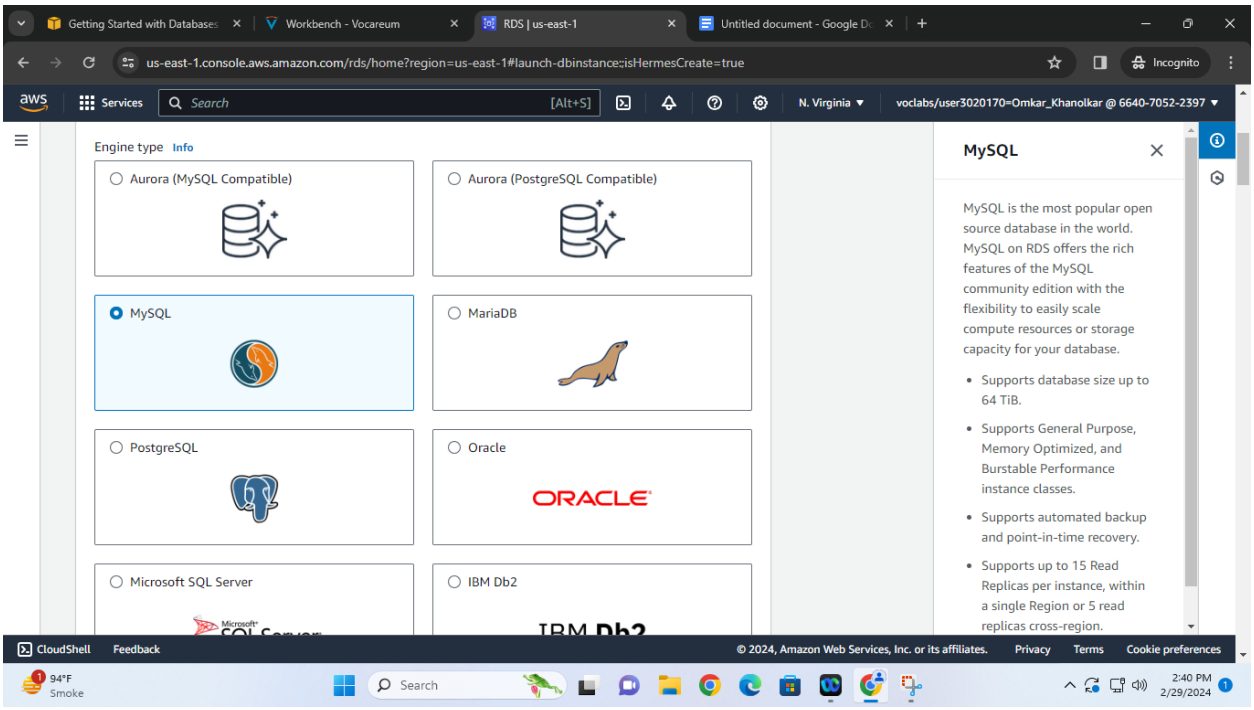
2. Choose **Create database**
   For this lab, you will keep the **Choose a database creation method** as **Standard create** to understand the full set of features available.



3. Under **Engine options**, select **MySQL**.

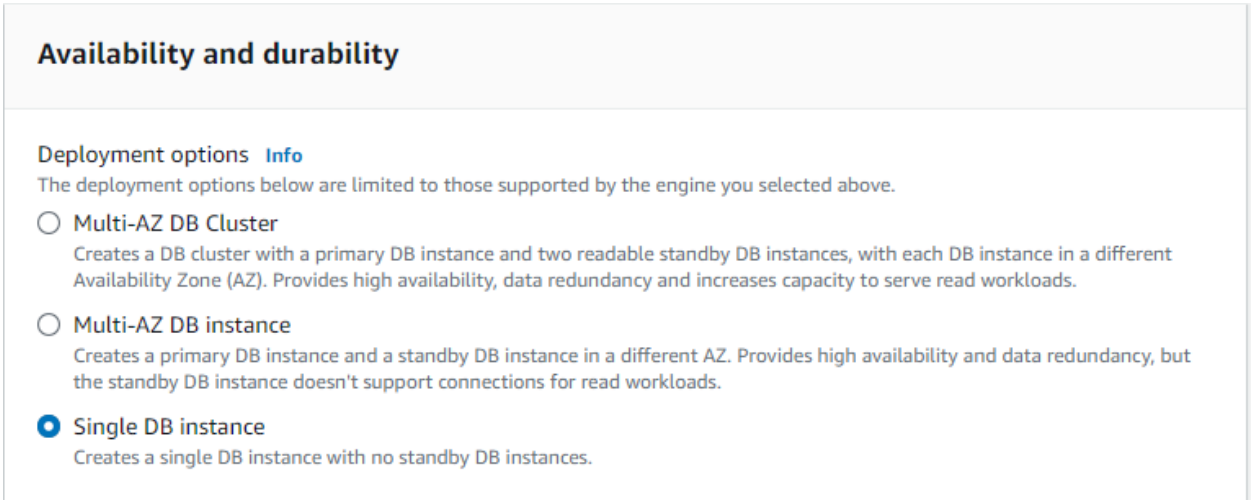
- For Version, keep MySQL 8.0.28.

  In the options, you might notice Amazon Aurora. Aurora is a global-scale relational database service built for the cloud with full MySQL and PostgreSQL compatibility. If your company uses large-scale MySQL or PostgreSQL databases, Aurora can provide enhanced performance.



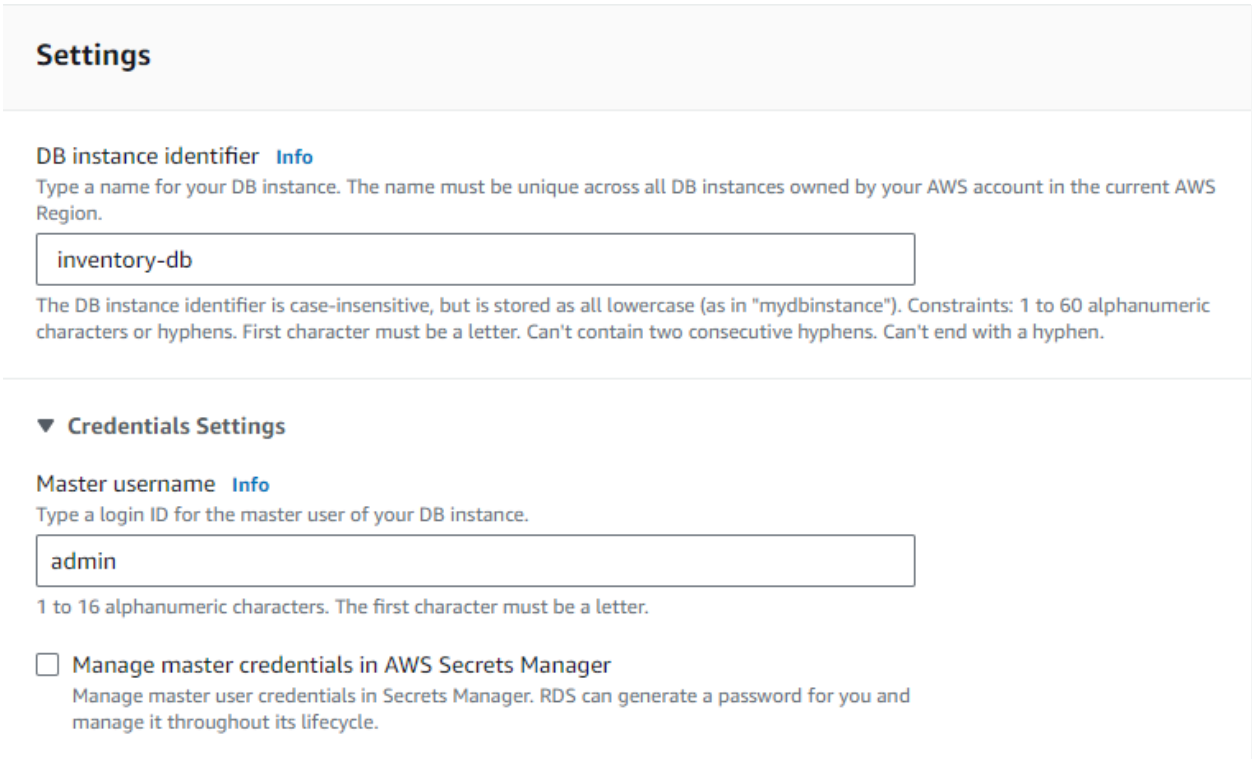
4. In the **Templates** section, select **Dev/Test**.
   You can now select a database configuration, including software version, instance class, storage, and login settings. The *Multi-AZ deployment* option automatically creates a replica of the database in a second Availability Zone for high availability.

5. In the **Availability and durability** section, choose **Single DB instance**



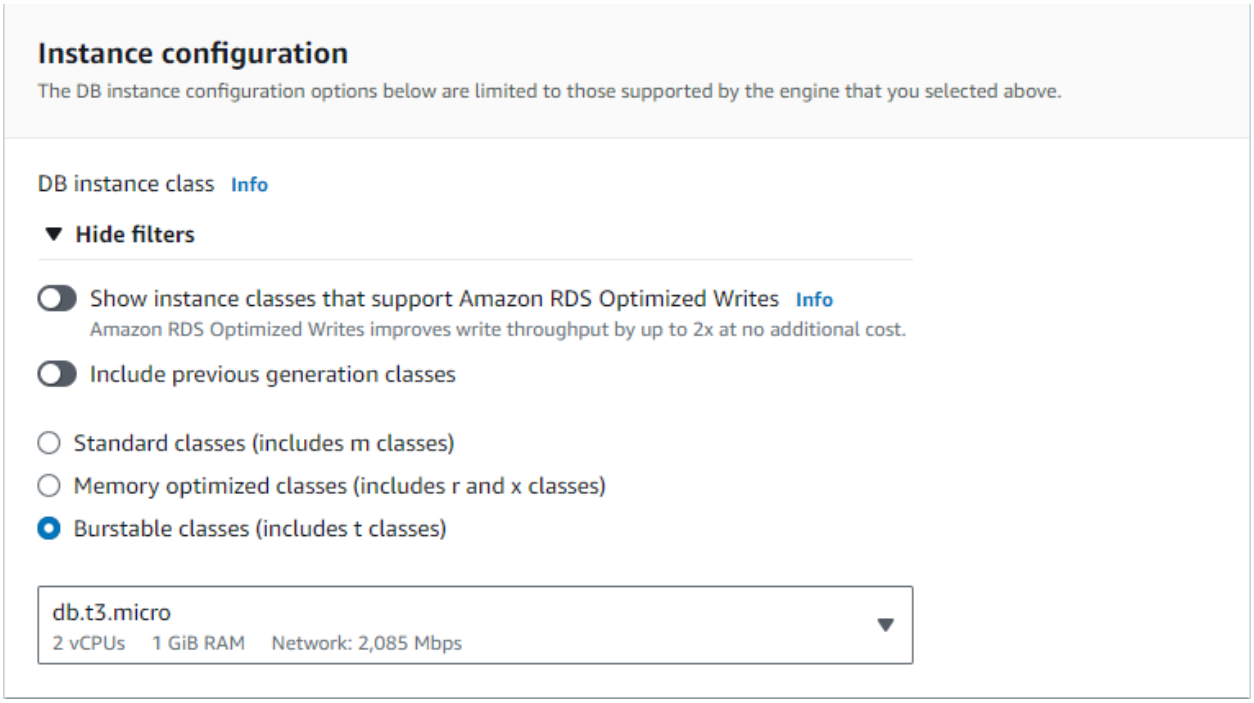
6. In the **Settings** section next, configure the following options :
   a. **DB instance identifier:** inventory-db

- **Master username:** admin
  - **Master password:** lab-password
- **Confirm password:** lab-password

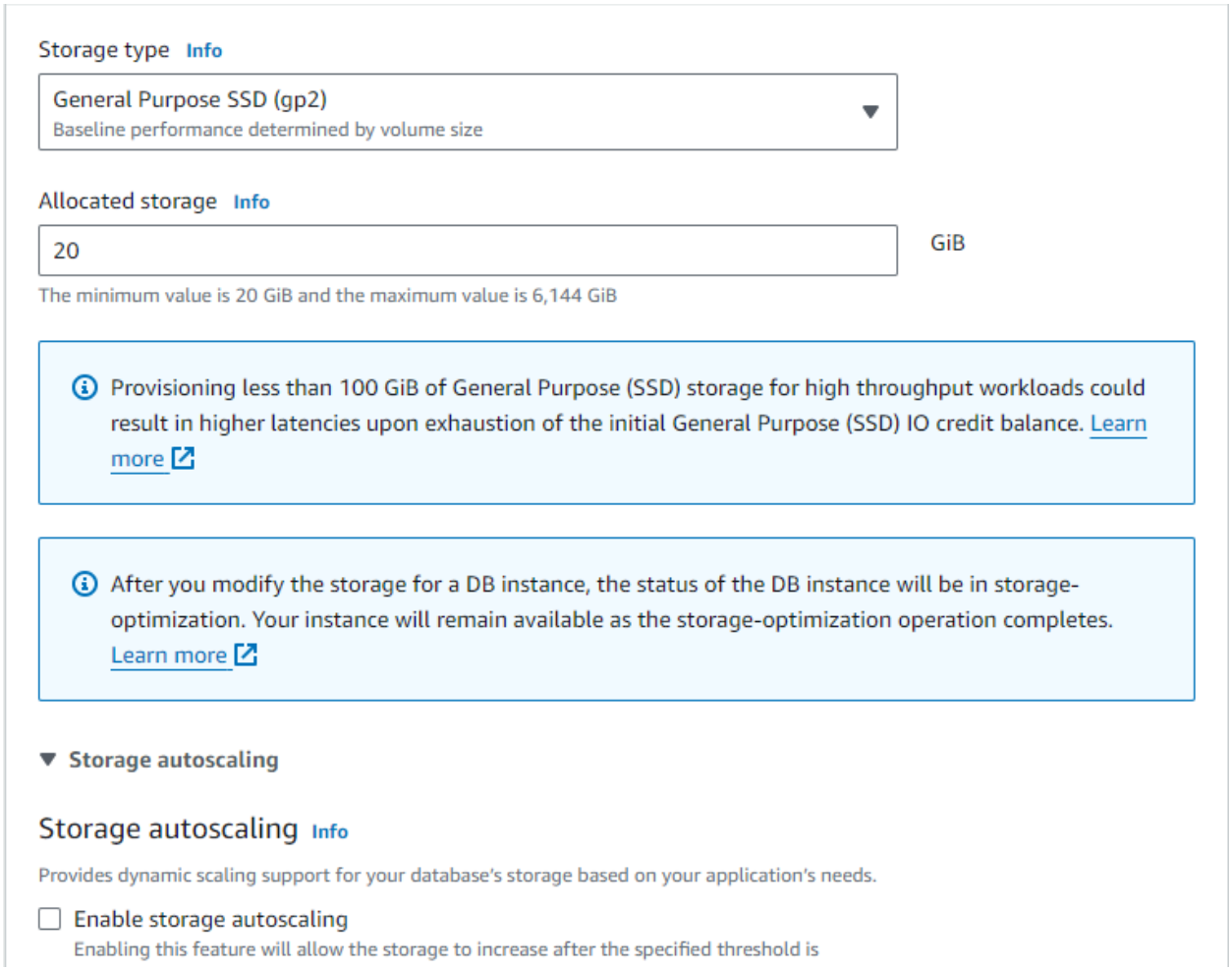


Note: Please use these values *verbatim*, do not make any changes.

7. In the **Instance configuration** section, configure the following options for DB instance class:
    a. Choose **Burstable classes (includes t classes)**.
    b. Choose **db.t3.micro**.



8. In the **Storage** section next,
    a. For **Storage type** choose **General Purpose SSD (gp2)** from the Dropdown menu.
    b. For **Allocated storage** keep 20.
    c. Clear or Deselect **Enable storage autoscaling**.



9. In the **Connectivity** section, configure the following options:
    - For **Compute resource**
        - keep default **Don't connect to an EC2 compute resource**, as you will establish this manually at a later stage.
    - For **Virtual private cloud (VPC)** Choose **Lab VPC** from the Dropdown menu.
    - For **DB Subnet group**, keep default value **rds-lab-db-subnet-group**
    - For **Public access** Keep default value (**No**)
    - For **VPC security group (firewall)**
        - Choose the **X** on **default** to remove this security group.
        - Choose **DB-SG** from the dropdown list to add it.
        - For **Availability Zone**, Keep default **No preference**
    - For **Database authentication** keep default value **Password authentication**

Connectivity Info

Compute resource

Choose whether to set up a connection to a compute resource for this database. Setting up a connection will automatically change connectivity settings so that the compute resource can connect to this database.

- (•) **Don't connect to an EC2 compute resource**
  Don't set up a connection to a compute resource for this database. You can manually set up a connection to a compute resource later.
- ( ) **Connect to an EC2 compute resource**
  Set up a connection to an EC2 compute resource for this database.

Virtual private cloud (VPC) Info

Choose the VPC. The VPC defines the virtual networking environment for this DB instance.

Lab VPC (vpc-01e575a3a357da9a4)
4 Subnets, 2 Availability Zones

Only VPCs with a corresponding DB subnet group are listed.

ⓘ After a database is created, you can't change its VPC.

DB subnet group Info

Choose the DB subnet group. The DB subnet group defines which subnets and IP ranges the DB instance can use in the VPC that you selected.

rds-lab-db-subnet-group
2 Subnets, 2 Availability Zones

Public access Info

- ( ) **Yes**
  RDS assigns a public IP address to the database. Amazon EC2 instances and other resources outside of the VPC can connect to your database. Resources inside the VPC can also connect to the database. Choose one or more VPC security groups that specify which resources can connect to the database.
- (•) **No**
  RDS doesn't assign a public IP address to the database. Only Amazon EC2 instances and other resources inside the VPC can connect to your database. Choose one or more VPC security groups that specify which resources can connect to the database.

VPC security group (firewall) Info

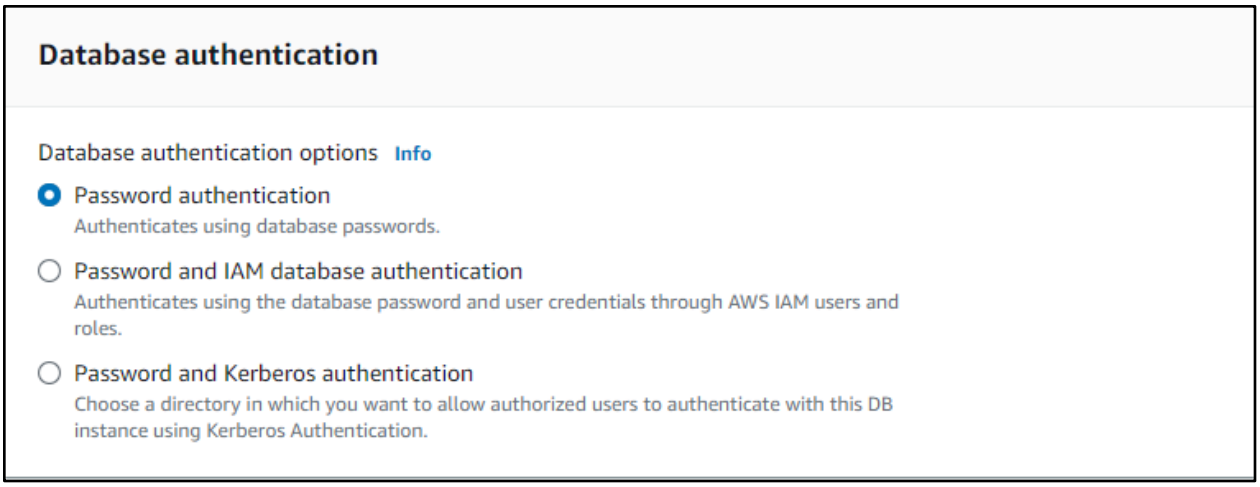
Choose one or more VPC security groups to allow access to your database. Make sure that the security group rules allow the appropriate incoming traffic.

- (•) **Choose existing**
  Choose existing VPC security groups
- ( ) **Create new**
  Create new VPC security group

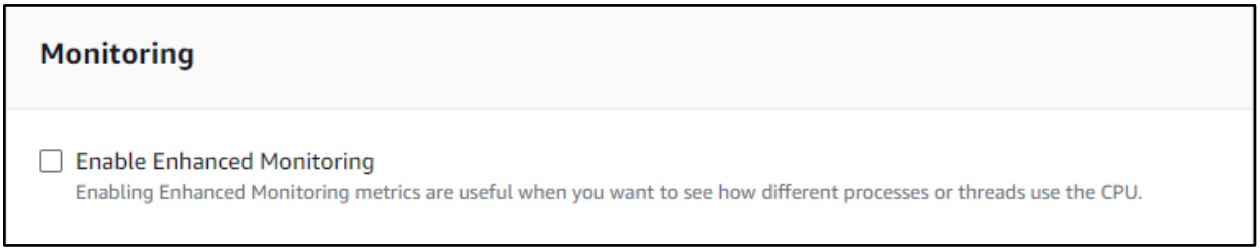
Existing VPC security groups

Choose one or more options

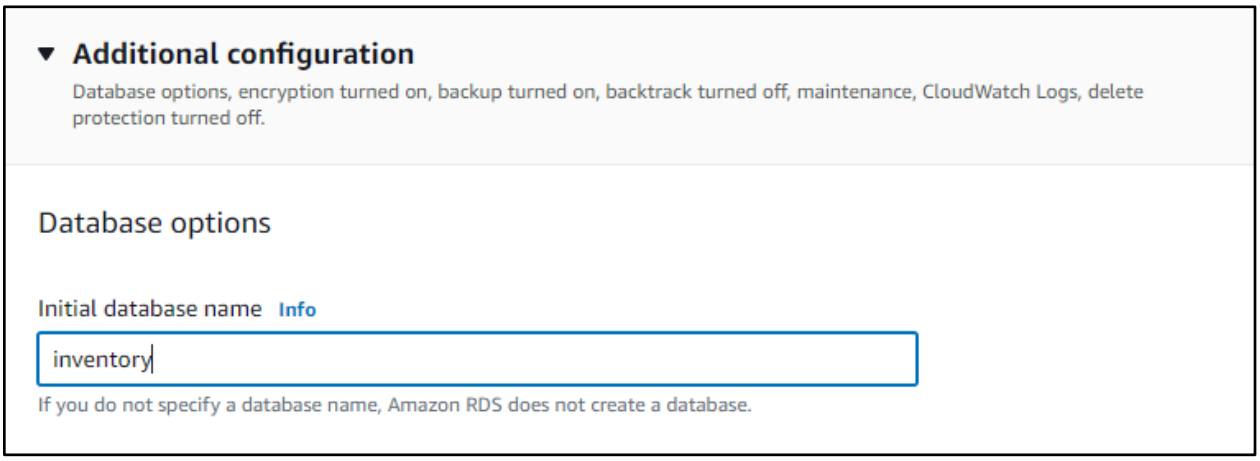
DB-SG ✕



10. In the **Monitoring** section
    a. Clear/DeSelect the **Enable Enhanced monitoring** option.



11. Expand the following **Additional configuration** section by choosing
    a. Under **Database options**, for **Initial database name**, enter inventory



This is the logical name of the database that the application will use.
You can review the few other options displayed on the page, but leave them set to

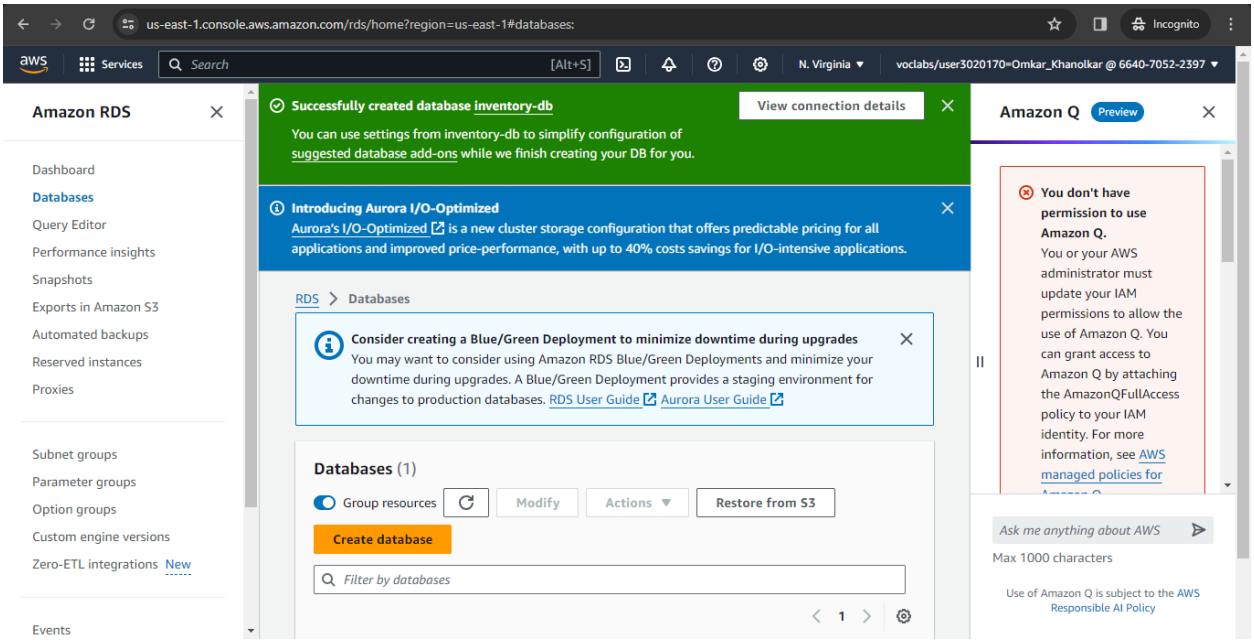
their default values. Options include **automatic backups**, **Log exports** , **Encryption** and **automatic version upgrades**. The ability to activate these features with check boxes demonstrates the power of using a fully managed database solution instead of installing, backing up, and maintaining the database yourself.

12. At the bottom of the page, choose **Create database**

    You should receive this message: **Creating database inventory-db**.

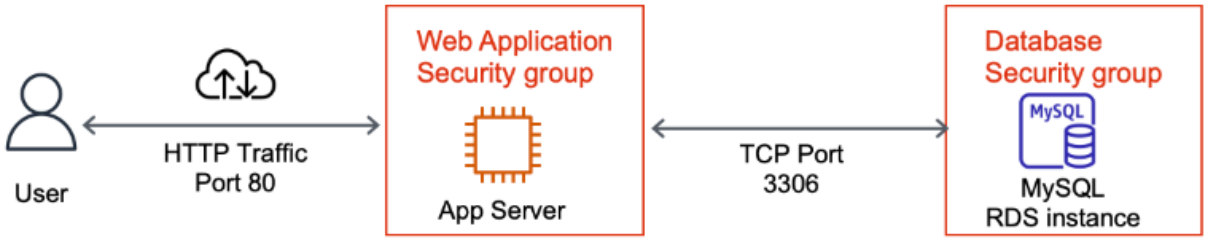
    If you receive an error message that mentions **rds-monitoring-role**, confirm that you have cleared the **Enable Enhanced monitoring** option in the previous step, and then try again.

    Before you continue to the next task, the database instance status must be **Available**. This process could take several minutes.

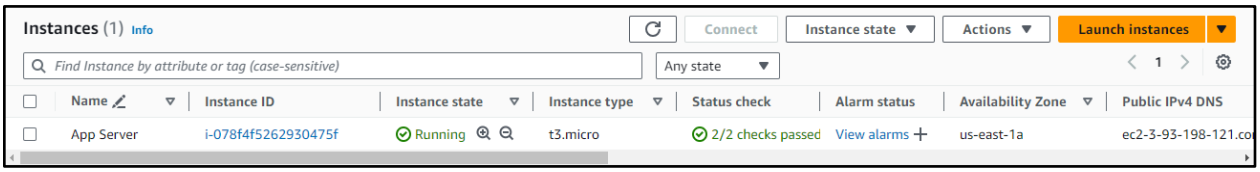


Task 2: Configuring web application communication with the database instance

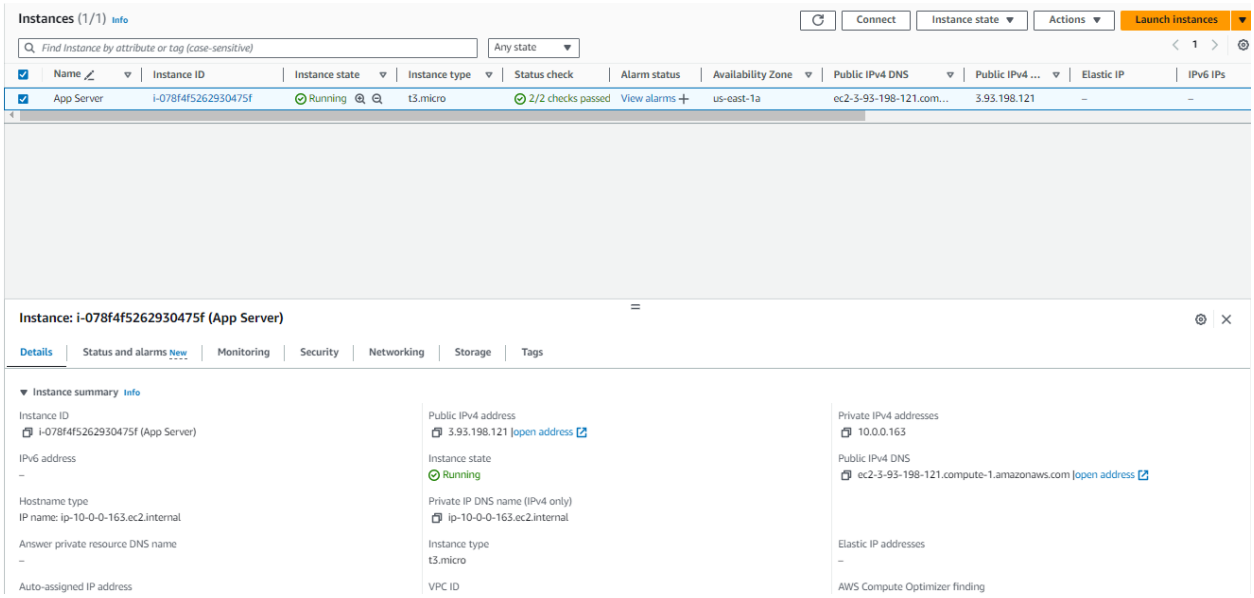
This lab automatically deployed an Amazon Elastic Compute Cloud (Amazon EC2) instance with a running web application. You must use the IP address of the instance to connect to the application. I this task, you will use application to configure connection settings which will be stored in **AWS Secrets Manager** for further use.



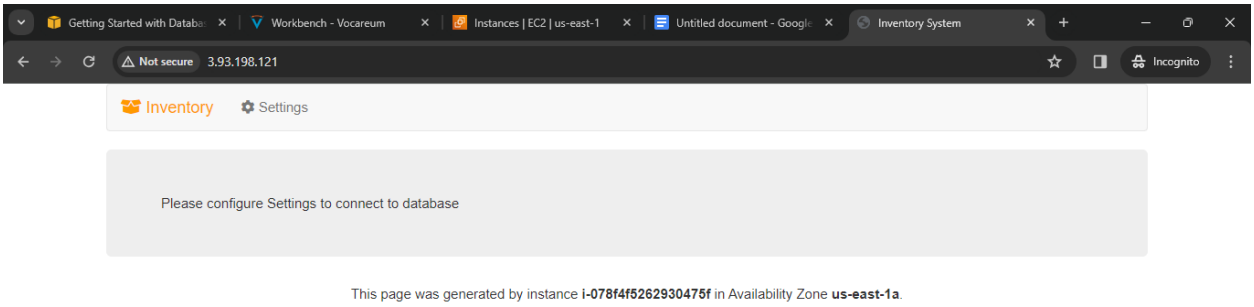
13. On the **Services** menu, choose **EC2**.
14. In the left navigation pane, choose **Instances**.
    In the center pane, there should be a running instance that is named **App Server**.



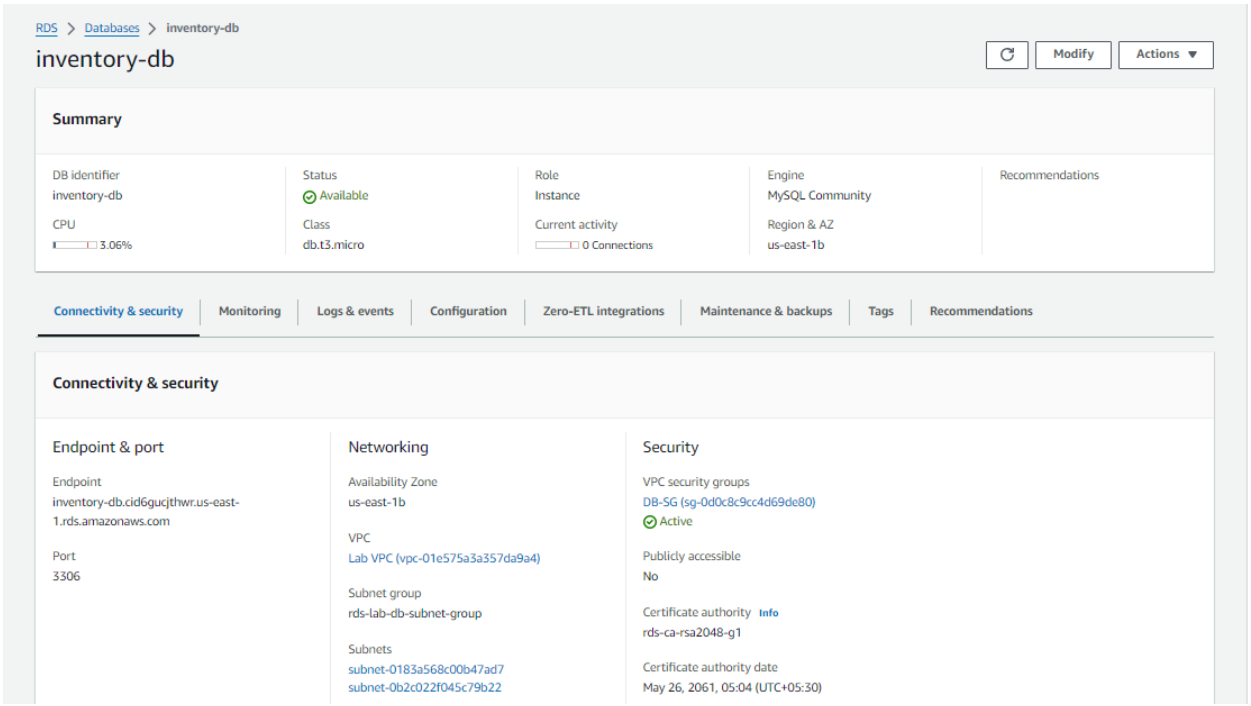
15. Select the check box for the **App Server** instance.
16. In the **Details** tab, copy the **Public IPv4 address** to your clipboard.
    Tip: You can choose copy to copy the displayed value the displayed value.



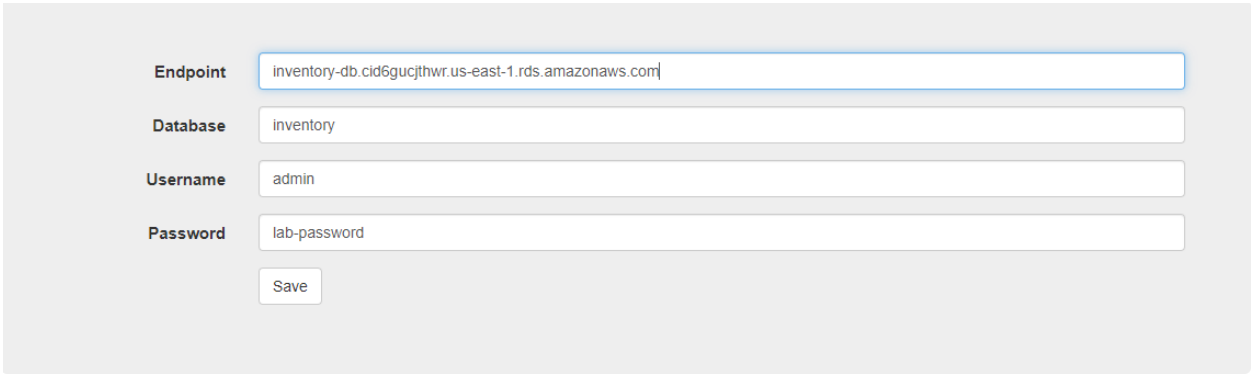
17. Open a new web browser tab, paste the IP address into the address bar, and then press Enter.
    The web application should appear. It does not display much information because the application is not yet connected to the database.



18. Choose **Settings**.
    You can now configure the application to use the Amazon RDS database instance that you created earlier. You first retrieve the database endpoint so that the application knows how to connect to a database.
19. Return to the AWS Management Console, but do not close the application tab. (You will return to it soon).
20. On the **Services** menu, choose **RDS**.
21. In the left navigation pane, choose **Databases**.
22. Under **DB identifier**, Choose 'inventory-db'.
23. From the **Connectivity & security** section, copy the **Endpoint** to your clipboard.
    It should look similar to this example: **inventory-db.crwxbgqad61a.rds.amazonaws.com**



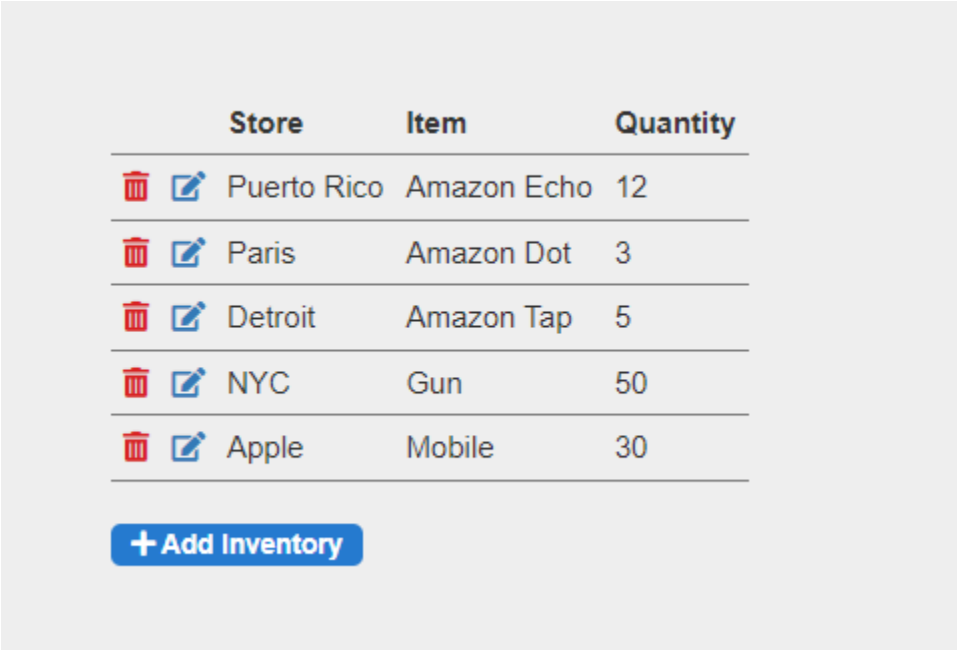
24. Return to the browser tab with the inventory application, and enter the following values:
    a. For **Endpoint**, paste the endpoint you copied earlier.
    b. For **Database**, enter inventory
    c. For **Username**, enter admin
    d. For **Password**, enter lab-password
    e. Choose **Save**.
25. The application will now Save this information into **AWS Secrets Manager** and connect to the database, load some initial data, and display information.



26. You can use the web application to Add inventory, edit, and delete inventory information.
    The inventory information is stored in the Amazon RDS MySQL database that you created earlier in the lab. This means that any failure in the application server will not

lead to loss of any data. It also means that multiple application servers can access the same data.

27. Insert new records into the table. Ensure that the table has **5** or more inventory records.



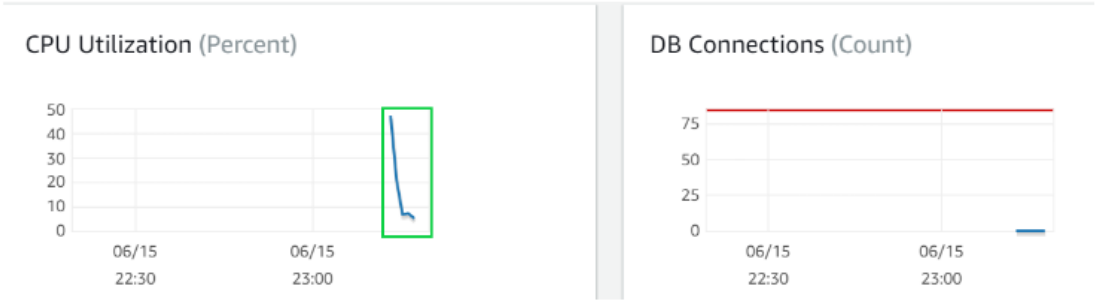
You have now successfully launched the application and connected it to the database.

Optional: To access the saved parameters, go to the AWS Management console. On the **Services** menu, choose **Secrets Manager** , choose **Secrets**.

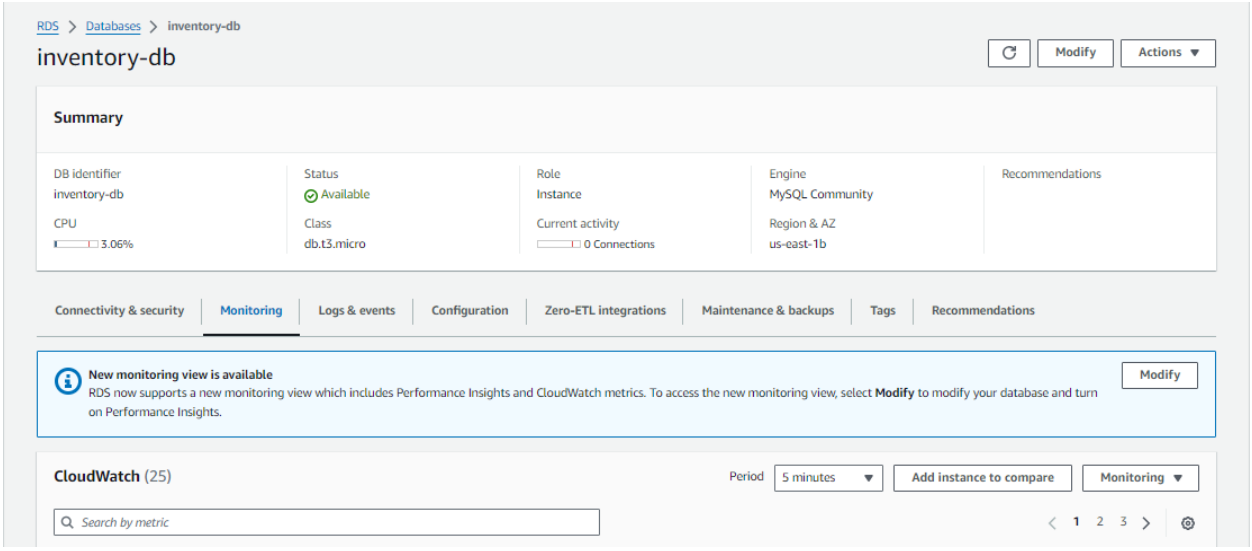
Task 3: Monitoring the Database Instance

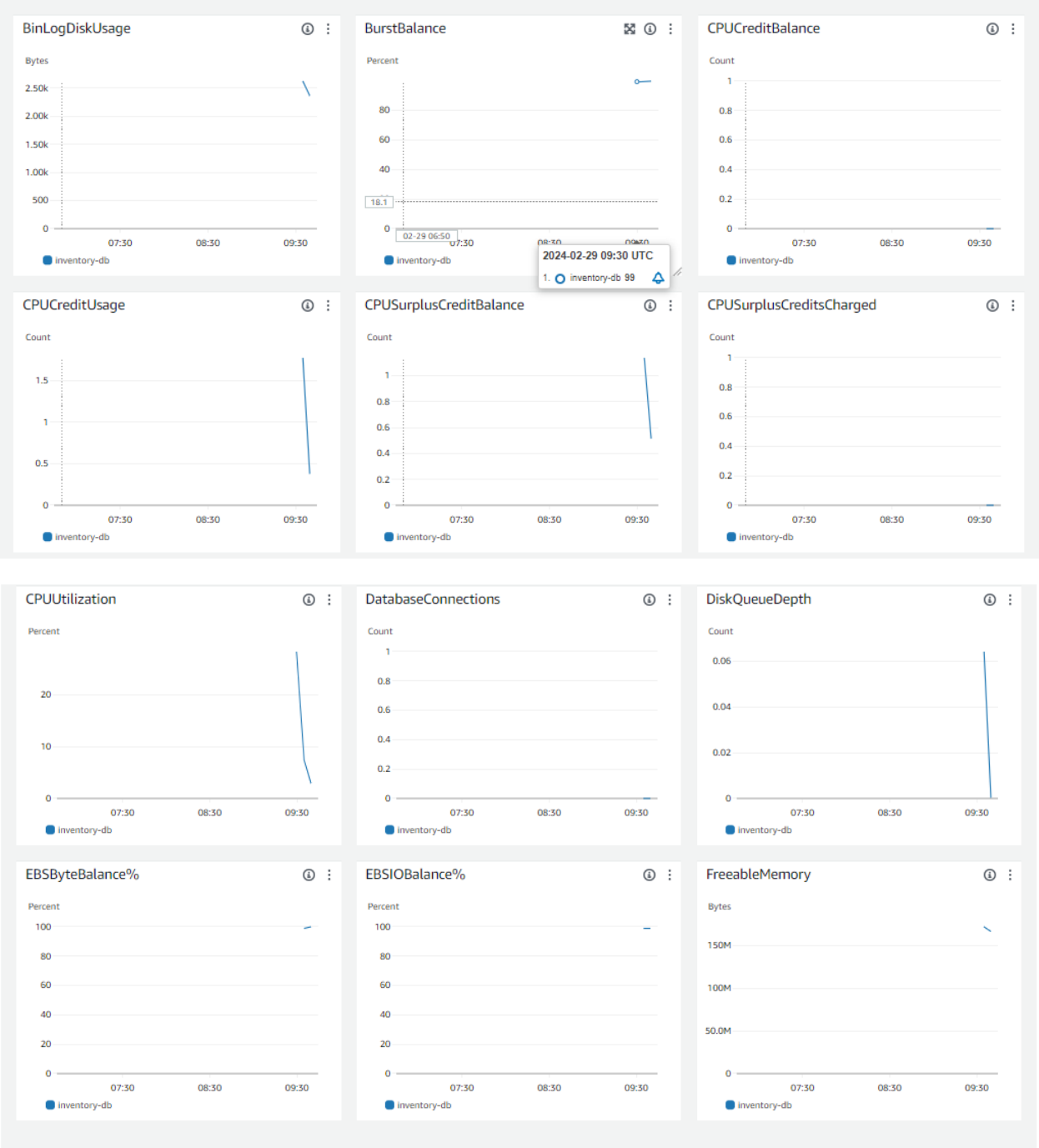
Monitoring is an important part of maintaining the reliability, availability, and performance of any database. Amazon RDS service provides many useful metrics to monitor the health of your database instance. In this task you will explore few useful metrics for the database instance you created.

28. Return to the AWS Management Console.
29. On the **Services** menu , choose **RDS**.
30. Choose **Databases**.
31. Choose 'inventory-db'.
32. In the pane below, choose **Monitoring** tab.
33. Observe the CloudWatch metrics indicating respective database Instance parameters as shown in example below.



34. Perform various operations on the web application like add, update or remove records from inventory database and observe the changes in the values mentioned above.
35. Scroll down further to observe other available metrics.





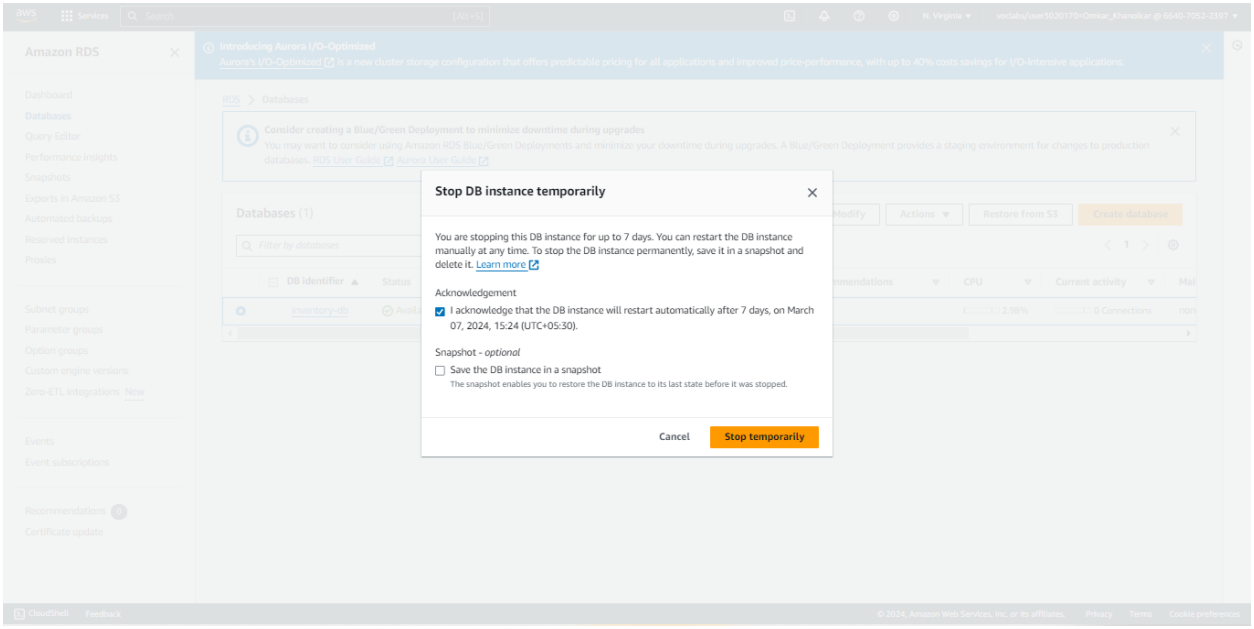
Task 4: Performing operations on Database.

In this task, you learn about a few administrative tasks that can be performed on the database in Amazon RDS.

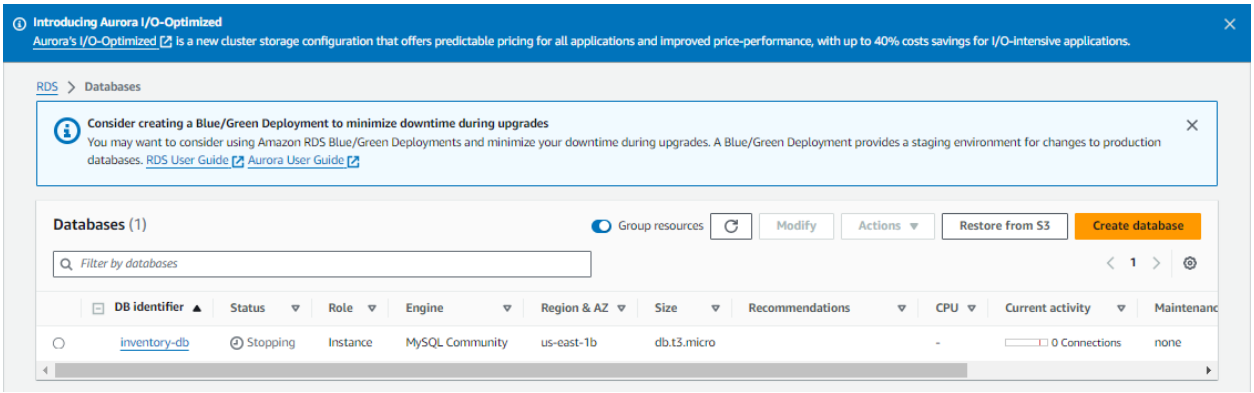
36. Return to the RDS Management Console (if you have navigated out)
37. Choose **Databases**.

38. Choose 'inventory-db'.
39. Under **Actions** menu, there are various operations to perform e.g. **Stop temporarily**, **Reboot**, etc.
40. Choose **Stop temporarily**, to stop the instance temporarily. (Database automatically restarts after 7 days)
    a. Select checkbox under 'Acknolwedgement'
    b. Choose **Stop temporarily**

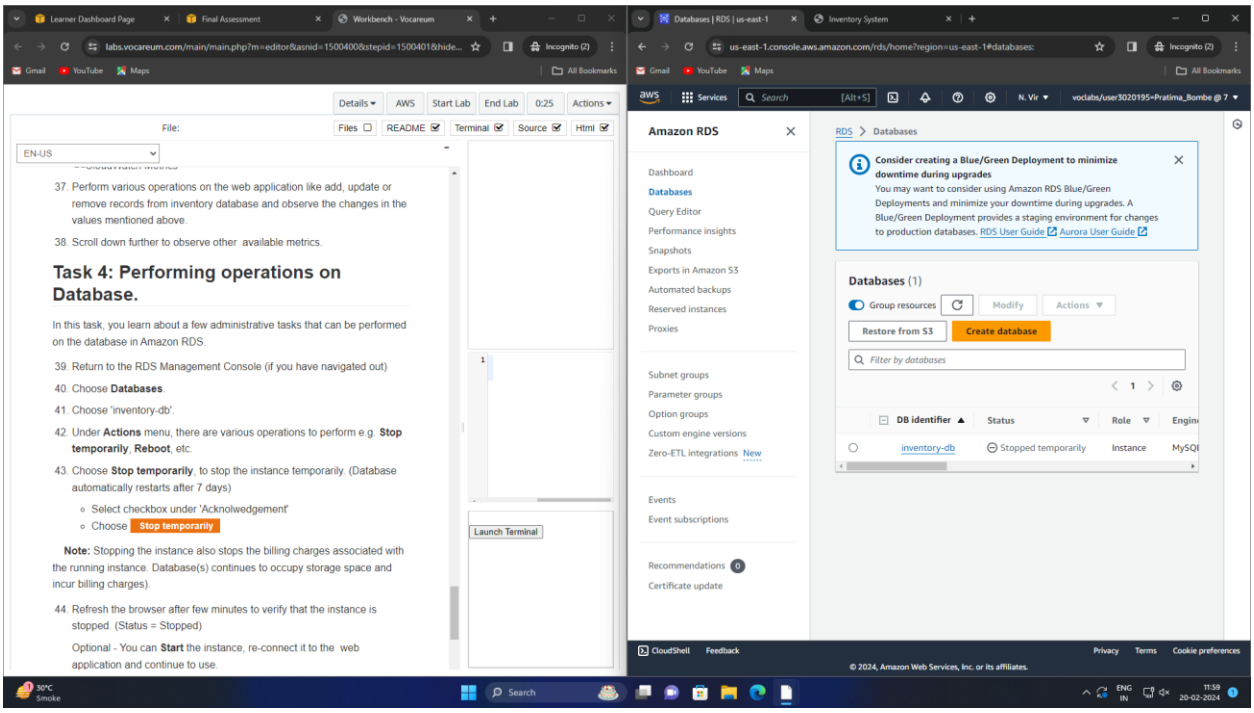
Note: Stopping the instance also stops the billing charges associated with the running instance. Database(s) continues to occupy storage space and incur billing charges).



41. Refresh the browser after few minutes to verify that the instance is stopped. (Status = Stopped)
    Optional - You can **Start** the instance, re-connect it to the web application and continue to use.



In this lab you launched MYSQL RDS database instance, configured an existing web application to interact with the database instance. Then you performed basic tasks such as querying, updating records and monitored the various metrics to gain insights into the health of the database and finally performed basic database administrative operations.



Conclusion: In conclusion, the endeavor to study and implement Database as a Service (DBaaS) on SQL/NOSQL databases such as AWS RDS, Azure SQL, MongoDB, and Firebase has provided valuable insights into the capabilities and advantages of cloud-native database solutions. Throughout this exploration, we have delved into the foundational principles of DBaaS offerings, understanding their role in simplifying database management tasks while providing scalability, reliability, and security. By leveraging platforms like AWS RDS, Azure SQL, MongoDB Atlas, and Firebase, we have gained practical experience in provisioning, configuring, and managing databases in the cloud, catering to both relational and non-relational data models. Furthermore, the experiment has highlighted the importance of selecting the appropriate database service based on data requirements, performance considerations, and scalability needs. Additionally, understanding database security, data integrity, backup, and recovery mechanisms have been essential aspects of this study. Overall, the study and implementation of DBaaS have equipped us with the knowledge and skills to build resilient, scalable, and cost-effective data solutions, accelerating innovation and driving business growth in the cloud era.