



LEROY OMABOE

Congratulations on finishing NextWork's Databases series. You're building serious momentum on your learning journey.



Visualize a Relational Database



Omaboe Leroy

The screenshot shows the MySQL Workbench interface. In the top-left corner, there's a navigation tree with 'Schemas' expanded, showing 'new_schema' and 'sys'. A query editor window is open with the following SQL code:

```
1 • SELECT * FROM newhire;
```

The 'Result Grid' tab is selected, displaying the following data:

empno	ename	job	manager	hiredate	salary	comm	department
1	JOHNSON	ADMIN	6	1990-12-17 00:00:00	18000.00	NULL	4
2	HARDING	MANAGER	9	1998-02-02 00:00:00	52000.00	300.00	3
3	TAFT	SALES I	2	1996-01-02 00:00:00	25000.00	500.00	3
4	HOOVER	SALES I	2	1990-04-02 00:00:00	27000.00	NULL	3
5	LINCOLN	TECH	6	1994-06-23 00:00:00	22500.00	1400.00	4
6	GARFIELD	MANAGER	9	1993-05-01 00:00:00	54000.00	NULL	4
7	POLK	TECH	6	1997-09-22 00:00:00	25000.00	NULL	4
8	GRANT	ENGINEER	10	1997-03-30 00:00:00	32000.00	NULL	2
9	JACKSON	CEO	NULL	1990-01-01 00:00:00	75000.00	NULL	4
10	FILLMORE	MANAGER	9	1994-08-09 00:00:00	56000.00	NULL	2
11	ADAMS	ENGINEER	10	1996-03-15 00:00:00	34000.00	NULL	2
12	WASHIN...	ADMIN	6	1998-04-16 00:00:00	18000.00	NULL	4
13	MONROE	ENGINEER	10	2000-12-03 00:00:00	30000.00	NULL	2
14	ROOSEVELT	CPA	9	1995-10-12 00:00:00	35000.00	NULL	1
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

In the bottom right corner of the main window, there's a message: "Automatic context help is disabled. Use the toolbar to manually get help for the current caret position or to toggle automatic help."

The 'Output' tab at the bottom shows the following log entries:

Action	Time	Action	Message	Duration / Fetch
1	11:35:25	Apply changes to QuickSightDatabase	Changes applied	
2	11:36:19	CREATE TABLE newhire(empno INT PRIMARY KEY,ename...	Error Code: 1045. No database selected Select the default DB!... 0.516 sec	



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Introducing Today's Project!

What is Amazon RDS?

Amazon RDS (Relational Database Service) is a managed database service for setting up, operating, and scaling relational databases in the cloud. It simplifies tasks like backups, patching, scaling, and replication, improving availability, performance

How I used Amazon RDS in this project

So I used RDS to create a database, connect that database to MySQL Workbench and query and visualize my dataset in QuickSight

One thing I didn't expect in this project was...

I didn't expect the ease with connecting MySQL Workbench to my RDS instance

This project took me...

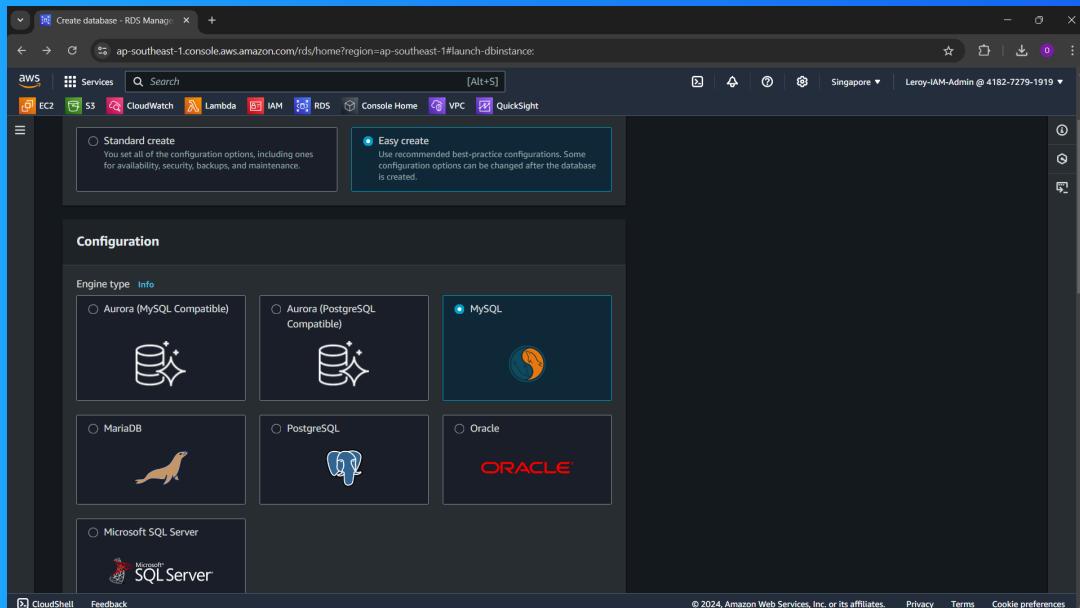
This project took me about 3 hours



In the first part of my project...

Creating a Relational Database

I created my relational database by using Amazon RDS. In addition I chose MySQL as the database engine, selected free tier, named my database and created a strong password for the database.





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Understanding Relational Databases

A relational database is a type of database that organises data into tables, which are a collection of rows and columns.

MySQL vs SQL

The difference between MySQL and SQL is MySQL is a relational database management system that uses SQL for the database interactions .Examples include PostgreSQL, or MariaDB. SQL is the programming language used for managing relational databases



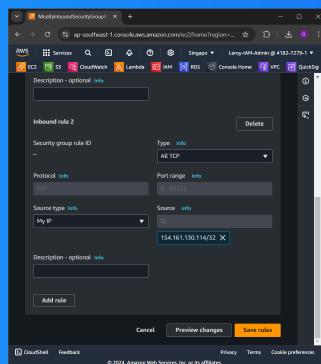
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Populating my RDS instance

The first thing I did was make my RDS instance public because I needed my local machine using Workbench to connect to my Amazon RDS instance. By default all created RDS instances are not publically accessible outside the AWS network for security.

I had to update the default security group for my RDS schema because my local machine which was using Workbench had been restricted by restricted by the security group. I simply allowed All TCP ports on my local IP address to access the RDS instance.





Using MySQL Workbench

The screenshot shows the MySQL Workbench interface with the following details:

- Navigator:** Shows the schema tree for the 'new_schema' database, including 'Quick', 'Vt', 'St', and 'Fu' nodes.
- SQL Editor:** Displays the query: `1 • SELECT * FROM newhire;`
- Result Grid:** Shows the data for the 'newhire' table. The columns are: empno, ename, job, manager, hiredate, salary, comm, and department. The data consists of 14 rows of employee information.
- Output:** Shows the following log entries:

#	Time	Action	Message	Duration / Fetch
1	11:35:25	Apply changes to QuickSightDatabase	Changes applied	
2	11:36:19	CREATE TABLE newhire(empno INT PRIMARY KEY, ename ...	Error Code: 1046. No database selected Select the default DB t...	0.516 sec

To populate my database I first created a new schema using the CREATE SCHEMA command and created a two tables called newhire with 14 rows and department with 4 rows using the CREATE TABLE command in SQL



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Connecting QuickSight and RDS

To connect my RDS instance to QuickSight I created a Quicksight account and added my RDS instance to it

This solution is risky because anyone who wants to access the database from anywhere on the internet isn't restricted

A better strategy

First, I made a new security group so that I could attach it to QuickSight for a more secure connection to my RDS instance

Next, I connected my new security group to QuickSight by adding a new VPC connection to QuickSight. I also added a new permission to my IAM role to allow the new VPC connection to work



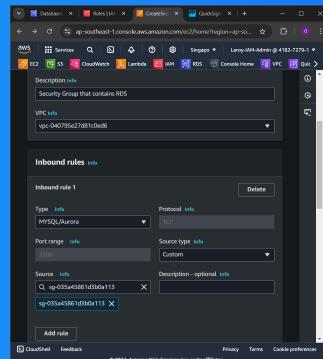
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Now to secure my RDS instance

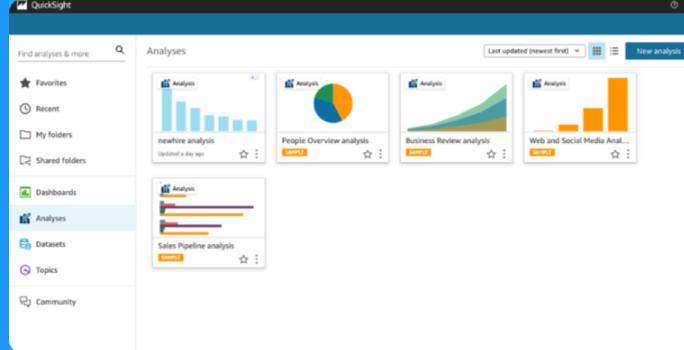
To make my RDS instance secure I created a security group and gave it inbound rules for only MySQL/Aurora with the sourcetype being the security group of QuickSight

I made sure that my RDS instance could be accessed from QuickSight by modifying the security group of the RDS instance to allow inbound request from only QuickSight

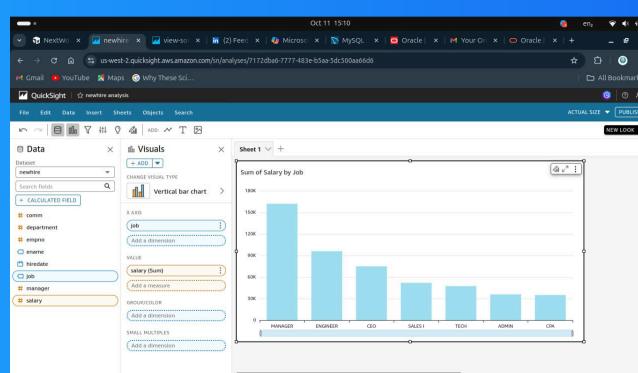




Adding RDS as a data source for QuickSight



This data source is different from my initial data source because I can visualize it with charts and have a clear view of what the data means

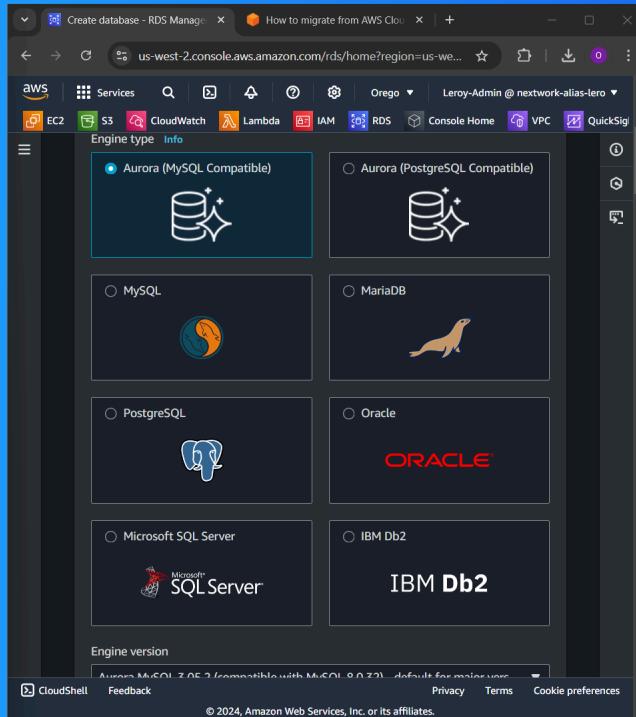




Aurora Database with EC2



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Introducing Today's Project!

What is Amazon Aurora?

Amazon Aurora is a high-performance, fully managed relational database compatible with MySQL and PostgreSQL. It provides scalability, fault tolerance, and automated backups, making it useful for applications needing performance and high availability.

How I used Amazon Aurora in this project

Amazon Aurora was used in today's project to create a database to store and display data for my very own web application

One thing I didn't expect in this project was...

I didn't expect how easy it was to set up the database

This project took me...

This project took me 40 minutes to complete

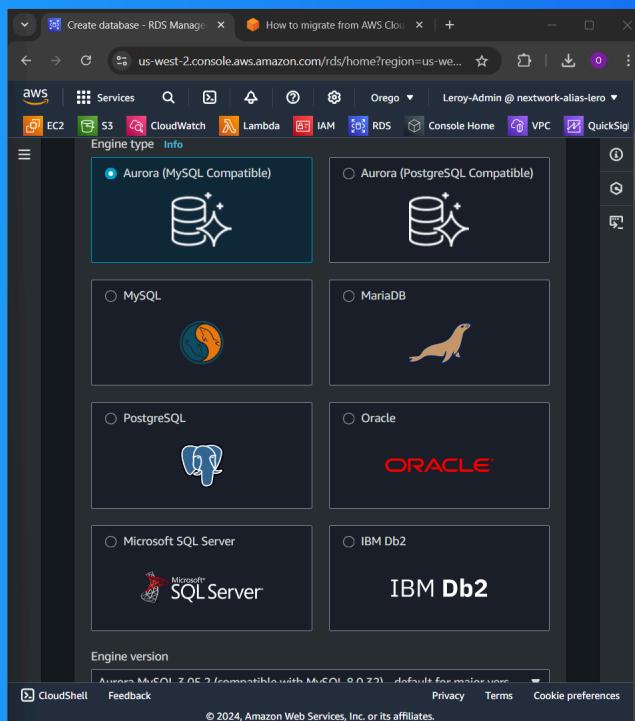


In the first part of my project...

Creating an Aurora Cluster

A relational database is a database that organises data into tables which is a collection of rows and columns

Aurora is a good choice when you are dealing with big data and need something large scale with high performance and uptime





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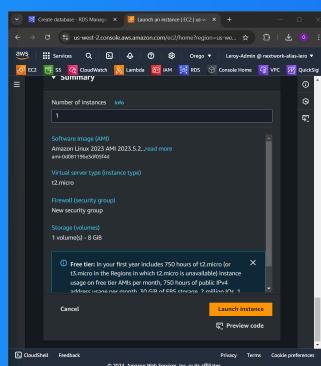
Halfway through I stopped!

I stopped creating my Aurora database because I didn't have an EC2 instance provisioned for the database

Features of my EC2 instance

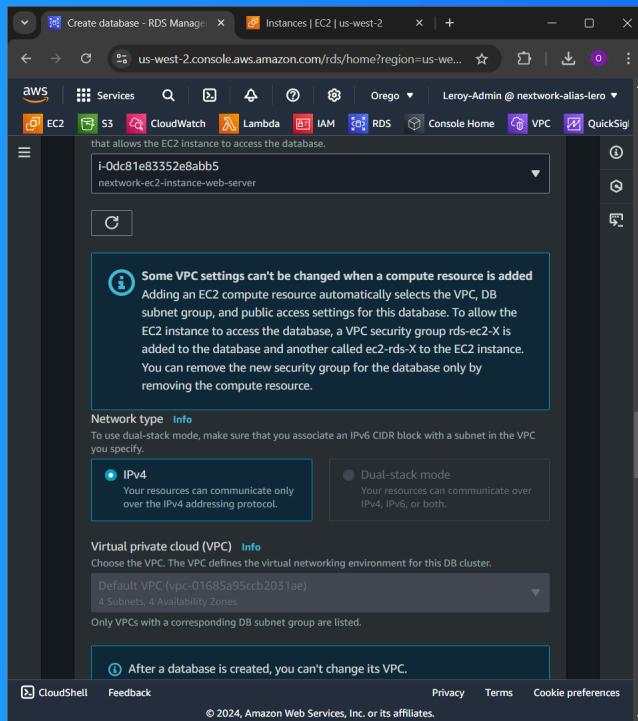
I created a new key pair for my EC2 instance because it is good practice to have a keypair to your virtual machine. Key pairs act as login credentials to your virtual machine if you want to add, change, or update how the instance is running.

When I created my EC2 instance, I took particular note of the Public IPV4 DNS and the Keypair name because without these two information I won't know where my EC2 instance is nor will I have a key to connect to it over the internet or my local device





Then I could finish setting up my database



Aurora Database uses clusters because Aurora is a group of database copies that work together so your data is readily and always available. One cluster is set as the primary cluster for writing(modification) and the other for reading(SELECT) queries



Connect A Web App with Aurora



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The screenshot shows a web browser window with three tabs open at the top: "Database Details", "Instances | EC2", and "ec2-54-187-128-102.us-west-2.compute.amazonaws.com". The main content area displays a table titled "Sample page". The table has columns for "NAME" and "ADDRESS". There are three rows of data:

ID	NAME	ADDRESS
1	Mr Ekow Turkson	24 Boulevard Lane
2	Mr Dickson Addai	4957 Taylor Way
3	Mr Joshua Adams	2080 RoseAlee Court



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What is Amazon Aurora?

Amazon Aurora is a high-performance, fully managed relational database compatible with MySQL and PostgreSQL. It provides scalability, fault tolerance, and automated backups, making it useful for applications needing performance and high availability.

How I used Amazon Aurora in this project

I used Amazon Aurora to create a database launch, connect an EC2 instance to that database, build a basic web application and connect it to Aurora and lastly test and verify the database interactions

One thing I didn't expect in this project was...

I didn't expect to discover all these learnings packed into one project.

This project took me...

This project took me about 40 minutes



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Creating a Web App

```
ec2-user@ip-172-31-28-130:~  
[ec2-user@ip-172-31-28-130 ~]$ exit  
Logout  
Connection to ec2-54-187-128-102.us-west-2.compute.amazonaws.com closed.  
user@Omaboe MINGW64 ~/Downloads  
$ ssh -i NextWorkAuroraApp.pem ec2-user@ec2-54-187-128-102.us-west-2.compute.amazonaws.com  
Amazon Linux 2023  
https://aws.amazon.com/linux/amazon-linux-2023  
Last login: Sun Oct 13 09:48:54 2024 from 212.85.210.17  
[ec2-user@ip-172-31-28-130 ~]$
```

To help me create my web app, I first installed Apache httpd , php , php-mysqli(a mysql extension for php) and mariadb105(a version of mysql database). Copied and pasted my Public IPV4 DNS in a browser and voila.

To connect to my EC2 instance, I first opened my terminal where my keypair was stored, changed the permissions to the keypair and used the ssh command (ssh -i YOUR_PEM_FILE_NAME ec2-user@YOUR_EC2_ADDRESS) to connect to my EC2 instance.



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Connecting my Web App to Aurora

```
ec2-user@ip-172-31-28-130:~/var/www/inc
$ vi dbinfo.inc
dbinfo.inc

define('DB_SERVER', 'nextwork-db-cluster-instance-1.cp2yeo8s2dce.us-west-2.rds.amazonaws.com');
define('DB_USERNAME', 'admin');
define('DB_PASSWORD', 'password');
define('DB_DATABASE', 'sample');

?>
```

I set up my EC2 instance's connection details to my database by creating a file called dbinfo.inc inside my www directory and placing this php code above in it.

To connect to my EC2 instance, I first opened my terminal where my keypair was stored, changed the permissions to the keypair and used the ssh command (ssh -i YOUR PEM FILE NAME ec2-user@YOUR EC2 ADDRESS) to connect to my EC2 instance.



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My Web App Upgrade

The screenshot shows a web browser window with three tabs: 'Database Details', 'Instances | EC2', and the active tab 'ec2-54-187-128-102.us-west-2.compute.amazonaws.com'. The page title is 'Sample page'. It features two input fields labeled 'NAME' and 'ADDRESS' with a 'Add Data' button. Below these is a table with columns 'ID', 'NAME', and 'ADDRESS', containing three rows of data:

ID	NAME	ADDRESS
1	Mr Ekow Turkson	24 Boulevard Lane
2	Mr Dickson Addai	4957 Taylor Way
3	Mr Joshua Adams	2080 RoseAlee Court

Next, I upgraded my web app by creating a Sample Page file in the html directory and pasting the above php code



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Testing my Web App

To make sure my web app was working correctly, I downloaded MySQL CLI on my EC2 instance and connected to my Aurora database and querying my database with some sql commands such as DESCRIBE EMPLOYEES and SELECT * FROM EMPLOYEES which showed my data

```
ec2-user@ip-172-31-28-130:~  
Database changed  
MySQL [sample]> SHOW TABLES;  
+-----+  
| Tables_in_sample |  
+-----+  
| EMPLOYEES |  
+-----+  
1 row in set (0.002 sec)  
  
MySQL [sample]> DESCRIBE EMPLOYEES;  
+-----+-----+-----+-----+-----+  
| Field | Type | Null | Key | Default | Extra |  
+-----+-----+-----+-----+-----+  
| ID | int unsigned | NO | PRI | NULL | auto_increment |  
| NAME | varchar(45) | YES | | NULL | |  
| ADDRESS | varchar(90) | YES | | NULL | |  
+-----+-----+-----+-----+-----+  
3 rows in set (0.005 sec)  
  
MySQL [sample]> SELECT * FROM EMPLOYEES;  
+-----+-----+  
| ID | NAME | ADDRESS |  
+-----+-----+  
| 1 | Mr Ekow Turkson | 24 Boulevard Lane |  
| 2 | Mr Dickson Addai | 4957 Taylor Way |  
| 3 | Mr Joshua Adams | 2080 RoseAlee Court |  
+-----+-----+  
3 rows in set (0.002 sec)  
  
MySQL [sample]>
```



Load Data into DynamoDB



Omaboe Leroy

The screenshot shows the AWS DynamoDB console interface. A success message at the top states "Completed. Read capacity units consumed: 0.5". Below it, a table titled "Items returned (6)" displays six items. The columns are "Id (Number)", "Authors", and "ContentType". The data is as follows:

Id (Number)	Authors	ContentType
3	[{"S": "Ne...}	Project
2	[{"S": "Ne...}	Project
203		Video
202		Video
201		Video
1	[{"S": "Nat...}	Project



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Introducing Today's Project!

What is Amazon DynamoDB?

Amazon DynamoDB is a fully managed NoSQL database that provides fast and flexible performance at any scale. It's useful for applications requiring low-latency data access, automatic scaling, high availability, and seamless integration with other AWS services.

How I used Amazon DynamoDB in this project

I used Amazon DynamoDB in today's project to create a DynamoDB table, load data into DynamoDB tables and edit data in my DynamoDB tables.

One thing I didn't expect in this project was...

I did not expect to discover all these learnings packed in one project

This project took me...

This project took me about 40 minutes to complete



Create a DynamoDB table

DynamoDB tables organises data using items and attributes

An attribute is a piece of data about an item. More like metadata which is data about data.

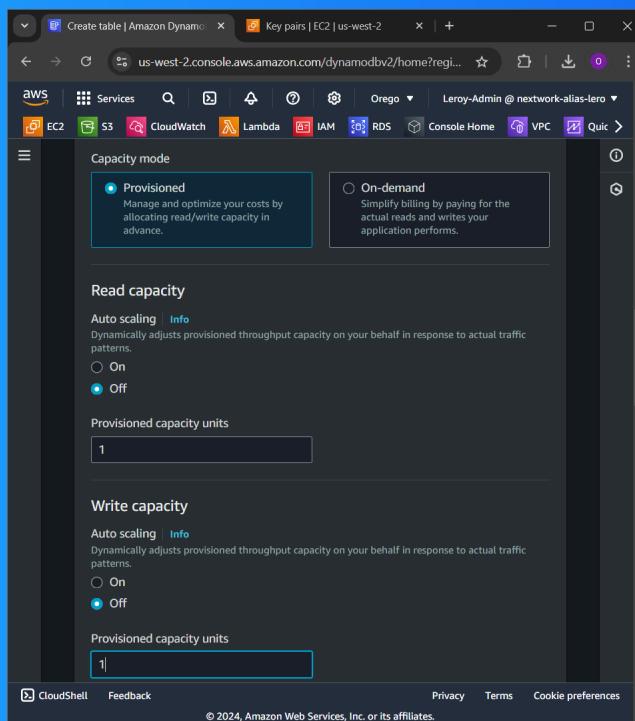
The screenshot shows the AWS DynamoDB console interface. A modal window titled "Scan or query items" is open. The "Scan" button is selected. The "Table" dropdown is set to "Table - NextWorkStudents" and the "Select attribute projection" dropdown is set to "All attributes". Below the table selection, there is a "Filters" section with a "Run" button. A success message at the bottom of the modal says "Completed. Read capacity units consumed: 0.5". Below the modal, the main table view shows one item: "Nikko" with a value of "4" under the "ProjectsCompleted" attribute. The table has columns "StudentName (String)" and "ProjectsCompleted". At the bottom of the screen, there are links for "CloudShell", "Feedback", "Privacy", "Terms", and "Cookie preferences".



Read and Write Capacity

Read capacity units (RCUs) and write capacity units (WCUs) are capacity units AWS uses to charge you based on how many updates (writes) and reads you've made to the DynamoDB in a month

Amazon DynamoDB's Free Tier covers 25GB of storage and 25 read and write capacity units. I turned off auto scaling so it doesn't automatically increase my RCUs and WCUs to exceed the Free Tier limit





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Using CLI and CloudShell

AWS CloudShell is shell in your AWS Management Console, which means it's a space for you to run code

AWS CLI (Command Line Interface) is a software that lets you create, delete and update AWS resources with commands instead of clicking through your console

I ran a CLI command in AWS CloudShell that created 4 tables called Comment , ContentCatalog, Forum,Post



Loading Data with CLI

I ran a CLI command in AWS CloudShell that is used to load or insert multiple items into DynamoDB tables. That command was the AWS CLI batch-write-item command

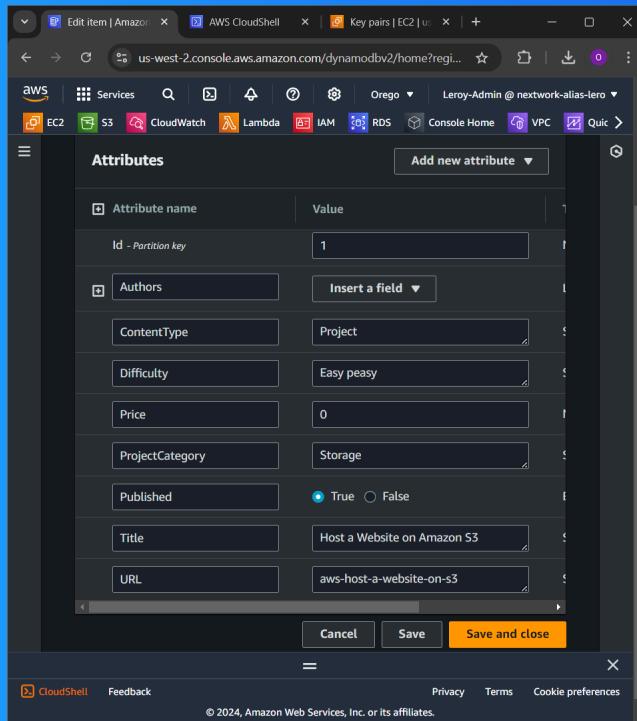
The screenshot shows a terminal window in AWS CloudShell with the following command and its output:

```
aws dynamodb batch-write-item --request-items file:/ContentCatalog.json
```

The output shows the command being run and the resulting JSON response from AWS, which indicates successful processing of multiple items.



Observing Item Attributes



I checked a ContentCatalog item, which had the following attributes: Id(partition key), Author, ContentType, Difficulty, Price, ProjectCategory, Published, Title and URL

I checked another ContentCatalog item, which had a different set of attributes: id, ContentType, Price, Services, Title, URL and VideoType



Benefits of DynamoDB

A benefit of DynamoDB over relational databases is flexibility, because every item having their own unique set of attributes is a huge advantage when items in a table could look different from each other.

Another benefit over relational databases is speed, because DynamoDB tables can use partition keys to split up a table and quickly find the items they're looking for

The screenshot shows the AWS DynamoDB console interface. At the top, there are tabs for 'Items | Amazon D...' (active), 'AWS CloudShell', and 'Key pairs | EC2'. The main navigation bar includes 'Services' (selected), 'EC2', 'S3', 'CloudWatch', 'Lambda', 'IAM', 'RDS', 'Console Home', 'VPC', 'Quic', and 'Oregon'. A user dropdown shows 'Leroy-Admin @ nextwork-alias-lero'. Below the navigation, a message box says 'Completed. Read capacity units consumed: 0.5'. The main area displays a table titled 'Items returned (6)'. The table has columns: 'Id (Number)', 'Authors', and 'ContentType'. The data rows are:

Id (Number)	Authors	ContentType
3	[{"S": "Ne...}	Project
2	[{"S": "Ne...}	Project
203		Video
202		Video
201		Video
1	[{"S": "Nat...}	Project



Query Data with DynamoDB



Omaboe Leroy

```
[cloudshell-user@ip-10-130-55-168 ~]$ aws dynamodb get-item \
>   --table-name ContentCatalog \
>   --key '{"ID": "1001"}' \
>   --consistent-read \
>   --projection-expression "Title, ContentType, Services" \
>   --return-consumed-capacity TOTAL
{
    "ConsumedCapacity": {
        "TableName": "ContentCatalog",
        "CapacityUnits": 1.0
    }
}[cloudshell-user@ip-10-130-55-168 ~]$ aws dynamodb get-item \
>   --table-name ContentCatalog \
>   --key {"ID": "1002"} \
>   --projection-expression "Title, ContentType, Services" \
>   --return-consumed-capacity TOTAL
{
    "Item": {
        "Title": {
            "S": "Don't miss out!"
        },
        "ContentType": {
            "S": "Video"
        }
    },
    "ConsumedCapacity": {
        "TableName": "ContentCatalog",
        "CapacityUnits": 0.5
    }
}[cloudshell-user@ip-10-130-55-168 ~]$
```



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How I used Amazon DynamoDB in this project

I used Amazon DynamoDB in today's project to create a table, load data into DynamoDB and query data in the DynamoDB console.

One thing I didn't expect in this project was...

I didn't expect to discover very fun and insightful learning packed into one project.

This project took me...

This project took me 40 minutes to complete.



Querying DynamoDB Tables

A partition key is value, which helps with finding a single, specific item even faster

A sort key is a secondary key used to filter your query results again! Sort keys work after the partition key i.e. you still have to use the partition key to split up your data first, and then the sort key partitions your data again.

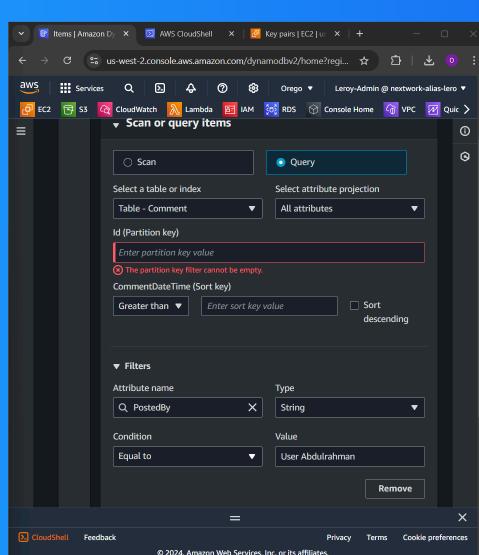
The screenshot shows the AWS DynamoDB console interface. The user is querying a table named 'Comment'. The partition key is set to 'Id (Partition key)' with the value 'I have a question/Just Complete Project #7 Dependencies and CodeArtifacts'. The sort key is set to 'CommentDateTime (Sort key)' with the condition 'Greater than' and the value '2024-09-01'. The 'Run' button is highlighted in orange. Below the query form, the results section shows one item returned, with the ID 'I have a question/Just...'. The item details show 'Message' as 'Legendary' and 'PostedBy' as 'User Abhishek'. At the bottom of the page, there are links for 'CloudShell', 'Feedback', 'Privacy', 'Terms', and 'Cookie preferences'.



Limits of Using DynamoDB

I run into an error I queried for PostedBy User Abdulrahman. This is because I didn't use the partition key when querying the DynamoDB

Insights we could extract from our Comment table includes data modelling . Insights we can't easily extract from the Comment table includes the use of a relational database would be beneficial at times like these





Running Queries with CLI

A query I ran in CloudShell was aws dynamodb get-item\|. This query will get the a singel item from the table

Query options I could add to my query are --consistent-read if you want the most recent updates of your table, --projection-expression if you only want to know some of the item's attributes and --return-consumed-capacity if you want to know the RCUs.

```
[cloudshell-user@ip-10-130-55-168 ~]$ aws dynamodb get-item \
>   --table-name ContentCatalog \
>   --key '{"Id": "N:101"}' \
>   --consistent-read \
>   --projection-expression "Title, ContentType, Services" \
>   --return-consumed-capacity TOTAL
{
  "ConsumedCapacity": {
    "TableName": "ContentCatalog",
    "CapacityUnits": 1.0
  }
}
[cloudshell-user@ip-10-130-55-168 ~]$ aws dynamodb get-item \
>   --table-name ContentCatalog \
>   --key '{"Id": "N:202"}' \
>   --projection-expression "Title, ContentType, Services" \
>   --return-consumed-capacity TOTAL
{
  "Item": {
    "Title": {
      "S": "Don't miss out!"
    },
    "ContentType": {
      "S": "Video"
    }
  },
  "ConsumedCapacity": {
    "TableName": "ContentCatalog",
    "CapacityUnits": 0.5
  }
}
[cloudshell-user@ip-10-130-55-168 ~]$
```



Transactions

A transaction is a group of operations that all have to succeed - if any of the operations in the group fails, none of the changes get applied

I ran a transaction using aws dynamodb transact-write-items --client-request-token TRANSACTION1 --transact-items. The transaction did two things. Add Connor's new comment to the comment table and Update the Forum table by increasing Events item by 1

```

Items | Amazon D... AWS CloudShell Key pairs | EC2 | ...
us-west-2.console.aws.amazon.com/dynamodbv2/home?egi...
AWS Services Q A Orgo Leroy-Admin @ nextwork-alias-fro...
EC2 S3 CloudWatch Lambda IAM RDS Console Home VPC Quic ...
Name (String) Category Comments P ...

CloudShell Actions +
us-west-2 +
aws dynamodb transact-write-items --client-request-token TRANSACTION1 --transact-items [
  {
    "Put": {
      "TableName": "Comment",
      "Item": {
        "id": "$": "Events/Do a Project Together - NextWork Study Session",
        "commenterId": "$": "User-Connor",
        "commenterName": "$": "Connor",
        "commentText": "$": "I didn't miss out!",
        "commentTime": "$": "2024-9-27T17:47:30Z",
        "postOrder": "$": 1,
        "PostedBy": "$": "User Connor"
      }
    }
  },
  {
    "Update": {
      "TableName": "Forum",
      "Key": {
        "id": "$": "Events"
      },
      "UpdateExpression": "ADD Events :inc",
      "ExpressionAttributeValues": {
        ":inc": {"N": "1"}
      }
    }
  }
]

```

The screenshot shows a terminal window in AWS CloudShell with the command `aws dynamodb transact-write-items --client-request-token TRANSACTION1 --transact-items` entered. The transaction itself consists of two items: a `Put` operation on the `Comment` table and an `Update` operation on the `Forum` table. The `Put` operation adds a new comment from user 'Connor' with ID 'Events/Do a Project Together - NextWork Study Session'. The `Update` operation increments the 'Events' item in the `Forum` table by 1.



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