

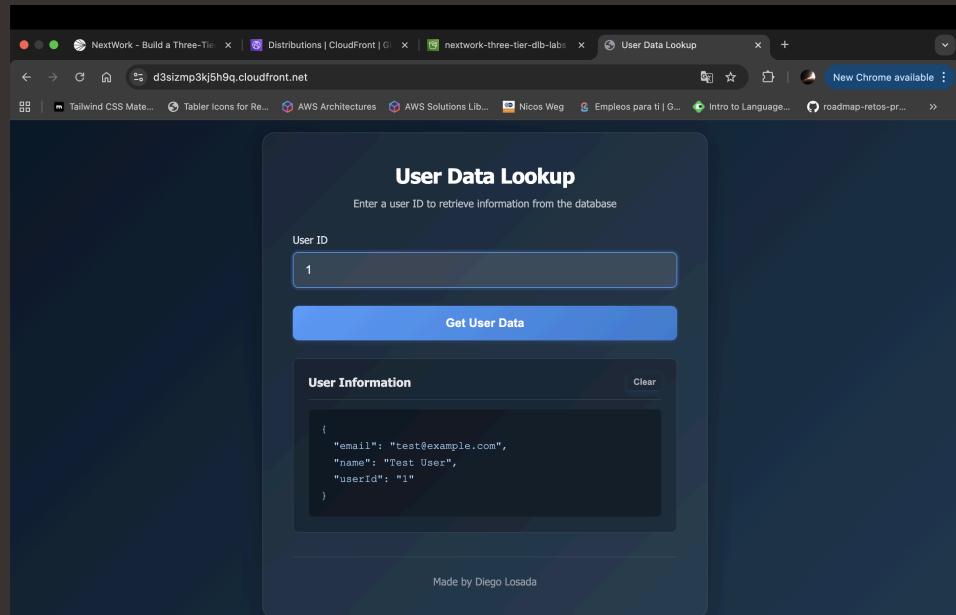


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Build a Three-Tier Web App



Diego Losada





Diego Losada

NextWork Student

nextwork.org

Introducing Today's Project!

In this project, I will demonstrate how to build a full three-tier serverless application using AWS services. I'm doing this project to learn how to:

- Create a storage bucket for website files using S3.
- Distribute content globally and improve performance with CloudFront.
- Implement serverless backend logic with Lambda functions.
- Build APIs to handle user requests using API Gateway.
- Store and retrieve user data securely with DynamoDB.
- Connect all these services seamlessly to create a scalable three-tier architecture.

Tools and concepts

Services I used were AWS S3, CloudFront, Lambda, API Gateway, and DynamoDB. Key concepts I learnt include serverless architecture, three-tier architecture, API integration, DynamoDB tables, Lambda function permissions, and caching with CloudFront.

Project reflection

This project took me approximately 1.5 hours. The most challenging part was resolving the API connection issues between CloudFront and API Gateway and ensuring the Lambda function had the correct permissions. It was most rewarding to see the full three-tier application working end-to-end, with data properly fetched and displayed on my website.



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NextWork Student

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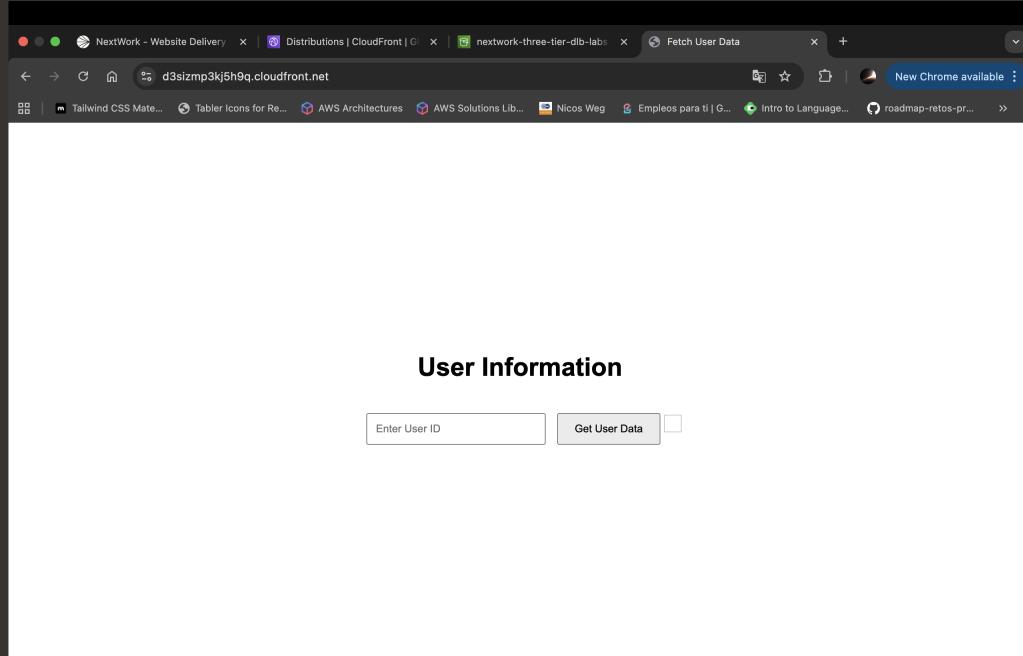
I chose to do this project today because I wanted to practice building a scalable serverless application and understand how the presentation, logic, and data tiers interact.



Presentation tier

For the presentation tier, I will set up an S3 bucket to store my website's files and upload a simple index.html. I will also set up CloudFront to deliver the content globally. Because this ensures my website is accessible to users anywhere with fast load times, and it provides the foundation for the front-end layer of my three-tier architecture.

I accessed my delivered website by visiting the CloudFront distribution URL. This URL points to the content stored in my S3 bucket and ensures that the website loads quickly from anywhere in the world.





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Logic tier

For the logic tier, I will set up a Lambda function and an API Gateway REST API because this allows my application to fetch and serve data from the DynamoDB database securely and serverlessly. The Lambda function contains the code that retrieves user data, and the API Gateway exposes this functionality through a GET endpoint that can be accessed by the front-end or other clients.

The Lambda function retrieves data by using the AWS SDK to query the DynamoDB table based on a provided userId. It sends a GetCommand to DynamoDB, receives the corresponding item if it exists, and returns that data to the API Gateway, which then delivers it to the front-end or any client making the request.



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The screenshot shows the AWS Lambda function editor interface. At the top, there's a green success message: "Successfully updated the function RetrieveUserData." Below this, the function name "RetrieveUserData" is displayed. The code editor contains the following JavaScript code:

```
index.mjs
1 import { DynamoDBClient } from "@aws-sdk/client-dynamodb";
2 import { DynamoDBDocumentClient, GetCommand } from "@aws-sdk/lib-dynamodb";
3
4 const ddbClient = new DynamoDBClient({ region: 'us-east-1' });
5 const ddb = DynamoDBDocumentClient.from(ddbClient);
6
7 async function handler(event) {
8     const userId = String(event.userId); // Make sure to extract userId from the event
9     const params = {
10         TableName: 'UserData',
11         Key: { userId }
12     };
13
14     try {
15         const command = new GetCommand(params);
16         const data = await ddb.send(command); // Log the raw response from Dynamodb
17         console.log("DynamodB Response:", JSON.stringify(data));
18         const { Item } = data;
19         if (Item) {
20             console.log("User data retrieved:", Item);
21         }
22     } catch (err) {
23         console.error("Error retrieving user data:", err);
24     }
25 }
26
27 module.exports = handler;
```

The left sidebar shows the function structure: "RETRIEVEUSERDATA" > "index.mjs". The "DEPLOY" section has "Deploy (F5)" and "Test (Shift+F5)" buttons. The bottom left shows "TEST EVENTS (NONE SELECTED)" and a "Create new test event" button. The bottom right includes links for "CloudShell", "Feedback", and "Console Mobile App", along with copyright information: "© 2026, Amazon Web Services, Inc. or its affiliates." and "Privacy Terms Cookie preferences".



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Data tier

For the data tier, I will set up a DynamoDB table because it provides a fully managed, scalable, and fast database to store and retrieve user data for my application. By adding user records to the table, my Lambda function can query and return the correct information when users make requests through the API.

The partition key for my DynamoDB table is userId, which means DynamoDB uses this value to uniquely identify and store each user's data and to quickly locate the correct item when my Lambda function queries the table.

The screenshot shows the AWS DynamoDB 'Create item' interface. At the top, there's a navigation bar with the AWS logo, a search bar, and links for EC2, S3, VPC, Lambda, DynamoDB, CloudFront, Aurora and RDS, API Gateway, and IAM. Below that is a breadcrumb trail: DynamoDB > Explore items: UserData > Create item. The main area is titled 'Create item' and contains a note: 'You can add, remove, or edit the attributes of an item. You can nest attributes inside other attributes up to 32 levels deep. [Learn more](#)'.

Below this is a 'Attributes' section with a 'View DynamoDB JSON' button. A JSON editor displays the following code:

```
1 [{}  
2   "userId": {  
3     "S": "1"  
4   },  
5   "name": {  
6     "S": "Test User"  
7   },  
8   "email": {  
9     "S": "test@example.com"  
10 }  
11 ]
```



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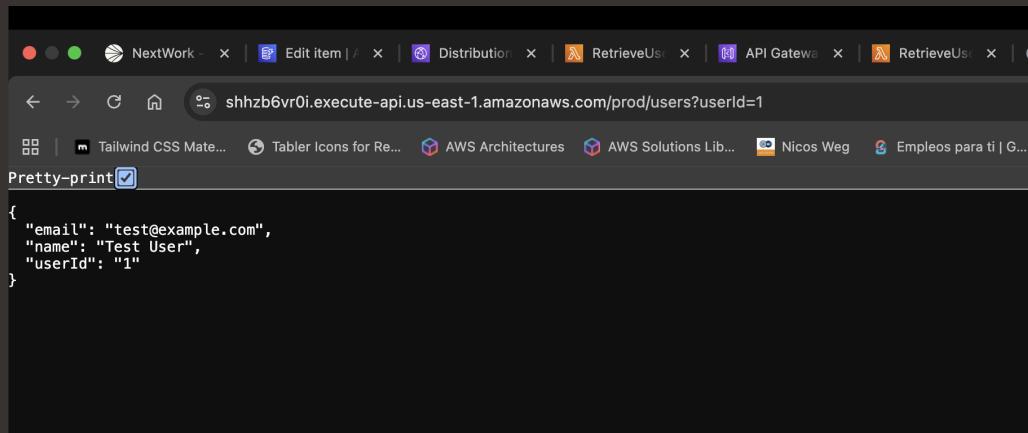
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Logic and Data tier

Once all three layers of my three-tier architecture are set up, the next step is to connect them by updating my script.js to make API requests to my backend, because this allows the presentation layer to communicate with the logic and data layers and display real user data on the website.

To test my API, I ran the edited API Gateway URL in my web browser. The results were a successful response showing the user data returned from my DynamoDB table, confirming that the API and Lambda function were working correctly.



A screenshot of a web browser window. The address bar shows the URL: `shhz6vr0i.execute-api.us-east-1.amazonaws.com/prod/users?userId=1`. Below the address bar, there are several tabs open, including "Edit Item", "Distribution", "RetrieveUser", "API Gateway", and another "RetrieveUser". The main content area of the browser displays a JSON response with the "Pretty-print" checkbox checked. The JSON data is:

```
{  
  "email": "test@example.com",  
  "name": "Test User",  
  "userId": "1"  
}
```



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Console Errors

The error in my distributed site was because my script.js was still pointing to a placeholder API URL instead of the real API Gateway production URL, so the browser tried to call `https://[YOUR-PROD-API-URL]/users?userId=1`, which doesn't exist and caused the request to fail.

To resolve the error, I updated script.js by replacing the placeholder API URL with my real API Gateway production endpoint. I then reuploaded it into S3 because CloudFront serves the files from S3, and updating the bucket ensures the website uses the new JavaScript code when users load the page.

I ran into a second error after updating script.js. This was an error with the CloudFront distribution not being fully updated, and I hadn't cleared my browser cache before testing again. As a result, the browser was still using an old version of script.js, which caused a 403 error when trying to fetch data and returned an HTML/XML page instead of valid JSON.



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The screenshot shows a browser window with the Network tab open in the developer tools. The URL in the address bar is `d3sizmp3kj5h9q.cloudfront.net`. The Network tab displays several requests:

- A successful `GET https://d3sizmp3kj5h9q.cloudfront.net/favicon.ico` response.
- An error message: `GET https://d3sizmp3kj5h9q.cloudfront.net/[YOUR-PROD-API-URL]/users/userId=1 403 (Forbidden)`.
- An error message: `GET https://d3sizmp3kj5h9q.cloudfront.net/[YOUR-PROD-API-URL]/users/userId=1 script.js:9 403 (Forbidden)`.
- An error message: `Failed to fetch user data: SyntaxError: Unexpected token '<', installHook.js:1 < XML vers..." is not valid JSON`.

The main content area of the browser shows a "User Information" page with a text input field containing "1" and a "Get User Data" button.



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Resolving CORS Errors

Nothing, i didn't get the CORS error

I also updated my Lambda function because the API needed to return the proper CORS headers for the browser to accept responses from a different origin. The changes I made were: Added the Access-Control-Allow-Origin header with the value of * (or my CloudFront domain) in the Lambda function's response. Added Access-Control-Allow-Methods and Access-Control-Allow-Headers to allow the GET request from the frontend. Ensured that these headers were included in both successful responses and error responses, so the browser wouldn't block the requests.



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```
async function handler(event) {
    console.log("Dynamodb Response:", JSON.stringify(event));
}

const { Item } = event;

if (Item) {
    console.log("User data retrieved:", Item);
    return {
        statusCode: 200,
        headers: {
            'Content-Type': 'application/json',
            'Access-Control-Allow-Origin': '*'
        },
        body: JSON.stringify(Item)
    };
} else {
    console.log("No user data found for userId:", userId);
    return {
        statusCode: 404,
        body: JSON.stringify({ error: "User not found" })
    };
}
```

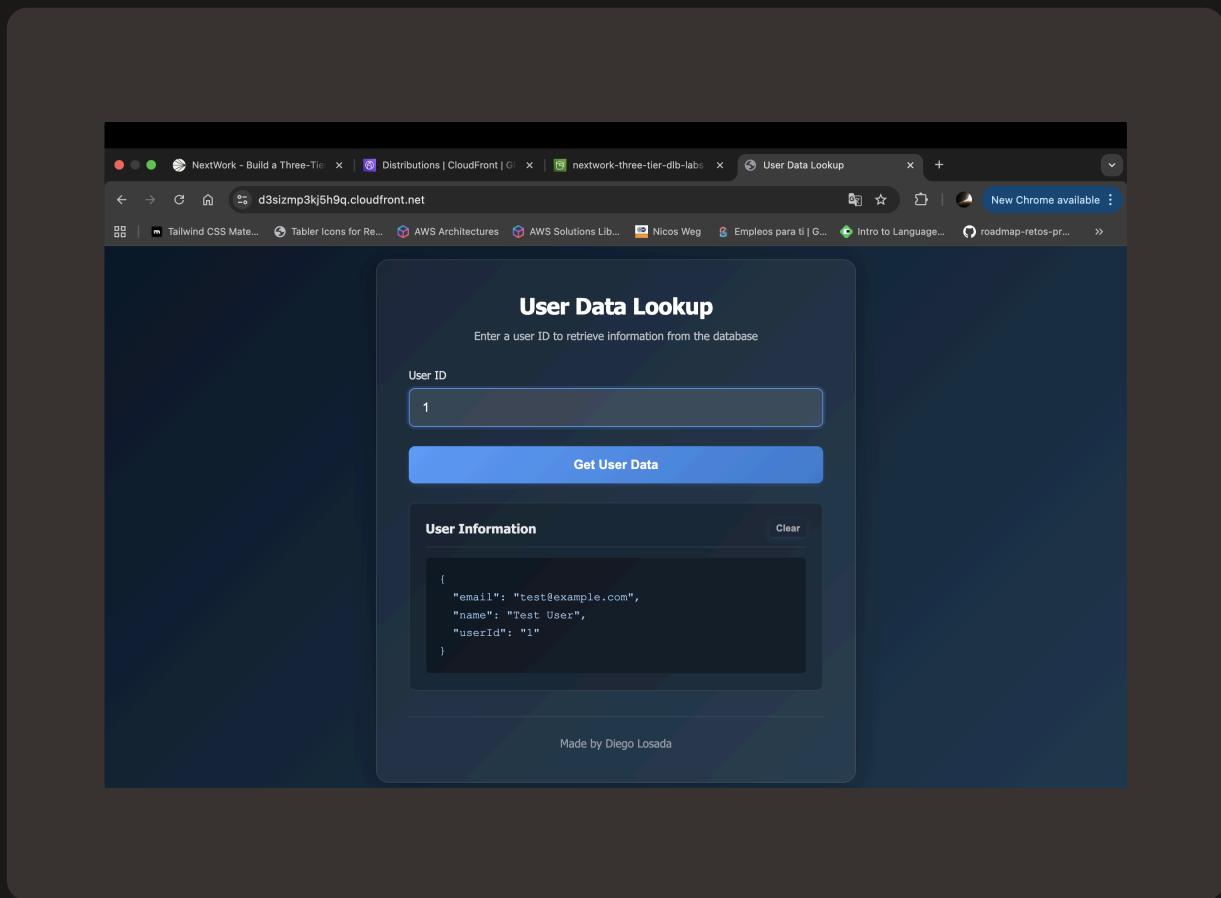


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Fixed Solution

I verified the fixed connection between API Gateway and CloudFront by clearing my browser cache, reloading the CloudFront URL, and confirming that the API requests now returned the expected JSON data without any 403 or CORS errors. I also checked the network tab in the developer tools to ensure that each request to the API Gateway endpoint went through CloudFront and received the correct response.





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