Hands-on tutorials

Build a Serverless Web Application using Generative AI

Build a Serverless Web Application using Generative AI: Hands-on tutorials

Table of Contents

Build a Serverless Web Application using Generative AI

AWS experience	Beginner
Time to complete	35 minutes
Cost to complete	Free tier eligible
Requires	• AWS account with administrator-level access • AWS profile configured • Nodejs and npm • A Github account **Note** Accounts created within the past 24 hours might not yet have access to the services required for this tutorial.
Last updated	July 19, 2024

Overview

In this tutorial, you will learn how to use AWS Amplify to build a serverless web application powered by Generative AI using Amazon Bedrock and the Claude 3 Sonnet foundation model. Users can enter a list of ingredients, and the application will generate delicious recipes based on the input ingredients. The application includes an HTML-based user interface for ingredient submission and a backend web app to request AI-generated recipes.

What you will accomplish

In this tutorial, you will:

- Configure AWS Amplify to host your frontend application with continuous deployment built in

- Configure Amplify Auth and enable Amazon Bedrock foundation model Access
- Build an app backend for handling requests for your web application
- Use Amplify Data to call the serverless backend
- Connect the app to the backend

Prerequisites

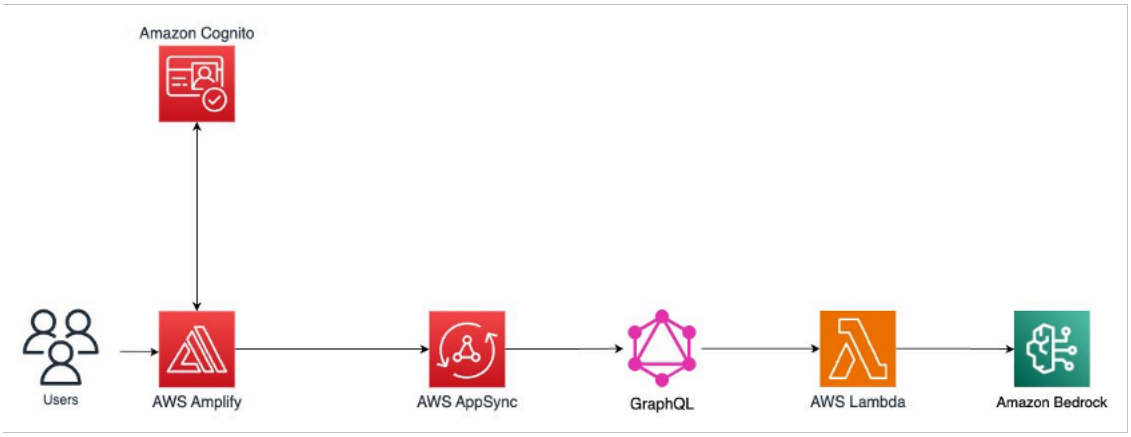
Before starting this tutorial, you will need:

- **An AWS account**: if you don't already have one follow the Setup Your Environment tutorial.
- **Configure** your **AWS profile** for local development.
- **Installed** on your environment: Nodejsand npm.
- **Familiarity** with git and a Github account.

Application Architecture

The following diagram provides a visual representation of the services used in this tutorial and how they are connected. This application uses AWS Amplify, a GraphQL API built with AWS AppSync, AWS Lambda, and Amazon Bedrock.

As you go through the tutorial, you will learn about the services in detail and find resources that will help you get up to speed with them.



Tasks

This tutorial is divided into the following tasks. You must complete each task before moving to the next one.

1. Task 1: Host a Static Website (5 minutes): Configure AWS Amplify to host your frontend application with continuous deployment built in
2. Task 2: Manage Users (5 minutes): Configure Amplify Auth and enable Amazon Bedrock foundation model Access
3. Task 3: Build a Serverless Backend (10 minutes): Build an app backend for handling requests for your web application
4. Task 4: Deploy the Backend API (5 minutes): Use Amplify Data to call the serverless backend
5. Task 5: Build the Frontend (5 minutes): Connect the app to the backend
6. Task 6: Clean up Resources (2 minutes): Clean up the resources used in this tutorial

Task 1: Host a Static Website

Time to complete	5 minutes
Requires	• A GitHub account • GitHub SSH connection
Get help	Troubleshooting Amplify How Amplify works Learn about Hosting

Overview

AWS Amplify offers a Git-based CI/CD workflow for building, deploying, and hosting single-page web applications or static sites with backends. When connected to a Git repository, Amplify determines the build settings for both the frontend framework and any configured backend resources, and automatically deploys updates with every code commit.

In this task, you will start by creating a new React application and pushing it to a GitHub repository. You will then connect the repository to AWS Amplify web hosting and deploy it to a globally available content delivery network (CDN) hosted on an **amplifyapp.com** domain.

What you will accomplish

In this tutorial, you will:

- Create a new web application
- Set up Amplify on your project

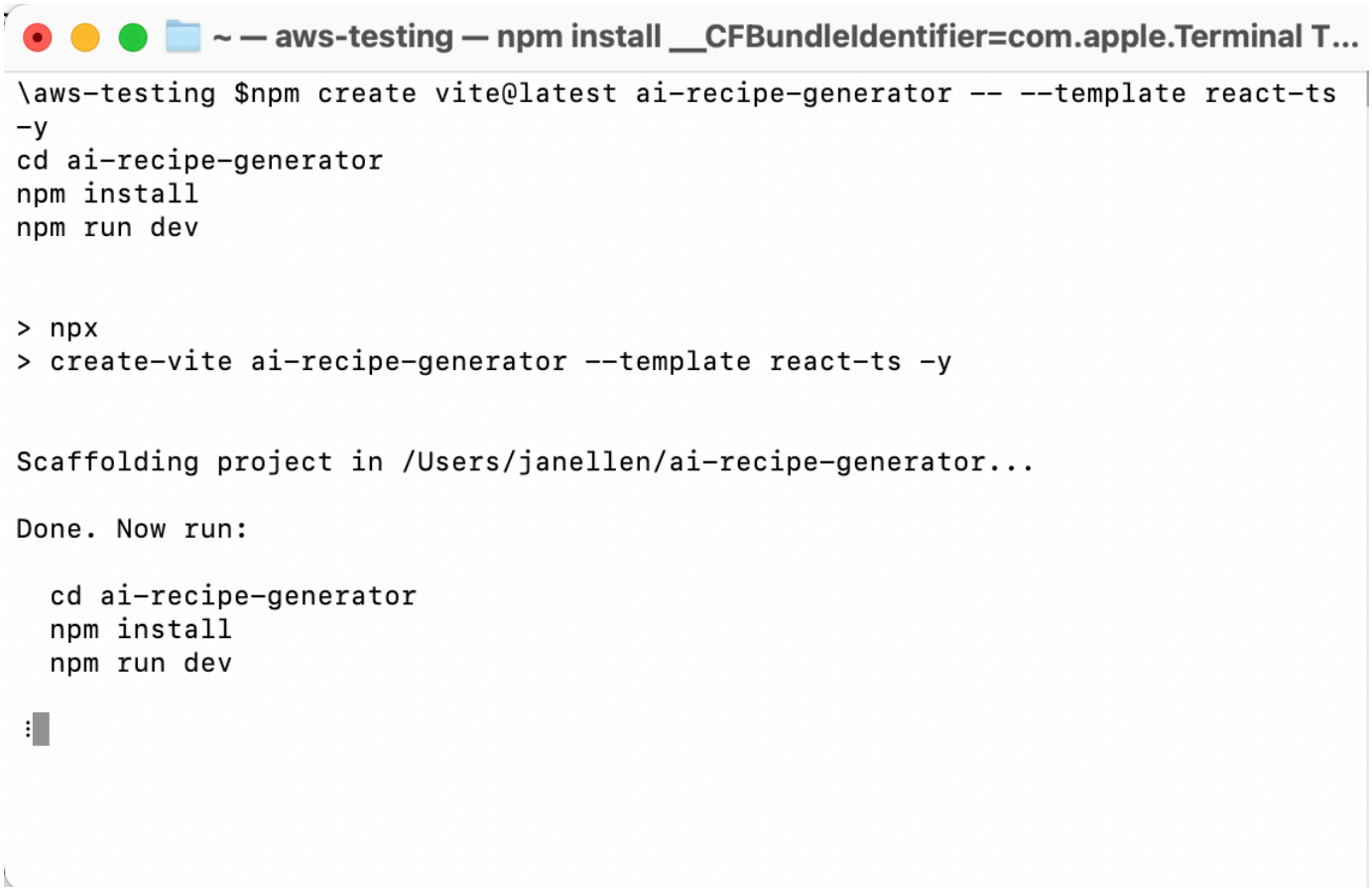
Implementation

Step 1: Create a new React application

1. Create the application

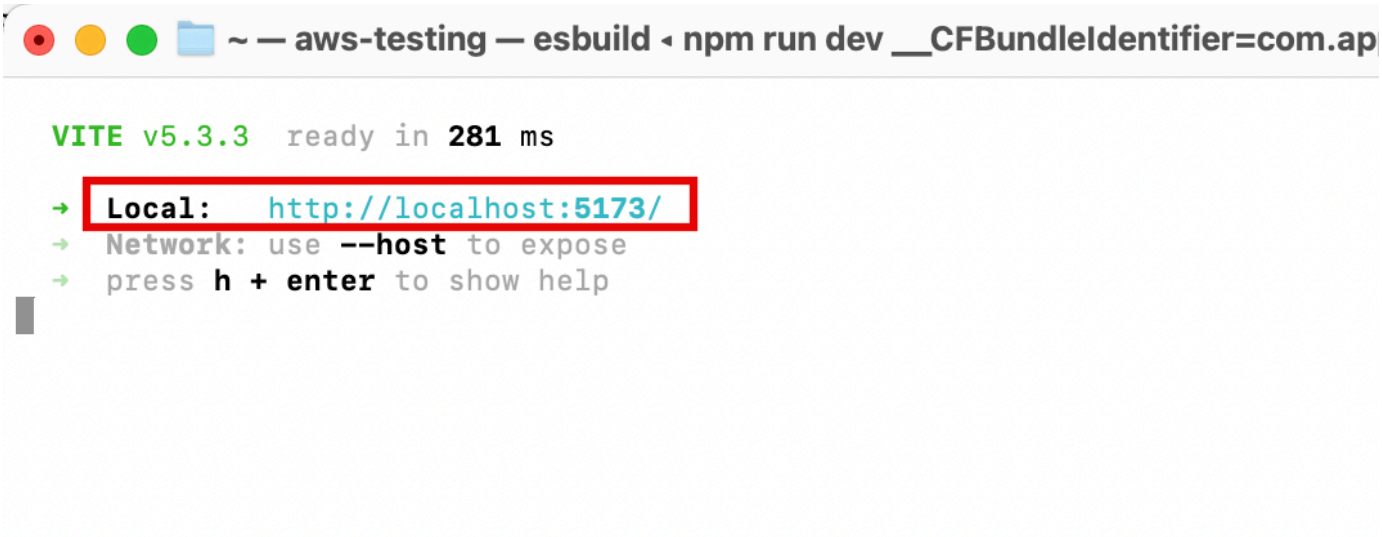
In a new terminal or command line window, run the following command to use Vite to create a React application:

```
npm create vite@latest ai-recipe-generator -- --template react-ts -y
cd ai-recipe-generator
npm install
npm run dev
```



2. Open the application

   In the terminal window, select and open the Local link to view the Vite + React application.



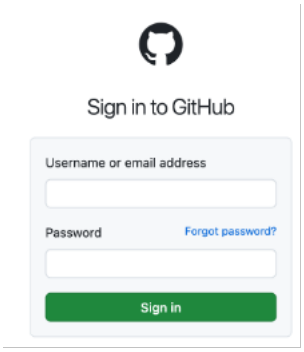
Step 2: Initialize a GitHub repository

In this step, you will create a GitHub repository and commit your code to the repository. You will need a GitHub account to complete this step, if you do not have an account, sign up here.

> **Note**
>
> If you have never used GitHub on your computer, follow these steps before continuing to allow connection to your account.

1. Sign in to GitHub

   Sign in to GitHub at https://github.com/.



2. Start a new repository

   In the **Start a new repository** section, make the following selections:

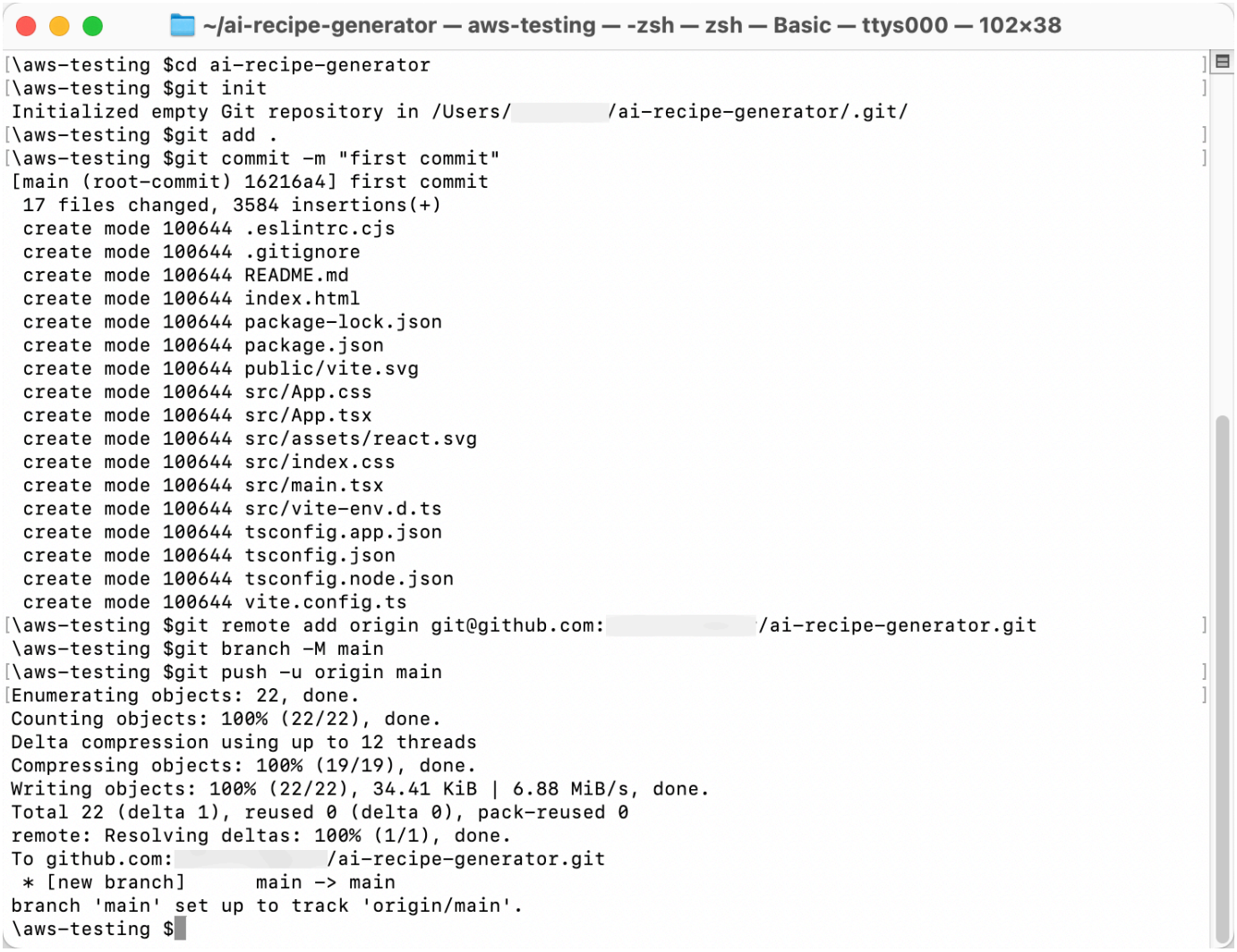
- For **Repository name**, enter **ai-recipe-generator**, and choose the **Public** radio button.
- Then select, **Create a new repository**.

3. Initialize Git

Open a new terminal window, **navigate** to your projects root folder (**ai-recipe-generator**), and **run** the following commands to initialize a git and push of the application to the new GitHub repo:

> **Note**
>
> Replace the **SSH GitHub URL** in the command with your GitHub URL.

```
git init
git add .
git commit -m "first commit"
git remote add origin git@github.com:<your-username>/ai-recipe-generator.git
git branch -M main
git push -u origin main
```

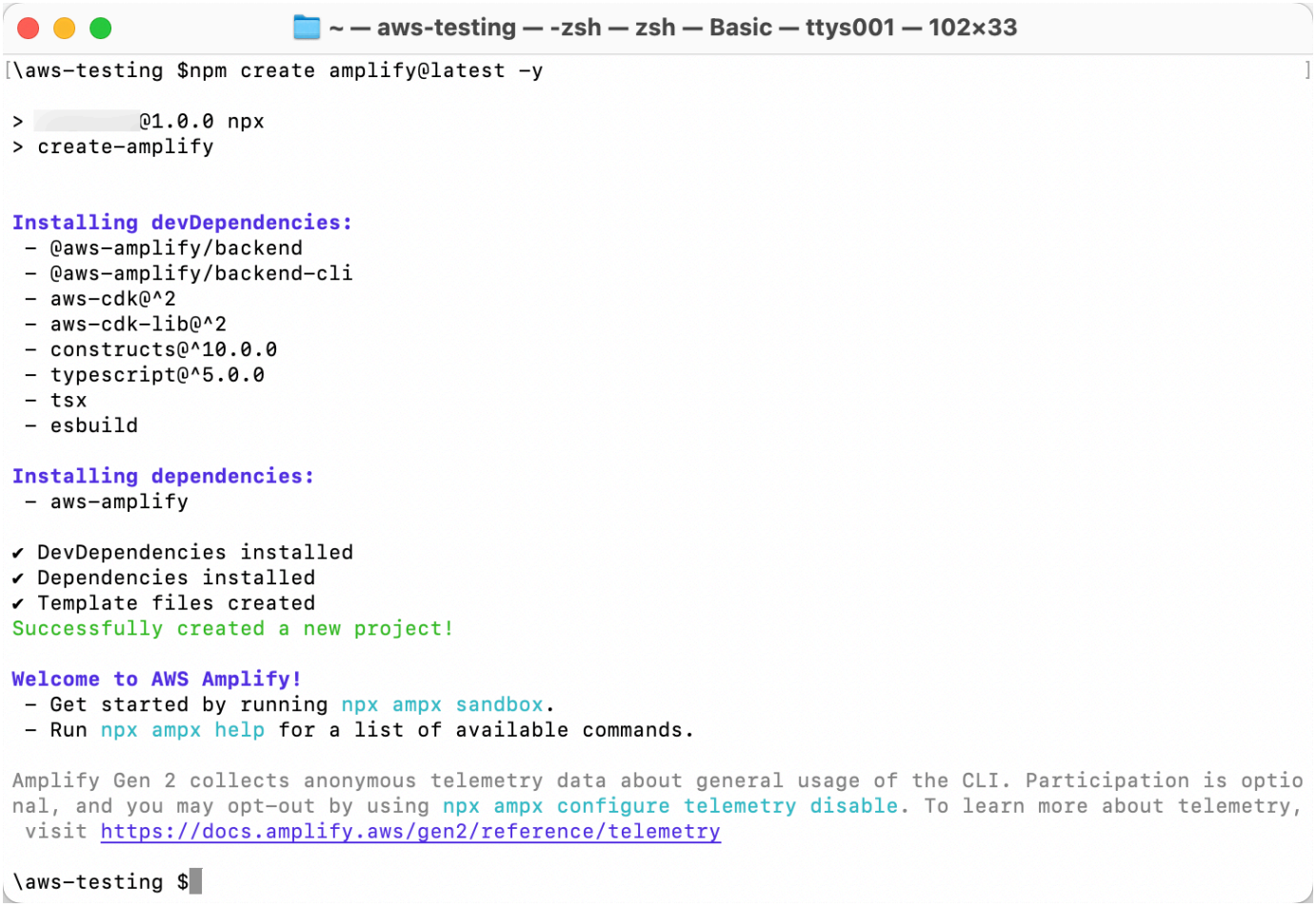


Step 3: Install the Amplify packages

1. Install Amplify

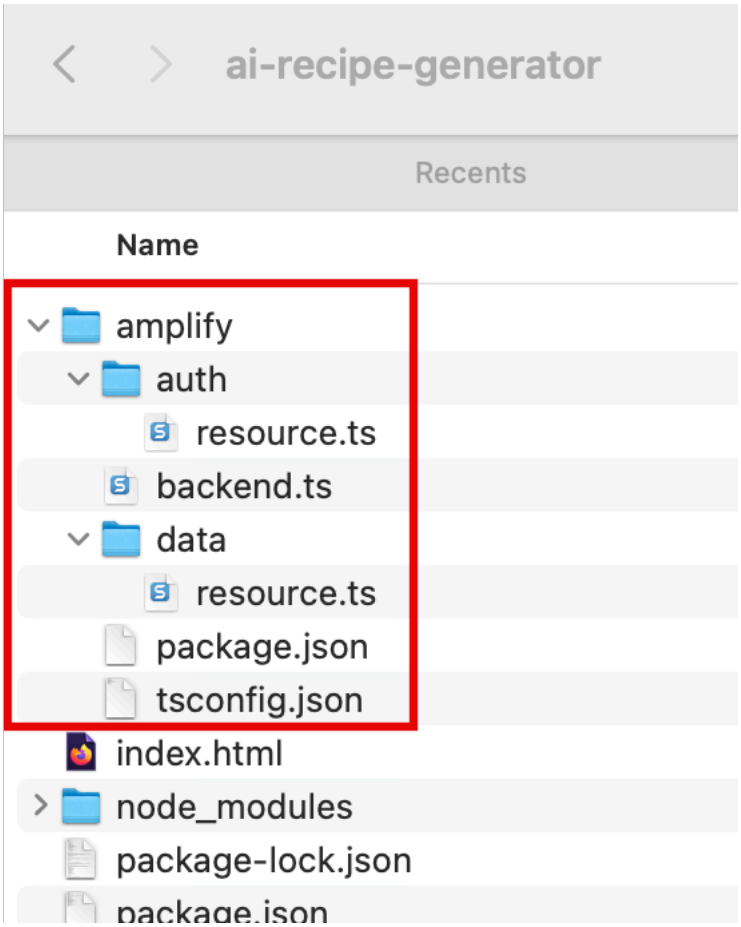
Open a new terminal window, navigate to your app's root folder (**ai-recipe-generator**), and run the following command:

```
npm create amplify@latest -y
```



2. View directory

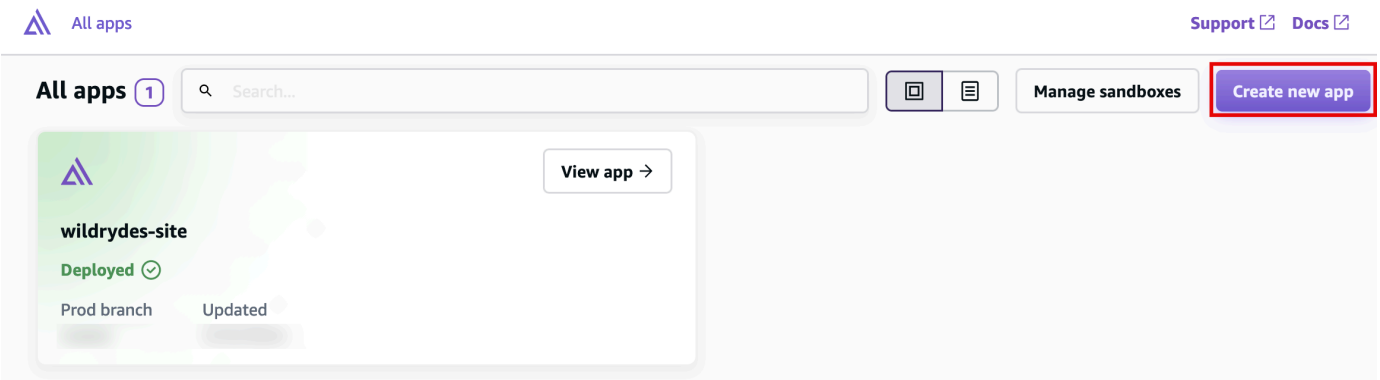
Running the previous command will scaffold a lightweight Amplify project in the app's directory.



Step 4: Deploy your app with AWS Amplify

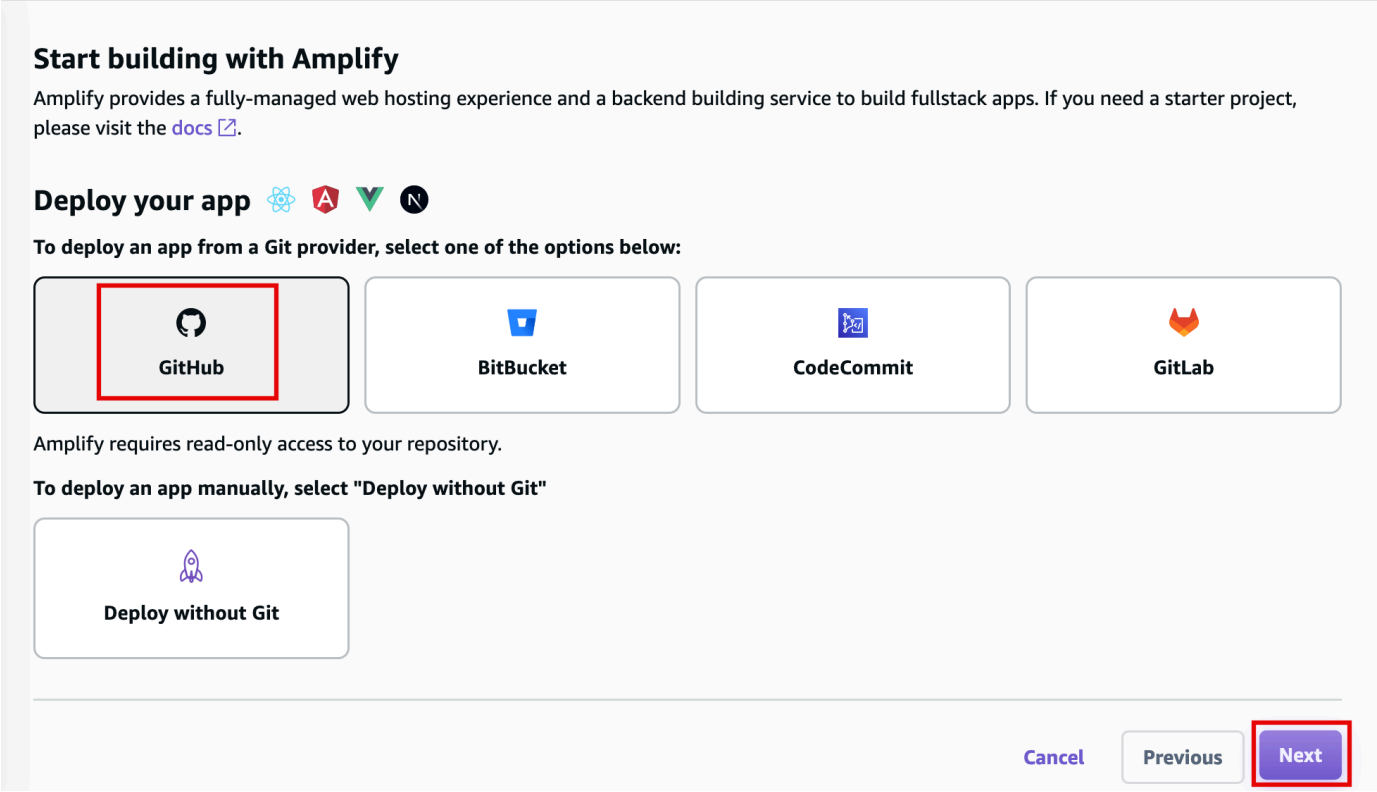
1. **Sign in** to the AWS Management Console in a new browser window, and **open** the AWS Amplify console at https://console.aws.amazon.com/amplify/apps.

   Choose **Create new app**.



2. Select GitHub to deploy your app

On the **Start building with Amplify** page, for **Deploy your app**, select **GitHub**, and select **Next**.

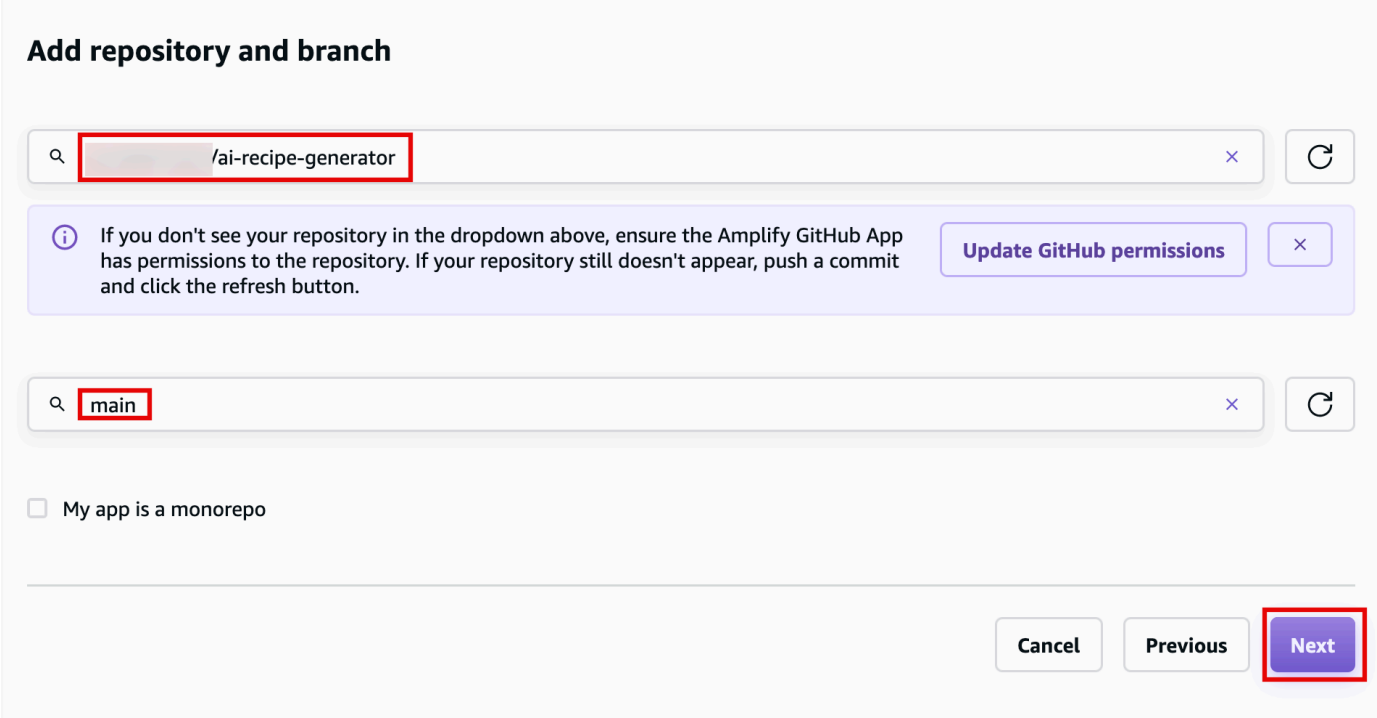


3. Authenticate with GitHub

   When prompted, **authenticate** with GitHub. You will be automatically redirected back to the Amplify console.

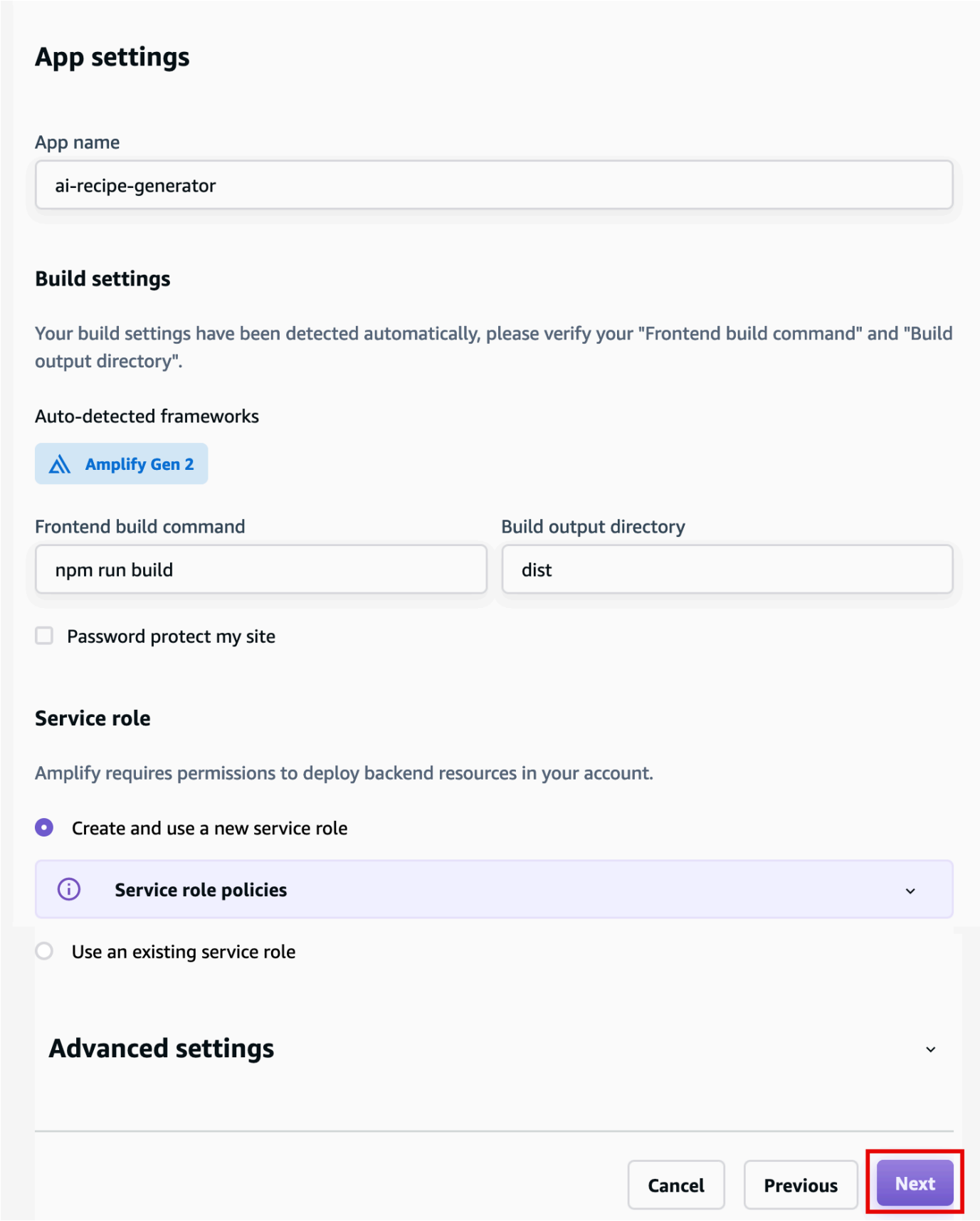
   Choose the **repository** and **main branch** you created earlier.

   Then select **Next**.



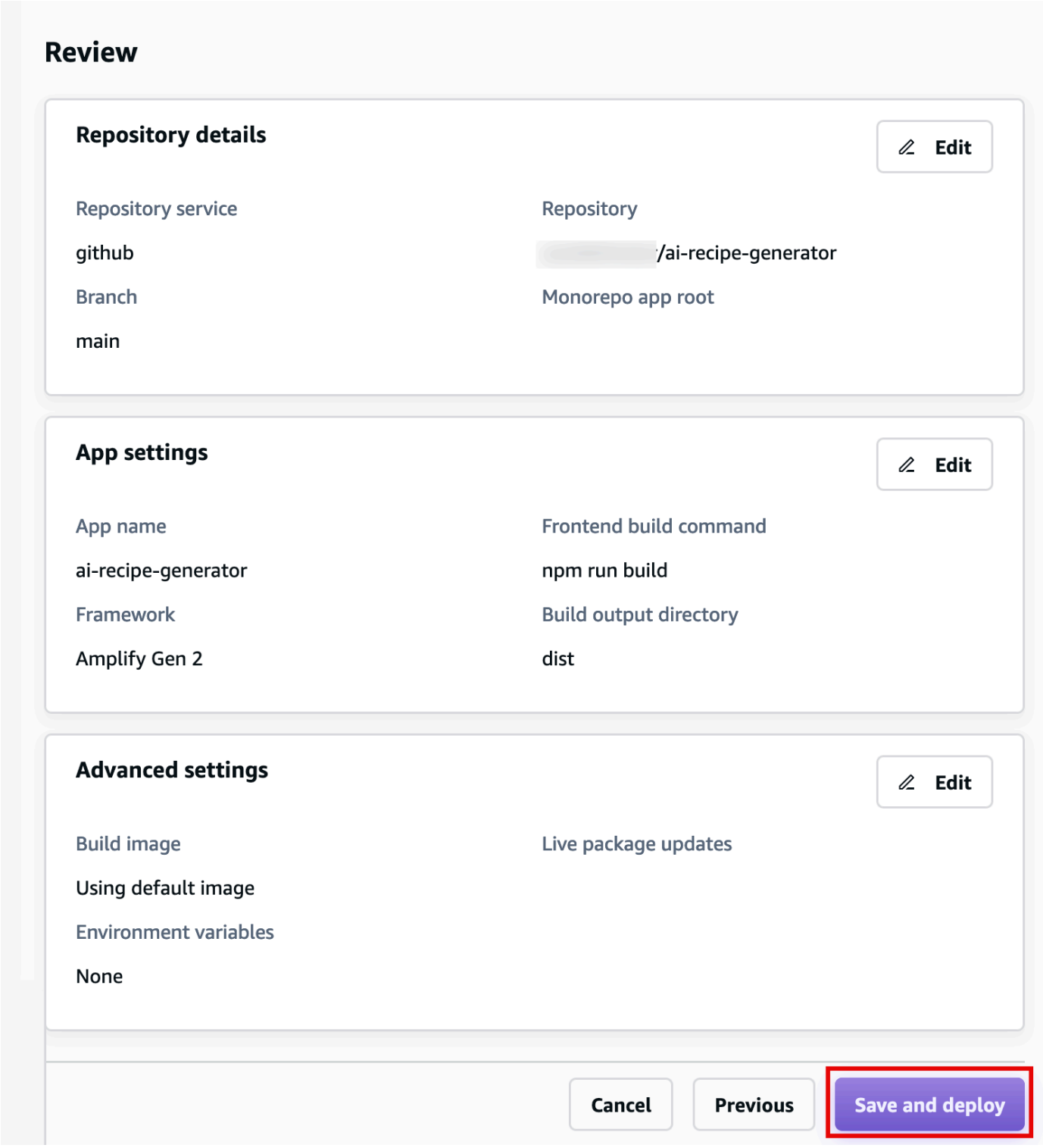
4. Select Next

   Leave the default **build settings**, and select **Next**.


App settings
App name
ai-recipe-generator
Build settings
Your build settings have been detected automatically, please verify your "Frontend build command" and "Build output directory".
Auto-detected frameworks
Amplify Gen 2
Frontend build command
npm run build
Build output directory
dist
Password protect my site
Service role
Amplify requires permissions to deploy backend resources in your account.
Create and use a new service role
Service role policies
Use an existing service role
Advanced settings
Cancel
Previous
Next

5. Review configuration

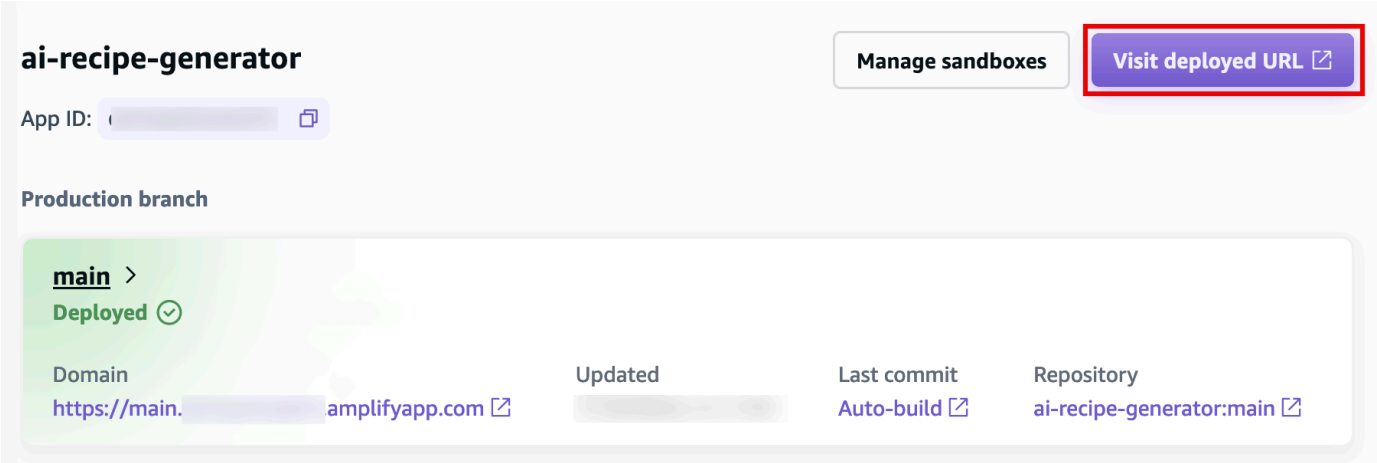
Review the inputs selected, and choose **Save and deploy**.



6. View your app

AWS Amplify will now **build** your source code and **deploy** your app at **https://...amplifyapp.com**, and on every git push your deployment instance will update. It may take up to 5 minutes to deploy your app.

Once the build completes, select the **Visit deployed URL** button to see your web app up and running live.



Conclusion

You have deployed a React application to AWS by integrating with GitHub and using AWS Amplify. With AWS Amplify, you can continuously deploy your application in the Cloud and host it on a globally available CDN.

Task 2: Manage Users

Time to complete	15 minutes
Requires	A text editor. Here are a few free ones: • Atom • Notepad++ • Sublime • Vim • Visual Studio Code
Get help	• Troubleshooting Amplify • Troubleshooting Amazon Bedrock • Learn about Auth

Overview

Now that you have a React web app, you will configure an authentication resource for the app using AWS Amplify Auth, powered by Amazon Cognito. Cognito is a powerful user directory service that manages user registration, authentication, account recovery, and more.

You will use the AWS Management Console to enable access to Amazon Bedrock and Claude 3 Sonnet foundation model, which the app will use to generate recipes.

What you will accomplish

In this tutorial, you will:

- Set up Amplify Authentication
- Set up access to Claude 3 Sonnet from Anthropic

Implementation

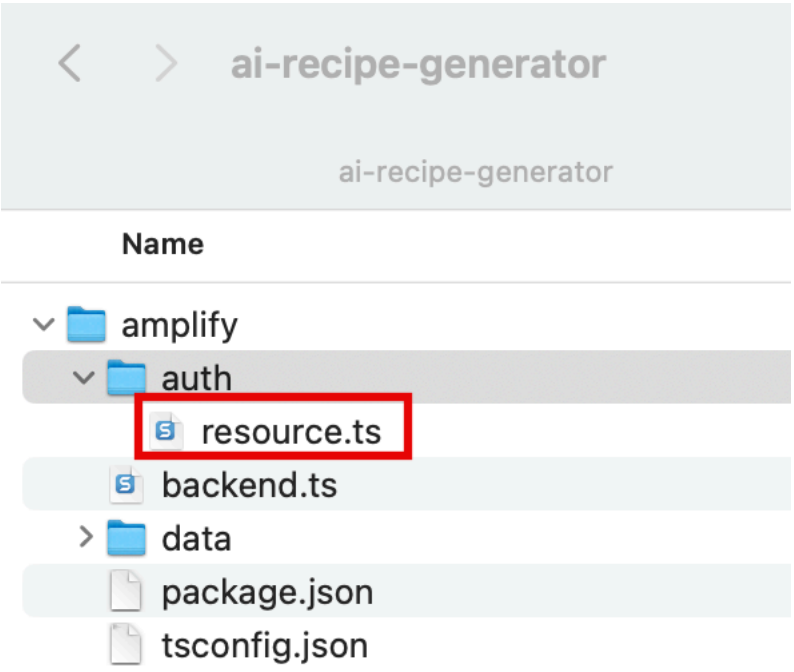
Step 1: Set up Amplify Auth

The app uses email as the default login mechanism. When the users sign up, they receive a verification email. In this step, you will customize the verification email that is sent to users.

1. Modify the resource file

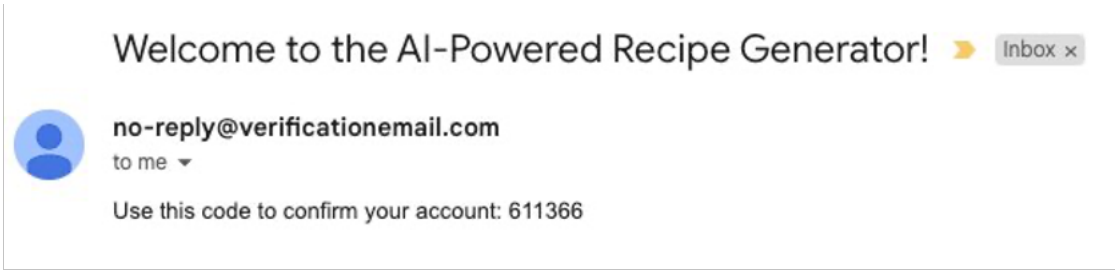
   On your local machine, navigate to the **ai-generated-recipes/amplify/auth/resource.ts** file and **update** it with the following code. Then, **save** the file.

```
import { defineAuth } from "@aws-amplify/backend";

export const auth = defineAuth({
  loginWith: {
    email: {
      verificationEmailStyle: "CODE",
      verificationEmailSubject: "Welcome to the AI-Powered Recipe Generator!",
      verificationEmailBody: (createCode) =>
        `Use this code to confirm your account: ${createCode()}`,
    },
  },
});
```



2. View the customized email

   The following image is an example of the customized verification email.



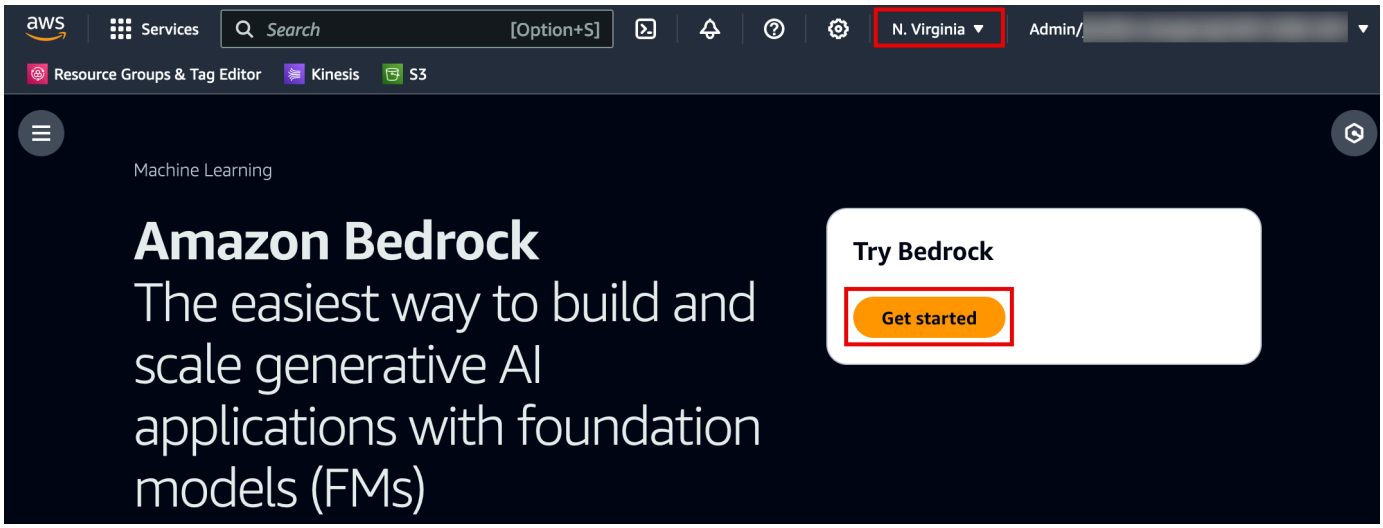
Step 2: Set up Amazon Bedrock Model Access

Amazon Bedrock enables users to request access to a variety of Generative AI models. In this tutorial, you will need access to Claude 3 Sonnet from Anthropic.

1. Open the Bedrock console

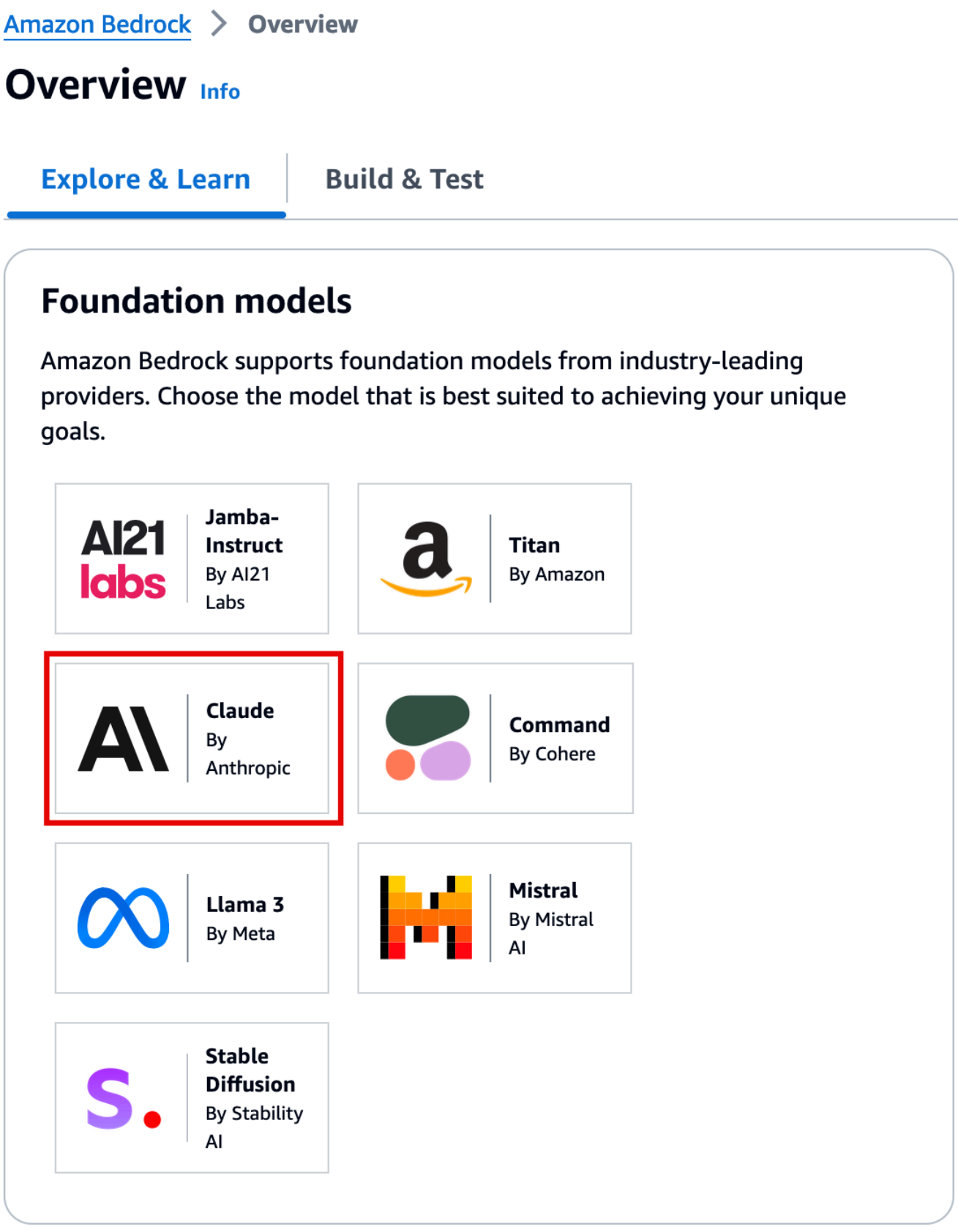
   Sign in to the AWS Management console in a new browser window, and **open** the AWS Amazon Bedrock console at https://console.aws.amazon.com/bedrock/.

   Verify that you are in the **N. Virginia us-east-1** region, and choose **Get started**.



2. Select the Claude model

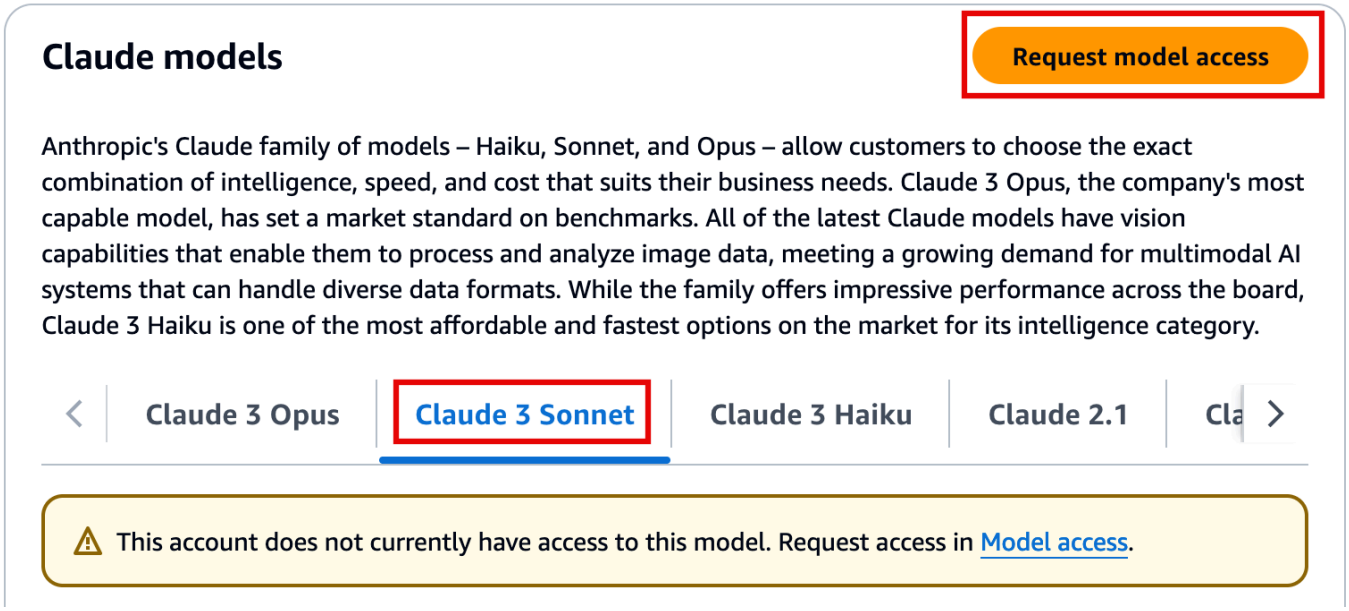
   In the **Foundation models** section, choose the **Claude model**.


Amazon Bedrock
Overview
Overview Info
Explore & Learn
Build & Test
Foundation models
Amazon Bedrock supports foundation models from industry-leading providers. Choose the model that is best suited to achieving your unique goals.
AI21 labs
Jamba-Instruct
By AI21 Labs
Titan
By Amazon
Claude
By Anthropic
Command
By Cohere
Llama 3
By Meta
Mistral
By Mistral AI
Stable Diffusion
By Stability AI

3. Request access to Claude 3 Sonnet

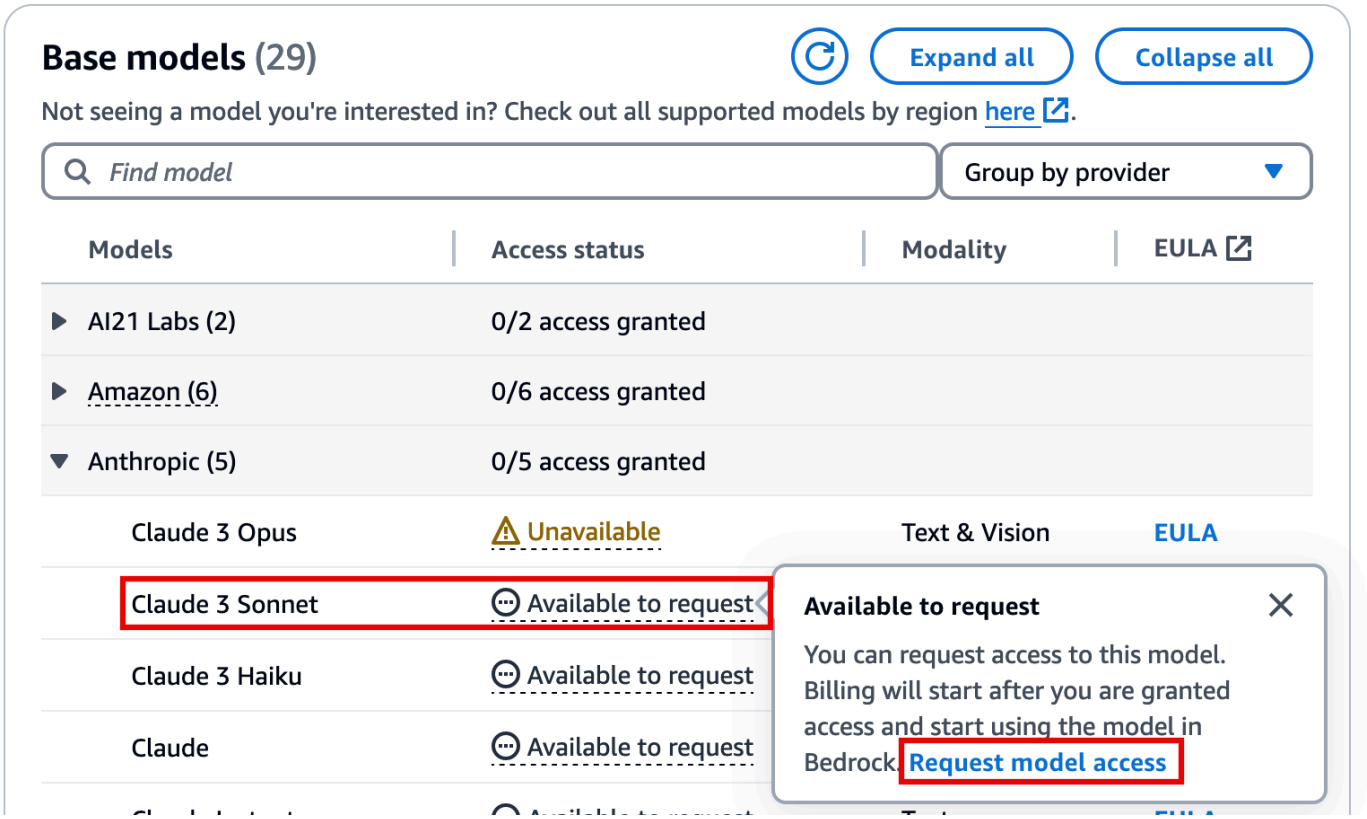
   Scroll down to the **Claude models** section, and choose the **Claude 3 Sonnet** tab, and select **Request model access**.

   > **Note**
   >
   > If you already have access to some models, then the button will display **Manage model access**.



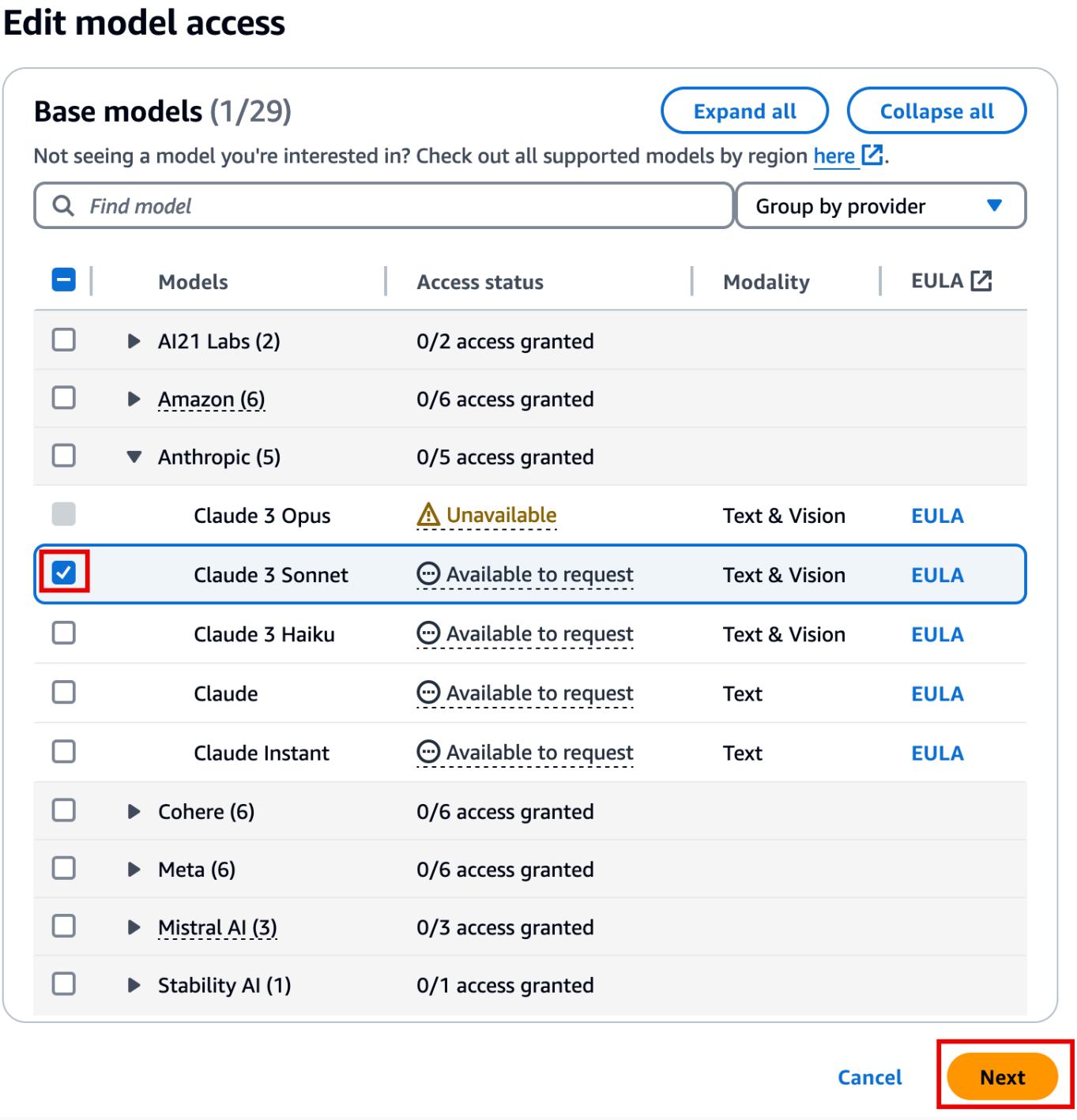
4. Request model access

   In the Base models section, for **Claude 3 Sonnet**, choose **Available to request,** and select **Request model access**.



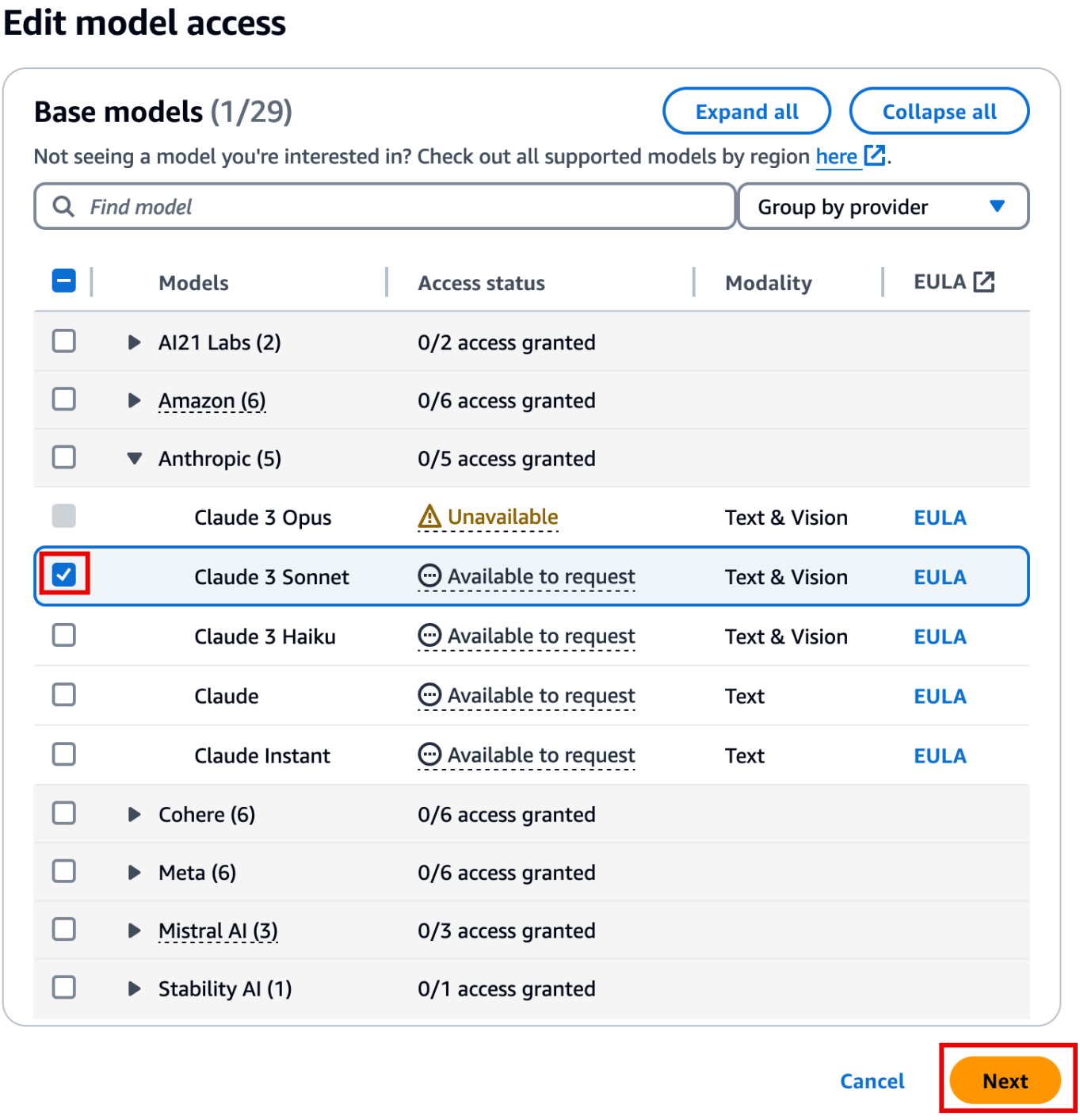
5. Choose Next

   On the **Edit model access** page, choose **Next**.



6. Submit request

   On the **Review and Submit** page, choose **Submit**.



Conclusion

You have configured Amplify for authentication and customized the verification email, and enabled access to Amazon Bedrock and Claude 3 Sonnet.

Task 3: Build a Serverless Backend

Time to complete	10 minutes
Requires	A text editor. Here are a few free ones: • Atom • Notepad++ • Sublime • Vim • Visual Studio Code
Get help	Troubleshooting Lambda Functions

Overview

In this task, you will configure a serverless function using AWS Amplify and AWS Lambda. This function takes an input parameter i.e. ingredients to generate a prompt. It then sends this prompt to Amazon Bedrock via an HTTP POST request to the Claude 3 Sonnet model. The body of the request includes the prompt string within a messages array.

What you will accomplish

In this tutorial, you will:

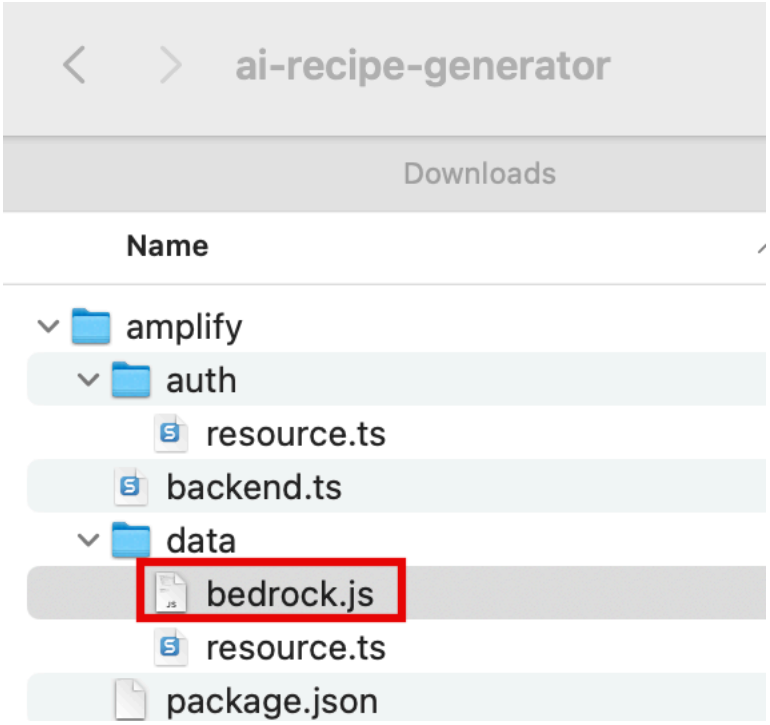
- Add Amazon Bedrock as a data source
- Configure custom business logic handler code

Implementation

Step 1: Create a Lambda function for handling requests

1. Create a Lambda function

On your local machine, navigate to the **ai-recipe-generator/amplify/data** folder, and **create** a file named **bedrock.js**.



2. Add the function code

Then, **update** the file with the following code:

```
export function request(ctx) {
    const { ingredients = [] } = ctx.args;

    // Construct the prompt with the provided ingredients
    const prompt = `Suggest a recipe idea using these ingredients:
 ${ingredients.join(", ")}.`;

    // Return the request configuration
    return {
      resourcePath: `/model/anthropic.claude-3-sonnet-20240229-v1:0/invoke`,
      method: "POST",
      params: {
        headers: {
          "Content-Type": "application/json",
        },
        body: JSON.stringify({
          anthropic_version: "bedrock-2023-05-31",
```

```
          max_tokens: 1000,
          messages: [
            {
              role: "user",
              content: [
                {
                  type: "text",
                  text: `\n\nHuman: ${prompt}\n\nAssistant:`,
                },
              ],
            },
          ],
        }),
      },
    };
  }

  export function response(ctx) {
    // Parse the response body
    const parsedBody = JSON.parse(ctx.result.body);
    // Extract the text content from the response
    const res = {
      body: parsedBody.content[0].text,
    };
    // Return the response
    return res;
  }
```

This code defines a request function that constructs the HTTP request to invoke the Claude 3 Sonnet foundation model in Amazon Bedrock. The response function parses the response and returns the generated recipe.

Step 2: Add Amazon Bedrock as a data source

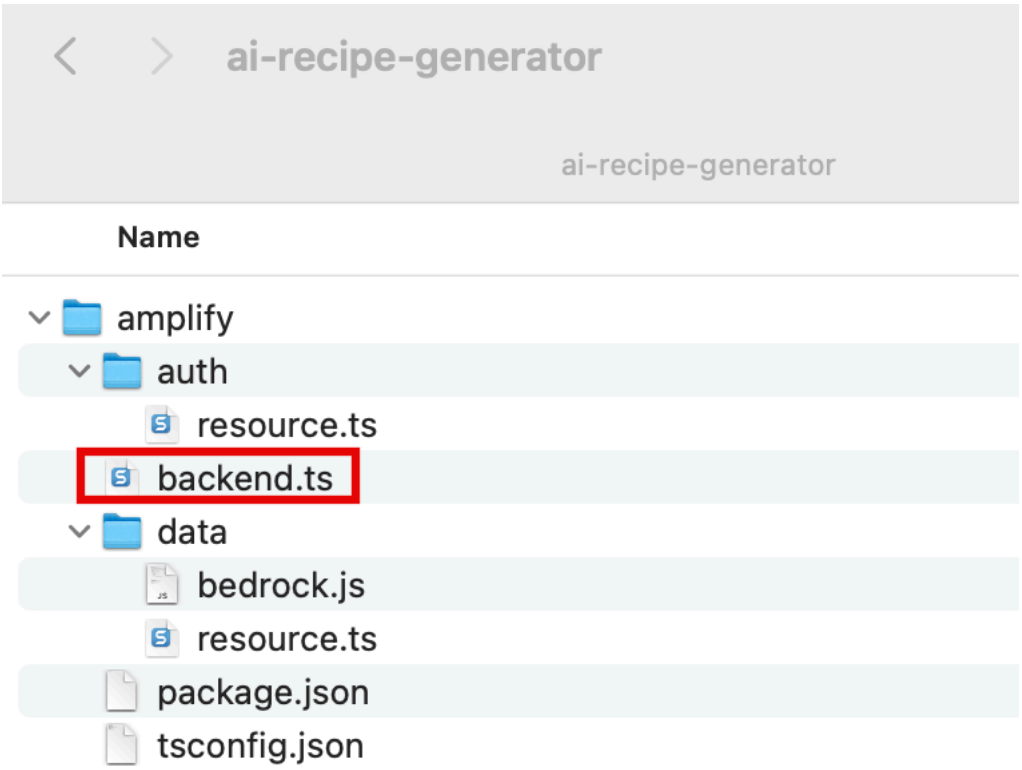
- Update the backend file

  Update the **amplify/backend.ts** file with the following code. Then, save the file.

```
import { defineBackend } from "@aws-amplify/backend";
import { data } from "./data/resource";
import { PolicyStatement } from "aws-cdk-lib/aws-iam";
import { auth } from "./auth/resource";
```

```
const backend = defineBackend({
  auth,
  data,
});

const bedrockDataSource = backend.data.resources.graphqlApi.addHttpDataSource(
  "bedrockDS",
  "https://bedrock-runtime.us-east-1.amazonaws.com",
  {
    authorizationConfig: {
      signingRegion: "us-east-1",
      signingServiceName: "bedrock",
    },
  }
);

bedrockDataSource.grantPrincipal.addToPrincipalPolicy(
  new PolicyStatement({
    resources: [
      "arn:aws:bedrock:us-east-1::foundation-model/anthropic.claude-3-
sonnet-20240229-v1:0",
    ],
    actions: ["bedrock:InvokeModel"],

  })
);
```

- The code adds an HTTP data source for Amazon Bedrock to your API and grant it permissions to invoke the Claude model.



Conclusion

You have defined a Lambda function using Amplify, and added Amazon Bedrock as an HTTP data source.

Task 4: Deploy the Backend API

Overview

In this task, you will configure a custom query that will reference the data source and the resolver you defined the previous model to produce a recipe based on a list of ingredients. This query will use a custom type to structure the response from Amazon Bedrock.

What you will accomplish

In this tutorial, you will:

- Define a GraphQL Query that takes an array of strings
- Define a custom type to be used to structure the response from the query

Implementation

Time to complete	5 minutes
Get help	Troubleshooting Amplify Learn about Data

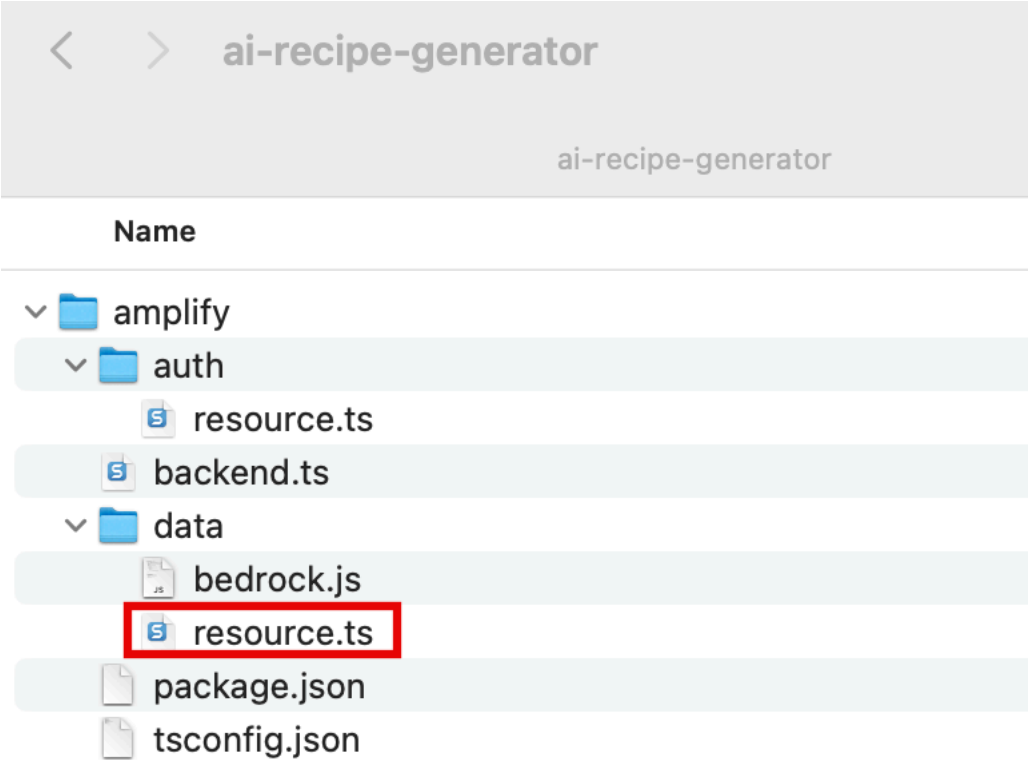
Step 1: Set up Amplify Data

1. Update the resource.ts file

   On your local machine, navigate to the **ai-recipe-generator/amplify/data/resource.ts** file, and **update** it with the following code. Then, **save** the file.

   - The following code defines the **askBedrock** query that takes an array of strings called **ingredients** and returns a **BedrockResponse**. The **.handler(a.handler.custom({ entry: "./bedrock.js", dataSource: "bedrockDS" }))** line sets up a custom handler for this query, defined in **bedrock.js**, using **bedrockDS** as its data source.

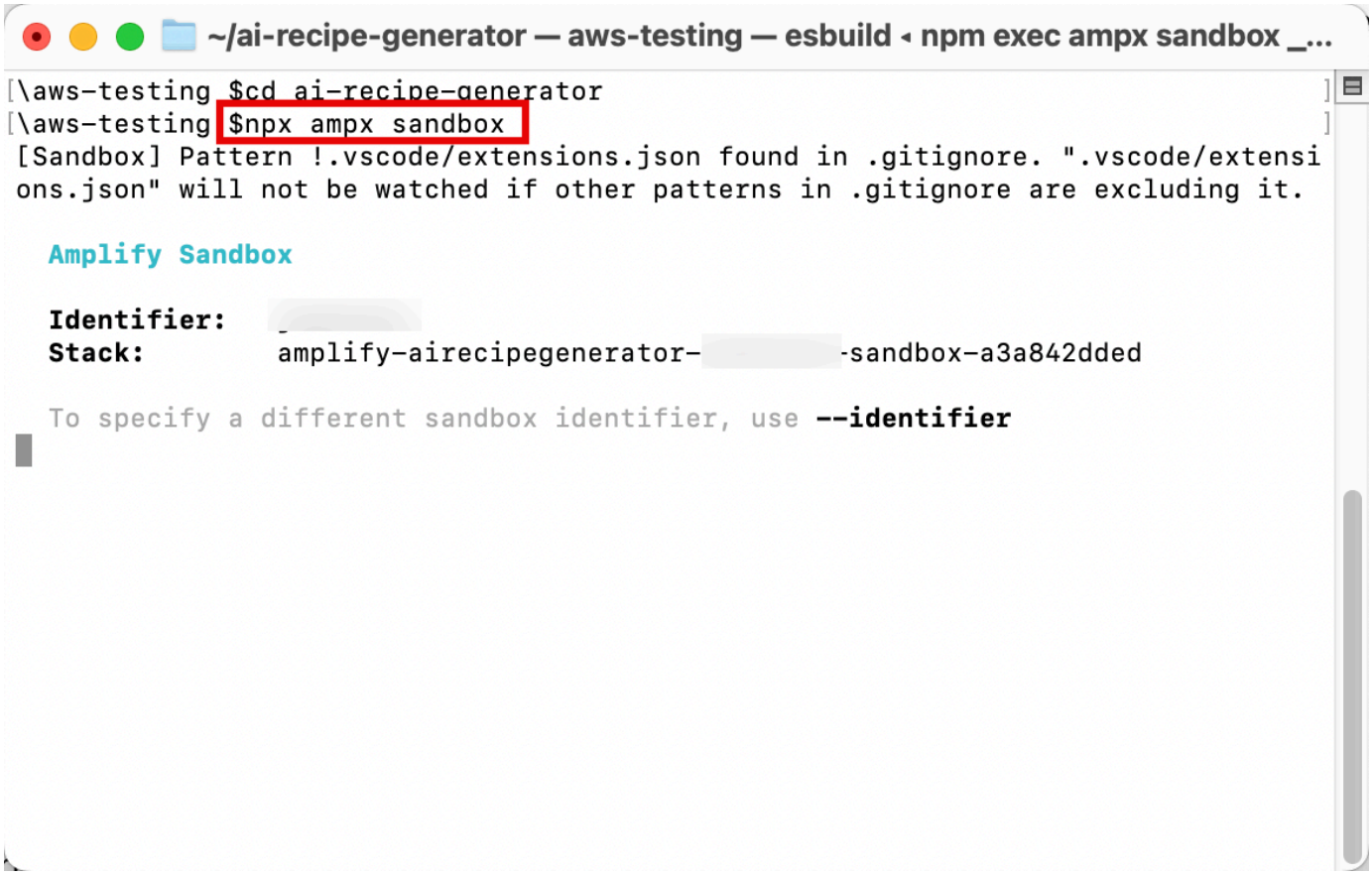
```
import { type ClientSchema, a, defineData } from "@aws-amplify/backend";

const schema = a.schema({
  BedrockResponse: a.customType({
    body: a.string(),
    error: a.string(),
  }),
  askBedrock: a
    .query()
    .arguments({ ingredients: a.string().array() })
    .returns(a.ref("BedrockResponse"))
    .authorization((allow) => [allow.authenticated()])
    .handler(
      a.handler.custom({
        entry: "./bedrock.js",
        dataSource: "bedrockDS"
      })
    ),
});

export type Schema = ClientSchema<typeof schema>;

export const data = defineData({
  schema,
  authorizationModes: {
    defaultAuthorizationMode: "apiKey",
    apiKeyAuthorizationMode: {
      expiresInDays: 30,
    },
  },
});
```



2. Deploy resources

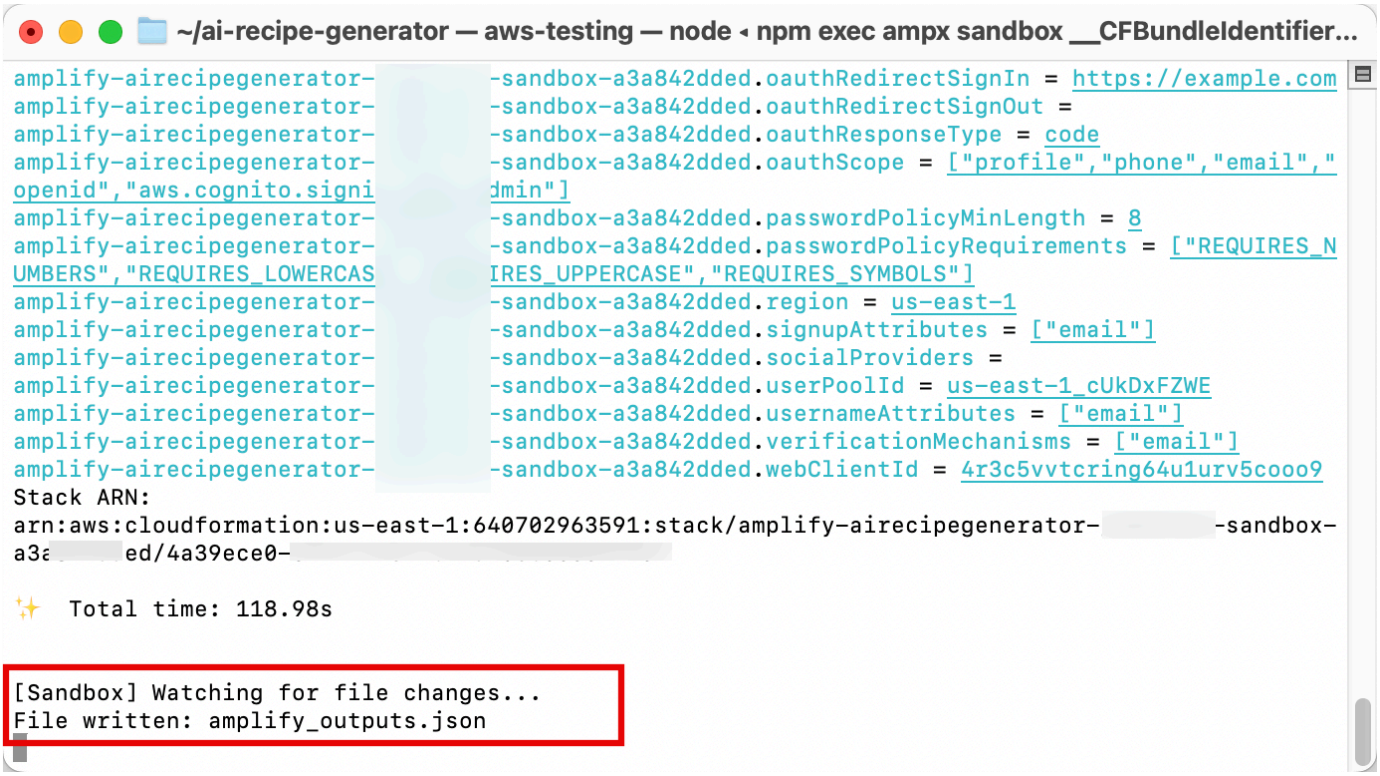
Open a new terminal window, **navigate** to your apps project folder (ai-recipe-generator), and **run** the following command to deploy cloud resources into an isolated development space so you can iterate fast.

```
npx ampx sandbox
```



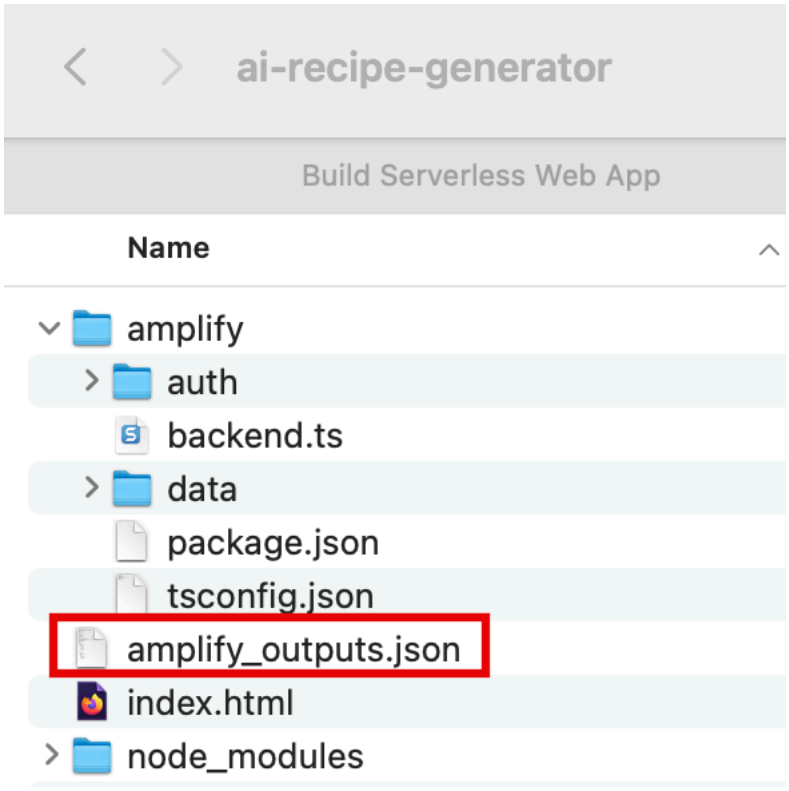
3. View confirmation message

   After the cloud sandbox has been fully deployed, your terminal will display a confirmation message.



4. Verify outputs file creation

   Verify that the *amplify_outputs.json* file was **generated** and **added** to your project.



Conclusion

You have configured a GraphQL API to define a custom query to connect to Amazon Bedrock and generate recipes based on a list of ingredients.

Task 5: Build the Frontend

Time to complete	5 minutes
Get help	Troubleshooting Amplify Troubleshooting common issues using Amplify UI

Overview

In this task, you will update the website you created in module one to use the Amplify UI component library to scaffold out an entire user authentication flow, allowing users to sign up, sign in, and reset their password and invoke the GraphQL API to use the customer query for generating recipe based on a list of ingredients.

What you will accomplish

In this tutorial, you will:

- Install the Amplify client libraries
- Configure your React app to add the authentication flow and invoke the GraphQL API

Implementation

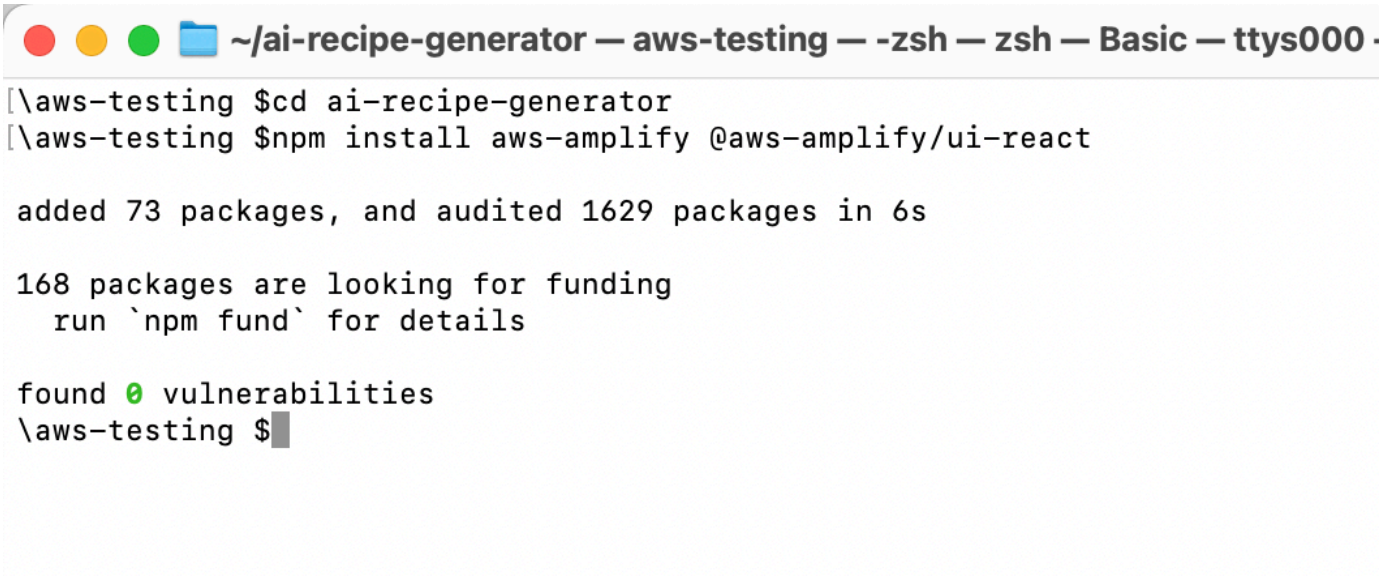
Step 1: Install the Amplify libraries

You will need two Amplify libraries for your project. The main **aws-amplify library** contains all of the client-side APIs for connecting your app's frontend to your backend, and the **@aws-amplify/ui-react** library contains framework-specific UI components.

- Install the libraries

  Open a new terminal window, **navigate** to your projects root folder (**ai-recipe-generator**), and **run** the following command to install the libraries.

```
npm install aws-amplify @aws-amplify/ui-react
```



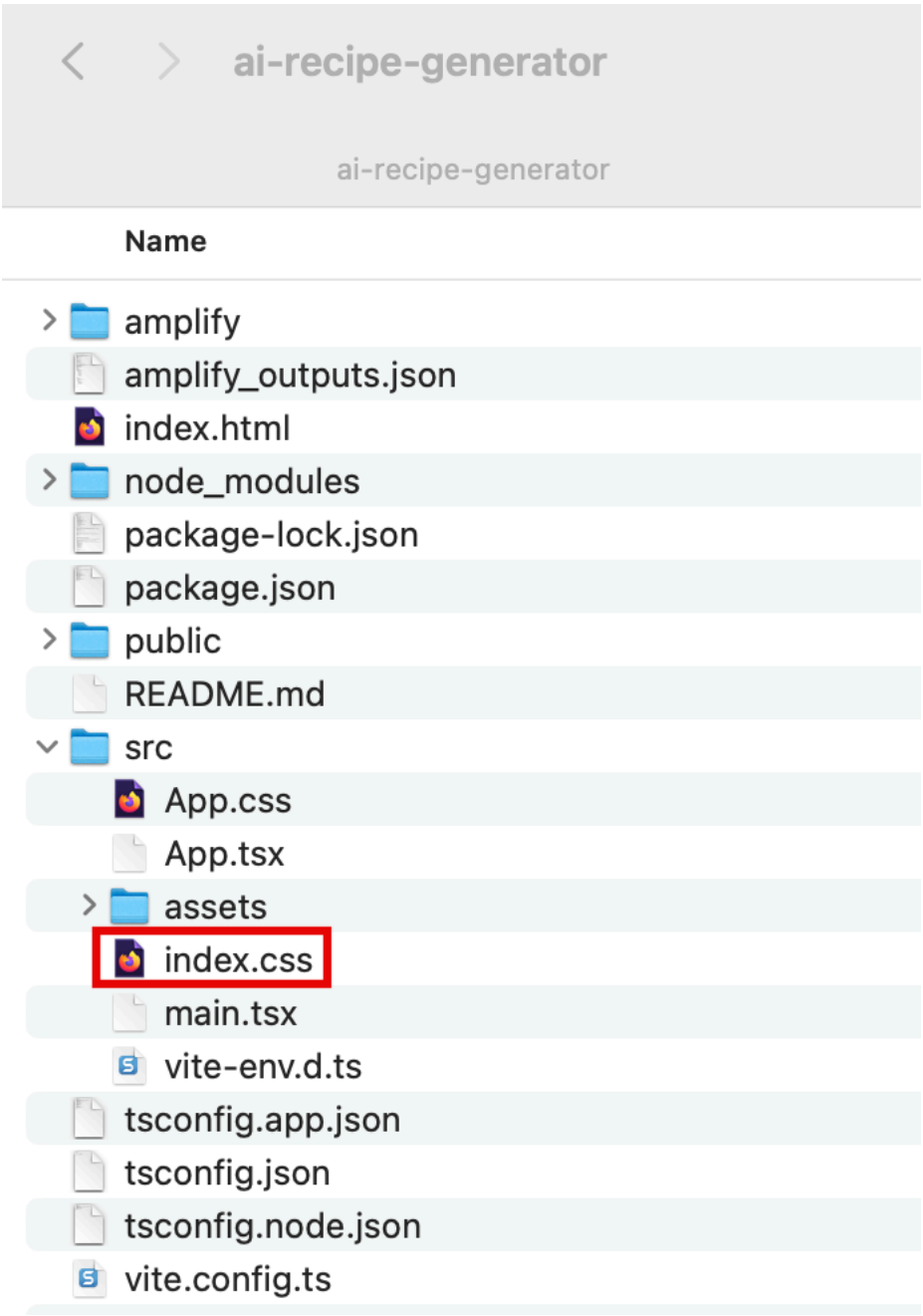
Step 2: Style the App UI

1. Modify the Index CSS

   On your local machine, navigate to the **ai-recipe-generator/src/index.css** file, and **update** it with the following code to center the App UI. Then, **save** the file.

```
:root {
  font-family: Inter, system-ui, Avenir, Helvetica, Arial, sans-serif;
  line-height: 1.5;
  font-weight: 400;

  color: rgba(255, 255, 255, 0.87);

  font-synthesis: none;
  text-rendering: optimizeLegibility;
  -webkit-font-smoothing: antialiased;
  -moz-osx-font-smoothing: grayscale;

  max-width: 1280px;
  margin: 0 auto;
  padding: 2rem;
```

```
}

.card {
  padding: 2em;
}

.read-the-docs {
  color: #888;
}

.box:nth-child(3n + 1) {
  grid-column: 1;
}
.box:nth-child(3n + 2) {
  grid-column: 2;
}
.box:nth-child(3n + 3) {
  grid-column: 3;
}
```



2. Modify the App CSS

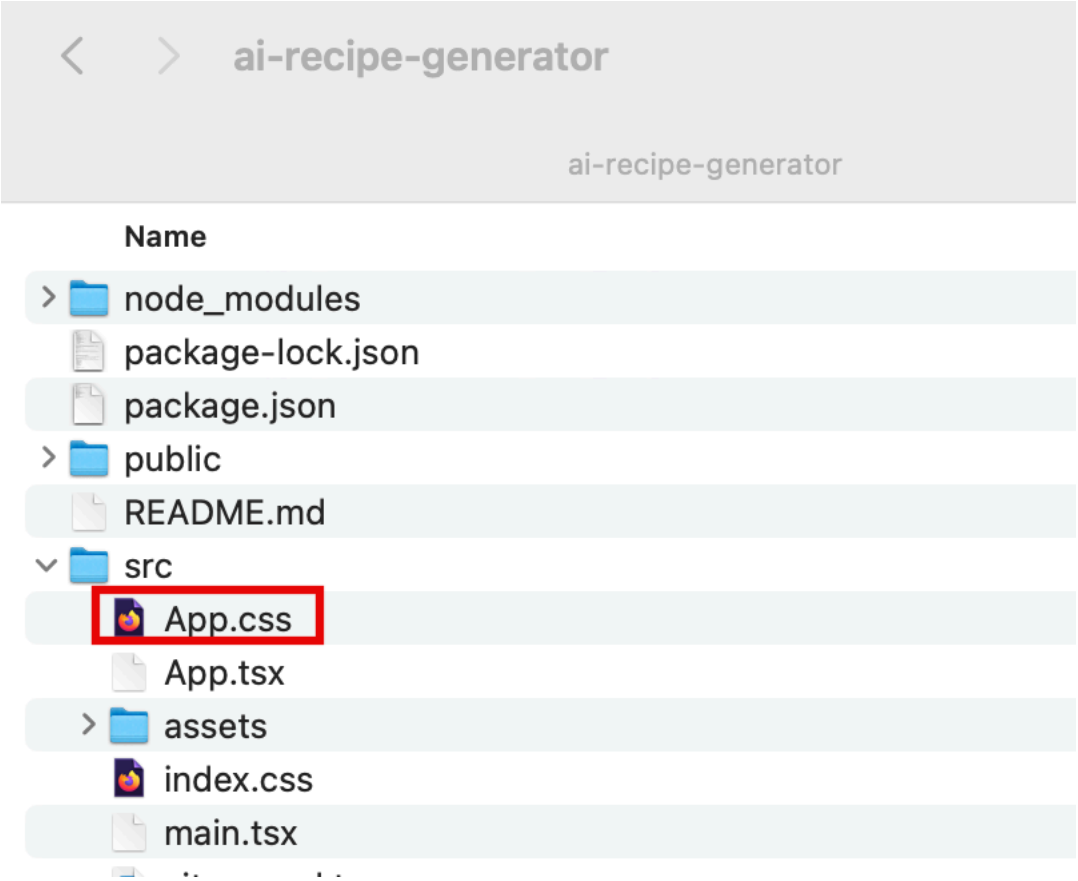
   Update the *src/App.css* file with the following code to style the ingredients form. Then, **save** the file.

```
.app-container {

  margin: 0 auto;
  padding: 20px;
```

```
  text-align: center;
}

.header-container {
  padding-bottom: 2.5rem;
  margin:  auto;
  text-align: center;

  align-items: center;
  max-width: 48rem;


}

.main-header {
  font-size: 2.25rem;
  font-weight: bold;
  color: #1a202c;
}

.main-header .highlight {
  color: #2563eb;
}

@media (min-width: 640px) {
  .main-header {
    font-size: 3.75rem;
  }
}

.description {

  font-weight: 500;
  font-size: 1.125rem;
  max-width: 65ch;
  color: #1a202c;
}

.form-container {
  margin-bottom: 20px;
}

.search-container {
  display: flex;
```

```
  flex-direction: column;
  gap: 10px;
  align-items: center;
}

.wide-input {
  width: 100%;
  padding: 10px;
  font-size: 16px;
  border: 1px solid #ccc;
  border-radius: 4px;
}

.search-button {
  width: 100%; /* Make the button full width */
  max-width: 300px; /* Set a maximum width for the button */
  padding: 10px;
  font-size: 16px;
  background-color: #007bff;
  color: white;
  border: none;
  border-radius: 4px;
  cursor: pointer;
}

.search-button:hover {
  background-color: #0056b3;
}

.result-container {
  margin-top: 20px;
  transition: height 0.3s ease-out;
  overflow: hidden;
}

.loader-container {
  display: flex;
  flex-direction: column;
  align-items: center;
  gap: 10px;
}

.result {
  background-color: #f8f9fa;
```

```
  border: 1px solid #e9ecef;
  border-radius: 4px;
  padding: 15px;
  white-space: pre-wrap;
  word-wrap: break-word;
  color: black;
  font-weight: bold;
  text-align: left; /* Align text to the left */
}
```



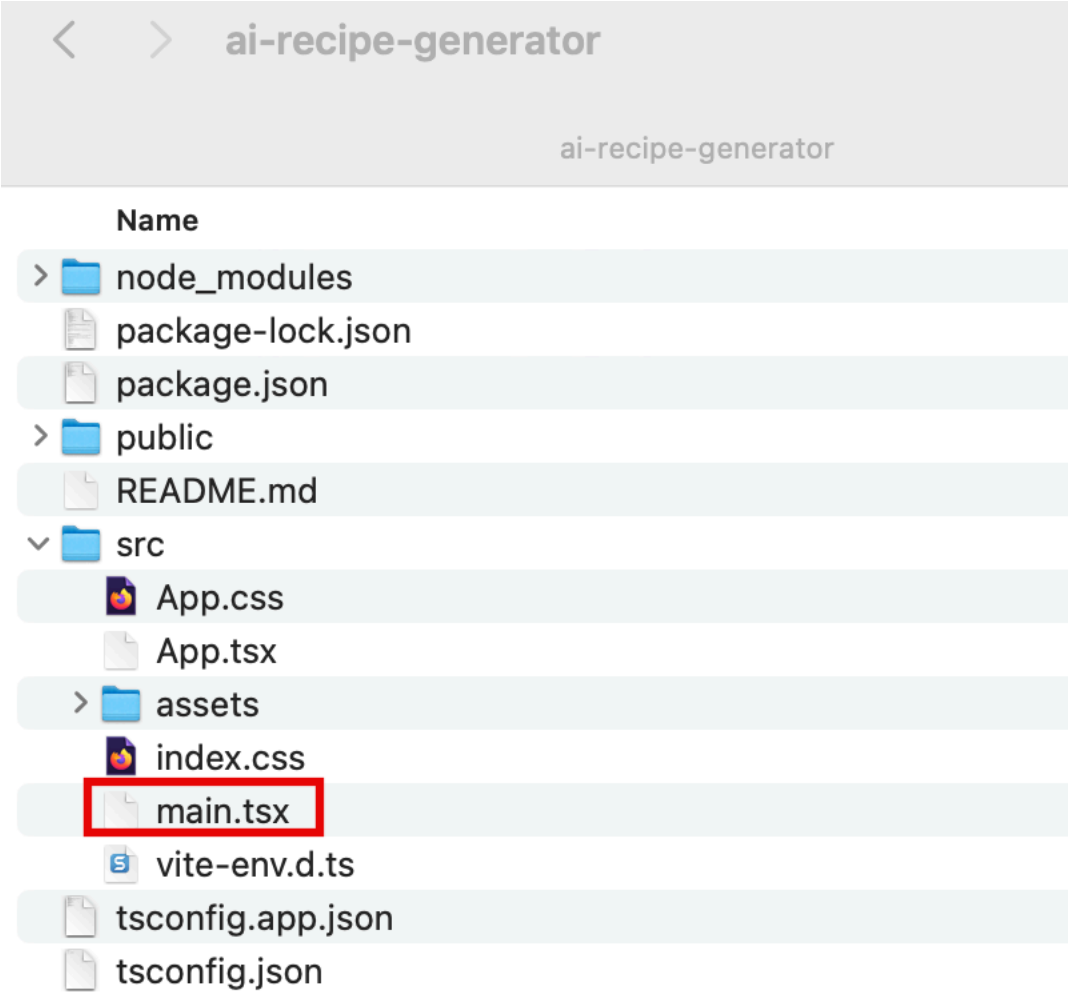
Step 3: Implement the UI

1. Add authentication

   On your local machine, navigate to the **ai-recipe-generator/src/main.tsx** file, and **update** it with the following code. Then, **save** the file.

- The code will use the Amplify Authenticator component to scaffold out an entire user authentication flow allowing users to sign up, sign in, reset their password, and confirm sign-in for multifactor authentication (MFA).

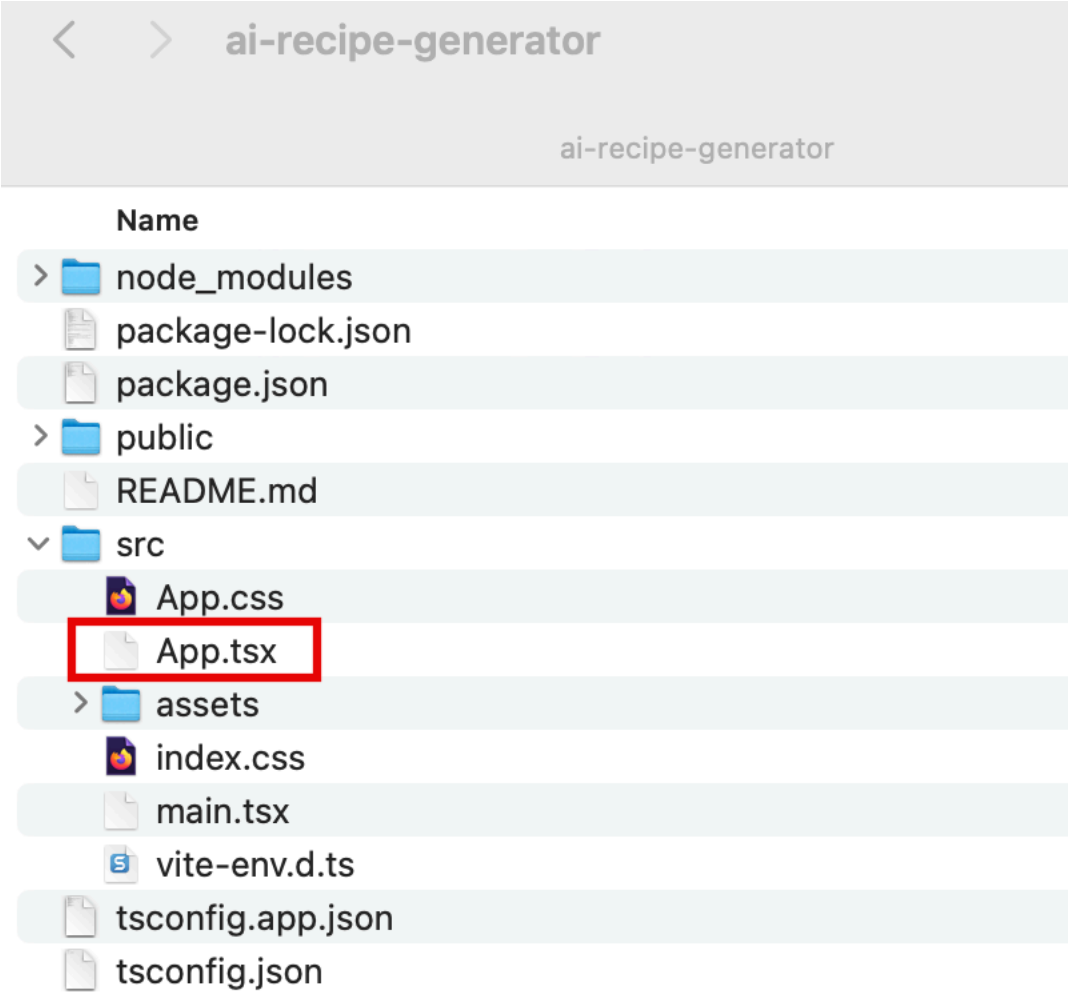
```
import React from "react";
import ReactDOM from "react-dom/client";
import App from "./App.jsx";
import "./index.css";
import { Authenticator } from "@aws-amplify/ui-react";

ReactDOM.createRoot(document.getElementById("root")!).render(
  <React.StrictMode>
    <Authenticator>
      <App />
    </Authenticator>
  </React.StrictMode>
);
```



2. Configure the Amplify library

   Open the **ai-recipe-generator/src/App.tsx** file, and **update** it with this code. Then, **save** the file.

   - The code starts by configuring the Amplify library with the client configuration file (**amplify_outputs.json)**. It then generates a data client using the **generateClient()** function. The app presents a form to users for submitting a list of ingredients. Once submitted, it will use the data client to pass the list to the **askBedrock** query and retrieve the generated recipe then display it to the user.



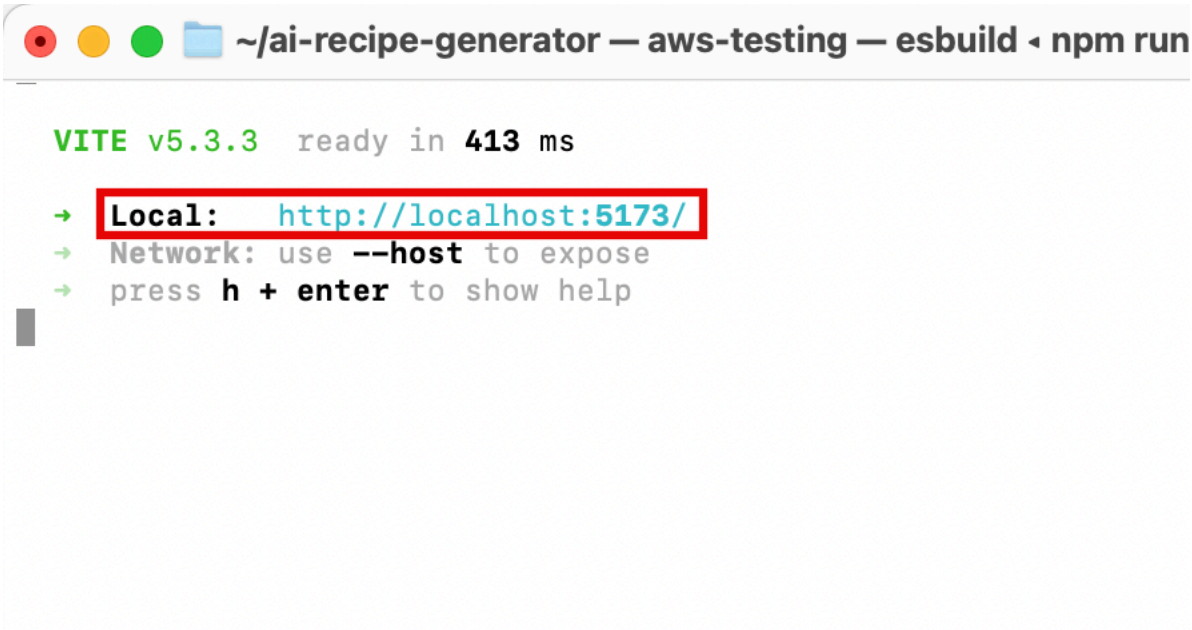
3. Launch the app

   Open a new terminal window, **navigate** to your projects root directory (**ai-recipe-generator**), and **run** the following command to launch the app:

   ```
   npm run dev
   ```

4. Open the app

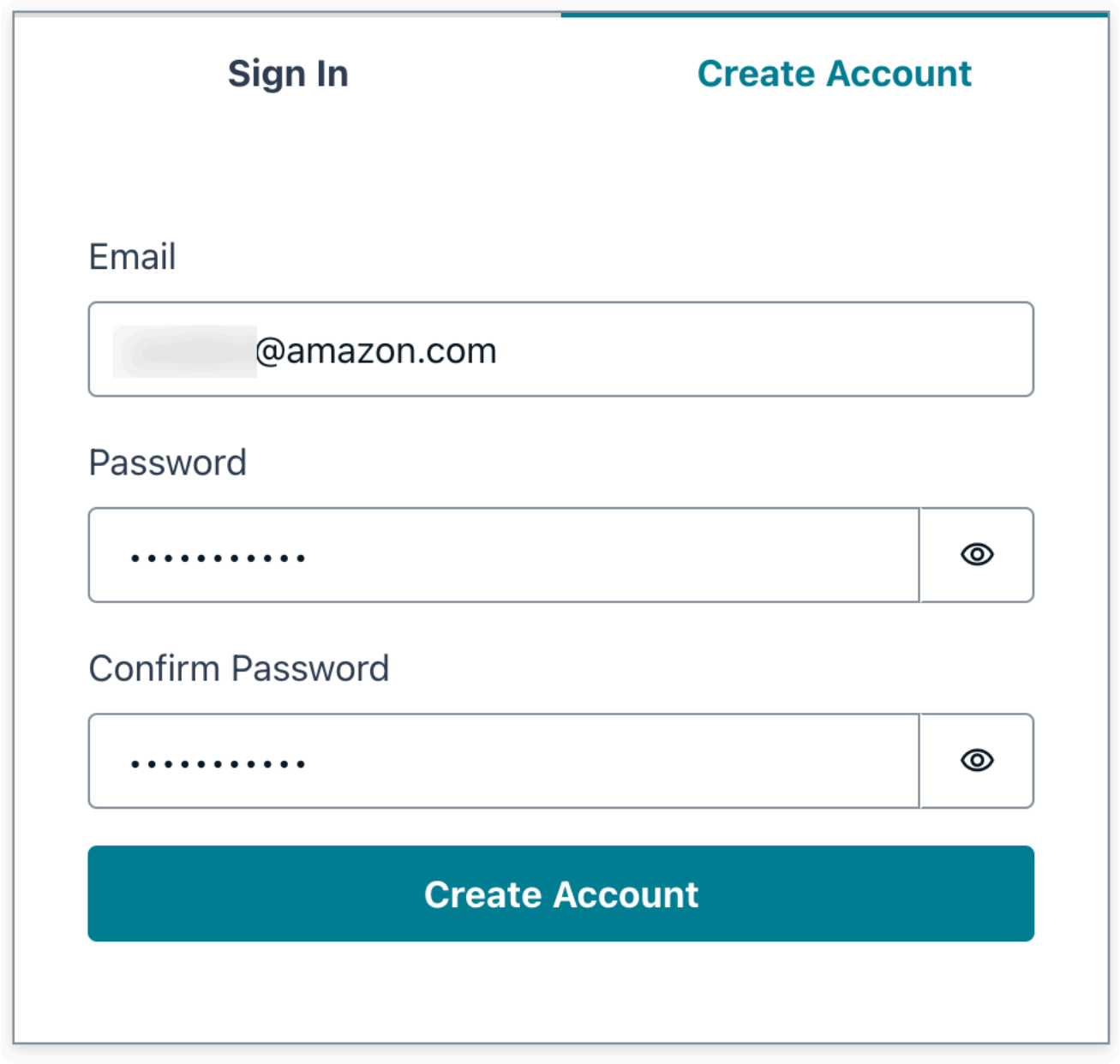
   Select the **Local host link** to open the Vite + React application.



5. Create an account

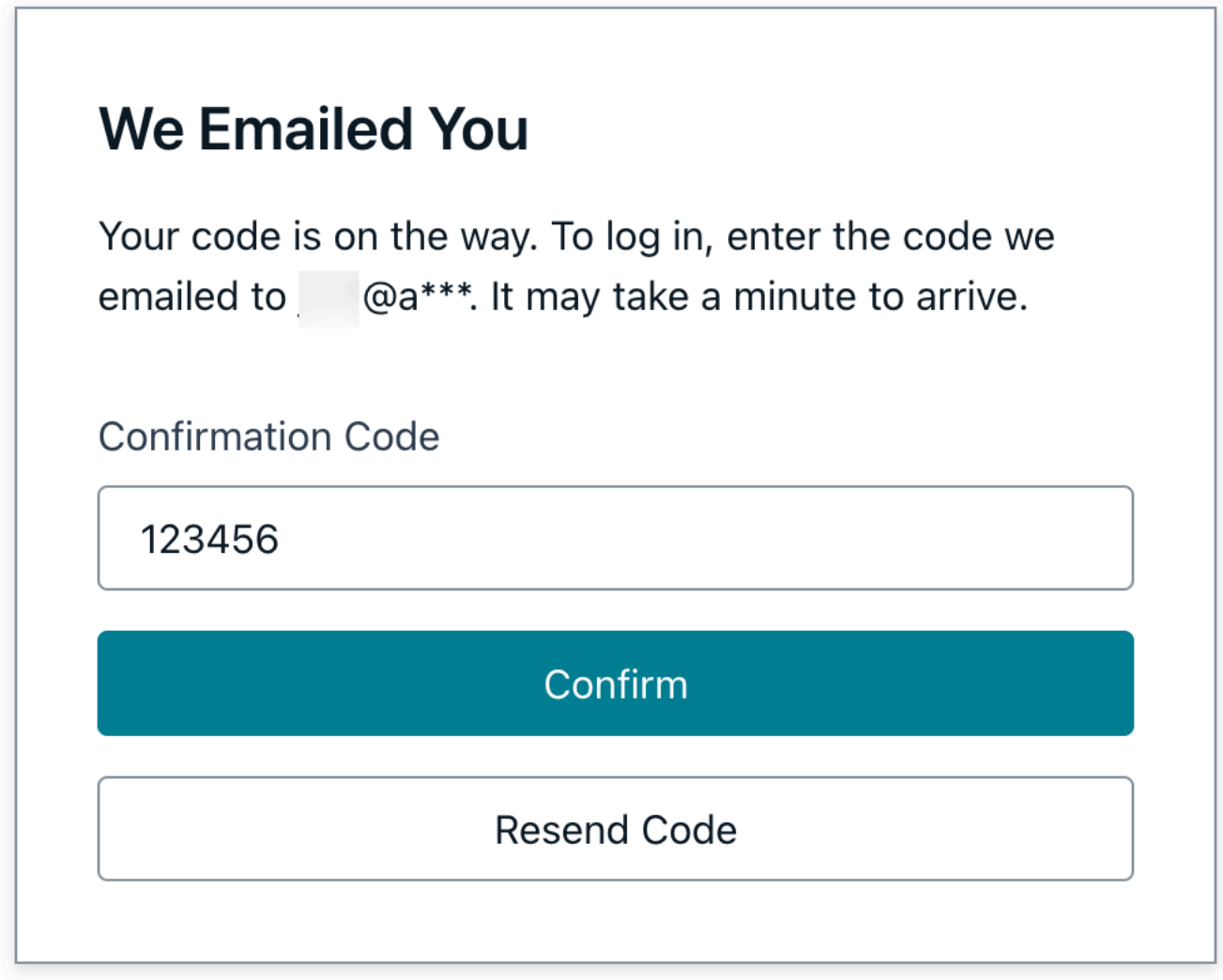
   Choose the **Create Account** tab, and use the authentication flow to create a new user by entering your **email address** and a **password**.

   Then, choose **Create Account**.



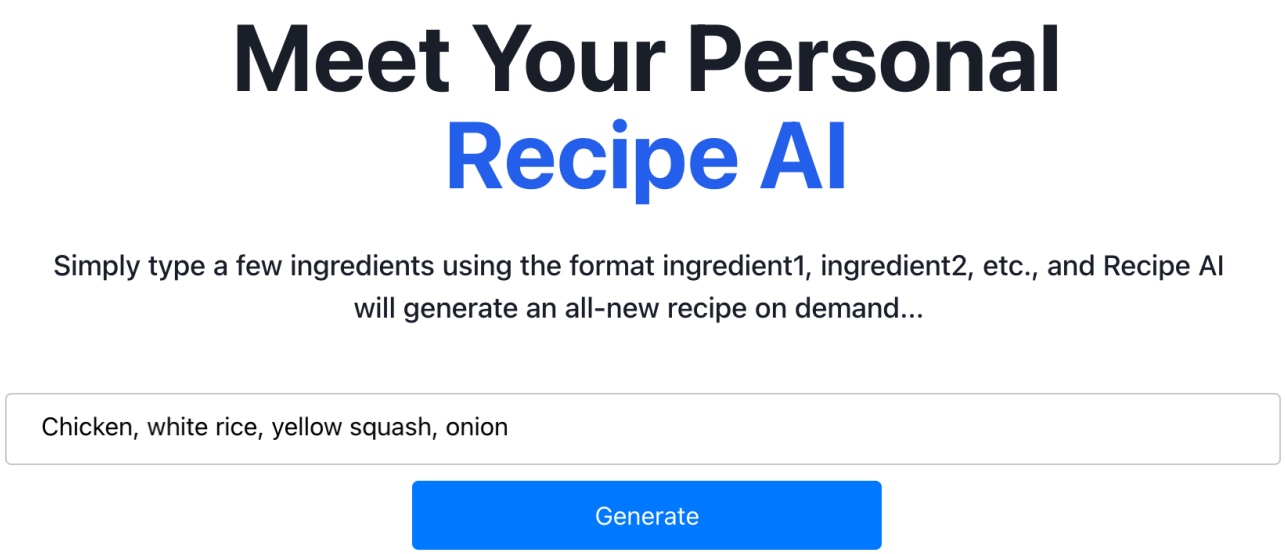
6. Enter verification code

   You will get a verification code sent to your email. Enter the **verification code** to log in to the app.



7. Generate recipes

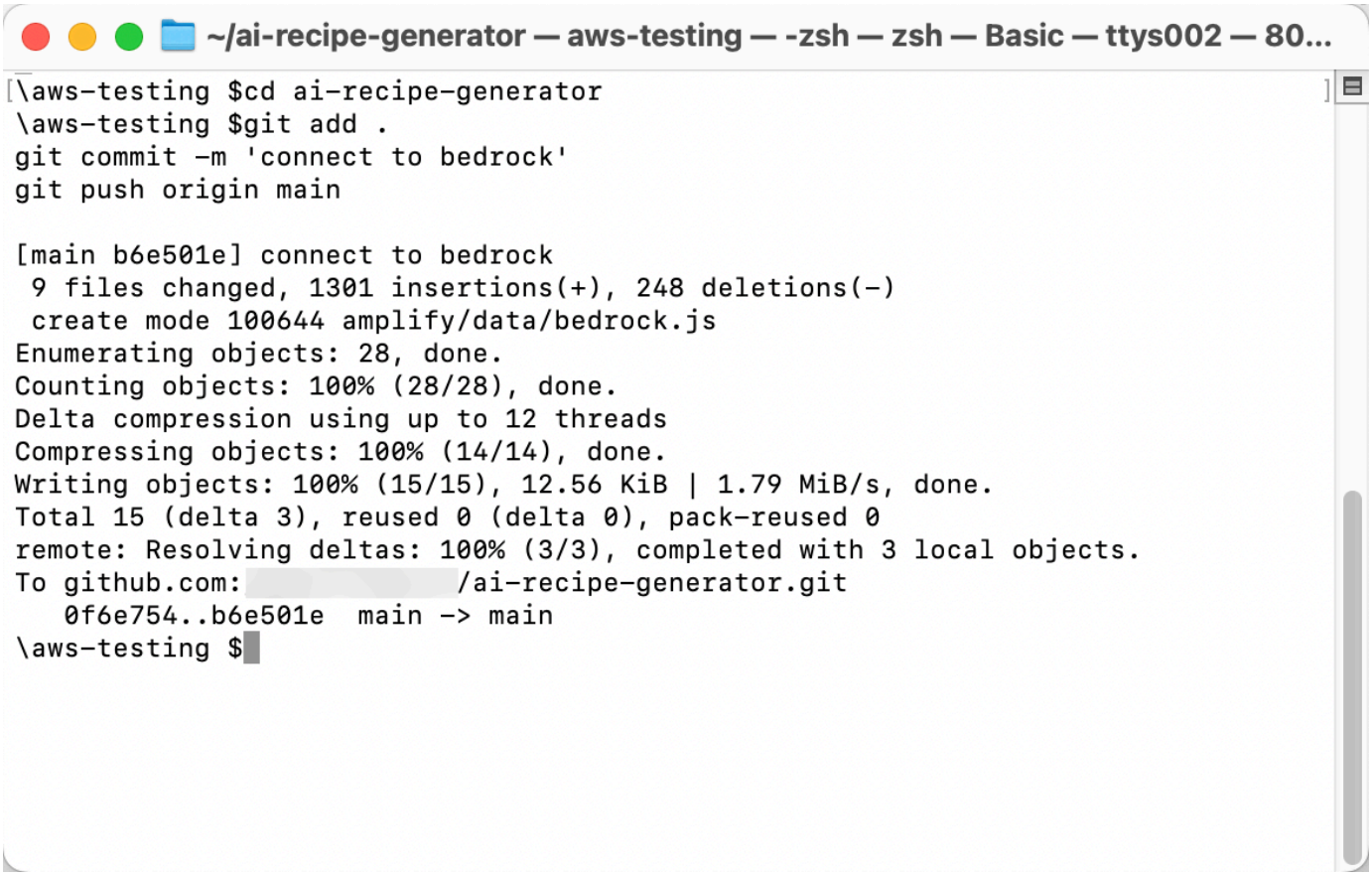
   When signed in, you can start **inputting ingredients** and **generating recipes.**



8. Push changes

   In the open terminal window, **run** the following command to push the changes to GitHub:

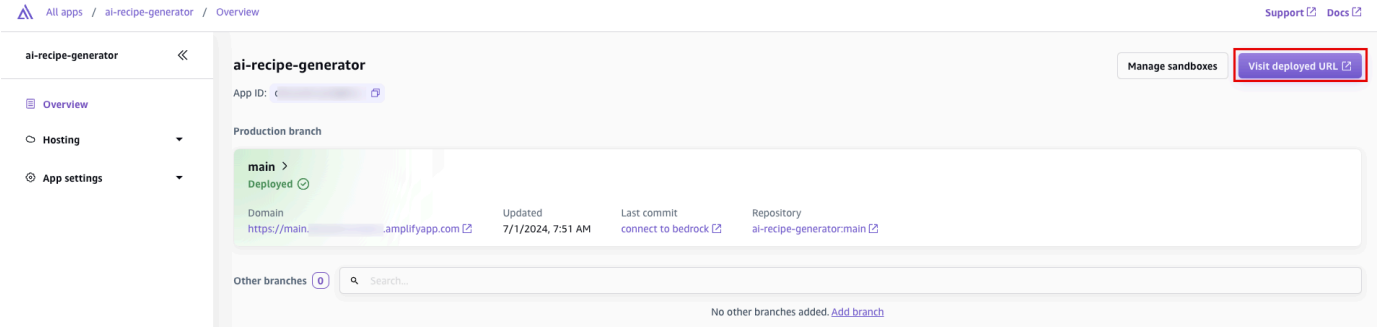
```
git add .
git commit -m 'connect to bedrock'
git push origin main
```



9. View your changes

Sign in to the AWS Management console in a new browser window, and **open** the AWS Amplify console at https://console.aws.amazon.com/amplify/apps.

AWS Amplify automatically builds your source code and deployed your app at **https://...amplifyapp.com**, and on every git push your deployment instance will update. Select the **Visit deployed URL** button to see your web app up and running live.



Conclusion

You have now connected your app to the Amplify backend and built a frontend to generate a recipe based on a list of ingredients submitted by the user.

Task 6: Clean up Resources

Time to complete	<2 minutes

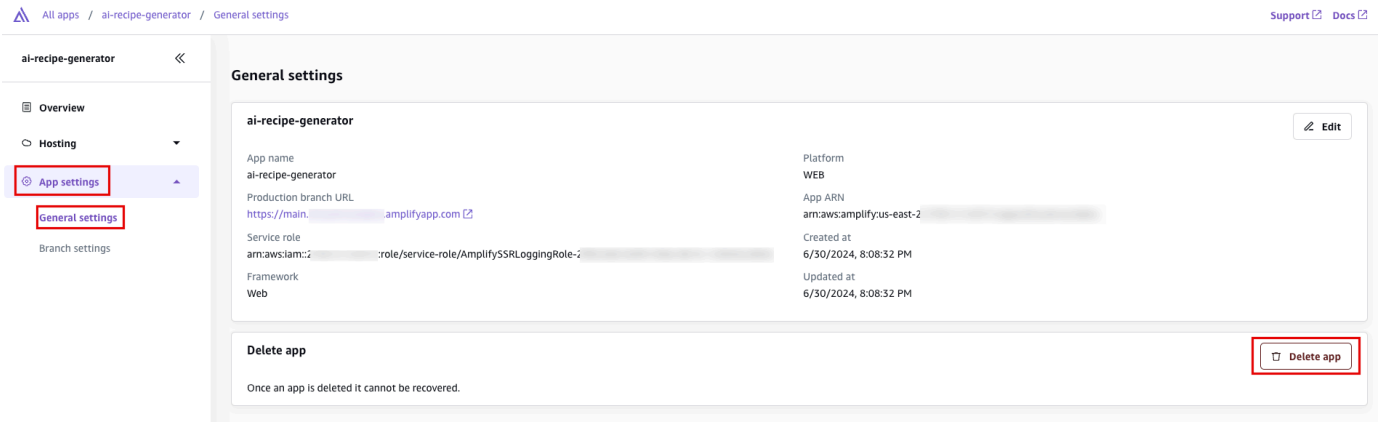
Overview

In this task, you will go through the steps to delete all the resources you created throughout this tutorial. It is a best practice to delete resources you are no longer using to avoid unwanted charges.

1. Open general settings

   In the Amplify console, in the left-hand navigation for the **ai-recipe-generator** app, choose **App settings**, and select **General settings**.
2. Delete the app

   In the **General settings** section, choose **Delete app**.



Congratulations

You have created a React web app and used Amplify and Amazon Bedrock to develop an AI-powered Recipe Generator App. Additionally, you've deployed the app on AWS using Amplify Hosting.