

CS3219 SE Toolbox - CD with GitHub Actions and AWS

The CS3219 SE Toolbox is a collection of guides and resources to help you get started with the various tools and technologies used CS3219 - Software Engineering Principles and Patterns.

This guide provides a step-by-step walkthrough on how to set up Continuous Deployment (CD) with GitHub Actions and Amazon Web Services (AWS).

Learning Objectives

Welcome to this guide on Continuous Deployment (CD) with GitHub Actions and Amazon Web Services (AWS). In this guide, you will learn:

- How to manually deploy the backend of the address book app you created previously to AWS environment.
- How to set up a GitHub Actions workflow that automates the deployment process.

Prerequisites

Before starting, ensure that you have the following:

1. Basic understanding of Git and version control
2. A GitHub account
3. Familiarity with the concepts of CD
4. Node.js and npm installed on your local machine
5. An AWS account (if you don't have one, sign up at <https://aws.amazon.com/>)
6. A MongoDB Atlas account (visit [this guide](#) to get started with MongoDB Atlas)

Setup

1. Fork and then clone the repository <https://github.com/nus-CS3219/CS3219-CD-GH-AWS-Code.git> to your device.

i About the project: The repository contains the backend code of an address book application, one that is similar to what you have seen in CS2103/T or CS2113/T but developed in JavaScript. The backend is equipped with basic functionalities, including

the ability to add, retrieve, edit, and delete information, by connecting to MongoDB Atlas – a cloud database.

2. Install all dependencies by running `npm install` in the project directory.
3. Set up a cloud MongoDB database on MongoDB Atlas and obtain the connection string. Create a copy of the `.env.sample` file and name it `.env`. Update the `CLOUD_URI` environment variable inside `.env` to point to the cloud database.

i If your password contains special characters which leads to a parsing error, you need to encode the URI. You may do so at [here](#). For more details, refer to this [guide](#).

4. Start the application locally using `npm start`.

Go to `localhost:8080` and you should be able to see “Welcome to Address Book with CD!”.

You can also use Postman to test CRUD operations on the API locally. By using the cloud database, you are now testing the application in a local deployment scenario without using a local database.

Part I: Deploying to AWS Elastic Beanstalk

We will first manually deploy the backend of the address book app to AWS Elastic Beanstalk. This will help you understand the deployment process and the different components involved. Then, we will set up GitHub Actions to automate the deployment process.

Amazon Web Services (AWS) is a cloud computing platform that allows developers to run their applications and services in the cloud without managing the underlying infrastructure, making it easier for developers to deploy and manage their applications.

AWS Elastic Beanstalk is a fully managed orchestration service within AWS that makes deploying web applications simple. It handles the complexities of infrastructure setup, scaling, and deployment, allowing developers to focus on writing code.

When you deploy your web application to AWS Elastic Beanstalk, it involves a few important parts:

- **Application:** This is the web application or API that you want to run in the cloud.
- **Environment:** It’s like a configuration/setup that specifies how your application will run on AWS. You can have different environments for testing, staging, or production.
- **EC2 Instances (Elastic Compute Cloud):** These are virtual servers in the cloud that host/run your application.
- **S3 Bucket (Simple Storage Service):** It might be used to store your application’s versions and files.
- **Application Version:** An application version refers to a specific labeled version of your application’s code that you upload, enabling you to roll back to a previous version if needed.

Each version points to an S3 object where the deployable application code is stored.

- **Load Balancer:** It helps distribute incoming traffic across multiple EC2 instances for better performance and reliability.
- **Security Groups:** These are like virtual firewalls for EC2 instances and other AWS resources. They control the inbound and outbound traffic for these resources, e.g., permit or deny specific types of traffic based on source and destination IP addresses.
- **IAM Role (Identity and Access Management):** An IAM role is an identity that has a set of permissions. It is similar to a user, but isn't tied to a specific individual and does not have long-term credentials. Instead, when you assume a role, it provides you with temporary security credentials to access resources.
- **Identity-based policies:** These are JSON documents that define permissions, i.e., specifying which actions can be performed on which AWS resources. Policies are attached to roles to grant specific permissions.

Now follow these steps to manually deploy the backend of the address book app:

Step 1. Set Up AWS Account and Elastic Beanstalk

If you haven't already, sign up for an AWS account at <https://aws.amazon.com/>. Once you have your AWS account ready, navigate to the AWS Management Console.

Step 2. Create an Elastic Beanstalk Application and Environment

2.1 In the AWS Management Console, search for and navigate to the **Elastic Beanstalk** service. In the navigation bar, choose **Asia Pacific (Singapore)** **ap-southeast-1** as the region. Alternatively, you can use this [direct link](#).

2.2 Choose Create application.

The screenshot shows the AWS Management Console interface for the Elastic Beanstalk service. The top navigation bar displays the AWS logo, a search bar, and the current region 'Singapore' with a dropdown arrow. The main content area features a large header for 'Amazon Elastic Beanstalk' with the subtitle 'End-to-end web application management'. Below this, there's a 'Get started' section with a 'Create application' button highlighted by a red box and a red number '2'. To the right, a list of regions is shown, with 'Asia Pacific (Singapore) ap-southeast-1' highlighted by a red box and a red number '1'. The bottom of the page includes a 'Pricing' section and a 'Getting started' section with a 'Launch a web application' button. The footer contains links for 'CloudShell', 'Feedback', 'Language', and copyright information for Amazon Web Services, Inc. or its affiliates.

2.3 Under **Application name**, enter a name for the application (e.g., `AddressBookApp`). The **Environment name** below will be auto-populated.

2.4 Under **Platform**, select **Node.js** as the platform, since our application is built using Node.js.

2.5 Keep the default settings for all other places, then choose **Next**. (Feel free to explore other settings for your own interest:wink:)

Configure environment [Info](#)


Environment tier [Info](#)

Amazon Elastic Beanstalk has two types of environment tiers to support different types of web applications.

☒ **Web server environment**

Run a website, web application, or web API that serves HTTP requests. [Learn more](#) 

☐ **Worker environment**

Run a worker application that processes long-running workloads on demand or performs tasks on a schedule. [Learn more](#) 

Application information [Info](#)

Application name

Maximum length of 100 characters.

► **Application tags (optional)**

Environment information [Info](#)

Choose the name, subdomain and description for your environment. These cannot be changed later.

Environment name

Must be from 4 to 40 characters in length. The name can contain only letters, numbers, and hyphens. It can't start or end with a hyphen. This name must be unique within a region in your account.

Platform [Info](#)

Platform type

☒ **Managed platform**

Platforms published and maintained by Amazon Elastic Beanstalk. [Learn more](#) 

☐ **Custom platform**

Platforms created and owned by you. This option is unavailable if you have no platforms.

Platform

Node.js

Platform branch

Node.js 20 running on 64bit Amazon Linux 2023

Platform version

6.2.1 (Recommended)

Intermission: Configuring Service Access

Now, we are at **Step 2 - Configure service access** in the console. This step requires us to set up some necessary permissions for the application to work properly within AWS. Here's why it matters:

As an orchestration service, *Elastic Beanstalk* needs to interact with various other AWS services. For example, it manages the creation and operation of EC2 instances (the servers running the app), sets up load balancers, and so on. To do these securely, we need to explicitly grant Elastic Beanstalk the necessary permissions through an *IAM role*, which is called the "**service role**" - essentially, a set of permissions.

On the other hand, the *EC2 instance* also require permissions to perform certain tasks, such as retrieving our application's code (which we will upload later) from S3. We configure these permissions through an "**EC2 instance profile**", which is a wrapper around an IAM role - essentially, another set of permissions.

If you expand the **EC2 instance profile** dropdown, it may be empty at the moment. In the past, Elastic Beanstalk could automatically create both the service role and instance profile when an AWS account first created an environment. However, due to recent changes in AWS security guidelines, we now need to manually create an instance profile first, then instruct Elastic Beanstalk to use it. If you already see the default `aws-elasticbeanstalk-ec2-role` in the list, you can simply choose it and proceed to the next step.

To create a new instance profile/IAM role, you can follow [these simple steps in the AWS documentation](#).

- Remember, an IAM role defines a set of permissions via policies. In step 6 of the process, you may assign all of the 3 default policies recommended by Elastic Beanstalk. You can find these by clicking **View permission details** under the EC2 instance profile dropdown. Simply search for the policy names and select them.

Configure service access [Info](#)

Service access

IAM roles, assumed by Elastic Beanstalk as a service role, and EC2 instance profiles allow Elastic Beanstalk to create and manage your environment. Both the IAM role and instance profile must be attached to IAM managed policies that contain the required permissions. [Learn more](#)

Service role

☐ Create and use new service role

☒ Use an existing service role

Existing service roles

Choose an existing IAM role for Elastic Beanstalk to assume as a service role. The existing IAM role must have the required IAM managed policies.

EC2 key pair

Select an EC2 key pair to securely log in to your EC2 instances. [Learn more](#)

Choose a key pair

EC2 instance profile

Choose an IAM instance profile with managed policies that allow your EC2 instances to perform required operations.

[View permission details](#)

Cancel

Skip to review

Previous

Next

- For step 8, you can either use a custom name or stick with the default `aws-elasticbeanstalk-ec2-role`.

[IAM](#)

>

[Roles](#)

>

Create role

Step 1

[Select trusted entity](#)

Step 2

[Add permissions](#)

Step 3

Name, review, and create

Name, review, and create

Role details

Role name
Enter a meaningful name to identify this role.

aws-elasticbeanstalk-ec2-role

Maximum 64 characters. Use alphanumeric and '+=, @-/_{}#\$\$%^()~;' characters.

Description
Add a short explanation for this role.

Allows EC2 instances to call AWS services on your behalf.

Maximum 1000 characters. Use letters (A-Z and a-z), numbers (0-9), tabs, new lines, or any of the following characters: _+=, @-/_{}#\$\$%^()~;'.

Step 1: Select trusted entities

Edit

Trust policy

```
1 {
2   "Version": "2012-10-17",
3   "Statement": [
4     {
5       "Effect": "Allow",
6       "Action": [
7         "sts:AssumeRole"
8       ],
9       "Principal": {
10        "Service": [
11          "ec2.amazonaws.com"
12        ]
13      }
14    }
15  ]
16 }
```

Step 2: Add permissions

Edit

Permissions policy summary

Policy name	Type	Attached as
AWSElasticBeanstalkMulticontainerDocker	AWS managed	Permissions policy
AWSElasticBeanstalkWebTier	AWS managed	Permissions policy
AWSElasticBeanstalkWorkerTier	AWS managed	Permissions policy

Step 3: Add tags

Add tags - optional [Info](#)

Tags are key-value pairs that you can add to AWS resources to help identify, organize, or search for resources.

No tags associated with the resource.

Add new tag

You can add up to 50 more tags.

Cancel

Previous

Create role


Once you've created the IAM role, return to **Step 2 - Configure service access**. Refresh the list under **EC2 instance profile**, and you should see the instance profile you just created.

2.6 Under **Service role**, choose **Create and use new service role** (or choose an existing one if available in the dropdown).

2.7 Under **EC2 instance profile**, choose the instance profile you just created (or your existing one if you already had it).

Configure service access [Info](#)

Service access

IAM roles, assumed by Elastic Beanstalk as a service role, and EC2 instance profiles allow Elastic Beanstalk to create and manage your environment. Both the IAM role and instance profile must be attached to IAM managed policies that contain the required permissions. [Learn more](#) 

Service role

- ☒ Create and use new service role
☐ Use an existing service role

Service role name

Enter the name for an IAM role that Elastic Beanstalk will create to assume as a service role. Beanstalk will attach the required managed policies to it.

[View permission details](#)

EC2 key pair

Select an EC2 key pair to securely log in to your EC2 instances. [Learn more](#) 



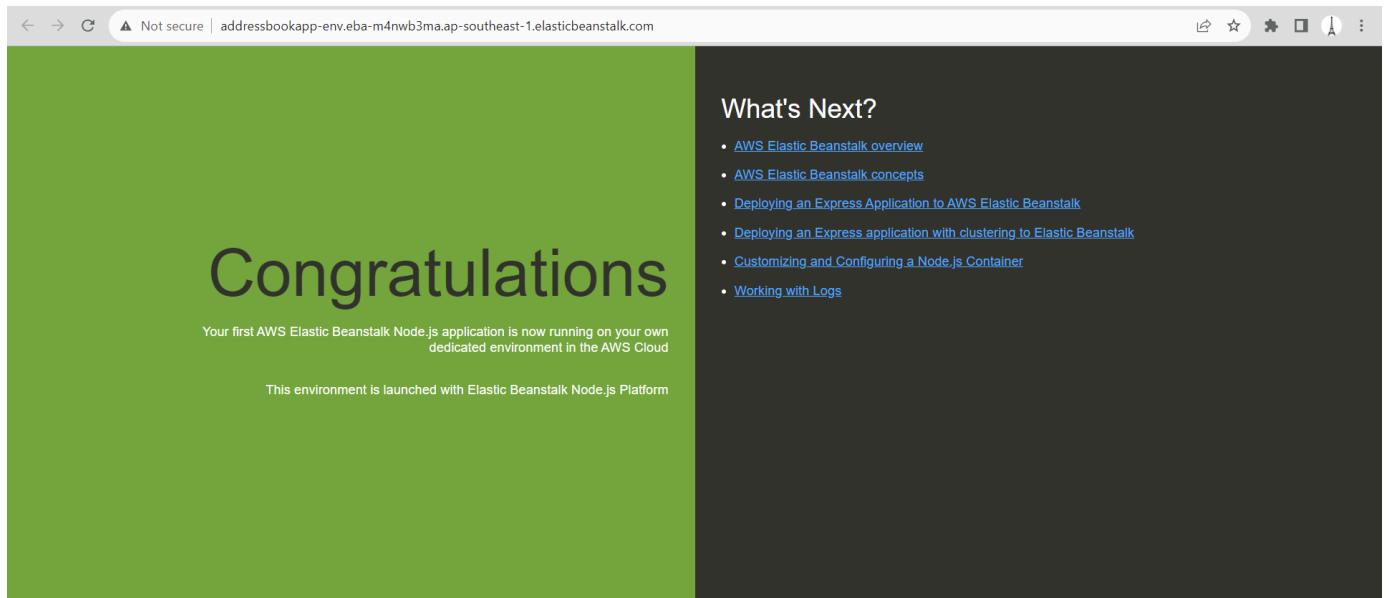
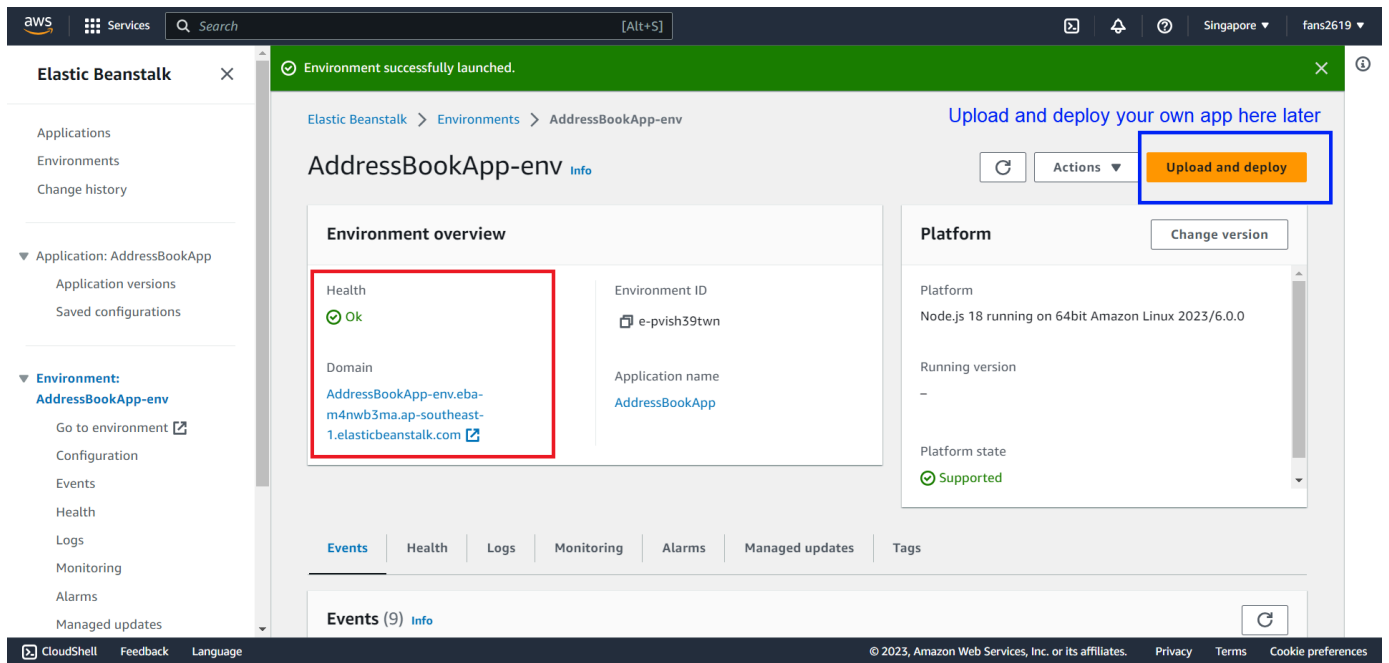
EC2 instance profile

Choose an IAM instance profile with managed policies that allow your EC2 instances to perform required operations.

[View permission details](#)[Cancel](#)[Skip to review](#)[Previous](#)[Next](#)

2.8 We will keep all other settings at their default values. Choose **Skip to review**, and then **Submit**. Elastic Beanstalk will now create a new *application* along with a new web server *environment* named `AddressBookApp-env` to run its sample application.

2.9 Wait for the environment's health status to change to "Ok". This may take a few minutes. Once it's ready, you can access the sample application at the auto-generated domain.



Step 3. Prepare Application for Deployment

In your local development environment, create a zip file named `address-book-app.zip` containing all the application files.

- You can omit the `node_modules` folder, as Elastic Beanstalk will install the dependencies in production mode as specified in `package.json`.
- For now, include the `.env` file in the zip, as it contains the cloud database connection string required for the application.

Step 4. Deploy Application

4.1 Return to the AWS Elastic Beanstalk dashboard and navigate to the environment you created earlier.

4.2 Choose **Upload and deploy**.

4.3 Upload the zip file you just created. Then in the **Version label** field, enter a version name for this deployment (e.g., 1.0.0).

4.4 Choose **Deploy** to start the deployment process.

Upload and deploy

To deploy a previous version, go to the [Application versions page](#)

Upload application

Choose file

✓ File name: **address-book-app.zip**

File must be less than 500MB max file size

Version label

Unique name for this version of your application code.

1.0.0

Current number of EC2 instances: 1

Cancel

Deploy

4.5 Elastic Beanstalk takes care of the rest. Once the deployment is complete, you can visit the environment URL to access the deployed application. Our backend API is now running in the cloud!



Part II: Setting Up GitHub Actions for Automated Deployment

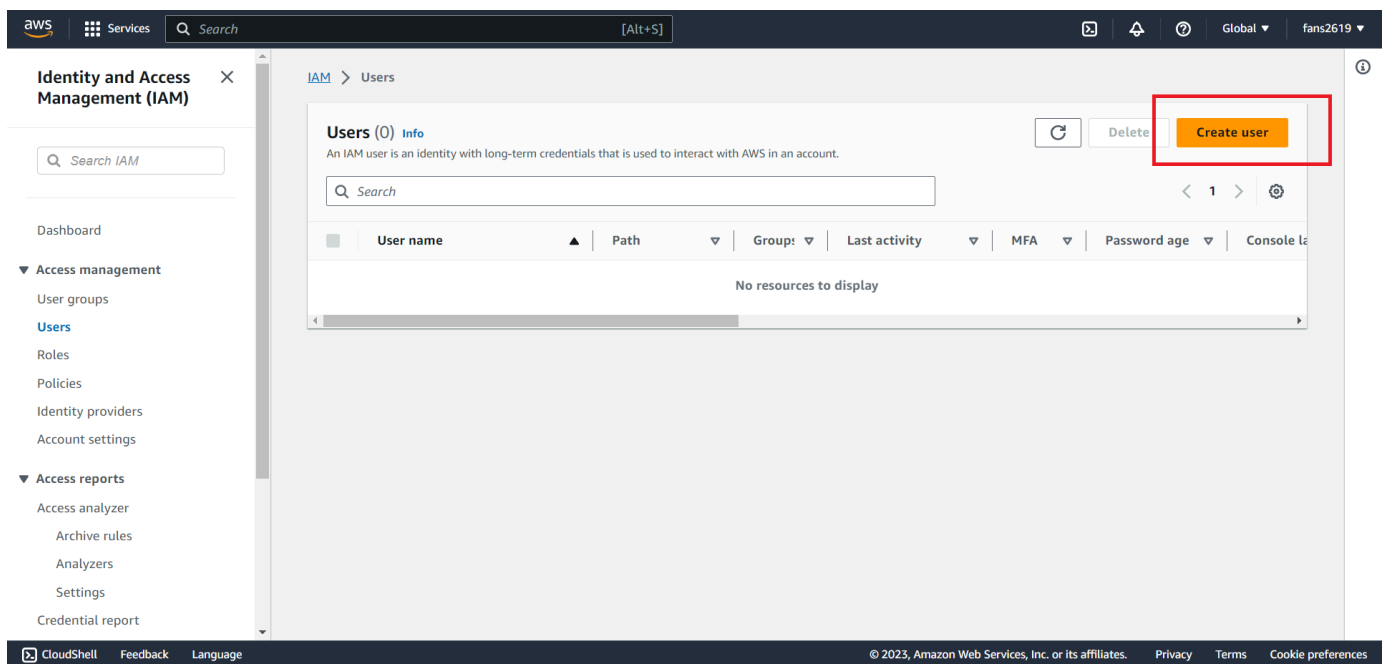
We will now set up GitHub Actions to automate the deployment process, enabling Continuous Deployment (CD) for our application on AWS Elastic Beanstalk. By doing so, every time changes are pushed to the master branch, GitHub Actions will automatically deploy the updated application to the cloud.

Step 1: Set Up AWS IAM User and Access Key

For GitHub to interact with AWS services securely, we need to provide the necessary credentials with appropriate permissions.

1.1 In the AWS Management Console, search for and navigate to the **IAM** service.

1.2 In the IAM console, select **Users** in the left navigation pane and then select **Create user**.



1.3 Enter a unique username (e.g., `AddressBookDeployUser`) and select **Next**.

Specify user details

User details

User name

AddressBookDeployUser

The user name can have up to 64 characters. Valid characters: A-Z, a-z, 0-9, and + = , . @ _ - (hyphen)

☐ Provide user access to the AWS Management Console - *optional*
If you're providing console access to a person, it's a [best practice](#) to manage their access in IAM Identity Center.

i If you are creating programmatic access through access keys or service-specific credentials for AWS CodeCommit or Amazon Keyspaces, you can generate them after you create this IAM user. [Learn more](#)

Cancel

Next

1.4 In the **Set permissions** section, select **Attach policies directly**, then search for and select "AdministratorAccess-AWSElasticBeanstalk" policy. This policy grants the permissions to access the Elastic Beanstalk service. Then choose **Next**, and finally **Create user**.

Set permissions

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

Permissions options

☐ Add user to group
Add user to an existing group, or create a new group. We recommend using groups to manage user permissions by job function.

☐ Copy permissions
Copy all group memberships, attached managed policies, and inline policies from an existing user.

☒ **Attach policies directly**
Attach a managed policy directly to a user. As a best practice, we recommend attaching policies to a group instead. Then, add the user to the appropriate group.

Permissions policies (1/1119)

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

Filter by Type
All types ▼ 1 match

<input checked="" type="checkbox"/>	Policy name	Type	Attached entities
<input checked="" type="checkbox"/>	AdministratorAccess-AWSElastic...	AWS managed	0

1.5 After the user is created, navigate to the **Security credentials** tab for the user. Under **Access keys**, choose **Create access key** to generate a new access key for the user. You can select **Other** in the **Access key best practices & alternatives** section.

The screenshot shows the AWS IAM console interface. On the left is the navigation menu with sections for Identity and Access Management (IAM), Access management, and Access reports. The main content area shows the details for a user named 'AddressBookDeployUser'. The 'Security credentials' tab is selected and highlighted with a red box. Below this tab, the 'Console sign-in' section is visible, showing the console sign-in link and password status. The 'Summary' section above the tabs displays the user's ARN, console access status (Disabled), and the status of two access keys (both Not enabled).

Permissions

Groups

Tags

Security credentials

Access Advisor

Console sign-in

Enable console access

Console sign-in link

https://467173293158.signin.aws.amazon.com/console

Console password

Not enabled

Multi-factor authentication (MFA) (0)

Use MFA to increase the security of your AWS environment. Signing in with MFA requires an authentication code from an MFA device. Each user can have a maximum of 8 MFA devices assigned. [Learn more](#)

Remove

Resync

Assign MFA device

Device type	Identifier	Certifications	Created on
-------------	------------	----------------	------------

Access keys (0)

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

Create access key

No access keys

As a best practice, avoid using long-term credentials like access keys. Instead, use tools which provide short term credentials. [Learn more](#)

Create access key

1.6 In your GitHub repository, navigate to **Settings » Secrets and variables » Actions**, and add the *Access key* as `AWS_ACCESS_KEY_ID` and the *Secret access key* as `AWS_SECRET_ACCESS_KEY`.

aws

Services

Search

[Alt+S]

Global

fans2619

Access key created

This is the only time that the secret access key can be viewed or downloaded. You cannot recover it later. However, you can create a new access key any time.

IAM > Users > AddressBookDeployUser > Create access key

Step 1

Access key best practices & alternatives

Step 2 - optional

Set description tag

Step 3

Retrieve access keys

Retrieve access keys

Access key

AKIAWZRNSXRTAGULHHWL

Secret access key

***** [Show](#)

Access key best practices

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

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

Download .csv file

Done

CloudShell

Feedback

Language

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Privacy

Terms

Cookie preferences

The screenshot shows the GitHub Actions 'Secrets and variables' settings page. The left sidebar contains a navigation menu with categories like 'General', 'Access', 'Code and automation', 'Security', and 'Actions'. The 'Actions' category is selected, and the 'Secrets and variables' sub-option is highlighted. The main content area is titled 'Actions secrets and variables' and includes a description of secrets and variables. Below this, there are tabs for 'Secrets' and 'Variables'. The 'Secrets' tab is active, showing 'Environment secrets' (which are currently empty) and 'Repository secrets'. The 'Repository secrets' section contains a table with two entries: 'AWS_ACCESS_KEY_ID' and 'AWS_SECRET_ACCESS_KEY', both updated 1 minute ago. A 'New repository secret' button is visible in the top right corner of the repository secrets section.

General

Access

Collaborators

Moderation options

Code and automation

Branches

Tags

Rules

Actions

Webhooks

Environments

Codespaces

Pages

Security

Code security

Deploy keys

Secrets and variables

Actions

Codespaces

Dependabot

Actions secrets and variables

Secrets and variables allow you to manage reusable configuration data. Secrets are **encrypted** and are used for sensitive data. [Learn more about encrypted secrets](#). Variables are shown as plain text and are used for **non-sensitive** data. [Learn more about variables](#).

Anyone with collaborator access to this repository can use these secrets and variables for actions. They are not passed to workflows that are triggered by a pull request from a fork.

Secrets Variables

Environment secrets

This environment has no secrets.

Manage environment secrets

Repository secrets

Name ↕	Last updated
AWS_ACCESS_KEY_ID	1 minute ago
AWS_SECRET_ACCESS_KEY	1 minute ago

New repository secret

Step 2: Create an Automated Deployment Workflow

2.1 Create a `.github` directory in the root of your project

2.2 Inside the `.github` directory, create another directory named `workflows`

2.3 Inside the `workflows` directory, create a new file named `cd.yml`

2.4 Add the following code inside `cd.yml` :

```
name: CD Pipeline

on:
  push:
    branches:
      - master

jobs:
  deploy:
    runs-on: ubuntu-latest

    steps:
      - name: Checkout repository
        uses: actions/checkout@v4

      - name: Setup Node.js
        uses: actions/setup-node@v4
        with:
          node-version: '20.x'
          cache: 'npm'
```

```

- name: Generate deployment package
  run: zip -r address-book-app.zip config controllers models routes index.js package

- name: Get Node.js version
  run: echo "VERSION=$(node -p 'require("./package.json").version')" >> "$GITHUB_ENV"

- name: Deploy to EB
  uses: einaregilsson/beanstalk-deploy@v22
  with:
    aws_access_key: $
    aws_secret_key: $
    application_name: AddressBookApp
    environment_name: AddressBookApp-env
    version_label: $
    region: ap-southeast-1
    deployment_package: address-book-app.zip

```

name : This sets the name of the workflow. In our case, it's "CD Pipeline".

on : This specifies the events that trigger the workflow. We use the `push` event on the `master` branch. So, whenever code is pushed to the `master` branch, this workflow will be triggered.

jobs : This section defines one or more jobs for the workflow. Each job represents a set of steps that run on the same runner. In our case, we have a single job named "deploy".

runs-on : This specifies the operating system on which the job will run. We use `ubuntu-latest`, which represents the latest version of Ubuntu available on GitHub Actions.

steps : This section contains a list of steps to be executed in the job. Steps are the individual units of work that run commands or actions.

name : Each step is given a name to make the output more descriptive and easier to understand.

uses : This keyword is used to specify an action that should be executed as part of the step. For example, we use the `actions/checkout` to check out the code from the repository and `actions/setup-node` to set up Node.js on the runner.

In the workflow, there are two essential steps. First, we create a deployment package named "address-book-app.zip" by compressing all the necessary application files. Then, we utilize the `beanstalk-deploy` action, which takes care of deploying the correct package to the specified environment with the provided AWS credentials.

The `with` section provides input parameters for the `beanstalk-deploy` action:

- `aws_access_key` and `aws_secret_key` will be automatically fetched from the GitHub repository secrets you added earlier.

- Make sure that `application_name` and `environment_name` match the ones you are using for your Elastic Beanstalk setup.
- The “Get Node.js version” step fetches the application version from `package.json` and saves it as the GitHub environment variable `VERSION`. The `version_label` is then set to the value of `VERSION`, eliminating the need for manual version updates in the workflow file.

Step 3: Configure Environment Variables in AWS

The final step is to configure the database connection string in Elastic Beanstalk, as it's best practice not to commit sensitive information, like database credentials, to GitHub.

3.1 In the AWS Management Console, navigate to the Elastic Beanstalk service and select your environment (`AddressBookApp-env`) in the left navigation pane. Ensure the correct region is selected to view your applications and environments.

3.2 In the navigation pane, choose **Configuration**. This will display all the configurations for the environment.

3.3 Scroll to the **Updates, monitoring, and logging** category and choose **Edit**.

The screenshot shows the AWS Management Console interface for the Elastic Beanstalk service. The left-hand navigation pane is open, showing the 'Elastic Beanstalk' section with options for 'Applications', 'Environments', and 'Change history'. Under 'Environments', the 'AddressBookApp-env' environment is selected, and the 'Configuration' link is highlighted. The main content area displays the 'Updates, monitoring, and logging' configuration page. At the top right of this page, an 'Edit' button is visible and highlighted with a red box. The configuration page is divided into three main sections: 'Monitoring', 'Updates', and 'Platform software', each with various settings and values.

Section	Property	Value
Monitoring	System enhanced	Cloudwatch custom metrics - instance
	Log streaming	Cloudwatch custom metrics - environment
	Deactivated	Retention
	7	Lifecycle
Updates	Managed updates	Deployment batch size
	Activated	100
	Command timeout	Deployment policy
	600	AllAtOnce
Platform software	Ignore health check	Instance replacement
	false	false
	Lifecycle	Log streaming
	false	Deactivated

3.4 Scroll to the bottom and select **Add environment property**.

3.5 Add your MongoDB Atlas connection string:

- For **Name**, enter `MONGO_URI`
- For **Value**, paste your MongoDB Atlas connection string (the same one from your `.env` file)

The screenshot shows the AWS Elastic Beanstalk console. The 'S3 log storage' configuration page is active. The 'Environment properties' section is highlighted with a red box. It contains a table with the following data:


Name	Value	
MONGO_URI	mongodb+srv://[redacted]	Remove

Below the table is an 'Add environment property' button. At the bottom of the console, there are 'Cancel', 'Continue', and 'Apply' buttons. The 'Apply' button is highlighted in orange.

3.6 Choose "Apply" to save the changes. The environment update may take a while.

Observe CD with GitHub Actions

1. Make some minor changes to your address book app.
2. Update the version number in `package.json` (e.g., change it to `1.0.1`).
3. Commit and push the changes to the `master` branch of your cloned GitHub repository.
4. Monitor the GitHub Actions workflow and your AWS Elastic Beanstalk environment to verify that the changes are automatically deployed.

 Congratulations on successfully following this CD with GitHub Actions and AWS guide! **Don't forget to terminate the AWS Elastic Beanstalk environment to avoid unnecessary charges.** 😊

References

The following resources were used in the creation of this guide:

GitHub Docs - Building and testing Node.js: <https://docs.github.com/en/actions/automating-builds-and-tests/building-and-testing-nodejs>

AWS Documentation: <https://docs.aws.amazon.com/>

Managing Elastic Beanstalk instance profiles:
<https://docs.aws.amazon.com/elasticbeanstalk/latest/dg/iam-instanceprofile.html>

AWS Elastic Beanstalk Tutorial: <https://youtu.be/jnMUp2c9AzA>

MongoDB in GitHub Actions: <https://github.com/marketplace/actions/mongodb-in-github-actions>

Beanstalk Deploy: <https://github.com/marketplace/actions/beanstalk-deploy>

Outline generated with [ChatGPT](#)

Other Resources

Using a matrix for your jobs: <https://docs.github.com/en/actions/using-jobs/using-a-matrix-for-your-jobs>

Using Elastic Beanstalk with Amazon S3:

<https://docs.aws.amazon.com/elasticbeanstalk/latest/dg/AWSHowTo.S3.html>

Deploying an Express application to Elastic Beanstalk using Elastic Beanstalk Command Line Interface (EB CLI):

https://docs.aws.amazon.com/elasticbeanstalk/latest/dg/create_deploy_nodejs_express.html

Deploying to AWS Elastic Beanstalk with GitHub Actions:

<https://leonardqmarcq.com/posts/github-actions-cicd-elastic-beanstalk>

Deploying a Docker application (React) to AWS Elastic Beanstalk:

<https://akashsingh.blog/complete-guide-on-deploying-a-docker-application-react-to-aws-elastic-beanstalk-using-docker-hub-and-github-actions>

Getting started with Elastic Beanstalk:

<https://docs.aws.amazon.com/elasticbeanstalk/latest/dg/GettingStarted.html>

Elastic Beanstalk Service roles, instance profiles, and user policies:

<https://docs.aws.amazon.com/elasticbeanstalk/latest/dg/concepts-roles.html>

Policies and permissions in AWS Identity and Access Management:

https://docs.aws.amazon.com/IAM/latest/UserGuide/access_policies.html

IAM roles: https://docs.aws.amazon.com/IAM/latest/UserGuide/id_roles.html