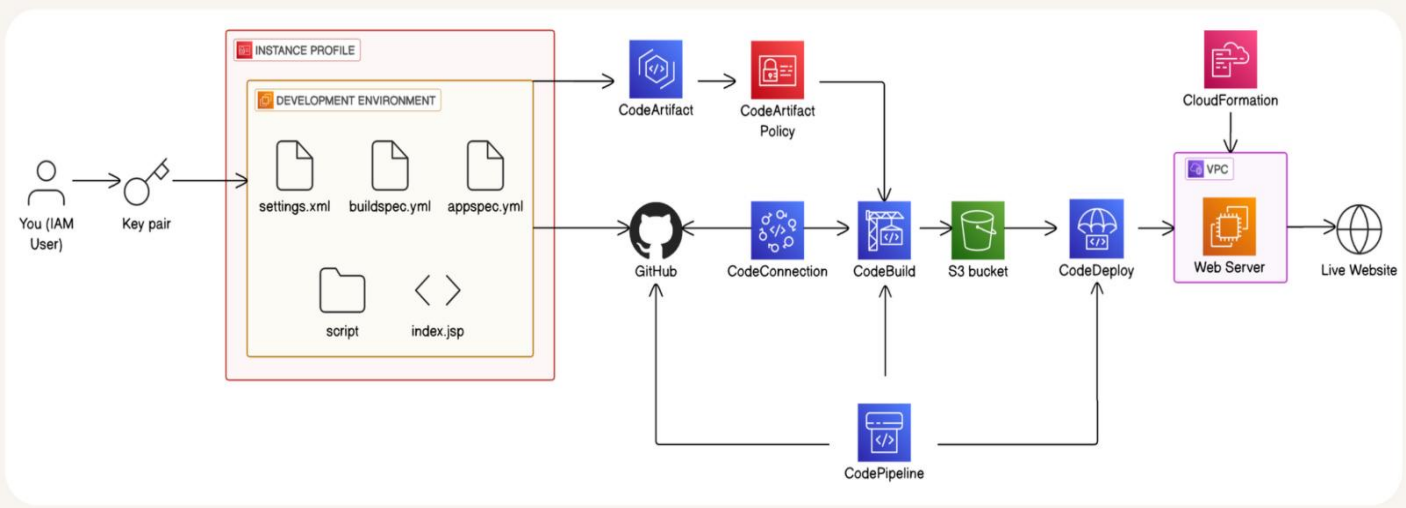
Automated CI/CD Pipeline with AWS



This project demonstrates how to **automate the deployment of a Java web application to EC2 using AWS CodeDeploy**, as part of a full CI/CD pipeline.

The pipeline follows a real-world DevOps flow:

- **Source**: GitHub
- **Build**: AWS CodeBuild (WAR artifact)
- **Artifact Storage**: Amazon S3
- **Deployment**: AWS CodeDeploy
- **Infrastructure**: AWS CloudFormation (IaC)

The goal was to eliminate manual deployments and replace them with a **repeatable, automated, and reliable deployment process**.

Why This Project Matters

In production environments, manually copying files to servers and restarting services is risky and error-prone. This project shows how to:

- Deploy consistently every time
- Reduce human error
- Enable rollbacks when deployments fail
- Treat infrastructure and deployments as code

Architecture Overview

End-to-end flow:

1. Developer pushes code to GitHub
2. CodeBuild compiles the app and produces a WAR file
3. Build artifacts (WAR + scripts + appspec.yml) are stored in S3
4. CodeDeploy pulls the artifact from S3
5. CodeDeploy runs lifecycle scripts on EC2
6. Application is deployed and made live

Step-by-Step Implementation

Step 1: Create IAM Access and Key Pair

- Log in using an IAM Admin user.
- Ensure permissions for EC2, S3, IAM, CodeArtifact, CodeBuild, CodeDeploy, CloudFormation, and CodeConnections.
- Create or use an EC2 key pair for SSH access.

Step 2: Launch Development EC2 Instance

This EC2 instance is used to write code and manage Git operations.

- Launch an EC2 instance
- Allow SSH access from your IP.
- Attach an IAM **instance profile** so the instance can securely access AWS services.
- Connect via SSH

On this instance, you manage:

- Application source code
- settings.xml
- buildspec.yml
- appspec.yml
- Deployment scripts

Step 3: Set Up Secure Dependency Management (CodeArtifact)

CodeArtifact is used to securely store and fetch Maven dependencies during the build process.

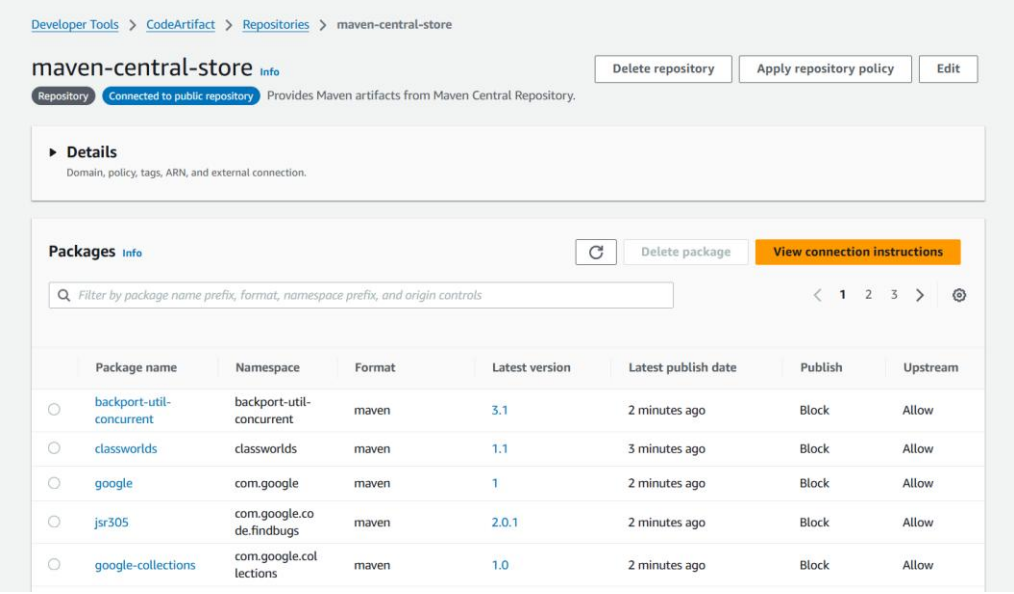
- Create a CodeArtifact **domain**
- Create a CodeArtifact **repository** (format: Maven).
- Enable Maven Central as an upstream repository.
- Grant permissions to the development EC2 role and CodeBuild role.

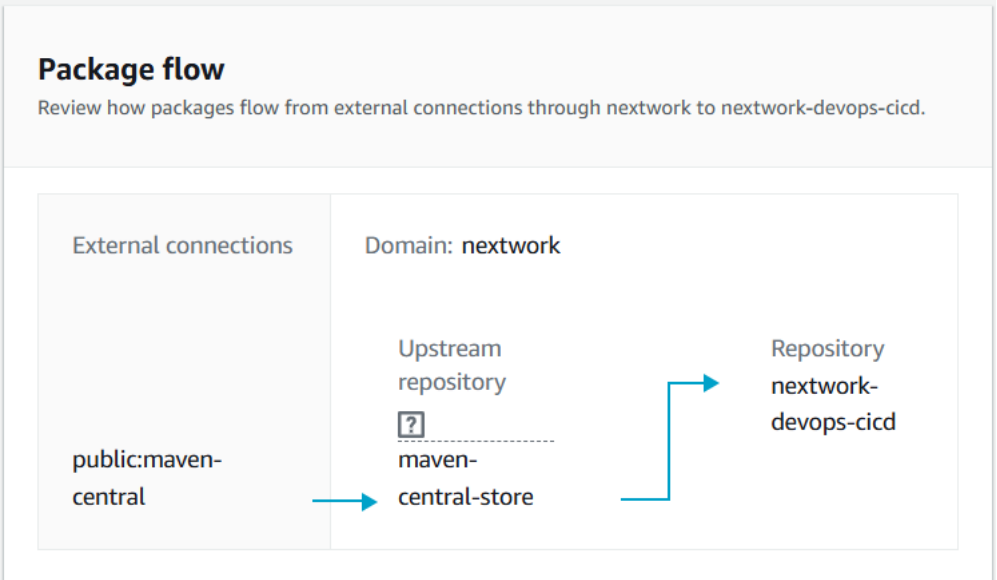
Configure Maven

- Update settings.xml to authenticate Maven with CodeArtifact.
- During builds, Maven pulls dependencies from CodeArtifact instead of the public internet.

Why CodeArtifact:

- Secure dependency sourcing
- Consistent builds
- Enterprise-grade supply chain security

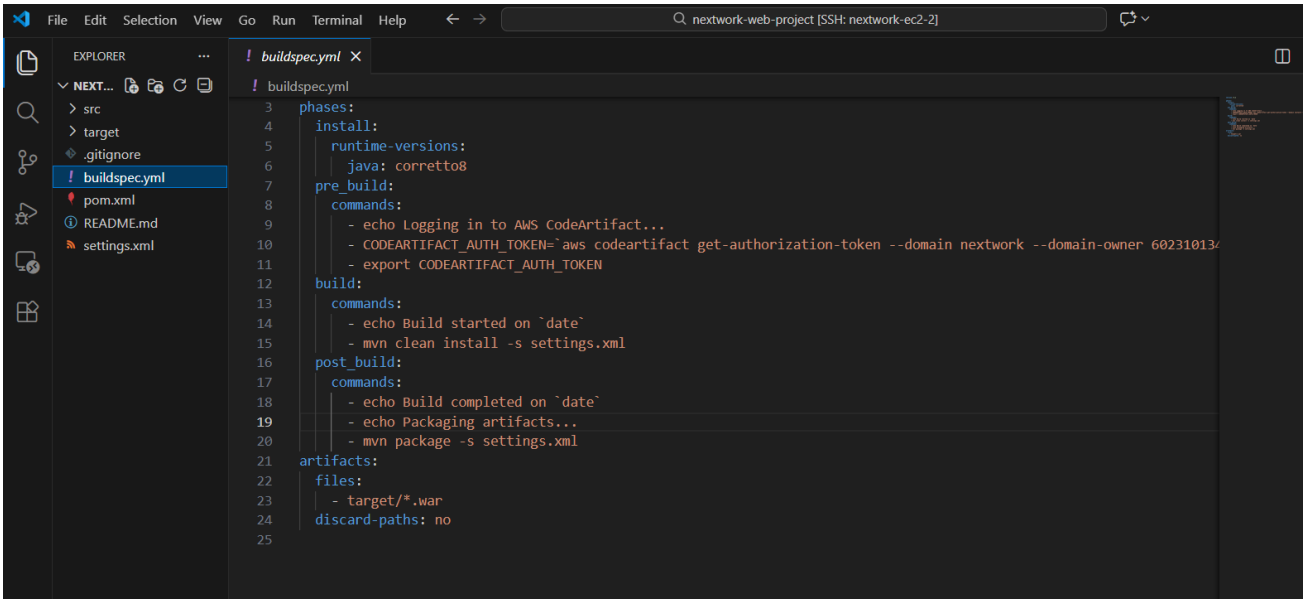




Step 4: Push Source Code to GitHub

- Create a GitHub repository.
- Push application code and pipeline files:
    - Application source files
    - settings.xml
    - buildspec.yml
    - appspec.yml
    - scripts/ directory

GitHub acts as the single source of truth.



Step 5: Connect GitHub to AWS (CodeConnection)

- Create an AWS CodeConnection connection to GitHub.
- Authorize access to your GitHub account and repository.
- This connection allows AWS services to pull source code securely.

Step 6: Configure CodeBuild (Continuous Integration)

CodeBuild compiles the application and produces deployable artifacts.

Setup

- Create an S3 bucket to store build artifacts.
- Create a CodeBuild project:
    - Source: GitHub (via CodeConnection)
    - Environment: Amazon Linux

IAM Permissions

Grant CodeBuild permissions to:

- Access CodeArtifact
- Write artifacts to S3

buildspec.yml Responsibilities

- Install dependencies
- Compile application
- Generate WAR file
- Package:
    - WAR file
    - appspec.yml
    - scripts/

Run the build and confirm it succeeds.

Step 7: Artifact Storage (S3)

- CodeBuild uploads the final artifact as a .zip file to S3.
- This S3 object becomes the **revision source** for CodeDeploy.

Step 8: Provision Production Infrastructure (CloudFormation)

CloudFormation is used to create the production environment.

Resources Created

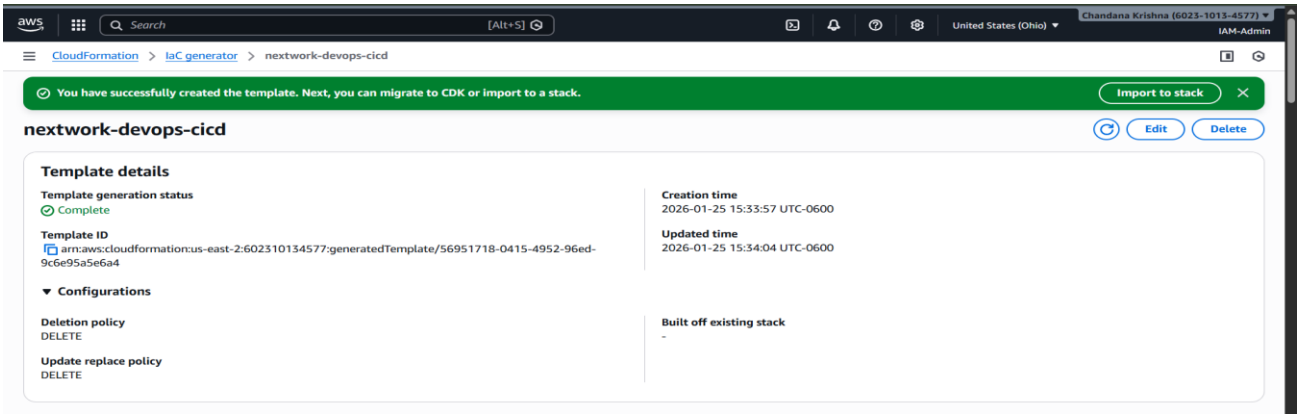
- VPC
- Subnet
- Internet Gateway
- Route Tables
- Security Group (HTTP + SSH)
- Production EC2 instance

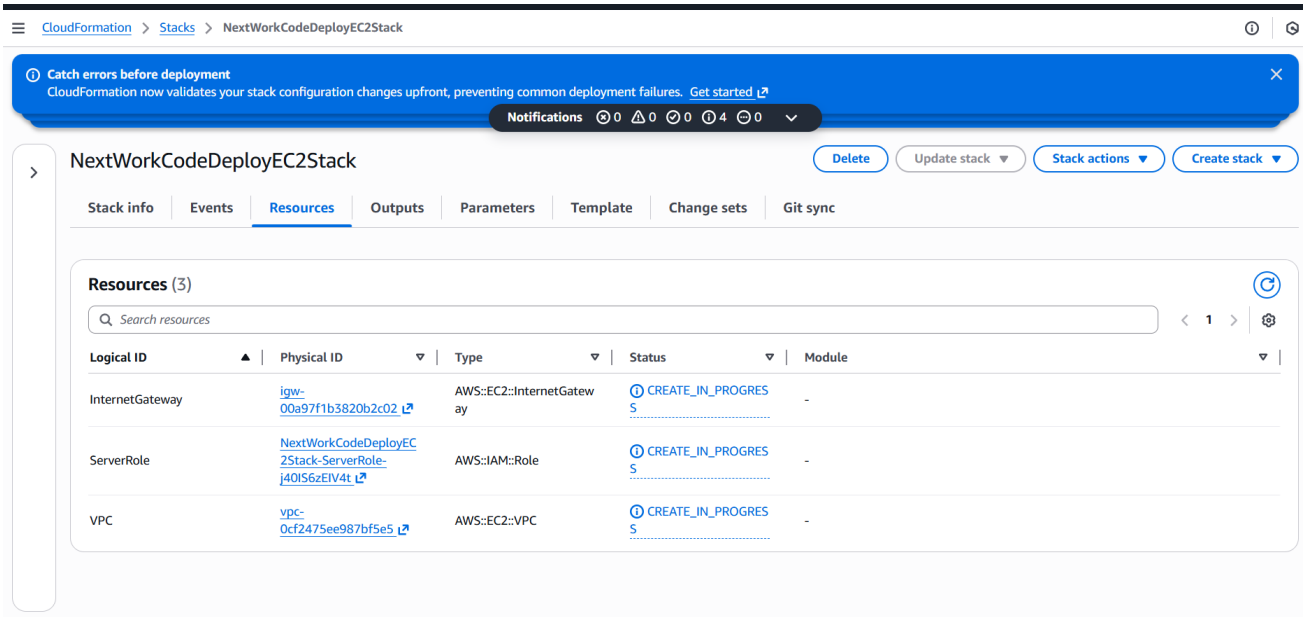
Important Tag

The EC2 instance is tagged as:

role = webserver

This tag allows CodeDeploy to identify deployment targets.





Step 9: Create CodeDeploy Application

- Create a CodeDeploy application.
- Select **EC2/On-premises** as the compute platform.

Step 10: Create CodeDeploy Deployment Group

- Create a deployment group.
- Select deployment type: **In-place**.
- Target EC2 instances using tag:
  - Key: role
  - Value: webserver

IAM Role

- Create a service role with AWSCodeDeployRole policy.
- Allows CodeDeploy to access EC2, S3, and CloudWatch.

Deployment Settings

- Deployment configuration: CodeDeployDefault.AllAtOnce
- Load balancer: Disabled
- CodeDeploy Agent updates enabled

Step 11: Prepare Deployment Scripts

Create a scripts folder with the following:

install_dependencies.sh

- Installs Tomcat and Apache
- Configures Apache as a reverse proxy

start_server.sh

- Starts Tomcat and Apache
- Enables services on reboot

stop_server.sh

- Safely stops services
- Checks if services are running before stopping

Scripts ensure automation and consistency.

Step 12: appspec.yml (Deployment Blueprint)

The appspec.yml file controls the deployment lifecycle.

Responsibilities

- Defines file copy locations
- Controls lifecycle hooks

Lifecycle Flow

- BeforeInstall → install dependencies
- ApplicationStop → stop services
- ApplicationStart → start services

CodeDeploy reads this file to execute deployments correctly.

Step 13: Create and Run Deployment

- Create a deployment in CodeDeploy.
- Select S3 as the revision source.
- Provide the S3 URI of the artifact .zip file.
- Start deployment.

CodeDeploy will:

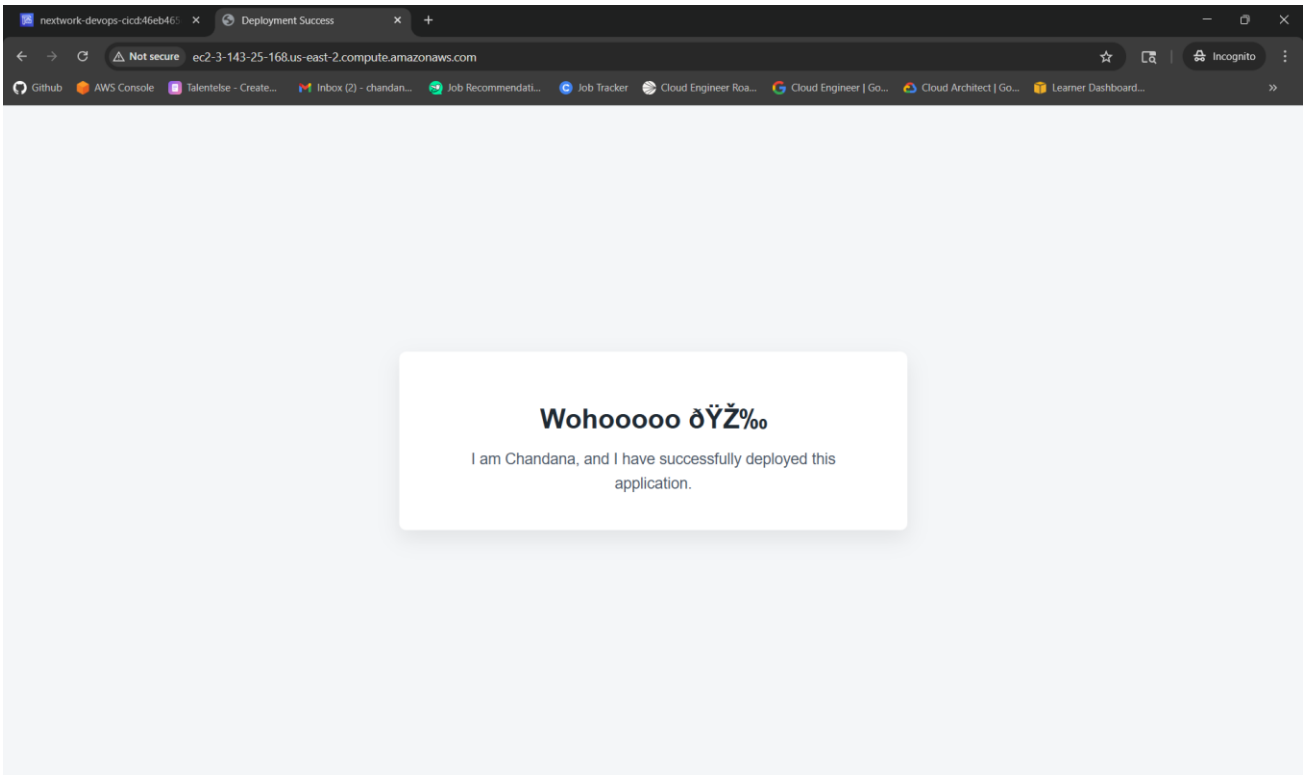
- Pull artifacts from S3
- Execute lifecycle scripts
- Deploy WAR to Tomcat

Step 14: Verify Live Application

- Retrieve the production EC2 public DNS.
- Open in a browser using:

http://<public-dns>

The application should be live.



Step 15: Disaster Recovery and Rollback

- Intentionally deploy a broken or outdated artifact.
- Observe deployment failure.
- Rebuild the application using CodeBuild.
- Redeploy using CodeDeploy.

This validates rollback and recovery capability.

Key Services Used

- Amazon EC2
- Amazon S3
- AWS CodeArtifact
- AWS CodeBuild
- AWS CodeDeploy
- AWS CloudFormation
- AWS IAM

Key Concepts Learned

- CI/CD pipelines
- Infrastructure as Code (IaC)
- Secure dependency management
- Automated deployments
- Deployment lifecycle hooks
- Rollback and disaster recovery
- IAM roles and least privilege