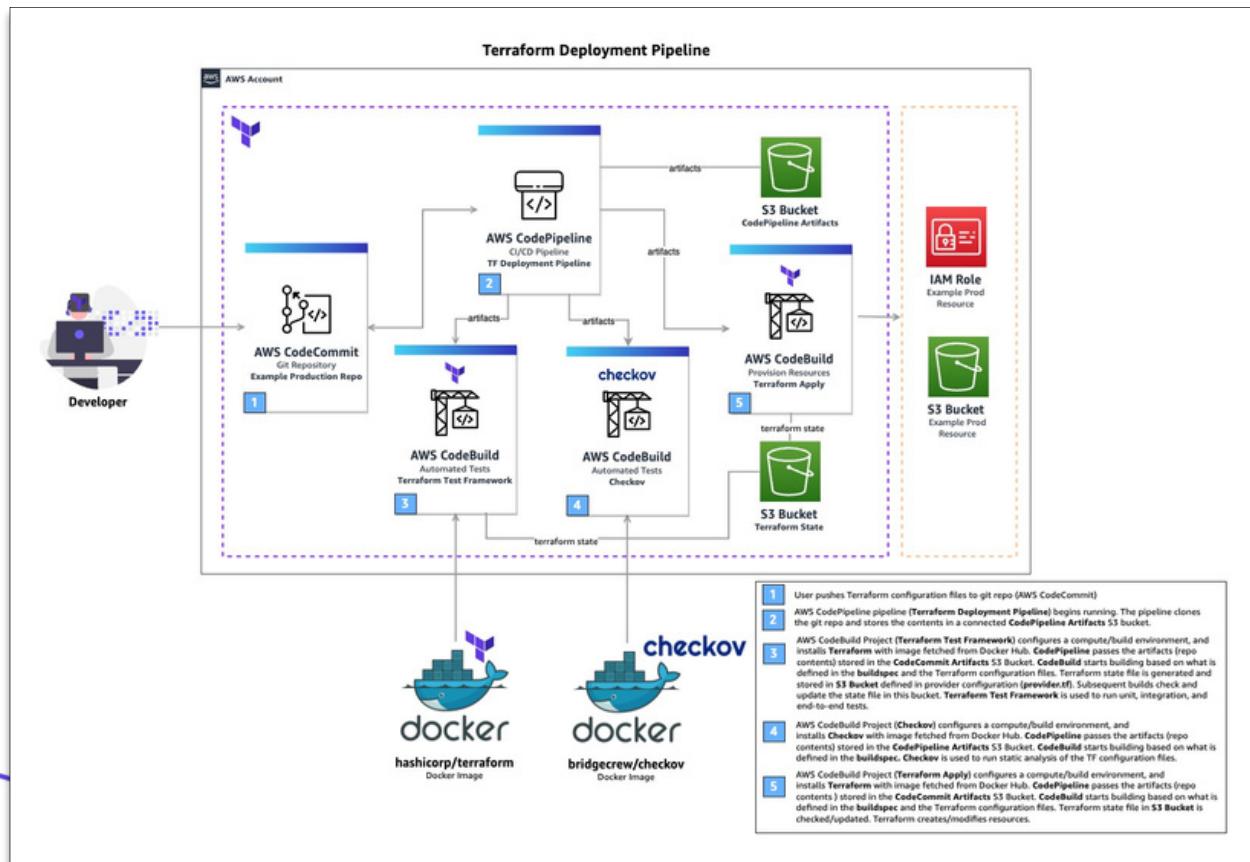


TERRAFORM CI/CD AND TESTING ON AWS

AWS Cloud Engineer



Problem Statement

Manual Terraform deployments and lack of testing increase the risk of misconfigured infrastructure, security issues, and unscalable cloud environments. This project solves that by building a CI/CD system that automates testing and deployment of Terraform modules.

Business Impact

- Reduced risk of misconfigured infrastructure through automated testing and validation
- Improved deployment speed and consistency with full CI/CD pipeline
- Strengthened security with Checkov integration
- Centralized Terraform state storage for team collaboration using S3 + DynamoDB
- Eliminated manual provisioning, enabling repeatable, production-ready deployments

Cloud Architecture

Services Used:

- **Terraform** – Infra automation, validation, testing
- **AWS CodePipeline** – CI/CD pipeline orchestration
- **AWS CodeBuild** – Executes Terraform tests, Checkov scans, and apply
- **S3** – Stores artifacts and remote backend state
- **DynamoDB** – State lock management
- **IAM** – Secure access roles and permissions
- **GitHub (via CodeStar Connections)** – Source repo and trigger for pipelines

Structure:

- Testing Pipeline (module validation)
- Deployment Pipeline (example workload)
- Remote state setup across two pipelines
- Refactored out CodeCommit, replaced with GitHub + CodeStar Connection



Technical Implementation

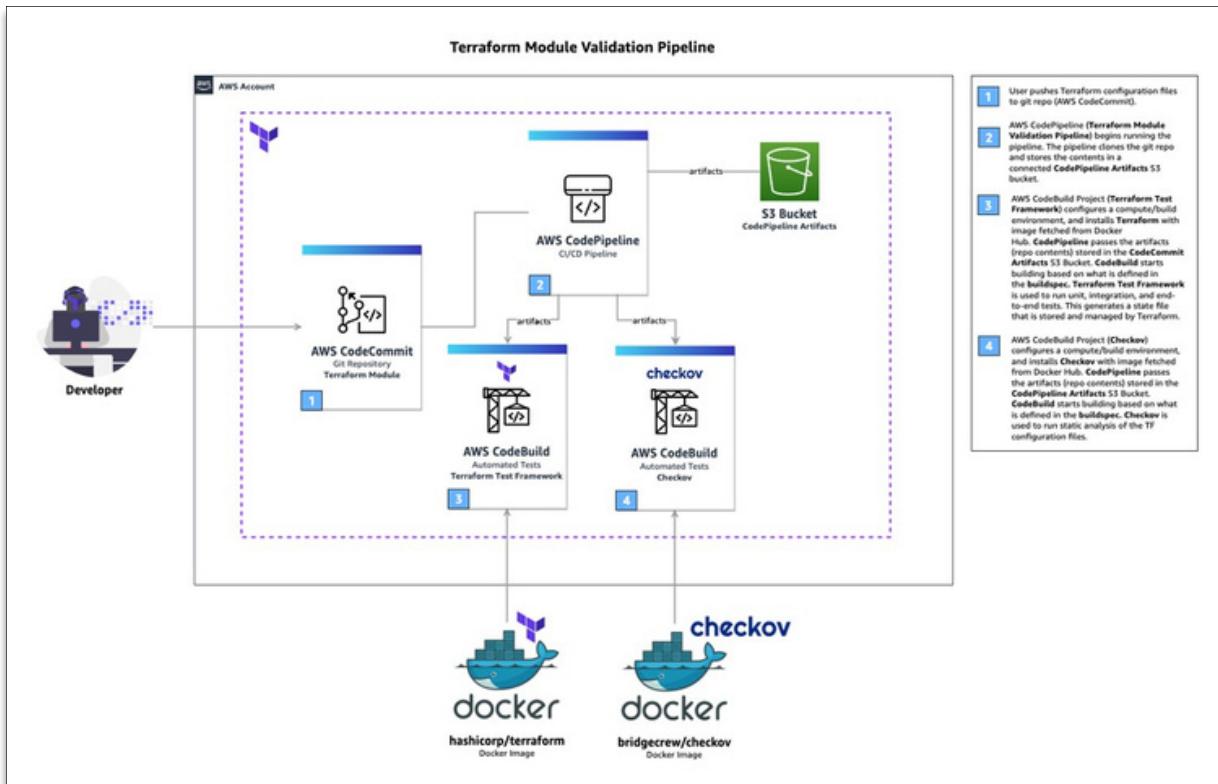
1. Developed a reusable Terraform module to provision AWS infrastructure using IaC best practices, including IAM roles, S3 buckets, and CodePipeline.

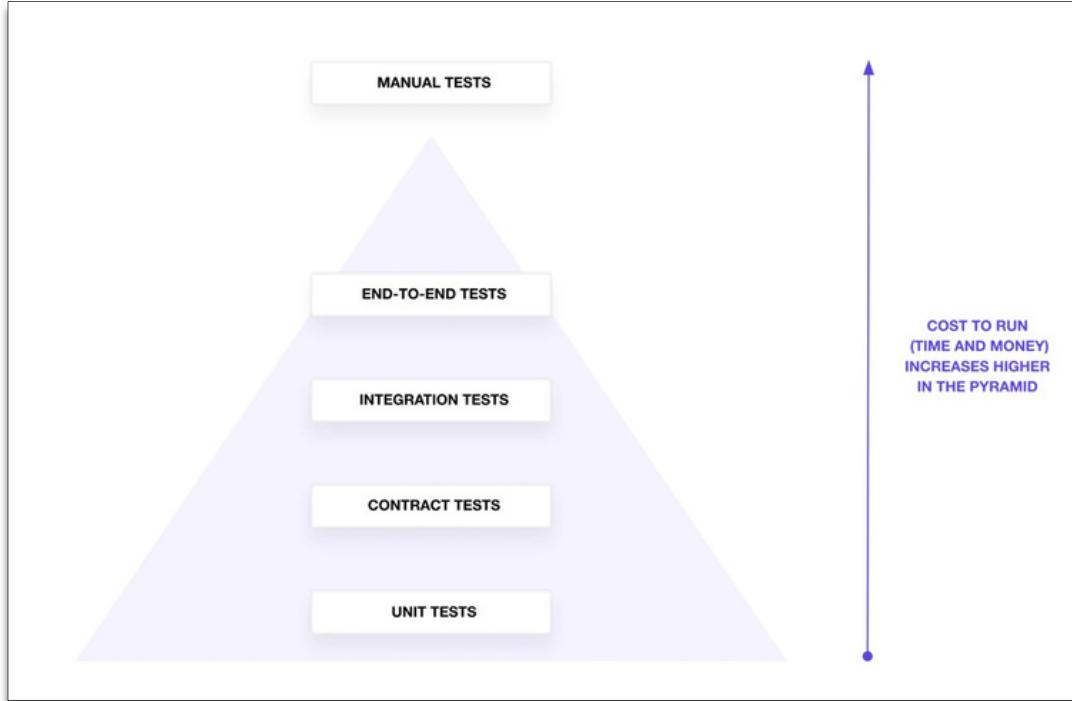
```
└─ terraform-config
    ├─ aws-devops-core
    ├─ example-production-workload
    └─ modules
        └─ module-aws-tf-cicd
            ├─ tests
            └─ README.md
```

```
└─ module-aws-tf-cicd
    └─ .terraform
        └─ buildspec
            └─ ! checkov-buildspec.yml
            └─ ! tf-apply-buildspec.yml
            └─ ! tf-plan-buildspec.yml
            └─ ! tf-test-buildspec.yml
```



2. Integrated Terraform Test Framework to validate module functionality with unit, integration, and end-to-end tests.





```
joeyacosta@Joeys-MacBook-Pro module-aws-tf-cicd % terraform init
Initializing the backend...
Initializing provider plugins...
- Reusing previous version of hashicorp/aws from the dependency lock file
- Reusing previous version of hashicorp/random from the dependency lock file
- Using previously-installed hashicorp/aws v5.94.1
- Using previously-installed hashicorp/random v3.7.1

Terraform has been successfully initialized!

You may now begin working with Terraform. Try running "terraform plan" to see
any changes that are required for your infrastructure. All Terraform commands
should now work.

If you ever set or change modules or backend configuration for Terraform,
rerun this command to reinitialize your working directory. If you forget, other
commands will detect it and remind you to do so if necessary.
joeyacosta@Joeys-MacBook-Pro module-aws-tf-cicd % terraform test
tests/main.tfstate.hcl... in progress
  run "input_validation"... pass
  run "e2e_test"... pass
tests/main.tfstate.hcl... tearing down
tests/main.tfstate.hcl... pass

Success! 2 passed, 0 failed.
```

3. Added security scanning with Checkov and enforced linCng with TFLint to ensure clean, secure, and compliant Terraform code.

```
joeyacosta@Joey's-MacBook-Pro module-aws-tf-cicd % checkov --directory /Users/joeyacosta/module-config/modules/module-aws-tf-cicd
[ terraform framework ]: 100%|[██████████] [10/10], Current File Scanned=variable
[ secrets framework ]: 100%|[██████████] [10/10], Current File Scanned=/Users/joeyacosta/module-config/modules/module-aws-tf-cicd/secrets.tf

By Prisma Cloud | version: 3.2.400
Update available 3.2.400 -> 3.2.403
Run pip3 install -U checkov to update

terraform scan results:

Passed checks: 94, Failed checks: 0, Skipped checks: 17

Check: CKV_AWS_93: "Ensure S3 bucket policy does not lockout all but root user. (Prevent
  PASSED for resource: aws_s3_bucket.tf_remote_state_s3_buckets
  File: /backend.tf:10-21
  Guide: https://docs.prismacloud.io/en/enterprise-edition/policy-reference/aws-policies/
Check: CKV_AWS_53: "Ensure S3 bucket has block public ACLS enabled"
  PASSED for resource: aws_s3_bucket_public_access_block.tf_remote_state_s3_bucket
  File: /backend.tf:31-39
  Guide: https://docs.prismacloud.io/en/enterprise-edition/policy-reference/aws-policies/
Check: CKV_AWS_54: "Ensure S3 bucket has block public policy enabled"
  PASSED for resource: aws_s3_bucket_public_access_block.tf_remote_state_s3_bucket
  File: /backend.tf:31-39
```

```
joeyacosta@Joey's-MacBook-Pro aws-devops-core % tflint
1 issue(s) found:

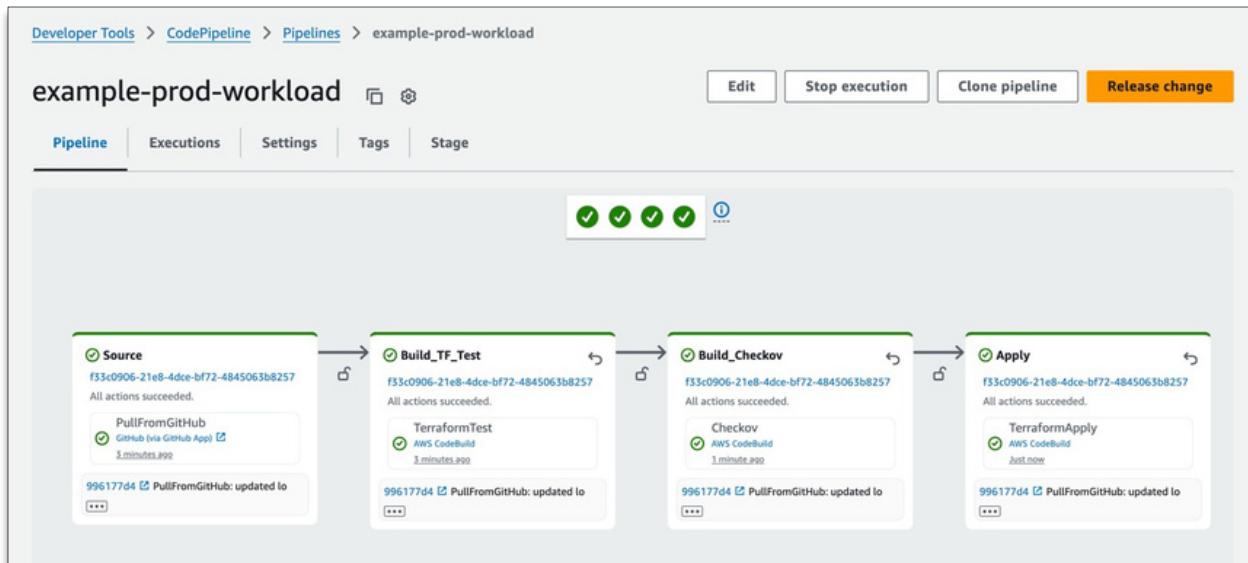
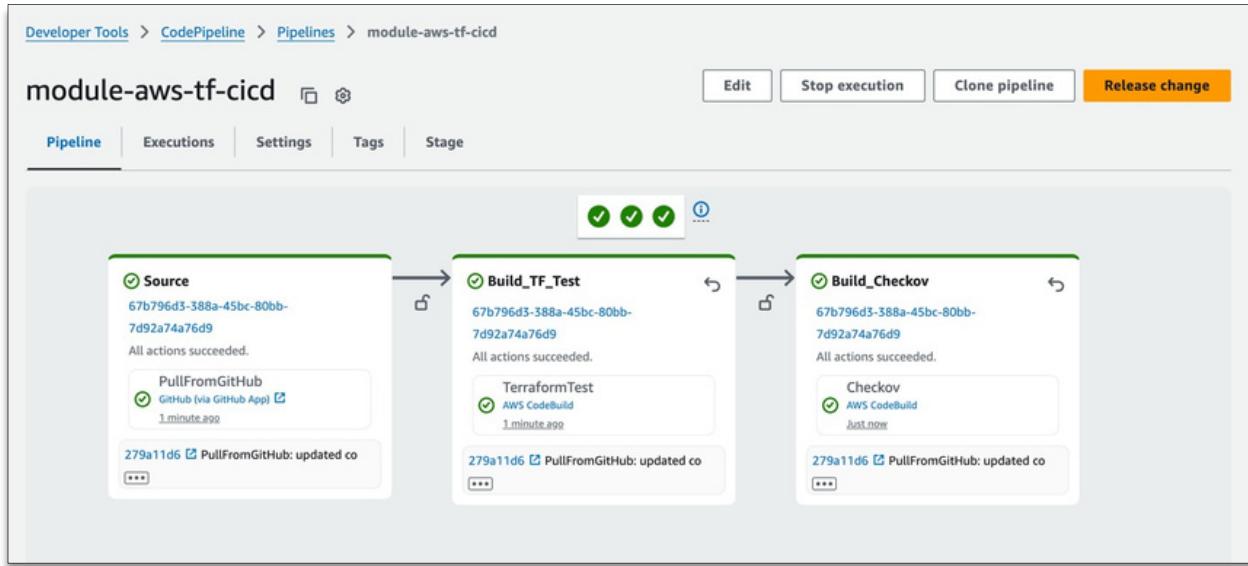
Warning: terraform "required_version" attribute is required (terraform_required_version)
on provider.tf line 3:
  3: terraform {

Reference: https://github.com/terraform-linters/tflint-ruleset-terraform/blob/v0.11.0/docs/required\_version.md

joeyacosta@Joey's-MacBook-Pro aws-devops-core % terraform -version
Terraform v1.11.3
on darwin_arm64
+ provider registry.terraform.io/hashicorp/aws v5.94.1
+ provider registry.terraform.io/hashicorp/random v3.7.1
joeyacosta@Joey's-MacBook-Pro aws-devops-core % tflint
joeyacosta@Joey's-MacBook-Pro aws-devops-core % 
```



4. Built two automated CI/CD pipelines using Terraform, CodePipeline, and CodeBuild to test and deploy infrastructure triggered by GitHub commits.



AWS Connector for GitHub

Installed 5 days ago Developed by aws <https://docs.aws.amazon.com/dtconsole/latest/userguide/welcome-connections.html>

Enables you to connect GitHub with AWS

Permissions

- ✓ Read access to deployments, issues, and metadata
- ✓ Read and write access to administration, code, commit statuses, pull requests, and repository hooks

Repository access

All repositories
This applies to all current and future repositories owned by the resource owner. Also includes public repositories (read-only).

Only select repositories
Select at least one repository. Also includes public repositories (read-only).

Select repositories ▾

Selected 2 repositories.

joeyclaudio/module-aws-tf-cicd

joeyclaudio/example-prod-workload



5. Configured S3 remote backend and DynamoDB state locking, enabling collaboration and safe, versioned state management.

```

joeyacosta@Joeys-MacBook-Pro aws-devops-core % terraform init
Initializing the backend...
Do you want to copy existing state to the new backend?
Pre-existing state was found while migrating the previous "local" backend to the
newly configured "s3" backend. No existing state was found in the newly
configured "s3" backend. Do you want to copy this state to the new "s3"
backend? Enter "yes" to copy and "no" to start with an empty state.

Enter a value: yes

Successfully configured the backend "s3"! Terraform will automatically
use this backend unless the backend configuration changes.
Initializing modules...
Initializing provider plugins...
- Reusing previous version of hashicorp/aws from the dependency lock file
- Reusing previous version of hashicorp/random from the dependency lock file
- Using previously-installed hashicorp/aws v5.94.1
- Using previously-installed hashicorp/random v3.7.1

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should now work.

If you ever set or change modules or backend configuration for Terraform,
rerun this command to reinitialize your working directory. If you forget, other
commands will detect it and remind you to do so if necessary.

```

state/

Objects	Properties										
Objects (1) <input type="button" value="C"/> <input type="button" value="Copy S3 URI"/> <input type="button" value="Copy URL"/> <input type="button" value="Download"/> <input type="button" value="Open"/> <input type="button" value="Delete"/> <input type="button" value="Actions ▾"/> <input type="button" value="Create folder"/> <input type="button" value="Upload"/> Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more <input type="text" value="Find objects by prefix"/> <input type="button" value="Show versions"/> <table border="1"> <thead> <tr> <th>Name</th> <th>Type</th> <th>Last modified</th> <th>Size</th> <th>Storage class</th> </tr> </thead> <tbody> <tr> <td>terraform.tfstate</td> <td>tfstate</td> <td>April 11, 2025, 23:35:11 (UTC-07:00)</td> <td>127.8 KB</td> <td>Standard</td> </tr> </tbody> </table>	Name	Type	Last modified	Size	Storage class	terraform.tfstate	tfstate	April 11, 2025, 23:35:11 (UTC-07:00)	127.8 KB	Standard	<input type="button" value="Copy S3 URI"/>
Name	Type	Last modified	Size	Storage class							
terraform.tfstate	tfstate	April 11, 2025, 23:35:11 (UTC-07:00)	127.8 KB	Standard							



6. Refactored the project to replace AWS CodeCommit with GitHub and CodeStar ConnecCons, resolving all repo trigger issues and enabling automated pipeline execuCon.

```
variable "codestar_connection_arn" {
  description = "CodeStar Connection ARN for GitHub integration"
  type        = string
```



```
stages = [
    # Clone from GitHub, store contents in artifacts S3 Bucket
    {
        name = "Source"
        action = [
            {
                name      = "PullFromGitHub"
                category = "Source"
                owner    = "AWS"
                provider = "CodeStarSourceConnection"
                version   = "1"
                configuration = {
                    ConnectionArn      = var.codestar_connection_arn
                    FullRepositoryId = "joeycloudio/module-aws-tf-cicd"
                    BranchName        = "main"
                }
                input_artifacts = []
                # Store the output of this stage as 'source_output_artifacts'
                output_artifacts = ["source_output_artifacts"]
                run_order       = 1
            },
        ],
    },
]
```

```
stages = [
    # Clone from GitHub, store contents in artifacts S3 Bucket
    {
        name = "Source"
        action = [
            {
                name      = "PullFromGitHub"
                category = "Source"
                owner    = "AWS"
                provider = "CodeStarSourceConnection"
                version   = "1"
                configuration = {
                    ConnectionArn      = var.codestar_connection_arn
                    FullRepositoryId = "joeycloudio/example-prod-workload"
                    BranchName        = "main"
                }
                input_artifacts = []
                # Store the output of this stage as 'source_output_artifacts'
                output_artifacts = ["source_output_artifacts"]
                run_order       = 1
            },
        ],
    },
]
```



Key Accomplishments

- Replaced CodeCommit with GitHub integration across both pipelines
- Built modular, testable Terraform infrastructure using terraform test framework
- Integrated security scanning (Checkov) and linting (TFLint)
- Configured and tested remote S3/DynamoDB backend
- Migrated local Terraform state to remote backend with zero downtime
- Troubleshooted and resolved CodePipeline ARN issues, buildspec errors, and webhook bugs
- Successfully deployed and verified 50+ AWS resources end-to-end

Key Learnings

- Real-world Terraform debugging is often reverse-engineering someone else's design
- CI/CD pipelines require precise wiring: GitHub → CodeStar → CodePipeline → CodeBuild
- Remote state config must be handled carefully, especially post-deploy
- Modular Terraform doesn't mean every folder should be a root module
- Git and Terraform interaction (rebase, state lock, force-unlock) may be more complex than tutorials admit

Why This Matters in Production

This project reflects actual practices used in infrastructure teams—testing Terraform modules, automating secure deployments, and managing state with best practices. It's built for scale, collaboration, and real-world reliability, not just a local sandbox.



Next Steps

- Add a manual approval stage + SNS notifications (optional stretch goal)
- Practice deploying to a second AWS account via cross-account IAM roles
- Reuse modules and pipelines for future real-world Terraform repos