AWS Infrastructure Automation

Terraform and CloudFormation Project

PROG 8870 - Final Project

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Project Overview

Multi-Service AWS Infrastructure Deployment

Project Scope

- **Infrastructure as Code (IaC)** using Terraform and CloudFormation
- **Multi-service environment** with S3, EC2, and RDS
- **Best practices** for modularity and reusability
- **Live demo** showcasing resource provisioning

Technology Stack

Terraform

- HashiCorp's Infrastructure as Code tool
- Declarative configuration
- State management and versioning

CloudFormation

- AWS native IaC service
- YAML-based templates
- Integrated with AWS services

Architecture Overview

- **VPC**: Custom network with CIDR 10.0.0.0/16
- **Subnets**: Multi-AZ deployment (us-east-1a, us-east-1b)
- **Services**: S3, EC2, RDS across availability zones

Task 1: S3 Bucket Setup

Terraform Requirements

- ✅ 4 Private S3 Buckets
- ✅ No public access
- ✅ Versioning enabled (Bonus)

CloudFormation Requirements

- ✅ 3 Private S3 Buckets
- ✅ PublicAccessBlockConfiguration
- ✅ Versioning enabled (Bonus)

Task 2: VPC and EC2 Instance

Terraform Implementation

- ✅ Custom VPC with dynamic variables
- ✅ EC2 instance with public IP
- ✅ SSH access on port 22
- ✅ Dynamic AMI selection

CloudFormation Implementation

- ✅ YAML-based configuration
- ✅ IGW and Route Tables
- ✅ Public IP output

Task 3: RDS Instance Deployment

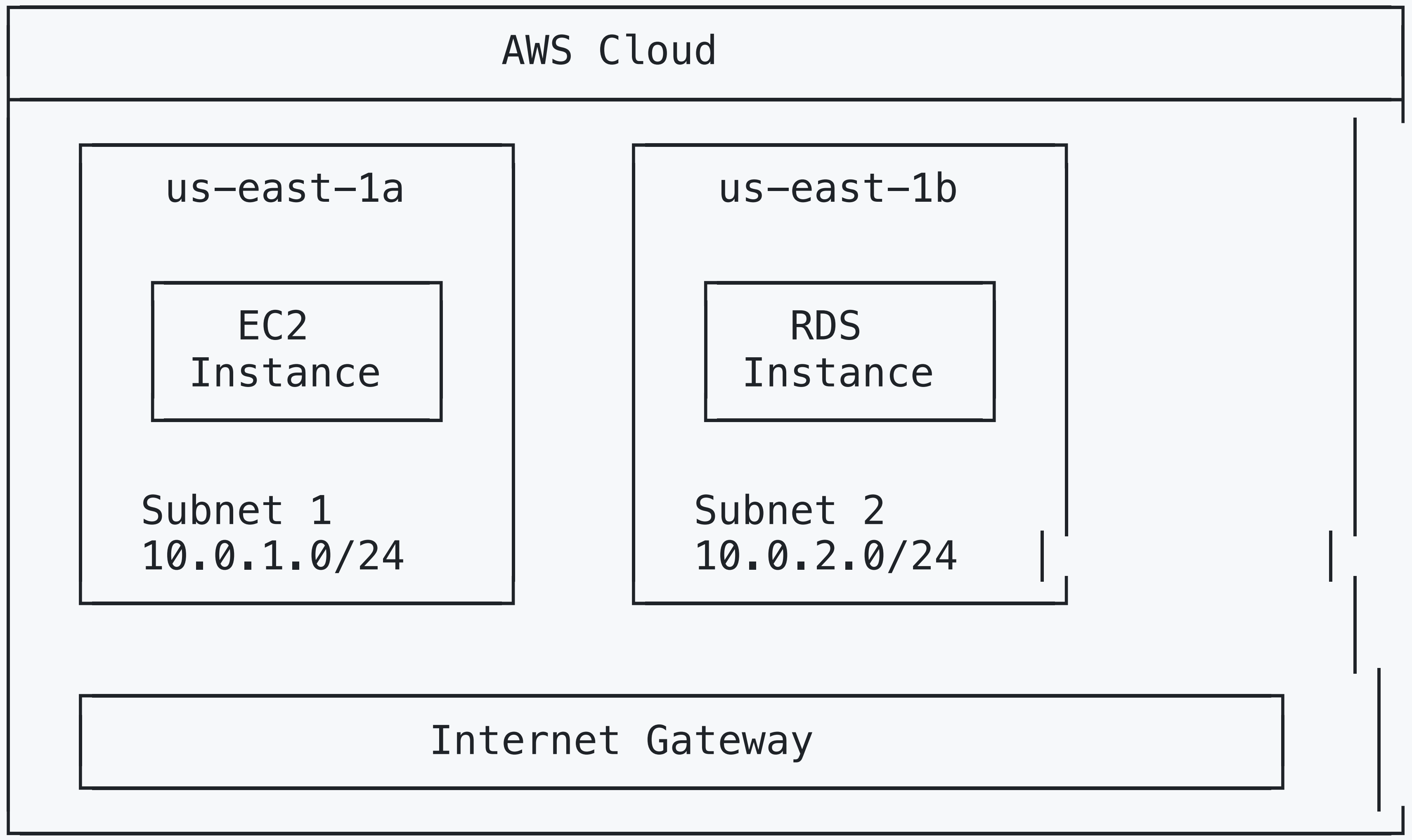
Terraform Features

- ✅ MySQL RDS with db.t3.micro
- ✅ Dynamic database credentials
- ✅ Dedicated DB Subnet Group

CloudFormation Features

- ✅ YAML template deployment
- ✅ Public access enabled
- ✅ Security groups for port 3306

Multi-AZ Design Architecture



Terraform Configuration Structure

```
@Terraform/
├── main.tf             # Main entry point and orchestration
├── s3.tf               # S3 buckets, versioning, and access controls
├── network.tf          # VPC, subnets, IGW, route tables, security groups
├── variables.tf        # Variable definitions
├── terraform.tfvars    # Variable values
├── provider.tf         # AWS provider configuration
├── backend.tf          # State management
├── outputs.tf          # Resource information outputs
└── terraform.tfstate # State file (local storage)
```

CloudFormation Template Structure

```
@CloudFormat/
├── ec2-vpc.yaml      # EC2 and VPC resources
├── rds-instance.yaml # RDS database configuration
└── s3-buckets.yaml   # S3 bucket resources
```

Deployment Order - CloudFormation

⚠️ **Critical**: Stacks must be deployed in this specific order due to dependencies:

1. **EC2-VPC Stack** (creates VPC and subnets)
2. **RDS Stack** (depends on subnet outputs)
3. **S3 Stack** (independent, can deploy anytime)

Terraform Deployment Commands

```
cd @Terraform
terraform init           # Initialize backend
terraform plan           # Preview changes
terraform apply          # Deploy infrastructure
terraform destroy        # Cleanup resources
```

CloudFormation Deployment Commands

```
# 1. Deploy EC2-VPC Stack
aws cloudformation create-stack \
  --stack-name ray-ec2-vpc-stack \
  --template-body file://@CloudFormat/ec2-vpc.yaml \
  --parameters ParameterKey=RayProjectName,ParameterValue=ray-infrastructure

# 2. Deploy RDS Stack
aws cloudformation create-stack \
  --stack-name ray-rds-stack \
  --template-body file://@CloudFormat/rds-instance.yaml

# 3. Deploy S3 Stack
aws cloudformation create-stack \
  --stack-name ray-s3-stack \
  --template-body file://@CloudFormat/s3-buckets.yaml
```

Best Practices Implemented

✅ Dynamic Configuration

- Variables files (variables.tf, .tfvars)
- CloudFormation Parameters
- No hardcoded values

✅ Modularity

- **Terraform**: Modular file structure (s3.tf, network.tf, compute.tf)
- **CloudFormation**: Separate templates for each service
- Reusable configurations
- Clean code structure

Best Practices Implemented (Cont.)

✅ Security

- Private S3 buckets
- Proper security groups
- VPC isolation

✅ State Management

- Local Terraform state
- CloudFormation stack management
- Resource tracking

Key Features & Challenges

🚀 Features

- Multi-AZ architecture
- Automated deployment
- Comprehensive documentation

⚠️ Challenges

- CloudFormation dependency management
- RDS multi-AZ requirements
- Proper subnet group configuration

Live Demo Agenda

1. **Terraform Deployment**
   - `terraform init` → `terraform plan` → `terraform apply`
   - Show resource creation in AWS Console
2. **CloudFormation Deployment**
   - Deploy stacks in order
   - Verify resource creation
3. **Resource Verification**
   - S3 buckets with versioning
   - EC2 instance with public IP
   - RDS instance running

Resource Verification Checklist

S3 Buckets

- 4 Terraform buckets created
- 3 CloudFormation buckets created
- Versioning enabled on all
- No public access

EC2 & VPC

- Custom VPC created
- EC2 instance running
- Public IP accessible
- SSH connectivity

Cleanup Commands

```
# Terraform Cleanup
cd @Terraform
terraform destroy

# CloudFormation Cleanup
aws cloudformation delete-stack --stack-name ray-s3-stack
aws cloudformation delete-stack --stack-name ray-rds-stack
aws cloudformation delete-stack --stack-name ray-ec2-vpc-stack
```

Thank You!

Questions & Live Demo

GitHub Repository: [Your Repository URL]

Contact: [Your Information]