Bootcamp-Project 3

AUTOMATE INFRASTRUCTURE PROVISIONING USING TERRAFORM AND AZURE DEVOPS WITH MULTIPLE WORKSPACES

Mohanramrajan Erran Bothalraj

Table of Contents

Introduction

In today’s cloud-first development landscape, automating infrastructure provisioning is essential for delivering scalable, secure, and repeatable environments. This project demonstrates how to implement Infrastructure as Code (IaC) using **Terraform** integrated with **Azure DevOps**, enabling consistent and automated infrastructure deployment across multiple environments.

Project Objectives

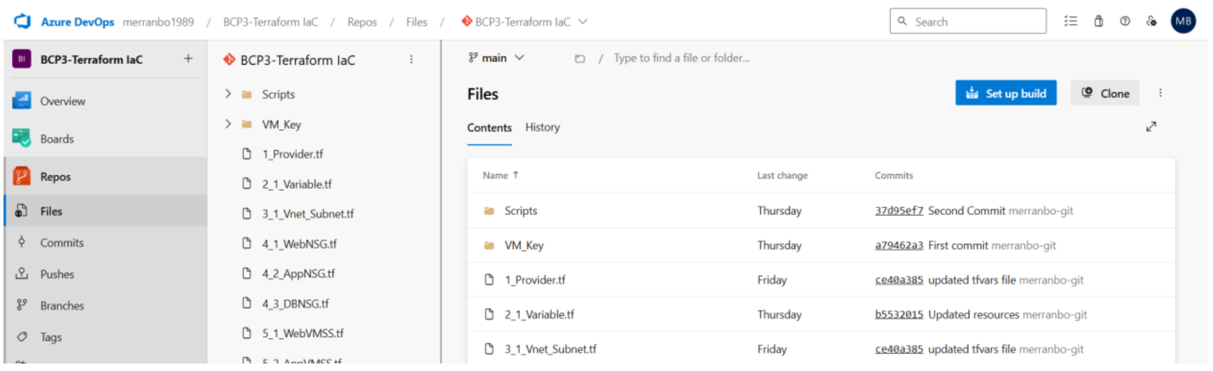
- **Three-Tier Architecture:** Deploy a secure and highly available three-tier architecture (Web, App, DB) across **Dev**, **Stage**, and **Production** environments using a single configuration file and separate workspaces.
- **Terraform Scripting:** Define and provision Azure resources such as Virtual Machines, Virtual Networks, Storage Accounts, Load Balancers, NSGs, and Scale Sets using reusable and modular Terraform scripts.
- **Terraform State Management:** Securely store Terraform state files in Azure Storage with proper **locking strategies** to ensure consistency in team environments.
- **Azure DevOps Pipelines:** Automate the validation, planning, and applying of Terraform configurations.
- **Scalability and Security:** Implement network isolation using subnets, firewalls, and NSGs, while ensuring high availability with VM Scale Sets and Load Balancers.

Expected Outcome

This project enables streamlined, automated infrastructure deployments using modern DevOps practices. By integrating Terraform with Azure DevOps pipelines, the solution promotes scalability, maintainability, and governance while reducing manual intervention and provisioning errors across development lifecycles.

Pre-requisite:

- GitHub Repository for terraform template file: https://github.com/merranbo-git/bcpp3-terraform
- Import the terraform code into Azure Repos after creating the project

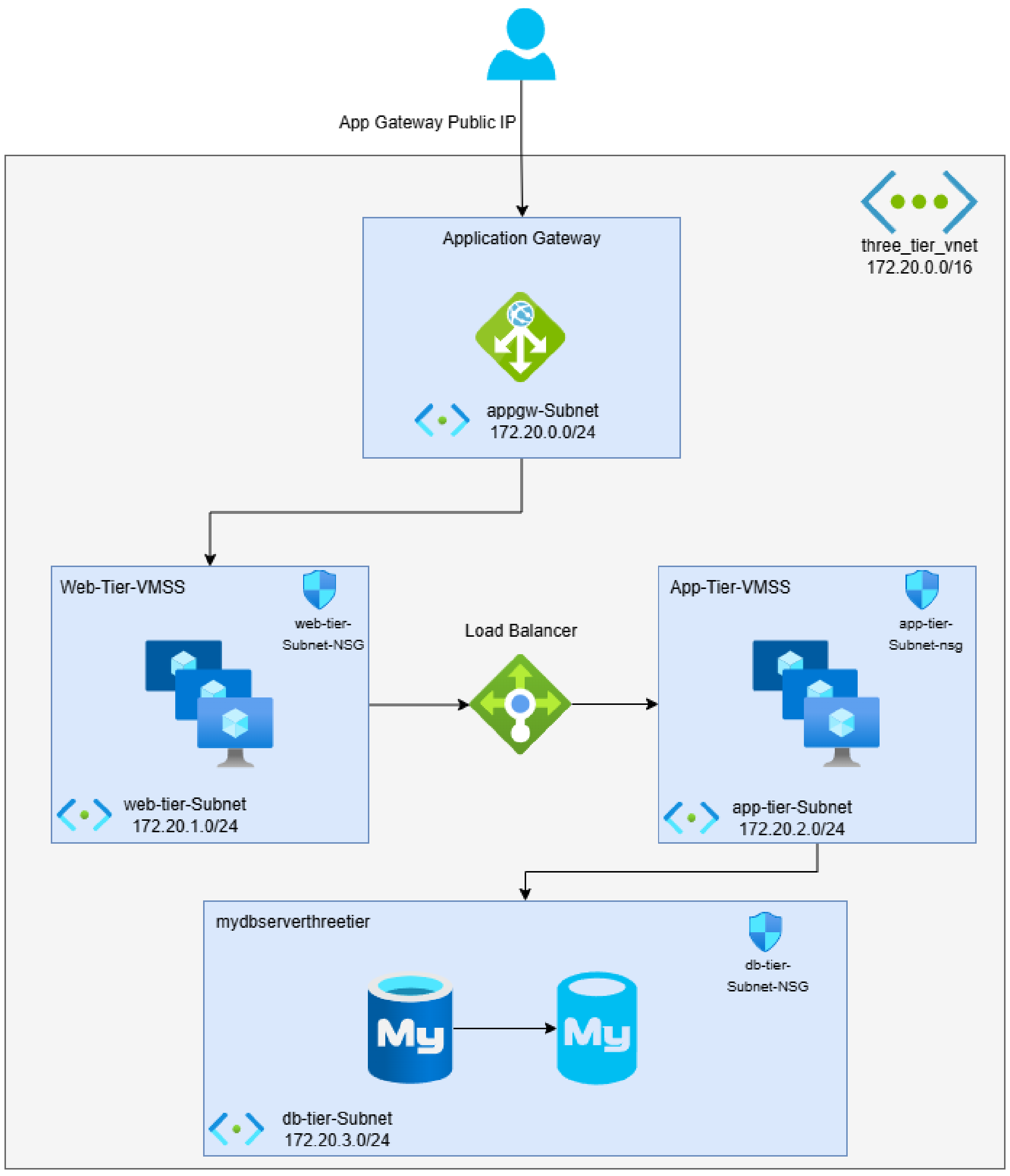


BCP3-Terraform IaC
- Scripts
- VM_Key
- 1_Provider.tf
- 2_1_Variable.tf
- 3_1_Vnet_Subnet.tf
- 4_1_WebNSG.tf
- 4_2_AppNSG.tf
- 4_3_DBNSG.tf
- 5_1_WebVMSS.tf

Files

Name ↑	Last change	Commits
Scripts	Thursday	37d95ef7 Second Commit merranbo-git
VM_Key	Thursday	a79462a3 First commit merranbo-git
1_Provider.tf	Friday	ce40a385 updated tfvars file merranbo-git
2_1_Variable.tf	Thursday	b5532015 Updated resources merranbo-git
3_1_Vnet_Subnet.tf	Friday	ce40a385 updated tfvars file merranbo-git

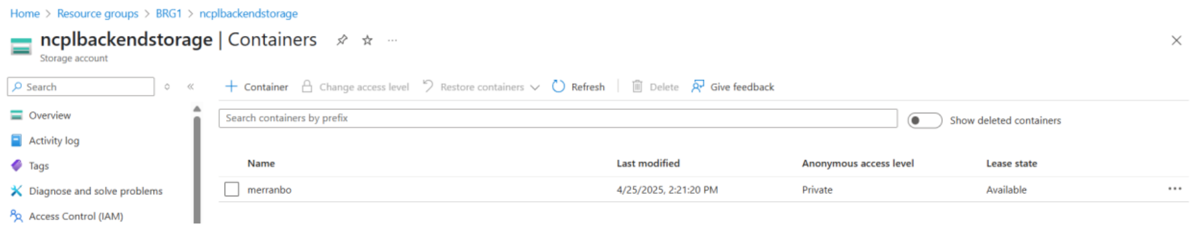
Architecture Diagram



Solution Steps

A. Terraform State Management

Creation of Storage Account → container for storing "terraform.tfstate" file.



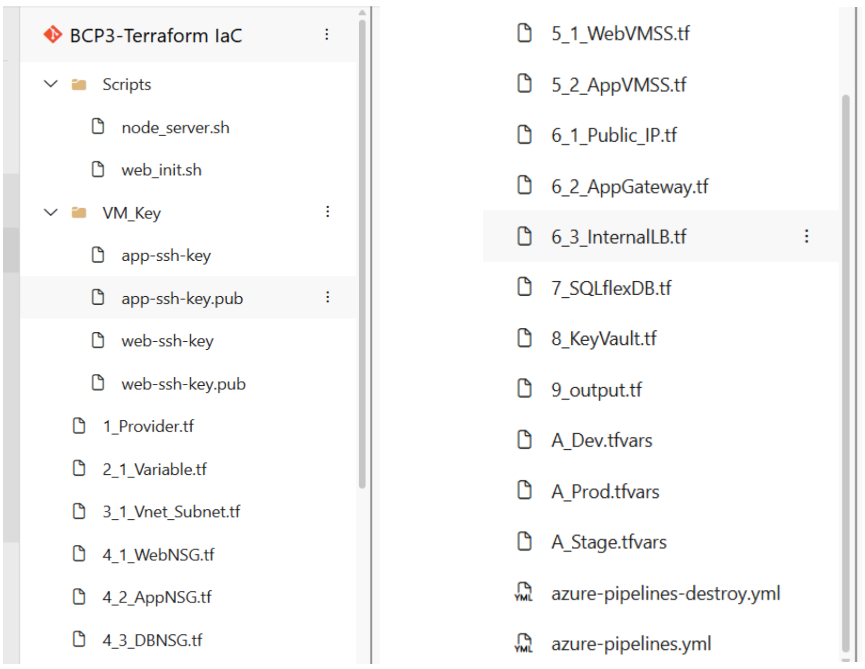
Name	Last modified	Anonymous access level	Lease state
merranbo	4/25/2025, 2:21:20 PM	Private	Available

B. Terraform Scripting

1. Develop terraform scripting using Visual studio code to provision the resources required for the three-tier architecture. Following are the resources to be provisioned:
    a. Resource Group
    b. Vnet and Subnets
    c. Network Security groups
    d. Virtual Machine Scale Sets (for Web tier and App tier)
        i. Deploy custom script using provisioner in both VMSS
    e. Application Gateway
    f. Public Ip
    g. Load Balancers for internal communication between VMSS
    h. MySQL flexible server with database
    i. Key Vault for storing secrets

Please Note: Terraform codes for above resources are available in the Appendix Section

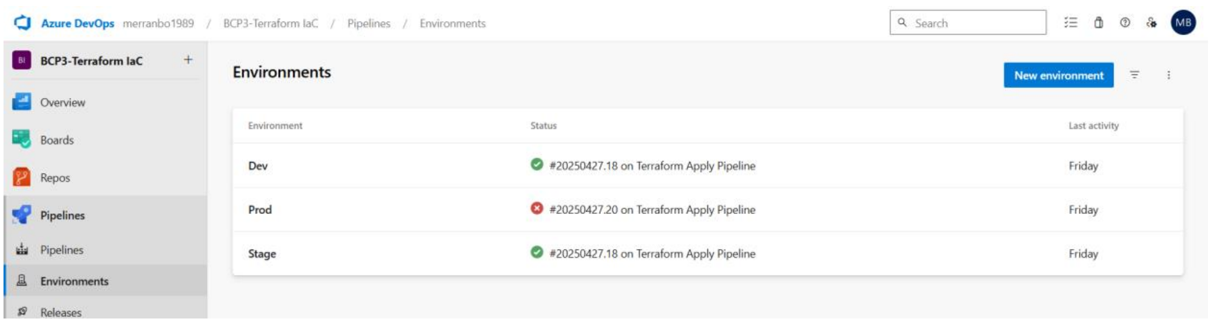
2. Below is the file structure for the terraform project.



```
BCP3-Terraform IaC
  Scripts
    node_server.sh
    web_init.sh
  VM_Key
    app-ssh-key
    app-ssh-key.pub
    web-ssh-key
    web-ssh-key.pub
  1_Provider.tf
  2_1_Variable.tf
  3_1_Vnet_Subnet.tf
  4_1_WebNSG.tf
  4_2_AppNSG.tf
  4_3_DBNSG.tf
  5_1_WebVMSS.tf
  5_2_AppVMSS.tf
  6_1_Public_IP.tf
  6_2_AppGateway.tf
  6_3_InternalLB.tf
  7_SQLflexDB.tf
  8_KeyVault.tf
  9_output.tf
  A_Dev.tfvars
  A_Prod.tfvars
  A_Stage.tfvars
  azure-pipelines-destroy.yml
  azure-pipelines.yml
```

C. Terraform Three-Tier Architecture

1. As per the project requirement, we need to deploy a secure and highly available three-tier architecture (Web, App, DB) across **Dev**, **Stage**, and **Production** environments using a single configuration file and separate workspaces.
2. To Achieve this, we will be creating three Environments in Azure DevOps pipeline



Azure DevOps merranbo1989 / BCP3-Terraform IaC / Pipelines / Environments

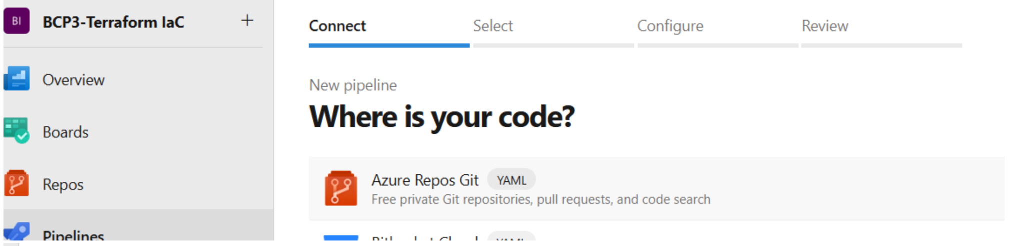
BCP3-Terraform IaC — Overview, Boards, Repos, Pipelines, Pipelines, Environments, Releases

Environments — New environment

Environment	Status	Last activity
Dev	✓ #20250427.18 on Terraform Apply Pipeline	Friday
Prod	✗ #20250427.20 on Terraform Apply Pipeline	Friday
Stage	✓ #20250427.18 on Terraform Apply Pipeline	Friday

D. Azure DevOps Pipeline

1. Create a new pipeline using the Azure repos uploaded with the terraform files



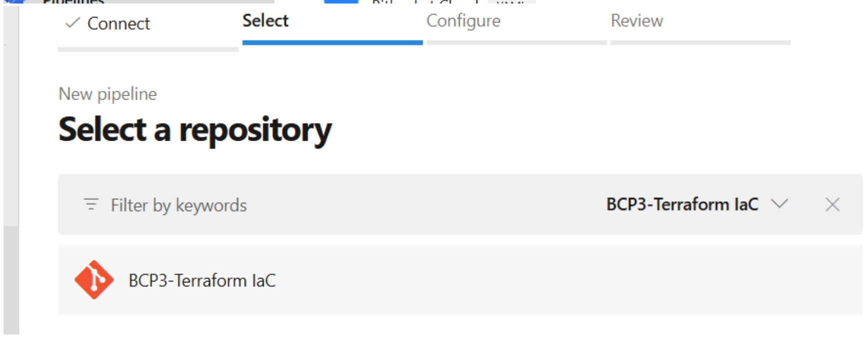
BCP3-Terraform IaC — Overview, Boards, Repos, Pipelines

Connect | Select | Configure | Review

New pipeline

Where is your code?

Azure Repos Git YAML
Free private Git repositories, pull requests, and code search



✓ Connect | Select | Configure | Review

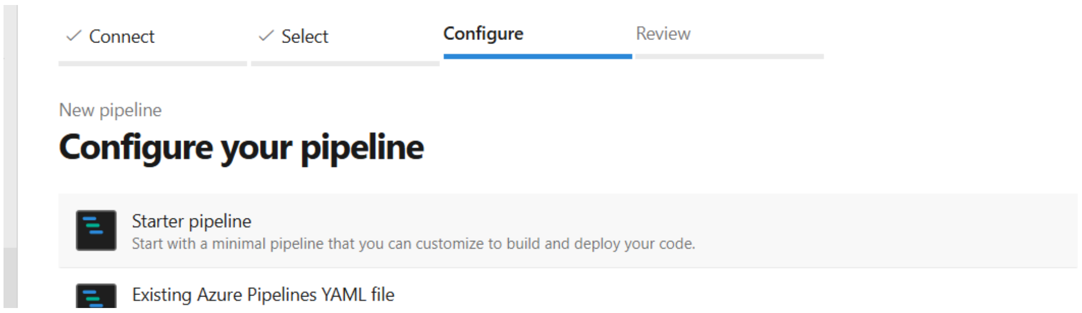
New pipeline

Select a repository

Filter by keywords — BCP3-Terraform IaC

BCP3-Terraform IaC

2. Use the "Starter Pipeline" option to get an empty YAML file



✓ Connect | ✓ Select | Configure | Review

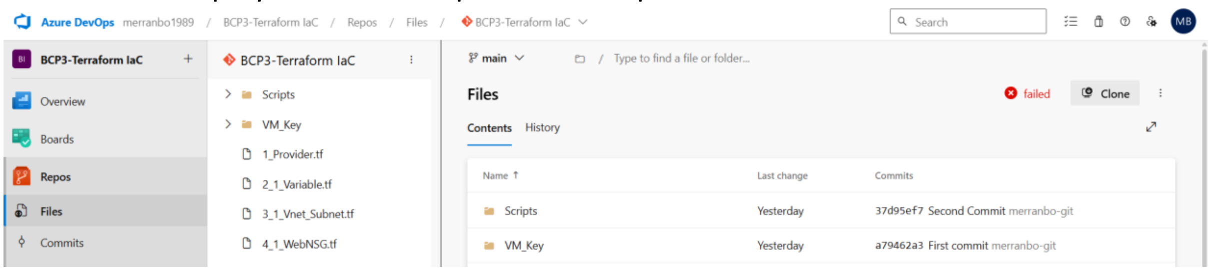
New pipeline

Configure your pipeline

Starter pipeline
Start with a minimal pipeline that you can customize to build and deploy your code.

Existing Azure Pipelines YAML file

3. Configure the YAML file with separate stages for "Dev", "Stage", "Prod" environments to be deployed in their respective workspace.



Azure DevOps merranbo1989 / BCP3-Terraform IaC / Repos / Files / BCP3-Terraform IaC

BCP3-Terraform IaC — Overview, Boards, Repos, Files, Commits

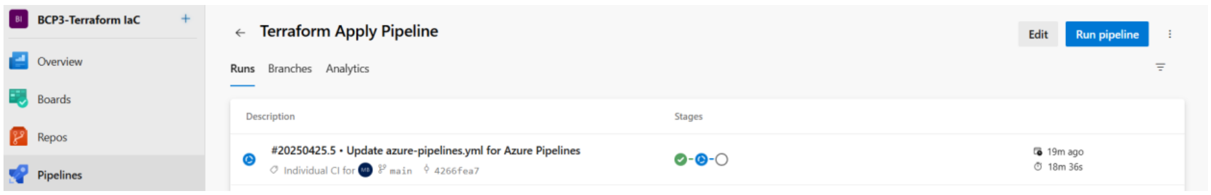
BCP3-Terraform IaC: Scripts, VM_Key, 1_Provider.tf, 2_1_Variable.tf, 3_1_Vnet_Subnet.tf, 4_1_WebNSG.tf

main / Type to find a file or folder...

Files — failed — Clone

Contents | History

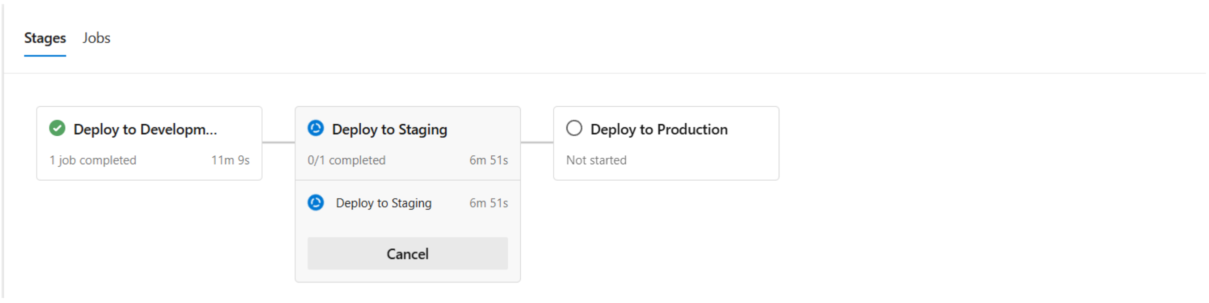
Name ↑	Last change	Commits
Scripts	Yesterday	37d95ef7 Second Commit merranbo-git
VM_Key	Yesterday	a79462a3 First commit merranbo-git



Terraform Apply Pipeline

Description	Stages	
#20250425.5 • Update azure-pipelines.yml for Azure Pipelines Individual CI for main 4266fea7	✓-●-○	19m ago 18m 36s

4. Trigger the pipeline after configuring the YAML file.



Stage	Status	Duration
Deploy to Developm...	1 job completed	11m 9s
Deploy to Staging	0/1 completed	6m 51s
Deploy to Staging		6m 51s
Deploy to Production	Not started	

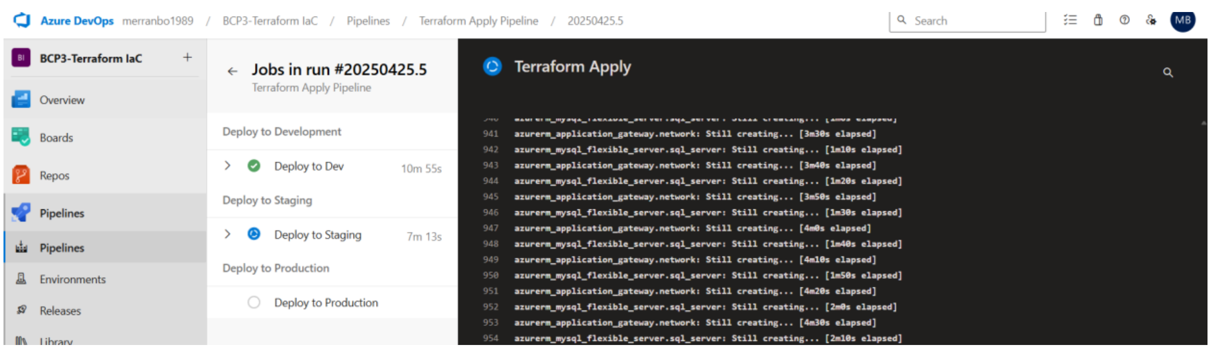
```
****** Code starts here ******
# Starter pipeline
# Start with a minimal pipeline that you can customize to build and deploy your code.
# Add steps that build, run tests, deploy, and more:
# https://aka.ms/yaml

trigger: none

pool: NewAgent

variables:
  bkstrgname : 'BRG1'
  bkstrgacc : 'ncplbackendstorage'
  bkcontainer : 'merranbo'
  #bkfile : '2_2_Values.tfvars'

stages:
  - stage: Dev
    displayName: Deploy to Development
    variables:
      env: 'Dev'
      bkkey : 'dev.terraform.tfstate'
      varfile: 'A_Dev.tfvars'
    jobs:
      - deployment: DeployDev
        displayName: Deploy to Dev
        environment: 'Dev'
        continueOnError: false
        strategy:
          runOnce:
```

```
      deploy:
        steps:
          - checkout: self
          - task: TerraformInstaller@1
            displayName: Terraform Install
            inputs:
              terraformVersion: 'latest'
          - task: TerraformTaskV4@4
            displayName: Terraform Init
            inputs:
              provider: 'azurerm'
              command: 'init'
              backendServiceArm: 'Azure subscription 1(3f48112c-a56d-44e0-9a80-
1ed5fbce3aac)'
              backendAzureRmResourceGroupName: '$(bkstrgname)'
              backendAzureRmStorageAccountName: '$(bkstrgacc)'
              backendAzureRmContainerName: '$(bkcontainer)'
              backendAzureRmKey: '$(bkkey)'
          - task: TerraformTaskV4@4
            displayName: Terraform Validate
            inputs:
              provider: 'azurerm'
              command: 'validate'
          - task: Bash@3
            displayName: Workspace Creation
            inputs:
              targetType: 'inline'
              script: 'terraform workspace new $(env)'
          - task: TerraformTaskV4@4
            displayName: Terraform Plan
            inputs:
              provider: 'azurerm'
              command: 'plan'
              commandOptions: '-var-file="$(varfile)"'
              environmentServiceNameAzureRM: 'Azure subscription 1(3f48112c-a56d-44e0-
9a80-1ed5fbce3aac)'
          - task: TerraformTaskV4@4
            displayName: Terraform Apply
            inputs:
              provider: 'azurerm'
              command: 'apply'
              commandOptions: '-var-file="$(varfile)"'
              environmentServiceNameAzureRM: 'Azure subscription 1(3f48112c-a56d-44e0-
9a80-1ed5fbce3aac)'
```

```
 - stage: Stage
   displayName: Deploy to Staging
   condition: succeeded ('Dev')
   dependsOn: Dev
   variables:
     env: 'Stage'
     bkkey : 'stage.terraform.tfstate'
     varfile: 'A_Stage.tfvars'
   jobs:
     - deployment: DeployStage
       displayName: Deploy to Staging
       environment: 'Stage'
       continueOnError: false
       strategy:
         runOnce:
           deploy:
             steps:
                 - checkout: self
                 - task: TerraformInstaller@1
                   displayName: Terraform Install
                   inputs:
                     terraformVersion: 'latest'
                 - task: TerraformTaskV4@4
                   displayName: Terraform Init
                   inputs:
                     provider: 'azurerm'
                     command: 'init'
                     backendServiceArm: 'Azure subscription 1(3f48112c-a56d-44e0-9a80-
1ed5fbce3aac)'
                     backendAzureRmResourceGroupName: '$(bkstrgname)'
                     backendAzureRmStorageAccountName: '$(bkstrgacc)'
                     backendAzureRmContainerName: '$(bkcontainer)'
                     backendAzureRmKey: '$(bkkey)'
                 - task: TerraformTaskV4@4
                   displayName: Terraform Validate
                   inputs:
                     provider: 'azurerm'
                     command: 'validate'
                 - task: Bash@3
                   displayName: Workspace Creation
                   inputs:
                     targetType: 'inline'
                     script: 'terraform workspace new $(env)'
```

```
                - task: TerraformTaskV4@4
                  displayName: Terraform Plan
                  inputs:
                    provider: 'azurerm'
                    command: 'plan'
                    commandOptions: '-var-file="$(varfile)"'
                    environmentServiceNameAzureRM: 'Azure subscription 1(3f48112c-a56d-44e0-
9a80-1ed5fbce3aac)'
                - task: TerraformTaskV4@4
                  displayName: Terraform Apply
                  inputs:
                    provider: 'azurerm'
                    command: 'apply'
                    commandOptions: '-var-file="$(varfile)"'
                    environmentServiceNameAzureRM: 'Azure subscription 1(3f48112c-a56d-44e0-
9a80-1ed5fbce3aac)'

  - stage: Prod
    displayName: Deploy to Production
    condition: succeeded ('Stage')
    dependsOn: Stage
    variables:
      env: 'Prod'
      bkkey : 'prod.terraform.tfstate'
      varfile: 'A_Prod.tfvars'
    jobs:
      - deployment: DeployProd
        displayName: Deploy to Production
        environment: 'Prod'
        continueOnError: false
        strategy:
          runOnce:
            deploy:
              steps:
                - checkout: self
                - task: TerraformInstaller@1
                  displayName: Terraform Install
                  inputs:
                    terraformVersion: 'latest'
                - task: TerraformTaskV4@4
                  displayName: Terraform Init
                  inputs:
                    provider: 'azurerm'
                    command: 'init'
                    backendServiceArm: 'Azure subscription 1(3f48112c-a56d-44e0-9a80-
1ed5fbce3aac)'
                    backendAzureRmResourceGroupName: '$(bkstrgname)'
                    backendAzureRmStorageAccountName: '$(bkstrgacc)'
                    backendAzureRmContainerName: '$(bkcontainer)'
                    backendAzureRmKey: '$(bkkey)'
                - task: TerraformTaskV4@4
                  displayName: Terraform Validate
                  inputs:
                    provider: 'azurerm'
                    command: 'validate'
                - task: Bash@3
                  displayName: Workspace Creation
                  inputs:
                    targetType: 'inline'
                    script: 'terraform workspace new $(env)'
                - task: TerraformTaskV4@4
                  displayName: Terraform Plan
                  inputs:
                    provider: 'azurerm'
                    command: 'plan'
                    commandOptions: '-var-file="$(varfile)"'
                    environmentServiceNameAzureRM: 'Azure subscription 1(3f48112c-a56d-44e0-
9a80-1ed5fbce3aac)'
                - task: TerraformTaskV4@4
                  displayName: Terraform Apply
                  inputs:
                    provider: 'azurerm'
                    command: 'apply'
                    commandOptions: '-var-file="$(varfile)"'
                    environmentServiceNameAzureRM: 'Azure subscription 1(3f48112c-a56d-44e0-
9a80-1ed5fbce3aac)'
```

****** Code Ends here ******

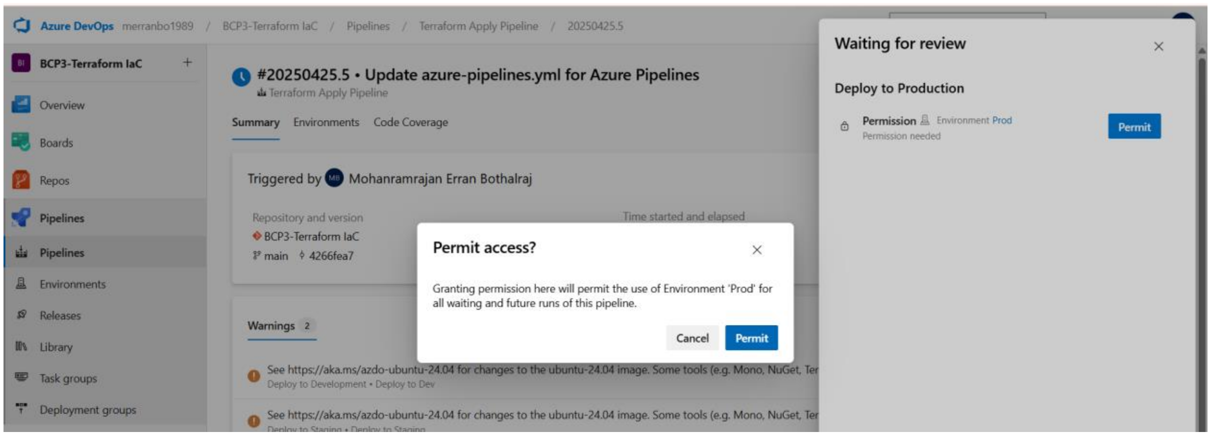

Azure DevOps merranbo1989 / BCP3-Terraform IaC / Pipelines / Terraform Apply Pipeline / 20250425.5
Search
MB
BCP3-Terraform IaC
Overview
Boards
Repos
Pipelines
Pipelines
Environments
Releases
Library

Jobs in run #20250425.5
Terraform Apply Pipeline

Deploy to Development
Deploy to Dev 10m 55s
Deploy to Staging
Deploy to Staging 7m 13s
Deploy to Production
Deploy to Production

Terraform Apply

```
azurerm_application_gateway.network: Still creating... [3m30s elapsed]
azurerm_mysql_flexible_server.sql_server: Still creating... [1m10s elapsed]
azurerm_application_gateway.network: Still creating... [3m40s elapsed]
azurerm_mysql_flexible_server.sql_server: Still creating... [1m20s elapsed]
azurerm_application_gateway.network: Still creating... [3m50s elapsed]
azurerm_mysql_flexible_server.sql_server: Still creating... [1m30s elapsed]
azurerm_application_gateway.network: Still creating... [4m0s elapsed]
azurerm_mysql_flexible_server.sql_server: Still creating... [1m40s elapsed]
azurerm_application_gateway.network: Still creating... [4m10s elapsed]
azurerm_mysql_flexible_server.sql_server: Still creating... [1m50s elapsed]
azurerm_application_gateway.network: Still creating... [4m20s elapsed]
azurerm_mysql_flexible_server.sql_server: Still creating... [2m0s elapsed]
azurerm_application_gateway.network: Still creating... [4m30s elapsed]
azurerm_mysql_flexible_server.sql_server: Still creating... [2m10s elapsed]
```


Azure DevOps merranbo1989 / BCP3-Terraform IaC / Pipelines / Terraform Apply Pipeline / 20250425.5

BCP3-Terraform IaC

Overview
Boards
Repos
Pipelines
Pipelines
Environments
Releases
Library
Task groups
Deployment groups

#20250425.5 • Update azure-pipelines.yml for Azure Pipelines
Terraform Apply Pipeline

Summary Environments Code Coverage

Triggered by Mohanramrajan Erran Bothalraj

Repository and version
BCP3-Terraform IaC
main 4266fea7

Time started and elapsed

Warnings 2

See https://aka.ms/azdo-ubuntu-24.04 for changes to the ubuntu-24.04 image. Some tools (e.g. Mono, NuGet, Ter
Deploy to Development • Deploy to Dev

See https://aka.ms/azdo-ubuntu-24.04 for changes to the ubuntu-24.04 image. Some tools (e.g. Mono, NuGet, Ter
Deploy to Staging • Deploy to Staging

Permit access?

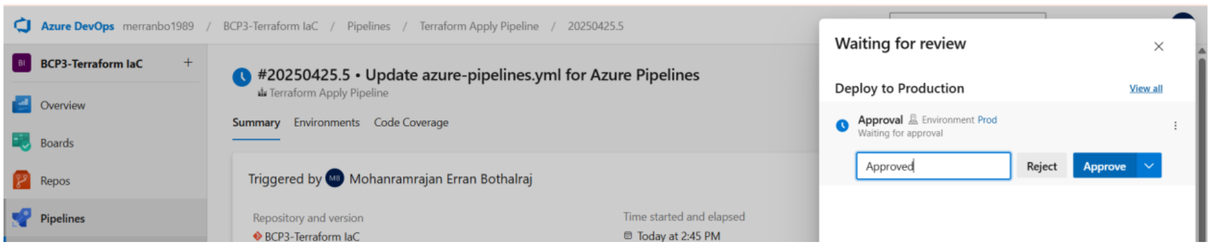
Granting permission here will permit the use of Environment 'Prod' for all waiting and future runs of this pipeline.

Cancel Permit

Waiting for review

Deploy to Production

Permission Environment Prod
Permission needed
Permit


Azure DevOps merranbo1989 / BCP3-Terraform IaC / Pipelines / Terraform Apply Pipeline / 20250425.5

BCP3-Terraform IaC

Overview
Boards
Repos
Pipelines

#20250425.5 • Update azure-pipelines.yml for Azure Pipelines
Terraform Apply Pipeline

Summary Environments Code Coverage

Triggered by Mohanramrajan Erran Bothalraj

Repository and version
BCP3-Terraform IaC

Time started and elapsed
Today at 2:45 PM

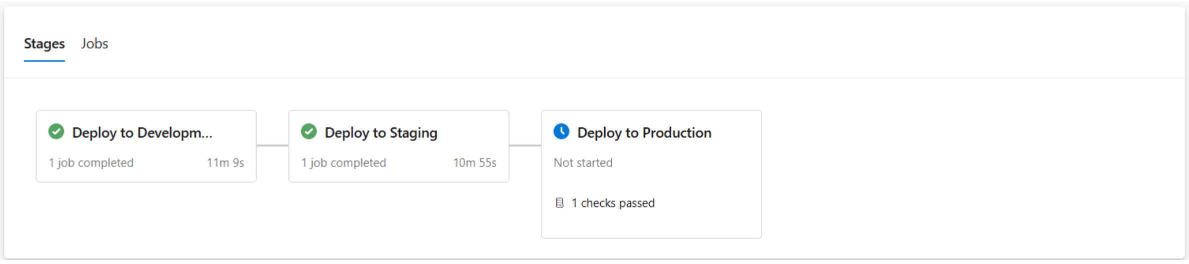
Waiting for review

Deploy to Production View all

Approval Environment Prod
Waiting for approval

Approved

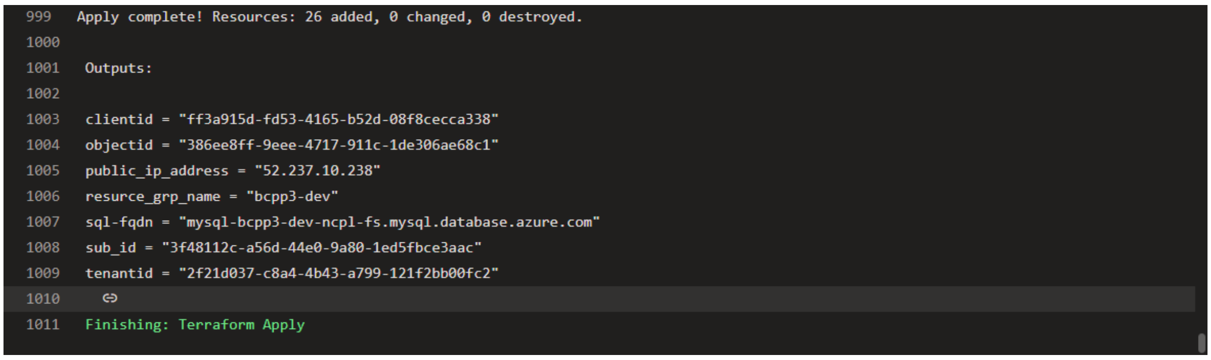
Reject Approve


Stages Jobs

Deploy to Developm...
1 job completed 11m 9s

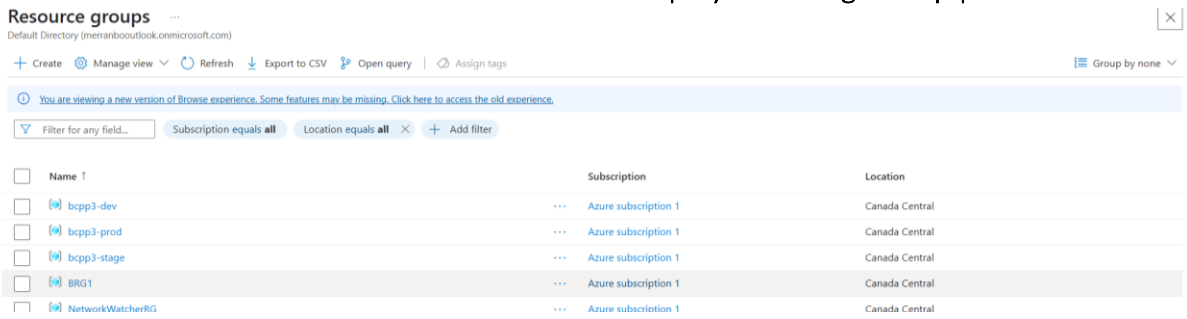
Deploy to Staging
1 job completed 10m 55s

Deploy to Production
Not started
1 checks passed


```
Apply complete! Resources: 26 added, 0 changed, 0 destroyed.

 Outputs:

 clientid = "ff3a915d-fd53-4165-b52d-08f8cecca338"
 objectid = "386ee8ff-9eee-4717-911c-1de306ae68c1"
 public_ip_address = "52.237.10.238"
 resurce_grp_name = "bcpp3-dev"
 sql-fqdn = "mysql-bcpp3-dev-ncpl-fs.mysql.database.azure.com"
 sub_id = "3f48112c-a56d-44e0-9a80-1ed5fbce3aac"
 tenantid = "2f21d037-c8a4-4b43-a799-121f2bb00fc2"

 Finishing: Terraform Apply
```

Validation

1. Check the Azure Portal for the resources deployed through the pipeline.


Resource groups
Default Directory (merranbooutlook.onmicrosoft.com)

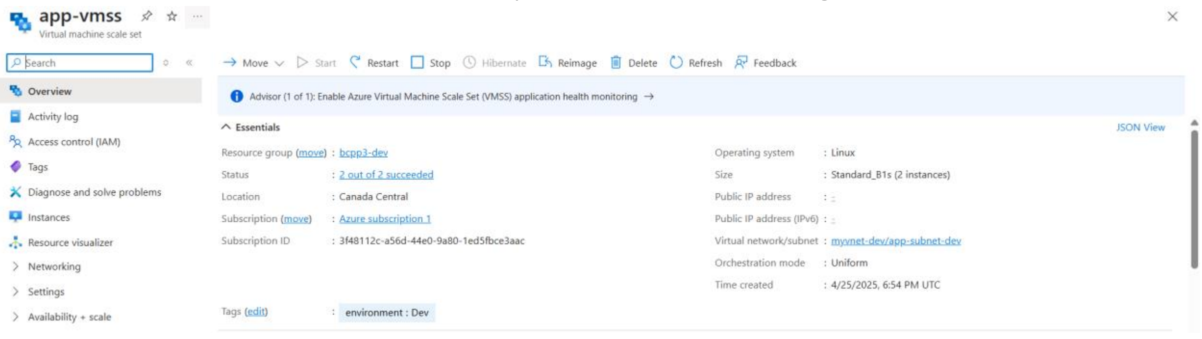
Create Manage view Refresh Export to CSV Open query Assign tags Group by none

You are viewing a new version of Browse experience. Some features may be missing. Click here to access the old experience.

Filter for any field... Subscription equals all Location equals all Add filter

Name ↑	Subscription	Location
bcpp3-dev	Azure subscription 1	Canada Central
bcpp3-prod	Azure subscription 1	Canada Central
bcpp3-stage	Azure subscription 1	Canada Central
BRG1	Azure subscription 1	Canada Central
NetworkWatcherRG	Azure subscription 1	Canada Central

2. Check if the Environment workspace is added in the tags section



app-vmss
Virtual machine scale set

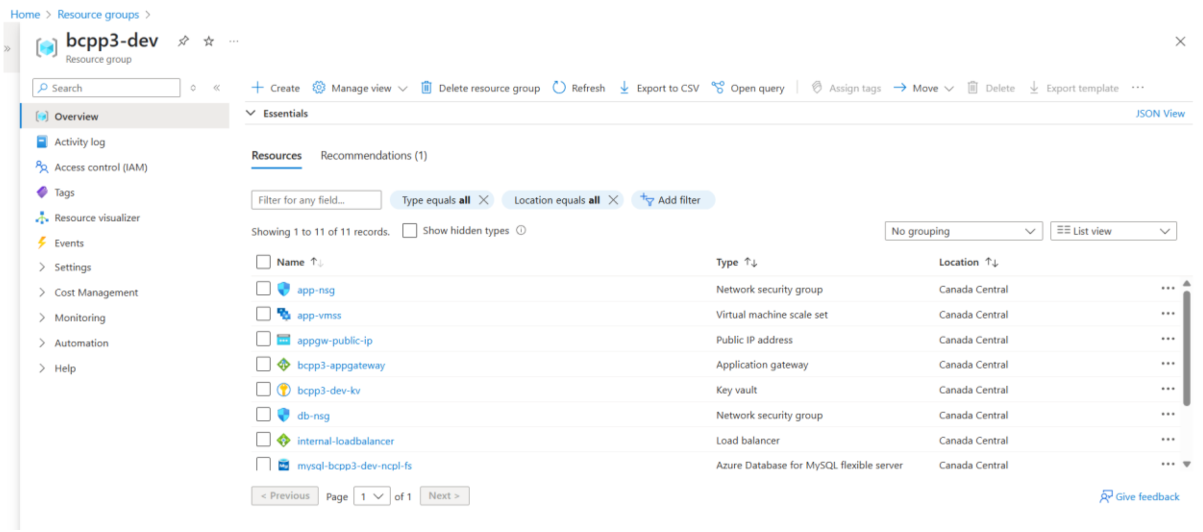
Move | Start | Restart | Stop | Hibernate | Reimage | Delete | Refresh | Feedback

Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems
Instances
Resource visualizer
Networking
Settings
Availability + scale

Advisor (1 of 1): Enable Azure Virtual Machine Scale Set (VMSS) application health monitoring →

Essentials — JSON View

Resource group (move)	: bcpp3-dev	Operating system	: Linux
Status	: 2 out of 2 succeeded	Size	: Standard_B1s (2 instances)
Location	: Canada Central	Public IP address	: -
Subscription (move)	: Azure subscription 1	Public IP address (IPv6)	: -
Subscription ID	: 3f48112c-a56d-44e0-9a80-1ed5fbce3aac	Virtual network/subnet	: myvnet-dev/app-subnet-dev
		Orchestration mode	: Uniform
		Time created	: 4/25/2025, 6:54 PM UTC
Tags (edit)	: environment : Dev		



Home > Resource groups >
bcpp3-dev
Resource group

Create | Manage view | Delete resource group | Refresh | Export to CSV | Open query | Assign tags | Move | Delete | Export template

Overview
Activity log
Access control (IAM)
Tags
Resource visualizer
Events
Settings
Cost Management
Monitoring
Automation
Help

Essentials — JSON View

Resources | Recommendations (1)

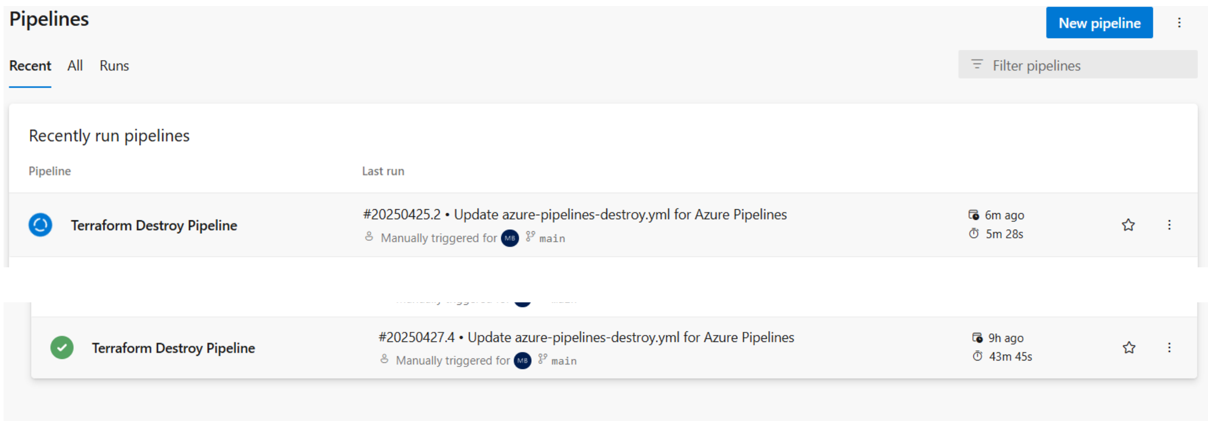
Filter for any field... | Type equals **all** | Location equals **all** | Add filter

Showing 1 to 11 of 11 records. Show hidden types — No grouping — List view

Name	Type	Location
app-nsg	Network security group	Canada Central
app-vmss	Virtual machine scale set	Canada Central
appgw-public-ip	Public IP address	Canada Central
bcpp3-appgateway	Application gateway	Canada Central
bcpp3-dev-kv	Key vault	Canada Central
db-nsg	Network security group	Canada Central
internal-loadbalancer	Load balancer	Canada Central
mysql-bcpp3-dev-ncpl-fs	Azure Database for MySQL flexible server	Canada Central

< Previous | Page 1 of 1 | Next > — Give feedback

3. Create a Destroy pipeline to remove the resources created through the pipeline

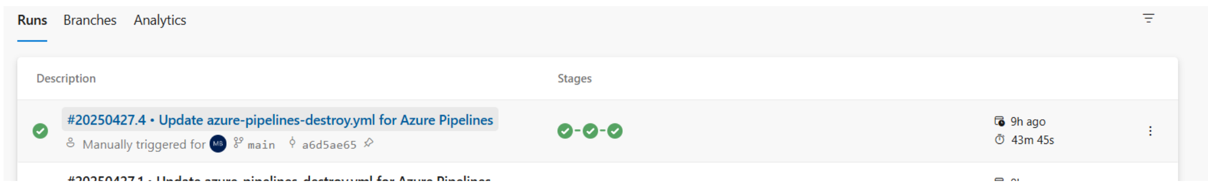


Pipelines — New pipeline

Recent | All | Runs — Filter pipelines

Recently run pipelines

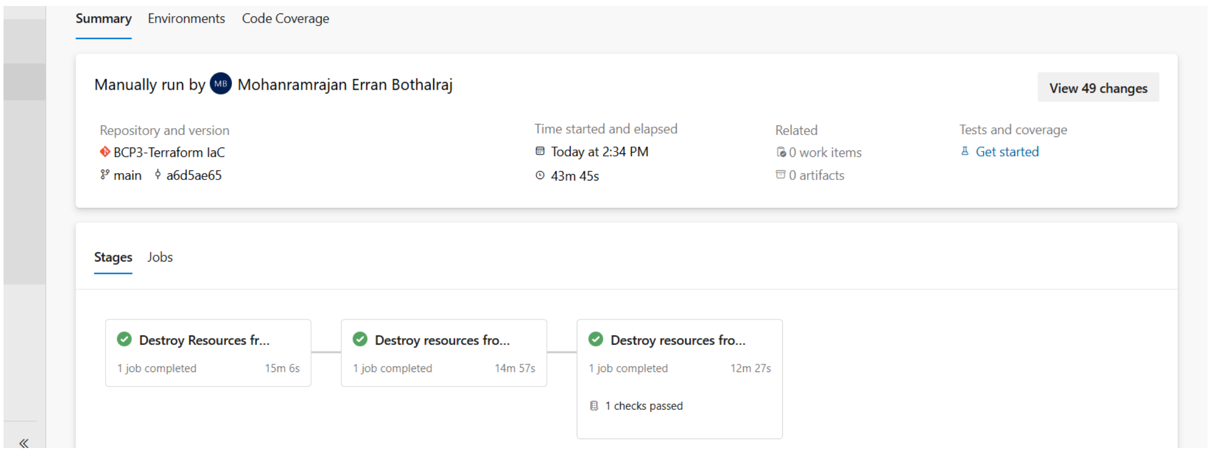
Pipeline	Last run		
Terraform Destroy Pipeline	#20250425.2 • Update azure-pipelines-destroy.yml for Azure Pipelines Manually triggered for MB main	6m ago 5m 28s	
Terraform Destroy Pipeline	#20250427.4 • Update azure-pipelines-destroy.yml for Azure Pipelines Manually triggered for MB main	9h ago 43m 45s	



Runs | Branches | Analytics

Description	Stages	
#20250427.4 • Update azure-pipelines-destroy.yml for Azure Pipelines Manually triggered for MB main a6d5ae65	✓-✓-✓	9h ago 43m 45s

12



Manually run by MB Mohanramrajan Erran Bothalraj

View 49 changes

Repository and version: BCP3-Terraform IaC, main, a6d5ae65

Time started and elapsed: Today at 2:34 PM, 43m 45s

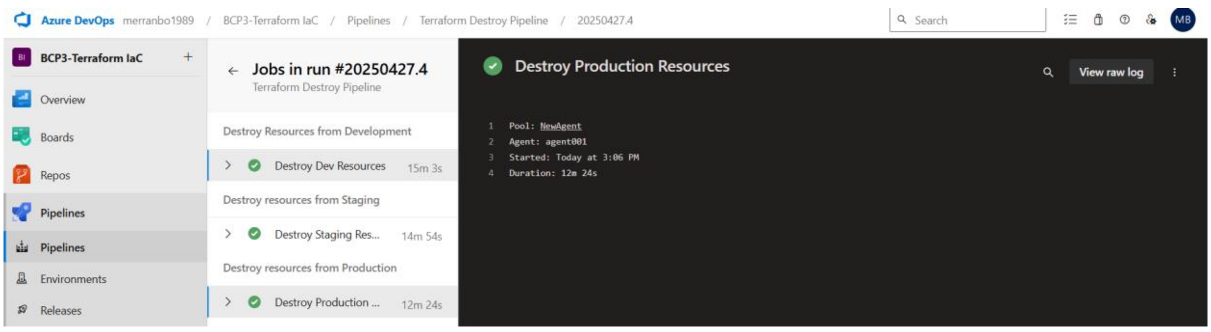
Related: 0 work items, 0 artifacts

Tests and coverage: Get started

Destroy Resources fr... — 1 job completed — 15m 6s

Destroy resources fro... — 1 job completed — 14m 57s

Destroy resources fro... — 1 job completed — 12m 27s — 1 checks passed



Jobs in run #20250427.4
Terraform Destroy Pipeline

Destroy Resources from Development
Destroy Dev Resources — 15m 3s

Destroy resources from Staging
Destroy Staging Res... — 14m 54s

Destroy resources from Production
Destroy Production ... — 12m 24s

Destroy Production Resources

```
Pool: NewAgent
Agent: agent001
Started: Today at 3:06 PM
Duration: 12m 24s
```

APPENDIX

Main.tf

```
terraform {
      required_providers {
        azurerm = {
          source  = "hashicorp/azurerm"
          version = "=3.0.0"
        }
      }
        backend "azurerm" {}
    }

    provider "azurerm" {
      subscription_id = "3f48112c-a56d-44e0-9a80-1ed5fbce3aac"
      tenant_id = "2f21d037-c8a4-4b43-a799-121f2bb00fc2"
      client_id = "ff3a915d-fd53-4165-b52d-08f8cecca338"
      client_secret = "IEe8Q~OoB2SA5fdjcQuIieqFLWp6b~Ff9XO1gapW"

      features {
        key_vault {
          purge_soft_delete_on_destroy    = true
          recover_soft_deleted_key_vaults = true
        }
      }
    }

    data "azurerm_client_config" "current" {}
```

```
resource "azurerm_resource_group" "res_grp" {
  name     = var.res_grp_name
  location = var.location
}
resource "azurerm_virtual_network" "myvnet" {
  name                = var.vnet_name
  address_space       = ["170.20.0.0/16"]
  location            = var.location
  resource_group_name = var.res_grp_name
  depends_on = [ azurerm_resource_group.res_grp ]
}
resource "azurerm_subnet" "appgateway_subnet" {
  name                 = var.vnet_appgw
  resource_group_name  = var.res_grp_name
  virtual_network_name = azurerm_virtual_network.myvnet.name
  address_prefixes     = ["170.20.0.0/24"]
  depends_on = [ azurerm_resource_group.res_grp ]
}
resource "azurerm_subnet" "web_subnet" {
  name                 = var.vnet_web
  resource_group_name  = var.res_grp_name
  virtual_network_name = azurerm_virtual_network.myvnet.name
  address_prefixes     = ["170.20.1.0/24"]
  depends_on = [ azurerm_resource_group.res_grp ]
}
resource "azurerm_subnet" "app_subnet" {
  name                 = var.vnet_app
  resource_group_name  = var.res_grp_name
  virtual_network_name = azurerm_virtual_network.myvnet.name
  address_prefixes     = ["170.20.2.0/24"]
  depends_on = [ azurerm_resource_group.res_grp ]
}
resource "azurerm_subnet" "db_subnet" {
  name                 = var.vnet_db
  resource_group_name  = var.res_grp_name
  virtual_network_name = azurerm_virtual_network.myvnet.name
  address_prefixes     = ["170.20.3.0/24"]

  service_endpoints    = ["Microsoft.Storage"]
  delegation {
    name = "fs"
    service_delegation {
      name  = "Microsoft.DBforMySQL/flexibleServers"
      actions = [
        "Microsoft.Network/virtualNetworks/subnets/join/action",
      ]
    }
  }
depends_on = [ azurerm_resource_group.res_grp ]
}
resource "azurerm_network_security_group" "webnsg" {
  name                = "web-nsg"
  location            = var.location
  resource_group_name = var.res_grp_name

  security_rule {
    name                       = "AllowSSH"
    priority                   = 1001
```

```
        direction                  = "Inbound"
        access                     = "Allow"
        protocol                   = "Tcp"
        source_port_range          = "*"
        destination_port_range     = "22"
        source_address_prefix      = "*"
        destination_address_prefix = "*"
      }

      security_rule {
        name                       = "AllowHTTP"
        priority                   = 1002
        direction                  = "Inbound"
        access                     = "Allow"
        protocol                   = "Tcp"
        source_port_range          = "*"
        destination_port_range     = "80"
        source_address_prefix      = "*"
        destination_address_prefix = "*"
      }
      security_rule {
        name                       = "AllowNodeJS"
        priority                   = 104
        direction                  = "Inbound"
        access                     = "Allow"
        protocol                   = "Tcp"
        source_port_range          = "*"
        destination_port_range     = "5000"
        source_address_prefix      = "*"
        destination_address_prefix = "*"
      }
      depends_on = [ azurerm_resource_group.res_grp ]

    }
    resource "azurerm_subnet_network_security_group_association" "webnsgconn" {
      subnet_id = azurerm_subnet.web_subnet.id
      network_security_group_id = azurerm_network_security_group.webnsg.id
       depends_on = [ azurerm_network_security_group.webnsg ]
    }

resource "azurerm_network_security_group" "appnsg" {
  name                = "app-nsg"
  location            = var.location
  resource_group_name = var.res_grp_name

  security_rule {
    name                       = "AllowHTTP"
    priority                   = 1003
    direction                  = "Inbound"
    access                     = "Allow"
    protocol                   = "Tcp"
    source_port_range          = "*"
    destination_port_range     = "80"
    source_address_prefix      = azurerm_subnet.web_subnet.address_prefixes[0]
    destination_address_prefix = "*"
  }

  security_rule {
    name                        = "AllowMySQL"
    priority                    = 1004
    direction                   = "Outbound"
    access                      = "Allow"
    protocol                    = "Tcp"
    source_port_range           = "*"
    destination_port_range      = "3306"
    source_address_prefix       = "*"
    destination_address_prefix  = "*"
  }
  security_rule {
    name                        = "AllowFlakySQL"
    priority                    = 1010
    direction                   = "Inbound"
    access                      = "Allow"
    protocol                    = "Tcp"
    source_port_range           = "*"
    destination_port_range      = "5000"
    source_address_prefix       = azurerm_subnet.web_subnet.address_prefixes[0]
    destination_address_prefix  = "*"
  }
    security_rule {
    name                        = "AllowOutboundDB"
    priority                    = 102
    direction                   = "Outbound"
    access                      = "Allow"
    protocol                    = "Tcp"
    source_port_range           = "*"
    destination_port_range      = "1433"
    source_address_prefix       = azurerm_subnet.app_subnet.address_prefixes[0]
    destination_address_prefix  = azurerm_subnet.db_subnet.address_prefixes[0]
  }

   depends_on = [ azurerm_resource_group.res_grp ]
}
resource "azurerm_subnet_network_security_group_association" "appnsgconn" {
  subnet_id = azurerm_subnet.app_subnet.id
  network_security_group_id = azurerm_network_security_group.appnsg.id
   depends_on = [ azurerm_network_security_group.appnsg ]
}

resource "azurerm_network_security_group" "dbnsg" {
  name                = "db-nsg"
  location            = var.location
  resource_group_name = var.res_grp_name

  security_rule {
    name                        = "AllowSQLRule"
    priority                    = 1005
    direction                   = "Inbound"
    access                      = "Allow"
    protocol                    = "Tcp"
    source_port_range           = "*"
    destination_port_range      = "3306"
    source_address_prefix       = azurerm_subnet.app_subnet.address_prefixes[0]
    destination_address_prefix  = "*"
  }
   depends_on = [ azurerm_resource_group.res_grp ]
```

```
}
resource "azurerm_subnet_network_security_group_association" "dbnsgconn" {
  subnet_id = azurerm_subnet.db_subnet.id
  network_security_group_id = azurerm_network_security_group.dbnsg.id
  depends_on = [ azurerm_network_security_group.dbnsg ]
}

locals {
  is_production = contains(["Prod", "Production", "prod", "production"], terraform.workspac
e)
}

resource "azurerm_linux_virtual_machine_scale_set" "web_vmss" {
  name                = "web-vmss"
  resource_group_name = var.res_grp_name
  location            = var.location
  sku                 = "Standard_B1s"
  instances           = 2
  admin_username      = var.admin_username
  upgrade_mode        = "Manual"

  zones = local.is_production ? ["1", "2"] : null

  source_image_reference {
    publisher = "Canonical"
    offer     = "0001-com-ubuntu-server-jammy"
    sku       = "22_04-lts"
    version   = "latest"
  }

  admin_ssh_key {
    username   = var.admin_username
    public_key = file("${path.module}/${var.web_ssh_key_path}")
  }

  os_disk {
    caching              = "ReadWrite"
    storage_account_type = "Standard_LRS"
  }

  network_interface {
    name    = "web-vmss-nic"
    primary = true

    ip_configuration {
      name      = "web-nic-ip"
      subnet_id = azurerm_subnet.web_subnet.id
      application_gateway_backend_address_pool_ids = [for pool in azurerm_application_gatew
ay.network.backend_address_pool : pool.id]
      load_balancer_backend_address_pool_ids = [azurerm_lb_backend_address_pool.backend_poo
l.id]
      }
  }

  tags = {
    environment = terraform.workspace
  }
  custom_data = filebase64("${path.module}/Scripts/web_init.sh")

  depends_on = [
    azurerm_application_gateway.network,
    azurerm_resource_group.res_grp,
    azurerm_linux_virtual_machine_scale_set.app_vmss
  ]
}

resource "azurerm_monitor_autoscale_setting" "vmss_autoscale" {
  name                = "web-vmss-autoscale"
  location            = var.location
  resource_group_name = var.res_grp_name
  target_resource_id  = azurerm_linux_virtual_machine_scale_set.web_vmss.id

  profile {
    name = "defaultProfile"
    capacity {
      minimum = "2"
      maximum = "5"
      default = "2"
    }

    rule {
      metric_trigger {
        metric_name        = "Percentage CPU"
        metric_resource_id = azurerm_linux_virtual_machine_scale_set.web_vmss.id
        time_grain         = "PT1M"
        statistic          = "Average"
        time_window        = "PT5M"
        time_aggregation   = "Average"
        operator           = "GreaterThan"
        threshold          = 75
      }

      scale_action {
        direction = "Increase"
        type      = "ChangeCount"
        value     = "1"
        cooldown  = "PT5M"
      }
    }

    rule {
      metric_trigger {
        metric_name        = "Percentage CPU"
        metric_resource_id = azurerm_linux_virtual_machine_scale_set.web_vmss.id
        time_grain         = "PT1M"
        statistic          = "Average"
        time_window        = "PT5M"
        time_aggregation   = "Average"
        operator           = "LessThan"
        threshold          = 25
      }

      scale_action {
        direction = "Decrease"
        type      = "ChangeCount"
        value     = "1"
        cooldown  = "PT5M"
      }
  }
  }

  tags = {
    environment = terraform.workspace
  }

  depends_on = [azurerm_linux_virtual_machine_scale_set.web_vmss]
}
resource "azurerm_linux_virtual_machine_scale_set" "app_vmss" {
  name                = "app-vmss"
  resource_group_name = var.res_grp_name
  location            = var.location
  sku                 = "Standard_B1s"
  instances           = 2
  admin_username      = var.admin_username
  upgrade_mode        = "Manual"

  zones = local.is_production ? ["1", "2"] : null

  admin_ssh_key {
    username   = var.admin_username
    public_key = file("${path.module}/${var.app_ssh_key_path}")
  }

  source_image_reference {
    publisher = "Canonical"
    offer     = "0001-com-ubuntu-server-jammy"
    sku       = "22_04-lts"
    version   = "latest"
  }

  os_disk {
    caching              = "ReadWrite"
    storage_account_type = "Standard_LRS"
  }

  network_interface {
    name    = "app-vmss-nic"
    primary = true

    ip_configuration {
      name                                   = "app-nic-ip"
      subnet_id                              = azurerm_subnet.app_subnet.id
      load_balancer_backend_address_pool_ids = [azurerm_lb_backend_address_pool.backend_poo
l.id]
    }
  }

  custom_data = base64encode(templatefile("${path.module}/Scripts/node_server.sh", {
    db_host = azurerm_mysql_flexible_server.sql_server.fqdn,
    db_user = "${azurerm_mysql_flexible_server.sql_server.administrator_login}@${azurerm_my
sql_flexible_server.sql_server.name}",
    db_pswd = azurerm_key_vault_secret.db_pass.value
  }))
  tags = {
    environment = terraform.workspace
  }
  depends_on = [azurerm_resource_group.res_grp, azurerm_mysql_flexible_database.sql_db]
}

resource "azurerm_monitor_autoscale_setting" "app_vmss_autoscale" {
  name                = "app-vmss-autoscale"
  location            = var.location
  resource_group_name = var.res_grp_name
  target_resource_id  = azurerm_linux_virtual_machine_scale_set.app_vmss.id

  profile {
    name = "defaultProfile"
    capacity {
      minimum = "2"
      maximum = "5"
      default = "2"
    }

    rule {
      metric_trigger {
        metric_name        = "Percentage CPU"
        metric_resource_id = azurerm_linux_virtual_machine_scale_set.app_vmss.id
        time_grain         = "PT1M"
        statistic          = "Average"
        time_window        = "PT5M"
        time_aggregation   = "Average"
        operator           = "GreaterThan"
        threshold          = 75
      }

      scale_action {
        direction = "Increase"
        type      = "ChangeCount"
        value     = "1"
        cooldown  = "PT5M"
      }
    }

    rule {
      metric_trigger {
        metric_name        = "Percentage CPU"
        metric_resource_id = azurerm_linux_virtual_machine_scale_set.app_vmss.id
        time_grain         = "PT1M"
        statistic          = "Average"
        time_window        = "PT5M"
        time_aggregation   = "Average"
        operator           = "LessThan"
        threshold          = 25
      }

      scale_action {
        direction = "Decrease"
        type      = "ChangeCount"
        value     = "1"
        cooldown  = "PT5M"
      }
    }
  }

  tags = {
    environment = terraform.workspace
  }

  depends_on = [azurerm_linux_virtual_machine_scale_set.app_vmss]
}

resource "azurerm_public_ip" "pubip" {
  name                = "appgw-public-ip"
  location            = var.location
  resource_group_name = var.res_grp_name
  allocation_method   = "Static"
  sku                 = "Standard"
   depends_on = [ azurerm_resource_group.res_grp ]
}

locals {
  backend_address_pool_name      = "${azurerm_virtual_network.myvnet.name}-beap"
  frontend_port_name             = "${azurerm_virtual_network.myvnet.name}-feport"
  frontend_ip_configuration_name = "${azurerm_virtual_network.myvnet.name}-feip"
  http_setting_name              = "${azurerm_virtual_network.myvnet.name}-be-htst"
  listener_name                  = "${azurerm_virtual_network.myvnet.name}-httplstn"
  request_routing_rule_name      = "${azurerm_virtual_network.myvnet.name}-rqrt"
}

resource "azurerm_application_gateway" "network" {
  name                = "bcpp3-appgateway"
  resource_group_name = var.res_grp_name
  location            = var.location

  sku {
    name     = "Standard_v2"
    tier     = "Standard_v2"
    capacity = 1
  }

  gateway_ip_configuration {
    name      = "my-gateway-ip-configuration"
    subnet_id = azurerm_subnet.appgateway_subnet.id
  }

  frontend_port {
    name = local.frontend_port_name
    port = 80
  }

  frontend_ip_configuration {
    name                 = local.frontend_ip_configuration_name
    public_ip_address_id = azurerm_public_ip.pubip.id
  }

  backend_address_pool {
    name = local.backend_address_pool_name
  }
  probe {
    name = "appgw-health-probe"
    protocol = "Http"
    path = "/"
    timeout = 30
    interval = 30
    unhealthy_threshold = 3
    pick_host_name_from_backend_http_settings = false
    host = "172.20.2.100"
    minimum_servers = 0
    match {
      status_code = ["200","201"]
      body = "*"
    }
  }

  backend_http_settings {
    name                  = local.http_setting_name
    cookie_based_affinity = "Disabled"
    port                  = 80
    protocol              = "Http"
    request_timeout       = 30
    probe_name = "appgw-health-probe"
  }

  http_listener {
    name                           = local.listener_name
    frontend_ip_configuration_name = local.frontend_ip_configuration_name
    frontend_port_name             = local.frontend_port_name
    protocol                       = "Http"
  }

  request_routing_rule {
    name                       = local.request_routing_rule_name
    rule_type                  = "Basic"
    priority                   = 25
    http_listener_name         = local.listener_name
    backend_address_pool_name  = local.backend_address_pool_name
    backend_http_settings_name = local.http_setting_name
  }
   depends_on = [ azurerm_resource_group.res_grp ]
}


# Internal Load Balancer
resource "azurerm_lb" "internal_lb" {
  name                = "internal-loadbalancer"
  location            = var.location
  resource_group_name = var.res_grp_name
  sku                 = "Standard"

  frontend_ip_configuration {
    name                           = "internal-lb-fe"
    subnet_id                      = azurerm_subnet.app_subnet.id
    private_ip_address_allocation = "Static"
    private_ip_address            = "170.20.2.100" # use any available IP in the app subnet
  }
```

```
}

# Backend Address Pool
resource "azurerm_lb_backend_address_pool" "backend_pool" {
  loadbalancer_id = azurerm_lb.internal_lb.id
  name            = "backend-pool"
}

# Health Probe
resource "azurerm_lb_probe" "health_probe" {
  loadbalancer_id     = azurerm_lb.internal_lb.id
  name                = "http-probe"
  protocol            = "Http"
  port                = 80
  request_path        = "/"
  interval_in_seconds = 15
  number_of_probes    = 2
}

# Load Balancer Rule
resource "azurerm_lb_rule" "http_rule" {
  name                            = "http-rule"
  loadbalancer_id                 = azurerm_lb.internal_lb.id
  protocol                        = "Tcp"
  frontend_port                   = 80
  backend_port                    = 80
  frontend_ip_configuration_name  = "internal-lb-fe"
  backend_address_pool_ids        = [azurerm_lb_backend_address_pool.backend_pool.id]
  probe_id                        = azurerm_lb_probe.health_probe.id
}

resource "azurerm_mysql_flexible_server" "sql_server" {
  name                   = "mysql-${var.res_grp_name}-ncpl-fs"
  resource_group_name    = var.res_grp_name
  location               = var.location
  administrator_login    = var.admin_username
  administrator_password = azurerm_key_vault_secret.db_pass.value
  backup_retention_days  = 7
  delegated_subnet_id    = azurerm_subnet.db_subnet.id
  private_dns_zone_id    = null
  sku_name               = "B_Standard_B1ms"

  depends_on = [ azurerm_resource_group.res_grp ]
}
resource "azurerm_mysql_flexible_database" "sql_db" {
  name                = "userdetails"
  resource_group_name = var.res_grp_name
  server_name         = azurerm_mysql_flexible_server.sql_server.name
  charset             = "utf8"
  collation           = "utf8_unicode_ci"

  depends_on = [ azurerm_mysql_flexible_server.sql_server  ]
}

resource "azurerm_key_vault" "kv" {
  name                        = "${var.res_grp_name}-kv"
  location                    = var.location
  resource_group_name         = var.res_grp_name
  tenant_id                   = data.azurerm_client_config.current.tenant_id
  sku_name                    = "standard"
  soft_delete_retention_days  = 7
  purge_protection_enabled    = false

  access_policy {
    tenant_id = data.azurerm_client_config.current.tenant_id
    object_id = data.azurerm_client_config.current.object_id

   key_permissions = [
      "Get", "List", "Create", "Update", "Delete", "Purge",
    ]

    secret_permissions = [
      "Get", "Set", "List", "Backup", "Delete", "Restore", "Purge",
    ]
  }

  depends_on = [ azurerm_resource_group.res_grp ,data.azurerm_client_config.current]
}

resource "azurerm_key_vault_secret" "db_pass" {
  name         = "mysql-password"
  value        = var.db_password
  key_vault_id = azurerm_key_vault.kv.id
  depends_on = [ azurerm_resource_group.res_grp, azurerm_key_vault.kv ]
}

output "public_ip_address" {
  value = azurerm_public_ip.pubip.ip_address
}
output "resurce_grp_name" {
  value = azurerm_resource_group.res_grp.name
}
output "sql-fqdn" {
  value = azurerm_mysql_flexible_server.sql_server.fqdn
}
output "sub_id" {
  value = data.azurerm_client_config.current.subscription_id
}
output "clientid" {
  value = data.azurerm_client_config.current.client_id
}
output "objectid" {
  value = data.azurerm_client_config.current.object_id
}
output "tenantid" {
  value = data.azurerm_client_config.current.tenant_id
}
```

Variables

```
variable "res_grp_name" {}
variable "location" {}
variable "db_password" {}
variable "environment" {}
variable "admin_username" {}
variable "web_ssh_key_path" {}
variable "app_ssh_key_path" {}
variable "vnet_name" {}
variable "vnet_web" {}
variable "vnet_app" {}
variable "vnet_db" {}
variable "vnet_appgw" {}
```

TFVARS file

1. Dev Environment

```
db_password             = "Mohan20ram1989*"
res_grp_name            = "bcpp3-dev"
location                = "Canada Central"
environment             = "dev"
admin_username          = "adminuser"
web_ssh_key_path        = "VM_Key/web-ssh-key.pub"
app_ssh_key_path        = "VM_Key/app-ssh-key.pub"
vnet_name               = "myvnet-dev"
vnet_web                = "web-subnet-dev"
vnet_app                = "app-subnet-dev"
vnet_db                 = "db-subnet-dev"
vnet_appgw              = "appgw-subnet-dev"
```

2. Staging Environment

```
db_password             = "Mohan20ram1989*"
res_grp_name            = "bcpp3-stage"
location                = "Canada Central"
environment             = "stage"
admin_username          = "adminuser"
web_ssh_key_path        = "VM_Key/web-ssh-key.pub"
app_ssh_key_path        = "VM_Key/app-ssh-key.pub"
vnet_name               = "myvnet-stage"
vnet_web                = "web-subnet-stage"
vnet_app                = "app-subnet-stage"
vnet_db                 = "db-subnet-stage"
vnet_appgw              = "appgw-subnet-stage"
```

3. Prod Environment

```
db_password             = "Mohan20ram1989*"
res_grp_name            = "bcpp3-prod"
location                = "Central US"
environment             = "prod"
admin_username          = "adminuser"
web_ssh_key_path        = "VM_Key/web-ssh-key.pub"
app_ssh_key_path        = "VM_Key/app-ssh-key.pub"
vnet_name               = "myvnet-prod"
vnet_web                = "web-subnet-prod"
vnet_app                = "app-subnet-prod"
vnet_db                 = "db-subnet-prod"
vnet_appgw              = "appgw-subnet-prod"
```