CLOUD COMPUTING

SUBMITTED TO

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SUBMITTED BY

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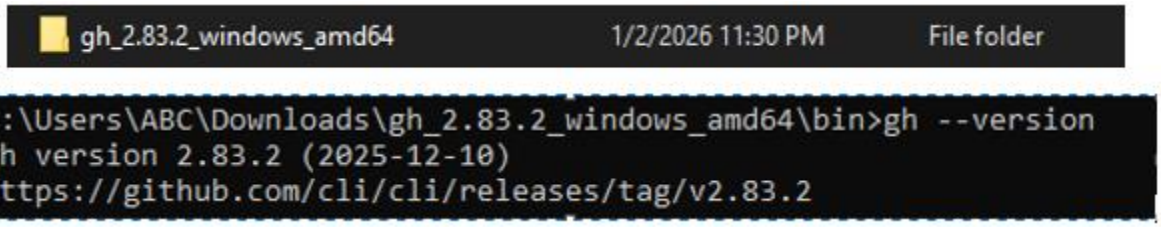
BSE V-A

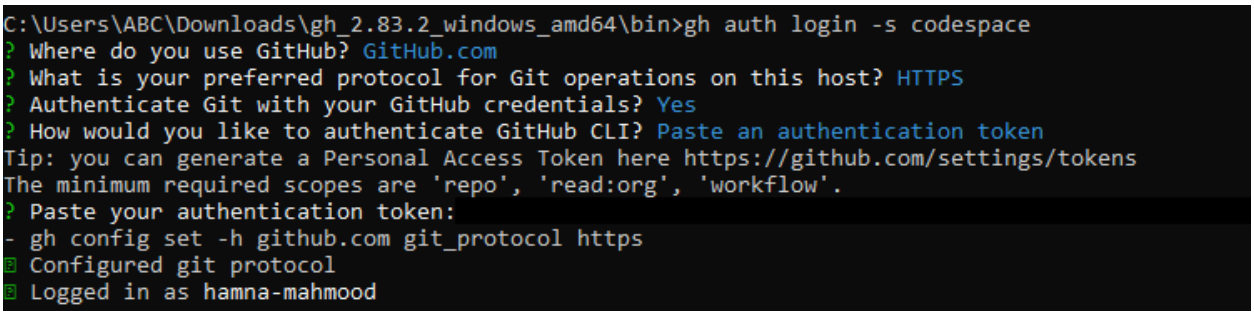
Lab 10 – GH CLI Codespaces + AWS + Terraform: CLI Automation of VPC/Subnet Creation

Task 1 — GitHub CLI Codespace Setup & Authentication

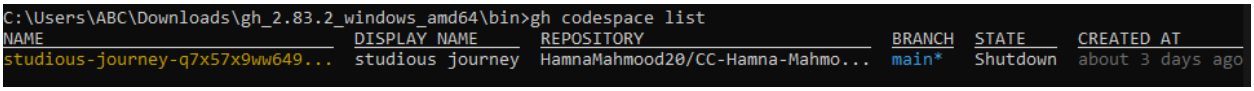
- task1_gh_install.png



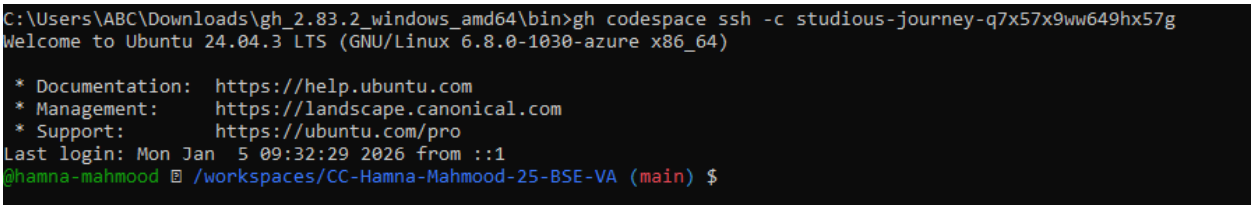
- task1_gh_auth_login.png



- task1_codespace_list.png

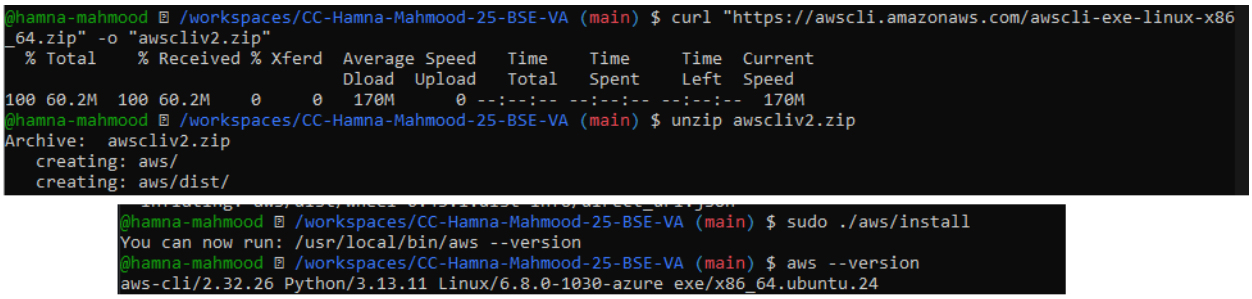


- task1_codespace_ssh_connected.png

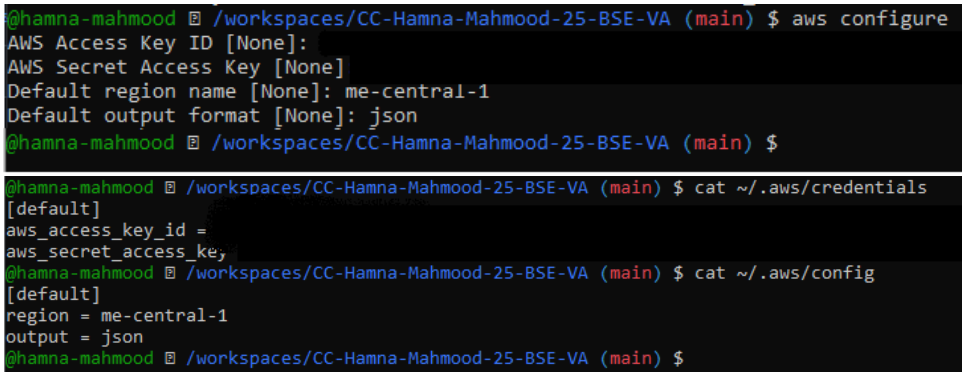


Task 2 – Install AWS CLI, Terraform CLI, Provider Setup

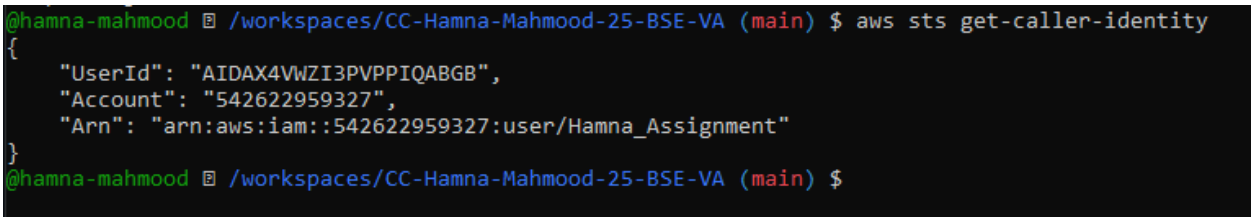
- task2_aws_install_and_version.png



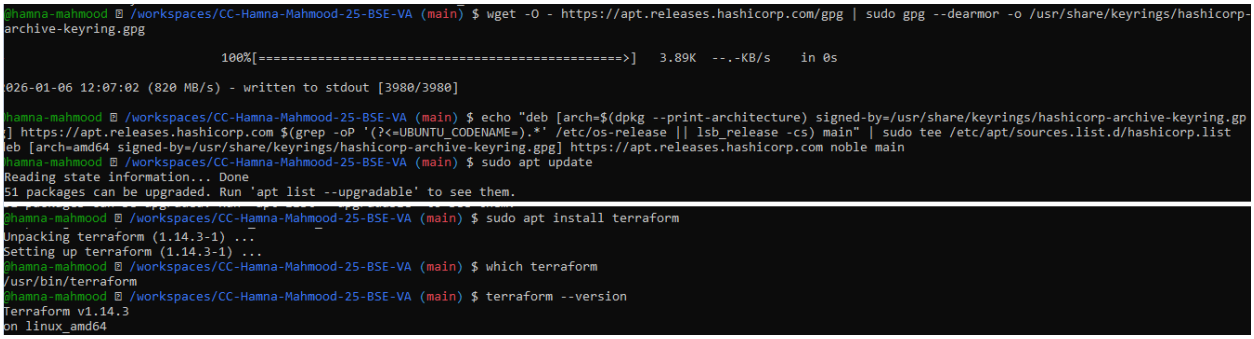
- task2_aws_configure_and_files.png



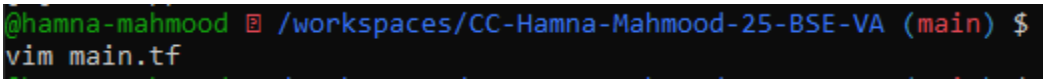
- task2_aws_get_caller_identity.png



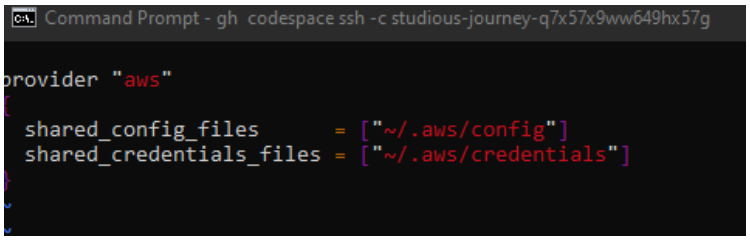
- task2_terraform_install_and_version.png



- task2_provider_file_creation.png



- task2_provider_block.png



- task2_vim_save_main_tf.png

```
provider "aws"
{
  shared_config_files      = ["~/.aws/config"]
  shared_credentials_files = ["~/.aws/credentials"]
}
~
~
~
~
~
~
~
~
~
~
:wq
```

- task2_terraform_init_output.png

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform init
Initializing the backend...
Initializing provider plugins...
- Finding latest version of hashicorp/aws...
- Installing hashicorp/aws v6.27.0...
- Installed hashicorp/aws v6.27.0 (signed by HashiCorp)
Terraform has created a lock file .terraform.lock.hcl to record the provider
selections it made above. Include this file in your version control repository
so that Terraform can guarantee to make the same selections by default when
you run "terraform init" in the future.

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.
```

- task2_terraform_lock_hcl.png

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ cat .terraform.lock.hcl
# This file is maintained automatically by "terraform init".
# Manual edits may be lost in future updates.

provider "registry.terraform.io/hashicorp/aws" {
  version = "6.27.0"
  hashes = [
    "h1:bixp2PSsP5ZGBczGCxcbSDn6lF5QFlUXlNroq9cdab4=",
    "zh:177a24b806c72e8484b5cabc93b2b38e3d770ae6f745a998b54d6619fd0e8129",
    "zh:4ac4a85c14fb868a3306b542e6a56c10bd6c6d5a67bc0c9b8f6a9060cf5f3be7",
    "zh:552652185bc85c8ba1da1d65dea47c454728a5c6839c458b6dcd3ce71c19ccfc",
    "zh:60284b8172d09aee91eae0856f09855eaf040ce3a58d6933602ae17c53f8ed04",
    "zh:6be38d156756ca61fb8e7c752cc5d769cd709686700ac4b230f40a6e95b5dbc9",
    "zh:7a409138fae4ef42e3a637e37cb9efedf96459e28a3c764fc4e855e8db9a7485",
    "zh:8070cf5224ed1ed3a3e9a59f7c30ff88bf071c7567165275d477c1738a56c064",
    "zh:894439ef340a9a79f69cd759e27ad11c7826adeca27be1b1ca82b3c9702fa300",
    "zh:89d035eebf08a97c89374ff06040955ddc09f275ecca609d0c9d58d149bef5cf",
    "zh:985b1145d724fc1f38369099e4a5087141885740fd6c0b1dbc492171e73c2e49",
    "zh:9b12af85486a96aedd8d7984b0ff811a4b42e3d88dad1a3fb4c0b580d04fa425",
    "zh:a80b47ae8d1475201c86bd94a5dcb9dd4da5e8b73102a90820b68b66b76d50fd",
    "zh:d3395be1556210f82199b9166a6b2e677cee9c4b67e96e63f6c3a98325ad7ab0",
    "zh:db0b869d09657f6f1e4110b56093c5fcdf9dbdd97c020db1e577b239c0adcbce",
    "zh:ffc72e680370ae7c21f9bd3082c6317730df805c6797427839a6b6b7e9a26a01",
  ]
}
```

- task2_terraform_dir_ls.png

```
@hamna-mahmood /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ls .terraform/
providers
```

Task3 – VPC Subnet Creation, Initialization, Verification

- task3_main_tf_resource_add.png

Command Prompt - gh codespace ssh -c studious-journey-q7x57x9ww649hx57g

```
provider "aws" {
  shared_config_files      = ["~/.aws/config"]
  shared_credentials_files = ["~/.aws/credentials"]
}
resource "aws_vpc" "development_vpc" {
  cidr_block = "10.0.0.0/16"
}

resource "aws_subnet" "dev_subnet_1" {
  vpc_id     = aws_vpc.development_vpc.id
  cidr_block = "10.0.10.0/24"
  availability_zone = "me-central-1a"
}
```

- task3_terraform_apply_vpc_subnet.png

```
  Enter a value: yes

aws_vpc.development_vpc: Creating...
aws_vpc.development_vpc: Creation complete after 1s [id=vpc-0c75646c981fbaa67]
aws_subnet.dev_subnet_1: Creating...
aws_subnet.dev_subnet_1: Creation complete after 1s [id=subnet-0e1f662733444c28b]

Apply complete! Resources: 2 added, 0 changed, 0 destroyed.
```

- task3_aws_cli_verify_subnet.png

```
@hamna-mahmood /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ aws ec2 describe-subnets --filter "Name=subnet-id,Values
=subnet-078f1b79825a5fee0"
{
    "Subnets": [
        {
            "AvailabilityZoneId": "mec1-az2",
            "MapCustomerOwnedIpOnLaunch": false,
            "OwnerId": "542622959327",
            "AssignIpv6AddressOnCreation": false,
            "Ipv6CidrBlockAssociationSet": [],
            "SubnetArn": "arn:aws:ec2:me-central-1:542622959327:subnet/subnet-078f1b79825a5fee0",
            "EnableDns64": false,
            "Ipv6Native": false,
            "PrivateDnsNameOptionsOnLaunch": {
                "HostnameType": "ip-name",
                "EnableResourceNameDnsARecord": false,
                "EnableResourceNameDnsAAAARecord": false
            },
            "BlockPublicAccessStates": {
                "InternetGatewayBlockMode": "off"
            },
            "SubnetId": "subnet-078f1b79825a5fee0",
            "State": "available",
            "VpcId": "vpc-0b412746b28b797e7",
            "CidrBlock": "172.31.16.0/20",
:...skipping...
```

- task3_aws_cli_verify_vpc.png

```
@hamna-mahmood /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ aws ec2 describe-vpcs \
>   --filters "Name=vpc-id,Values=vpc-0b412746b28b797e7" \
>   --region me-central-1
{
    "Vpcs": [
        {
            "OwnerId": "542622959327",
            "InstanceTenancy": "default",
            "CidrBlockAssociationSet": [
                {
                    "AssociationId": "vpc-cidr-assoc-0d7f0fa773ce8d726",
                    "CidrBlock": "172.31.0.0/16",
                    "CidrBlockState": {
:...skipping...
```

Task4 – Data Source, Targeted Destroy, Tags

- task4_main_tf_datasource_resource_add.png

```
data "aws_vpc" "existing_vpc" {
  default = true
}

resource "aws_subnet" "dev_subnet_1_existing" {
  vpc_id     = data.aws_vpc.existing_vpc.id
  cidr_block = "172.31.48.0/24"
  availability_zone = "me-central-1a"
}
~
```

- task4_terraform_apply_datasource_resource.png

```
Plan: 1 to add, 0 to change, 0 to destroy.

Do you want to perform these actions?
  Terraform will perform the actions described above.
  Only 'yes' will be accepted to approve.

  Enter a value: yes

aws_subnet.dev_subnet_1_existing: Creating...
aws_subnet.dev_subnet_1_existing: Creation complete after 1s [id=subnet-0e3d0deccd5087b1f]

Apply complete! Resources: 1 added, 0 changed, 0 destroyed.
```

- task4_terraform_destroy_targeted.png

```
aws_subnet.dev_subnet_1_existing: Destroying... [id=subnet-0e3d0deccd5087b1f]
aws_subnet.dev_subnet_1_existing: Destruction complete after 1s

  Warning: Applied changes may be incomplete

  The plan was created with the -target option in effect, so some changes requested in the configuration may have been
  ignored and the output values may not be fully updated. Run the following command to verify that no other changes are
  pending:
      terraform plan

  Note that the -target option is not suitable for routine use, and is provided only for exceptional situations such as
  recovering from errors or mistakes, or when Terraform specifically suggests to use it as part of an error message.


Destroy complete! Resources: 1 destroyed.
```

- task4_terraform_refresh_state.png

```
@hamna-mahmood /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform refresh
data.aws_vpc.existing_vpc: Reading...
aws_vpc.development_vpc: Refreshing state... [id=vpc-0c75646c981fbaa67]
data.aws_vpc.existing_vpc: Read complete after 1s [id=vpc-0b412746b28b797e7]
aws_subnet.dev_subnet_1: Refreshing state... [id=subnet-0e1f662733444c28b]
```

- task4_terraform_apply_after_refresh.png

```
Plan: 1 to add, 0 to change, 0 to destroy.

Do you want to perform these actions?
  Terraform will perform the actions described above.
  Only 'yes' will be accepted to approve.

  Enter a value: yes

aws_subnet.dev_subnet_1_existing: Creating...
aws_subnet.dev_subnet_1_existing: Creation complete after 1s [id=subnet-00960f277fd06040a]

Apply complete! Resources: 1 added, 0 changed, 0 destroyed.
```

- task4_terraform_destroy_all.png

```
Plan: 0 to add, 0 to change, 3 to destroy.

Do you really want to destroy all resources?
  Terraform will destroy all your managed infrastructure, as shown above.
  There is no undo. Only 'yes' will be accepted to confirm.

  Enter a value: yes

aws_subnet.dev_subnet_1: Destroying... [id=subnet-0e1f662733444c28b]
aws_subnet.dev_subnet_1_existing: Destroying... [id=subnet-00960f277fd06040a]
aws_subnet.dev_subnet_1_existing: Destruction complete after 0s
aws_subnet.dev_subnet_1: Destruction complete after 0s
aws_vpc.development_vpc: Destroying... [id=vpc-0c75646c981fbaa67]
aws_vpc.development_vpc: Destruction complete after 1s

Destroy complete! Resources: 3 destroyed.
```

- task4_terraform_plan_output.png

```
  # aws_vpc.development_vpc will be created
  + resource "aws_vpc" "development_vpc" {
      + arn                                  = (known after apply)
      + cidr_block                           = "10.0.0.0/16"
      + default_network_acl_id               = (known after apply)
      + default_route_table_id               = (known after apply)
      + default_security_group_id            = (known after apply)
      + dhcp_options_id                      = (known after apply)
      + enable_dns_hostnames                 = (known after apply)
      + enable_dns_support                   = true
      + enable_network_address_usage_metrics = (known after apply)
      + id                                   = (known after apply)
      + instance_tenancy                     = "default"
      + ipv6_association_id                  = (known after apply)
      + ipv6_cidr_block                      = (known after apply)
      + ipv6_cidr_block_network_border_group = (known after apply)
      + main_route_table_id                  = (known after apply)
      + owner_id                             = (known after apply)
      + region                               = "me-central-1"
      + tags_all                             = (known after apply)
    }

Plan: 3 to add, 0 to change, 0 to destroy.

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Note: You didn't use the -out option to save this plan, so Terraform can't guarantee to take exactly these actions if
you run "terraform apply" now.
```

- task4_terraform_apply_after_destroy.png

```
Plan: 3 to add, 0 to change, 0 to destroy.

Do you want to perform these actions?
  Terraform will perform the actions described above.
  Only 'yes' will be accepted to approve.

  Enter a value: yes

aws_vpc.development_vpc: Creating...
aws_subnet.dev_subnet_1_existing: Creating...
aws_subnet.dev_subnet_1_existing: Creation complete after 0s [id=subnet-024745bf211a02a21]
aws_vpc.development_vpc: Creation complete after 1s [id=vpc-0511dfe8d2c0fa70f]
aws_subnet.dev_subnet_1: Creating...
aws_subnet.dev_subnet_1: Creation complete after 1s [id=subnet-0adf2d7099862dd16]

Apply complete! Resources: 3 added, 0 changed, 0 destroyed.
```

- task4_main_tf_tagging.png

```
resource "aws_vpc" "development_vpc" {
  cidr_block = "10.0.0.0/16"
  tags = {
     Name: "development"
     vpc_env = "dev"
  }
}

resource "aws_subnet" "dev_subnet_1" {
  vpc_id     = aws_vpc.development_vpc.id
  cidr_block = "10.0.10.0/24"
  availability_zone = "me-central-1a"
  tags = {
     Name: "subnet-1-dev"
  }
}

resource "aws_subnet" "dev_subnet_1_existing" {
  vpc_id     = data.aws_vpc.existing_vpc.id
  cidr_block = "172.31.48.0/24"
  availability_zone = "me-central-1a"
  tags = {
     Name: "subnet-1-default"
  }
}
```

- task4_terraform_apply_tagging.png

```
@hamna-mahmood 🖹 /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform refresh
data.aws_vpc.existing_vpc: Reading...
aws_vpc.development_vpc: Refreshing state... [id=vpc-0511dfe8d2c0fa70f]
data.aws_vpc.existing_vpc: Read complete after 1s [id=vpc-0b412746b28b797e7]
aws_subnet.dev_subnet_1_existing: Refreshing state... [id=subnet-024745bf211a02a21]
aws_subnet.dev_subnet_1: Refreshing state... [id=subnet-0adf2d7099862dd16]
```

```
@hamna-mahmood 🖹 /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform apply -auto-approve
data.aws_vpc.existing_vpc: Reading...
aws_vpc.development_vpc: Refreshing state... [id=vpc-0511dfe8d2c0fa70f]
data.aws_vpc.existing_vpc: Read complete after 0s [id=vpc-0b412746b28b797e7]
aws_subnet.dev_subnet_1_existing: Refreshing state... [id=subnet-024745bf211a02a21]
aws_subnet.dev_subnet_1: Refreshing state... [id=subnet-0adf2d7099862dd16]
```

```
      }
    ~ tags_all                               = {
        + "Name"    = "development"
        + "vpc_env" = "dev"
      }
      # (19 unchanged attributes hidden)
  }

Plan: 0 to add, 3 to change, 0 to destroy.
aws_vpc.development_vpc: Modifying... [id=vpc-0511dfe8d2c0fa70f]
aws_subnet.dev_subnet_1_existing: Modifying... [id=subnet-024745bf211a02a21]
aws_subnet.dev_subnet_1_existing: Modifications complete after 0s [id=subnet-024745bf211a02a21]
aws_vpc.development_vpc: Modifications complete after 1s [id=vpc-0511dfe8d2c0fa70f]
aws_subnet.dev_subnet_1: Modifying... [id=subnet-0adf2d7099862dd16]
aws_subnet.dev_subnet_1: Modifications complete after 0s [id=subnet-0adf2d7099862dd16]

Apply complete! Resources: 0 added, 3 changed, 0 destroyed.
```

- task4_terraform_plan_remove_tag.png

```
resource "aws_vpc" "development_vpc" {
  cidr_block = "10.0.0.0/16"
  tags = {
     Name: "development"
  }
}
```

```
    ~ tags                                   = {
          "Name"    = "development"
        - "vpc_env" = "dev" -> null
      }
    ~ tags_all                               = {
        - "vpc_env" = "dev" -> null
          # (1 unchanged element hidden)
      }
      # (19 unchanged attributes hidden)
  }

Plan: 0 to add, 1 to change, 0 to destroy.

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Note: You didn't use the -out option to save this plan, so Terraform can't guarantee to take
exactly these actions if you run "terraform apply" now.
```

- task4_terraform_apply_remove_tag.png

```
      ~ tags_all                              = {
          - "vpc_env" = "dev" -> null
            # (1 unchanged element hidden)
        }
        # (19 unchanged attributes hidden)
    }

Plan: 0 to add, 1 to change, 0 to destroy.

Do you want to perform these actions?
  Terraform will perform the actions described above.
  Only 'yes' will be accepted to approve.

  Enter a value: yes

aws_vpc.development_vpc: Modifying... [id=vpc-0511dfe8d2c0fa70f]
aws_vpc.development_vpc: Modifications complete after 1s [id=vpc-0511dfe8d2c0fa70f]

Apply complete! Resources: 0 added, 1 changed, 0 destroyed.
```

Task 5 – State File Inspection and Terraform State Commands

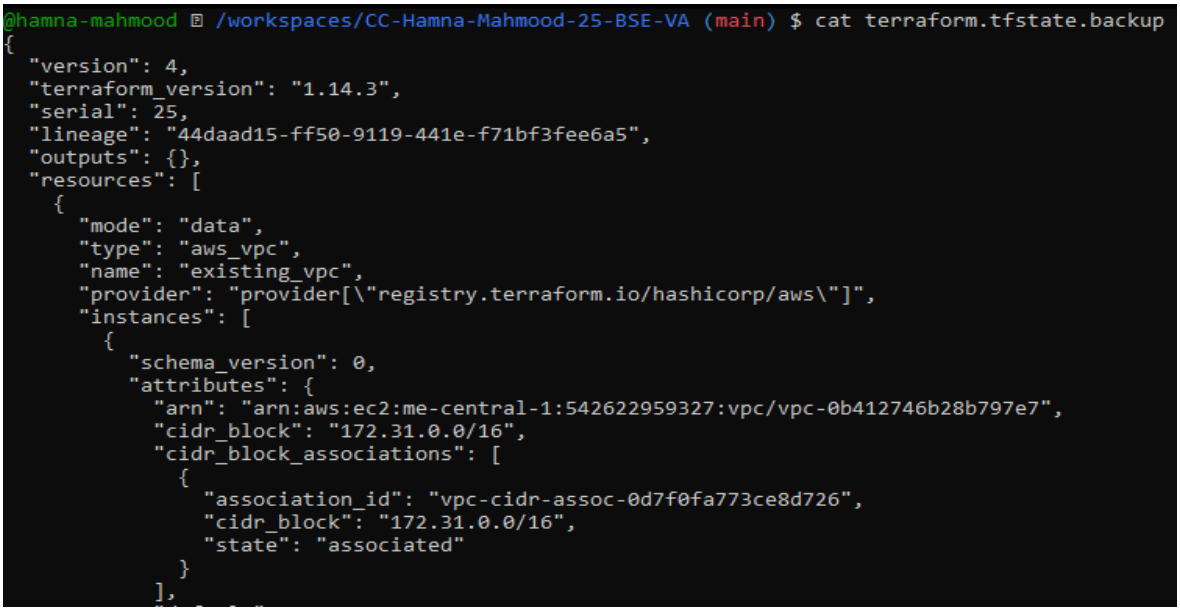
- task5_terraform_destroy.png

```
Plan: 0 to add, 0 to change, 3 to destroy.

Do you really want to destroy all resources?
  Terraform will destroy all your managed infrastructure, as shown above.
  There is no undo. Only 'yes' will be accepted to confirm.

  Enter a value: yes

aws_subnet.dev_subnet_1: Destroying... [id=subnet-0adf2d7099862dd16]
aws_subnet.dev_subnet_1_existing: Destroying... [id=subnet-024745bf211a02a21]
aws_subnet.dev_subnet_1: Destruction complete after 1s
aws_subnet.dev_subnet_1_existing: Destruction complete after 1s
aws_vpc.development_vpc: Destroying... [id=vpc-0511dfe8d2c0fa70f]
aws_vpc.development_vpc: Destruction complete after 1s

Destroy complete! Resources: 3 destroyed.
```

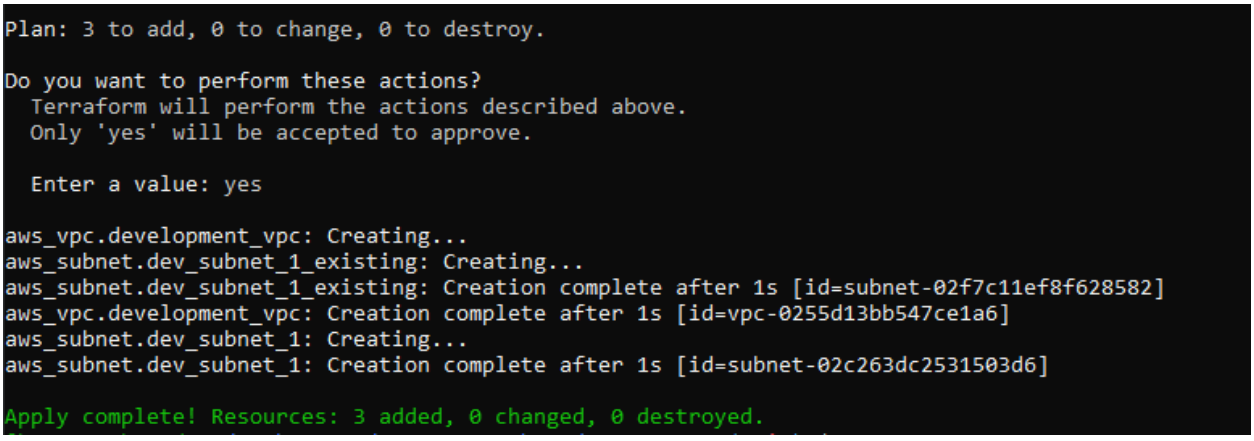
- task5_terraform_state_file_empty.png

```
@hamna-mahmood /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ cat terraform.tfstate
{
  "version": 4,
  "terraform_version": "1.14.3",
  "serial": 30,
  "lineage": "44daad15-ff50-9119-441e-f71bf3fee6a5",
  "outputs": {},
  "resources": [],
  "check_results": null
}
```

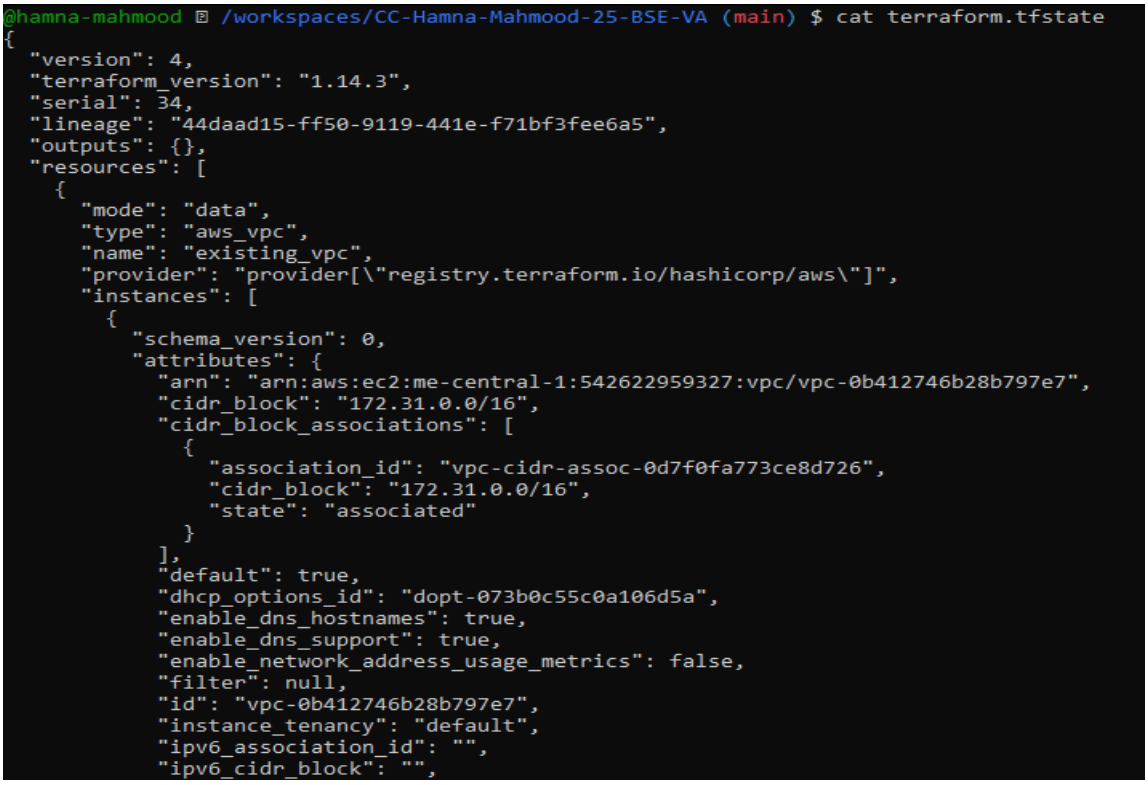
- task5_terraform_state_backup_prev.png



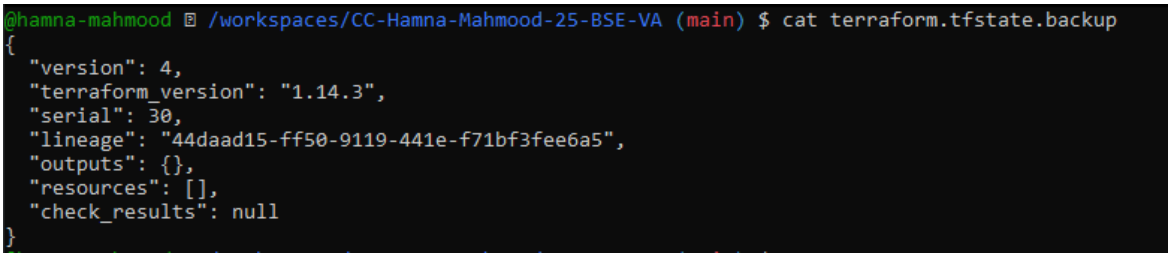
- task5_terraform_apply_recreated.png



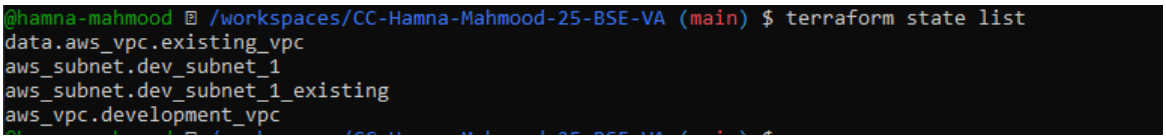
- task5_terraform_state_file_populated.png



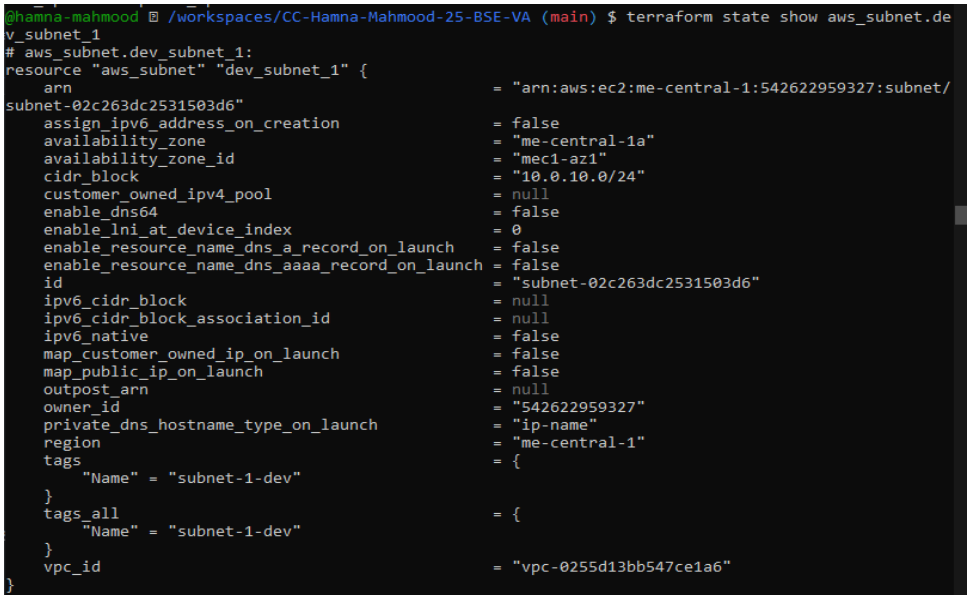
- task5_terraform_state_backup_empty.png



- task5_terraform_state_list.png



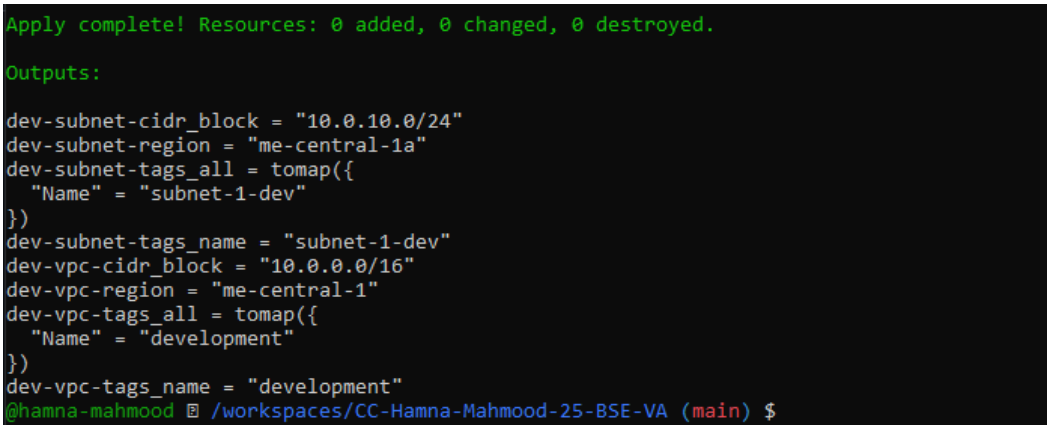
- task5_terraform_state_show_resource.png



Task 6—Terraform Outputs & Attributes Reporting

- task6_terraform_outputs_basic.png

- task6_expanded_outputs.png



Cleanup

- cleanup_destroy_resources.png

```
Plan: 0 to add, 0 to change, 3 to destroy.

Changes to Outputs:
  - dev-subnet-cidr_block = "10.0.10.0/24" -> null
  - dev-subnet-region     = "me-central-1a" -> null
  - dev-subnet-tags_all   = {
      - Name = "subnet-1-dev"
    } -> null
  - dev-subnet-tags_name  = "subnet-1-dev" -> null
  - dev-vpc-cidr_block    = "10.0.0.0/16" -> null
  - dev-vpc-region        = "me-central-1" -> null
  - dev-vpc-tags_all      = {
      - Name = "development"
    } -> null
  - dev-vpc-tags_name     = "development" -> null

Do you really want to destroy all resources?
  Terraform will destroy all your managed infrastructure, as shown above.
  There is no undo. Only 'yes' will be accepted to confirm.

  Enter a value: yes

aws_subnet.dev_subnet_1: Destroying... [id=subnet-02c263dc2531503d6]
aws_subnet.dev_subnet_1_existing: Destroying... [id=subnet-02f7c11ef8f628582]
aws_subnet.dev_subnet_1_existing: Destruction complete after 0s
aws_subnet.dev_subnet_1: Destruction complete after 0s
aws_vpc.development_vpc: Destroying... [id=vpc-0255d13bb547ce1a6]
aws_vpc.development_vpc: Destruction complete after 0s

Destroy complete! Resources: 3 destroyed.
```

- cleanup_state_files.png

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ cat terraform.tfstate
{
  "version": 4,
  "terraform_version": "1.14.3",
  "serial": 40,
  "lineage": "44daad15-ff50-9119-441e-f71bf3fee6a5",
  "outputs": {},
  "resources": [],
  "check_results": null
}
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ cat terraform.tfstate.backup
{
  "version": 4,
  "terraform_version": "1.14.3",
  "serial": 35,
  "lineage": "44daad15-ff50-9119-441e-f71bf3fee6a5",
  "outputs": {
    "dev-subnet-cidr_block": {
      "value": "10.0.10.0/24",
      "type": "string"
    },
    "dev-subnet-region": {
      "value": "me-central-1a",
      "type": "string"
    },
    "dev-subnet-tags_all": {
      "value": {
        "Name": "subnet-1-dev"
      },
      "type": [
        "map",
        "string"
      ]
    },
```