

CLOUD COMPUTING LAB

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LAB #10

Task 1 — GitHub CLI Codespace Setup & Authentication

- task1_gh_install.png

```
Command Prompt - winget install --id GitHub.cli
Microsoft Windows [Version 10.0.19045.6466]
(c) Microsoft Corporation. All rights reserved.

C:\Users\A>winget install --id GitHub.cli
The 'msstore' source requires that you view the following agreements before using.
Terms of Transaction: https://aka.ms/microsoft-store-terms-of-transaction
The source requires the current machine's 2-letter geographic region to be sent to the backend service to function properly (ex. "US").

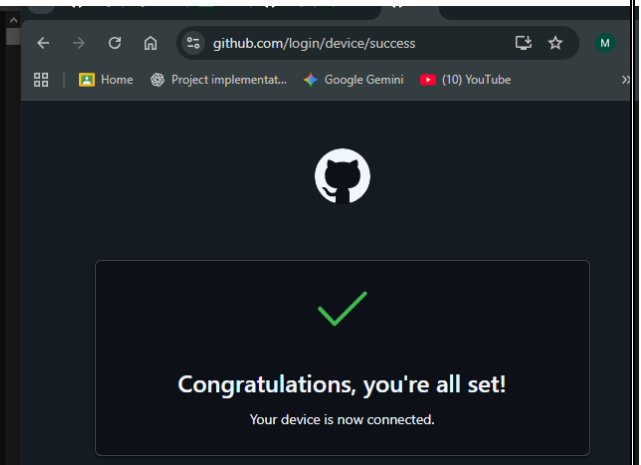
Do you agree to all the source agreements terms?
[Y] Yes [N] No: y
Found GitHub CLI [GitHub.cli] Version 2.83.2
This application is licensed to you by its owner.
Microsoft is not responsible for, nor does it grant any licenses to, third-party packages.
Downloading https://github.com/cli/cli/releases/download/v2.83.2/gh_2.83.2_windows_amd64.msi
17.7 MB / 17.7 MB
Successfully verified installer hash
Starting package install...
  █
```

- task1_gh_auth_login.png

```
Microsoft Windows [Version 10.0.19045.6466]
(c) Microsoft Corporation. All rights reserved.

C:\Users\A>gh auth login -s codespace
? Where do you use GitHub? GitHub.com
? What is your preferred protocol for Git operations on this host? HTTPS
? Authenticate Git with your GitHub credentials? Yes
? How would you like to authenticate GitHub CLI? Login with a web browser

! First copy your one-time code: 767A-A38E
Press Enter to open https://github.com/login/device in your browser...
? Authentication complete.
- gh config set -h github.com git_protocol https
? Configured git protocol
```



- task1_codespace_list.png

```
C:\Users\A>gh codespace list
NAME                                DISPLAY NAME      REPOSITORY          BRANCH  STATE      CREATED AT
refactored-umbrella-v6j6vpwjwxxh6gjp  refactored umbrella  mariamalik11/Lab-9  main    Available  about 8 minutes ago
```

- task1_codespace_ssh_connected.png

```
C:\Users\A>gh codespace ssh -c refactored-umbrella-v6j6vpxjwwxxh6gjp
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-1030-azure x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/pro

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

@mariamalik11 ▢ /workspaces/Lab-9 (main) $ _
```

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

- task2_aws_install_and_version.png

```
@mariamalik11 ▢ /workspaces/Lab12 (main) $ curl "https://awscli.amazonaws.com/awscli-exe-linux-x86_64.zip" -o "awscliv2.zip"
% Total % Received % Xferd Average Speed Time Time Time Current
Dload Upload Total Spent Left Speed
100 60.2M 100 60.2M 0 0 183M 0 --:--:-- --:--:-- --:--:-- 183M
```

```
@mariamalik11 ▢ /workspaces/Lab12 (main) $ unzip awscliv2.zip
Archive: awscliv2.zip
creating: aws/
creating: aws/dist/
inflating: aws/README.md
inflating: aws/install
inflating: aws/THIRD_PARTY_LICENSES
creating: aws/dist/awscli/
creating: aws/dist/dateutil/
creating: aws/dist/docutils/
creating: aws/dist/lib-dynload/
creating: aws/dist/prompt_toolkit-3.0.51.dist-info/
creating: aws/dist/wheel-0.45.1.dist-info/
inflating: aws/dist/aws
inflating: aws/dist/aws_completer
inflating: aws/dist/libpython3.13.so.1.0
inflating: aws/dist/_awscli.abi3.so
inflating: aws/dist/_ruamel_yaml.cpython-313-x86_64-linux-gnu.so
inflating: aws/dist/libz.so.1
```

```
@mariamalik11 ▢ /workspaces/Lab12 (main) $ sudo ./aws/install
You can now run: /usr/local/bin/aws --version
@mariamalik11 ▢ /workspaces/Lab12 (main) $ aws --version
aws-cli/2.32.28 Python/3.13.11 Linux/6.8.0-1030-azure exe/x86_64.ubuntu.24
```

- task2_aws_configure_and_files.png

```
@mariamalik11 ▢ /workspaces/Lab12 (main) $ aws configure
AWS Access Key ID [None]: AKIAZCUSI5S7NM4YTFXF
AWS Secret Access Key [None]: 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
Default region name [None]: me-central-1
Default output format [None]: json
@mariamalik11 ▢ /workspaces/Lab12 (main) $ ^C
```

```
@mariamalik11 ▢ /workspaces/Lab12 (main) $ cat ~/.aws/credentials
[default]
aws_access_key_id = AKIAZCUSI5S7NM4YTFXF
aws_secret_access_key = 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
@mariamalik11 ▢ /workspaces/Lab12 (main) $ cat ~/.aws/config
[default]
region = me-central-1
output = json
```

- task2_aws_get_caller_identity.png

```
{
  "UserId": "AIDAZCUSI5S7IFMHUH7UB",
  "Account": "624150768830",
  "Arn": "arn:aws:iam:624150768830:user/Admin"
}
```

- task2_terraform_install_and_version.png

```
--2026-01-06 08:40:45-- https://apt.releases.hashicorp.com/gpg
file '/usr/share/keyrings/hashicorp-archive-keyring.gpg' exists. Overwrite? (y/N) Resolving apt.releases.hashicorp.com (apt.releases.hashicorp.com)... 18.172.78.65, 18.172.78.30, 18.172.78.12, ...
Connecting to apt.releases.hashicorp.com (apt.releases.hashicorp.com)[18.172.78.65]:443... connected.
HTTP request sent, awaiting response... 200 OK

length: 3980 (3.9K) [binary/octet-stream]
Saving to: 'STDOUT'

100%[=====] 3.89K --.-KB/s in 0s

2026-01-06 08:40:45 (715 MB/s) - written to stdout [3980/3980]

Enter new filename: terraform
@mariamalik11 @ /workspaces/Lab12 (main) $ echo "deb [arch=$(dpkg --print-architecture) signed-by=/usr/share/keyrings/hashicorp-archive-keyring.gpg] https://apt.releases.hashicorp.com $(grep -oP '(?=<UBUNTU_CODENAME>=).*' /etc/os-release || lsb_release -cs) main" | sudo tee /etc/apt/sources.list.d/hashicorp.list
deb [arch=amd64 signed-by=/usr/share/keyrings/hashicorp-archive-keyring.gpg] https://apt.releases.hashicorp.com noble main
@mariamalik11 @ /workspaces/Lab12 (main) $ sudo apt update
Get:1 https://apt.releases.hashicorp.com noble InRelease [12.9 kB]
Get:2 https://packages.microsoft.com/repos/microsoft-ubuntu-noble-prod noble InRelease [3600 B]
Hit:3 https://dl.yarnpkg.com/debian stable InRelease
Err:1 https://apt.releases.hashicorp.com noble InRelease
  The following signatures couldn't be verified because the public key is not available: NO_PUBKEY AA16FCBCA621E701
Get:4 https://packages.microsoft.com/repos/microsoft-ubuntu-noble-prod noble/main amd64 Packages [77.4 kB]
Hit:5 https://repo.anaconda.com/pkgs/misc/debrepo/conda stable InRelease
Hit:6 http://archive.ubuntu.com/ubuntu noble InRelease
Get:7 http://archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Get:8 http://security.ubuntu.com/ubuntu noble-security InRelease [126 kB]
Get:9 http://archive.ubuntu.com/ubuntu noble-backports InRelease [126 kB]
Hit:10 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 Packages [2130 kB]

Hit:1 https://packages.microsoft.com/repos/microsoft-ubuntu-noble-prod noble InRelease
Hit:2 https://dl.yarnpkg.com/debian stable InRelease
Get:3 https://apt.releases.hashicorp.com noble InRelease [12.9 kB]
Hit:4 https://repo.anaconda.com/pkgs/misc/debrepo/conda stable InRelease
Get:5 https://apt.releases.hashicorp.com noble/main amd64 Packages [266 kB]
Hit:6 http://archive.ubuntu.com/ubuntu noble InRelease
Hit:7 http://security.ubuntu.com/ubuntu noble-security InRelease
Hit:8 http://archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:9 http://archive.ubuntu.com/ubuntu noble-backports InRelease
Fetched 279 kB in 1s (258 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
51 packages can be upgraded. Run 'apt list --upgradable' to see them.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  terraform
0 upgraded, 1 newly installed, 0 to remove and 51 not upgraded.
Need to get 30.6 MB of archives.
After this operation, 101 MB of additional disk space will be used.
Get:1 https://apt.releases.hashicorp.com noble/main amd64 terraform amd64 1.14.3-1 [30.6 MB]
Fetched 30.6 MB in 0s (157 MB/s)
Selecting previously unselected package terraform.
(Reading database ... 58629 files and directories currently installed.)
Preparing to unpack .../terraform_1.14.3-1_amd64.deb ...
Unpacking terraform (1.14.3-1) ...
Setting up terraform (1.14.3-1) ...

@mariamalik11 @ /workspaces/Lab12 (main) $ which terraform
/usr/local/bin/terraform
@mariamalik11 @ /workspaces/Lab12 (main) $ terraform --version
Terraform v1.9.5
on linux_amd64

Your version of Terraform is out of date! The latest version
is 1.14.3. You can update by downloading from https://www.terraform.io/downloads.html
```

- task2_provider_file_creation.png

```

Command Prompt - gh codespace ssh -c curly-goldfish-jjpj5j6w7vgjcqp5x
provider "aws" {
  shared_config_files = ["~/.aws/config"]
  shared_credentials_files = ["~/.aws/credentials"]
}

resource "aws_vpc" "myapp_vpc" {
  cidr_block = var.vpc_cidr_block
  tags = {
    Name = "${var.env_prefix}-vpc"
  }
}

resource "aws_subnet" "myapp_subnet_1" {
  vpc_id = aws_vpc.myapp_vpc.id
  cidr_block = var.subnet_cidr_block
  availability_zone = var.availability_zone
  tags = {
    Name = "${var.env_prefix}-subnet-1"
  }
}

resource "aws_default_route_table" "main_rt" {
  default_route_table_id = aws_vpc.myapp_vpc.default_route_table_id

  route {
    cidr_block = "0.0.0.0/0"
    gateway_id = aws_internet_gateway.myapp_igw.id
  }
  tags = {
    Name = "${var.env_prefix}-rt"
  }
}

resource "aws_internet_gateway" "myapp_igw" {
  vpc_id = aws_vpc.myapp_vpc.id
  tags = {
    Name = "${var.env_prefix}-igw"
  }
}

"main.tf" 91L, 1994B

```

- task2_provider_block.png

```

Command Prompt - gh codespace ssh -c curly-goldfish-jjpj5j6w7vgjcqp5x
provider "aws" {
  shared_config_files = ["~/.aws/config"]
  shared_credentials_files = ["~/.aws/credentials"]
}

resource "aws_vpc" "myapp_vpc" {
  cidr_block = var.vpc_cidr_block
  tags = {
    Name = "${var.env_prefix}-vpc"
  }
}

resource "aws_subnet" "myapp_subnet_1" {
  vpc_id = aws_vpc.myapp_vpc.id

```

- task2_vim_save_main_tf.png

```

}
}
:wq_

amarlamalik11 @ /workspaces/Lab12 (main) $ vim main.tf
amarlamalik11 @ /workspaces/Lab12 (main) $ vim main.tf

```

- task2_terraform_init_output.png

```

Initializing the backend...
Initializing provider plugins...
- Finding latest version of hashicorp/http...
- Finding latest version of hashicorp/aws...
- Installing hashicorp/http v3.5.0...
- Installed hashicorp/http v3.5.0 (signed by HashiCorp)
- 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

```

# 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:bixp2PSsP5ZGBczGCxcbsDn61F5QF1UX1Nroq9cdab4=",
    "zh:177a24b806c72e8484b5cab93b2b38e3d770ae6f745a998b54d6619fd0e8129",
    "zh:4ac4a85c14fb868a3306b542e6a56c10bd6c6d5a67bc0c9b8f6a9060cf5f3be7",
    "zh:552652185bc85c8ba1da1d65dea47c454728a5c6839c458b6dcd3ce71c19ccfc",
    "zh:60284b8172d09aee91eae0856f09855eaf040ce3a58d6933602ae17c53f8ed04",
    "zh:6be38d156756ca61fb8e7c752cc5d769cd709686700ac4b230f40a6e95b5dbc9",
    "zh:7a409138fae4ef42e3a637e37cb9efedf96459e28a3c764fc4e855e8db9a7485",
    "zh:8070cf5224ed1ed3a3e9a59f7c30ff88bf071c7567165275d477c1738a56c064",
    "zh:894439ef340a9a79f69cd759e27ad11c7826adeca27be1b1ca82b3c9702fa300",
    "zh:89d035eebf08a97c89374ff06040955ddc09f275ecca609d0c9d58d149bef5cf",
    "zh:985b1145d724fc1f38369099e4a5087141885740fd6c0b1dbc492171e73c2e49",
    "zh:9b12af85486a96aed8d7984b0ff811a4b42e3d88dad1a3fb4c0b580d04fa425",
    "zh:a80b47ae8d1475201c86bd94a5dcb9dd4da5e8b73102a90820b68b66b76d50fd",
    "zh:d3395be1556210f82199b9166a6b2e677cee9c4b67e96e63f6c3a98325ad7ab0",
    "zh:db0b869d09657f6f1e4110b56093c5fcd9dbdd97c020db1e577b239c0adc0bce",
    "zh:ffc72e680370ae7c21f9bd3082c6317730df805c6797427839a6b6b7e9a26a01",
  ]
}

provider "registry.terraform.io/hashicorp/http" {
  version = "3.5.0"
  hashes = [
    "h1:8bUpPvS4hahOvzCBj6b04ObLVFXCEmEN8T/5eOHmWOM=",
    "zh:047c5b4920751b13425efe0d011b3a23a3be97d02d9c0e3c60985521c9c456b7",
  ]
}

```

- task2_terraform_dir_ls.png

```

@mariamalik11 @ /workspaces/Lab12 (main) $ ls .terraform/
providers

```

Task 3 — VPC/Subnet Creation, Initialization, Verification

- task3_main_tf_resource_add.png

```

}

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"
}

resource "aws_subnet" "myapp_subnet_1" {
  vpc_id      = aws_vpc.myapp_vpc.id
  cidr_block  = var.subnet_cidr_block
  availability_zone = var.availability_zone
  tags = {
    Name = "${var.env_prefix}-subnet-1"
  }
}

resource "aws_default_route_table" "main_rt" {
  default_route_table_id = aws_vpc.myapp_vpc.default_route_tab

  route {
    cidr_block = "0.0.0.0/0"
    gateway_id = aws_internet_gateway.myapp_igw.id
  }
  tags = {
    Name = "${var.env_prefix}-rt"
  }
}
:WQ

```

- task3_terraform_apply_vpc_subnet.png

```

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.myapp_vpc: Creating...
aws_vpc.development_vpc: Creating...
aws_key_pair.ssh-key: Creating...
aws_key_pair.ssh-key: Creation complete after 0s [id=serverkey]
aws_vpc.development_vpc: Creation complete after 1s [id=vpc-02565d77d51fb329f]
aws_subnet.dev_subnet_1: Creating...
aws_subnet.dev_subnet_1: Creation complete after 1s [id=subnet-0a5c2b714727c30a8]
aws_vpc.myapp_vpc: Creation complete after 2s [id=vpc-0b1c0e93437f8eff5]
aws_internet_gateway.myapp_igw: Creating...
aws_subnet.myapp_subnet_1: Creating...
aws_default_security_group.default_sg: Creating...
aws_internet_gateway.myapp_igw: Creation complete after 0s [id=igw-0611a9be6f6e676c5]
aws_default_route_table.main_rt: Creating...
aws_subnet.myapp_subnet_1: Creation complete after 1s [id=subnet-09c377d931b9bc367]
aws_default_route_table.main_rt: Creation complete after 1s [id=rtb-062e62c8ed1b6b70f]
aws_default_security_group.default_sg: Creation complete after 3s [id=sg-0f9e846d3dec76e5e]
aws_instance.myapp-server: Creating...
aws_instance.myapp-server: Still creating... [10s elapsed]
aws_instance.myapp-server: Creation complete after 14s [id=i-01c40c424be1c2983]

Apply complete! Resources: 9 added, 0 changed, 0 destroyed.

```

- task3_aws_cli_verify_subnet.png

```

@mariamalik11 [workspaces/Lab12 (main)] $ aws ec2 describe-subnets --filter "Name=subnet-id,Values=<subnet-id>"
{
  "Subnets": []
}

```

- task3_aws_cli_verify_vpc.png

```

@mariamalik11 [workspaces/Lab12 (main)] $ aws ec2 describe-vpcs --filter "Name=vpc-id,Values=<vpc-id>"
{
  "Vpcs": []
}

```

Task 4 — 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"
}

variable "env_prefix" {
  description = "Prefix for naming resources (e.g., dev or prod)"
}

variable "my_ip" {
  description = "Your IP address for SSH access"
}

variable "instance_type" {
  description = "EC2 instance type"
}

variable "public_key" {
  description = "Path to your public SSH key"
}

provider "aws" {
  shared_config_files = ["~/.aws/config"]
}
```

- task4_terraform_apply_datasource_resource.png

```
To silence these warnings, use TF_VAR... environment variables to provide certain "global" settings
of these warnings, use the -compact-warnings option.

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-09f36818714cc6790]

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

- task4_terraform_destroy_targeted.png

```
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_existing: Destroying... [id=subnet-09f36818714cc6790]
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 req
updated. Run the following command to verify that no other changes are pend
terraform plan

Note that the -target option is not suitable for routine use, and is provid
Terraform specifically suggests to use it as part of an error message.

Destroy complete! Resources: 1 destroyed.
```

- task4_terraform_refresh_state.png

```
var.my_ip
  Your IP address for SSH access

Enter a value: 20.192.21.51

data.http.my_ip: Reading...
data.http.my_ip: Read complete after 0s [id=https://icanhazip.com]
data.aws_vpc.existing_vpc: Reading...
aws_vpc.myapp_vpc: Refreshing state... [id=vpc-0b1c0e93437f8aff5]
aws_vpc.development_vpc: Refreshing state... [id=vpc-02565d77d51fb329f]
aws_key_pair.ssh-key: Refreshing state... [id=serverkey]
data.aws_vpc.existing_vpc: Read complete after 1s [id=vpc-0bfb37302dc628797]
aws_subnet.myapp_subnet_1: Refreshing state... [id=subnet-09c377d931b9bc367]
aws_internet_gateway.myapp_igw: Refreshing state... [id=igw-0611a9be6f6a676c5]
aws_default_security_group.default_sg: Refreshing state... [id=sg-0f9a846d3dec76e5e]
```

- task4_terraform_apply_after_refresh.png

```
of these warnings, use the -compact-warnings option.

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-01eddb587fc9ae35e]

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

- task4_terraform_destroy_all.png

```
aws_instance.myapp-server: Still destroying... [id=i-01c40c424be1c2983, 20s
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0611a9be6f6e676
aws_instance.myapp-server: Still destroying... [id=i-01c40c424be1c2983, 30s
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0611a9be6f6e676
aws_instance.myapp-server: Still destroying... [id=i-01c40c424be1c2983, 40s
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0611a9be6f6e676
aws_instance.myapp-server: Still destroying... [id=i-01c40c424be1c2983, 50s
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0611a9be6f6e676
aws_internet_gateway.myapp_igw: Destruction complete after 58s
aws_instance.myapp-server: Still destroying... [id=i-01c40c424be1c2983, 1m0
aws_instance.myapp-server: Destruction complete after 1m1s
aws_subnet.myapp_subnet_1: Destroying... [id=subnet-09c377d931b9bc367]
aws_default_security_group.default_sg: Destroying... [id=sg-0f9e846d3dec76e
aws_key_pair.ssh-key: Destroying... [id=serverkey]
aws_default_security_group.default_sg: Destruction complete after 0s
aws_key_pair.ssh-key: Destruction complete after 0s
aws_subnet.myapp_subnet_1: Destruction complete after 1s
aws_vpc.myapp_vpc: Destroying... [id=vpc-0b1c0e93437f8eff5]
aws_vpc.myapp_vpc: Destruction complete after 0s
```

- task4_terraform_plan_output.png

```
+ 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                         = {
+   + "Name" = "dev-vpc"
+ }
+ tags_all                     = {
+   + "Name" = "dev-vpc"
+ }
}

Plan: 10 to add, 0 to change, 0 to destroy.
```

- task4_terraform_apply_after_destroy.png

```
aws_subnet.dev_subnet_1_existing: Creation complete after 1s [id=subnet-07add6e15960508d1
aws_vpc.development_vpc: Creation complete after 1s [id=vpc-0c9b8537e4694ad24]
aws_subnet.dev_subnet_1: Creating...
aws_vpc.myapp_vpc: Creation complete after 1s [id=vpc-0be77a2b03d469147]
aws_internet_gateway.myapp_igw: Creating...
aws_subnet.myapp_subnet_1: Creating...
aws_default_security_group.default_sg: Creating...
aws_internet_gateway.myapp_igw: Creation complete after 1s [id=igw-0909337f1c49bee51]
aws_default_route_table.main_rt: Creating...
aws_subnet.dev_subnet_1: Creation complete after 1s [id=subnet-0562950bb0fac2ab4]
aws_subnet.myapp_subnet_1: Creation complete after 1s [id=subnet-0ffc090e286fe074d]
aws_default_route_table.main_rt: Creation complete after 1s [id=rtb-076c2de6e34b584b2]
aws_default_security_group.default_sg: Creation complete after 3s [id=sg-0420586fdd6cb9a6]
aws_instance.myapp-server: Creating...
aws_instance.myapp-server: Still creating... [10s elapsed]
aws_instance.myapp-server: Creation complete after 13s [id=i-0640f55bafea46e0d]

Apply complete! Resources: 10 added, 0 changed, 0 destroyed.
```

- task4_main_tf_tagging.png

```
    Name = "${var.env_prefix}-ec2-instance"
  }
}

data "http" "my_ip" {
  url = "https://icanhazip.com"
}

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"
  }
}

;wq_
```

- task4_terraform_apply_tagging.png

```
var.my_ip
Your IP address for SSH access

Enter a value: 20.192.21.51

data.http.my_ip: Reading...
data.http.my_ip: Read complete after 0s [id=https://icanhazip.com]
aws_key_pair.ssh-key: Refreshing state... [id=serverkey]
aws_vpc.development_vpc: Refreshing state... [id=vpc-0c9b8537e4694ad24]
data.aws_vpc.existing_vpc: Reading...
aws_vpc.myapp_vpc: Refreshing state... [id=vpc-0be77a2b03d469147]
data.aws_vpc.existing_vpc: Read complete after 1s [id=vpc-0bfbc7302dc628797]
aws_subnet.dev_subnet_1_existing: Refreshing state... [id=subnet-07add6e15960508d1]
aws_subnet.dev_subnet_1: Refreshing state... [id=subnet-0562950bb0fac2ab4]
aws_subnet.myapp_subnet_1: Refreshing state... [id=subnet-0ffc090e286fe074d]
aws_default_security_group.default_sg: Refreshing state... [id=sg-0420586fbd6cb9a0]
aws_internet_gateway.myapp_igw: Refreshing state... [id=igw-0909337f1c49bee51]
aws_default_route_table.main_rt: Refreshing state... [id=rtb-076c2de6e34b584b2]
aws_instance.myapp_server: Refreshing state... [id=i-0640f59bafae46e0d]

Warning: Value for undeclared variable

The root module does not declare a variable named "private_key" but a value was found in file "
```

```
}
# (20 unchanged attributes hidden)
}

# aws_vpc.development_vpc will be updated in-place
~ resource "aws_vpc" "development_vpc" {
  id              = "vpc-0c9b8537e4694ad24"
  ~ tags          = {
    + "Name"      = "development"
    + "vpc_env"   = "dev"
  }
  ~ 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-0c9b8537e4694ad24]
aws_subnet.dev_subnet_1_existing: Modifying... [id=subnet-07add6e15960508d1]
aws_subnet.dev_subnet_1_existing: Modifications complete after 1s [id=subnet-07add6e15960508d1]
aws_vpc.development_vpc: Modifications complete after 1s [id=vpc-0c9b8537e4694ad24]
aws_subnet.dev_subnet_1: Modifying... [id=subnet-0562950bb0fac2ab4]
aws_subnet.dev_subnet_1: Modifications complete after 0s [id=subnet-0562950bb0fac2ab4]

Warning: Value for undeclared variable

The root module does not declare a variable named "private_key" but a value was found in file "ter
to the configuration.

To silence these warnings, use TF_VAR... environment variables to provide certain "global" settin
of these warnings, use the -compact-warnings option.

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

- task4_terraform_plan_remove_tag.png

```
var.my_ip
Your IP address for SSH access

Enter a value: 20.192.21.51

data.http.my_ip: Reading...
data.http.my_ip: Read complete after 0s [id=https://icanhazip.com]
aws_vpc.myapp_vpc: Refreshing state... [id=vpc-0be77a2b03d469147]
aws_vpc.development_vpc: Refreshing state... [id=vpc-0c9b8537e4694ad24]
data.aws_vpc.existing_vpc: Reading...
aws_key_pair.ssh-key: Refreshing state... [id=serverkey]
data.aws_vpc.existing_vpc: Read complete after 1s [id=vpc-0bfbc7302dc628797]
aws_subnet.dev_subnet_1_existing: Refreshing state... [id=subnet-07add6e15960508d1]
aws_subnet.dev_subnet_1: Refreshing state... [id=subnet-0562950bb0fac2ab4]
aws_internet_gateway.myapp_igw: Refreshing state... [id=igw-0909337f1c49bee51]
aws_subnet.myapp_subnet_1: Refreshing state... [id=subnet-0ffc090e286fe074d]
aws_default_security_group.default_sg: Refreshing state... [id=sg-0420586fbd6cb9a0]
aws_default_route_table.main_rt: Refreshing state... [id=rtb-076c2de6e34b584b2]
aws_instance.myapp_server: Refreshing state... [id=i-0640f59bafae46e0d]
```

- task4_terraform_apply_remove_tag.png

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

Plan: 0 to add, 1 to change, 0 to destroy.
aws_vpc.development_vpc: Modifying... [id=vpc-0c9b8537e4694ad24]
aws_vpc.development_vpc: Modifications complete after 1s [id=vpc-0c9b8537e4694ad24]

Warning: Value for undeclared variable

The root module does not declare a variable named "private_key" but a value was found in file "terraform.tfvars".
to the configuration.

To silence these warnings, use TF_VAR... environment variables to provide certain "global" settings to all config
of these warnings, use the -compact-warnings option.

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

Task 5 — State File Inspection & Terraform State Commands

- task5_terraform_destroy.png

```
aws_subnet.dev_subnet_1 existing: Destruction complete after 1s
aws_vpc.development_vpc: Destruction complete after 1s
aws_instance.myapp-server: Still destroying... [id=i-0640f55bafea46e0d, 10s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0909337f1c49bee51, 10s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-0640f55bafea46e0d, 20s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0909337f1c49bee51, 20s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-0640f55bafea46e0d, 30s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0909337f1c49bee51, 30s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-0640f55bafea46e0d, 40s elapsed]
aws_instance.myapp-server: Destruction complete after 41s
aws_key_pair.ssh-key: Destroying... [id=serverkey]
aws_subnet.myapp_subnet_1: Destroying... [id=subnet-0ffc090e286fe074d]
aws_default_security_group.default_sg: Destroying... [id=sg-0420586fbd6cb9a0]
aws_default_security_group.default_sg: Destruction complete after 0s
aws_key_pair.ssh-key: Destruction complete after 0s
aws_subnet.myapp_subnet_1: Destruction complete after 0s
aws_vpc.myapp_vpc: Destroying... [id=vpc-0be77a2b03d469147]
aws_vpc.myapp_vpc: Destruction complete after 1s

Destroy complete! Resources: 10 destroyed.
```

- task5_terraform_state_file_empty.png

```
{
  "version": 4,
  "terraform_version": "1.9.5",
  "serial": 62,
  "lineage": "58281ff4-bf6f-2317-3441-125f5206a5a3",
  "outputs": {},
  "resources": [],
  "check_results": null
}
```

- task5_terraform_state_backup_prev.png

```
{
  "version": 4,
  "terraform_version": "1.9.5",
  "serial": 49,
  "lineage": "58281ff4-bf6f-2317-3441-125f5206a5a3",
  "outputs": {},
  "resources": [
    {
      "mode": "data",
      "type": "aws_vpc",
      "name": "existing_vpc",
      "provider": "provider[\"registry.terraform.io/hashicorp/aws\"]",
      "instances": [
        {
          "schema_version": 0,
          "attributes": {
            "arn": "arn:aws:ec2:me-central-1:624150768830:vpc/vpc-0bfb7302dc628797",
            "cidr_block": "172.31.0.0/16",
            "cidr_block_associations": [
              {
                "association_id": "vpc-cidr-assoc-027999a33e7d95d29",
                "cidr_block": "172.31.0.0/16",
                "state": "associated"
              }
            ]
          },
          "default": true,
          "dhcp_options_id": "dopt-0a34a379bd2dccb8",
          "enable_dns_hostnames": true,
          "enable_dns_support": true,
          "enable_network_address_usage_metrics": false,

```

- task5_terraform_apply_recreated.png

```
aws_vpc.development_vpc: Creating...
aws_key_pair.ssh-key: Creating...
aws_subnet.dev_subnet_1 existing: Creating...
aws_vpc.myapp_vpc: Creating...
aws_key_pair.ssh-key: Creation complete after 1s [id=serverkey]
aws_subnet.dev_subnet_1 existing: Creation complete after 1s [id=subnet-0b8e412f384cc5b1a]
aws_vpc.myapp_vpc: Creation complete after 2s [id=vpc-02f4318a1b6de175b]
aws_internet_gateway.myapp_igw: Creating...
aws_vpc.development_vpc: Creation complete after 2s [id=vpc-092c303b53fe9afa2]
aws_default_security_group.default_sg: Creating...
aws_subnet.myapp_subnet_1: Creating...
aws_subnet.dev_subnet_1: Creating...
aws_internet_gateway.myapp_igw: Creation complete after 0s [id=igw-070fbb55e26eb4f95]
aws_default_route_table.main_rt: Creating...
aws_subnet.dev_subnet_1: Creation complete after 0s [id=subnet-0fe04ff180c92d65f]
aws_subnet.myapp_subnet_1: Creation complete after 0s [id=subnet-08b0c0f3af59e01eb]
aws_default_route_table.main_rt: Creation complete after 1s [id=rtb-0fd5e494ecfe7c12c]
aws_default_security_group.default_sg: Creation complete after 2s [id=sg-0df02e55dc27c1e34]
aws_instance.myapp-server: Creating...
aws_instance.myapp-server: Still creating... [10s elapsed]
aws_instance.myapp-server: Creation complete after 13s [id=i-04a4d71acbe72b02c]

Apply complete! Resources: 10 added, 0 changed, 0 destroyed.
```

- ```

"version": 4,
"terraform_version": "1.9.5",
"serial": 73,
"lineage": "58281ff4-bf6f-2317-3441-125f5206a5a3",
"outputs": {},
"resources": [
 {
 "mode": "data",
 "type": "aws_vpc",
 "name": "existing_vpc",
 "provider": "provider[\"registry.terraform.io/hashicorp/aws\"]",
 "instances": [
 {
 "schema_version": 0,
 "attributes": {
 "arn": "arn:aws:ec2:me-central-1:624150768830:vpc/vpc-0bfbc7302dc62879",
 "cidr_block": "172.31.0.0/16",
 "cidr_block_associations": [
 {
 "association_id": "vpc-cidr-assoc-027999a33e7d95d29",
 "cidr_block": "172.31.0.0/16",
 "state": "associated"
 }
],
 "default": true,
 "dhcp_options_id": "dopt-0e34a379bd2dccbe8",
 "enable_dns_hostnames": true,
 "enable_dns_support": true,
 "enable_network_address_usage_metrics": false,
 "filter": null,
 "id": "vpc-0bfbc7302dc62879",
 "instance_tenancy": "default",
 "ipv6_association_id": "",
 "ipv6_cidr_block": ""
 }
 }
]
 }
]

```

- ```
amariamalik11 /workspaces/Lab12 (main) $ cat terraform.tfstate.backup
{
  "version": 4,
  "terraform_version": "1.9.5",
  "serial": 62,
  "lineage": "58281ff4-bf6f-2317-3441-125f5206a5a3",
  "outputs": {},
  "resources": [],
  "check_results": null
}
```

- ```

maria@malik11: /workspaces/Lab12 (main) $ terraform state list
data.aws_vpc.existing_vpc
data.http.my_ip
aws_default_route_table.main_rt
aws_default_security_group.default_sg
aws_instance.myapp-server
aws_internet_gateway.myapp_igw
aws_key_pair.ssh-key
aws_subnet.dev_subnet_1
aws_subnet.dev_subnet_1_existing
aws_subnet.myapp_subnet_1
aws_vpc.development_vpc
aws_vpc.myapp_vpc

```

- ```

mar1ama1k11 @ /workspace/Lab12 (main) $ terraform state show aws_vpc.myapp_vpc
# aws_vpc.myapp_vpc:
resource "aws_vpc" "myapp_vpc" {
  arn          = "arn:aws:ec2:me-central-1:624150768830:vpc/vpc-02f4318e1b6de175b"
  assign_generated_ipv6_cidr_block = false
  cidr_block   = "10.0.0.0/16"
  default_network_acl_id = "acl-0ad105d4e1bdfcbcd7"
  default_route_table_id = "rtb-0fd5e494ecfe7c12c"
  default_security_group_id = "sg-0df02e55dc27c1e34"
  dhcp_options_id = "dopt-0e34a379bd2dccbe8"
  enable_dns_hostnames = false
  enable_dns_support   = true
  enable_network_address_usage_metrics = false
  id                   = "vpc-02f4318e1b6de175b"
  instance_tenancy     = "default"
  ipv6_association_id  = null
  ipv6_cidr_block      = null
  ipv6_cidr_block_network_border_group = null
  ipv6_ipam_pool_id    = null
  ipv6_netmask_length  = 0
  main_route_table_id  = "rtb-0fd5e494ecfe7c12c"
  owner_id             = "624150768830"
  region              = "me-central-1"
  tags                 = {
    "Name" = "dev-vpc"
  }
  tags_all             = {
    "Name" = "dev-vpc"
  }
}

```

Task 6 — Terraform Outputs & Attributes Reporting

- task6_terraform_outputs_basic.png

```
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"
  }
}

output "dev-vpc-id" {
  value = aws_vpc.development_vpc.id
}

output "dev-subnet-id" {
  value = aws_subnet.dev_subnet_1.id
}

output "dev-vpc-arn" {
  value = aws_vpc.development_vpc.arn
}

output "dev-subnet-arn" {
  value = aws_subnet.dev_subnet_1.arn
}
```

- task6_expanded_outputs.png

```
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

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

Outputs:

dev-subnet-arn = "arn:aws:ec2:me-central-1:624150768830:subnet/subnet-0fe04ff180c92d65f"
dev-subnet-id  = "subnet-0fe04ff180c92d65f"
dev-vpc-arn   = "arn:aws:ec2:me-central-1:624150768830:vpc/vpc-092c303b53fe9afa2"
dev-vpc-id    = "vpc-092c303b53fe9afa2"
```

Cleanup — Delete Resources & State Verification

- cleanup_destroy_resources.png

```
aws_instance.myapp_server: Still destroying... [id=i-04a4d71acbe72b02c, 40s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-070fbb55e26eb4f95, 40s elapsed]
aws_instance.myapp_server: Still destroying... [id=i-04a4d71acbe72b02c, 50s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-070fbb55e26eb4f95, 50s elapsed]
aws_instance.myapp_server: Still destroying... [id=i-04a4d71acbe72b02c, 1m0s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-070fbb55e26eb4f95, 1m0s elapsed]
aws_instance.myapp_server: Still destroying... [id=i-04a4d71acbe72b02c, 1m10s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-070fbb55e26eb4f95, 1m10s elapsed]
aws_internet_gateway.myapp_igw: Destruction complete after 1m18s
aws_instance.myapp_server: Still destroying... [id=i-04a4d71acbe72b02c, 1m20s elapsed]
aws_instance.myapp_server: Destruction complete after 1m21s
aws_subnet.myapp_subnet_1: Destroying... [id=subnet-08b0c0f3af59e01eb]
aws_key_pair.ssh-key: Destroying... [id=serverkey]
aws_default_security_group.default_sg: Destroying... [id=sg-0df02e55dc27c1e34]
aws_default_security_group.default_sg: Destruction complete after 0s
aws_key_pair.ssh-key: Destruction complete after 1s
aws_subnet.myapp_subnet_1: Destruction complete after 1s
aws_vpc.myapp_vpc: Destroying... [id=vpc-02f4318e1b6de175b]
aws_vpc.myapp_vpc: Destruction complete after 1s

Destroy complete! Resources: 10 destroyed.
```

- cleanup_state_files.png

```
@mariamalik11 [ ] /workspaces/Lab12 (main) $ cat terraform.tfstate
```

```
{  
  "version": 4,  
  "terraform_version": "1.9.5",  
  "serial": 87,  
  "lineage": "58281ff4-bf6f-2317-3441-125f5206a5a3",  
  "outputs": {},  
  "resources": [],  
  "check_results": null  
}
```

```
@mariamalik11 [ ] /workspaces/Lab12 (main) $ cat terraform.tfstate.backup
```

```
{  
  "version": 4,  
  "terraform_version": "1.9.5",  
  "serial": 74,  
  "lineage": "58281ff4-bf6f-2317-3441-125f5206a5a3",  
  "outputs": {  
    "dev-subnet-arn": {  
      "value": "arn:aws:ec2:me-central-1:624150768830:subnet/subnet-0fe04ff180c92d65f",  
      "type": "string"  
    },  
    "dev-subnet-id": {  
      "value": "subnet-0fe04ff180c92d65f",  
      "type": "string"  
    },  
    "dev-vpc-arn": {  
      "value": "arn:aws:ec2:me-central-1:624150768830:vpc/vpc-092c303b53fe9afa2",  
      "type": "string"  
    },  
    "dev-vpc-id": {  
      "value": "vpc-092c303b53fe9afa2",  
      "type": "string"  
    }  
  },  
  "resources": [  
    {  
      "mode": "data"
```