CLOUD COMPUTING

LAB: 12

Submitted by:

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Submitted to:

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Roll no:

2023-BSE-060

Section:

5 B

```
PS C:\Users\Waseem\Documents\Lab12> gh codespace list
NAME                                 DISPLAY NAME         REPOSITORY                                  BRANCH  STATE      CREATED AT
verbose-system-wrq7q47rjx7vcgq46     verbose system       SeratFatima00/Lab9                          main*   Shutdown   about 2 days ago
jubilant-happiness-7vj9jx9v4r7pcp5wx jubilant happiness SeratFatima00/CC_SeeratFatima_060_Lab11     main*   Shutdown   about 20 hours ago
fuzzy-doodle-97g9gx974j5q2x4wx       fuzzy doodle         SeratFatima00/CC_SeeratFatima_060_Lab12     main    Available  about 4 minutes ago
```

```
PS C:\Users\Waseem\Documents\Lab12> gh codespace ssh -c fuzzy-doodle-97g9gx974j5q2x4wx
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
Last login: Mon Dec 29 11:34:01 2025 from ::1
@SeratFatima00 ➜ /workspaces/CC_SeeratFatima_060_Lab12 (main) $
```

Task 1 — Organize Terraform code into separate files

```
@SeratFatima00 ➜ /workspaces/CC_SeeratFatima_060_Lab12 (main) $ mkdir -p ~/Lab12
@SeratFatima00 ➜ /workspaces/CC_SeeratFatima_060_Lab12 (main) $ cd ~/Lab12
@SeratFatima00 ➜ ~/Lab12 $
```

```
@SeratFatima00 ➜ ~/Lab12 $ touch main.tf variables.tf outputs.tf locals.tf terraform.tfvars entry-script.sh
@SeratFatima00 ➜ ~/Lab12 $ ls -la
total 12
drwxrwxr-x 2 codespace codespace 4096 Dec 29 11:41 .
drwxr-x--- 1 codespace codespace 4096 Dec 29 11:40 ..
-rw-rw-r-- 1 codespace codespace    0 Dec 29 11:41 entry-script.sh
-rw-rw-r-- 1 codespace codespace    0 Dec 29 11:41 locals.tf
-rw-rw-r-- 1 codespace codespace    0 Dec 29 11:41 main.tf
-rw-rw-r-- 1 codespace codespace    0 Dec 29 11:40 outputs.
-rw-rw-r-- 1 codespace codespace    0 Dec 29 11:41 outputs.tf
-rw-rw-r-- 1 codespace codespace    0 Dec 29 11:41 terraform.tfvars
-rw-rw-r-- 1 codespace codespace    0 Dec 29 11:40 tf
-rw-rw-r-- 1 codespace codespace    0 Dec 29 11:41 variables.tf
```

```
variable "vpc_cidr_block"
variable "subnet_cidr_block"
variable "availability_zone"
variable "env_prefix"
variable "instance_type"
variable "public_key"
variable "private_key"
```

```
utput "aws_instance_public_ip"
  value = aws_instance.myapp-server.public_ip
```

```
locals
  my_ip = "${chomp(data.http.my_ip.response_body)}/32"
```

```
vpc_cidr_block     = "10.0.0.0/16"
subnet_cidr_block = "10.0.10.0/24"
availability_zone = "eu-north-1a"
env_prefix         = "dev"
instance_type      = "t3.micro"
public_key         = "~/.ssh/id_ed25519.pub"
private_key        = "~/.ssh/id_ed25519"
```

```
resource "aws_default_security_group" "default_sg"
  vpc_id = aws_vpc.myapp_vpc.id

  ingress
    from_port    = 22
    to_port      = 22
    protocol     = "tcp"
    cidr_blocks =  local.my_ip


  ingress
    from_port    = 80
    to_port      = 80
    protocol     = "tcp"
    cidr_blocks =  "0.0.0.0/0"


  egress
    from_port    = 0
    to_port      = 0
    protocol     = "-1"
    cidr_blocks =  "0.0.0.0/0"


  tags =   Name = "${var.env_prefix}-default-sg"


resource "aws_key_pair" "ssh_key"
  key_name   = "serverkey"
  public_key = file var.public_key


resource "aws_instance" "myapp-server"
  ami                         = "ami-0021ca50382945ce2"
  instance_type               = var.instance_type
  subnet_id                   = aws_subnet.myapp_subnet_1.id
  vpc_security_group_ids      =  aws_default_security_group.default_sg.id
  availability_zone           = var.availability_zone
  associate_public_ip_address = true
  key_name                    = aws_key_pair.ssh_key.key_name
  user_data                   = file "./entry-script.sh"

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


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

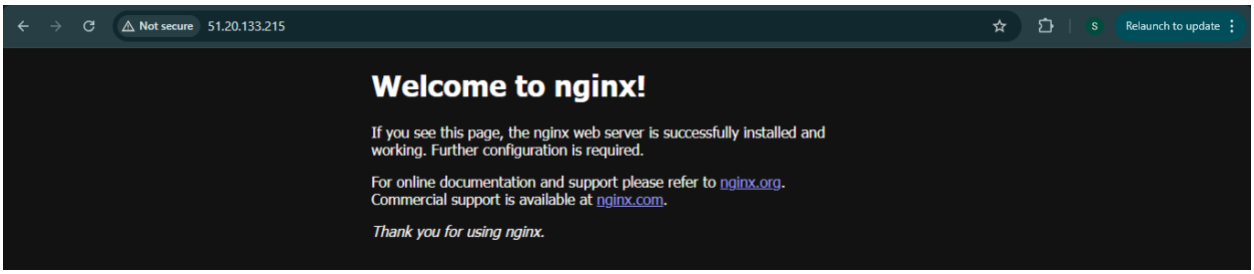
```
#!/bin/bash
#set -e
#yum update -y
#yum install -y nginx
#systemctl start nginx
#systemctl enable nginx
~
~
```

```
@SeratFatima00 ~/Lab12 $ ssh-keygen -t ed25519 -f ~/.ssh/id_ed25519 -N ""
Generating public/private ed25519 key pair.
Your identification has been saved in /home/codespace/.ssh/id_ed25519
Your public key has been saved in /home/codespace/.ssh/id_ed25519.pub
The key fingerprint is:
SHA256:gyLErazXSYzxP6X+X9exJPjl8le7ypBTUP2Ebb+Uloc codespace@codespaces-885ac9
The key's randomart image is:
+--[ED25519 256]--+
|             ..o |
| . .        . ..+|
|  + .      .   +=|
| o *   .    o E=+|
|  = = . S  . oo+o|
| . + + o .  + =o+|
|. . o +    +.o.o+|
| .   . .   .+.o..|
|      .....  o.oo|
+----[SHA256]-----+
```

```
@SeratFatima00 ~/Lab12 $ terraform init
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.
```

```
@SeratFatima00 ~/Lab12 $ terraform apply -auto-approve
data.http.my_ip: Reading...
data.http.my_ip: Read complete after 0s [id=https://icanhazip.com]

Terraform used the selected providers to generate the following execution plan. Resource actions are indicated with the following symbo
  + create

Terraform will perform the following actions:

  # aws_default_route_table.main_rt will be created
  + resource "aws_default_route_table" "main_rt" {
      + arn                    = (known after apply)
      + default_route_table_id = (known after apply)
      + id                     = (known after apply)
      + owner_id               = (known after apply)
      + region                 = "eu-north-1"
      + route                  = [
          + {
              + cidr_block                = "0.0.0.0/0"
              + gateway_id                = (known after apply)
                # (10 unchanged attributes hidden)
            },
        ]
      + tags                   = {
          + "Name" = "dev-rt"
        }
      + tags_all               = {
          + "Name" = "dev-rt"
        }
      + vpc_id                 = (known after apply)
    }

  # aws_default_security_group.default_sg will be created
  + resource "aws_default_security_group" "default_sg" {
      + arn                    = (known after apply)
      + description            = (known after apply)
      + egress                 = [
          + {
              + cidr_blocks      = [
                  + "0.0.0.0/0",
                ]
              + from_port        = 0
              + ipv6_cidr_blocks = []
              + prefix_list_ids  = []
              + protocol         = "-1"
              + security_groups  = []
              + self             = false
              + to_port          = 0
                # (1 unchanged attribute hidden)
```

```
@SeratFatima00 ~/Lab12 $ terraform output
aws_instance_public_ip = "51.20.133.215"
```




```
aws_default_route_table.main_rt: Destroying... [id=rtb-01530b7f350bf833c]
aws_default_route_table.main_rt: Destruction complete after 0s
aws_instance.myapp-server: Destroying... [id=i-0dd3f46c04576d2f8]
aws_internet_gateway.myapp_igw: Destroying... [id=igw-0e3033a3f39d730b5]
aws_instance.myapp-server: Still destroying... [id=i-0dd3f46c04576d2f8, 00m10s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0e3033a3f39d730b5, 00m10s elapsed]
aws_internet_gateway.myapp_igw: Destruction complete after 20s
aws_instance.myapp-server: Still destroying... [id=i-0dd3f46c04576d2f8, 00m20s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-0dd3f46c04576d2f8, 00m30s elapsed]
aws_instance.myapp-server: Destruction complete after 31s
aws_subnet.myapp_subnet_1: Destroying... [id=subnet-097bcec786ed7f631]
aws_key_pair.ssh_key: Destroying... [id=serverkey]
aws_default_security_group.default_sg: Destroying... [id=sg-093e8ff65e01ecfc6]
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 2s
aws_vpc.myapp_vpc: Destroying... [id=vpc-096b05cdd131960d6]
aws_vpc.myapp_vpc: Destruction complete after 1s

Destroy complete! Resources: 7 destroyed.
```

Task 2 — Use remote-exec provisioner

```
resource "aws_instance" "myapp-server" {
  ami                         = "ami-0021ca50382945ce2"
  instance_type               = var.instance_type
  subnet_id                   = aws_subnet.myapp_subnet_1.id
  security_groups             = [aws_default_security_group.default_sg.id]
  availability_zone           = var.availability_zone
  associate_public_ip_address = true
  key_name                    = aws_key_pair.ssh-key.key_name

  connection {
    type        = "ssh"
    user        = "ec2-user"
    private_key = file(var.private_key)
    host        = self.public_ip
  }

  provisioner "remote-exec" {
    inline = [
      "sudo dnf update -y",
      "sudo dnf install -y nginx",
      "sudo systemctl start nginx",
      "sudo systemctl enable nginx"
    ]
  }

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

```
aws_instance.myapp-server (remote-exec):     Release notes:
aws_instance.myapp-server (remote-exec):      https://docs.aws.amazon.com/linux/al2023/release-notes/relnotes-2023.9.20251105.html

aws_instance.myapp-server (remote-exec):   Version 2023.9.20251110:
aws_instance.myapp-server (remote-exec):     Run the following command to upgrade to 2023.9.20251110:

aws_instance.myapp-server (remote-exec):       dnf upgrade --releasever=2023.9.20251110

aws_instance.myapp-server (remote-exec):     Release notes:
aws_instance.myapp-server (remote-exec):      https://docs.aws.amazon.com/linux/al2023/release-notes/relnotes-2023.9.20251110.html

aws_instance.myapp-server (remote-exec):   Version 2023.9.20251117:
aws_instance.myapp-server (remote-exec):     Run the following command to upgrade to 2023.9.20251117:

aws_instance.myapp-server (remote-exec):       dnf upgrade --releasever=2023.9.20251117

aws_instance.myapp-server (remote-exec):     Release notes:
aws_instance.myapp-server (remote-exec):      https://docs.aws.amazon.com/linux/al2023/release-notes/relnotes-2023.9.20251117.html

aws_instance.myapp-server (remote-exec):   Version 2023.9.20251208:
aws_instance.myapp-server (remote-exec):     Run the following command to upgrade to 2023.9.20251208:

aws_instance.myapp-server (remote-exec):       dnf upgrade --releasever=2023.9.20251208

aws_instance.myapp-server (remote-exec):     Release notes:
aws_instance.myapp-server (remote-exec):      https://docs.aws.amazon.com/linux/al2023/release-notes/relnotes-2023.9.20251208.html

aws_instance.myapp-server (remote-exec): ====================================

aws_instance.myapp-server (remote-exec): Installed:
aws_instance.myapp-server (remote-exec):   generic-logos-httpd-18.0.0-12.amzn2023.0.3.noarch
aws_instance.myapp-server (remote-exec):   gperftools-libs-2.9.1-1.amzn2023.0.3.x86_64
aws_instance.myapp-server (remote-exec):   libunwind-1.4.0-5.amzn2023.0.2.x86_64
aws_instance.myapp-server (remote-exec):   nginx-1:1.28.0-1.amzn2023.0.1.x86_64
aws_instance.myapp-server (remote-exec):   nginx-core-1:1.28.0-1.amzn2023.0.1.x86_64
aws_instance.myapp-server (remote-exec):   nginx-filesystem-1:1.28.0-1.amzn2023.0.1.noarch
aws_instance.myapp-server (remote-exec):   nginx-mimetypes-2.1.49-3.amzn2023.0.3.noarch

aws_instance.myapp-server (remote-exec): Complete!
aws_instance.myapp-server (remote-exec): Created symlink /etc/systemd/system/multi-user.target.wants/nginx.service → /usr/lib/systemd/system/nginx.service.
aws_instance.myapp-server: Creation complete after 1m22s [id=i-09fd9d2381b300761]

Apply complete! Resources: 7 added, 0 changed, 0 destroyed.

Outputs:

aws_instance_public_ip = "51.21.2.45"
```

```
@SeratFatima00 ~/Lab12 $ terraform output
aws_instance_public_ip = "51.21.2.45"
```

Task 3 — Use file and local-exec provisioners

```
resource "aws_instance" "myapp-server" {
  ami                         = "ami-0021ca50382945ce2" # Amazon Linux 2023
  instance_type               = var.instance_type
  subnet_id                   = aws_subnet.myapp_subnet_1.id
  security_groups             = [aws_default_security_group.default_sg.id]
  availability_zone           = var.availability_zone
  associate_public_ip_address = true
  key_name                    = aws_key_pair.ssh-key.key_name

  connection {
    type        = "ssh"
    user        = "ec2-user"
    private_key = file(var.private_key)
    host        = self.public_ip
  }

  provisioner "file" {
    source      = "./entry-script.sh"
    destination = "/home/ec2-user/entry-script-on-ec2.sh"
  }

  provisioner "remote-exec" {
    inline = [
      "sudo chmod +x /home/ec2-user/entry-script-on-ec2.sh",
      "sudo /home/ec2-user/entry-script-on-ec2.sh"
    ]
  }

  provisioner "local-exec" {
    command = <<-EOF
      echo Instance ${self.id} with public IP ${self.public_ip} has been created
    EOF
  }

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

```
Changes to Outputs:
  ~ aws_instance_public_ip = "51.21.2.45" -> (known after apply)
aws_instance.myapp-server: Destroying... [id=i-09fd9d2381b300761]
aws_instance.myapp-server: Still destroying... [id=i-09fd9d2381b300761, 00m10s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-09fd9d2381b300761, 00m20s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-09fd9d2381b300761, 00m30s elapsed]
aws_instance.myapp-server: Destruction complete after 30s
aws_instance.myapp-server: Creating...
aws_instance.myapp-server: Still creating... [00m10s elapsed]
aws_instance.myapp-server: Provisioning with 'file'...
aws_instance.myapp-server: Provisioning with 'remote-exec'...
aws_instance.myapp-server (remote-exec): Connecting to remote host via SSH...
aws_instance.myapp-server (remote-exec):   Host: 13.48.71.2
aws_instance.myapp-server (remote-exec):   User: ec2-user
aws_instance.myapp-server (remote-exec):   Password: false
aws_instance.myapp-server (remote-exec):   Private key: true
aws_instance.myapp-server (remote-exec):   Certificate: false
aws_instance.myapp-server (remote-exec):   SSH Agent: false
aws_instance.myapp-server (remote-exec):   Checking Host Key: false
aws_instance.myapp-server (remote-exec):   Target Platform: unix
aws_instance.myapp-server (remote-exec): Connected!
aws_instance.myapp-server: Provisioning with 'local-exec'...
aws_instance.myapp-server (local-exec): Executing: ["/bin/sh" "-c" "echo Instance i-04b00b4725be9fa4f with public IP 13.48.71.2 has been created\n"]
aws_instance.myapp-server (local-exec): Instance i-04b00b4725be9fa4f with public IP 13.48.71.2 has been created
aws_instance.myapp-server: Creation complete after 20s [id=i-04b00b4725be9fa4f]

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

Outputs:

aws_instance_public_ip = "13.48.71.2"
```

```
@SeratFatima00 ~/Lab12 $ terraform output
aws_instance_public_ip = "13.48.71.2"
```


```
aws_default_route_table.main_rt: Destroying... [id=rtb-081730299fb2fac14]
aws_default_route_table.main_rt: Destruction complete after 0s
aws_instance.myapp-server: Destroying... [id=i-04b00b4725be9fa4f]
aws_internet_gateway.myapp_igw: Destroying... [id=igw-0daa8acf09c4a2ef5]
aws_instance.myapp-server: Still destroying... [id=i-04b00b4725be9fa4f, 00m10s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0daa8acf09c4a2ef5, 00m10s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-04b00b4725be9fa4f, 00m20s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0daa8acf09c4a2ef5, 00m20s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-04b00b4725be9fa4f, 00m30s elapsed]
aws_internet_gateway.myapp_igw: Still destroying... [id=igw-0daa8acf09c4a2ef5, 00m30s elapsed]
aws_internet_gateway.myapp_igw: Destruction complete after 40s
aws_instance.myapp-server: Still destroying... [id=i-04b00b4725be9fa4f, 00m40s elapsed]
aws_instance.myapp-server: Destruction complete after 42s
aws_subnet.myapp_subnet_1: Destroying... [id=subnet-06690fbc9f6f3c33b]
aws_default_security_group.default_sg: Destroying... [id=sg-062a68a0dc8c43cda]
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 1s
aws_subnet.myapp_subnet_1: Destruction complete after 1s
aws_vpc.myapp_vpc: Destroying... [id=vpc-0c54a1bcaf15a45cf]
aws_vpc.myapp_vpc: Destruction complete after 1s

Destroy complete! Resources: 7 destroyed.
```

```
resource "aws_instance" "myapp-server" {
  ami                         = "ami-0021ca50382945ce2" # Amazon Linux 2023
  instance_type               = var.instance_type
  subnet_id                   = aws_subnet.myapp_subnet_1.id
  security_groups             = [aws_default_security_group.default_sg.id]
  availability_zone           = var.availability_zone
  associate_public_ip_address = true
  key_name                    = aws_key_pair.ssh-key.key_name

  user_data = file("./entry-script.sh")

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

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

Task 4 — Create Terraform modules (subnet module)

```
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ mkdir -p modules/subnet
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ touch modules/subnet/main.tf
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ touch modules/subnet/variables.tf
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ touch modules/subnet/outputs.tf
```

```
variable "vpc_id"
variable "subnet_cidr_block"
variable "availability_zone"
variable "env_prefix"
variable "default_route_table_id"
~
~
~
~
```

```
resource "aws_subnet" "myapp_subnet_1"
  vpc_id     = var.vpc_id
  cidr_block = var.subnet_cidr_block
  availability_zone = var.availability_zone
  map_public_ip_on_launch = true
  tags =
     Name = "${var.env_prefix}-subnet-1"



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



resource "aws_default_route_table" "main_rt"
  default_route_table_id = var.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"



~
```

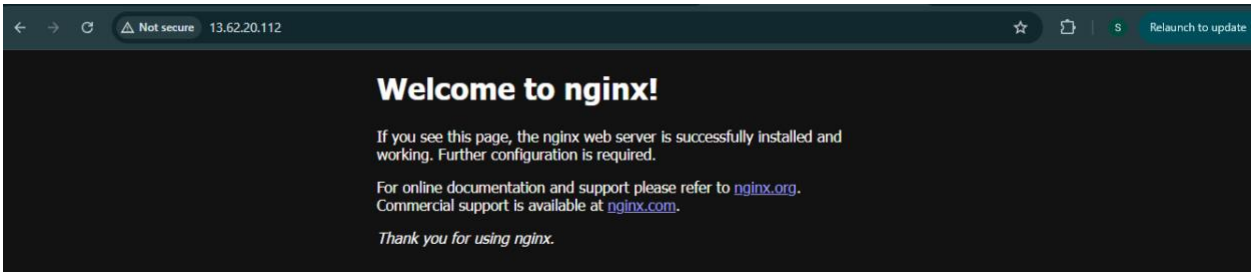
```
output "subnet"
  value = aws_subnet.myapp_subnet_1

~
~
~
~
```

```
resource "aws_instance" "myapp-server" {
  ami                         = "ami-0021ca50382945ce2" # Amazon Linux 2023
  instance_type               = var.instance_type
  subnet_id                 = module.myapp-subnet.subnet.id
  security_groups             = [aws_default_security_group.default_sg.id]
  availability_zone           = var.availability_zone
  associate_public_ip_address = true
  key_name                    = aws_key_pair.ssh-key.key_name

  user_data = file("./entry-script.sh")

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

data "http" "my_ip" {
  url = "https://icanhazip.com"
}
module "myapp-subnet" {
  source = "./modules/subnet"
  vpc_id = aws_vpc.myapp_vpc.id
  subnet_cidr_block = var.subnet_cidr_block
  availability_zone = var.availability_zone
  env_prefix = var.env_prefix
  default_route_table_id = aws_vpc.myapp_vpc.default_route_table_id
}
```

```
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ terraform init
Initializing the backend...
Initializing modules...
- myapp-subnet in modules/subnet
Initializing provider plugins...
- Finding latest version of hashicorp/aws...
- Finding latest version of hashicorp/http...
- Installing hashicorp/aws v6.27.0...
- Installed hashicorp/aws v6.27.0 (signed by HashiCorp)
- Installing hashicorp/http v3.5.0...
- Installed hashicorp/http v3.5.0 (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.
```

```
Plan: 7 to add, 0 to change, 0 to destroy.

Changes to Outputs:
  + aws_instance_public_ip = (known after apply)
aws_key_pair.ssh-key: Creating...
aws_vpc.myapp_vpc: Creating...
aws_key_pair.ssh-key: Creation complete after 1s [id=serverkey]
aws_vpc.myapp_vpc: Creation complete after 3s [id=vpc-0157fe8df572e2745]
module.myapp-subnet.aws_subnet.myapp_subnet_1: Creating...
module.myapp-subnet.aws_internet_gateway.myapp_igw: Creating...
aws_default_security_group.default_sg: Creating...
module.myapp-subnet.aws_internet_gateway.myapp_igw: Creation complete after 1s [id=igw-03235aac2278178e4]
module.myapp-subnet.aws_default_route_table.main_rt: Creating...
module.myapp-subnet.aws_default_route_table.main_rt: Creation complete after 2s [id=rtb-0d2f5454dc82c2c87]
aws_default_security_group.default_sg: Creation complete after 4s [id=sg-07362a9a2f764a9e4]
module.myapp-subnet.aws_subnet.myapp_subnet_1: Still creating... [00m10s elapsed]
module.myapp-subnet.aws_subnet.myapp_subnet_1: Creation complete after 11s [id=subnet-083681e00344f8e75]
aws_instance.myapp-server: Creating...
aws_instance.myapp-server: Still creating... [00m10s elapsed]
aws_instance.myapp-server: Creation complete after 14s [id=i-0dcf212dc2a31c082]

Apply complete! Resources: 7 added, 0 changed, 0 destroyed.
```

```
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ terraform output
aws_instance_public_ip = "13.62.20.112"
```



Task 5 — Create webserver module

```
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ cd /workspaces/CC_SeeratFatima_060_Lab12
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ mkdir -p modules/webserver
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ touch modules/webserver/main.tf
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ touch modules/webserver/variables.tf
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ touch modules/webserver/outputs.tf
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $
```

```
variable "env_prefix"
variable "instance_type"
variable "availability_zone"
variable "public_key"
variable "my_ip"
variable "vpc_id"
variable "subnet_id"
variable "script_path"
variable "instance_suffix"
```

```
resource "aws_security_group" "web_sg"
  vpc_id      = var.vpc_id
  name        = "${var.env_prefix}-web-sg-${var.instance_suffix}"
  description = "Security group for web server allowing HTTP, HTTPS and SSH"

  ingress
    from_port   = 22
    to_port     = 22
    protocol    = "tcp"
    cidr_blocks =  var.my_ip

  ingress
    from_port   = 443
    to_port     = 443
    protocol    = "tcp"
    cidr_blocks =  "0.0.0.0/0"

  ingress
    from_port   = 80
    to_port     = 80
    protocol    = "tcp"
    cidr_blocks =  "0.0.0.0/0"

  egress
    from_port   = 0
    to_port     = 0
    protocol    = "-1"
    cidr_blocks =  "0.0.0.0/0"


  tags =
    Name = "${var.env_prefix}-default-sg"



resource "aws_key_pair" "ssh-key"
  key_name   = "${var.env_prefix}-serverkey-${var.instance_suffix}"
  public_key = file var.public_key


resource "aws_instance" "myapp-server"
  ami                         = "ami-05524d6658fcf35b6"
  instance_type               = var.instance_type
  subnet_id                   = var.subnet_id
  security_groups             =  aws_security_group.web_sg.id
  availability_zone           = var.availability_zone
  associate_public_ip_address = true
  key_name                    = aws_key_pair.ssh-key.key_name
```

```
output "aws_instance"
  value = aws_instance.myapp-server


~
~
~
```

```
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" }
}

data "http" "my_ip" {
  url = "https://icanhazip.com"
}
module "myapp-subnet" {
  source = "./modules/subnet"
  vpc_id = aws_vpc.myapp_vpc.id
  subnet_cidr_block = var.subnet_cidr_block
  availability_zone = var.availability_zone
  env_prefix = var.env_prefix
  default_route_table_id = aws_vpc.myapp_vpc.default_route_table_id
}
module "myapp-webserver" {
  source             = "./modules/webserver"
  env_prefix         = var.env_prefix
  instance_type      = var.instance_type
  availability_zone  = var.availability_zone
  public_key         = var.public_key
  my_ip              = local.my_ip
  vpc_id             = aws_vpc.myapp_vpc.id
  subnet_id          = module.myapp-subnet.subnet.id
  script_path        = "./entry-script.sh"
  instance_suffix    = "0"
}
~
~
~
```

```
output "webserver_public_ip" {
  value = module.myapp-webserver.aws_instance.public_ip
}
~
~
~
~
```

```
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ terraform init
Initializing the backend...
Initializing modules...
- myapp-webserver in modules/webserver
Initializing provider plugins...
- Reusing previous version of hashicorp/aws from the dependency lock file
- Reusing previous version of hashicorp/http from the dependency lock file
- Using previously-installed hashicorp/aws v6.27.0
- Using previously-installed hashicorp/http v3.5.0

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.
```

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

Changes to Outputs:
  - aws_instance_public_ip = "13.62.20.112" -> null
  + webserver_public_ip    = (known after apply)
aws_instance.myapp-server: Destroying... [id=i-0dcf212dc2a31c082]
module.myapp-webserver.aws_security_group.web_sg: Creating...
module.myapp-webserver.aws_key_pair.ssh-key: Creating...
module.myapp-webserver.aws_key_pair.ssh-key: Creation complete after 0s [id=dev-serverkey-0]
module.myapp-webserver.aws_security_group.web_sg: Creation complete after 4s [id=sg-0430309287f0229c1]
module.myapp-webserver.aws_instance.myapp-server: Creating...
aws_instance.myapp-server: Still destroying... [id=i-0dcf212dc2a31c082, 00m10s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still creating... [00m10s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Creation complete after 14s [id=i-007b937ca7af0ed0c]
aws_instance.myapp-server: Still destroying... [id=i-0dcf212dc2a31c082, 00m20s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-0dcf212dc2a31c082, 00m30s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-0dcf212dc2a31c082, 00m40s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-0dcf212dc2a31c082, 00m50s elapsed]
aws_instance.myapp-server: Still destroying... [id=i-0dcf212dc2a31c082, 01m00s elapsed]
aws_instance.myapp-server: Destruction complete after 1m1s
aws_key_pair.ssh-key: Destroying... [id=serverkey]
aws_default_security_group.default_sg: Destroying... [id=sg-07362a9a2f764a9e4]
aws_default_security_group.default_sg: Destruction complete after 0s
aws_key_pair.ssh-key: Destruction complete after 0s

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

```
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ terraform output
webserver_public_ip = "16.171.235.234"
```

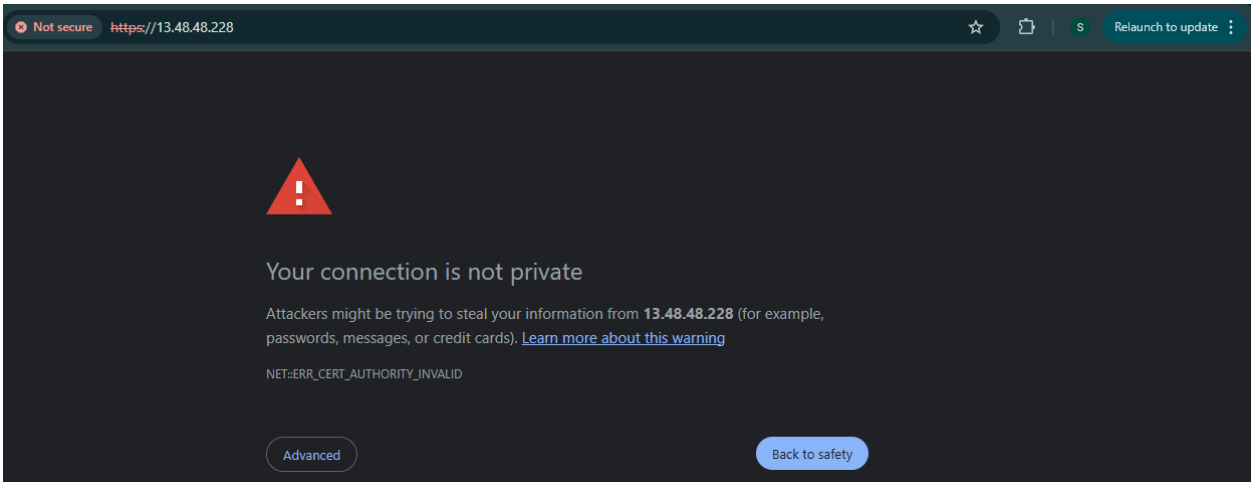

```
Plan: 0 to add, 0 to change, 7 to destroy.

Changes to Outputs:
  - webserver_public_ip = "16.171.235.234" -> 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

module.myapp-subnet.aws_default_route_table.main_rt: Destroying... [id=rtb-0d2f5454dc82c2c87]
module.myapp-subnet.aws_default_route_table.main_rt: Destruction complete after 0s
module.myapp-webserver.aws_instance.myapp-server: Destroying... [id=i-007b937ca7af0ed0c]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Destroying... [id=igw-03235aac2278178e4]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-007b937ca7af0ed0c, 00m10s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Still destroying... [id=igw-03235aac2278178e4, 00m10s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Destruction complete after 19s
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-007b937ca7af0ed0c, 00m20s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-007b937ca7af0ed0c, 00m30s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Destruction complete after 31s
module.myapp-webserver.aws_key_pair.ssh-key: Destroying... [id=dev-serverkey-0]
module.myapp-webserver.aws_security_group.web_sg: Destroying... [id=sg-0430309287f0229c1]
module.myapp-subnet.aws_subnet.myapp_subnet_1: Destroying... [id=subnet-083681e00344f8e75]
module.myapp-webserver.aws_key_pair.ssh-key: Destruction complete after 1s
module.myapp-subnet.aws_subnet.myapp_subnet_1: Destruction complete after 1s
module.myapp-webserver.aws_security_group.web_sg: Destruction complete after 2s
aws_vpc.myapp_vpc: Destroying... [id=vpc-0157fe8df572e2745]
aws_vpc.myapp_vpc: Destruction complete after 1s

Destroy complete! Resources: 7 destroyed.
```

Task 6 — Configure HTTPS with self-signed certificates

```
#!/bin/bash
set

# Update and install nginx
sudo dnf update
sudo dnf install    nginx

# Start and enable nginx
sudo systemctl start nginx
sudo systemctl enable nginx

# Create directories for SSL certificates
mkdir    /etc/ssl/private
mkdir    /etc/ssl/certs

# Get IMDSv2 token
TOKEN=                  "http://169.254.169.254/latest/api/token"
     "X-aws-ec2-metadata-token-ttl-seconds: 21600"

# Get current public IP and hostname
PUBLIC_IP=              "X-aws-ec2-metadata-token:       "
         169 254 169 254

PUBLIC_HOSTNAME=              "X-aws-ec2-metadata-token:      "
         169 254 169 254

# Generate self-signed certificate
openssl req   509              365         rsa:2048 \
          /etc/ssl/private/selfsigned.key \
       /etc/ssl/certs/selfsigned.crt \
        "/CN=           " \
          "subjectAltName=IP:           " \
          "basicConstraints=CA:FALSE" \
          "keyUsage=digitalSignature,keyEncipherment" \
          "extendedKeyUsage=serverAuth"

echo "Self-signed certificate created for IP:           "

# Backup existing nginx.conf
cp /etc/nginx/nginx.conf /etc/nginx/nginx.conf.bak

# Overwrite nginx.conf with SSL configuration
cat <<EOF > /etc/nginx/nginx.conf
user nginx;
worker_processes auto;
error_log /var/log/nginx/error.log notice;
pid /run/nginx.pid;

events {
```

```
Plan: 7 to add, 0 to change, 0 to destroy.

Changes to Outputs:
  + webserver_public_ip = (known after apply)
module.myapp-webserver.aws_key_pair.ssh-key: Creating...
aws_vpc.myapp_vpc: Creating...
module.myapp-webserver.aws_key_pair.ssh-key: Creation complete after 1s [id=dev-serverkey-0]
aws_vpc.myapp_vpc: Creation complete after 3s [id=vpc-043d5af279f51c894]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Creating...
module.myapp-subnet.aws_subnet.myapp_subnet_1: Creating...
module.myapp-webserver.aws_security_group.web_sg: Creating...
module.myapp-subnet.aws_internet_gateway.myapp_igw: Creation complete after 1s [id=igw-0cfcaf1242b2579d5]
module.myapp-subnet.aws_default_route_table.main_rt: Creating...
module.myapp-subnet.aws_default_route_table.main_rt: Creation complete after 1s [id=rtb-0afe92eb5829a532a]
module.myapp-webserver.aws_security_group.web_sg: Creation complete after 4s [id=sg-08c2af293919f1369]
module.myapp-subnet.aws_subnet.myapp_subnet_1: Still creating... [00m10s elapsed]
module.myapp-subnet.aws_subnet.myapp_subnet_1: Creation complete after 11s [id=subnet-0ff339ef432280281]
module.myapp-webserver.aws_instance.myapp-server: Creating...
module.myapp-webserver.aws_instance.myapp-server: Still creating... [00m10s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Creation complete after 15s [id=i-03982db9d765f2273]

Apply complete! Resources: 7 added, 0 changed, 0 destroyed.
```

```
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ terraform output
webserver_public_ip = "13.48.48.228"
```



```
yum update
yum install httpd
systemctl start httpd
systemctl enable httpd
echo "<h1>Welcome to My Web Server</h1>" > /var/www/html/index.html
hostnamectl set-hostname myapp-webserver

TOKEN=                "http://169.254.169.254/latest/api/token"
            "X-aws-ec2-metadata-token-ttl-seconds: 21600"

echo "<h2>Hostname:            </h2>" >> /var/www/html/index.html
echo "<h2>Private IP:            "X-aws-ec2-metadata-token:       "        169.254.169.254                          </h2>" >> /var/www/html/index.html
echo "<h2>Public IP:           "X-aws-ec2-metadata-token:       "        169.254.169.254                          </h2>" >> /var/www/html/index.html
echo "<h2>Public DNS:            "X-aws-ec2-metadata-token:       "        169.254.169.254                              </h2>" >> /var/www/html/index.html
echo "<h2>Deployed via Terraform</h2>" >> /var/www/html/index.html
~
```

```
module "myapp-web-1" {
  source = "./modules/webserver"
  env_prefix = var.env_prefix
  instance_type = var.instance_type
  availability_zone = var.availability_zone
  public_key = var.public_key
  my_ip = local.my_ip
  vpc_id = aws_vpc.myapp_vpc.id
  subnet_id = module.myapp-subnet.subnet.id
  script_path = "./apache.sh"
  instance_suffix = "1"
}
```

```
output "webserver_public_ip" {
  value = module.myapp-webserver.aws_instance.public_ip
}
output "aws_web-1_public_ip" {
  value = module.myapp-web-1.aws_instance.public_ip
}
~
~
~
~
~
~
```

```
Plan: 2 to add, 0 to change, 2 to destroy.

Changes to Outputs:
  ~ aws_web-1_public_ip = "13.48.130.100" -> (known after apply)
  + webserver_public_ip = (known after apply)
module.myapp-web-1.aws_instance.myapp-server: Destroying... [id=i-0d270e53cf44e57d5]
module.myapp-webserver.aws_instance.myapp-server: Destroying... [id=i-06700c47904b3d4ea]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-06700c47904b3d4ea, 00m10s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0d270e53cf44e57d5, 00m10s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0d270e53cf44e57d5, 00m20s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-06700c47904b3d4ea, 00m20s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-06700c47904b3d4ea, 00m30s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0d270e53cf44e57d5, 00m30s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0d270e53cf44e57d5, 00m40s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-06700c47904b3d4ea, 00m40s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Destruction complete after 41s
module.myapp-webserver.aws_instance.myapp-server: Creating...
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0d270e53cf44e57d5, 00m50s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still creating... [00m10s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Creation complete after 14s [id=i-0bccc75f7fea5cd90]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0d270e53cf44e57d5, 01m00s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Destruction complete after 1m2s
module.myapp-web-1.aws_instance.myapp-server: Creating...
module.myapp-web-1.aws_instance.myapp-server: Still creating... [00m10s elapsed]
^@^@module.myapp-web-1.aws_instance.myapp-server: Creation complete after 14s [id=i-0eb1758ae434cf990]

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

Outputs:

aws_web-1_public_ip = "13.51.237.240"
webserver_public_ip = "51.20.137.97"
```

```
@SeratFatima00 ➜ /workspaces/CC_SeeratFatima_060_Lab12 (main) $ terraform output
aws_web-1_public_ip = "13.51.237.240"
webserver_public_ip = "51.20.137.97"
```

```
@SeratFatima00 ➜ /workspaces/CC_SeeratFatima_060_Lab12 (main) $ ssh ec2-user@51.20.137.97
The authenticity of host '51.20.137.97 (51.20.137.97)' can't be established.
ED25519 key fingerprint is SHA256:kVJrThQAIL2VEn2D2+nvyoetXa2Oz6CXnn2pSS0v78g.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '51.20.137.97' (ED25519) to the list of known hosts.

A newer release of "Amazon Linux" is available.
  Version 2023.8.20250707:
  Version 2023.8.20250715:
  Version 2023.8.20250721:
  Version 2023.8.20250808:
  Version 2023.8.20250818:
  Version 2023.8.20250908:
  Version 2023.8.20250915:
  Version 2023.9.20250929:
  Version 2023.9.20251014:
  Version 2023.9.20251020:
  Version 2023.9.20251027:
  Version 2023.9.20251105:
  Version 2023.9.20251110:
  Version 2023.9.20251117:
  Version 2023.9.20251208:
Run "/usr/bin/dnf check-release-update" for full release and version update info
   ,     #_
   ~\_  ####_
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   Amazon Linux 2023 (ECS Optimized)
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'

For documentation, visit http://aws.amazon.com/documentation/ecs
[ec2-user@ip-10-0-10-86 ~]$
```

```
location / {
        #    root /usr/share/nginx/html;
        #    index index.html;
             proxy_pass http://<web-1-public-ip>:80;
             #   proxy_pass http://backend_servers;
    }
~
~
~
~
```

```
user nginx;
worker_processes auto;
error_log /var/log/nginx/error.log notice;
pid /run/nginx.pid;

events {
    worker_connections 1024;
}

http {
    log_format main '             -             [            ] "          "
                    '                          "             " '
                    '"                 " "                     "';

    access_log /var/log/nginx/access.log main;
    sendfile on;
    tcp_nopush on;
    keepalive_timeout 65;
    types_hash_max_size 4096;

    include /etc/nginx/mime.types;
    default_type application/octet-stream;

    upstream backend_servers {
        server 158.252.94.241:80;
        server 158.252.94.242:80 backup;
    }

    server {
        listen 443 ssl;
        server_name 51.20.137.97;
        ssl_certificate /etc/ssl/certs/selfsigned.crt;
        ssl_certificate_key /etc/ssl/private/selfsigned.key;

        location / {
                    proxy_pass http://13.51.237.240:80;
        }

    }

    server {
        listen 80;
        server_name _;
        return 301 https://$host$request_uri;
    }
}
~
~
```

```
[ec2-user@ip-10-0-10-86 ~]$ cat /var/log/nginx/error.log
2025/12/29 17:20:22 [notice] 2255#2255: using the "epoll" event method
2025/12/29 17:20:22 [notice] 2255#2255: nginx/1.28.0
2025/12/29 17:20:22 [notice] 2255#2255: OS: Linux 6.1.141-155.222.amzn2023.x86_64
2025/12/29 17:20:22 [notice] 2255#2255: getrlimit(RLIMIT_NOFILE): 65535:65535
2025/12/29 17:20:22 [notice] 2256#2256: start worker processes
2025/12/29 17:20:22 [notice] 2256#2256: start worker process 2257
2025/12/29 17:20:22 [notice] 2256#2256: start worker process 2258
2025/12/29 17:20:23 [notice] 2256#2256: signal 3 (SIGQUIT) received from 1, shutting down
2025/12/29 17:20:23 [notice] 2258#2258: gracefully shutting down
2025/12/29 17:20:23 [notice] 2258#2258: exiting
2025/12/29 17:20:23 [notice] 2258#2258: exit
2025/12/29 17:20:23 [notice] 2257#2257: gracefully shutting down
2025/12/29 17:20:23 [notice] 2257#2257: exiting
2025/12/29 17:20:23 [notice] 2257#2257: exit
2025/12/29 17:20:23 [notice] 2256#2256: signal 17 (SIGCHLD) received from 2257
2025/12/29 17:20:23 [notice] 2256#2256: worker process 2257 exited with code 0
2025/12/29 17:20:23 [notice] 2256#2256: worker process 2258 exited with code 0
2025/12/29 17:20:23 [notice] 2256#2256: exit
2025/12/29 17:20:23 [notice] 2299#2299: using the "epoll" event method
2025/12/29 17:20:23 [notice] 2299#2299: nginx/1.28.0
2025/12/29 17:20:23 [notice] 2299#2299: OS: Linux 6.1.141-155.222.amzn2023.x86_64
2025/12/29 17:20:23 [notice] 2299#2299: getrlimit(RLIMIT_NOFILE): 65535:65535
2025/12/29 17:20:23 [notice] 2300#2300: start worker processes
2025/12/29 17:20:23 [notice] 2300#2300: start worker process 2301
2025/12/29 17:20:23 [notice] 2300#2300: start worker process 2302
2025/12/29 17:31:11 [error] 2302#2302: *1 open() "/usr/share/nginx/html/SDK/webLanguage" failed (2: No such file or directory), client: 5.
ebLanguage HTTP/1.1", host: "51.20.137.97:443"
2025/12/29 17:37:17 [crit] 2301#2301: *2 SSL_do_handshake() failed (SSL: error:0A000172:SSL routines::wrong signature type) while SSL hand
2025/12/29 17:42:11 [notice] 2300#2300: signal 3 (SIGQUIT) received from 1, shutting down
2025/12/29 17:42:11 [notice] 2301#2301: gracefully shutting down
2025/12/29 17:42:11 [notice] 2301#2301: exiting
2025/12/29 17:42:11 [notice] 2301#2301: exit
2025/12/29 17:42:11 [notice] 2302#2302: gracefully shutting down
2025/12/29 17:42:11 [notice] 2302#2302: exiting
2025/12/29 17:42:11 [notice] 2302#2302: exit
2025/12/29 17:42:11 [notice] 2300#2300: signal 17 (SIGCHLD) received from 2301
2025/12/29 17:42:11 [notice] 2300#2300: worker process 2301 exited with code 0
2025/12/29 17:42:11 [notice] 2300#2300: signal 29 (SIGIO) received
2025/12/29 17:42:11 [notice] 2300#2300: signal 17 (SIGCHLD) received from 2302
2025/12/29 17:42:11 [notice] 2300#2300: worker process 2302 exited with code 0
2025/12/29 17:42:11 [notice] 2300#2300: exit
2025/12/29 17:42:11 [emerg] 23584#23584: host not found in upstream "<WEB-1_PUBLIC_IP>" in /etc/nginx/nginx.conf:36
2025/12/29 17:44:05 [emerg] 25098#25098: host not found in upstream "<WEB-1_PUBLIC_IP>" in /etc/nginx/nginx.conf:36
2025/12/29 17:48:17 [notice] 28912#28912: using the "epoll" event method
2025/12/29 17:48:17 [notice] 28912#28912: nginx/1.28.0
2025/12/29 17:48:17 [notice] 28912#28912: OS: Linux 6.1.141-155.222.amzn2023.x86_64
2025/12/29 17:48:17 [notice] 28912#28912: getrlimit(RLIMIT_NOFILE): 65535:65535
2025/12/29 17:48:17 [notice] 28913#28913: start worker processes
2025/12/29 17:48:17 [notice] 28913#28913: start worker process 28914
```

```
[ec2-user@ip-10-0-10-86 ~]$ cat /var/log/nginx/access.log
5.187.35.158 - - [29/Dec/2025:17:31:11 +0000] "GET /SDK/webLanguage HTTP/1.1" 404 555 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/90.0.4430.85 Safari/537.36 Edg/90.0.818.46" "-"
```

```
[ec2-user@ip-10-0-10-86 ~]$ cat /etc/nginx/mime.types
types {
application/A2L                                  a2l;
application/AML                                  aml;
application/andrew-inset                         ez;
application/ATF                                  atf;
application/ATFX                                 atfx;
application/ATXML                                atxml;
application/atom+xml                             atom;
application/atomcat+xml                          atomcat;
application/atomdeleted+xml                      atomdeleted;
application/atomsvc+xml                          atomsvc;
application/atsc-dwd+xml                         dwd;
application/atsc-held+xml                        held;
application/atsc-rsat+xml                        rsat;
application/auth-policy+xml                      apxml;
application/bacnet-xdd+zip                       xdd;
application/calendar+xml                         xcs;
application/cbor                                 cbor;
application/cccex                                c3ex;
application/ccmp+xml                             ccmp;
application/ccxml+xml                            ccxml;
application/CDFX+XML                             cdfx;
application/cdmi-capability                      cdmia;
application/cdmi-container                       cdmic;
application/cdmi-domain                          cdmid;
application/cdmi-object                          cdmio;
application/cdmi-queue                           cdmiq;
application/CEA                                  cea;
application/cellml+xml                           cellml cml;
application/clue_info+xml                        clue;
application/cms                                  cmsc;
application/cpl+xml                              cpl;
application/csrattrs                             csrattrs;
application/dash+xml                             mpd;
application/dashdelta                            mpdd;
application/davmount+xml                         davmount;
application/DCD                                  dcd;
application/dicom                                dcm;
application/DII                                  dii;
application/DIT                                  dit;
application/dskpp+xml                            xmls;
application/dssc+der                             dssc;
application/dssc+xml                             xdssc;
application/dvcs                                 dvc;
application/ecmascript                           es;
application/efi                                  efi;
application/emma+xml                             emma;
application/emotionml+xml                        emotionml;
```

```
[ec2-user@ip-10-0-10-86 ~]$ cat /etc/ssl/certs/selfsigned.crt
-----BEGIN CERTIFICATE-----
MIIDPTCCAiWgAwIBAgIUIyJva3d8ODAAS1ALFjuBVE3OsocwDQYJKoZIhvcNAQEL
BQAwFzEVMBMGA1UEAwwMNTEuMjAuMTM3Ljk3MB4XDTI1MTIyOTE3MjAyM1oXDTI2
MTIyOTE3MjAyM1owFzEVMBMGA1UEAwwMNTEuMjAuMTM3Ljk3MIIBIjANBgkqhkiG
9w0BAQEFAAOCAQ8AMIIBCgKCAQEAtXrZodCrPKOiFmHcDgMZzz2QW/Zhel7pm9bK
W+y9U00MgazZDfARwgTl4dpgKSiTmWFv9+gipQeZ/XbumJov/9NFdW75Y1+MIZ8p
PUvo4XKF+dTaIESgNtFhs3Blo8NTLNzpSv7YfOb3P751hUR0jTwuESnAwmsPHr/C
TSNTGlwy6HuHBfLtuDhNw6njWQ5N4x02JSh5HLj+UewPJXM63RC46jCKW8vY5dqz
8NeaQUPphAgqHSXFonZEguqj68fqRKUMhedMlzbeyKIxYtiXoPT1R56IFOBKNumX
7ps74XyHkUlqptAQhNrn9qdPzHwcJcJJKnuCOSqHzJn3ZSsNQQIDAQABo4GAMH4w
HQYDVR0OBBYEFOWqQzYmvY4hRaN5sQwIgxTfG0MTMB8GA1UdIwQYMBaAFOWqQzYm
vY4hRaN5sQwIgxTfG0MTMA8GA1UdEQQIMAaHBDMUiWEwCQYDVR0TBAIwADALBgNV
HQ8EBAMCBaAwEwYDVR0lBAwwCgYIKwYBBQUHAwEwDQYJKoZIhvcNAQELBQADggEB
ABqGAYN47iAe5gQUMOQ7LwqzJBSW1PY/6hHU+y24P0TC8/+7Ss00p82xwBWgat8v
8ahsc0JTp3r/lz+hyftSlXJ3oI0b4Uh7DwnA7xW+LDjFZEUEBE19wHVLh7iXcHT/
fqe/5yQ38i6ytMahDq87bgSiwWCVPxuB4QgElL3mrwLrVWuBiPUaNXL4MFS5sbGG
pxKkUx8mxdxsk2pIkRWtFgluSgcMyrfSc7RpZWpik9b79JxonIFsiMjrzh38MHfA
Y89cnIg0dX8zCg9OHTzaqxCWW2sngwUHxfEhr302+90LZsrGgJZqH/mWU2C5qKlj
gI6Bd/ISt4riAYNcDJ7cBe4=
-----END CERTIFICATE-----
```

```
[ec2-user@ip-10-0-10-86 ~]$ cat /etc/ssl/private/selfsigned.key
cat: /etc/ssl/private/selfsigned.key: Permission denied
```

It works!

Task 8 — Configure Nginx as load balancer

```
module "myapp-web-2" {
  source             = "./modules/webserver"
  env_prefix         = var.env_prefix
  instance_type      = var.instance_type
  availability_zone  = var.availability_zone
  public_key         = var.public_key
  my_ip              = local.my_ip
  vpc_id             = aws_vpc.myapp_vpc.id
  subnet_id          = module.myapp-subnet.subnet.id
  script_path        = "./apache.sh"
  instance_suffix    = "2"
}
```

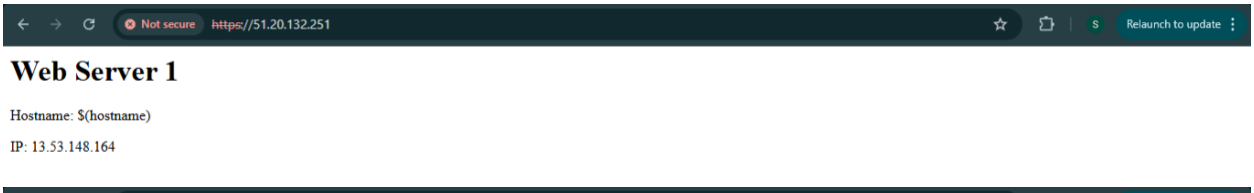
```
output "webserver_public_ip" {
  value = module.myapp-webserver.aws_instance.public_ip
}
output "aws_web-1_public_ip" {
  value = module.myapp-web-1.aws_instance.public_ip
}
output "aws_web-2_public_ip" {
  value = module.myapp-web-2.aws_instance.public_ip
}
```

```
Plan: 5 to add, 2 to change, 2 to destroy.

Changes to Outputs:
  ~ aws_web-1_public_ip = "51.20.78.189" -> (known after apply)
  + aws_web-2_public_ip = (known after apply)
  ~ webserver_public_ip = "13.61.154.249" -> (known after apply)
module.myapp-webserver.aws_instance.myapp-server: Destroying... [id=i-04910ee5f7d0cb0e7]
module.myapp-web-1.aws_instance.myapp-server: Destroying... [id=i-0351f5e8771e2a17d]
module.myapp-web-2.aws_key_pair.ssh-key: Creating...
module.myapp-web-2.aws_security_group.web_sg: Creating...
module.myapp-web-2.aws_key_pair.ssh-key: Creation complete after 1s [id=dev-serverkey-2]
module.myapp-web-2.aws_security_group.web_sg: Creation complete after 4s [id=sg-0613c066ed93b349a]
module.myapp-web-2.aws_instance.myapp-server: Creating...
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-04910ee5f7d0cb0e7, 00m10s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0351f5e8771e2a17d, 00m10s elapsed]
module.myapp-web-2.aws_instance.myapp-server: Still creating... [00m10s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-04910ee5f7d0cb0e7, 00m20s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0351f5e8771e2a17d, 00m20s elapsed]
module.myapp-web-2.aws_instance.myapp-server: Still creating... [00m20s elapsed]
module.myapp-web-2.aws_instance.myapp-server: Creation complete after 20s [id=i-0a4f5809a2ff1b816]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-04910ee5f7d0cb0e7, 00m30s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0351f5e8771e2a17d, 00m30s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-04910ee5f7d0cb0e7, 00m40s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0351f5e8771e2a17d, 00m40s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-04910ee5f7d0cb0e7, 00m50s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0351f5e8771e2a17d, 00m50s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Destruction complete after 53s
module.myapp-web-1.aws_instance.myapp-server: Destruction complete after 53s
module.myapp-webserver.aws_security_group.web_sg: Modifying... [id=sg-06b968f76a76f81ee]
module.myapp-web-1.aws_security_group.web_sg: Modifying... [id=sg-02587de98972b3d97]
module.myapp-web-1.aws_security_group.web_sg: Modifications complete after 2s [id=sg-02587de98972b3d97]
module.myapp-webserver.aws_security_group.web_sg: Modifications complete after 2s [id=sg-06b968f76a76f81ee]
module.myapp-web-1.aws_instance.myapp-server: Creating...
module.myapp-webserver.aws_instance.myapp-server: Creating...
module.myapp-web-1.aws_instance.myapp-server: Still creating... [00m10s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still creating... [00m10s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Creation complete after 14s [id=i-0f0ff2dd9cb2b3ccd]
module.myapp-web-1.aws_instance.myapp-server: Creation complete after 14s [id=i-0da15e7f8a55bf0dd]

Apply complete! Resources: 5 added, 2 changed, 2 destroyed.
```

```
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ terraform output
aws_web-1_public_ip = "13.53.148.164"
aws_web-2_public_ip = "16.170.172.99"
webserver_public_ip = "51.20.132.251"
```

```
user nginx;
worker_processes auto;
error_log /var/log/nginx/error.log notice;
pid /run/nginx.pid;

events {
    worker_connections 1024;
}

http {
    log_format main '              -              [            ] "
                    '                        "              " '
                    '"                " "                      "';

    access_log /var/log/nginx/access.log main;
    sendfile on;
    tcp_nopush on;
    keepalive_timeout 65;
    types_hash_max_size 4096;

    include /etc/nginx/mime.types;
    default_type application/octet-stream;

    upstream backend_servers {
            server 13.53.148.164:80;
                server 16.170.172.99:80;
    }

    server {
        listen 443 ssl;
        server_name 51.20.132.251;
        ssl_certificate /etc/ssl/certs/selfsigned.crt;
        ssl_certificate_key /etc/ssl/private/selfsigned.key;

        location / {
                proxy_pass http://backend_servers;
        }

    }

    server {
        listen 80;
        server_name _;
        return 301 https://$host$request_uri;
    }
}
```

```
[ec2-user@ip-10-0-10-225 ~]$ sudo nginx -t
nginx: the configuration file /etc/nginx/nginx.conf syntax is ok
nginx: configuration file /etc/nginx/nginx.conf test is successful
[ec2-user@ip-10-0-10-225 ~]$ sudo systemctl restart nginx
[ec2-user@ip-10-0-10-225 ~]$
```



Task 9 — Configure high availability with backup servers

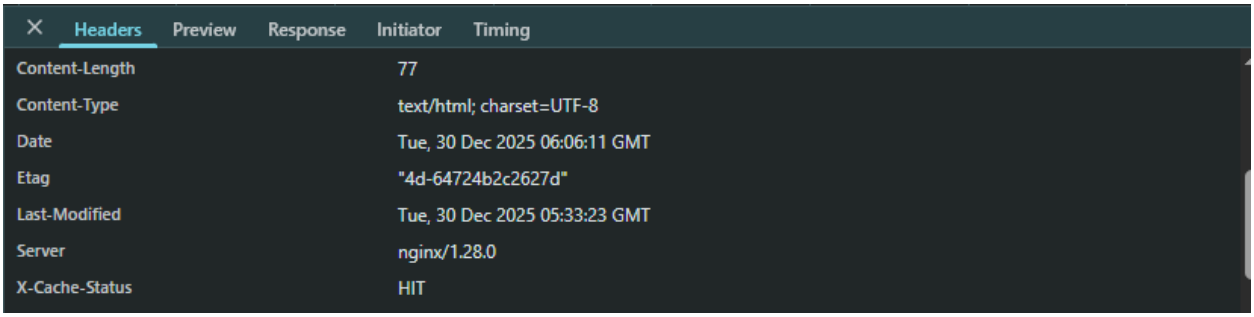
```
user nginx;
worker_processes auto;
error_log /var/log/nginx/error.log notice;
pid /run/nginx.pid;

events {
    worker_connections 1024;
}

http {
    log_format main '              -               [            ] "
                    '                        "             " '
                    '"                  " "                        "';

    access_log /var/log/nginx/access.log main;
    sendfile on;
    tcp_nopush on;
    keepalive_timeout 65;
    types_hash_max_size 4096;

    include /etc/nginx/mime.types;
    default_type application/octet-stream;

    upstream backend_servers {
                server 13.53.148.164:80;
                    server 16.170.172.99:80 backup;
    }

    server {
        listen 443 ssl;
        server_name 51.20.132.251;
        ssl_certificate /etc/ssl/certs/selfsigned.crt;
        ssl_certificate_key /etc/ssl/private/selfsigned.key;

        location / {
                    proxy_pass http://backend_servers;
        }

    }

    server {
        listen 80;
        server_name _;
        return 301 https://$host$request_uri;
    }
}
```

```
user nginx;
worker_processes auto;
error_log /var/log/nginx/error.log notice;
pid /run/nginx.pid;

events {
    worker_connections 1024;
}

http {
    log_format main '              -             [            ] "
                    '                      "             " '
                    '"                  " "                  "';

    access_log /var/log/nginx/access.log main;
    sendfile on;
    tcp_nopush on;
    keepalive_timeout 65;
    types_hash_max_size 4096;

    include /etc/nginx/mime.types;
    default_type application/octet-stream;

    upstream backend_servers {
                server 13.53.148.164:80 backup;
                    server 16.170.172.99:80;
    }

    server {
        listen 443 ssl;
        server_name 51.20.132.251;
        ssl_certificate /etc/ssl/certs/selfsigned.crt;
        ssl_certificate_key /etc/ssl/private/selfsigned.key;

        location / {
                    proxy_pass http://backend_servers;
        }

    }

    server {
        listen 80;
        server_name _;
        return 301 https://$host$request_uri;
    }
}
```

Task 10 — Enable Nginx caching

```
user nginx;
worker_processes auto;
error_log /var/log/nginx/error.log notice;
pid /run/nginx.pid;

events {
    worker_connections 1024;
}

http {
    proxy_cache_path /var/cache/nginx
                levels=1:2
                    keys_zone=my_cache:10m
                        inactive=60m
                            max_size=1g;
    log_format main '           -           [          ] "        "
                    '                 "           " '
                    '"           " "                 "';

    access_log /var/log/nginx/access.log main;
    sendfile on;
    tcp_nopush on;
    keepalive_timeout 65;
    types_hash_max_size 4096;

    include /etc/nginx/mime.types;
    default_type application/octet-stream;

    upstream backend_servers {
                server 13.53.148.164:80 backup;
                    server 16.170.172.99:80;
    }

    server {
        listen 443 ssl;
        server_name 51.20.132.251;
        ssl_certificate /etc/ssl/certs/selfsigned.crt;
        ssl_certificate_key /etc/ssl/private/selfsigned.key;

        location / {
                    proxy_pass http://backend_servers;
        }

    }

    server {
        listen 80;
        server_name _;
        return 301 https://$host$request_uri;
```

```
[ec2-user@ip-10-0-10-225 ~]$ sudo nginx -t
nginx: the configuration file /etc/nginx/nginx.conf syntax is ok
nginx: configuration file /etc/nginx/nginx.conf test is successful
[ec2-user@ip-10-0-10-225 ~]$ sudo systemctl restart nginx
```



Cleanup

```
[ec2-user@ip-10-0-10-225 ~]$ exit
logout
Connection to 51.20.132.251 closed.
```

```
module.myapp-web-2.aws_instance.myapp-server: Still destroying... [id=i-0a4f5809a2ff1b816, 00m10s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-0f0ff2dd9cb2b3ccd, 00m10s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Still destroying... [id=igw-053bc13d2f00459dc, 00m10s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0da15e7f8a55bf0dd, 00m20s elapsed]
module.myapp-web-2.aws_instance.myapp-server: Still destroying... [id=i-0a4f5809a2ff1b816, 00m20s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-0f0ff2dd9cb2b3ccd, 00m20s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Still destroying... [id=igw-053bc13d2f00459dc, 00m20s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0da15e7f8a55bf0dd, 00m30s elapsed]
module.myapp-web-2.aws_instance.myapp-server: Still destroying... [id=i-0a4f5809a2ff1b816, 00m30s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Still destroying... [id=i-0f0ff2dd9cb2b3ccd, 00m30s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Still destroying... [id=igw-053bc13d2f00459dc, 00m30s elapsed]
module.myapp-webserver.aws_instance.myapp-server: Destruction complete after 31s
module.myapp-webserver.aws_key_pair.ssh-key: Destroying... [id=dev-serverkey-0]
module.myapp-webserver.aws_security_group.web_sg: Destroying... [id=sg-06b968f76a76f81ee]
module.myapp-webserver.aws_key_pair.ssh-key: Destruction complete after 1s
module.myapp-webserver.aws_security_group.web_sg: Destruction complete after 1s
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0da15e7f8a55bf0dd, 00m40s elapsed]
module.myapp-web-2.aws_instance.myapp-server: Still destroying... [id=i-0a4f5809a2ff1b816, 00m40s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Still destroying... [id=igw-053bc13d2f00459dc, 00m40s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0da15e7f8a55bf0dd, 00m50s elapsed]
module.myapp-web-2.aws_instance.myapp-server: Still destroying... [id=i-0a4f5809a2ff1b816, 00m50s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Still destroying... [id=igw-053bc13d2f00459dc, 00m50s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0da15e7f8a55bf0dd, 01m00s elapsed]
module.myapp-web-2.aws_instance.myapp-server: Still destroying... [id=i-0a4f5809a2ff1b816, 01m00s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Still destroying... [id=igw-053bc13d2f00459dc, 01m00s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0da15e7f8a55bf0dd, 01m10s elapsed]
module.myapp-web-2.aws_instance.myapp-server: Still destroying... [id=i-0a4f5809a2ff1b816, 01m10s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Still destroying... [id=igw-053bc13d2f00459dc, 01m10s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0da15e7f8a55bf0dd, 01m20s elapsed]
module.myapp-web-2.aws_instance.myapp-server: Still destroying... [id=i-0a4f5809a2ff1b816, 01m20s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Still destroying... [id=igw-053bc13d2f00459dc, 01m20s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Destruction complete after 1m20s
module.myapp-web-2.aws_instance.myapp-server: Destruction complete after 1m23s
module.myapp-web-2.aws_key_pair.ssh-key: Destroying... [id=dev-serverkey-2]
module.myapp-web-2.aws_security_group.web_sg: Destroying... [id=sg-0613c066ed93b349a]
module.myapp-web-2.aws_key_pair.ssh-key: Destruction complete after 0s
module.myapp-web-2.aws_security_group.web_sg: Destruction complete after 1s
module.myapp-web-1.aws_instance.myapp-server: Still destroying... [id=i-0da15e7f8a55bf0dd, 01m30s elapsed]
module.myapp-web-1.aws_instance.myapp-server: Destruction complete after 1m33s
module.myapp-web-1.aws_key_pair.ssh-key: Destroying... [id=dev-serverkey-1]
module.myapp-subnet.aws_subnet.myapp_subnet_1: Destroying... [id=subnet-0648eb38878d9e13f]
module.myapp-web-1.aws_security_group.web_sg: Destroying... [id=sg-02587de98972b3d97]
module.myapp-web-1.aws_key_pair.ssh-key: Destruction complete after 1s
module.myapp-subnet.aws_subnet.myapp_subnet_1: Destruction complete after 1s
module.myapp-web-1.aws_security_group.web_sg: Destruction complete after 2s
aws_vpc.myapp_vpc: Destroying... [id=vpc-08b4258c268996cf7]
aws_vpc.myapp_vpc: Destruction complete after 0s

Destroy complete! Resources: 13 destroyed.
```

```
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ cat terraform.tfstate
{
  "version": 4,
  "terraform_version": "1.14.3",
  "serial": 164,
  "lineage": "31a0e3af-8632-b9b5-6b6f-342cb262eb39",
  "outputs": {},
  "resources": [],
  "check_results": null
}
```

```
@SeratFatima00 /workspaces/CC_SeeratFatima_060_Lab12 (main) $ ls -la
total 61876
drwxrwxrwx+ 6 codespace root          4096 Dec 30 06:21 .
drwxr-xrwx+ 5 codespace root          4096 Dec 29 11:33 ..
drwxrwxrwx+ 8 codespace root          4096 Dec 29 11:33 .git
drwxrwxrwx+ 4 codespace codespace     4096 Dec 29 14:21 .terraform
-rw-r--r--  1 codespace codespace     2422 Dec 29 14:21 .terraform.lock.hcl
-rw-rw-rw-  1 codespace root            20 Dec 29 11:33 README.md
-rw-rw-rw-  1 codespace codespace      873 Dec 29 19:12 apache.sh
drwxr-xr-x+ 3 codespace codespace     4096 Dec 26 19:16 aws
-rw-rw-rw-  1 codespace codespace 63249975 Dec 29 12:40 awscliv2.zip
-rwxrwxr-x  1 codespace codespace     2430 Dec 29 16:46 entry-script.sh
-rw-rw-r--  1 codespace codespace       67 Dec 29 14:21 locals.tf
-rw-rw-r--  1 codespace codespace     1760 Dec 30 04:48 main.tf
drwxrwxrwx+ 4 codespace codespace     4096 Dec 29 15:59 modules
-rw-rw-r--  1 codespace codespace        0 Dec 29 14:21 outputs.
-rw-rw-r--  1 codespace codespace      260 Dec 30 04:49 outputs.tf
-rw-rw-r--  1 codespace codespace      183 Dec 30 06:21 terraform.tfstate
-rw-rw-r--  1 codespace codespace    42548 Dec 30 06:19 terraform.tfstate.backup
-rw-rw-r--  1 codespace codespace      245 Dec 29 14:21 terraform.tfvars
-rw-rw-r--  1 codespace codespace        0 Dec 29 14:21 tf
-rw-rw-r--  1 codespace codespace      198 Dec 29 14:21 variables.tf
```