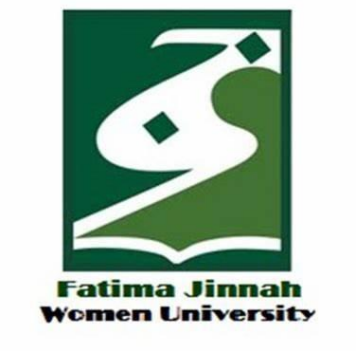
CLOUD COMPUTING



SUBMITTED TO

SIR WAQAS SALEEM & SIR SHOAIB

SUBMITTED BY

HAMNA MAHMOOD

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BSE V-A

Lab 11 – GH CLI Codespaces + AWS + Terraform: Variables, Collections, Sensitivity & EC2 Provisioning

Task 0 Lab Setup (Codespace & GH CLI)

- **taskA_codespace_create_and_list.png**

```
C:\Users\ABC\Downloads\gh_2.83.2_windows_amd64\bin>gh codespace list
NAME                              DISPLAY NAME      REPOSITORY                     BRANCH  STATE     CREATED AT
studious-journey-q7x57x9ww649...  studious journey  HamnaMahmood20/CC-Hamna-Mahmo...  main*   Shutdown  about 6 days ago
```

- **taskA_codespace_ssh_connected.png**

```
C:\Users\ABC\Downloads\gh_2.83.2_windows_amd64\bin>gh codespace ssh -c studious-journey-q7x57x9ww649hx57g
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: Tue Jan  6 17:07:52 2026 from ::1
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: Tue Jan  6 17:07:52 2026 from ::1
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $
```

Task 1- Provider & Basic variable

- **task1_touch_main_tf.png**

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ touch main.tf
```

- **task1_main_tf_provider.png**

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

- **task1_terraform_init.png**

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform init
Initializing the backend...
Initializing provider plugins...
- Reusing previous version of hashicorp/aws from the dependency lock file
- Using previously-installed hashicorp/aws v6.27.0

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.
```

- **task1_variable_and_output_added.png**

```
variable "subnet_cidr_block" {
  type = string
}

output "subnet_cidr_block_output" {
  value = var.subnet_cidr_block
}
```

- **task1_apply_prompt_for_var.png**

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform apply -auto-approve
subnet_cidr_blockvar.subnet_cidr_block
  Enter a value:
```

- **task1_apply_with_default.png**

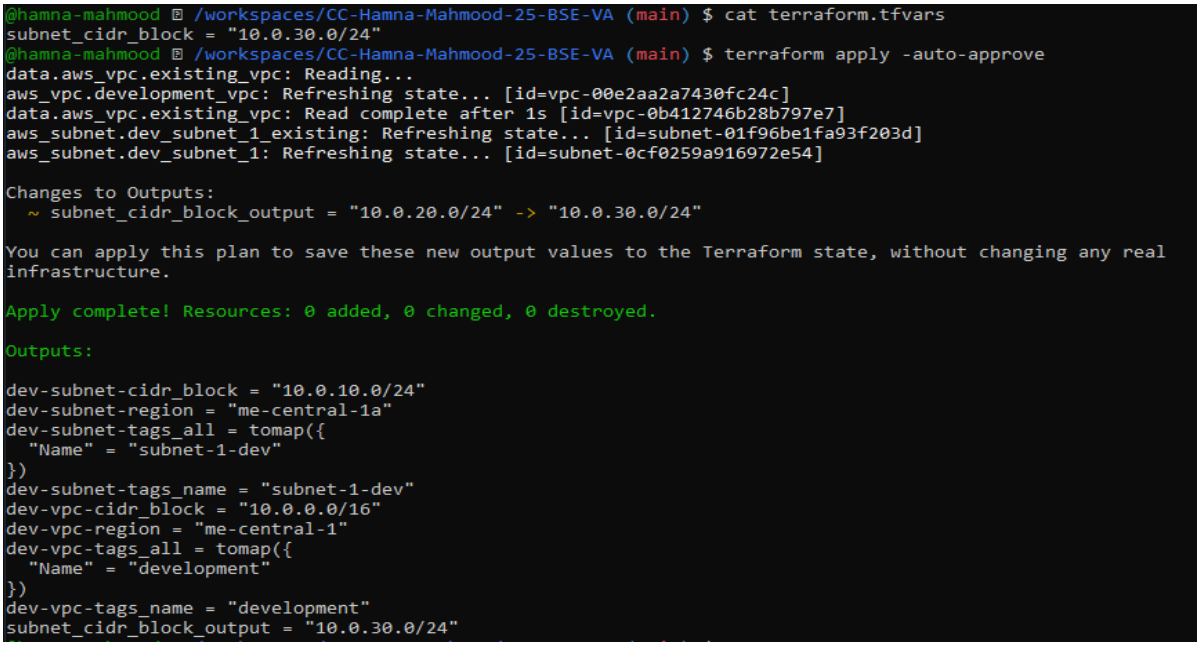
```
variable "subnet_cidr_block" {
  type = string
default= "10.0.0.0/24"
}
```

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

Outputs:

dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
subnet_cidr_block_output = "10.0.0.0/24"
```

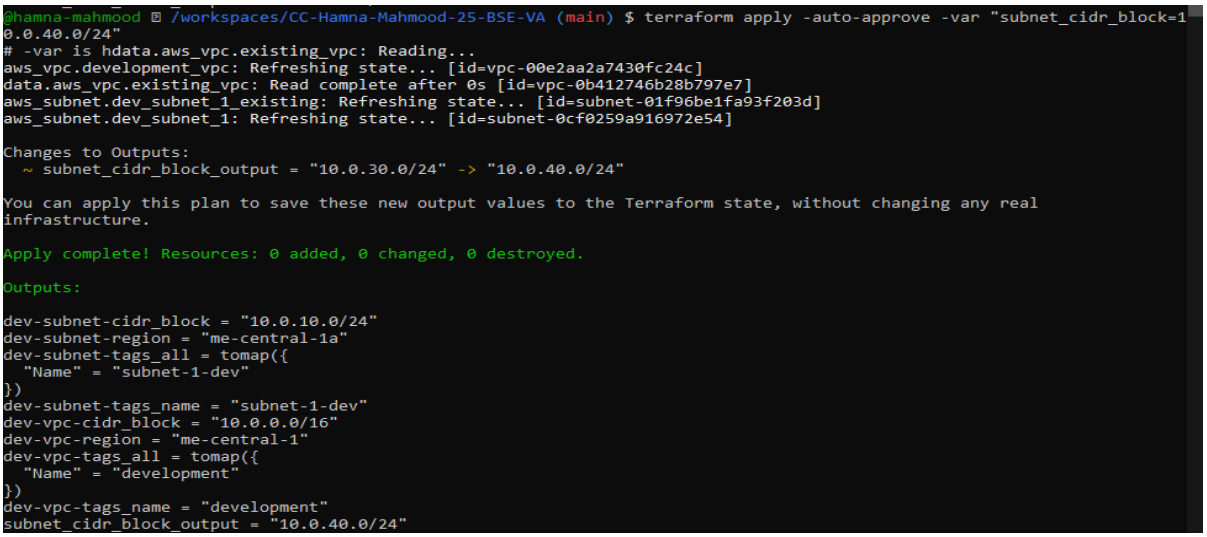
- **task1_env_var_set_and_apply.png**

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ export TF_VAR_subnet_cidr_block=10.0.20.0/24
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform apply -auto-approve
data.aws_vpc.existing_vpc: Reading...
aws_vpc.development_vpc: Refreshing state... [id=vpc-00e2aa2a7430fc24c]
data.aws_vpc.existing_vpc: Read complete after 0s [id=vpc-0b412746b28b797e7]
aws_subnet.dev_subnet_1_existing: Refreshing state... [id=subnet-01f96be1fa93f203d]
aws_subnet.dev_subnet_1: Refreshing state... [id=subnet-0cf0259a916972e54]

Changes to Outputs:
  ~ subnet_cidr_block_output = "10.0.0.0/24" -> "10.0.20.0/24"

You can apply this plan to save these new output values to the Terraform state, without changing any real
infrastructure.

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

Outputs:

dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
subnet_cidr_block_output = "10.0.20.0/24"
```

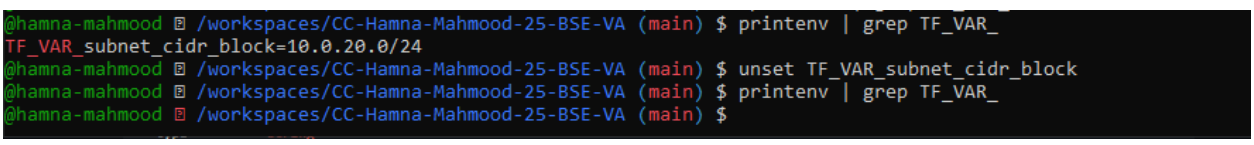
- **task1_terraform_tfvars_and_apply.png**



- **task1_var_override_with_dash_var.png**

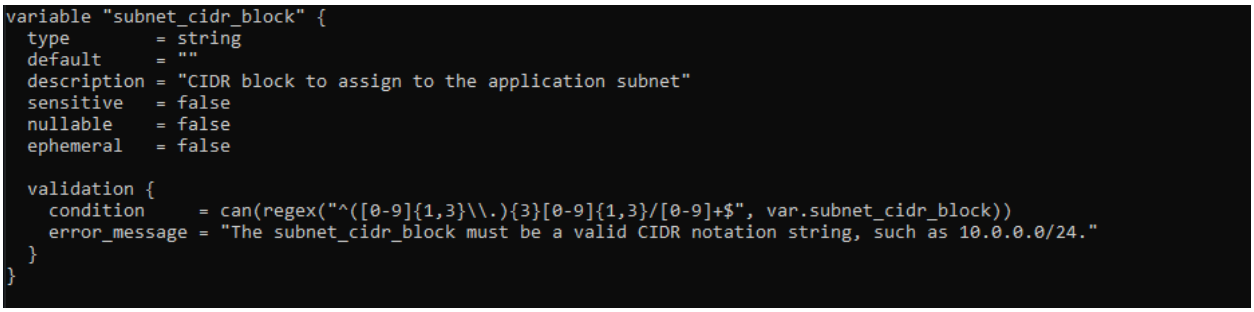


- **task1_printenv_tf_var_and_unset.png**



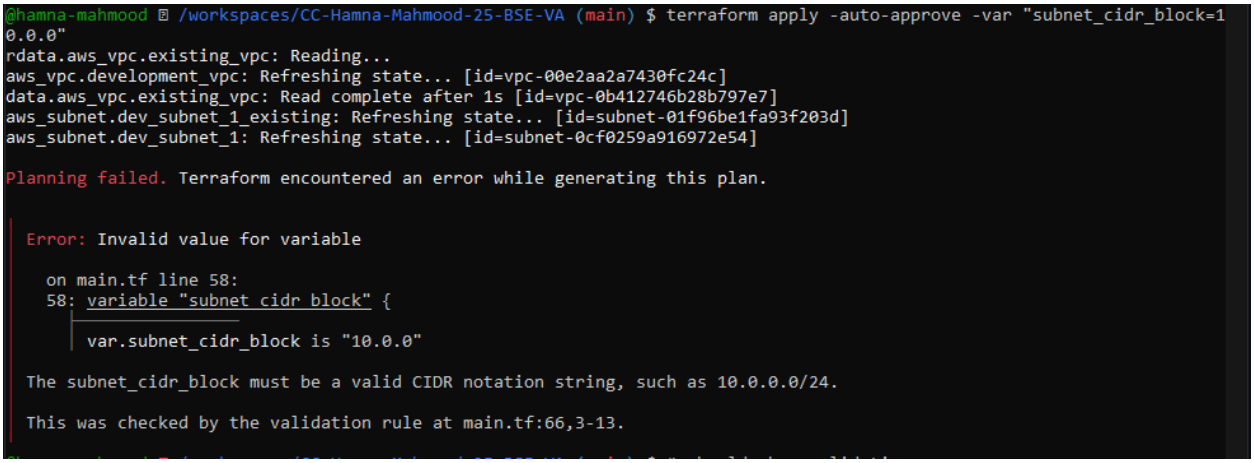
Task 2- Variable validation & sensitive/ephemeral variables

- **task2_subnet_variable_with_validation.png**



```
variable "subnet_cidr_block" {
  type        = string
  default     = ""
  description = "CIDR block to assign to the application subnet"
  sensitive   = false
  nullable    = false
  ephemeral   = false

  validation {
    condition     = can(regex("^([0-9]{1,3}\\.){3}[0-9]{1,3}/[0-9]+$", var.subnet_cidr_block))
    error_message = "The subnet_cidr_block must be a valid CIDR notation string, such as 10.0.0.0/24."
  }
}
```

- **task2_subnet_validation_error.png**



```
@hamna-mahmood /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform apply -auto-approve -var "subnet_cidr_block=1
0.0.0"
rdata.aws_vpc.existing_vpc: Reading...
aws_vpc.development_vpc: Refreshing state... [id=vpc-00e2aa2a7430fc24c]
data.aws_vpc.existing_vpc: Read complete after 1s [id=vpc-0b412746b28b797e7]
aws_subnet.dev_subnet_1_existing: Refreshing state... [id=subnet-01f96be1fa93f203d]
aws_subnet.dev_subnet_1: Refreshing state... [id=subnet-0cf0259a916972e54]

Planning failed. Terraform encountered an error while generating this plan.


  Error: Invalid value for variable

    on main.tf line 58:
    58: variable "subnet_cidr_block" {
        ├────────────────
        │ var.subnet_cidr_block is "10.0.0"

  The subnet_cidr_block must be a valid CIDR notation string, such as 10.0.0.0/24.

  This was checked by the validation rule at main.tf:66,3-13.
```

- **task2_api_token_variable_added.png**

```
variable "api_session_token" {
  type        = string
  default     = ""
  description = "Short-lived API session token used during apply operations"
  sensitive   = true
  nullable    = false
  ephemeral   = false

  validation {
    condition     = can(regex("^[A-Za-z0-9-_]{20,}$", var.api_session_token))
    error_message = "The API session token must be at least 20 characters and contain only letters, numbers, hyphens, or
 underscores."
  }
}

output "api_session_token_output" {
  value     = var.api_session_token
  sensitive = true
}
```

- **task2_api_token_apply_sensitive.png**

```
@hamna-mahmood /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform apply -auto-approve -var "api_session_token=m
y_API_session_Token"
te for outputsdata.aws_vpc.existing_vpc: Reading...
aws_vpc.development_vpc: Refreshing state... [id=vpc-00e2aa2a7430fc24c]
data.aws_vpc.existing_vpc: Read complete after 0s [id=vpc-0b412746b28b797e7]
aws_subnet.dev_subnet_1_existing: Refreshing state... [id=subnet-01f96be1fa93f203d]
aws_subnet.dev_subnet_1: Refreshing state... [id=subnet-0cf0259a916972e54]

Changes to Outputs:
  + api_session_token_output = (sensitive value)
  ~ subnet_cidr_block_output = "10.0.40.0/24" -> "10.0.30.0/24"

You can apply this plan to save these new output values to the Terraform state, without changing any real
infrastructure.

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

Outputs:

api_session_token_output = <sensitive>
dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
subnet_cidr_block_output = "10.0.30.0/24"
```

- **task2_check_terraform_state_api_token.png**

```
"api_session_token_output": {
  "value": "my_API_session_Token",
  "type": "string",
  "sensitive": true
},
```

- **task2_api_token_ephemeral_error.png**

```
variable "api_session_token"
ephemeral=true
```

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

Error: Error acquiring the state lock

Error message: 2 problems:

- Unsupported state file format: The state file could not be parsed as JSON: syntax error at byte offset 264.
- Unsupported state file format: The state file does not have a "version" attribute, which is required to identify
the format version.

Terraform acquires a state lock to protect the state from being written
by multiple users at the same time. Please resolve the issue above and try
again. For most commands, you can disable locking with the "-lock=false"
flag, but this is not recommended.
```

- **task2_api_token_default_apply.png**

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform apply -auto-approve
data.aws_vpc.existing_vpc: Reading...
aws_vpc.development_vpc: Refreshing state... [id=vpc-00e2aa2a7430fc24c]
data.aws_vpc.existing_vpc: Read complete after 1s [id=vpc-0b412746b28b797e7]
aws_subnet.dev_subnet_1_existing: Refreshing state... [id=subnet-01f96be1fa93f203d]
aws_subnet.dev_subnet_1: Refreshing state... [id=subnet-0cf0259a916972e54]

Changes to Outputs:
  + api_session_token_output = (sensitive value)

You can apply this plan to save these new output values to the Terraform state, without changing any real
infrastructure.

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

Outputs:

api_session_token_output = <sensitive>
dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
subnet_cidr_block_output = "10.0.30.0/24"
```

Task3- Project level variables, locals & outputs

- **task3_variables_added.png**

```
variable "environment" {}
variable "project_name" {}
variable "primary_subnet_id" {}
variable "subnet_count" {}
variable "monitoring" {}
```

- **task3_terraform_tfvars_populated.png**

```
environment="dev"
project_name="lab_work"
primary_subnet_id="subnet-01f96be1fa93f203d "
subnet_count=3
monitoring=true
~
~
```

- **task3_locals_tf_created.png**

```
locals {
  resource_name = "${var.project_name}-${var.environment}"
  primary_public_subnet = var.primary_subnet_id
  subnet_count          = var.subnet_count
  is_production         = var.environment == "prod"
  monitoring_enabled    = var.monitoring || local.is_production
}
~
~
```

- **task3_outputs_apply.png**

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

Outputs:

api_session_token_output = <sensitive>
dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
is_production = false
monitoring_enabled = true
primary_public_subnet = "subnet-01f96be1fa93f203d "
resource_name = "lab_work-dev"
subnet_cidr_block_output = "10.0.30.0/24"
subnet_count = 3
```

Task 4 — Maps and Objects

- **task4_tags_variable_added.png**

```
variable "tags" {
  type = map(string)
}

output "tags" {
  value = var.tags
}
```

- **task4_tags_output.png**

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

Outputs:

api_session_token_output = <sensitive>
dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
is_production = false
monitoring_enabled = true
primary_public_subnet = "subnet-01f96be1fa93f203d "
resource_name = "lab_work-dev"
subnet_cidr_block_output = "10.0.30.0/24"
subnet_count = 3
tags = tomap({
  "Environment" = "dev"
  "Owner" = "platform-team"
  "Project" = "sample-app"
})
```

- **task4_server_config_output.png**

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

Outputs:

api_session_token_output = <sensitive>
dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
is_production = false
monitoring_enabled = true
primary_public_subnet = "subnet-01f96be1fa93f203d "
resource_name = "lab_work-dev"
server_config = {
  "backup_enabled" = false
  "instance_type" = "t3.micro"
  "monitoring" = true
  "name" = "web-server"
  "storage_gb" = 20
}
subnet_cidr_block_output = "10.0.30.0/24"
subnet_count = 3
tags = tomap({
  "Environment" = "dev"
  "Owner" = "platform-team"
  "Project" = "sample-app"
})
```

Task 5- Collections: list, tuple, set & mutation via locals

- **task5_collections_defined.png**

```
variable "server_names" {
  type = list(string)
  default = ["web-2", "web-1", "web-2"]
}

variable "server_metadata" {
  type = tuple([string, number, bool])
  default = ["web-1", 4, true]
}

variable "availability_zones" {
  type = set(string)
  default = ["me-central-1b", "me-central-1a", "me-central-1b"]
}

output "compare_collections" {
  value = {
    list_example  = var.server_names
    tuple_example = var.server_metadata
    set_example   = var.availability_zones
  }
}
```

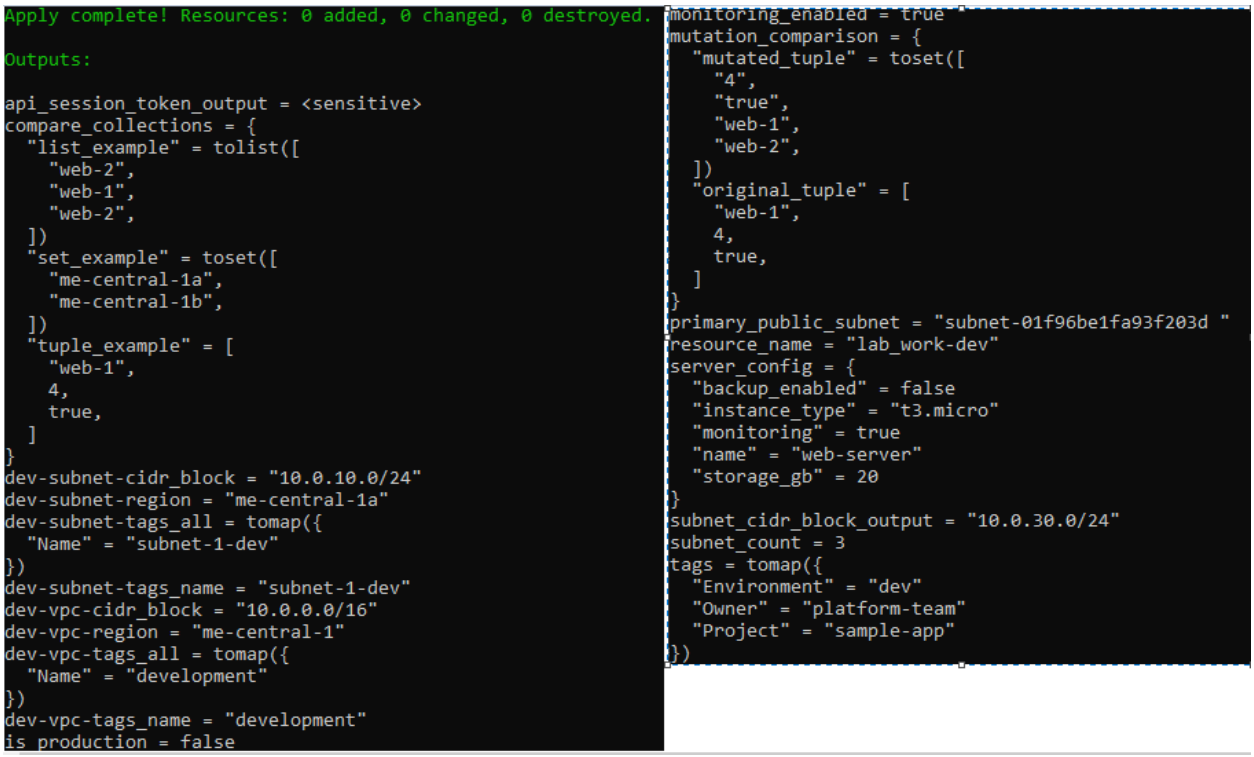
- **task5_compare_collections.png**

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

Outputs:

api_session_token_output = <sensitive>
compare_collections = {
  "list_example" = tolist([
    "web-2",
    "web-1",
    "web-2",
  ])
  "set_example" = toset([
    "me-central-1a",
    "me-central-1b",
  ])
  "tuple_example" = [
    "web-1",
    4,
    true,
  ]
}
dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
is_production = false
monitoring_enabled = true
primary_public_subnet = "subnet-01f96be1fa93f203d "
resource_name = "lab_work-dev"
server_config = {
  "backup_enabled" = false
  "instance_type" = "t3.micro"
```

- **task5_locals_mutations.png**

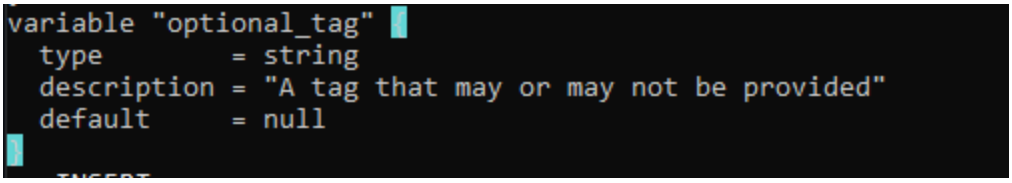
```
locals {
  mutated_list  = setunion(var.server_names, ["web-3"])
  mutated_tuple = setunion(var.server_metadata, ["web-2"])
  mutated_set   = setunion(var.availability_zones, ["me-central-1c"])
}
~
~
~
```

- **task5_mutation_comparison.png**

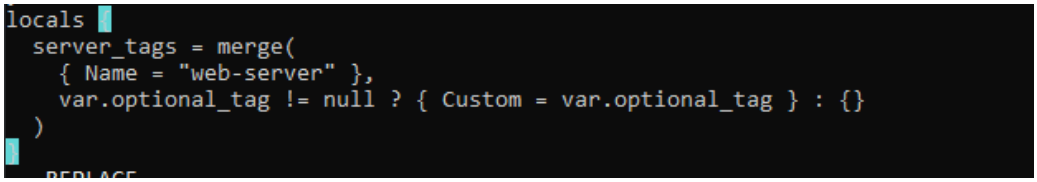


Task 6 — Null, any type & dynamic values

- **task6_optional_tag_variable.png**



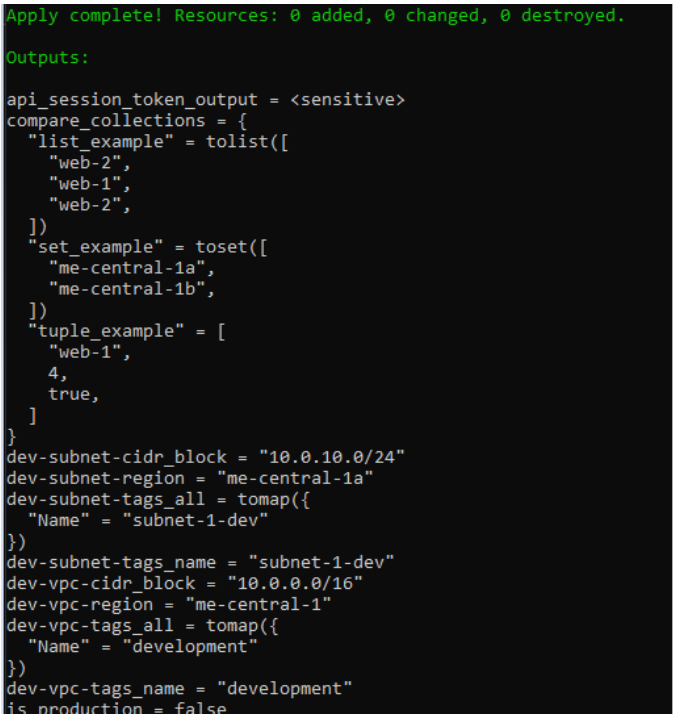
- **task6_locals_merge.png**



- **task6_optional_tag_no_value.png**

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

Outputs:

api_session_token_output = <sensitive>
compare_collections = {
  "list_example" = tolist([
    "web-2",
    "web-1",
    "web-2",
  ])
  "set_example" = toset([
    "me-central-1a",
    "me-central-1b",
  ])
  "tuple_example" = [
    "web-1",
    4,
    true,
  ]
}
dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
is_production = false
```

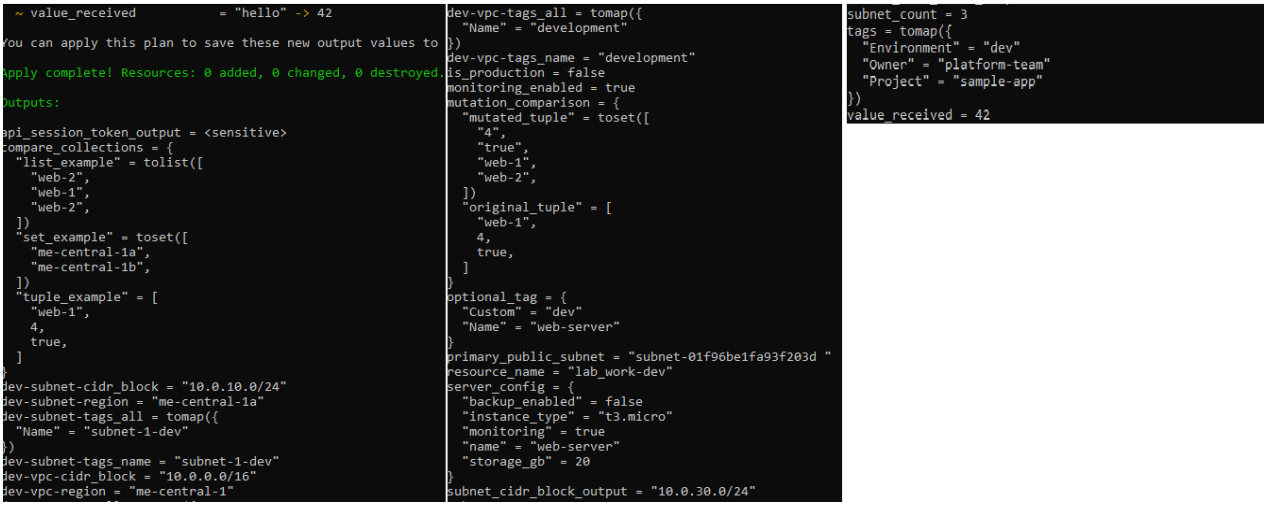
- **task6_optional_tag_with_value.png**



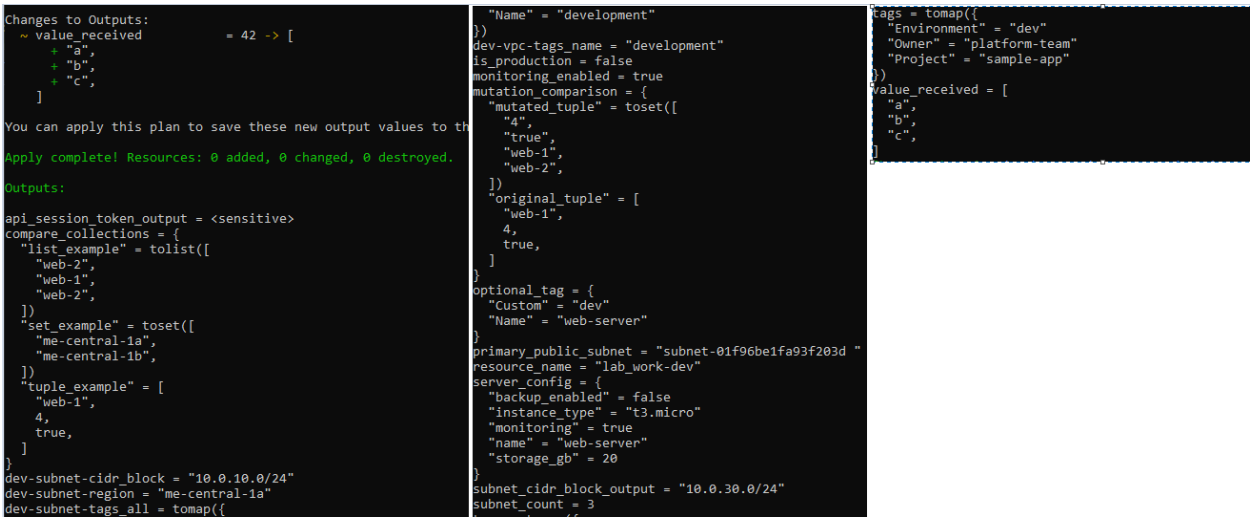
```
Apply complete! Resources: 0 added, 0 changed, 0 destroyed.

Outputs:

api_session_token_output = <sensitive>
compare_collections = {
  "list_example" = tolist([
    "web-2",
    "web-1",
    "web-2",
  ])
  "set_example" = toset([
    "me-central-1a",
    "me-central-1b",
  ])
  "tuple_example" = [
    "web-1",
    4,
    true,
  ]
}
dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
is_production = false
monitoring_enabled = true
mutation_comparison = {
  "mutated_tuple" = toset([
    "4",
    "true",
    "web-1",
    "web-2",
  ])
  "original_tuple" = [
    "web-1",
    4,
    true,
  ]
}
optional_tag = {
  "Custom" = "dev"
  "Name" = "web-server"
}
primary_public_subnet = "subnet-01f96be1fa93f203d "
resource_name = "lab_work-dev"
server_config = {
  "backup_enabled" = false
  "instance_type" = "t3.micro"
  "monitoring" = true
  "name" = "web-server"
  "storage_gb" = 20
}
subnet_cidr_block_output = "10.0.30.0/24"
subnet_count = 3
tags = tomap({
  "Environment" = "dev"
  "Owner" = "platform-team"
  "Project" = "sample-app"
})
```

- **task6_dynamic_value_string.png**

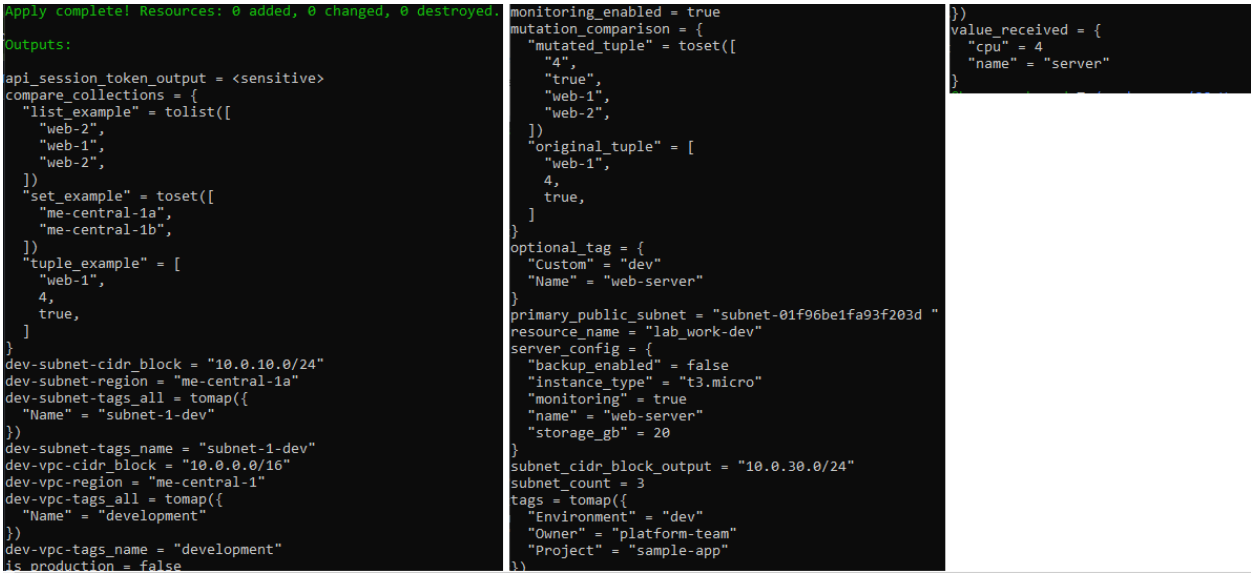
- **task6_dynamic_value_number.png**



- **task6_dynamic_value_list.png**

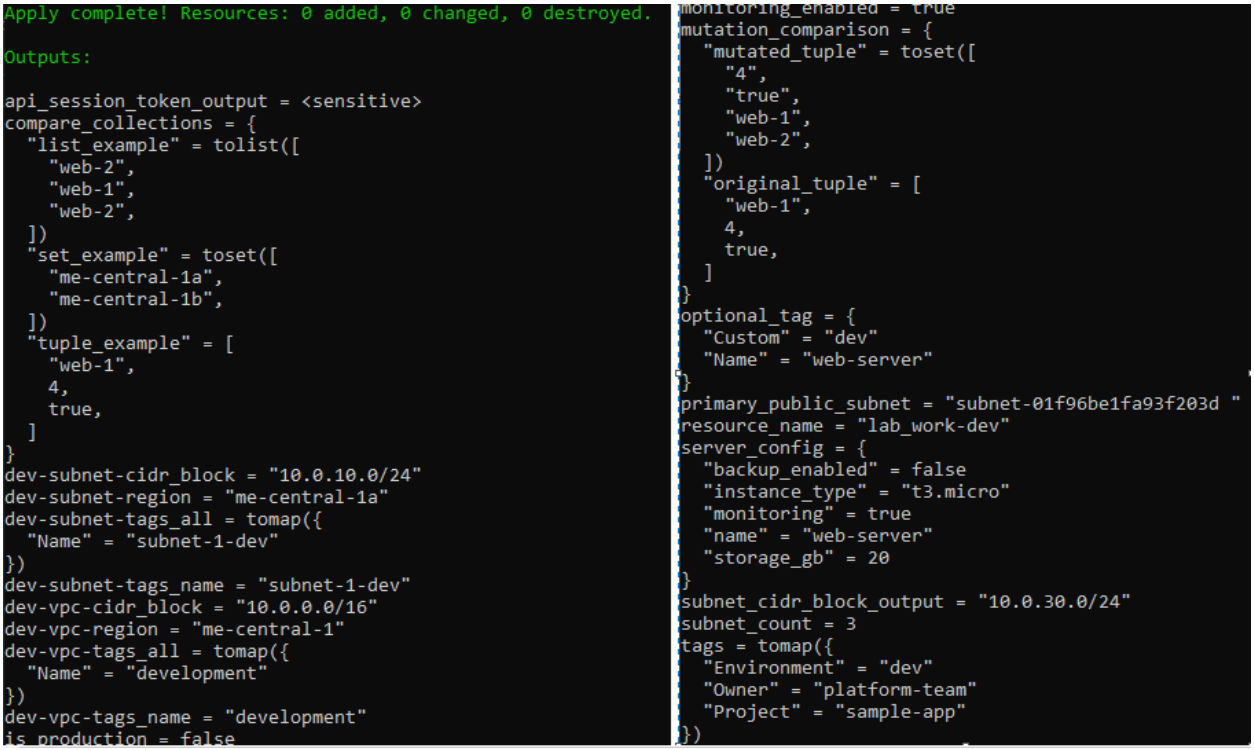


- **task6_dynamic_value_map.png**



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

Outputs:

api_session_token_output = <sensitive>
compare_collections = {
  "list_example" = tolist([
    "web-2",
    "web-1",
    "web-2",
  ])
  "set_example" = toset([
    "me-central-1a",
    "me-central-1b",
  ])
  "tuple_example" = [
    "web-1",
    4,
    true,
  ]
}
dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
is_production = false
monitoring_enabled = true
mutation_comparison = {
  "mutated_tuple" = toset([
    "4",
    "true",
    "web-1",
    "web-2",
  ])
  "original_tuple" = [
    "web-1",
    4,
    true,
  ]
}
optional_tag = {
  "Custom" = "dev"
  "Name" = "web-server"
}
primary_public_subnet = "subnet-01f96be1fa93f203d "
resource_name = "lab_work-dev"
server_config = {
  "backup_enabled" = false
  "instance_type" = "t3.micro"
  "monitoring" = true
  "name" = "web-server"
  "storage_gb" = 20
}
subnet_cidr_block_output = "10.0.30.0/24"
subnet_count = 3
tags = tomap({
  "Environment" = "dev"
  "Owner" = "platform-team"
  "Project" = "sample-app"
})
})
value_received = {
  "cpu" = 4
  "name" = "server"
}
```

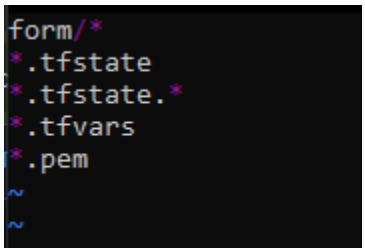
- **task6_dynamic_value_null.png**



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

Outputs:

api_session_token_output = <sensitive>
compare_collections = {
  "list_example" = tolist([
    "web-2",
    "web-1",
    "web-2",
  ])
  "set_example" = toset([
    "me-central-1a",
    "me-central-1b",
  ])
  "tuple_example" = [
    "web-1",
    4,
    true,
  ]
}
dev-subnet-cidr_block = "10.0.10.0/24"
dev-subnet-region = "me-central-1a"
dev-subnet-tags_all = tomap({
  "Name" = "subnet-1-dev"
})
dev-subnet-tags_name = "subnet-1-dev"
dev-vpc-cidr_block = "10.0.0.0/16"
dev-vpc-region = "me-central-1"
dev-vpc-tags_all = tomap({
  "Name" = "development"
})
dev-vpc-tags_name = "development"
is_production = false
monitoring_enabled = true
mutation_comparison = {
  "mutated_tuple" = toset([
    "4",
    "true",
    "web-1",
    "web-2",
  ])
  "original_tuple" = [
    "web-1",
    4,
    true,
  ]
}
optional_tag = {
  "Custom" = "dev"
  "Name" = "web-server"
}
primary_public_subnet = "subnet-01f96be1fa93f203d "
resource_name = "lab_work-dev"
server_config = {
  "backup_enabled" = false
  "instance_type" = "t3.micro"
  "monitoring" = true
  "name" = "web-server"
  "storage_gb" = 20
}
subnet_cidr_block_output = "10.0.30.0/24"
subnet_count = 3
tags = tomap({
  "Environment" = "dev"
  "Owner" = "platform-team"
  "Project" = "sample-app"
})
```

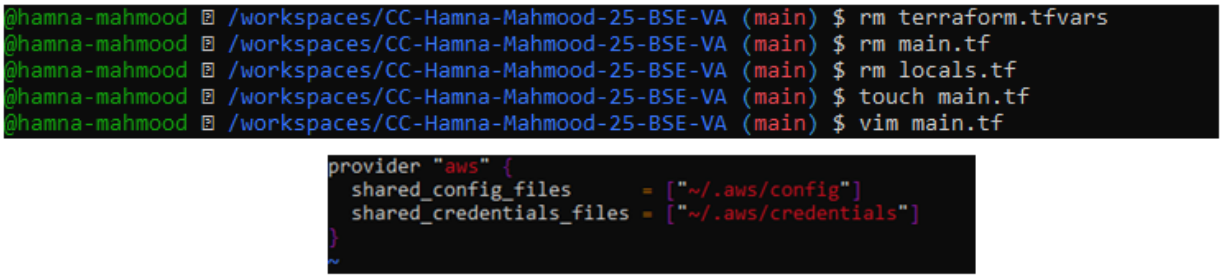
Task 7- Git Ignore

- **task7_gitignore_created.png**

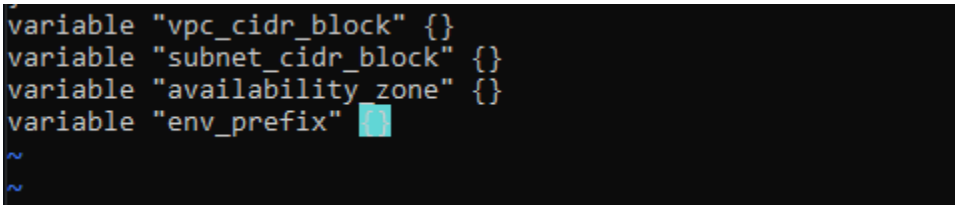


Task 8- Cleanup then build real infra (VPC, Subnet, IGW, routing, default route table)

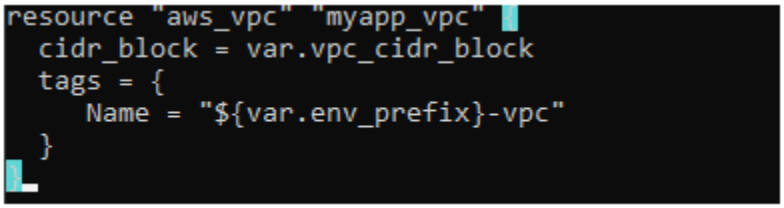
- **task8_clean_files.png**



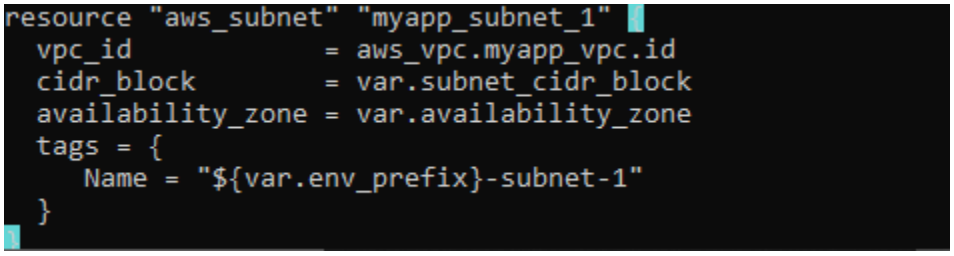
- **task8_variables_recreated.png**



- **task8_vpc_resources_added.png**



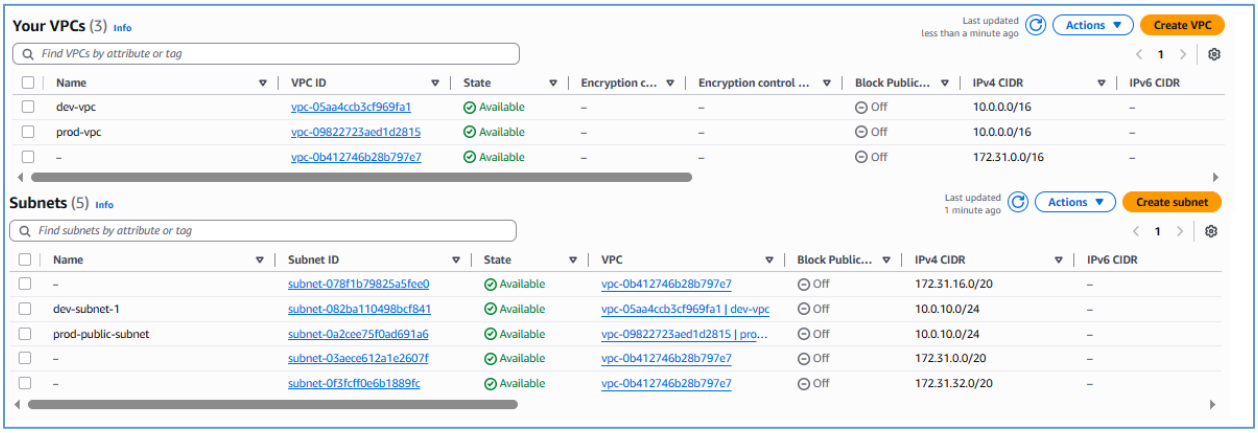
- **task8_subnet_resources_added.png**



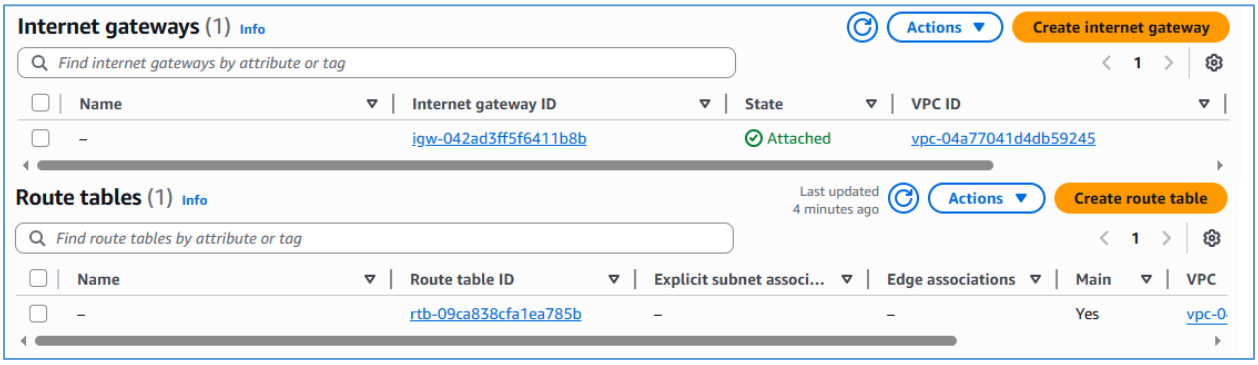
- **task8_terraform_tfvars_vpc_values.png**

```
cidr_block      = "10.0.0.0/16"
subnet_cidr_block   = "10.0.10.0/24"
availability_zone   = "me-central-1a"
env_prefix          = "dev"
~
~
```

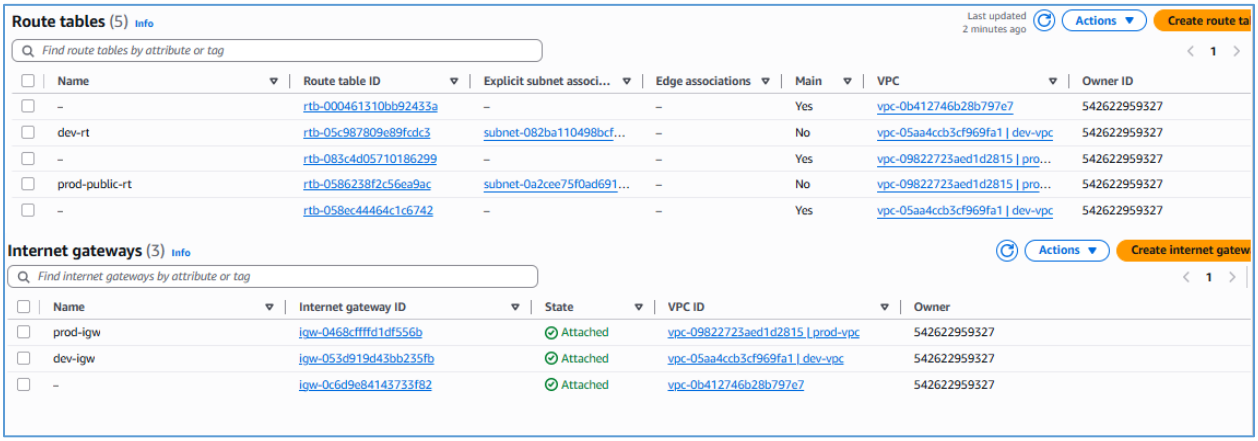
- **task8_vpc_subnet_apply.png**



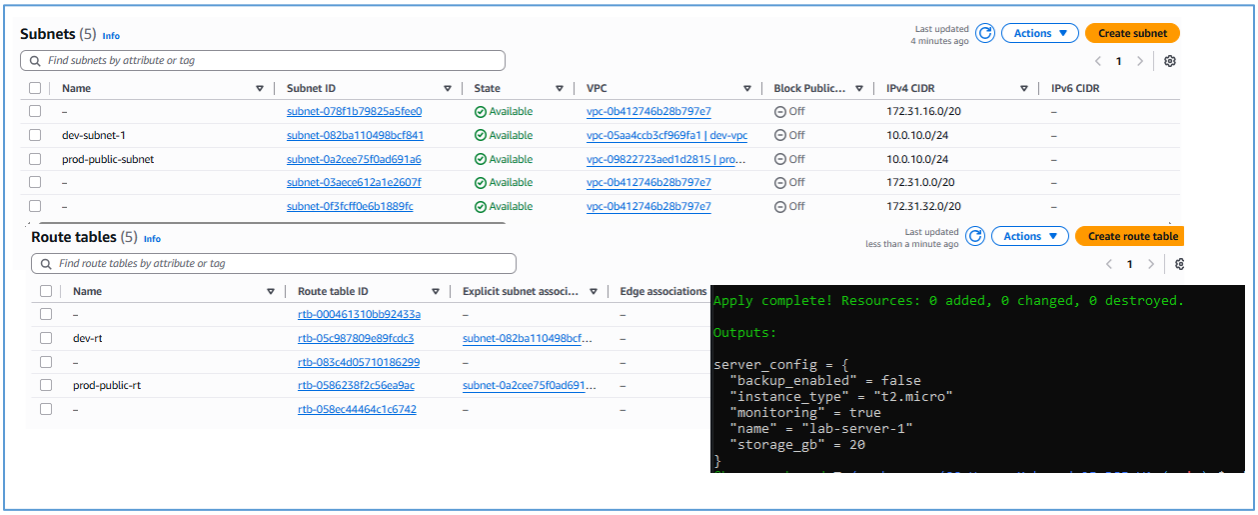
- **task8_igw_route_table_before_apply.png**



- **task8_igw_route_table_after_apply.png**

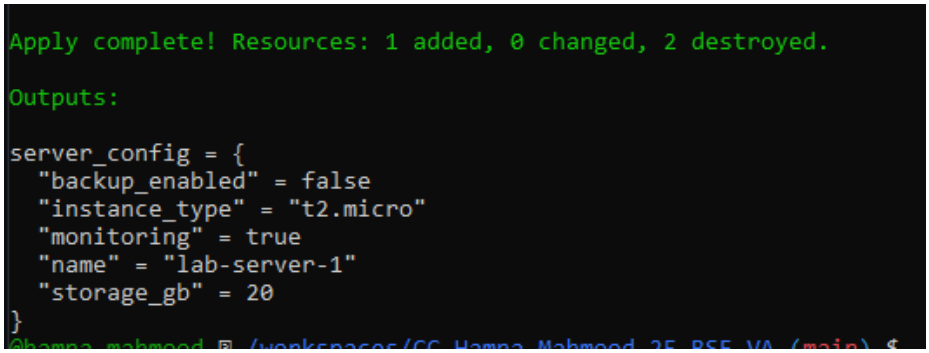


- **task8_association_apply.png**



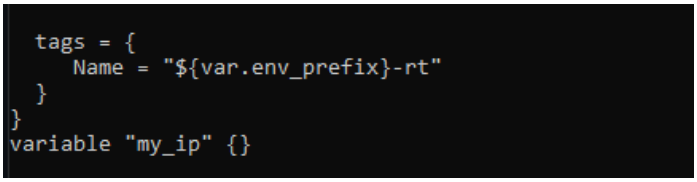
- **task8_default_route_table.png**

- **task8_default_route_table_apply.png**



Task 9- Security group, key apir, EC2 instance, user_data & nginx

- **task9_my_ip_variable_added.png**



- **task9_public_ip_curl.png**

```
@hamna-mahmood 🖹 /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ curl icanhazip.com
20.192.21.54
```

```
my_ip = "20.192.21.54/32"
instance_type = "t3.micro"
availability_zone = "me-central-1a"   # or your chosen AZ
env_prefix = "dev"

-- INSERT --
```

- **task9_security_group_apply.png**

```
resource "aws_default_security_group" "myapp_sg" {
  vpc_id      = aws_vpc.myapp_vpc.id

  ingress {
    from_port   = 22
    to_port     = 22
    protocol    = "tcp"
    cidr_blocks = [var.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"]
    prefix_list_ids = []
  }

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

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

Outputs:

server_config = {
  "backup_enabled" = false
  "instance_type" = "t2.micro"
  "monitoring" = true
  "name" = "lab-server-1"
  "storage_gb" = 20
}
@hamna-mahmood 🖹 /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $
```

- **task9_keypair_created_and_saved.png**

```
00 MyE@hamna-mahmood 🖹 /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ chmod 600 MyED25519Key.pem
@hamna-mahmood 🖹 /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ aws ec2 create-key-pair   --key-name MyED25519Key   --k
ey-type ed25519   --key-format pem   --query 'KeyMaterial'   --output text > MyED25519Key.pem
```

```
@hamna-mahmood 🖹 /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ cat .gitignore
form/*
*.tfstate
*.tfstate.*
*.tfvars
*.pem
*.pem
```

- **task9_instance_type_set.png**

```
resource "aws_instance" "myapp-server" {
  ami                         = "ami-05524d6658fcf35b6" # 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                    = "MyED25519Key"

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

output "aws_instance_public_ip" {
  value = aws_instance.myapp-server.public_ip
}
```

- **task9_ec2_apply_and_public_ip.png**

```
Changes to Outputs:
  + aws_instance_public_ip = (known after apply)
aws_instance.myapp-server: Creating...
aws_instance.myapp-server: Still creating... [00m10s elapsed]
aws_instance.myapp-server: Creation complete after 13s [id=i-06f2433df6a51e8e4]

  Warning: Value for undeclared variable

  The root module does not declare a variable named "cidr_block" but a value was found in file "terraform.tfvars". If
  you meant to use this value, add a "variable" block to the configuration.

  To silence these warnings, use TF_VAR_... environment variables to provide certain "global" settings to all
  configurations in your organization. To reduce the verbosity of these warnings, use the -compact-warnings option.


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

Outputs:

aws_instance_public_ip = "3.28.191.9"
server_config = {
  "backup_enabled" = false
  "instance_type" = "t2.micro"
  "monitoring" = true
  "name" = "lab-server-1"
  "storage_gb" = 20
}
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $
```

- **task9_ssh_into_ec2.png**

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ssh -i MyED25519Key.pem ec2-user@3.28.191.9
The authenticity of host '3.28.191.9 (3.28.191.9)' can't be established.
ED25519 key fingerprint is SHA256:Q/edvNjeVf1a/Llikda4JRq3iBftGokFQtrEopvY1bg.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '3.28.191.9' (ED25519) to the list of known hosts.
   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
[ec2-user@ip-10-0-10-188 ~]$
```

- **task9_ssh_keypair_and_ssh.png**

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ 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:tYZlqo3cDRtHka2SJp4Unzf0jEkcaL30xbb3ki4ugLQ codespace@codespaces-aa6536
The key's randomart image is:
+--[ED25519 256]--+
|         +o+ .   |
|      . o B.. +  |
|       + *=O o . |
|      + *BB.+ . .|
|     + *So+.   o.|
|     .E=.B    o .|
|      + +..  . . |
|         . . .   |
|          o..    |
+----[SHA256]-----+
```

- **task9_ssh_keypair_and_shh2.png**

```
resource "aws_instance" "myapp-server" {
  ami                         = "ami-05524d6658fcf35b6" # Amazon Linux 2023
  instance_type               = var.instance_type
  subnet_id                   = aws_subnet.myapp_subnet_1.id
  security_groups             = [aws_default_security_group.myapp_sg.id]
  availability_zone           = var.availability_zone
  associate_public_ip_address = true
  key_name                    = aws_key_pair.ssh_key.key_name
```

```
resource "aws_key_pair" "ssh_key" {
  key_name   = "serverkey"
  public_key = file("~/.ssh/id_ed25519.pub")
}
```

- **task9_ec2_apply_and_public_ip**

```
Apply complete! Resources: 2 added, 0 changed, 1 destroyed.

Outputs:

aws_instance_public_ip = "51.112.229.108"
server_config = {
  "backup_enabled" = false
  "instance_type" = "t2.micro"
  "monitoring" = true
  "name" = "lab-server-1"
  "storage_gb" = 20
}
```

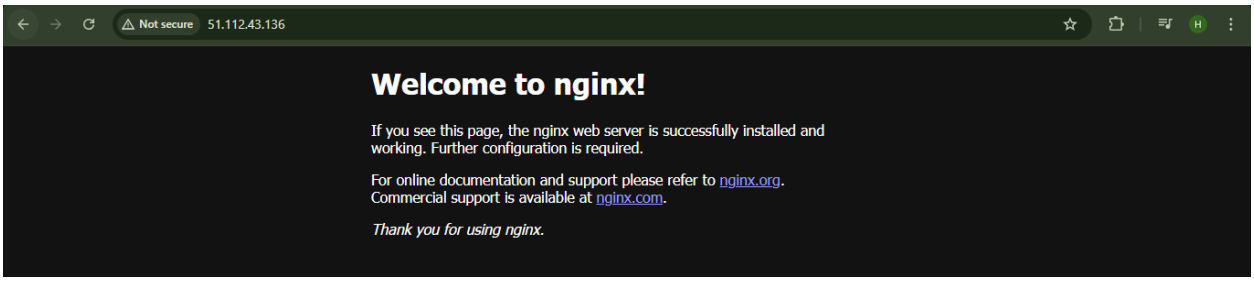
- **task9_ssh_keypair_And_ssh3**

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ssh ec2-user@51.112.229.108
The authenticity of host '51.112.229.108 (51.112.229.108)' can't be established.
ED25519 key fingerprint is SHA256:F6IX2Dlh2f53v82zUaP77+F38RNJxyv6T8uRYfP1wAY.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '51.112.229.108' (ED25519) to the list of known hosts.
   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
[ec2-user@ip-10-0-10-254 ~]$
```

- **task9_nginx_local_curl.png**

```
[ec2-user@ip-10-0-10-62 ~]$ curl localhost
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx!</title>
<style>
html { color-scheme: light dark; }
body { width: 35em; margin: 0 auto;
font-family: Tahoma, Verdana, Arial, sans-serif; }
</style>
</head>
<body>
<h1>Welcome to nginx!</h1>
<p>If you see this page, the nginx web server is successfully installed and
working. Further configuration is required.</p>

<p>For online documentation and support please refer to
<a href="http://nginx.org/">nginx.org</a>.<br/>
Commercial support is available at
<a href="http://nginx.com/">nginx.com</a>.</p>

<p><em>Thank you for using nginx.</em></p>
</body>
</html>
[ec2-user@ip-10-0-10-62 ~]$
```

- **task9_nginx_browser_page.png**



Cleanup

- **cleanup_destroy.png**

```
Destroy complete! Resources: 7 destroyed.
@hamna-mahmood /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $
```

- **cleanup_state_files.png**

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ cat terraform.tfstate
{
  "version": 4,
  "terraform_version": "1.14.3",
  "serial": 97,
  "lineage": "44daad15-ff50-9119-441e-f71bf3fee6a5",
  "outputs": {},
  "resources": [],
  "check_results": null
}
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ cat terraform.tfstate.backup
{
  "version": 4,
  "terraform_version": "1.14.3",
  "serial": 89,
  "lineage": "44daad15-ff50-9119-441e-f71bf3fee6a5",
  "outputs": {
    "aws_instance_public_ip": {
      "value": "[redacted]",
      "type": "string"
    },
    "server_config": {
      "value": {
        "backup_enabled": false,
        "instance_type": "t2.micro",
        "monitoring": true,
        "name": "lab-server-1",
        "storage_gb": 20
```

- **cleanup_verify_no_secrets.png**

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ git status
On branch main
Your branch is up to date with 'origin/main'.

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        .gitignore
        .main.tf.swo
        .main.tf.swp
        .terraform.lock.hcl
        .terraform/
        aws/
        awscliv2.zip
        "ec2 describe-vpcs \\"
        main.tf
        variables.tf

nothing added to commit but untracked files present (use "git add" to track)
```

```
@hamna-mahmood ➜ /workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ cat .gitignore
form/*
*.tfstate
*.tfstate.*
*.tfvars
*.pem
*.pem
```