Name –Aasif mohd
Project – Terraform

I won't add the installation part it is pretty easy can be found on youtube
Task 1. Create an EC2 instance using terraform on AWS.

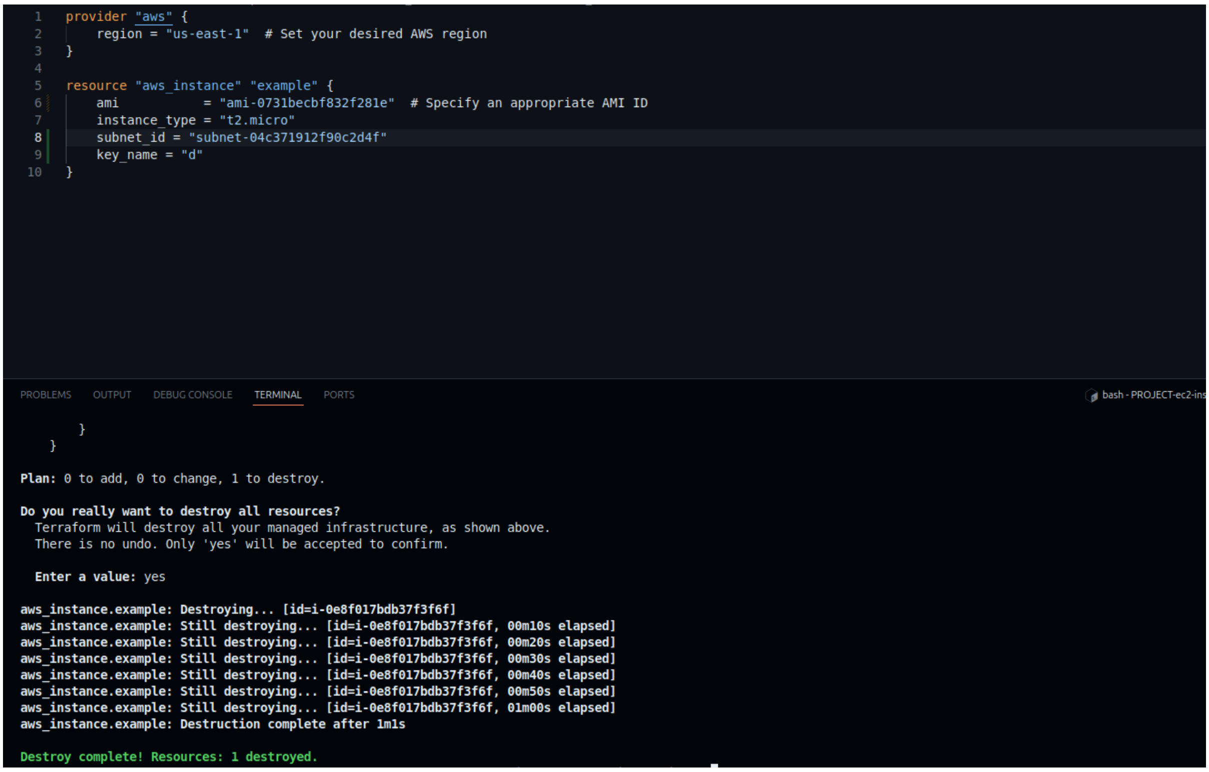
Provider:- A provider is a plugin that helps Terraform to understand where it has to create the infrastructure

Solution.

1.First setup the provider aws
2. write the code for instance-type,id,key etc.

3. Check the implementation using terraform plan cammand

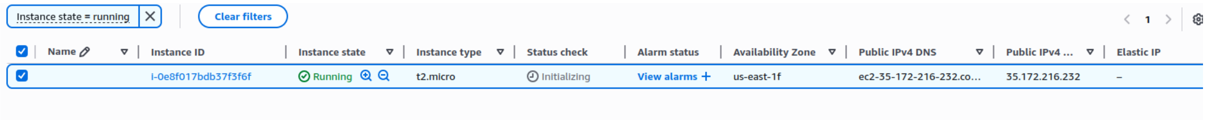
4. use the cammand terraform apply to create an instance



```
provider "aws" {
    region = "us-east-1"  # Set your desired AWS region
}

resource "aws_instance" "example" {
    ami           = "ami-0731becbf832f281e"  # Specify an appropriate AMI ID
    instance_type = "t2.micro"
    subnet_id = "subnet-04c371912f90c2d4f"
    key_name = "d"
}
```

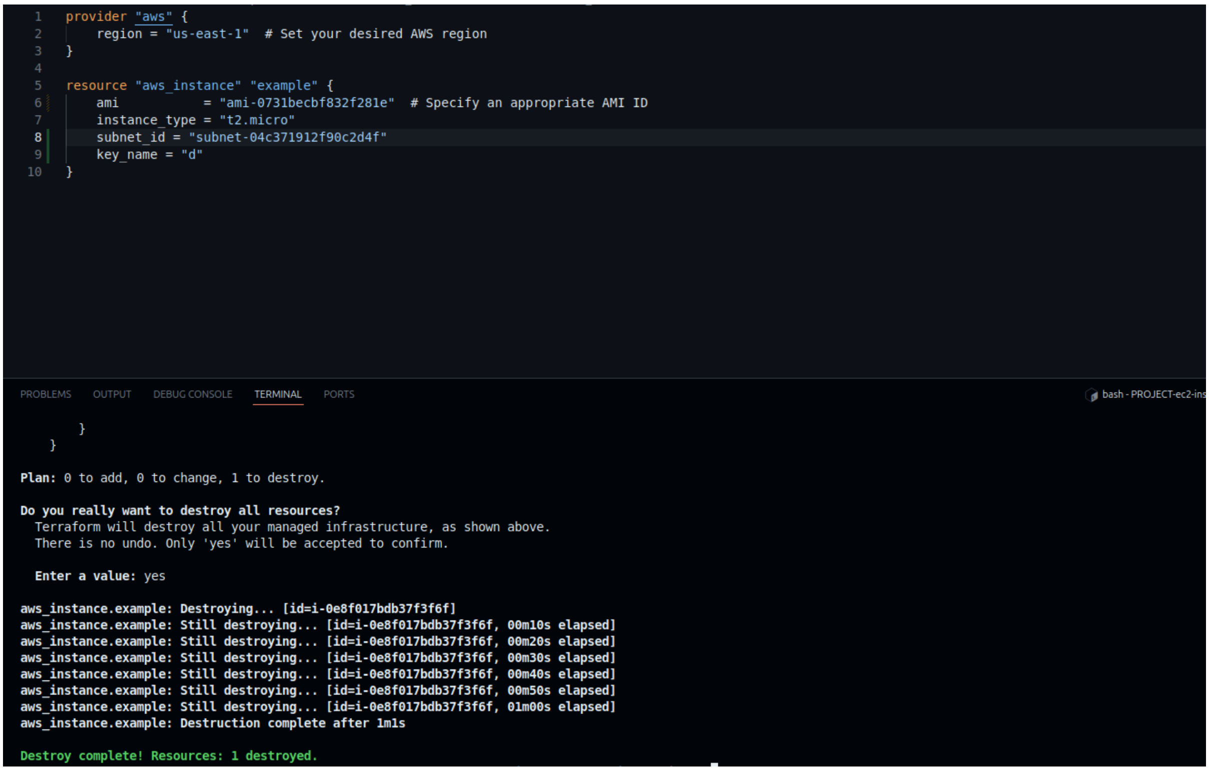
```
      }
  }

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

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

  Enter a value: yes

aws_instance.example: Destroying... [id=i-0e8f017bdb37f3f6f]
aws_instance.example: Still destroying... [id=i-0e8f017bdb37f3f6f, 00m10s elapsed]
aws_instance.example: Still destroying... [id=i-0e8f017bdb37f3f6f, 00m20s elapsed]
aws_instance.example: Still destroying... [id=i-0e8f017bdb37f3f6f, 00m30s elapsed]
aws_instance.example: Still destroying... [id=i-0e8f017bdb37f3f6f, 00m40s elapsed]
aws_instance.example: Still destroying... [id=i-0e8f017bdb37f3f6f, 00m50s elapsed]
aws_instance.example: Still destroying... [id=i-0e8f017bdb37f3f6f, 01m00s elapsed]
aws_instance.example: Destruction complete after 1m1s

Destroy complete! Resources: 1 destroyed.
```

instance is created on aws



☑	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS	Public IPv4 ...	Elastic IP
☑		i-0e8f017bdb37f3f6f	Running	t2.micro	Initializing	View alarms +	us-east-1f	ec2-35-172-216-232.co...	35.172.216.232	–

Now to delete this instance we can use the cammand-terraform destroy



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aws_instance.example: Still destroying... [id=i-0e8f017bdb37f3f6f, 00m40s elapsed]
aws_instance.example: Still destroying... [id=i-0e8f017bdb37f3f6f, 00m50s elapsed]
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Destroy complete! Resources: 1 destroyed.
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Task 2----

What is a variable in terraform?

A **variable** in Terraform is like a placeholder. It lets you **store a value** (like a region name, server type, etc.) so you can **reuse** it in your code.

Eg. ----

```
variable "region" {

  default = "us-east-1"

}
```

What is an Output ?

An **output or output variable** shows **useful information** after you run terraform apply. It's like Terraform saying:

"Here's the result you might want to see!"

Why Use Output ?

- To see values like IP addresses, bucket names, or resource IDs.
- To pass values between modules.
- To debug and check values.

```
output "bucket_name" {

 value = aws_s3_bucket.my_bucket.bucket

 }
```

⛅ **Multicloud in Terraform** (Multiple Cloud Providers)

- **What it means:** Using **more than one cloud provider** in the same Terraform project.
- **Example:** You deploy a web app on **AWS** and a database on **Azure**.
- **Why it's used:** To avoid putting all your services on one provider (vendor lock-in), or to take advantage of features from different providers.

In Terraform:
 You use **multiple provider blocks**.
Example-

```
provider "aws" {

  region = "us-east-1"

}

provider "azurerm" {

  features = {}   }
```

Multiregion in Terraform (Multiple Regions in One Cloud)

- **What it means:** Deploying resources in **multiple regions** of the **same cloud provider** (like AWS).
- **Example:** Deploying servers in **us-east-1** and **us-west-1** to improve performance or reliability.
- **Why it's used:** For disaster recovery, performance, or compliance.

In Terraform:
 You use **multiple provider blocks** for the same cloud but with different regions.

Example-

```
provider "aws" {

alias = "us_east"

region = "us-east-1"

 }

provider "aws" {

alias = "us_west"

 region = "us-west-1"

 }

resource "aws_instance" "east_server" {

provider = aws.us_east

...

}

resource "aws_instance" "west_server" {

provider = aws.us_west

...

}
```

Module

What is a Module in Terraform?

A **module** in Terraform is a **folder** that contains Terraform code and can be **reused** in different places by passing values to it.

A **module** is just a **folder** that contains Terraform code (like resources, variables, outputs) — it's like a **reusable component**.

Think of it like a **Lego block**:

- You build it once.
- You can plug it into multiple places.
- You can pass values to it, and it gives outputs back.

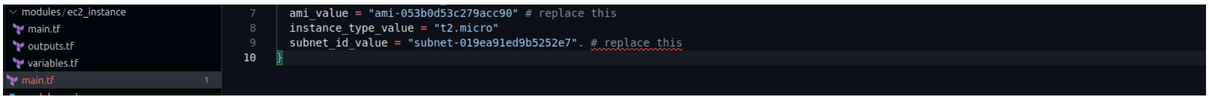
Why use Modules?

- To **organize** your code.
- To **reuse** the same setup (e.g., EC2 instance, VPC) in multiple environments.
- To **avoid copy-pasting** the same code everywhere.

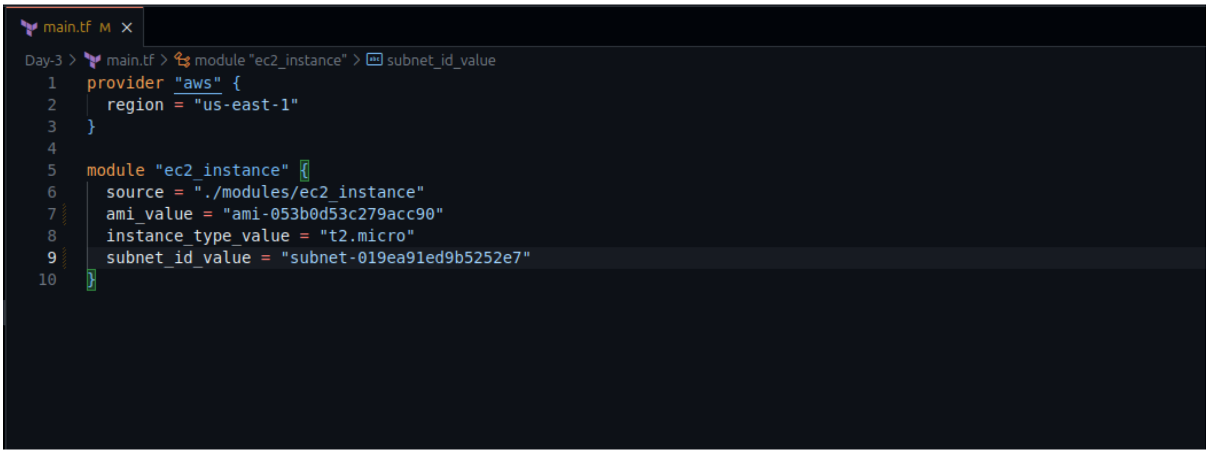
Value from main.tf → goes into → **variable block in module** → used in → **resource or logic inside module's main.tf**

We can use the module code from the outside of module folder easily without have to write the complex code

```
modules/
└── ec2_instance/
   ├── main.tf       # Contains resources
   ├── variables.tf   # Defines input variables
  └── outputs.tf     # Defines output values
```



```
  ami_value = "ami-053b0d53c279acc90" # replace this
  instance_type_value = "t2.micro"
  subnet_id_value = "subnet-019ea91ed9b5252e7". # replace this
}
```



```
provider "aws" {
  region = "us-east-1"
}

module "ec2_instance" {
  source = "./modules/ec2_instance"
  ami_value = "ami-053b0d53c279acc90"
  instance_type_value = "t2.micro"
  subnet_id_value = "subnet-019ea91ed9b5252e7"
}
```

What is a Terraform State File?

When you use **Terraform** to create cloud resources (like servers or databases), it needs to **remember what it created**. That's what the **state file** does!

- It's a file called terraform.tfstate.
- It keeps track of **all the resources** Terraform manages.
- Without it, Terraform wouldn't know what exists or what needs to be changed.

*1. **Security Risk (Sensitive Data)***

- The state file may contain **secrets** like passwords, API keys, or cloud resource IDs.
- If pushed to GitHub, even in private repos, there's a risk of **accidental leaks.**-

  --A developer might **clone** the repo to another machine or **copy/paste** it elsewhere (like in a public issue, gist, or Slack).

*2. **No Locking or Sync***

- GitHub doesn't support **locking** — if two people push or pull at the same time, it can cause **conflicts or corrupted state**.
- It's not designed for **real-time collaboration** on infrastructure.

How S3 Fixes These Issues

*1. **Secure & Encrypted Storage***

- S3 allows you to enable **server-side encryption**.
- You can set **IAM permissions** to tightly control who can access the file.

*2. **Supports Locking & Versioning***

- With **S3 + DynamoDB**, Terraform can **lock the state** so only one person can change it at a time.
- **Versioning** in S3 means you can roll back to older state files if something breaks.

Workflow: Using GitHub + S3 for Terraform

1. **Terraform Code in GitHub**
    a. The DevOps engineer pulls only the **Terraform code** (like .tf files) from GitHub.
    b. The **state file is not in GitHub** — it's safely stored in **S3**.
2. **Run terraform init**
    a. This connects Terraform to the **remote backend (S3)** using the config in backend "s3" block.
    b. Terraform now knows where the state lives.
3. **Make Changes & Run terraform apply**
    a. Terraform compares the **current state in S3** with your updated code.
    b. It updates infrastructure and automatically **writes the new state** back to S3.
4. **State File is Updated in S3 Automatically**
    a. You don't need to download or upload the state manually.
    b. S3 handles storage, and **DynamoDB (optional)** handles locking.
5. **If You Make a Mistake? No Worries!**
    a. If something breaks, you can **restore a previous version** of the state file from S3's **versioning** feature.
    b. That makes it easy to recover from mistakes.

if you're not using remote state (like S3) and someone forgets to **push or update the state file**, there's a **real risk of duplicate resources being created.**

Let's break it down:

When Using Local State and GitHub Only (Bad Practice)

1. **Engineer A**
    a. Clones the repo.
    b. Applies Terraform with **local state file**.
    c. Creates, for example, an EC2 instance.
    d. **Forgets to push the updated state file** to GitHub (or it's not in GitHub at all).
2. **Engineer B**
    a. Pulls the same repo, **but without the latest state**.
    b. Terraform sees **no record** of the EC2 instance.

c. So when B runs terraform apply, it **creates another EC2 instance** — a **duplicate**.

What does "provision" mean in Terraform?

In **Terraform**, **provisioning** means **setting up or configuring** a resource **after** it's created. It’s like saying:

“Hey Terraform, after you create this server, run this script to install software or make some changes inside it.”

Example to understand it:

Imagine you're using Terraform to create a **virtual machine (VM)** in the cloud. That’s easy:

```
resource "aws_instance" "example" {
  ami           = "ami-123456"
  instance_type = "t2.micro"
}
```

This creates a VM. But what if you want that VM to:

- Install **Nginx**?
- Set up **some files**?
- Run a **shell script**?

That’s where **provisioners** come in.

🛠 Example with a provisioner:

```
resource "aws_instance" "example" {
  ami           = "ami-123456"
  instance_type = "t2.micro"
  provisioner "remote-exec" {
   inline = [
     "sudo apt update",
     "sudo apt install -y nginx"
   ]
  }
}
```

This tells Terraform:

“After you create the VM, connect to it and run these commands.”

Types of Provisioners:

1. **file** – Uploads a file to the server
2. **remote-exec** – Runs commands on the server (SSH)
3. **local-exec** – Runs a command on your local machine (not the server)

◇ Terraform Workspaces (Quick Explanation)

Terraform workspaces let you use the **same code** for different environments (like dev, stage, prod) by creating a **separate state file** for each one.

So:

- One codebase ✅
- Multiple environments ✅
- Separate .tfstate files ✅

Why Use Workspaces?

You might have one Terraform codebase (like for setting up a server), but want:

- One for **development** (dev)

- One for **production** (prod)

Instead of copying the code multiple times, you can:

- Keep **one codebase**
- Use **different workspaces** for each environment

Each workspace has its **own separate state**.

Command	**What It Does**
terraform workspace list	Shows all available workspaces
terraform workspace new dev	Creates a new workspace named dev
terraform workspace select dev	Switches to the dev workspace
terraform workspace show	Shows the current workspace

Terraform Secrets with Vault

Vault is a tool to **securely store secrets** like passwords, API keys, and access tokens.

Instead of putting secrets directly in your Terraform code (which is risky), you can:

1. **Store secrets in Vault**
2. **Configure Terraform to read those secrets**
3. **Use them in your infrastructure setup**

Step-by-Step Process

1. **Secrets Stored in Vault**
   a. Example: Store db_password = "supersecret" in Vault at path like secret/data/db.
2. **Terraform Authenticates with Vault**
   a. Terraform uses an **AppRole**, **Token**, or other auth method.
   b. Vault checks if Terraform is allowed to access the secret.
3. **Terraform Reads Secret**
   a. Terraform uses the **Vault provider** to fetch the secret.
   b. The secret is used during provisioning (like setting up a database).
4. **No Secrets in Code!**

a. The sensitive data stays in Vault.
b. Terraform just reads it at runtime.

Why Use Vault with Terraform?

- **Security**: No hardcoding secrets in code
- **Central management**: Keep all secrets in one place
- **Auditing**: See who accessed what and when