

# Terraform

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Infrastructure Automation with  
Terraform

# Introduction to the course

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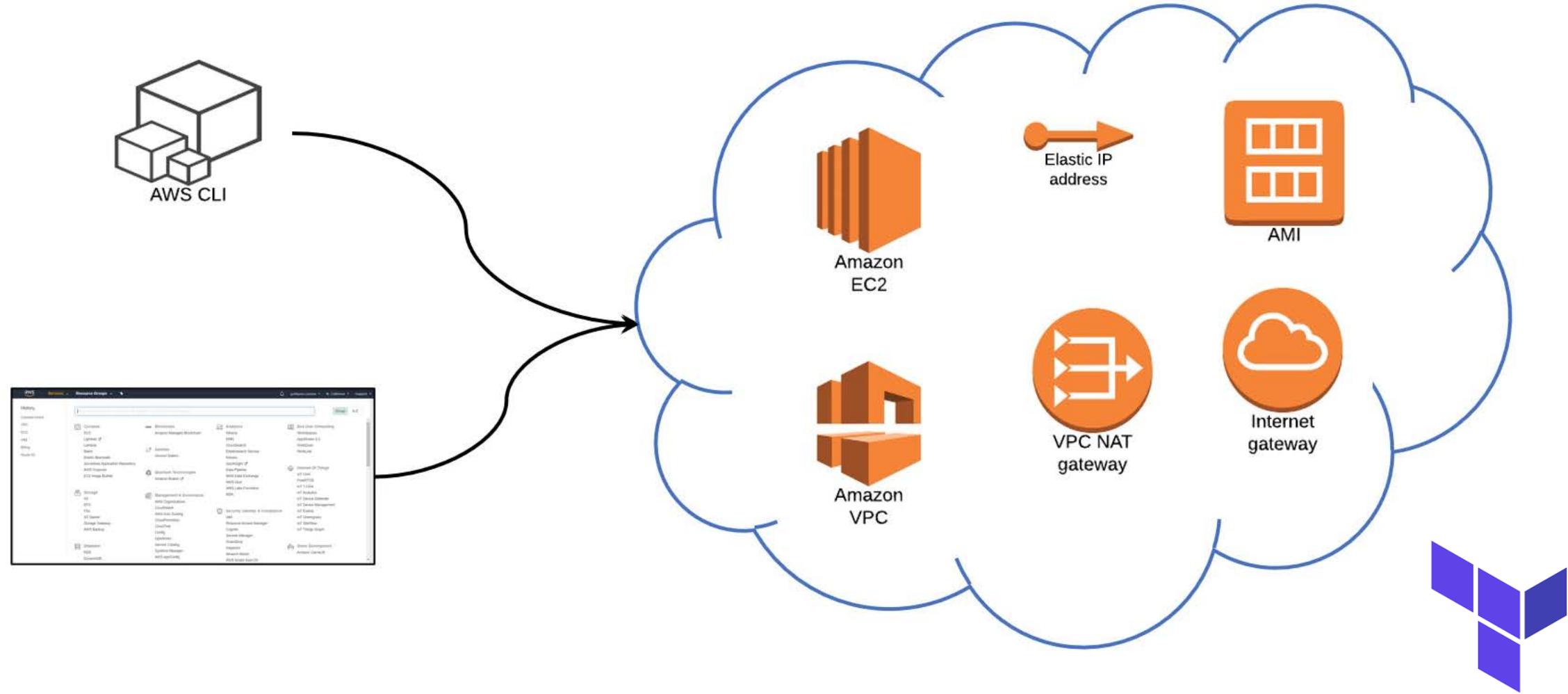
## About Terraform

- ❑ Open-source, Infrastructure as Code software tool
- ❑ Building, changing and versioning infrastructure safely and efficiently
- ❑ Manage IT Infrastructure using configuration files



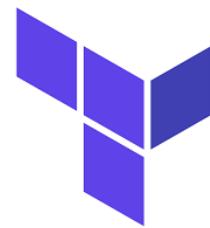
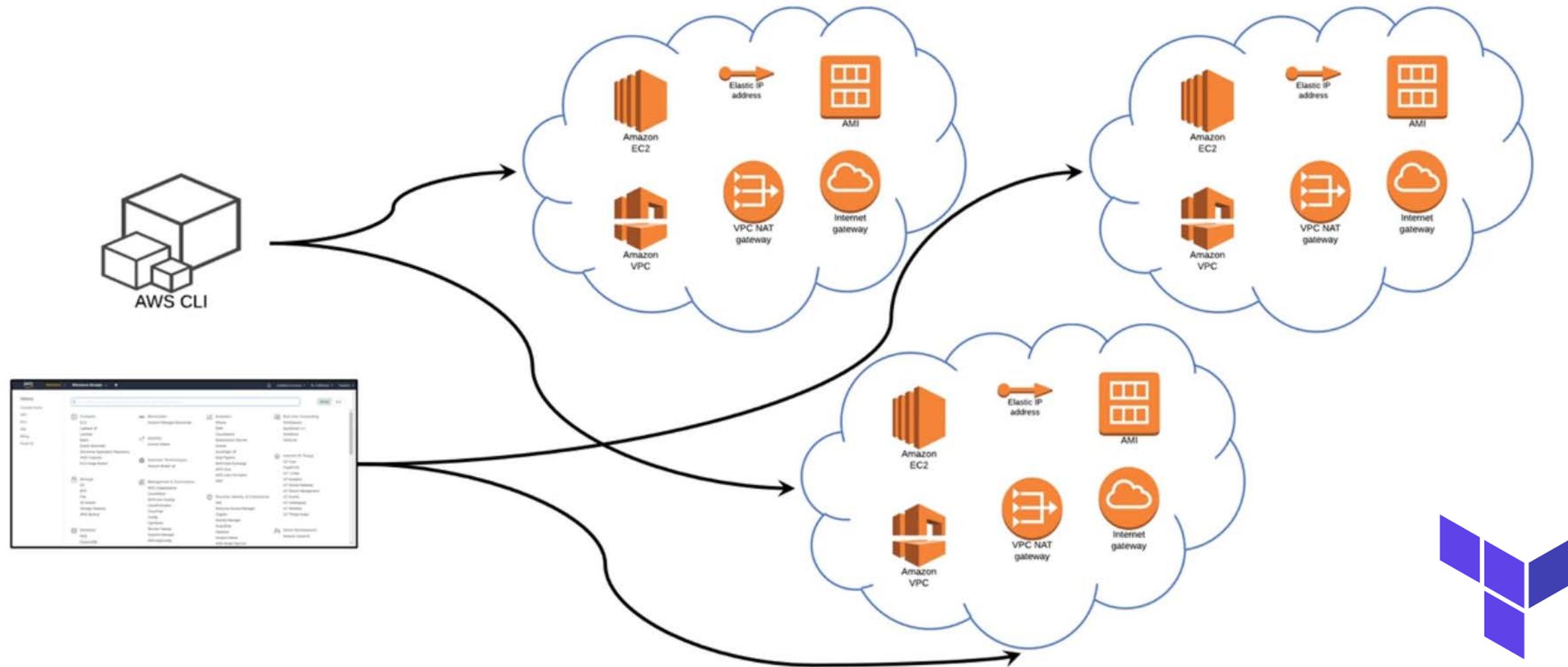
# Introduction to the course

## Need for IaC



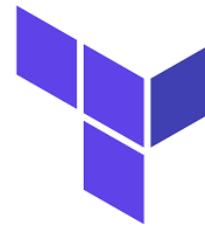
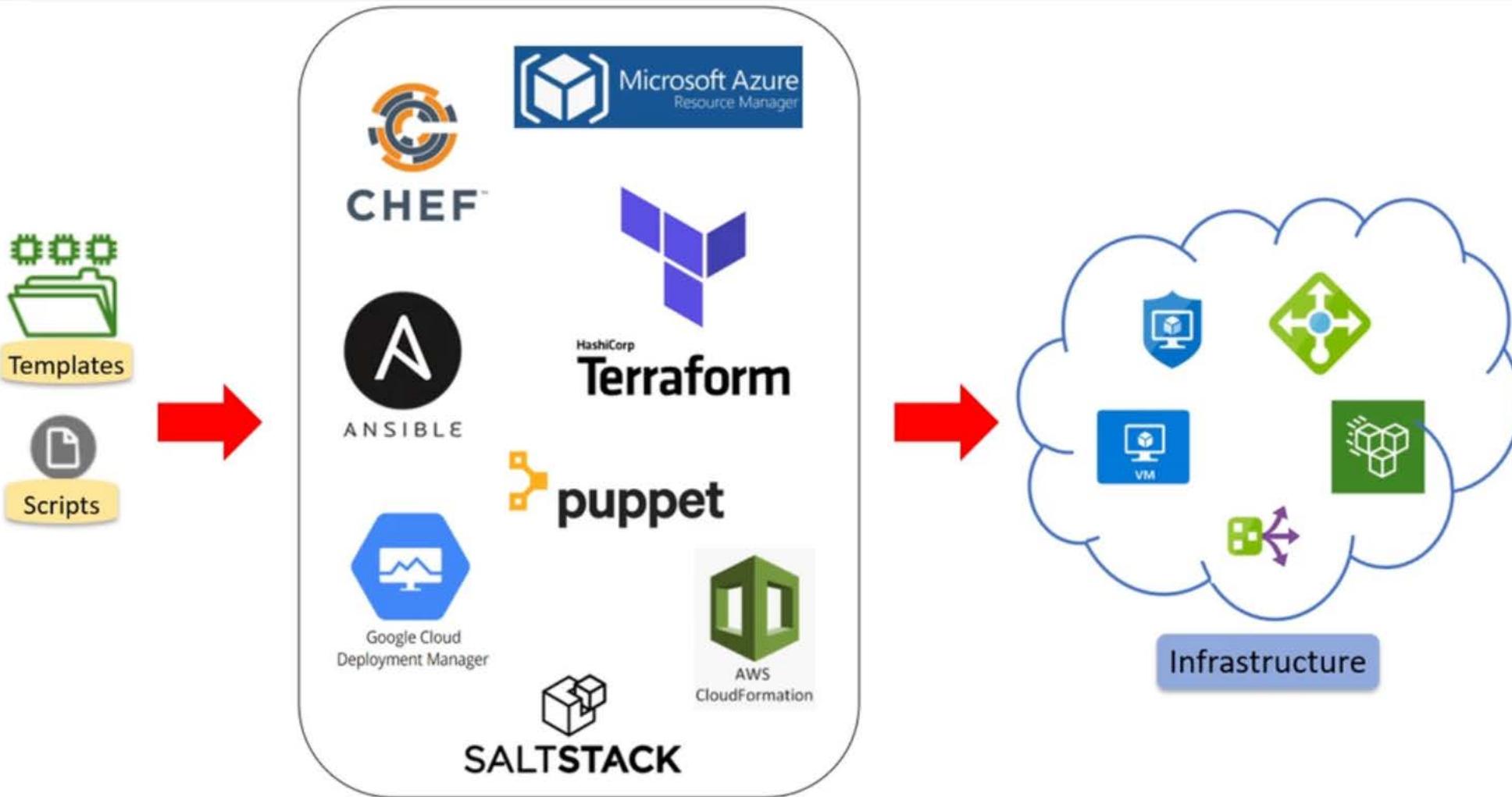
# Introduction to the course

## Need for IaC



# Introduction to the course

## Products in IaC area



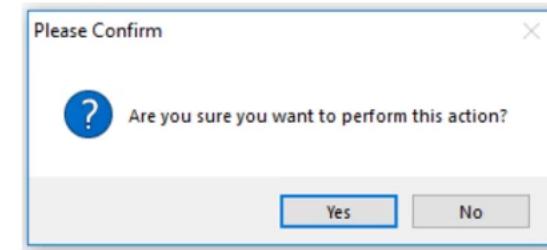
# Introduction to the course

## Advantages of IaC

1. Consistency



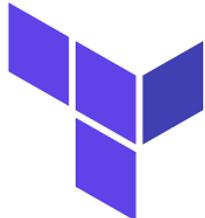
2. Version Controlled



3. Infrastructure validation before deployment



4. Speed



# Introduction to the course

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## Advantages of IaC      contd...

5. Accountability

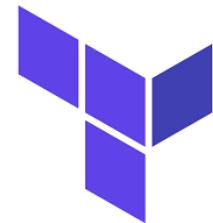


6. High efficiency



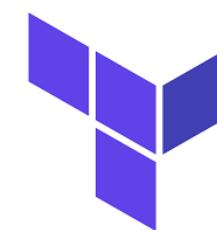
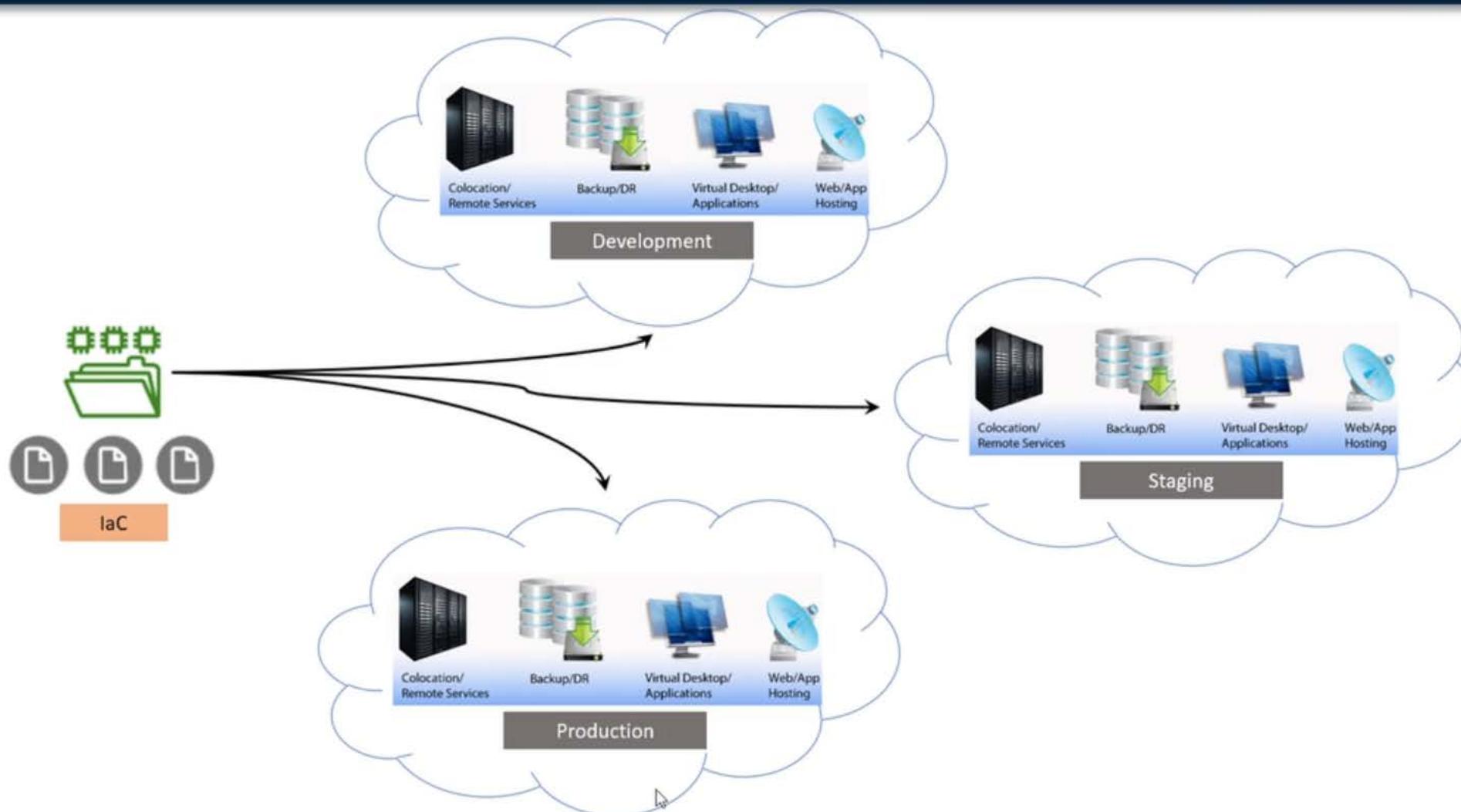
7. Reusability

8. Minimization of costs & effort



# Introduction to the course

## IaC - Consistency

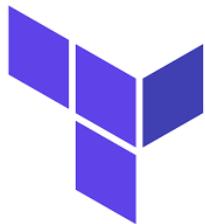


# Infrastructure Automation with Terraform

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## Comparison of IaC Tools



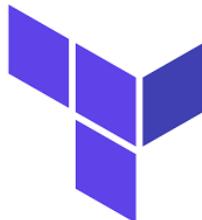
# Comparison of IaC Tools

## Cloud native and Cloud agnostic

- Cloud providers have their own deployment automation technologies
- Code is designed to provision & manage infrastructure only on their specific cloud



- Cloud agnostic tools such as Terraform works with on-premises servers and multiple cloud provider IaC offering

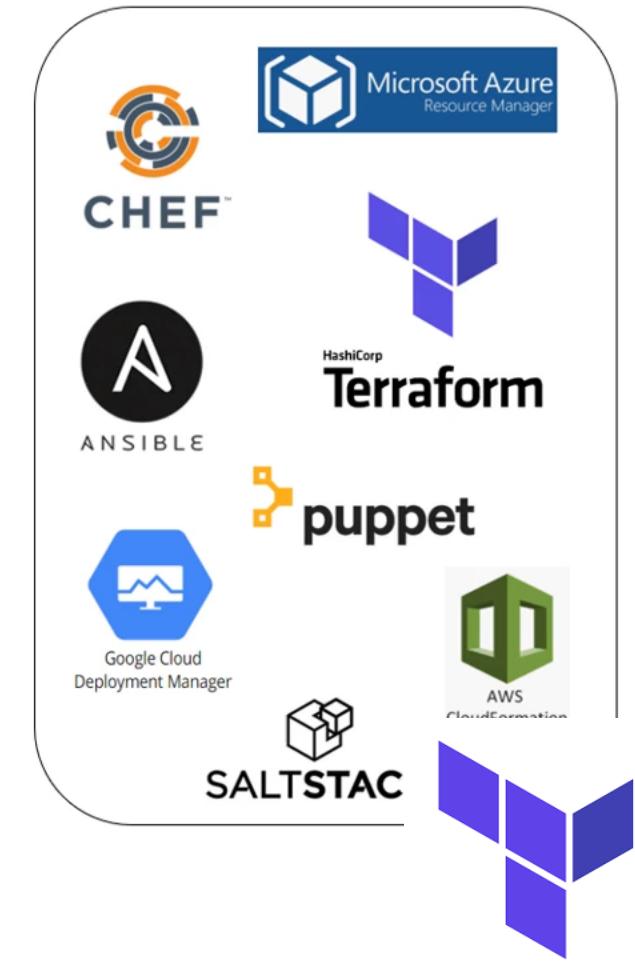


# Comparison of IaC Tools

## Cloud native and Cloud agnostic

Cloud agnostic	Cloud native (Not cloud agnostic)
Terraform	AWS CloudFormation
Chef	ARM
Puppet	Google cloud deployment manager

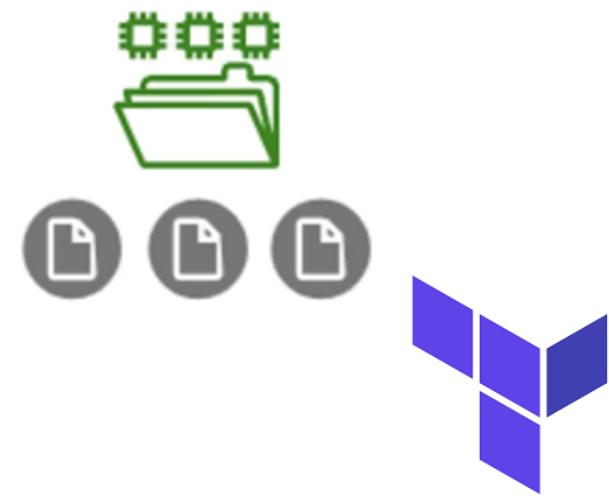
- Cloud providers tools focus on single-cloud or simple hybrid-cloud deployments
- They use terraform as an extension on their own IaC tools



# Comparison of IaC Tools

## Terraform and its features

- Define and provision infrastructure using Hashicorp Configuration Language or JSON
- Written in Go programming language
- Released under Free and Open-source Mozilla Public License
  
- Codifies APIs into declarative configuration files
- Files are treated as code; they can be reviewed, edited and versioned



# Comparison of IaC Tools

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## Terraform and its features

- ❑ Infrastructure as Code
- ❑ Execution Plans
- ❑ Resource Graph
- ❑ Change Automation



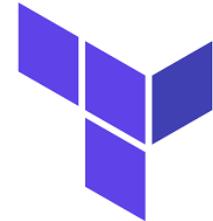
# Comparison of IaC Tools

## Terraform and other tools

- Chef, Puppet, Ansible and SaltStack are configuration management tools



- CloudFormation, Terraform and OpenStack Heat are provisioning tools



# Comparison of IaC Tools

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## Terraform and other tools

- Configuration management tools are used to manage the configuration of systems and the applications running on the systems
- Provisioning tools are used to provision the infrastructure
- Manage networks, compute instances, load balancers, container orchestration etc.
- Configuration management tools can be tweaked to provide the infrastructure provisioning capabilities, but not really a good idea



# Comparison of IaC Tools

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## Differences

### Mutable vs. Immutable architecture

- Mutable paradigm means that the servers are continually modified in place
- Terraform provides support for immutable environments
- In immutable paradigm, the servers are never modified
- Data is carried over to the new server and once verified, the old one is decommissioned



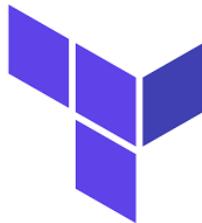
# Comparison of IaC Tools

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## Differences

### Procedural vs. Declarative language

- In procedural style, you write code that specifies, step by step, how to achieve some desired end state
- Terraform encourages declarative style
- You specify your desired end state and the IAC tool itself is responsible for figuring out how to achieve that state
- Procedural code does not fully capture the state of infrastructure
- Procedural code limits reusability



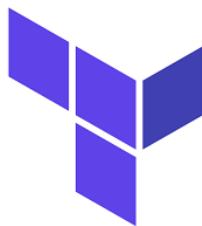
# Comparison of IaC Tools

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## Differences

### Master and Agents

- Chef, Puppet, and SaltStack require a master server for storing the infrastructure state
- Terraform is primarily master less
  - Terraform communicates with cloud providers using the cloud provider's APIs
  - With Terraform, you don't need to install any agent software as well



# Comparison of IaC Tools

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## Differences

### State files

- Terraform follows a stateful management approach
- The state of the infrastructure contains thorough information about the provisioned infrastructure and its various configurations
- When we create an infrastructure, terraform will store all the config files in a state file
- This state is stored locally by default, as "terraform.tfstate", but it can also be stored remotely
- State helps provides idempotence to terraform as it already knows if one resource is present prevent it to be created again when the same configuration executes



{} terraform tfstate •

```
{ } terraform.tfstate >
```

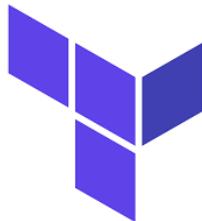
```
1 {  
2     "version": 4,  
3     "terraform_version": "0.12.6",  
4     "serial": 9,  
5     "lineage": "39c80729-666d-388a-51a3-75884ac6d1df",  
6     "outputs": {},  
7     "resources": [  
8         {  
9             "mode": "data",  
10            "type": "aws_ami",  
11            "name": "ubuntu",  
12            "provider": "provider.aws",  
13            "instances": [  
14                {  
15                    "schema_version": 0,  
16                    "attributes": {  
17                        "architecture": "x86_64",  
18                        "block_device_mappings": [  
19                            {  
20                                "device_name": "/dev/sda1",  
21                                "ebs": {  
22                                    "delete_on_termination": "true",  
23                                    "encrypted": "false",  
24                                    "iops": "0",  
25                                    "snapshot_id": "snap-013fb4433bd2108c7",  
26                                    "volume_size": "8",  
27                                    "volume_type": "gp2"  
28                                },  
29                                "no_device": "",  
30                                "virtual_name": ""  
31                            },  
32                            {  
33                                "device_name": "/dev/sdb",  
34                                "ebs": {},  
35                                "no_device": "",  
36                                "virtual_name": "ephemeral0"  
37                            },  
38                        }  
39                    }  
40                }  
41            }  
42        }  
43    }  
44}
```

# Terraform

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Terraform in practice

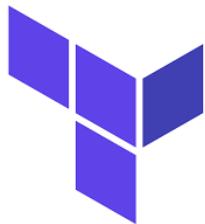


# Terraform in practice

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## Topics in this section

- ❑ Install terraform on Windows and Linux machines
- ❑ What is state in terraform and benefits of it
- ❑ Local and Remote state storage



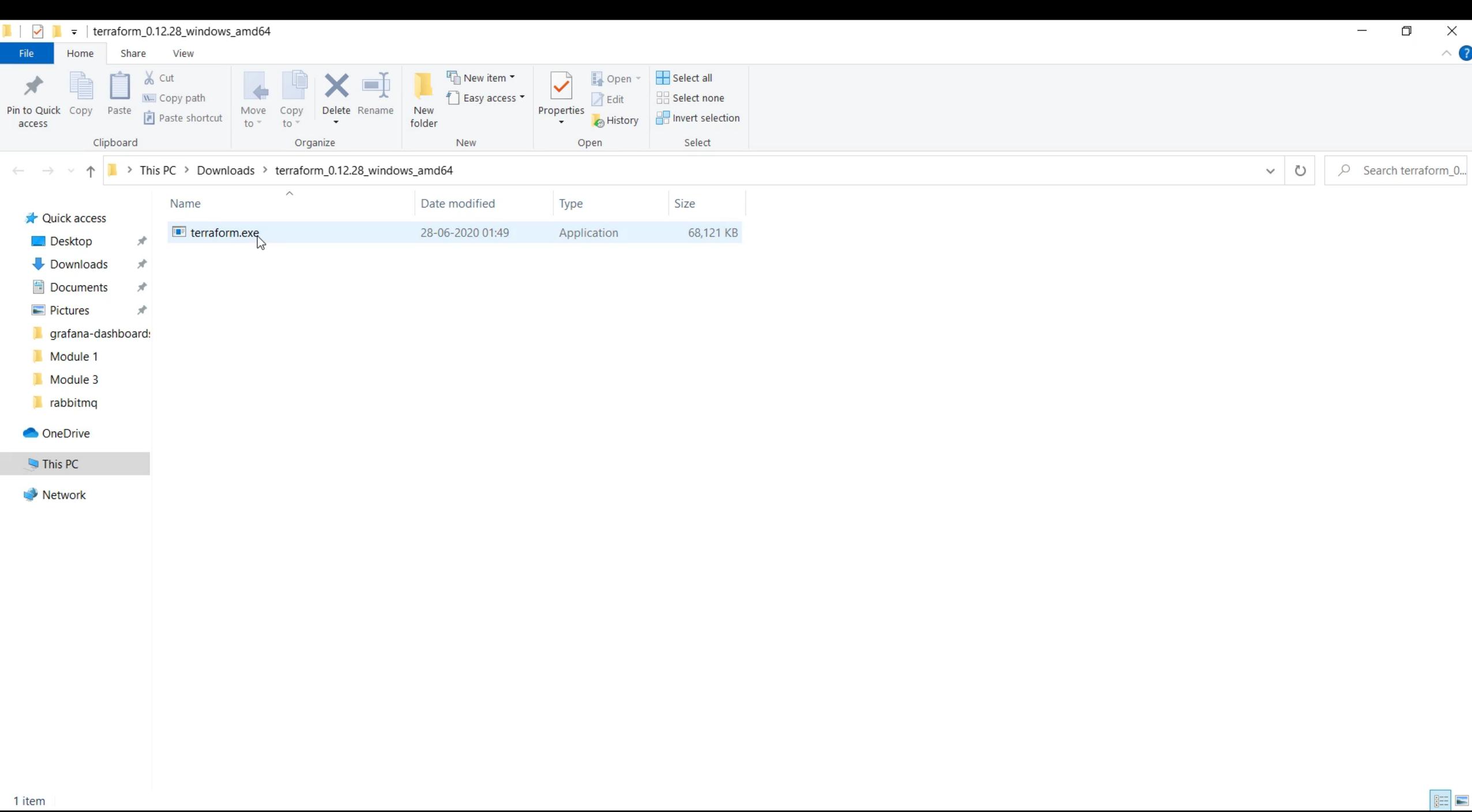
# Installation

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## On Windows

- Download the package and unzip it
- Add the directory containing the binary to the PATH environment variable
- Use package manager such as chocolatey
  - `choco install terraform`
  - `choco install terraform --pre`





C:\&gt;terraform -help

Usage: terraform [-version] [-help] &lt;command&gt; [args]

The available commands for execution are listed below.

The most common, useful commands are shown first, followed by less common or more advanced commands. If you're just getting started with Terraform, stick with the common commands. For the other commands, please [read the help and docs before usage](#).

Common commands:

apply	Builds or changes infrastructure
console	Interactive console for Terraform interpolations
destroy	Destroy Terraform-managed infrastructure
env	Workspace management
fmt	Rewrites config files to canonical format
get	Download and install modules for the configuration
graph	Create a visual graph of Terraform resources
import	Import existing infrastructure into Terraform
init	Initialize a Terraform working directory
login	Obtain and save credentials for a remote host
logout	Remove locally-stored credentials for a remote host
output	Read an output from a state file
plan	Generate and show an execution plan
providers	Prints a tree of the providers used in the configuration
refresh	Update local state file against real resources
show	Inspect Terraform state or plan
taint	Manually mark a resource for recreation
untaint	Manually unmark a resource as tainted
validate	Validates the Terraform files
version	Prints the Terraform version
workspace	Workspace management

All other commands:

0.12upgrade	Rewrites pre-0.12 module source code for v0.12
debug	Debug output management (experimental)
force-unlock	Manually unlock the terraform state
push	Obsolete command for Terraform Enterprise legacy (v1)
state	Advanced state management

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terraform.io/downloads.html

Incognito

64-bit

 FreeBSD  
32-bit | 64-bit | Arm

 Linux  
32-bit | 64-bit | Arm

 OpenB  
32-bit | 64-bit

 Solaris  
64-bit

 Windows  
32-bit | 64-bit

fastly

[https://releases.hashicorp.com/terraform/0.12.28/terraform\\_0.12.28\\_linux\\_amd64.zip](https://releases.hashicorp.com/terraform/0.12.28/terraform_0.12.28_linux_amd64.zip)

terraform\_0.12.28....zip

Show all

A screenshot of a web browser showing the Terraform download page on terraform.io. The page lists download links for various operating systems: FreeBSD, Linux, OpenBSD, Solaris, and Windows. A context menu is open over the '64-bit' link for the Linux entry, with options like 'Open link in new tab', 'Open link in new window', 'Open link in incognito window', 'Save link as...', and 'Copy link address'. At the bottom of the page, there is a large red 'fastly' logo. The browser's address bar shows the URL of the download file. The status bar at the bottom indicates the file is being downloaded.

[root@rhel76 home]

```
[root@rhel76 home]# cd /home/terraform/  
[root@rhel76 terraform]# ls  
[root@rhel76 terraform]# wget https://releases.hashicorp.com/terraform/0.12.28/terraform_0.12.28_linux_amd64.zip  
--2020-06-28 01:58:26-- https://releases.hashicorp.com/terraform/0.12.28/terraform_0.12.28_linux_amd64.zip  
Resolving releases.hashicorp.com (releases.hashicorp.com)... 151.101.153.183, 2a04:4e42:24::439  
Connecting to releases.hashicorp.com (releases.hashicorp.com)|151.101.153.183|:443... connected.  
HTTP request sent, awaiting response... 200 OK  
Length: 28425934 (27M) [application/zip]  
Saving to: 'terraform_0.12.28_linux_amd64.zip'  
  
100%[=====] 28,425,934 9.77MB/s in 2.8s
```

2020-06-28 01:58:29 (9.77 MB/s) - 'terraform\_0.12.28\_linux\_amd64.zip' saved [28425934/28425934]

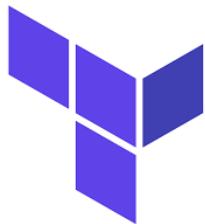
```
[root@rhel76 terraform]# ls -l  
total 27760  
-rw-r--r--. 1 root root 28425934 Jun 25 19:05 terraform_0.12.28_linux_amd64.zip  
[root@rhel76 terraform]# unzip terraform_0.12.28_linux_amd64.zip  
Archive: terraform_0.12.28_linux_amd64.zip  
  inflating: terraform  
[root@rhel76 terraform]# ls -l  
total 95944  
-rwxr-xr-x. 1 root root 69818039 Jun 25 18:41 terraform  
-rw-r--r--. 1 root root 28425934 Jun 25 19:05 terraform_0.12.28_linux_amd64.zip  
[root@rhel76 terraform]# 
```

# Terraform in practice

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## Terraform State files



# Terraform State files

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## What is state in terraform?

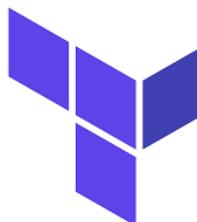
- ❑ Terraform stores the infrastructure objects and its values in the state file
- ❑ This state is used by terraform to map real world resources
- ❑ Prior to any operation, Terraform does a refresh to update the state with the real infrastructure
- ❑ State file named **terraform.tfstate** will get generated



# Terraform State files

## What is state in terraform? ...contd.

- Terraform state can contain sensitive data, depending on the resources in use
- By default, the state file will be stored on local machine running Terraform
- But it can be configured to use Remote Storage
- Quite a few backends can be used to support Remote Storage
- State helps provides idempotence to terraform
- It allows the users to make incremental changes in the future, to the infrastructure

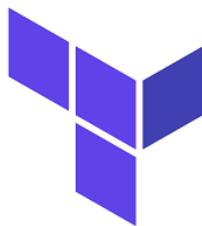


# Terraform State files

## Benefits of State file

### Example of a State file

```
{  
  "version": 4,  
  "terraform_version": "0.12.6",  
  "serial": 19,  
  "lineage": "39c80729-666d-388a-51a3-75884ac6d1df",  
  "outputs": {},  
  "resources": [  
    {  
      "mode": "managed",  
      "type": "aws_ebs_volume",  
      "name": "name",  
      "provider": "provider.aws",  
      "instances": [  
        {  
          "schema_version": 0,  
          "attributes": {  
            "arn": "arn:aws:ec2:us-west-2:559605288921:volume/vol-021c7ed1195eea8de",  
            "availability_zone": "us-west-2a",  
            "encrypted": false,  
            "id": "vol-021c7ed1195eea8de",  
            "iops": 100,  
            "kms_key_id": "",  
            "multi_attach_enabled": false,  
            "outpost_arn": "",  
            "size": 10,  
            "snapshot_id": "",  
            "tags": null,  
            "type": "gp2"  
          },  
          "private": "bnVsbA=="  
        }  
      ]  
    }  
  ]  
}
```

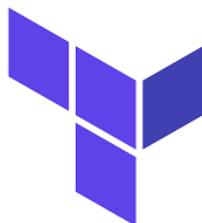


# Terraform State files

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## State Locking

- While we are adding something to the configuration file, a lock gets enabled
- Once the update gets completed, the lock is released
- It makes sure that no two members can do the configuration updates and changes at the same time
- If state locking fails, Terraform will not continue

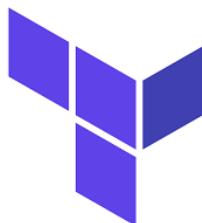


# Terraform State files

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## Local State Storage

- It stores the state file on the local file system
- Using system APIs it will lock the state file and performs all the operations locally
- Use of local file makes terraform usage hard among team members
- State file stores data (including the sensitive content) in the plain-text json format



# Terraform State files

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## Remote State Storage

- Terraform writes the state data to a remote data store, which can then be shared between all members of a team
- Terraform supports storing state in Terraform Cloud, HashiCorp Consul, Amazon S3, Alibaba Cloud OSS and more
- Remote work allows you to delegate the outputs to other teams
- Storing the state file remotely helps prevent sensitive information
- Storing state remotely can provide better security as well

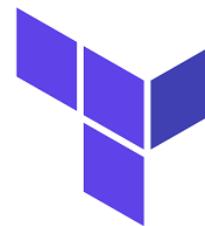


# Terraform

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Manage Infrastructure

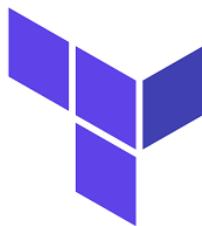


# Manage Infrastructure

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## Topics in this section

- ❑ How terraform works and what are the core and plugin components?
- ❑ What are providers and how they work
- ❑ The initialization process.
- ❑ Terraform plan and apply processes.
- ❑ Terraform destroy

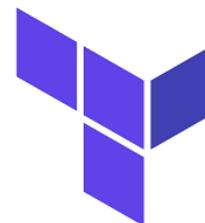


# Manage Infrastructure

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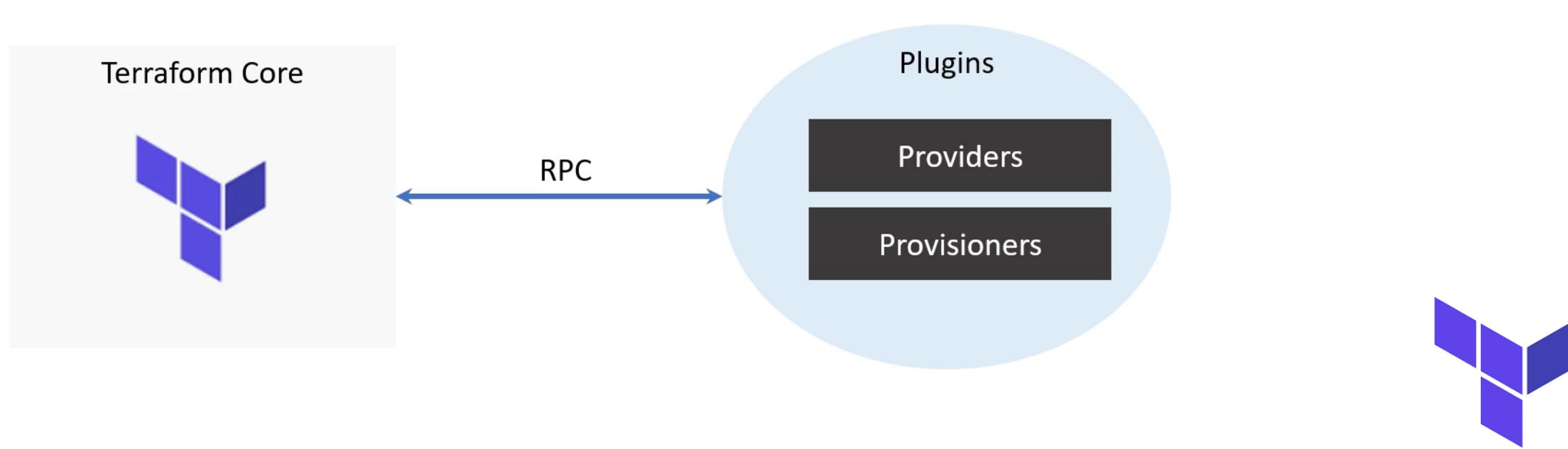
## How Terraform Works



# How Terraform Works

## Main Parts

- ❑ Open source tool which is written in Go programming language
- ❑ We just need the binary to deploy the infrastructure



# How Terraform Works

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## Terraform Core – Responsibilities

- ❑ Infrastructure as code
- ❑ Resource state management
- ❑ Construction of the Resource Graph
- ❑ Plan execution
- ❑ Communication with plugins over RPC



# How Terraform Works

## Terraform Plugins

- External single static binaries
- Each plugin exposes an implementation for a service provider or provisioner
- Several Provisioners are built-in, while Providers are discovered dynamically

### Responsibilities of Provider Plugins

- Initialization of any included libraries
- Authentication
- Define resources

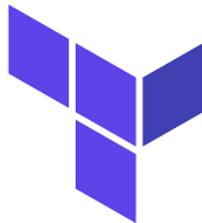
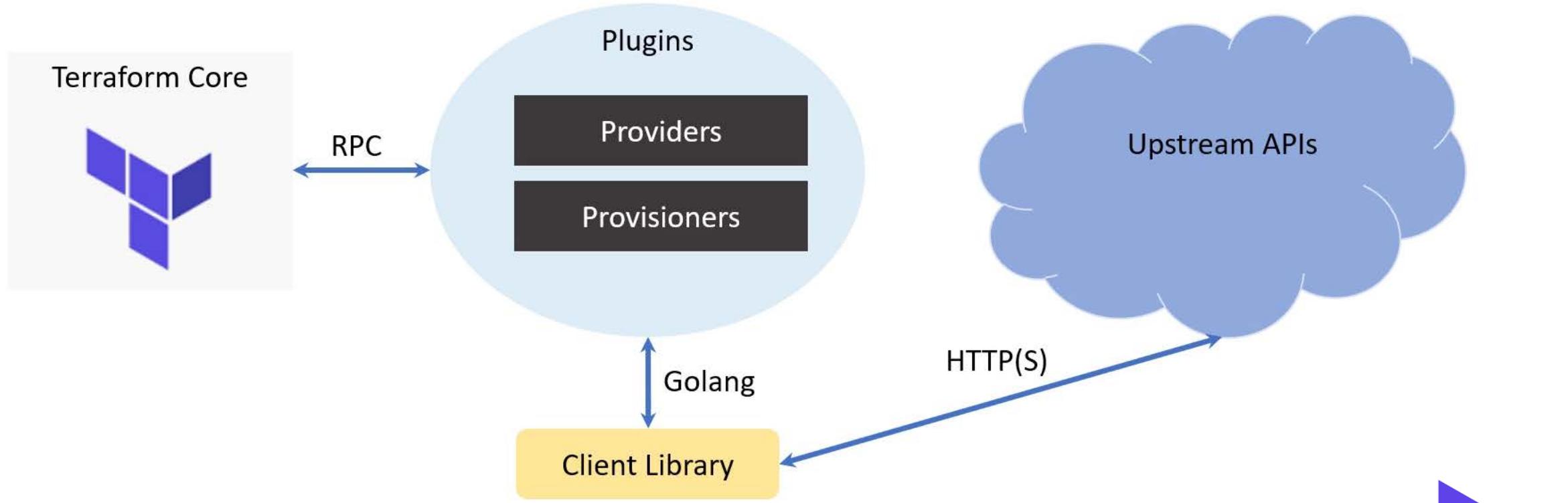
### Responsibilities of Provisioner Plugins

- Executing commands or scripts on the designated Resource after creation, or on destruction



# How Terraform Works

## Working



# How Terraform Works

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## Providers

- Communicate with clouds and other servers; expose resources
- Below are some providers:
  - GitLab
  - Google Cloud Platform
  - AWS
  - Azure
  - Rancher



# How Terraform Works

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## *init* command

- Used to initialize a working directory containing Terraform configuration files
- Terraform reads configuration files to determine which plugins are necessary
- Searches and decides which plugin versions to use
- Writes a lock file
- Plugins behave in one of three ways:
  - Built-in provisioners
  - Providers distributed by HashiCorp
  - Third-party providers and provisioners





Services

Resource Groups



N. California

Support

 New EC2 Experience  
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Tags

Reports

Limits

**INSTANCES**

Instances

Instance Types

Launch Templates

Spot Requests

Savings Plans

Reserved Instances

Dedicated Hosts [New](#)

Capacity Reservations

**IMAGES**

AMIs

Bundle Tasks

**ELASTIC BLOCK STORE**

Volumes

EC2

**Resources**

You are using the following Amazon EC2 resources in the US West (N. California) Region:

Running instances	0	Elastic IPs	0
Dedicated Hosts	0	Snapshots	0
Volumes	0	Load balancers	0
Key pairs	0	Security groups	1
Placement groups	0		

Easily size, configure, and deploy Microsoft SQL Server Always On availability groups on AWS using the AWS Launch Wizard for SQL Server. [Learn more](#)

**Launch instance**

To get started, launch an Amazon EC2 instance, which is a virtual server in the cloud.

**Service health**

Region Status

**Account attributes** **Supported platforms**

- VPC

**Default VPC**

vpc-c2c7d2a5

**Settings**[EBS encryption](#)[Zones](#)[Console experiments](#)**Additional information** [Getting started guide](#)[Documentation](#)[All EC2 resources](#)[Forums](#)[Pricing](#)[Contact us](#)

```
D:\tf-labs  
> code .  
  
D:\tf-labs  
> cd ../../  
  
D:\  
> terraform-training  
'terraform-training' is not recognized as an internal or external command,  
operable program or batch file.
```

```
D:\  
> cd terraform-training
```

```
D:\terraform-training  
> code .
```

```
D:\terraform-training  
> terraform init
```

Initializing the backend...

Initializing provider plugins...

- Finding latest version of hashicorp/aws...
- Installing hashicorp/aws v3.36.0...
- Installed hashicorp/aws v3.36.0 (signed by HashiCorp)

The following providers do not have any version constraints in configuration,  
so the latest version was installed.

To prevent automatic upgrades to new major versions that may contain breaking  
changes, we recommend adding version constraints in a required\_providers block  
in your configuration, with the constraint strings suggested below.

```
* hashicorp/aws: version = "~> 3.36.0"
```

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.

```
D:\terraform-training  
>
```



Type here to search



```
+ delete_on_termination = (known after apply)
+ device_index          = (known after apply)
+ network_interface_id = (known after apply)
}

+ root_block_device {
  + delete_on_termination = (known after apply)
  + device_name           = (known after apply)
  + encrypted              = (known after apply)
  + iops                   = (known after apply)
  + kms_key_id             = (known after apply)
  + tags                   = (known after apply)
  + throughput              = (known after apply)
  + volume_id               = (known after apply)
  + volume_size              = (known after apply)
  + volume_type              = (known after apply)
}
}
```

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

---

Note: You didn't specify an "-out" parameter to save this plan, so Terraform can't guarantee that exactly these actions will be performed if "terraform apply" is subsequently run.

```
D:\terraform-training
> terraform plan
Refreshing Terraform state in-memory prior to plan...
The refreshed state will be used to calculate this plan, but will not be persisted to local or remote state storage.
```

---

An execution plan has been generated and is shown below.  
Resource actions are indicated with the following symbols:

+ create

Terraform will perform the following actions:

```
# aws_instance.example1 will be created
+ resource "aws_instance" "example1" {
  + ami                  = "ami-0742b4e673072066f"
  + arn                  = (known after apply)
  + associate_public_ip_address = (known after apply)
  + availability_zone      = (known after apply)
  + cpu_core_count         = (known after apply)
```



Type here to search



```
D:\terraform-training  
> terraform apply
```

An execution plan has been generated and is shown below.  
Resource actions are indicated with the following symbols:

+ create

Terraform will perform the following actions:

```
# aws_instance.example1 will be created  
+ resource "aws_instance" "example1" {  
    + ami                      = "ami-0742b4e673072066f"  
    + arn                      = (known after apply)  
    + associate_public_ip_address = (known after apply)  
    + availability_zone        = (known after apply)  
    + cpu_core_count           = (known after apply)  
    + cpu_threads_per_core     = (known after apply)  
    + get_password_data        = false  
    + host_id                  = (known after apply)  
    + id                       = (known after apply)  
    + instance_state           = (known after apply)  
    + instance_type             = "t2.micro"  
    + ipv6_address_count       = (known after apply)  
    + ipv6_addresses           = (known after apply)  
    + key_name                 = (known after apply)  
    + outpost_arn              = (known after apply)  
    + password_data            = (known after apply)  
    + placement_group          = (known after apply)  
    + primary_network_interface_id = (known after apply)  
    + private_dns               = (known after apply)  
    + private_ip                = (known after apply)  
    + public_dns                = (known after apply)  
    + public_ip                 = (known after apply)  
    + secondary_private_ips    = (known after apply)  
    + security_groups           = (known after apply)  
    + source_dest_check         = true  
    + subnet_id                 = (known after apply)  
    + tenancy                   = (known after apply)  
    + vpc_security_group_ids   = (known after apply)  
  
+ ebs_block_device {  
    + delete_on_termination = (known after apply)  
    + device_name          = (known after apply)  
    + encrypted             = (known after apply)  
    + iops                  = (known after apply)  
    + kms_key_id            = (known after apply)  
    + snapshot_id           = (known after apply)  
    + tags                  = (known after apply)  
    + throughput             = (known after apply)
```



Type here to search



```
+ device_name  = (known after apply)
+ no_device    = (known after apply)
+ virtual_name = (known after apply)
}

+ metadata_options {
  + http_endpoint          = (known after apply)
  + http_put_response_hop_limit = (known after apply)
  + http_tokens             = (known after apply)
}

+ network_interface {
  + delete_on_termination = (known after apply)
  + device_index          = (known after apply)
  + network_interface_id  = (known after apply)
}

+ root_block_device {
  + delete_on_termination = (known after apply)
  + device_name           = (known after apply)
  + encrypted              = (known after apply)
  + iops                   = (known after apply)
  + kms_key_id             = (known after apply)
  + tags                   = (known after apply)
  + throughput              = (known after apply)
  + volume_id               = (known after apply)
  + volume_size              = (known after apply)
  + volume_type              = (known after apply)
}
```

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

Do you want to perform these actions?

Terraform will perform the actions described above.

Only 'yes' will be accepted to approve.

Enter a value: yes

```
aws_instance.example1: Creating...
aws_instance.example1: Still creating... [10s elapsed]
aws_instance.example1: Still creating... [20s elapsed]
aws_instance.example1: Still creating... [30s elapsed]
aws_instance.example1: Still creating... [40s elapsed]
aws_instance.example1: Creation complete after 44s [id=i-0cf7e4a6a1613d685]
```

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

D:\terraform-training

>



Type here to search



ENG

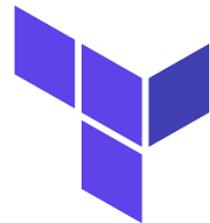
17:04  
12-04-2021

# How Terraform Works

---

## *destroy command*

- ❑ Destroy the infrastructure changes



```
    ] -> null
- source_dest_check      = true -> null
- subnet_id              = "subnet-2497f705" -> null
- tags                   = {} -> null
- tenancy                = "default" -> null
- vpc_security_group_ids = [
  - "sg-0e8e1301",
]
] -> null

- credit_specification {
  - cpu_credits = "standard" -> null
}

- enclave_options {
  - enabled = false -> null
}

- metadata_options {
  - http_endpoint         = "enabled" -> null
  - http_put_response_hop_limit = 1 -> null
  - http_tokens           = "optional" -> null
}
}

- root_block_device {
  - delete_on_termination = true -> null
  - device_name          = "/dev/xvda" -> null
  - encrypted             = false -> null
  - iops                  = 100 -> null
  - tags                  = {} -> null
  - throughput            = 0 -> null
  - volume_id             = "vol-03cfe688c4a7094b9" -> null
  - volume_size            = 8 -> null
  - volume_type            = "gp2" -> null
}
}
```

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

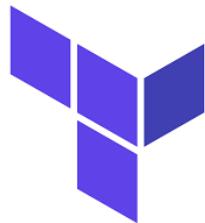
```
aws_instance.example1: Destroying... [id=i-0cf7e4a6a1613d685]
aws_instance.example1: Still destroying... [id=i-0cf7e4a6a1613d685, 10s elapsed]
aws_instance.example1: Still destroying... [id=i-0cf7e4a6a1613d685, 20s elapsed]
aws_instance.example1: Still destroying... [id=i-0cf7e4a6a1613d685, 30s elapsed]
aws_instance.example1: Still destroying... [id=i-0cf7e4a6a1613d685, 40s elapsed]
```

# Manage Infrastructure

---



## Plugins: Providers

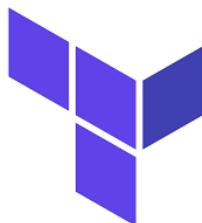


# Plugins: Providers

---

## Concepts

- ❑ Provider is a plugin used to communicate with the external services through the use of APIs
  - ❖ Examples – AWS, GCP, Microsoft Azure, OpenStack
  - ❖ Examples – Heroku
  - ❖ Examples – RabbitMQ, CloudFlare, PostgreSQL
- ❑ Provider offers resource types and certain arguments for each type



 Providers Modules

FILTERS

[Clear Filters](#)

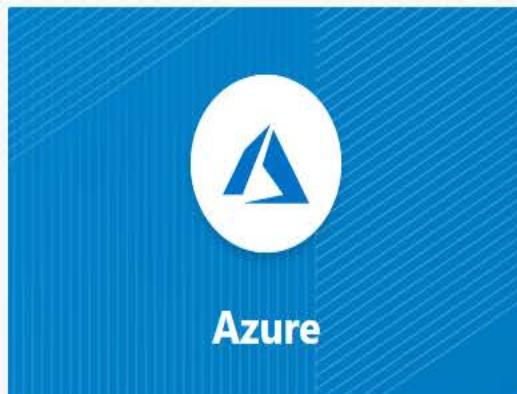
Tier ?

  Official  Verified Community

Category

 HashiCorp Platform Public Cloud Asset Management Cloud Automation Communication & Messaging Container Orchestration Continuous Integration/Deployment (CI/CD) Data Management Database Providers

Providers are a logical abstraction of an upstream API. They are responsible for understanding API interactions and exposing resources.



# Plugins: Providers

## Provider and Resources

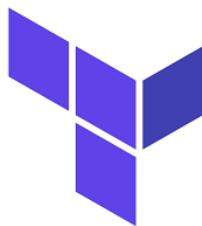
### □ Provider Block

```
provider "aws" {  
}
```

<https://registry.terraform.io/browse/providers> version 0.12.6

### □ Resource Block

```
resource "resource_type" "name" {  
}
```



# Plugins: Providers

## Authentication

### □ Static credentials

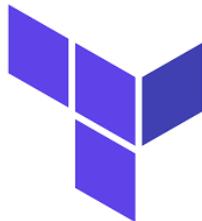
```
provider "aws" {
  region      = "us-west-2"
  access_key  = "AKIAYESYTB7MUAMNK5XX"
  secret_key  = "WRAZAk+0Pd8XXxxXXTTz7EB2bZsORS+IOUhDAr"
}
```

### □ Environment variables

```
$ export AWS_ACCESS_KEY_ID="AKIAYESYTB7MUAMNK5XX"
```

```
$ export AWS_SECRET_ACCESS_KEY="WRAZAk+0Pd8XXxxXXTTz7EB2bZsORS+IOUhDAr"
```

```
provider "aws" {
  region      = "us-west-2"
}
```



# Plugins: Providers

## Authentication

### □ Shared Credentials file

- ❖ AWS CLI creates the credentials file at **\$HOME/.aws/credentials** on Linux, by default

```
provider "aws" {  
    region          = "us-west-2"  
    shared_credentials_file = "/terraform/aws/creds"  
}
```

- ❖ Alternatively, by configuring the **AWS\_SHARED\_CREDENTIALS\_FILE** environment variable

### □ EC2 Role

- ❖ Running Terraform from an EC2 instance with IAM Instance Profile using IAM Role
- ❖ Running Terraform on ECS or CodeBuild



# Plugins: Providers

## Provider Meta-Arguments

### □ Provider Versions

- ❖ Providers are released on a separate rhythm from Terraform itself
- ❖ When `terraform init` is run without provider version it prints a suggested version string

```
* provider.aws: version = "~> 2.69"  
Terraform has been successfully initialized!
```

- ❖ To upgrade the providers, use `-upgrade` flag
- ❖ To constrain the provider version as needed, add a `required_providers` block

```
terraform {  
  required_providers {  
    aws = "~> 1.0"  
  }  
}
```



# Plugins: Providers

## Provider Meta-Arguments

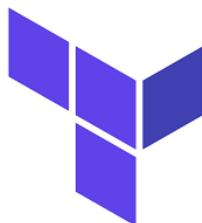
### □ Alias

- ❖ It creates an additional provider configuration

```
# The default provider configuration
provider "aws" {
  region = "us-east-1"
}

# Additional provider configuration for west coast region
provider "aws" {
  alias  = "west"
  region = "us-west-2"
}
```

- ❖ To include multiple configurations for a given provider



# Plugins: Providers

---

## Individual Provider Arguments

- Arguments supported by individual providers
- List of arguments for AWS –
  - ❖ <https://www.terraform.io/docs/providers/aws/index.html#argument-reference>

`region` - (Optional) This is the AWS region. It must be provided, but it can also be sourced from the `AWS_DEFAULT_REGION` environment variables, or via a shared credentials file if `profile` is specified.



- › Security Hub
- › SES
- › Service Catalog
- › Service Discovery
- › Service Quotas
- › Shield
- › SimpleDB
- › SNS
- › SQS
- › SSM
- › Step Function (SFN)
- › Storage Gateway
- › SWF
- › Transfer
- › VPC
- › WAF
- › WAF Regional
- › WAFv2
- › WorkLink
- › WorkSpaces
- › XRay

# Argument Reference

In addition to `generic provider` arguments (e.g. `alias` and `version`), the following arguments are supported in the AWS `provider` block:

- `access_key` - (Optional) This is the AWS access key. It must be provided, but it can also be sourced from the `AWS_ACCESS_KEY_ID` environment variable, or via a shared credentials file if `profile` is specified.
- `secret_key` - (Optional) This is the AWS secret key. It must be provided, but it can also be sourced from the `AWS_SECRET_ACCESS_KEY` environment variable, or via a shared credentials file if `profile` is specified.
- `region` - (Optional) This is the AWS region. It must be provided, but it can also be sourced from the `AWS_DEFAULT_REGION` environment variables, or via a shared credentials file if `profile` is specified.
- `profile` - (Optional) This is the AWS profile name as set in the shared credentials file.
- `assume_role` - (Optional) An `assume_role` block (documented below). Only one `assume_role` block may be in the configuration.
- `endpoints` - (Optional) Configuration block for customizing service endpoints. See the [Custom Service Endpoints Guide](#) for more information about connecting to alternate AWS endpoints or AWS compatible solutions.
- `shared_credentials_file` = (Optional) This is the path to the shared credentials file. If this is not set and a profile is specified, `~/.aws/credentials` will be used.
- `token` - (Optional) Session token for validating temporary credentials. Typically provided after successful identity federation or Multi-Factor Authentication (MFA) login. With MFA login, this is the session token provided afterwards, not the 6 digit MFA code used to get temporary credentials. It can also be sourced

# Plugins: Providers

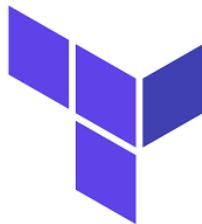
## Provider and Resources

### □ Provider Block

```
provider "aws" {  
}
```

### □ Resource Block

```
resource "resource_type" "name" {  
}
```



# Plugins: Providers

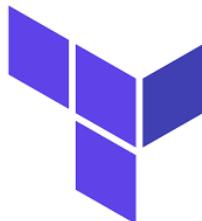
---

## Resources

- Each resource block describes one or more infrastructure objects, such as -
  - ❖ virtual networks
  - ❖ compute instances
  - ❖ higher-level components such as DNS records
- Used in conjunction with providers

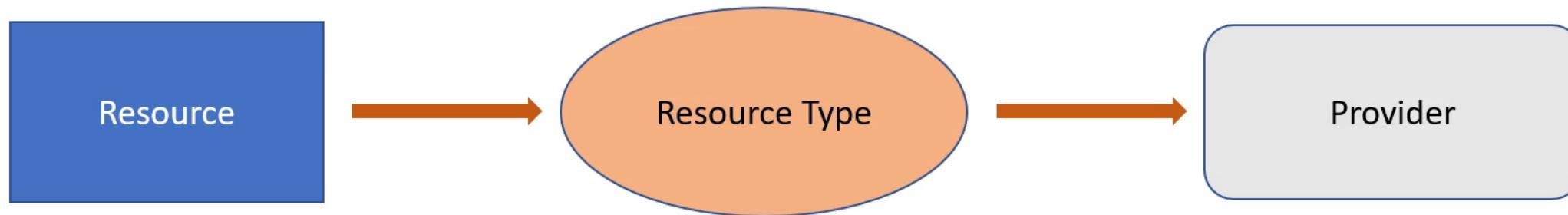
```
resource "aws_instance" "example1" {  
    ami = "ami-04e59c05167ea7bd5"  
    instance_type = "t2.micro"  
}
```

- The resource type and name together serve as an identifier for a given resource



# Plugins: Providers

## Resource type and Arguments

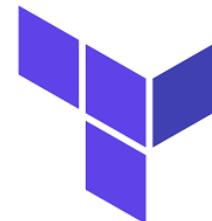


```
resource "resource_type" "name" {  
}
```



### ❑ Resource Meta-arguments

- count
- depends\_on
- for\_each



# Plugins: Providers

## Resource Meta-Arguments

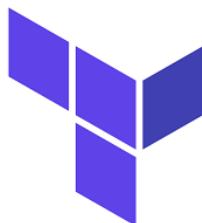
### □ Count

```
resource "aws_instance" "example" {
    count = 4

    ami          = "ami-04e59c05167ea7bd5"
    instance_type = "t2.micro"

    tags = {
        Name = "Server ${count.index}"
    }
}
```

- ❖ Terraform creates that many instances of the resource as mentioned with the count variable
- ❖ Count.index gives a distinct index number (starting with 0) to each of the instances

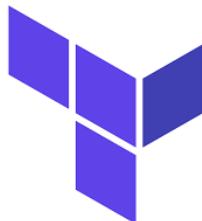


# Plugins: Providers

---

## Resource Behavior

- When Terraform creates a new infrastructure object represented by a resource block, the identifier for that real object is saved in Terraform's state
- For already existing resources, Terraform compares the actual configuration of the object with the arguments given in the configuration



# References:

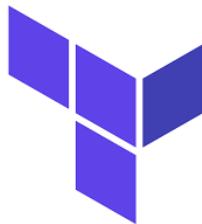
- <https://registry.terraform.io/providers/hashicorp/aws/latest/docs>
- <https://registry.terraform.io/providers/hashicorp/aws/latest/docs/resources/eip>

# Plugins: Providers

---

## Examples

- ❑ Create EC2 Instance with Elastic IP Address
- ❑ Create S3 storage in AWS

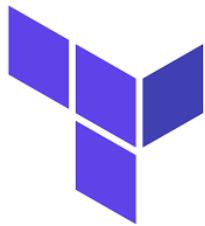


# Terraform

---



## Variables and Values



# Input Variables

---

## Introduction

- To become truly shareable and useful in production, we need to parameterize the configurations
- Source code in the shared repo can be used differently
- Three aspects of using input variables:
  - Defining variables
  - Assigning values to variables
  - Using variables in a configuration

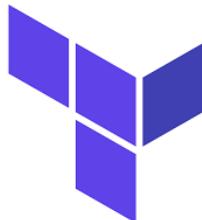


# Input Variables

---

## Defining Variables

- Input variables are usually defined by stating –
  - Name
  - Type (*Optional*)
  - Default value (*Optional*)
- Type of the variable –
  - String, Number or Boolean
  - Rich data types as list, set, map, object or tuple
- Description for the variable





aws-resource.tf terraform.tfvars vars.tf X

04\_1\_variables > vars.tf

```
1
2
3 variable "region" {
4     default = "us-east-1"
5 }
6
7 variable "instance_type" {
8 }
9
10 variable "aws_ami_id" {
11     type = string
12     description = "The id of the machine image (AMI) to use for the server."
13     default = "ami-04e59c05167ea7bd5"
14 }
15
16
17 variable "vpc_val" {
18     type = bool
19 }
20
21
22 variable "cidrs" {
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Microsoft Windows [Version 10.0.19041.329]  
(c) 2020 Microsoft Corporation. All rights reserved.

D:\Terraform\My-Course\Resources>cd 04\_1\_variables

D:\Terraform\My-Course\Resources\04\_1\_variables>[]

1: cmd

+ □ ^ ×

⚠ No root module found for vars.tf functionality may be limited

⚠ No root module found for aws-resource.tf functionality may be limited

aws-resource.tf

terraform.tfvars

vars.tf

X

```
04_1_variables > vars.tf
18     type = bool
19 }
20
21 variable "cidrs" {
22     type = "list"
23     default = [ "10.0.0.0/16", "10.1.0.0/16" ]
24 }
25
26 variable "amis" {
27     type = "map"
28     default = {
29         "us-east-1" = "ami-b374d5a5"
30         "us-west-2" = "ami-4b32be2b"
31     }
32 }
33
34
35 variable "image_id" []
36     type      = string
37     description = "The id of the machine image (AMI) to use for the server."
38
39
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Microsoft Windows [Version 10.0.19041.329]  
(c) 2020 Microsoft Corporation. All rights reserved.

D:\Terraform\My-Course\Resources&gt;cd 04\_1\_variables

D:\Terraform\My-Course\Resources\04\_1\_variables&gt;[]

1: cmd

+ ×

04:24

Ln 36, Col 22 Spaces: 2, EOL: CRLF Terraform

# Input Variables

## Assigning values to Variables

- Command-line flags –

```
$ terraform apply -var 'region=us-east-1'
```

- In variables definition files –

- We can create a file and assign variables within this file
- Files terraform.tfvars or any variation of \*.auto.tfvars are automatically loaded
- Can also specify file as terraform.tfvars.json or any file ending in .auto.tfvars.json
- Can use the -var-file flag to specify a file name

```
$ terraform apply -var-file="testing.tfvars"
```



A screenshot of the Visual Studio Code interface, showing a Terraform configuration file named `terraform.tfvars`. The file contains the following code:

```
1  region = "us-east-1"
2
3  image_id = "ami-abc123"
4
5  availability_zone_names = [
6      "us-east-1a",
7      "us-west-1c",
8  ]
```

The left sidebar shows the project structure under the `RESOURCES` section, including files like `03_4_aws-instance-eip`, `03_4_aws-s3`, `04_1_variables`, `aws-resource.tf`, `terraform.tfvars` (which is currently selected), `vars.tf`, `04_2_Example`, `04_3_Outputs`, `04_4_Data_Sources`, `03_2_aws-instance.tf`, and `03_3_temp.tf`.

The bottom right corner shows the terminal tab is active, with the path `D:\Terraform\My-Course\Resources>[]` displayed.

File Edit Selection View Go Run Terminal Help terraform.tfvars - Resources - Visual Studio Code

EXPLORER

OPEN EDITORS

RESOURCES

- > 03\_4\_aws-instance-eip
- > 03\_4\_aws-s3
- > 04\_1\_variables
  - aws-resource.tf
  - terraform.tfvars
- > vars.tf
- > 04\_2\_Example
- > 04\_3\_Outputs
- > 04\_4\_Data\_Sources
- > 03\_2\_aws-instance.tf
- > 03\_3\_temp.tf

terraform.tfvars X

04\_1\_variables > terraform.tfvars

```
1  region = "us-east-1"
2
3  image_id = "ami-abc123"
4
5  availability_zone_names = [
6      "us-east-1a",
7      "us-west-1c",
8  ]
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: cmd

D:\Terraform\My-Course\Resources>[]

OUTLINE

TIMELINE

Ln 10, Col 1 Spaces: 2 CRLF tfvars

# Input Variables

---

## Assigning values to Variables ...contd.

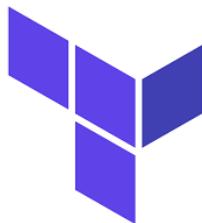
### □ Environment Variables –

- Environment variables named `TF_VAR_` followed by the name of a declared variable
- Can only populate string-type variables

### □ UI input –

- Terraform asks to input the values interactively, if unspecified

I



# Input Variables

---

## Assigning values to Variables - Priority of variables

- A variable cannot be assigned values multiple times within the same source
- A variable can be assigned values multiple times across multiple sources
- Precedence order is as follows –
  - Environment variables
  - `terraform.tfvars` file
  - `terraform.tfvars.json` file
  - Any `*.auto.tfvars` or `*.auto.tfvars.json` files
  - Any `-var` and `-var-file` options on the command line



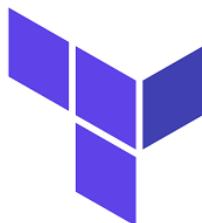
# Input Variables

## Using variables in Configuration

- value of the variable can be accessed from within expressions as var.<NAME>

```
provider "aws" {  
    region      = var.region  
}
```

```
resource "aws_instance" "example" {  
    instance_type = var.instance_type  
    ami          = var.aws_ami_id  
}
```

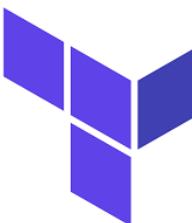


# Input Variables

## Custom Validation Rules

- In addition to Type Constraints such as the type of input as string, Boolean etc.
- Using Custom validation, we can specify arbitrary validation rules

```
variable "image_id" {  
    type      = string  
    description = "The id of the machine image (AMI) to use for the server."  
  
    validation {  
        condition      = length(var.image_id) > 4 && substr(var.image_id, 0, 4) == "ami-"  
        error_message = "The image_id value must be a valid AMI id, starting with \"ami-\"."  
    }  
}
```

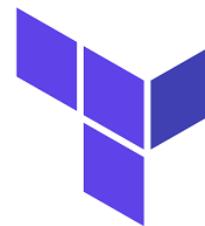


# Variables and Values

---



Example using Variables

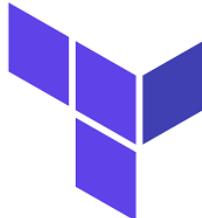


# Example using Variables

---

## Objective

- ❑ In AWS, select region us-west-2
- ❑ Create VPC & subnet
- ❑ Spin an instance with t2.micro type
- ❑ Provide two 10 GB EBS storage devices
- ❑ Add a tag with Name as Variables-1
- ❑ Use the default security group and launch the instance



# Variables and Values

---



## Output Variables



# Output Variables

---

## Introduction

- Used to get information about the infrastructure after deployment
- With output variables, we can extract any server-specific values including the calculated details
- Data is outputted when **terraform apply** is called, and  
Can be queried using the **terraform output** command as well

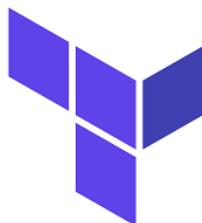


# Output Variables

---

## Defining Outputs

- To define the output of a configuration, we need to define an output block
- Multiple output blocks are supported
- Output can optionally include **description**, **sensitive** & **depends\_on** arguments
- Query the outputs after apply-time using **terraform output** command





EXPLORER

OPEN EDITORS

instance.tf 04\_3\_Outputs

RESOURCES

&gt; 03\_4\_aws-instance-eip

&gt; 03\_4\_aws-s3

&gt; 04\_1\_variables

&gt; 04\_2\_Example

&gt; 04\_3\_Outputs

instance.tf

terraform.tfvars

var.tf

&gt; 04\_4\_Data\_Sources

03\_2\_aws-instance.tf

03\_3\_temp.tf

instance.tf X

04\_3\_Outputs &gt; instance.tf

```
82
83
84
85    ### Output ####
86    output "instance_public_ip" {
87        value = aws_instance.example_ec2.public_ip
88    }
89
90    output "instance_state" {
91        value = aws_instance.example_ec2.instance_state
92        description = "The state of the server instance."
93    }
94
95    output "instance_public_ip_sensitive" {
96        value = aws_instance.example_ec2.public_ip
97        sensitive = true
98    }
99
```



PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: cmd

+ □ ×

D:\Terraform\My-Course\Resources\04\_3\_Outputs&gt;[]



&gt; OUTLINE

&gt; TIMELINE

⊗ 0 △ 0

Ln 99, Col 1 Spaces: 2 UTF-8 LF Terraform

```
aws_internet_gateway.name: Still creating... [10s elapsed]
aws_internet_gateway.name: Creation complete after 11s [id=igw-0c3299eb2ff310a2d]
aws_route_table.name: Creating...
aws_route_table.name: Creation complete after 5s [id=rtb-077c832b75b891b3f]
aws_route_table_association.a[1]: Creating...
aws_route_table_association.a[0]: Creating...
aws_route_table_association.a[0]: Creation complete after 1s [id=rtbassoc-01ee959fd485612a5]
aws_route_table_association.a[1]: Creation complete after 1s [id=rtbassoc-0421b523994458d52]
aws_instance.example_ec2: Still creating... [10s elapsed]
aws_instance.example_ec2: Still creating... [20s elapsed]
aws_instance.example_ec2: Still creating... [30s elapsed]
aws_instance.example_ec2: Still creating... [40s elapsed]
aws_instance.example_ec2: Creation complete after 46s [id=i-0e2afff9c33a02b92]
aws_volume_attachment.name1: Creating...
aws_volume_attachment.name2: Creating...
aws_volume_attachment.name2: Still creating... [10s elapsed]
aws_volume_attachment.name1: Still creating... [10s elapsed]
aws_volume_attachment.name1: Still creating... [20s elapsed]
aws_volume_attachment.name2: Still creating... [20s elapsed]
aws_volume_attachment.name1: Creation complete after 27s [id=vai-660660281]
aws_volume_attachment.name2: Still creating... [30s elapsed]
aws_volume_attachment.name2: Creation complete after 31s [id=vai-1989596956]
```

Apply complete! Resources: 12 added, 0 changed, 0 destroyed.

Outputs:

```
instance_public_ip = 18.236.70.36
instance_public_ip_sensitive = <sensitive>
instance_state = running
```

D:\terraform-training\example01  
>

```
aws_internet_gateway.name: Still creating... [10s elapsed]
aws_internet_gateway.name: Creation complete after 11s [id=igw-0c3299eb2ff310a2d]
aws_route_table.name: Creating...
aws_route_table.name: Creation complete after 5s [id=rtb-077c832b75b891b3f]
aws_route_table_association.a[1]: Creating...
aws_route_table_association.a[0]: Creating...
aws_route_table_association.a[0]: Creation complete after 1s [id=rtbassoc-01ee959fd485612a5]
aws_route_table_association.a[1]: Creation complete after 1s [id=rtbassoc-0421b523994458d52]
aws_instance.example_ec2: Still creating... [10s elapsed]
aws_instance.example_ec2: Still creating... [20s elapsed]
aws_instance.example_ec2: Still creating... [30s elapsed]
aws_instance.example_ec2: Still creating... [40s elapsed]
aws_instance.example_ec2: Creation complete after 46s [id=i-0e2afff9c33a02b92]
aws_volume_attachment.name1: Creating...
aws_volume_attachment.name2: Creating...
aws_volume_attachment.name2: Still creating... [10s elapsed]
aws_volume_attachment.name1: Still creating... [10s elapsed]
aws_volume_attachment.name1: Still creating... [20s elapsed]
aws_volume_attachment.name2: Still creating... [20s elapsed]
aws_volume_attachment.name1: Creation complete after 27s [id=vai-660660281]
aws_volume_attachment.name2: Still creating... [30s elapsed]
aws_volume_attachment.name2: Creation complete after 31s [id=vai-1989596956]
```

Apply complete! Resources: 12 added, 0 changed, 0 destroyed.

#### Outputs:

```
instance_public_ip = 18.236.70.36
instance_public_ip_sensitive = <sensitive>
instance_state = running
```

```
D:\terraform-training\example01
> terraform output
instance_public_ip = 18.236.70.36
instance_public_ip_sensitive = <sensitive>
instance_state = running
```

```
D:\terraform-training\example01
> terraform output instance_public_ip_sensitive
18.236.70.36
```

```
D:\terraform-training\example01
>
```



Type here to search

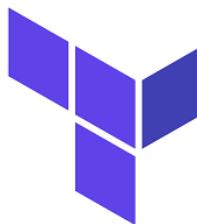


# Variables and Values

---



## Data Sources



# Terraform Data Source

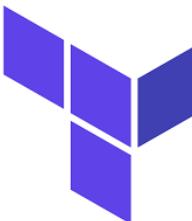
- <https://registry.terraform.io/providers/hashicorp/aws/latest/docs>

# Data Sources

---

## Introduction

- Data Source can query external sources and return data
- Each provider may offer data sources alongside its set of resource types
- All data sources have a list of returned attributes
- Each data instance will export one or more attributes, which can be used in other resources as **data.<TYPE>.<NAME>.<ATTRIBUTE>**



## Amazon Elastic Compute Cloud

User Guide for Linux Instances

What is Amazon EC2?

Set up

Get started tutorial

Best practices

► Tutorials

▼ Amazon Machine Images

AMI types

Virtualization types

Boot modes

[Find a Linux AMI](#)

► Shared AMIs

Paid AMIs

► AMI lifecycle

Use encryption with EBS-backed AMIs

► Understand AMI billing

► Amazon Linux

User provided kernels

Configure the MATE desktop connection

► Instances

► Monitor

► Networking

To locate the current version of a Quick Start AMI, you can enumerate all AMIs with its AMI name, and then find the one with the most recent creation date.

### Example: Find the current Amazon Linux 2 AMI

```
aws ec2 describe-images \
    --owners amazon \
    --filters "Name=name,Values=amzn2-ami-hvm-2.0.?????????-x86_64-gp2" "Name=state,Values=
    --query "reverse(sort_by(Images, &CreationDate))[:1].ImageId" \
    --output text
```

### Example: Find the current Amazon Linux AMI

```
aws ec2 describe-images \
    --owners amazon \
    --filters "Name=name,Values=amzn-ami-hvm-????.???.?????-x86_64-gp2" "Name=state,Value
    --query "reverse(sort_by(Images, &CreationDate))[:1].ImageId" \
    --output text
```

### Example: Find the current Ubuntu Server 16.04 LTS AMI

```
aws ec2 describe-images \
    --owners 099720109477 \
    --filters "Name=name,Values=ubuntu/images/hvm-ssd/ubuntu-xenial-16.04-amd64-server-?????
    --query "reverse(sort_by(Images, &CreationDate))[:1].ImageId" \
    --output text
```

### Example: Find the current Red Hat Enterprise Linux 7.5 AMI

## On this page

[Find a Linux AMI using the Amazon EC2 console](#)

[Find an AMI using the AWS CLI](#)

[Find the latest Amazon Linux AMI using Systems Manager](#)

[Use a Systems Manager parameter to find an AMI](#)

[Find a Quick Start AMI](#)



EC2

97 matching results

## EC2

&gt; Resources

## Data Sources

## • aws\_ami

aws\_ami\_ids

aws\_ebs\_default\_kms\_key

aws\_ebs\_encryption\_by\_default

aws\_ebs\_snapshot

aws\_ebs\_snapshot\_ids

aws\_ebs\_volume

aws\_ec2\_coip\_pool

aws\_ec2\_coip\_pools

aws\_ec2\_instance\_type

aws\_ec2\_instance\_type\_offering

aws\_ec2\_instance\_type\_offerings

aws\_ec2\_local\_gateway

aws\_ec2\_local\_gateway\_route\_table

aws\_ec2\_local\_gateway\_route\_tables

aws\_ec2\_local\_gateway\_virtual\_interface

aws\_ec2\_local\_gateway\_virtual\_interface\_group

aws\_ec2\_local\_gateway\_virtual\_interface\_groups

Use this data source to get the ID of a registered AMI for use in other resources.

ON THIS PAGE

## • Example Usage

Argument Reference

Attributes Reference

Report an issue

## Example Usage

```
data "aws_ami" "example" {
  executable_users = ["self"]
  most_recent     = true
  name_regex       = "^myami-\d{3}"
  owners           = ["self"]

  filter {
    name  = "name"
    values = ["myami-*"]
  }

  filter {
    name  = "root-device-type"
    values = ["ebs"]
  }

  filter {
    name  = "virtualization-type"
    values = ["hvm"]
  }
}
```

## Argument Reference

- `owners` - (Required) List of AMI owners to limit search. At least 1 value must be specified. Valid values: an AWS account ID, `self` (the current account), or an AWS owner alias (e.g. `amazon`, `aws-marketplace`, `microsoft`).



EXPLORER

- > OPEN EDITORS
- ✓ TERRAFORM-TRAINING
- > backup
  - > example
  - > example-aws
  - ✓ example-ds
    - ✓ instance.tf
    - ✓ terraform.tf
    - ✓ var.tf
  - > example-s3
  - ✓ example-test
  - > example01



&gt; OUTLINE



Type here to search



instance.tf X

terraform.tf

example-ds &gt; instance.tf &gt; data "aws\_ami" "ubuntu"

```
1 provider "aws" {  
2   region    = var.aws_region  
3 }  
4  
5  
6 data "aws_ami" "ubuntu" {  
7   most_recent = true  
8  
9   filter {  
10    name    = "name"  
11    values  = ["ubuntu/images/hvm-ssd/ubuntu-xenial-16.04-amd64-server-*"]  
12  }  
13  
14  filter {  
15    name    = "virtualization-type"  
16    values  = ["hvm"]  
17  }  
18  
19  owners = ["099720109477"]  
20  
21}  
22  
23 resource "aws_instance" "ubuntu_ec2" {  
24   ami           = data.aws_ami.ubuntu.id  
25   instance_type = var.instance_type  
26   availability_zone = var.aws_instance_azs  
27   tags = {  
28     Name = var.aws_instance_name  
29   }  
30 }
```



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New EC2 Experience  
Tell us what you think X

[Create Volume](#)[Actions ▾](#)

Filter by tags and attributes or search by keyword

1 to 1 of 1 ? K < > >>

Name	Volume ID	Size	Volume Type	IOPS	Throughput	Snapshot	Created	Availability Zone	State	Alarm Status
my-vol	vol-0cfa42c5ca48036a3	1 GiB	gp2	100	-	-	April 14, 2021 at 10:30:06 AM UTC+5:30	us-west-2a	available	None

EC2 Dashboard New  
Events  
Tags  
Limits

Instances

Instances New  
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Savings Plans  
Reserved Instances New  
Dedicated Hosts

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Capacity Reservations

Images

AMIs

Elastic Block Store

Volumes

Volumes: vol-0cfa42c5ca48036a3 (my-vol)

Description

Status Checks

Monitoring

Tags

Volume ID: vol-0cfa42c5ca48036a3

Outposts ARN: -

Alarm status: None

Size: 1 GiB

Snapshot: -

Created: April 14, 2021 at 10:30:06 AM UTC+5:30

Availability Zone: us-west-2a

State: available

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11:31  
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## AWS DOCUMENTATION

 aws ebs

32 matching results

## ▼ EC2

## Resources

- aws\_ebs\_default\_kms\_key
- aws\_ebs\_encryption\_by\_default
- aws\_ebs\_snapshot
- aws\_ebs\_snapshot\_copy
- aws\_ebs\_volume

## Data Sources

- aws\_ebs\_default\_kms\_key
- aws\_ebs\_encryption\_by\_default
- aws\_ebs\_snapshot
- aws\_ebs\_snapshot\_ids
- aws\_ebs\_volume

## ▼ ECS

## &gt; Resources

## Data Source: aws\_ebs\_volume

Use this data source to get information about an EBS volume for use in other resources.

ON THIS PAGE

- Example Usage
- Argument Reference
- Attributes Reference

[Report an issue](#) 

### Example Usage

```
data "aws_ebs_volume" "ebs_volume" {  
    most_recent = true  
  
    filter {  
        name    = "volume-type"  
        values  = ["gp2"]  
    }  
  
    filter {  
        name    = "tag:Name"  
        values  = ["Example"]  
    }  
}
```

### Argument Reference

The following arguments are supported:



EXPLORER

- > OPEN EDITORS
- ✓ TERRAFORM-TRAINING
- > backup
  - > example
  - > example-aws
  - ✓ example-ds
    - > .terraform
    - instance.tf
    - {terraform.tfstate}
    - terrafrom.tfstate.backup
    - terraform.tfvars
    - var.tf
  - > example-s3
  - ✓ example-test
  - ✓ example01
    - > .terraform
    - instance.tf
    - {terraform.tfstate}
    - terrafrom.tfstate.backup
    - terraform.tfvars
    - var.tf

... instance.tf X terraform.tfvars

example-ds > instance.tf > data "aws\_ebs\_volume" "ebs\_volume"

```
22
23 resource "aws_instance" "ubuntu_ec2" {
24   ami           = data.aws_ami.ubuntu.id
25   instance_type = var.instance_type
26   availability_zone = var.aws_instance_azs
27   tags = {
28     Name = var.aws_instance_name
29   }
30 }
31
32 data "aws_ebs_volume" "ebs_volume" {
33   most_recent = true
34
35   filter {
36     name    = "volume-type"
37     values = ["gp2"]
38   }
39
40   filter {
41     name    = "tag:Name"
42     values = ["my-vol"]
43   }
44 }
45
46 resource "aws_volume_attachment" "name" {
47   device_name = var.volume_device_name
48   volume_id   = data.aws_ebs_volume.ebs_volume.id
49   instance_id = aws_instance.ubuntu_ec2.id
50 }
51
```





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## ▼ Images

AMIs

## ▼ Elastic Block Store

Volumes

Instances (1/1) Info

Connect

Instance state ▾

Actions ▾

Launch instances



Filter instances

&lt; 1 &gt;



<input checked="" type="checkbox"/>	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS
<input checked="" type="checkbox"/>	Example-2	i-0e797af80f72f624c	<span style="color: green;">Running</span>	t2.micro	<span style="color: yellow;">Initializing</span>	No alarms	us-west-2a	ec2-52-27-130-2

Platform	AMI ID	Monitoring
Ubuntu (Inferred)	ami-04b01d7f989b9ac8b	disabled
Platform details	AMI name	Termination protection
Linux/UNIX	ubuntu/images/hvm-ssd/ubuntu-xenial-16.04-amd64-server-20210413	Disabled
Launch time	AMI location	Lifecycle
Wed Apr 14 2021 11:22:11 GMT+0530 (India Standard Time) (5 minutes)	099720109477/ubuntu/images/hvm-ssd/ubuntu-xenial-16.04-amd64-server-20210413	normal
Stop-hibernate behavior	AMI Launch index	Key pair name
disabled	0	-
State transition reason	Credit specification	Kernel ID
-	standard	-



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AMIs

## ▼ Elastic Block Store

**Volumes**

Snapshots

Lifecycle Manager

## ▼ Network &amp; Security

Security Groups NewElastic IPs New

Placement Groups

Key Pairs

Network Interfaces New**Create Volume**

Actions ▾

Filter by tags and attributes or search by keyword



1 to 2 of 2



<input type="checkbox"/>	Name	Volume ID	Size	Volume Type	IOPS	Throughput	Snapshot	Created	Availability Zone	State	Alarm Status
<input type="checkbox"/>	vol-08aa1a8...	8 GiB	gp2	100	-	-	snap-05d0d79...	April 14, 2021 at 11:...	us-west-2a	<span style="color: green;">●</span> in-use	None
<input type="checkbox"/>	my-vol	vol-0cfa42c5...	1 GiB	gp2	100	-	-	April 14, 2021 at 10:...	us-west-2a	<span style="color: green;">●</span> in-use	None

Select a volume above



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Capacity Reservations

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AMIs

## ▼ Elastic Block Store

## Volumes

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Network Interfaces New

Create Volume

Actions ▾



1 to 2 of 2

Volume Type	IOPS	Throughput	Snapshot	Created	Availability Zone	State	Alarm Status	Attachment Information	Monitoring	Volume Status
	100	-	snap-05d0d79...	April 14, 2021 at 11:...	us-west-2a	in-use	None	i-0e797af80f72f624c ...		Okay
	100	-		April 14, 2021 at 10:...	us-west-2a	in-use	None	i-0e797af80f72f624c ...		Okay

Select a volume above



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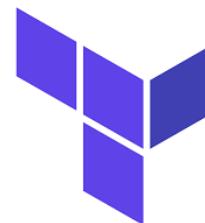
11:26  
14-04-2021  
ENG

# Terraform

---



## Modules

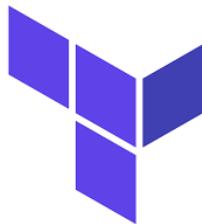


# Modules

---

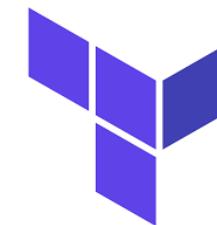
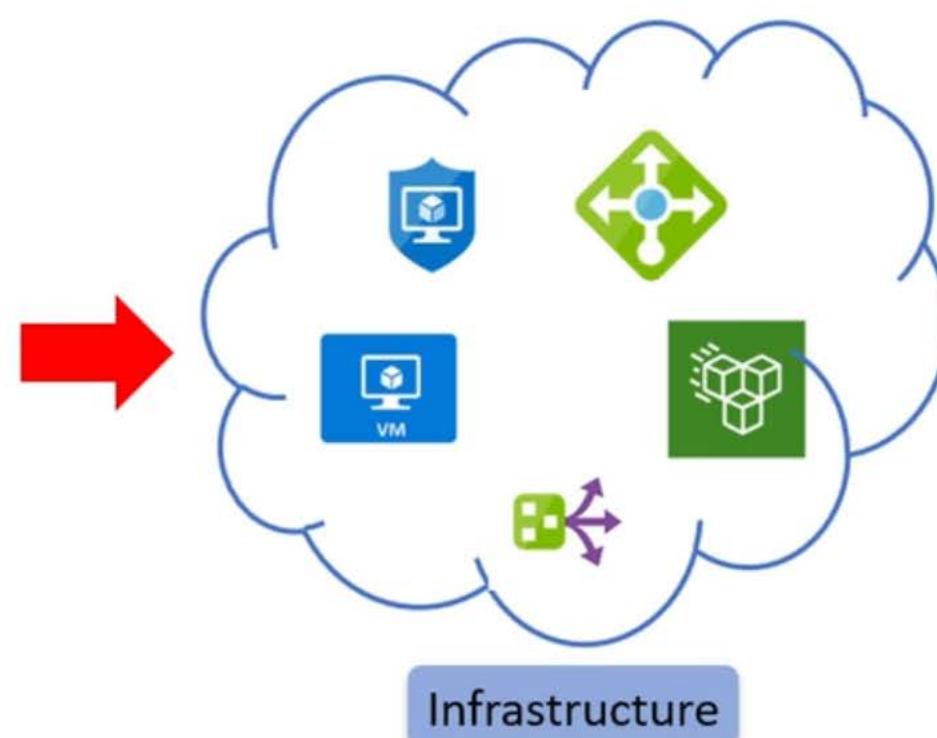
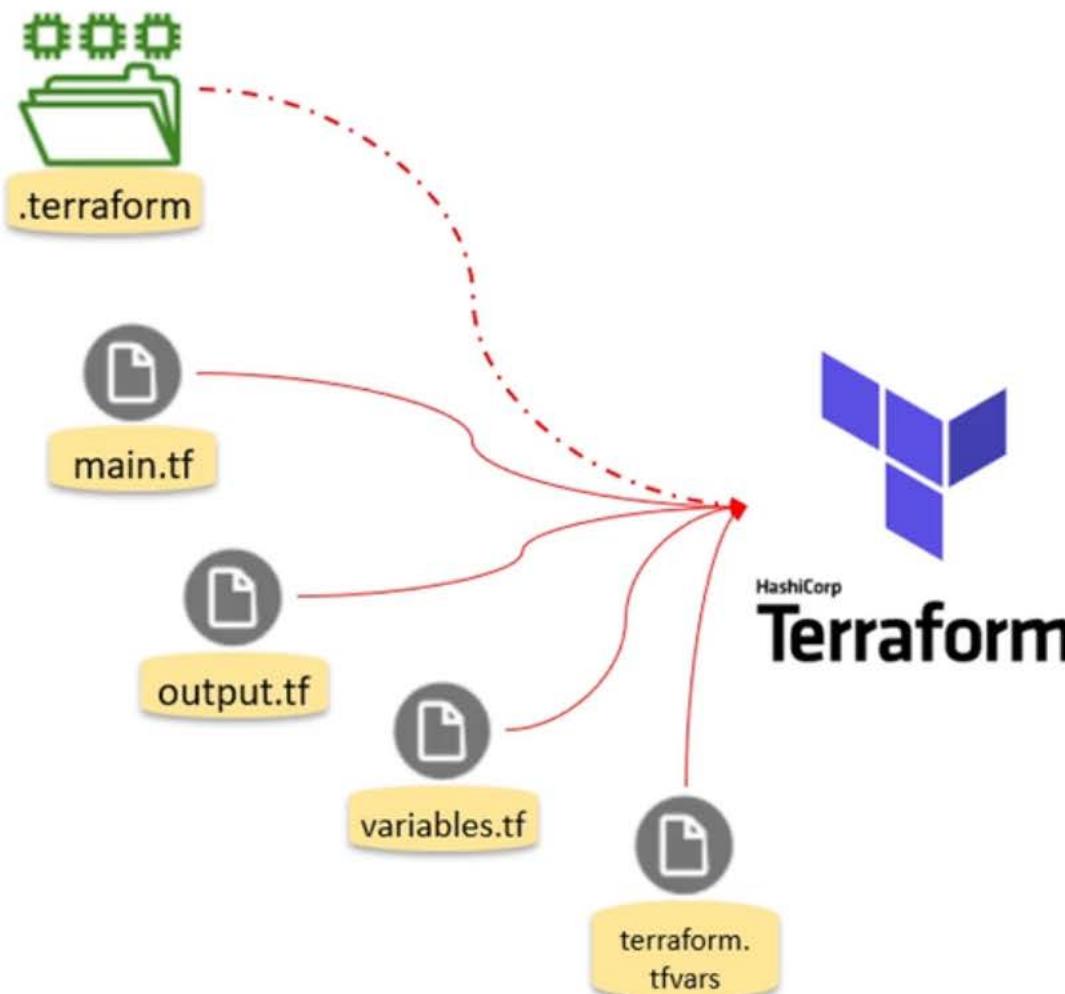
## Topics in this section

1. Why and how to use modules
2. Using Remote Modules
3. Create and use modules



# Why and how to use modules

## Layout of Terraform Directory



# Why and how to use modules

## Need for modules

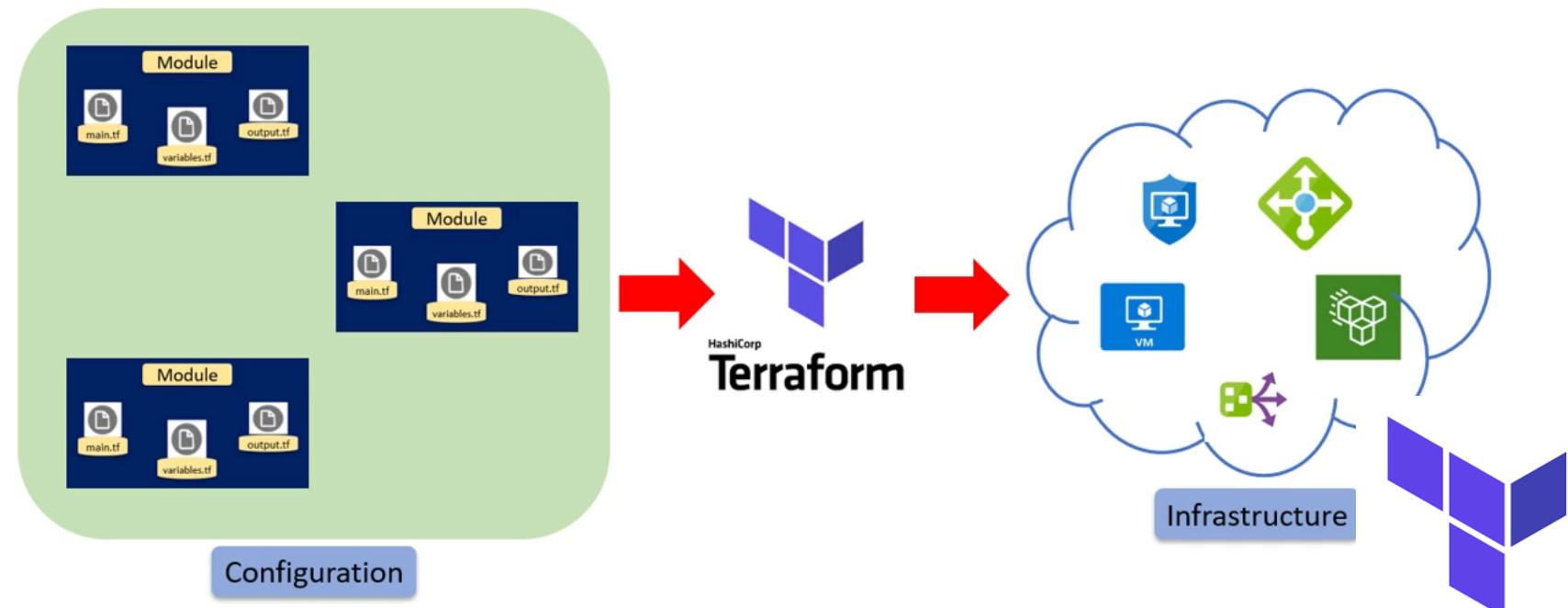
- As infrastructure grows, following are the problems –
  - lack of organization
  - lack of reusability
  - team management
- Real-world infrastructure tends to be complex with many different components
- Updating the configuration becomes riskier
- Another key problem is of the duplication of code
- Share parts of configuration between projects and teams



# Why and how to use modules

## What are modules

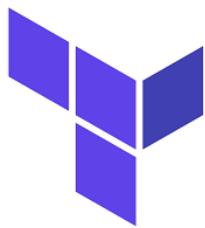
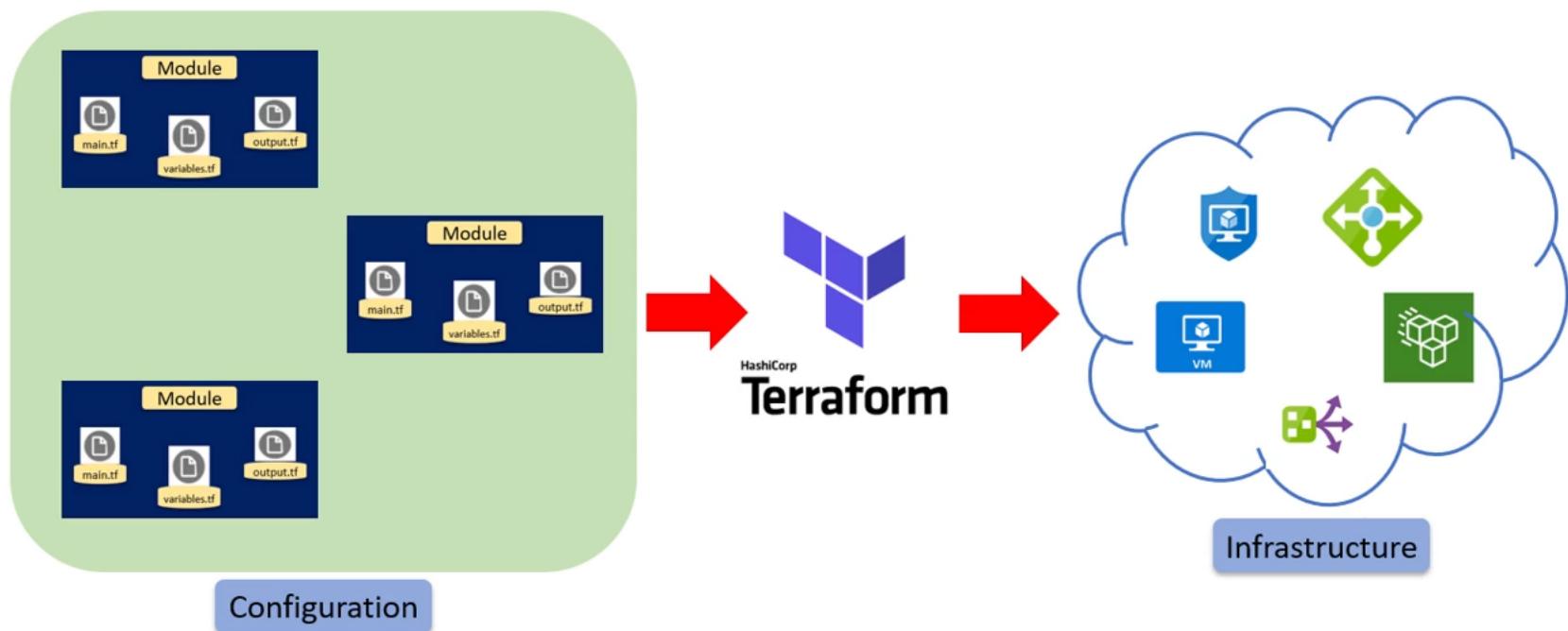
- Modules are a key part of writing maintainable, shareable Terraform configurations
- A module is a group of configuration files located within a single directory
- Terraform commands only directly use the configuration files in current directory



# Why and how to use modules

## What are modules

- Configuration can use module blocks to call modules in other directories
- Module called by another configuration is referred to as a “child module”

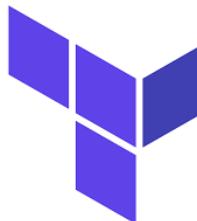


# Why and how to use modules

---

## How modules help to solve the problems?

- ❑ Organize configuration
- ❑ Encapsulate configuration
- ❑ Re-use configuration
- ❑ Provide consistency and ensure best practices



# Why and how to use modules

## Local and remote modules

- Modules can either be loaded from the local filesystem or from a remote source
  - Terraform Registry
  - version control systems
  - HTTP URLs
  - Terraform Cloud or Terraform Enterprise private module registries
- We need to define the module inside a module block
- **terraform init** downloads the source code to a directory on local disk



# Why and how to use modules

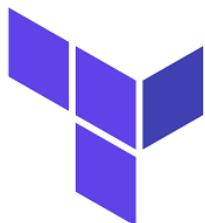
## Local Paths

```
module "website_s3_bucket" {
  source = "./modules/aws-s3-static-website-bucket"

  bucket_name = "<UNIQUE BUCKET NAME>

  tags = {
    Terraform  = "true"
    Environment = "dev"
  }
}
```

- The files are already present on local disk
- Local paths are not "installed" in the same sense that other sources are

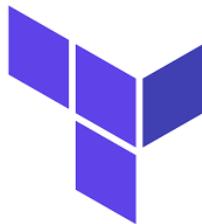


# Why and how to use modules

---

## Terraform Registry

- ❑ Public Registry and uses a Terraform-specific protocol
- ❑ It is the native way of distributing Terraform modules





Terraform | Registry

Search for modules

Browse

Publish



# Terraform Registry

Discover Terraform providers that power all of Terraform's resource types,  
or find modules for quickly deploying common infrastructure  
configurations.

 [Browse Providers](#) [Browse Modules](#)

66 providers, 3493 modules &amp; counting



## Providers

NEW

 Providers Modules

## FILTERS

Provider

Provider

**terraform-aws-modules / s3-bucket**

Terraform module which creates S3 bucket resources on AWS



1.2M

**cloudposse / s3-log-storage**

This module creates an S3 bucket suitable for receiving logs from other AWS services such as S3, CloudFront, and CloudTrail



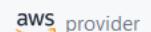
73.9K

**cloudposse / iam-s3-user**

Terraform module to provision a basic IAM user with permissions to access S3 resources, e.g. to give the user read/write/delete access to the objects in an S3 bucket



55.1K

**infrablocks / encrypted-bucket**

A terraform module for creating an encrypted bucket in S3



52.8K





Registry

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## s3-bucket

AWS

Terraform module which creates S3 bucket resources on AWS

Version 1.9.0

Published July 1, 2020 by terraform-aws-modules

Module managed by antonbabenko

Total provisions: 243,863

Source Code: [github.com/terraform-aws-modules/terraform-aws-s3-bucket](https://github.com/terraform-aws-modules/terraform-aws-s3-bucket) (report an issue)

Submodules

Examples

### Provision Instructions

Copy and paste into your Terraform configuration, insert the variables, and run `terraform init`:

```
module "s3-bucket" {  
  source  = "terraform-aws-modules/s3-bucket/aws"  
  version = "1.9.0"  
  # insert the 6 required variables here  
}
```

[Readme](#) [Inputs \(25\)](#) [Outputs \(8\)](#) [Dependency \(1\)](#) [Resources \(7\)](#)

## AWS S3 bucket Terraform module

Terraform module which creates S3 bucket on AWS with all (or almost all) features provided by Terraform AWS provider.

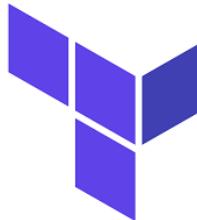
This type of resources are supported:

# Why and how to use modules

---

## Terraform Registry

- ❑ Public Registry and uses a Terraform-specific protocol
- ❑ It is the native way of distributing Terraform modules
- ❑ `terraform init` will download and store the referenced module in the configuration
- ❑ Can also use a private registry



# Why and how to use modules

## GitHub

- Terraform recognizes un-prefixed github.com URLs & interpret them as Git sources

```
module "consul" {  
  source = "github.com/hashicorp/example"  
}
```

```
module "consul" {  
  source = "git@github.com:hashicorp/example.git"  
}
```

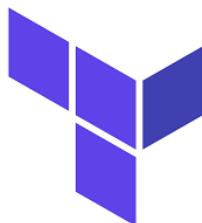


# Why and how to use modules

---

## Other Remote Modules

- Generic Git Repository
- Generic Mercurial repository
- HTTP URLs
- BitBucket
- S3 Bucket or GCS Bucket

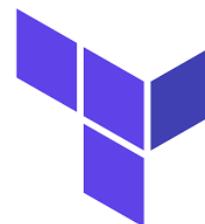


# Modules

---



Calling Remote modules



# Calling Remote modules

---

## Objective of the example - 1

- ❑ Create a single ec2-instance
- ❑ using a default subnet, and
- ❑ default security group





Registry

Search for modules

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## ec2-instance



AWS

Terraform module which creates EC2 instance(s) on AWS

Version 2.15.0

Published June 11, 2020 by terraform-aws-modules

Module managed by antonbabenko

Total provisions: 516,128

Source Code: [github.com/terraform-aws-modules/terraform-aws-ec2-instance](https://github.com/terraform-aws-modules/terraform-aws-ec2-instance) (report an issue)

Examples

### Provision Instructions

Copy and paste into your Terraform configuration, insert the variables, and run `terraform init`:

```
module "ec2-instance" {  
  source  = "terraform-aws-modules/ec2-instance/aws"  
  version = "2.15.0"  
  # insert the 10 required variables here  
}
```

[Readme](#) [Inputs \(33\)](#) [Outputs \(22\)](#) [Dependency \(1\)](#) [Resource \(1\)](#)

## AWS EC2 Instance Terraform module

Terraform module which creates EC2 instance(s) on AWS.

These types of resources are supported:

EXPLORER  
OPEN EDITORS  
TERRAFORM-TRAINING  
backup  
example  
example-aws  
example-ds  
example-module  
main.tf  
terraform  
variables  
example-s3  
example-test  
example01  
.terraform  
instance.tf  
terraform.tfstate  
terraform.tfstate.backup  
terraform.tfvars  
var.tf

main.tf

example-module &gt; main.tf &gt; provider "aws"

```
1 provider "aws" {
2   region    = var.aws_region
3 }
4
5
6 module "ec2-instance" {
7   source  = "terraform-aws-modules/ec2-instance/aws"
8   version = "2.15.0"
9
10  ami = var.ami_name
11  instance_count = var.instance_count
12  associate_public_ip_address = var.req_public_ip
13  instance_type = var.instance_type
14  name = var.aws_instance_name
15  vpc_security_group_ids = var.sec_group_id
16  subnet_id = var.subnet_id
17 }
18 }
```

ⓘ No schema found for "example-module". Functionality may be limited. You may need to run `terraform init`.

Source: HashiCorp Terraform (Extension)

terraform init

EXPLORER

> OPEN EDITORS

< TERRAFORM-TRAINING

- > backup
- > example
- > example-aws
- > example-ds
- < example-module
  - > .terraform
  - main.tf
  - terraform.tfvars
  - variables.tf
- > example-s3
- < example-test
  - < example01
    - > .terraform
    - instance.tf
    - { terraform.tfstate
  - terraformer.tfstate.backup
  - terraform.tfvars
  - var.tf

example-module > main.tf > provider "aws" > region

```
1 provider "aws" {  
2   region = "us-west-2">#var.aws_region  
3 }  
4  
5  
6 module "ec2-instance" {  
7   source  = "terraform-aws-modules/ec2-instance/aws"  
8   version = "2.15.0"  
9  
10  ami = "ami-0b1e2eeb33ce3d66f" #var.ami_name  
11  instance_count = 1 #var.instance_count  
12  associate_public_ip_address = true #var.req_public_ip  
13  instance_type = "t2.micro" #var.instance_type  
14  name = "example-1-module"#var.aws_instance_name  
15  private_ip = ""  
16  user_data = ""  
17  vpc_security_group_ids =["sg-73dc7533"] #var.sec_group_id  
18  subnet_id = "subnet-0bcedd72"#var.subnet_id  
19 }  
20 }
```

```
D:\terraform-training\example-module
```

```
> terraform init
```

```
Initializing modules...
```

```
Initializing the backend...
```

```
Initializing provider plugins...
```

The following providers do not have any version constraints in configuration,  
so the latest version was installed.

To prevent automatic upgrades to new major versions that may contain breaking  
changes, it is recommended to add `version = "..."` constraints to the  
corresponding provider blocks in configuration, with the constraint strings  
suggested below.

```
* provider.aws: version = "~> 3.36"
```

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.

```
D:\terraform-training\example-module
```

```
>
```



Type here to search



12:20

14-04-2021



```
+ no_device      = (known after apply)
+ virtual_name  = (known after apply)
}

+ metadata_options {
  + http_endpoint        = (known after apply)
  + http_put_response_hop_limit = (known after apply)
  + http_tokens           = (known after apply)
}

+ network_interface {
  + delete_on_termination = (known after apply)
  + device_index          = (known after apply)
  + network_interface_id  = (known after apply)
}

+ root_block_device {
  + delete_on_termination = (known after apply)
  + device_name           = (known after apply)
  + encrypted              = (known after apply)
  + iops                   = (known after apply)
  + kms_key_id             = (known after apply)
  + tags                   = (known after apply)
  + throughput              = (known after apply)
  + volume_id               = (known after apply)
  + volume_size              = (known after apply)
  + volume_type              = (known after apply)
}
}
```

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

Do you want to perform these actions?

Terraform will perform the actions described above.

Only 'yes' will be accepted to approve.

Enter a value: yes

```
module.ec2-instance.aws_instance.this[0]: Creating...
module.ec2-instance.aws_instance.this[0]: Still creating... [10s elapsed]
module.ec2-instance.aws_instance.this[0]: Still creating... [20s elapsed]
module.ec2-instance.aws_instance.this[0]: Still creating... [30s elapsed]
module.ec2-instance.aws_instance.this[0]: Still creating... [40s elapsed]
module.ec2-instance.aws_instance.this[0]: Still creating... [50s elapsed]
module.ec2-instance.aws_instance.this[0]: Creation complete after 59s [id=i-0c1a912aa75139b7e]
```

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

D:\terraform-training\example-module

>



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Events

Tags

Limits

## Instances

Instances New

Instance Types

Launch Templates

Spot Requests

Savings Plans

Reserved Instances New

Dedicated Hosts

Scheduled Instances

Capacity Reservations

## Images

AMIs

## Elastic Block Store

Volumes

Instances (1/2) Info

Connect

Instance state ▾

Actions ▾

Launch instances



Filter instances



1



Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	P
<input checked="" type="checkbox"/> example-1-module	i-0c1a912aa75139b7e	<span style="color: green;">Running</span> <span style="color: blue;">?</span> <span style="color: blue;">Q</span>	t2.micro	<span style="color: blue;">?</span> Initializing	No alarms <span style="color: green;">+</span>	us-west-2b	e
<input type="checkbox"/> Example-2	i-0e797af80f72f624c	<span style="color: red;">?</span> Terminated <span style="color: blue;">?</span> <span style="color: blue;">Q</span>	t2.micro	-	No alarms <span style="color: green;">+</span>	us-west-2a	-

Instance state	Public IPv4 DNS	Private IPv4 DNS
<span style="color: green;">Running</span>	<span style="color: blue;">?</span> ec2-18-237-174-52.us-west-2.compute.amazonaws.com   <a href="#">open address</a> <span style="color: blue;">?</span>	<span style="color: blue;">?</span> ip-172-31-36-26.us-west-2.compute.internal
Instance type	Elastic IP addresses	VPC ID
t2.micro	-	<span style="color: blue;">?</span> vpc-788ea300 <span style="color: blue;">?</span>
AWS Compute Optimizer finding	IAM Role	Subnet ID
<span style="color: blue;">?</span> Opt-in to AWS Compute Optimizer for recommendations.   <a href="#">Learn more</a> <span style="color: blue;">?</span>	-	<span style="color: blue;">?</span> subnet-75ff243f <span style="color: blue;">?</span>
<span style="color: green;">▼ Instance details <span style="color: blue;">Info</span></span>	AMI ID	Monitoring
Platform	<span style="color: blue;">?</span> ami-0b1e2eeb33ce3d66f	disabled
<span style="color: blue;">?</span> Amazon Linux (Inferred)		

Feedback English (US) ▾

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14-04-2021  
ENG



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Support ▾

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Events

Tags

Limits

## ▼ Instances

Instances New

Instance Types

Launch Templates

Spot Requests

Savings Plans

Reserved Instances New

Dedicated Hosts

Scheduled Instances

Capacity Reservations

## ▼ Images

AMIs

## ▼ Elastic Block Store

Volumes

Instances (1/2) Info

Connect

Instance state ▾

Actions ▾

Launch instances



Filter instances

&lt; 1 &gt;



Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	P
<input checked="" type="checkbox"/> example-1-module	i-0c1a912aa75139b7e	<span>Running</span> <span>QQ</span>	t2.micro	<span>Initializing</span> <span>QQ</span>	No alarms <span>+</span>	us-west-2b	e
<input type="checkbox"/> Example-2	i-0e797af80f72f624c	<span>Terminated</span> <span>QQ</span>	t2.micro	-	No alarms <span>+</span>	us-west-2a	-

## Instance: i-0c1a912aa75139b7e (example-1-module)

Details Security Networking Storage Status checks Monitoring Tags

## ▼ Security details

IAM Role

-

Owner ID

784184871882

Launch time

Wed Apr 14 2021 12:25:10 GMT+0530 (India Standard Time)

Security groups

sg-177e4d2a (default)

## ▼ Inbound rules

Filter rules

&lt; 1 &gt;

Feedback English (US) ▾

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EXPLORER

> OPEN EDITORS

✓ TERRAFORM-TRAINING

- > backup
- > example
- > example-aws
- > example-ds
- ✓ example-module
  - > .terraform
  - tf datasources.tf
  - tf main.tf
  - tf output.tf
  - { terraform.tfstate
  - terraform.tfstate.backup
  - tfvars
  - variables.tf
- > example-s3
- ✓ example-test
- ✓ example01
  - > .terraform
  - tf instance.tf
  - { terraform.tfstate
  - terraform.tfstate.backup
  - tfvars
  - var.tf

> OUTLINE

> TIMELINE

example-module > tf main.tf > ...

```
1 provider "aws" {
2   region = var.aws_region
3 }
4
5
6
7
8
9 module "ec2-instance" {
10   source  = "terraform-aws-modules/ec2-instance/aws"
11   version = "2.15.0"
12
13   ami = data.aws_ami.ubuntu.id  #"ami-0b1e2eeb33ce3d66f" #var.ami_name
14   instance_count = var.instance_count
15   associate_public_ip_address = var.req_public_ip
16   instance_type = var.instance_type
17   name = var.aws_instance_name
18   private_ip = ""
19   user_data = ""
20   vpc_security_group_ids = data.aws_security_groups.test.ids  #[ "sg-177e4d2a" ] #var.sec_
21   subnet_id = var.subnet_id
22 }
23 }
```

File Edit Selection View Go Run Terminal Help

datasources.tf - terraform-training - Visual Studio Code

EXPLORER

> OPEN EDITORS

✓ TERRAFORM-TRAINING

- > backup
- > example
- > example-aws
- > example-ds
- ✓ example-module
  - > .terraform
  - datasources.tf
  - main.tf
  - output.tf
  - { terraform.tfstate
  - terraform.tfstate.backup
  - terraform.tfvars
  - variables.tf
- > example-s3
- ✓ example-test
- ✓ example01
  - > .terraform
  - instance.tf
  - { terraform.tfstate
  - terraform.tfstate.backup
  - terraform.tfvars
  - var.tf

... terraform.tfvars main.tf datasources.tf X output.tf

example-module > datasources.tf > data "aws\_ami" "ubuntu" > filter > [ ] values

```
1
2 data "aws_ami" "ubuntu" {
3   most_recent = true
4
5   filter {
6     name    = "name"
7     values  = ["ubuntu/images/hvm-ssd/ubuntu-xenial-16.04-amd64-server-*"]
8   }
9
10  filter {
11    name    = "virtualization-type"
12    values  = ["hvm"]
13  }
14
15  owners = ["099720109477"]
16
17 }
18
19 data "aws_security_groups" "test"{
20   filter{
21     name = "group-name"
22     values = ["*default*"]
23   }
24 }
```

...

> OUTLINE

> TIMELINE

v2.15.0 Type here to search

Ln 12, Col 21 Spaces: 4 UTF-8 CRLF Terraform

12:48 14-04-2021 ENG



EXPLORER

...

terraform.tfvars

main.tf

datasources.tf

output.tf X

example-module &gt; output.tf &gt; ...

```
1
2  ### Output ###
3  output "instance_public_ip" {
4    value = module.ec2-instance.public_ip
5  }
6
7  output "instance_state" {
8    value = module.ec2-instance.instance_state
9    description = "The state of the server instance."
10 }
11
12 output "instance_security_group" {
13   value = module.ec2-instance.security_groups
14 }
```

15

16

17

```
Command Prompt  
+ throughput      = (known after apply)  
+ volume_id       = (known after apply)  
+ volume_size     = (known after apply)  
+ volume_type     = (known after apply)  
}  
}
```

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

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

Enter a value: yes

```
module.ec2-instance.aws_instance.this[0]: Creating...  
module.ec2-instance.aws_instance.this[1]: Creating...  
module.ec2-instance.aws_instance.this[0]: Still creating... [10s elapsed]  
module.ec2-instance.aws_instance.this[1]: Still creating... [10s elapsed]  
module.ec2-instance.aws_instance.this[0]: Still creating... [20s elapsed]  
module.ec2-instance.aws_instance.this[1]: Still creating... [20s elapsed]  
module.ec2-instance.aws_instance.this[1]: Still creating... [30s elapsed]  
module.ec2-instance.aws_instance.this[0]: Still creating... [30s elapsed]  
module.ec2-instance.aws_instance.this[0]: Creation complete after 36s [id=i-02052c8edc5c72ea1]  
module.ec2-instance.aws_instance.this[1]: Still creating... [40s elapsed]  
module.ec2-instance.aws_instance.this[1]: Creation complete after 48s [id=i-0ff02dd24a2e1cec8]
```

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

Outputs:

```
instance_public_ip = [  
    "34.216.214.16",  
    "34.221.101.178",  
]  
instance_security_group = [  
    [  
        "default",  
    ],  
    [  
        "default",  
    ],  
]  
instance_state = [  
    "running",  
    "running",  
]
```

D:\terraform-training\example-module

>



Type here to search



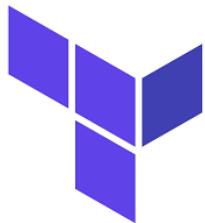
12:51  
14-04-2021  
ENG

# Modules

---



Creating modules

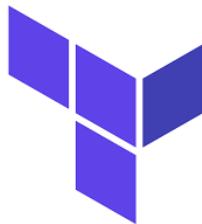


# Creating modules

---

## Objective of the example

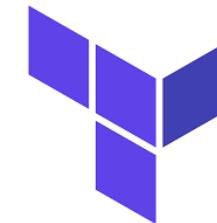
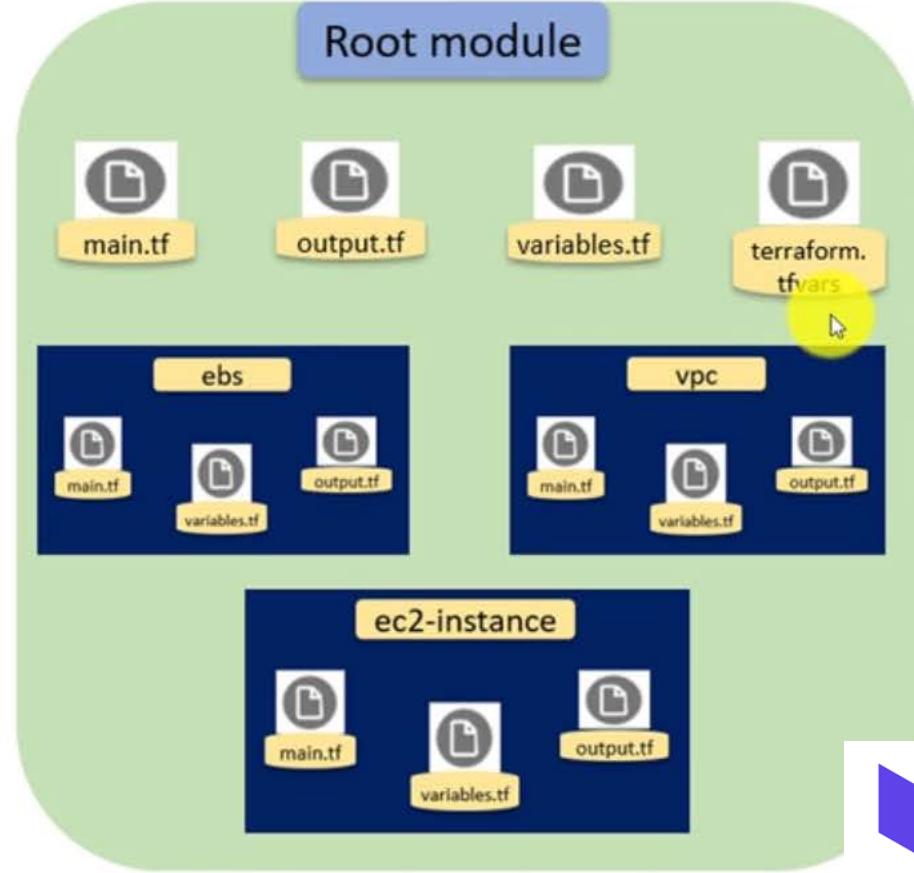
- ❑ Create a VPC and subnet
- ❑ Create two EBS volumes
- ❑ Create an EC2 instance using above subnet
- ❑ Attach above volumes to EC2 instance



# Creating modules

## Objective of the example

- Create a VPC and subnet
- Create two EBS volumes
- Create an EC2 instance using above subnet
- Attach above volumes to EC2 instance



EXPLORER ...

> OPEN EDITORS

< TERRAFORM-TRAINING

- > backup
- > example
- > example-aws
- < example-cmodule
- > .terraform
- > modules
- ≡ .terraform.tfstate.lock.info
- datasources.tf
- main.tf
- outputs.tf
- { } terraform.tfstate
- terraforms.tfvars
- variables.tf
- > example-ds
- > example-module
- > example-s3
- < example-test
- > example01

OUTLINE

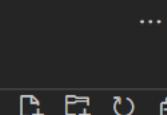
TIMELINE

Show All Commands Ctrl + Shift + PGo to File Ctrl + PFind in Files Ctrl + Shift + FStart Debugging F5Toggle Terminal Ctrl + `



EXPLORER

## &gt; OPEN EDITORS



TERRAFORM-TRAINING

&gt; backup

&gt; example

&gt; example-aws

&gt; example-cmodule

&gt; .terraform

&gt; modules

&gt; ebs

&gt; ec2-instance

&gt; vpc

≡ .terraform.tfstate.lock.info

➤ datasources.tf

➤ main.tf

➤ outputs.tf

➤ terraform.tfstate

➤ terraforms.tfvars

➤ variables.tf

&gt; example-ds

&gt; example-module

&gt; example-s3

&gt; example-test

&gt; example01



Show All Commands Ctrl + Shift + P

Go to File Ctrl + P

Find in Files Ctrl + Shift + F

Start Debugging F5

Toggle Terminal Ctrl + `



&gt; OUTLINE

&gt; TIMELINE



EXPLORER ...

> OPEN EDITORS

✓ TERRAFORM-TRAINING

- > backup
- > example
- > example-aws
- ✓ example-cmodule
- > .terraform
- ✓ modules
  - ✓ ebs
    - main.tf
    - outputs.tf
    - variables.tf
  - ✓ ec2-instance
    - main.tf
    - outputs.tf
    - variables.tf
  - ✓ vpc
    - main.tf
    - outputs.tf
    - variables.tf
- > example-ds
- > example-module
- > example-s3
- ✓ example-test
- ✓ example01
  - > .terraform
  - main.tf

- > OUTLINE
- > TIMELINE


Show All Commands Ctrl + Shift + P

Go to File Ctrl + P

Find in Files Ctrl + Shift + F

Start Debugging F5

Toggle Terminal Ctrl + `

i No schema found for "example01". Functionality may be limited. You may need to run terraform init.

Source: HashiCorp Terraform (Extension)

terraform init

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS TERRAFORM-TRAINING

main.tf example-createmodule\modules... backup example example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-configure-remotestate example-createmodule .terraform modules ebs ec2-instance vpc main.tf outputs.tf variables.tf datasources.tf main.tf outputs.tf terraform.tfstate terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-instance-LocalExec example-instance-RemoteExec

main.tf

```
1 # VPC
2 resource "aws_vpc" "name" {
3     cidr_block = var.vpc_cidr
4     tags = {
5         Name = var.aws_vpc_name
6     }
7 }
8
9
10
11 # Subnets : public
12 resource "aws_subnet" "public" {
13     count = length(var.subnets_cidr)
14     vpc_id = aws_vpc.name.id
15     cidr_block = element(var.subnets_cidr, count.index)
16     availability_zone = element(var.azs, count.index)
17     tags = [
18         {
19             Name = "Demo-Subnet-${count.index+1}"
20         }
21     ]
22
23 # Internet Gateway
24 resource "aws_internet_gateway" "name" {
25     vpc_id = aws_vpc.name.id
26     tags = [
27         {
28             Name = var.aws_igw_name
29         }
30     ]
31     # Route table: attach Internet Gateway
32 }
```

Ln 39, Col 4 Spaces: 2 UTF-8 CRLF HCL

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15:47 21-04-2021

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf

example-createmodule > modules > vpc > main.tf

```
21
22 # Internet Gateway
23 resource "aws_internet_gateway" "name" {
24   vpc_id = aws_vpc.name.id
25   tags = {
26     Name = var.aws_igw_name
27   }
28 }
29
30 # Route table: attach Internet Gateway
31 resource "aws_route_table" "name" {
32   vpc_id = aws_vpc.name.id
33   route {
34     cidr_block = "0.0.0.0/0"
35     gateway_id = aws_internet_gateway.name.id
36   }
37   tags = [
38     {
39       Name = var.aws_rt_name
40     }
41
42 # Route table association with public subnets
43 resource "aws_route_table_association" "a" {
44   count = length(var.subnets_cidr)
45   subnet_id      = element(aws_subnet.public.*.id, count.index)
46   route_table_id = aws_route_table.name.id
47 }
48
49 }
```

backup example example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-configure-remotestate example-createmodule .terraform modules ebs ec2-instance vpc

main.tf outputs.tf variables.tf datasources.tf main.tf outputs.tf terraform.tfstate terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-instance-LocalExec example-instance-RemoteExec

OUTLINE

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Ln 39, Col 4 Spaces: 2 UTF-8 CRLF HCL 15:48 21-04-2021 ENG

File Edit Selection View Go Run Terminal Help variables.tf - terraform-training - Visual Studio Code

EXPLORER ... variables.tf X

OPEN EDITORS variables.tf example-createmodule\mod... TERRAFORM-TRAINING backup example example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-configure-remotestate example-createmodule .terraform modules ebs ec2-instance vpc main.tf outputs.tf variables.tf datasources.tf main.tf outputs.tf terraform.tfstate terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-instance-LocalExec example-instance-RemoteExec OUTLINE

variables.tf - terraform-training - Visual Studio Code

example-createmodule > modules > vpc > variables.tf

```
1 variable "vpc_cidr" {
2     default = "10.20.0.0/16"
3 }
4 variable "aws_vpc_name" {
5     type = string
6     default = "Demo_VPC"
7 }
8 }
9 variable "subnets_cidr" {
10    type = list(string)
11    default = ["10.20.1.0/24", "10.20.2.0/24"]
12 }
13 variable "azs" {
14    type = list(string)
15    default = ["us-west-2a", "us-west-2b"]
16 }
17 }
18 variable "aws_igw_name" {
19    type = string
20    default = "Demo_igw"
21 }
22 variable "aws_rt_name" {
23    type = string
24    default = "Demo_rt"
25 }
```

Ln 23, Col 19 Tab Size: 4 UTF-8 CRLF HCL 15:48 21-04-2021

Type here to search

File Edit Selection View Go Run Terminal Help outputs.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS outputs.tf x

example-createmodule > modules > vpc > outputs.tf

```
1 output "subnet_id" {  
2   value = aws_subnet.public.0.id  
3 }  
4
```

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- < example-createmodule
  - > .terraform
  - < modules
    - > ebs
    - > ec2-instance
    - < vpc
      - main.tf
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      - variables.tf
    - datasources.tf
    - main.tf
    - outputs.tf
    - {} terraform.tfstate
    - terraformer.tfvars
    - variables.tf
  - > example-datasource
  - > example-File-RemoteExec
  - > example-functions
  - > example-gcp
  - > example-instance-LocalExec
  - > example-instance-RemoteExec

OUTLINE

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15:48 21-04-2021

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS TERRAFORM-TRAINING

main.tf example-createmodule\modules... backup example example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-configure-remotestate example-createmodule .terraform modules ebs ec2-instance

main.tf outputs.tf variables.tf vpc datasources.tf main.tf outputs.tf terraform.tfstate terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-instance-LocalExec example-instance-RemoteExec example-module

main.tf

```
1 resource "aws_instance" "example_ec2" {  
2     ami           = var.ami_string  
3     instance_type = var.instance_type  
4     availability_zone = var.aws_instance_azs  
5     subnet_id = var.aws_subnet_id  
6     associate_public_ip_address = true  
7     tags = {  
8         Name = var.aws_instance_name  
9     }  
10 }  
11 }  
12  
13
```

Ln 13, Col 1 Spaces: 2 UTF-8 CRLF HCL ⚙ 15:49 21-04-2021

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File Edit Selection View Go Run Terminal Help variables.tf - terraform-training - Visual Studio Code

EXPLORER ... variables.tf X

OPEN EDITORS variables.tf example-createmodule\mod... TERRAFORM-TRAINING < > backup example example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-configure-remotestate example-createmodule .terraform modules ebs ec2-instance main.tf outputs.tf variables.tf vpc datasources.tf main.tf outputs.tf terraform.tfstate terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-instance-LocalExec example-instance-RemoteExec example-module OUTLINE

variables.tf - terraform-training - Visual Studio Code

example-createmodule > modules > ec2-instance > variables.tf

```
1 variable "ami_string" {
2     type = string
3     default = "ami-0b1e2eeb33ce3d66f"
4 }
5 variable "instance_type" {
6     default = "t2.micro"
7 }
8 variable "aws_instance_azs" {
9     type = string
10    default = "us-west-2a"
11 }
12 variable "aws_instance_name" {
13     type = string
14     default = "example-5-module"
15 }
16
17 variable "aws_subnet_id"{
18     type = string
19 }
```

Ln 1, Col 1 Spaces: 4 UTF-8 LF HCL ⚙ 15:49 21-04-2021

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File Edit Selection View Go Run Terminal Help outputs.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS outputs.tf

TERRAFORM-TRAINING outputs.tf example-createmodule\mod... backup example example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-configure-remotestate example-createmodule .terraform modules ebs ec2-instance main.tf outputs.tf variables.tf vpc datasources.tf main.tf outputs.tf terraform.tfstate terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-instance-LocalExec example-instance-RemoteExec example-module OUTLINE

outputs.tf

```
example-createmodule > modules > ec2-instance > outputs.tf
1 output "instance_id" {
2   value = aws_instance.example_ec2.id
3 }
4
5 output "instance_public_ip" {
6   value = aws_instance.example_ec2.public_ip
7 }
8
9 output "instance_state" [
10  value = aws_instance.example_ec2.instance_state
11  description = "The state of the server instance."
12 ]
13
```

0 △ 0 In 11, Col 19 Spaces: 2 UTF-8 CRLF HCL ⚙ 15:49 21-04-2021 Type here to search

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > .terraform
- > modules
- > ebs

main.tf outputs.tf variables.tf & ec2-instance & vpc & datasources.tf & main.tf & outputs.tf & {} terraform.tfstate & terraform.tfvars & variables.tf & example-datasource & example-File-RemoteExec & example-functions & example-gcp & example-instance-LocalExec & example-instance-RemoteExec & example-module & OUTLINE

main.tf

example-createmodule > modules > ebs > main.tf

```
1 resource "aws_ebs_volume" "name1" {  
2   availability_zone = var.ebs_azs  
3   size              = 10  
4 }  
5  
6 resource "aws_ebs_volume" "name2" {  
7   availability_zone = var.ebs_azs  
8   size              = 10  
9 }  
10
```

Ln 10, Col 1 Spaces: 2 UTF-8 CRLF HCL ⚙ 15:50 21-04-2021

Type here to search

File Edit Selection View Go Run Terminal Help variables.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS variables.tf X

example-createmodule > modules > ebs > variables.tf

```
1 variable "ebs_azs" {  
2   default = "us-west-2a"  
3 }
```

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- < example-createmodule
  - > .terraform
  - < modules
    - < ebs
      - variables.tf
      - main.tf
      - outputs.tf
- > ec2-instance
- > vpc
- datasources.tf
- main.tf
- outputs.tf
- { } terraform.tfstate
- terraform.tfvars
- variables.tf
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module

- > OUTLINE

LN 3, COL 2 Spaces: 4 UTF-8 LF HCL ⚙ 15:50 21-04-2021

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File Edit Selection View Go Run Terminal Help outputs.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS outputs.tf x

example-createmodule > modules > ebs > outputs.tf

```
1 output "ebs_volume_name_1" {  
2   value = aws_ebs_volume.name1.id  
3 }  
4 output "ebs_volume_name_2" {  
5   value = aws_ebs_volume.name2.id  
6 }  
7
```

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- < example-createmodule
- > .terraform
- < modules
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- main.tf
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- variables.tf
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- > vpc
- datasources.tf
- main.tf
- outputs.tf
- {} terraform.tfstate
- terrafrom.tfvars
- variables.tf
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module

OUTLINE

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File Edit Selection View Go Run Terminal Help

datasources.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
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    - > vpc

datasources.tf

main.tf

outputs.tf

terraformer.tfstate

terraform.tfvars

variables.tf

> example-datasource

> example-File-RemoteExec

> example-functions

> example-gcp

> example-instance-LocalExec

> example-instance-RemoteExec

> example-module

> example-NullResource

example-override

OUTLINE

datasources.tf X

example-createmodule > datasources.tf

```
1 data "aws_ami" "ubuntu" {
2   most_recent = true
3
4   filter {
5     name    = "name"
6     values  = ["ubuntu/images/hvm-ssd/ubuntu-xenial-16.04-amd64-server-*"]
7   }
8
9   filter {
10    name   = "virtualization-type"
11    values = ["hvm"]
12  }
13
14
15  owners = ["099720109477"]
16
17 }
18
19 data "aws_security_groups" "test" {
20   filter {
21     name    = "group-name"
22     values  = ["*default*"]
23   }
24 }
```

Ln 1, Col 1 Spaces: 2 UTF-8 CRLF HCL ⚙ 15:50

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21-04-2021 ENG

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf example-createmodule TERRAFORM-TRAINING backup example example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-configure-remotestate example-createmodule .terraform modules ebs ec2-instance vpc datasources.tf main.tf outputs.tf terraform.tfstate terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-instance-LocalExec example-instance-RemoteExec example-module example-NullResource example-override OUTLINE

main.tf

```
provider "aws" {
  region      = var.aws_region
}

module "ec2-instance" {
  source  = "./modules/ec2-instance"
  aws_subnet_id = module.vpc.subnet_id
}

module "ebs" {
  source  = "./modules/ebs"
}

module "vpc" {
  source  = "./modules/vpc"
}

resource "aws_volume_attachment" "name1" {
  device_name = var.volume_device_name1
  volume_id   = module.ebs.ebs_volume_name_1
  instance_id = module.ec2-instance.instance_id
}

resource "aws_volume_attachment" "name2" {
  device_name = var.volume_device_name2
  volume_id   = module.ebs.ebs_volume_name_2
  instance_id = module.ec2-instance.instance_id
}
```

Ln 19, Col 1 Spaces: 2 UTF-8 CRLF HCL ⚙ 15:51 21-04-2021

Type here to search

File Edit Selection View Go Run Terminal Help variables.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS variables.tf X

TERRAFORM-TRAINING variables.tf example-createmodule

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
  - > .terraform
- > modules
  - > ebs
  - > ec2-instance
  - > vpc
- variables.tf
- main.tf
- outputs.tf
- terraformer.tfstate
- terraformer.tfvars
- variables.tf
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
  - > .terraform
- > OUTLINE

variables.tf X

example-createmodule > variables.tf

```
1 variable "aws_region" {  
2   type = string  
3 }  
4 variable "volume_device_name1" {  
5   type = string  
6 }  
7 variable "volume_device_name2" {  
8   type = string  
9 }  
10
```

Ln 10, Col 1 Spaces: 4 UTF-8 LF HCL ⚙ 15:51 21-04-2021

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File Edit Selection View Go Run Terminal Help

terraform.tfvars - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

terraform.tfvars example-createmodule

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
  - > .terraform
  - > modules
    - > ebs
    - > ec2-instance
    - > vpc
  - > datasources.tf
  - > main.tf
  - > outputs.tf
  - > terraform.tfstate
  - > terraform.tfvars
  - > variables.tf
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
  - > .terraform

OUTLINE

terrafarm.tfvars

example-createmodule > terraform.tfvars

```
1 aws_region = "us-west-2"
2
3 volume_device_name1 = "/dev/sdb"
4
5 volume_device_name2 = "/dev/sdc"
6
7
```

Ln 7, Col 1 Spaces: 4 UTF-8 LF HCL ⚙ 15:52 21-04-2021

Type here to search

File Edit Selection View Go Run Terminal Help outputs.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS outputs.tf x example-createmodule > outputs.tf

TERRAFORM-TRAINING

- backup
- example
- example-access-remotestate
- example-aws
- example-aws-rw
- example-azure
- example-azure-backend
- example-configure-remotestate
- example-createmodule
  - .terraform
- modules
  - ebs
  - ec2-instance
  - vpc
- datasources.tf
- main.tf
- outputs.tf
- terraform.tfstate
- terraform.tfvars
- variables.tf

outputs.tf

```
1 output "instance_public_ip" {  
2   value = module.ec2-instance.instance_public_ip  
3 }  
4  
5 output "instance_state" {  
6   value = module.ec2-instance.instance_state  
7   description = "The state of the server instance."  
8 }  
9
```

OUTLINE

LN 9, COL 1 Spaces: 2 UTF-8 CRLF HCL

Type here to search

15:52 21-04-2021

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- example-createmodule
  - > .terraform
  - modules
    - > ebs
    - > ec2-instance
    - > vpc
  - datasources.tf
  - main.tf
  - outputs.tf
  - {} terraform.tfstate
  - terraform.tfvars
  - variables.tf
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- example-override
  - > .terraform

- > OUTLINE

main.tf x

example-createmodule > main.tf

```
1 provider "aws" {
2   region      = var.aws_region
3 }
4
5
6 module "ec2-instance" {
7   source  = "./modules/ec2-instance"
8   aws_subnet_id = module.vpc.subnet_id
9 }
10
11 module "ebs" {
12   source  = "./modules/ebs"
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell + - ×

```
[i] 2021/04/21 15:42:16 [TRACE] vertex "provider.aws (close)": visit complete
2021/04/21 15:42:16 [TRACE] dag/walk: visiting "root"
2021/04/21 15:42:16 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)
2021/04/21 15:42:16 [TRACE] vertex "root": visit complete
2021/04/21 15:42:16 [TRACE] statemgr.Filesystem: no original state snapshot to back up
d=v2021/04/21 15:42:16 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 13
a2021/04/21 15:42:16 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate
i-660126349]2021/04/21 15:42:16 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info
2021/04/21 15:42:16 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate
```

Apply complete! Resources: 12 added, 0 changed, 0 destroyed.

Outputs:

```
instance_public_ip = 54.218.78.205
instance_state = running
PS D:\terraform-training\example-createmodule>
```

0 △ 0 Ln 19, Col 1 Spaces: 2 UTF-8 CRLF HCL ⚙ 15:53  
Type here to search ⚙ ENG 21-04-2021

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Services ▾

Search for services, features, marketplace products, and docs

[Alt+S]



Oregon ▾

Support ▾

 New EC2 Experience  
Tell us what you think XEC2 Dashboard New

Events

Tags

Limits

## ▼ Instances

**Instances** New

Instance Types

Launch Templates

Spot Requests

Savings Plans

Reserved Instances New

Dedicated Hosts

Scheduled Instances

Capacity Reservations

## ▼ Images

AMIs

## ▼ Elastic Block Store

Volumes

Snapshots

Lifecycle Manager

## ▼ Network &amp; Security

Security Groups NewElastic IPs NewInstances (1/1) Info

Connect

Instance state ▾

Actions ▾

Launch instances

 Filter instances< 1 > ⚙️

<input checked="" type="checkbox"/>	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Pub
<input checked="" type="checkbox"/>	example-5-module	i-013a09fd98d6b5f90	<span style="color: green;">Running</span> <span style="color: #ccc;">🕒</span>	t2.micro	<span style="color: green;">2/2 checks passed</span>	No alarms <span style="color: #ccc;">+</span>	us-west-2a	-

Instance: i-013a09fd98d6b5f90 (example-5-module)

Details

Security

Networking

Storage

Status checks

Monitoring

Tags

▼ Instance summary Info

Instance ID

Public IPv4 address

Private IPv4 addresses

New EC2 Experience  
Tell us what you think X**Create Volume**

Actions ▾



Filter by tags and attributes or search by keyword

? K &lt; 1 to 3 of 3 &gt; ▶

<input type="checkbox"/>	Name	Volume ID	Size	Volume Type	IOPS	Throughput	Snapshot	Created	Availability Zone	State	Alarm Status
<input type="checkbox"/>	vol-01438e4...	8 GiB	gp2	100	-		snap-0f3d0316...	April 21, 2021 at 3:4...	us-west-2a	<span style="color: green;">●</span> in-use	None
<input type="checkbox"/>	vol-0fd51c45...	10 GiB	gp2	100	-			April 21, 2021 at 3:3...	us-west-2a	<span style="color: green;">●</span> in-use	None
<input type="checkbox"/>	vol-046df822...	10 GiB	gp2	100	-			April 21, 2021 at 3:3...	us-west-2a	<span style="color: green;">●</span> in-use	None

Instances New

Instance Types

Launch Templates

Spot Requests

Savings Plans

Reserved Instances New

Dedicated Hosts

Scheduled Instances

Capacity Reservations

Select a volume above



Images

AMIs

Elastic Block Store

**Volumes**

Snapshots

Lifecycle Manager

Network &amp; Security

Security Groups NewElastic IPs New



New EC2 Experience  
Tell us what you think X

EC2 Dashboard New

Events

Tags

Limits

▼ Instances

Instances New

Instance Types

Launch Templates

Spot Requests

Savings Plans

Reserved Instances New

Dedicated Hosts

Scheduled Instances

Capacity Reservations

▼ Images

AMIs

▼ Elastic Block Store

Volumes

Snapshots

Lifecycle Manager

▼ Network & Security

Security Groups New

Elastic IPs New

Instances (1/1) Info



Connect

Instance state ▾

Actions ▾

Launch instances



Filter instances

Instance state: running X

Clear filters

<input checked="" type="checkbox"/> Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	P
<input checked="" type="checkbox"/> example-5-module	i-013a09fd98d6b5f90	<span>Running</span>	t2.micro	<span>2/2 checks passed</span>	No alarms	us-west-2a	-

Instance: i-013a09fd98d6b5f90 (example-5-module)

Details Security Networking Storage Status checks Monitoring Tags

▼ Root device details

Root device name /dev/xvda Root device type EBS EBS optimization disabled

▼ Block devices

Filter block devices

Volume ID	Device name	Volume size (GiB)	Attachment status	Attachment time	Encrypted	KMS key ID
vol-01438e4c39d1014c8	/dev/xvda	8	<span>Attached</span>	Wed Apr 21 2021 15:40:06 ...	No	-
vol-046df822943fd0801	/dev/sdc	10	<span>Attached</span>	Wed Apr 21 2021 15:41:51 ...	No	-
vol-0fd51c45f4f40baf1	/dev/sdb	10	<span>Attached</span>	Wed Apr 21 2021 15:41:57 ...	No	-

New VPC Experience  
Tell us what you think

VPC Dashboard [New](#)

Filter by VPC:

Select a VPC

**VIRTUAL PRIVATE CLOUD**

[Your VPCs](#) [New](#)

[Subnets](#) [New](#)

[Route Tables](#)

[Internet Gateways](#) [New](#)

Egress Only Internet  
Gateways [New](#)

Carrier Gateways [New](#)

DHCP Options Sets [New](#)

Elastic IPs [New](#)

Managed Prefix  
Lists [New](#)

Endpoints

Endpoint Services

NAT Gateways [New](#)

Peering Connections

**SECURITY**

Network ACLs [New](#)

Security Groups [New](#)

**REACHABILITY**

Press **F11** to exit full screen

Your VPCs (2) [Info](#)

Filter VPCs



Actions ▾

Create VPC

< 1 > |

<input type="checkbox"/>	Name	VPC ID	State	IPv4 CIDR	IPv6 CIDR (Network border group)
<input type="checkbox"/>	-	vpc-788ea300	Available	172.31.0.0/16	-
<input type="checkbox"/>	Demo_VPC	vpc-0331d11909dff1ca8	Available	10.20.0.0/16	-

Select a VPC above





New VPC Experience  
Tell us what you think

VPC Dashboard [New](#)

Filter by VPC:

Select a VPC

**VIRTUAL PRIVATE CLOUD**

Your VPCs [New](#)

**Subnets** [New](#)

Route Tables

Internet Gateways [New](#)

Egress Only Internet Gateways [New](#)

Carrier Gateways [New](#)

DHCP Options Sets [New](#)

Elastic IPs [New](#)

Managed Prefix Lists [New](#)

Endpoints

Endpoint Services

NAT Gateways [New](#)

Peering Connections

**SECURITY**

Network ACLs [New](#)

Security Groups [New](#)

**REACHABILITY**

**Subnets (2)** [Info](#)



Actions ▾

Create subnet

< 1 >

Filter subnets

<input type="checkbox"/>	Name	Subnet ID	State	VPC	IPv4 CIDR	IPv6 CIDR
<input type="checkbox"/>	Demo-Subnet-1	subnet-0e752e17d51b870da	Available	vpc-0331d11909dff1ca8   De...	10.20.1.0/24	-
<input type="checkbox"/>	Demo-Subnet-2	subnet-0d35a973fe6b861b4	Available	vpc-0331d11909dff1ca8   De...	10.20.2.0/24	-

Select a subnet





Create route table

Actions ▾



Filter by tags and attributes or search by keyword

1 to 3 of 3

 New VPC Experience  
Tell us what you thinkVPC Dashboard [New](#)

Filter by VPC:

 Select a VPC**VIRTUAL PRIVATE CLOUD**Your VPCs [New](#)Subnets [New](#)**Route Tables**Internet Gateways [New](#)Egress Only Internet Gateways [New](#)Carrier Gateways [New](#)DHCP Options Sets [New](#)Elastic IPs [New](#)Managed Prefix Lists [New](#)

Endpoints

Endpoint Services

NAT Gateways [New](#)

Peering Connections

**SECURITY**Network ACLs [New](#)Security Groups [New](#)**REACHABILITY**

	Name	Route Table ID	Explicit subnet association	Edge associations	Main	VPC ID	Owner
		rtb-085852f4891b51807	-	-	Yes	vpc-0331d11909dff1ca8   ...	784184871882
	Demo_rt	rtb-0dfbf4f4f09e990f	2 subnets	-	No	vpc-0331d11909dff1ca8   ...	784184871882
		rtb-e9fef092	-	-	Yes	vpc-788ea300	784184871882



New VPC Experience  
Tell us what you think

VPC Dashboard [New](#)

Filter by VPC:

Select a VPC

**VIRTUAL PRIVATE CLOUD**

Your VPCs [New](#)

Subnets [New](#)

Route Tables

**Internet Gateways [New](#)**

Egress Only Internet Gateways [New](#)

Carrier Gateways [New](#)

DHCP Options Sets [New](#)

Elastic IPs [New](#)

Managed Prefix Lists [New](#)

Endpoints

Endpoint Services

NAT Gateways [New](#)

Peering Connections

**SECURITY**

Network ACLs [New](#)

Security Groups [New](#)

**REACHABILITY**

Feedback English (US) ▾

Internet gateways (1/1) [Info](#)

Filter internet gateways

C Actions ▾ Create internet gateway

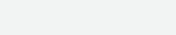
< 1 > |

<input checked="" type="checkbox"/>	Name	Internet gateway ID	State	VPC ID	Owner
<input checked="" type="checkbox"/>	Demo_igw	igw-07f609a2cbd202d78	Attached	vpc-0331d11909dff1ca8   Demo_VPC	784184871882

igw-07f609a2cbd202d78 / Demo\_igw

**Details**

Tags



# Creating modules

---

## Points to note

- With introduction of module blocks, the configuration becomes hierarchical rather than flat
- Module composition - takes multiple composable building-block modules and assembles them together to produce a larger system

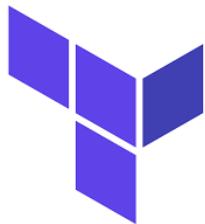


# Terraform

---



## Remote State

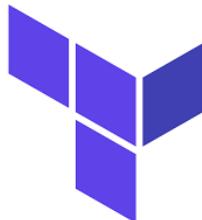


# Remote State

---

## Advantages of Remote backend

- It is considered a best practice to store state elsewhere than your local machine
- Working in a team
  - Remote data store can be shared between all members
  - Infrastructure can be broken down into multiple components
  - Share infrastructure resources in a read-only way
- State Locking
- Keep sensitive information securely
- Remote operations



# Remote State

---

## Remote backends

- By default, Terraform stores state locally in a file named `terraform.tfstate`.
- Working in a team makes the use of a local file usage complicated
- Each user should have the latest state data before running Terraform
- Make sure that nobody else runs Terraform at the same time.



# Remote State

---

## Remote backends

- Terraform writes the state data to a remote data store
- Shared between all members of a team.
- Remote state is implemented by a backend, which you can configure in your configuration's root module.
- Terraform supports storing state in followings
  - Terraform Cloud, HashiCorp Consul, Amazon S3,
  - Azure Blob Storage, Google Cloud Storage, Alibaba Cloud OSS, and more.

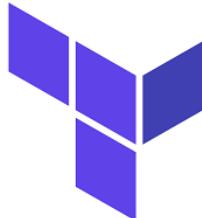


# Remote State

---

## Remote backends

- **Delegation and Teamwork**
- Remote state allows you to share [output values](#) with other configurations.
- This allows your infrastructure to be decomposed into smaller components.
- Remote state also allows teams to share infrastructure resources in a read-only way without relying on any additional configuration store.
- For example, a core infrastructure team can handle building the core machines, networking, etc. and can expose some information to other teams to run their own infrastructure. As a more specific example with AWS: you can expose things such as VPC IDs, subnets, NAT instance IDs, etc. through remote state and have other Terraform states consume that.



# Remote State

---

## Remote backends

- ❑ Migrate existing setups running local state to remote state and vice-versa
- ❑ Backend determines how state is loaded and how operations are executed
- ❑ Backends support differing levels of features in Terraform
- ❑ Standard Backend – <https://www.terraform.io/docs/language/settings/backends/index.html>
  - State management, storing state and providing an API for state locking
- ❑ Enhanced backend –
  - All functionalities supported by Standard plus remote operations



# Remote State

---

## Remote backends

- ❑ Currently, Terraform Cloud is the only remote execution environment
- ❑ Rest all of the backends are of the type Standard Backend



# Remote State

---

## Configuring AWS S3 as the remote Backend

- ❑ Stores the state as a given key in a given bucket on Amazon S3
- ❑ Configure state locking with Dynamo DB



Amazon S3 X**Buckets**

Access Points

Object Lambda Access Points

Batch Operations

Access analyzer for S3

Block Public Access settings for this account

## ▼ Storage Lens

Dashboards

AWS Organizations settings

Feature spotlight

▶ AWS Marketplace for S3

**i Follow security best practices for S3.**Press **F11** to exit full screen[Learn more](#)

Amazon S3

[Copy ARN](#)[Empty](#)[Delete](#)[Create bucket](#)**Buckets (1)**Buckets are containers for data stored in S3. [Learn more](#) Find buckets by name< 1 > ⚙️

Name	AWS Region	Access	Creation date
sh01-terraform-remote	US West (Oregon) us-west-2	Bucket and objects not public	April 14, 2021, 15:24:48 (UTC+05:30)



EXPLORER

&gt; OPEN EDITORS 1 UNSAVED

## TERRAFORM-TRAINING

- > backup
- > example
- > example-aws
- > example-cmodule
- > example-ds
- > example-module
- < example-rs
  - main.tf
- > example-s3
- < example-test
  - > example01



&gt; OUTLINE

&gt; TIMELINE

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS TERRAFORM-TRAINING backup example example-aws example-cmodule example-ds example-module example-rs .terraform main.tf example-s3 example-test example01

main.tf

```
example-rs > main.tf > ...
1  terraform {
2    backend "s3" {
3      bucket = "sh01-terraform-remote"
4      key    = "mystate/terraform.tfstate"
5      region = "us-west-2"
6    }
7  }
8
9  provider "aws" {
10   region = "us-west-2"
11 }
12
13 resource "aws_instance" "instance1" {
14   ami = "ami-0a243dbef00e96192"
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-rs> **terraform init**

Initializing the backend...

Successfully configured the backend "s3"! Terraform will automatically use this backend unless the backend configuration changes.

Initializing provider plugins...

- Checking for available provider plugins...

- Downloading plugin for provider "aws" (hashicorp/aws) 3.36.0...

v2.15.0 Type here to search 15:37 14-04-2021

Ln 18, Col 1 Spaces: 2 UTF-8 CRLF Terraform

File Edit Selection View Go Run Terminal Help

main.tf - terraform-training - Visual Studio Code

EXPLORER

> OPEN EDITORS

< TERRAFORM-TRAINING

- > backup
- > example
- > example-aws
- > example-cmodule
- > example-ds
- > example-module
- < example-rs
  - > .terraform
  - < main.tf
- > example-s3
- < example-test
- > example01

main.tf

```
example-rs > main.tf > ...
1 terraform {
2   backend "s3" {
3     bucket = "sh01-terraform-remote"
4     key    = "mystate/terraform.tfstate"
5     region = "us-west-2"
6   }
7 }
8
9 provider "aws" {
10   region = "us-west-2"
11 }
12
13 resource "aws_instance" "instance1" {
14   ami = "ami-0a243dbef00e96192"
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

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

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

Enter a value: yes

aws\_instance.instance1: Creating...  
aws\_instance.instance1: Still creating... [10s elapsed]  
aws\_instance.instance1: Still creating... [20s elapsed]  
aws\_instance.instance1: Still creating... [30s elapsed]  
aws\_instance.instance1: Creation complete after 37s [id=i-080fe8b7975806dd4]

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

Outputs:

instance\_id = i-080fe8b7975806dd4  
public\_ip = 54.201.41.81

PS D:\terraform-training\example-rs>

v2.15.0 Type here to search

Ln 18, Col 1 Spaces: 2 UTF-8 CRLF Terraform

16:03 ENG 14-04-2021

Amazon S3 X**Buckets**

Access Points

Object Lambda Access Points

Batch Operations

Access analyzer for S3

Block Public Access settings for this account

## ▼ Storage Lens

Dashboards

AWS Organizations settings

Feature spotlight

▶ AWS Marketplace for S3

Amazon S3 &gt; sh01-terraform-remote &gt; mystate/

Copy S3 URI

mystate/

**Objects**

Properties

**Objects (1)**

Objects are the fundamental entities stored in Amazon S3. You can use [Amazon S3 inventory](#) to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. [Learn more](#)



Delete

Actions ▾

Create folder

Upload



Find objects by prefix

&lt; 1 &gt;



Name



Type



Last modified



Size



Storage class



terraform.tfstate

tfstate

April 14, 2021, 16:02:45 (UTC+05:30)

3.4 KB

Standard

```
18 },
19 "resources": [
20 {
21     "mode": "managed",
22     "type": "aws_instance",
23     "name": "instance1",
24     "provider": "provider.aws",
25     "instances": [
26     {
27         "schema_version": 1,
28         "attributes": {
29             "ami": "ami-0a243dbef00e96192",
30             "arn": "arn:aws:ec2:us-west-2:784184871882:instance/i-080fe8b7975806dd4",
31             "associate_public_ip_address": true,
32             "availability_zone": "us-west-2a",
33             "cpu_core_count": 1,
34             "cpu_threads_per_core": 1,
35             "credit_specification": [
36                 {
37                     "cpu_credits": "standard"
38                 }
39             ],
40             "disable_api_termination": false,
41             "ebs_block_device": [
42
43             ],
44             "ebs_optimized": false,
45             "enclave_options": [
46                 {
47                     "enabled": false
48                 }
49             ],
50             "ephemeral_block_device": [
51
52             ],
53             "get_password_data": false,
```

```
68     "http_endpoint": "enabled",
69     "http_put_response_hop_limit": 1,
70     "http_tokens": "optional"
71   }
72 ],
73 "monitoring": false,
74 "network_interface": [
75
76 ],
77 "outpost_arn": "",
78 "password_data": "",
79 "placement_group": "",
80 "primary_network_interface_id": "eni-093aede118658364a",
81 "private_dns": "ip-172-31-21-34.us-west-2.compute.internal",
82 "private_ip": "172.31.21.34",
83 "public_dns": "ec2-54-201-41-81.us-west-2.compute.amazonaws.com",
84 "public_ip": "54.201.41.81",
85 "root_block_device": [
86   {
87     "delete_on_termination": true,
88     "device_name": "/dev/xvda",
89     "encrypted": false,
90     "iops": 100,
91     "kms_key_id": "",
92     "tags": {
93
94       },
95     "throughput": 0,
96     "volume_id": "vol-02a313e6e1f491e49",
97     "volume_size": 8,
98     "volume_type": "gp2"
99   }
100 ],
101 "secondary_private_ips": [
102 ]
```

```
84 "public_ip": "54.201.41.81",
85 "root_block_device": [
86     {
87         "delete_on_termination": true,
88         "device_name": "/dev/xvda",
89         "encrypted": false,
90         "iops": 100,
91         "kms_key_id": "",
92         "tags": {
93             },
94         "throughput": 0,
95         "volume_id": "vol-02a313e6e1f491e49",
96         "volume_size": 8,
97         "volume_type": "gp2"
98     }
99 ],
100 ],
101 "secondary_private_ips": [
102 ],
103 ],
104 "security_groups": [
105     "default"
106 ],
107 "source_dest_check": true,
108 "subnet_id": "subnet-b2328cca",
109 "tags": null,
110 "tenancy": "default",
111 "timeouts": null,
112 "user_data": null,
113 "user_data_base64": null,
114 "volume_tags": null,
115 "vpc_security_group_ids": [
116     "sg-177e4d2a"
117 ],
118 ],
119 "private":
```

# Remote State

---

## Configuring AWS S3 as the remote Backend

- ❑ Stores the state as a given key in a given bucket on Amazon S3
- ❑ Configure state locking with Dynamo DB
- ❑ Terraform needs the following AWS IAM permissions on target backend bucket –
  - ListBucket, GetObject, PutObject

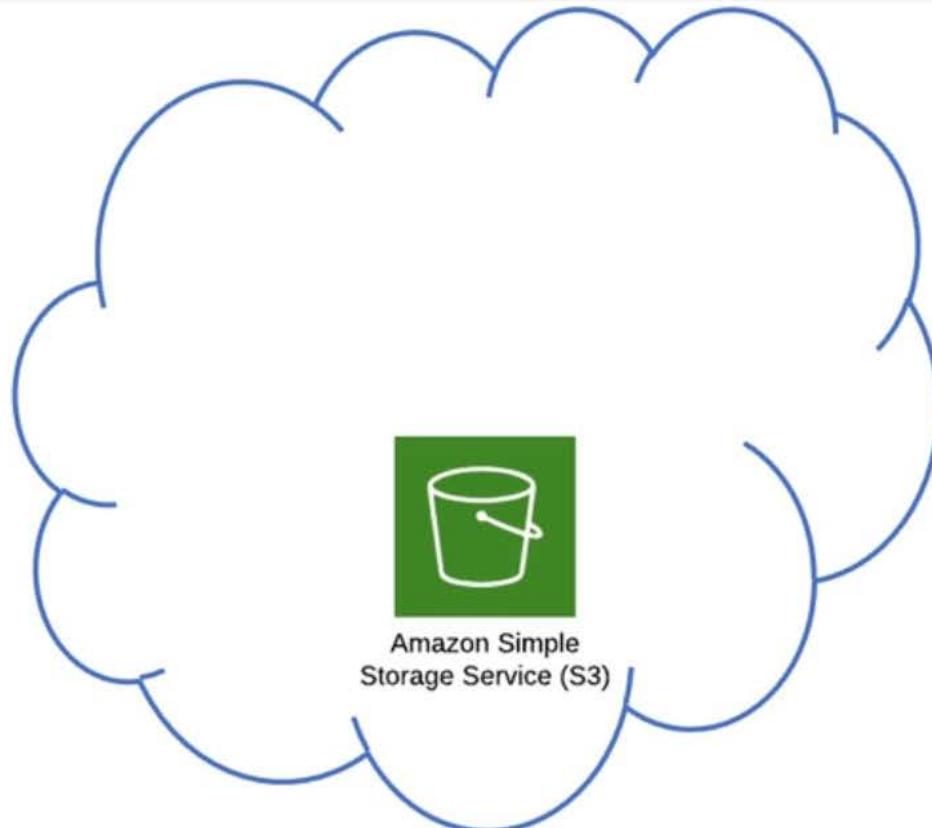


# Remote State

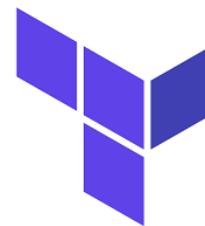
## Example



Team - 1

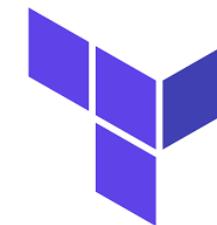
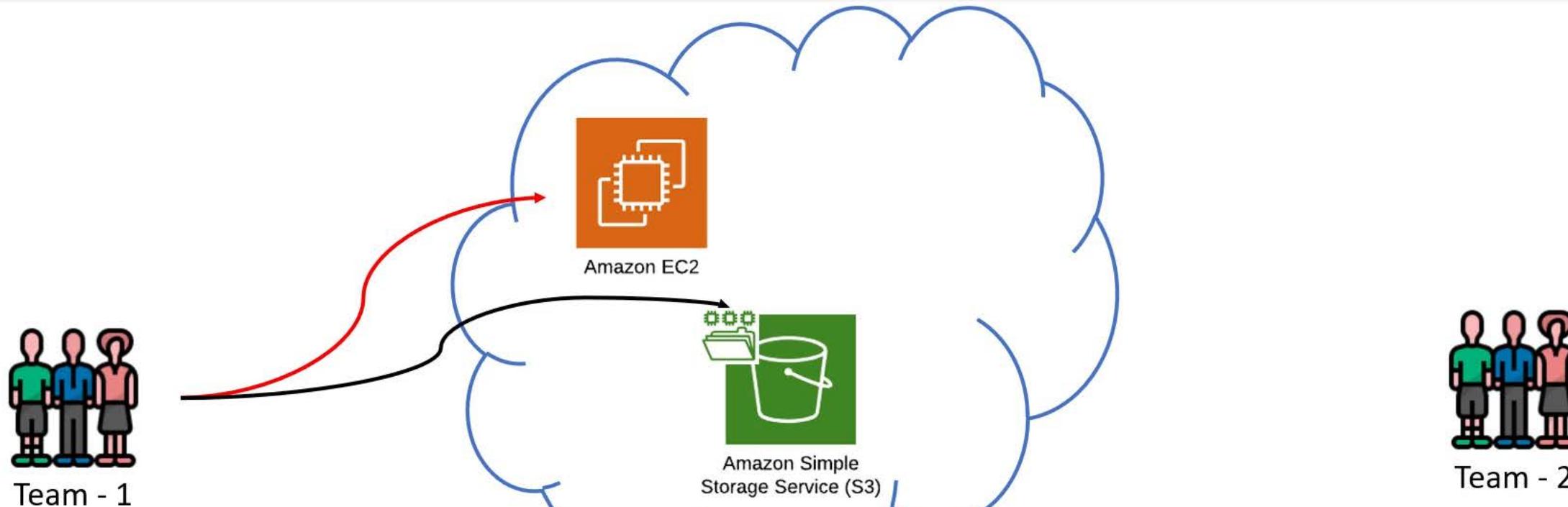


Team - 2



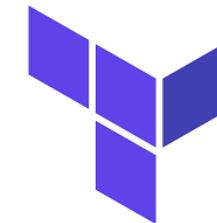
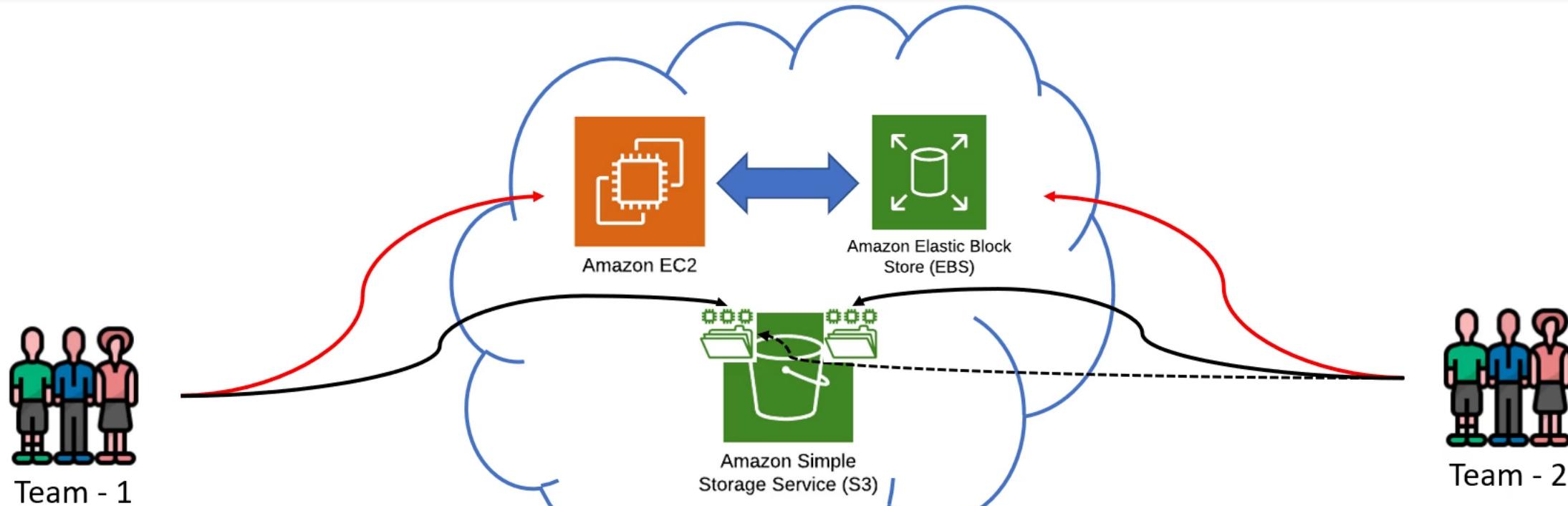
# Remote State

## Example



# Remote State

## Example

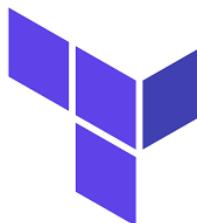


# Remote State

---

## Using the S3 remote state

- ❑ To fetch S3 remote state we can use the `terraform_remote_state` data source
- ❑ It will return all of the root module outputs defined in the referenced remote state
- ❑ We can use this data source to fetch the Terraform state file stored by another set of templates
- ❑ Data returned is read-only



File Edit Selection View Go Run Terminal Help

main.tf - example-access-remotestate - Visual Studio Code

EXPLORER

OPEN EDITORS

- main.tf
- variables.tf

EXAMPLE-ACCESS-REMOTESTATE

- main.tf
- variables.tf

```
1 terraform {  
2   backend "s3" {  
3     bucket = "sh01-terraform-remote"  
4     key    = "mystate-1/terraform.tfstate"  
5     region = "us-west-2"  
6   }  
7 }  
8  
9 data "terraform_remote_state" "remote1" {  
10  backend = "s3"  
11  config = {  
12    bucket = "sh01-terraform-remote"  
13    key    = "mystate/terraform.tfstate"  
14    region = "us-west-2"  
15  }  
16 }  
17  
18 provider "aws" {  
19   region = "us-west-2"  
20 }  
21  
22 resource "aws_ebs_volume" "ebs_volume" {  
23   availability_zone = var.ebs_azs  
24   size              = 10  
25 }  
26  
27 resource "aws_volume_attachment" "name" {  
28   device_name = var.volume_device_name  
29   volume_id   = aws_ebs_volume.ebs_volume.id  
30   instance_id = data.terraform_remote_state.remote1.outputs.instance_id
```

> OUTLINE

0 △ 0

Type here to search

Ln 33, Col 1 Spaces: 2 UTF-8 CRLF Terraform

18:26 14-04-2021





EXPLORER

...

**OPEN EDITORS**  
X main.tf  
variables.tf**EXAMPLE-ACCESS-REMOTESTATE**main.tf  
variables.tf

main.tf X variables.tf

main.tf &gt; ...

```
10  backend = "s3"
11  config = {
12    bucket = "sh01-terraform-remote"
13    key    = "mystate/terraform.tfstate"
14    region = "us-west-2"
15  }
16 }
17
18 provider "aws" {
19   region = "us-west-2"
20 }
21
22 resource "aws_ebs_volume" "ebs_volume" {
23   availability_zone = var.ebs_azs
24   size              = 10
25 }
26
27 resource "aws_volume_attachment" "name" {
28   device_name = var.volume_device_name
29   volume_id   = aws_ebs_volume.ebs_volume.id
30   instance_id = data.terraform_remote_state.remote1.outputs.instance_id
31   # terraform_remote_state data source is fetching ec2 instance id from "mystate/terraform
32 }
33
34
```

&gt; OUTLINE

⊗ 0 △ 0

Ln 33, Col 1 Spaces: 2 UTF-8 CRLF Terraform

18:24  
14-04-2021

Type here to search



File Edit Selection View Go Run Terminal Help

main.tf - example-access-remotestate - Visual Studio Code

EXPLORER

OPEN EDITORS

- main.tf
- variables.tf

EXAMPLE-ACCESS-REMOTESTATE

- .terraform
- main.tf
- variables.tf

main.tf variables.tf

```
resource "aws_ebs_volume" "ebs_volume"
  count = 1
  bucket = "sh01-terraform-remote"
  key    = "mystate/terraform.tfstate"
  region = "us-west-2"
}

provider "aws" {
  region = "us-west-2"

# aws_ebs_volume.ebs_volume will be created
+ resource "aws_ebs_volume" "ebs_volume" {
    + arn          = (known after apply)
    + availability_zone = "us-west-2a"
    + encrypted    = (known after apply)
    + id           = (known after apply)
    + iops         = (known after apply)
    + kms_key_id   = (known after apply)
    + size         = 10
    + snapshot_id  = (known after apply)
    + throughput   = (known after apply)
    + type         = (known after apply)
  }

# aws_volume_attachment.name will be created
+ resource "aws_volume_attachment" "name" {
    + device_name = "/dev/sdf"
    + id          = (known after apply)
    + instance_id = "i-080fe8b7975806dd4"
    + volume_id   = (known after apply)
  }

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

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

Enter a value: 
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: terraform

Ln 24, Col 26 Spaces: 2 UTF-8 CRLF Terraform 19:26 14-04-2021

Type here to search

Amazon S3 X

## Buckets

Access Points

Object Lambda Access Points

Batch Operations

Access analyzer for S3

Block Public Access settings for this account

## ▼ Storage Lens

Dashboards

AWS Organizations settings

Feature spotlight

▶ AWS Marketplace for S3

Amazon S3 &gt; sh01-terraform-remote

## sh01-terraform-remote

[Objects](#) [Properties](#) [Permissions](#) [Metrics](#) [Management](#) [Access Points](#)

## Objects (2)

Objects are the fundamental entities stored in Amazon S3. You can use [Amazon S3 inventory](#) to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. [Learn more](#)

[Delete](#)[Actions ▾](#)[Create folder](#)[Upload](#)[Find objects by prefix](#)[List versions](#) [1](#)  

<input type="checkbox"/>	Name	Type	Last modified	Size	Storage class
<input type="checkbox"/>	mystate-1/	Folder	-	-	-
<input type="checkbox"/>	mystate/	Folder	-	-	-

```
8 "lineage": "185305e6-945a-6009-3de7-2aececa93463",
9 "outputs": [
10 },
11 ],
12 "resources": [
13 {
14     "mode": "data",
15     "type": "terraform_remote_state",
16     "name": "remote1",
17     "provider": "provider.terraform",
18     "instances": [
19     {
20         "schema_version": 0,
21         "attributes": {
22             "backend": "s3",
23             "config": {
24                 "value": {
25                     "bucket": "sh01-terraform-remote",
26                     "key": "mystate/terraform.tfstate",
27                     "region": "us-west-2"
28                 },
29                 "type": [
30                     "object",
31                     {
32                         "bucket": "string",
33                         "key": "string",
34                         "region": "string"
35                     }
36                 ]
37             },
38             "defaults": null,
39             "outputs": {
40                 "value": {
41                     "instance_id": "i-080fe8b7975806dd4",
42                     "public_ip": "54.201.41.81"
43                 },
44             }
45         }
46     }
47 ],
48 "version": 1
49 }
```

Press F11 to exit full screen

```
7
8     "serial": 0,
9     "lineage": "185305e6-945a-6009-3de7-2aececa93463",
10    "outputs": {
11    },
12    "resources": [
13    {
14        "mode": "data",
15        "type": "terraform_remote_state",
16        "name": "remote1",
17        "provider": "provider.terraform",
18        "instances": [
19        {
20            "schema_version": 0,
21            "attributes": {
22                "backend": "s3",
23                "config": {
24                    "value": {
25                        "bucket": "sh01-terraform-remote",
26                        "key": "mystate/terraform.tfstate",
27                        "region": "us-west-2"
28                    },
29                    "type": [
30                        "object",
31                        {
32                            "bucket": "string",
33                            "key": "string",
34                            "region": "string"
35                        }
36                    ]
37                },
38                "defaults": null,
39                "outputs": {
40                    "value": {
41                        "instance_id": "i-080fe8b7975806dd4",
42                        "public_ip": "54.201.41.81"
43                    }
44                }
45            }
46        }
47    }
48    ],
49    "version": 0
50 }
```

Press F11 to exit full screen



RAW



```
48     "public_ip": "string"
49   }
50 ]
51 },
52 "workspace": "default"
53 }
54 ]
55 ],
56 },
57 [
58   {
59     "mode": "managed",
60     "type": "aws_ebs_volume",
61     "name": "ebs_volume",
62     "provider": "provider.aws",
63     "instances": [
64       {
65         "schema_version": 0,
66         "attributes": {
67           "arn": "arn:aws:ec2:us-west-2:784184871882:volume/vol-0077c36c89a7bf5d0",
68           "availability_zone": "us-west-2a",
69           "encrypted": false,
70           "id": "vol-0077c36c89a7bf5d0",
71           "iops": 100,
72           "kms_key_id": "",
73           "multi_attach_enabled": false,
74           "outpost_arn": "",
75           "size": 10,
76           "snapshot_id": "",
77           "tags": null,
78           "throughput": 0,
79           "type": "gp2"
80         },
81         "private": "bnVsbA=="
82       }
83     ]
84   }
85 }
```

```
71 "kms_key_id": "",  
72 "multi_attach_enabled": false,  
73 "outpost_arn": "",  
74 "size": 10,  
75 "snapshot_id": "",  
76 "tags": null,  
77 "throughput": 0,  
78 "type": "gp2"  
79 },  
80 "private": "bnVsbA=="  
81 }  
82 ]  
83 },  
84 {  
85   "mode": "managed",  
86   "type": "aws_volume_attachment",  
87   "name": "name",  
88   "provider": "provider.aws",  
89   "instances": [  
90     {  
91       "schema_version": 0,  
92       "attributes": {  
93         "device_name": "/dev/sdf",  
94         "force_detach": null,  
95         "id": "vai-1610440822",  
96         "instance_id": "i-080fe8b7975806dd4",  
97         "skip_destroy": null,  
98         "volume_id": "vol-0077c36c89a7bf5d0"  
99       },  
100      "private": "bnVsbA==",  
101      "depends_on": [  
102        "aws_ebs_volume.ebs_volume",  
103        "data.terraform_remote_state.remote1"  
104      ]  
105    }  
106  ]
```



```
// 20210414195337
// https://sh01-terraform-remote.s3.us-west-2.amazonaws.com/mystate/terraform.tfstate?response-content-disposition=inline&X-Amz-Security-Token=IQoJb3JpZ2luX2VjEJL%2F%2F%2F%2F%2F%2F%2F%2F%2F%2F%2F%2F%2F%2FwEaCmFwLXNvdXRoLTEiRjBEAiAgfIn2STAAWkoW%2FGrfmenjWrOn1CUmCB5%2F67rcW0CvvgIgCeOgmWdU3ZEfhMmn8Khf0sTtmzQ5xatmUgROKvK76VwqgwMI6%2F%2F%2F%2F%2F%2F%2F%2F%2F%2F%2FARAAGgw30DQx0DQ4NzE4ODIiDPHmboER0B076k3YFyrXAuHVSkQvKSY%2FZwo%2FB9fb2W20sif0KEGc6m%2FGE3Qz1IOHc9jPJXwwaQ1VZWR7PDLdV3o9ZPESkYr9Lup%2BkW06Ta488z0tY0m6F8wFXjAgq7BjxqPwBAtghaJ53APJ0vGA%2BHJ10M52VV8h%2FsmAJ%2BwzJ9JH4CEFgukTooGeRgVNbLvqLyY7b%2B03ptGBMA40eqo7YIFzu5w0bJ7yR5NKXmVdIZrB%2BavTULdd3qJSuLCRO2FaIx7V3psGuuRnwFL%2FNDDdGjv6w%2FqpQIVMHvb81EhNHHFqv6Fd4%2B3v03jc7w6KeggajGHazLGv9Iiwm3A%2F4APMzDPJ0dCibFIe4akBseM2srj41pRdNR8tnUy9wPltcU21Ds2%2BG22pgkQXgHN0%2BiruukQ8iJ%2FPZTzdCiipx7utAQoTxpFDpkv%2FruAlQ1v%2F%2F%2BmsctvYACc6p77DRYBwdLAXR6Q6PdywheXZgwY6tAk%2FTfs34kgUT9bm35NSBr2xXuWehtWy8ESvvdr9oM9tJ%2BlyDGjmFFEFeqk8Aui20DGW7GTmek%2BXn099ABf0WtSC2ebyzqd20GJu0bCX0vLvem6uDZvxeeG1pru06m15EXAx6vcIjZAC5zNywbkNBhFTwbHrmtd3ug7tvvJcs2hv7t9N2e2ccPb5fMp2dqT1x8zAFjGVt7NB%2FXbqRkFQf40%2BwQbj17sgAYJqEry59MyNOYk2iH8xe0WQ4rHx%2F9bGwyf%2BaPOzbRBKwEEZ91bJE4c71NEqsK5hZMd7FPUb4I5Eq56gyFP4Uv1NJClJsABFt1hunH3AwvVFjnnXiisd3xDd3061%2FEvn3mAqztFi7r1x0Aqnn3DLJN0qOII2%2FmzBJCkc06FFZH1cN9Dns0%2BL8XViVTtQ%3D%3D&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20210414T142334Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIA3NFIPRFKBZOHCEB%2F20210414%2Fus-west-2%2Fs3%2Faws4_request&X-Amz-Signature=2baac307e5c89c117afad6c1cd91ce1a8cbcd792666693d7ef602b18ead24a54
```

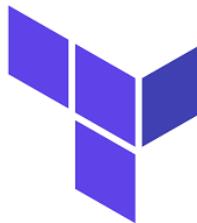
```
{  
  "version": 4,  
  "terraform_version": "0.12.6",  
  "serial": 1,  
  "lineage": "c689867f-e80e-b9c2-356e-a18c8c47c429",  
  "outputs": {  
    "aws_lambda_function.function": {  
      "arn": "arn:aws:lambda:us-east-1:123456789012:function:my-lambda-function",  
      "function_name": "my-lambda-function",  
      "state": "Active",  
      "version": "$LATEST"  
    },  
    "aws_s3_bucket.bucket": {  
      "arn": "arn:aws:s3:::my-bucket",  
      "bucket": "my-bucket",  
      "creation_time": "2023-01-01T00:00:00Z",  
      "last_modified": "2023-01-01T00:00:00Z",  
      "owner": "my-owner",  
      "region": "us-east-1",  
      "size": 104857600, "status": "Complete",  
      "versioning": "Enabled",  
      "website": null  
    }  
  },  
  "resources": [  
    {"type": "aws_lambda_function", "name": "my-lambda-function", "id": "A1B2C3D4E5F6G7H8I9J0K1L2M3N4O5P6Q7R8S9T0U1V2W3X4Y5Z6"},  
    {"type": "aws_s3_bucket", "name": "my-bucket", "id": "A1B2C3D4E5F6G7H8I9J0K1L2M3N4O5P6Q7R8S9T0U1V2W3X4Y5Z6"}  
  ]  
}
```

# Terraform

---



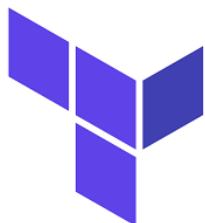
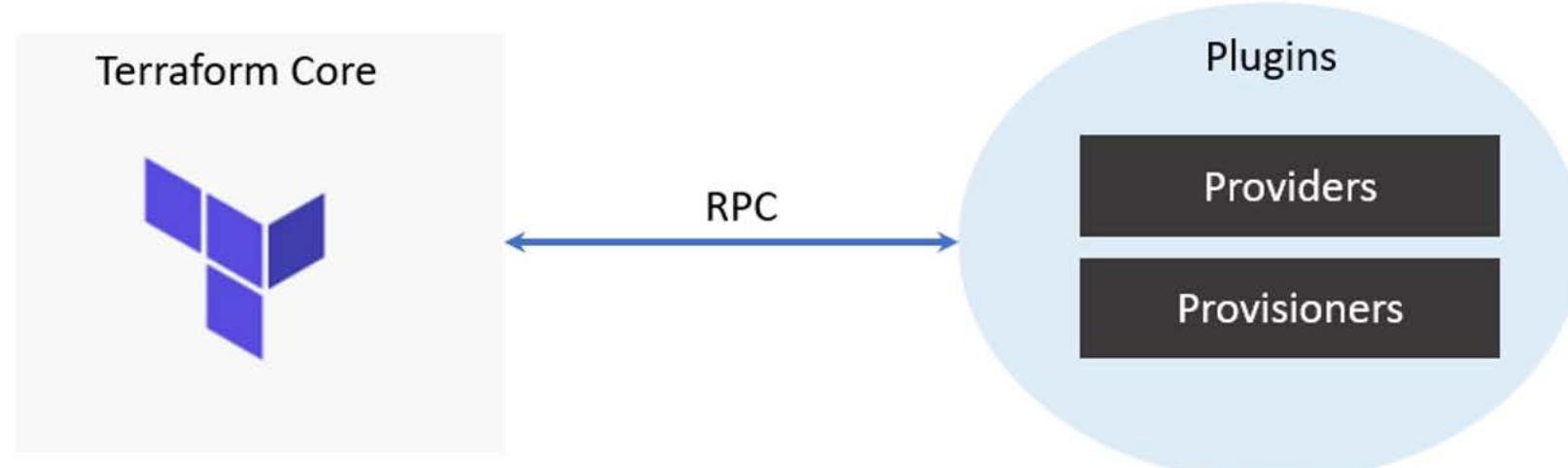
## Provisioners



# Provisioners

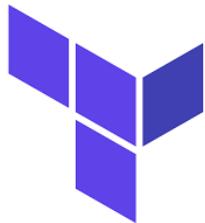
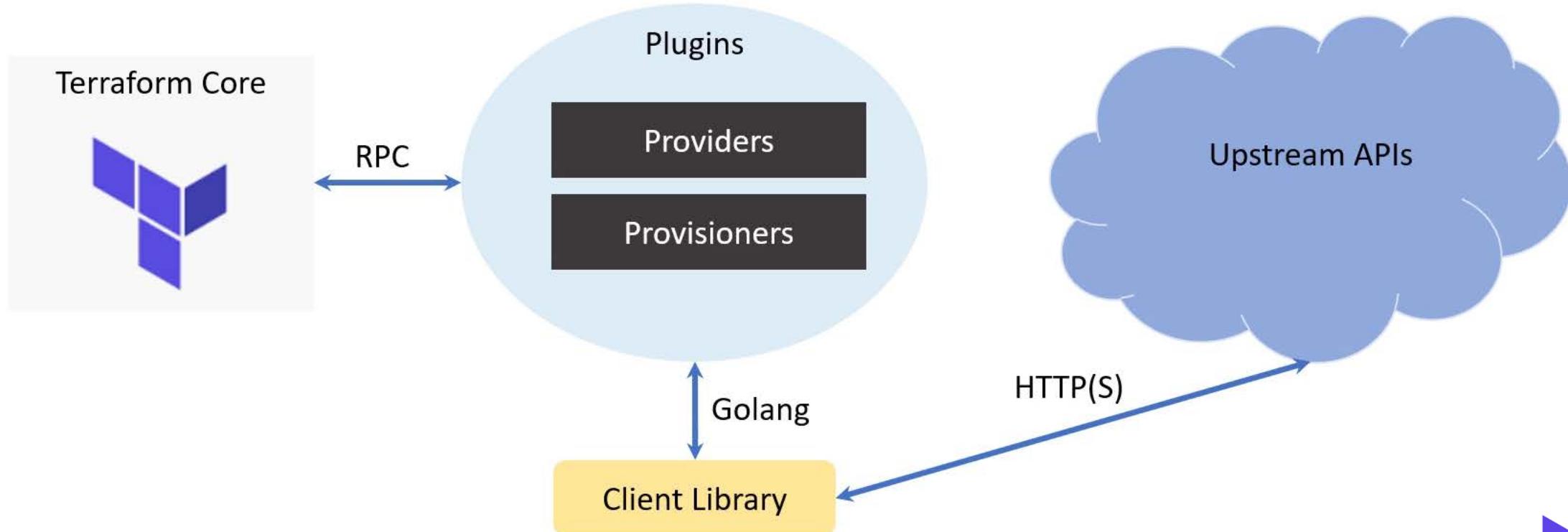
---

## Main Parts



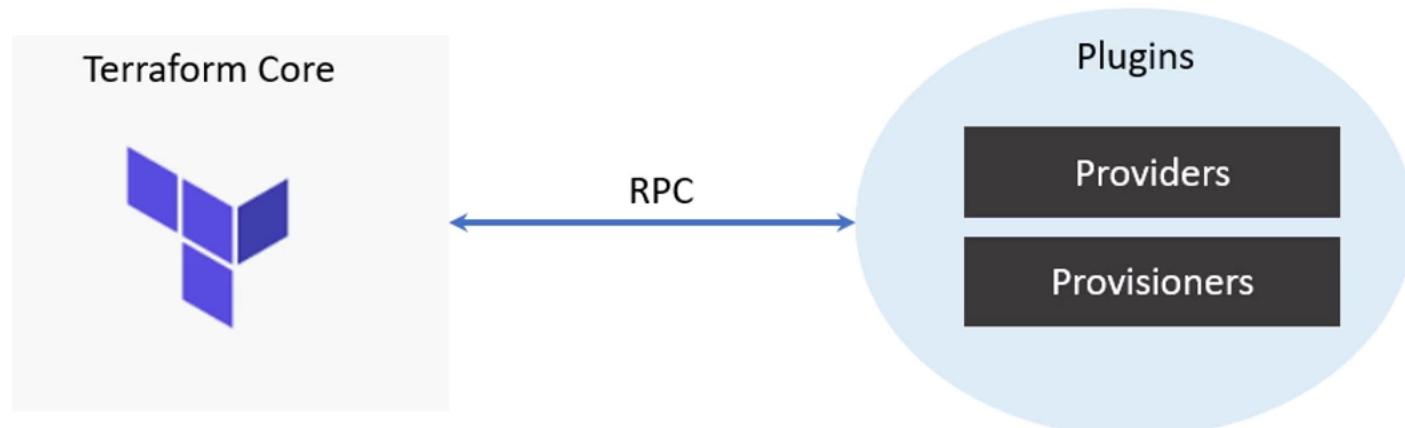
# How Terraform Works

## Working



# Provisioners

## Main Parts



### Responsibilities of Provider Plugins

- Initialization of any included libraries
- Authentication
- Define resources

### Responsibilities of Provisioner Plugins

- Executing commands or scripts on the designated Resource after creation, or on destruction

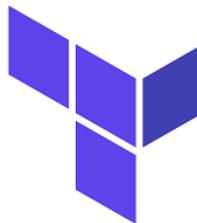


# Provisioners

---

## Few Use Cases

- Passing data into virtual machines and other compute resources
  - Over SSH or WinRM
  
- Running configuration management software
  - Provides visibility and control of the system's performance

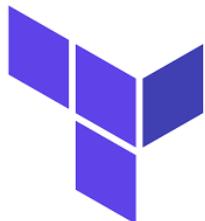


# Provisioners

---

## When to use

- ❑ Terraform advises caution while using the provisioners
- ❑ Considerable amount of complexity and uncertainty to Terraform usage
  - Cannot integrate the actions of provisioners internally as part of a plan
  - Requires coordinating a lot more details than what are usually required
- ❑ Provider might itself be providing some of the facility of the provisioner
  - user\_data or user\_data\_base64 on aws\_instance can be used to provide user data
- ❑ Are not intended to maintain desired state & configuration of existing resources
- ❑ We should use provisioners only if there is no other option





main.tf

```
main.tf > resource "aws_instance" "example"
1 provider "aws" {
2   region           = var.aws_region
3 }
4
5 resource "aws_key_pair" "custom_pair" {
6   key_name         = "examplekey"
7   public_key       = file("~/ssh/id_rsa.pub")
8 }
9
10 resource "aws_instance" "example" {
11   key_name         = aws_key_pair.custom_pair.key_name
12
13   ami              = data.aws_ami.ubuntu.id
14   vpc_security_group_ids = data.aws_security_groups.sec_group.ids
15   subnet_id        = tolist(data.aws_subnet_ids.example.ids)[0]
16
17   associate_public_ip_address = var.req_public_ip
18   instance_type        = var.instance_type
19   tags = {
20     Name            = var.aws_instance_name
21   }
22
23   connection {
24     type            = "ssh"
25     user            = "ubuntu"
26     private_key     = file("~/ssh/id_rsa")
27     host            = self.public_ip
28   }
29
30   provisioner "remote-exec" {
```



main.tf - example-instance-RemoteExec - Visual Studio Code

EXPLORER 1 OPEN EDITORS 1 UNSAVED

main.tf variables.tf datasources.tf outputs.tf

main.tf > resource "aws\_instance" "example" > provisioner "remote-exec" > [ ] inline

```
15 ami = data.aws_ami.ubuntu.id
16 vpc_security_group_ids = data.aws_security_groups.sec_group.ids
17 subnet_id = tolist(data.aws_subnet_ids.example.ids)[0]
18
19 associate_public_ip_address = var.req_public_ip
20 instance_type = var.instance_type
21
22 tags = {
23     Name = var.aws_instance_name
24 }
25
26 connection {
27     agent = true
28     type = "ssh"
29     user = "ubuntu"
30     port = 22
31     private_key = file("./terraform")
32     host = self.public_ip
33 }
34
35 provisioner "remote-exec" {
36     inline = [
37         "touch terraform-learning.txt",
38         "echo learning terraform is awesome > terraform-learning.txt"
39     ]
40 }
41
42 }
```

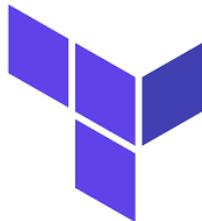


# Provisioners

---

## Connection block

- Defines the connection type, user, host and private\_key attributes
- Don't take a block label
- Can be nested within either a resource or a provisioner.
  - When nested directly within a resource, it affects all of that resource's provisioners
  - When nested in a provisioner block, it only affects that provisioner



File Edit Selection View Go Run Terminal Help

• main.tf - example-instance-RemoteExec - Visual Studio Code

EXPLORER

OPEN EDITORS 1 UNSAVED

- main.tf
- outputs.tf
- variables.tf

EXAMPLE-INSTANCE-REMOTEEXEC

- .terraform
- .terraform.state.lock.info
- datasources.tf
- main.tf
- outputs.tf
- terraform.tfstate
- terraform.tfvars
- variables.tf

main.tf > resource "aws\_instance" "example" > provisioner "remote-exec" > [ ] inline > 1

```
host = self.public_ip
}
provisioner "remote-exec" {
    inline = [
        "touch terraform-learning.txt",
        "echo learning terraform is awesome > terraform-learning.txt"
]
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: terraform

To prevent automatic upgrades to new major versions that may contain breaking changes, please review https://www.terraform.io/docs/backward-compatibility/index.html before upgrading.

PS D:\terraform-training\example-instance-RemoteExec> terraform apply

data.aws\_security\_groups.sec\_group: Refreshing state...

data.aws\_vpc.default: Refreshing state...

data.aws\_ami.ubuntu: Refreshing state...

data.aws\_subnet\_ids.example: Refreshing state...

An execution plan has been generated and is shown below.

Resource actions are indicated with the following symbols:

- + create

Terraform will perform the following actions:

```
# aws_instance.example will be created
+ resource "aws_instance" "example" {
    + ami = "ami-04b01d7f989b9ac8b"
    + arn = (known after apply)
    + associate_public_ip_address = true
    + availability_zone = (known after apply)
    + cpu_core_count = (known after apply)
    + cpu_threads_per_core = (known after apply)
    + get_password_data = false
    + host_id = (known after apply)
    + id = (known after apply)
    + instance_state = (known after apply)
    + instance_type = "t2.micro"
    + ipv6_address_count = (known after apply)
    + ipv6_addresses = (known after apply)
    + key_name = "examplekey"
    + outpost_arn = (known after apply)
```

OUTLINE

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Type here to search

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File Edit Selection View Go Run Terminal Help

• main.tf - example-instance-RemoteExec - Visual Studio Code

EXPLORER

OPEN EDITORS 1 UNSAVED

- main.tf
- outputs.tf

EXAMPLE-INSTANCE-REMOTEEXEC

- .terraform\plugins\windows\_386
  - lock.json
  - terraform-provider-aws\_v3.36.0\_x5.exe
  - .terraform.state.lock.info
- datasources.tf
- main.tf
- outputs.tf
- terraform
- terraform.pub
- terraform.state
- terraform.tfvars
- variables.tf

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

TERMINAL

1: terraform

```
3 }
4
5 resource "aws_key_pair" "custom_pair" {
6   key_name          = "keypair01"
7   public_key        = file("./terraform.pub")
8 }
9
10

+ kms_key_id      = (known after apply)
+ tags            = (known after apply)
+ throughput      = (known after apply)
+ volume_id       = (known after apply)
+ volume_size     = (known after apply)
+ volume_type     = (known after apply)
}

# aws_key_pair.custom_pair will be created
+ resource "aws_key_pair" "custom_pair" {
  + arn           = (known after apply)
  + fingerprint  = (known after apply)
  + id           = (known after apply)
  + key_name     = "keypair"
  + key_pair_id  = (known after apply)
  + public_key   = "ssh-r
Ltpff1bc0cfXiCpZMoid40hEoak
HUXNvkoL7fKRBGUyCPCCkIAopBNw
K"
}

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

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

Enter a value: 
```

WeCJ  
JXgn  
4EB8

OUTLINE

0 △ 0

Type here to search

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File Edit Selection View Go Run Terminal Help

main.tf - example-instance-RemoteExec - Visual Studio Code

EXPLORER ... main.tf X variables.tf datasources.tf outputs.tf ●

OPEN EDITORS 1 UNSAVED main.tf > resource "aws\_instance" "example" > connection > type

main.tf variables.tf datasources.tf outputs.tf

EXAMPLE-INSTANCE-REMOTEEXEC .terraform datasources.tf main.tf outputs.tf

terrafrom terraform.pub terraform.tfstate terraform.tfstate.backup terraform.tfvars variables.tf

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

```
1/    subnet_id          = tolist(data.aws_subnet_ids.example.ids)[0]
2/
3/    associate_public_ip_address = var.req_public_ip
4/    instance_type           = var.instance_type
5/
6/    tags = {
7/      Name                = var.aws_instance_name
8/    }
9/
10   connection {
11     agent               = true
12     type                = "ssh"
13     user                = "ubuntu"
14     port                = 22
15     private_key         = file("./terraform")
16   }
```

aws\_instance.example (remote-exec): Password: false  
aws\_instance.example (remote-exec): Private key: true  
aws\_instance.example (remote-exec): Certificate: false  
aws\_instance.example (remote-exec): SSH Agent: true  
aws\_instance.example (remote-exec): Checking Host Key: false  
aws\_instance.example: Still creating... [40s elapsed]  
aws\_instance.example (remote-exec): Connected!  
aws\_instance.example: Creation complete after 48s [id=i-048fec3a13fee533b]

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

Outputs:

```
instance_public_ip = 34.212.32.245
instance_security_groups = [
  "sg-177e4d2a",
]
instance_state = running
instance_subnet_id = subnet-b2328cca
```

PS D:\terraform-training\example-instance-RemoteExec>

Ln 28, Col 40 Spaces: 2 UTF-8 CRLF Terraform

0 △ 0 Type here to search

23:36 ENG 14-04-2021

File Edit Selection View Go Run Terminal Help

main.tf - example-instance-RemoteExec - Visual Studio Code

EXPLORER ... main.tf X variables.tf datasources.tf outputs.tf ●

OPEN EDITORS 1 UNSAVED main.tf > resource "aws\_instance" "example" > connection > type

main.tf variables.tf datasources.tf outputs.tf

EXAMPLE-INSTANCE-REMOTEEXEC .terraform datasources.tf main.tf outputs.tf

.terraform

terrafrom

terrafrom.pub

terrafrom.tfstate

terrafrom.tfstate.backup

terrafrom.tfvars

variables.tf

main.tf > subnet\_id = tolist(data.aws\_subnet\_ids.example.ids)[0]

associate\_public\_ip\_address = var.req\_public\_ip

instance\_type = var.instance\_type

tags = {

Name = var.aws\_instance\_name

}

connection {

agent = true

type = "ssh"

user = "ubuntu"

port = 22

private\_key = file("./terraform")

ssh into the instance

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: ssh

aws\_instance.example: Connecting to remote host via SSH...

aws\_instance.example: Host: 34.212.32.245

aws\_instance.example: User: ubuntu

PS D:\terraform-training\example-instance-RemoteExec> ssh -i terraform ubuntu@34.212.32.245

The authenticity of host '34.212.32.245 (34.212.32.245)' can't be established.

ECDSA key fingerprint is SHA256:U+lOn408mWSqx/r7HS8gGZJvMFDCGuBUZZJzUiPE5PU.

Are you sure you want to continue connecting (yes/no)? yes

Warning: Permanently added '34.212.32.245' (ECDSA) to the list of known hosts.

Welcome to Ubuntu 16.04.7 LTS (GNU/Linux 4.4.0-1126-aws x86\_64)

\* Documentation: <https://help.ubuntu.com>

\* Management: <https://landscape.canonical.com>

\* Support: <https://ubuntu.com/advantage>

0 packages can be updated.

0 of these updates are security updates.

New release '18.04.5 LTS' available.

Run 'do-release-upgrade' to upgrade to it.

Ln 28, Col 40 Spaces: 2 UTF-8 CRLF Terraform

0 △ 0 Type here to search

23:44 ENG 14-04-2021

File Edit Selection View Go Run Terminal Help

EXPLORER

OPEN EDITORS 1 UNSAVED

- main.tf
- variables.tf
- datasources.tf
- outputs.tf

EXAMPLE-INSTANCE-REMOTEEXEC

- .terraform
- datasources.tf
- main.tf
- outputs.tf
- terraform
- terraform.pub
- terraform.tfstate
- terraform.tfstate.backup
- terraform.tfvars
- variables.tf

main.tf

```
1/    main.tf > resource "aws_instance" "example" > connection > type
18      subnet_id = tolist(data.aws_subnet_ids.example.ids)[0]
19
20      associate_public_ip_address = var.req_public_ip
21      instance_type                = var.instance_type
22
23      tags = {
24        Name = var.aws_instance_name
25      }
26
27      connection {
28        agent = true
29        type = "ssh"
30        user = "ubuntu"
31        port = 22
32        private_key = file("./terraform")
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

\* Documentation: <https://help.ubuntu.com>  
\* Management: <https://landscape.canonical.com>  
\* Support: <https://ubuntu.com/advantage>

0 packages can be updated.  
0 of these updates are security updates.

New release '18.04.5 LTS' available.  
Run 'do-release-upgrade' to upgrade to it.

Follow link (ctrl + click)

Last login: Wed Apr 14 18:06:18 2021 from 103.113.140.255  
To run a command as administrator (user "root"), use "sudo <command>".  
See "man sudo\_root" for details.

```
ubuntu@ip-172-31-28-64:~$ ls
ubuntu@ip-172-31-28-64:~$ cat terraform-learning.txt
learning terraform is awesome
ubuntu@ip-172-31-28-64:~$
```

Verification of the file and text in it

OUTLINE

0 △ 0

Type here to search

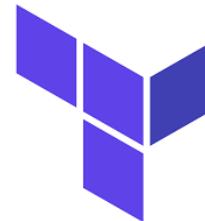
Ln 28, Col 40 Spaces: 2 UTF-8 CRLF Terraform 23:45 14-04-2021 ENG

# Provisioners

---



## Need for Provisioners

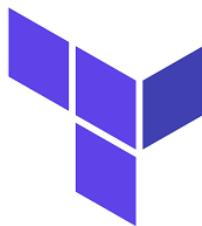


# Provisioners

---

## Provisioner types

- ❑ remote-exec Provisioner
  - invokes a script on a remote resource after it is created
  
- ❑ local-exec Provisioner
  - invokes a local executable after a resource is created



File Edit Selection View Go Run Terminal Help

main.tf - example-instance-LocalExec - Visual Studio Code

EXPLORER

OPEN EDITORS

- outputs.tf
- main.tf

EXAMPLE-INSTANCE-LOCALEXEC

- datasources.tf
- main.tf
- outputs.tf
- securityGroup.tf
- terraforms.tfvars
- variables.tf

main.tf > resource "aws\_security\_group" "allow\_tls\_ssh" > provisioner "local-exec"

```
7   description = var.secGroupDescription
8   vpc_id       = data.aws_vpc.default.id
9   tags = {
10    Name = "Terraform"
11  }
12
13  ingress {
14    description = "TLS from VPC"
15    from_port   = 443
16    to_port     = 443
17    protocol    = "tcp"
18    cidr_blocks = ["0.0.0.0/0"]
19  }
20
21  ingress {
22    description = "SSH Access"
23    from_port   = 22
24    to_port     = 22
25    protocol    = "tcp"
26    cidr_blocks = ["0.0.0.0/0"]
27  }
28
29  egress {
30    from_port   = 0
31    to_port     = 0
32    protocol    = "-1"
33    cidr_blocks = ["0.0.0.0/0"]
34  }
35
36 provisioner "local-exec" {
```

> OUTLINE

1 △ 0

Type here to search

Ln 38, Col 4 Spaces: 2 UTF-8 CRLF Terraform 00:18 15-04-2021 ENG

A vertical column of dark-themed icons used for navigating files and performing various operations in the code editor. outputs.tf  main.tf 

```
  main.tf > resource "aws_security_group" "allow_tls_ssh" > egress > to_port
17 |   to_port = 443
18 |   protocol = "tcp"
19 |   cidr_blocks = ["0.0.0.0/0"]
20 |
21 < ingress {
22 |   description = "SSH Access"
23 |   from_port   = 22
24 |   to_port     = 22
25 |   protocol    = "tcp"
26 |   cidr_blocks = ["0.0.0.0/0"]
27 }
28
29 < egress {
30 |   from_port   = 0
31 |   to_port     = 0
32 |   protocol    = "-1"
33 |   cidr_blocks = ["0.0.0.0/0"]
34 }
35
36 < provisioner "local-exec" {
37 |   command = "echo ${aws_security_group.allow_tls_ssh.id} ${aws_security_group.allow_tls_ssh.name} >> securityGroup.txt"
38 }
39
40 }
41
42
```



EXPLORER

OPEN EDITORS

- outputs.tf
- main.tf

EXAMPLE-INSTANCE-LOCALEXEC

- .terraform
- .terraform.tfstate.lock.info
- datasources.tf
- main.tf
- outputs.tf
- securityGroup.txt
- terraform.tfstate
- terraform.tfvars
- variables.tf

main.tf > resource "aws\_security\_group" "allow\_tls\_ssh" > ingress > # from\_port

```
1 provider "aws" {
2   region = var.aws_region
3 }
4
5 resource "aws_security_group" "allow_tls_ssh" {
6   name      = var.secGroupName
7   description = var.secGroupDescription
8   vpc_id    = data.aws_vpc.default.id
9   tags = {
10     Name = "Terraform"
11 }
```

PROBLEMS 1 OUTPUT DEBUG CONSOLE TERMINAL

1: terraform

suggested below.

```
* provider.aws: version = "~> 3.36"
PS D:\terraform-training\example-instance-LocalExec> terraform apply
data.aws_vpc.default: Refreshing state...
```

An execution plan has been generated and is shown below.  
Resource actions are indicated with the following symbols:

+ create

Terraform will perform the following actions:

```
# aws_security_group.allow_tls_ssh will be created
+ resource "aws_security_group" "allow_tls_ssh" {
    + arn          = (known after apply)
    + description    = "Allow SSH and TLS inbound traffic"
    + egress        = [
        + {
            + cidr_blocks = [
                + "0.0.0.0/0",
            ]
            + description    = ""
            + from_port      = 0
            + ipv6_cidr_blocks = []
            + prefix_list_ids = []
            + protocol       = "-1"
        }
    ]
}
```

File Edit Selection View Go Run Terminal Help main.tf - example-instance-LocalExec - Visual Studio Code

EXPLORER ... outputs.tf main.tf X

main.tf > resource "aws\_security\_group" "allow\_tls\_ssh" > ingress > # from\_port

```
1 provider "aws" {
2   region = var.aws_region
3 }
4
5 resource "aws_security_group" "allow_tls_ssh" {
6   name      = var.secGroupName
7   description = var.secGroupDescription
8   vpc_id    = data.aws_vpc.default.id
9   tags = {
10     Name = "Terraform"
11 }
```

PROBLEMS 1 OUTPUT DEBUG CONSOLE TERMINAL 1: powershell + - X

```
+ "Name" = "Terraform"
}
+ vpc_id          = "vpc-788ea300"
```

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

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

Enter a value: yes

```
aws_security_group.allow_tls_ssh: Creating...
aws_security_group.allow_tls_ssh: Still creating... [10s elapsed]
aws_security_group.allow_tls_ssh: Provisioning with 'local-exec'...
aws_security_group.allow_tls_ssh (local-exec): Executing: ["cmd" "/C" "echo sg-0ee2f5fe53e98ebe5 allow_tls_ssh >> securityGroup.txt"]
aws_security_group.allow_tls_ssh: Creation complete after 17s [id=sg-0ee2f5fe53e98ebe5]
```

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

Outputs:

```
security_group_id = sg-0ee2f5fe53e98ebe5
security_group_name = allow_tls_ssh
```

PS D:\terraform-training\example-instance-LocalExec>

Ln 23, Col 21 (22 selected) Spaces: 2 UTF-8 CRLF Terraform 00:35 15-04-2021

Type here to search

File Edit Selection View Go Run Terminal Help securityGroup.txt - example-instance-LocalExec - Visual Studio Code

EXPLORER outputs.tf main.tf securityGroup.txt

OPEN EDITORS outputs.tf main.tf securityGroup.txt

EXAMPLE-INSTANCE-LOC... .terraform datasources.tf main.tf outputs.tf securityGroup.txt

terraformer.tfstate terraformer.tfvars variables.tf

PROBLEMS 1 OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

```
+ "Name" = "Terraform"
}
+ vpc_id          = "vpc-788ea300"
```

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

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

Enter a value: yes

```
aws_security_group.allow_tls_ssh: Creating...
aws_security_group.allow_tls_ssh: Still creating... [10s elapsed]
aws_security_group.allow_tls_ssh: Provisioning with 'local-exec'...
aws_security_group.allow_tls_ssh (local-exec): Executing: ["cmd" "/c" "echo sg-0ee2f5fe53e98ebe5 allow_tls_ssh >> securityGroup.txt"]
aws_security_group.allow_tls_ssh: Creation complete after 17s [id=sg-0ee2f5fe53e98ebe5]
```

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

Outputs:

```
security_group_id = sg-0ee2f5fe53e98ebe5
security_group_name = allow_tls_ssh
```

PS D:\terraform-training\example-instance-LocalExec>

1 △ 0 Ln 1, Col 1 Spaces: 4 UTF-8 CRLF Plain Text

Type here to search

00:35 15-04-2021

Verification of security group id and name

## ▼ Instances

Instances New

Instance Types

Launch Templates

Spot Requests

Savings Plans

Reserved Instances New

Dedicated Hosts

Scheduled Instances

Capacity Reservations

## ▼ Images

AMIs

## ▼ Elastic Block Store

Volumes

Snapshots

Lifecycle Manager

## ▼ Network &amp; Security

Security Groups NewElastic IPs New

Placement Groups

Key Pairs

Network Interfaces New

## ▼ Load Balancing

Load Balancers

Security Groups (1/2) Info

Actions ▾

Create security group

&lt; 1 &gt;

-	Name	Security group ID	Security group name	VPC ID	Description	Owner
<input checked="" type="checkbox"/>	Terraform	sg-0ee2f5fe53e98ebef	allow_tls_ssh	vpc-788ea300	Allow SSH and TLS inb...	78418487188
<input type="checkbox"/>	-	sg-177e4d2a	default	vpc-788ea300	default VPC security gr...	78418487188

## sg-0ee2f5fe53e98ebef - allow\_tls\_ssh

Details

Inbound rules

Outbound rules

Tags



## Inbound rules (2)

Edit inbound rules

Type	Protocol	Port range	Source	Description - optional
SSH	TCP	22	0.0.0.0/0	SSH Access
HTTPS	TCP	443	0.0.0.0/0	TLS from VPC

# Provisioners

---

## Provisioner types

- ❑ remote-exec Provisioner

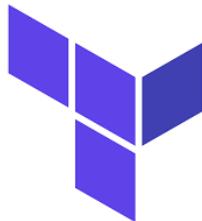
- invokes a script on a remote resource after it is created

- ❑ local-exec Provisioner

- invokes a local executable after a resource is created

- ❑ File Provisioner

- used to copy files or directories from the machine executing Terraform to the newly created resource



# Provisioners

---

## Provisioner types ... contd.

### □ Chef Provisioner

- installs, configures and runs the Chef Client on a remote resource
- supports both ssh and winrm type connections

### □ Provisioners for habitat, puppet and salt-masterless

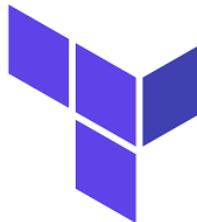


# Provisioners

---

## Provisioners Without a Resource

- ❑ To run provisioners that aren't directly associated with any specific resource
- ❑ Treated like normal resources, with the difference that they don't do anything



File Edit Selection View Go Run Terminal Help main.tf - example-NullResource - Visual Studio Code

EXPLORER main.tf completed.txt

OPEN EDITORS main.tf completed.txt

EXAMPLE-NULLRESOURCE .terraform completed.txt main.tf

terraform.tfstate terraform.tfstate.backup

```
main.tf > resource "null_resource" "example1" > provisioner "local-exec"
1
2   resource "null_resource" "example1" {
3     provisioner "local-exec" {
4       command = "Get-Date > completed.txt"
5       interpreter = ["PowerShell", "-Command"]
6     }
7 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

-/+ destroy and then create replacement

Terraform will perform the following actions:

```
# null_resource.example1 is tainted, so must be replaced
-/+ resource "null_resource" "example1" {
    ~ id = "940949581" -> (known after apply)
}
```

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

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

Enter a value: yes

```
null_resource.example1: Destroying... [id=940949581]
null_resource.example1: Destruction complete after 0s
null_resource.example1: Creating...
null_resource.example1: Provisioning with 'local-exec'...
null_resource.example1 (local-exec): Executing: ["Powershell" "-Command" "Get-Date > completed.txt"]
null_resource.example1: Creation complete after 3s [id=210630885]
```

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

PS D:\terraform-training\example-NullResource>

0 △ 0



Type here to search



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01:35  
15-04-2021

File Edit Selection View Go Run Terminal Help completed.txt - example-NullResource - Visual Studio Code

EXPLORER main.tf completed.txt

OPEN EDITORS main.tf completed.txt

EXAMPLE-NULLRESOURCE .terraform completed.txt

main.tf terraform.tfstate terraform.tfstate.backup

completed.txt

```
1 15 April 2021 01:35:11
2
3
4
5
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

-/+ destroy and then create replacement

Terraform will perform the following actions:

```
# null_resource.example1 is tainted, so must be replaced
-/+ resource "null_resource" "example1" {
    ~ id = "940949581" -> (known after apply)
}
```

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

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

Enter a value: yes

```
null_resource.example1: Destroying... [id=940949581]
null_resource.example1: Destruction complete after 0s
null_resource.example1: Creating...
null_resource.example1: Provisioning with 'local-exec'...
null_resource.example1 (local-exec): Executing: ["Powershell" "-Command" "Get-Date > completed.txt"]
null_resource.example1: Creation complete after 3s [id=210630885]
```

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

PS D:\terraform-training\example-NullResource>

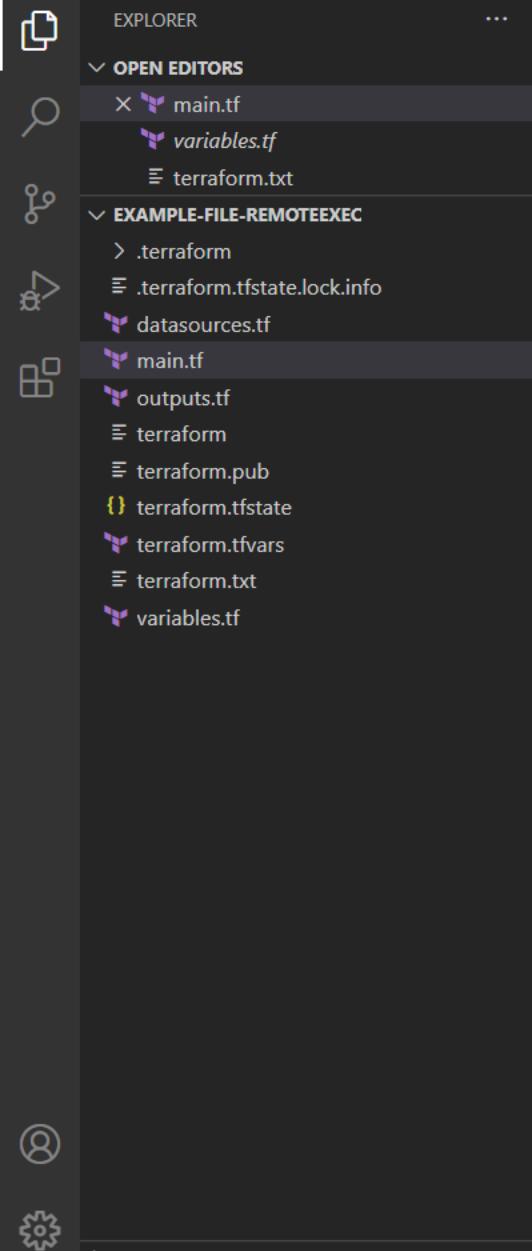
# Provisioners

---

## Using multiple provisioner blocks

- Multiple provisioners can be specified within a resource
- They are executed in the order they're defined in the configuration file





```
main.tf    variables.tf    terraform.txt  
main.tf > resource "aws_instance" "example" > provisioner "remote-exec" > [ ] inline > 0  
  
connection {  
  agent = true  
  type = "ssh"  
  user = "ubuntu"  
  port = 22  
  private_key = file("./terraform")  
  host = self.public_ip  
}  
  
provisioner "file" {  
  source = "terraform.txt"  
  destination = "terraform.txt"  
}  
  
provisioner "remote-exec" {  
  inline = [  
    "echo----->> terraform.txt",  
    "echo Added content remotely >> terraform.txt "  
  ]  
}  
}
```

File Edit Selection View Go Run Terminal Help main.tf - example-File-RemoteExec - Visual Studio Code

EXPLORER ... main.tf variables.tf terraform.txt

OPEN EDITORS main.tf variables.tf terraform.txt

EXAMPLE-FILE-REMOTEEXEC .terraform datasources.tf main.tf outputs.tf terraform terraform.pub terraform.tfstate terraform.tfvars terraform.txt variables.tf

main.tf > resource "aws\_instance" "example"

```
host = self.public_ip
}

provisioner "file" {
    source = "terraform.txt"
    destination = "terraform.txt"
}

provisioner "remote-exec" {
    inline = [
        "echo-----> terraform.txt",
        "echo Added content remotely >> terraform.txt "
    ]
}
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

```
aws_instance.example (remote-exec): Password: false
aws_instance.example (remote-exec): Private key: true
aws_instance.example (remote-exec): Certificate: false
aws_instance.example (remote-exec): SSH Agent: true
aws_instance.example (remote-exec): Checking Host Key: false
aws_instance.example (remote-exec): Connected!
aws_instance.example: Still creating... [1m0s elapsed]
aws_instance.example (remote-exec): /tmp/terraform_864462333.sh: 2: /tmp/terraform_864462333.sh: echo-----: not found
aws_instance.example: Creation complete after 1m5s [id=i-0618019359a99df3a]

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

Outputs:
```

```
instance_public_ip = 52.26.17.226
instance_security_groups = [
    "sg-177e4d2a",
]
instance_state = running
instance_subnet_id = subnet-b2328cca
PS D:\terraform-training\example-File-RemoteExec>
```

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Type here to search

# More Features

---

## Topics in this section

- ❑ Local Values
- ❑ Built-in functions
- ❑ Files Override
- ❑ Resource Dependencies
- ❑ Debugging
- ❑ Example of configuring infrastructure on AWS



# Local Values

---

- Local expressions are used within a module

```
locals {  
    service_name = "forums"  
    owner        = "Whizlabs Team"  
}
```

- Assign local value names to simple constants or to merge/transform multiple values
- Local values can be used multiple times within the module
- Can be referenced from elsewhere in the module with an expression like

local.service\_name



# Built-in functions

---

- Can be used within expressions as another way to transform and combine values
- Functions are called with the syntax name(arg, arg2, ...)
- List of supported functions at <https://www.terraform.io/docs/configuration-0-11/interpolation.html#supported-built-in-functions>
- Terraform language does not support user-defined functions



## Supported built-in functions

The supported built-in functions are:

- `abs(float)` - Returns the absolute value of a given float. Example: `abs(1)` returns `1`, and `abs(-1)` would also return `1`, whereas `abs(-3.14)` would return `3.14`. See also the `signum` function.
- `basename(path)` - Returns the last element of a path.
- `base64decode(string)` - Given a base64-encoded string, decodes it and returns the original string.
- `base64encode(string)` - Returns a base64-encoded representation of the given string.
- `base64gzip(string)` - Compresses the given string with gzip and then encodes the result to base64. This can be used with certain resource arguments that allow binary data to be passed with base64 encoding, since Terraform strings are required to be valid UTF-8.
- `base64sha256(string)` - Returns a base64-encoded representation of raw SHA-256 sum of the given string. **This is not equivalent of `base64encode(sha256(string))` since `sha256()` returns hexadecimal representation.**
- `base64sha512(string)` - Returns a base64-encoded representation of raw SHA-512 sum of the given string. **This is not equivalent of `base64encode(sha512(string))` since `sha512()` returns hexadecimal representation.**
- `bcrypt(password, cost)` - Returns the Blowfish encrypted hash of the string at the given cost. A default `cost` of 10 will be used if not provided.
- `ceil(float)` - Returns the least integer value greater than or equal to the argument.

Examples: `contains(var.list_of_strings, "an_element")`

- `dirname(path)` - Returns all but the last element of path, typically the path's directory.
- `distinct(list)` - Removes duplicate items from a list. Keeps the first occurrence of each element, and removes subsequent occurrences. This function is only valid for flat lists. Example:  
`distinct(var.usernames)`
- `element(list, index)` - Returns a single element from a list at the given index. If the index is greater than the number of elements, this function will wrap using a standard mod algorithm. This function only works on flat lists. Examples:
  - `element(aws_subnet.foo.*.id, count.index)`
  - `element(var.list_of_strings, 2)`
- `file(path)` - Reads the contents of a file into the string. Variables in this file are *not* interpolated. The contents of the file are read as-is. The `path` is interpreted relative to the working directory. Path variables can be used to reference paths relative to other base locations. For example, when using `file()` from inside a module, you generally want to make the path relative to the module base, like this:  
`file("${path.module}/file")`.
- `floor(float)` - Returns the greatest integer value less than or equal to the argument.
- `flatten(list of lists)` - Flattens lists of lists down to a flat list of primitive values, eliminating any nested lists recursively. Examples:
  - `flatten(data.github_user.user.*.gpg_keys)`
- `format(format, args, ...)` - Formats a string according to the given format. The syntax for the format is

EXPLORER ...

> OPEN EDITORS

< TERRAFORM-TRAINING    

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-configure-remotestate
- < example-createmodule 
- > .terraform
- > modules
- < datasources.tf 
- < main.tf 
- < outputs.tf 
- < terraforms.tfvars 
- < variables.tf 
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-s3
- < example-test 
- > example01

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```
PS D:\terraform-training> terraform console
> file("example-createmodule/variables.tf")
variable "aws_region" {
    type = string
}
variable "instance_count" {
    type = number
}
variable "req_public_ip" {
    type = bool
}
variable "instance_type" {
    type = string
}
variable "aws_instance_name" {
    type = string
}
variable "subnet_id" {
    type = string
}

> []
```

1: **terraform**   

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf variables.tf

example-functions > main.tf

```
1
2   output "example1" {
3
4     value = {for s in var.test_list : s => upper(s)}
5   }
6
7   
```

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions

main.tf

variables.tf

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

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.

PS D:\terraform-training\example-functions> **terraform apply**

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

Outputs:

```
example1 = {
    "Terraform" = "TERRAFORM"
    "awesome" = "AWESOME"
    "is" = "IS"
}
```

PS D:\terraform-training\example-functions>

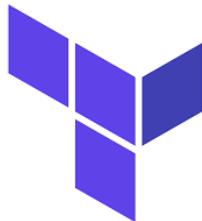
Ln 7, Col 1 Spaces: 2 UTF-8 CRLF HCL ⚙ 11:44 15-04-2021

Type here to search

# Overriding files

---

- ❑ Terraform loads all of the `.tf` and `.tf.json` files within a directory and expects each one to define a distinct set of configuration objects



EXPLORER

OPEN EDITORS

- file1.tf example-override
- file2.tf example-override

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- example-override
- .terraform
- file1.tf
- file2.tf
- > example-s3
- example-test
- > example01

file1.tf

```
provider "aws" {
  region      = "us-west-2"
}

resource "aws_instance" "example1" {
  ami          = "ami-04e59c05167ea7bd5"
  instance_type = "t2.small"
  depends_on   = [aws_s3_bucket.b1]
}

resource "aws_s3_bucket" "b1" {
  bucket = "terraform-b1"
  acl    = "private"
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

initialization. If you've recently upgraded to Terraform v0.12, this may be because your configuration uses syntax constructs that are no longer valid, and so must be updated before full initialization is possible.

Terraform has installed the required providers to support the configuration upgrade process. To begin upgrading your configuration, run the following:

```
terraform 0.12upgrade
```

To see the full set of errors that led to this message, run:

```
terraform validate
```

PS D:\terraform-training\example-override> **terraform validate**

Error: Duplicate resource "aws\_instance" configuration

on file2.tf line 1:

```
1: resource "aws_instance" "example1" {
```

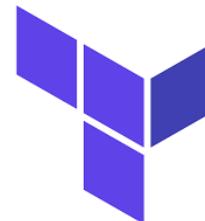
A aws\_instance resource named "example1" was already declared at file1.tf:5,1-35. Resource names must be unique per type in each module.

PS D:\terraform-training\example-override>

## Overriding files

---

- ❑ Terraform loads all of the `.tf` and `.tf.json` files within a directory and expects each one to define a distinct set of configuration objects
- ❑ There are few cases where we want to override specific portions of an existing configuration object
- ❑ Terraform has special handling of any configuration file whose name ends in `_override.tf` or `_override.tf.json`
- ❑ This special handling also applies to a file named literally `override.tf` or `override.t`



File Edit Selection View Go Run Terminal Help file1.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS file1.tf file2\_override.tf

TERRAFORM-TRAINING example-override > file1.tf

```
1 provider "aws" {  
2   region      = "us-west-2"  
3 }  
4  
5 resource "aws_instance" "example1" {  
6   ami          = "ami-04e59c05167ea7bd5"  
7   instance_type = "t2.small"  
8  
9   depends_on = [aws_s3_bucket.b1]  
10 }  
11  
12 resource "aws_s3_bucket" "b1" {  
13   bucket      = "terraform-b1"  
14   acl         = "private"
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

2: powershell

PS D:\terraform-training\example-override> **terraform validate**  
Success! The configuration is valid.

PS D:\terraform-training\example-override>  
PS D:\terraform-training\example-override>



> OUTLINE

⊗ 0 △ 0

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15-04-2021

ENG



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File Edit Selection View Go Run Terminal Help file2\_override.tf (deleted) - terraform-training - Visual Studio Code

EXPLORER ... file1.tf file2\_override.tf (deleted) X

OPEN EDITORS file1.tf example-override X file2\_override.tf (deleted) example-ov... TERRAFORM-TRAINING backup example example-access-remotestate example-aws example-configure-remotestate example-createmodule example-datasource example-File-RemoteExec example-functions example-instance-LocalExec example-instance-RemoteExec example-module example-NullResource example-override .terraform file1.tf override.tf example-s3 example-test example01

example-override > file2\_override.tf

```
1 resource "aws_instance" "example1" {
2   instance_type = "t2.micro"
3 }
4
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 2: powershell

PS D:\terraform-training\example-override> **terraform validate**  
Success! The configuration is valid.

PS D:\terraform-training\example-override>  
PS D:\terraform-training\example-override> **terraform validate**  
Success! The configuration is valid.

PS D:\terraform-training\example-override>

OUTLINE

0 △ 0

Type here to search

11:57 15-04-2021



EXPLORER

...

file1.tf

file2\_override.tf (deleted) X

-

□

...

## OPEN EDITORS

file1.tf example-override

X file2\_override.tf (deleted) example-ov...

## TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module

## example-NullResource

- ✓ example-override
  - > .terraform
  - Ξ .terraform.tfstate.lock.info
  - Y file1.tf
  - Y override.tf
  - { terraform.tfstate
  - > example-s3
  - ✓ example-test
  - > example01

## &gt; OUTLINE

example-override &gt; file2\_override.tf

```
1 resource "aws_instance" "example1" {  
2   instance_type = "t2.micro"  
3 }  
4
```

PROBLEMS

OUTPUT

DEBUG CONSOLE

TERMINAL

2: terraform

+ □ × ^

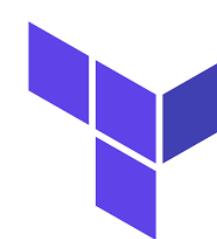
```
+ associate_public_ip_address  = (known after apply)  
+ availability_zone           = (known after apply)  
+ cpu_core_count              = (known after apply)  
+ cpu_threads_per_core        = (known after apply)  
+ get_password_data           = false  
+ host_id                     = (known after apply)  
+ id                          = (known after apply)  
+ instance_state              = (known after apply)  
+ instance_type               = "t2.micro"  
+ ipv6_address_count          = (known after apply)  
+ ipv6_addresses              = (known after apply)  
+ key_name                    = (known after apply)  
+ outpost_arn                 = (known after apply)  
+ password_data               = (known after apply)  
+ placement_group             = (known after apply)  
+ primary_network_interface_id = (known after apply)  
+ private_dns                 = (known after apply)  
+ private_ip                  = (known after apply)  
+ public_dns                  = (known after apply)  
+ public_ip                   = (known after apply)  
+ secondary_private_ips       = (known after apply)
```



# Resource Dependencies

- ❑ In a configuration, some resources must be processed after other specific resources
- ❑ Most resource dependencies are handled automatically
- ❑ In few cases, dependencies are not recognized implicitly in configuration
- ❑ In such cases, the `depends_on` meta-argument can explicitly specify a dependency

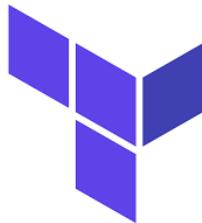
```
example-override > file1.tf
1 provider "aws" {
2   region      = "us-west-2"
3 }
4
5 resource "aws_instance" "example1" {
6   ami          = "ami-04e59c05167ea7bd5"
7   instance_type = "t2.small"
8
9   depends_on = [aws_s3_bucket.b1]
10 }
11
12 resource "aws_s3_bucket" "b1" {
13   bucket      = "terraform-b1"
14   acl         = "private"
15 }
```



# Debug Terraform

---

- ❑ Terraform has detailed logs; enabled by setting the TF\_LOG environment variable
- ❑ The supported log levels are TRACE, DEBUG, INFO, WARN or ERROR



EXPLORER

OPEN EDITORS

- main.tf example-NullResource

TERRAFORM-TRAINING

- backup
- example
- example-access-remotestate
- example-aws
- example-aws-rw
- example-azure
- example-azure-backend
  - .terraform
  - main.tf
  - vars.tf
- example-configure-remotestate
- example-createmodule
- example-datasource
- example-File-RemoteExec
- example-functions
- example-gcp
- example-instance-LocalExec
- example-instance-RemoteExec
- example-module
- example-NullResource
  - .terraform
  - completed.txt
  - main.tf
  - terraform.tfstate
  - terraform.tfstate.backup
- example-override
- example-s3
- example-test
- example01

OUTLINE

main.tf

```
1 resource "null_resource" "example1" {
2   provisioner "local-exec" {
3     command = "Get-Date > completed.txt"
4     interpreter = ["PowerShell", "-Command"]
5   }
6 }
7 }
```

TERMINAL

```
PS D:\terraform-training\example-NullResource> setx TF_LOG "TRACE"

SUCCESS: Specified value was saved.
PS D:\terraform-training\example-NullResource>
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

EXPLORER

OPEN EDITORS

- main.tf example-NullResource

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
  - .terraform
  - main.tf
  - vars.tf
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
  - .terraform
  - completed.txt
  - main.tf
  - terrafrom.tfstate
  - terrafrom.tfstate.backup
- > example-override
- > example-s3
- > example-test
- > example01

OUTLINE

main.tf x

example-NullResource > main.tf

```
1
2 resource "null_resource" "example1" {
3   provisioner "local-exec" {
4     command = "Get-Date > completed.txt"
5     interpreter = ["PowerShell", "-Command"]
6   }
7 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

```
2021/04/21 16:37:16 [TRACE] Meta.Backend: instantiated backend of type <nil>
2021/04/21 16:37:16 [DEBUG] checking for provider in "."
2021/04/21 16:37:16 [DEBUG] checking for provider in "C:\\terraform"
2021/04/21 16:37:16 [DEBUG] checking for provider in ".terraform\\plugins\\windows_386"
2021/04/21 16:37:16 [DEBUG] found provider "terraform-provider-null_v3.1.0_x5.exe"
2021/04/21 16:37:16 [DEBUG] found valid plugin: "null", "3.1.0", "D:\\terraform-training\\example-NullResource\\.terraform\\plugins\\windows_386\\terraform-provider-null_v3.1.0_x5.exe"
2021/04/21 16:37:16 [DEBUG] checking for provisioner in "."
...2021/04/21 16:37:16 [DEBUG] checking for provisioner in "C:\\terraform"
2021/04/21 16:37:16 [DEBUG] checking for provisioner in ".terraform\\plugins\\windows_386"
2021/04/21 16:37:16 [TRACE] Meta.Backend: backend <nil> does not support operations, so wrapping it in a local backend

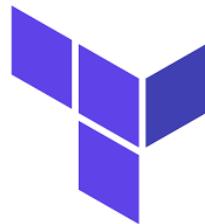
2021/04/21 16:37:16 [TRACE] backend/local: state manager for workspace "default" will:
- read initial snapshot from terraform.tfstate
- write new snapshots to terraform.tfstate
- create any backup at terraform.tfstate.backup
2021/04/21 16:37:16 [TRACE] statemgr.Filesystem: reading initial snapshot from terraform.tfstate
2021/04/21 16:37:16 [TRACE] statemgr.Filesystem: read snapshot with lineage "79b0317c-a6b6-942e-7e39-41823ffbd085" serial 10
2021/04/21 16:37:16 [DEBUG] checking for provider in "."
2021/04/21 16:37:16 [DEBUG] checking for provider in "C:\\terraform"
2021/04/21 16:37:16 [DEBUG] checking for provider in ".terraform\\plugins\\windows_386"
2021/04/21 16:37:16 [DEBUG] found provider "terraform-provider-null_v3.1.0_x5.exe"

2021/04/21 16:37:16 [DEBUG] found valid plugin: "null", "3.1.0", "D:\\terraform-training\\example-NullResource\\.terraform\\plugins\\windows_386\\terraform-provider-null_v3.1.0_x5.exe"
```

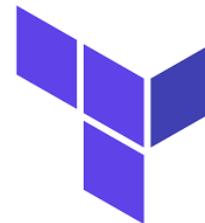
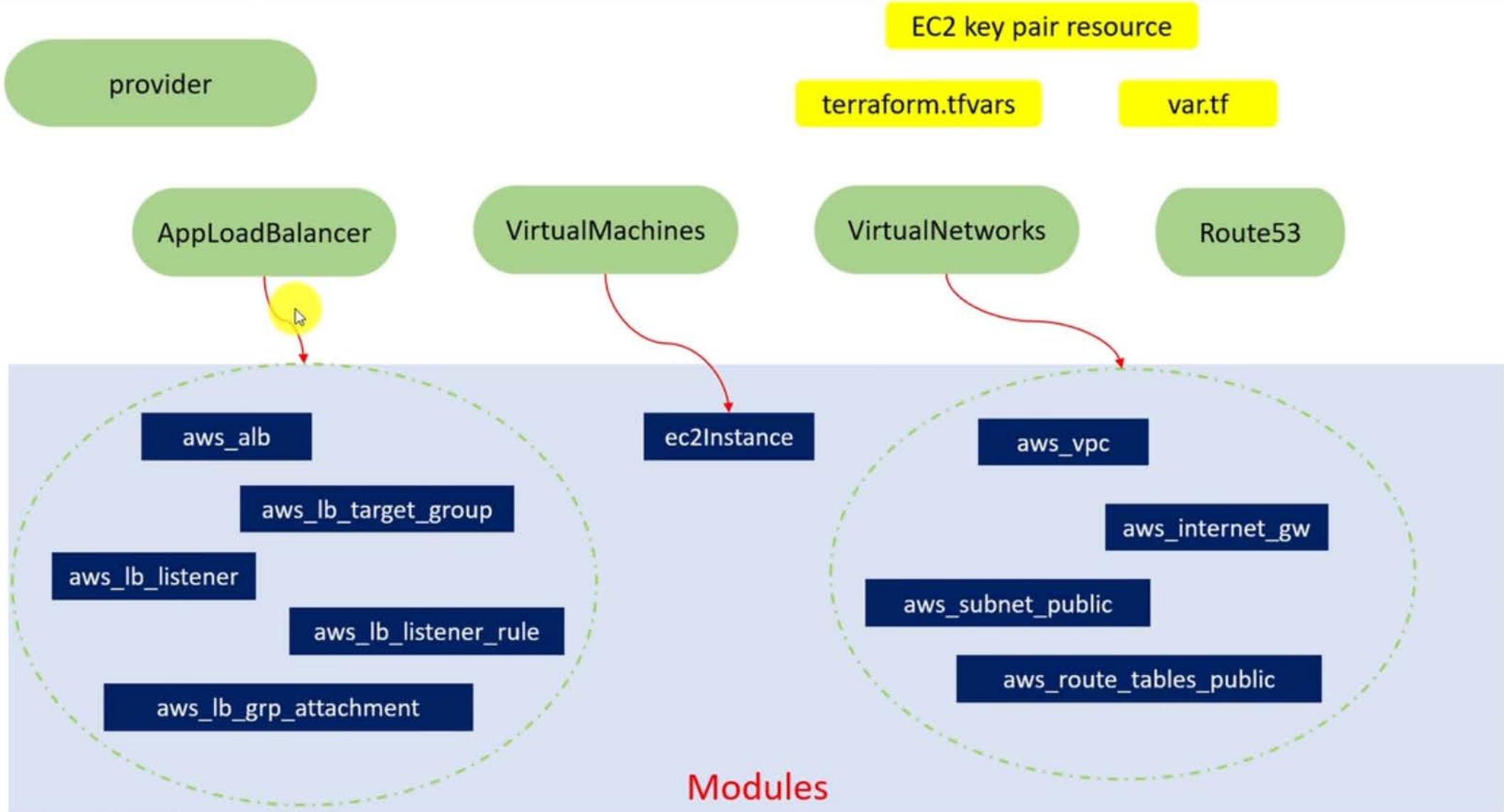
# Example with Terraform

---

- ❑ Run web applications on two EC2 instances
- ❑ Use a Load Balancer to distribute the traffic
- ❑ Route the traffic to Load Balancer via Route53 record



# Example with Terraform



# Terraform

---



Examples on  
Google Cloud Platform



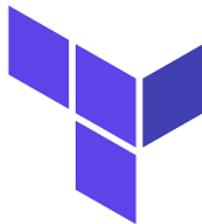
# Examples on GCP

---

## Prerequisites

- Need to have a project in the Google Cloud Console with billing configured
- Provider for Google Cloud Platform is **google**

```
provider "google" {  
  credentials = file("account.json")  
  project     = "my-project-id"  
  region      = "us-central1"  
}
```



# Examples on GCP

---

## Prerequisites

- ❑ Configure Authentication

- `gcloud auth application-default login`
- GCP Service Accounts

- ❑ Default project

- ❑ Default region and zone





IAM &amp; Admin

Service accounts

+ CREATE SERVICE ACCOUNT

DELETE

MANAGE ACCESS

## Service accounts for project 'learning-gcp'

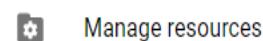
A service account represents a Google Cloud service identity, such as code running on Compute Engine VMs, App Engine apps or systems running outside Google. [Learn more about service accounts.](#)

Organisation policies can be used to secure service accounts and block risky service account features, such as automatic IAM Grants, key creation/upload or the creation of service accounts entirely. [Learn more about service account organisation policies.](#)

Filter Enter property name or value



<input type="checkbox"/>	Email	Status	Name ↑	Description	Key ID	Key creation date	Actions
<input type="checkbox"/>	[REDACTED]	✓	Compute Engine default service account		[REDACTED]	15 Apr 2021	⋮
<input type="checkbox"/>	[REDACTED]	✓	full-access	full-access	[REDACTED]	15 Apr 2021	⋮



Manage resources



learning-gcp-185....json

Show all



Type here to search

12:59  
15-04-2021 ENG



EXPLORER

 OPEN EDITORS

- ```
└── vars.tf      example-gcp  
└── terraform.tfvars    example-gcp  
× └── vm_instance.tf  example-gcp
```

TERRAFORM-TRAINING

- > backup
  - > example
  - > example-access-remotestate
  - > example-aws
  - > example-configure-remotestate
  - > example-createmodule
  - > example-datasource
  - > example-File-RemoteExec

> example-functions

- ```
✓ example-gcp
  > .terraform
{ learning-gcp.json
└─ terraform.tfvars
└─ vars.tf
```

vm\_instance.tf

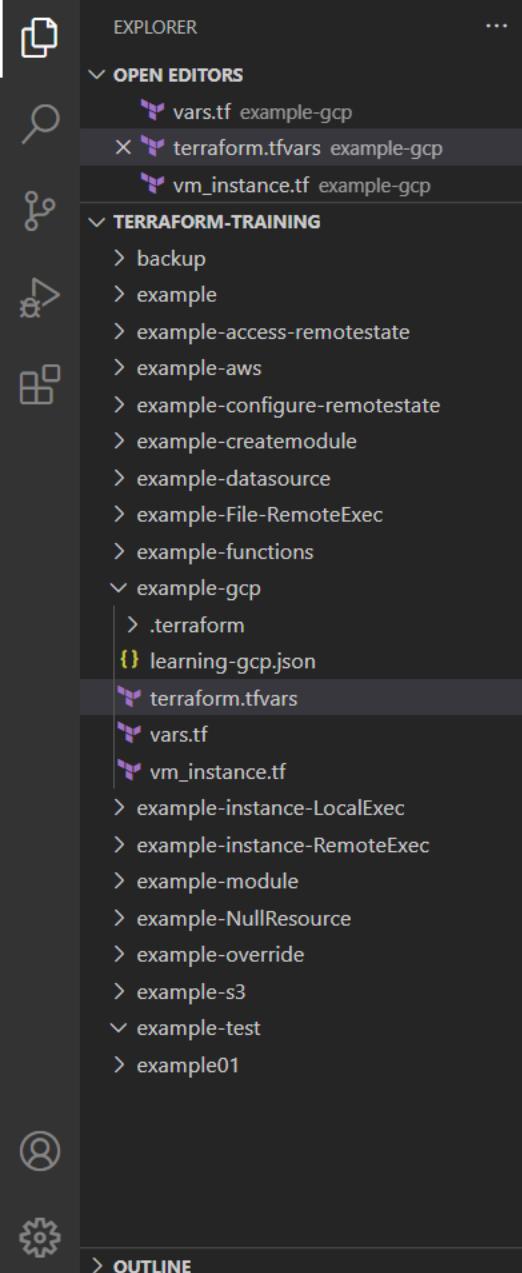
- > example-instance-LocalExec
  - > example-instance-RemoteExec
  - > example-module
  - > example-NullResource
  - > example-override
  - > example-s3
  - ✓ example-test
  - > example01

> OUTLINE

 [vars.tf](#)  [terraform tfvars](#)  [vm\\_instance tf](#)

```
example-gcp > 🐾 vm_instance.tf
 1 provider "google" {
 2   credentials = file(var.credentialsfile)
 3   project     = var.project
 4   region      = var.defaultregion
 5   zone        = var.defaultzone
 6 }
 7
 8 resource "google_compute_network" "gcp_vpc" {
 9   name = var.vpc_network_name
10 }
11
12 resource "google_compute_subnetwork" "gcp_subnet" {
13   name          = var.subnet_name
14   ip_cidr_range = "192.168.1.0/24"
15   region        = var.defaultregion
16   network       = google_compute_network.gcp_vpc.id
17 }
18
19 resource "google_compute_instance" "gcp_vm" {
20   name        = var.instance_name
21   machine_type = "n1-standard-1"
22   zone        = var.defaultzone
23
24   boot_disk {
25     initialize_params {
26       image = "debian-cloud/debian-9"
27     }
28   }
29
30   network_interface {
```

Ln 32, Col 4 Spaces: 2 UTF-8 LF HCL



```
1 vpc_network_name      =      "vpcnetwork"
2
3 subnet_name           =      "first-subnetwork"
4
5 instance_name         =      "my-instance"
6
```

File Edit Selection View Go Run Terminal Help vars.tf - terraform-training - Visual Studio Code

EXPLORER ... vars.tf × terraform.tfvars vm\_instance.tf

example-gcp > vars.tf

```
1 variable credentialsfile {  
2   type = string  
3   default = "./learning-gcp.json"  
4 }  
5  
6 variable project {  
7   type = string  
8   default = "learning-gcp-185425"  
9 }  
10  
11 variable defaultregion {  
12   type = string  
13   default = "us-central1"  
14 }  
15  
16 variable defaultzone {  
17   type = string  
18   default = "us-central1-a"  
19 }  
20  
21 variable vpc_network_name { }  
22  
23 variable subnet_name { }  
24  
25 variable instance_name { }  
26  
27
```

OPEN EDITORS vars.tf example-gcp terraform.tfvars vm\_instance.tf

TERRAFORM-TRAINING backup example example-access-remotestate example-aws example-configure-remotestate example-createmodule example-datasource example-File-RemoteExec example-functions example-gcp .terraform learning-gcp.json terraform.tfvars vars.tf vm\_instance.tf

example-instance-LocalExec example-instance-RemoteExec example-module example-NullResource example-override example-s3 example-test example01

OUTLINE

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File Edit Selection View Go Run Terminal Help vars.tf - terraform-training - Visual Studio Code

EXPLORER

vars.tf example-gcp terraform.tfvars vm\_instance.tf

example-gcp > vars.tf

```
1 variable credentialsfile {  
2   type = string  
3   default = "./learning-gcp.json"  
4 }  
5  
6 variable project {  
7   type = string  
8   default = "learning-gcp-185425"  
9 }  
10  
11 variable defaultregion {  
12   type = string  
13   default = "us-central1"  
14 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

2: powershell

persisted to local or remote state storage.

An execution plan has been generated and is shown below.  
Resource actions are indicated with the following symbols:  
+ create

Terraform will perform the following actions:

```
# google_compute_instance.gcp_vm will be created  
+ resource "google_compute_instance" "gcp_vm" {  
  + can_ip_forward = false  
  + cpu_platform = (known after apply)  
  + current_status = (known after apply)  
  + deletion_protection = false  
  + guest_accelerator = (known after apply)  
  + id = (known after apply)  
  + instance_id = (known after apply)  
  + label_fingerprint = (known after apply)
```

OUTLINE

0 △ 0 Type here to search

12:57 15-04-2021

File Edit Selection View Go Run Terminal Help

vm\_instance.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

- vars.tf example-gcp
- terraform.tfvars example-gcp
- vm\_instance.tf example-gcp

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- example-gcp
  - > .terraform
  - { learning-gcp.json
  - { terraform.tfstate
  - terraform.tfvars
  - vars.tf
  - vm\_instance.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- example-test
  - > example01

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

2: powershell

```
10 }
11
12 resource "google_compute_subnetwork" "gcp_subnet" {
13   name        = var.subnet_name
14   ip_cidr_range = "192.168.1.0/24"
15   region      = var.defaultregion
16   network     = google_compute_network.gcp_vpc.id
}
Plan: 3 to add, 0 to change, 0 to destroy.

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

Enter a value: yes

google_compute_network.gcp_vpc: Creating...
google_compute_network.gcp_vpc: Still creating... [10s elapsed]
google_compute_network.gcp_vpc: Still creating... [20s elapsed]
google_compute_network.gcp_vpc: Still creating... [30s elapsed]
google_compute_network.gcp_vpc: Still creating... [40s elapsed]
google_compute_network.gcp_vpc: Creation complete after 45s [id=projects/learning-gcp-185425/global/networks/vpcnetwork]
google_compute_subnetwork.gcp_subnet: Creating...
google_compute_subnetwork.gcp_subnet: Still creating... [10s elapsed]
google_compute_subnetwork.gcp_subnet: Creation complete after 17s [id=projects/learning-gcp-185425/regions/us-central1/subnetworks/first-subnetwork]
google_compute_instance.gcp_vm: Creating...
google_compute_instance.gcp_vm: Still creating... [10s elapsed]
google_compute_instance.gcp_vm: Creation complete after 19s [id=projects/learning-gcp-185425/zones/us-central1-a/instances/my-instance]

Apply complete! Resources: 3 added, 0 changed, 0 destroyed.
PS D:\terraform-training\example-gcp>
```

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Type here to search



## Compute Engine

VM instances

CREATE INSTANCE

IMPORT VM

REFRESH

START/RESUME

STOP



OPERATIONS ▾

SHOW INFO PANEL

LEARN

## Virtual machines

INSTANCES

INSTANCE SCHEDULE

Filter Enter property name or value



	Name	Zone	Recommendations	In use by	Internal IP	External IP	Connect	
<input type="checkbox"/>	my-instance	us-central1-a			192.168.1.2 (nic0)	None	SSH	

## VM instances

Instance templates

Sole-tenant nodes

Machine images

TPUs

Migrate for Compute Engi...

Committed use discounts

## Storage

Marketplace

Release Notes



learning-gcp-185....json

Show all



Type here to search





## Compute Engine

### VM instance details

[EDIT](#)[RESET](#)[CREATE MACHINE IMAGE](#)[CREATE SIMILAR](#)[STOP](#)[SUSPEND](#)[DELETE](#)[LEARN](#)

Intel Haswell

**Display device**

Turn on a display device if you want to use screen capturing and recording tools.

 Turn on display device**Zone**

us-central1-a

**Labels**

None

**Creation time**

15 Apr 2021, 12:58:47

**Network interfaces**

Name	Network	Subnetwork	Primary internal IP	Alias IP ranges	External IP	Network Tier	IP forwarding	Network details
nic0	vpcnetwork	first-subnetwork	192.168.1.2	-	None		Off	<a href="#">View details</a>

**Firewalls**

- Allow HTTP traffic
- Allow HTTPS traffic

**Network tags**

None

**Deletion protection** Enable deletion protectionWhen deletion protection is enabled, instance cannot be deleted. [Learn more](#)

Type here to search



Show all



13:01

15-04-2021



 VPC network

VPC networks

 CREATE VPC NETWORK REFRESH VPC networks External IP addresses Firewall Routes VPC network peering Shared VPC Serverless VPC access Packet mirroring

Name	Region	Subnets	MTU	Mode	IP address ranges	Gateways	Firewall Rules	Global dynamic routing	Flow logs
default		25	1460	Auto			4	Off	
▼ vpcnetwork		26	1460	Auto			0	Off	
	us-central1	first-subnetwork			192.168.1.0/24	192.168.1.1			Off
	us-central1	vpcnetwork			10.128.0.0/20	10.128.0.1			Off
	europe-west1	vpcnetwork			10.132.0.0/20	10.132.0.1			Off
	us-west1	vpcnetwork			10.138.0.0/20	10.138.0.1			Off
	asia-east1	vpcnetwork			10.140.0.0/20	10.140.0.1			Off
	us-east1	vpcnetwork			10.142.0.0/20	10.142.0.1			Off
	asia-northeast1	vpcnetwork			10.146.0.0/20	10.146.0.1			Off
	asia-southeast1	vpcnetwork			10.148.0.0/20	10.148.0.1			Off
	us-east4	vpcnetwork			10.150.0.0/20	10.150.0.1			Off
	australia-southeast1	vpcnetwork			10.152.0.0/20	10.152.0.1			Off
	europe-west2	vpcnetwork			10.154.0.0/20	10.154.0.1			Off
	europe-west3	vpcnetwork			10.156.0.0/20	10.156.0.1			Off
	southamerica-	vpcnetwork			10.158.0.0/20	10.158.0.1			Off



Type here to search

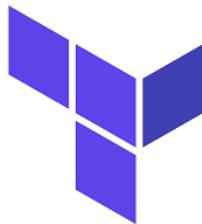


# Examples on GCP

---

## Example 2

- ❑ Use data sources to identify a network created outside of Terraform
- ❑ Create a new VM instance in that network





## VPC network

- [VPC networks](#)
- [External IP addresses](#)
- [Bring your own IP](#)
- [Firewall](#)
- [Routes](#)
- [VPC network peering](#)
- [Shared VPC](#)
- [Serverless VPC access](#)
- [Packet mirroring](#)

◀ VPC network details

EDIT

DELETE VPC NETWORK

SHOW INFO PANEL

test-network

Subnet creation mode

Custom subnets

Dynamic routing mode

Regional

DNS server policy

Enable DNS API

Applying DNS server policies to the network requires DNS API. This is a one-off enablement per project and may take a few minutes to complete.

ENABLE API

None

Maximum transmission unit

1460

SUBNETS

STATIC INTERNAL IP ADDRESSES

FIREWALL POLICIES

FIREWALL RULES

ROUTES

VPC NETWORK PEERING

PRIVATE SERVICE CONNECTION

ADD SUBNET

FLOW LOGS ▾

Filter Enter property name or value

?

☰

<input type="checkbox"/>	Name	Region	IP address ranges	Gateway	Private Google Access	Flow logs
<input type="checkbox"/>	test-subnet	us-central1	10.0.0.0/16	10.0.0.1	Off	

## VPC network

[Create a VPC network](#)

## Name

Name is permanent

## Description (Optional)

## Subnets

Subnets let you create your own private cloud topology within Google Cloud. Click Automatic to create a subnet in each region, or click Custom to manually define the subnets. [Learn more](#)

## Subnet creation mode

Custom Automatic

## New subnet



## Name

Name is permanent

## Add a description

## Region



## IP address range

## Create secondary IP range

## Private Google access

## Google Cloud Platform

Search products and resources



## VPC network

## Create a VPC network

IP address range ?

10.0.0.0/16

## Create secondary IP range

Private Google access ? On Off

## Flow logs

Turning on VPC flow logs doesn't affect performance, but some systems generate a large number of logs, which can increase costs in Stackdriver. [Learn more](#)

 On Off[Done](#) [Cancel](#)[+ Add subnet](#)Dynamic routing mode ? Regional

Cloud Routers will learn routes only in the region in which they were created

 Global

Global routing lets you dynamically learn routes to and from all regions with a single VPN or interconnect and Cloud Router

DNS server policy ?

No server policy

[Create](#) [Cancel](#)

Equivalent REST or command line

VPC network
VPC networks
External IP addresses
Bring your own IP
Firewall
Routes
VPC network peering
Shared VPC
Serverless VPC access
Packet mirroring

VPC networks		<a href="#">CREATE VPC NETWORK</a>	<a href="#">REFRESH</a>						
Name	Region	Subnets	MTU	Mode	IP address ranges	Gateways	Firewall Rules	Global dynamic routing	Flow logs
▶ default		25	1460	Auto ▾			4	Off	
▼ test-network	us-central1	test-subnet	1460	Custom	10.0.0.0/16	10.0.0.1	0	Off	
▶ vpcnetwork		26	1460	Auto ▾			0	Off	

File Edit Selection View Go Run Terminal Help datasource.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

- datasource.tf example-gcp-ds

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- datasource.tf
- terraform.tfvars.tf
- vars.tf
- vm\_instance.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- > example-test
- > example01

datasource.tf X

example-gcp-ds > datasource.tf

```
1
2 data "google_compute_network" "my-network" {
3
4   name = var.vpc_network_name
5
6 }
7
8 output "subnets" {
9   value = data.google_compute_network.my-network.subnetworks_self_links
10 }
```

This data source block will read the above configured vpc network

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-ds>

1: powershell

0 △ 0

Type here to search

19:30  
21-04-2021

File Edit Selection View Go Run Terminal Help • terraform.tfvars - terraform-training - Visual Studio Code

EXPLORER ...

OPEN EDITORS 1 UNSAVED

- terraform.tfvars example-gcp-ds
- datasource.tf example-gcp-ds
- vm\_instance.tf example-gcp-ds
- vars.tf example-gcp-ds

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- example-gcp-ds
  - > .terraform
  - datasource.tf
  - { learning-gcp.json
  - { terraform.tfstate
  - terraform.tfvars
  - vars.tf
  - vm\_instance.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3

TERMINAL

PS D:\terraform-training\example-gcp-ds> [ ]

1: powershell

Ln 4, Col 1 Spaces: 4 UTF-8 CRLF HCL ⚙ 20:33 21-04-2021

Type here to search

Chrome Edge Microsoft Store File Explorer Microsoft Word Microsoft Powerpoint

File Edit Selection View Go Run Terminal Help datasource.tf - terraform-training - Visual Studio Code

EXPLORER ...

OPEN EDITORS

- terraform.tfvars.tf
- datasource.tf **example-gcp-ds > datasource.tf**

TERRAFORM-TRAINING

- backup
- example
- example-access-remotestate
- example-aws
- example-aws-rw
- example-azure
- example-azure-backend
- example-configure-remotestate
- example-createmodule
- example-datasource
- example-File-RemoteExec
- example-functions
- example-gcp
- example-gcp-ds
- datasource.tf
- terraform.tfvars.tf
- vars.tf
- vm\_instance.tf
- example-instance-LocalExec
- example-instance-RemoteExec
- example-module
- example-NullResource
- example-override
- example-s3
- example-test
- example01

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-ds>

1  
2 data "google\_compute\_network" "my-network" {  
3  
4 name = var.vpc\_network\_name  
5  
6 }  
7  
8 output "subnets" {  
9 value = data.google\_compute\_network.my-network.subnetworks\_self\_links  
10 }

Output will give list of subnetwork which is under this network

LN 10, Col 2 (36 selected) Spaces: 2 UTF-8 CRLF HCL

Type here to search

19:44 21-04-2021

File Edit Selection View Go Run Terminal Help vm\_instance.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS 1 UNSAVED example-gcp-ds > vm\_instance.tf

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- datasource.tf
- terraform.tfvars.tf
- vars.tf

vm\_instance.tf

- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- > example-test
- > example01

> OUTLINE

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-ds> [ ]

1 provider "google" {  
2 credentials = file(var.credentialsfile)  
3 project = var.project  
4 region = var.defaultregion  
5 zone = var.defaultzone  
6 }  
7  
8 resource "google\_compute\_instance" "gcp\_vm" {  
9 name = var.instance\_name  
10 machine\_type = "n1-standard-1"  
11 zone = var.defaultzone  
12  
13 boot\_disk {  
14 initialize\_params {  
15 image = "debian-cloud/debian-9"  
16 }  
17 }  
18  
19 network\_interface {  
20 subnetwork = data.google\_compute\_network.my-network.subnetworks\_self\_links[0]  
21 }  
22 }  
23  
24  
25 output "vm-instance-id" {  
26 value = google\_compute\_instance.gcp\_vm.instance\_id  
27 }

Instance created here will be connected to  
subnetwork - line 9 to 23 in same block

Ln 1, Col 1 Spaces: 2 UTF-8 LF HCL 19:47 21-04-2021 Type here to search

File Edit Selection View Go Run Terminal Help vars.tf - terraform-training - Visual Studio Code

EXPLORER ...

OPEN EDITORS example-gcp-ds > vars.tf

- terraform.tfvars example-gcp-ds
- datasource.tf example-gcp-ds
- vm\_instance.tf example-gcp-ds
- vars.tf example-gcp-ds

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- example-gcp-ds
  - > .terraform
  - datasource.tf
  - learning-gcp.json
  - terraform.tfvars
  - vars.tf
- vm\_instance.tf
  - > example-instance-LocalExec
  - > example-instance-RemoteExec
  - > example-module
  - > example-NullResource
  - > example-override
  - > example-s3

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

```
variable defaultregion {  
    type = string  
    default = "us-central1"  
}  
  
variable defaultzone {  
    type = string  
    default = "us-central1-a"  
  
# google_compute_instance.gcp_vm will be created  
+ resource "google_compute_instance" "gcp_vm" {  
    can_ip_forward = false  
    cpu_platform = (known after apply)  
    current_status = (known after apply)  
    deletion_protection = false  
    guest_accelerator = (known after apply)  
    id = (known after apply)  
    instance_id = (known after apply)  
    label_fingerprint = (known after apply)  
    machine_type = "n1-standard-1"  
    metadata_fingerprint = (known after apply)  
    min_cpu_platform = (known after apply)  
    name = "my-instance"  
    project = (known after apply)  
    self_link = (known after apply)  
    tags_fingerprint = (known after apply)  
    zone = "us-central1-a"  
  
    boot_disk {  
        auto_delete = true  
        device_name = (known after apply)  
        disk_encryption_key_sha256 = (known after apply)  
        kms_key_self_link = (known after apply)  
        mode = "READ_WRITE"  
        source = (known after apply)  
    }  
  
    initialize_params {  
        image = "debian-cloud/debian-9"  
        labels = (known after apply)  
    }  
}
```

Ln 25, Col 1 Spaces: 4 UTF-8 CRLF HCL ⚙ 20:31 21-04-2021

Type here to search

File Edit Selection View Go Run Terminal Help vm\_instance.tf - terraform-training - Visual Studio Code

EXPLORER ...

OPEN EDITORS example-gcp-ds > vm\_instance.tf

- terraform.tfvars example-gcp-ds
- datasource.tf example-gcp-ds
- X vm\_instance.tf example-gcp-ds
- vars.tf example-gcp-ds

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- example-gcp-ds
  - > .terraform
  - datasource.tf
  - { learning-gcp.json
  - { terraform.tfstate
  - terraform.tfstate.backup
  - terraform.tfvars
  - vars.tf
- vm\_instance.tf
  - > example-instance-LocalExec
  - > example-instance-RemoteExec
  - > example-module
  - > example-NullResource
  - > example\_override

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell + - ×

```
2021/04/21 20:34:57 [TRACE] dag/walk: visiting "root"
2021/04/21 20:34:57 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)
2021/04/21 20:34:57 [TRACE] vertex "root": visit complete
2021/04/21 20:34:57 [TRACE] statemgr.Filesystem: have already backed up original terraform.tfstate to terraform.tfstate.backup on a previous write
2021/04/21 20:34:57 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 3
2021/04/21 20:34:57 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate
2021/04/21 20:34:57 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info
2021/04/21 20:34:57 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate
```

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

Outputs:

```
subnets = [
    "https://www.googleapis.com/compute/v1/projects/learning-gcp-185425/regions/us-central1/subnetworks/test-subnet",
]
vm-instance-id = 4841660801396605413
```

PS D:\terraform-training\example-gcp-ds>

Ln 1, Col 1 Spaces: 2 UTF-8 LF HCL ⚙ 20:37 21-04-2021

Type here to search

 Compute Engine

## VM instance details

 EDIT RESET CREATE MACHINE IMAGE CREATE SIMILAR STOP SUSPEND DELETE LEARN

## Virtual machines

 VM instances Instance templates Sole-tenant nodes Machine images TPUs Migrate for Compute Engi... Committed use discounts

## Storage

 Disks Snapshots Marketplace Release Notes my-instance-ds Details Monitoring Screenshot

## Remote access

 SSH Connect to serial console Enable connecting to serial ports 

## Logs

 Cloud Logging

Serial port 1 (console)

▼ More

## Instance ID

4841660801396605413

## Machine type

n1-standard-1 (1 vCPU, 3.75 GB memory)

## Reservation

Automatically choose (default)

## CPU platform

Intel Haswell

## Display device

Turn on a display device if you want to use screen capturing and recording tools.

 Turn on display device

## Zone

The instance is created



Type here to search



ENG

20:40

21-04-2021



## Compute Engine

### VM instance details

[EDIT](#)[RESET](#)[CREATE MACHINE IMAGE](#)[CREATE SIMILAR](#)[STOP](#)[SUSPEND](#)[DELETE](#)[LEARN](#)

Automatically choose (default)

CPU platform

Intel Haswell

Display device

Turn on a display device if you want to use screen capturing and recording tools.

 Turn on display device

Zone

us-central1-a

Labels

None

Creation time

21 Apr 2021, 20:34:43

Network interfaces

Name	Network	Subnetwork	Primary internal IP	Alias IP ranges	External IP	Network Tier	IP forwarding	Network details
nid0	test-network	test-subnet	10.0.0.2	-	None		Off	<a href="#">View details</a>

Firewalls

- Allow HTTP traffic
- Allow HTTPS traffic

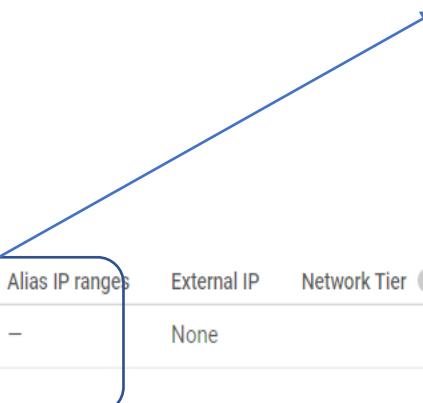
Network tags

None

Deletion protection

 Enable deletion protectionWhen deletion protection is enabled, instance cannot be deleted. [Learn more](#)

The instance is connected to the subnet



Type here to search



# Examples on GCP

---

## Example 3

- Make use of the modules from the Terraform registry
- Create a Cloud-Router and a Cloud-NAT





## cloud-router

GOOGLE

Manage a Cloud Router on GCP

Version 0.2.0 ▾

Published June 30, 2020 by terraform-google-modules

Module managed by morgante

Total provisions: 18,478

Source Code: [github.com/terraform-google-modules/terraform-google-cloud-router](https://github.com/terraform-google-modules/terraform-google-cloud-router) (report an issue)[Submodules ▾](#)[Examples ▾](#)

### Provision Instructions

Copy and paste into your Terraform configuration, insert the variables, and run `terraform init`:

```
module "cloud-router" {  
  source  = "terraform-google-modules/cloud-router"  
  version = "0.2.0"  
  # insert the 5 required variables here  
}
```

[Readme](#) [Inputs \(6\)](#) [Output \(1\)](#) [Dependency \(1\)](#) [Resources \(5\)](#)

## terraform-google-cloud-router

This module handles opinionated Google Cloud Platform routing.



## cloud-nat

GOOGLE

Version 1.3.0 ▾

This module handles opinionated Google Cloud Platform Cloud NAT creation and configuration.

Published March 30, 2020 by terraform-google-modules

Module managed by aaron-lane

Total provisions: 44,953

Source Code: [github.com/terraform-google-modules/terraform-google-cloud-nat](https://github.com/terraform-google-modules/terraform-google-cloud-nat) (report an issue)

 Examples ▾

### Provision Instructions

Copy and paste into your Terraform configuration, insert the variables, and run `terraform init`:

```
module "cloud-nat" {  
    source  = "terraform-google-modules/cloud-nat/gc"  
    version = "1.3.0"  
    # insert the 3 required variables here  
}
```

[Readme](#) [Inputs \(18\)](#) [Outputs \(4\)](#) [Dependencies \(2\)](#) [Resources \(3\)](#)

## Terraform Google Cloud NAT Module

This module handles opinionated Google Cloud Platform Cloud NAT creation and configuration.

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf example-gcp-module > main.tf

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- > example-gcp-module
- main.tf
- outputs.tf
- vars.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- > example-test
- > example01

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-module> **terraform init**

Ln 24, Col 2 (1 selected) Spaces: 2 UTF-8 LF HCL

Type here to search

1 provider "google" {  
2 credentials = file(var.credentialsfile)  
3 project = var.project  
4 region = var.defaultregion  
5 zone = var.defaultzone  
6 }  
7  
8 module "cloud-nat" {  
9 source = "terraform-google-modules/cloud-nat/google"  
10 version = "1.3.0"  
11 project\_id = var.project  
12 region = var.defaultregion  
13 router = module.cloud-router.router.name  
14 name = "my-cloud-nat"  
15 }  
16  
17 module "cloud-router" {  
18 source = "terraform-google-modules/cloud-router/google"  
19 version = "0.2.0"  
20 name = "example-router"  
21 project = var.project  
22 region = var.defaultregion  
23 network = "default"  
24 }

1: powershell + ×

15:44 22-04-2021

File Edit Selection View Go Run Terminal Help vars.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS vars.tf main.tf example-gcp-module > vars.tf

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- > example-gcp-module
  - main.tf
  - outputs.tf
  - vars.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- > example-test
- > example01

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

PS D:\terraform-training\example-gcp-module> **terraform init**

0 △ 0 In 10, Col 1 Spaces: 4 UTF-8 CRLF HCL ⚙ 15:48 22-04-2021 Type here to search

Chrome File Explorer Microsoft Edge Microsoft Store Power BI

EXPLORER

OPEN EDITORS

- vars.tf example-gcp-module
- X outputs.tf example-gcp-module
- main.tf example-gcp-module

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- example-gcp-module

  - > .terraform
  - { learning-gcp.json
  - main.tf
  - outputs.tf
  - vars.tf

- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- > example-test

OUTLINE

TIMELINE

vars.tf outputs.tf main.tf

example-gcp-module &gt; outputs.tf

powershell

```
1  
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL  
# module.cloud-nat.google_compute_router_nat.main will be created  
+ resource "google_compute_router_nat" "main" {  
+   enable_endpoint_independent_mapping = true  
+   icmp_idle_timeout_sec             = 30  
+   id                               = (known after apply)  
+   min_ports_per_vm                 = 64  
+   name                            = "my-cloud-nat"  
+   nat_ip_allocate_option          = "AUTO_ONLY"  
+   project                          = "learning-gcp-185425"  
+   region                           = "us-central1"  
+   router                           = "example-router"  
+   source_subnetwork_ip_ranges_to_nat = "ALL_SUBNETWORKS_ALL_IP_RANGES"  
+   tcp_established_idle_timeout_sec = 1200  
+   tcp_transitory_idle_timeout_sec  = 30  
+   udp_idle_timeout_sec             = 30  
}  
  
# module.cloud-nat.random_string.name_suffix will be created  
+ resource "random_string" "name_suffix" {  
+   id           = (known after apply)  
+   length       = 6  
+   lower        = true  
+   min_lower    = 0  
+   min_numeric  = 0  
+   min_special  = 0  
+   min_upper    = 0  
+   number       = true  
+   result       = (known after apply)  
+   special      = false  
+   upper        = false  
}  
  
# module.cloud-router.google_compute_router.router will be created  
+ resource "google_compute_router" "router" {  
+   creation_timestamp = (known after apply)  
+   id                = (known after apply)  
+   name              = "example-router"  
+   network           = "default"  
+   project           = "learning-gcp-185425"  
+   region            = "us-central1"
```



File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER ... vars.tf outputs.tf main.tf

example-gcp-module > main.tf

```
1 provider "google" {
2   credentials = file(var.credentialsfile)
3   project     = var.project
4   region      = var.defaultregion
5   zone        = var.defaultzone
6 }
7
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

```
vider-google_v3.65.0_x5.exe pid=12712
lo2021-04-22T16:06:35.904+0530 [DEBUG] plugin: plugin exited
2021/04/22 16:06:35 [TRACE] [walkApply] Exiting eval tree: provider.google (close)
u2021/04/22 16:06:35 [TRACE] vertex "provider.google (close)": visit complete
2021/04/22 16:06:35 [TRACE] dag/walk: visiting "root"
2021/04/22 16:06:35 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)
2021/04/22 16:06:35 [TRACE] vertex "root": visit complete
2021/04/22 16:06:35 [TRACE] statemgr.Filesystem: no original state snapshot to back up
d-nat.2021/04/22 16:06:35 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 4
go2021/04/22 16:06:35 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate
ogle2021/04/22 16:06:35 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info
_2021/04/22 16:06:35 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate
compute_router_nat.main: Creation complete after 14s [id=learning-gcp-185425/us-central1/example-router/my-cloud-nat]
```

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

Outputs:

```
cloud-nat = my-cloud-nat
router = [
  "bgp" = []
  "creation_timestamp" = "2021-04-22T03:36:09.023-07:00"
  "description" = ""
  "id" = "projects/learning-gcp-185425/regions/us-central1/routers/example-router"
  "name" = "example-router"
  "network" = "https://www.googleapis.com/compute/v1/projects/learning-gcp-185425/global/networks/default"
  "project" = "learning-gcp-185425"
  "region" = "us-central1"
  "self_link" = "https://www.googleapis.com/compute/v1/projects/learning-gcp-185425/regions/us-central1/routers/example-router"
```

D:\terrafrom-training\example-gcp-module>

v1.3.0 0 △ 0 Ln 16, Col 1 Spaces: 2 UTF-8 LF HCL 16:06 Type here to search ^ ENG 22-04-2021



Cloud router and Cloud NAT modules are initialized here to local system

```
Initializing modules...
Downloading terraform-google-modules/cloud-nat/google 1.3.0 for cloud-nat...
- cloud-nat in .terraform\modules\cloud-nat\terraform-google-cloud-nat-1.3.0
Downloading terraform-google-modules/cloud-router/google 0.2.0 for cloud-router...
- cloud-router in .terraform\modules\cloud-router\terraform-google-cloud-router-0.2.0

Initializing the backend...

Initializing provider plugins...
- Checking for available provider plugins...
- Downloading plugin for provider "google" (hashicorp/google) 3.33.0...
- Downloading plugin for provider "random" (hashicorp/random) 2.3.0...
```



File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER vars.tf outputs.tf main.tf

OPEN EDITORS example-gcp-module > main.tf

```
1 provider "google" {
2   credentials = file(var.credentialsfile)
3   project     = var.project
4   region      = var.defaultregion
5   zone        = var.defaultzone
6 }
7
```

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- example-gcp-module
  - > .terraform
  - { learning-gcp.json
  - main.tf
  - outputs.tf
  - { terraform.tfstate
  - vars.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

```
vider-google_v3.65.0_x5.exe pid=12712
lo2021-04-22T16:06:35.904+0530 [DEBUG] plugin: plugin exited
2021/04/22 16:06:35 [TRACE] [walkApply] Exiting eval tree: provider.google (close)
u2021/04/22 16:06:35 [TRACE] vertex "provider.google (close)": visit complete
2021/04/22 16:06:35 [TRACE] dag/walk: visiting "root"
2021/04/22 16:06:35 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)
2021/04/22 16:06:35 [TRACE] vertex "root": visit complete
2021/04/22 16:06:35 [TRACE] statemgr.Filesystem: no original state snapshot to back up
d-nat.2021/04/22 16:06:35 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 4
go2021/04/22 16:06:35 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate
ogle2021/04/22 16:06:35 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info
_2021/04/22 16:06:35 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate
compute_router_nat.main: Creation complete after 14s [id=learning-gcp-185425/us-central1/example-router/my-cloud-nat]
```

All router details are here

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

Outputs:

```
cloud-nat = my-cloud-nat
router = {
  "bgp" = []
  "creation_timestamp" = "2021-04-22T03:36:09.023-07:00"
  "description" = ""
  "id" = "projects/learning-gcp-185425/regions/us-central1/routers/example-router"
  "name" = "example-router"
  "network" = "https://www.googleapis.com/compute/v1/projects/learning-gcp-185425/global/networks/default"
  "project" = "learning-gcp-185425"
  "region" = "us-central1"
  "self_link" = "https://www.googleapis.com/compute/v1/projects/learning-gcp-185425/regions/us-central1/routers/example-router"
```

PS D:\terraform-training\example-gcp-module>

v1.3.0 0 △ 0

Ln 16, Col 1 Spaces: 2 UTF-8 LF HCL

16:16 22-04-2021

Type here to search

 Network services[← NAT gateway details](#)[EDIT](#)[DELETE](#) my-cloud-natStatus [Running](#)[DETAILS](#)[LOGS](#)[MONITORING](#)**Cloud Router**Region [us-central1](#)VPC network [default](#)Cloud Router [example-router](#)**NAT mapping**

High availability Yes

Source subnets and IP ranges All subnets' primary and secondary IP ranges

NAT IP addresses Auto-allocate

**Advanced configurations**

Minimum ports per VM instance 64

Endpoint-independent mapping enabled

Timeout for protocol connections

UDP 30 seconds

TCP established 1,200 seconds

TCP transitory 30 seconds

ICMP 30 seconds

 Marketplace Release Notes

Hybrid connectivity

Cloud Routers

[+ CREATE ROUTER](#)

[REFRESH](#)

[DELETE](#)

VPN

Interconnect

Cloud routers

Filter Enter property name or value

<input type="checkbox"/>	Name 	Network	Region	Google ASN	Interconnect	Connection	BGP sessions	Logs
<input type="checkbox"/>	example-router	default	us-central1		None			<a href="#">View</a>

# Examples on GCP

---

## Example 4

- Create a NAT service within a router
- Allocate External IP for NAT
  - User given IP is allocated to the NAT
  - Only a set of subnetwork is allowed to the NAT



File Edit Selection View Go Run Terminal Help network.tf - terraform-training - Visual Studio Code

EXPLORER vars.tf network.tf

OPEN EDITORS vars.tf example-gcp-NAT network.tf example-gcp-NAT

TERRAFORM-TRAINING backup example example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-configure-remotestate example-createmodule example-datasource example-File-RemoteExec example-functions example-gcp example-gcp-ds example-gcp-module example-gcp-NAT learning-gcp.json network.tf router\_nat.tf vars.tf

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

PS D:\terraform-training\example-gcp-NAT> [ ]

Ln 26, Col 36 Spaces: 2 UTF-8 LF HCL

v13.0 0 △ 0 Type here to search

1 provider "google" {  
2 credentials = file(var.credentialsfile)  
3 project = var.project  
4 region = var.defaultregion  
5 zone = var.defaultzone  
6 }  
7  
8 resource "google\_compute\_network" "gcp\_vpc" {  
9 name = "vpcnetwork"  
10 auto\_create\_subnetworks = "false"  
11 }  
12  
13 # network is created in custom subnet mode,  
14 # user can explicitly connect to subnet resources  
15 # if true subnet will automatically created under each region by def  
16  
17 resource "google\_compute\_route" "route-ilb" {  
18 name = "route-ilb"  
19 dest\_range = "0.0.0.0/0"  
20 network = google\_compute\_network.gcp\_vpc.name  
21 next\_hop\_gateway = "default-internet-gateway"  
22  
23 resource "google\_compute\_subnetwork" "gcp\_subnet\_one" {  
24 name = "first-subnetwork"  
25 ip\_cidr\_range = "192.168.1.0/24"  
26 region = var.defaultregion  
27 network = google\_compute\_network.gcp\_vpc.id

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File Edit Selection View Go Run Terminal Help

network.tf - terraform-training - Visual Studio Code

EXPLORER

vars.tf network.tf

example-gcp-NAT > network.tf

OPEN EDITORS

- vars.tf example-gcp-NAT
- X network.tf example-gcp-NAT

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- > example-gcp-module
- < example-gcp-NAT
- { learning-gcp.json
- Y network.tf
- Y router\_nat.tf
- Y vars.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- < example-test
- > example01

OUTLINE

TIMELINE

12 # user can explicitly connect to subnet resources  
13 # if true subnet will automatically created under each region by def  
14  
15  
16 resource "google\_compute\_route" "route-ilb" {  
17 name = "route-ilb"  
18 dest\_range = "0.0.0.0/0"  
19 network = google\_compute\_network.gcp\_vpc.name  
20 next\_hop\_gateway = "default-internet-gateway"  
21 }  
22  
23 resource "google\_compute\_subnetwork" "gcp\_subnet\_one" {  
24 name = "first-subnetwork"  
25 ip\_cidr\_range = "192.168.1.0/24"  
26 region = var.defaultregion  
27 network = google\_compute\_network.gcp\_vpc.id  
28 }  
29  
30 resource "google\_compute\_subnetwork" "gcp\_subnet\_two" {  
31 name = "second-subnetwork"  
32 ip\_cidr\_range = "192.168.2.0/24"  
33 region = var.defaultregion  
34 network = google\_compute\_network.gcp\_vpc.id  
35 }  
36

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-NAT>

1: powershell

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v13.0 0 △ 0

Type here to search

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22-04-2021

File Edit Selection View Go Run Terminal Help

router\_nat.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

- vars.tf example-gcp-NAT
- network.tf example-gcp-NAT
- router\_nat.tf example-gcp-NAT

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- > example-gcp-module
- example-gcp-NAT
- learning-gcp.json
- network.tf
- router\_nat.tf
- vars.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- > example-test

OUTLINE

TIMELINE

vars.tf network.tf router\_nat.tf

example-gcp-NAT > router\_nat.tf

```
1 resource "google_compute_address" "ip-address" {
2   name          = "my-address"
3   address_type = "EXTERNAL"
4   region        = var.defaultregion
5 }
6
7 resource "google_compute_router" "gcp_router" {
8   name      = "my-router"
9   region    = var.defaultregion
10  network  = google_compute_network.gcp_vpc.id
11 }
12
13 resource "google_compute_router_nat" "nat" {
14   name           = "my-router-nat"
15   router         = google_compute_router.gcp_router.name
16   region         = var.defaultregion
17   nat_ip_allocate_option = "MANUAL_ONLY"
18   nat_ips       = google_compute_address.ip-address.*.self_link
19   source_subnetwork_ip_ranges_to_nat = "LIST_OF_SUBNETWORKS"
20   subnetwork {
21     name           = google_compute_subnetwork.gcp_subnet_one.id
22     source_ip_ranges_to_nat = ["ALL_IP_RANGES"]
23   }
24 }
25
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-NAT>

1: powershell

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v13.0 0 △ 0

Type here to search

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22-04-2021



## Network services

## Cloud NAT

[+ CREATE NAT GATEWAY](#)[DELETE](#)[REFRESH](#)

Filter Enter property name or value

<input type="checkbox"/>	Gateway name	Region	Cloud Router	Status	
<input type="checkbox"/>	my-router-nat	us-central1	my-router	Running	

Load balancing

Cloud DNS

Cloud CDN

Cloud NAT

Traffic Director

Service Directory

Cloud Domains

Private Service Connect

Marketplace

Release Notes



## VPC network

VPC networks

CREATE VPC NETWORK

REFRESH

### VPC networks

External IP addresses

Bring your own IP

Firewall

Routes

VPC network peering

Shared VPC

Serverless VPC access

Packet mirroring

Name	Region	Subnets	MTU	Mode	IP address ranges	Gateways	Firewall Rules	Global dynamic routing	Flow logs
▶ default		25	1460	Auto ▾			4	Off	
▼ vpcnetwork		2	1460	Custom			0	Off	
	us-central1	first-subnetwork			192.168.1.0/24	192.168.1.1			Off
	us-central1	second-subnetwork			192.168.2.0/24	192.168.2.1			Off

## VPC network

External IP addresses

+ RESERVE STATIC ADDRESS

REFRESH

RELEASE STATIC ADDRESS

SHOW INFO PANEL

Filter Enter property name or value

?

<input type="checkbox"/>	Name	External address	Region	Type	Version	In use by	Network tier	Labels
<input type="checkbox"/>	my-address	34.69.242.25	us-central1	Static	IPv4	Router my-router	Premium	<a href="#">CHANGE</a>

VPC networks

External IP addresses

Bring your own IP

Firewall

Routes

VPC network peering

Shared VPC

Serverless VPC access

Packet mirroring

 VPC network

Routes

 CREATE ROUTE REFRESH DELETEALL

DYNAMIC

PEERING

 Filter Enter property name or value

?

<input type="checkbox"/>	Name	Description	Destination IP range	Priority	Instance tags	Next hop	Network
--------------------------	------	-------------	----------------------	----------	---------------	----------	---------

<input type="checkbox"/>	default-route-43426743161aaaed	Default route to the Internet.	0.0.0.0/0	1000	None	Default Internet gateway	vpcnetwork
--------------------------	--------------------------------	--------------------------------	-----------	------	------	--------------------------	------------

<input type="checkbox"/>	default-route-57923ad7ce2b7e32	Default local route to the subnetwork 192.168.2.0/24.	192.168.2.0/24	0	None	Virtual network	vpcnetwork
--------------------------	--------------------------------	---	----------------	---	------	-----------------	------------

<input type="checkbox"/>	default-route-be304450aaacb063	Default local route to the subnetwork 192.168.1.0/24.	192.168.1.0/24	0	None	Virtual network	vpcnetwork
--------------------------	--------------------------------	---	----------------	---	------	-----------------	------------

<input type="checkbox"/>	route-ilb		0.0.0.0/0	1000	None	Default Internet gateway	vpcnetwork
--------------------------	-----------	--	-----------	------	------	--------------------------	------------

<input type="checkbox"/>	default-route-03e1ddabcc5c0ac9	Default local route to the subnetwork 10.174.0.0/20.	10.174.0.0/20	0	None	Virtual network default	default
--------------------------	--------------------------------	--	---------------	---	------	-------------------------	---------

<input type="checkbox"/>	default-route-0b9181695cc468ad	Default local route to the subnetwork 10.148.0.0/20.	10.148.0.0/20	0	None	Virtual network default	default
--------------------------	--------------------------------	--	---------------	---	------	-------------------------	---------

<input type="checkbox"/>	default-route-0d6e469590374dc	Default local route to the subnetwork 10.184.0.0/20.	10.184.0.0/20	0	None	Virtual network default	default
--------------------------	-------------------------------	--	---------------	---	------	-------------------------	---------

<input type="checkbox"/>	default-route-144a60237121dea4	Default local route to the subnetwork 10.146.0.0/20.	10.146.0.0/20	0	None	Virtual network default	default
--------------------------	--------------------------------	--	---------------	---	------	-------------------------	---------

<input type="checkbox"/>	default-route-1867182f38b3b752	Default local route to the subnetwork 10.156.0.0/20.	10.156.0.0/20	0	None	Virtual network default	default
--------------------------	--------------------------------	--	---------------	---	------	-------------------------	---------

<input type="checkbox"/>	default-route-29d03ff52e2de833	Default local route to the subnetwork 10.158.0.0/20.	10.158.0.0/20	0	None	Virtual network default	default
--------------------------	--------------------------------	--	---------------	---	------	-------------------------	---------

<input type="checkbox"/>	default-route-2b8422b1e178c5e5	Default local route to the subnetwork 10.180.0.0/20.	10.180.0.0/20	0	None	Virtual network default	default
--------------------------	--------------------------------	--	---------------	---	------	-------------------------	---------

<input type="checkbox"/>	default-route-3691669897d8c331	Default local route to the subnetwork 10.160.0.0/20.	10.160.0.0/20	0	None	Virtual network default	default
--------------------------	--------------------------------	--	---------------	---	------	-------------------------	---------

 Hybrid connectivity

## Cloud Routers

 CREATE ROUTER REFRESH DELETE Filter Enter property name or value

?

<input type="checkbox"/>	Name 	Network	Region	Google ASN	Interconnect	Connection	BGP sessions	Logs
<input type="checkbox"/>	my-router	vpcnetwork	us-central1		None			<a href="#">View</a>

 Network services Load balancing Cloud DNS Cloud CDN Cloud NAT Traffic Director Service Directory Cloud Domains Private Service Connect NAT gateway details EDIT DELETEStatus  Running DETAILS LOGS MONITORING

## Cloud Router

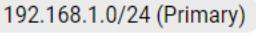
Region us-central1

VPC network vpcnetwork

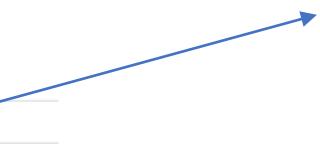
Cloud Router my-router

## NAT mapping

High availability Yes

Source subnets and IP ranges  first-subnetwork: 192.168.1.0/24 (Primary)

NAT IP addresses my-address 34.69.242.25

 NAT GW configured with the first subnet

## Advanced configurations

Minimum ports per VM instance 64

Endpoint-independent mapping enabled

Timeout for protocol connections

UDP 30 seconds

TCP established 1,200 seconds

TCP transitory 30 seconds

ICMP 30 seconds

Stackdriver logging No logging

 Marketplace Release Notes

File Edit Selection View Go Run Terminal Help

vpc.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

- vars.tf example-gcp-SQL
- x vpc.tf example-gcp-SQL

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- > example-gcp-module
- > example-gcp-NAT
- > example-gcp-SQL
- { learning-gcp.json
- sql.tf
- vars.tf
- vpc.tf**
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- > example-test

OUTLINE

TIMELINE

vpc.tf

example-gcp-SQL > vpc.tf

```
1 resource "google_compute_network" "private_network" {  
2   name = "private-network"  
3   auto_create_subnetworks = "true"  
4 }  
5  
6 resource "google_compute_global_address" "private_ip_address" {  
7   name          = "private-ip-address"  
8   purpose       = "VPC_PEERING"  
9   address_type = "INTERNAL"  
10  prefix_length = 16  
11  network       = google_compute_network.private_network.id  
12 }  
13  
14 resource "google_serviceNetworking_connection" "private_vpc_connection" {  
15   network      = google_compute_network.private_network.id  
16   service       = "servicenetworking.googleapis.com"  
17   reserved_peering_ranges = [google_compute_global_address.private_ip_address.name]  
18 }  
19  
20
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-SQL>

1: powershell

Vm ip address range

Private vpc network, subnet under each region

Internal ip range given to vpc network

Manage private vpc connection with gcp service provider

Gcp service provider – provider peering service to manage peering connectivity

v1.3.0 0 △ 0

Type here to search

23:48 22-04-2021

File Edit Selection View Go Run Terminal Help

sql.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

- vars.tf example-gcp-SQL
- sql.tf example-gcp-SQL

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- > example-gcp-module
- > example-gcp-NAT
- example-gcp-SQL
- learning-gcp.json
- sql.tf
- vars.tf
- vpc.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- > example-test

OUTLINE

TIMELINE

sql.tf

example-gcp-SQL > sql.tf

```
1 provider "google" {
2   credentials = file(var.credentialsfile)
3   project     = var.project
4   region      = var.defaultregion
5   zone        = var.defaultzone
6 }
7
8 resource "google_sql_database_instance" "db_inst" {
9   name          = "masterinstance"
10  region        = var.defaultregion
11  database_version = "POSTGRES_11"
12  depends_on    = [google_service_networking_connection.private_vpc_connection]
13
14  settings {
15    tier = "db-f1-micro"
16    ip_configuration {
17      ipv4_enabled    = false
18      private_network = google_compute_network.private_network.id
19    }
20  }
21 }
22
23 }
```

Create new sql server DB instance, depends\_on for private vpc

False for private network and True for public network, vpc network from which sql instance is accessible for private ip

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-SQL>

1: powershell

v1.3.0 0 △ 0

Type here to search

00:02  
23-04-2021



SQL

Instances

Cloud SQL

## Cloud SQL instances

Cloud SQL instances are fully managed, relational MySQL, PostgreSQL and SQL Server databases. Google handles replication, patch management and database management to ensure availability and performance.[Learn more](#)

To get started with Cloud SQL, you can create a new instance or use Database Migration Service to migrate your SQL database to Google Cloud.

[CREATE INSTANCE](#)[MIGRATE DATA WITH DATABASE MIGRATION SERVICE](#)

There is No SQL instance in GCP

Let us do the terraform plan and then apply and view the result

File Edit Selection View Go Run Terminal Help

sql.tf - terraform-training - Visual Studio Code

EXPLORER PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

OPEN EDITORS

- vars.tf example-gcp-SQL
- sql.tf example-gcp-SQL

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- > example-gcp-module
- > example-gcp-NAT
- > example-gcp-SQL
- > .terraform
- { learning-gcp.json
- sql.tf
- { terraform.tfstate
- vars.tf
- vpc.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example\_override

OUTLINE

TIMELINE

2021/04/23 00:13:19 [TRACE] EvalMaybeTainted: google\_service\_networking\_connection.private\_vpc\_connection encountered an error during creation, so it is now marked as tainted

2021/04/23 00:13:19 [TRACE] <root>: eval: \*terraform.EvalWriteState

2021/04/23 00:13:19 [TRACE] EvalWriteState: removing state object for google\_service\_networking\_connection.private\_vpc\_connection

2021/04/23 00:13:19 [TRACE] <root>: eval: \*terraform.EvalApplyProvisioners

2021/04/23 00:13:19 [TRACE] EvalApplyProvisioners: google\_service\_networking\_connection.private\_vpc\_connection has no state, so skipping provisioners

2021/04/23 00:13:19 [TRACE] <root>: eval: \*terraform.EvalMaybeTainted

2021/04/23 00:13:19 [TRACE] EvalMaybeTainted: google\_service\_networking\_connection.private\_vpc\_connection encountered an error during creation, so it is now marked as tainted

2021/04/23 00:13:19 [TRACE] <root>: eval: \*terraform.EvalWriteState

2021/04/23 00:13:19 [TRACE] EvalWriteState: removing state object for google\_service\_networking\_connection.private\_vpc\_connection

2021/04/23 00:13:19 [TRACE] <root>: eval: \*terraform.EvalIf

2021/04/23 00:13:19 [TRACE] <root>: eval: \*terraform.EvalIf

2021/04/23 00:13:19 [TRACE] <root>: eval: \*terraform.EvalWriteDiff

2021/04/23 00:13:19 [TRACE] <root>: eval: \*terraform.EvalApplyPost

2021/04/23 00:13:19 [ERROR] <root>: eval: \*terraform.EvalApplyPost, err: googleapi: Error 403: Service Networking API has not been used in project 707521900825 before or it is disabled. Enable it by visiting https://console.developers.google.com/apis/api/servicenetworking.googleapis.com/overview?project=707521900825 then retry. If you enabled this API recently, wait a few minutes for the action to propagate to our systems and retry., accessNotConfigured

2021/04/23 00:13:19 [ERROR] <root>: eval: \*terraform.EvalSequence, err: googleapi: Error 403: Service Networking API has not been used in project 707521900825 before or it is disabled. Enable it by visiting https://console.developers.google.com/apis/api/servicenetworking.googleapis.com/overview?project=707521900825 then retry. If you enabled this API recently, wait a few minutes for the action to propagate to our systems and retry., accessNotConfigured

2021/04/23 00:13:19 [TRACE] [walkApply] Exiting eval tree: google\_service\_networking\_connection.private\_vpc\_connection

2021/04/23 00:13:19 [TRACE] vertex "google\_service\_networking\_connection.private\_vpc\_connection": visit complete

2021/04/23 00:13:19 [TRACE] dag/walk: upstream of "google\_sql\_database\_instance.db\_inst" errored, so skipping

2021/04/23 00:13:19 [TRACE] dag/walk: upstream of "meta.count-boundary (EachMode fixup)" errored, so skipping

2021/04/23 00:13:19 [TRACE] dag/walk: upstream of "provider.google (close)" errored, so skipping

2021/04/23 00:13:19 [TRACE] dag/walk: upstream of "root" errored, so skipping

2021/04/23 00:13:19 [TRACE] statemgr.Filesystem: no original state snapshot to back up

2021/04/23 00:13:19 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 3

2021/04/23 00:13:19 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate

2021/04/23 00:13:19 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info

2021/04/23 00:13:19 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate

Error: googleapi: Error 403: Service Networking API has not been used in project 707521900825 before or it is disabled. Enable it by visiting https://console.developers.google.com/apis/api/servicenetworking.googleapis.com/overview?project=707521900825 then retry. If you enabled this API recently, wait a few minutes for the action to propagate to our systems and retry., accessNotConfigured

on vpc.tf line 14, in resource "google\_service\_networking\_connection" "private\_vpc\_connection":  
14: resource "google service networking connection" "private vpc connection" {

PS D:\terraform-training\example-gcp-SQL>

1: powershell

v1.3.0

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23-04-2021

Need to enable Service Networking API

## API APIs &amp; Services



## Service Networking API

Google

Provides automatic management of network configurations

[ENABLE](#)[TRY THIS API](#)

Enable the Service Networking API here on GCP

[OVERVIEW](#)[DOCUMENTATION](#)

### Overview

The Service Networking API provides automatic management of network configurations necessary for certain services.

### About Google

Google's mission is to organize the world's information and make it universally accessible and useful. Through products and platforms like Search, Maps, Gmail, Android, Google Play, Chrome and YouTube, Google plays a meaningful role in the daily lives of billions of people.

### Additional details

Type: [APIs & services](#)

Last updated: 19/03/2021

Category: [Networking](#)

Service name: [servicenetworking.googleapis.com](#)

### Tutorials and documentation

[Learn more](#)

The screenshot shows the Google Cloud Platform (GCP) IAM & Admin interface. On the left sidebar, under the 'IAM & Admin' section, the 'PERMISSION' tab is selected. The main area displays 'Permissions for project learning-gcp'. It lists two service accounts with highly privileged roles: 'full-access@learning-gcp-185425.iam.gserviceaccount.com' and '707521900825-compute@googleapis.com'. A blue callout box highlights the 'Compute Network Admin' role entry for the first account, which is described as having 'Full control of Compute Engine networking resources'. Below this, another role entry for 'Service Account Admin' is shown, with a note about creating and managing service accounts. At the bottom right of the permissions page, there are 'SAVE', 'SIMULATE', and 'CANCEL' buttons.

Member

Project

Role

Condition

Condition

Condition

Role

Condition

Condition

Role

Condition

+ ADD ANOTHER ROLE

SAVE SIMULATE CANCEL

Member

Project

Role

Condition

Condition

Condition

Role

Condition

Condition

Role

Condition

+ ADD ANOTHER ROLE

SAVE SIMULATE CANCEL

Add the role Compute Network Admin to the member under IAM Policy and do terraform apply again

File Edit Selection View Go Run Terminal Help vars.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

- vars.tf example-gcp-SQL
- vpc.tf example-gcp-SQL
- sql.tf example-gcp-SQL

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- > example-gcp-module
- > example-gcp-NAT
- example-gcp-SQL
  - > .terraform
  - { learning-gcp.json
  - sql.tf
  - terraform.tfstate
  - terraform.tfstate.backup
- vars.tf
- vpc.tf
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module

OUTLINE

TIMELINE

vars.tf x vpc.tf sql.tf

example-gcp-SQL > vars.tf

```
1 variable credentialsfile {  
2   type = string  
3   default = "./learning-gcp.json"  
4 }  
5  
6 variable project {  
7   type = string  
8   default = "learning-gcp-185425"  
9 }  
10  
11 variable defaultregion {  
12   type = string  
13   default = "us-central1"  
14 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

2021/04/23 11:12:03 [TRACE] vertex "google\_sql\_database\_instance.db\_inst": visit complete  
2021/04/23 11:12:03 [TRACE] dag/walk: upstream of "provider.google (close)" errored, so skipping  
2021/04/23 11:12:03 [TRACE] dag/walk: upstream of "meta.count-boundary (EachMode fixup)" errored, so skipping  
2021/04/23 11:12:03 [TRACE] dag/walk: upstream of "root" errored, so skipping  
2021/04/23 11:12:03 [TRACE] statemgr.Filesystem: have already backed up original terraform.tfstate to terraform.tfstate.backup on a previous write  
2021/04/23 11:12:03 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 13  
2021/04/23 11:12:03 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate  
2021/04/23 11:12:03 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info  
2021/04/23 11:12:03 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate

ERROR: Error, failed to create instance masterinstance: googleapi: Error 403: Cloud SQL Admin API has not been used in project 707521900825 before or it is disabled. Enable it by visiting https://console.developers.google.com/api/2021-04-23T11:12:03.102+0530 [DEBUG] plugin: plugin process exited: path=D:\terraform-training\example-gcp-SQL\terraform\plugins\windows\_386\terraform-provider-google\_v3.65.0\_x5.exe pid=31900

s/api/sqladmin.googleapis.com/overview?project=707521900825 then retry. If you enabled this API recently, wait a few minutes for the action to propagate to our systems and retry., accessNotConfigured 2021-04-23T11:12:03.102+0530 [DEBUG] plugin: plugin exited red

on sql.tf line 8, in resource "google\_sql\_database\_instance" "db\_inst":  
8: resource "google\_sql\_database\_instance" "db\_inst" {

PS D:\terraform-training\example-gcp-SQL>

Ln 8, Col 35 (19 selected) Spaces: 4 UTF-8 CRLF HCL ↵

Type here to search

11:22  
23-04-2021

Need to enable Cloud SQL Admin API

## API APIs &amp; Services



## Cloud SQL Admin API

Google

API for Cloud SQL database instance management

[MANAGE](#)[TRY THIS API](#) ↗ API Enabled[OVERVIEW](#)[DOCUMENTATION](#)

## Overview

API for Cloud SQL database instance management

## About Google

Google's mission is to organize the world's information and make it universally accessible and useful. Through products and platforms like Search, Maps, Gmail, Android, Google Play, Chrome and YouTube, Google plays a meaningful role in the daily lives of billions of people.

## Additional details

Type: [APIs & services](#)

Last updated: 19/03/2021

Service name: `sqladmin.googleapis.com`

## Tutorials and documentation

[Learn more](#) ↗

## Terms of Service

Google Cloud Platform learning-gcp Search products

IAM & Admin

IAM

+ADD REMOVE

PERMISSION RECOMMENDATIONS HISTORY

## Permissions for project learning-gcp

These permissions affect this project and all of its resources. [Learn more](#)

View By: MEMBERS ROLES

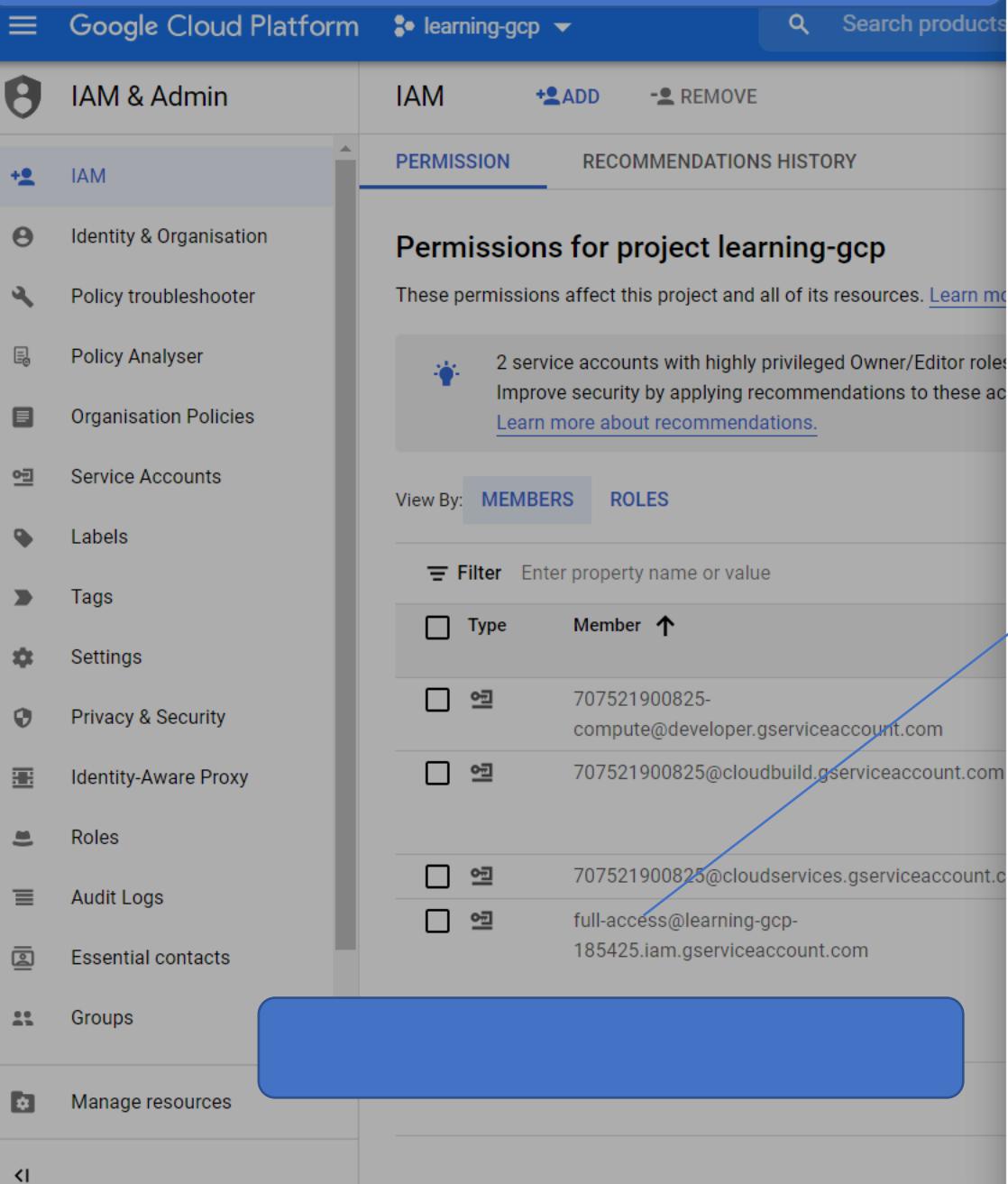
Filter Enter property name or value

Type	Member
<input type="checkbox"/>	707521900825-compute@googleapis.com
<input type="checkbox"/>	707521900825@cloudbuild.gserviceaccount.com
<input type="checkbox"/>	707521900825@cloudservices.gserviceaccount.com
<input type="checkbox"/>	full-access@learning-gcp-185425.iam.gserviceaccount.com

2 service accounts with highly privileged Owner/Editor roles. Improve security by applying recommendations to these accounts. [Learn more about recommendations.](#)

+ ADD ANOTHER ROLE

SAVE SIMULATE CANCEL



## Edit permissions

Member	Project
full-access@learning-gcp-185425.iam.gserviceaccount.com	learning-gcp
<input type="button" value="Role"/> Cloud SQL Admin	Condition <a href="#">Add condition</a> <input type="button" value="Delete"/>
Full control of Cloud SQL resources.	
<input type="button" value="Role"/> Cloud SQL Client	Condition <a href="#">Add condition</a> <input type="button" value="Delete"/>
Connectivity access to Cloud SQL instances.	
<input type="button" value="Role"/> Compute Admin	Condition <a href="#">Add condition</a> <input type="button" value="Delete"/>
Full control of all Compute Engine resources.	
<input type="button" value="Role"/> Compute Network Admin	Condition <a href="#">Add condition</a> <input type="button" value="Delete"/>
Full control of Compute Engine networking resources.	
<input type="button" value="Role"/> Service Account Admin	Condition <a href="#">Add condition</a> <input type="button" value="Delete"/>
Create and manage service accounts.	
<a href="#">+ ADD ANOTHER ROLE</a>	

Member 'full-access': 2 SQL role and 3 Admin role for google service-network

Terraform apply again with yes

File Edit Selection View Go Run Terminal Help vars.tf - terraform-training - Visual Studio Code

EXPLORER ... vars.tf vpc.tf sql.tf

OPEN EDITORS vars.tf example-gcp-SQL vpc.tf example-gcp-SQL sql.tf example-gcp-SQL

TERRAFORM-TRAINING > backup > example > example-access-remotestate > example-aws > example-aws-rw > example-azure > example-azure-backend > example-configure-remotestate > example-createmodule > example-datasource > example-File-RemoteExec > example-functions > example-gcp > example-gcp-ds > example-gcp-module > example-gcp-NAT > example-gcp-SQL .terraform learning-gcp.json sql.tf terraform.tfstate terraform.tfstate.backup vars.tf vpc.tf > example-instance-LocalExec > example-instance-RemoteExec > example-module

vars.tf

example-gcp-SQL > vars.tf

4 }

5

6 variable project {

7 type = string

8 default = "learning-gcpn-185425"

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: have already backed up original terraform.tfstate to terraform.tfstate.backup on a previous write

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 17

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate

g1e\_sql\_database\_instance.db\_inst: Creation complete after 12m26s [id=masterinstance]

2021/04/23 11:53:23 [TRACE] [walkApply] Exiting eval tree: google\_sql\_database\_instance.db\_inst

2021/04/23 11:53:23 [TRACE] vertex "google\_sql\_database\_instance.db\_inst": visit complete

2021/04/23 11:53:23 [TRACE] dag/walk: visiting "provider.google (close)"

2021/04/23 11:53:23 [TRACE] vertex "provider.google (close)": starting visit (\*terraform.graphNodeCloseProvider)

2021/04/23 11:53:23 [TRACE] vertex "provider.google (close)": evaluating

2021/04/23 11:53:23 [TRACE] [walkApply] Entering eval tree: provider.google (close)

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalCloseProvider

2021/04/23 11:53:23 [TRACE] GRPCProvider: Close

2021/04/23 11:53:23 [TRACE] dag/walk: visiting "meta.count-boundary (EachMode fixup)"

2021/04/23 11:53:23 [TRACE] vertex "meta.count-boundary (EachMode fixup)": starting visit (\*terraform.NodeCountBoundary)

2021/04/23 11:53:23 [TRACE] vertex "meta.count-boundary (EachMode fixup)": evaluating

2021/04/23 11:53:23 [TRACE] [walkApply] Entering eval tree: meta.count-boundary (EachMode fixup)

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalCountFixZeroOneBoundaryGlobal

2021/04/23 11:53:23 [TRACE] [walkApply] Exiting eval tree: meta.count-boundary (EachMode fixup)

2021/04/23 11:53:23 [TRACE] vertex "meta.count-boundary (EachMode fixup)": visit complete

2021-04-23T11:53:23.773+0530 [DEBUG] plugin: plugin process exited: path=D:\terraform-training\example-gcp-SQL\terraform\plugins\windows\_386\terraform-provider-google\_v3.65.0\_x5.exe pid=27944

2021-04-23T11:53:23.773+0530 [DEBUG] plugin: plugin exited

2021/04/23 11:53:23 [TRACE] [walkApply] Exiting eval tree: provider.google (close)

2021/04/23 11:53:23 [TRACE] vertex "provider.google (close)": visit complete

2021/04/23 11:53:23 [TRACE] dag/walk: visiting "root"

2021/04/23 11:53:23 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)

2021/04/23 11:53:23 [TRACE] vertex "root": visit complete

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: have already backed up original terraform.tfstate to terraform.tfstate.backup on a previous write

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 18

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate

Apply complete! Resources: 4 added, 0 changed, 0 destroyed.

PS D:\terraform-training\example-gcp-SQL>

v13.0 0 △ 0

In 11, Col 25 Spaces: 4 UTF-8 CRLF HCL

14:11 23-04-2021

Type here to search

File Edit Selection View Go Run Terminal Help vars.tf - terraform-training - Visual Studio Code

EXPLORER ... vars.tf vpc.tf sql.tf

OPEN EDITORS vars.tf example-gcp-SQL vpc.tf example-gcp-SQL sql.tf example-gcp-SQL

TERRAFORM-TRAINING > backup > example > example-access-remotestate > example-aws > example-aws-rw > example-azure > example-azure-backend > example-configure-remotestate > example-createmodule > example-datasource > example-File-RemoteExec > example-functions > example-gcp > example-gcp-ds > example-gcp-module > example-gcp-NAT > example-gcp-SQL .terraform learning-gcp.json sql.tf terraform.tfstate terraform.tfstate.backup vars.tf vpc.tf

example-gcp-SQL > vars.tf

4 }

5

6 variable project {

7 type = string

8 default = "learning-gcpn-185425"

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

SQL DB instance is created, let us verify

1: powershell

goo2021/04/23 11:53:23 [WARN] Provider "google" produced an unexpected new value for google\_sql\_database\_instance.db\_inst, but we are tolerating it because it is using the legacy plugin SDK.

The following problems may be the cause of any confusing errors from downstream operations:

- .settings[0].ip\_configuration[0].require\_ssl: was null, but now cty.False

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalMaybeTainted

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalWriteState

2021/04/23 11:53:23 [TRACE] EvalWriteState: writing current state object for google\_sql\_database\_instance.db\_inst

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalApplyProvisioners

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalMaybeTainted

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalWriteState

2021/04/23 11:53:23 [TRACE] EvalWriteState: writing current state object for google\_sql\_database\_instance.db\_inst

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalIf

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalIf

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalWriteDiff

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalApplyPost

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalUpdateStateHook

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: have already backed up original terraform.tfstate to terraform.tfstate.backup on a previous write

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 17

2021/04/23 11:53:23 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate

g1e\_sql\_database\_instance.db\_inst: Creation complete after 12m26s [id=masterinstance]

2021/04/23 11:53:23 [TRACE] [walkApply] Exiting eval tree: google\_sql\_database\_instance.db\_inst

2021/04/23 11:53:23 [TRACE] vertex "google\_sql\_database\_instance.db\_inst": visit complete

2021/04/23 11:53:23 [TRACE] dag/walk: visiting "provider.google (close)"

2021/04/23 11:53:23 [TRACE] vertex "provider.google (close)": starting visit (\*terraform.graphNodeCloseProvider)

2021/04/23 11:53:23 [TRACE] vertex "provider.google (close)": evaluating

2021/04/23 11:53:23 [TRACE] [walkApply] Entering eval tree: provider.google (close)

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalCloseProvider

2021/04/23 11:53:23 [TRACE] GRPCProvider: Close

2021/04/23 11:53:23 [TRACE] dag/walk: visiting "meta.count-boundary (EachMode fixup)"

2021/04/23 11:53:23 [TRACE] vertex "meta.count-boundary (EachMode fixup)": starting visit (\*terraform.NodeCountBoundary)

2021/04/23 11:53:23 [TRACE] vertex "meta.count-boundary (EachMode fixup)": evaluating

2021/04/23 11:53:23 [TRACE] [walkApply] Entering eval tree: meta.count-boundary (EachMode fixup)

2021/04/23 11:53:23 [TRACE] <root>: eval: \*terraform.EvalCountFixZeroOneBoundaryGlobal

2021/04/23 11:53:23 [TRACE] [walkApply] Exiting eval tree: meta.count-boundary (EachMode fixup)

2021/04/23 11:53:23 [TRACE] vertex "meta.count-boundary (EachMode fixup)": visit complete

v1.3.0 0 △ 0

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14:09  
23-04-2021



SQL

Instances

+ CREATE INSTANCE

MIGRATE DATA

SHOW INFO PANEL

Filter Enter property name or value



<input type="checkbox"/> Instance ID	<a href="#">?</a>	<a href="#">↑</a>	Type	Public IP address	Private IP address	Instance connection name	High availability	Location	Storage used	Labels <a href="#">?</a>	<a href="#">...</a>
<input checked="" type="checkbox"/> masterinstance	<a href="#">masterinstance</a>		PostgreSQL 11		10.95.0.3	learning-gcp-185425:us-central1:masterinstance	<a href="#">^</a>	<a href="#">ADD</a>	us-central1-b	 84 MB of 10 GB	<a href="#">...</a>

SQL DB instance created



SQL

Overview

EDIT

IMPORT

EXPORT

RESTART

STOP

DELETE

CLONE

## PRIMARY INSTANCE

 Overview Query insights Connections Users Databases Backups Replicas Operations Release Notes

14:10 14:15 14:20 14:25 14:30 14:35 14:40 14:45 14:50 14:55 15:00 15:05 0

 CPU utilisation (masterinstance): 2.25% Go to Query Insights for more in-depth info on queries and performance Connect to this instance

Private IP address

10.95.0.3



Associated networking

projects/learning-gcp-185425/global/networks/private-network



Connection name

learning-gcp-185425:us-central1:masterinstance

 Connect using Cloud Shell See all connection methods Suggested actions Create a backup Configuration

vCPUs

1

Memory

614.4 MB

SSD storage

10 GB

 Database version is PostgreSQL 11 Auto storage increase is enabled Automated backups are disabled Point-in-time recovery is disabled Located in us-central1-b Not highly available (zonal) No database flags set No labels set Edit configuration

File Edit Selection View Go Run Terminal Help

sql.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

- vars.tf example-gcp-SQL
- vpc.tf example-gcp-SQL
- sql.tf example-gcp-SQL

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-ds
- > example-gcp-module
- > example-gcp-NAT
- example-gcp-SQL
  - > .terraform
  - { learning-gcp.json
  - sql.tf
  - { terraform.tfstate
  - terraformer.tfstate.backup
  - vars.tf
  - vpc.tf
  - > example-gcp-VM
  - > example-instance-LocalExec
  - > example-instance-RemoteExec
- > OUTLINE
- > TIMELINE

sql.tf

```
provider "google" {  
  credentials = file(var.credentialsfile)  
  project    = var.project  
  region     = var.defaultregion  
  zone       = var.defaultzone  
}  
  
resource "google_sql_database_instance" "db_inst" {  
  name          = "masterinstance"  
  region        = var.defaultregion  
  database_version = "POSTGRES_11"  
  depends_on = [google_service_networking_connection.private_vpc_connection]  
  
  settings {  
    tier = "db-f1-micro"  
    ip_configuration {  
      ipv4_enabled = false  
      private_network = google_compute_network.private_network.id  
    }  
  }  
  deletion_protection = false  
}
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

PS D:\terraform-training\example-gcp-SQL> **terraform apply**

Add the deletion\_protection=false and do terraform apply before using terraform destroy to delete all resources

By default this is set to true and SQL instance will not delete with just terraform destroy

v1.3.0 0 △ 0

Type here to search

15:20  
23-04-2021



SQL

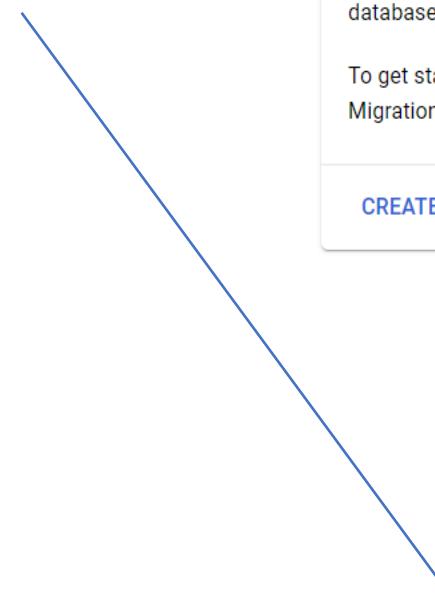
Instances

Cloud SQL

## Cloud SQL instances

Cloud SQL instances are fully managed, relational MySQL, PostgreSQL and SQL Server databases. Google handles replication, patch management and database management to ensure availability and performance.[Learn more](#)

To get started with Cloud SQL, you can create a new instance or use Database Migration Service to migrate your SQL database to Google Cloud.

[CREATE INSTANCE](#)[MIGRATE DATA WITH DATABASE MIGRATION SERVICE](#)

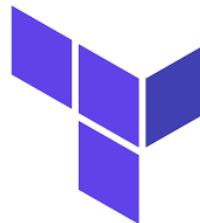
SQL DB instance is deleted

# Examples on GCP

---

## Example 6

- ❑ Create a VM instance
- ❑ Ignite it to run a custom page on Apache



File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER vars.tf main.tf

example-gcp-VM > main.tf

```
1 provider "google" {
2   credentials = file(var.credentialsfile)
3   project     = var.project
4   region      = var.defaultregion
5   zone        = var.defaultzone
6
7
8   resource "google_compute_instance" "startup" {
9     name          = "gcpinst"
10    machine_type = "n1-standard-1"
11    zone         = var.defaultzone
12
13   boot_disk {
14     initialize_params {
15       image = "debian-cloud/debian-9"
16     }
17   }
18
19   metadata_startup_script = "sudo apt-get update && sudo apt-get install apache2 -y && echo '<!doctype ht
20
21   network_interface {
22     network = "default"
23     access_config {
24       network_tier = "STANDARD"
25     }
26   }
27 }
```

Metadata startup script update the VM package , install apache on the it and echo a message in index.html file at the /var/www/html folder

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-VM>

v1.3.0 Type here to search

Ln 1, Col 1 Spaces: 2 UTF-8 LF HCL 15:52 23-04-2021 ENG

File Edit Selection View Go Run Terminal Help firewall.tf - terraform-training - Visual Studio Code

EXPLORER ... vars.tf main.tf firewall.tf outputs.tf

OPEN EDITORS example-gcp-VM > firewall.tf

TERRAFORM-TRAINING example-azure-backend example-configure-remotestate example-createmodule example-datasource example-File-RemoteExec example-functions example-gcp example-gcp-ds example-gcp-module example-gcp-NAT example-gcp-SQL example-gcp-VM > firewall.tf learning-gcp.json main.tf outputs.tf vars.tf example-instance-LocalExec example-instance-RemoteExec example-module example-NullResource example-override example-s3 example-test > example01

firewall.tf

```
1 resource "google_compute_firewall" "http-server" {
2   name      = "default-allow-http"
3   network   = "default"
4
5   allow {
6     protocol = "tcp"
7     ports    = ["80"]
8   }
9
10  source_ranges = ["0.0.0.0/0"]
11  target_tags   = ["http-server"]
12}
13
14/*
15 *  source_ranges = ["0.0.0.0/0"]:- means all source
16 *  target_tags   = ["http-server"]:- this tell on which instance the fi
17 *  if not explicit then firewall rule will be applicable to all instance
18 */
19
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-VM> []

1: powershell + - ×

v1.3.0 0 △ 0

Type here to search

16:09 23-04-2021

File Edit Selection View Go Run Terminal Help outputs.tf - terraform-training - Visual Studio Code

EXPLORER ... vars.tf main.tf firewall.tf outputs.tf

OPEN EDITORS example-gcp-VM > outputs.tf

vars.tf example-gcp-VM  
main.tf example-gcp-VM  
firewall.tf example-gcp-VM  
outputs.tf example-gcp-VM

TERRAFORM-TRAINING example-azure-backend  
> example-configure-remotestate  
> example-createmodule  
> example-datasource  
> example-File-RemoteExec  
> example-functions  
> example-gcp  
> example-gcp-ds  
> example-gcp-module  
> example-gcp-NAT  
> example-gcp-SQL  
example-gcp-VM  
firewall.tf  
learning-gcp.json  
main.tf  
outputs.tf  
vars.tf

example-instance-LocalExec  
> example-instance-RemoteExec  
> example-module  
> example-NullResource  
> example-override  
> example-s3  
example-test  
> example01

OUTLINE

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

PS D:\terraform-training\example-gcp-VM> []

1: powershell + - ×

v1.3.0 0 △ 0

Type here to search

1 | output "ExternalIPAddress" {  
2 | description = "The ephemeral IP address attached to the VM instance"  
3 | value = google\_compute\_instance.startup.network\_interface.0.access\_config.0.nat\_ip  
4 | }

First access\_config block from first network interface

VM instance ip address from first access\_config block

The diagram consists of two blue arrows. One arrow points from the text 'First access\_config block from first network interface' to the 'access\_config' block in the code. Another arrow points from the text 'VM instance ip address from first access\_config block' to the 'nat\_ip' variable within the same block.

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER ... vars.tf main.tf X

OPEN EDITORS vars.tf example-gcp-VM X main.tf example-gcp-VM

TERRAFORM-TRAINING example-aws-rw > example-azure > example-azure-backend > example-configure-remotestate > example-createmodule > example-datasource > example-File-RemoteExec > example-functions > example-gcp > example-gcp-ds > example-gcp-module > example-gcp-NAT > example-gcp-SQL > example-gcp-VM > .terraform > firewall.tf & learning-gcp.json > main.tf > outputs.tf > vars.tf > example-instance-LocalExec > example-instance-RemoteExec > example-module > example-NullResource > example-override > example-s3 > example-test > example01

OUTLINE TIMELINE

example-gcp-VM > main.tf

```
8 resource "google_compute_instance" "startup" {
9   name          = "gcpinst"
10  machine_type = "n1-standard-1"
11  zone          = var.defaultzone
12
13  boot_disk {
14    initialize_params {
15      image = "debian-cloud/debian-9"
16
17    }
18
19  # google_compute_instance.startup will be created
20  + resource "google_compute_instance" "startup" {
21    + can_ip_forward      = false
22    + cpu_platform        = "(known after apply)"
23    + current_status      = "(known after apply)"
24    + deletion_protection = false
25    + guest_accelerator   = "(known after apply)"
26    + id                  = "(known after apply)"
27    + instance_id         = "(known after apply)"
28    + label_fingerprint   = "(known after apply)"
29    + machine_type        = "n1-standard-1"
30    + metadata_fingerprint = "(known after apply)"
31    + metadata_startup_script = "sudo apt-get update && sudo apt-get install apache2 -y && echo '<!doctype html><html><body><h1>Hello from Shartul on Google Cloud!</h1></body></html>' | sudo tee /var/www/html/index.html"
32    + min_cpu_platform    = "(known after apply)"
33    + name                = "gcpinst"
34    + project              = "(known after apply)"
35    + self_link             = "(known after apply)"
36    + tags                 = [
37      + "http-server",
38    ]
39    + tags_fingerprint     = "(known after apply)"
40    + zone                = "us-central1-a"
41
42    + boot_disk {
43      + auto_delete        = true
44      + device_name        = "(known after apply)"
45    }
46  }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell + - X

v1.3.0 Type here to search 16:21 23-04-2021

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER ... vars.tf main.tf X firewall.tf

example-gcp-VM > main.tf

```
1 provider "google" {  
2   credentials = file(var.credentialsfile)  
3   project     = var.project  
4   region      = var.defaultregion  
5   zone        = var.defaultzone  
6 }  
7  
8 resource "google_compute_instance" "startup" {  
9   name          = "gcpinst"  
10  machine_type = "n1-standard-1"  
11  zone         = var.defaultzone  
12  
13 boot_disk {  
14   initialize_params {  
15     image = "debian-cloud/debian-9"  
16   }  
17 }  
18  
19 metadata_startup_script = "sudo apt-get update && sudo apt-get install apache2 -y && echo '<!doctype h
```

VM instance name

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

```
2021/04/23 16:23:25 [TRACE] statemgr.Filesystem: no original state snapshot to back up  
ut2021/04/23 16:23:25 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 3  
2021/04/23 16:23:25 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate  
e 2021/04/23 16:23:25 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info  
i2021/04/23 16:23:25 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate  
nstance.startup: Creation complete after 23s [id=projects/learning-gcp-185425/zones/us-central1-a/instances/gcpinst]  
nstante.startup: Creation complete after 23s [id=projects/learning-gcp-185425/zones/us-central1-a/instances/gcpinst]  
Apply complete! Resources: 2 added, 0 changed, 0 destroyed.  
Outputs:  
ExternalIPAddress = 35.208.157.220  
PS D:\terraform-training\example-gcp-VM>
```

v1.3.0 0 △ 0 Ln 9, Col 27 (9 selected) Spaces: 2 UTF-8 LF HCL

Type here to search

16:25 23-04-2021

 Compute Engine

## VM instances

 CREATE INSTANCE IMPORT VM REFRESH START/RESUME STOP OPERATIONS

SHOW INFO PANEL

 LEARN

## Virtual machines

-  VM instances
-  Instance templates
-  Sole-tenant nodes
-  Machine images
-  TPUs
-  Migrate for Compute Engi...
-  Committed use discounts

## Storage

-  Disks
-  Snapshots
-  Images

## Instance groups

-  Instance groups
-  Marketplace
-  Release Notes

## INSTANCES

## INSTANCE SCHEDULE

 Filter Enter property name or value

<input type="checkbox"/>	Name 	Zone	Recommendations	In use by	Internal IP	External IP	Connect	
<input type="checkbox"/>	 gcpinst	us-central1-a			10.128.0.5 (nic0)	35.208.157.220 	SSH 	

## VPC network

## Firewall

[+ CREATE FIREWALL RULE](#)[REFRESH](#)[CONFIGURE LOGS](#)[DELETE](#)

VPC networks  
Firewall rules control incoming or outgoing traffic to an instance. By default, incoming traffic from outside your network is blocked.[Learn more](#)

Note: App Engine firewalls are managed in the [App Engine firewall rules section](#).

Filter  Enter property name or value

Name	Type	Targets	Filters	Protocols/ports	Action	Priority	Network	Logs	Hit count	Last hit	⋮
<input checked="" type="checkbox"/> default-allow-http	Ingress	http-server	IP ranges: 0.0.0.0/0	tcp:80	Allow	1000	default	Off	-	-	
<input type="checkbox"/> default-allow-icmp	Ingress	Apply to all	IP ranges: 0.0.0.0/0	icmp	Allow	65534	default	Off	-	-	
<input type="checkbox"/> default-allow-internal	Ingress	Apply to all	IP ranges: 10	tcp:0-65535 udp:0-65535 icmp	Allow	65534	default	Off	-	-	
<input type="checkbox"/> default-allow-rdp	Ingress	Apply to all	IP ranges: 0.0.0.0/0	tcp:3389	Allow	65534	default	Off	-	-	
<input type="checkbox"/> default-allow-ssh	Ingress	Apply to all	IP ranges: 0.0.0.0/0	tcp:22	Allow	65534	default	Off	-	-	

 VPC network VPC networks External IP addresses Bring your own IP Firewall Routes VPC network peering Shared VPC Serverless VPC access Packet mirroring[!\[\]\(c59f6bab1db0faf09ac5e6b1639f25da\_img.jpg\) Firewall rule details](#) EDIT DELETE

default-allow-http

Logs 

Off

[view in Logs Explorer](#)

## Network

default

## Priority

1000

## Direction

Ingress

## Action on match

Allow

## Targets

Target tags

[http-server](#)

Target VM tag and allowed source, tcp

## Source filters

IP ranges

0.0.0.0/0

## Protocols and ports

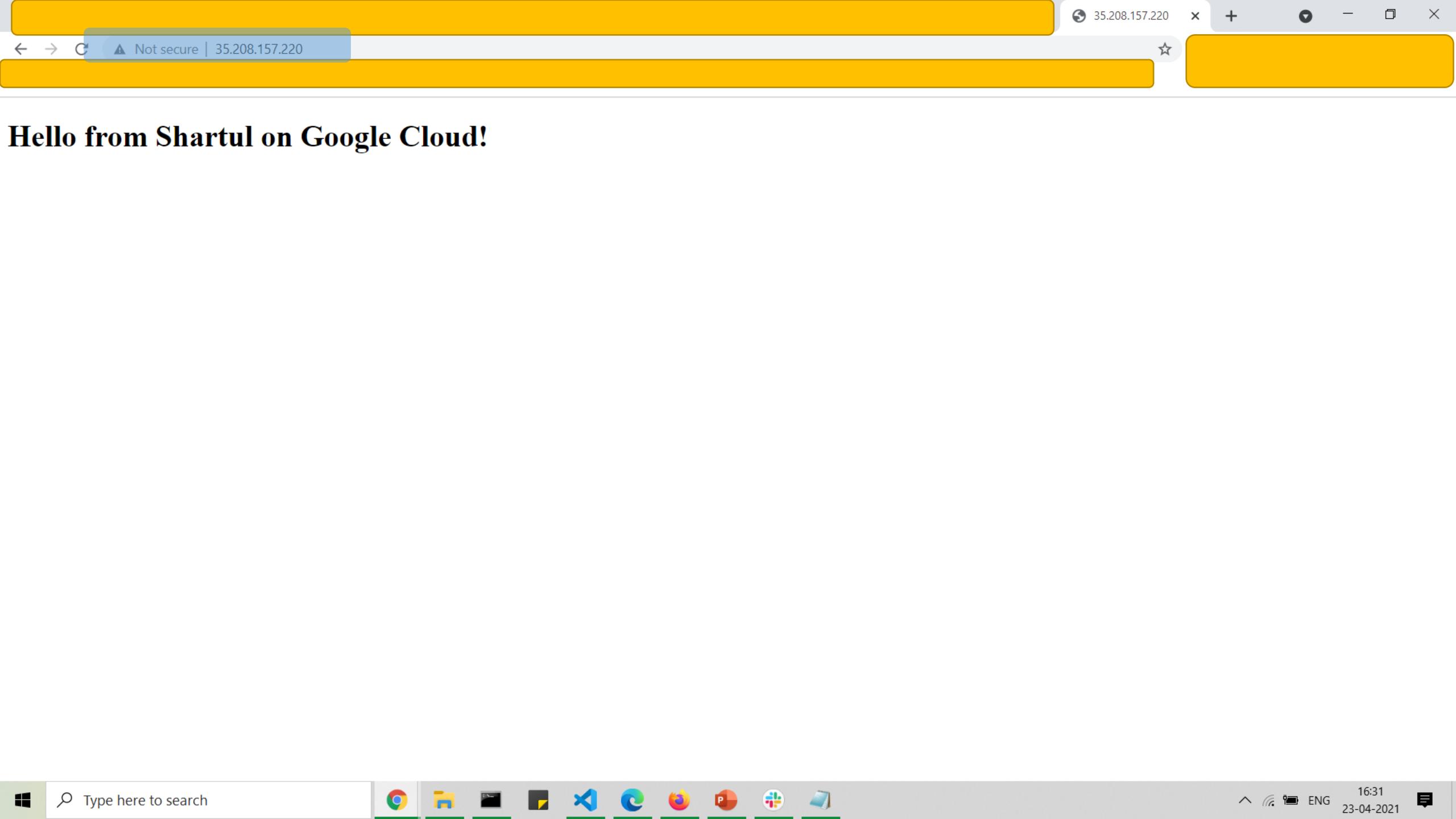
tcp:80

## Enforcement

Enabled

## Insights

None



Hello from Shartul on Google Cloud!



Type here to search



16:31  
23-04-2021

# Examples on GCP

---

## Example 7

- ❑ Configure Remote Backend on GCP
- ❑ Use the backend for creating infrastructure



File Edit Selection View Go Run Terminal Help bucket.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

- vars.tf example-gcp-backend
- bucket.tf example-gcp-backend

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-backend
- bucket.tf
- learning-gcp.json
- vars.tf
- > example-gcp-ds
- > example-gcp-module
- > example-gcp-NAT
- > example-gcp-SQL
- > example-gcp-VM
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3

OUTLINE

TIMELINE

vars.tf

bucket.tf

example-gcp-backend > bucket.tf

```
1 provider "google" {  
2   credentials = file(var.credentialsfile)  
3   project     = var.project  
4   region      = var.defaultregion  
5   zone        = var.defaultzone  
6 }  
7  
8 resource "google_storage_bucket" "backend-bucket" {  
9   name          = "sh01-terraform-backend"  
10  location      = var.defaultregion  
11  force_destroy = true  
12  storage_class = "STANDARD"  
13  versioning {  
14    enabled = true  
15  }  
16 }  
17  
18 output "bucket-url" {  
19   value = google_storage_bucket.backend-bucket.url  
20 }
```

Output the bucket URL

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell

PS D:\terraform-training\example-gcp-backend>

v13.0 0 △ 0

Type here to search

17:09  
23-04-2021

Google Cloud Platform learning-gcp Search products

IAM & Admin

IAM

+ADD REMOVE

PERMISSION RECOMMENDATIONS HISTORY

## Permissions for project learning-gcp

These permissions affect this project and all of its resources. [Learn more](#)

View By: MEMBERS ROLES

Filter Enter property name or value

Type	Member
<input type="checkbox"/>	707521900825-compute@developer.gserviceaccount.com
<input type="checkbox"/>	707521900825@cloudbuild.gserviceaccount.com
<input type="checkbox"/>	707521900825@cloudservices.gserviceaccount.com
<input type="checkbox"/>	full-access@learning-gcp-185425.iam.gserviceaccount.com

+ ADD ANOTHER ROLE

## Edit permissions

Member	Project
full-access@learning-gcp-185425.iam.gserviceaccount.com	learning-gcp
Role Cloud SQL Admin	Condition <a href="#">Add condition</a>
Full control of Cloud SQL resources.	<a href="#">Edit</a>
Role Cloud SQL Client	Condition <a href="#">Add condition</a>
Connectivity access to Cloud SQL instances.	<a href="#">Edit</a>
Role Compute Admin	Condition <a href="#">Add condition</a>
Full control of all Compute Engine resources.	<a href="#">Edit</a>
Role Compute Network Admin	Condition <a href="#">Add condition</a>
Full control of Compute Engine networking resources.	<a href="#">Edit</a>
Role Service Account Admin	Condition <a href="#">Add condition</a>
Create and manage service accounts.	<a href="#">Edit</a>
Role Storage Admin	Condition <a href="#">Add condition</a>
Full control of GCS resources.	<a href="#">Edit</a>
<a href="#">+ ADD ANOTHER ROLE</a>	
<a href="#">SAVE</a>	<a href="#">SIMULATE</a>
	<a href="#">?</a>
	<a href="#">CANCEL</a>

Add Storage Admin role to the Member and do terraform apply

File Edit Selection View Go Run Terminal Help • bucket.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS 1 UNSAVED vars.tf bucket.tf example-gcp-backend > bucket.tf

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-backend
- > .terraform
- bucket.tf
- { learning-gcp.json
- { terraform.tfstate
- terraform.tfstate.backup
- vars.tf
- > example-gcp-ds
- > example-gcp-module
- > example-gcp-NAT
- > example-gcp-SQL
- > example-gcp-VM
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

```
2021/04/23 17:28:15 [TRACE] vertex "root": visit complete
2021/04/23 17:28:15 [TRACE] statemgr.Filesystem: have already backed up original terraform.tfstate to terraform.tfstate.backup on a previous write
2021/04/23 17:28:15 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 3
2021/04/23 17:28:15 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate
2021/04/23 17:28:15 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info
2021/04/23 17:28:15 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate

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

Outputs:
bucket-url = gs://sh01-terraform-backend
PS D:\terraform-training\example-gcp-backend>
```

Ln 20, Col 3 Spaces: 2 UTF-8 LF HCL ⚙ 17:30 23-04-2021

v13.0 0 △ 0

Type here to search

Chrome File Explorer Task View VS Code Edge Firefox Powerpoint OneDrive Microsoft Edge



## Cloud Storage

Browser

+ CREATE BUCKET

DELETE

REFRESH

SHOW INFO PANEL

Filter buckets

<input type="checkbox"/> Name <span>↑</span>	Created	Location type	Location	Default storage class	Updated	Public access
<input type="checkbox"/> sh01-terraform-backend	23 Apr 2021, 17:28:14	Region	us-central1 (lo...)	Standard	23 Apr 2021, 17:28:14	Subject to object ACLs

◀ ▶

## Browser

## Monitoring

## Settings

## Release Notes



## Cloud Storage

## Bucket details

REFRESH

LEARN

OBJECTS CONFIGURATION PERMISSIONS RETENTION LIFECYCLE

Buckets &gt; sh01-terraform-backend

UPLOAD FILES UPLOAD FOLDER CREATE FOLDER MANAGE HOLDS DOWNLOAD DELETE

Filter by name prefix only

Filter

Filter objects and folders

Name Size Type Created time ? Storage class Last modified Public access ? Encryption ? Retention expiry date ? Holds ?

No rows to display



Your bucket is ready. Just add data.

Drop files and folders here or use the upload buttons above

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER ...

OPEN EDITORS instance\_disk.tf main.tf X

example-gcp-backend > main.tf

```
1 provider "google" {
2   credentials = file(var.credentialsfile)
3   project     = var.project
4   region      = var.defaultregion
5   zone        = var.defaultzone
6 }
7
8 terraform {
9   backend "gcs"{
10    bucket      = "sh01-terraform-backend"
11    prefix      = "instance_disk/tfstate"
12    credentials = "../learning-gcp.json" #variable not accepted so directly given credentials
13  }
14 }
```

Backed is added here

The Marketplace has extensions that can help with '.backup' files

Search Marketplace Don't Show Again for '.backup' files

v13.0 0 △ 0

Ln 14, Col 2 Spaces: 2 UTF-8 CRLF HCL

Type here to search

17:54 23-04-2021

File Edit Selection View Go Run Terminal Help instance\_disk.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

- instance\_disk.tf example-gcp-backend
- TERRAFORM-TRAINING
  - example-configure-remotestate
  - example-createmodule
  - example-datasource
  - example-File-RemoteExec
  - example-functions
  - example-gcp
  - example-gcp-backend
    - .terraform
    - bucket.tf
    - instance\_disk.tf
    - learning-gcp.json
    - main.tf
    - terraform.tfstate
    - terraform.tfstate.backup
    - vars.tf
  - example-gcp-ds
    - .terraform
    - datasource.tf
    - learning-gcp.json
    - terraform.tfstate
    - terraform.tfstate.backup
    - terraform.tfvars
    - vars.tf
    - vm\_instance.tf
  - example-gcp-module
  - example-gcp-NAT
  - example-gcp-SQL
  - example-gcp-VM
  - example-instance-LocalExec

OUTLINE

TIMELINE

instance\_disk.tf X

example-gcp-backend > instance\_disk.tf

```
1 resource "google_compute_instance" "instance1" {
2   name          = "vminstance1"
3   machine_type = "n1-standard-1"
4   zone         = var.defaultzone
5
6   boot_disk {
7     initialize_params {
8       image = "debian-cloud/debian-9"
9       size  = 10
10    }
11  }
12
13  network_interface {
14    network = "default"
15  }
16
17 resource "google_compute_disk" "disk1" {
18   name    = "test-disk"
19   type    = "pd-ssd"
20   zone    = "us-central1-a"
21   size    = 15
22   image   = "debian-9"
23   physical_block_size_bytes = 4096
24
25 resource "google_compute_attached_disk" "default" {
26   disk      = google_compute_disk.disk1.id
27   instance  = google_compute_instance.instance1.id
28 }
29 }
```

VM instance is created with two disk storage one of 10 Gb and other of 15 Gb

The Marketplace has extensions that can help with '.backup' files

Search Marketplace Don't Show Again for '.backup' files

v13.0 0 △ 0

Ln 11, Col 4 Spaces: 4 UTF-8 CRLF HCL

17:53 23-04-2021

Type here to search

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf example-gcp-backend > main.tf

TERRAFORM-TRAINING / example-aws > example-aws-rw > example-azure > example-azure-backend > example-configure-remotestate > example-createmodule > example-datasource > example-File-RemoteExec > example-functions > example-gcp > example-gcp-backend .terraform instance\_disk.tf { learning-gcp.json main.tf vars.tf > example-gcp-bucket > example-gcp-ds > example-gcp-module > example-gcp-NAT > example-gcp-SQL > example-gcp-VM > example-instance-LocalExec > example-instance-RemoteExec > example-module > example-NullResource > example-override > example-s3 > example-test > OUTLINE > TIMELINE

main.tf

```
1 provider "google" {
2   credentials = file(var.credentialsfile)
3   project     = var.project
4   region      = var.defaultregion
5   zone        = var.defaultzone
6 }
7
8 terraform {
9   backend "gcs"{
10    bucket      = "sh01-terraform-backend"
11    prefix      = "instance_disk/tfstate"
12    credentials = "./learning-gcp.json" #variable not accepted so directly given credentials
13  }
14 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: terraform + ^ x

2021/04/23 18:22:52 [TRACE] statemgr.Filesystem: snapshot file has nil snapshot, but that's okay  
2021/04/23 18:22:52 [TRACE] statemgr.Filesystem: read nil snapshot  
2021/04/23 18:22:52 [TRACE] Meta.Backend: ignoring local "default" workspace because its state is empty  
backend...  
2021/04/23 18:22:52 [DEBUG] New state was assigned lineage "ce6b6ac0-c2a2-a8d8-4577-803145d883d4"  
2021/04/23 18:22:52 [TRACE] Preserving existing state lineage "ce6b6ac0-c2a2-a8d8-4577-803145d883d4"  
  
Successfully configured the backend "gcs"! Terraform will automatically  
use this backend unless the backend configuration changes.  
2021/04/23 18:22:55 [TRACE] Meta.Backend: instantiated backend of type \*gcs.Backend  
2021/04/23 18:22:55 [DEBUG] checking for provider in "."  
2021/04/23 18:22:55 [DEBUG] checking for provider in "C:\\\\terraform"  
2021/04/23 18:22:55 [DEBUG] checking for provisioner in "."  
2021/04/23 18:22:55 [DEBUG] checking for provisioner in "C:\\\\terraform"  
2021/04/23 18:22:55 [INFO] Failed to read plugin lock file .terraform\\plugins\\windows\_386\\lock.json: open .terraform\\plugins\\windows\_386\\lock.json: The system can  
not find the path specified.  
2021/04/23 18:22:55 [TRACE] Meta.Backend: backend \*gcs.Backend does not support operations, so wrapping it in a local backend

Ln 14, Col 2 Spaces: 2 UTF-8 CRLF HCL ↻ 18:22 Type here to search ↻ ENG 23-04-2021

Successful to configure backend on google cloud storage

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf

example-gcp-backend > main.tf

```
1 provider "google" {
2   credentials = file(var.credentialsfile)
3   project     = var.project
4   region      = var.defaultregion
5   zone        = var.defaultzone
6 }
7
8 terraform {
9   backend "gcs"{
10    bucket      = "sh01-terraform-backend"
11    prefix      = "instance_disk/tfstate"
12    credentials = "./learning-gcp.json" #variable not accepted so directly given credentials
13  }
14 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

```
2021/04/23 18:26:07 [TRACE] <root>: eval: *terraform.EvalCloseProvider
2021/04/23 18:26:07 [TRACE] [walkApply] Entering eval tree: meta.count-boundary (EachMode fixup)
2021/04/23 18:26:07 [TRACE] GRPCProvider: Close
2021/04/23 18:26:07 [TRACE] <root>: eval: *terraform.EvalCountFixZeroOneBoundaryGlobal
2021/04/23 18:26:07 [TRACE] [walkApply] Exiting eval tree: meta.count-boundary (EachMode fixup)
2021/04/23 18:26:07 [TRACE] vertex "meta.count-boundary (EachMode fixup)": visit complete
2021-04-23T18:26:07.946+0530 [DEBUG] plugin: plugin process exited: path=D:\terraform-training\example-gcp-backend\.terraform\plugins\windows_386\terraform-provider-google_v3.65.0_x5.exe pid=26328
2021-04-23T18:26:07.948+0530 [DEBUG] plugin: plugin exited
2021/04/23 18:26:07 [TRACE] [walkApply] Exiting eval tree: provider.google (close)
2021/04/23 18:26:07 [TRACE] vertex "provider.google (close)": visit complete
2021/04/23 18:26:07 [TRACE] dag/walk: visiting "root"
2021/04/23 18:26:07 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)
2021/04/23 18:26:07 [TRACE] vertex "root": visit complete
compute_attached_disk.default: Creation complete after 14s [id=projects/learning-gcp-185425/zones/us-central1-a/instances/vminstance1/test-disk]
```

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

PS D:\terraform-training\example-gcp-backend>

v1.3.0 0 △ 0

Ln 14, Col 2 Spaces: 2 UTF-8 CRLF HCL

18:26 23-04-2021

 Compute Engine

## VM instances

 CREATE INSTANCE IMPORT VM REFRESH START/RESUME STOP OPERATIONS ▾

SHOW INFO PANEL

 LEARNVirtual machines 

-  VM instances
-  Instance templates
-  Sole-tenant nodes
-  Machine images
-  TPUs
-  Migrate for Compute Engi...
-  Committed use discounts

Storage 

-  Disks
-  Snapshots
-  Images

Instance groups 

-  Instance groups
-  Marketplace
-  Release Notes

## INSTANCES

## INSTANCE SCHEDULE

 Filter Enter property name or value

<input type="checkbox"/>	<input checked="" type="radio"/>	Name 	Zone	Recommendations	In use by	Internal IP	External IP	Connect	
	<input checked="" type="checkbox"/>	vminstance1	us-central1-a			10.128.0.6 (nic0)	None	SSH 	

 Compute Engine

Disks

 CREATE DISK REFRESH DELETE OPERATIONS LEARN

SHOW INFO PANEL

## Virtual machines

 VM instances Instance templates Sole-tenant nodes Machine images TPUs Migrate for Compute Engi... Committed use discounts

## Storage

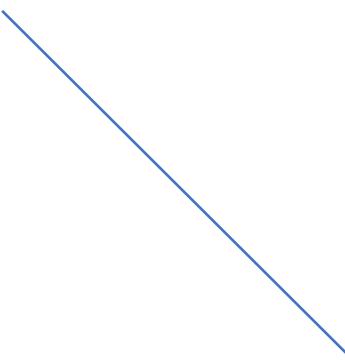
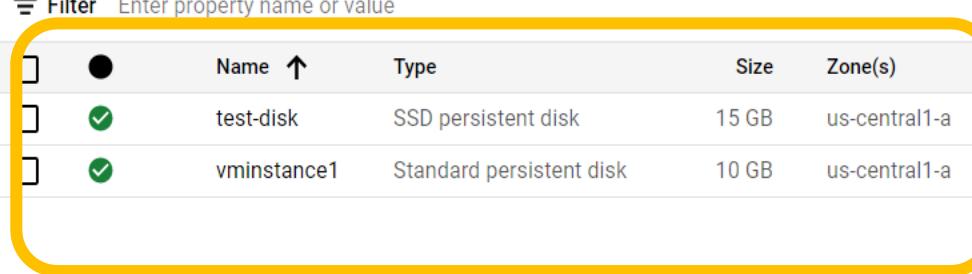
 Disks Snapshots Images

## Instance groups

 Instance groups Marketplace Release Notes

Filter Enter property name or value

	Name 	Type	Size	Zone(s)	In use by	Snapshot schedule	Actions
<input type="checkbox"/>	 test-disk	SSD persistent disk	15 GB	us-central1-a	vminstance1	None	
<input type="checkbox"/>	 vminstance1	Standard persistent disk	10 GB	us-central1-a	vminstance1	None	



VM with 10 Gb and 15 Gb storage

## Cloud Storage

## Bucket details

REFRESH

LEARN

## sh01-terraform-backend

OBJECTS

CONFIGURATION

PERMISSIONS

RETENTION

LIFECYCLE

Buckets > sh01-terraform-backend > instance\_disk > tfstate 

UPLOAD FILES

UPLOAD FOLDER

CREATE FOLDER

MANAGE HOLDS

DOWNLOAD

DELETE

Filter by name prefix only

Filter

Filter objects and folders

<input type="checkbox"/>	Name	Size	Type	Created time	Storage class	Last modified	Public access	Encryption	Retention
<input type="checkbox"/>	default.tfstate	6.1 KB	text/plain; charset=utf-8	23 Apr 2021, 1...	Standard	23 Apr 202...	Not public	Google-managed key	-

Release Notes

```
1 // 20210423191855
2 // https://00f74ba44bffc5f8437aa9035d169988ba1bc9af68-apidata.googleusercontent.com/download/storage/v1/b/sh01-terraform-
backend/o/instance_disk%2Ftfstate%2Fdefault.tfstate?
jk=AFshE3XAcqDjgWs8FEVEWc51tR9MEzoqtYsOkIYlNiZAH7jbyAsInQ_0dytcPV9yotH19zRIx8evMiYvBVKG4te3ioSkY1CTryhK8JPJnWosrl3Ci-
IReTyhs71JgwLU9mL8e8Ki3wiIJvK9kB5vi0Gqzvu1fSd2ZjXttCU7F9ItcgAt6GxJs-aFhNdV6152qxIZK7j4R1PkYV5zPCtTFVpVaZjb0-2poCbyd6rc0wGm-b3SpdS6a8BTCKVIEheiboiDy_7kV-
bqwNI5urzIYkOEYLVJU_aTahiCL0bQiT5Az2V7VWaugh68QqF4sfA5SnXoZvDw11Rvsm1E705fTKxdVeDKpV3Nq0DhCtBlX6oaaQlp4fut0_Ls2ZgopMbtAJBCeHMyuitowBaJw51_Rv3w6USiw19cg15f1d
TxnN_WplIiWodE_hDff6kn4Bdhcek8Nh20lqjjTGRwNeoL4E0kXeyxridOG4hP9bLu0AbJitGxlp-5U_BU8837CDXF9Fc_y-
M8Q0vtH0oEIb70dou1tK2WI5Z1K18N1bkJSjHIwdUgY71p6uZ6intub49DGXWoYowurm5kNGk8sLghj07jXGh2dCKVxI1tL79hw122S02UE5B42pwV5NNcZsrna8qgtNEtOpaS6MLsanQOTqr_C07Ro73u6u
u996GCnyPy_e06dTgcH1bSVP0k7Pkwo_Wl5G11TgH4rNisCOL_PQwV2mKeWZSg0e0V0pq4GyJLXN1dCpfRBgaOPkkxhUe-
2SwSdzSKYw1IHXEFD4zlyq8hhLi6gK26llqlguSNRYNEUeWTtZV16AnoKuHHjpNHmFFFilGGM9A4xI2GDwJ2fUMqTHCCidaC7I70YJI-
aW11DfUJZ7GmqAmCf_ZpP8mE2h6MHTUyYqkym1NooJ12SFjZaF0YjUF3h141C10cct2BZNTi1POv1PRheNbtvUo5Z0B0w15f0d9EZ4M-D-9ewzwA5m0iHpNWTJq_felftfCX-z6Zo&isca=1
```

```
3
4 {
5   "version": 4,
6   "terraform_version": "0.12.6",
7   "serial": 1,
8   "lineage": "26e7094e-2c29-48f3-ffbd-a05e5cd42eb1",
9   "outputs": {
10
11 },
12   "resources": [
13     {
14       "mode": "managed",
15       "type": "google_compute_attached_disk",
16       "name": "default",
17       "provider": "provider.google",
18       "instances": [
19         {
20           "schema_version": 0,
21           "attributes": {
22             "device_name": "persistent-disk-1",
23             "disk": "projects/learning-gcp-185425/zones/us-central1-a/disks/test-disk",
24             "id": "projects/learning-gcp-185425/zones/us-central1-a/instances/vminstance1/test-disk",
25             "instance": "projects/learning-gcp-185425/zones/us-central1-a/instances/vminstance1",
26             "mode": "READ_WRITE",
27             "project": "learning-gcp-185425",
```

```
35
36
37
38
39
40     "mode": "managed",
41     "type": "google_compute_disk",
42     "name": "disk1",
43     "provider": "provider.google",
44
45     "instances": [
46
47         {
48             "schema_version": 0,
49             "attributes": {
50                 "creation_timestamp": "2021-04-23T05:55:41.540-07:00",
51                 "description": "",
52                 "disk_encryption_key": [
53
54                     ],
55                 "id": "projects/learning-gcp-185425/zones/us-central1-a/disks/test-disk",
56                 "image": "https://www.googleapis.com/compute/v1/projects/debian-cloud/global/images/debian-9-stretch-v20210420",
57                 "label_fingerprint": "42WmSpB8rSM=",
58                 "labels": null,
59                 "last_attach_timestamp": "",
60                 "last_detach_timestamp": "",
61                 "name": "test-disk",
62                 "physical_block_size_bytes": 4096,
63                 "project": "learning-gcp-185425",
64                 "self_link": "https://www.googleapis.com/compute/v1/projects/learning-gcp-185425/zones/us-central1-a/disks/test-disk",
65                 "size": 15,
66                 "snapshot": "",
67                 "source_image_encryption_key": [
68
69                     ],
70                 "source_image_id": "5516898903801370523",
71                 "source_snapshot_encryption_key": [
72
73                     ]
74             }
75         }
76     ]
77 }
78 }
```



```
85
86    "mode": "managed",
87    "type": "google_compute_instance",
88    "name": "instance1",
89    "provider": "provider.google",
90    "instances": [
91        {
92            "schema_version": 6,
93            "attributes": {
94                "allow_stopping_for_update": null,
95                "attached_disk": [
96                    ],
97                    "boot_disk": [
98                        {
99                            "auto_delete": true,
100                           "device_name": "persistent-disk-0",
101                           "disk_encryption_key_raw": "",
102                           "disk_encryption_key_sha256": "",
103                           "initialize_params": [
104                               {
105                                   "image": "https://www.googleapis.com/compute/v1/projects/debian-cloud/global/images/debian-9-stretch-v20210420",
106                                   "labels": {
107                                       },
108                                       "size": 10,
109                                       "type": "pd-standard"
110                                   }
111                               ],
112                               ],
113                               "kms_key_self_link": "",
114                               "mode": "READ_WRITE",
115                               "source": "https://www.googleapis.com/compute/v1/projects/learning-gcp-185425/zones/us-central1-a/disks/vminstance1"
116                           }
117                       ],
118                       "can_ip_forward": false,
119                       "confidential_instance_config": [
120
```



```
124
125 "deletion_protection": false,
126 "description": "",
127 "desired_status": null,
128 "enable_display": false,
129 "guest_accelerator": [
130 ],
131 "hostname": "",
132 "id": "projects/learning-gcp-185425/zones/us-central1-a/instances/vminstance1",
133 "instance_id": "116809554430229795",
134 "label_fingerprint": "42WmSpB8rSM=",
135 "labels": null,
136 "machine_type": "n1-standard-1",
137 "metadata": null,
138 "metadata_fingerprint": "hJFWepsQIDw=",
139 "metadata_startup_script": "",
140 "min_cpu_platform": "",
141 "name": "vminstance1",
142 "network_interface": [
143 {
144 "access_config": [
145 ],
146 ],
147 "alias_ip_range": [
148 ],
149 "name": "nic0",
150 "network": "https://www.googleapis.com/compute/v1/projects/learning-gcp-185425/global/networks/default",
151 "network_ip": "10.128.0.6",
152 "nic_type": "",
153 "subnetwork": "https://www.googleapis.com/compute/v1/projects/learning-gcp-185425/regions/us-central1/subnetworks/default",
154 "subnetwork_project": "learning-gcp-185425"
155 }
156 ],
157 "project": "learning-gcp-185425",
158 "resource_policies": null,
```



# Terraform

---



Examples on  
Microsoft Azure

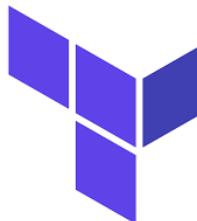


# Examples on Azure

---

## Authentication

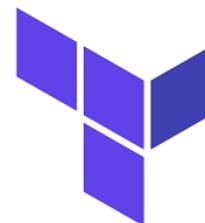
- Authenticating to Azure using the Azure CLI
  - Authenticating via the Azure CLI is only supported when using a User Account
  - `$ az login`
  
- Authenticating to Azure using Managed Service Identity
  - Can be used to authenticate to services that support Azure AD
  - Used as environment variables or by defining the fields within the provider block



# Examples on Azure

## Authentication

- Authenticating to Azure using a Service Principal and a Client Certificate
  - Service Principal can be granted access to resources within Azure Subscriptions
  - To create the certificate, we need to generate a Certificate Signing Request
  - Can be self-signed or through Certifying Authority
  - ```
$ export ARM_CLIENT_ID="00000000-0000-0000-000000000000"
$ export ARM_CLIENT_CERTIFICATE_PATH="/path/to/my/client/certificate.pfx"
$ export ARM_CLIENT_CERTIFICATE_PASSWORD="Pa55w0rd123"
$ export ARM_SUBSCRIPTION_ID="00000000-0000-0000-000000000000"
$ export ARM_TENANT_ID="00000000-0000-0000-0000-000000000000"
```
  - ```
provider "azurerm" {
    subscription_id          = "00000000-0000-0000-000000000000"
    client_id                = "00000000-0000-0000-000000000000"
    client_certificate_path   = var.client_certificate_path
    client_certificate_password = var.client_certificate_password
    tenant_id                = "00000000-0000-0000-000000000000"
}
```



# Examples on Azure

---

## Authentication

- Authenticating to Azure using a Service Principal and a Client Secret
  - Uses Service principal as in the above case
  - Instead of Certificate, we can create a Client Secret
- Recommended to use Service Principal or Managed Service Identity in CI
- Azure CLI for development purposes

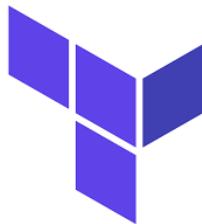


# Examples on Azure

---

## Example 1

- ❑ Configure Authentication using Service Principal and Client Secret
- ❑ Create Resource Group and a VPC network within it



Microsoft Azure

Search resources, services, and docs (G+/)

Home > Default Directory

## Default Directory | App registrations

Azure Active Directory

Overview

Getting started

Preview features

Diagnose and solve problems

Manage

- Users
- Groups
- External Identities
- Roles and administrators
- Administrative units
- Enterprise applications
- Devices
- App registrations
- Identity Governance
- Application proxy
- Licenses
- Azure AD Connect

+ New registration    Endpoints    Troubleshooting    Download    Preview features    Got feedback?

Try out the new App registrations search preview! Click to enable the preview. →

Starting June 30th, 2020 we will no longer add any new features to Azure Active Directory Authentication Library (ADAL) and Azure AD Graph. We will continue to provide technical support and security updates but we will no longer provide feature updates. Applications will need to be upgraded to Microsoft Authentication Library (MSAL) and Microsoft Graph. [Learn more](#)

All applications    Owned applications    Deleted applications (Preview)    Applications from personal account

Start typing a name or Application ID to filter these results

https://portal.azure.com/#blade/Microsoft\_AAD\_IAM/ActiveDirectoryMenuBlade/Registered...

Type here to search

13:26  
15-04-2021

[Home](#) > [Default Directory | App registrations](#) >

## Register an application

\* Name 

The user-facing display name for this application (this can be changed later).

 Terraform 

### Supported account types

#### Who can use this application or access this API?

- Accounts in this organizational directory only (Default Directory only - Single tenant)
- Accounts in any organizational directory (Any Azure AD directory - Multitenant)
- Accounts in any organizational directory (Any Azure AD directory - Multitenant) and personal Microsoft accounts (e.g. Skype, Xbox)
- Personal Microsoft accounts only

[Help me choose...](#)

### Redirect URI (optional)

We'll return the authentication response to this URI after successfully authenticating the user. Providing this now is optional and it can be changed later, but a value is required for most authentication scenarios.

 Web e.g. https://myapp.com/auth

By proceeding, you agree to the [Microsoft Platform Policies](#) 

[Register](#)

Microsoft Azure

Search resources, services, and docs (G+)

Home > Default Directory >

# Terraform

Search (Ctrl + /) Delete Endpoints Preview features

Got a second? We would love your feedback on Microsoft identity platform (previously Azure AD for developer). →

**Essentials**

Display name	: Terraform	Supported account types	: My organization only
Application (client) ID	: 9c8a0b5a-f711-4d39-a698-c2ee79b4ccdc	Redirect URIs	: Add a Redirect URI
Directory (tenant) ID	: 6ec3741d-3435-48b4-82c2-6fb7a1a8e9e3	Application ID URI	: Add an Application ID URI
Object ID	: ee40f881-d7a3-4d26-9a46-1fe376024953	Managed application in I...	: Terraform

ee40f881-d7a3-4d26-9a46-1fe376024953

Starting June 30th, 2020 we will no longer add any new features to Azure Active Directory Authentication Library (ADAL) and Azure AD Graph. We will continue to provide technical support and security updates but we will no longer provide feature updates. Applications will need to be upgraded to Microsoft Authentication Library (MSAL) and Microsoft Graph. [Learn more](#)

Get Started Documentation

## Build your application with the Microsoft identity platform

The Microsoft identity platform is an authentication service, open-source libraries, and application management tools. You can create modern, standards-based authentication solutions, access and protect APIs, and add sign-in for your users and customers. [Learn more](#)

Support + Troubleshooting

Troubleshooting

Type here to search

13:26 15-04-2021

Microsoft Azure Search resources, services, and docs (G+/)

Home > Subscriptions

Default Directory

+ Add Manage Policies

View list of subscriptions for which you have role-based access control (RBAC) permissions to manage Azure resources. To view subscriptions for which you have billing access, [click here](#)

Showing subscriptions in Default Directory directory. Don't see a subscription? [Switch directories](#)

My role ⓘ Status ⓘ

8 selected 3 selected

**Apply**

Showing 1 of 1 subscriptions  Show only subscriptions selected in the [global subscriptions filter](#) ⓘ

Search

Subscription name ↑↓	Subscription ID ↑↓	My role ↑↓	Current cost	Status ↑↓	...
Azure-sh-01-PAYG		Account admin	0.00	Active	...

< Previous 1 Next >

Type here to search

13:27 15-04-2021 ENG

# Terraform

[Search \(Ctrl+ /\)](#)

«

[Delete](#) [Endpoints](#)

**i** Got a second? We would love your feedback on Microsoft identity platform (previously Azure AD for developer). →

Display name : Terraform

[Copy to clipboard](#)

Application (client) ID : 2d969586-a57d-485c-adda-8db14db51293

Supported account types : My organization only

Directory (tenant) ID : adb5803b-ab07-47af-8c47-3874ce5cefef

Redirect URIs : Add a Redirect URI

Object ID : e5cc3369-4064-431e-9b08-ce2dfab2eb93

Application ID URI : Add an Application ID URI

## Essentials

[View as JSON](#)

**i** Welcome to the new and improved App registrations. Looking to learn how it's changed from App registrations (Legacy)? [Learn more](#)

X

**i** Starting June 30th, 2020 we will no longer add any new features to Azure Active Directory Authentication Library (ADAL) and Azure AD Graph. We will continue to provide technical support and security updates but we will no longer provide feature updates. Applications will need to be upgraded to Microsoft Authentication Library (MSAL) and Microsoft Graph. [Learn more](#)

X

## Call APIs



Build more powerful apps with rich user and business data  
from Microsoft services and your own company's data

## Documentation

[Microsoft identity platform](#)

[Authentication scenarios](#)

[Authentication libraries](#)

[Code samples](#)

[Microsoft Graph](#)

[Glossary](#)

[Help and Support](#)

## 🔑 Terraform | Certificates & secrets

... Update application

Updating application Terraform credentials

Search (Ctrl+ /)



Got feedback?

Overview

Quickstart

Integration assistant (preview)

### Manage

Branding

Authentication

Certificates &amp; secrets

Token configuration

API permissions

Expose an API

Owners

Roles and administrators (Preview)

Manifest

### Support + Troubleshooting

Troubleshooting

New support request

Credentials enable confidential applications to identify themselves to the authentication service when receiving tokens at a web addressable location (using an HTTPS scheme). For a higher level of assurance, we recommend using a certificate (instead of a client secret) as a credential.

### Certificates

Certificates can be used as secrets to prove the application's identity when requesting a token. Also can be referred to as public keys.

Upload certificate

#### Thumbprint

#### Start date

#### Expires

No certificates have been added for this application.

### Client secrets

A secret string that the application uses to prove its identity when requesting a token. Also can be referred to as application password.

New client secret

#### Description

#### Expires

#### Value

No client secrets have been created for this application.

## 🔑 Terraform | Certificates & secrets ✎

 Search (Ctrl+ /) «[Got feedback?](#)

Copy the new client secret value. You won't be able to retrieve it after you perform another operation or leave this blade.

### Certificates

Certificates can be used as secrets to prove the application's identity when requesting a token. Also can be referred to as public keys.

[Upload certificate](#)

Thumbprint	Start date	Expires
No certificates have been added for this application.		

### Client secrets

A secret string that the application uses to prove its identity when requesting a token. Also can be referred to as application password.

[New client secret](#)

Description	Expires	Value	
Terraform Authentication	8/20/2021	PFEZ92_Q839Lu2p2dfytLhP_1hN.UaH.37	

### Support + Troubleshooting

[Troubleshooting](#)[New support request](#)

File Edit Selection View Go Run Terminal Help • vars.tf - terraform-training - Visual Studio Code

EXPLORER main.tf vars.tf ●  
OPEN EDITORS 1 UNSAVED  
main.tf example-azure  
vars.tf example-azure  
TERRAFORM-TRAINING  
> backup  
> example  
> example-access-remotestate  
> example-aws  
> example-azure  
main.tf  
vars.tf  
> example-configure-remotestate  
> example-createmodule  
> example-datasource  
> example-File-RemoteExec  
> example-functions  
> example-gcp  
> example-instance-LocalExec  
> example-instance-RemoteExec  
> example-module  
> example-NullResource  
> example-override  
> example-s3  
example-test  
> example01

example-azure > vars.tf

```
1 variable "subscription_id" {  
2   type = string  
3   default =  
4 }  
5  
6 variable "client_id" {  
7   type = string  
8   default = "9c8a0b5a-f711-4d39-a698-c2ee79b4ccdc"  
9 }  
10  
11 variable "client_secret" {  
12   type = string  
13   default = "0W~7R.x62_SQL1_vQd8s8d~CpB7P-0t~ul"  
14 }  
15  
16 variable "tenant_id" {  
17   type = string  
18   default = "6ec3741d-3435-48b4-82c2-6fb7a1a8e9e3"  
19 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 2: powershell

PS D:\terraform-training\example-azure>

OUTLINE

0 △ 0 In 13, Col 53 Spaces: 4 UTF-8 CRLF HCL 13:27 15-04-2021 Type here to search

Microsoft Azure

Search resources, services, and docs (G+/)

Home > Subscriptions > Azure-sh-01-PAYG

## Subscriptions

Default Directory

+ Add Manage Policies

View list of subscriptions for which you have role-based access control (RBAC) permissions to manage Azure resources. To view subscriptions for which you have billing access, [click here](#)

Showing subscriptions in Default Directory directory. Don't see a subscription? [Switch directories](#)

My role ⓘ Status ⓘ

8 selected 3 selected

Apply

Showing 1 of 1 subscriptions  global  
Show only subscriptions selected in the [subscriptions filter](#)

Search

Subscription name ↑↓

Azure-sh-01-PAYG ...

< Previous 1 Next >

## Azure-sh-01-PAYG | Access control (IAM)

Subscription

Search (Ctrl+ /)

+ Add Download role assignments Edit columns Refresh

Check access Role assignments Roles Roles (Preview) Deny assignments

**My access**  
View my level of access to this resource.

[View my access](#)

**Check access**  
Review the level of access a user, group, service principal, or managed identity has to this resource. [Learn more](#)

Find ⓘ User, group, or service principal

Search by name or email address

Access control (IAM)

Tags

Diagnose and solve problems

Security

Events

Cost Management

Cost analysis

Cost alerts

Budgets

Advisor recommendations

Billing

Invoices

External services

Payment methods

Partner information

## Add role assignment

Role ⓘ Contributor

Assign access to ⓘ User, group, or service principal

Select ⓘ Terraform

Terraform

Grant access

Grant access to Terraform

Add role assignment

View access

Selected members:  
No members selected. Search for and add one or more members you want to assign to the role for this resource.

Learn more about RBAC

View details

Save Discard

13:28 15-04-2021 ENG

## Subscriptions

«

Default Directory

+ Add    Manage Policies

View list of subscriptions for which you have role-based access control (RBAC) permissions to manage Azure resources. To view subscriptions for which you have billing access, [click here](#)

Showing subscriptions in Default Directory directory. Don't see a subscription?

[Switch directories](#)

My role

Status

8 selected    3 selected

[Apply](#)

Showing 1 of 1 subscriptions  global

Show only subscriptions selected in the subscriptions filter

[Search](#)

Subscription name ↑

Azure-sh-01-PAYG

...



## Azure-sh-01-PAYG | Access control (IAM)

Subscription

[Search \(Ctrl+ /\)](#)

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Security

Events

Cost Management

Cost analysis

Cost alerts

Budgets

Advisor recommendations

Billing

Invoices

External services

Payment methods

+ Add

Download role assignments

Edit columns

Refresh

Remove

Got feedback?

Check access

Role assignments

Roles

Roles (Preview)

Deny assignments

Classic administrators

Number of role assignments for this subscription

3

2000

Search by name or email

Type : All

Role : All

Scope : All scopes

Group by : Role

3 items (2 Users, 1 Service Principals)

<input type="checkbox"/>	Name	Type	Role	Scope
<input type="checkbox"/>	Contributor	User	Contributor	This resource
<input type="checkbox"/>	Contributor	User	Contributor	This resource
<input type="checkbox"/>	Terraform	App	Contributor	This resource

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf vars.tf example-azure > main.tf

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-azure
  - main.tf
  - vars.tf
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- > example-test
- > example01

```
provider "azurerm" {  
    version = "=2.5.0"  
  
    subscription_id = var.subscription_id  
    client_id       = var.client_id  
    client_secret   = var.client_secret  
    tenant_id       = var.tenant_id  
  
    features {} # required to customize behavior of some azure provider resources  
}  
  
# Create a resource group  
resource "azurerm_resource_group" "example" {  
    name      = "example-resources"  
    location  = "East US"  
}  
  
# Create a virtual network within the resource group  
resource "azurerm_virtual_network" "example" {  
    name          = "example-network"  
    resource_group_name = azurerm_resource_group.example.name  
    location      = azurerm_resource_group.example.location  
    address_space  = ["10.0.0.0/16"]  
}
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 2: powershell + ×

PS D:\terraform-training\example-azure>

OUTLINE

0 △ 0 In 23, Col 40 Spaces: 2 UTF-8 CRLF HCL ↻ 13:34 15-04-2021 Type here to search ↻ ENG

EXPLORER

OPEN EDITORS

- main.tf example-azure
- vars.tf example-azure

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-azure
  - > .terraform
  - > .terraform.state.lock.info
- main.tf
- { terraform.state
- vars.tf
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource
- > example-override
- > example-s3
- > example-test
- > example01

example-azure > main.tf

```
9 | features {} # required to customize behavior of some azure provider resources
10 }
11
12 # Create a resource group
13 resource "azurerm_resource_group" "example" {
14   name      = "example-resources"
15   location  = "East US"
16 }
17
18 # Create a virtual network within the resource group
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

TERMINAL

An execution plan has been generated and is shown below.  
Resource actions are indicated with the following symbols:  
+ create

Terraform will perform the following actions:

```
# azurerm_resource_group.example will be created
+ resource "azurerm_resource_group" "example" {
    + id      = (known after apply)
    + location = "eastus"
    + name    = "example-resources"
}

# azurerm_virtual_network.example will be created
+ resource "azurerm_virtual_network" "example" {
    + address_space      = [
        + "10.0.0.0/16",
    ]
    + id                = (known after apply)
    + location          = "eastus"
    + name              = "example-network"
    + resource_group_name = "example-resources"

    + subnet {
        + address_prefix = (known after apply)
        + id            = (known after apply)
        + name          = (known after apply)
    }
}
```

OUTLINE

0 △ 0 Type here to search

13:37 15-04-2021

File Edit Selection View Go Run Terminal Help • main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS 1 UNSAVED ● main.tf vars.tf

example-azure > main.tf

```
subscription_id = var.subscription_id
client_id      = var.client_id
client_secret   = var.client_secret
tenant_id       = var.tenant_id

features {} # required to customize behavior of some azure provider resources

# Create a resource group
resource "azurerm_resource_group" "example"
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

2: powershell + ×

Terraform will perform the actions described above.  
Only 'yes' will be accepted to approve.

Enter a value: yes

```
azurerm_resource_group.example: Creating...
azurerm_resource_group.example: Creation complete after 3s [id=/subscriptions/4b787b90-ec08-4b9c-8dbf-54dd5e97cbd0/resourceGroups/example-resources]
azurerm_virtual_network.example: Creating...
azurerm_virtual_network.example: Creation complete after 9s [id=/subscriptions/4b787b90-ec08-4b9c-8dbf-54dd5e97cbd0/resourceGroups/example-resources/providers/Microsoft.Network/virtualNetworks/example-network]
```

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

PS D:\terraform-training\example-azure>

OUTLINE

0 △ 0 Type here to search

13:40 15-04-2021

Microsoft Azure

Search resources, services, and docs (G+/)

Home > Resource groups

Default Directory

Create Manage view Refresh Export to CSV Open query Assign tags Feedback

Filter for any field... Subscription == all Location == all Add filter

No grouping List view

Name ↑ Subscription ↑↓ Location ↑↓

Name	Subscription	Location
<a href="#">example-resources</a>	Azure-sh-01-PAYG	East US
<a href="#">NetworkWatcherRG</a>	Azure-sh-01-PAYG	East US 2

< Previous Page 1 of 1 Next >

https://portal.azure.com/#@shartulkumargmail.onmicrosoft.com/resource/subscriptions/4b78...

Type here to search

13:39 15-04-2021 ENG

Home &gt; Resource groups &gt;

## Resource groups

 example-resources  
Resource group

Default Directory

[+ Create](#) [Manage view](#) [...](#)

Filter for any field...

Name ↑↓

 example-resources [...](#) NetworkWatcherRG [...](#)

## Overview

[Activity log](#)[Access control \(IAM\)](#)[Tags](#)[Events](#)

## Settings

[Deployments](#)[Security](#)[Policies](#)[Properties](#)[Locks](#)

## Cost Management

[Cost analysis](#)[Cost alerts \(preview\)](#)[Budgets](#)[Advisor recommendations](#)

&lt; Page 1 &gt; of 1

[+ Add](#) [Edit columns](#) [Delete resource group](#) [Refresh](#) [Export to CSV](#) [Open query](#) [Assign tags](#) [Move](#) [...](#)[JSON View](#)

## Essentials

Subscription (change)

Deployments

Azure-sh-01-PAYG

No deployments

Subscription ID

Location

4b787b90-ec08-4b9c-8dbf-54dd5e97cbd0

East US

Tags (change)

[Click here to add tags](#)

Filter for any field...

Type == all [X](#)Location == all [X](#)[+ Add filter](#)Showing 1 to 1 of 1 records.  Show hidden types [?](#)[No grouping](#) [List view](#) Name ↑↓

Type ↑↓

Location ↑↓

 example-network

Virtual network

East US

Virtual network



Type here to search



13:40

15-04-2021

# Examples on Azure

---

## Example 2

- ❑ Configure Remote Backend on Azure Storage Account
- ❑ Create Virtual Machine using the remote backend



## Examples on Azure

---

### Example 2

- State is a map of the actual state of infrastructure configuration
- By default, Terraform manages state on local filesystem using the local backend
- Remote backends allow Terraform to use a shared storage space for state data
- Azurerm provides a standard remote backend, native to the Azure platform
- Azurerm backend stores remote state on Azure Blob storage



File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf example-azure-backend > main.tf

TERRAFORM-TRAINING Backup example example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend .terraform main.tf vars.tf example-configure-remotestate example-createmodule example-datasource example-File-RemoteExec example-functions example-gcp example-gcp-backend example-gcp-bucket example-gcp-ds example-gcp-module example-gcp-NAT example-gcp-SQL example-gcp-VM example-instance-LocalExec example-instance-RemoteExec example-module example-NullResource example-override example-s3

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PS D:\terraform-training\example-azure-backend> PS D:\terraform-training\example-azure-backend>

1 provider "azurerm" {  
2 version = "=2.5.0"  
3 subscription\_id = var.subscription\_id  
4 client\_id = var.client\_id  
5 client\_secret = var.client\_secret  
6 tenant\_id = var.tenant\_id  
7 features {}  
8 }  
9  
10 resource "azurerm\_resource\_group" "rg" {  
11 name = "backend-rg"  
12 location = "East US"  
13 }  
14  
15 resource "azurerm\_storage\_account" "storage" {  
16 name = "terraformstorageaccount"  
17 resource\_group\_name = azurerm\_resource\_group.rg.name  
18 location = azurerm\_resource\_group.rg.location  
19 account\_tier = "Standard"  
20 account\_replication\_type = "LRS"  
21 }  
22  
23 resource "azurerm\_storage\_container" "storagecontainer" {  
24 name = "terraformstoragecontainer"  
25 storage\_account\_name = azurerm\_storage\_account.storage.name  
26 container\_access\_type = "private"  
27 }

Resource Group

Storage acc, LRS, Standard

Container within Storage is required - configured of the type private

v1.3.0 Type here to search

20:03 22.04.2021

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS example-azure-backend > main.tf  
main.tf example-azure-backend vars.tf  
vars.tf example-azure-backend

TERRAFORM-TRAINING  
Backup  
> example  
> example-access-remotestate  
> example-aws  
> example-aws-rw  
> example-azure  
> example-azure-backend  
.terraform  
main.tf  
{terraform.tfstate  
terraform.tfstate.backup  
vars.tf  
> example-configure-remotestate  
> example-createmodule  
> example-datasource  
> example-File-RemoteExec  
> example-functions  
> example-gcp  
> example-gcp-backend  
> example-gcp-bucket  
> example-gcp-ds  
> example-gcp-module  
> example-gcp-NAT  
> example-gcp-SQL  
> example-gcp-VM  
> example-instance-LocalExec  
> example-instance-RemoteExec  
> example-module

storage\_account\_name = azurerm\_storage\_account.storage.name  
container\_access\_type = "private"  
}  
output "storage-access-key1" {  
value = azurerm\_storage\_account.storage.primary\_access\_key  
}

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell + - ×

2021/04/23 20:46:08 [TRACE] [walkApply] Exiting eval tree: provider.azurerm (close)  
2021/04/23 20:46:08 [TRACE] vertex "provider.azurerm (close)": visit complete  
2021/04/23 20:46:08 [TRACE] dag/walk: visiting "root"  
2021/04/23 20:46:08 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)  
2021/04/23 20:46:08 [TRACE] vertex "root": visit complete  
2021/04/23 20:46:08 [TRACE] statemgr.Filesystem: have already backed up original terraform.tfstate to terraform.tfstate.backup on a previous write  
or 2021/04/23 20:46:08 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 5  
2021/04/23 20:46:08 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate  
ageacc.blob.core.win2021/04/23 20:46:08 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info  
d2021/04/23 20:46:08 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate  
ows.net/terraformshcontainer]  
Apply complete! Resources: 2 added, 0 changed, 0 destroyed.  
Outputs:  
storage-access-key1 = 1kNv0GGSoLVASrPQhnJkz6V0eS0dtyUX1wT3p5yKnUmlYWMYj1qGjwzsFGagcF3LMWMIxntJJBezfMx//DMoQ==  
PS D:\terraform-training\example-azure-backend>

v1.3.0 0 △ 0 In 24, Col 24 Spaces: 2 UTF-8 CRLF HCL ⚙ 20:46 23-04-2021

Type here to search

Home &gt;

## Storage accounts ...

X

Default Directory

+ Create Manage view Refresh Export to CSV Open query | Assign tags Delete | Feedback

Filter for any field...

Subscription == all

Resource group == all

Location == all

Add filter

Showing 1 to 1 of 1 records.

No grouping

List view

 Name ↑↓

Type ↑↓

Kind ↑↓

Resource group ↑↓

Location ↑↓

Subscri

 terraformshstorageacc

Storage account

StorageV2

backend-rg

East US

Azure-sh-ut-ran

List view

Summary view

...

## Storage accounts

Default Directory

[+ Create](#) [Manage view](#) [...](#)

Filter for any field...

Name ↑↓

terraformshstorageacc [...](#)terraformshstorageacc | Containers [...](#)

Storage account

[Search \(Ctrl+\)/](#)[Container](#)[Change access level](#)[Restore containers](#)[Refresh](#)[Delete](#) Show deleted containers[Overview](#)[Activity log](#)[Tags](#)[Diagnose and solve problems](#)[Access Control \(IAM\)](#)[Data migration](#)[Events](#)[Storage Explorer \(preview\)](#)

## Settings

[Access keys](#)[Geo-replication](#)[CORS](#)[Configuration](#)[Encryption](#)[Shared access signature](#)[Networking](#)[Security](#)[Advisor recommendations](#)[Static website](#)[Properties](#)[Locks](#)

Name	Last modified	Public access level	Lease state	...
terraformshcontainer	4/23/2021, 8:46:07 PM	Private	Available	...

File Edit Selection View Go Run Terminal Help backend.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS ... backend.tf X main.tf example-azure-backend01 > backend.tf

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-azure-backend01
  - backend.tf
  - main.tf
  - vars.tf
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-backend
- > example-gcp-bucket
- > example-gcp-ds
- > example-gcp-module
- > example-gcp-NAT
- > example-gcp-SQL
- > example-gcp-VM
- > example-instance-LocalExec
- > example-instance-RemoteExec
- > example-module
- > example-NullResource

subscription\_id = var.subscription\_id  
client\_id = var.client\_id  
client\_secret = var.client\_secret  
tenant\_id = var.tenant\_id  
features {}  
}  
9  
10 terraform {  
11 backend "azurerm"{  
12 resource\_group\_name = "backend-rg"  
13 storage\_account\_name = "terraformshstorageacc"  
14 container\_name = "terraformshcontainer"  
15 key = "terraform.tfstate"  
16 access\_key = "1kNv0GGSoLVASrPQhnJkz6V0eS0dtyUX1wT3p5yKnUm+IYWMYj1qGjwzsFGagcF3LMWMIxntJJBezfMx//D  
17 }  
18 }

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: powershell + - ×

```
2021/04/23 20:46:08 [TRACE] [walkApply] Exiting eval tree: provider.azurerm (close)  
2021/04/23 20:46:08 [TRACE] vertex "provider.azurerm (close)": visit complete  
2021/04/23 20:46:08 [TRACE] dag/walk: visiting "root"  
2021/04/23 20:46:08 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)  
2021/04/23 20:46:08 [TRACE] vertex "root": visit complete  
2021/04/23 20:46:08 [TRACE] statemgr.Filesystem: have already backed up original terraform.tfstate to terraform.tfstate.backup on a previous write or  
2021/04/23 20:46:08 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 5  
2021/04/23 20:46:08 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate  
ageacc.blob.core.win2021/04/23 20:46:08 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info  
d2021/04/23 20:46:08 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate  
ows.net/terraformshcontainer]  
Apply complete! Resources: 2 added, 0 changed, 0 destroyed.  
Outputs:  
storage-access-key1 = 1kNv0GGSoLVASrPQhnJkz6V0eS0dtyUX1wT3p5yKnUm+IYWMYj1qGjwzsFGagcF3LMWMIxntJJBezfMx//DMoQ==
```

PS D:\terraform-training\example-azure-backend> []

v13.0 0 △ 0

Ln 16, Col 110 Spaces: 4 UTF-8 CRLF HCL

21:02 ENG 23-04-2021

Type here to search

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS TERRAFORM-TRAINING

backend.tf example-azure-backend01  
main.tf example-azure-backend01  
example-access-remotestate  
example-aws  
example-aws-rw  
example-azure  
example-azure-backend  
.terraform  
main.tf  
{ terraform.tfstate  
terraformer.tfstate.backup  
vars.tf  
example-azure-backend01  
.terraform  
backend.tf  
main.tf  
vars.tf  
example-configure-remotestate  
example-createmodule  
example-datasource  
example-File-RemoteExec  
example-functions  
example-gcp  
example-gcp-backend  
example-gcp-bucket  
example-gcp-ds  
example-gcp-module  
example-gcp-NAT  
example-gcp-SQL  
example-gcp-VM  
OUTLINE  
TIMELINE

backend.tf main.tf

example-azure-backend01 > main.tf

```
1 resource "azurerm_resource_group" "example" {
2   name = "example-resources"
3   location = "East US"
4 }
5
6 resource "azurerm_virtual_network" "example" {
7   name          = "example-network"
8   resource_group_name = azurerm_resource_group.example.name
9   location      = azurerm_resource_group.example.location
10  address_space    = ["10.0.0.0/16"]
11 }
12
13 resource "azurerm_subnet" "internal" {
14   name = "internal"
15   resource_group_name = azurerm_resource_group.example.name
16   virtual_network_name = azurerm_virtual_network.example.name
17   address_prefix = "10.0.0.0/24"
18 }
19
20 resource "azurerm_network_interface" "example" {
21   name      = "example-nic"
22   resource_group_name = azurerm_resource_group.example.name
23   location      = azurerm_resource_group.example.location
24   ip_configuration {
25     name           = "testconfiguration1"
26     subnet_id       = azurerm_subnet.internal.id
27     private_ip_address_allocation = "Dynamic"
28   }
29 }
30 }
```

v1.3.0 0 △ 0

Ln 36, Col 6 Spaces: 2 UTF-8 CRLF HCL

22:17 23-04-2021

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS TERRAFORM-TRAINING OUTLINE TIMELINE

backend.tf main.tf

example-azure-backend01 > main.tf

```
20 resource "azurerm_network_interface" "example" {
21   name      = "example-nic"
22   resource_group_name  = azurerm_resource_group.example.name
23   location           = azurerm_resource_group.example.location
24   ip_configuration {
25     name          = "testconfiguration1"
26     subnet_id    = azurerm_subnet.internal.id
27     private_ip_address_allocation = "Dynamic"
28   }
29 }
30
31 resource "azurerm_virtual_machine" "example"{
32   name          = "example-vm"
33   location       = azurerm_resource_group.example.location
34   resource_group_name = azurerm_resource_group.example.name
35   network_interface_ids = [azurerm_network_interface.example.id]
36   vm_size        = "Standard_DS1_v2"
37
38   storage_image_reference {
39     publisher = "Canonical"
40     offer     = "UbuntuServer"
41     sku       = "16.04-LTS"
42     version   = "latest"
43
44   storage_os_disk {
45     name          = "myOSDisk"
46     create_option = "FromImage"
47     caching       = "ReadWrite"
48     managed_disk_type = "Standard_LRS"
49 }
```

v13.0 0 △ 0

Type here to search

22:17 23-04-2021

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS TERRAFORM-TRAINING

backend.tf example-azure-backend01 main.tf example-azure-backend01

main.tf example-azure-backend01

example-azure-backend01 > main.tf

```
resource_group_name = azurerm_resource_group.example.name
network_interface_ids = [azurerm_network_interface.example.id]
vm_size = "Standard_DS1_v2"

storage_image_reference {
    publisher = "Canonical"
    offer     = "UbuntuServer"
    sku       = "16.04-LTS"
    version   = "latest"
}

storage_os_disk {
    name          = "myOSDisk"
    create_option = "FromImage"
    caching       = "ReadWrite"
    managed_disk_type = "Standard_LRS"
}

delete_os_disk_on_termination = true
os_profile {
    computer_name  = "hostname"
    admin_username = "newadmin"
    admin_password = "P@ssw0rd123"
}
os_profile_linux_config{
    disable_password_authentication = false
}
```

v1.3.0 0 △ 0

Type here to search

Ln 36, Col 6 Spaces: 2 UTF-8 CRLF HCL

22:18 23-04-2021 ENG

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS TERRAFORM-TRAINING

- backend.tf example-azure-backend01
- main.tf example-azure-backend01
- example-access-remotestate
- example-aws
- example-aws-rw
- example-azure
- example-azure-backend
- .terraform
- main.tf
- { } terraform.tfstate
- terraformer.state.backup
- vars.tf
- example-azure-backend01
- .terraform
- backend.tf
- main.tf
- vars.tf
- example-configure-remotestate
- example-createmodule
- example-datasource
- example-File-RemoteExec
- example-functions
- example-gcp
- example-gcp-backend
- example-gcp-bucket
- example-gcp-ds
- example-gcp-module
- example-gcp-NAT
- example-gcp-SQL
- example-gcp-VM

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

2: powershell

```
2021/04/23 22:18:00 [TRACE] [walkApply] Exiting eval tree: provider.azurerm (close)
2021/04/23 22:18:00 [TRACE] vertex "provider.azurerm (close)": visit complete
2021/04/23 22:18:00 [TRACE] dag/walk: visiting "root"
2021/04/23 22:18:00 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)
2021/04/23 22:18:00 [TRACE] vertex "root": visit complete
s [id=/subscriptions/4b787b90-ec08-4b9c-8dbf-54dd5e97cbd0/resourceGroups/example-resources/providers/Microsoft.Compute/virtualMachines/example-vm]

Apply complete! Resources: 5 added, 0 changed, 0 destroyed.
Releasing state lock. This may take a few moments...
PS D:\terraform-training\example-azure-backend01>
```

v1.3.0 0 △ 0

Ln 36, Col 6 Spaces: 2 UTF-8 CRLF HCL

22:18 23-04-2021

Type here to search



## Virtual networks

Default Directory

[Create](#) [Manage view](#) [...](#)

Filter for any field...

Name ↑↓

[example-network](#) [...](#)

## example-network

Virtual network

Search (Ctrl+ /)

[Refresh](#) [Move](#) [Delete](#)

JSON View

[Overview](#)[Activity log](#)[Access control \(IAM\)](#)[Tags](#)[Diagnose and solve problems](#)

## Settings

[Address space](#)[Connected devices](#)[Subnets](#)[DDoS protection](#)[Firewall](#)[Security](#)[DNS servers](#)[Peerings](#)[Service endpoints](#)[Private endpoints](#)[Properties](#)[Locks](#)

## Monitoring

[Alerts](#)[Metrics](#)

## Essentials

Resource group ([change](#))

example-resources

Address space

10.0.0.0/16

Location

East US

DNS servers

Multiple

Subscription ([change](#))

Azure-sh-01-PAYG

Subscription ID

4b787b90-ec08-4b9c-8dbf-54dd5e97cbd0

Tags ([change](#))[Click here to add tags](#)

## Connected devices

Search connected devices

Device ↑↓	Type ↑↓	IP Address ↑↓	Subnet ↑↓
example-nic	Network interface	10.0.0.4	internal

Home &gt;

# terraformshcontainer

Container

X

Search (Ctrl+/)

Upload Change access level Refresh Delete Change tier Acquire lease Break lease View snapshots Create snapshot

Overview

Diagnose and solve problems

Access Control (IAM)

## Settings

Shared access signature

Access policy

Properties

Metadata

**Authentication method:** Access key ([Switch to Azure AD User Account](#))**Location:** terraformshcontainer

Search blobs by prefix (case-sensitive)

 Show deleted blobs

Name	Modified	Access tier	Blob type	Size	Lease state	...
<input checked="" type="checkbox"/> terraform.tfstate	4/23/2021, 10:18:04 PM	Hot (Inferred)	Block blob	7.86 KiB	Available	

Home &gt; terraformshcontainer &gt;

## terraformshcontainer

Container

[Upload](#) [Change access level](#) [...](#)

**Authentication method:** Access key ([Switch to Azure AD User Account](#))

**Location:** terraformshcontainer

[Show deleted blobs](#)**Name**

<input checked="" type="checkbox"/>	terraform.tfstate	<a href="#">...</a>
-------------------------------------	-------------------	---------------------

### Settings

[Shared access signature](#)[Access policy](#)[Properties](#)[Metadata](#)

## terraform.tfstate

Blob

[Save](#) [Discard](#) [Download](#) [Refresh](#) [Delete](#) [Change tier](#) [Acquire lease](#) [Break lease](#)[Overview](#) [Versions](#) [Snapshots](#) [Edit](#) [Generate SAS](#)

### Properties

URL	<a href="https://terraformshsto...">https://terraformshsto...</a>
LAST MODIFIED	4/23/2021, 10:18:04 PM
CREATION TIME	4/23/2021, 10:10:20 PM
VERSION ID	-
TYPE	Block blob
SIZE	7.86 KiB
ACCESS TIER	Hot (Inferred)
ACCESS TIER LAST MODIFIED	N/A
SERVER ENCRYPTED	true
ETAG	0x8D90677904E84BF
CONTENT-TYPE	application/json
CONTENT-MD5	-
LEASE STATUS	Unlocked
LEASE STATE	Available
LEASE DURATION	-
COPY STATUS	-
COPY COMPLETION TIME	-

[Undelete](#)

### Metadata

Key	Value

terraform - Notepad

File Edit Format View Help

```
{  
  "version": 4,  
  "terraform_version": "0.12.6",  
  "serial": 1,  
  "lineage": "380f91ae-8b34-b3be-efbc-102bd2557dd4",  
  "outputs": {},  
  "resources": [  
    {  
      "mode": "managed",  
      "type": "azurerm_network_interface",  
      "name": "example",  
      "provider": "provider.azurerm",  
      "instances": [  
        {  
          "schema_version": 0,  
          "attributes": {  
            "applied_dns_servers": [],  
            "dns_servers": [],  
            "enable_accelerated_networking": false,  
            "enable_ip_forwarding": false,  
            "id": "/subscriptions/4b787b90-ec08-4b9c-8dbf-54dd5e97cbd0/resourceGroups/example-resources/providers/Microsoft.Network/networkInterfaces/example-nic",  
            "internal_dns_name_label": "",  
            "ip_configuration": [  
              {  
                "name": "testconfiguration1",  
                "primary": true,  
                "private_ip_address": "10.0.0.4",  
                "private_ip_address_allocation": "Dynamic",  
                "private_ip_address_version": "IPv4",  
                "public_ip_address_id": "",  
                "subnet_id": "/subscriptions/4b787b90-ec08-4b9c-8dbf-54dd5e97cbd0/resourceGroups/example-resources/providers/Microsoft.Network/virtualNetworks/example-network/subnets/internal"  
              }  
            ],  
            "location": "eastus",  
            "mac_address": "",  
            "name": "example-nic",  
            "private_ip_address": "10.0.0.4",  
            "private_ip_addresses": [  
              "10.0.0.4"  
            ],  
            "resource_group_name": "example-resources",  
            "tags": null,  
          }  
        ]  
      ]  
    }  
  ]  
}
```

Ln 1, Col 1 | 100% | Unix (LF) | UTF-8

Type here to search

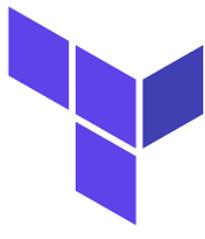
22:23  
23-04-2021

# Examples on Azure

---

## Example 3

- Provision a Linux App Service running a single Docker container



File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf

example-azure-linuxAppService > main.tf

main.tf example-azure-linuxAppService

TERRAFORM-TRAINING

- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-azure-backend01
- > example-azure-linuxAppService
  - main.tf
  - outputs.tf
  - vars.tf
- > example-configure-remotestate
- > example-createmodule
  - .terraform
  - modules
  - datasources.tf
  - main.tf
  - outputs.tf
- { terraform.tfstate
- terraforms.state.backup
- terraforms.state
- variables.tf
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-backend
- > example-gcp-bucket
- > example-gcp-ds
- > example-gcp-module

- > OUTLINE
- > TIMELINE

1 provider "azurerm" {  
2 version = "=2.5.0"  
3 subscription\_id = var.subscription\_id  
4 client\_id = var.client\_id  
5 client\_secret = var.client\_secret  
6 tenant\_id = var.tenant\_id  
7 features {}  
8 }  
9  
10 resource "azurerm\_resource\_group" "rg" {  
11 name = "backend-rg"  
12 location = "East US"  
13 }  
14  
15 resource "azurerm\_app\_service\_plan" "main" {  
16 name = "example-asp"  
17 location = azurerm\_resource\_group.rg.location  
18 resource\_group\_name = azurerm\_resource\_group.rg.name  
19 kind = "Linux"  
20 reserved = true  
21  
22 sku {  
23 tier = "Standard"  
24 size = "S1"  
25 }  
26 }  
27  
28 resource "azurerm\_app\_service" "main" {  
29 name = "example-appservice"  
30 location = azurerm\_resource\_group.rg.location

Define the hosting plan for the App

Type of AppService Plan to create

Pricing range - category

1 Core, 1.5 Gb RAM, 50 Gb disk  
Storage capacity

v13.0 0 △ 0 In 15, Col 35 (24 selected) Spaces: 2 UTF-8 CRLF HCL 23:11 23-04-2021 Type here to search

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf example-azure-linuxAppService TERRAFORM-TRAINING example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-azure-backend01 example-azure-linuxAppService main.tf outputs.tf vars.tf example-configure-remotestate example-createmodule .terraform modules datasources.tf main.tf outputs.tf terraform.tfstate terraform.tfstate.backup terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-gcp-backend example-gcp-bucket example-gcp-ds example-gcp-module OUTLINE TIMELINE

```
23     tier = "Standard"
24     size = "S1"
25   }
26 }
27
28 resource "azurerm_app_service" "main" {
29   name          = "example-appservice"
30   location      = azurerm_resource_group.rg.location
31   resource_group_name = azurerm_resource_group.rg.name
32   app_service_plan_id = azurerm_app_service_plan.main.id
33
34   site_config {
35     app_command_line = ""
36     linux_fx_version = "DOCKER|nginx:latest"
37   }
38
39   app_settings = {
40     "WEBSITES_ENABLE_APP_SERVICE_STORAGE" = "false"
41     "DOCKER_REGISTRY_SERVER_URL"         = "https://index.docker.io"
42   }
43 }
```

Creating AppService in the plan

No explicit terminal command so this is blank, docker will take care

Linux app framework with nginx image

Docker hub as registry

False to disable smb shared to home directory

v13.0 0 △ 0

Ln 36, Col 37 (5 selected) Spaces: 2 UTF-8 CRLF HCL

23:24 23-04-2021

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf

example-azure-linuxAppService > main.tf

TERRAFORM-TRAINING example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-azure-backend01 example-azure-linuxAppService main.tf outputs.tf vars.tf example-configure-remotestate example-createmodule .terraform modules datasources.tf main.tf outputs.tf terraform.tfstate terraform.tfstate.backup terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-gcp-backend example-gcp-bucket example-gcp-ds example-gcp-module

OUTLINE TIMELINE

main.tf example-azure-linuxAppService > main.tf

```
23     tier = "Standard"
24     size = "S1"
25   }
26 }
27
28 resource "azurerm_app_service" "main" {
29   name          = "example-appservice"
30   location      = azurerm_resource_group.rg.location
31   resource_group_name = azurerm_resource_group.rg.name
32   app_service_plan_id = azurerm_app_service_plan.main.id
33
34   site_config {
35     app_command_line = ""
36     linux_fx_version = "DOCKER|jenkins:latest"
37   }
38
39   app_settings = {
40     "WEBSITES_ENABLE_APP_SERVICE_STORAGE" = "false"
41     "DOCKER_REGISTRY_SERVER_URL"        = "https://index.docker.io"
42   }
43 }
```

Creating AppService in the plan

v13.0 0 △ 0

Type here to search

23:11 23-04-2021

File Edit Selection View Go Run Terminal Help outputs.tf - terraform-training - Visual Studio Code

EXPLORER main.tf outputs.tf

OPEN EDITORS main.tf example-azure-linuxAppService outputs.tf example-azure-linuxAppService

TERRAFORM-TRAINING example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-azure-backend01 example-azure-linuxAppService .terraform main.tf outputs.tf vars.tf example-configure-remotestate example-createmodule .terraform modules datasources.tf main.tf outputs.tf terraform.tfstate terraform.tfstate.backup terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-gcp-backend example-gcp-bucket

OUTLINE

TIMELINE

outputs.tf

```
example-azure-linuxAppService > outputs.tf
1 output "app_service_name" {
2   value = azurerm_app_service.main.name
3 }
4
5 output "app_service_default_hostname" {
6   value = "https://${azurerm_app_service.main.default_site_hostname}"
7 }
```

Get the name of the AppService

Access the hostname of AppService running in the container using the URL

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 3: powershell

```
2021/04/24 03:32:18 [DEBUG] checking for provider in ".terraform\plugins\windows_386"
2021/04/24 03:32:18 [DEBUG] found provider "terraform-provider-azurerm_v2.5.0_x5.exe"
2021/04/24 03:32:18 [DEBUG] found valid plugin: "azurerm", "2.5.0", "D:\terrafrom-training\example-azure-linuxAppService\.terraform\plugins\windows_386\terrafom-provider-azurerm_v2.5.0_x5.exe"
2021/04/24 03:32:20 [DEBUG] checking for provider in ".terraform\plugins\windows_386"
2021/04/24 03:32:20 [DEBUG] found provider "terraform-provider-azurerm_v2.5.0_x5.exe"
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.

PS D:\terrafrom-training\example-azure-linuxAppService>

v1.3.0 0 △ 0

Type here to search

03:35 24-04-2021

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER OPEN EDITORS main.tf outputs.tf

OPEN EDITORS main.tf example-azure-linuxAppService outputs.tf example-azure-linuxAppService

TERRAFORM-TRAINING example-access-remotestate example-aws example-aws-rw example-azure example-azure-backend example-azure-backend01 example-azure-linuxAppService .terraform main.tf outputs.tf terraform.tfstate vars.tf example-configure-remotestate example-createmodule .terraform modules main.tf outputs.tf terraform.tfstate terraform.tfstate.backup terraform.tfvars variables.tf example-datasource example-File-RemoteExec example-functions example-gcp example-gcp-backend

example-azure-linuxAppService > main.tf

```
36     linux_fx_version = "DOCKER|nginx:latest"
37 }
38
39 app_settings = {
40     "WEBSITES_ENABLE_APP_SERVICE_STORAGE" = "false"
41     "DOCKER_REGISTRY_SERVER_URL"         = "https://index.docker.io"
42 }
43 }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 3: powershell

```
2021/04/24 03:40:58 [TRACE] [walkApply] Entering eval tree: meta.count-boundary (EachMode fixup)
2021/04/24 03:40:58 [TRACE] <root>: eval: *terraform.EvalCountFixZeroOneBoundaryGlobal
2021/04/24 03:40:58 [TRACE] [walkApply] Exiting eval tree: meta.count-boundary (EachMode fixup)
2021/04/24 03:40:58 [TRACE] vertex "meta.count-boundary (EachMode fixup)": visit complete
2021-04-24T03:40:58.110+0530 [DEBUG] plugin: plugin process exited: path=D:\terraform-training\example-azure-linuxAppService\.terraform\plugins\windows_386\terraform-provider-azurerm_v2.5.0_x5.exe pid=25800
2021-04-24T03:40:58.110+0530 [DEBUG] plugin: plugin exited
2021/04/24 03:40:58 [TRACE] [walkApply] Exiting eval tree: provider.azurerm (close)
2021/04/24 03:40:58 [TRACE] vertex "provider.azurerm (close)": visit complete
2021/04/24 03:40:58 [TRACE] dag/walk: visiting "root"
2021/04/24 03:40:58 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)
2021/04/24 03:40:58 [TRACE] vertex "root": visit complete
2021/04/24 03:40:58 [TRACE] statemgr.Filesystem: no original state snapshot to back up
2021/04/24 03:40:58 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 4
2021/04/24 03:40:58 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate
2021/04/24 03:40:58 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info
2021/04/24 03:40:58 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate

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

Outputs:

app_service_default_hostname = https://example-appservice.azurewebsites.net
app_service_name = example-appservice
PS D:\terraform-training\example-azure-linuxAppService>
```

Ln 43, Col 2 Spaces: 2 UTF-8 CRLF HCL 03:54 24-04-2021

v13.0 0 △ 0 Type here to search

# Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to [nginx.org](http://nginx.org).  
Commercial support is available at [nginx.com](http://nginx.com).

*Thank you for using nginx.*



Type here to search



Home &gt;

## App Services ...

X

Default Directory

Create Manage view Refresh Export to CSV Open query | Assign tags Start Restart Stop Delete | Feedback

 Filter for any field...

Subscription == all

Resource group == all

Location == all

Add filter

Showing 1 to 1 of 1 records.

No grouping

List view

 Name ↑↓

Status ↑↓

Location ↑↓

Pricing Tier ↑↓

App Service Plan ↑↓

Subscription ↑↓

App Type ↑↓

 example-appservice

Running

East US

Standard

example-asp

Azure-sh-01-PAYG

Web App

...

Microsoft Azure

Search resources, services, and docs (G+/)

Home > App Services > example-appservice

## App Services

Default Directory

+ Create    Manage view    ...

Filter for any field...

Name ↑

example-appservice ...

Deployment

- Quickstart
- Deployment credentials
- Deployment slots
- Deployment Center

Settings

- Configuration
- Container settings (Classic)
- Authentication
- Authentication (classic)
- Application Insights
- Identity
- Backups
- Custom domains
- TLS/SSL settings
- Networking
- Scale up (App Service plan)
- Scale out (App Service plan)
- WebJobs
- Push
- MySQL In App
- Properties

## example-appservice | Configuration

App Service

Search (Ctrl+ /) Refresh Save Discard

Application settings General settings Path mappings

### Application settings

Application settings are encrypted at rest and transmitted over an encrypted channel. You can choose to display them in plain text in your browser by using the controls below. Application Settings are exposed as environment variables for access by your application at runtime. [Learn more](#)

+ New application setting    Show values    Advanced edit

Filter application settings

Name	Value	Source	Deployment slot setting
DOCKER_REGISTRY_SERVER_URL	Hidden value. Click to show value	App Service Config	
WEBSITES_ENABLE_APP_SERVICE_STORAGE	Hidden value. Click to show value	App Service Config	

### Connection strings

Connection strings are encrypted at rest and transmitted over an encrypted channel.

+ New connection string    Show values    Advanced edit

Filter connection strings

Name	Value	Source	Type	Deploy...	Delete
(no connection strings to display)					

< Page 1 > of 1

example-appservice | Container settings (Classic) 

Search (Ctrl+/)

## Repository Access

 Public  Private Deployment credentials Deployment slots Deployment Center

## Settings

 Configuration Container settings (Classic)  Authentication Authentication (classic) Application Insights Identity Backups Custom domains TLS/SSL settings Networking Scale up (App Service plan) Scale out (App Service plan) WebJobs

## Repository Access

 Public  Private

## Full Image Name and Tag

jenkins:2.60.3

## Startup File

## Continuous Deployment

 On  OffWebhook URL [show url](#)

\*\*\*

 Copy

## Logs

```
2021-04-24T13:57:30.904Z INFO - Waiting for response to warmup request for container example-appservice_0_a729711a. Elapsed time = 17.0238107 sec
2021-04-24T13:38:03.021Z INFO - Container example-appservice_0_a729711a for site example-appservice initialized successfully and is ready to serve requests.
2021-04-24T13:39:00.186Z INFO - Pulling image from Docker hub: library/jenkins:2.60.3
2021-04-24T13:39:01.813Z INFO - 2.60.3 Pulling from library/jenkins
2021-04-24T13:39:01.944Z INFO - Digest: sha256:eeb4850eb65f2d92500e421b430ed1ec58a7ac909e91f518926e02473904f668
2021-04-24T13:39:01.945Z INFO - Status: Image is up to date for jenkins:2.60.3
2021-04-24T13:39:01.956Z INFO - Pull Image successful, Time taken: 0 Minutes and 1 Seconds
2021-04-24T13:39:01.995Z INFO - Starting container for site
2021-04-24T13:39:02.005Z INFO - docker run -d -p 5879:8080 --name example-appservice_1_307c7443 -e WEBSITES_ENABLE_APP_SERVICE_STORAGE=false -e WEBSITE_SITE_NAME=example-appservice -e WEBSITE_AUTH_ENABLED=False -e PORT=8080 -e WEBSITE_ROLE_INSTANCE_ID=0 -e WEBSITE_HOSTNAME=example-appservice.azurewebsites.net -e WEBSITE_INSTANCE_ID=d157d6920a73c6a3171d796ad0f40d2ea26074983cbfc6c70ebfb23c8b530 jenkins:2.60.3
```

 Download Refresh Save Discard

Type here to search



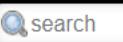
19:10

24-04-2021





Jenkins



search



log in

Jenkins > Jenkins' own user database

## Create First Admin User

Username:

Password:

Confirm password:

Full name:

Create First Admin User

Check the url

# Examples on Azure

---

## Example 4

- ❑ Use data sources with Azure cloud infrastructure
- ❑ Create a new virtual machine



Home &gt; Resource groups &gt;

## Create a resource group

...

X

[Basics](#) [Tags](#) [Review + create](#)

Resource group - A container that holds related resources for an Azure solution. The resource group can include all the resources for the solution, or only those resources that you want to manage as a group. You decide how you want to allocate resources to resource groups based on what makes the most sense for your organization. [Learn more](#)

## Let us create a Resource Group

## Project details

Subscription \* ⓘ

Azure-sh-01-PAYG



Resource group \* ⓘ

manual-group

## Resource details

Region \* ⓘ

(US) East US

[Review + create](#)

&lt; Previous

Next : Tags &gt;

Home &gt; Resource groups &gt;

## Create a resource group ...

X

Validation passed.

Basics Tags Review + create

## Basics

Subscription	Azure-sh-01-PAYG
Resource group	manual-group
Region	East US

## Tags

None

[Create](#)[< Previous](#)[Next >](#)[Download a template for automation](#)

Microsoft Azure

Search resources, services, and docs (G+/)

Home > Virtual networks >

## Virtual networks

Default Directory

+ Create   Manage view   ...

Filter for any field...

Name ↑   Resource group ↑

No virtual networks to display

Create a virtual network to securely connect your Azure resources to each other. Connect your virtual network to your on-premises network using an Azure VPN Gateway or ExpressRoute.

Learn more ↗

Create virtual network

## Create virtual network

### Add subnet to Virtual network

Basics   IP Addresses   Security   Tags   Review + create

The virtual network's address space, specified as one or more address prefixes in CIDR notation (e.g. 192.168.1.0/24).

IPv4 address space

198.168.0.0/16

Add IPv6 address space ⓘ

The subnet's address range in CIDR notation (e.g. 192.168.1.0/24). It must be contained by the address space of the virtual network.

+ Add subnet   Remove subnet

Subnet name   Subnet address range

This virtual network doesn't have any subnets.

✖ This virtual network doesn't have any subnets.

Review + create   < Previous   Next : Security >   Download a template for automation

### Add custom IP address range

Subnet name \*

manual-subnet

Subnet address range \* ⓘ

e.g. 10.0.0.0/24

(0 Addresses)

### SERVICE ENDPOINTS

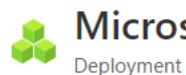
Create service endpoint policies to allow traffic to specific azure resources from your virtual network over service endpoints. [Learn more](#)

Services ⓘ

0 selected

Add   Cancel

Home &gt;



# Microsoft.VirtualNetwork-20210424192441 | Overview



Search (Ctrl+ /)

&lt;&lt;

Delete

Cancel

Redeploy

Refresh

Deployment succeeded

7:35 PM X

Deployment 'Microsoft.VirtualNetwork-20210424192441' to resource group 'manual-group' was successful.

[Go to resource](#)[Pin to dashboard](#)

Overview

Inputs

Outputs

Template

We'd love your feedback! →

## ... Deployment is in progress



Deployment name: Microsoft.VirtualNetwork-20210424192441  
Subscription: Azure-sh-01-PAYG  
Resource group: manual-group

Start time: 4/24/2021, 7:35:24 PM

Correlation ID: 9fe0ee49-34c4-45b4-b1a3-eff3a380fa78

 Deployment details [\(Download\)](#)

Resource	Type	Status	Operation details
No results.			



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File Edit Selection View Go Run Terminal Help datasource.tf - terraform-training - Visual Studio Code

EXPLORER 1 OPEN EDITORS 1 UNSAVED

- datasource.tf example-azure-ds
- vars.tf example-azure-ds
- main.tf example-azure-ds

TERRAFORM-TRAINING

- backup
- example
- example-access-remotestate
- example-aws
- example-aws-rw
- example-azure
- example-azure-backend
- example-azure-backend01
- example-azure-ds
  - .terraform
  - datasource.tf
  - main.tf
  - terraform.tfstate
  - vars.tf
- example-azure-linuxAppService
- example-configure-remotestate
- example-createmodule
- example-datasource
- example-File-RemoteExec
- example-functions
- example-gcp
- example-gcp-backend
- example-gcp-bucket
- example-gcp-ds
- example-gcp-module
- example-gcp-NAT
- example-gcp-SQL
- example-gcp-VM

OUTLINE

datasource.tf X vars.tf main.tf

example-azure-ds > datasource.tf

```
1 provider "azurerm" {  
2   version = "=2.5.0"  
3   subscription_id = var.subscription_id  
4   client_id       = var.client_id  
5   client_secret    = var.client_secret  
6   tenant_id        = var.tenant_id  
7   features {}  
8 }  
9  
10 data "azurerm_virtual_network" "example" {  
11   name          = var.network_name  
12   resource_group_name = var.group_name  
13 }  
14  
15 data "azurerm_subnet" "example" {  
16   name           = data_azurerm_virtual_network.example.subnets.0  
17   virtual_network_name = var.network_name  
18   resource_group_name = var.group_name  
19 }  
20  
21 output "virtual_network_location" {  
22   value = data_azurerm_virtual_network.example.location  
23 }  
24  
25 output "virtual_network_subnets" {  
26   value = data_azurerm_virtual_network.example.subnets.0  
27 }  
28  
29 output "subnet_id" {  
30 }
```

Virtual Network and subnet datasource to retrieve the data

0 △ 0 Type here to search

21:22 24-04-2021

File Edit Selection View Go Run Terminal Help datasource.tf - terraform-training - Visual Studio Code

EXPLORER ... datasource.tf X vars.tf main.tf example-azure-ds > datasource.tf

OPEN EDITORS

X datasource.tf example-azure-ds  
vars.tf example-azure-ds  
main.tf example-azure-ds

TERRAFORM-TRAINING

> backup  
> example  
> example-access-remotestate  
> example-aws  
> example-aws-rw  
> example-azure  
> example-azure-backend  
> example-azure-backend01  
> example-azure-ds  
> .terraform  
datasource.tf  
main.tf  
{} terraform.tfstate  
vars.tf  
> example-azure-linuxAppService  
> example-configure-remotestate  
> example-createmodule  
> example-datasource  
> example-File-RemoteExec  
> example-functions  
> example-gcp  
> example-gcp-backend  
> example-gcp-bucket  
> example-gcp-ds  
> example-gcp-module  
> example-gcp-NAT  
> example-gcp-SQL  
> example-gcp-VM

OUTLINE

10  
11 data "azurerm\_virtual\_network" "example" {  
12 name = var.network\_name  
13 resource\_group\_name = var.group\_name  
14 }  
15  
16 data "azurerm\_subnet" "example" {  
17 name = data\_azurerm\_virtual\_network\_example.subnets.0  
18 virtual\_network\_name = var.network\_name  
19 resource\_group\_name = var.group\_name  
20 }  
21  
22 output "virtual\_network\_location" {  
23 value = data\_azurerm\_virtual\_network\_example.location  
24 }  
25  
26 output "virtual\_network\_subnets" {  
27 value = data\_azurerm\_virtual\_network\_example.subnets.0  
28 }  
29  
30 output "subnet\_id" {  
31 value = data\_azurerm\_subnet\_example.id  
32 }

Output the virtual network location, subnet and id

0 △ 0 Type here to search

LN 16, COL 24 Spaces: 2 UTF-8 CRLF HCL 21:24 24-04-2021 ENG

File Edit Selection View Go Run Terminal Help main.tf - terraform-training - Visual Studio Code

EXPLORER

OPEN EDITORS

- datasource.tf example-azure-ds
- vars.tf example-azure-ds
- main.tf example-azure-ds

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
- > example-azure-backend01
- example-azure-ds
  - > .terraform
  - datasource.tf
  - main.tf
  - { terraform.tfstate
  - vars.tf
- > example-azure-linuxAppService
- > example-configure-remotestate
- > example-createmodule
- > example-datasource
- > example-File-RemoteExec
- > example-functions
- > example-gcp
- > example-gcp-backend
- > example-gcp-bucket
- > example-gcp-ds
- > example-gcp-module
- > example-gcp-NAT
- > example-gcp-SQL
- > example-gcp-VM

OUTLINE

datasource.tf vars.tf main.tf

example-azure-ds > main.tf

```
1
2 resource "azurerm_network_interface" "example" {
3   name      = "example-nic"
4   resource_group_name  = var.group_name
5   location           = data.azurerm_virtual_network.example.location
6   ip_configuration {
7     name          = "testconfiguration1"
8     subnet_id    = data.azurerm_subnet.example.id
9     private_ip_address_allocation = "Dynamic"
10  }
11 }
12
13 resource "azurerm_virtual_machine" "example"{
14   name              = "example-vm"
15   location          = data.azurerm_virtual_network.example.location
16   resource_group_name = var.group_name
17   network_interface_ids = [azurerm_network_interface.example.id]
18   vm_size           = "Standard_DS1_v2"
19   storage_image_reference {
20     publisher = "Canonical"
21     offer     = "UbuntuServer"
22     sku       = "16.04-LTS"
23     version   = "latest"
24   }
25   storage_os_disk {
26     name          = "myOSDisk"
27     create_option = "FromImage"
28     caching       = "ReadWrite"
29     managed_disk_type = "Standard_LRS"
30   }
}
```

Network interface and Azure VM components

Ln 24, Col 4 Spaces: 2 UTF-8 CRLF HCL ⚙️ 🔍

Ln 11, Col 1 Spaces: 2 UTF-8 CRLF Terraform ⚙️ 🔍

File Edit Selection View Go Run Terminal Help vars.tf - terraform-training - Visual Studio Code

EXPLORER ...

OPEN EDITORS

- datasource.tf example-azure-ds
- vars.tf example-azure-ds
- main.tf example-azure-ds

TERRAFORM-TRAINING

- > backup
- > example
- > example-access-remotestate
- > example-aws
- > example-aws-rw
- > example-azure
- > example-azure-backend
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  - .terraform
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- > example-gcp-bucket
- > example-gcp-ds
- > example-gcp-module
- > example-gcp-NAT
- > example-gcp-SQL
- > example-gcp-VM

OUTLINE

datasource.tf vars.tf main.tf

example-azure-ds > vars.tf

```
1 variable "subscription_id" {  
2   type = string  
3   default =  
4 }  
5  
6 variable "client_id" {  
7   type = string  
8   default =  
9 }  
10  
11 variable "client_secret" {  
12   type = string  
13   default =  
14 }  
15  
16 variable "tenant_id" {  
17   type = string  
18   default =  
19 }  
20  
21 variable "group_name" {  
22   type = string  
23   default = "manual-group"  
24 }  
25  
26 variable "network_name" {  
27   type = string  
28   default = "manual-network"  
29 }  
30
```

Resource group and network name given as variable

Let us do terraform apply

0 △ 0 Type here to search

Ln 21, Col 21 (10 selected) Spaces: 4 UTF-8 CRLF HCL ⚙ 21:29 24-04-2021 ⚙ ENG

File Edit Selection View Go Run Terminal Help • main.tf - terraform-training - Visual Studio Code

EXPLORER ... datasource.tf vars.tf main.tf ●

example-azure-ds > main.tf

```
13 resource "azurerm_virtual_machine" "example"{
14   name           = "example-vm"
15   location       = data.azurerm_virtual_network.example.location
16   resource_group_name = var.group_name
17   network_interface_ids = [azurerm_network_interface.example.id]
18   vm_size         = "Standard_DS1_v2"
19   storage_image_reference {
20     publisher = "Canonical"
21     offer     = "UbuntuServer"
22     sku       = "16.04-LTS"
23     version   = "latest"
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

```
2021/04/24 21:21:06 [TRACE] vertex "meta.count-boundary (EachMode fixup)": visit complete
1-group/providers/Microsoft.Compute/virtualMachines/example-vm]
2021-04-24T21:21:06.378+0530 [DEBUG] plugin: plugin process exited: path=D:\terraform-training\example-azure-ds\.terraform\plugins\windows_386\terraform-provider-azurerm_v2.5.0_x5.exe pid=27704
2021-04-24T21:21:06.378+0530 [DEBUG] plugin: plugin exited
2021/04/24 21:21:06 [TRACE] [walkApply] Exiting eval tree: provider.azurerm (close)
2021/04/24 21:21:06 [TRACE] vertex "provider.azurerm (close)": visit complete
2021/04/24 21:21:06 [TRACE] dag/walk: visiting "root"
2021/04/24 21:21:06 [TRACE] vertex "root": starting visit (terraform.graphNodeRoot)
2021/04/24 21:21:06 [TRACE] vertex "root": visit complete
2021/04/24 21:21:06 [TRACE] statemgr.Filesystem: no original state snapshot to back up
2021/04/24 21:21:06 [TRACE] statemgr.Filesystem: state has changed since last snapshot, so incrementing serial to 3
2021/04/24 21:21:06 [TRACE] statemgr.Filesystem: writing snapshot at terraform.tfstate
2021/04/24 21:21:06 [TRACE] statemgr.Filesystem: removing lock metadata file .terraform.tfstate.lock.info
2021/04/24 21:21:06 [TRACE] statemgr.Filesystem: unlocked by closing terraform.tfstate
```

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

Outputs:

```
subnet_id = /subscriptions/4b787b90-ec08-4b9c-8dbf-54dd5e97cbd0/resourceGroups/manual-group/providers/Microsoft.Network/virtualNetworks/manual-network/subnets/manual-subnet
virtual_network_location = eastus
virtual_network_subnets = manual-subnet
PS D:\terraform-training\example-azure-ds>
```

Network location and subnet , and subnet id

Microsoft Azure

Search resources, services, and docs (G+/)

Home > Virtual machines >

# Virtual machines

Default Directory

+ Add ▾ Switch to classic ⋮

Filter for any field... Name ↑↓ example-vm ⋮

- Overview
- Activity log
- Access control (IAM)
- Tags
- Diagnose and solve problems

### Settings

- Networking
- Connect
- Disks
- Size
- Security
- Advisor recommendations
- Extensions
- Continuous delivery
- Availability + scaling
- Configuration
- Identity
- Properties
- Locks

### Operations

- Bastion

example-vm Virtual machine

Search (Ctrl+ /) Connect Start Restart Stop Capture Delete Refresh Open in mobile JSON View

Resource group (change)  
manual-group

Status  
Running

Location  
East US

Subscription (change)  
Azure-sh-01-PAYG

Subscription ID  
4b787b90-ec08-4b9c-8dbf-54dd5e97cbd0

Tags (change)  
Click here to add tags

Properties Monitoring Capabilities (7) Recommendations Tutorials

Virtual machine		Networking	
Computer name	hostname	Public IP address	-
Operating system	Linux (ubuntu 16.04)	Public IP address (IPv6)	-
Publisher	Canonical	Private IP address	198.168.1.4
Offer	UbuntuServer	Private IP address (IPv6)	-
Plan	16.04-LTS	Virtual network/subnet	manual-network/manual-subnet
VM generation	V1	DNS name	-
Agent status	Ready		
Agent version	2.2.54.2		
Host group	None		
Host	-		
Proximity placement group	-		

Size  
Standard DS1 v2

vCPUs  
1

RAM  
3.5 GiB

Operating system  
Linux (ubuntu 16.04)

Size  
Standard DS1 v2 (1 vcpus, 3.5 GiB memory)

Public IP address  
-

Virtual network/subnet  
manual-network/manual-subnet

DNS name  
-

Public IP address

Virtual network/subnet  
manual-network/manual-subnet

DNS name

Private IP address  
198.168.1.4

Private IP address (IPv6)

Virtual network/subnet  
manual-network/manual-subnet

DNS name

Size  
Standard DS1 v2

vCPUs  
1

RAM  
3.5 GiB

Page 1 of 1

## manual-network ...

Virtual network

Search (Ctrl+/)

Refresh Move Delete

JSON View

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

### Settings

Address space

Connected devices

Subnets

DDoS protection

Firewall

Security

DNS servers

Peering

Service endpoints

Private endpoints

Properties

Locks

### Monitoring

Alerts

Metrics

### Essentials

Resource group (change) : manual-group

Address space : 198.168.0.0/16

Location : East US

DNS servers : Azure provided DNS service

Subscription (change) : Azure-sh-01-PAYG

Subscription ID : 4b787b90-ec08-4b9c-8dbf-54dd5e97cbd0

Tags (change) : Click here to add tags

### Connected devices

Search connected devices

Device ↑↓

Type ↑↓

IP Address ↑↓

Subnet ↑↓

example-nic

Network interface

198.168.1.4

manual-subnet



Thank You

