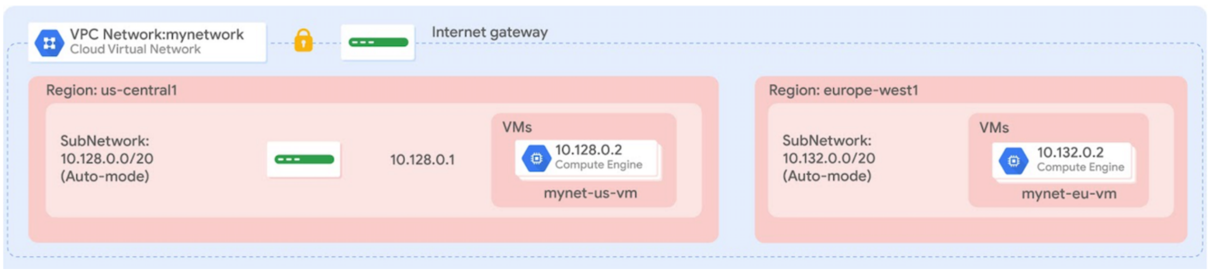
# Automating the Deployment of Infrastructure Using Terraform

1 hour1 Credit

## Overview

Terraform enables you to safely and predictably create, change, and improve infrastructure. It is an open-source tool that codifies APIs into declarative configuration files that can be shared among team members, treated as code, edited, reviewed, and versioned.

In this lab, you create a Terraform configuration with a module to automate the deployment of Google Cloud infrastructure. Specifically, you deploy one auto mode network with a firewall rule and two VM instances, as shown in this diagram:



## Objectives

In this lab, you learn how to perform the following tasks:

- Create a configuration for an auto mode network
- Create a configuration for a firewall rule
- Create a module for VM instances
- Create and deploy a configuration
- Verify the deployment of a configuration

## Setup

For each lab, you get a new Google Cloud project and set of resources for a fixed time at no cost.

1. Sign in to Qwiklabs using an **incognito window**.
2. Note the lab's access time (for example, `1:15:00`), and make sure you can finish within that time.
   There is no pause feature. You can restart if needed, but you have to start at the beginning.
3. When ready, click **Start lab**.
4. Note your lab credentials (**Username** and **Password**). You will use them to sign in to the Google Cloud Console.

5. Click **Open Google Console**.
6. Click **Use another account** and copy/paste credentials for **this** lab into the prompts.
   If you use other credentials, you'll receive errors or **incur charges**.
7. Accept the terms and skip the recovery resource page.

**Note:** Do not click **End Lab** unless you have finished the lab or want to restart it. This clears your work and removes the project.

## Task 1. Set up Terraform and Cloud Shell

Configure your Cloud Shell environment to use Terraform.

### Install Terraform

Terraform is now integrated into Cloud Shell. Verify which version is installed.

1. In the Cloud Console, click **Activate Cloud Shell** ( ).
2. If prompted, click **Continue**.
3. To confirm that Terraform is installed, run the following command:

```
terraform --version
```

Copied!

content_copy

The output should look like this:

```
Terraform v1.3.3
```

**Note:** Don't worry if you get a warning that the version of Terraform is out of date, because the lab instructions will work with Terraform v1.3.3 and later. The available downloads for the latest version of Terraform are on the Terraform website. Terraform is distributed as a binary package for all supported platforms and architectures, and Cloud Shell uses Linux 64-bit.

4. To create a directory for your Terraform configuration, run the following command:

```
mkdir tfinfra
```

Copied!

content_copy

5. In Cloud Shell, click **Open editor** (✎).

**Note:** If you see the message **"Unable to load code editor because third-party cookies are disabled"**, click **Open in New Window.** The code editor will open in a new tab. Return to the original tab, click **Open Terminal** and then switch back to the code editor tab. You will periodically need to switch back to the Cloud Shell terminal in this lab.

6. In the left pane of the code editor, expand the **tfinfra** folder.

## Initialize Terraform

Terraform uses a plugin-based architecture to support the numerous infrastructure and service providers available. Each "provider" is its own encapsulated binary distributed separately from Terraform itself. Initialize Terraform by setting Google as the provider.

1. To create a new file inside **tfinfra** folder, `right-click` on **tfinfra** folder and then click **New File**.
2. Name the new file **provider.tf**, and then open it.
3. Copy the code into `provider.tf`:

```
provider "google" {}
```

Copied!

content_copy

4. To save **provider.tf**, click **File** > **Save**.
5. To initialize Terraform, run the following command:

```
cd tfinfra
terraform init
```

Copied!

content_copy

The output should look like this:

```
* provider.google: version = "~> 4.43.0"
Terraform has been successfully initialized!
```

You are now ready to work with Terraform in Cloud Shell.

## Task 2. Create mynetwork and its resources

Create the auto mode network **mynetwork** along with its firewall rule and two VM instances (**mynet_us_vm** and **mynet_eu_vm**).

## Configure mynetwork

Create a new configuration, and define **mynetwork**.

1. To create a new file inside **tfinfra**, `right-click` on **tfinfra** folder and then click **New File**.
2. Name the new file **mynetwork.tf**, and then open it.
3. Copy the following base code into `mynetwork.tf`:

```
# Create the mynetwork network
resource [RESOURCE_TYPE] "mynetwork" {
name = [RESOURCE_NAME]
# RESOURCE properties go here
}
```

Copied!

content_copy

This base template is a great starting point for any Google Cloud resource. The **name** field allows you to name the resource, and the **type** field allows you to specify the Google Cloud resource that you want to create. You can also define properties, but these are optional for some resources.

4. In `mynetwork.tf`, replace `[RESOURCE_TYPE]` with `"google_compute_network"` (with the quotes).

**Note:** The **google_compute_network** resource is a VPC network. Available resources are in the Google Cloud provider documentation. Learn more about this specific resource in the Terraform documentation.

5. In `mynetwork.tf`, replace `[RESOURCE_NAME]` with `"mynetwork"` (with the quotes).
6. Add the following property to `mynetwork.tf`:

```
auto_create_subnetworks = "true"
```

Copied!

content_copy

By definition, an auto mode network automatically creates a subnetwork in each region. Therefore, you are setting **auto_create_subnetworks** to **true**.

7. Verify that **mynetwork.tf** file look like this:

```
# Create the mynetwork network
resource "google_compute_network" "mynetwork" {
name = "mynetwork"
# RESOURCE properties go here
auto_create_subnetworks = "true"
}
```

Copied!

content_copy

8. To save `mynetwork.tf`, click **File** > **Save**.

## Configure the firewall rule

Define a firewall rule to allow HTTP, SSH, RDP, and ICMP traffic on mynetwork.

1. Add the following base code to `mynetwork.tf`:

```
# Add a firewall rule to allow HTTP, SSH, RDP and ICMP traffic on
mynetwork
resource [RESOURCE_TYPE] "mynetwork-allow-http-ssh-rdp-icmp" {
```

```
name = [RESOURCE_NAME]
# RESOURCE properties go here
}
```

Copied!

content_copy

2. In `mynetwork.tf`, replace `[RESOURCE_TYPE]` with `"google_compute_firewall"` (with the quotes).

**Note:** The **google_compute_firewall** resource is a firewall rule. Learn more about this specific resource in the Terraform documentation.

3. In `mynetwork.tf`, replace `[RESOURCE_NAME]` with `"mynetwork-allow-http-ssh-rdp-icmp"` (with the quotes).
4. Add the following property to `mynetwork.tf`:

```
network = google_compute_network.mynetwork.self_link
```

Copied!

content_copy

**Note:** Because this firewall rule depends on its network, you are using the **google_compute_network.mynetwork.self_link** reference to instruct Terraform to resolve these resources in a dependent order. In this case, the network is created before the firewall rule.

5. Add the following properties to `mynetwork.tf`:

```
allow {
    protocol = "tcp"
    ports    = ["22", "80", "3389"]
    }
allow {
    protocol = "icmp"
    }
```

```
source_ranges = ["0.0.0.0/0"]
```

Copied!

content_copy

The list of **allow** rules specifies which protocols and ports are permitted.

6. Verify that your `mynetwork.tf` file look like this:

```
# Create the mynetwork network
resource "google_compute_network" "mynetwork" {
name = "mynetwork"
# RESOURCE properties go here
auto_create_subnetworks = "true"
}
# Add a firewall rule to allow HTTP, SSH, RDP and ICMP traffic on
mynetwork
resource "google_compute_firewall" "mynetwork-allow-http-ssh-rdp-icmp"
{
name = "mynetwork-allow-http-ssh-rdp-icmp"
# RESOURCE properties go here
network = google_compute_network.mynetwork.self_link
allow {
    protocol = "tcp"
    ports    = ["22", "80", "3389"]
    }
allow {
    protocol = "icmp"
    }
source_ranges = ["0.0.0.0/0"]
}
```

Copied!

content_copy

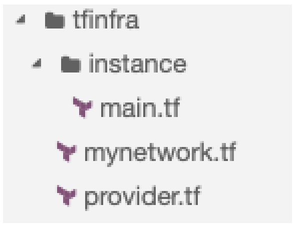
7. To save **mynetwork.tf**, click **File** > **Save**.

## Configure the VM instance

Define the VM instances by creating a VM instance module. A module is a reusable configuration inside a folder. You will use this module for both VM instances of this lab.

1. To create a new folder inside **tfinfra**, select the **tfinfra** folder, and then click **File** > **New Folder**.
2. Name the new folder **instance**.
3. To create a new file inside **instance**, `right-click` on **instance** folder and then click **New File**.
4. Name the new file **main.tf**, and then open it.

You should have the following folder structure in Cloud Shell:



5. Copy the following base code into **main.tf**:

```
resource [RESOURCE_TYPE] "vm_instance" {
  name = [RESOURCE_NAME]
  # RESOURCE properties go here
}
```

Copied!

content_copy

6. In `main.tf`, replace `[RESOURCE_TYPE]` with `"google_compute_instance"` (with the quotes).

**Note:** The **google_compute_instance** resource is a Compute Engine instance. Learn more about this specific resource in the Terraform documentation.

7. In `main.tf`, replace `[RESOURCE_NAME]` with `"${var.instance_name}"` (with the quotes).

Because you will be using this module for both VM instances, you are defining the instance name as an input variable. This allows you to control the name of the variable from mynetwork.tf. Learn more about input variables in the Terraform: Define Input Variables Guide.

8. Add the following properties to `main.tf`:

```
zone         = "${var.instance_zone}"
 machine_type = "${var.instance_type}"
```

Copied!

content_copy

These properties define the zone and machine type of the instance as input variables.

9. Add the following properties to `main.tf`:

```
boot_disk {
   initialize_params {
     image = "debian-cloud/debian-11"
     }
 }
```

Copied!

content_copy

This property defines the boot disk to use the Debian 11 OS image. Because both VM instances will use the same image, you can hard-code this property in the module.

10. Add the following properties to `main.tf`:

```
network_interface {
    network = "${var.instance_network}"
    access_config {
      # Allocate a one-to-one NAT IP to the instance
    }
  }
```

Copied!

content_copy

This property defines the network interface by providing the network name as an input variable and the access configuration. Leaving the access configuration empty results in an ephemeral external IP address (required in this lab). To create instances with only an internal IP address, remove the access_config section. For more information, see the Terraform documentation.

11. Verify that `main.tf` looks like this, including brackets `{}`

```
resource "google_compute_instance" "vm_instance" {
  name         = "${var.instance_name}"
  zone         = "${var.instance_zone}"
  machine_type = "${var.instance_type}"
  boot_disk {
    initialize_params {
      image = "debian-cloud/debian-11"
      }
  }
  network_interface {
    network = "${var.instance_network}"
    access_config {
      # Allocate a one-to-one NAT IP to the instance
    }
  }
}
```

Copied!

content_copy

12. To save main.tf, click **File** > **Save**.

13. To create a new file inside **instance**, `right-click` on **instance** folder and then click **New File**.
14. Name the new file **variables.tf**, and then open it.
15. Define the 4 input variables in `variables.tf`.

```
variable "instance_name" {}
variable "instance_zone" {}
variable "instance_type" {
  default = "e2-micro"
  }
variable "instance_network" {}
```

Copied!

content_copy

By giving **instance_type** a default value, you make the variable optional. The **instance_name**, **instance_zone**, and **instance_network** are required, and you will define them in `mynetwork.tf`.

16. To save variables.tf, click **File** > **Save**.
17. Add the following VM instances to `mynetwork.tf`:

```
# Create the mynet-us-vm instance
module "mynet-us-vm" {
  source           = "./instance"
  instance_name    = "mynet-us-vm"
  instance_zone    = "Zone"
  instance_network = google_compute_network.mynetwork.self_link
}
# Create the mynet-eu-vm" instance
module "mynet-eu-vm" {
  source           = "./instance"
  instance_name    = "mynet-eu-vm"
  instance_zone    = "europe-west1-d"
  instance_network = google_compute_network.mynetwork.self_link
}
```

Copied!

content_copy

These resources are leveraging the module in the **instance** folder and provide the name, zone, and network as inputs. Because these instances depend on a VPC network, you are using the **google_compute_network.mynetwork.self_link** reference to instruct Terraform to resolve these resources in a dependent order. In this case, the network is created before the instance.

**Note:** The benefit of writing a Terraform module is that it can be reused across many configurations. Instead of writing your own module, you can also leverage existing modules from the Terraform Module registry.

18. To save `mynetwork.tf`, click **File** > **Save**.
19. Verify that `mynetwork.tf` looks like this, including brackets `{}`

```
# Create the mynetwork network
resource "google_compute_network" "mynetwork" {
name = "mynetwork"
# RESOURCE properties go here
auto_create_subnetworks = "true"
}
# Add a firewall rule to allow HTTP, SSH, RDP and ICMP traffic on
mynetwork
resource "google_compute_firewall" "mynetwork-allow-http-ssh-rdp-icmp"
{
name = "mynetwork-allow-http-ssh-rdp-icmp"
# RESOURCE properties go here
network = google_compute_network.mynetwork.self_link
allow {
    protocol = "tcp"
    ports    = ["22", "80", "3389"]
    }
allow {
    protocol = "icmp"
    }
source_ranges = ["0.0.0.0/0"]
}
# Create the mynet-us-vm instance
module "mynet-us-vm" {
  source           = "./instance"
  instance_name    = "mynet-us-vm"
  instance_zone    = "Zone"
  instance_network = google_compute_network.mynetwork.self_link
}
# Create the mynet-eu-vm" instance
module "mynet-eu-vm" {
  source           = "./instance"
  instance_name    = "mynet-eu-vm"
  instance_zone    = "europe-west1-d"
  instance_network = google_compute_network.mynetwork.self_link
}
```

Copied!

content_copy

## Create mynetwork and its resources

It's time to apply the mynetwork configuration.

1. To rewrite the Terraform configuration files to a canonical format and style, run the following command:

```
terraform fmt
```

Copied!

content_copy

The output should look like this:

```
mynetwork.tf
```

**Note:** If you get an error, revisit the previous steps to ensure that your configuration matches the lab instructions. If you cannot troubleshoot the issue of your configuration, download and then look at these finished configurations:

- mynetwork.tf
- main.tf
- provider.tf
- variables.tf

2. To initialize Terraform, run the following command:

```
terraform init
```

Copied!

content_copy

The output should look like this:

```
Initializing modules...
- mynet-eu-vm in instance
- mynet-us-vm in instance
...
* provider.google: version = "~> 4.43.0"
Terraform has been successfully initialized!
```

**Note:** If you get an error, revisit the previous steps to ensure that you have the correct folder/file structure. If you cannot troubleshoot the issue of your configuration, refer to the finished configurations linked above. When you have corrected the issue, re-run the previous command.

3. To create an execution plan, run the following command:

```
terraform plan
```

Copied!

content_copy

The output should look like this:

```
...
Plan: 4 to add, 0 to change, 0 to destroy.
...
```

Terraform determined that the following 4 resources need to be added:

| Name | Description |
|---|---|
| mynetwork | VPC network |
| mynetwork-allow-http-ssh-rdp-icmp | Firewall rule to allow HTTP, SSH, RDP and ICMP |
| mynet-us-vm | VM instance in Zone |
| mynet-eu-vm | VM instance in "europe-west1-d" |

4. To apply the desired changes, run the following command:

```
terraform apply
```

Copied!

content_copy

5. To confirm the planned actions, type:

```
yes
```

Copied!

content_copy

The output should look like this:

```
...
Apply complete! Resources: 4 added, 0 changed, 0 destroyed.
```

Click **Check my progress** to verify the objective.

Create mynetwork and its resources

Check my progress

**Note:** If you get an error during the execution, revisit the previous steps to ensure that you have the correct folder/file structure. If you cannot troubleshoot the issue of your configuration, refer to the finished configurations linked above. When you have corrected the issue, re-run the previous command.

## Task 3. Verify your deployment

In the Cloud Console, verify that the resources were created.

### Verify your network in the Cloud Console

1. In the Cloud Console, on the **Navigation menu** (≡), click **VPC network** > **VPC networks**.
2. View the **mynetwork** VPC network with a subnetwork in every region.
3. On the **Navigation menu**, click **VPC network** > **Firewall**.
4. Sort the firewall rules by **Network**.
5. View the **mynetwork-allow-http-ssh-rdp-icmp** firewall rule for **mynetwork**.

### Verify your VM instances in the Cloud Console

1. On the **Navigation menu** (≡), click **Compute Engine** > **VM instances**.
2. View the **mynet-us-vm** and **mynet-eu-vm** instances.

3. Note the internal IP address for **mynet-eu-vm**.
4. For **mynet-us-vm**, click **SSH** to launch a terminal and connect.
5. To test connectivity to **mynet-eu-vm**'s internal IP address, run the following command in the SSH terminal (replacing mynet-eu-vm's internal IP address with the value noted earlier):

```
ping -c 3 <Enter mynet-eu-vm's internal IP here>
```

Copied!

content_copy

**Note:** This should work because both VM instances are on the same network, and the firewall rule allows ICMP traffic!

## Task 4. Review

In this lab, you created a Terraform configuration with a module to automate the deployment of Google Cloud infrastructure. As your configuration changes, Terraform can create incremental execution plans, which allows you to build your overall configuration step by step.

The instance module allowed you to re-use the same resource configuration for multiple resources while providing properties as input variables. You can leverage the configuration and module that you created as a starting point for future deployments.