

As you manage your infrastructure with Terraform, increasingly complex configurations will be created. There is no intrinsic limit to the complexity of a single Terraform configuration file or directory, so it is possible to continue writing and updating your configuration files in a single directory. However, if you do, you may encounter one or more of the following problems:

- Understanding and navigating the configuration files will become increasingly difficult.
- Updating the configuration will become more risky, because an update to one block may cause unintended consequences to other blocks of your configuration.
- Duplication of similar blocks of configuration may increase, for example, when you configure separate dev/staging/production environments, which will cause an increasing burden when updating those parts of your configuration.
- If you want to share parts of your configuration between projects and teams, cutting and pasting blocks of configuration between projects could be error-prone and hard to maintain.

In this lab, you will learn how modules can address these problems, the structure of a Terraform module, and best practices when using and creating modules.

What are modules for?

Here are some of the ways that modules help solve the problems listed above:

- **Organize configuration:** Modules make it easier to navigate, understand, and update your configuration by keeping related parts of your configuration together. Even moderately complex infrastructure can require hundreds or thousands of lines of configuration to implement. By using modules, you can organize your configuration into logical components.
- **Encapsulate configuration:** Another benefit of using modules is to encapsulate configuration into distinct logical components. Encapsulation can help prevent unintended consequences—such as a change to one part of your configuration accidentally causing changes to other infrastructure—and reduce the chances of simple errors like using the same name for two different resources.
- **Re-use configuration:** Writing all of your configuration without using existing code can be time-consuming and error-prone. Using modules can save time and reduce costly errors by re-using configuration written either by yourself, other members of your team, or other Terraform practitioners who have published modules for you to use. You can also share modules that you have written with your team or the general public, giving them the benefit of your hard work.

- **Provide consistency and ensure best practices:** Modules also help to provide consistency in your configurations. Consistency makes complex configurations easier to understand, and it also helps to ensure that best practices are applied across all of your configuration. For example, cloud providers offer many options for configuring object storage services, such as Amazon S3 (Simple Storage Service) or Google's Cloud Storage buckets. Many high-profile security incidents have involved incorrectly secured object storage, and because of the number of complex configuration options involved, it's easy to accidentally misconfigure these services.

Using modules can help reduce these errors. For example, you might create a module to describe how all of your organization's public website buckets will be configured, and another module for private buckets used for logging applications. Also, if a configuration for a type of resource needs to be updated, using modules allows you to make that update in a single place and have it be applied to all cases where you use that module.

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

- Use a module from the Registry
- Build a module

A Terraform module is a set of Terraform configuration files in a single directory. Even a simple configuration consisting of a single directory with one or more `.tf` files is a module. When you run Terraform commands directly from such a directory, it is considered the **root module**. So in this sense, every Terraform configuration is part of a module. You may have a simple set of Terraform configuration files like this:

```
$ tree minimal-module/  
.  
├── LICENSE  
├── README.md  
├── main.tf  
├── variables.tf  
└── outputs.tf
```

In this case, when you run Terraform commands from within the `minimal-module` directory, the contents of that directory are considered the root module.

Calling modules

Terraform commands will only directly use the configuration files in one directory, which is usually the current working directory. However, your configuration can use module blocks to call modules in other directories. When Terraform encounters a module block, it loads and processes that module's configuration files.

A module that is called by another configuration is sometimes referred to as a "child module" of that configuration.

Local and remote modules

Modules can be loaded from either the local filesystem or a remote source. Terraform supports a variety of remote sources, including the Terraform Registry, most version control systems, HTTP URLs, and Terraform Cloud or Terraform Enterprise private module registries.

In many ways, Terraform modules are similar to the concepts of libraries, packages, or modules found in most programming languages, and they provide many of the same benefits. Just like almost any non-trivial computer program, real-world Terraform configurations should almost always use modules to provide the benefits mentioned above.

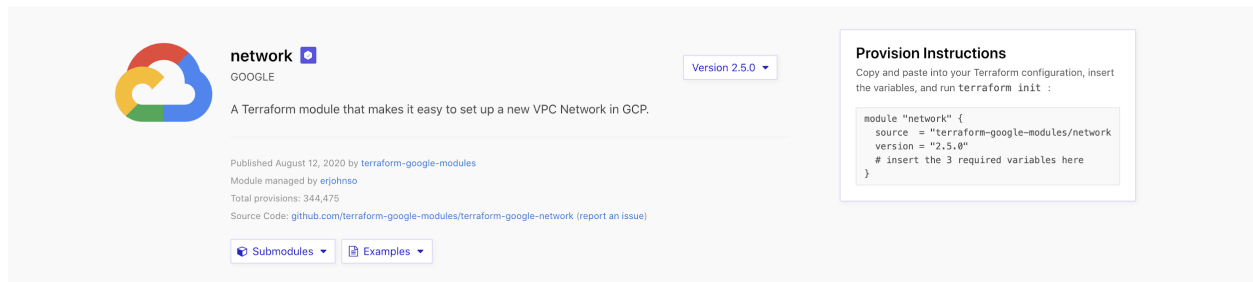
It is recommended that every Terraform practitioner use modules by following these best practices:

- Start writing your configuration with a plan for modules. Even for slightly complex Terraform configurations managed by a single person, the benefits of using modules outweigh the time it takes to use them properly.
- Use local modules to organize and encapsulate your code. Even if you aren't using or publishing remote modules, organizing your configuration in terms of modules from the beginning will significantly reduce the burden of maintaining and updating your configuration as your infrastructure grows in complexity.
- Use the public Terraform Registry to find useful modules. This way you can quickly and confidently implement your configuration by relying on the work of others.
- Publish and share modules with your team. Most infrastructure is managed by a team of people, and modules are an important tool that teams can use to create and maintain infrastructure. As mentioned earlier, you can publish modules either publicly or privately.

Task 1. Use modules from the Registry

In this section, you use modules from the Terraform Registry to provision an example environment in Google Cloud. The concepts you use here will apply to any modules from any source.

- Open the Terraform Registry page for the Terraform Network module in a new browser tab or window. The page will look like this:



The page includes information about the module and a link to the source repository. The right side of the page includes a dropdown interface to select the module version and instructions for using the module to provision infrastructure.

When you call a module, the source argument is required. In this example, Terraform will search for a module in the Terraform Registry that matches the given string. You could also use a URL or local file path for the source of your modules. See the Terraform documentation for a list of possible module sources.

The other argument shown here is the version. For supported sources, the version will let you define what version or versions of the module will be loaded. In this lab, you will specify an exact version number for the modules you use. You can read about more ways to specify versions in the module documentation.

Other arguments to module blocks are treated as input variables to the modules.

Create a Terraform configuration

1. To start, run the following commands in Cloud Shell to clone the example simple project from the Google Terraform modules GitHub repository and switch to the v3.3.0 branch:

```
git clone
https://github.com/terraform-google-modules/terraform-google-network
cd terraform-google-network
git checkout tags/v3.3.0 -b v3.3.0
```

```

student_00_7ce2281996c7@cloudshell:~ (qwiklabs-gcp-00-9569ae2370d3) $ git clone https://github.com/terraform-google-modules/terraform-google-network
cd terraform-google-network
git checkout tags/v3.3.0 -b v3.3.0
Cloning into 'terraform-google-network'...
remote: Enumerating objects: 4420, done.
remote: Counting objects: 100% (259/259), done.
remote: Compressing objects: 100% (107/107), done.
remote: Total 4420 (delta 149), reused 244 (delta 145), pack-reused 4161
Resolving objects: 100% (4420/4420), 950.58 KiB | 16.97 MiB/s, done.
Resolving deltas: 100% (2870/2870), done.
Switched to a new branch 'v3.3.0'
student_00_7ce2281996c7@cloudshell:~/terraform-google-network (qwiklabs-gcp-00-9569ae2370d3) $

```

In the editor, navigate to terraform-google-network/examples/simple_project, and open the main.tf

main.tf :

```

/**
 * Copyright 2019 Google LLC
 *
 * Licensed under the Apache License, Version 2.0 (the "License");
 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *     http://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
 * implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

provider "google" {
  version = "~> 3.45.0"
}

provider "null" {
  version = "~> 2.1"
}

# [START vpc_custom_create]
module "test-vpc-module" {
  source      = "terraform-google-modules/network/google"
  version     = "~> 3.2.0"

```

```

project_id    = var.project_id # Replace this with your project ID in
quotes
network_name = "my-custom-mode-network"
mtu           = 1460

subnets = [
  {
    subnet_name    = "subnet-01"
    subnet_ip      = "10.10.10.0/24"
    subnet_region  = "us-west1"
  },
  {
    subnet_name      = "subnet-02"
    subnet_ip        = "10.10.20.0/24"
    subnet_region    = "us-west1"
    subnet_private_access = "true"
    subnet_flow_logs  = "true"
  },
  {
    subnet_name      = "subnet-03"
    subnet_ip        = "10.10.30.0/24"
    subnet_region    = "us-west1"
    subnet_flow_logs  = "true"
    subnet_flow_logs_interval = "INTERVAL_10_MIN"
    subnet_flow_logs_sampling = 0.7
    subnet_flow_logs_metadata = "INCLUDE_ALL_METADATA"
  }
]
}
# [END vpc_custom_create]

```

This configuration includes a few important blocks:

- `provider "google"` defines your provider.
- `locals` are the names of your three subnets. A local value assigns a name to an expression, which allows the expression to be used multiple times within a module without repeating it.
- `module "test-vpc-module"` defines a Virtual Private Cloud (VPC), which will provide networking services for the rest of your infrastructure.

Set values for module input variables

Some input variables are *required*, which means that the module doesn't provide a default value; an explicit value must be provided in order for Terraform to run correctly.

- Within the module "test-vpc-module" block, review the input variables you are setting. Each of these input variables is documented in the [Terraform Registry](#).

The required inputs for this module are:

- network_name: The name of the network being created
- project_id: The ID of the project where this VPC will be created
- subnets: The list of subnets being created

In order to use most modules, you will need to pass input variables to the module configuration. The configuration that calls a module is responsible for setting its input values, which are passed as arguments to the module block. Aside from source and version, most of the arguments to a module block will set variable values.

On the Terraform Registry page for the Google Cloud network module, an Inputs tab describes all of the [input variables](#) that module supports.

Define root input variables

Using input variables with modules is very similar to how you use variables in any Terraform configuration. A common pattern is to identify which module input variables you might want to change in the future, and then create matching variables in your configuration's `variables.tf` file with sensible default values. Those variables can then be passed to the module block as arguments.

1. To retrieve your Project ID, run the following command in Cloud Shell:

```
gcloud config list --format 'value(core.project)'
```

```
student_00_7ce2281996c7@cloudshell:~/terraform-google-network/examples/simple_project (qwklabs-gcp-00-9569ae2370d3)$ gcloud config list --format 'value(core.project)'
```

2. In the Editor, still in the same directory, navigate to `variables.tf`.

```
variable "project_id" {  
  description = "The project ID to host the network in"  
}
```

```
variable "network_name" {
  description = "The name of the VPC network being created"
}
```

3. Fill in the variable `project_id` with the output of the previous command. You must follow the format below and set the default value for the variable:
4. In `variables.tf`, fill in the variable `network_name`. You can use the name `example-vpc` or any other name you'd like. You must follow the format below and set the default value for the variable:

```
cat variables.tf
variable "project_id" {
  description = "The project ID to host the network in"
  default = "qwiklabs-gcp-00-9569ae2370d3"
}
```

```
variable "network_name" {
  description = "The name of the VPC network being created"
  default = "example_vpc"
}
```

Define root output values

Modules also have output values, which are defined within the module with the `output` keyword. You can access them by referring to `module.<MODULE NAME>.<OUTPUT NAME>`. Like input variables, module outputs are listed under the `outputs` tab in the [Terraform Registry](#).

Module outputs are usually either passed to other parts of your configuration or defined as outputs in your root module. You will see both uses in this lab.

- Navigate to the `outputs.tf` file inside of your configuration's directory. Verify that the file contains the following:

`output.tf`

```
output "network_name" {
  value    = module.test-vpc-module.network_name
  description = "The name of the VPC being created"
}
```

```
output "network_self_link" {
```



```
    value    = module.test-vpc-module.network_self_link
    description = "The URI of the VPC being created"
}
```

```
output "project_id" {
    value    = module.test-vpc-module.project_id
    description = "VPC project id"
}
```

```
output "subnets_names" {
    value    = module.test-vpc-module.subnets_names
    description = "The names of the subnets being created"
}
```

```
output "subnets_ips" {
    value    = module.test-vpc-module.subnets_ips
    description = "The IP and cidrs of the subnets being created"
}
```

```
output "subnets_regions" {
    value    = module.test-vpc-module.subnets_regions
    description = "The region where subnets will be created"
}
```

```
output "subnets_private_access" {
    value    = module.test-vpc-module.subnets_private_access
    description = "Whether the subnets will have access to Google API's without a public IP"
}
```

```
output "subnets_flow_logs" {
    value    = module.test-vpc-module.subnets_flow_logs
    description = "Whether the subnets will have VPC flow logs enabled"
}
```

```
output "subnets_secondary_ranges" {
    value    = module.test-vpc-module.subnets_secondary_ranges
    description = "The secondary ranges associated with these subnets"
}
```

```
output "route_names" {
    value    = module.test-vpc-module.route_names
    description = "The routes associated with this VPC"
}
```

Provision infrastructure

1. In Cloud Shell, navigate to your `simple_project` directory:

```
cd ~/terraform-google-network/examples/simple_project
```

2. Initialize your Terraform configuration:

```
terraform init
```

```
student_00_7ce2281996c7@cloudshell:~/terraform-google-network/examples/simple_project (qwiklabs-gcp-00-9569ae2370d3)$ terraform init
Initializing modules...
Downloading registry.terraform.io/terraform-google-modules/network/google 3.2.2 for test-vpc-module...
- test-vpc-module in .terraform/modules/test-vpc-module
- test-vpc-module.firewall.rules in .terraform/modules/test-vpc-module/modules/firewall-rules
- test-vpc-module.routes in .terraform/modules/test-vpc-module/modules/routes
- test-vpc-module.subnets in .terraform/modules/test-vpc-module/modules/subnets
- test-vpc-module.vpc in .terraform/modules/test-vpc-module/modules/vpc

Initializing the backend...

Initializing provider plugins...
- Finding hashicorp/null versions matching "~> 2.1"...
- Finding hashicorp/google-beta versions matching "~> 3.45"...
- Finding hashicorp/google versions matching ">= 2.12.0, ~> 3.45.0, ~> 3.45, < 4.0.0"...
- Installing hashicorp/null v2.1.2...
- Installed hashicorp/null v2.1.2 (signed by HashiCorp)
- Installing hashicorp/google-beta v3.90.1...
- Installed hashicorp/google-beta v3.90.1 (signed by HashiCorp)
- Installing hashicorp/google v3.45.0...
- Installed hashicorp/google v3.45.0 (signed by HashiCorp)

Terraform has created a lock file .terraform.lock.hcl to record the provider
selections it made above. Include this file in your version control repository
so that Terraform can guarantee to make the same selections by default when
you run "terraform init" in the future.
```

3. Create your VPC:

```
terraform apply
```

```
module.test-vpc-module.module.vpc.google_compute_network.network: Creating...
module.test-vpc-module.module.vpc.google_compute_network.network: Still creating... [1
module.test-vpc-module.module.vpc.google_compute_network.network: Creation complete af
work]
module.test-vpc-module.module.subnets.google_compute_subnetwork.subnetwork["us-west1/s
module.test-vpc-module.module.subnets.google_compute_subnetwork.subnetwork["us-west1/s
module.test-vpc-module.module.subnets.google_compute_subnetwork.subnetwork["us-west1/s
module.test-vpc-module.module.subnets.google_compute_subnetwork.subnetwork["us-west1/s
module.test-vpc-module.module.subnets.google_compute_subnetwork.subnetwork["us-west1/s
module.test-vpc-module.module.subnets.google_compute_subnetwork.subnetwork["us-west1/s
gions/us-west1/subnetworks/subnet-03]
module.test-vpc-module.module.subnets.google_compute_subnetwork.subnetwork["us-west1/s
gions/us-west1/subnetworks/subnet-02]
module.test-vpc-module.module.subnets.google_compute_subnetwork.subnetwork["us-west1/s
gions/us-west1/subnetworks/subnet-01]

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

Understand how modules work

When using a new module for the first time, you must run either `terraform init` or `terraform get` to install the module. When either of these commands is run, Terraform will install any new modules in the `.terraform/modules` directory within your configuration's working directory. For local modules, Terraform will create a symlink to the module's directory. Because of this, any changes to local modules will be effective immediately, without your having to re-run `terraform get`.

1. Destroy the infrastructure you created:

`terraform destroy`

```
module.test-vpc-module.module.subnets.google_compute_subnetwork.sub
/subnetworks/subnet-03]
module.test-vpc-module.module.subnets.google_compute_subnetwork.sub
/subnetworks/subnet-02]
module.test-vpc-module.module.subnets.google_compute_subnetwork.sub
/subnetworks/subnet-01]
module.test-vpc-module.module.subnets.google_compute_subnetwork.sub
-west1/subnetworks/subnet-02, 10s elapsed]
module.test-vpc-module.module.subnets.google_compute_subnetwork.sub
-west1/subnetworks/subnet-03, 10s elapsed]
module.test-vpc-module.module.subnets.google_compute_subnetwork.sub
-west1/subnetworks/subnet-01, 10s elapsed]
module.test-vpc-module.module.subnets.google_compute_subnetwork.sub
module.test-vpc-module.module.subnets.google_compute_subnetwork.sub
module.test-vpc-module.module.subnets.google_compute_subnetwork.sub
module.test-vpc-module.module.vpc.google_compute_network.network: I
module.test-vpc-module.module.vpc.google_compute_network.network: S
s elapsed]
module.test-vpc-module.module.vpc.google_compute_network.network: S
s elapsed]
module.test-vpc-module.module.vpc.google_compute_network.network: I

Destroy complete! Resources: 4 destroyed.
student_00 7ce2281996c7@cloudshell:~/terraform-google-network/exam
```

Task 2. Build a module

In the last task, you used a module from the Terraform Registry to create a VPC network in Google Cloud. Although using existing Terraform modules correctly is an important skill, every Terraform practitioner will also benefit from learning how to create modules. We recommend that you create every Terraform configuration with the assumption that it may be used as a module, because this will help you design your configurations to be flexible, reusable, and composable.

As you may already know, Terraform treats every configuration as a module. When you run `terraform` commands, or use Terraform Cloud or Terraform Enterprise to remotely

run Terraform, the target directory containing Terraform configuration is treated as the root module.

In this task, you create a module to manage Compute Storage buckets used to host static websites.

Module structure

Terraform treats any local directory referenced in the source argument of a module block as a module. A typical file structure for a new module is:

```
$ tree minimal-module/  
.  
├── LICENSE  
├── README.md  
├── main.tf  
├── variables.tf  
└── outputs.tf
```

Note: None of these files are required or has any special meaning to Terraform when it uses your module. You can create a module with a single `.tf` file or use any other file structure you like.

Each of these files serves a purpose:

- `LICENSE` contains the license under which your module will be distributed. When you share your module, the `LICENSE` file will let people using it know the terms under which it has been made available. Terraform itself does not use this file.
- `README.md` contains documentation in markdown format that describes how to use your module. Terraform does not use this file, but services like the Terraform Registry and GitHub will display the contents of this file to visitors to your module's Terraform Registry or GitHub page.
- `main.tf` contains the main set of configurations for your module. You can also create other configuration files and organize them in a way that makes sense for your project.
- `variables.tf` contains the variable definitions for your module. When your module is used by others, the variables will be configured as arguments in the module block. Because all Terraform values must be defined, any variables that don't have a default value will become required arguments. A variable with a default value can also be provided as a module argument, thus overriding the default value.
- `outputs.tf` contains the output definitions for your module. Module outputs are made available to the configuration using the module, so they are often used to

pass information about the parts of your infrastructure defined by the module to other parts of your configuration.

Be aware of these files and ensure that you don't distribute them as part of your module:

- `terraform.tfstate` and `terraform.tfstate.backup` files contain your Terraform state and are how Terraform keeps track of the relationship between your configuration and the infrastructure provisioned by it.
- The `.terraform` directory contains the modules and plugins used to provision your infrastructure. These files are specific to an individual instance of Terraform when provisioning infrastructure, not the configuration of the infrastructure defined in `.tf` files.
- `*.tfvars` files don't need to be distributed with your module unless you are also using it as a standalone Terraform configuration because module input variables are set via arguments to the module block in your configuration.

Note: If you are tracking changes to your module in a version control system such as Git, you will want to configure your version control system to ignore these files. For an example, see this [.gitignore file](#) from GitHub.

Create a module

Navigate to your home directory and create your root module by constructing a new `main.tf` configuration file. Then create a directory called `modules` that contains another folder called `gcs-static-website-bucket`. You will work with three Terraform configuration files inside the `gcs-static-website-bucket` directory: `website.tf`, `variables.tf`, and `outputs.tf`.

1. Create the directory for your new module:

```
cd ~
```

```
touch main.tf
```

```
mkdir -p modules/gcs-static-website-bucket
```

```
cat: /home/student_00_7ce2281996c7: Is a directory
student_00_7ce2281996c7@cloudshell:~/terraform-google-network/examples/simple_project (qwiklabs-gcp-00-9569ae2370d3)$ cd ~
touch main.tf
mkdir -p modules/gcs-static-website-bucket
student_00_7ce2281996c7@cloudshell:~ (qwiklabs-gcp-00-9569ae2370d3)$ ls
main.tf  modules  README-cloudshell.txt  terraform-google-network
student_00_7ce2281996c7@cloudshell:~ (qwiklabs-gcp-00-9569ae2370d3)$
```

2. Navigate to the module directory and run the following commands to create three empty files:

```
cd modules/gcs-static-website-bucket
touch website.tf variables.tf outputs.tf
```

3. Inside the gcs-static-website-bucket directory, create a file called README.md with the following content:

```
# GCS static website bucket
This module provisions Cloud Storage buckets configured for static website hosting.
```

```
student_00_7ce2281996c7@cloudshell:~/modules/gcs-static-website-bucket (qwiklabs-gcp-00-9569ae2370d3)$ ls
outputs.tf  README.md  variables.tf  website.tf
student_00_7ce2281996c7@cloudshell:~/modules/gcs-static-website-bucket (qwiklabs-gcp-00-9569ae2370d3)$ cat README.md
# GCS static website bucket
This module provisions Cloud Storage buckets configured for static website hosting.
student_00_7ce2281996c7@cloudshell:~/modules/gcs-static-website-bucket (qwiklabs-gcp-00-9569ae2370d3)$
```

Note: Choosing the correct license for your modules is out of the scope of this lab. This lab will use the Apache 2.0 open source license.

4. Create another file called LICENSE with the following content:

```
Licensed under the Apache License, Version 2.0 (the "License");
you may not use this file except in compliance with the License.
You may obtain a copy of the License at
    http://www.apache.org/licenses/LICENSE-2.0
Unless required by applicable law or agreed to in writing, software
distributed under the License is distributed on an "AS IS" BASIS,
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
See the License for the specific language governing permissions and
limitations under the License.
```

Note: Neither of these files is required or used by Terraform. Having them is a best practice for modules that might be shared with others.

```
student_00_7ce2281996c7@cloudshell:~/modules/gcs-static-website-bucket (qwiklabs-gcp-00-9569ae2370d3)$ cat LICENSE
Licensed under the Apache License, Version 2.0 (the "License");
you may not use this file except in compliance with the License.
You may obtain a copy of the License at
    http://www.apache.org/licenses/LICENSE-2.0
Unless required by applicable law or agreed to in writing, software
distributed under the License is distributed on an "AS IS" BASIS,
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
See the License for the specific language governing permissions and
limitations under the License.
student_00_7ce2281996c7@cloudshell:~/modules/gcs-static-website-bucket (qwiklabs-gcp-00-9569ae2370d3)$
```

Your current module directory structure should now look like this:

```
main.tf
modules/
└─ gcs-static-website-bucket
    └─ LICENSE
```

```
|— README.md
|— website.tf
|— outputs.tf
|— variables.tf
```

5. Add this Cloud Storage bucket resource to your `website.tf` file inside the `modules/gcs-static-website-bucket` directory:

```
resource "google_storage_bucket" "bucket" {
  name                = var.name
  project             = var.project_id
  location            = var.location
  storage_class       = var.storage_class
  labels              = var.labels
  force_destroy       = var.force_destroy
  uniform_bucket_level_access = true
  versioning {
    enabled = var.versioning
  }
  dynamic "retention_policy" {
    for_each = var.retention_policy == null ? [] : [var.retention_policy]
    content {
      is_locked          = var.retention_policy.is_locked
      retention_period = var.retention_policy.retention_period
    }
  }
  dynamic "encryption" {
    for_each = var.encryption == null ? [] : [var.encryption]
    content {
      default_kms_key_name = var.encryption.default_kms_key_name
    }
  }
  dynamic "lifecycle_rule" {
    for_each = var.lifecycle_rules
    content {
      action {
        type = lifecycle_rule.value.action.type
        storage_class = lookup(lifecycle_rule.value.action,
"storage_class", null)
      }
      condition {
```

```

        age = lookup(lifecycle_rule.value.condition,
"age", null)
        created_before = lookup(lifecycle_rule.value.condition,
"created_before", null)
        with_state = lookup(lifecycle_rule.value.condition,
"with_state", null)
        matches_storage_class = lookup(lifecycle_rule.value.condition,
"matches_storage_class", null)
        num_newer_versions = lookup(lifecycle_rule.value.condition,
"num_newer_versions", null)
    }
}
}
}

```

The provider documentation is [GitHub](#).

6. Navigate to the `variables.tf` file in your module and add the following code:

```

variable "name" {
    description = "The name of the bucket."
    type       = string
}
variable "project_id" {
    description = "The ID of the project to create the bucket in."
    type       = string
}
variable "location" {
    description = "The location of the bucket."
    type       = string
}
variable "storage_class" {
    description = "The Storage Class of the new bucket."
    type       = string
    default    = null
}
variable "labels" {
    description = "A set of key/value label pairs to assign to the bucket."
    type       = map(string)
    default    = null
}

```



```

variable "bucket_policy_only" {
    description = "Enables Bucket Policy Only access to a bucket."
    type        = bool
    default     = true
}
variable "versioning" {
    description = "While set to true, versioning is fully enabled for this
bucket."
    type        = bool
    default     = true
}
variable "force_destroy" {
    description = "When deleting a bucket, this boolean option will delete
all contained objects. If false, Terraform will fail to delete buckets
which contain objects."
    type        = bool
    default     = true
}
variable "iam_members" {
    description = "The list of IAM members to grant permissions on the
bucket."
    type = list(object({
        role    = string
        member  = string
    }))
    default = []
}
variable "retention_policy" {
    description = "Configuration of the bucket's data retention policy for
how long objects in the bucket should be retained."
    type = object({
        is_locked        = bool
        retention_period = number
    })
    default = null
}
variable "encryption" {
    description = "A Cloud KMS key that will be used to encrypt objects
inserted into this bucket"
    type = object({

```

```

        default_kms_key_name = string
    })
    default = null
}
variable "lifecycle_rules" {
    description = "The bucket's Lifecycle Rules configuration."
    type = list(object({
        # Object with keys:
        # - type - The type of the action of this Lifecycle Rule. Supported
values: Delete and SetStorageClass.
        # - storage_class - (Required if action type is SetStorageClass) The
target Storage Class of objects affected by this Lifecycle Rule.
        action = any
        # Object with keys:
        # - age - (Optional) Minimum age of an object in days to satisfy this
condition.
        # - created_before - (Optional) Creation date of an object in RFC 3339
(e.g. 2017-06-13) to satisfy this condition.
        # - with_state - (Optional) Match to live and/or archived objects.
Supported values include: "LIVE", "ARCHIVED", "ANY".
        # - matches_storage_class - (Optional) Storage Class of objects to
satisfy this condition. Supported values include: MULTI_REGIONAL,
REGIONAL, NEARLINE, COLDLINE, STANDARD, DURABLE_REDUCED_AVAILABILITY.
        # - num_newer_versions - (Optional) Relevant only for versioned
objects. The number of newer versions of an object to satisfy this
condition.
        condition = any
    })))
    default = []
}

```

7. Add an output to your module in the `outputs.tf` file inside your module

```

output "bucket" {
    description = "The created storage bucket"
    value      = google_storage_bucket.bucket
}

```

Like variables, outputs in modules perform the same function as they do in the root module but are accessed in a different way. A module's outputs can be accessed as

read-only attributes on the module object, which is available within the configuration that calls the module.

8. Return to the `main.tf` in your **root directory** and add a reference to the new module:

```
module "gcs-static-website-bucket" {
  source = "../modules/gcs-static-website-bucket"
  name    = var.name
  project_id = var.project_id
  location = "us-east1"
  lifecycle_rules = [{
    action = {
      type = "Delete"
    }
    condition = {
      age      = 365
      with_state = "ANY"
    }
  }]
}
```

9. In your home directory, create an `outputs.tf` file for your root module:

```
cd ~
```

```
touch outputs.tf
```

10. Add the following code in the `outputs.tf` file:

```
output "bucket-name" {
  description = "Bucket names."
  value       = "module.gcs-static-website-bucket.bucket"
}
```

11. IN your home directory, create a `variables.tf` file:

```
touch variables.tf
```

12. Add the following code to the `variables.tf` file and define the variables `project_id` and `name`:

```
variable "project_id" {
  description = "The ID of the project in which to provision resources."
  type        = string
  default     = "FILL IN YOUR PROJECT ID HERE"
}

variable "name" {
```

```
description = "Name of the buckets to create."
type        = string
default     = "FILL IN YOUR (UNIQUE) BUCKET NAME HERE"
}
```

Note: The name of your storage bucket must be globally unique. Using your name and the date is usually a good way to create a unique bucket name. You can also use your Project ID.

Install the local module

Whenever you add a new module to a configuration, Terraform must install the module before it can be used. Both the `terraform get` and `terraform init` commands will install and update modules. The `terraform init` command will also initialize backends and install plugins.

1. Install the module:

```
terraform init
```

2. Provision your bucket:

```
terraform apply
```

```

+ id                = (known after apply)
+ labels            = null
+ lifecycle_rule    = []
+ location          = "US-CENTRAL1"
+ logging           = []
+ name              = "qwiklabs-gcp-00-9569ae2370d3"
+ project           = "qwiklabs-gcp-00-9569ae2370d3"
+ public_access_prevention = (known after apply)
+ requester_pays    = null
+ retention_policy   = []
+ self_link         = (known after apply)
+ storage_class      = "STANDARD"
+ timeouts          = null
+ uniform_bucket_level_access = true
+ url               = (known after apply)
+ versioning        = [
  + {
    + enabled = true
  },
]
+ website           = (known after apply)
}

```

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_storage_bucket.bucket: Creating...

google_storage_bucket.bucket: Creation complete after 3s [id=qwiklabs-gcp-00-9569ae2370d3]

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

Upload files to the bucket

You have now configured and used your own module to create a static website. You may want to visit this static website. Right now there is nothing inside your bucket, so there is nothing to see at the website. In order to see any content, you will need to upload objects to your bucket. You can upload the contents of the www directory in the GitHub repository.

1. Download the sample contents to your home directory:

```
cd ~
```

```
curl
```

```
https://raw.githubusercontent.com/hashicorp/learn-terraform-modules/master/modules/aws-s3-static-website-bucket/www/index.html > index.html
```

```
curl
```

```
https://raw.githubusercontent.com/hashicorp/learn-terraform-modules/blob/master/modules/aws-s3-static-website-bucket/www/error.html > error.html
```

2. Copy the files over to the bucket, replacing YOUR-BUCKET-NAME with the name of your storage bucket:

```
gsutil cp *.html gs://YOUR-BUCKET-NAME
```

3. In a new tab in your browser, go to the website
<https://storage.cloud.google.com/YOUR-BUCKET-NAME/index.html>,
replacing YOUR-BUCKET-NAME with the name of your storage bucket.

Clean up the website and infrastructure

Lastly, you will clean up your project by destroying the infrastructure you just created.

- Destroy your Terraform resources:

```
terraform destroy
```

After you respond to the prompt with yes, Terraform will destroy all of the resources you created by following this lab.

In this lab, you learned the foundations of Terraform modules and how to use a pre-existing module from the Registry. You then built your own module to create a static website hosted on a Cloud Storage bucket. In doing so, you defined inputs, outputs, and variables for your configuration files and learned the best-practices for building modules.