Infrastructure as Code: Terraform

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- Cloud infrastructure provisioning
- Infrastructure as Code
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- Terraform: Resources & modules
- Terraform: Providers
- Terraform: State & Terraform workflow
- Terraform: State Management

Historical infrastructure provisioning

> Buy, configure & operate the servers.

> Setup everything yourself.

> Plan ahead.

Historical infrastructure provisioning (1/2)

In the **pre-cloud** era, companies used to own their datacenter or sometimes share it with other companies.

These companies:

- Rented or owned the **building**.
- **Bought** the servers, disks, network appliances and **every** needed piece of equipment to run their workloads.
- Employed professionals to **install, configure and maintain** these setups.

Historical infrastructure provisioning (2/2)

Although this approach gives **complete control** over the infrastructure, it has a few **drawbacks** such as:

- **Getting** new equipment **takes time** (choose, buy, ship or transport, install, etc).
- **Planning** for capacity has to be done **in advance** or accept **additional costs** to avoid resources shortage.
- **Focus** on the **infrastructure** issues **instead** of the actual **business** of the company.
- **Managing** infrastructure costs is not very simple.

Cloud infrastructure provisioning

> Focus on your business, let us handle the rest.

Cloud infrastructure provisioning

Cloud providers came in with a few promises that challenged the old way of managing infrastructure:

- Resources are up and running **right after** being requested
- Resources can be downgraded or removed **at any time**
- **Services** are provided instead of separate resources or appliances (Kubernetes, BigQuery, Pub/Sub, etc)
- Billing analysis is provided in **real time** and const estimation on a **monthly basis** are available.
- **API** based system alongside manual setup of services through a **UI**.

Infrastructure as Code

> Why should you use a Version control System for your infrastrcuture ?

Infrastructure as Code

Cloud infrastructure provisioning enabled **fast** and **frequent** infrastructure updates.

- **What** changed since last time ?
- **Who** made the changes ?
- **How** can we go back to a given stable state ?

Terraform: HCL & declarative definition

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Terraform is one of the options for managing infrastructure as code.

Terraform code is writen in Hashicorp Configuration Language, with Hashicorp being the company behind products such as **Terraform** & **Vault**.

Terraform uses a declarative approach. Instead of focusing on how to do things (the algorithm) we state what we would like to have. **Terraform** is responible of how to create, update or delete it.

Terraform: Project structure

Typical Terraform projects contain `.tf` files which contain source code and `.tfvars` files that contain variable values.

Typical Terraform projects contain the following files:

- `main.tf` : contains resources declaration.
- `variables.tf` : contains declaration of variables that can be used.
- `something.tfvars` : contains values for the variables for example `dev.tfvars` , `staging.tfvars` , etc.
- `outputs.tf` : contains outputs of the terraform that was run
- `providers.tf` : contains providers configuration.

Terraform: Resources & modules

Terraform: Resources

Resources are used to tell **Terraform** what needs to exist.

For example, here is a resource definition for a **Google Cloud Storage**:

```
resource "google_storage_bucket" "tj-bucket" {
  name          = "tj-bucket"
  location      = "EUROPE-WEST1"
}
```

Terraform: Modules

Modules can be viewed as a group of resources definition.

Modules are to be used to adress some recurrent use case.

For instance, if we suppose that an application needs a kubernetes cluster, a pub/sub and a google cloud storage, then a module called `my-app` can be created. In this way, instead of declaring each resource on its own, we would call the module.

Call to module is similar to resource declaration. Here is an example:

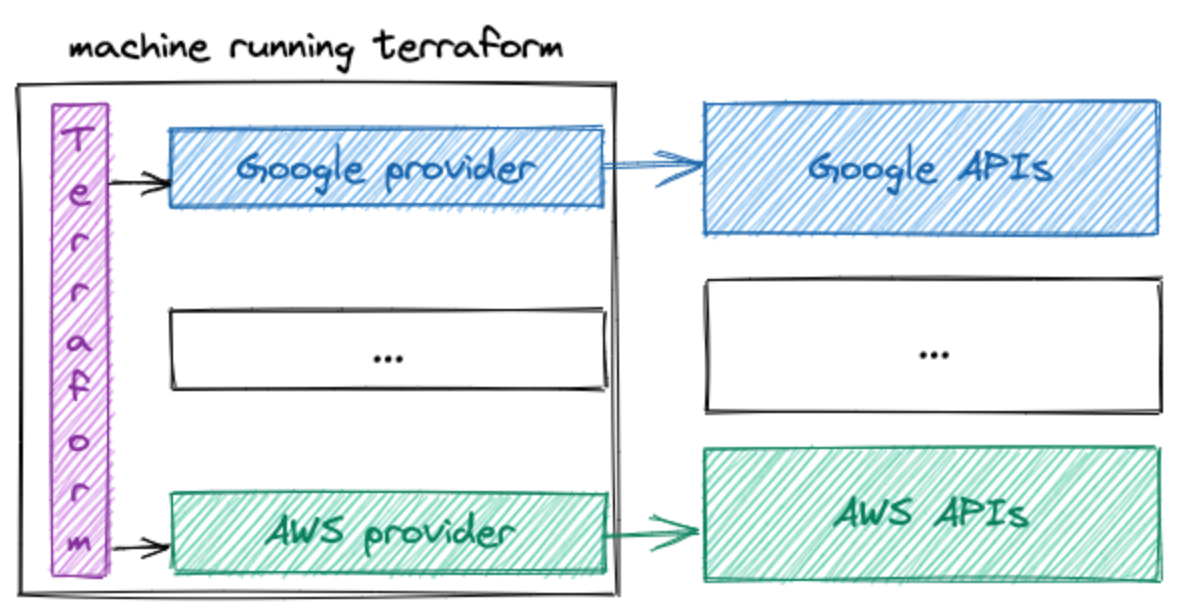
```
module "application" {
  source = "git::ssh://git@github.com/my-repo/terraform-modules.git//app-type-1"

  app_name     = var.app_name
  app_location = var.app_location
}
```

Terraform: Providers

Terraform: Providers

Providers are used by **Terraform** to communicate with **APIs** of the different service providers such as **GCP** or **AWS**



Providers can be bypassed by calling the API if you do not want to use terraform for your infrastructure as code. However, using **terraform** with **providers** is very convenient.

Terraform: State & deployment cycle

Terraform: State

Terraform uses a state file to keep track of the infrastructure.

The state file enables Terraform to only apply the delta or difference between the desired and current state of the infrastructure:

- Declared resources that exist in the state will only be modified if their configuration has changed.
- Declared resources that are not in the state will be created.
- No longer declared resources that exist in the state will be removed.

It is highly recommended to store the state file on a remote backend such as a google cloud storage.

Terraform: Terraform workflow

Terraform workflow goes as follows:

1. `terraform init` : this command retrieves the state file from the backend and downloads any missing providers or modules.
2. `terraform plan` : this command first reads the state file and tries to refresh the state by getting the current state of any listed resources. Then it shows the creations, modifications & deletion to be done.
3. `terraform apply` : this command first applies the changes defined by the `plan` command. Then it updates the state file.

Additional steps can be added for better control over the terraform code, such as, `terraform validate` (to be done after `init`) and `terraform fmt` which is a linter.

Terraform: Terraform plan

An extract from a Terraform plan looks as follows:

```
provider_name_resource_name.chosen_resource_id: Refreshing state... [id=resource-id]
# other refreshes here were removed to keep the example simple

Terraform used the selected providers to generate the following execution plan. Resource actions are indicated with the
following symbols:
  + create
  ~ update in-place
  - delete

Terraform will perform the following actions:

  # provider_name_resource_name.chosen_resource_id will be created
  ~ resource "provider_name_resource_name" "chosen_resource_id" {
      id         = "resource-id"
      ~ some_list_attribute    = [
          - "value-0",
          + "value-1",
          + "value-2",
        ]
    }

  # other changes here were removed to keep the example simple

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

Terraform: State Management