Infrastructure as Code

What is IaC, Provision and Configuration Management tools

Technical Trainers

SoftUni Team

Software University

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#Dev-Ops

Table of Content

Infrastructure as Code

Automating Infrastructure Management Using Code

What is IaC?

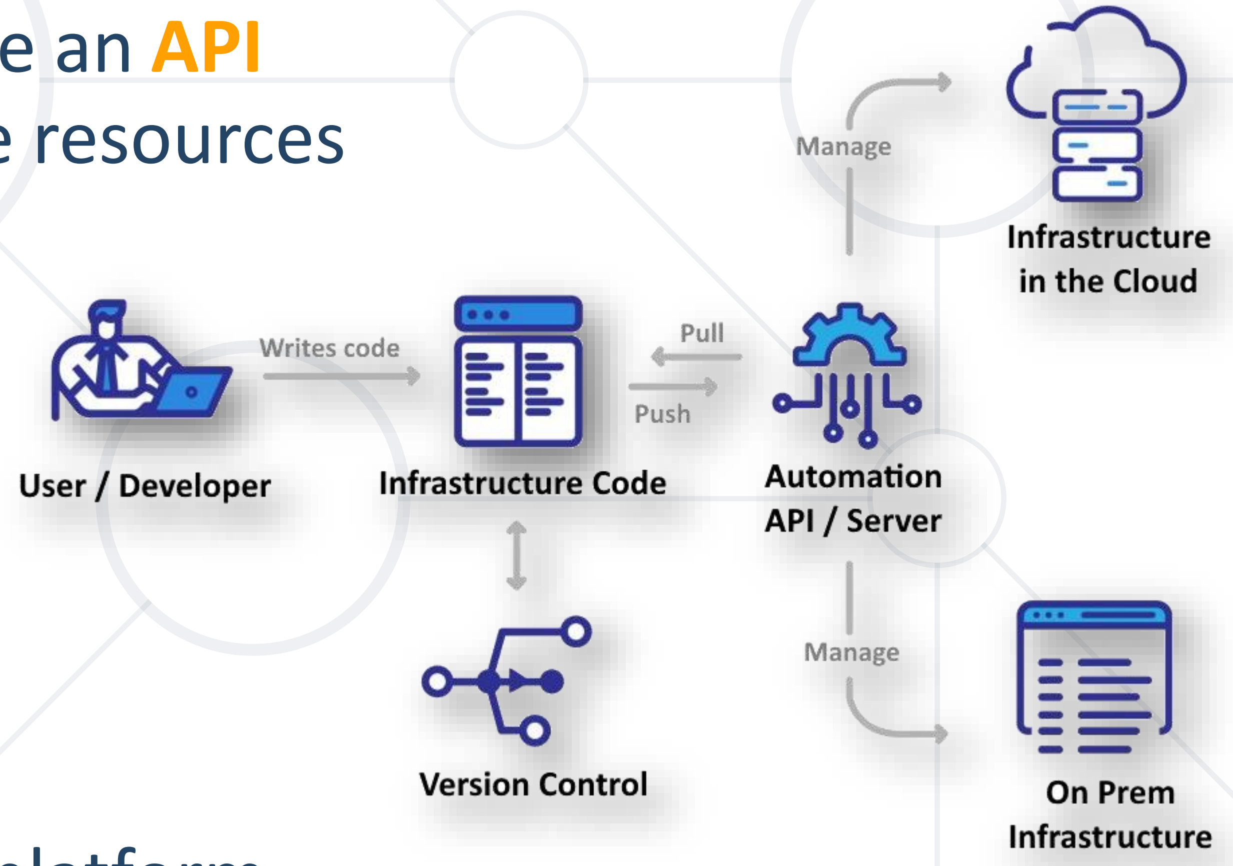
- **Infrastructure as Code** (**IaC**) is the managing and provisioning of **infrastructure through code** instead of through manual processes
  - As VMs, networks, OS servers, storage, etc.
- **IaC** involves
  - Writing **code** to define the desired state of an **infrastructure environment**
  - Using **tools** to **automatically** deploy and configure the environment based on the code

IaC Configuration Files

- **IaC** is a form of configuration management that **codifies infrastructure resources** into text files
- **Configuration files** are created with your infrastructure specifications
  - Should be **version controlled** and **tested** (unit, integration, ... tests)
  - Ensure that you provision the **same environment every time**
  - Allow you to divide your infrastructure into **modular components** and combine them through automation
  - Should contain always **up-to-date infrastructure documentation**

What Do You Need for IaC?

- **Remote accessible hosting** or **IaaS cloud hosting platform**
  - IaC tools connect and modify remote host
  - IaaS cloud hosting platforms have an **API** for modification of infrastructure resources
- **Provisioning tool**
  - Automates the infrastructure deploy and management
- **Configuration management tool**
  - Manages infrastructure state
- **Version control system**
  - Stores text files used by the CM platform

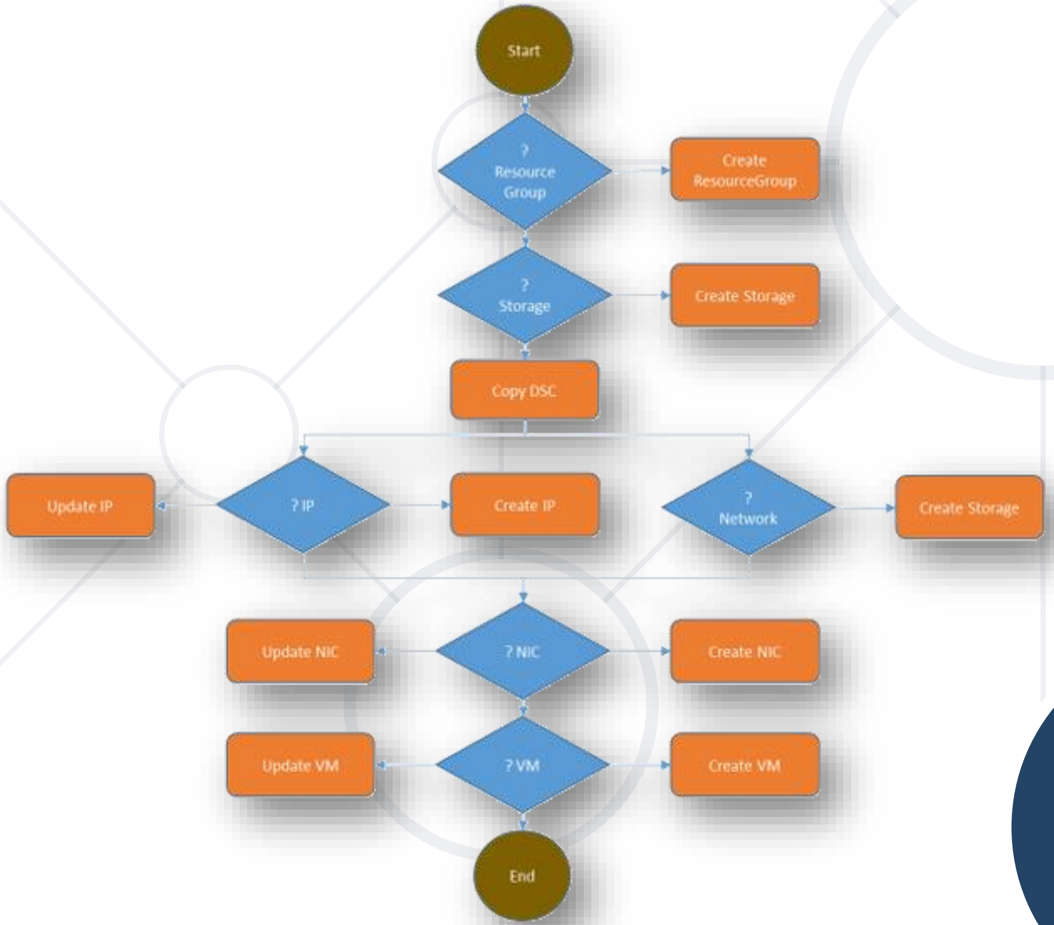


Approaches to IaC

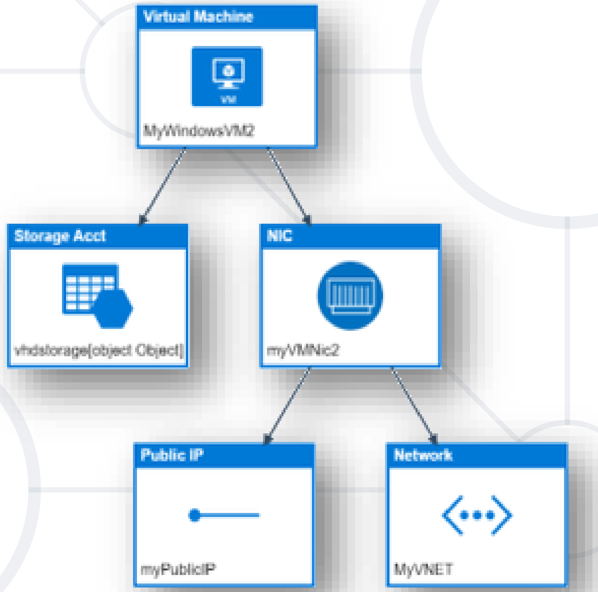
- **Imperative approach**
  - Tell the system **how** to do something every step of the way
  - Defines the **specific commands** to be executed in a **specific order** for the **desired configuration**
- **Declarative approach**
  - Tell the system **what** you want and let it figure out how to do it
  - Defines the **desired state** of the **system** – resources, their properties and an IaC tool for configuration

Imperative vs Declarative Approach

- Imperative Approach



- Declarative Approach



IaC Tools

- The primary goal of **IaC tools** is to **bring the infrastructure component** to the **desired state** declared by the user
- **IaC tools** fall into two categories
  - **Infrastructure provisioning tools**
    - Create infrastructure components
  - **Configurations management tools**
    - Configure provisioned servers

Infrastructure Provisioning Tools

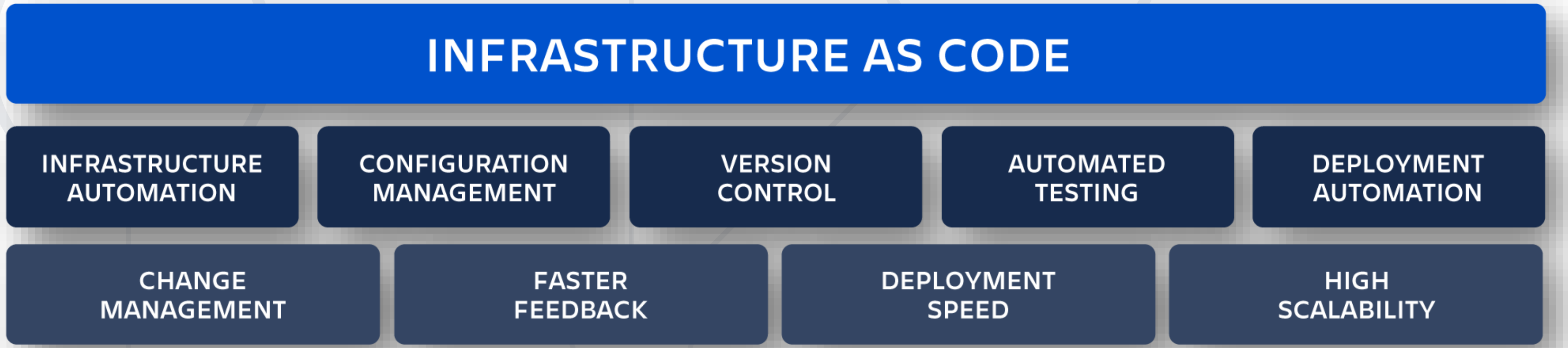
- **Infrastructure provisioning**
  - Create infrastructure resources like virtual servers, storage, networking, cloud managed services, etc.
- Primary goal
  - **Keep the infrastructure in its desired state** and reproduce or update it
- Tools
  - Terraform, AWS Cloudformation, Azure Resource Manager (ARM) Templates, Pulumi
- They can also **trigger CM tools**

Configuration Management Tools

- **Configuration management**
  - Configuring infrastructure resources
    - e.g., configuring a server with required applications or configuring a firewall device
- Primary goal
  - **Configure the server**
- Tools
  - Ansible, Chef, Puppet, SaltStack, etc.
- In **cloud environments**, tools use an **API-based dynamic inventory** to get the server details

IaC Benefits for DevOps

- **IaC** is an important part of implementing **DevOps practices**
  - **Version control**, **test** and **deploy** of infrastructure code changes
  - **Improved collaboration** – Ops team can participate in writing IaC templates together with Dev team, as IaC uses simple, text-based files
  - **Automation** of creation and management of infrastructure resources
  - **Consistency and reliability across environments** is achieved as IaC generates the same environment every time



Terraform

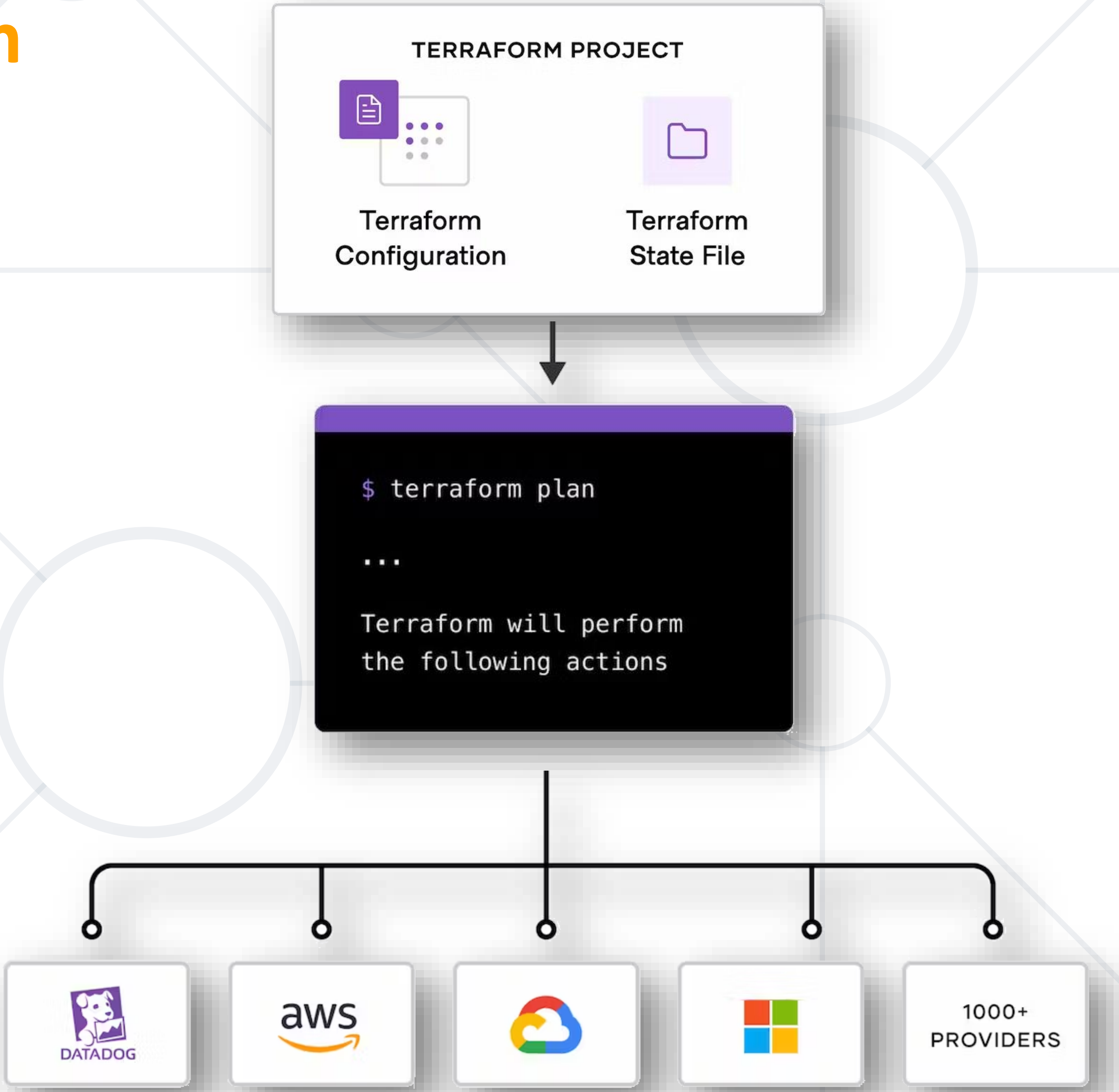
IaC Tool for Infrastructure Provisioning Automation

Terraform Overview

- Open-source **IaC** tool
  - Used for **provisioning**, **managing** and **deploying** infrastructure resource
  - Written in Golang
- Allows managing infrastructure for applications across **multiple cloud providers** – AWS, Azure, GCP, etc.
  - Through their application programming interfaces (**APIs**)
- Uses **declarative syntax** – you define desired infrastructure state, Terraform figures out the best way to achieve it

Terraform Workflow

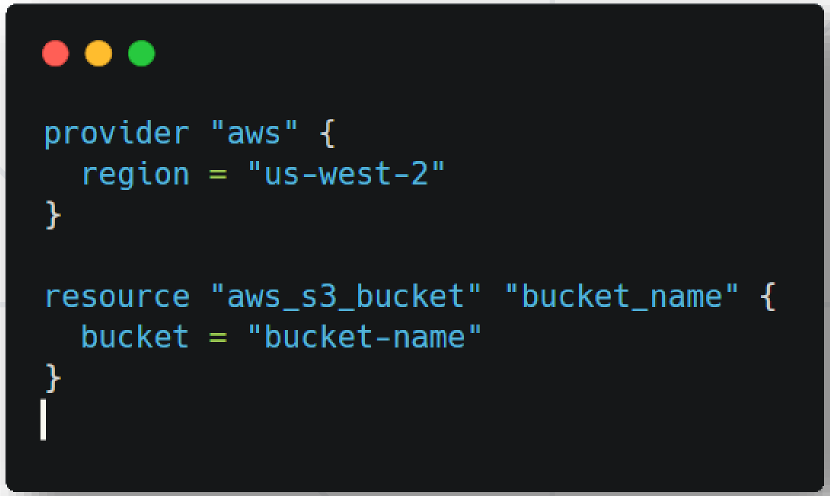
- To **deploy infrastructure with Terraform**
  - Scope – **identify the infrastructure** for your project
  - Author – define **infrastructure** in **configuration files**
  - Initialize – **install the plugins** Terraform needs to manage the infrastructure
  - Plan – **preview the changes** Terraform will make to match your configuration
  - Apply – Terraform **provisions the infrastructure** and **updates state file**



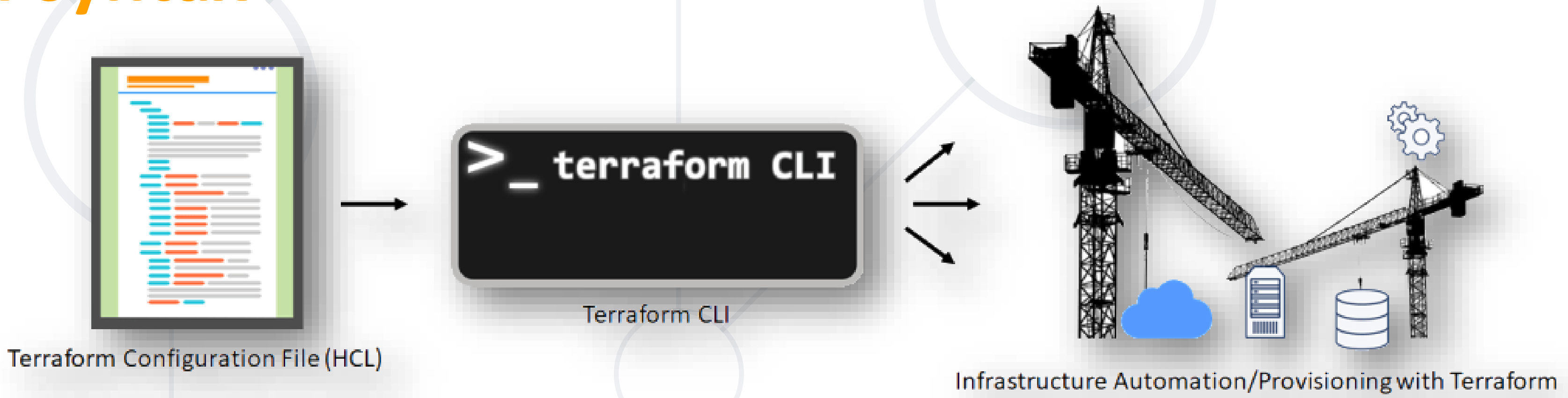
```
$ terraform plan

...

Terraform will perform
the following actions
```

Terraform Configuration File

- To **create an infrastructure**, a **Terraform Configuration file** (**.tf**) should be executed
- Executed with the help of **Terraform CLI** or other executors
- Written in HashiCorp Configuration Language (**HCL**) or **JSON syntax**

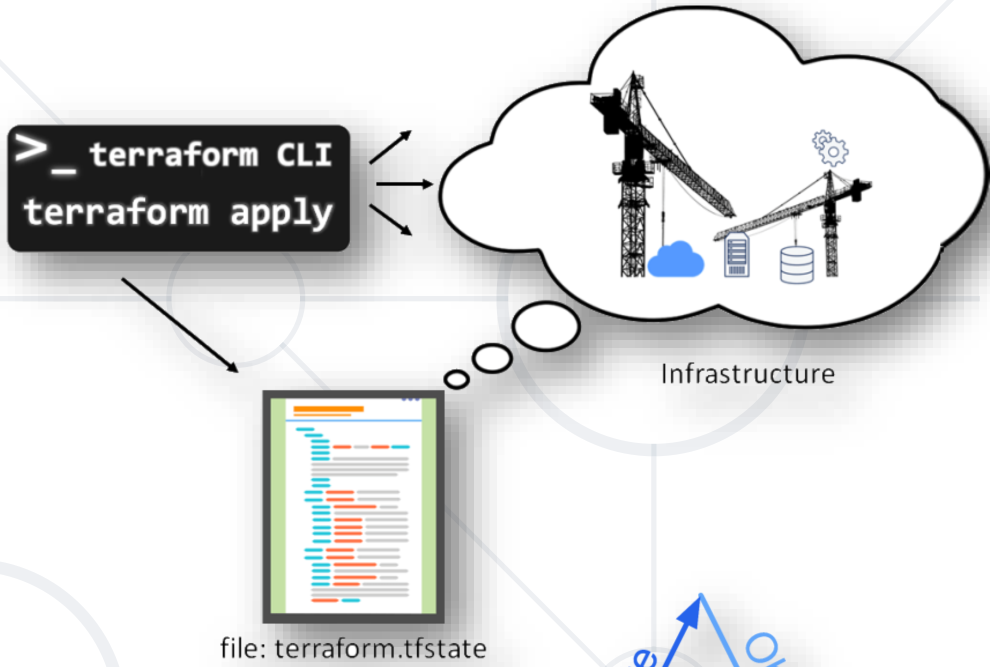


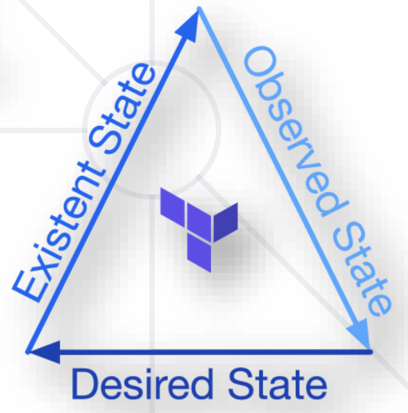
```
provider "aws" {
  region = "us-west-2"
}

resource "aws_s3_bucket" "bucket_name" {
  bucket = "bucket-name"
}
```


>_ terraform CLI
Terraform Configuration File (HCL)
Terraform CLI
Infrastructure Automation/Provisioning with Terraform

Terraform State File

- Terraform stores **state** about managed infrastructure and configuration
- **State** allows us to have a point-in-time **view of our infrastructure** and **compare**
  - **Desired state** (our code)
  - **Perceived state** (the state file)
  - **Reality** (the resources within the platform / service)
- This state is stored in a **local file** "**terraform.tfstate**"
- State file is recommended to be **kept in cloud**
- State file format is **JSON**, but should not be edited directly





Live Demo

Installing Terraform

Live Demo

Terraform and Docker:
Provision a NGINX Server

Configuration Management Tools

Ansible

- Open-source infrastructure **automation tool**
  - Written in Python
- Focuses on **security** and **reliability**
  - Uses OpenSSH
- Easy to read and write
  - Uses **YAML**
  - Structured
- **Agentless**
  - No agents, repositories, etc.

Ansible – Key Features

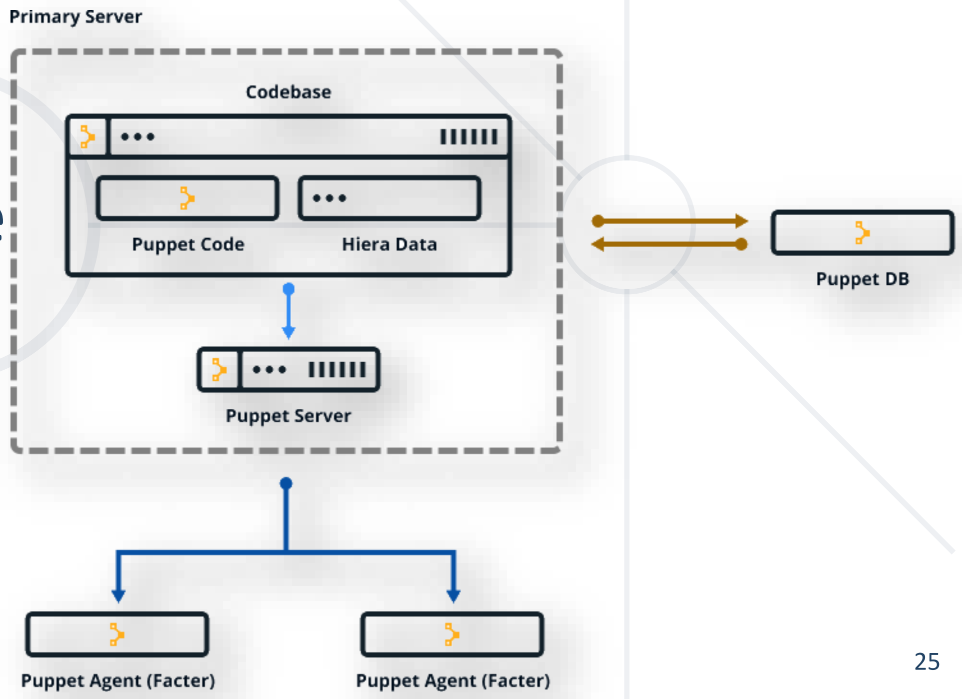
- Powerful tool for **managing Infrastructure as Code**
- **Declarative**
- **Idempotent**
  - Run an operation multiple times, without changing the initial state of the application
- Three major **use cases**
  - Inventory (Provision)
  - Configuration management
  - Application deployment

Puppet

- Configuration management tool for servers
  - Ensures all systems are configured to the desired states
- Also used as a deployment tool
- Uses server-agent model
- Configurations are written in Puppet code
  - Ruby DSL
- Open Source and Enterprise

Puppet – Platform

- **Puppet Server**
  - Controls configuration for one or more managed nodes
  - Communicate via HTTPS with the agents
  - Has a built-in certificate authority
  - Runs an agent to configure itself
- **Puppet Agent**
  - **Facter** → gather information about a node
  - **Hiera** → separate the data from the code
- **Puppet DB**
  - Stores facts, catalog, reports, etc.



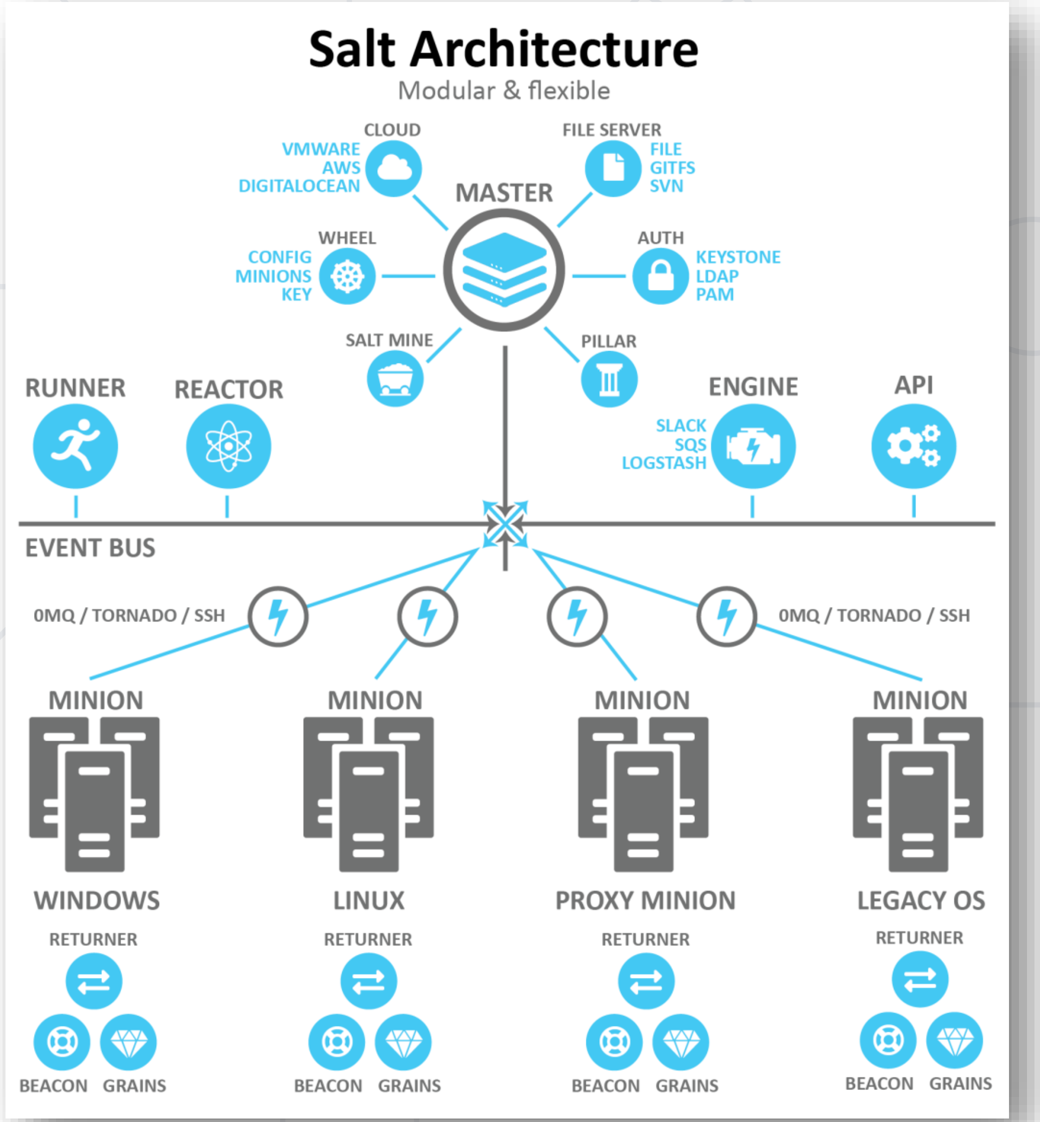
SaltStack

- Management tool
  - Used for configuration management, data-driven orchestration and remote execution
- Two operation modes
  - With agents (minions)
  - Agent-less
- Management instructions in YAML

Salt Master

- **Salt master**
  - The machine that **controls** the infrastructure and dictates policies for the servers it manages
  - Operates as
    - A **repository** for **configuration data**
    - A **control center**
      - Initiates **remote commands**
      - Ensures the **state** of other machines

General Salt Architecture



Chef

- Configuration Management tool
  - Written in Ruby and Erlang
  - Uses pure-Ruby DSL
- Works with system configuration "recipes"
- Used for configuring and maintaining servers
- Can be integrated with cloud-based platforms to automatically provision and configure new machines
- Chef Infra → configure and manage infrastructure

Chef Infra

- Policy-based **configuration management** tool
  - Define and enforce desired state of systems
- Uses the **master-agent** model
- "**Recipes**" are contained in "**cookbooks**"
  - Manage configuration, software installations and system updates

Summary

- **Infrastructure as Code** (**IaC**) uses DevOps practices and versioning with a descriptive model to **define** and **deploy infrastructure**
- **Terraform** is an IaC **provisioning** tool used to create infrastructure
- **Ansible**, **Puppet**, **Salt** and **Chef** are **configuration management** tools used to configure provisioned servers

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