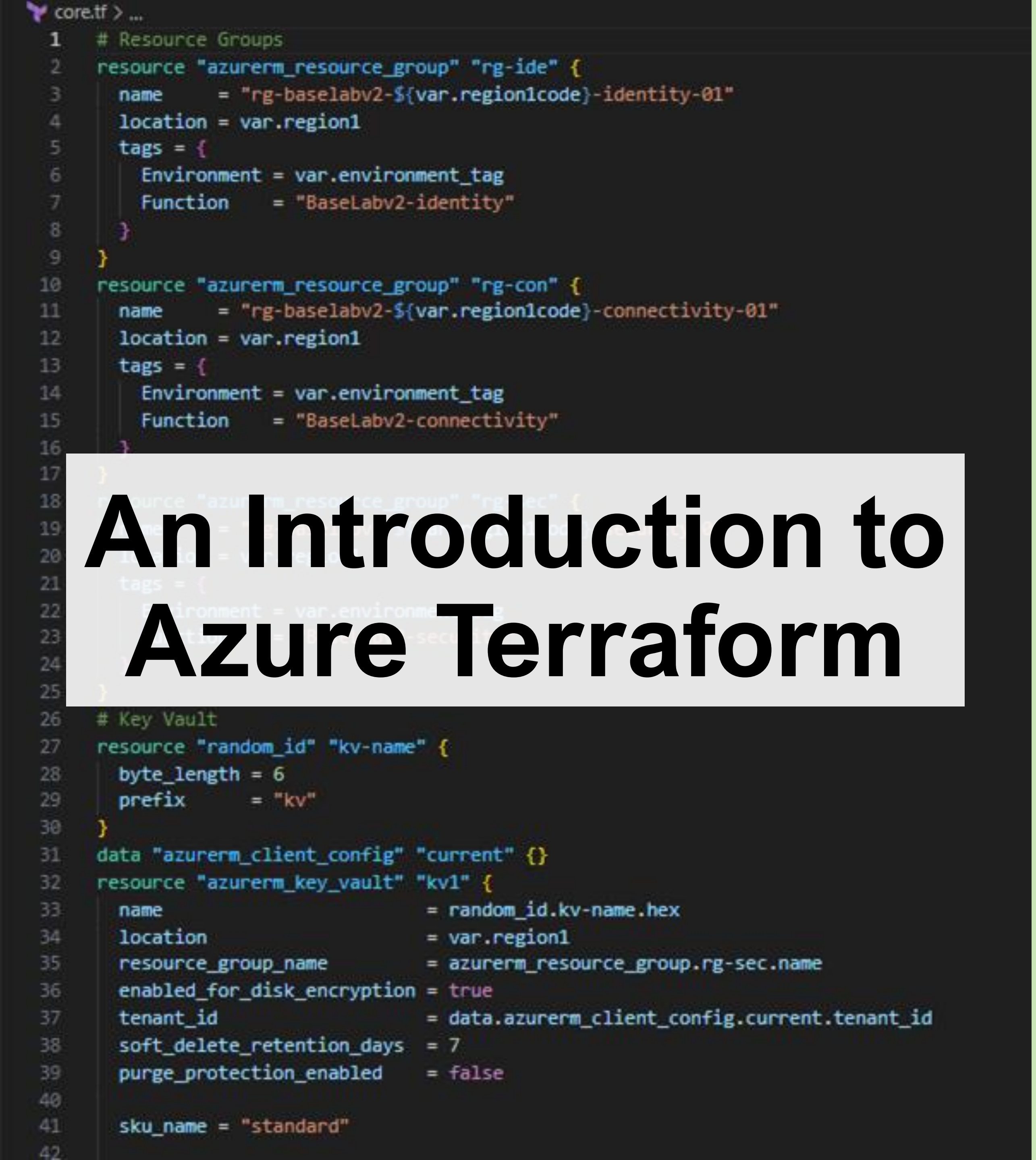
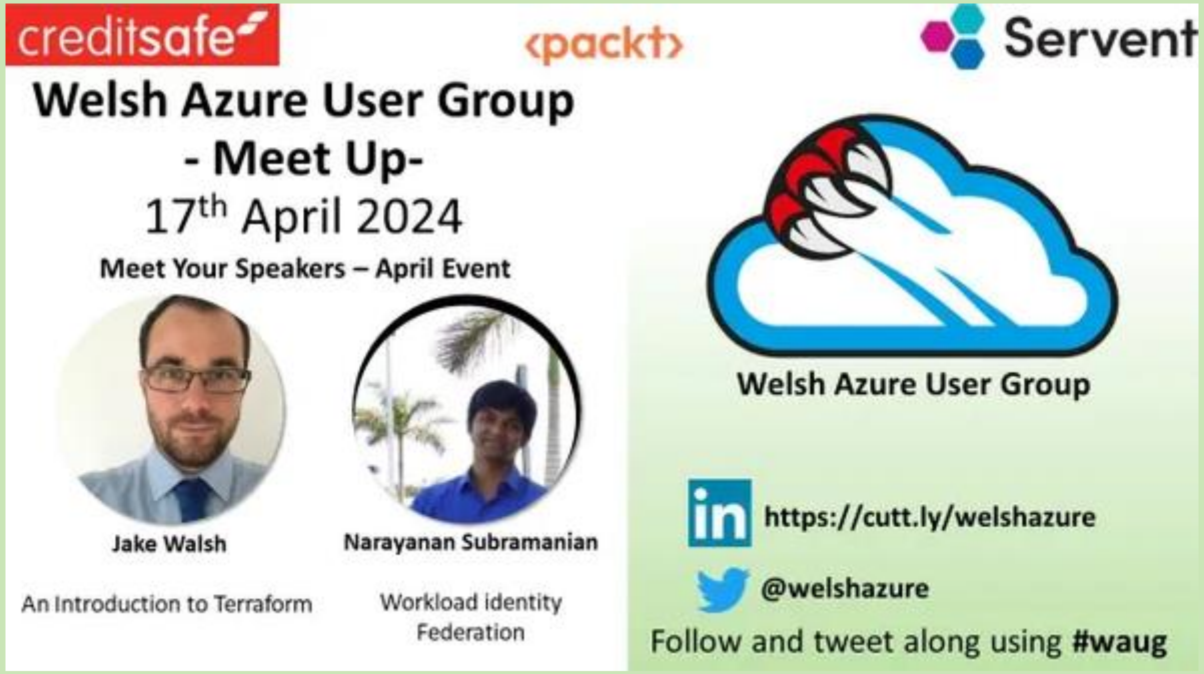


```
core.tf > ...
# Resource Groups
resource "azurerm_resource_group" "rg-ide" {
  name     = "rg-baselabv2-${var.region1code}-identity-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-identity"
  }
}
resource "azurerm_resource_group" "rg-con" {
  name     = "rg-baselabv2-${var.region1code}-connectivity-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-connectivity"
  }
}
[illegible]
}
# Key Vault
resource "random_id" "kv-name" {
  byte_length = 6
  prefix      = "kv"
}
data "azurerm_client_config" "current" {}
resource "azurerm_key_vault" "kv1" {
  name                        = random_id.kv-name.hex
  location                    = var.region1
  resource_group_name         = azurerm_resource_group.rg-sec.name
  enabled_for_disk_encryption = true
  tenant_id                   = data.azurerm_client_config.current.tenant_id
  soft_delete_retention_days  = 7
  purge_protection_enabled    = false

  sku_name = "standard"
```

An Introduction to Azure Terraform



creditsafe ‹packt› Servent

Welsh Azure User Group
- Meet Up-
17th April 2024
Meet Your Speakers – April Event

Jake Walsh
An Introduction to Terraform

Narayanan Subramanian
Workload identity Federation

Welsh Azure User Group

https://cutt.ly/welshazure
@welshazure
Follow and tweet along using **#waug**

Please note – the views/opinions in this presentation are entirely my own. This presentation will not be kept updated after the April Welsh Azure User Group Meeting (April 2024 – so may **be outdated if downloaded afterwards.**

If in any doubt, please check latest documentation and Links for updated info!

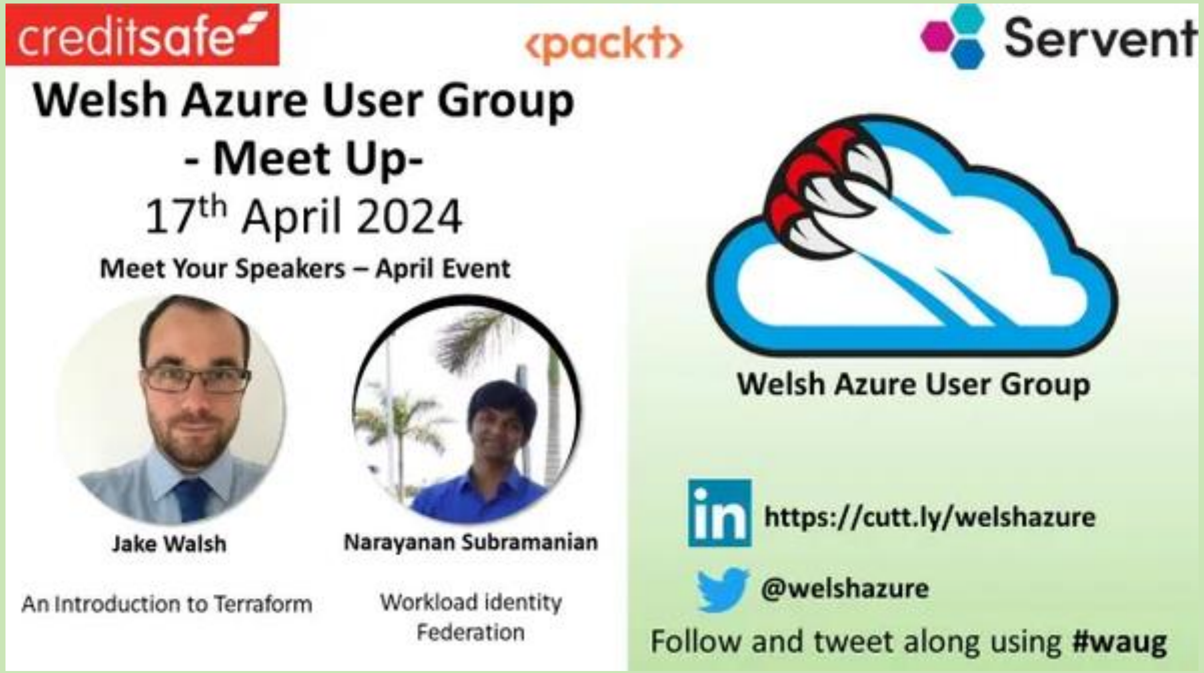
Hello!

Jake Walsh

Senior Solution Architect @ CDW UK

@jakewalsh90
jakewalsh.co.uk

Please note – the views/opinions in this presentation are entirely my own. If in any doubt, please check latest documentation etc!



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Welsh Azure User Group
- Meet Up-
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Meet Your Speakers – April Event

Jake Walsh	Narayanan Subramanian
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Welsh Azure User Group

https://cutt.ly/welshazure

@welshazure

Follow and tweet along using **#waug**

Microsoft® MVP Most Valuable Professional

HashiCorp AMBASSADOR 2024

CTA Citrix Technology Advocate

Session Goals

- **What** is Infrastructure as Code – and **why** use it?
- What is Azure **Terraform**?
- How Terraform Works & Why it's relevant
- **Getting Started** – Installation
- Code Samples / Demo

What is Infrastructure as Code (IAC)?

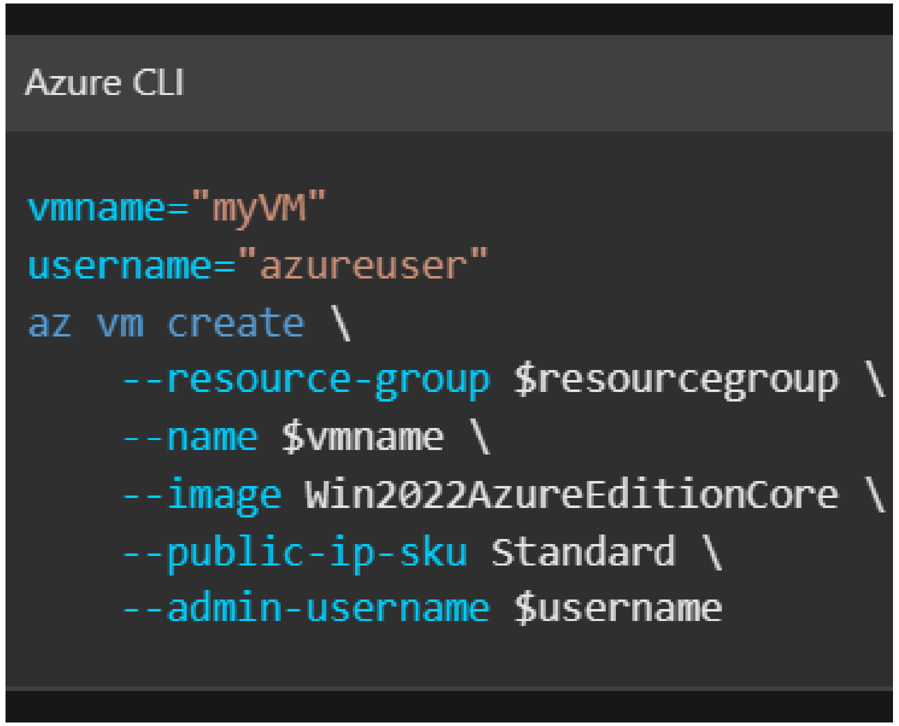
- ✓ A method of managing and provisioning infrastructure resources via code.
- ✓ In most cases either uses **imperative** or **declarative** code.

$\downarrow$ **"do this"** $\downarrow$ **"build this"**

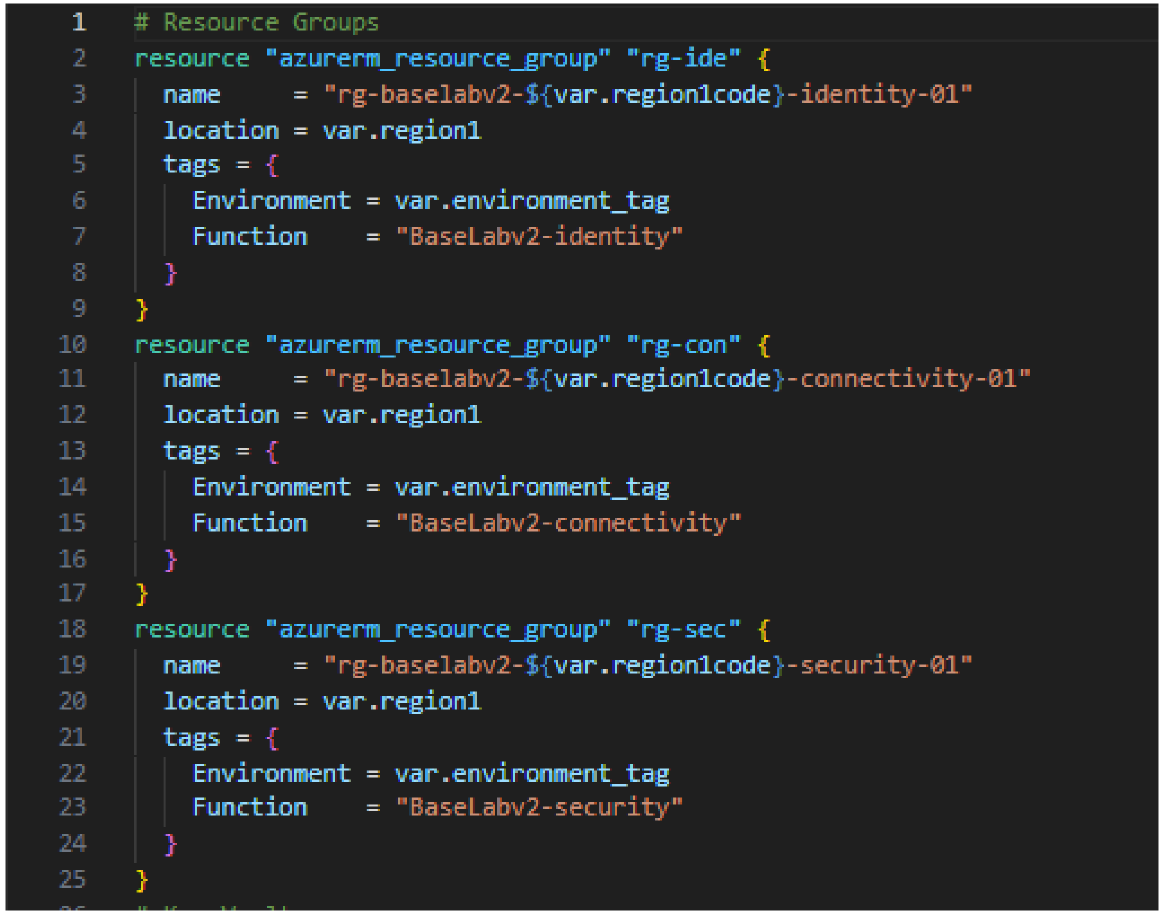
- ✓ Often integrated into version control systems – e.g. Git.
- ✓ Can be edited and managed in most common tools and platforms – e.g. GitHub, Visual Studio Code, Azure DevOps etc.
- ✓ Usually adopted as part of a wider DevOps Strategy.
- ✓ Allows a move away from ClickOps and provides options to version control infrastructure resources.

Imperative

- Defines a task to be carried out
- In this example repeated executions would error – as the VM already exists after 1 run



```
vmname="myVM"
username="azureuser"
az vm create \
    --resource-group $resourcegroup \
    --name $vmname \
    --image Win2022AzureEditionCore \
    --public-ip-sku Standard \
    --admin-username $username
```



```
# Resource Groups
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  name     = "rg-baselabv2-${var.region1code}-identity-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-identity"
  }
}
resource "azurerm_resource_group" "rg-con" {
  name     = "rg-baselabv2-${var.region1code}-connectivity-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-connectivity"
  }
}
resource "azurerm_resource_group" "rg-sec" {
  name     = "rg-baselabv2-${var.region1code}-security-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-security"
  }
}
```

Declarative

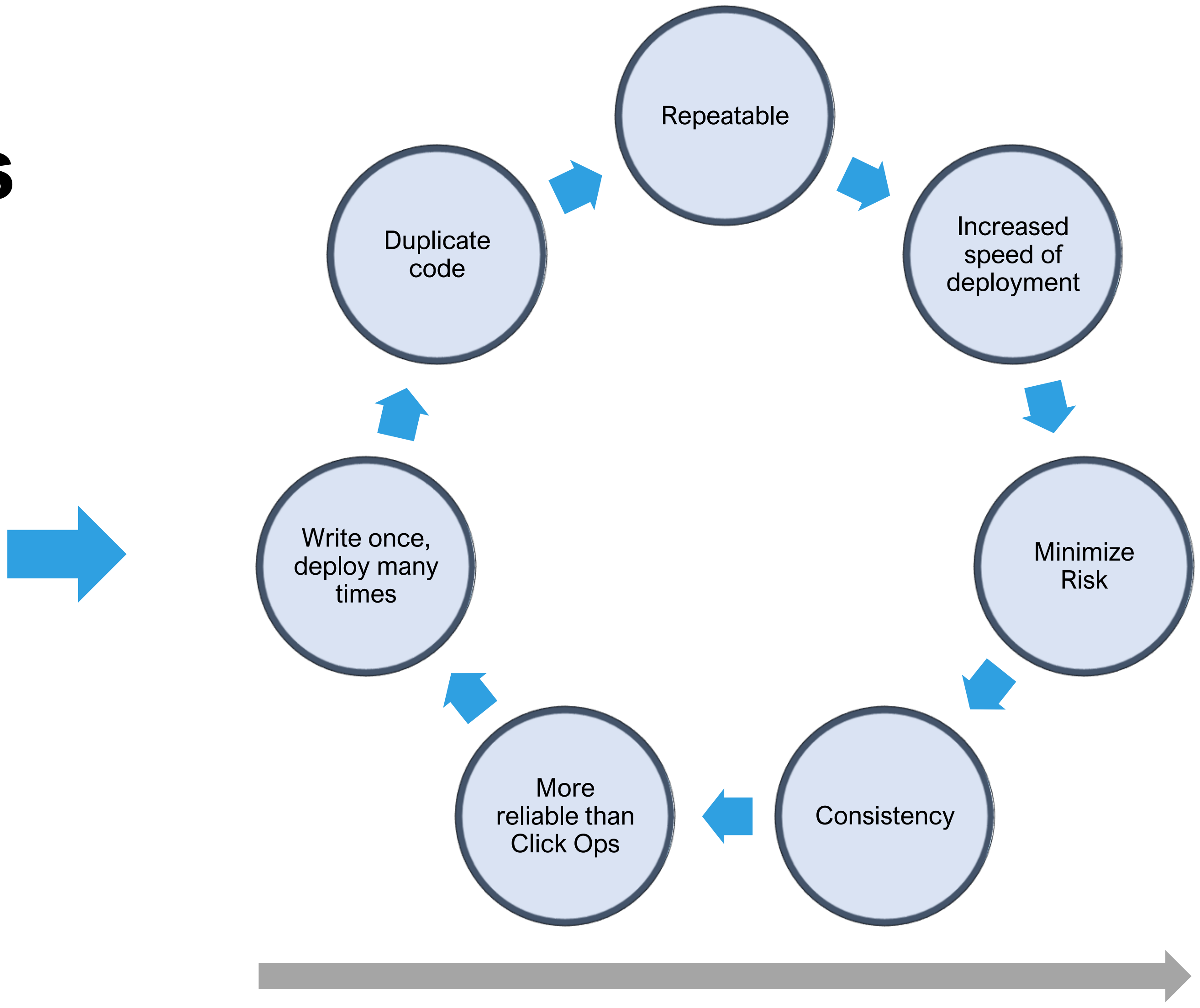
- Defines infrastructure components to be created
- In this example repeated executions would result in a message informing us that "no changes" are required (as the VM is already built).

Why use Infrastructure as Code?

- **Cost** – enables more rapid deployment, changes, test environments etc.
- **Speed** – faster deployment due to less manual intervention (no ClickOps), easy testing, less human error etc. Enables DevOps methods/practices.
- **Risk** – reduced through testing, consistency of deployments, version control etc.

Why use Infrastructure as Code?

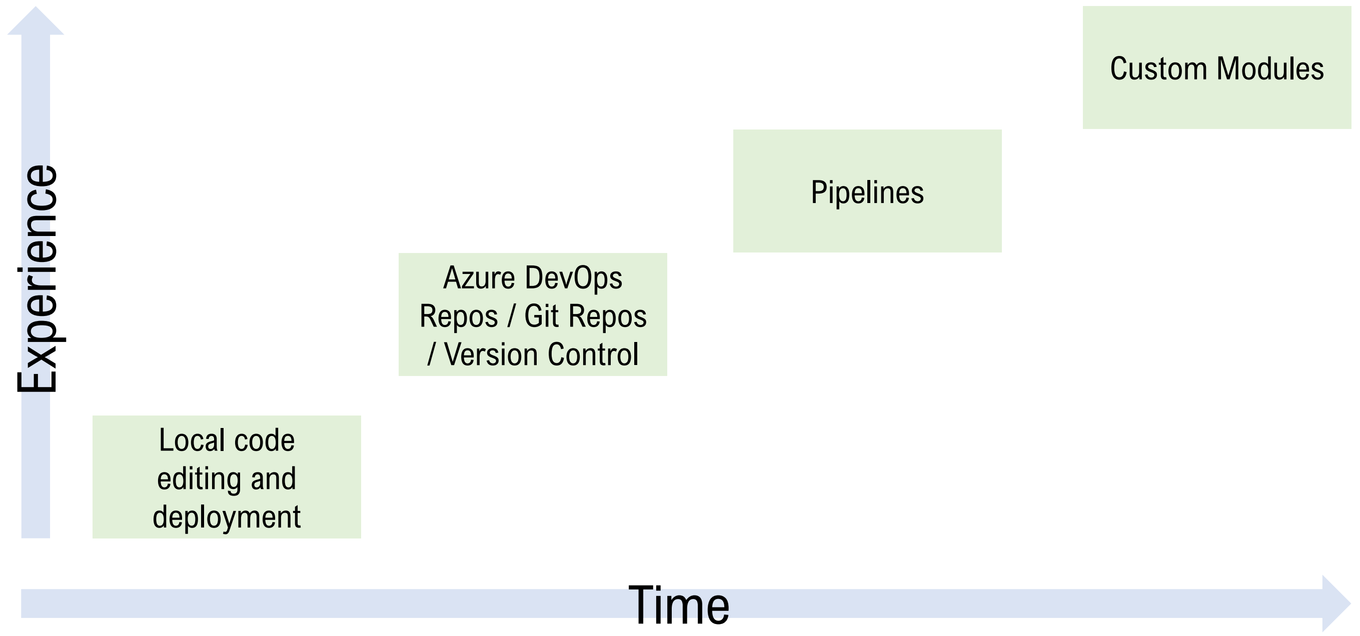
Benefits Cycle


Repeatable
Increased speed of deployment
Minimize Risk
Consistency
More reliable than Click Ops
Write once, deploy many times
Duplicate code

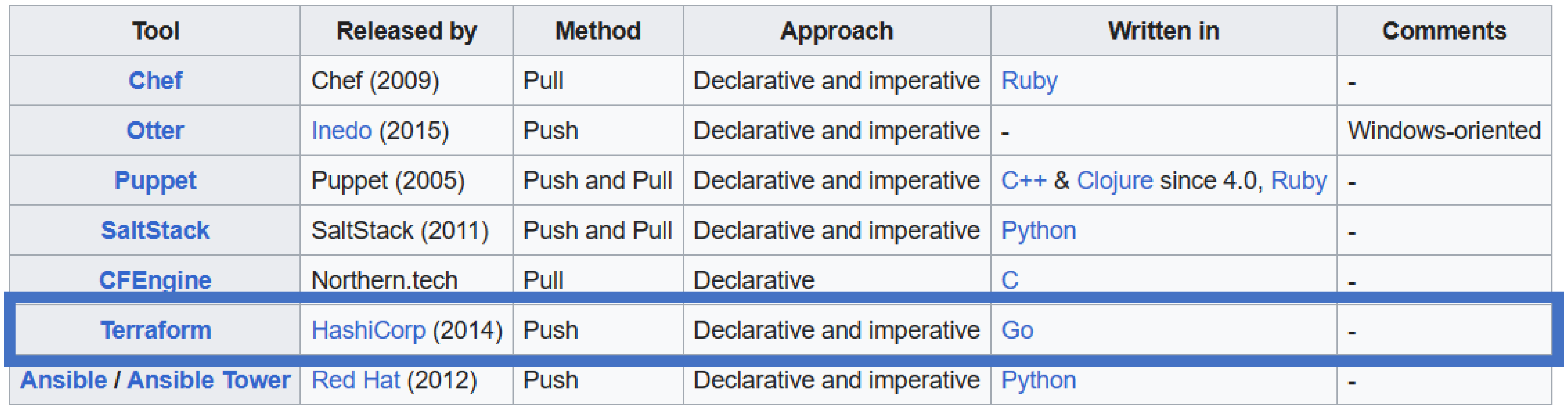
As IAC experience and use increases – levels of DevOps Practices and Principals also usually increases in an organisation.

Why use Infrastructure as Code?

As IAC maturity increases – levels of DevOps Practices and Principals also usually increases in an organisation.


Experience
Local code editing and deployment
Azure DevOps Repos / Git Repos / Version Control
Pipelines
Custom Modules
Time

Other platforms are available…



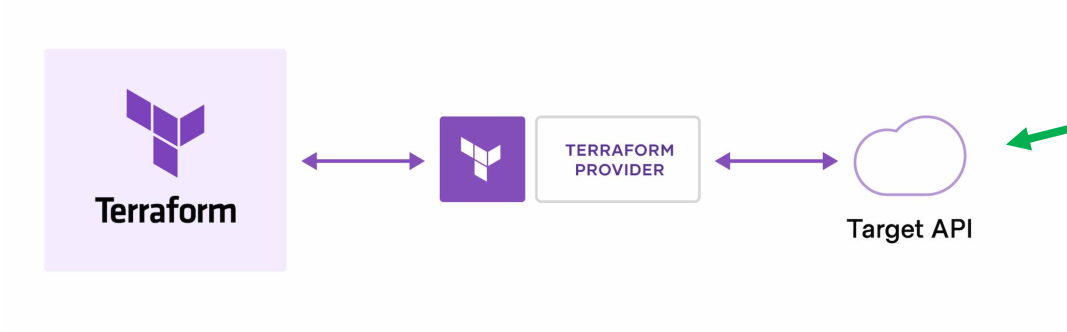
Tool	Released by	Method	Approach	Written in	Comments
Chef	Chef (2009)	Pull	Declarative and imperative	Ruby	-
Otter	Inedo (2015)	Push	Declarative and imperative	-	Windows-oriented
Puppet	Puppet (2005)	Push and Pull	Declarative and imperative	C++ & Clojure since 4.0, Ruby	-
SaltStack	SaltStack (2011)	Push and Pull	Declarative and imperative	Python	-
CFEngine	Northern.tech	Pull	Declarative	C	-
Terraform	HashiCorp (2014)	Push	Declarative and imperative	Go	-
Ansible / Ansible Tower	Red Hat (2012)	Push	Declarative and imperative	Python	-

https://en.wikipedia.org/wiki/Infrastructure_as_code

What is Terraform?

HashiCorp Terraform

- Terraform is an **<u>Infrastructure as Code</u>** Software tool, that can interact with a wide range of Platforms and Environments, using Providers.



AWS, VMware, Azure, etc

- Can be used in both Cloud and On-Premises environments. Can be used to combine on-premises and Cloud, or Cloud and Cloud for example.

- Terraform comes in 3 main varieties:
    - Community Edition – I will be using this to demo today!
    - Terraform Cloud
    - Terraform Enterprise

https://developer.hashicorp.com/terraform/intro

What is Terraform?

HashiCorp Terraform

- Terraform comes in 3 main varieties:
  - Community Edition – I will be using this to demo today!
  - Terraform Cloud
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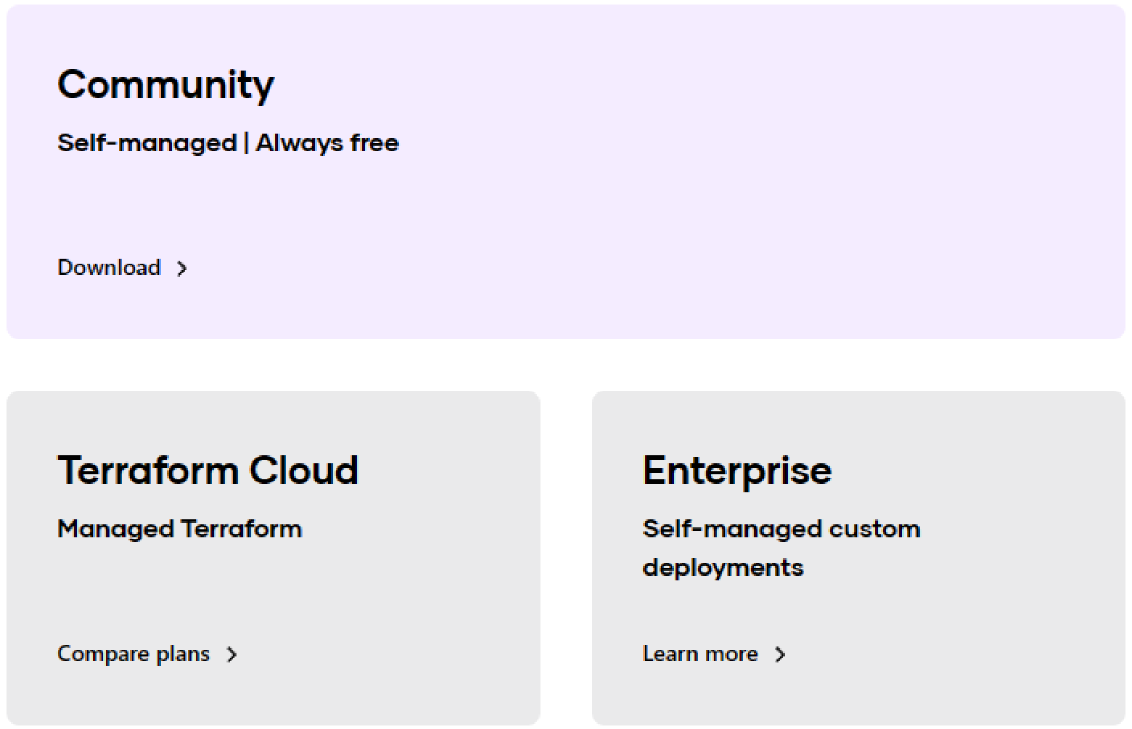


Community

Self-managed | Always free

Download >

Terraform Cloud

Managed Terraform

Compare plans >

Enterprise

Self-managed custom deployments

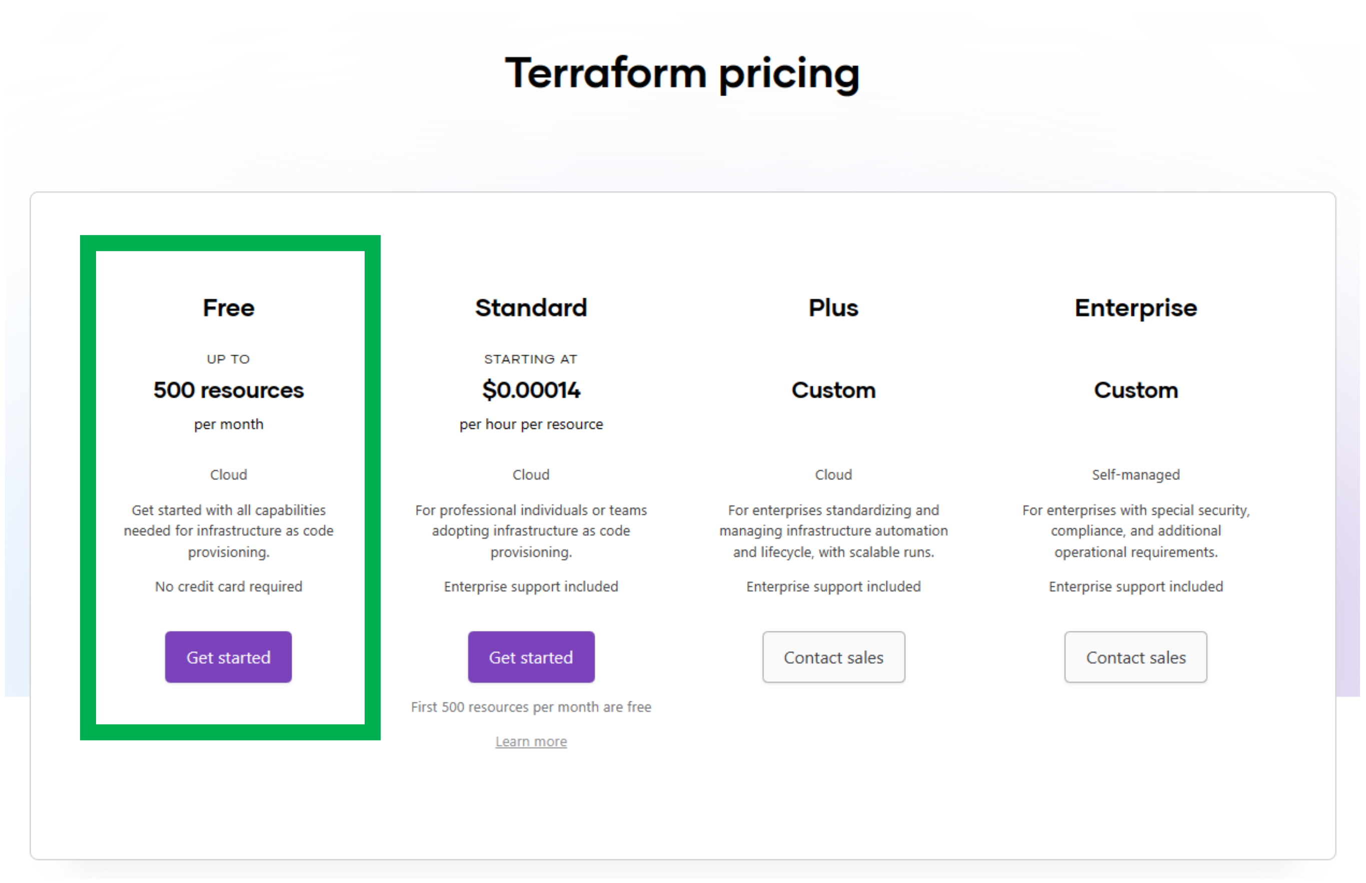
Learn more >

https://www.terraform.io/

What is Terraform?

HashiCorp
Terraform

- Terraform Cloud
- Terraform Enterprise



Terraform pricing

Free	Standard	Plus	Enterprise
UP TO 500 resources per month	STARTING AT $0.00014 per hour per resource	Custom	Custom
Cloud	Cloud	Cloud	Self-managed
Get started with all capabilities needed for infrastructure as code provisioning.	For professional individuals or teams adopting infrastructure as code provisioning.	For enterprises standardizing and managing infrastructure automation and lifecycle, with scalable runs.	For enterprises with special security, compliance, and additional operational requirements.
No credit card required	Enterprise support included	Enterprise support included	Enterprise support included
Get started	Get started	Contact sales	Contact sales
	First 500 resources per month are free Learn more		

Authentication

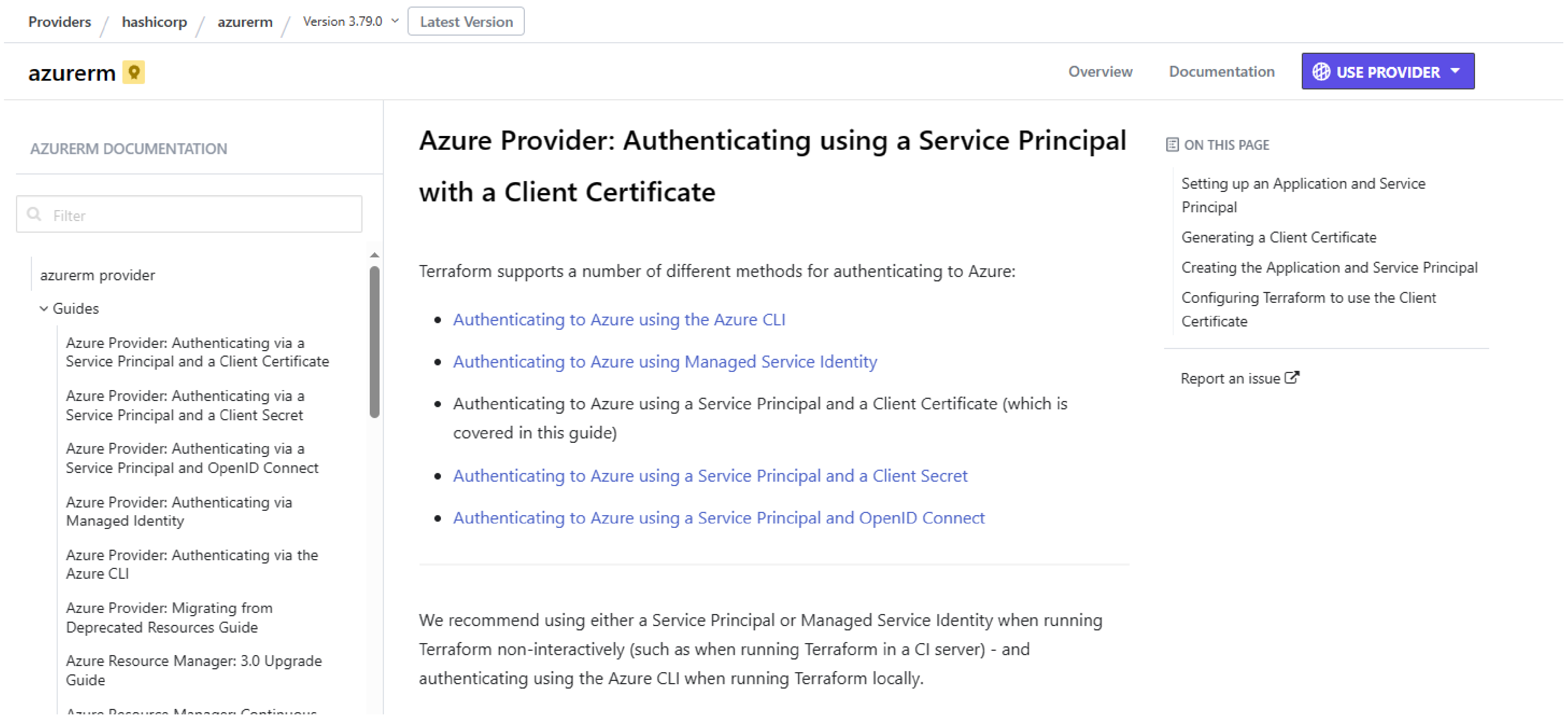
- **Demo / Lab Environments**

Usually authenticate at the CLI or use a Service Principal

- **Production Environments**

Service Principal or a Managed Service Identity

https://learn.microsoft.com/en-us/azure/developer/terraform/authenticate-to-azure?tabs=bash


Providers / hashicorp / azurerm / Version 3.79.0 Latest Version

azurerm

Overview Documentation USE PROVIDER

AZURERM DOCUMENTATION

Filter

azurerm provider

Guides

- Azure Provider: Authenticating via a Service Principal and a Client Certificate
- Azure Provider: Authenticating via a Service Principal and a Client Secret
- Azure Provider: Authenticating via a Service Principal and OpenID Connect
- Azure Provider: Authenticating via Managed Identity
- Azure Provider: Authenticating via the Azure CLI
- Azure Provider: Migrating from Deprecated Resources Guide
- Azure Resource Manager: 3.0 Upgrade Guide

Azure Provider: Authenticating using a Service Principal with a Client Certificate

Terraform supports a number of different methods for authenticating to Azure:

- Authenticating to Azure using the Azure CLI
- Authenticating to Azure using Managed Service Identity
- Authenticating to Azure using a Service Principal and a Client Certificate (which is covered in this guide)
- Authenticating to Azure using a Service Principal and a Client Secret
- Authenticating to Azure using a Service Principal and OpenID Connect

We recommend using either a Service Principal or Managed Service Identity when running Terraform non-interactively (such as when running Terraform in a CI server) - and authenticating using the Azure CLI when running Terraform locally.

ON THIS PAGE

Report an issue

https://registry.terraform.io/providers/hashicorp/azurerm/latest/docs

Providers

- Before we can run Terraform, we need to add a “Provider” to our Code. Providers are plugins for Terraform that allow Terraform to interact with an external API.

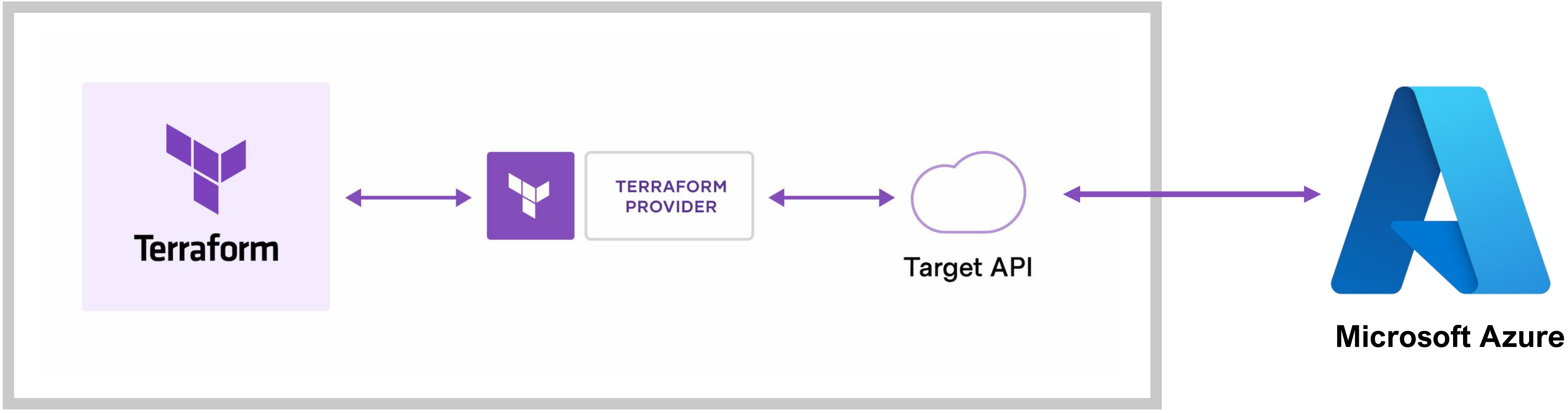
  https://registry.terraform.io/browse/providers

- In simple Terms – providers enable communication with platforms or services outside of Terraform

- For example – with Microsoft Azure, we would need to add the AzureRM Provider to Terraform before we can interact with Azure.

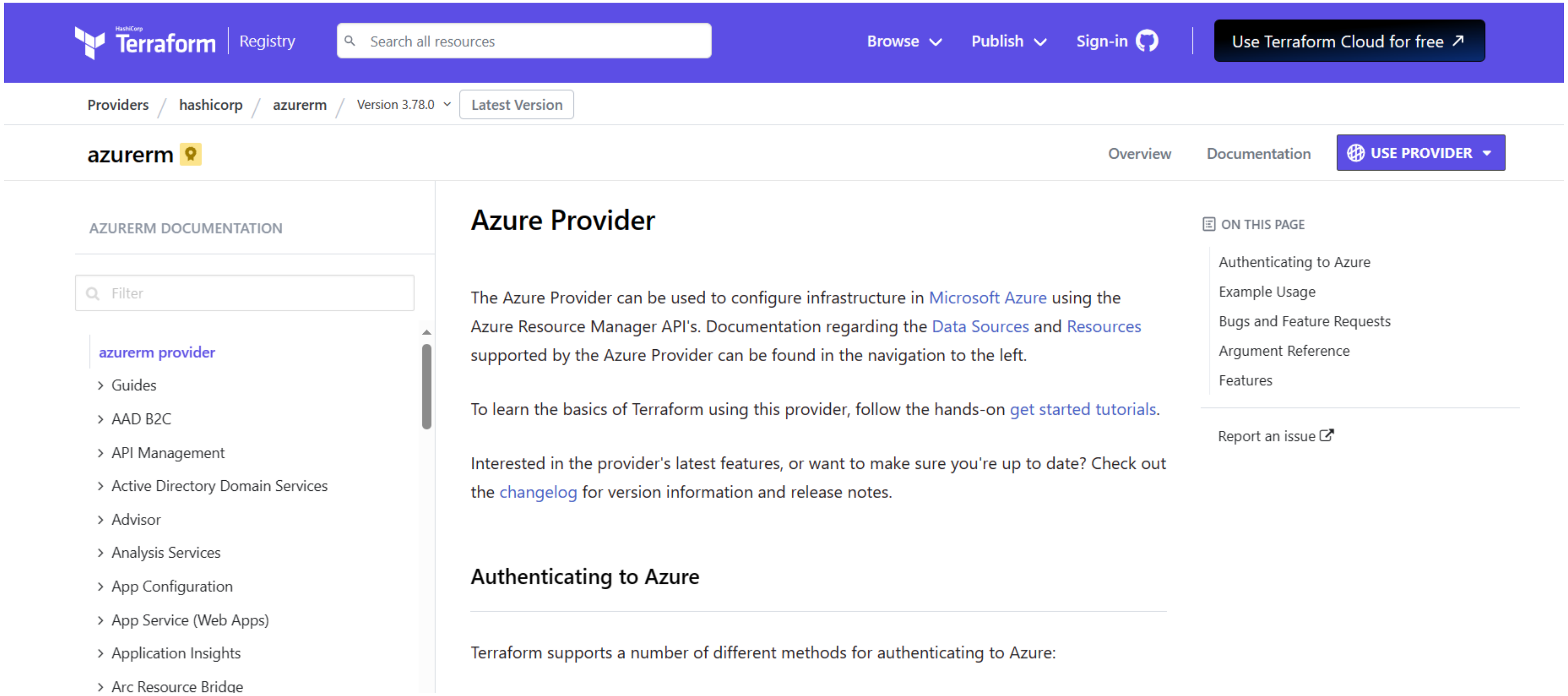
  https://registry.terraform.io/providers/hashicorp/azurerm/latest/docs

AzureRM Provider



https://registry.terraform.io/providers/hashicorp/azurerm/latest/docs

Use the guidance in the Terraform Registry to help:



Azure Provider

The Azure Provider can be used to configure infrastructure in Microsoft Azure using the Azure Resource Manager API's. Documentation regarding the Data Sources and Resources supported by the Azure Provider can be found in the navigation to the left.

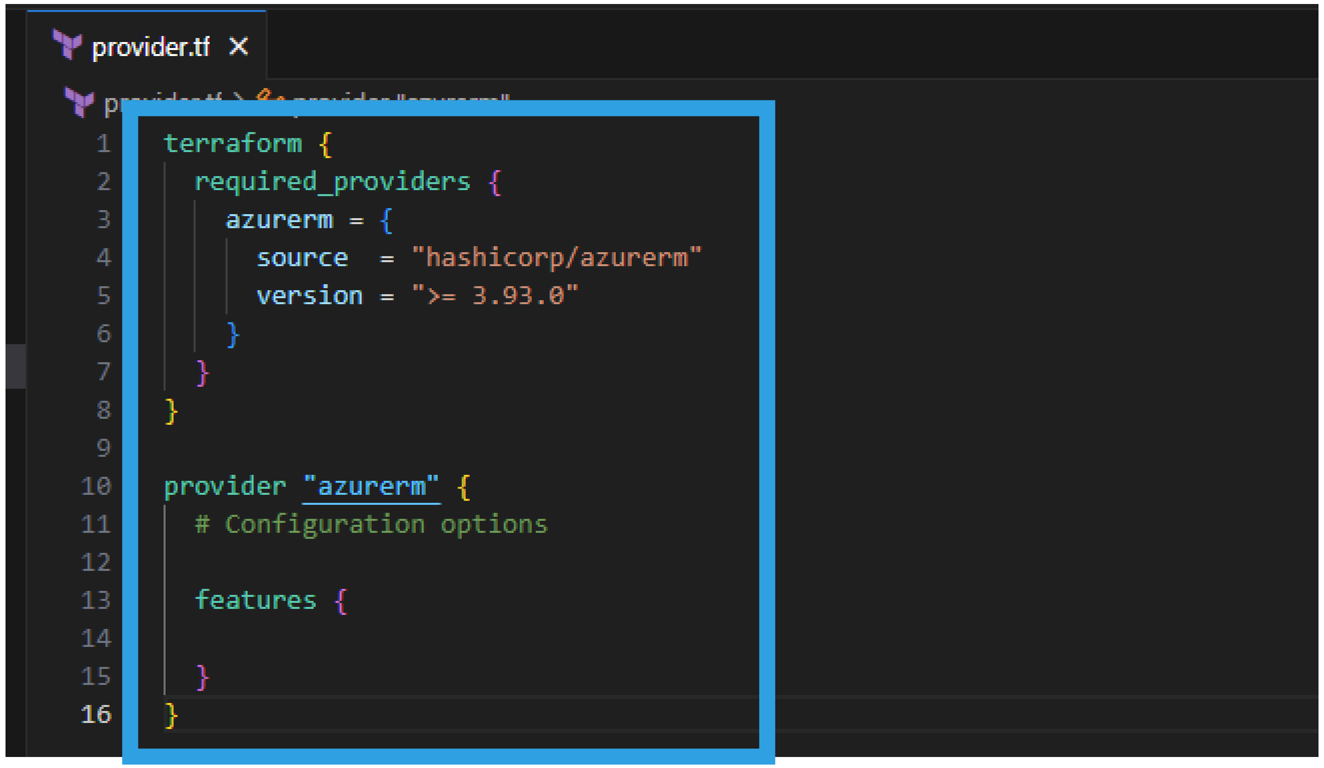
To learn the basics of Terraform using this provider, follow the hands-on get started tutorials.

Interested in the provider's latest features, or want to make sure you're up to date? Check out the changelog for version information and release notes.

Authenticating to Azure

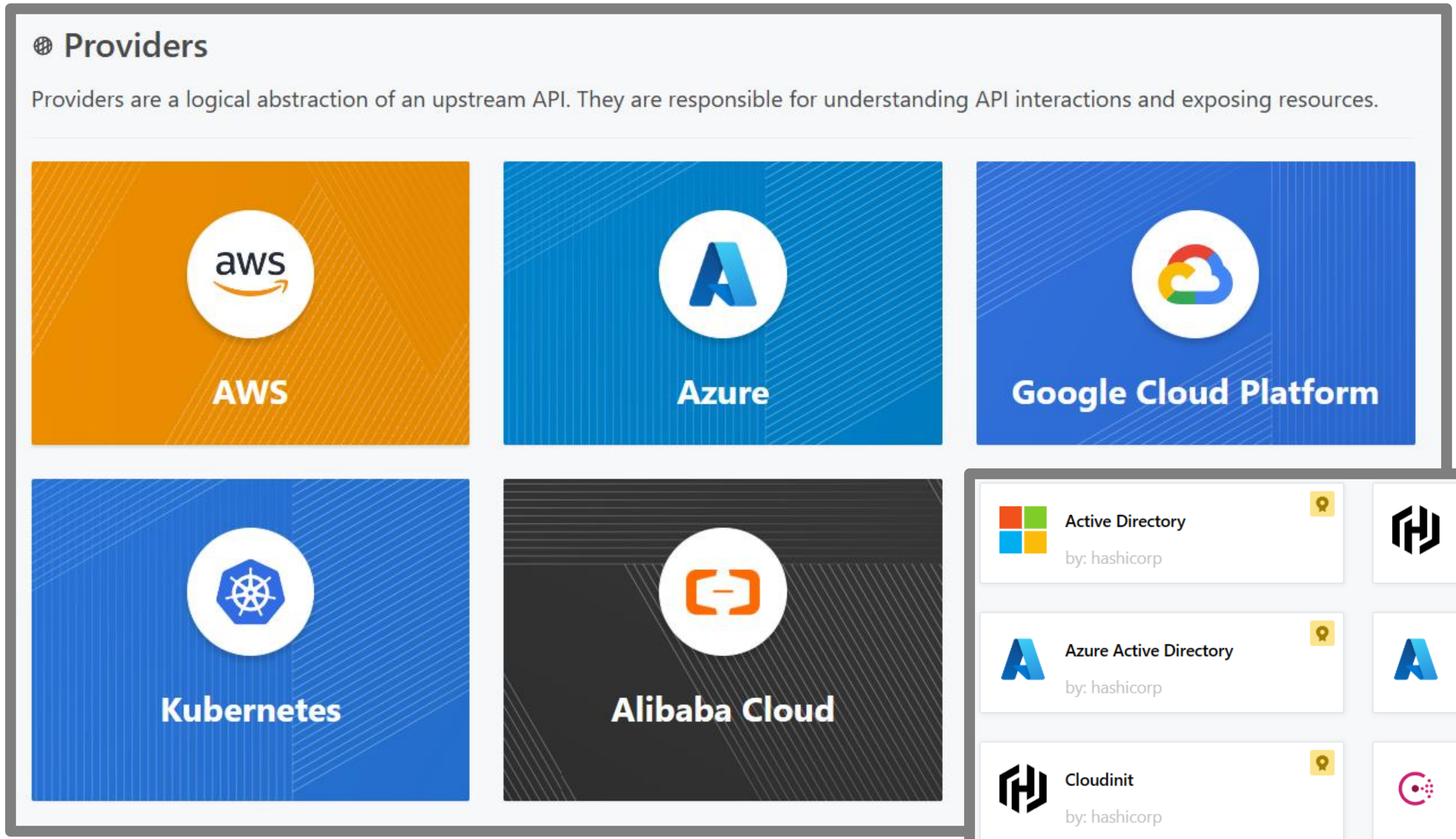
Terraform supports a number of different methods for authenticating to Azure:

provider.tf



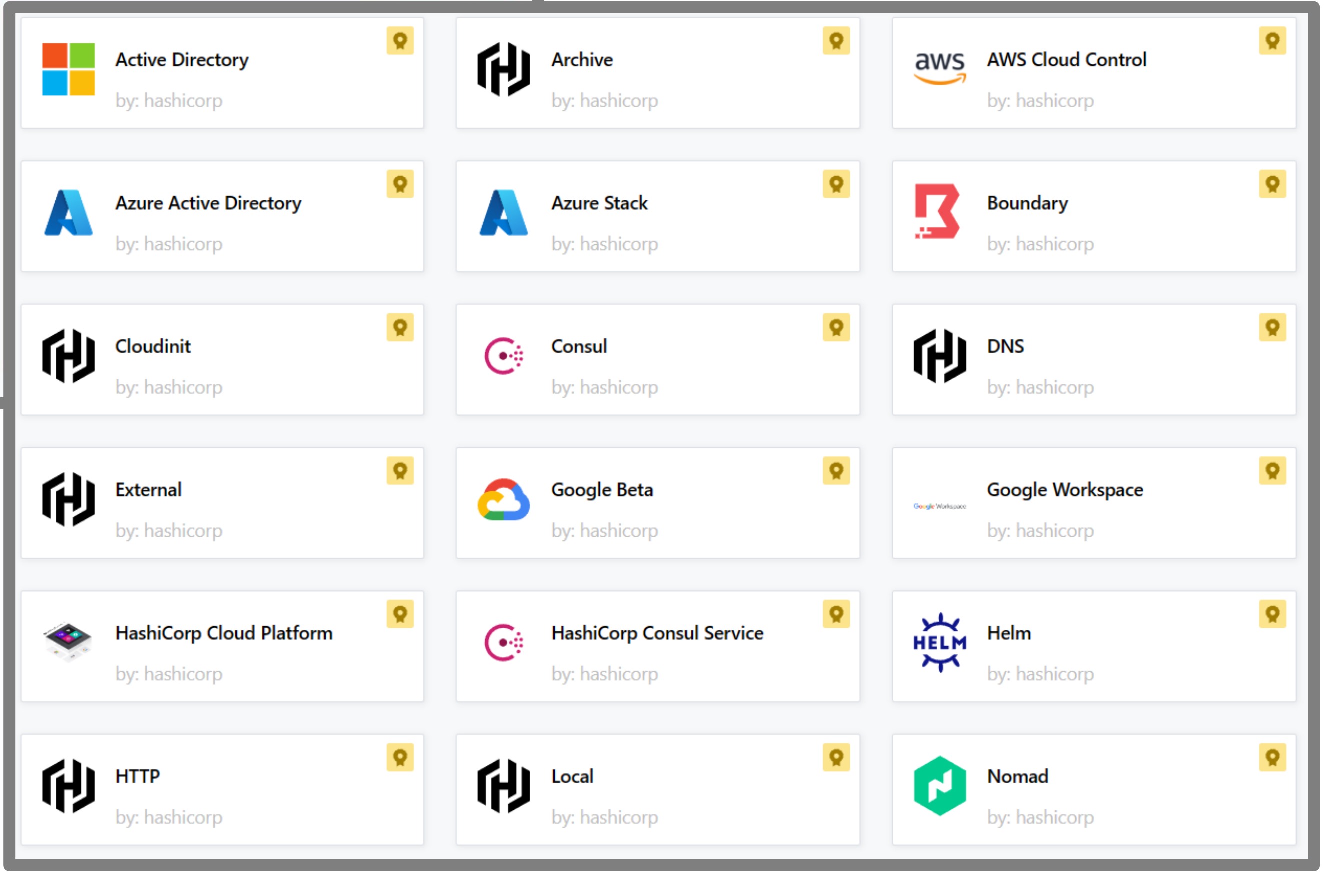
```
terraform {
  required_providers {
    azurerm = {
      source  = "hashicorp/azurerm"
      version = ">= 3.93.0"
    }
  }
}

provider "azurerm" {
  # Configuration options

  features {

  }
}
```

What other Providers are available?



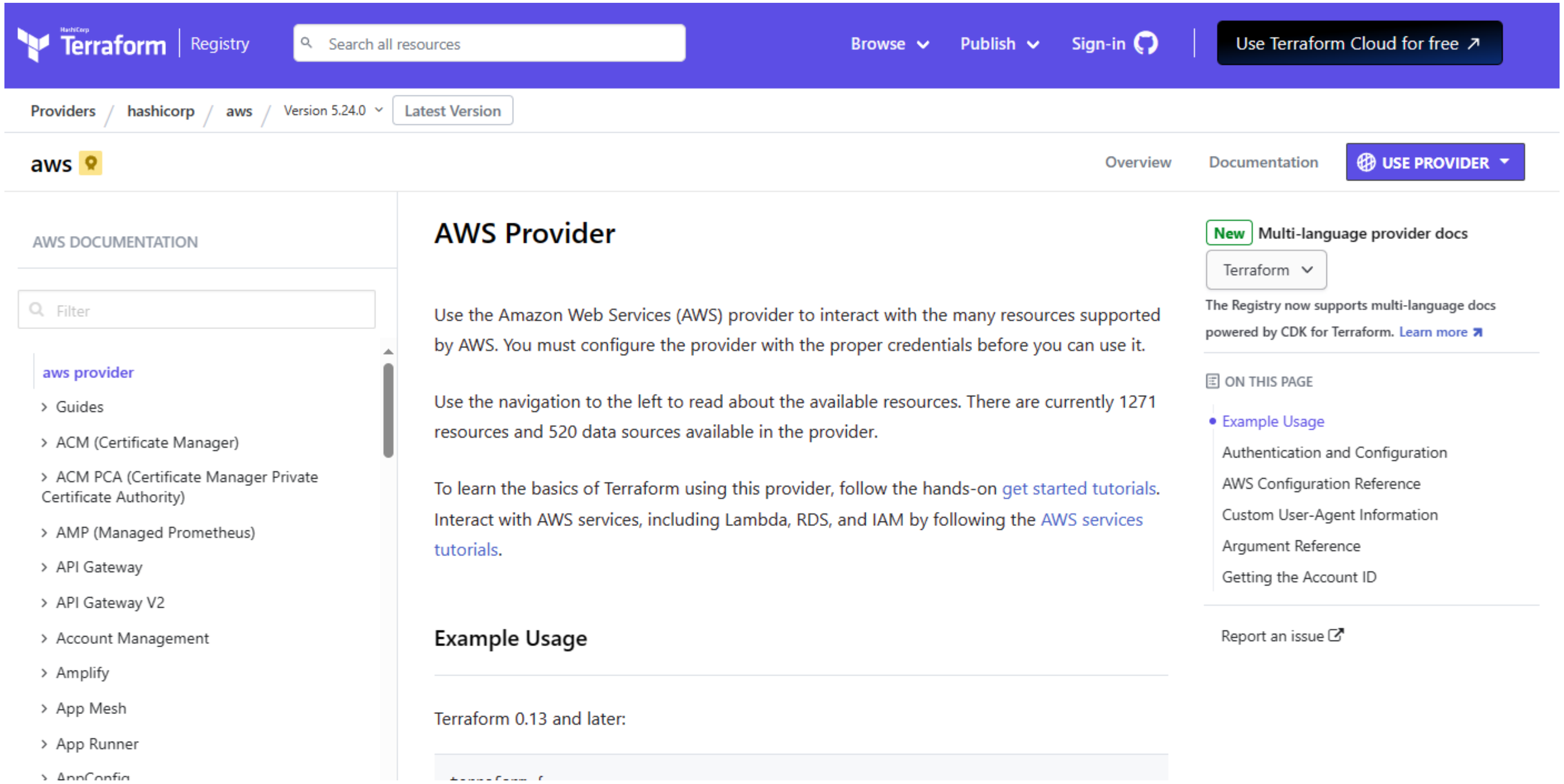
Providers

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



Active Directory by: hashicorp	Archive by: hashicorp	AWS Cloud Control by: hashicorp
Azure Active Directory by: hashicorp	Azure Stack by: hashicorp	Boundary by: hashicorp
Cloudinit by: hashicorp	Consul by: hashicorp	DNS by: hashicorp
External by: hashicorp	Google Beta by: hashicorp	Google Workspace by: hashicorp
HashiCorp Cloud Platform by: hashicorp	HashiCorp Consul Service by: hashicorp	Helm by: hashicorp
HTTP by: hashicorp	Local by: hashicorp	Nomad by: hashicorp

https://registry.terraform.io/browse/providers



AWS Provider

Use the Amazon Web Services (AWS) provider to interact with the many resources supported by AWS. You must configure the provider with the proper credentials before you can use it.

Use the navigation to the left to read about the available resources. There are currently 1271 resources and 520 data sources available in the provider.

To learn the basics of Terraform using this provider, follow the hands-on get started tutorials. Interact with AWS services, including Lambda, RDS, and IAM by following the AWS services tutorials.

Example Usage

Terraform 0.13 and later:

The Registry now supports multi-language docs powered by CDK for Terraform. Learn more ↗

Process

1. Terraform code is typically arranged across a number of files: “tf files”. (Because they have the extension TF)

↓

2. These files define the infrastructure and its configuration (or changes!) that we want Terraform to apply.

↓

3. At the time of running Terraform, these files are analysed by Terraform, and turned into an execution plan to apply our changes.

Terraform Stages

- Running Terraform involves a number of stages of deployment:

`Terraform init`	This stage initialises the Terraform binaries, and downloads the required providers, based on what we have defined.
`Terraform plan`	This stage examines our TF files and provides an overview of the infrastructure changes – by providing an execution plan.
`Terraform apply`	This stage carries out the execution plan, and implements the changes. Note: this also runs plan.
`Terraform destroy`	This stage destroys the created infrastructure – use carefully!

The State File

Terraform must store information about your infrastructure within a file known as the "State File".

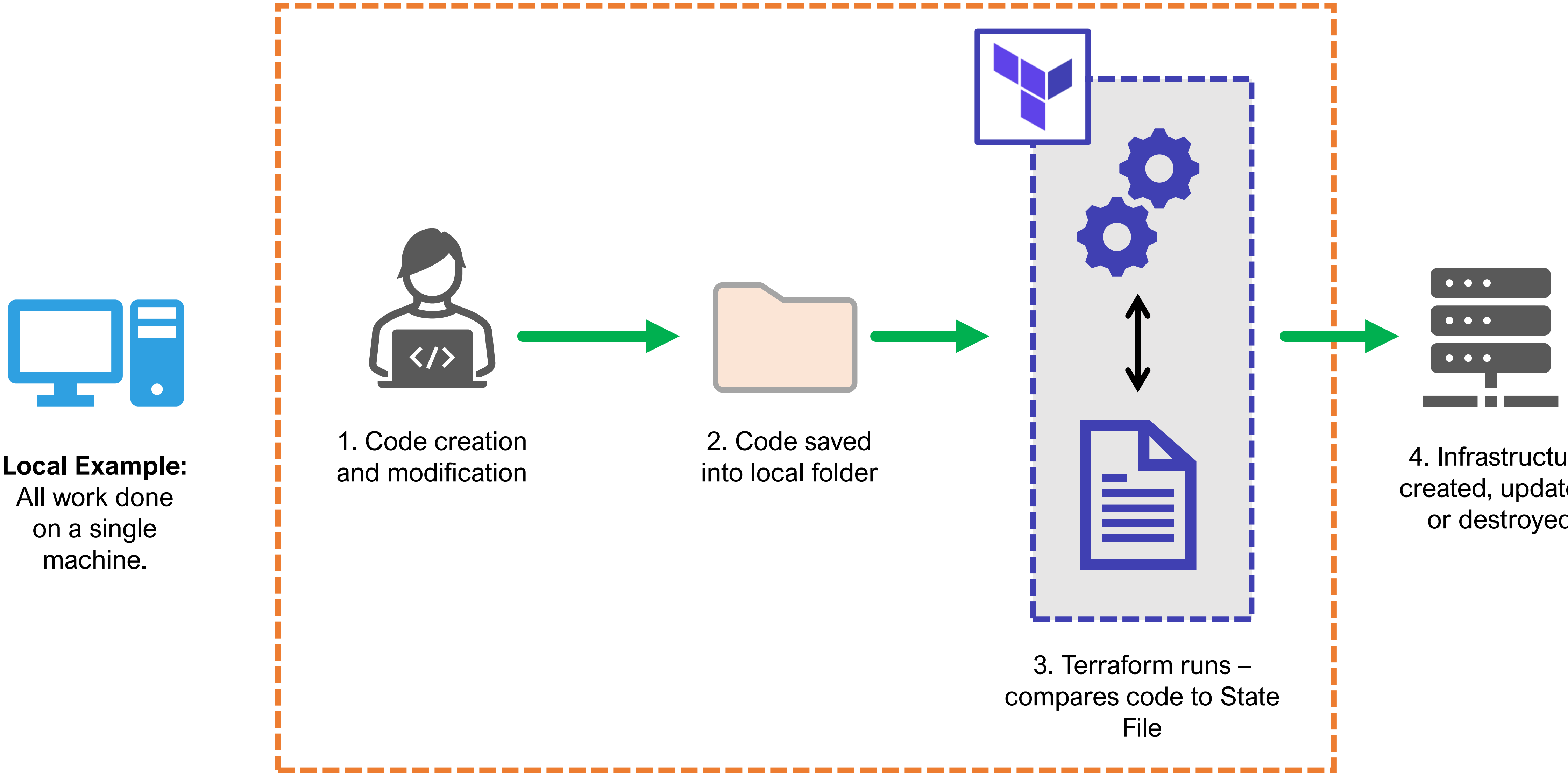
This is so that Terraform can work out changes required to the infrastructure based on your code or configuration changes.

The State File can be stored locally, or remotely, depending on the deployment type and needs.

- Local State – learning/testing/labs/development ✓
- Remote State – using DevOps tooling or collaborating on code

https://developer.hashicorp.com/terraform/language/state

Ways of Working – Local Example



Local Example: All work done on a single machine.

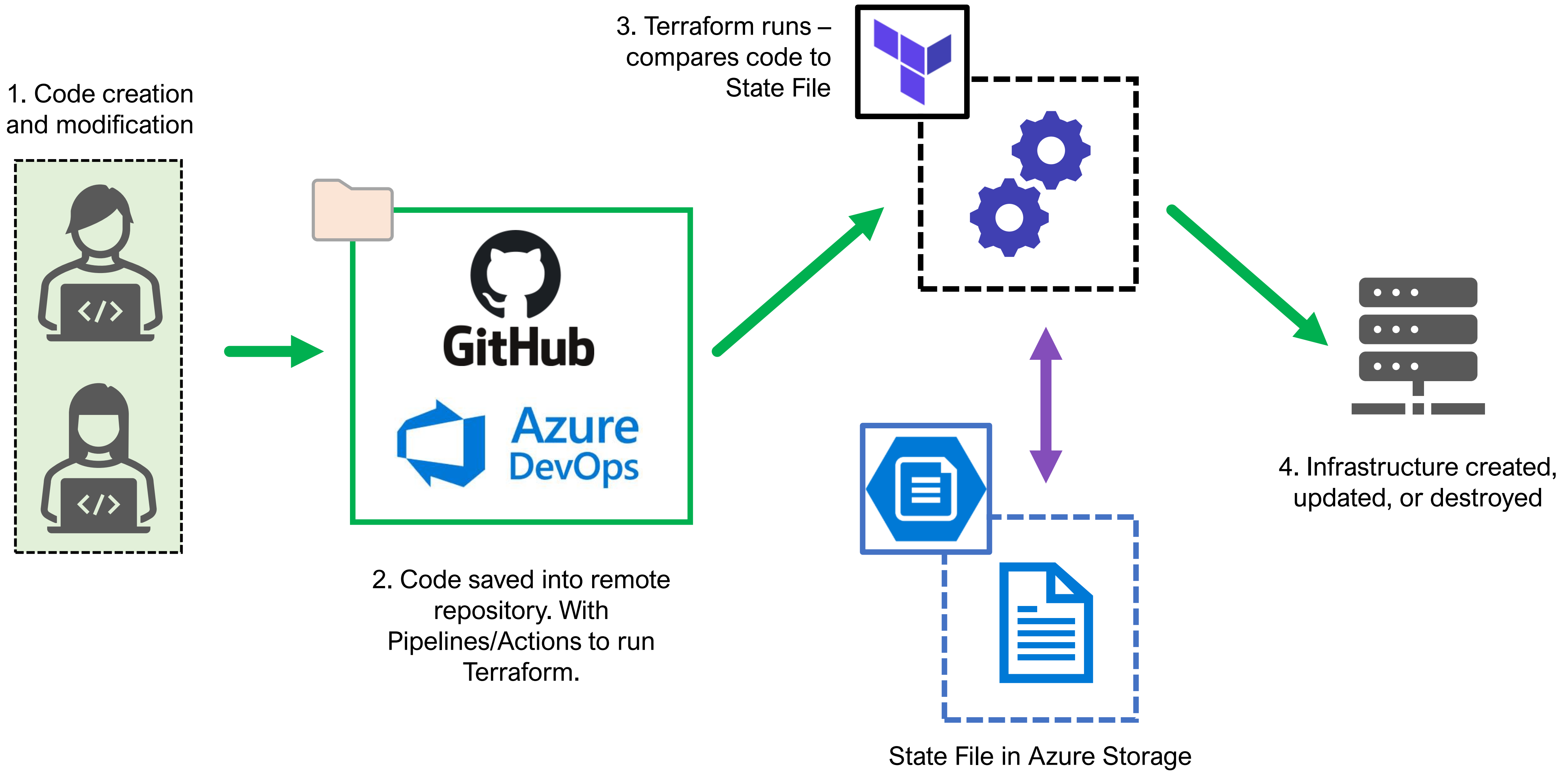
1. Code creation and modification

2. Code saved into local folder

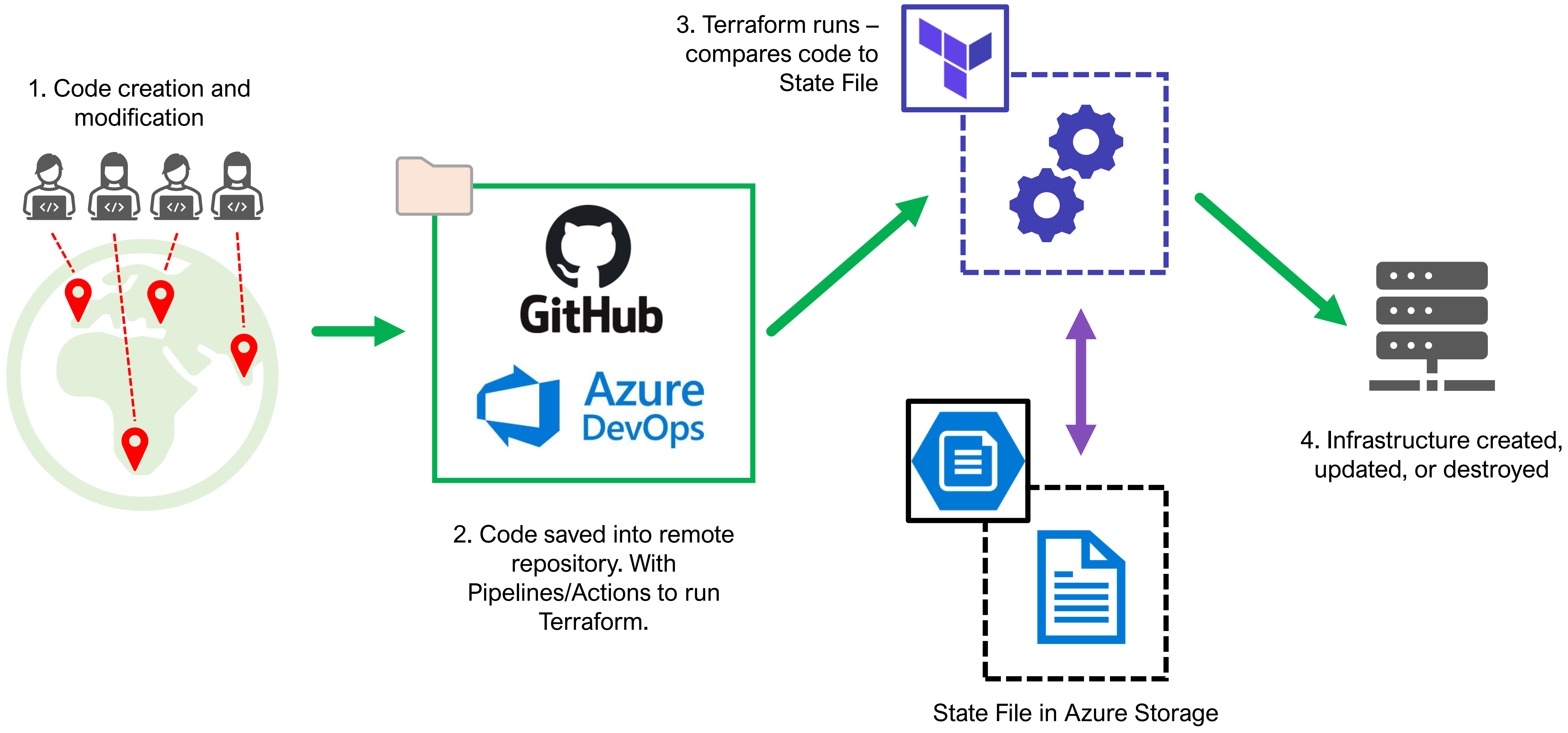
3. Terraform runs – compares code to State File

4. Infrastructure created, updated, or destroyed

Ways of Working – A Remote Example


1. Code creation and modification
2. Code saved into remote repository. With Pipelines/Actions to run Terraform.
GitHub
Azure DevOps
3. Terraform runs – compares code to State File
State File in Azure Storage
4. Infrastructure created, updated, or destroyed

Ways of Working – An even more Remote Example



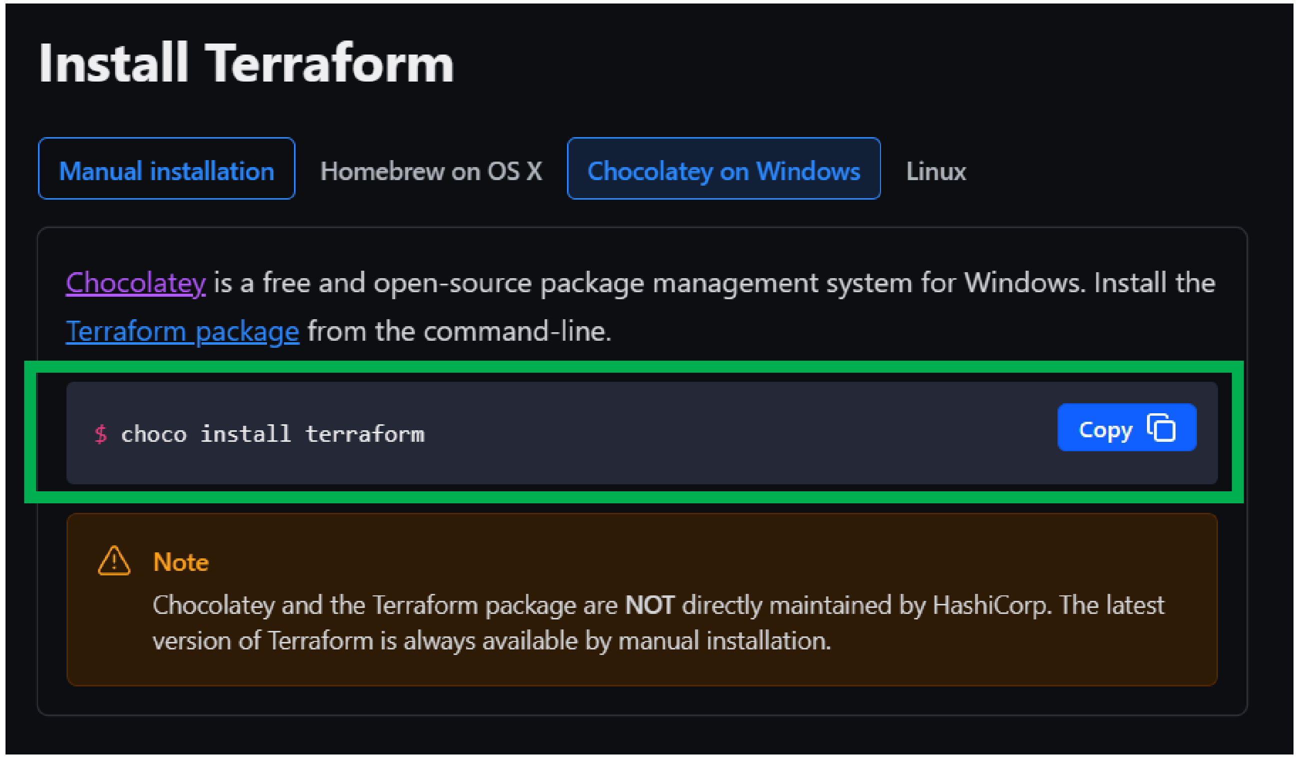
1. Code creation and modification
GitHub
Azure DevOps
2. Code saved into remote repository. With Pipelines/Actions to run Terraform.
3. Terraform runs – compares code to State File
State File in Azure Storage
4. Infrastructure created, updated, or destroyed

Why use Terraform for Azure Deployment?

Just a few key reasons!

- Create infrastructure easily, repeatably, in different locations/platforms/regions.
- Enables Rapid Development / Testing
- Cost Effective Test Environments – create on demand, destroy once used.
- Scale up/down/in/out as required
- Expansion – use functions like count and variable methods like maps
- Enables Version control of Infrastructure
- Work safely and in a standardised way across distributed teams.
- Write once, deploy many times.

Installing Terraform



Install Terraform

Manual installation | Homebrew on OS X | Chocolatey on Windows | Linux

Chocolatey is a free and open-source package management system for Windows. Install the Terraform package from the command-line.

```
$ choco install terraform
```

Copy

⚠ Note
Chocolatey and the Terraform package are **NOT** directly maintained by HashiCorp. The latest version of Terraform is always available by manual installation.

Recommended minimum software:

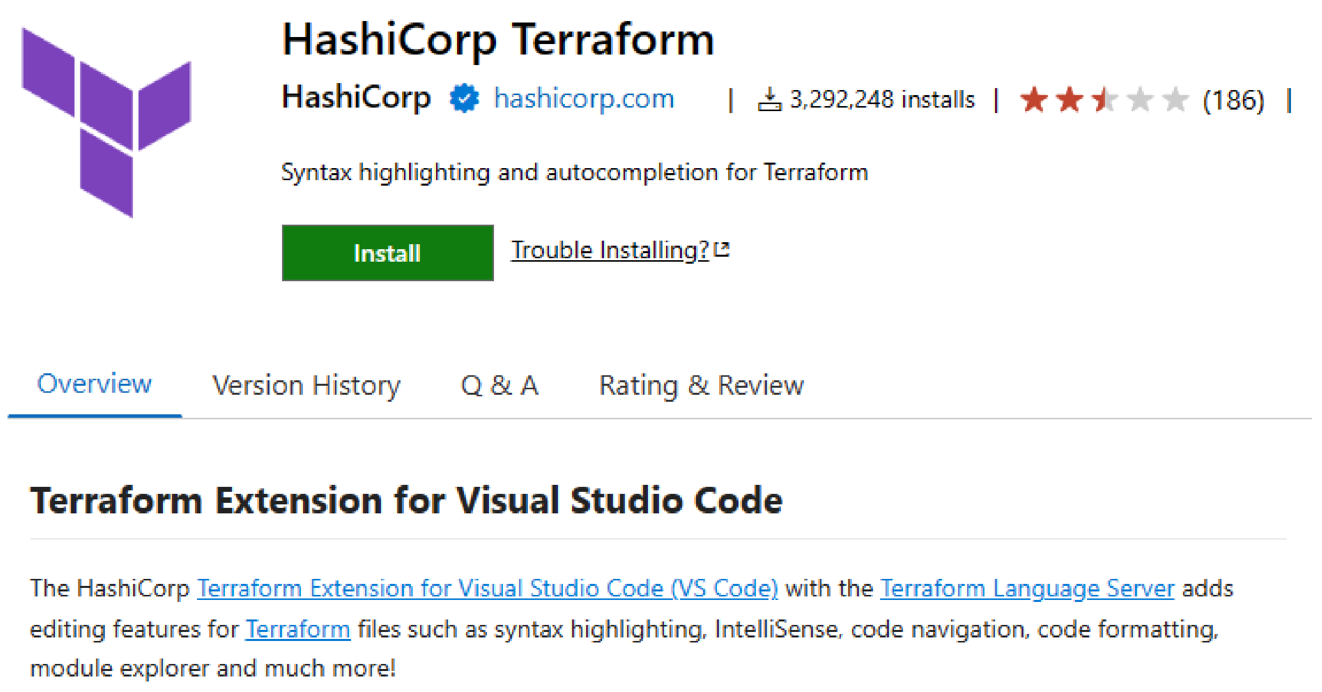
- Terraform
- Visual Studio Code + Extensions

https://community.chocolatey.org/

```
choco install terraform -y
choco install azure-cli -y
choco install vscode -y
```

https://developer.hashicorp.com/terraform/tutorials/azure-get-started/install-cli

Installing Terraform – VSCode Plugin



HashiCorp Terraform

HashiCorp hashicorp.com | 3,292,248 installs | (186) |

Syntax highlighting and autocompletion for Terraform

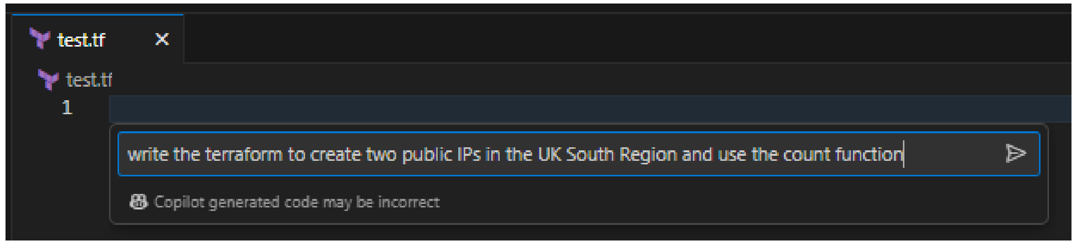
Terraform Extension for Visual Studio Code

The HashiCorp Terraform Extension for Visual Studio Code (VS Code) with the Terraform Language Server adds editing features for Terraform files such as syntax highlighting, IntelliSense, code navigation, code formatting, module explorer and much more!

Features:

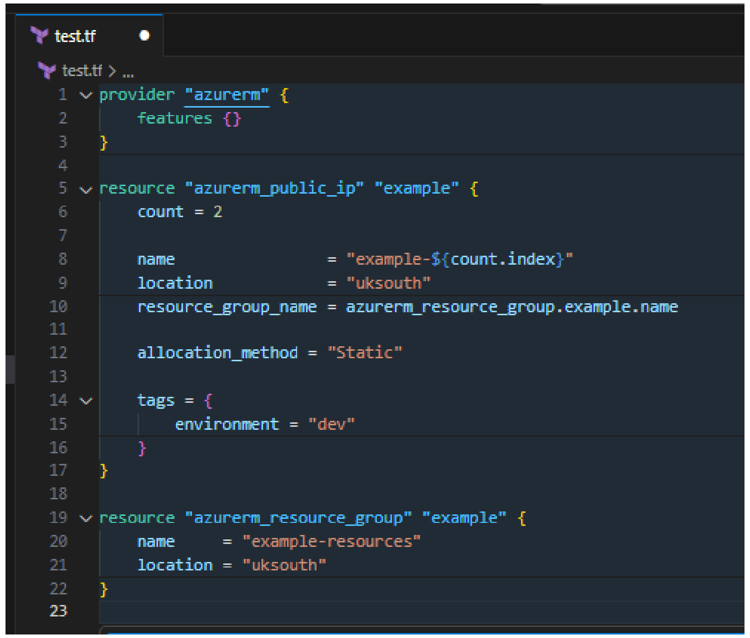
- Intellisense
- Syntax Validation and Highlighting
- Code Naviation
- Code Formatting
- Code Snippets
- Terraform Cloud Integration

https://marketplace.visualstudio.com/items?itemName=HashiCorp.terraform



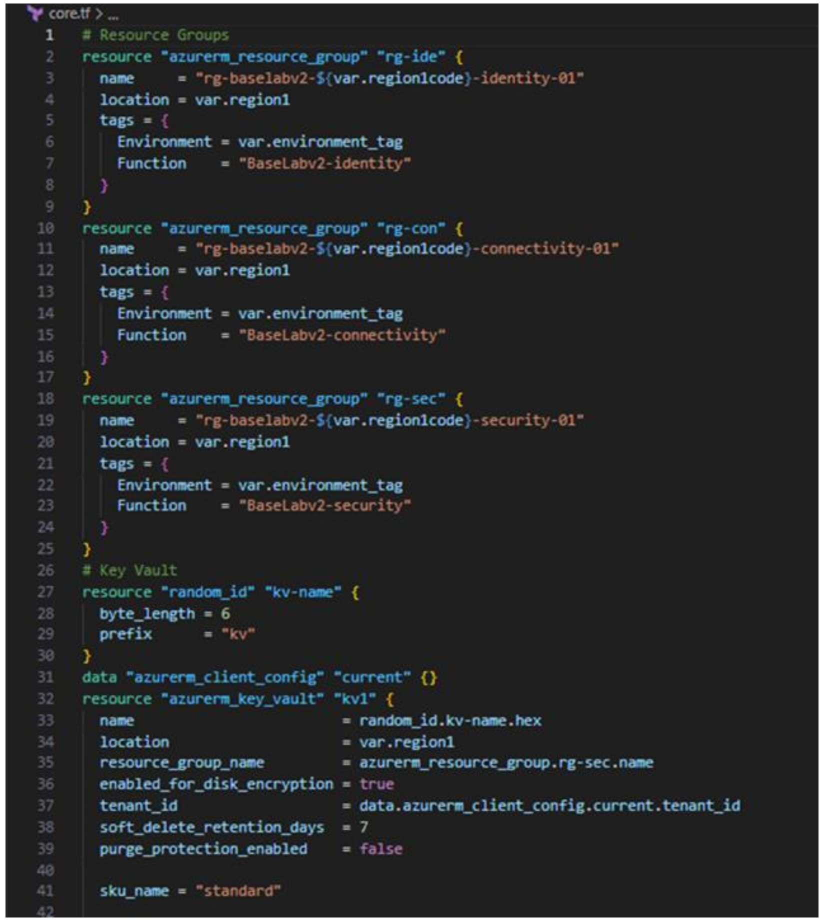
write the terraform to create two public IPs in the UK South Region and use the count function

Copilot generated code may be incorrect



```
provider "azurerm" {
    features {}
}

resource "azurerm_public_ip" "example" {
    count = 2

    name                = "example-${count.index}"
    location            = "uksouth"
    resource_group_name = azurerm_resource_group.example.name

    allocation_method = "Static"

    tags = {
        environment = "dev"
    }
}

resource "azurerm_resource_group" "example" {
    name     = "example-resources"
    location = "uksouth"
}
```

A helping hand… Try GitHub Copilot!


core.tf > ...

```
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resource "azurerm_resource_group" "rg-ide" {
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    Environment = var.environment_tag
    Function    = "BaseLabv2-identity"
  }
}
resource "azurerm_resource_group" "rg-con" {
  name     = "rg-baselabv2-${var.region1code}-connectivity-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-connectivity"
  }
}
resource "azurerm_resource_group" "rg-sec" {
  name     = "rg-baselabv2-${var.region1code}-security-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-security"
  }
}
# Key Vault
resource "random_id" "kv-name" {
  byte_length = 6
  prefix      = "kv"
}
data "azurerm_client_config" "current" {}
resource "azurerm_key_vault" "kv1" {
  name                        = random_id.kv-name.hex
  location                    = var.region1
  resource_group_name         = azurerm_resource_group.rg-sec.name
  enabled_for_disk_encryption = true
  tenant_id                   = data.azurerm_client_config.current.tenant_id
  soft_delete_retention_days  = 7
  purge_protection_enabled    = false

  sku_name = "standard"

```
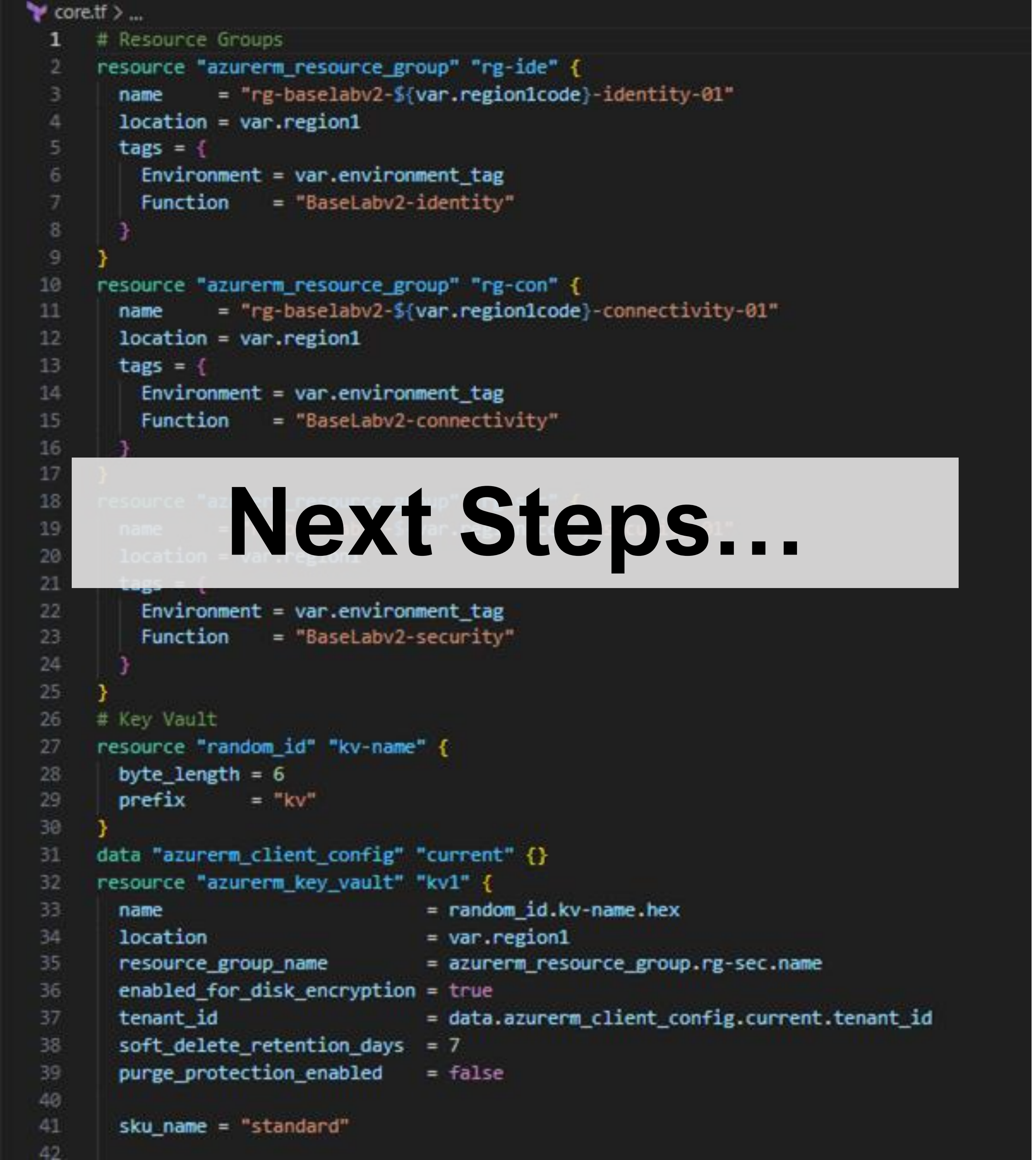

Demo Time!

- Everything I am using today is available in my Terraform-Azure repo: https://github.com/jakewalsh90/Terraform-Azure
- All you need is Terraform, VSCode, Azure CLI, and an Azure Subscription.
- We will explore & demo the following:
  - Deployment of a Lab Environment
  - Run through code files & deployment
  - Changes
  - Destruction


core.tf > ...

```
# Resource Groups
resource "azurerm_resource_group" "rg-ide" {
  name     = "rg-baselabv2-${var.region1code}-identity-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-identity"
  }
}
resource "azurerm_resource_group" "rg-con" {
  name     = "rg-baselabv2-${var.region1code}-connectivity-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-connectivity"
  }
}
resource "azurerm_resource_group" "rg-sec" {
  name     = "rg-baselabv2-${var.region1code}-security-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-security"
  }
}
# Key Vault
resource "random_id" "kv-name" {
  byte_length = 6
  prefix      = "kv"
}
data "azurerm_client_config" "current" {}
resource "azurerm_key_vault" "kv1" {
  name                        = random_id.kv-name.hex
  location                    = var.region1
  resource_group_name         = azurerm_resource_group.rg-sec.name
  enabled_for_disk_encryption = true
  tenant_id                   = data.azurerm_client_config.current.tenant_id
  soft_delete_retention_days  = 7
  purge_protection_enabled    = false

  sku_name = "standard"
```

Next Steps…

Links and Resources:

Azure / Terraform Blog Posts:

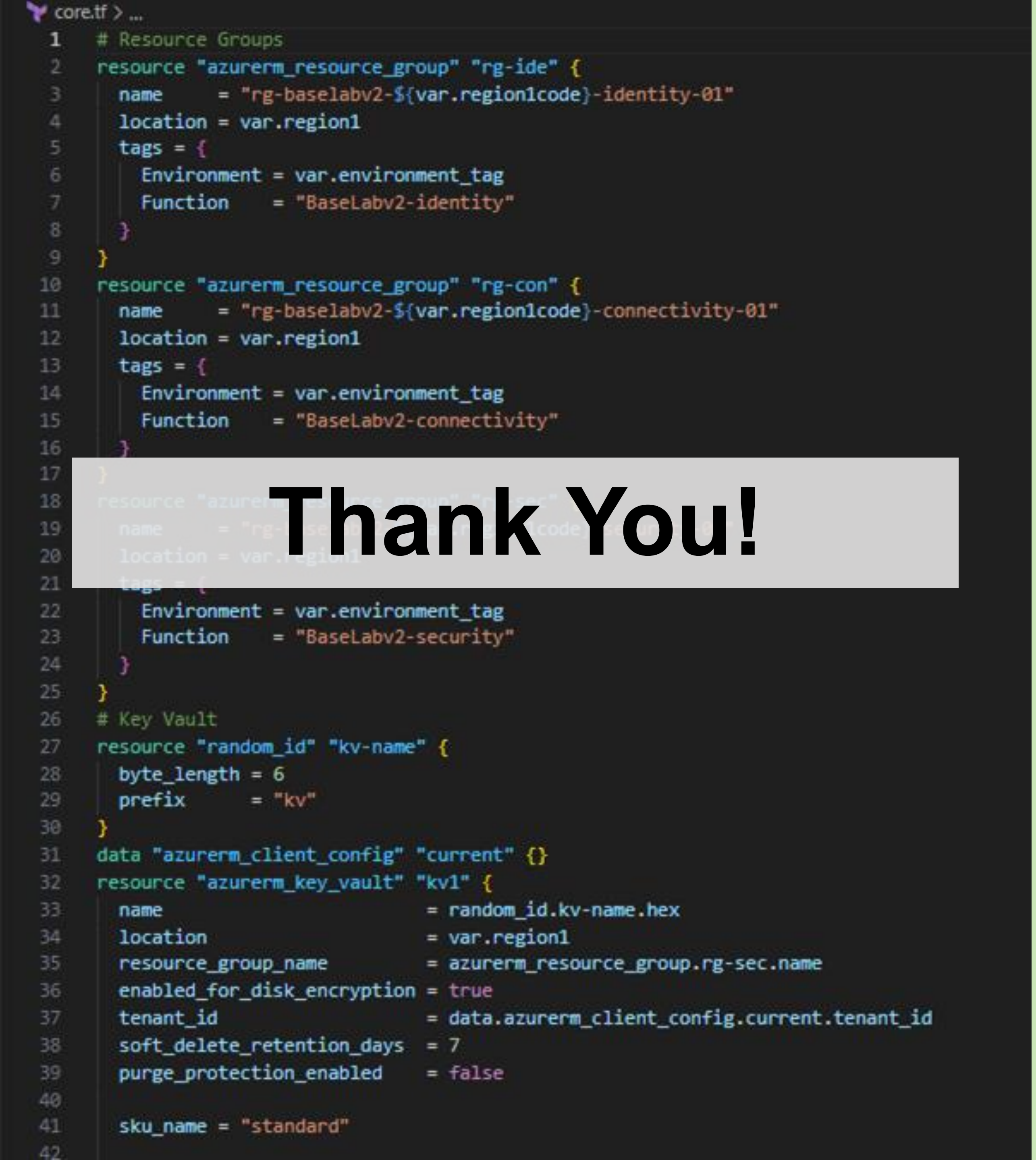
- https://jakewalsh.co.uk/category/terraform/
- https://jakewalsh.co.uk/category/azure/

HashiCorp Learn – Azure Tutorial:

- https://developer.hashicorp.com/terraform/tutorials/azure-get-started

Try Some Sample Environments:

- https://github.com/jakewalsh90/Terraform-Azure



core.tf > ...

```
# Resource Groups
resource "azurerm_resource_group" "rg-ide" {
  name     = "rg-baselabv2-${var.region1code}-identity-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-identity"
  }
}
resource "azurerm_resource_group" "rg-con" {
  name     = "rg-baselabv2-${var.region1code}-connectivity-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-connectivity"
  }
}
resource "azurerm_resource_group" "rg-sec" {
  name     = "rg-baselabv2-${var.region1code}-security-01"
  location = var.region1
  tags = {
    Environment = var.environment_tag
    Function    = "BaseLabv2-security"
  }
}
# Key Vault
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  byte_length = 6
  prefix      = "kv"
}
data "azurerm_client_config" "current" {}
resource "azurerm_key_vault" "kv1" {
  name                        = random_id.kv-name.hex
  location                    = var.region1
  resource_group_name         = azurerm_resource_group.rg-sec.name
  enabled_for_disk_encryption = true
  tenant_id                   = data.azurerm_client_config.current.tenant_id
  soft_delete_retention_days  = 7
  purge_protection_enabled    = false

  sku_name = "standard"
```
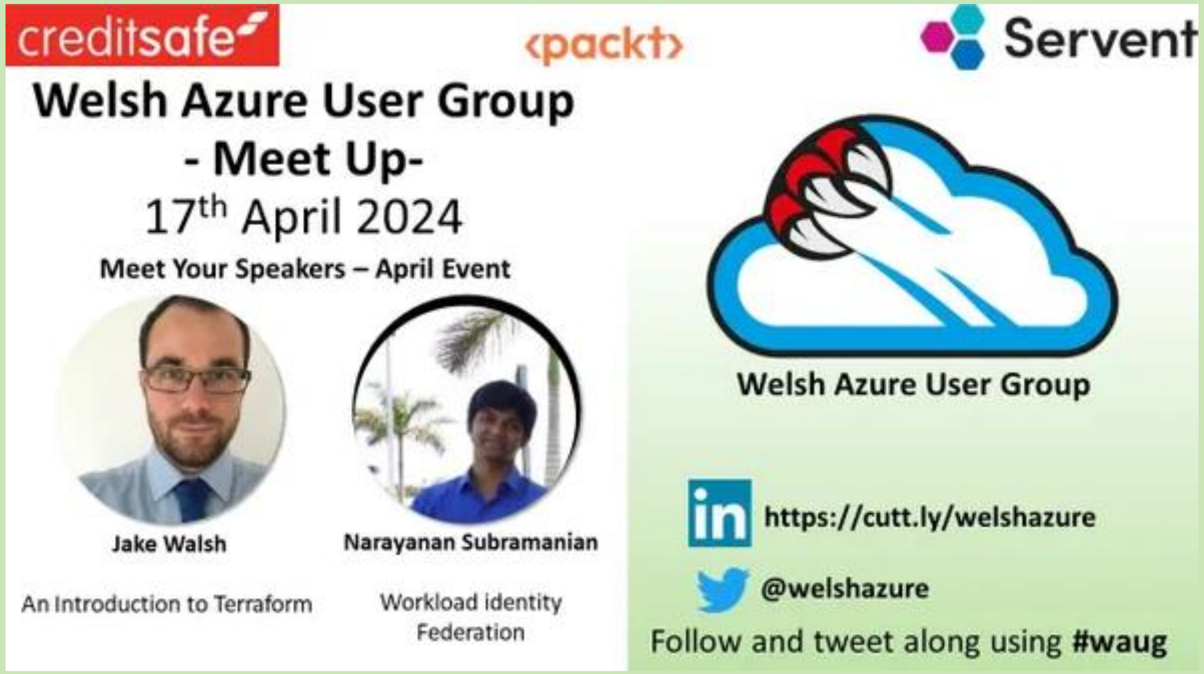

Thank You!



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Servent

Welsh Azure User Group
- Meet Up-
17th April 2024
Meet Your Speakers – April Event

Jake Walsh
An Introduction to Terraform

Narayanan Subramanian
Workload identity Federation

Welsh Azure User Group

https://cutt.ly/welshazure

@welshazure

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