Terraform

Lokeshkumar
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Objectives

- Introduction to IaC
- Types of IaC Tools
- Why Terraform?
- HCL Basics
- Provision, Update and Destory
- Providers
- Input Variables
- Output Variables
- Resource Attributes
- Resource Dependencies

Objectives

- Terraform State
- Commands
- Mutable vs Immutable
- LifeCycle Rules
- Datasources
- Meta-Arguments
- count
- for-each
- Version Constraints
- AWS Basics

Objectives

- Programmatic Access
- IAM Basics
- IAM with Terraform
- Introduction to S3
- S3 with Terraform
- Introduction to DynanoDB
- DynamoDB with Terraform

Objectives

- Remote State
- State Locking
- Remote Backend with S3
- State Commands
- Introduction to EC2
- AWS EC2 With Terraform
- Provisioners

Objectives

- Terraform Taints
- Debugging
- Terraform Import
- Modules
- Functions
- Conditional Expressions
- Workspaces
- Terraform Cloud

Traditional IT & Challengers

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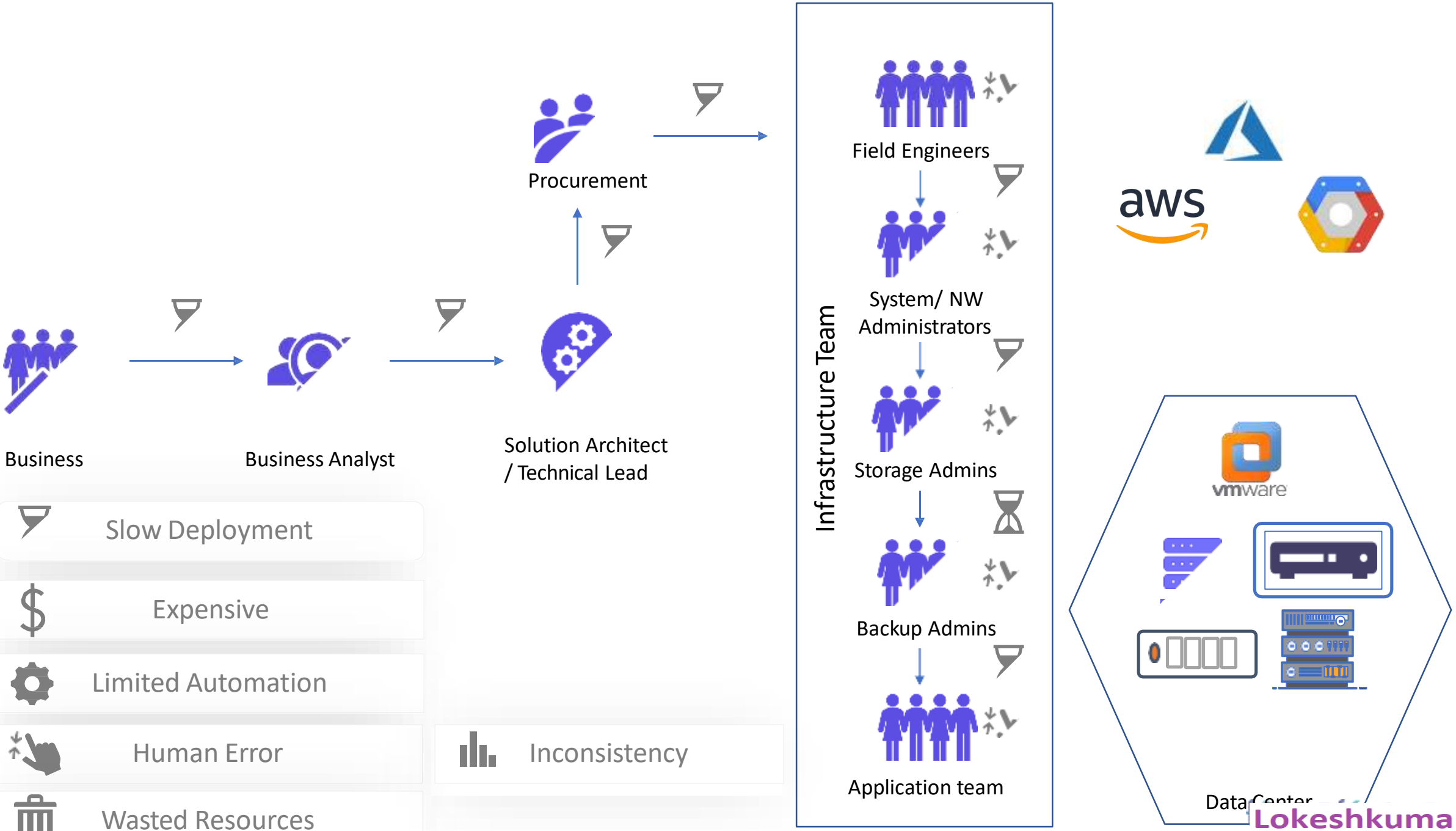
Procurement
Business
Business Analyst
Solution Architect
/ Technical Lead
Infrastructure Team
Field Engineers
System/ NW
Administrators
Storage Admins
Backup Admins
Application team
aws
vmware
Data Center
Slow Deployment
Expensive
Limited Automation
Human Error
Inconsistency
Wasted Resources
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Step 7: Review Instance Launch

Please review your instance launch details. You can go back to edit changes for each section. Click **Launch** to assign a key pair to your instance and complete the launch process.

AMI Details

Amazon Linux 2 AMI (HVM), SSD Volume Type - ami-0b1e2eeb33ce3d66f

Free tier eligible

Amazon Linux 2 comes with five years support. It provides Linux kernel 4.14 tuned for optimal performance on Amazon EC2, systemd 219, GCC 7.3, Glibc 2.26, Binutils 2.29.1, and the latest software packages through extra

Root Device Type: ebs Virtualization type: hvm

Instance Type

Instance Type	ECUs	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance
t2.micro	Variable	1	1	EBS only	-	Low to Moderate

Security Groups

Security group name launch-wizard-1
Description launch-wizard-1 created 2020-07-09T15:48:36.426-04:00

Type	Protocol	Port Range	Source	Description

This security group has no rules

Instance Details

Number of instances 1
Network vpc-fe3baa86
Subnet No preference (default subnet in any Availability Zone)

Purchasing option On demand

Infrastructure as Code

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Infrastructure as Code

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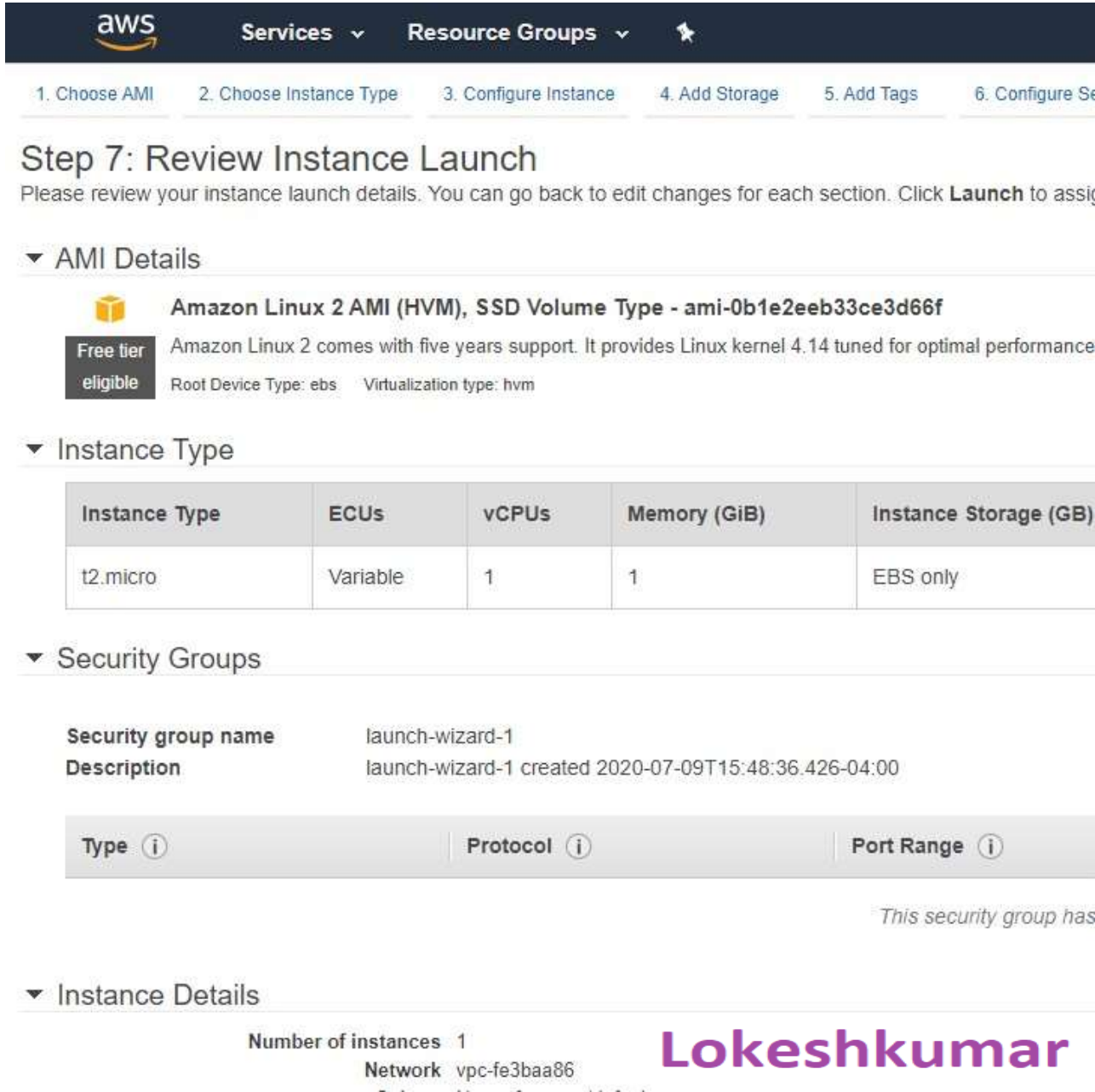
Infrastructure as Code

ec2.sh

```
#!/bin/bash

IP_ADDRESS="10.2.2.1"

EC2_INSTANCE=$(ec2-run-instances --instance-type
t2.micro ami-0edab43b6fa892279)

INSTANCE=$(echo ${EC2_INSTANCE} | sed 's/*INSTANCE //'
| sed 's/ .*//')

# Wait for instance to be ready
while ! ec2-describe-instances $INSTANCE | grep -q
"running"
do
  echo Waiting for $INSTANCE is to be ready...
done

# Check if instance is not provisioned and exit
if [ ! $(ec2-describe-instances $INSTANCE | grep -q
"running") ]; then
  echo Instance $INSTANCE is stopped.
  exit
fi

ec2-associate-address $IP_ADDRESS -i $INSTANCE

echo Instance $INSTANCE was created successfully!!!
```



Infrastructure as Code

ec2.sh

```
#!/bin/bash

IP_ADDRESS="10.2.2.1"

EC2_INSTANCE=$(ec2-run-instances --instance-type
t2.micro ami-0edab43b6fa892279)

INSTANCE=$(echo ${EC2_INSTANCE} | sed 's/*INSTANCE //'
| sed 's/ .*//')

# Wait for instance to be ready
while ! ec2-describe-instances $INSTANCE | grep -q
"running"
do
  echo Waiting for $INSTANCE is to be ready...
done

# Check if instance is not provisioned and exit
if [ ! $(ec2-describe-instances $INSTANCE | grep -q
"running") ]; then
  echo Instance $INSTANCE is stopped.
  exit
fi

ec2-associate-address $IP_ADDRESS -i $INSTANCE

echo Instance $INSTANCE was created successfully!!!
```

main.tf

```
resource "aws_instance"  "webserver"  {
  ami           = "ami-0edab43b6fa892279"
  instance_type = "t2.micro"
}
```

Infrastructure as Code

ec2.yaml

```yaml
-   amazon.aws.ec2:
    key_name: mykey
    instance_type: t2.micro
    image:  ami-123456
    wait: yes
    group: webserver
    count: 3
    vpc_subnet_id: subnet-29e63245
    assign_public_ip: yes
```

main.tf

```
resource "aws_instance"  "webserver"  {
  ami           = "ami-0edab43b6fa892279"
  instance_type = "t2.micro"
}
```

Types of IAC Tools

Types of IAC Tools

Configuration Management

Server Templating

Provisioning Tools

Types of IAC Tools

Configuration Management

Designed to Install and Manage Software

Maintains Standard Structure

Version Control

Idempotent

Server Templating Tools

Pre Installed Software and Dependencies

Virtual Machine or Docker Images

Immutable Infrastructure

Provisioning Tools

Deploy Immutable Infrastructure resources

Servers, Databases, Network Components etc.

Multiple Providers

Terraform

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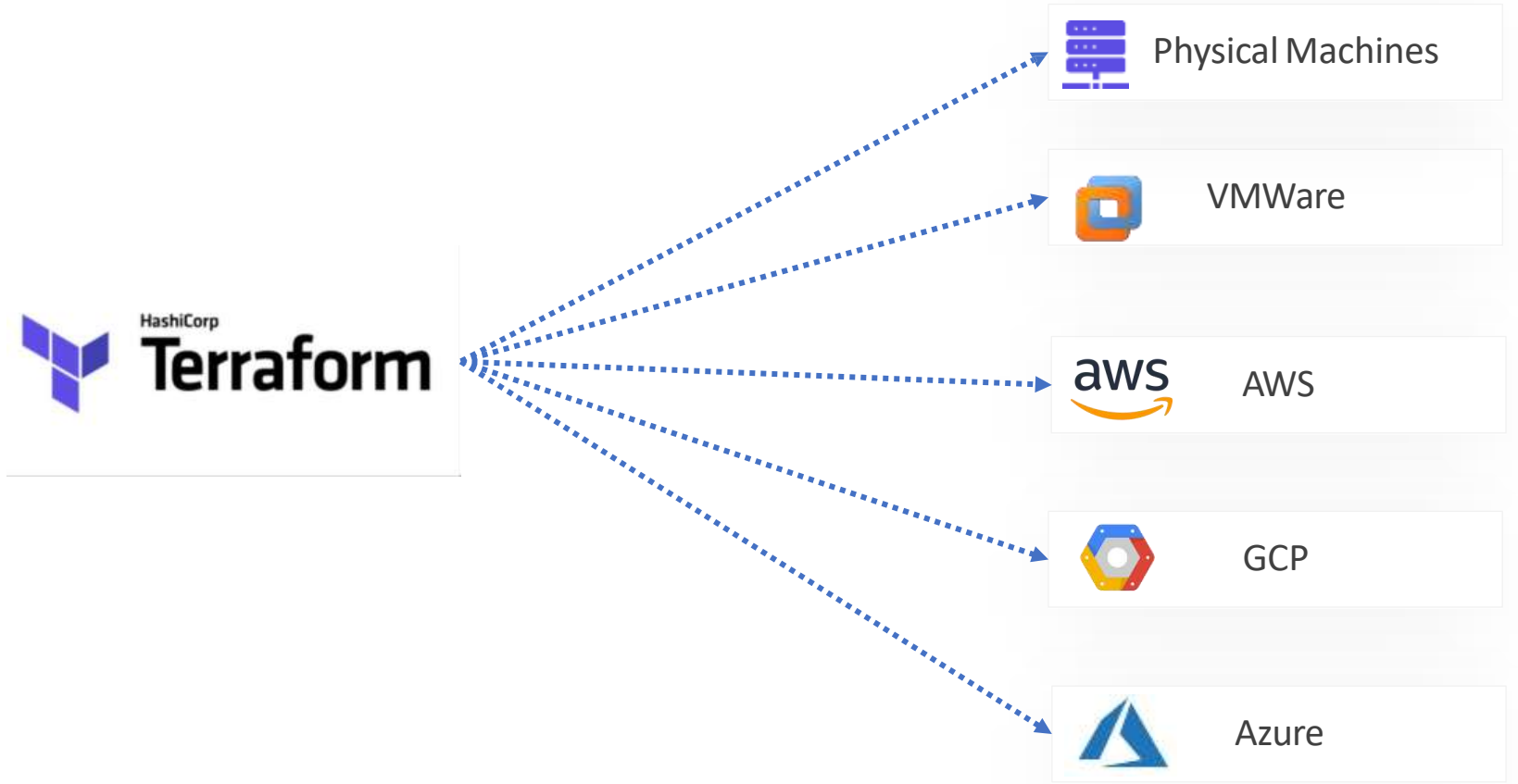
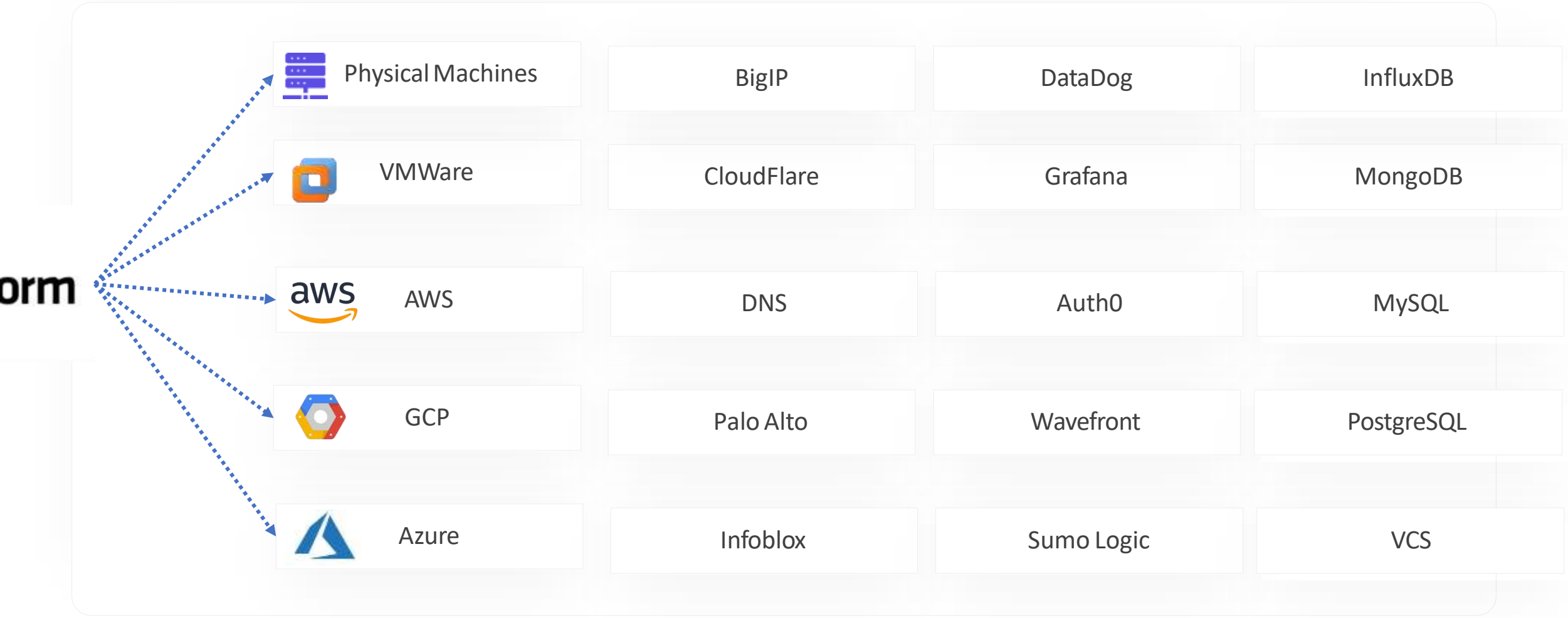
Why Terraform?



Providers



HashiCorp Configuration Language

main.tf

```
resource "aws_instance"  "webserver"  {
  ami           = "ami-0edab43b6fa892279"
  instance_type = "t2.micro"
}

resource "aws_s3_bucket" "finance" {
    bucket = "finanace-21092020"
    tags   = {
        Description = "Finance and Payroll"
    }
}
 resource "aws_iam_user" "admin-user" {
     name = "lucy"
     tags = {
       Description = "Team Leader"
     }
 }
```

Declarative

main.tf

```
resource "aws_instance" "webserver" {
  ami           = "ami-0edab43b6fa892279"
  instance_type = "t2.micro"
}

resource "aws_s3_bucket" "finance" {
    bucket = "finanace-21092020"
    tags   = {
        Description = "Finance and Payroll"
    }
}
 resource "aws_iam_user" "admin-user" {
     name = "lucy"
     tags = {
       Description = "Team Leader"
     }
 }
```

Init

Plan

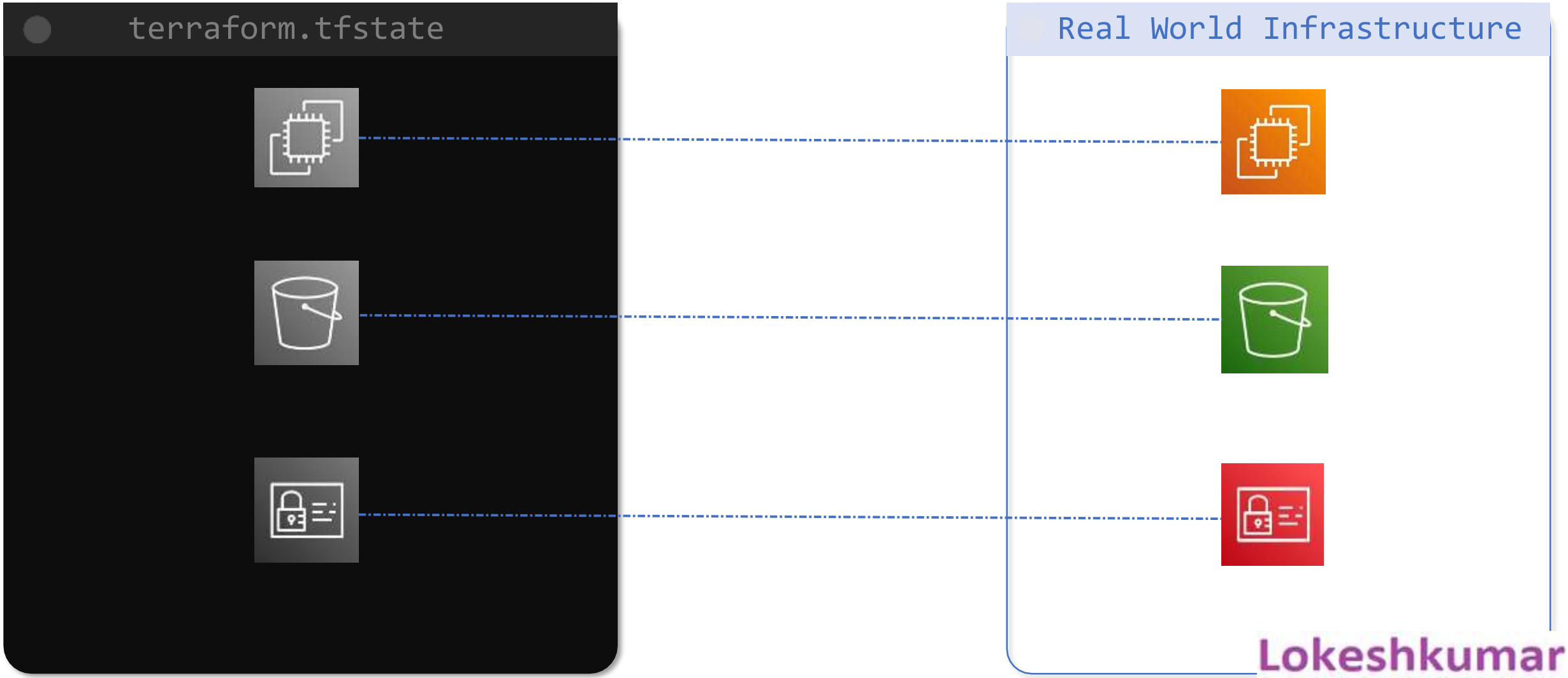
Apply

Real World Infrastructure

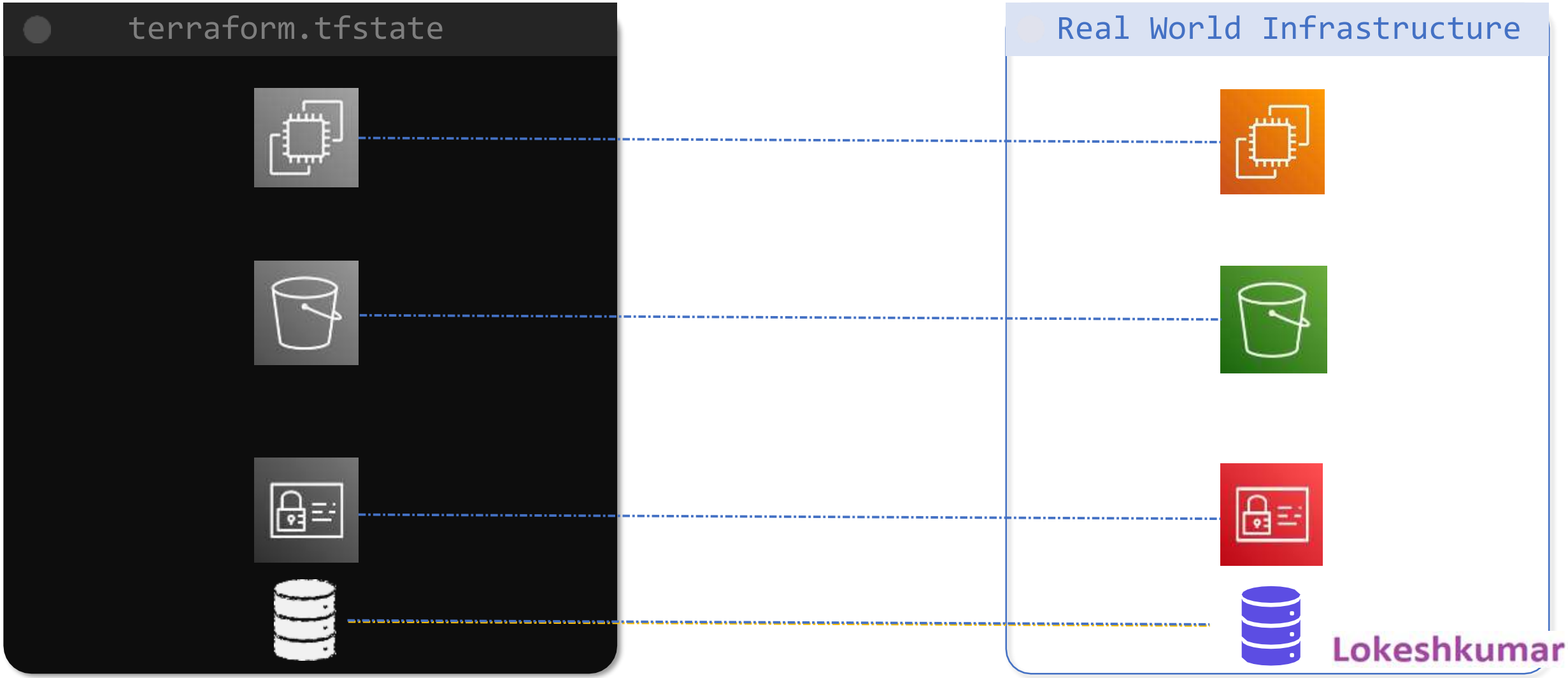
Resource

Real World Infrastructure

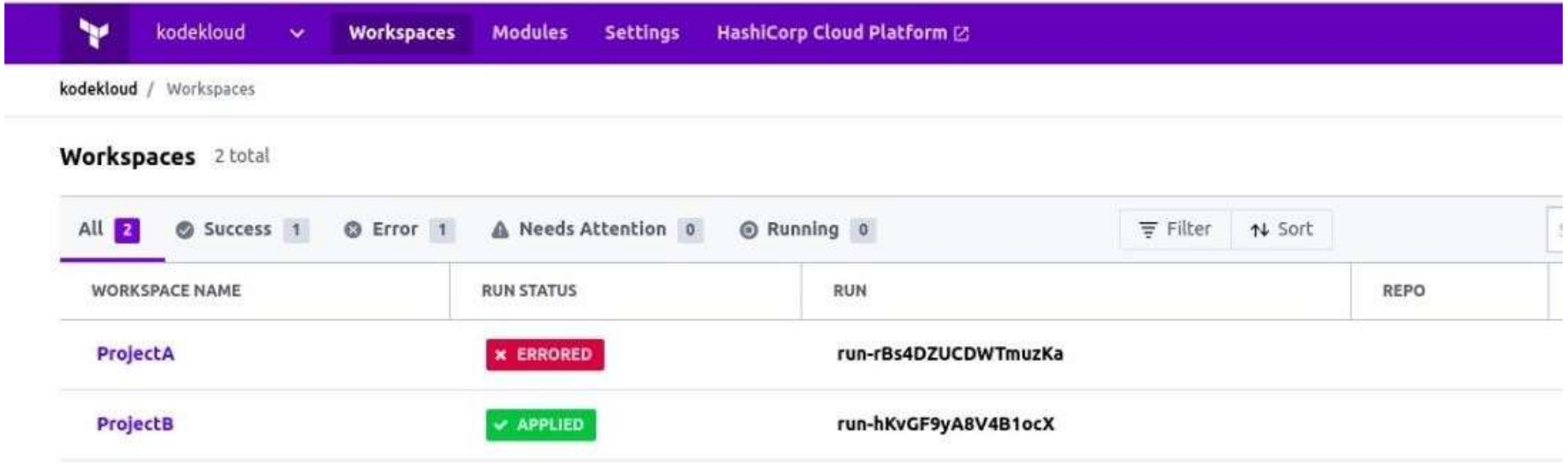
Terraform State



Terraform Import



Terraform Cloud and Terraform Enterprise



Installing Terraform

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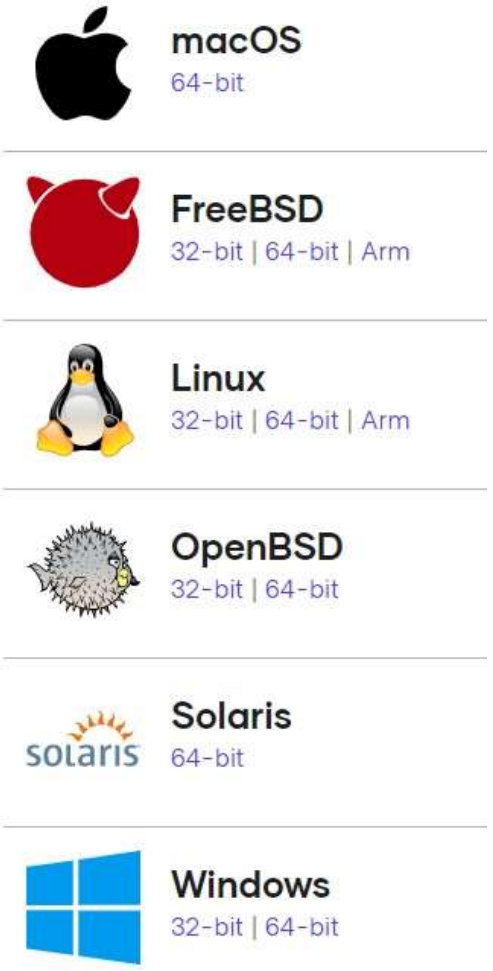
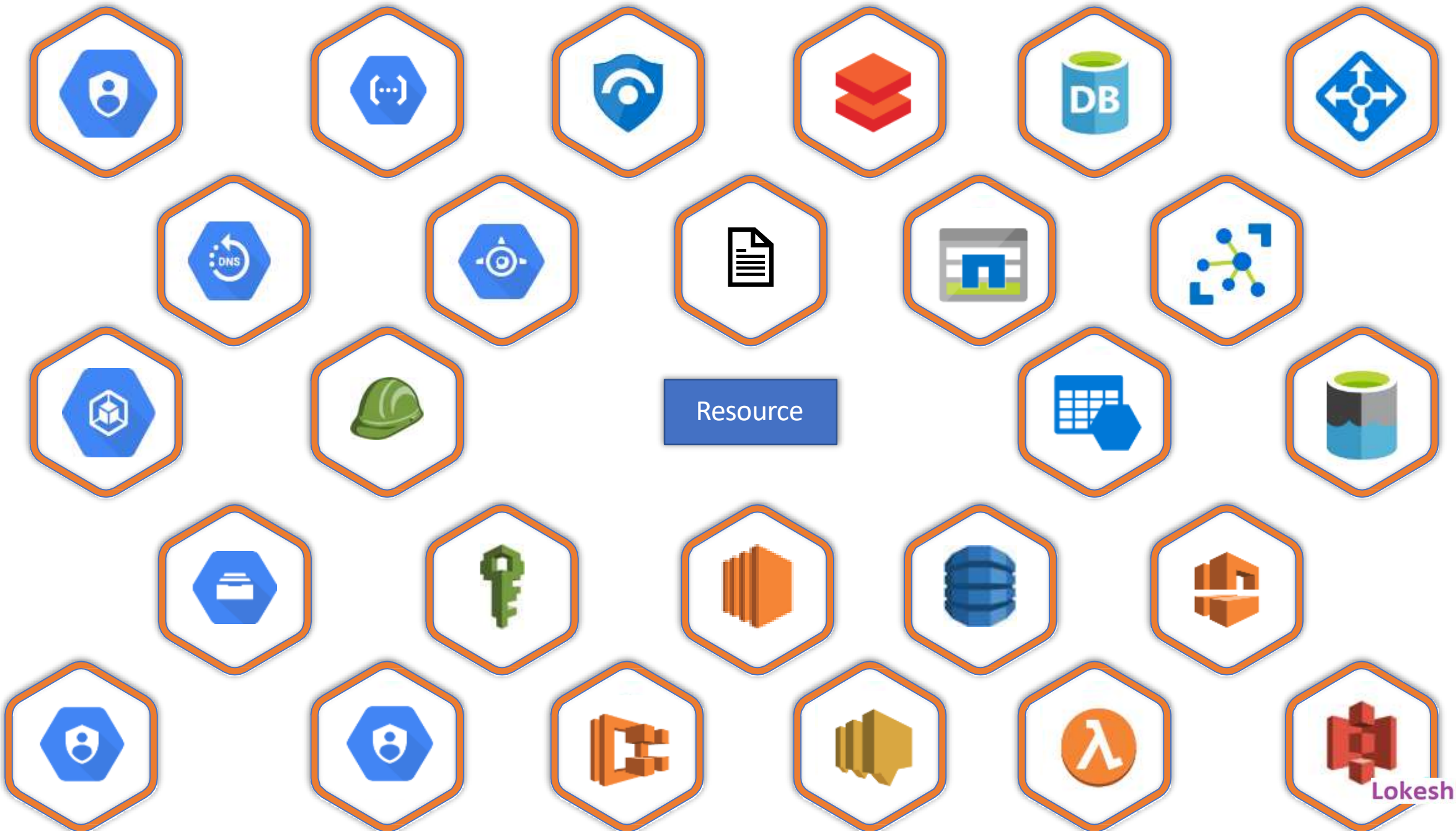
```
>_

$ wget
https://releases.hashicorp.com/terraform/0.13.0/terraform_0.13.0_linux_amd64.zip

$ unzip terraform_0.13.0_linux_amd64.zip

$ mv terraform /usr/local/bin

$ terraform version
  Terraform v0.13.0
```



HCL – Declarative Language

aws.tf

```
resource "aws_instance" "webserver" {
    ami = "ami-0c2f25c1f66a1ff4d"
    instance_type = "t2.micro"
}
```



Resource

HCL BASICS

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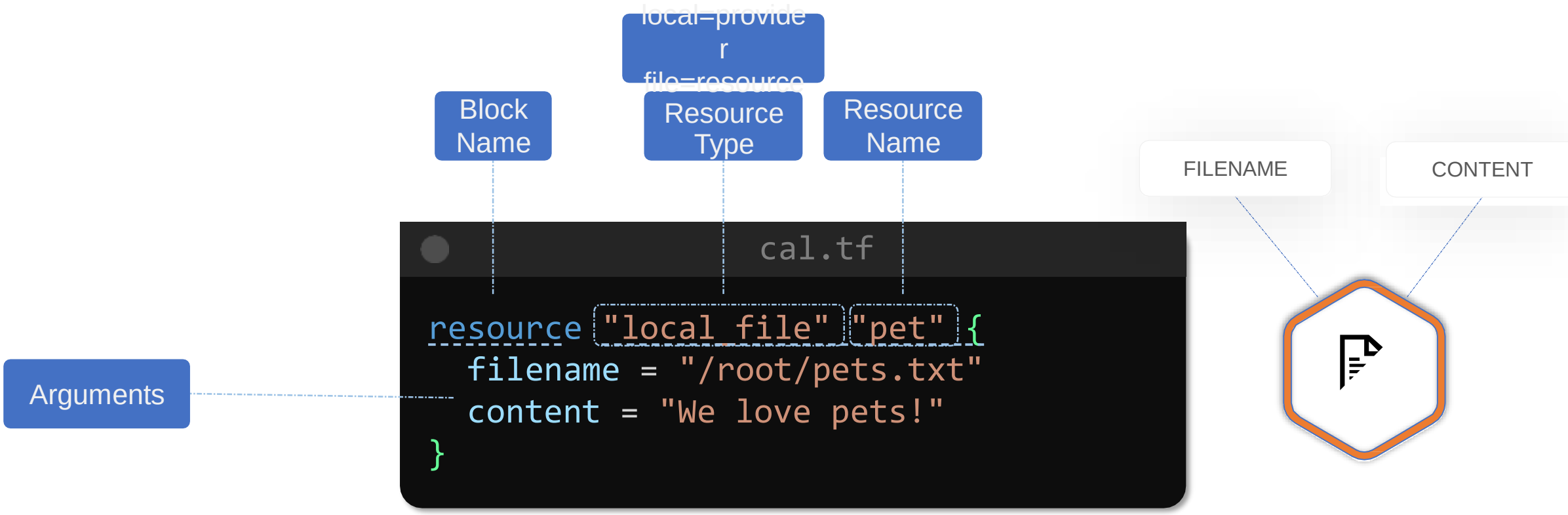
```
>_
$ mkdir /root/terraform-local-file
$ cd /root/terraform-local-file
```

local.tf

```
resource "local_file" "pet" {
  filename = "/root/pets.txt"
  content = "We love pets!"
}
```



aws-ec2.tf

```
resource "aws_instance" "webserver" {
    ami = "ami-0c2f25c1f66a1ff4d"
    instance_type = "t2.micro"
}
```

aws-s3.tf

```
resource "aws_s3_bucket"  "data"  {
    bucket = "webserver-bucket-org-2207"
    acl    = "private"
 }
```

local.tf

```
resource "local_file" "pet" {
  filename = "/root/pets.txt"
  content = "We love pets!"
}
```

local.tf

```
resource "local_file" "pet" {
  filename = "/root/pets.txt"
  content = "We love pets!"
}
```

>_

```
$ terraform init
Initializing the backend...

Initializing provider plugins...
- Finding latest version of hashicorp/local...
- Installing hashicorp/local v1.4.0...
- Installed hashicorp/local v1.4.0 (signed by HashiCorp)

The following providers do not have any version constraints in
configuration, so the latest version was installed.

To prevent automatic upgrades to new major versions that may contain breaking
changes, we recommend adding version constraints in a required_providers
block in your configuration, with the constraint strings suggested below.

* hashicorp/local: version = "~> 1.4.0"

Terraform has been successfully initialized!
```

```
$ terraform plan
Refreshing Terraform state in-memory prior to plan...
The refreshed state will be used to calculate this plan, but will not
be persisted to local or remote state storage.


------------------------------------------------------------------------

An execution plan has been generated and is shown below.
Resource actions are indicated with the following symbols:
  + create

Terraform will perform the following actions:

  # local_file.pet will be created
  + resource "local_file" "pet" {
      + content              = "We love pets!"
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/pets.txt"
      + id                   = (known after apply)
    }

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

------------------------------------------------------------------------

Note: You didn't specify an "-out" parameter to save this plan, so
Terraform
can't guarantee that exactly these actions will be performed if
"terraform apply" is subsequently run.
```

```
$ terraform apply
An execution plan has been generated and is shown below.
Resource actions are indicated with the following symbols:
  + create

Terraform will perform the following actions:

  # local_file.pet will be created
  + resource "local_file" "pet" {
      + content              = "We love pets!"
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/pets.txt"
      + id                   = (known after apply)
    }

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

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

local_file.new_file: Creating...
local_file.new_file: Creation complete after 0s
[id=521c5c732c78cb42cc9513ecc7c0638c4a115b55]
Apply complete! Resources: 1 added, 0 changed, 0 destroyed.

$ cat /root/pets.txt
We love pets!
```

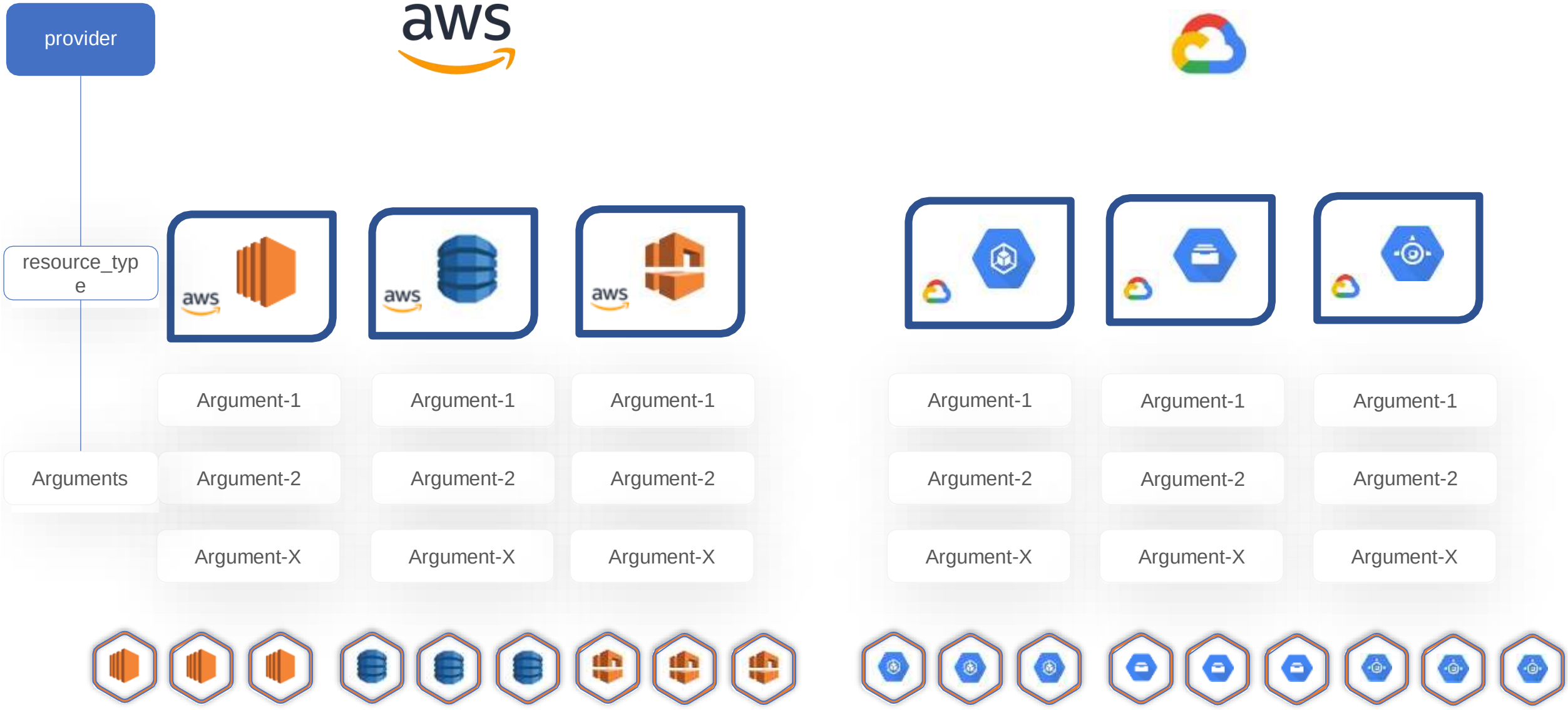
```
$ terraform show
# local_file.pet:
resource "local_file" “pet" {
    content              = "We love pets!"
    directory_permission = "0777"
    file_permission      = "0777"
    filename             = "/root/pets.txt"
    id                   = "cba595b7d9f94ba1107a46f3f731912d95fb3d2c"
}
```

local=provide
r
file=resource

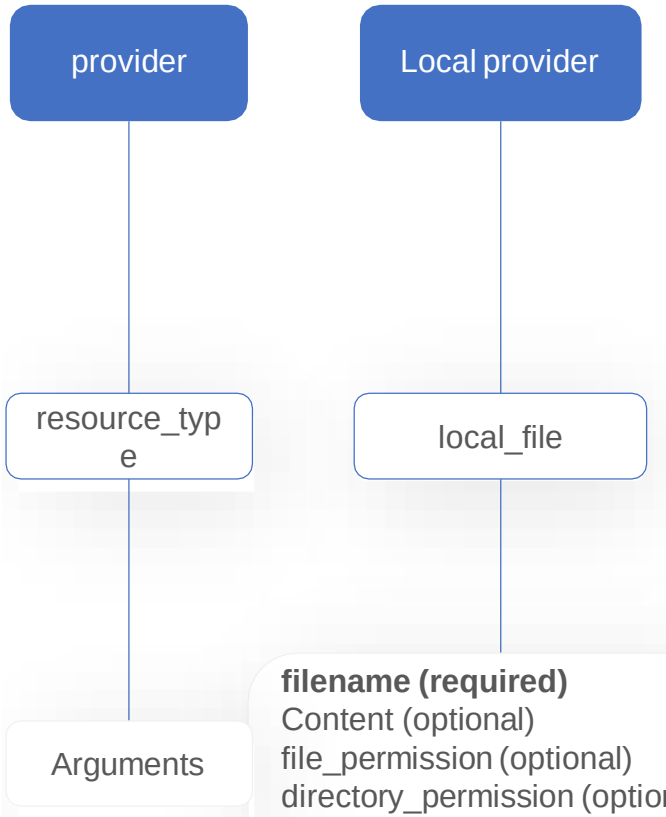
Resource Type

local.tf

```
resource "local_file" "pet" {
  filename = "/root/pets.txt"
  content = "We love pets!"
}
```



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



Argument Reference

The following arguments are supported:

- `content` - (Optional) The content of file to create. Conflicts with `sensiti` `content_base64` .
- `sensitive_content` - (Optional) The content of file to create. Will not be c Conflicts with `content` and `content_base64` .
- `content_base64` - (Optional) The base64 encoded content of the file to c when dealing with binary data. Conflicts with `content` and `sensitive_co`
- `filename` - (Required) The path of the file to create.
- `file_permission` - (Optional) The permission to set for the created file. E string. The default value is `"0777"` .
- `directory_permission` - (Optional) The permission to set for any directori Expects a string. The default value is `"0777"` .

Updates and Destroy Infrastructure

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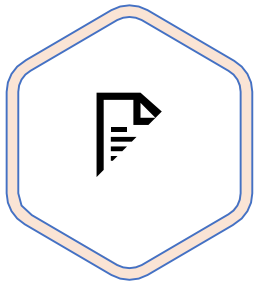
local.tf

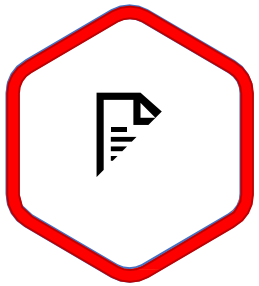
```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
    file_permission = "0700"

}
```



```
$ terraform plan
local_file.pet: Refreshing state...
[id=5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf]

------------------------------------------------------------------------

An execution plan has been generated and is shown below.
Resource actions are indicated with the following symbols:
-/+ destroy and then create replacement

Terraform will perform the following actions:

  # local_file.pet must be replaced
-/+ resource "local_file" "pet" {
        content              = "We love pets!"
        directory_permission = "0777"
      ~ file_permission      = "0777" -> "0700" # forces replacement
        filename             = "/root/pet.txt"
      ~ id                   =
"5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf" -> (known after apply)
    }

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

------------------------------------------------------------------------

Note: You didn't specify an "-out" parameter to save this plan, so
Terraform
can't guarantee that exactly these actions will be performed if
"terraform apply" is subsequently run.
```

```
$ ls -ltr /root/pets.txt
-rwx------  1 root root 30 Aug 17 23:20 pet.txt
```

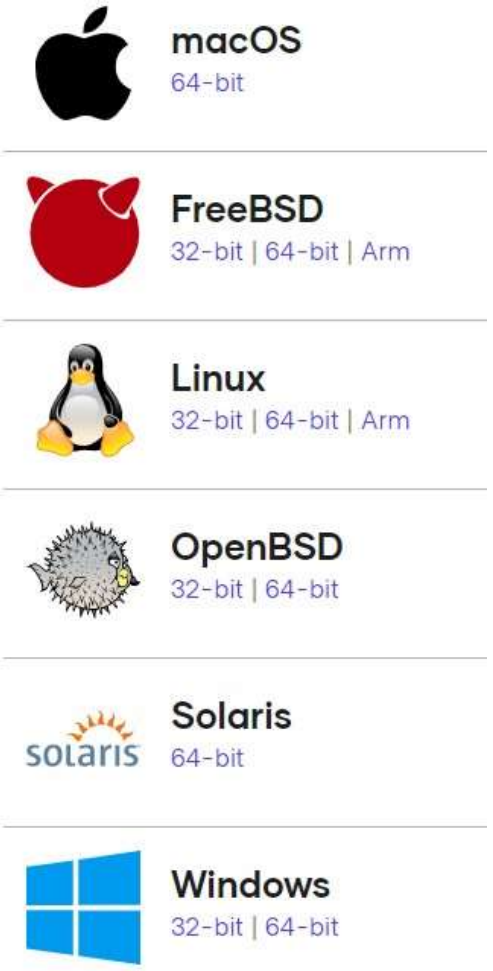
```
$ terraform apply

# local_file.pet must be replaced
-/+ resource "local_file" "pet" {
        content              = "We love pets!"
        directory_permission = "0777"
      ~ file_permission      = "0777" -> "0700" # forces replacement
        filename             = "/root/pet.txt"
      ~ id                   =
"5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf" -> (known after apply)
    }

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

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

local_file.pet: Destroying...
[id=5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf]
local_file.pet: Destruction complete after 0s
local_file.pet: Creating...
local_file.pet: Creation complete after 0s
[id=5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf]

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



```
$ terraform destroy
local_file.pet: Refreshing state...
[id=5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf]

An execution plan has been generated and is shown below.
Resource actions are indicated with the following symbols:
  - destroy

Terraform will perform the following actions:

  # local_file.pet will be destroyed
  - resource "local_file" "pet" {
      - content              = "My favorite pet is a gold fish" -> null
      - directory_permission = "0777" -> null
      - file_permission      = "0700" -> null
      - filename             = "/root/pet.txt" -> null
      - id                   = "5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf" -
> null
    }

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

Do you really want to destroy all resources?
  Terraform will destroy all your managed infrastructure, as shown above.
  There is no undo. Only 'yes' will be accepted to confirm.

  Enter a value: yes

local_file.pet: Destroying... [id=5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf]
local_file.pet: Destruction complete after 0s

Destroy complete! Resources: 1 destroyed.
```

Installing Terraform

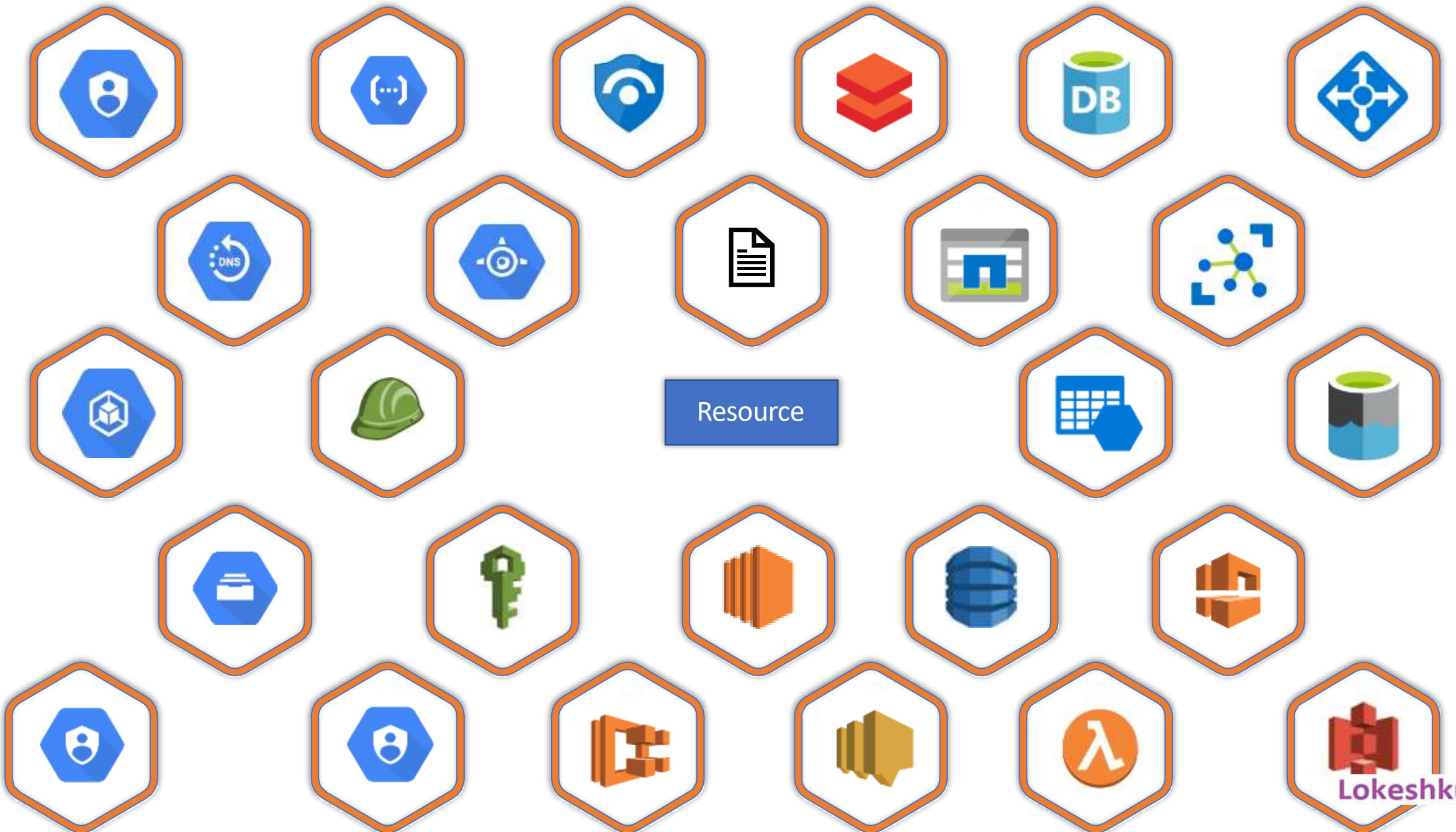
```
>_

$ wget
https://releases.hashicorp.com/terraform/0.13.0/terraform_0.13.0_linux_amd64.zip

$ unzip terraform_0.13.0_linux_amd64.zip

$ mv terraform /usr/local/bin

$ terraform version
  Terraform v0.13.0
```



HCL – Declarative Language

aws.tf

```
resource "aws_instance" "webserver" {
    ami = "ami-0c2f25c1f66a1ff4d"
    instance_type = "t2.micro"
}
```



Resource

Using Terraform Providers

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```
>_

$ terraform init
```

Official

Verified

bigip
by: F5Networks

heroku
by: heroku

digitalocean
by: digitalocean

Community

activedirectory

ucloud

netapp-gcp

registry.terraform.io

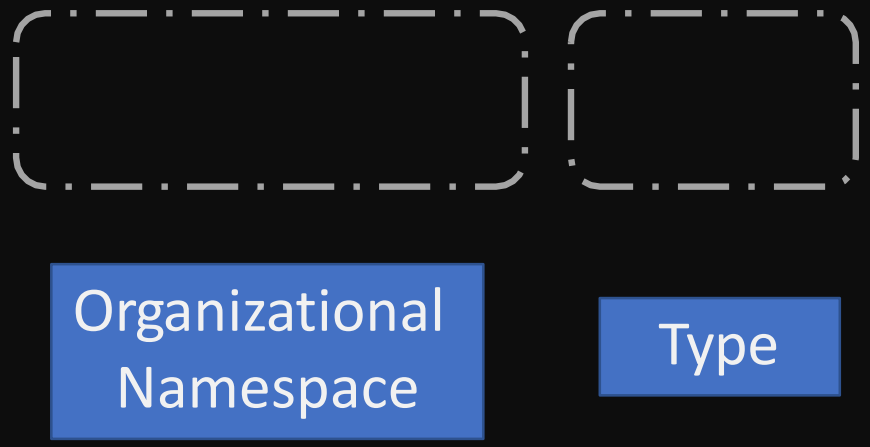
```
$ terraform init
Initializing the backend...

Initializing provider plugins...
- Finding latest version of hashicorp/local...
- Installing hashicorp/local v2.0.0...
- Installed hashicorp/local v2.0.0 (signed by HashiCorp)

The following providers do not have any version constraints
in
configuration,
so the latest version was installed.

To prevent automatic upgrades to new major versions that
may contain breaking
changes, we recommend adding version constraints in
a required_providers block
in your configuration, with the constraint strings suggested
below.

* hashicorp/local: version = "~> 2.0.0"

Terraform has been successfully

initialized!
```

```
$ ls /root/terraform-local-
file/.terraform plugins
```

To prevent automatic upgrades to new maj

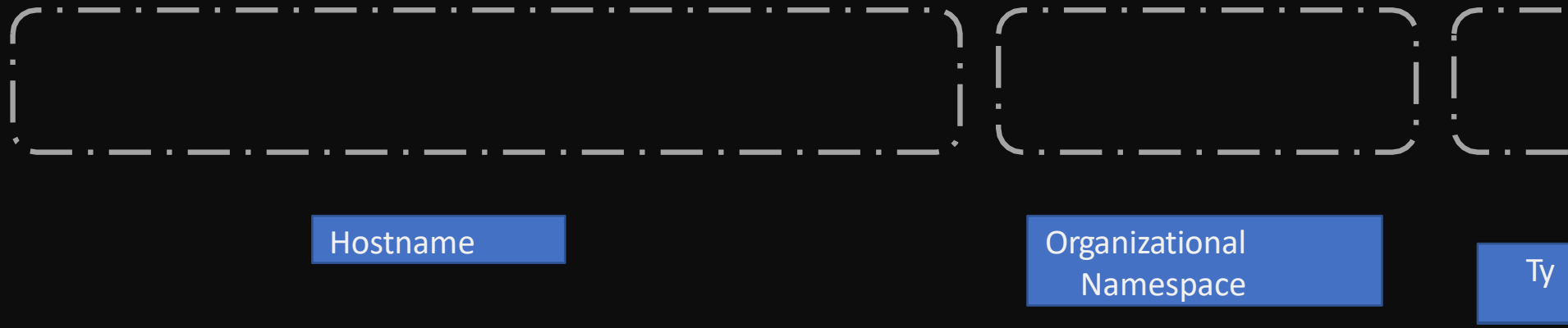
contain breaking
changes, we recommend adding version con required_providers block
in your configuration, with the constrai below.

```
* hashicorp/local: version = "~> 2.0.0"
```



Terraform has been successfully initiali

```
To prevent automatic upgrades to new maj

contain breaking
changes, we recommend adding version con required_providers block
in your configuration, with the constrai below.

*         registry.terraform.io/ hashicorp/loc
```




```
Terraform has been successfully initiali
```

```
Initializing provider plugins...
- Finding latest version of hashicorp/local...
- Installing hashicorp/local v2.0.0...
- Installed hashicorp/local v2.0.0 (signed by H

The following providers do not have any version
configuration,
so the latest version was installed.

To prevent automatic upgrades to new major vers
contain breaking
changes, we recommend adding version constraint
required_providers block
```

Configuration Directory

Lokeshkumar

```
>_

[terraform-local-file]$ ls /root/terraform-local-
file local.tf
```

local.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
}
```

cat.tf

```
resource "local_file"  "cat" {
    filename = "/root/cat.txt"
    content = "My favorite pet is Mr. Whiskers"

}
```

local.tf

cat.tf

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
}

resource "local_file"  "cat" {
    filename = "/root/cat.txt"
    content = "My favorite pet is Mr. Whiskers"

}
```

File Name	Purpose
main.tf	Main configuration file containing resource definition
variables.tf	Contains variable declarations
outputs.tf	Contains outputs from resources
provider.tf	Contains Provider definition

Multiple Providers

Lokeshkumar

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
}
```

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
}


resource "random_pet" "my-pet" {
    prefix = "Mrs"
    separator = "."
    length = "1"
}
```

random provider

Resources

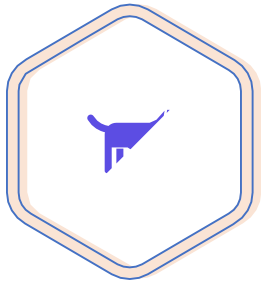
- random_id
- random_integer
- random_password
- random_pet
- random_shuffle
- random_string
- random_uuid

Argument Reference

The following arguments are supported:

- `keepers` - (Optional) Arbitrary map of values that, w
  to be generated. See the main provider documentati
- `length` - (Optional) The length (in words) of the pet
- `prefix` - (Optional) A string to prefix the name with
- `separator` - (Optional) T

```
$ terraform plan
Refreshing Terraform state in-memory prior to plan...
The refreshed state will be used to calculate this plan,
but will not be
persisted to local or remote state storage.

local_file.pet: Refreshing state...
[id=d1a31467f206d6ea8ab1cad382bc106bf46df69e]


.
.
  # random_pet.my-pet will be created
  + resource "random_pet" "my-pet" {
      + id        = (known after apply)
      + length    = 1
      + prefix    = "Mrs"
      + separator = "."
    }

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



```
$ terraform init
Initializing the backend...

Initializing provider plugins...
- Using previously-installed hashicorp/local v2.0.0
- Finding latest version of hashicorp/random...
- Installing hashicorp/random v2.3.0...
- Installed hashicorp/random v2.3.0 (signed by HashiCorp)

The following providers do not have any version constraints in
configuration,
so the latest version was installed.

To prevent automatic upgrades to new major versions that may contain
breaking
changes, we recommend adding version constraints in a
required_providers block
in your configuration, with the constraint strings suggested below.

* hashicorp/local: version = "~> 2.0.0"
* hashicorp/random: version = "~> 2.3.0"

Terraform has been successfully initialized!
```

```
$ terraform apply
local_file.new_file: Refreshing state...
[id=d1a31467f206d6ea8ab1cad382bc106bf46df69e]

An execution plan has been generated and is shown below.
Resource actions are indicated with the following
symbols:
  + create

Terraform will perform the following actions:
  # random_pet.my-pet will be created
  + resource "random_pet" "my-pet" {
      + id        = (known after apply)
      + length    = 1
      + prefix    = "Mrs"
      + separator = "."
    }

Plan: 1 to add, 0 to change, 0 to

destroy. random_pet.my-pet: Creating...
random_pet.my-pet: Creation complete after 0s [id=Mrs.hen]

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

Mrs.hen

Define Input Variables

Lokeshkumar

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"

}

resource "random_pet" "my-pet" {
    prefix = "Mrs"
    separator = "."
    length = "1"
}
```

Argument	Value
filename	"/root/pets.txt"
content	"We love pets!"
prefix	"Mrs"
separator	"."
length	"1"

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"

}

resource "random_pet" "my-pet" {
    prefix = "Mrs"
    separator = "."
    length = "1"
}
```

variables.tf

```
variable "filename" {
        default = "/root/pets.txt"
}
variable "content" {
        default = "We love pets!"
}
variable "prefix" {
        default = "Mrs"
}
variable "separator" {
        default = "."
}
variable "length" {
        default = "1"
}
```

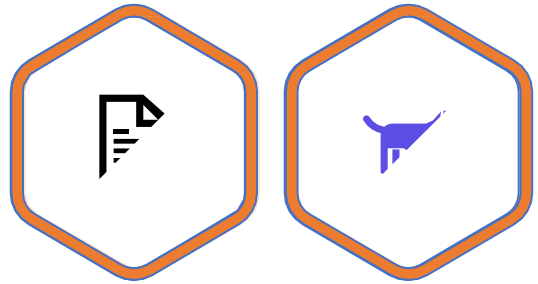
main.tf

```
resource "local_file" "pet" {
    filename = var.filename
    content = var.content

}

resource "random_pet" "my-pet" {
    prefix = var.prefix
    separator = var.separator
    length = var.length
}
```

variables.tf

```
variable "filename" {
        default = "/root/pets.txt"
}
variable "content" {
        default = "We love pets!"
}
variable "prefix" {
        default = "Mrs"
}
variable "separator" {
        default = "."
}
variable "length" {
        default = "1"
}
```

```
$ terraform apply
# local_file.pet will be created
  + resource "local_file" "pet" {
      + content              = “We love pets!"
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/pet.txt"
      + id                   = (known after apply)
    }

  # random_pet.my-pet will be created
  + resource "random_pet" "my-pet" {
      + id        = (known after apply)
      + length    = 1
      + prefix    = "Mrs"
      + separator = "."
    }

Plan: 2 to add, 0 to change, 0 to destroy.
.
.
random_pet.my-pet: Creating...
random_pet.my-pet: Creation complete after 0s
[id=Mrs.ram] local_file.pet: Creating...
local_file.pet: Creation complete after 0s
[id=f392b4bcf5db76684f719bf72061627a9a177de1]
```



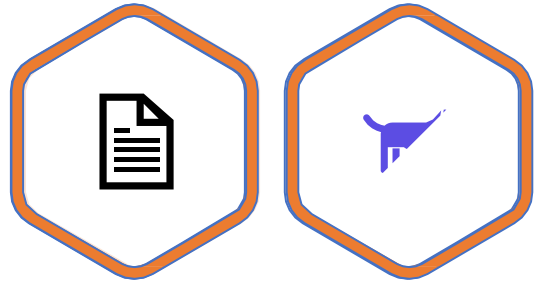
main.tf

```
resource "local_file" "pet" {
    filename = var.filename
    content = var.content

}

resource "random_pet" "my-pet" {
    prefix = var.prefix
    separator = var.separator
    length = var.length
}
```

variables.tf

```
variable "filename" {
    default = "/root/pets.txt"
}
variable "content" {
    default = "My favorite pet is Mrs. Whiskers"
}
variable "prefix" {
    default = "Mrs"
}
variable "separator" {
    default = "."
}
variable "length" {
    default = "2"
}
```

```
>_

$ terraform apply
Terraform will perform the following actions:

-/+ resource "local_file" "pet" {
      ~ content              = “We love pets!" -> "My favorite pet is Mrs. Whiskers!"
# forces replacement
        directory_permission = "0777"
        file_permission      = "0777"
        filename             = "/root/pet.txt"
      ~ id                   = "bc9cabef1d8b0071d3c4ae9959a9c328f35fe697" -> (known after
apply)
    }

  # random_pet.my-pet must be replaced
-/+ resource "random_pet" "my-pet" {
      ~ id        = "Mrs.Hen" -> (known after apply)
      ~ length    = 1 -> 2 # forces replacement
        prefix    = "Mrs"
        separator = "."
    }

Plan: 2 to add, 0 to change, 2 to destroy.
random_pet.my-pet: Destroying... [id=Mrs.hen]
random_pet.my-pet: Destruction complete after 0s
local_file.pet: Destroying...
[id=bc9cabef1d8b0071d3c4ae9959a9c328f35fe697] local_file.pet: Destruction
complete after 0s
random_pet.my-pet: Creating...
```



main.tf

```
resource "aws_instance" "webserver" {
  ami           = var.ami
  instance_type = var.instance_type
}
```

variables.tf

```
variable "ami" {
  default = "ami-0edab43b6fa892279"
}
variable "instance_type" {
  default = "t2.micro"
}
```

Understanding the Variable Block

Lokeshkumar

variables.tf

```
variable  "filename"  {
   default = "/root/pets.txt"
}
variable "content" {
    default = "I love pets!"
}
variable "prefix" {
    default = "Mrs"
}
variable "separator" {
    default = "."
}
variable "length" {
    default = "1"
}
```

variables.tf

```
variable  "filename"  {
   default = "/root/pets.txt"
   type = string
   description = "the path of local file"

}
variable "content"  {
    default = "I love pets!"
    type = string
    description = “the content of the file"

}
variable "prefix" {
    default = "Mrs"
    type = string
    description = "the prefix to be set"

}
variable "separator" {
    default = "."
```

variables.tf

```
variable  "filename"  {
   default = "/root/pets.txt"
   type = string
   description = "the path of local file"

}
variable "content"  {
    default = "I love pets!"
    type = string
    description = “the content of the file"

}
variable "prefix" {
    default = "Mrs"
    type = string
    description = "the prefix to be set"

}
variable "separator" {
    default = "."
```

Type	Example
string	"/root/pets.txt"
number	1
bool	true/false
any	Default Value

variables.tf

```
variable "length" {
  default = "2"
  type = number
  description = "length of the pet name"
}

variable "password_change" {
  default = "true"
  type = bool
}
```

Type	Example
string	"/root/pets.txt"
number	1
bool	true/false
any	Default Value
list	["cat", "dog"]
map	pet1 = cat pet2 = dog
object	Complex Data Structure
tuple	Complex Data Structure

List

variables.tf

```
variable "prefix" {
  default = ["Mr", "Mrs", "Sir"]
  type = list  0     1      2
}
```

maint.tf

```
resource "random_pet" "my-pet" {
  prefix    = var.prefix[0]
}
```

Index	Value
0	Mr
1	Mrs
2	Sir

Map

variables.tf

```
variable file-content {
  type        = map
  default     = {
      "statement1" = "We love pets!"
      "statement2" = “We love animals!"
  }
 }
```

maint.tf

```
resource local_file my-pet {
  filename  = "/root/pets.txt"
  content = var.file-content["statement2"]
}
```

Key	Value
statement1	We love pets!
statement2	We love animals!

List of a Type

variables.tf

```
variable "prefix" {
  default = ["Mr", "Mrs", "Sir"]
  type = list(string)
}
```

variables.tf

```
variable "prefix" {
  default = ["Mr", "Mrs", "Sir"]
  type = list(number)
}
```

variables.tf

```
variable "prefix" {
  default = ["1", "2", "3"]
  type = list(number)
}
```

>_

```
$ terraform plan
Error: Invalid default value for variable

  on variables.tf line 3, in variable
   "prefix": 3:     default = ["Mr", "Mrs",
   "Sir"]

This default value is not compatible with the
variable's type constraint: a number is required.
```

Map of a Type

variables.tf

```
variable "cats" {
  default = {
    "color" = "brown"
    "name" = "bella"
  }
  type = map(string)
}
```

variables.tf

```
variable "pet_count" {
  default = {
    "dogs" = "3"
    "cats" = "1"
    "goldfish" = "2"
  }
  type = map(number)
}
```

Set

variables.tf

```
variable "prefix" {
  default = ["Mr", "Mrs", "Sir"]
  type = set(string)
}
```

variables.tf

```
variable "prefix" {
  default = ["Mr", "Mrs", "Sir", "Sir"]
  type = set(string)
}
```

variables.tf

```
variable "fruit" {
  default = ["apple", “banana"]
  type = set(string)
}
```

variables.tf

```
variable "fruit" {
  default = ["apple", "banana", "banana"]
  type = set(string)
}
```

variables.tf

```
variable "age" {
  default = ["10", "12", "15"]
  type = set(number)
}
```

variables.tf

```
variable "age" {
  default = ["10", "12", "15", "10"]
  type = set(number)
}
```

Objects

Key	Example	Type
name	bella	string
color	brown	string
age	7	number
food	["fish", "chicken", "turkey"]	list
favorite_pet	true	bool

variables.tf

```
variable  "bella"  {
  type = object({
      name = string
      color = string
      age = number
      food = list(string)
      favorite_pet = bool
  })

  default = {
      name = "bella"
      color = "brown"
      age = 7
      food = ["fish", "chicken", "turkey"]
      favorite_pet = true
  }
}
```

Tuples

variables.tf

```
variable kitty {
  type        = tuple([string, number, bool])
  default     = ["cat", 7, true]

}
```

variables.tf

```
variable kitty {
  type        = tuple([string, number, bool])
  default     = ["cat", 7, true, "dog"]

}
```

>_

```
$ terraform plan

  Error: Invalid default value for variable

    on variables.tf line 3, in variable "kitty":
     3:   default     = ["cat", 7, true, "dog"]

  This default value is not compatible with
  the variable's type constraint:
  tuple required.
```

Using Variables in Terraform

Lokeshkumar

main.tf

```
resource "local_file" "pet" {
    filename = var.filename
    content = var.content

}

resource "random_pet" "my-pet" {
    prefix = var.prefix
    separator = var.separator
    length = var.length
}
```

variables.tf

```
variable "filename" {
        default = "/root/pets.txt"
}
variable "content" {
        default = "We love pets!"
}
variable "prefix" {
        default = "Mrs"
}
variable "separator" {
        default = "."
}
variable "length" {
        default = 2
}
```

main.tf

```
resource "local_file" "pet" {
    filename = var.filename
    content = var.content

}

resource "random_pet" "my-pet" {
    prefix = var.prefix
    separator = var.separator
    length = var.length
}
```

variables.tf

```
variable "filename" {

}
variable "content" {

}
variable "prefix" {

}
variable "separator" {

}
variable "length" {

}
```

Interactive Mode

```
$ terraform apply
var.content
  Enter a value: We love Pets!

var.filename
  Enter a value:  /root/pets.txt

var.length
  Enter a value:  2

var.prefix
  Enter a value:  Mrs.

var.separator
  Enter a value: .
```

Command Line Flags

```
$ terraform apply -var "filename=/root/pets.txt" -var "content=We love
Pets!"  -var "prefix=Mrs" -var "separator=." -var "length=2"
```

Environment Variables

```
>_

$ export TF_VAR_filename="/root/pets.txt"
$ export TF_VAR_content="We love pets!"
$ export TF_VAR_prefix="Mrs"
$ export TF_VAR_separator="."
$ export TF_VAR_length="2"
$ terraform apply
```

Variable Definition Files

terraform.tfvars

```
filename = "/root/pets.txt"
content = "We love pets!"
prefix = "Mrs"
separator = "."
length = "2"
```

>_

```
$ terraform apply -var-file variables.tfvars
```

Automatically Loaded

terraform.tfvars	terraform.tfvars.json
*.auto.tfvars	*.auto.tfvars.json

Variable Definition Precedence

main.tf

```
resource local_file pet {
  filename = var.filename
}
```

variables.tf

```
variable filename {
  type    = string
}
```

>_

```
$ export TF_VAR_filename="/root/cats.txt"
```

?

terraform.tfvars

```
filename = "/root/pets.txt"
```

?

variable.auto.tfvars

```
filename = "/root/mypet.txt"
```

?

>_

```
$ terraform apply -var "filename=/root/best-pet.txt"
```

?

Variable Definition Precedence

Order	Option
1	Environment Variables
2	terraform.tfvars
3	*.auto.tfvars (alphabetical order)
4	-var or –var-file (command-line flags)

```
>_
$ export TF_VAR_filename="/root/cats.txt"
```
1

terraform.tfvars
```
filename = "/root/pets.txt"
```
2

variable.auto.tfvars
```
filename = "/root/mypet.txt"
```
3

```
>_
$ terraform apply -var "filename=/root/best-pet.txt"
```
4

Resource Attribute Reference

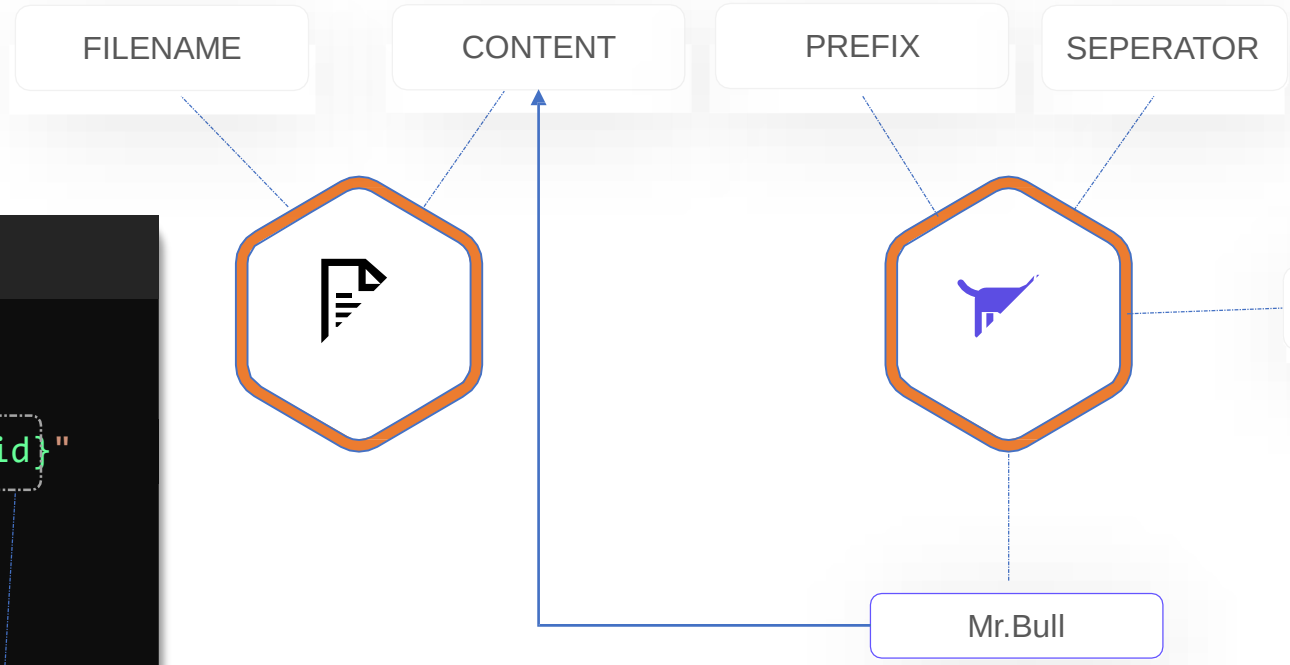
Lokeshkumar

main.tf

```
resource "local_file" "pet" {
    filename = var.filename
    content =  "My favorite pet is ${random_pet.my-pet.id}"
}

resource "random_pet" "my-pet" {
    prefix = var.prefix
    separator = var.separator
    length = var.length
}
```

```
>_

random_pet.my-pet: Creating...
local_file.pet: Creating...
random_pet.my-pet: Creation complete after
0s local_file.pet: Creation complete after 0s
[id=059090e865809f9b6debfda7aebf48fdce2220a6]

Apply complete! Resources: 2 added, 0 changed, 0
destroyed.
```

[id=Mr.bull]

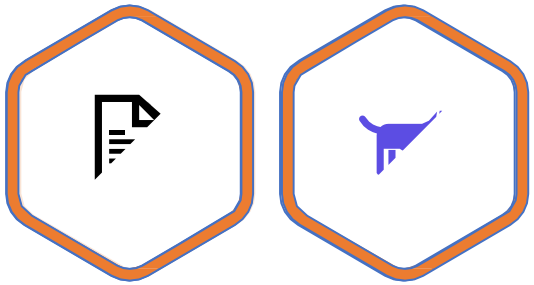


Attribute Reference

The following attributes are supported:

- `id` - (string) The random pet name

```
_file" "pet" {
ar.filename

My favorite pet is Mr.Bull"


m_pet" "my-pet" {
.prefix
var.separator
.length
```



```
$ terraform apply
.
.
.
  # local_file.pet must be replaced
-/+ resource "local_file" "pet" {
      ~ content              = "My favorite pet is Mrs.Cat!" ->
"My favorite pet is Mr.bull" # forces
        replacement directory_permission = "0777"
        file_permission      = "0777"
        filename             = "/roots/pets.txt"
      ~ id                   =
"98af5244e23508cffd4a0c3c46546821c4ccbbd0" -> (known
after apply)
    }
.
.
local_file.pet: Destroying...
[id=98af5244e23508cffd4a0c3c46546821c4ccbbd0]
local_file.pet: Destruction complete after
0s local_file.pet: Creating...
local_file.pet: Creation complete after 0s
[id=e56101d304de7cf1b1001102923c6bdeaa60c523]

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

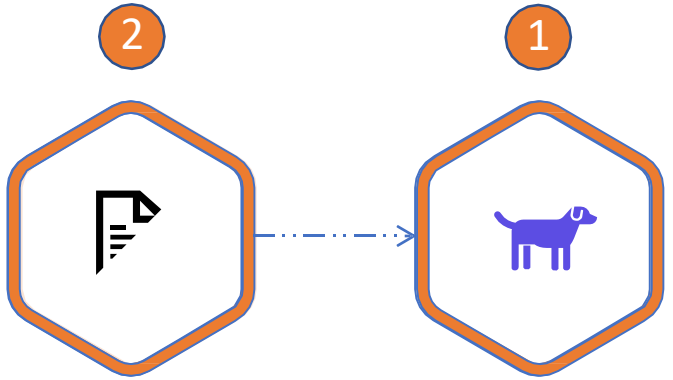
Resourse Dependencies

Lokeshkumar

Implicit Dependency

main.tf

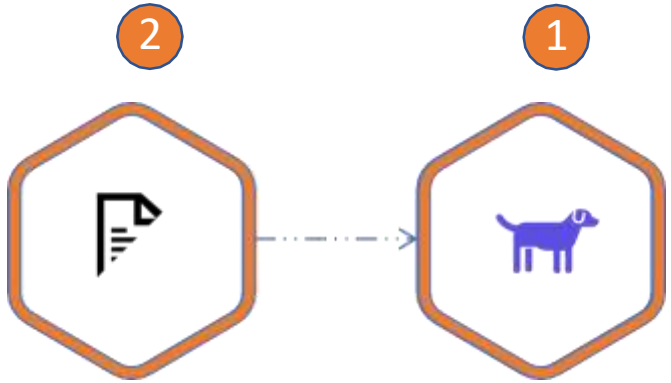
```
resource "local_file" "pet" {
    filename = var.filename
    content =  "My favorite pet is ${random_pet.my-pet.id}"
}

resource "random_pet" "my-pet" {
    prefix = var.prefix
    separator = var.separator
    length = var.length
}
```



Explicit Dependency

main.tf

```
resource "local_file" "pet" {
    filename = var.filename
    content =  "My favorite pet is Mr.Cat"

    depends_on = [
      random_pet.my-pet
    ]


}

resource "random_pet" "my-pet" {
    prefix = var.prefix
    separator = var.separator
    length = var.length
}
```



Output Variables

main.tf

```
resource "local_file" "pet" {
   filename = var.filename
   content =  "My favorite pet is ${random_pet.my-pet.id}"
}

resource "random_pet" "my-pet" {
   prefix = var.prefix
   separator = var.separator
   length = var.length
}

output pet-name {
  value       = random_pet.my-pet.id
  description = "Record the value of pet ID generated by
 the random_pet resource"
}
```

variables.tf

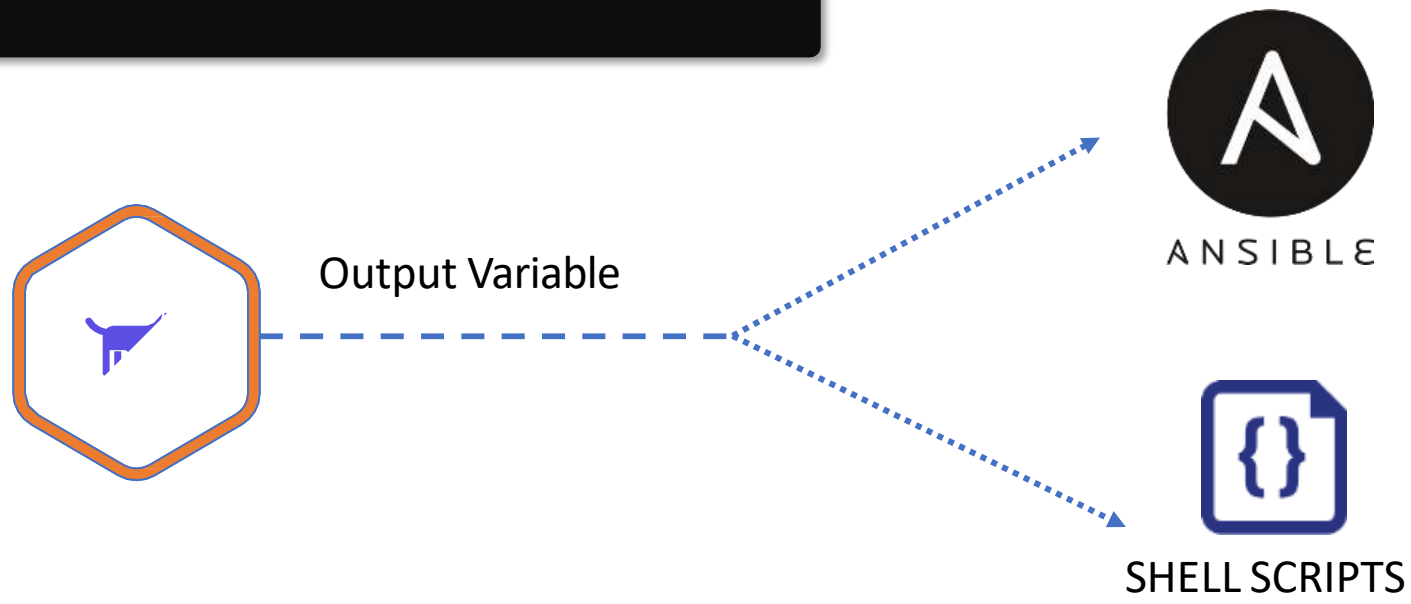
```
variable "filename" {
         default = "/root/pets.txt"
}
variable "content" {
         default = "I love pets!"
}
variable "prefix" {
         default = "Mrs"
}
variable "separator" {
         default = "."
}
variable "length" {
         default = "1"
}
```

```
output "<variable_name>" {
  value = "<variable_value>"
  <arguments>
}
```

```
>_
 $ terraform apply

 .
 .

Outputs:

pet-name = Mrs.gibbon
```

```
>_
$ terraform output
pet-name = Mrs.gibbon
```

```
>_
$ terraform output pet-name
Mrs.gibbon
```



Introduction to Terraform State

Lokeshkumar

```
>_
$ ls terraform-local-file
main.tf variables.tf
```

main.tf

```hcl
resource "local_file" "pet" {
  filename = var.filename
  content  = var.content
}
```

variables.tf

```hcl
variable "filename" {
  default = "/root/pets.txt"
}
variable "content" {
  default = "I love pets!"
}
```


```
>_
$ cd terraform-local-file

[terraform-local-file]$ terraform init

Initializing the backend...

Initializing provider plugins...
- Finding latest version of hashicorp/local...
- Installing hashicorp/local v1.4.0...
- Installed hashicorp/local v1.4.0 (signed by HashiCorp)

The following providers do not have any version constraints
in configuration,
so the latest version was installed.

To prevent automatic upgrades to new major versions that
may contain breaking
changes, we recommend adding version constraints in a
required_providers block
in your configuration, with the constraint strings
suggested below.

* hashicorp/local: version = "~> 1.4.0"

Terraform has been successfully initialized!
```

```
>_

$ ls terraform-local-file
main.tf variables.tf
```

main.tf

```
resource "local_file" "pet" {
  filename = var.filename
  content  = var.content
}
```

variables.tf

```
variable "filename" {
  default = "/root/pets.txt"
}
variable "content" {
  default = "I love pets!"
}
```


```
>_

[terraform-local-file]$ terraform plan

Refreshing Terraform state in-memory prior to
plan...
The refreshed state will be used to calculate this plan,
but will not be
persisted to local or remote state storage.


------------------------------------------------------------

An execution plan has been generated and is shown
below.
Resource actions are indicated with the following symbol
  + create

Terraform will perform the following
actions:
  # local_file.pet will be created
  + resource "local_file" "pet" {
      + content              = "I love pets!"
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/pets.txt"
      + id                   = (known after apply)
    }

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

------------------------------------------------------------

Note: You didn't specify an "-out" parameter to save
```

```
>_
$ ls terraform-local-file
main.tf variables.tf
```

main.tf

```
resource "local_file" "pet" {
  filename = var.filename
  content  = var.content
}
```

variables.tf

```
variable "filename" {
  default = "/root/pets.txt"
}
variable "content" {
  default = "I love pets!"
}
```


```
>_
[terraform-local-file]$ terraform apply

An execution plan has been generated and is shown
below Resource actions are indicated with the
following symbo
  + create
Terraform will perform the following
actions:
  # local_file.pet will be created
  + resource "local_file" "pet" {
      + content              = "I love pets!"
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/pets.txt"
      + id                   = (known after apply)
    }

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

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

local_file.pet: Creating...
local_file.pet: Creation complete after
0s
[id=7e4db4fbfdbb108bdd04692602bae3e9bd1e1b68]
```

```
>_

[terraform-local-file]$ cat /root/pets
I love pets!
```

```
>_

[terraform-local-file]$ terraform apply
local_file.pet: Refreshing state...
[id=7e4db4fbfdbb108bdd04692602bae3e9bd1e1b68]

Apply complete! Resources: 0 added, 0 changed, 0
destro
```

```
>_

[terraform-local-file]$ ls
main.tf variables.tf terraform.tfstate
```


```
>_

[terraform-local-file]$ cat  terraform.tfstate
{
  "version": 4,
  "terraform_version": "0.13.0",
  "serial": 1,
  "lineage": "e35dde72-a943-de50-3c8b-1df8986e5a31",
  "outputs": {},
  "resources": [
    {
      "mode": "managed",
      "type": "local_file",
      "name": "pet",
      "provider":
"provider[\"registry.terraform.io/hashicorp/local\"",
      "instances": [
        {
          "schema_version": 0,
          "attributes": {
            "content": "I love pets!",
            "content_base64": null,
            "directory_permission": "0777",
            "file_permission": "0777",
            "filename": "/root/pets.txt",
            "id":
"7e4db4fbfdbb108bdd04692602bae3e9bd1e1b68",
            "sensitive_content": null
          },
          "private": "bnVsbA=="
```

variables.tf

```
variable "filename" {
  default = "/root/pets.txt"
}
variable "content" {
  default = "We love pets!"
}
```


```
$ terraform plan
Refreshing Terraform state in-memory
prior to plan...
The refreshed state will be used to
calculate this plan, but will not be
persisted to local or remote state
storage.

local_file.pet: Refreshing state...
[id=7e4db4fbfdbb108bdd04692602bae3e9bd1e
1b68]
.
.
.
[Output Truncated ]
```

```
[terraform-local-file]$ cat  terraform.tfstate
{
  "version": 4,
  "terraform_version": "0.13.0",
  "serial": 1,
  "lineage": "e35dde72-a943-de50-3c8b-1df8986e5a31"
  "outputs": {},
  "resources": [
    {
      "mode": "managed",
      "type": "local_file",
      "name": "pet",
      "provider":
"provider[\"registry.terraform.io/hashicorp/local\"
      "instances": [
        {
          "schema_version": 0,
          "attributes": {
            "content": "I love pets!",
            "content_base64": null,
            "directory_permission": "0777",
            "file_permission": "0777",
            "filename": "/root/pets.txt",
            "id":
"7e4db4fbfdbb108bdd04692602bae3e9bd1e1b68",
            "sensitive_content": null
          },
          "private": "bnVsbA=="
```

variables.tf

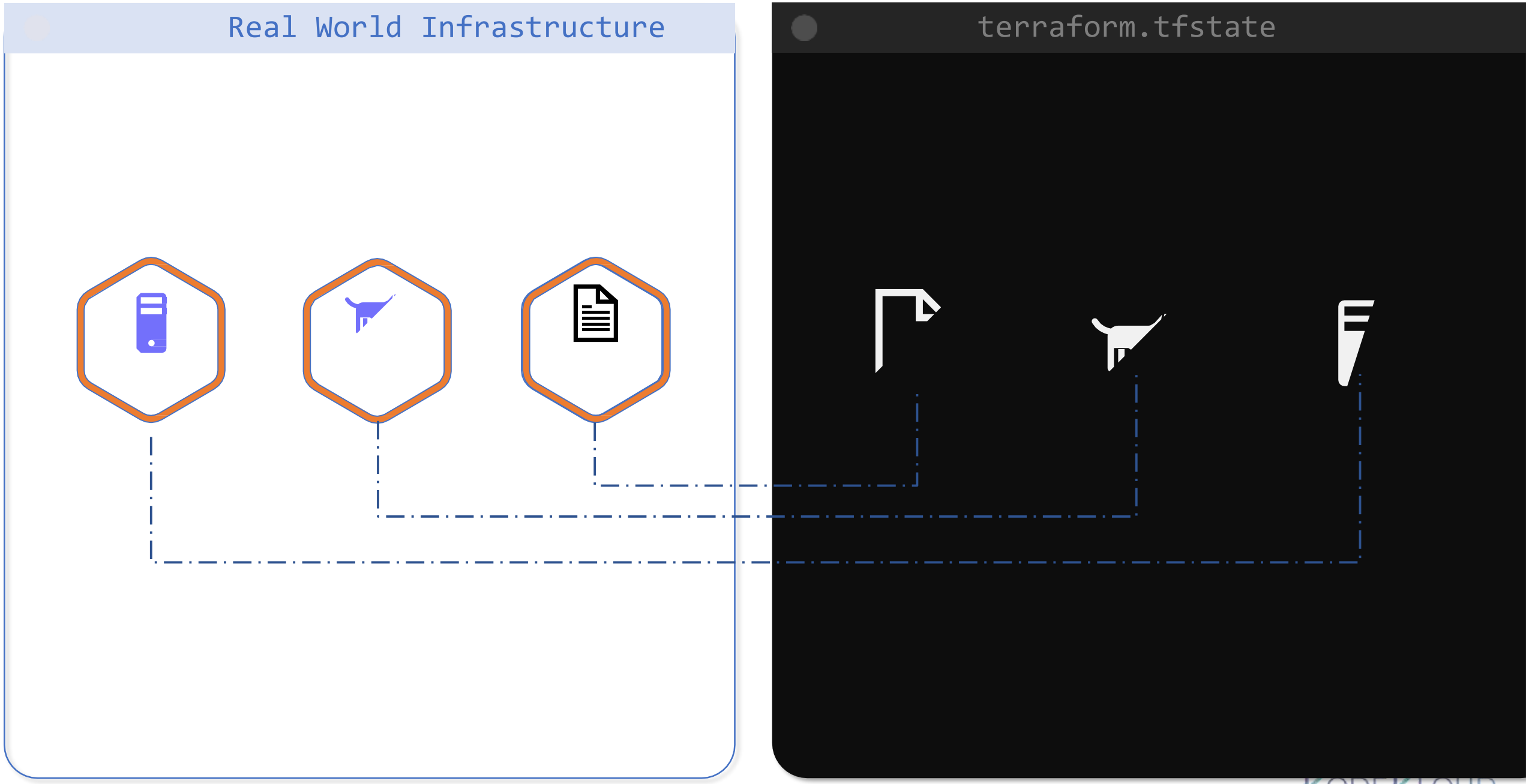
```
variable "filename" {
  default = "/root/pets.txt"
}
variable "content" {
  default = "We love pets!"
}
```

>_

```
$ terraform apply
local_file.pet: Refreshing state...
[id=7e4db4fbfdbb108bdd04692602bae3e9bd1e1b68]

Terraform will perform the following actions:

  # local_file.pet must be replaced
-/+ resource "local_file" "pet" {
      ~ content              = "I love pets!" -
> "We love pets!" # forces replacement
  directory_permission = "0777"
        file_permission      = "0777"
        filename             = "/root/pets.txt"
      ~ id                   =
"7e4db4fbfdbb108bdd04692602bae3e9bd1e1b68" ->
(known after apply)
    }
```

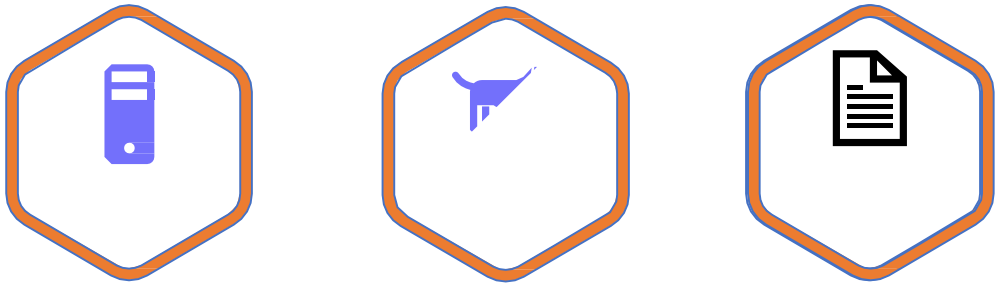
>_

```
[terraform-local-file]$ cat  terraform.tfstate
{
  "version": 4,
  "terraform_version": "0.13.0",
  "serial": 1,
  "lineage": "e35dde72-a943-de50-3c8b-1df8986e5a31"
  "outputs": {},
  "resources": [
    {
      "mode": "managed",
      "type": "local_file",
      "name": "pet",
      "provider":
"provider[\"registry.terraform.io/hashicorp/local\"
      "instances": [
        {
          "schema_version": 0,
          "attributes": {
            "content": "We love pets!",
            "content_base64": null,
            "directory_permission": "0777",
            "file_permission": "0777",
            "filename": "/root/pets.txt",
            "id":
"7e4db4fbfdbb108bdd04692602bae3e9bc4d1c14",
            "sensitive_content": null
          },
          "private": "bnVsbA=="
```

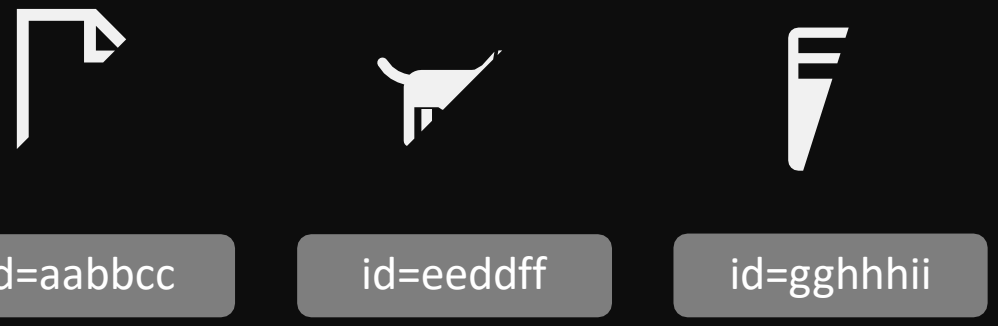

Real World Infrastructure
terraform.tfstate

Purpose of state

Real World Infrastructure



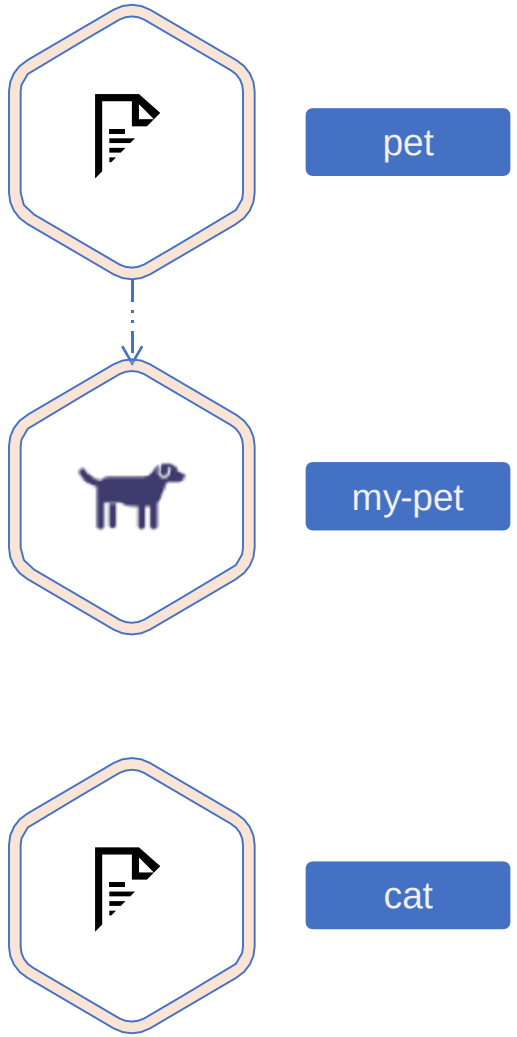
terraform.tfstate



Tracking Metadata

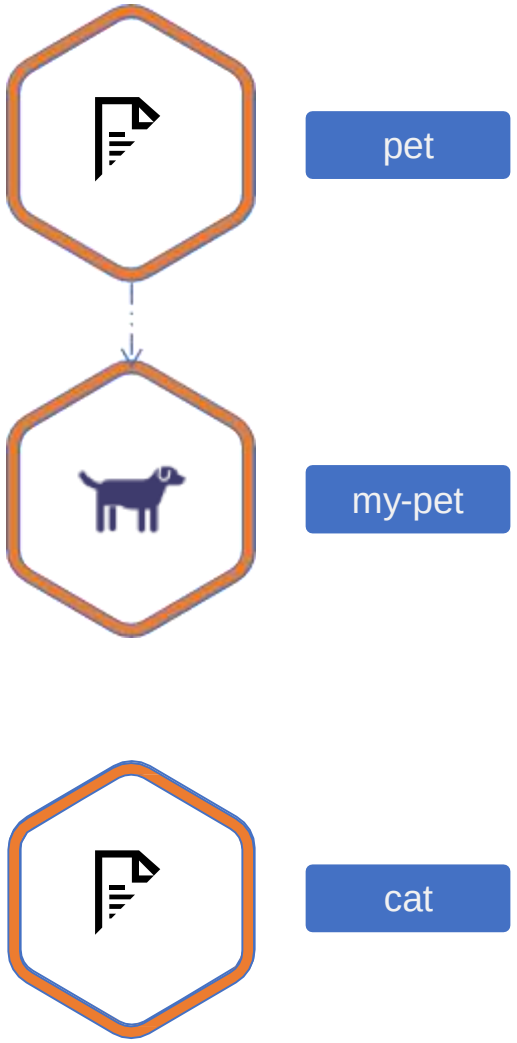
main.tf

```
resource "local_file" "pet" {
  filename = "/root/pet.txt"
  content  = "My favorite pet is ${random_pet.my-pet.id}!"
}
resource "random_pet" "my-pet" {
  length = 1
}
resource "local_file" "cat" {
  filename = "/root/cat.txt"
  content  = "I like cats too!"
}
```



Tracking Metadata

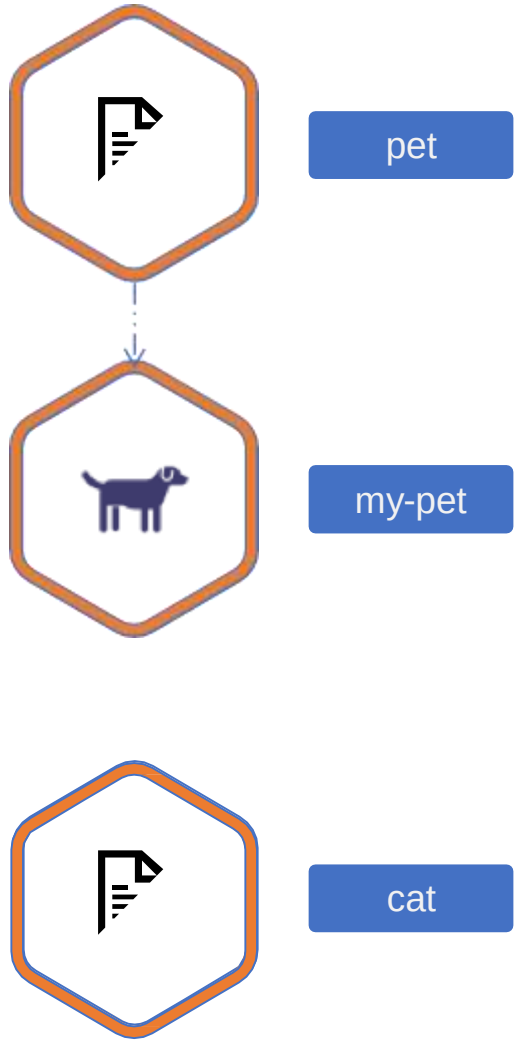
```
>_

$ terraform apply

.
.
.
Plan: 3 to add, 0 to change, 0 to destroy.

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

local_file.cat: Creating...
random_pet.my-pet: Creating...
local_file.cat: Creation complete after 0s
[id=fe448888891fc40342313bc44a1f1a8986520c89]
random_pet.my-pet: Creation complete after 0s
[id=yak]

local_file.pet: Creating...
local_file.pet: Creation complete after
0s
[id=28b373c6c1fa3fce132a518eadd0175c98f37f20]

Apply complete! Resources: 3 added, 0 changed,
0 destroyed.
```



Tracking Metadata

main.tf

```
resource "local_file" "pet" {
  filename = "/root/pet.txt"
  content  = "My favorite pet is ${random_pet.my-pet.id}!"
}
resource "random_pet" "my-pet" {
  length = 1
}
resource "local_file" "cat" {
  filename = "/root/cat.txt"
  content  = "I like cats too!"
}
```



Tracking Metadata

main.tf

```
resource "local_file" "cat" {
  filename = "/root/cat.txt"
  content  = "I like cats too!"
}
```

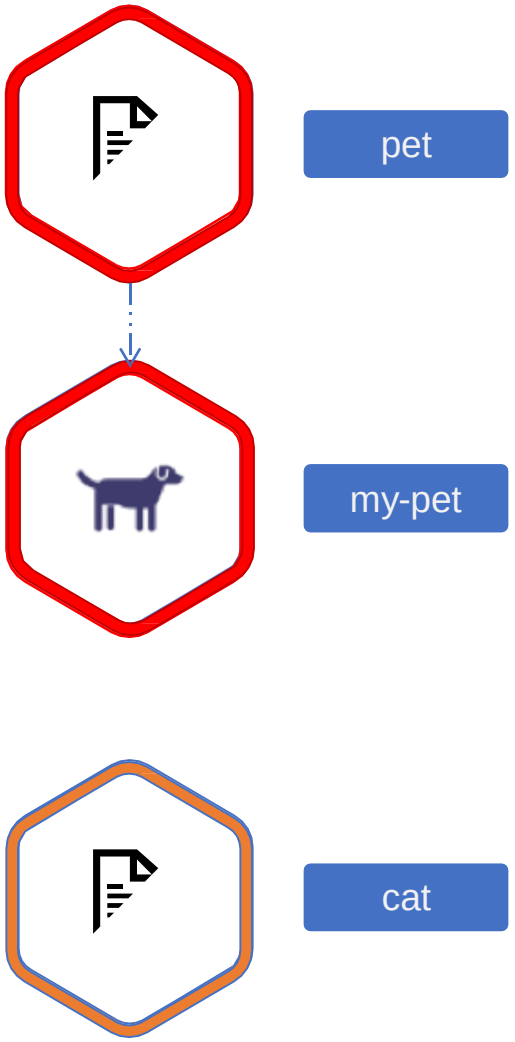
Tracking Metadata

main.tf

```
resource "local_file" "cat" {
  filename = "/root/cat.txt"
  content  = "I like cats too!"
}
```

>_

```
$ cat terraform.tfstate
{
      "mode": "managed",
      "type": "local_file",
      "name": "pet",
      "instances": [
        {
          "schema_version": 0,
          "attributes": {
            "content": "My favorite pet is yak!",
.           },
          "private": "bnVsbA==",
          "dependencies": [
            "random_pet.my-pet"
          ]
```

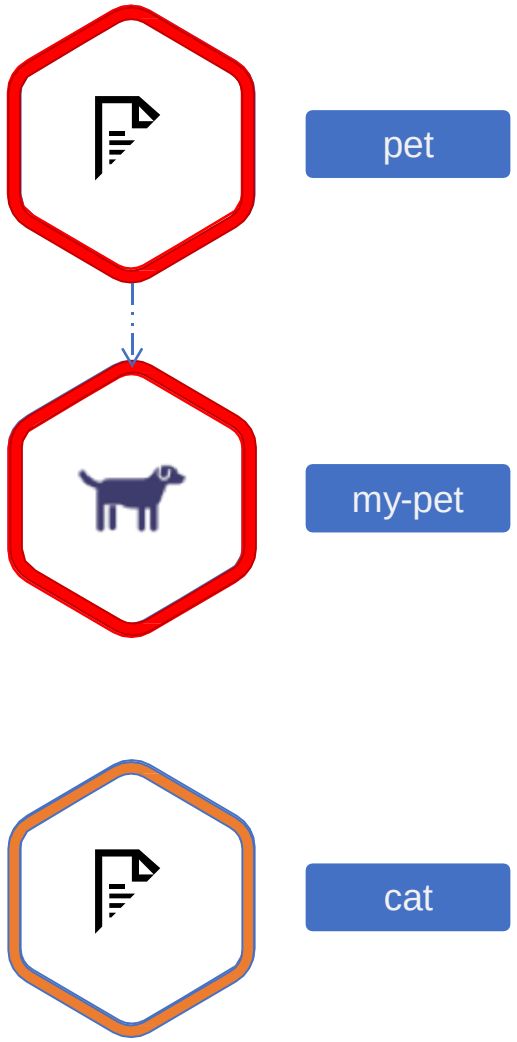


Tracking Metadata

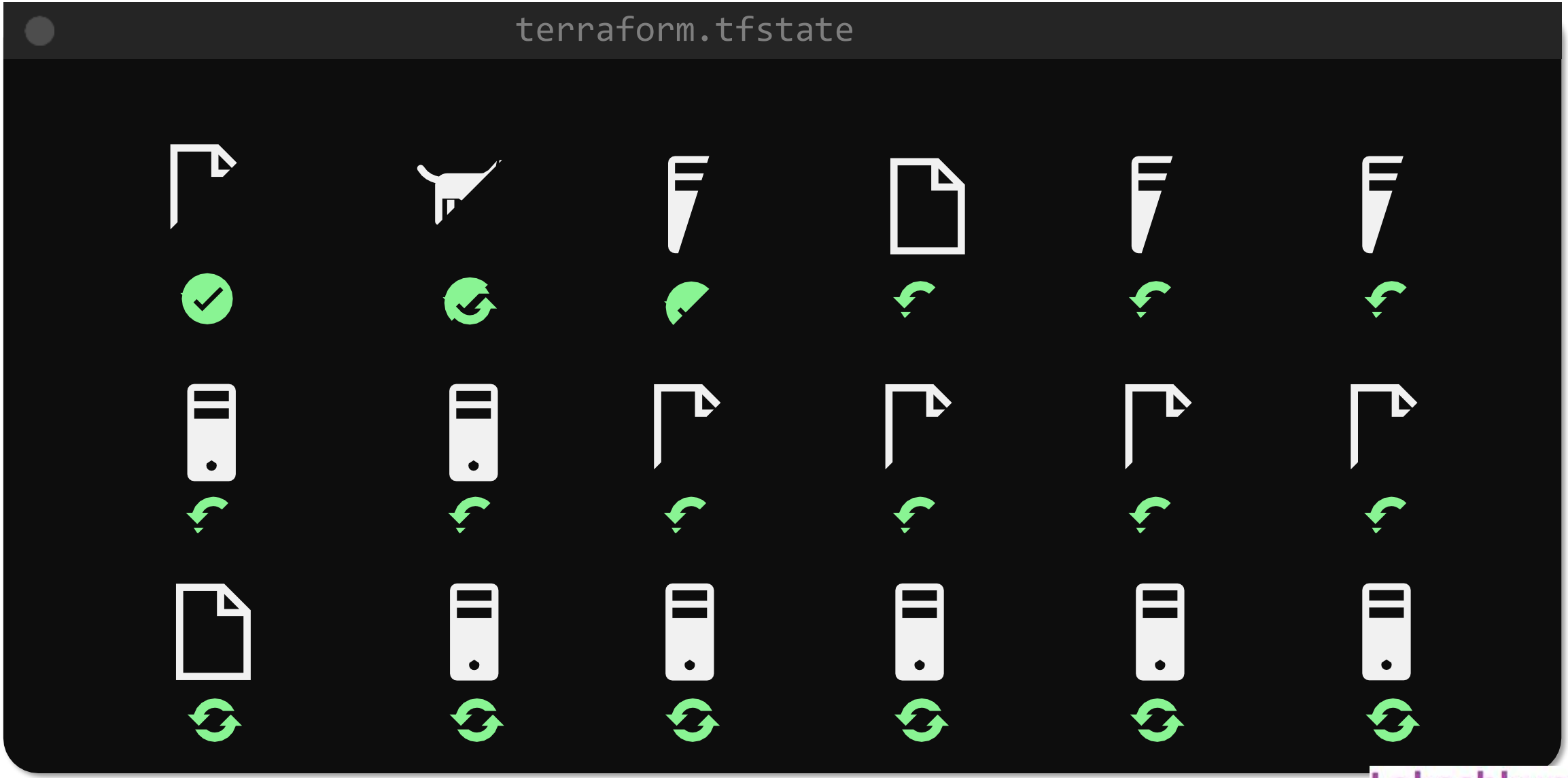
main.tf

```
resource "local_file" "cat" {
  filename = "/root/cat.txt"
  content  = "I like cats too!"
}
```

```
$ terraform apply

Plan: 0 to add, 0 to change, 2 to destroy.

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

local_file.pet: Destroying...
[id=28b373c6c1fa3fce132a518eadd0175c98f37f20]
local_file.pet: Destruction complete after
0s
```



Performance



Performance

terraform.tfstate

```
{
  "version": 4,
  "terraform_version": "0.13.0",
  "serial": 4,
  "lineage": "e35dde72-a943-de50-3c8b-
  1df8986e5a31", "outputs": {},
  "resources": [
    {
      "mode": "managed",
      "type": "local_file",
      "name": "pet",
      "instances": [
        {
          "schema_version": 0,
          "attributes": {
            "content": "We love pets!",
            "content_base64": null,
            "directory_permission": "0777",
...
```

>_

```
$ terraform plan --refresh=false

An execution plan has been generated and is
shown below.
Resource actions are indicated with the following
symbols:
-/+ destroy and then create replacement

Terraform will perform the following
actions:
  # local_file.cat must be replaced
-/+ resource "local_file" "pet" {
      ~ content              = "I like cats too!" ->
"Dogs are awesome!" # forces
          replacement directory_permission
          file_permission      = "0777"
          filename             = "/root/pets.txt"
      ~ id                   =
"cba595b7d9f94ba1107a46f3f731912d95fb3d2c" ->
(known
after apply)
    }
Plan: 1 to add, 0 to change, 1 to destroy.

------------------------------------------------
```

Collaboration

terraform.tfstate

```
{
  "version": 4,
  "terraform_version": "0.13.0",
  "serial": 4,
  "lineage": "e35dde72-a943-de50-3c8b-
  1df8986e5a31", "outputs": {},
  "resources": [
    {
      "mode": "managed",
      "type": "local_file",
      "name": "pet",
      "instances": [
        {
          "schema_version": 0,
          "attributes": {
            "content": "We love pets!",
            "content_base64": null,
            "directory_permission": "0777",
...
```

```
>_
$ ls
main.tf variables.tf terraform.tfstate
```

Collaboration

AWS S3

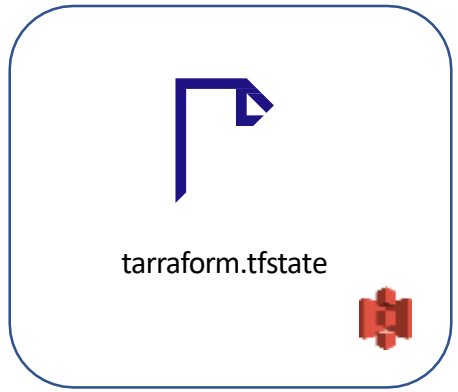
Google Cloud Storage

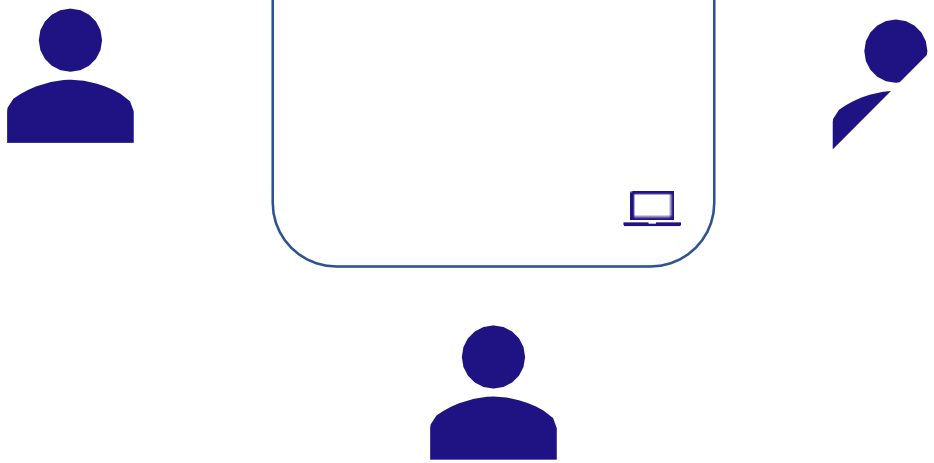
HashiCorp Consul

Terraform Cloud

terraform.tfstate

```
{
  "version": 4,
  "terraform_version": "0.13.0",
  "serial": 4,
  "lineage": "e35dde72-a943-de50-3c8b-
  1df8986e5a31", "outputs": {},
  "resources": [
    {
      "mode": "managed",
      "type": "local_file",
      "name": "pet",
      "instances": [
        {
          "schema_version": 0,
          "attributes": {
            "content": "We love pets!",
            "content_base64": null,
            "directory_permission": "0777",
...
```





Lokeshkumar

Terraform State Considerations

Lokeshkumar

Sensitive Data

terraform.tfstate

```
{
      "mode": "managed",
      "type": "aws_instance",
      "name": "dev-ec2",
      "provider":
      "provider[\"registry.terraform.io/hashicorp/aws\"]",
      "instances": [
        {
          "schema_version": 1,
          "attributes": {
            "ami": "ami-0a634ae95e11c6f91",
.
.
.
            "primary_network_interface_id": "eni-0ccd57b1597e633e0",
            "private_dns": "ip-172-31-7-21.us-west-
            2.compute.internal", "private_ip": "172.31.7.21",
            "public_dns": "ec2-54-71-34-19.us-west-
            2.compute.amazonaws.com", "public_ip": "54.71.34.19",
            "root_block_device": [
              {
                "delete_on_termination": true,
                "device_name": "/dev/sda1",
                "encrypted": false,
                "iops": 100
```

Terraform State Considerations

Remote State Backends

Version Control

terraform.tfstate


```
{
      "mode": "managed",
      "type": "aws_instance",
      "name": "dev-ec2",
      "provider": "provider[\"registry.terraform.io/hashicorp/aws\"]",
      "instances": [
        {
          "schema_version": 1,
          "attributes": {
            "ami": "ami-0a634ae95e11c6f91",
.
.
.
            "primary_network_interface_id": "eni-0ccd57b1597e633e0",
            "private_dns": "ip-172-31-7-21.us-west-2.compute.internal",
            "private_ip": "172.31.7.21",
            "public_dns": "ec2-54-71-34-19.us-west-2.compute.amazonaws.com",
            "public_ip": "54.71.34.19",
            "root_block_device": [
              {
                "delete_on_termination": true,
                "device_name": "/dev/sda1",
                "encrypted": false,
                "iops": 100,
                "kms_key_id": "",
                "volume_id": "vol-070720a3636979c22",
                "volume_size": 8,
```


main.tf

```
resource "local_file" "pet" {
  filename = "/root/pet.txt"
  content  = "My favorite pet is Mr.Whiskers!"
}
resource "random_pet" "my-pet" {
  length = 1
}
resource "local_file" "cat" {
  filename = "/root/cat.txt"
  content  = "I like cats too!"
}
```

No Manual Edits

terraform.tfstate


```
{
      "mode": "managed",
      "type": "aws_instance",
      "name": "dev-ec2",
      "provider":
      "provider[\"registry.terraform.io/hashicorp/aws\"]",
      "instances": [
        {
          "schema_version": 1,
          "attributes": {
            "ami": "ami-0a634ae95e11c6f91",
.
.
.
            "primary_network_interface_id": "eni-0ccd57b1597e633e0",
            "private_dns": "ip-172-31-7-21.us-west-
            2.compute.internal", "private_ip": "172.31.7.21",
            "public_dns": "ec2-54-71-34-19.us-west-
            2.compute.amazonaws.com", "public_ip": "54.71.34.19",
            "root_block_device": [
              {
                "delete_on_termination": true,
                "device_name": "/dev/sda1",
                "encrypted": false,
                "iops": 100,
```

Terraform Commands

Lokeshkumar

terraform validate

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
    file_permissions = "0700"
}
```

>_

```
$ terraform validate
Success! The configuration is valid.

$ terraform validate

Error: Unsupported argument

  on main.tf line 4, in resource "local_file"
   "pet": 4:       file_permissions = "0777"

An argument named "file_permissions" is not
expected here. Did you mean "file_permission"?
```

terraform fmt

main.tf

```
resource "local_file" "pet" {
    filename        = "/root/pets.txt"
    content         = "We love pets!"
    file_permission = "0700"
}
```

>_

```
$ terraform fmt
main.tf
```

terraform show

```
$ terraform show
# local_file.pet:
resource "local_file" "pet" {
    content              = "We love pets!"
    directory_permission = "0777"
    file_permission      = "0777"
    filename             = "/root/pets.txt"
    id                   =
"cba595b7d9f94ba1107a46f3f731912d95fb3d2c"
}
```

```
$ terraform show -json
{"format_version":"0.1","terraform_version":"0.13.0
","values":{"root_module":{"resources":[{"address":
"local_file.pet","mode":"managed","type":"local_fil
e","name":"pet","provider_name":"registry.terraform
.io/hashicorp/local","schema_version":0,"values":{"
content":"We love
pets!","content_base64":null,"directory_permission"
:"0777","file_permission":"0777","filename":"/root/
pets.txt","id":"cba595b7d9f94ba1107a46f3f731912d95f
b3d2c","sensitive_content":null}}]}}}
```

terraform providers

main.tf

```
resource "local_file" "pet" {
    filename        = "/root/pets.txt"
    content         = "We love pets!"
    file_permission = "0700"
}
```

>_

```
$ terraform providers
Providers required by configuration:
.
└── provider[registry.terraform.io/hashicorp/local]

Providers required by state:

    provider[registry.terraform.io/hashicorp/local]
```

```
$ terraform providers mirror
/root/terraform/new_local_file
- Mirroring hashicorp/local...
  - Selected v1.4.0 with no constraints
  - Downloading package for windows_amd64...
  - Package authenticated: signed by HashiCorp
```

terraform output

main.tf

```
resource "local_file" "pet" {
  filename        = "/root/pets.txt"
  content         = "We love pets!"
  file_permission = "0777"
}
resource "random_pet" "cat" {
  length    = "2"
  separator = "-"
}
output content {
  value       = local_file.pet.content
  sensitive   = false
  description = "Print the content of the file"

}
output pet-name {
  value       = random_pet.cat.id
  sensitive   = false
  description = "Print the name of the pet"

}
```

>_

```
$ terraform output
content = We love pets!
pet-name = huge-owl
```

```
$ terraform output pet-name
pet-name = huge-owl
```

terraform refresh

main.tf

```
resource "local_file" "pet" {
  filename        = "/root/pets.txt"
  content         = "We love pets!"
  file_permission = "0777"
}
resource "random_pet" "cat" {
  length    = "2"
  separator = "-"
}
```

>_

```
$ terraform refresh
random_pet.cat: Refreshing state... [id=huge-
owl] local_file.pet: Refreshing state...
[id=cba595b7d9f94ba1107a46f3f731912d95fb3d2c]



$ terraform plan
Refreshing Terraform state in-memory prior to plan...
The refreshed state will be used to calculate this
plan, but will not be
persisted to local or remote state storage.

random_pet.cat: Refreshing state... [id=huge-
owl] local_file.pet: Refreshing state...
[id=cba595b7d9f94ba1107a46f3f731912d95fb3d2c]
------------------------------------------------

No changes. Infrastructure is up-to-date.
```

terraform graph

main.tf

```
resource "local_file" "pet" {
  filename = "/root/pets.txt"
  content  = "My favorite pet is ${random_pet.my-pet.id}"
}
resource "random_pet" "my-pet" {
  prefix = "Mr"
  separator = "."
  length = "1"
}
```

>_

```
 $ terraform graph
digraph {
        compound = "true"
        newrank = "true"
        subgraph "root" {
                "[root] local_file.pet (expand)" [label = "local_file.pet", shape = "box"]
                "[root] provider[\"registry.terraform.io/hashicorp/local\"]" [label = "provider[\"registry.terraform.io/hashicorp/local\"]", shape = "diamond"]
                "[root] provider[\"registry.terraform.io/hashicorp/random\"]" [label = "provider[\"registry.terraform.io/hashicorp/random\"]", shape = "diamond"]
                "[root] random_pet.my-pet (expand)" [label = "random_pet.my-pet", shape = "box"]
                "[root] local_file.pet (expand)" -> "[root] provider[\"registry.terraform.io/hashicorp/local\"]"
                "[root] local_file.pet (expand)" -> "[root] random_pet.my-pet (expand)"
                "[root] meta.count-boundary (EachMode fixup)" -> "[root] local_file.pet (expand)"
                "[root] provider[\"registry.terraform.io/hashicorp/local\"] (close)" ->
```

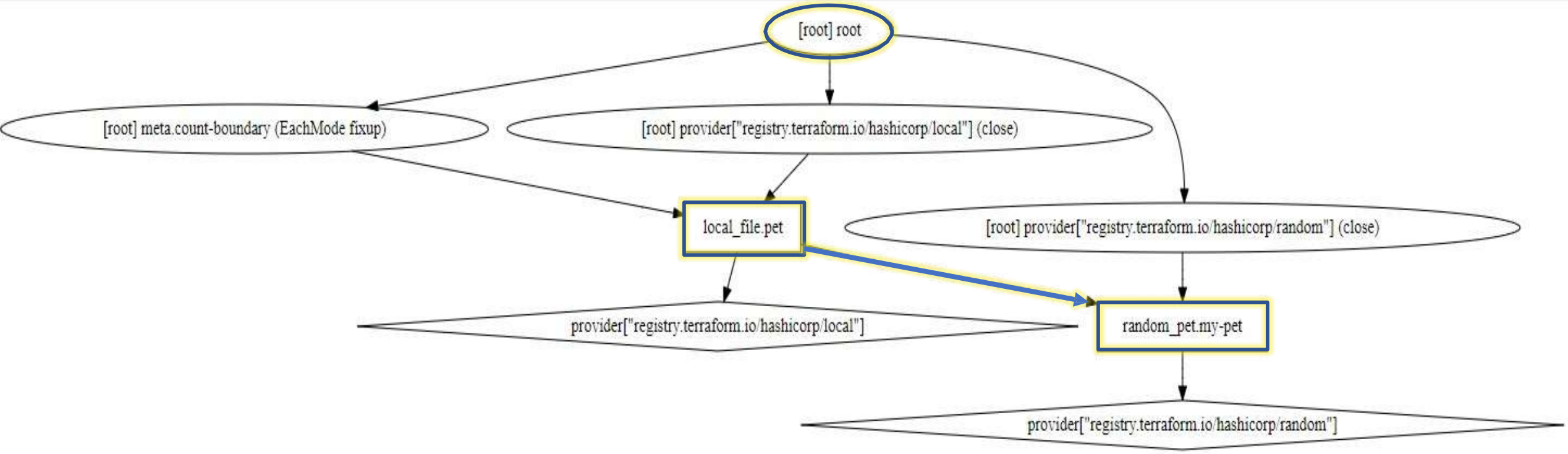
terraform graph

main.tf

```
resource "local_file" "pet" {
  filename = "/root/pets.txt"
  content  = "My favorite pet is ${random_pet.my-pet.id}"
}
```

>_

```
$ apt update
$ apt install graphviz -y
$ terraform graph | dot -Tsvg > graph.svg
```



Lokeshkumar

Mutable vs Immutable Infrastructure

Lokeshkumar

terraform validate

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
    file_permission = "0700"
}
```

>_

```
$ terraform apply

# local_file.pet must be replaced
-/+ resource "local_file" "pet" {
        content              = "We love pets!"
        directory_permission = "0777"
      ~ file_permission      = "0777" -> "0700" # forces
replacement
        filename             = "/root/pet.txt"
      ~ id                   =
"5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf" -> (known after
apply)
    }

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

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

local_file.pet: Destroying...
[id=5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf]
local_file.pet: Destruction complete after 0s
```

upgrade-nginx.sh

Configuration Drift

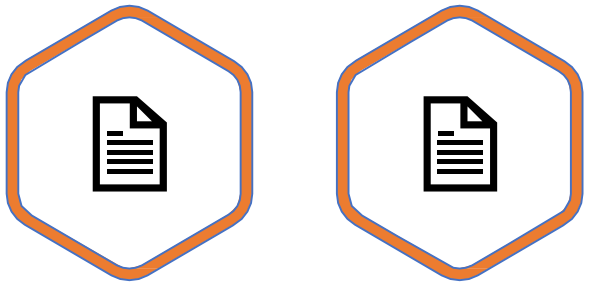
Immutable Infrastructure

Immutable Infrastructure

Immutable Infrastructure

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
    file_permission = "0700"
}
```



>_

```
$ terraform apply

# local_file.pet must be replaced
-/+ resource "local_file" "pet" {
        content              = "We love pets!"
        directory_permission = "0777"
      ~ file_permission      = "0777" -> "0700" # forces
replacement
        filename             = "/root/pet.txt"
      ~ id                   =
"5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf" -> (known after
apply)
    }

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

local_file.pet: Destroying...
[id=5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf]
local_file.pet: Destruction complete after 0s
local_file.pet: Creating...
local_file.pet: Creation complete after 0s
[id=5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf]

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

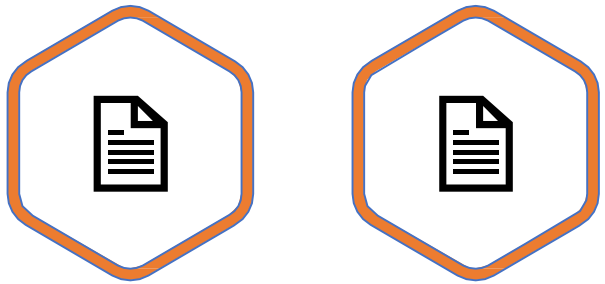
Lifecycle Rules

Lokeshkumar

create_before_destroy

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
    file_permission = "0700"

    lifecycle  {
        create_before_destroy  = true
    }


}
```



>_

```
$ terraform apply

# local_file.pet must be replaced
-/+ resource "local_file" "pet" {
        content              = "We love pets!"
        directory_permission = "0777"
      ~ file_permission      = "0777" -> "0755" # forces repl
        filename             = "/root/pet.txt"
      ~ id                   =
"5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf" -> (known after ap
    }

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

...

local_file.pet: Creating...
local_file.pet: Creation complete after 0s
[id=5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf]

local_file.pet: Destroying...
[id=5f8fb950ac60f7f23ef968097cda0a1fd3c11bdf]
local_file.pet: Destruction complete after 0s

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

prevent_destroy

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
    file_permission = "0700"

    lifecycle  {
        prevent_destroy  = true
    }


}
```

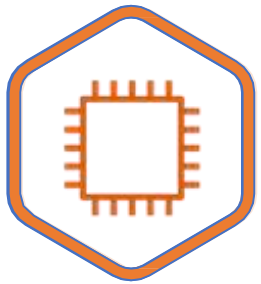
>_

```
$ terraform apply
local_file.my-pet: Refreshing state...
[id=cba595b7d9f94ba1107a46f3f731912d95fb3d2c]

Error: Instance cannot be destroyed

  on main.tf line 1:
   1: resource "local_file" "my-pet" {

Resource local_file.my-pet has
lifecycle.prevent_destroy set, but the plan
calls
for this resource to be destroyed. To avoid this
error and continue with the plan, either disable
lifecycle.prevent_destroy or reduce the scope of the
plan using the -target flag.
```

ignore_changes

main.tf

```
resource "aws_instance" "webserver" {
  ami           = "ami-0edab43b6fa892279"
  instance_type = "t2.micro"
  tags = {
      Name = “ProjectA-Webserver"
  }
 }
```



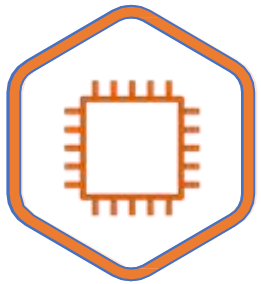
>_

```
$ terraform apply

...
Terraform will perform the following
actions:
  # aws_instance.webserver will be created
  + resource "aws_instance" "webserver" {
      + ami                          = "ami-0edab43b6fa892279"
      + get_password_data            = false
      + host_id                      = (known after apply)
      + id                           = (known after apply)
      + instance_state               = (known after apply)
      + instance_type                = "t2.micro“
      + tags                         {
          + "Name"       = "ProjectA-WebServer"
        }
.
aws_instance.webserver: Creation complete after 33s [id=i-
05cd83b221911acd5]

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

ignore_changes

main.tf

```
resource "aws_instance" "webserver" {
  ami           = "ami-0edab43b6fa892279"
  instance_type = "t2.micro"
  tags = {
      Name = “ProjectA-Webserver"
  }
 }
```



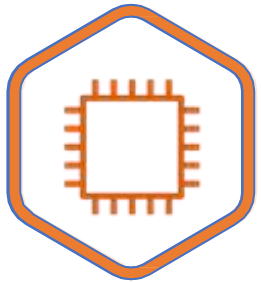
```
$ terraform apply

aws_instance.webserver: Refreshing state...
[id=i- 05cd83b221911acd5]

An execution plan has been generated and is shown below.
Resource actions are indicated with the following
symbols:
  ~ update in-place
Terraform will perform the following actions:

  # aws_instance.webserver will be updated in-place
  ~ resource "aws_instance" "webserver" {
.
.
~ tags                          = {
  ~ "Name"       = "ProjectB-WebServer" -> "ProjectA-WebServer"
      }
.
.
Apply complete! Resources: 0 added, 1 changed, 0
destroyed.
```

☑	ProjectB-WebServer	i-05cd83b221911acd5	Running	t2.micro	2/2 che

ignore_changes

main.tf

```
resource "aws_instance" "webserver" {
  ami           = "ami-0edab43b6fa892279"
  instance_type = "t2.micro"
  tags = {
      Name = “ProjectA-Webserver"
  }
  lifecycle {
        ignore_changes = [
          tags

        ]
    }
}
```



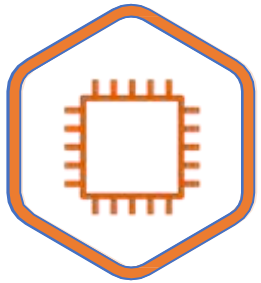
>_

```
$ terraform apply

aws_instance.webserver: Refreshing state...
[id=i- 05cd83b221911acd5]

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

ignore_changes

main.tf

```
resource "aws_instance" "webserver" {
  ami           = "ami-0edab43b6fa892279"
  instance_type = "t2.micro"
  tags = {
      Name = “ProjectA-Webserver"
  }
  lifecycle {
        ignore_changes = all



    }
}
```

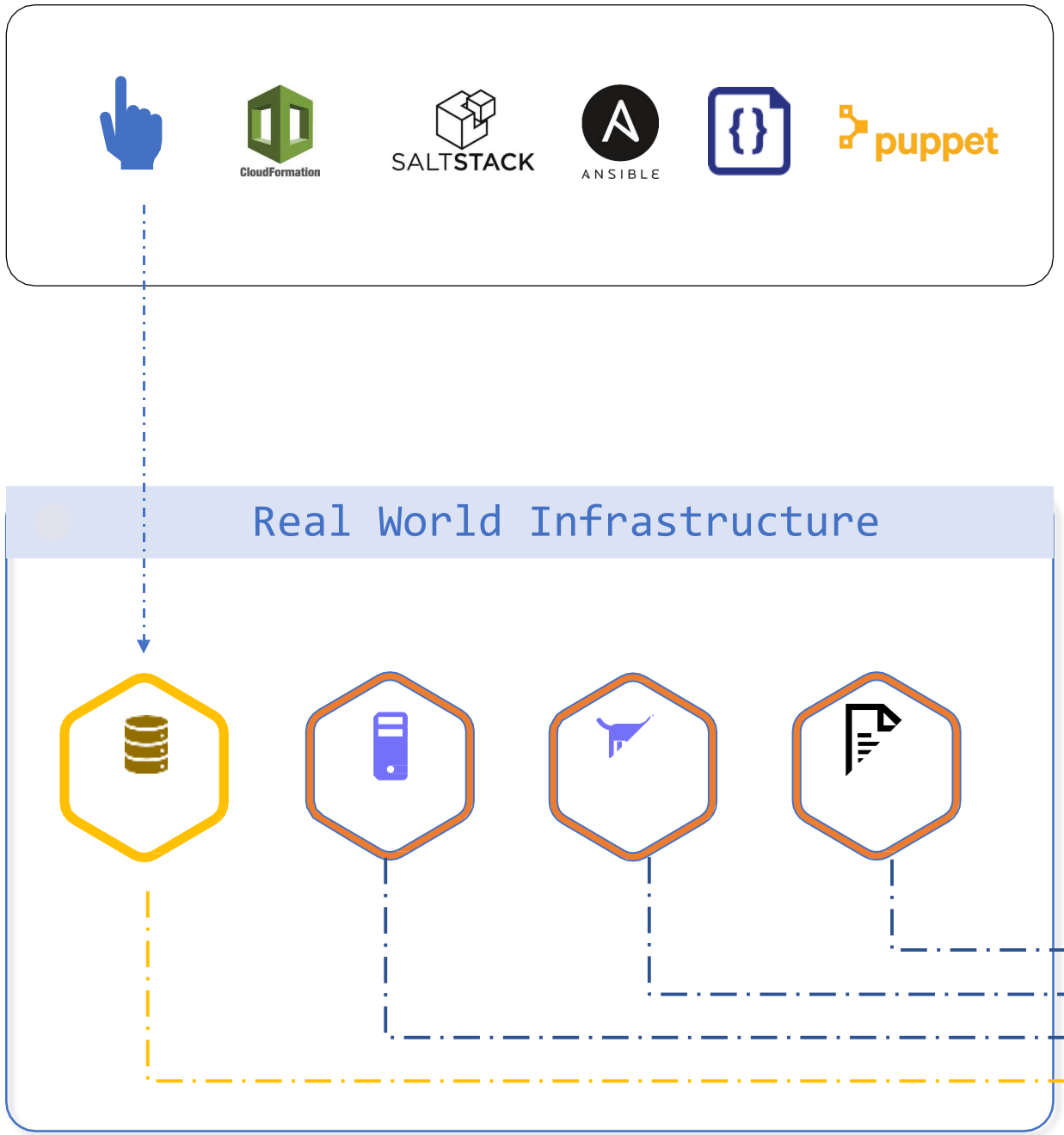


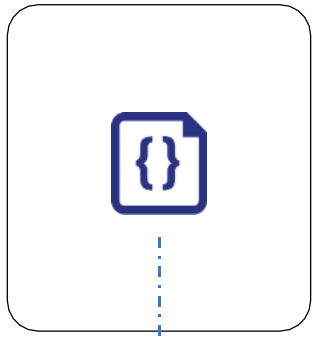
>_

```
$ terraform apply

aws_instance.webserver: Refreshing state...
[id=i- 05cd83b221911acd5]

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

Order	Option	
1	create_before_destroy	Create the resource first and then destroy older
2	prevent_destroy	Prevents destroy of a resource
3	ignore_changes	Ignore Changes to Resource Attributes (specific/all)

Data sources


CloudFormation
SALTSTACK
ANSIBLE
puppet
HashiCorp
Terraform
Real World Infrastructure
terraform.tfstate



main.tf

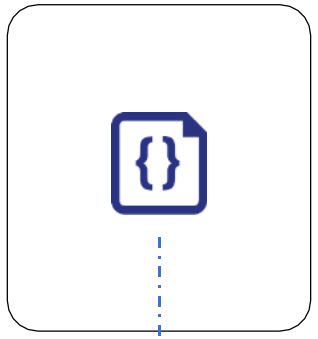
```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = "We love pets!"
}
```

```
>_
$ cat /root/dog.txt
Dogs are awesome!
```

Real World Infrastructure

terraform.tfstate

Data Sources



```
>_
$ cat /root/dog.txt
Dogs are awesome!
```

main.tf

```
resource "local_file" "pet" {
    filename = "/root/pets.txt"
    content = data.local_file.dog.content
}

data "local_file" "dog" {
    filename = "/root/dog.txt"
}
```

Real World Infrastructure

terraform.tfstate

Argument Reference

The following argument is required:

- `filename` - (Required) The path to the file that will be read. The data source will return an error if the file does not exist.

Attributes Exported

The following attribute is exported:

- `content` - The raw content of the file that was read.
- `content_base64` - The base64 encoded version of the file content (use this when dealing with binary data).

Resource	Data Source
Keyword: **resource**	Keyword: **data**
Creates, Updates, Destroys Infrastructure	Only **Reads** Infrastructure
Also called **Managed Resources**	Also called **Data Resources**

Meta Arguments

Lokeshkumar

main.tf

```
resource "local_file" "pet" {
    filename = var.filename
    content = var.content

}
```

variables.tf

```
variable "filename" {
  default = "/root/pets.txt"
}
variable "content" {
  default = "I love pets!"
}
```

Shell Scripts

create_files.sh

```
#!/bin/bash

for i in {1..3}
  do
    touch /root/pet${i}
  done
```

>_

```
$ ls -ltr /root/
-rw-r--r-- 1 root root    0 Sep  9 02:04 pet2
-rw-r--r-- 1 root root    0 Sep  9 02:04 pet1
-rw-r--r-- 1 root root    0 Sep  9 02:04 pet3
```

Iteration	filename
1	/root/pet1
2	/root/pet2
3	/root/pet3

Meta Arguments

depends_on

main.tf

```
resource "local_file" "pet" {
  filename = var.filename
  content  = var.content
  depends_on = [
    random_pet.my-pet
  ]
}
resource "random_pet" "my-pet" {
  prefix    = var.prefix
  separator = var.separator
  length    = var.length
}
```

lifecycle

main.tf

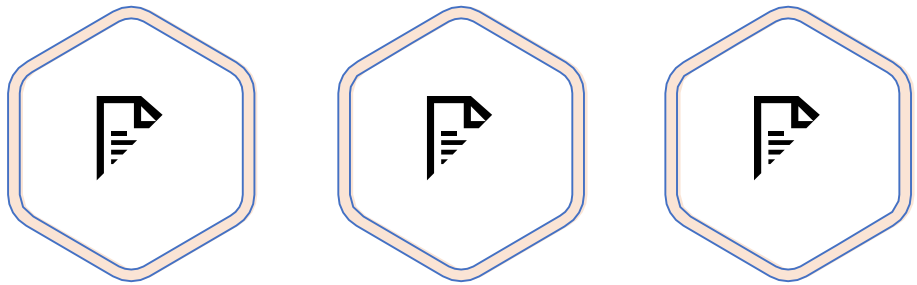
```
resource "local_file" "pet" {
   filename = "/root/pets.txt"
   content = "We love pets!"
   file_permission = "0700
   lifecycle  {
     create_before_destroy  = true
   }
}
```

Count

count

main.tf

```
resource "local_file" "pet" {
    filename = var.filename

    count    = 3

}
```



variables.tf

```
variable "filename" {
  default = "/root/pets.txt"
}
```

>_

```
$ terraform plan

[Output Truncated]
Terraform will perform the following actions:
...
# local_file.pet[2] will be created
  + resource "local_file" "pet" {
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/pets.txt"
      + id                   = (known after apply)
    }

Plan: 3 to add, 0 to change, 0 to destroy.
```

count

main.tf

```
resource "local_file" "pet" {
    filename = var.filename
    count    = 3
}
```

variables.tf

```
variable "filename" {
  default = "/root/pets.txt"
}
```

>_

```
$ terraform apply
[Output Truncated]
.

local_file.pet[2]: Creating...
local_file.pet[0]: Creating...
local_file.pet[1]: Creating...
local_file.pet[0]: Creation complete after 0s
[id=7e4db4fbfdbb108bdd04692602bae3e9bd1e1b68]
local_file.pet[2]: Creation complete after 0s
[id=7e4db4fbfdbb108bdd04692602bae3e9bd1e1b68]
local_file.pet[1]: Creation complete after 0s
[id=7e4db4fbfdbb108bdd04692602bae3e9bd1e1b68]

Apply complete! Resources: 3 added, 0 changed, 0
destroyed
```

count

main.tf

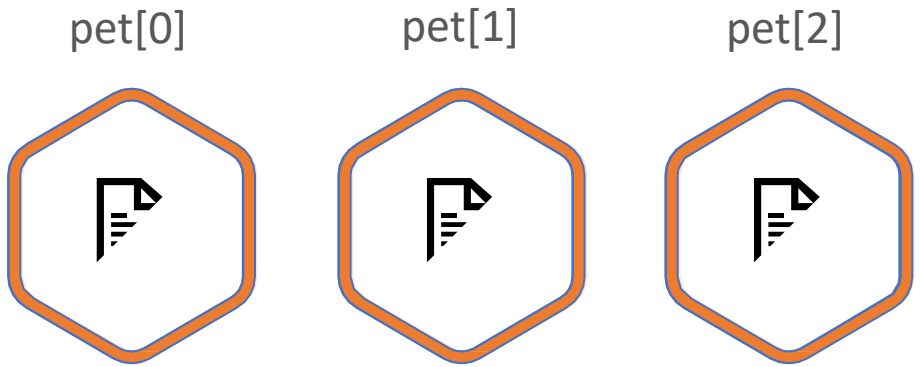
```
resource "local_file" "pet" {
    filename = var.filename
    count    = 3
}
```

variables.tf

```
variable "filename" {
  default = "/root/pets.txt"
}
```

>_

```
$ ls /root
pet.txt
```



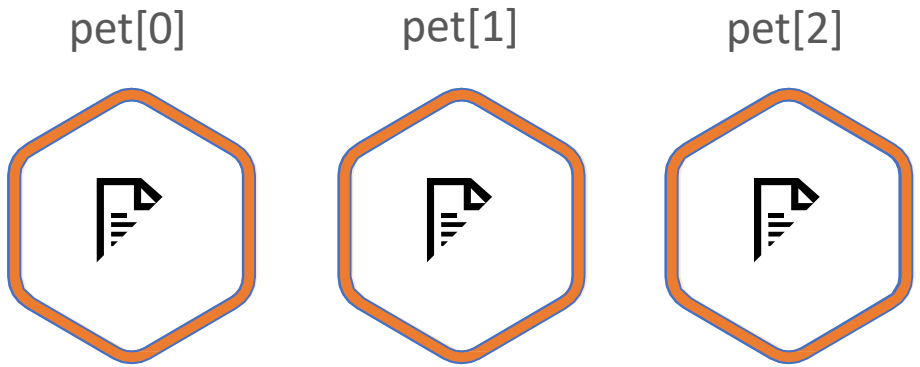
count

main.tf

```
resource "local_file" "pet" {
    filename = var.filename[count.index]
    count    = 3
}
```

variables.tf

```
variable "filename" {
    default = [
      "/root/pets.txt",
      "/root/dogs.txt",
      "/root/cats.txt"
    ]
}
```



>_

```
$ terraform apply
$ ls /root
pets.txt
dogs.txt
cats.txt
[Output Truncated]
.
.
local_file.pet[2]: Creating...  local_file.pet[0]: Creating...  local_file.pet[1]: Creating...
local_file.pet[0]: Creation complete after 0s [id=7e4db4fbfdbb108bdd04692602bae3e9bd1e1b68]
```

Length Function

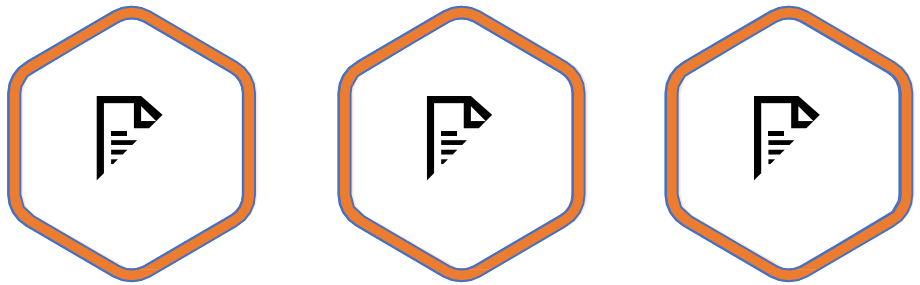
main.tf

```
resource "local_file" "pet" {
    filename = var.filename[count.index]
    count    = length(var.filename)
}
```

variables.tf

```
variable "filename" {
  default = [
    "/root/pets.txt",
    "/root/dogs.txt",
    "/root/cats.txt",
    "/root/cows.txt",
    "/root/ducks.txt"
  ]
}
```

pet[0] pet[1] pet[2]



>_

```
$ ls /root
pets.txt
dogs.txt
cats.txt
```

Length Function

variable	function	value
fruits = ["apple", "banana", "orange"]	length(fruits)	3
cars = [“honda”, “bmw”, “nissan”, “kia”]	length(cars)	4
colors = [“red”, “purple”]	length(colors)	2

LengthFunction

main.tf

```
resource "local_file" "pet" {
    filename = var.filename[count.index]
    count    = length(var.filename)
}
```

variables.tf

```
variable "filename" {
    default = [
      "/root/pets.txt",
      "/root/dogs.txt",
      "/root/cats.txt",
      "/root/cows.txt",
      "/root/ducks.txt"
    ]
}
```


```
>_
$ ls /root
pets.txt
dogs.txt
cats.txt
```

```
$ terraform apply

.
.
Terraform will perform the following
actions:
  # local_file.pet[0] will be created
  + resource "local_file" "pet" {
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/pets.txt"
      + id                   = (known after apply)
    }

  # local_file.pet[1] will be created
  + resource "local_file" "pet" {
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/dogs.txt"
      + id                   = (known after apply)
    }

  # local_file.pet[2] will be created
  + resource "local_file" "pet" {
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/cats.txt"
      + id                   = (known after apply)
    }
```

```
$ ls /root
pet.txt
dogs.txt
cats.txt
```

main.tf

```
resource "local_file" "pet" {
    filename = var.filename[count.index]
    count    = length(var.filename)
}
```

variables.tf

```
variable "filename" {
    default = [
        "/root/dogs.txt",
        "/root/cats.txt"
    ]
}
```

main.tf

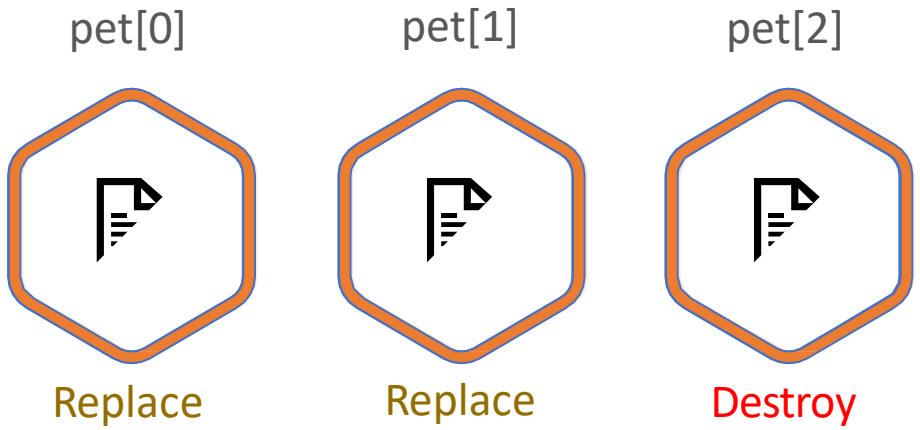
```
resource "local_file" "pet" {
    filename = var.filename[count.index]

    count    = length(var.filename)

}
```

variables.tf

```
variable "filename" {
    default = [

      "/root/dogs.txt",
      "/root/cats.txt"
    ]

}
```

>_

```
$ terraform plan

...
  # local_file.pet[0] must be replaced
-/+ resource "local_file" "pet" {
        directory_permission = "0777"
        file_permission      = "0777"
      ~ filename             = "/root/pets.txt" -> "/root/dogs.txt" #
forces replacement
    }
  # local_file.pet[1] must be replaced
-/+ resource "local_file" "pet" {
        directory_permission = "0777"
        file_permission      = "0777"
      ~ filename             = "/root/dogs.txt" -> "/root/cats.txt" #
forces replacement
    }
  # local_file.pet[2] will be destroyed
  - resource "local_file" "pet" {
      - directory_permission = "0777" -> null
      - file_permission      = "0777" -> null
```

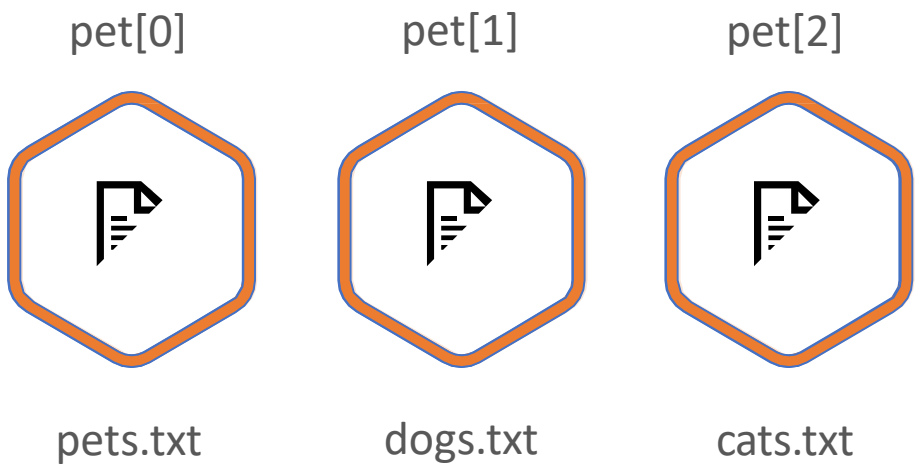


main.tf

```
resource "local_file" "pet" {
    filename = var.filename[count.index]

    count    = length(var.filename)
}

output "pets" {
  value = local_file.pet
}
```

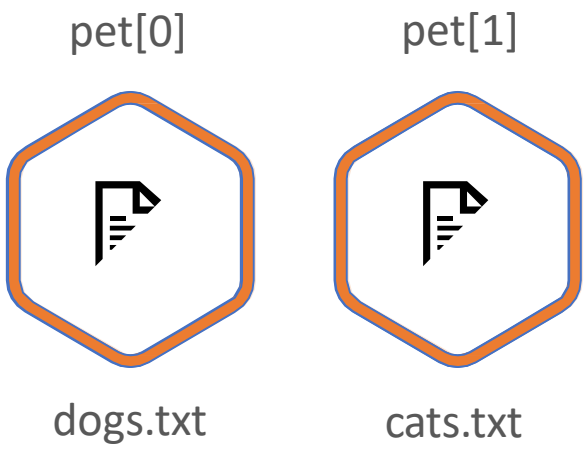
>_

```
$ terraform output
Outputs:

pets = [
  {
    "directory_permission" = "0777"
    "file_permission" = "0777"
    "filename" = "/root/pets.txt"
    "id" =
    "da39a3ee5e6b4b0d3255bfef95601890afd80709"
  },
  {
    "directory_permission" = "0777"
    "file_permission" = "0777"
    "filename" = "/root/dogs.txt"
    "id" =
    "da39a3ee5e6b4b0d3255bfef95601890afd80709"
  },
  {
    "directory_permission" = "0777"
    "file_permission" = "0777"
    "filename" = "/root/cats.txt"
    "id" =
    "da39a3ee5e6b4b0d3255bfef95601890afd80709"
```



variables.tf

```
variable "filename" {
  default = [

    "/root/dogs.txt",
    "/root/cats.txt"
  ]

}
```



variables.tf

```
variable "filename" {
  default = [

    "/root/dogs.txt",
    "/root/cats.txt"
  ]

}
```

Resource	Resource Updates	Action
pet[0]	/root/pets.txt" -> "/root/dogs.txt"	Destroy and Replace
pet[1]	"/root/dogs.txt" -> "/root/cats.txt"	Destroy and Replace
pet[2]	Does not Exist	Destroy

for_each

Lokeshkumar

for_each

main.tf

```
resource "local_file" "pet" {
    filename = each.value

    for_each = var.filename

}
```

variables.tf

```
variable "filename" {
    type=set(string)
    default = [
      "/root/pets.txt",
      "/root/dogs.txt",
      "/root/cats.txt"
    ]

}
```

>_

```
$ terraform plan

Terraform will perform the following actions:
  # local_file.pet["/root/cats.txt"] will be created
  + resource "local_file" "pet" {
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/cats.txt"
    }
... <output trimmed>
Plan: 3 to add, 0 to change, 0 to destroy.
```

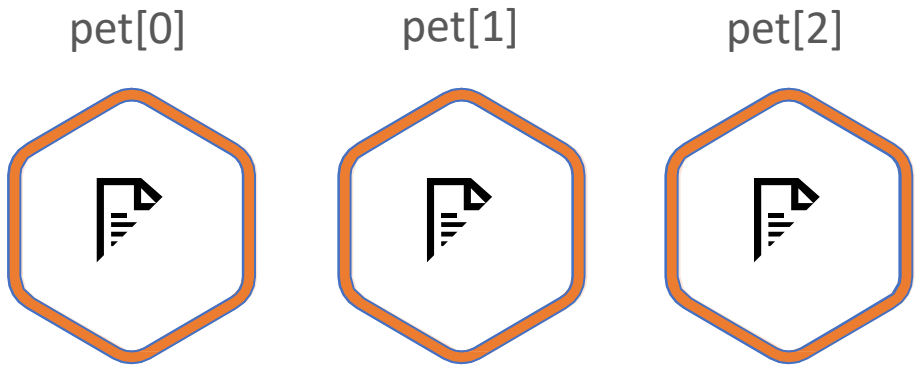
for_each

main.tf

```
resource "local_file" "pet" {
    filename = each.value
    for_each = toset(var.filename)
}
```

variables.tf

```
variable "filename" {
  type=set(string)
  default = [
    "/root/pets.txt",
    "/root/dogs.txt",
    "/root/cats.txt"
  ]
}
```



>_

```
$ terraform plan

Terraform will perform the following actions:
  # local_file.pet["/root/cats.txt"] will be created
  + resource "local_file" "pet" {
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/cats.txt"
    }
... <output trimmed>
Plan: 3 to add, 0 to change, 0 to destroy.
```

for_each

main.tf

```
resource "local_file" "pet" {
    filename = each.value

    for_each = toset(var.filename)
}

output "pets" {
  value = local_file.pet
}
```

variables.tf

```
variable "filename" {
  type=list(string)

  default = [
    "/root/dogs.txt",
    "/root/cats.txt"
  ]

}
```

>_

```
$ terraform plan
Terraform will perform the following actions:
  # local_file.pet["/root/pets.txt"] will be destroyed
  + resource "local_file" "pet" {
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "/root/pets.txt"
    }
... <output trimmed>
Plan: 0 to add, 0 to change, 1 to destroy.
```

for_each

main.tf

```
resource "local_file" "pet" {
    filename = each.value

    for_each = toset(var.filename)
}

output "pets" {
  value = local_file.pet
}
```

>_

```
$ terraform output
pets = {
  "/root/cats.txt" = {
    "directory_permission" = "0777"
    "file_permission" = "0777"
    "filename" = "/root/cats.txt"
    "id" =
    "da39a3ee5e6b4b0d3255bfef95601890afd80709"
  }

  "/root/dogs.txt" = {
    "directory_permission" = "0777"
    "file_permission" = "0777"
    "filename" = "/root/dogs.txt"
    "id" =
    "da39a3ee5e6b4b0d3255bfef95601890afd80709"
} }
```

count

```
>_
$ terraform output
pets = [
  {
    "directory_permission" = "0777"
    "file_permission" = "0777"
    "filename" = "/root/pets.txt"
    "id" =
    "da39a3ee5e6b4b0d3255bfef95601890afd80709"
  },
  {
    "directory_permission" = "0777"
    "file_permission" = "0777"
    "filename" = "/root/dogs.txt"
    "id" =
    "da39a3ee5e6b4b0d3255bfef95601890afd80709"
  },
  {
    "directory_permission" = "0777"
    "file_permission" = "0777"
    "filename" = "/root/cats.txt"
    "id" =
    "da39a3ee5e6b4b0d3255bfef95601890afd80709"
  },
]
```

for_each

```
>_
$ terraform output
pets = {
  "/root/cats.txt" = {
    "directory_permission" = "0777"
    "file_permission" = "0777"
    "filename" = "/root/cats.txt"
    "id" =
    "da39a3ee5e6b4b0d3255bfef95601890afd80709"
  }


  "/root/dogs.txt" = {
    "directory_permission" = "0777"
    "file_permission" = "0777"
    "filename" = "/root/dogs.txt"
    "id" =
}   "da39a3ee5e6b4b0d3255bfef95601890afd80709"
  }
```

Version Constraints

Lokeshkumar

main.tf

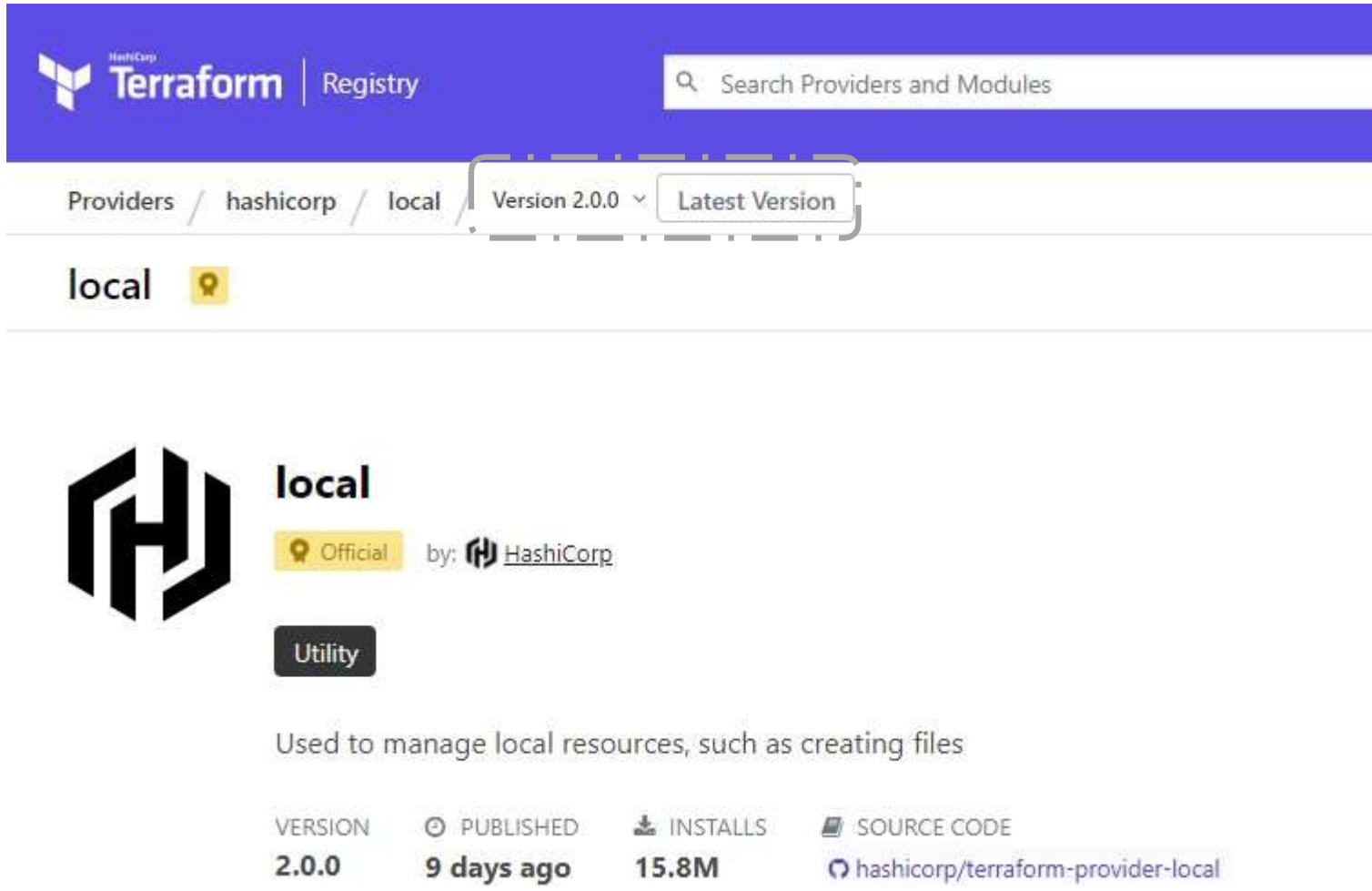
```
resource "local_file" "pet" {
  filename     = "/root/pet.txt"
  content  = "We love pets!"
}
```

>_

```
$ terraform init
Initializing the backend...

Initializing provider plugins...
- Finding latest version of hashicorp/local...
- Installing hashicorp/local v1.4.0...
- Installed hashicorp/local v1.4.0 (signed by HashiCorp)

The following providers do not have any version constraints
in configuration, so the latest version was installed.

To prevent automatic upgrades to new major versions that may
contain breaking
changes, we recommend adding version constraints in a
required_providers block
in your configuration, with the constraint strings suggested
below.

* hashicorp/local: version = "~> 1.4.0"

Terraform has been successfully initialized!
```

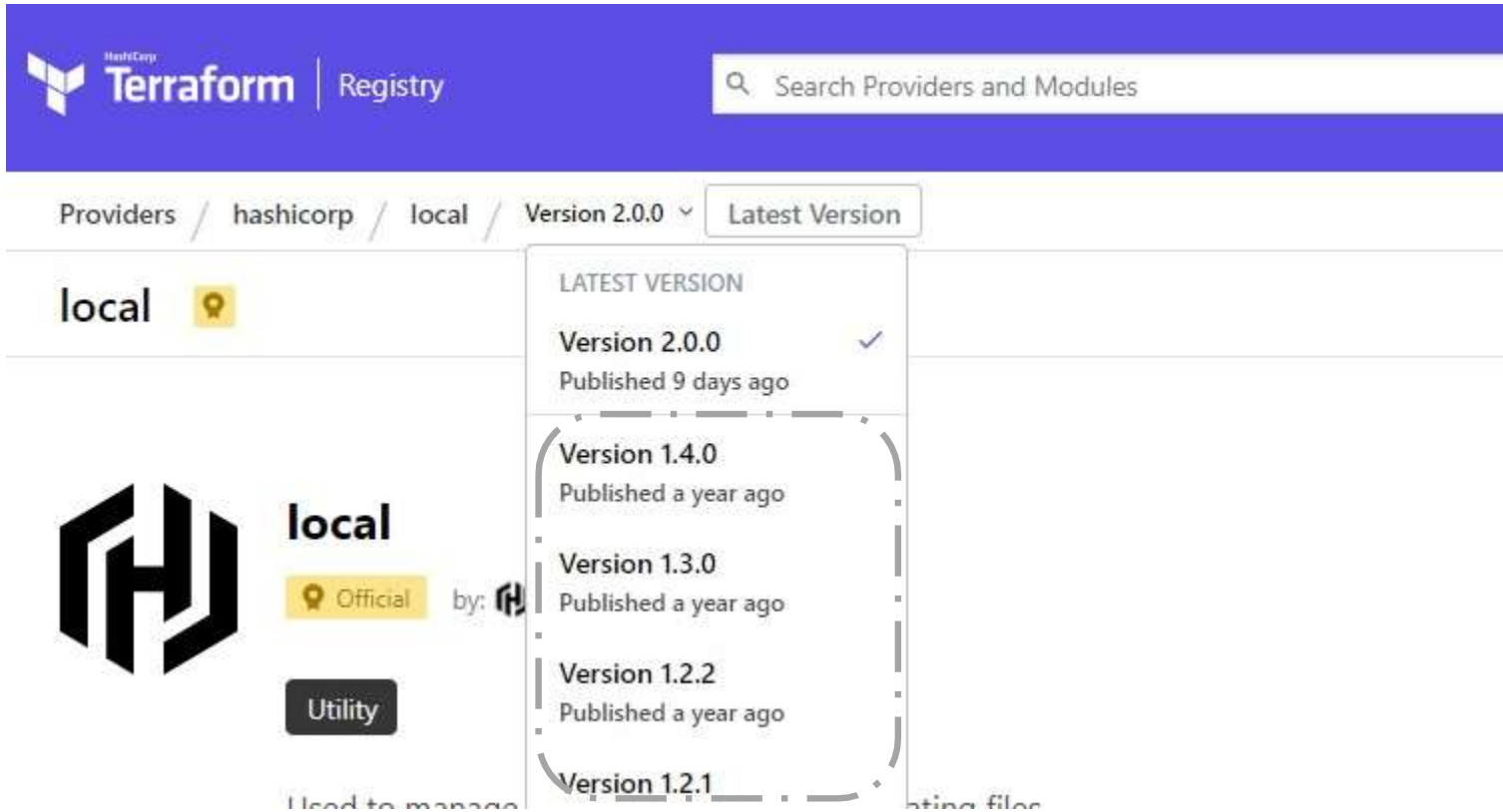
main.tf

```
resource "local_file" "pet" {
  filename     = "/root/pet.txt"
  content  = "We love pets!"
}
```



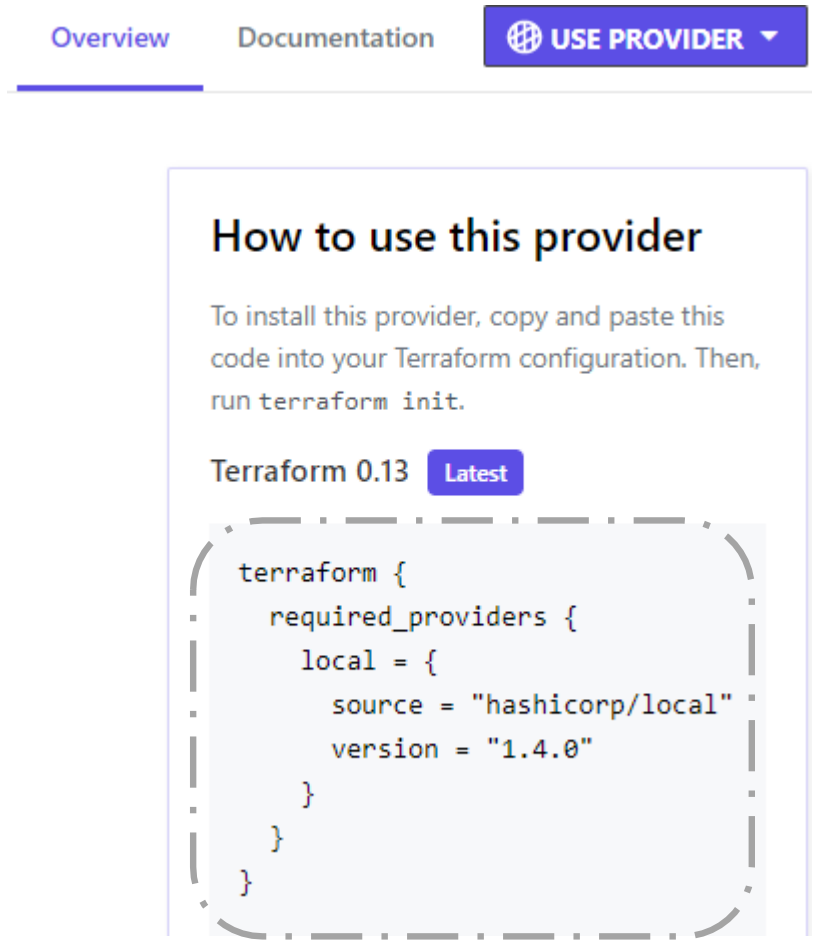
main.tf

```
resource "local_file" "pet" {
  filename     = "/root/pet.txt"
  content  = "We love pets!"
}
```



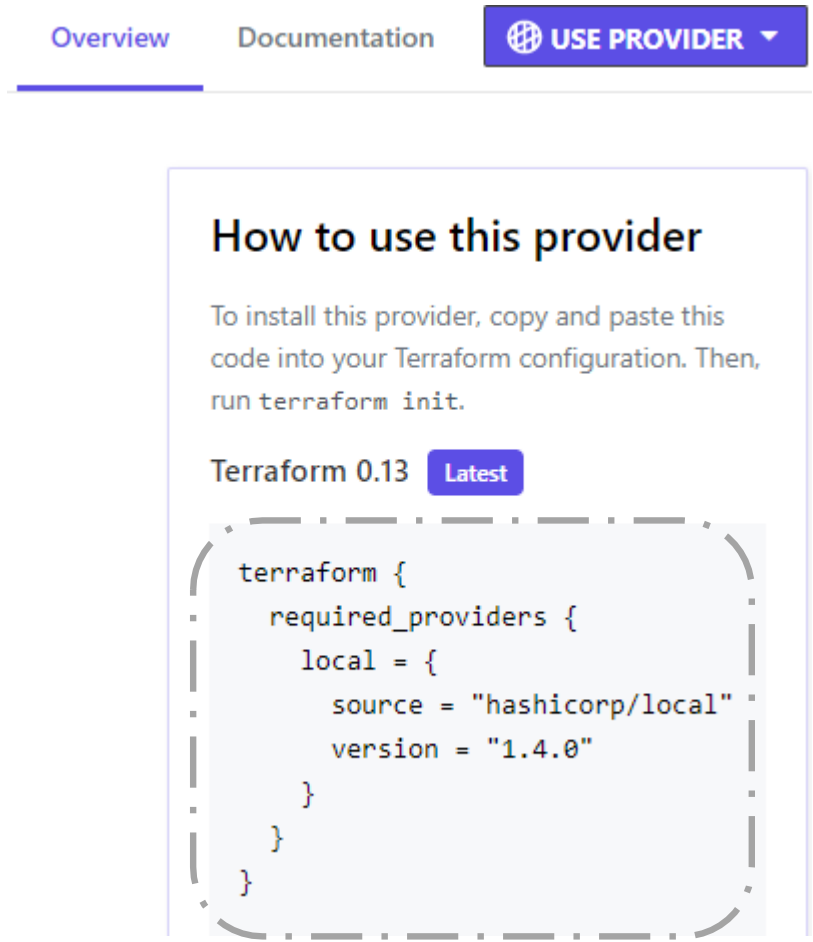
main.tf

```
resource "local_file" "pet" {
  filename     = "/root/pet.txt"
  content  = "We love pets!"
}
```



main.tf

```
terraform {
  required_providers {
    local = {
      source = "hashicorp/local"
      version = "1.4.0"
    }
  }
}

resource "local_file" "pet" {
  filename     = "/root/pet.txt"
  content  = "We love pets!"
}
```



main.tf

```
terraform {
  required_providers {
    local = {
      source = "hashicorp/local"
      version = "1.4.0"
    }
  }
}

resource "local_file" "pet" {
  filename     = "/root/pet.txt"
  content  = "We love pets!"
}
```

>_

```
$ terraform init

Initializing the backend...

Initializing provider plugins...
- Finding hashicorp/local versions matching "1.4.0"...
- Installing hashicorp/local v1.4.0...
- Installed hashicorp/local v1.4.0 (signed by HashiCorp)

Terraform has been successfully initialized!

You may now begin working with Terraform. Try running
"terraform plan" to see
any changes that are required for your infrastructure. All
Terraform commands
should now work.

If you ever set or change modules or backend configuration for
Terraform,
rerun this command to reinitialize your working directory. If
you forget, other
commands will detect it and remind you to do so if necessary.
```

main.tf

```
terraform {
  required_providers {
    local = {
      source = "hashicorp/local"
      version = "> 1.2.0, < 2.0.0, != 1.4.0"
    }
  }
}

resource "local_file" "pet" {
  filename     = "/root/pet.txt"
  content  = "We love pets!"
}
```

>_

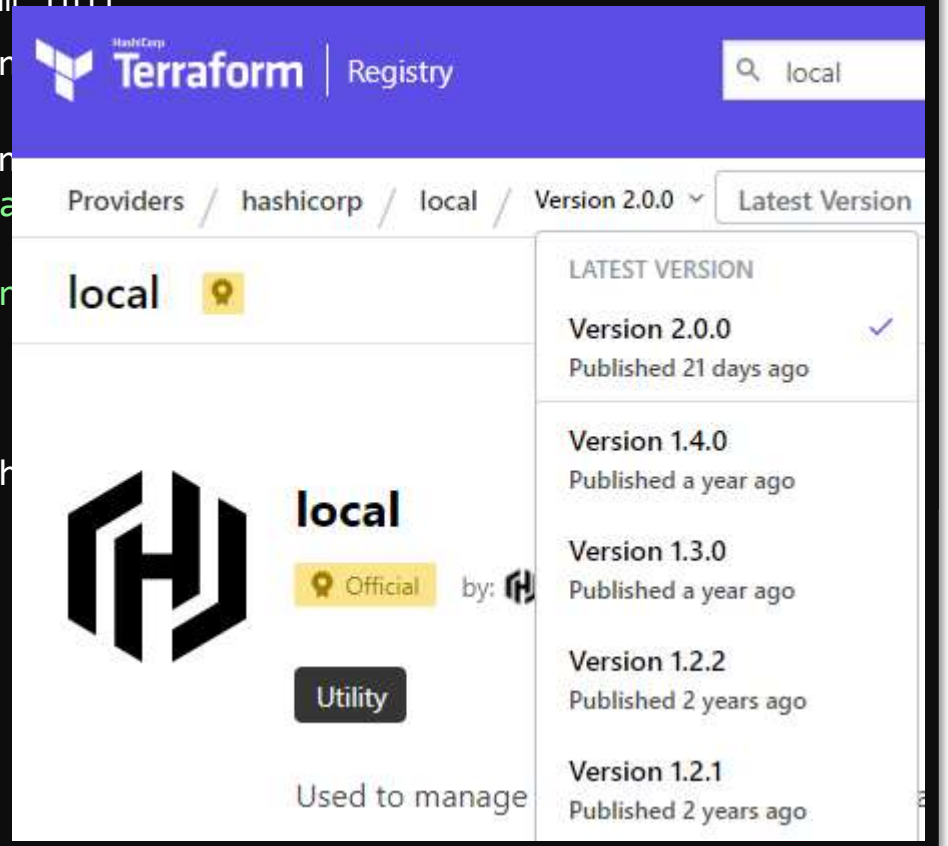
```
$ terraform init

Initializing the backend...

Initializing provider plugins...
-Finding hashicorp/local versions matching "> 1.2.0, < 2.0.0, != 1.4.0"...
- Installing hashicorp/local v1.3.0...
- Installed hashicorp/local v1.3.0 (signed by HashiCorp)

Terraform has been successfully initialized!
```

main.tf

```
terraform {
  required_providers {
    local = {
      source = "hashicorp/local"
      version = "~> 1.2.0"
    }
  }
}

resource "local_file" "pet" {
  filename     = "/root/pet.txt"
  content  = "We love pets!"
}
```

>_

```
$ terraform init

Initializin

Initializin
-Finding ha
1.2.0"...
- Installin
-Installed
HashiCorp)

Terraform h
```



Getting Started With AWS

Lokeshkumar

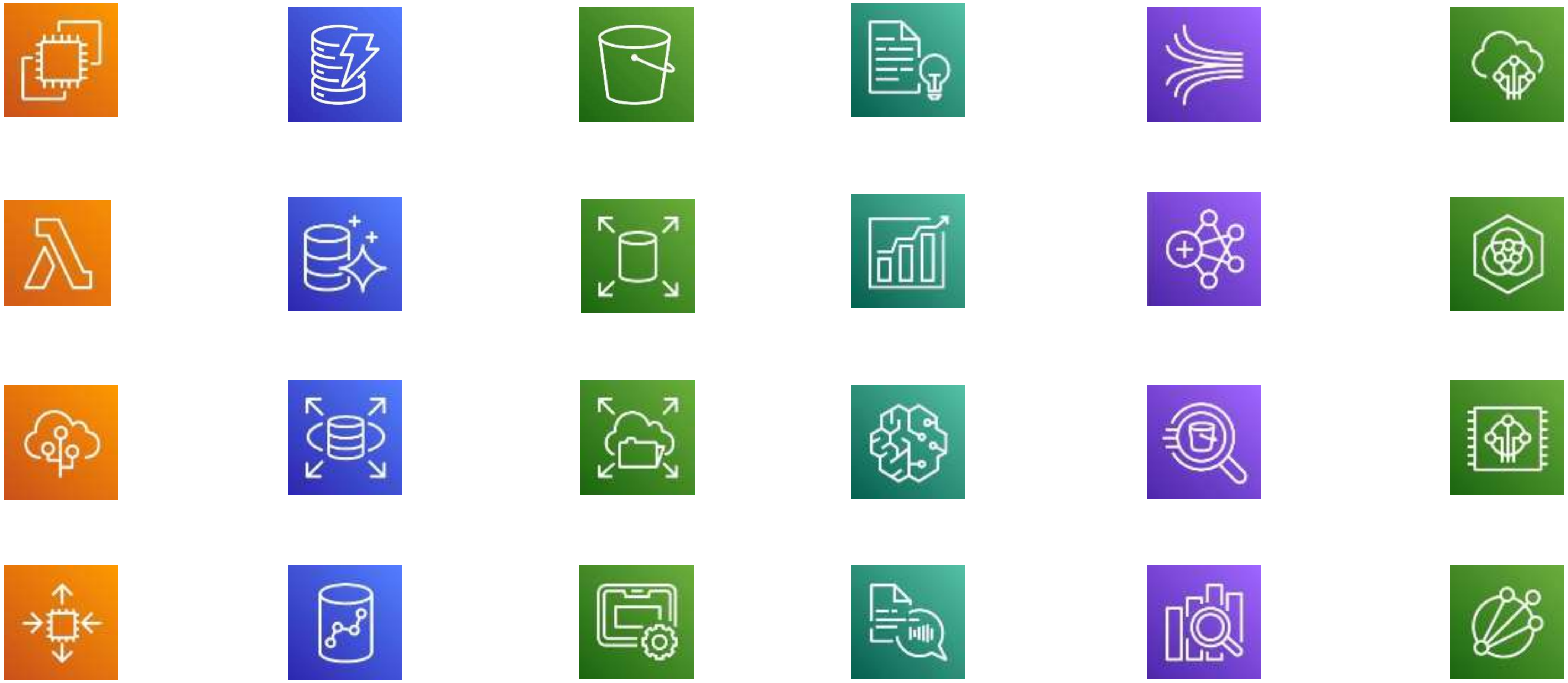
Why AWS?

Lokeshkumar

https://aws.amazon.com/blogs/aws/aws-named-as-a-cloud-leader-for-the-10th-consecutive-year-in-gartners-infrastructure-platform-services-magic-quadrant/

Why AWS?

Compute	Databases	Storage	Machine Learning	Analytics	IoT



Why AWS?

US East (Ohio) Region

US West (Oregon) Region

US West (Northern California) Region

GovCloud (US-West) Region

GovCloud (US-East) Region

Canada (Central) Region

South America (São Paulo) Region

Europe (Frankfurt) Region

Europe (London) Region

Europe (Paris) Region

Europe (Ireland) Region

Europe (Milan) Region

Mainland China (Beijing) Region

Asia Pacific (Sydney) Region

Asia Pacific (Tokyo) Region

Asia Pacific (Mumbai) Region

Asia Pacific (H

Why AWS with Terraform?

Getting Started with AWS

Demo: Setup an AWS Account

Introduction to IAM

Demo: IAM

Programmatic Access

IAM with Terraform

Introduction to AWS S3

S3 with Terraform

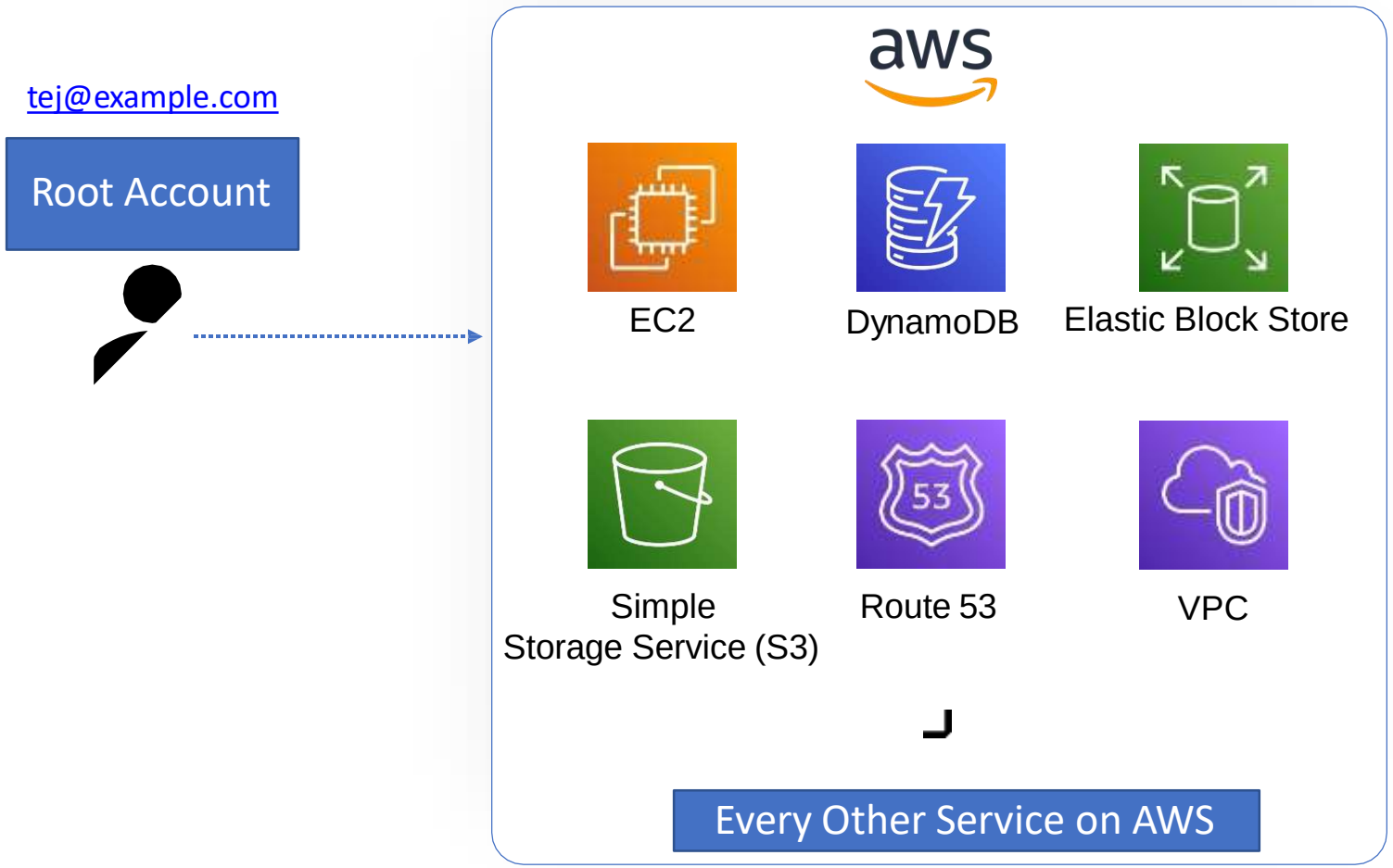
Introduction to DynamoDB

Demo DynamoDB

DynamoDB with Terraform

Introduction to IAM

Identity and Access Management in AWS



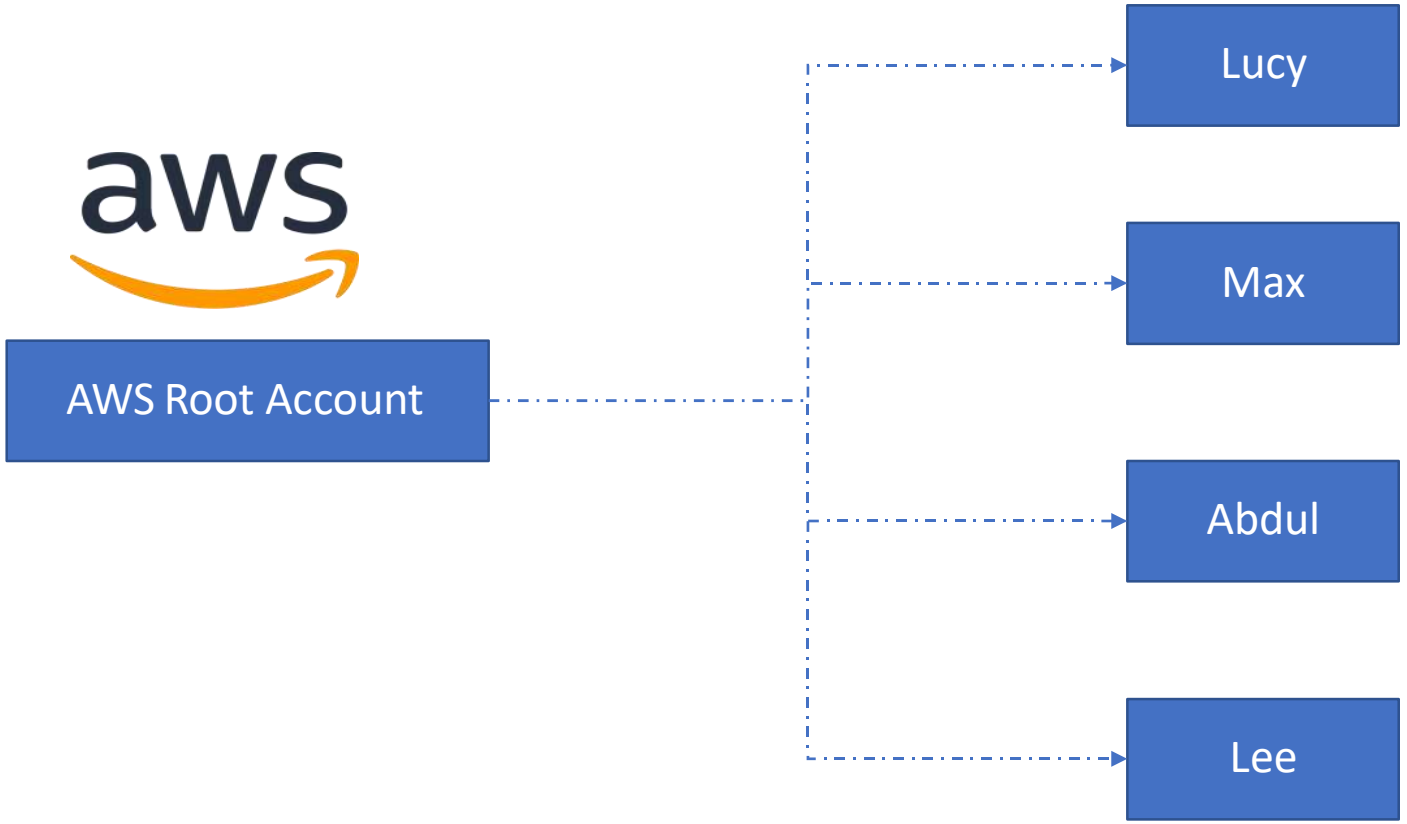
Linux Root User

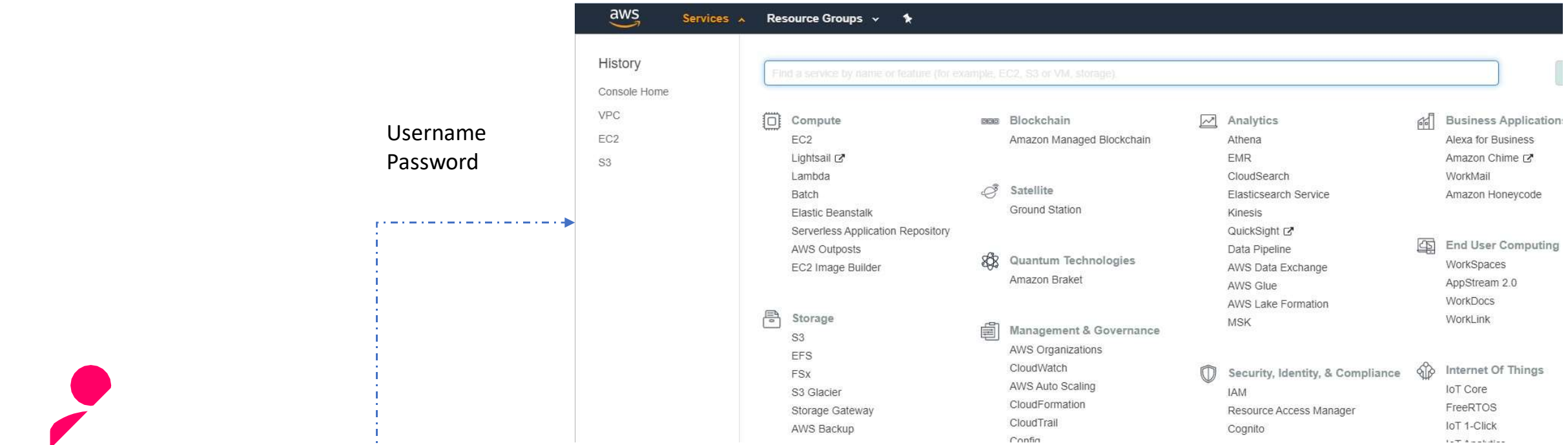
Windows

Windows Admin User

aws

AWS Root Account





Username
Password

console.aws.com

Lucy

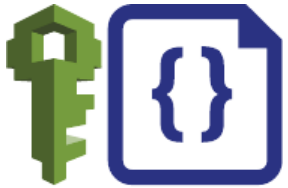
```
$ aws s3api create-bucket –bucket my-bucket –region us-east-1
```

Access Key ID
Secret Access Key

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "*",
            "Resource": "*"
        }
    ]
}
```

AdministratorAccess Policy

Lucy



IAM Policy

AdministratorAccess

AdministratorAccess

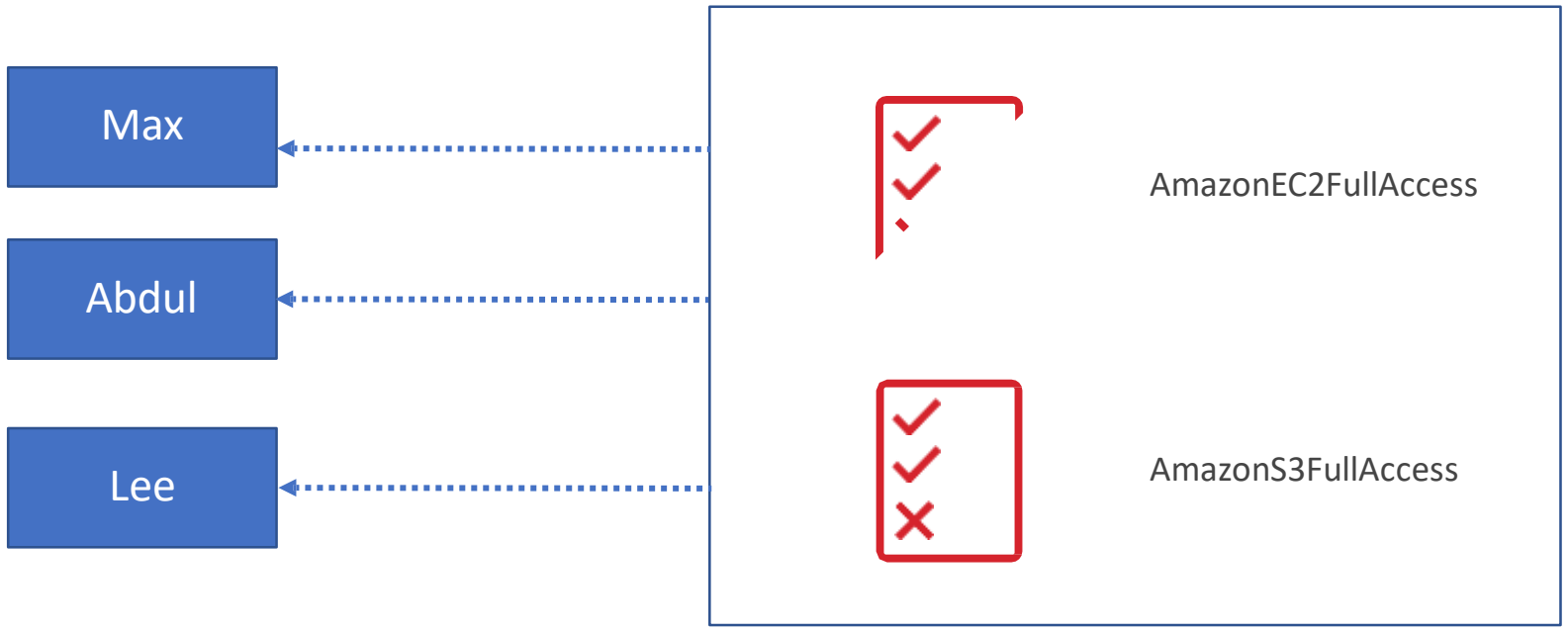
Filter policies | Search | Showing 583 results

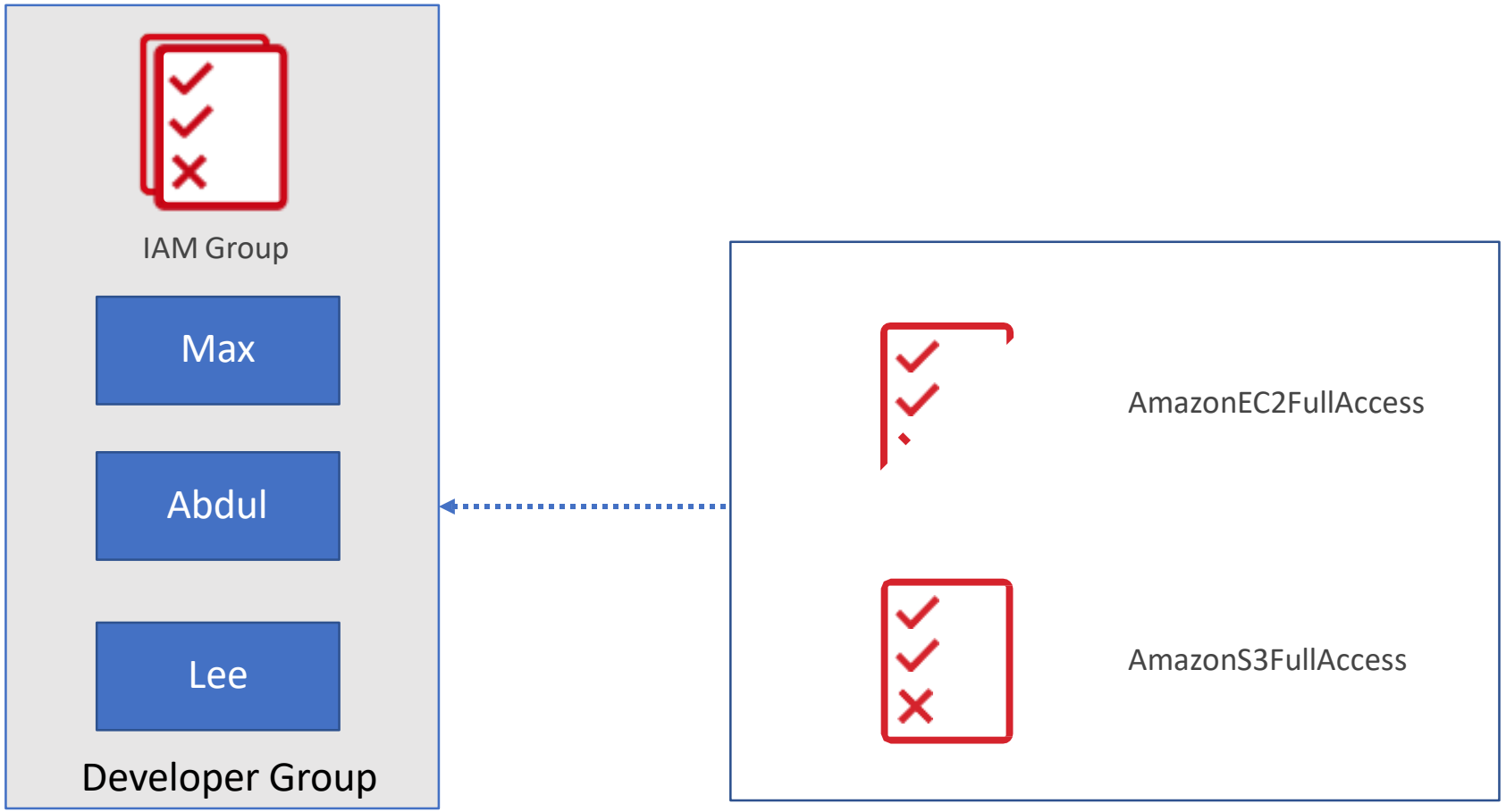
Policy name	Type	Used as
AdministratorAccess	Job function	Permissions policy (2)
AlexaForBusinessDeviceSetup	AWS managed	None
AlexaForBusinessFullAccess	AWS managed	None
AlexaForBusinessGatewayExecution	AWS managed	None
AlexaForBusinessLifesizeDelegatedAccessPolicy	AWS managed	None
AlexaForBusinessPolyDelegatedAccessPolicy	AWS managed	None
AlexaForBusinessReadOnlyAccess	AWS managed	None
AmazonAPIGatewayAdministrator	AWS managed	None

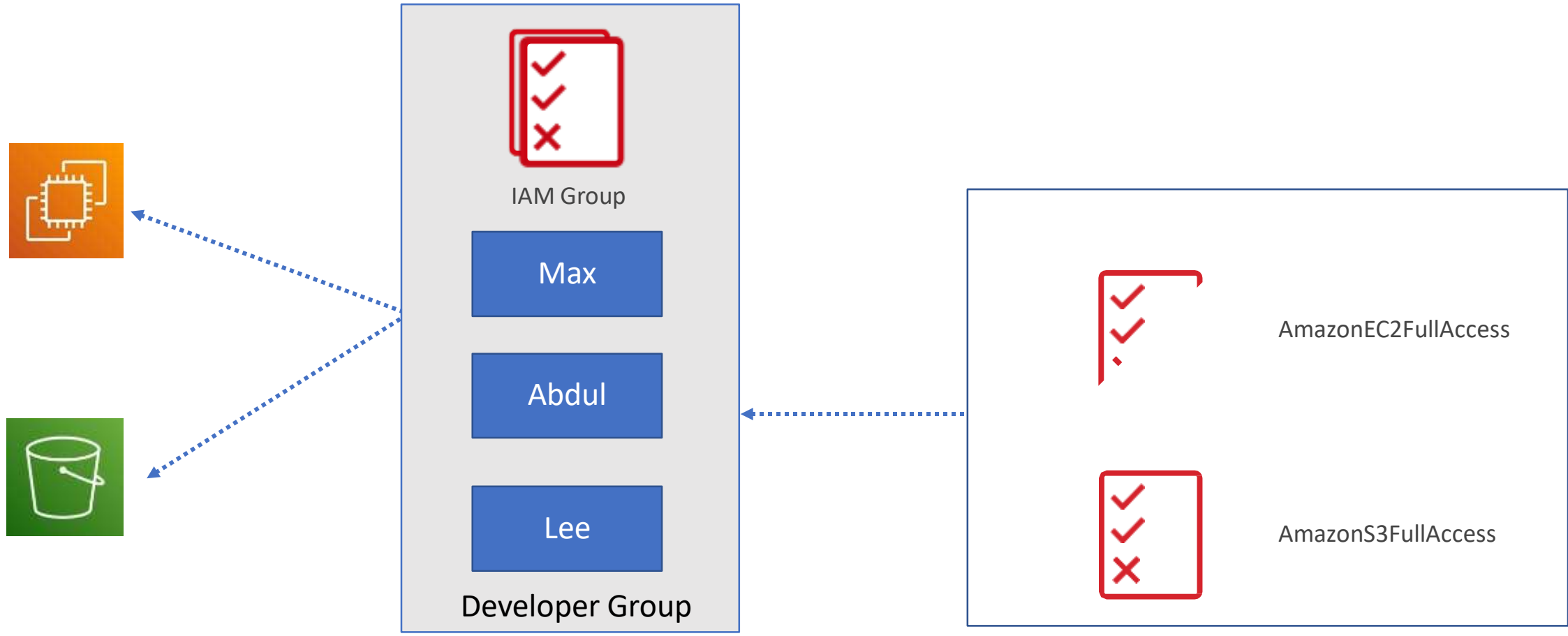
https://docs.aws.amazon.com/IAM/latest/UserGuide/access_policies_job-functions.html

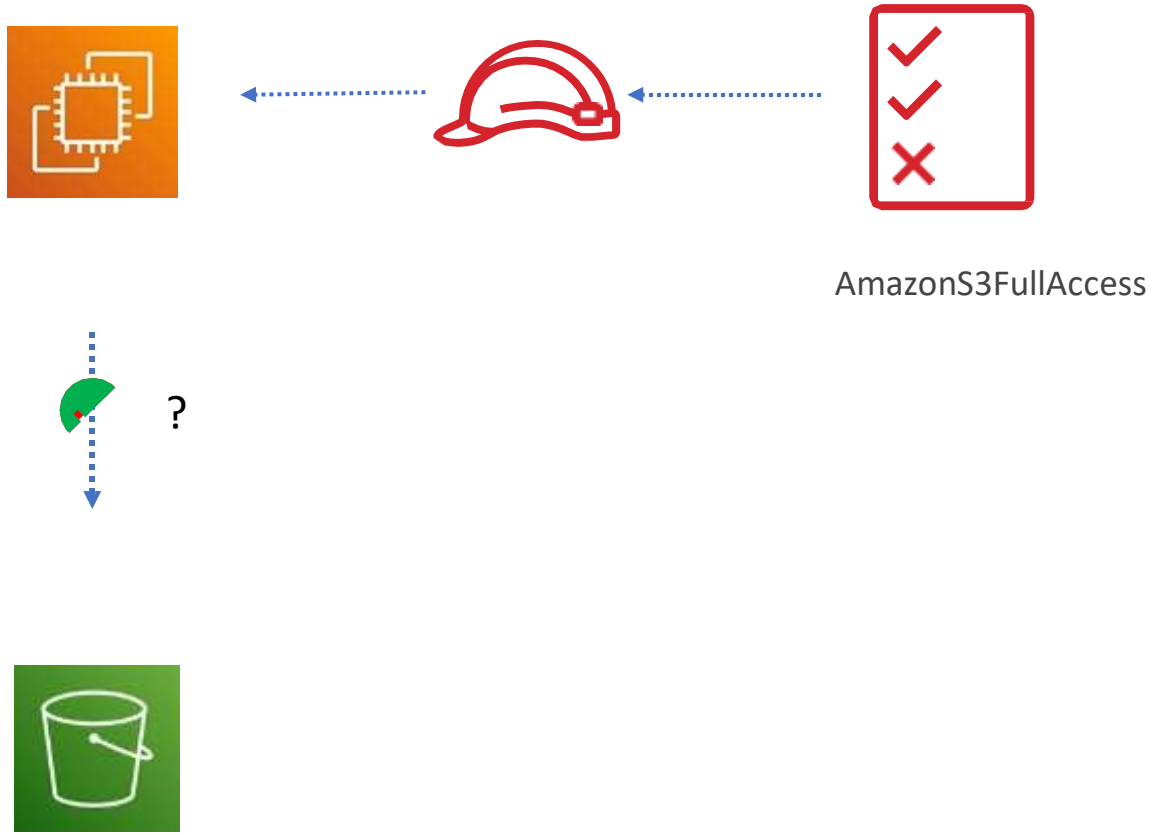
Job Function	Policy Name
Administrator	AdministratorAccess
Billing	Billing
Database Administrator	DatbaseAdministrator
Network Administrator	NetworkAdministrator
View-Only User	ViewOnlyAccess

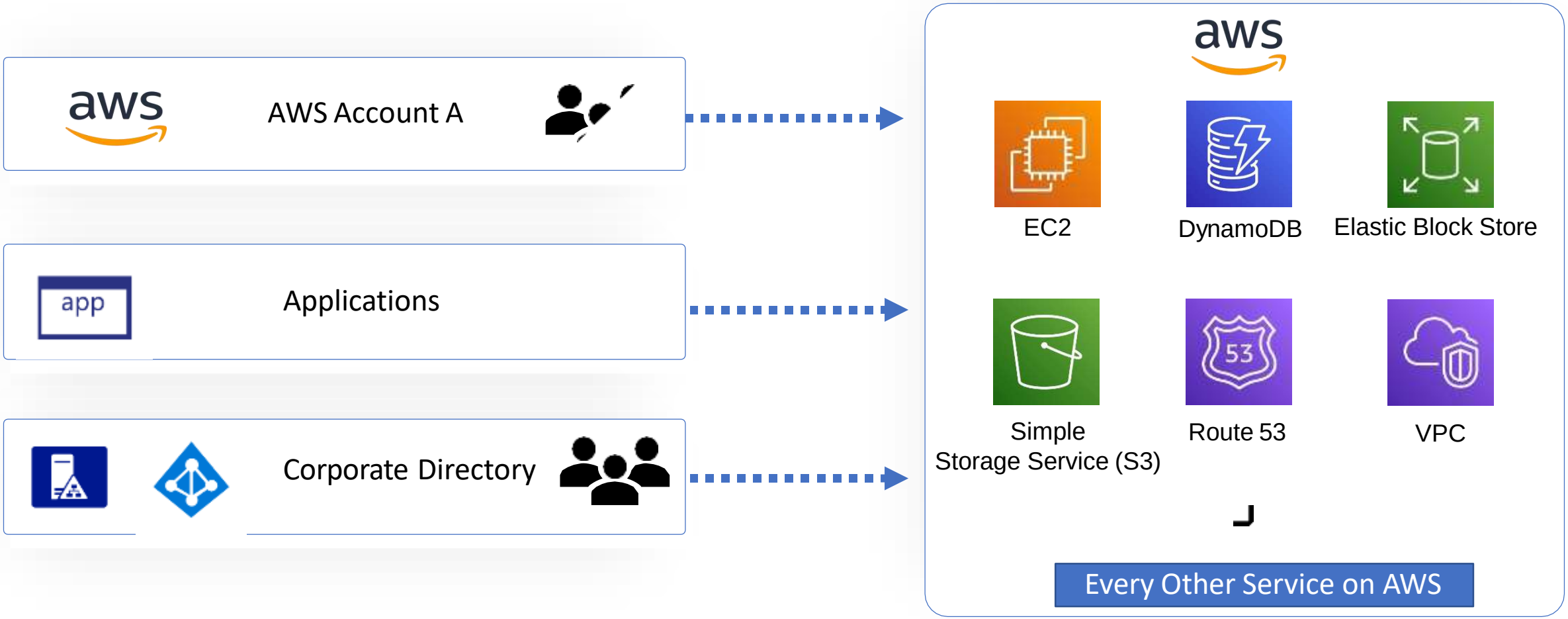
https://docs.aws.amazon.com/IAM/latest/UserGuide/access_policies_job-functions.html









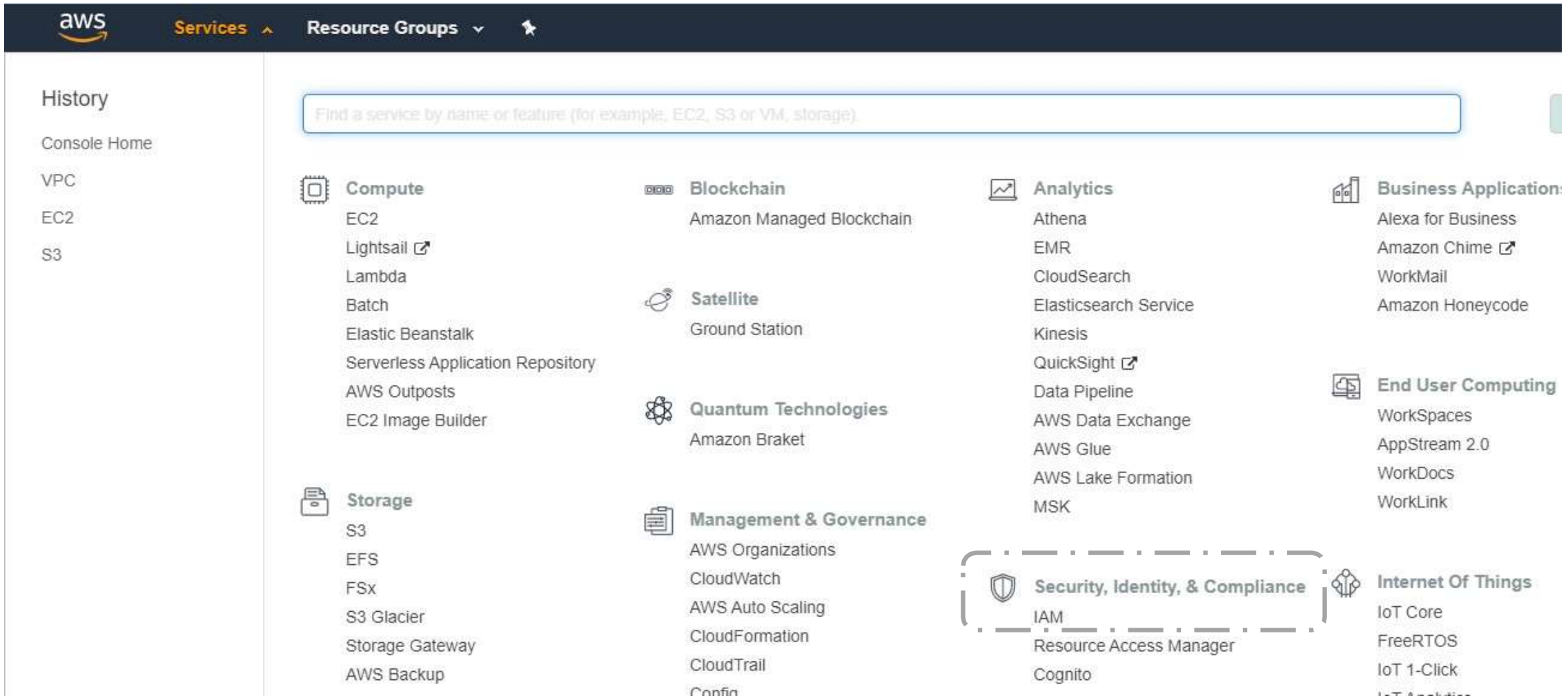


CreateEC2TagsPolicy

```
{
        "Version": "2012-10-17",
        "Statement": [
            {
                "Effect": "Allow",
                "Action": [
                    "ec2:DeleteTags",
                    "ec2:CreateTags"
                ],
                "Resource": "*"
            }
        ]
```

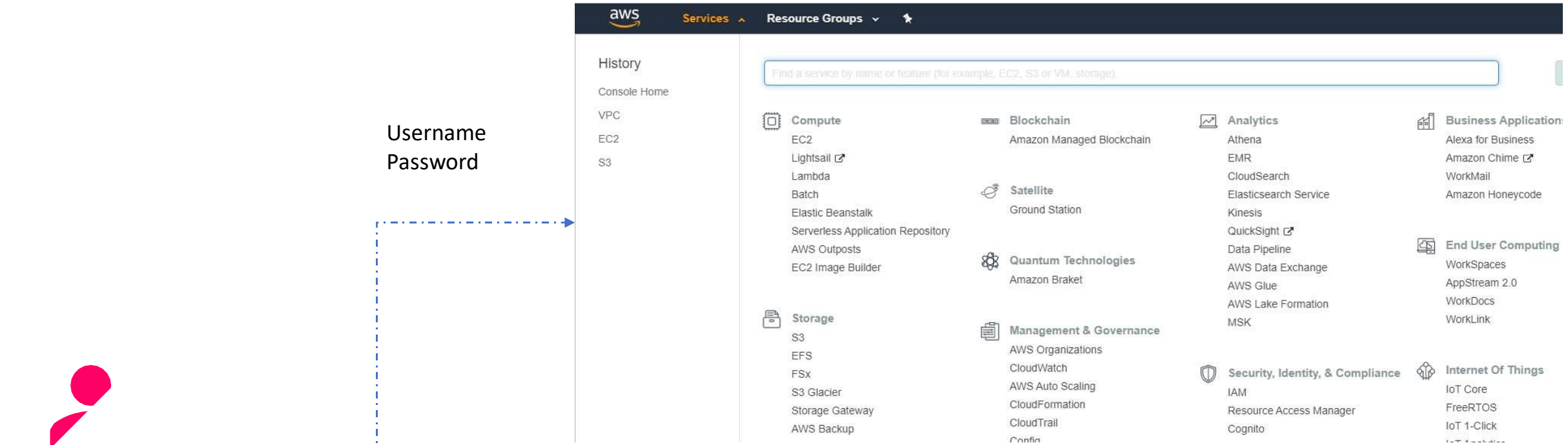
Filter policies | CreateEC2TagsPolicy

Policy name	Type	Used as	Description
CreateEC2TagsPolicy	Customer managed	*None*	Permission to create and delete EC2 Tags



Programmatic Access

Lokeshkumar



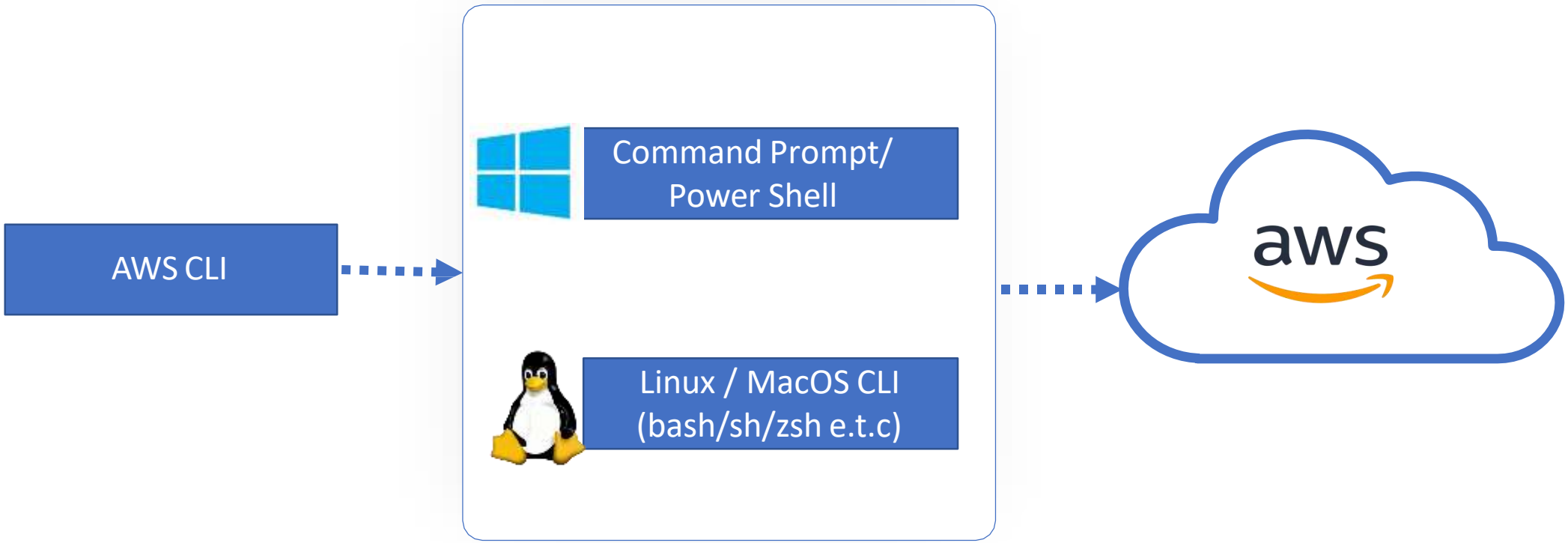
Username
Password

console.aws.com

Lucy

```
$ aws s3api create-bucket –bucket my-bucket –region us-east-1
```

Access Key ID
Secret Access Key



https://aws.amazon.com/cli/

```
$ curl "https://awscli.amazonaws.com/awscli-exe-linux-x86_64-2.0.30.zip" -o "awscliv2.zip"
$ unzip awscliv2.zip
$ sudo ./aws/install

$ aws --version
aws-cli/2.0.47 Python/3.7.4 Linux/4.14.133-113.105.amzn2.x86_64 botocore/2.0.0
```

Download and Install https://awscli.amazonaws.com/AWSCLIV2.msi

```
C:\> aws –version
aws-cli/2.0.47 Python/3.7.4 Windows/10 botocore/2.0.0
```

Download and Install
https://awscli.amazonaws.com/AWSCLIV2.pkg

```
$ aws –version
aws-cli/2.0.47 Python/3.7.4 Darwin/18.7.0 botocore/2.0.0
```

```
$ aws configure
  AWS Access Key ID [None]: AKIAI44QH8DHBEXAMPLE
  AWS Secret Access Key [None]:
  je7MtGbClwBF/2Zp9Utk/h3yCo8nvbEXAMPLEKEY
  Default region name [None]: us-west-2
  Default output format [None]: json
```

```
$ cat .aws/config/config
[default]
region = us-west-2
output = text
```

```
$ cat .aws/config/credentials
[default]
aws_access_key_id = AKIAI44QH8DHBEXAMPLE
aws_secret_access_key = je7MtGbClwBF/2Zp9Utk/h3yCo8nvbEXAMPLEKEY
```

```
$ aws <command> <subcommand> [options and parameters]
```

```
$ aws iam create-user --user-name lucy
{
    "User": {
        "UserName": "lucy",
        "Tags": [],
        "CreateDate": "2020-09-15T23:40:11.168Z",
        "UserId": "h9r2sc5br8ss7uzhs2qm",
        "Path": "/",
        "Arn": "arn:aws:iam::000000000000:user/lucy"
    }
}
```

Command	Value
command	iam
subcommand	create-user
option	--user-name
parameter	lucy

```
$ aws help
AWS()

NAME
       aws -

DESCRIPTION
       The  AWS  Command  Line  Interface is a unified tool to
manage your AWS
       services.

SYNOPSIS
          aws [options] <command> <subcommand> [parameters]

       Use aws command help for information on a  specific
command.  Use  aws
       help  topics  to view a list of available help topics.
The synopsis for
       each command shows its parameters and their usage.
Optional  parameters
       are shown in square brackets.
.
.
[Output Truncated]
```

```
$ aws iam help

IAM()

NAME
       iam -

DESCRIPTION
       AWS  Identity and Access Management (IAM) is a web
service for securely
       controlling access to AWS services. With IAM, you
can centrally    manage
       users,  security  credentials such as access keys, and
permissions that
       control which AWS resources users and applications
can access. For more
       information about IAM, see AWS Identity and
Access Management (IAM) and
       the AWS Identity and Access Management User Guide .

AVAILABLE COMMANDS
       o add-client-id-to-open-id-connect-provider

       o add-role-to-instance-profile
.
.
[Output Truncated]
```

```
$ aws <command> help
```

https://docs.aws.amazon.com/cli/latest/reference

```
$ aws iam create-user help
NAME
       create-user -

DESCRIPTION
       Creates a new IAM user for your AWS account.

       The number and size of IAM resources in an AWS account
are limited. For
       more information, see IAM and STS Quotas in the IAM User
Guide .

       See also: AWS API Documentation

       See 'aws help' for descriptions of global parameters.

SYNOPSIS
            create-user
          [--path <value>]
          --user-name <value>
          [--permissions-boundary <value>]
          [--tags <value>]
          [--cli-input-json <value>]
          [--generate-cli-skeleton <value>]
```

```
$ aws <command> <subcommand> help
```

IAM With Terraform

Lokeshkumar

Filter

- GuardDuty
- IAM
  - Resources
    - aws_iam_access_key
    - aws_iam_account_alias
    - aws_iam_account_password_policy
    - aws_iam_group
    - aws_iam_role
    - aws_iam_role_policy
    - aws_iam_role_policy_attachment
    - aws_iam_saml_provider
    - aws_iam_server_certificate
    - aws_iam_service_linked_role
    - aws_iam_user
    - aws_iam_user_group_membership
    - aws_iam_user_login_profile
    - aws_iam_user_policy

```
EOF
}
```

Argument Reference

The following arguments are supported:

- `name` - (Required) The user's name. The name must consist of upper and lowercase alphanumeric characters with no spaces. You can also include any of the following characters: `=,.@-_.` . User names are not distinguished by case. For example, you cannot create users named both "TESTUSER" and "testuser".
- `path` - (Optional, default "/") Path in which to create the user.
- `permissions_boundary` - (Optional) The ARN of the policy that is used to set the permissions boundary for the user.
- `force_destroy` - (Optional, default false) When destroying this user, destroy even if it has non-Terraform-managed IAM access keys, login profile or MFA devices. Without `force_destroy` a user with non-Terraform-managed access keys and login profile will fail to be destroyed.
- `tags` - Key-value map of tags for the IAM user

https://registry.terraform.io/providers/hashicorp/aws/latest/docs/resources/iam_user

aws=provider
iam_user=resourc
e

Block Name

Resource Type

Resource Name

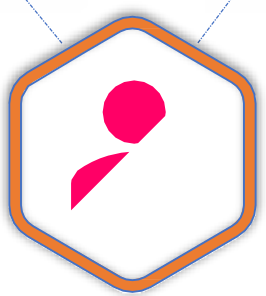
NAME

TAGS

main.tf

```
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
```

Arguments



main.tf

```
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
```

>_

```
$ terraform init

Initializing the backend...

Initializing provider plugins...
- Finding latest version of hashicorp/aws...
- Installing hashicorp/aws v3.6.0...
- Installed hashicorp/aws v3.6.0 (signed by HashiCorp)

The following providers do not have any version constraints in
configuration, so the latest version was installed.

To prevent automatic upgrades to new major versions that may
contain breaking changes, we recommend adding version
constraints in a required_providers block in your configuration,
with the constraint strings suggested below.

* hashicorp/aws: version = "~> 3.6.0"

Terraform has been successfully initialized!

You may now begin working with Terraform. Try running "terraform
plan" to see
any changes that are required for your infrastructure. All
Terraform commands
should now work.

If you ever set or change modules or backend configuration for
```

main.tf

```
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
```

>_

```
$ terraform plan
provider.aws.region
  The region where AWS operations will take place. Examples
  are us-east-1, us-west-2, etc.


  Enter a value: us-west-1
Refreshing Terraform state in-memory prior to plan...
The refreshed state will be used to calculate this plan, but
will not be
persisted to local or remote state storage.

Error: error configuring Terraform AWS Provider: no valid
credential sources for Terraform AWS Provider found.

Please see
https://registry.terraform.io/providers/hashicorp/aws
for more information about providing credentials.

Error: NoCredentialProviders: no valid providers in chain.
Deprecated.
        For verbose messaging see
aws.Config.CredentialsChainVerboseErrors
```

main.tf

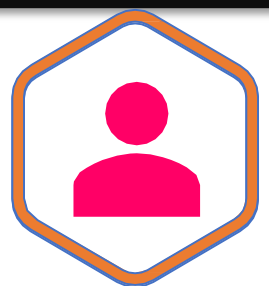
```
provider "aws" {
    region = "us-west-2"
    access_key = "AKIAI44QH8DHBEXAMPLE"
    secret_key = "je7MtGbClwBF/2tk/h3yCo8n…"
}
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
```

>_

```
$ terraform plan
.
.
+ create

Terraform will perform the following actions:

  # aws_iam_user.admin-user will be created
  + resource "aws_iam_user" "admin-user" {
      + arn           = (known after apply)
      + force_destroy = false
      + id            = (known after apply)
      + name          = "Lucy"
      + path          = "/"
      + tags          = {
          + "Description" = "Technical Team Lead"
        }
      + unique_id     = (known after apply)
    }

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

------------------------------------------------------------------------
------------------

Note: You didn't specify an "-out" parameter to save this
```

main.tf

```
provider "aws" {
    region = "us-west-2"
    access_key = "AKIAI44QH8DHBEXAMPLE"
    secret_key = "je7MtGbClwBF/2tk/h3yCo8n…"
}
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
```



>_

```
$ terraform apply


# aws_iam_user.admin-user will be created
  + resource "aws_iam_user" "admin-user" {
      + arn           = (known after apply)
      + force_destroy = false
      + id            = (known after apply)
      + name          = "Lucy"
      + path          = "/"
      + tags          = {
          + "Description" = "Technical Team Lead"
        }
      + unique_id     = (known after apply)
    }

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

aws_iam_user.admin-user: Creating...
aws_iam_user.admin-user: Creation complete after 1s
[id=Lucy]

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

main.tf

```
provider "aws" {
    region = "us-west-2"
    access_key = "AKIAI44QH8DHBEXAMPLE"
    secret_key = "je7MtGbClwBF/2tk/h3yCo8n…"
}
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
```

.aws/config/credentials

```
[default]
aws_access_key_id =
aws_secret_access_key =
```

main.tf

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


}
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
```

.aws/config/credentials

```
[default]
aws_access_key_id = AKIAI44QH8DHBEXAMPLE
aws_secret_access_key = je7MtGbClwBF/2tk/h3yCo8n…
```

>_

```
$ export AWS_ACCESS_KEY_ID=

$ export AWS_SECRET_ACCESS_KEY_ID=
```

main.tf

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


}
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
```

.aws/config/credentials

```
[default]
aws_access_key_id =
aws_secret_access_key =
```

>_

```
$ export AWS_ACCESS_KEY_ID=AKIAI44QH8DHBEXAMPLE

$ export
AWS_SECRET_ACCESS_KEY_ID=je7MtGbClwBF/2tk/h3yCo8n
$ export AWS_REGION=us-west-2
```

IAM policies with Terraform

Lokeshkumar

main.tf

```
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
```


```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "*",
            "Resource": "*"
        }
    ]
}
```

AdministratorAccess Policy

Argument Reference

The following arguments are supported:

- `description` - (Optional, Forces new resource) Description of the IAM policy.
- `name` - (Optional, Forces new resource) The name of the policy. If omitted, Terraform will assign a random, unique name.
- `name_prefix` - (Optional, Forces new resource) Creates a unique name beginning with the specified prefix. Conflicts with `name`.
- `path` - (Optional, default "/") Path in which to create the policy. See IAM Identifiers fo more information.
- `policy` - (Required) The policy document. This is a JSON formatted string. For more information about building AWS IAM policy documents with Terraform, see the AWS I Policy Document Guide

main.tf

```hcl
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}

resource "aws_iam_policy" "adminUser" {
  name   = "AdminUsers"
  policy = ?
}
```


```json
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "*",
            "Resource": "*"
        }
    ]
}
```

AdministratorAccess Policy

```
[COMMAND] <<DELIMITER
  Line1
  Line2
  Line3
DELIMITER
```

Heredoc Syntax

main.tf

```
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}

resource "aws_iam_policy" "adminUser" {
  name   = "AdminUsers"
  policy =  <<EOF

  EOF
}
```


```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "*",
            "Resource": "*"
        }
    ]
}
```

AdministratorAccess Policy

```
[COMMAND] <<DELIMITER
  Line1
  Line2
  Line3
DELIMITER
```

Heredoc Syntax

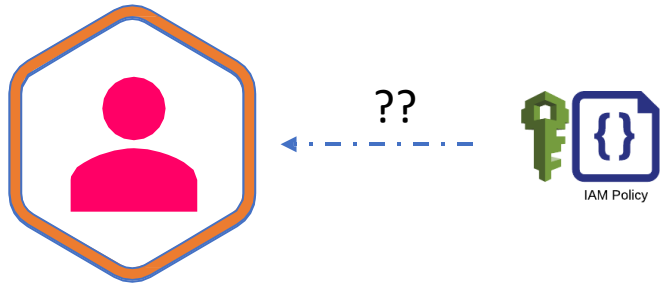
main.tf

```
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
resource "aws_iam_policy" "adminUser" {
  name   = "AdminUsers"
  policy =  <<EOF
    {
        "Version": "2012-10-17",
        "Statement": [
            {
                "Effect": "Allow",
                "Action": "*",
                "Resource": "*"
            }
        ]
    }
   EOF
}

 resource "aws_iam_user_policy_attachment" "lucy-admin-access" {

     user = aws_iam_user.admin-user.name

     policy_arn = aws_iam_policy.adminUser.arn

 }
```

AdministratorAccess Policy

```
[COMMAND] <<DELIMITER
  Line1
  Line2
  Line3
DELIMITER
```

Heredoc Syntax



Lokeshkumar

main.tf

```
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
resource "aws_iam_policy" "adminUser" {
  name    = "AdminUsers"
  policy =  <<EOF
    {
        "Version": "2012-10-17",
        "Statement": [
            {
                "Effect": "Allow",
                "Action": "*",
                "Resource": "*"
            }
        ]
    }
   EOF
}

 resource "aws_iam_user_policy_attachment" "lucy-admin-access" {

     user = aws_iam_user.admin-user.name

     policy_arn = aws_iam_policy.adminUser.arn

 }
```

>_

```
$ terraform apply

# aws_iam_policy.adminUser will be created
  + resource "aws_iam_policy" "adminUser" {
      + arn    = (known after apply)
      + id     = (known after apply)
      + name   = "AdminUsers"
      + path   = "/"
      + policy = jsonencode(
            {
              + Statement = [
                  + {
                      + Action   = "*"
                      + Effect   = "Allow"
                      + Resource = "*"
                    },
                ]
              + Version   = "2012-10-17"
            }
        )
    }
.
.[Output Truncated]
aws_iam_user.lucy: Creating...
aws_iam_policy.adminUser: Creating...
aws_iam_user.lucy: Creation complete after 0s [id=lucy]
aws_iam_policy.adminUser: Creation complete after 0s
[id=arn:aws:iam::000000000000:policy/AdminUsers]
aws_iam_user_policy_attachment.lucy-admin-access: Creating...
aws_iam_user_policy_attachment.lucy-admin-access: Creation complete
after 0s [id=lucy-20200919034158686100000001]

Apply complete! Resources: 3 added, 0 changed, 0 destroyed.
```

main.tf

```
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}

resource "aws_iam_policy" "adminUser" {
  name   = "AdminUsers"
  policy =  <<EOF
   {
       "Version": "2012-10-17",
       "Statement": [
           {
               "Effect": "Allow",
               "Action": "*",
               "Resource": "*"
           }
       ]
   }
  EOF
}

 resource "aws_iam_user_policy_attachment" "lucy-admin-access" {

     user = aws_iam_user.admin-user.name

     policy_arn = aws_iam_policy.adminUser.arn

 }
```

admin-policy.json

main.tf

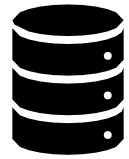
```
resource "aws_iam_user" "admin-user" {
    name = "lucy"
    tags = {
      Description = "Technical Team Leader"
    }
}
resource "aws_iam_policy" "adminUser" {
  name   = "AdminUsers"
  policy = file("admin-policy.json")


  EOF
}
resource "aws_iam_user_policy_attachment" "lucy-admin-access" {

    user = aws_iam_user.admin-user.name

    policy_arn = aws_iam_policy.adminUser.arn

}
```

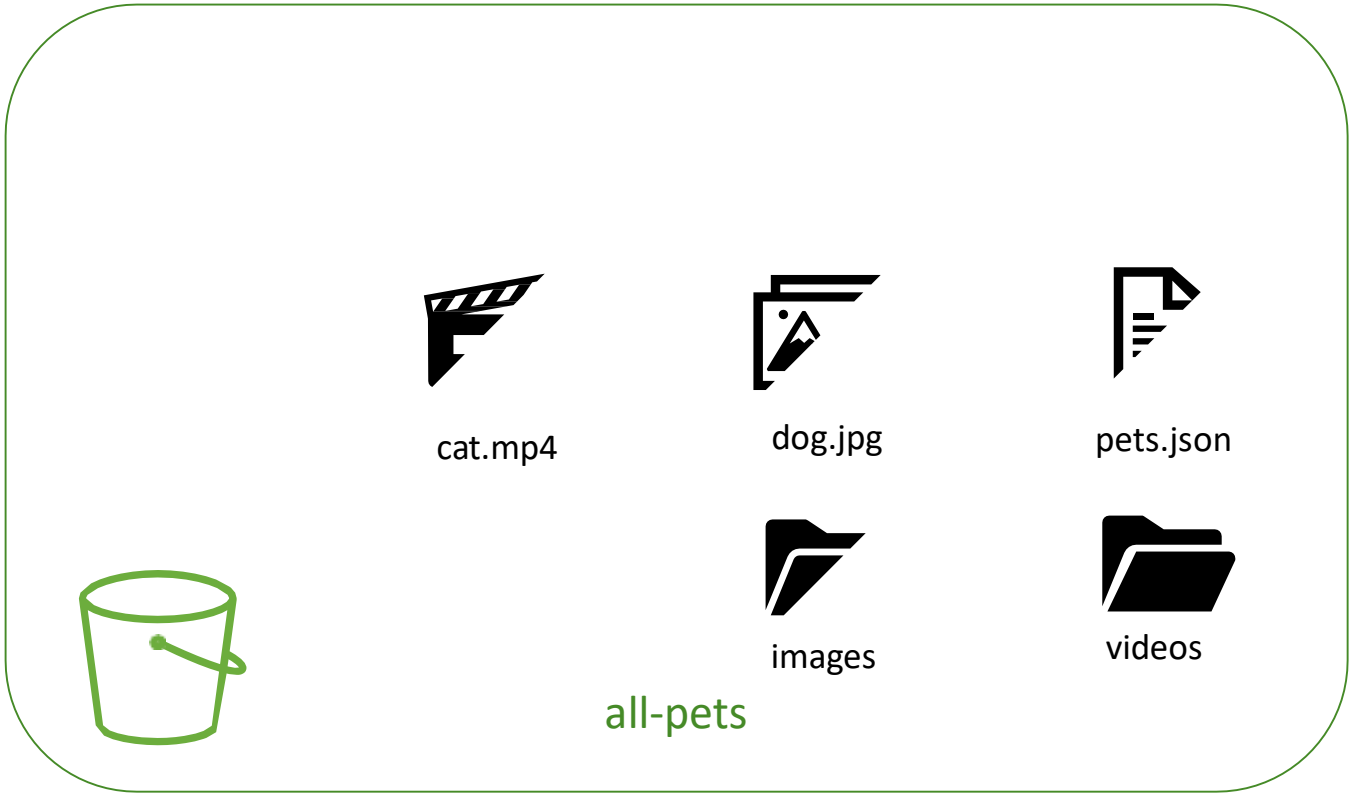
admin-policy.json

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "*",
            "Resource": "*"
        }
    ]
}
```

AWS S3

Lokeshkumar





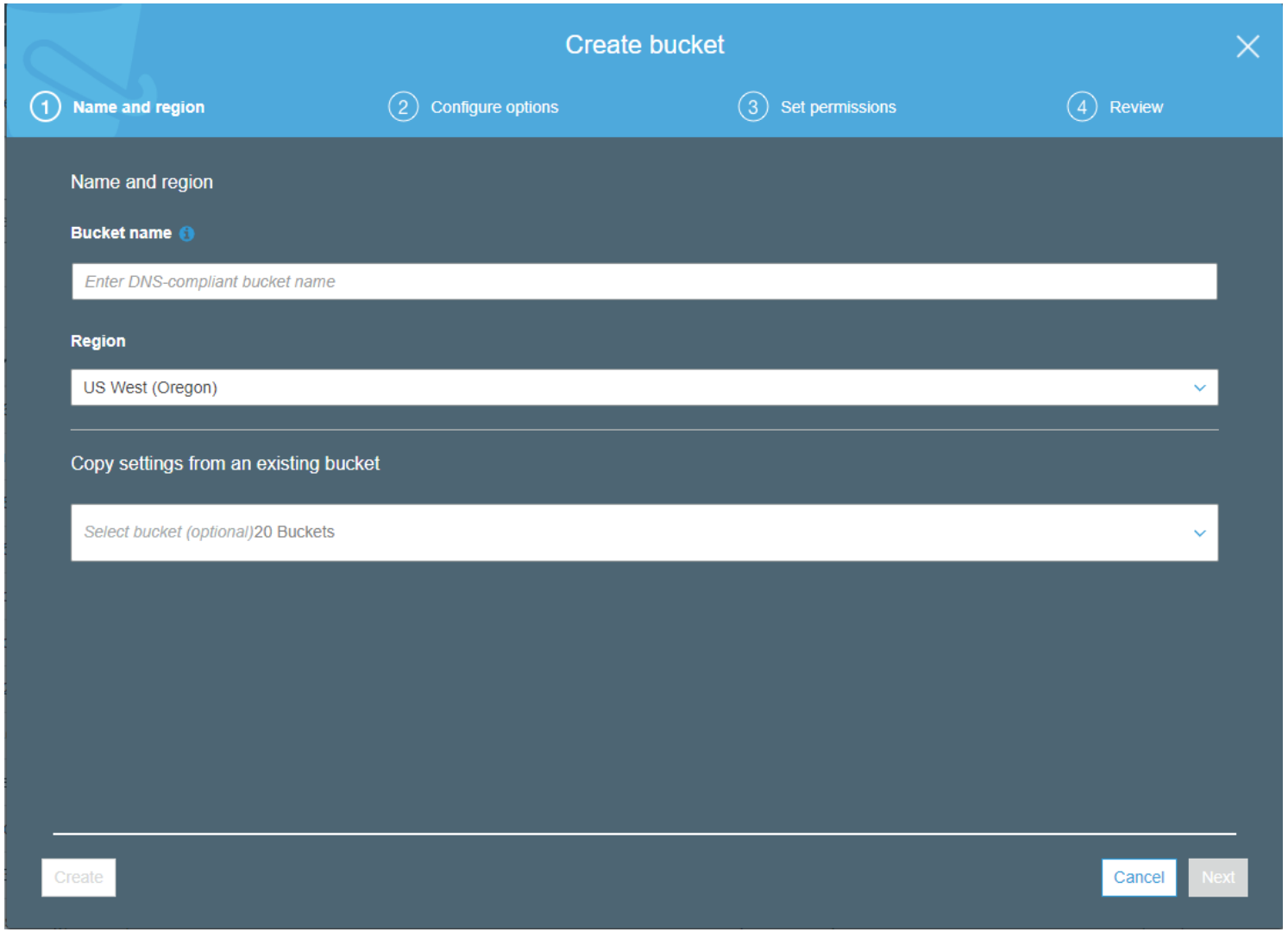
Object #	Name
1	pets.json
2	dog.jpg
3	cat.mp4
4	pictures/cat.jpg
5	videos/dog.mp4

https://docs.aws.amazon.com/AmazonS3/latest/dev/BucketRestrictions.html

Unique Bucket Name

DNS Compliant Name

Files size between 0 to 5TB



https://<bucket_name>.<region>.amazonaws.com

https://all-pets.us-west-1.amazonaws.com

Object #	Name	Address
1	pets.json	https://all-pets.us-west-1.amazonaws.com/pets.json
2	dog.jpg	https://all-pets.us-west-1.amazonaws.com/dog.jpg
3	cat.mp4	https://all-pets.us-west-1.amazonaws.com/cat.mp4
4	pictures/cat.jpg	https://all-pets.us-west-1.amazonaws.com/pictures/cat.jpg
5	videos/dog.mp4	https://all-pets.us-west-1.amazonaws.com/videos/dog.mp4

dog.jpg

Key = dog.jpg

Value = Data

Object data

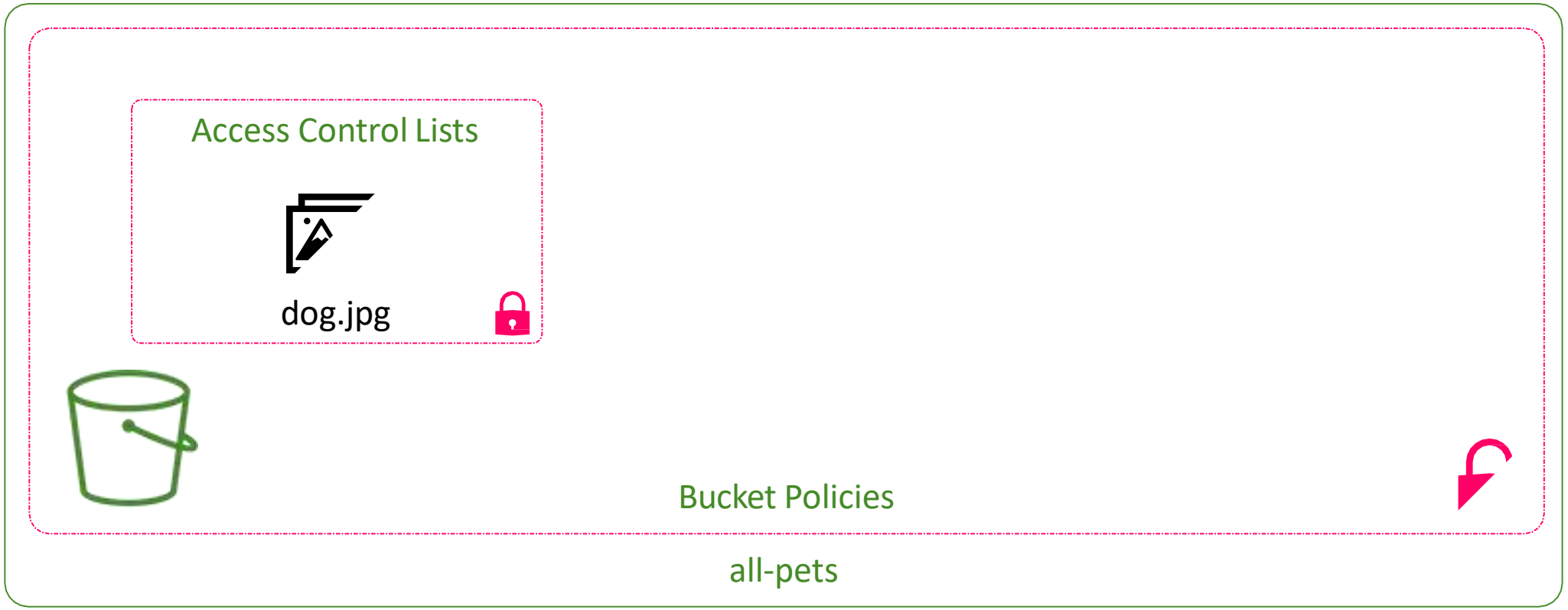
Owner = Lucy

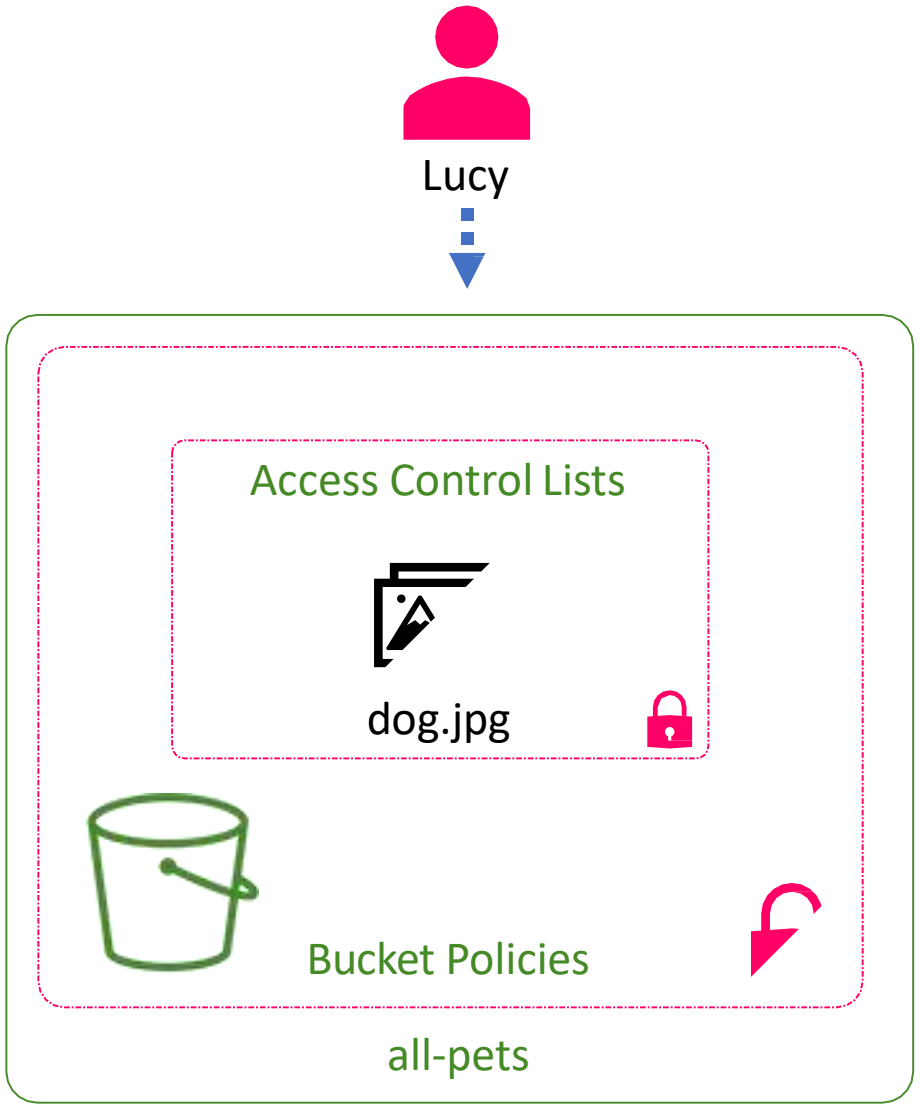
Size = 5MB

Last Modified = Jan 26, 2020 12:55:21 AM GMT-0500

Metadata

all-pets






```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Action": [
                "s3:GetObject"
            ],
            "Effect": "Allow",
            "Resource": "arn:aws:s3:::all-pets/*",
            "Principal": {
                "AWS": [
                    "arn:aws:iam::123456123457:user/Lucy"
                ]
            }
        }
    ]
}
```

S3 With Terraform

Lokeshkumar

main.tf

```
resource "aws_s3_bucket" "finance" {
    bucket = "finanace-21092020"
    tags   = {
        Description = "Finance and Payroll"
    }
}
```

>_

```
$ terraform apply

Terraform will perform the following
actions:

  # aws_s3_bucket.finance will be created
  + resource "aws_s3_bucket" "finance" {
      + acceleration_status         = (known after apply)
      + acl                         = "private"
      + arn                         = (known after apply)
      + bucket                      = "finanace-21092020"
.
.
Plan: 1 to add, 0 to change, 0 to destroy.

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

aws_s3_bucket.finance: Creating...

aws_s3_bucket.finance: Creation complete after
0s [id=finanace-21092020]

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

main.tf

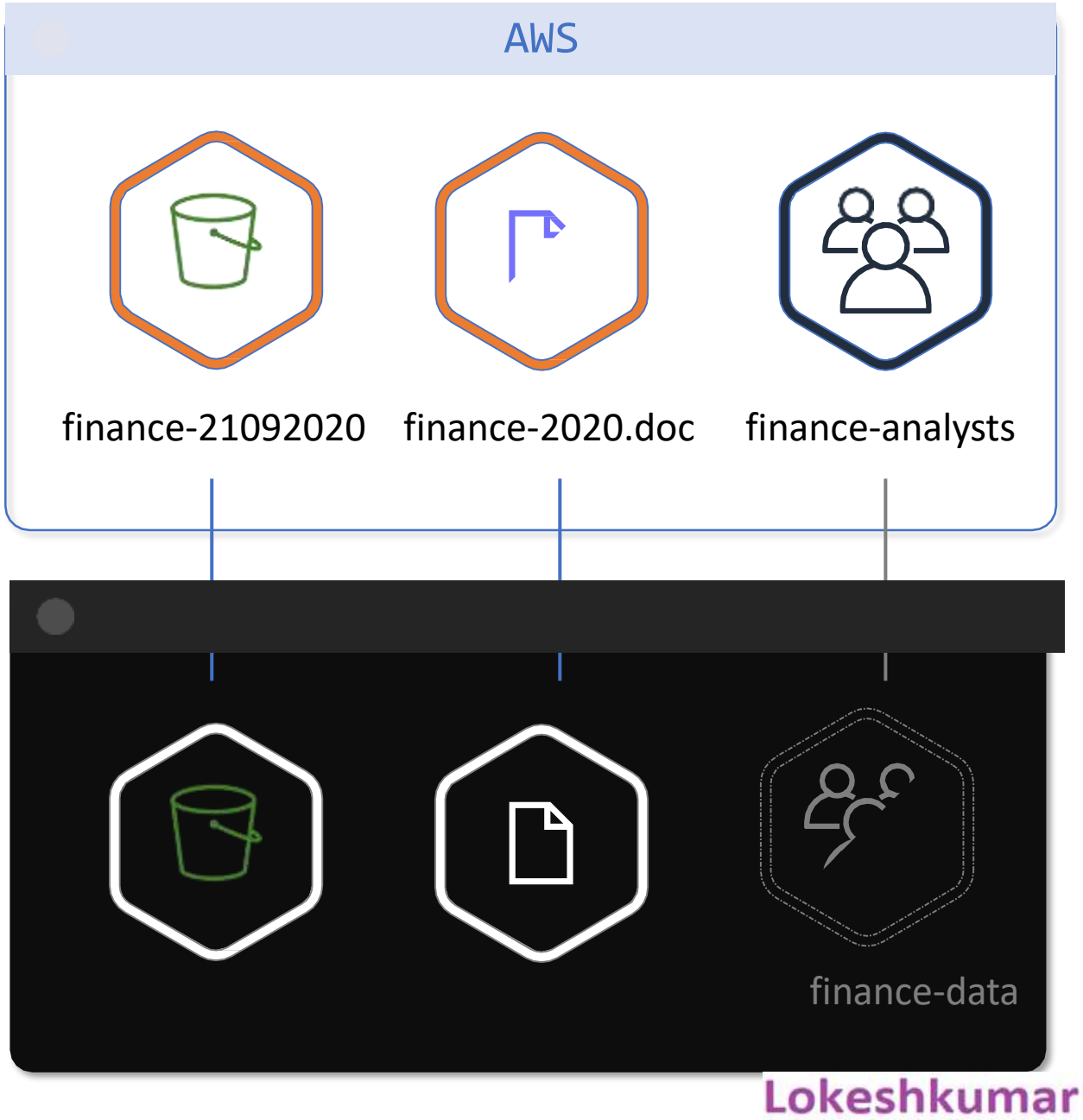
```
resource "aws_s3_bucket" "finance" {
    bucket = "finanace-21092020"
    tags   = {
        Description = "Finance and Payroll"
    }
}

resource "aws_s3_bucket_object" "finance-2020" {
    content = "/root/finance/finance-2020.doc"
    key     = "finance-2020.doc"
    bucket = aws_s3_bucket.finance.id
}
```

>_

```
$ terraform apply
.
.
Terraform will perform the following actions:

  # aws_s3_bucket_object.finance-2020 will be created
  + resource "aws_s3_bucket_object" "finance-2020" {
      + acl                    = "private"
      + bucket                 = "finanace-21092020"
      + content                = "/root/finance/finance-
2020.doc"
+ force_destroy          = false
      + id                     = (known after apply)
      + key                    = "finance/finance-
2020.doc"

Plan: 1 to add, 0 to change, 0 to

destroy. 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

aws_s3_bucket_object.finance-2020:
```

main.tf

```
resource "aws_s3_bucket" "finance" {
    bucket = "finanace-21092020"
    tags   = {
        Description = "Finance and Payroll"
    }
}

resource "aws_s3_bucket_object" "finance-2020" {
    content = "/root/finance/finance-2020.doc"
    key     = "finance-2020.doc"
    bucket = aws_s3_bucket.finance.id
}

data "aws_iam_group" "finance-data" {
  group_name = "finance-analysts"

}
```



```
    content = "/root/finance/finance-2020.doc"
    key     = "finance-2020.doc"
    bucket = aws_s3_bucket.finance.id
}

data "aws_iam_group" "finance-data" {
  group_name = "finance-analysts"

}
resource "aws_s3_bucket_policy" "finance-policy" {
  bucket = aws_s3_bucket.finance.id
  policy = <<EOF




EOF
}
```

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Action": “*",
            "Effect": "Allow",
            "Resource": "arn:aws:s3:::<<bucket-name>>/*",
            "Principal": {
                "AWS": [
                    “<<   arn    >>"
                ]
            }
        }
    ]
}
```

read-objects.json

```
    content = "/root/finance/finance-2020.doc"
    key     = "finance-2020.doc"
    bucket = aws_s3_bucket.finance.id
}

data "aws_iam_group" "finance-data" {
  group_name = "finance-analysts"

}

resource "aws_s3_bucket_policy" "finance-policy" {
  bucket = aws_s3_bucket.finance.id
  policy = <<EOF
  {
      "Version": "2012-10-17",
      "Statement": [
          {
              "Action": "*",
              "Effect": "Allow",
              "Resource": "arn:aws:s3:::${aws_s3_bucket.finance.id}/*",
              "Principal": {
                  "AWS": [
                      "${data.aws_iam_group.finance-data.arn}"
                  ]
              }
          }
      ]
  }

EOF
}
```

```
>_
$ terraform apply
.
.
Terraform will perform the following actions:

  # aws_s3_bucket_object.finance-2020 will be
  created
  + resource "aws_s3_bucket_object" "finance-2020" {
      + acl                    = "private"
      + bucket                 = "finanace-21092020"
      + content                = "/root/finance/finance-2020.doc"
+ force_destroy          = false
      + id                     = (known after apply)
      + key                    = "finance/finance-2020.doc"

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

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

aws_s3_bucket_object.finance-2020: Creating...
aws_s3_bucket_object.finance-2020: Creation complete after
0s [id=finance/finance-2020.doc]

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

Introduction to DynamoDB

Lokeshkumar

DynamoDB

- Highly Scalable
- Fully Managed by AWS
- NoSQL Database
- Single-Digit MilliSecond Latency
- Data Replicated across Regions

Manufacturer	Model
Toyota	Corolla
Honda	Civic
Dodge	Journey
Ford	F150

	Manufacturer	Model	Year	VIN
Item 1	Toyota	Corolla	2004	4Y1SL65848Z411439
Item 2	Honda	Civic	2017	DY1SL65848Z411432
Item 3	Dodge	Journey	2014	SD1SL65848Z411443
Item 4	Ford	F150	2020	DH1SL65848Z41100

Manufacturer	Model	Year	VIN
Toyota	Corolla	2004	4Y1SL65848Z411439
Honda	Civic	2017	DY1SL65848Z411432
Dodge	Journey	2014	SD1SL65848Z411443
Ford	F150	2020	DH1SL65848Z41100

cars


```
{
    "Manufacturer": "Toyota",
    "Make": "Corolla",
    "Year": 2004,
    "VIN" : "4Y1SL65848Z411439"
}
```

```
{
    "Manufacturer": "Honda",
    "Make": "Civic",
    "Year": 2017,
    "VIN" : "DY1SL65848Z411432"
}
```

```
{
    "Manufacturer": "Dodge",
    "Make": "Journey",
    "Year": 2014,
    "VIN" : "SD1SL65848Z411443"
}
```

```
{
    "Manufacturer": "Ford",
    "Make": "F150",
    "Year": 2020,
    "VIN" : "DH1SL65848Z41100"
}
```

PRIMARY KEY

Manufacturer	Model	Year	VIN
Toyota	Corolla	2004	4Y1SL65848Z411439
Honda	Civic	2017	DY1SL65848Z411432
Dodge	Journey	2014	SD1SL65848Z411443
Ford	F150	2020	DH1SL65848Z41100


```
    "Manufacturer": "Honda",
    "Make": "Civic",
    "Year": 2017,
    "VIN" : "DY1SL65848Z411432"
}
```

```
{
    "Manufacturer": "Dodge",
    "Make": "Journey",
    "Year": 2014,
    "VIN" : "SD1SL65848Z411443"
}
```

```
{
    "Manufacturer": "Ford",
    "Make": "F150",
    "Year": 2020,
    "VIN" : "DH1SL65848Z41100"
}
```

```
{
    "Manufacturer": "Jaguar",
    "Make": "",
    "Year": "",
    "VIN" : "LB1SL65848Z41123"
    }
```

DynamoDB with Terraform

Lokeshkumar

main.tf

```hcl
resource "aws_dynamodb_table" "cars" {
  name         = "cars"
  hash_key = "VIN"
  billing_mode = "PAY_PER_REQUEST"
  attribute {
    name = "VIN"
    type = "S"
  }
}
```

- `billing_mode` - (Optional) Controls how you are charged for read and write throughput and how you manage capacity. The valid values are `PROVISIONED` and `PAY_PER_REQUEST`. Defaults to `PROVISIONED`.

- `write_capacity` - (Optional) The number of write units for this table. If the `billing_mode` is `PROVISIONED`, this field is required.

- `read_capacity` - (Optional) The number of read units for this table. If the `billing_mode` is `PROVISIONED`, this field is required.

main.tf

```
resource "aws_dynamodb_table" "cars" {
  name      = "cars"
  hash_key = "VIN"
  billing_mode = "PAY_PER_REQUEST"
  attribute {
    name = "VIN"
    type = "S"
  }
}
```

>_

```
$ terraform apply
+ create

Terraform will perform the following actions:

  # aws_dynamodb_table.cars will be created
  + resource "aws_dynamodb_table" "cars" {
      + arn              = (known after apply)
      + billing_mode     = "PAY_PER_REQUEST"
      + hash_key         = "VIN"
      + id               = (known after apply)
      + name             = "cars"
      + stream_arn       = (known after apply)
      + stream_label     = (known after apply)
      + stream_view_type = (known after apply)

      + attribute {
          + name = "VIN"
          + type = "S"
        }

      + point_in_time_recovery {
          + enabled = (known after apply)
        }
.
.
aws_dynamodb_table.cars:  Creating...
aws_dynamodb_table.cars: Creation complete after 0s [id=cars]
```

main.tf

```
resource "aws_dynamodb_table" "cars" {
  name      = "cars"
  hash_key = "VIN"
  billing_mode = "PAY_PER_REQUEST"
  attribute {
    name = "VIN"
    type = "S"
  }
}
resource "aws_dynamodb_table_item" "car-items" {
  table_name = aws_dynamodb_table.cars.name
  hash_key   = aws_dynamodb_table.cars.hash_key
  item       = <<EOF



EOF
}
```

cars

```
{
    "Manufacturer": "Toyota",
    "Make": "Corolla",
    "Year": 2004,
    "VIN" : "4Y1SL65848Z411439"
}
```

```
{
    "Manufacturer": "Honda",
    "Make": "Civic",
    "Year": 2017,
    "VIN" : "DY1SL65848Z411432"
}
```

```
{
    "Manufacturer": "Dodge",
    "Make": "Journey",
    "Year": 2014,
    "VIN" : "SD1SL65848Z411443"
}
```

```
{
    "Manufacturer": "Ford",
    "Make": "F150",
    "Year": 2020,
    "VIN" : "DH1SL65848Z41100"
}
```

main.tf

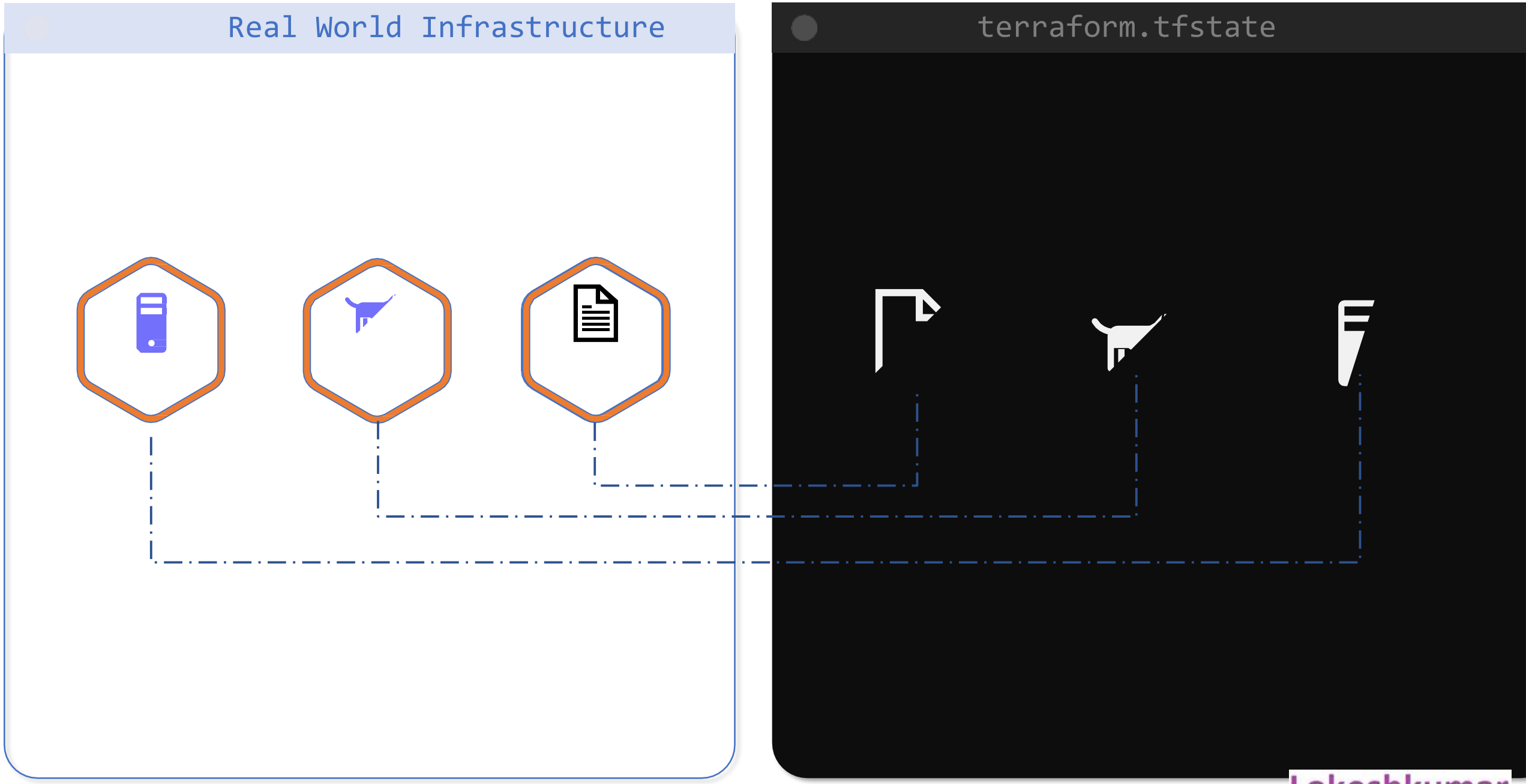
```
resource "aws_dynamodb_table" "cars" {
  name      = "cars"
  hash_key = "VIN"
  billing_mode = "PAY_PER_REQUEST"
  attribute {
    name = "VIN"
    type = "S"
  }
}
resource "aws_dynamodb_table_item" "car-items" {
  table_name = aws_dynamodb_table.cars.name
  hash_key   = aws_dynamodb_table.cars.hash_key
  item       = <<EOF

  {
      "Manufacturer":{"S": "Toyota"},
      "Make": {"S": "Corolla"},
      "Year": {"N": "2004"},
      "VIN" : {"S": "4Y1SL65848Z411439"},
  }
EOF
}
```

>_

```
$ terraform apply

  # aws_dynamodb_table_item.car-items will be created
  + resource "aws_dynamodb_table_item" "car-items" {
      + hash_key   = "VIN"
      + id         = (known after apply)
      + item       = jsonencode(
            {
              + Manufacturer = {
                  + S = "Toyota"
                }
              + Model        = {
                  + S = "Corolla"
                }
              + VIN          = {
                  + S = "4Y1SL65848Z411439"
                }
              + Year         = {
                  + N = "2004"
                }
            }
        )
      + table_name = "cars"
    }

Plan: 1 to add, 0 to change, 0 to destroy.
.
.
aws_dynamodb_table_item.car-items: Creating...
```

Remote State

Lokeshkumar


Real World Infrastructure
terraform.tfstate
Lokeshkumar

Mapping Configuration to Real World

Tracking Metadata

Performance

Collaboration

```
>_

$ ls
main.tf variables.tf terraform.tfstate
```

Version Control

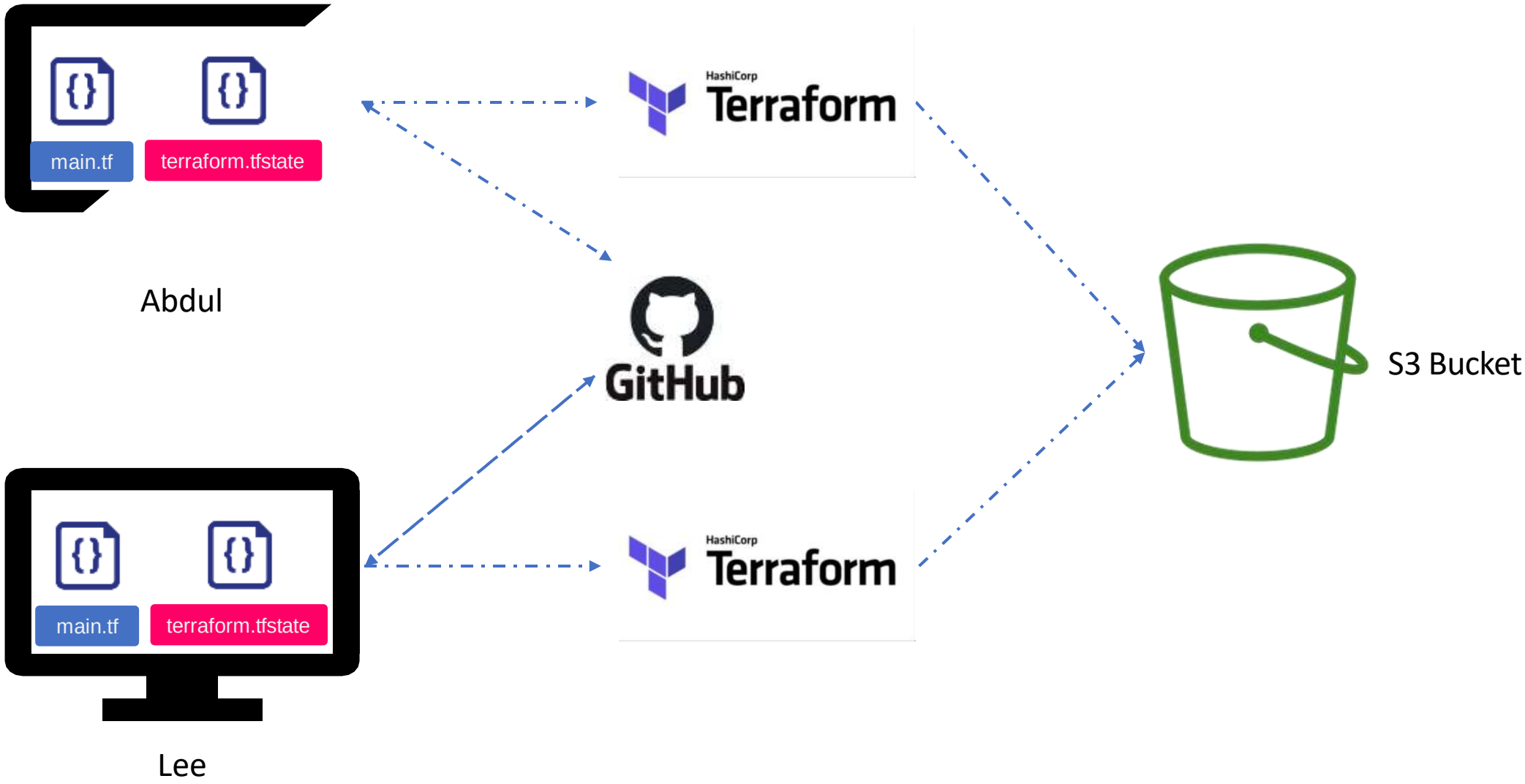
Remote State Backends

main.tf

```
resource "local_file" "pet" {
  filename = "/root/pet.txt"
  content  = "My favorite pet is Mr.Whiskers!"
}
resource "random_pet" "my-pet" {
  length = 1
}
resource "local_file" "cat" {
  filename = "/root/cat.txt"
  content  = "I like cats too!"
}
```

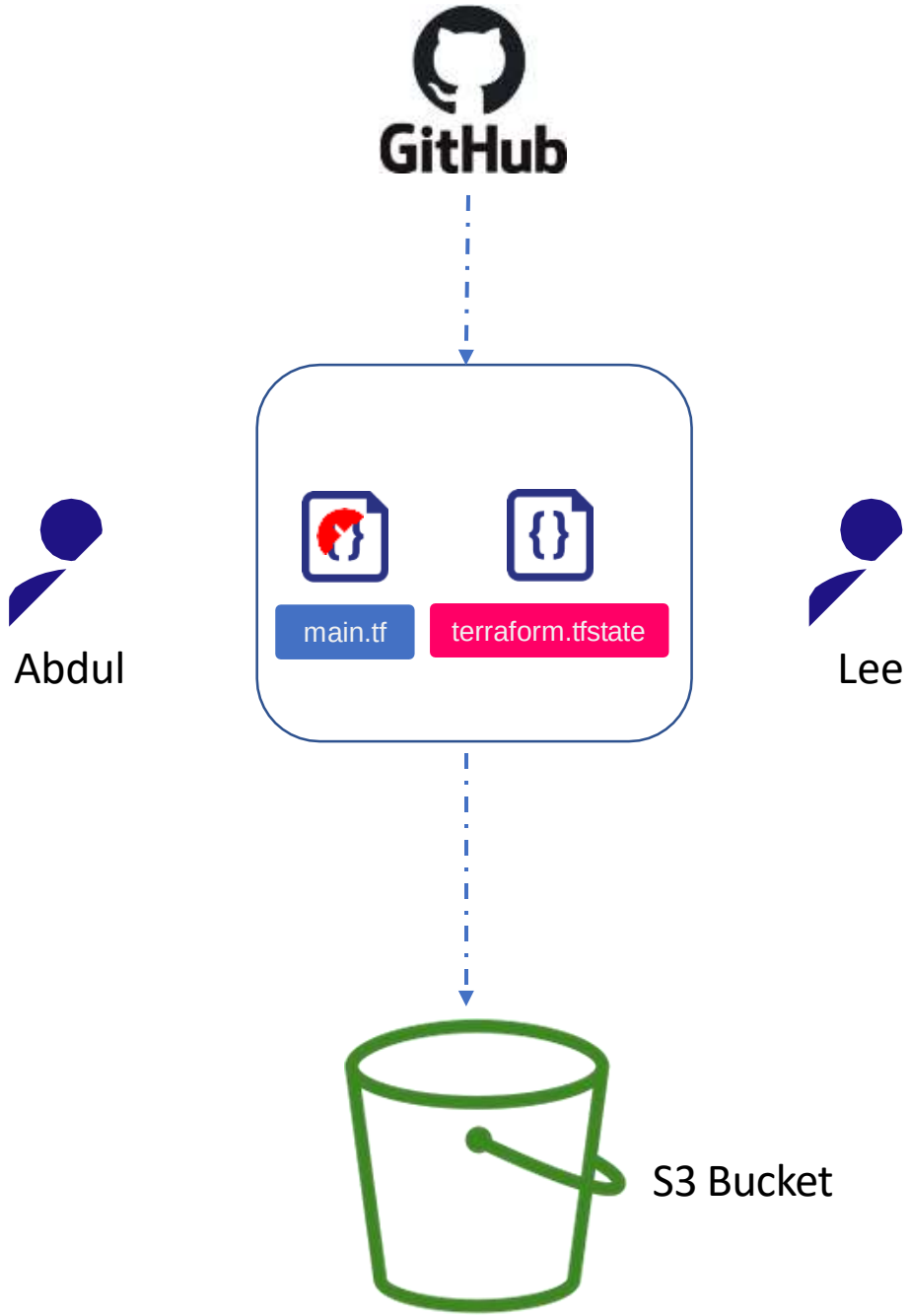
terraform.tfstate


```
{
      "mode": "managed",
      "type": "aws_instance",
      "name": "dev-ec2",
      "provider": "provider[\"registry.terraform.io/hashicorp/aws\"]",
      "instances": [
        {
          "schema_version": 1,
          "attributes": {
            "ami": "ami-0a634ae95e11c6f91",
.
.
.
            "primary_network_interface_id": "eni-0ccd57b1597e633e0",
            "private_dns": "ip-172-31-7-21.us-west-2.compute.internal",
            "private_ip": "172.31.7.21",
            "public_dns": "ec2-54-71-34-19.us-west-2.compute.amazonaws.com",
            "public_ip": "54.71.34.19",
            "root_block_device": [
              {
                "delete_on_termination": true,
                "device_name": "/dev/sda1",
                "encrypted": false,
                "iops": 100,
                "kms_key_id": "",
                "volume_id": "vol-070720a3636979c22",
                "volume_size": 8,
                "volume_type": "gp2"
              }
```



terraform.tfstate

```
{
      "mode": "managed",
      "type": "aws_instance",
      "name": "dev-ec2",
      "provider": "provider[\"registry.terraform.io/hashicorp/aws\"]",
      "instances": [
        {
          "schema_version": 1,
          "attributes": {
            "ami": "ami-0a634ae95e11c6f91",
.
.
.
            "primary_network_interface_id": "eni-0ccd57b1597e633e0",
            "private_dns": "ip-172-31-7-21.us-west-2.compute.internal",
            "private_ip": "172.31.7.21",
            "public_dns": "ec2-54-71-34-19.us-west-2.compute.amazonaws.com",
            "public_ip": "54.71.34.19",
            "root_block_device": [
              {
                "delete_on_termination": true,
                "device_name": "/dev/sda1",
                "encrypted": false,
                "iops": 100,
                "kms_key_id": "",
                "volume_id": "vol-070720a3636979c22",
                "volume_size": 8,
                "volume_type": "gp2"
              }
            ],
```



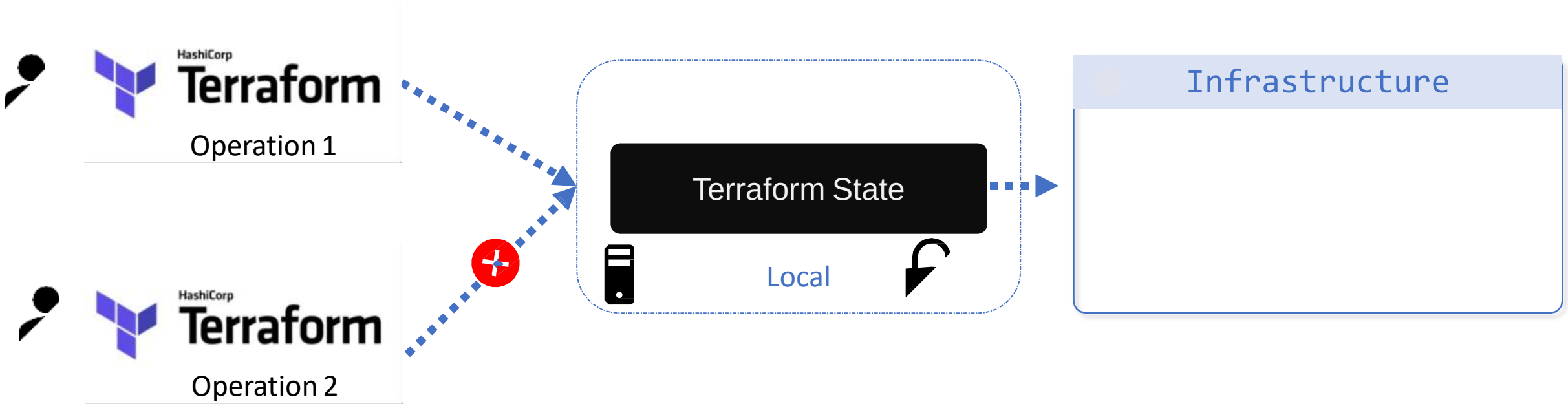
>_ Terminal 1

```
$ terraform apply
.
.
."
      + server_side_encryption = (known after
      apply)
      + storage_class          = (known after apply)
      + version_id             = (known after apply)
    }

Plan: 2 to add, 0 to change, 0 to

destroy. 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

aws_s3_bucket_object.finance-2020: Creating...
aws_s3_bucket.finance: Creating...
aws_s3_bucket_object.finance-2020: Still
creating... [10s elapsed]
aws_s3_bucket.finance: Still creating... [10s
elapsed]
```

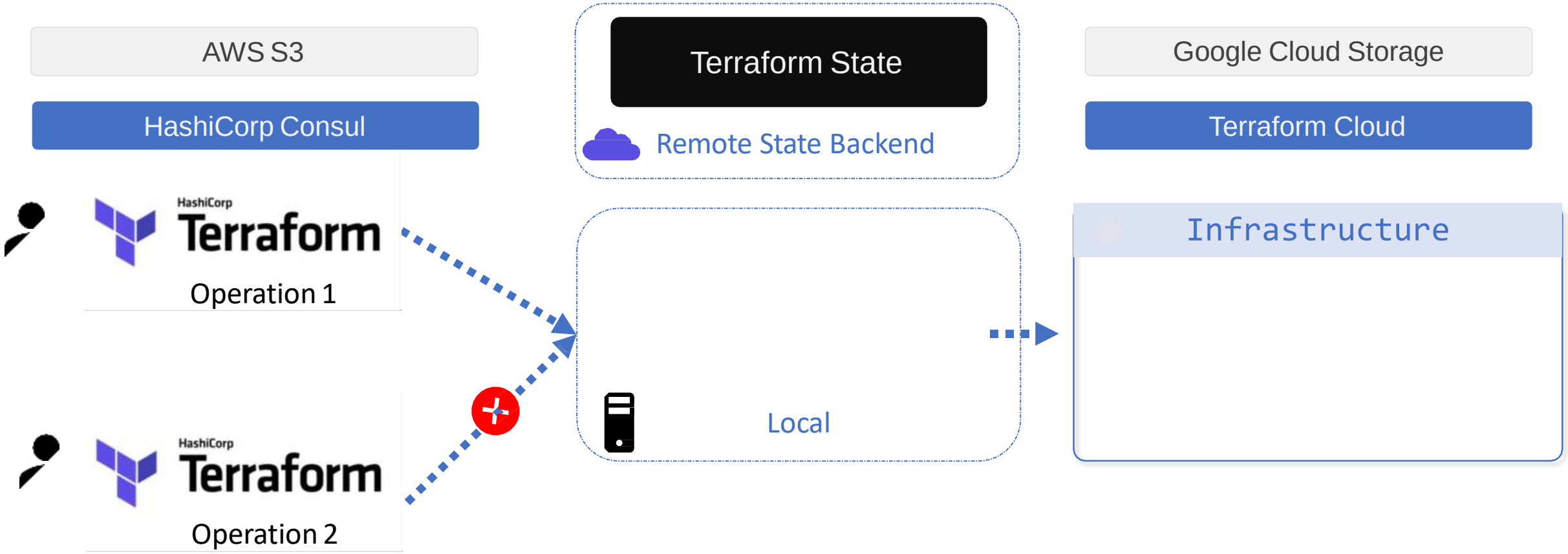
>_ Terminal 2

```
$ terraform apply
Error: Error locking state: Error acquiring the
state lock: resource temporarily unavailable
Lock Info:
  ID:        fefe3806-007c-084b-be61-cef4cdc77dee
  Path:      terraform.tfstate
  Operation: OperationTypeApply
  Who:       root@iac-server
  Version:   0.13.3
  Created:   2020-09-22 20:35:27.051330492 +0000 UTC
  Info:


Terraform acquires a state lock to protect the state
from being written
by multiple users at the same time. Please resolve
the issue above and try
again. For most commands, you can disable locking with
the "-lock=false"
flag, but this is not recommended.
```

State Locking



State Locking



State Locking

AWS S3

HashiCorp Consul

Terraform State

Remote State Backend

Google Cloud Storage

Terraform Cloud

Automatically Load and Upload State File

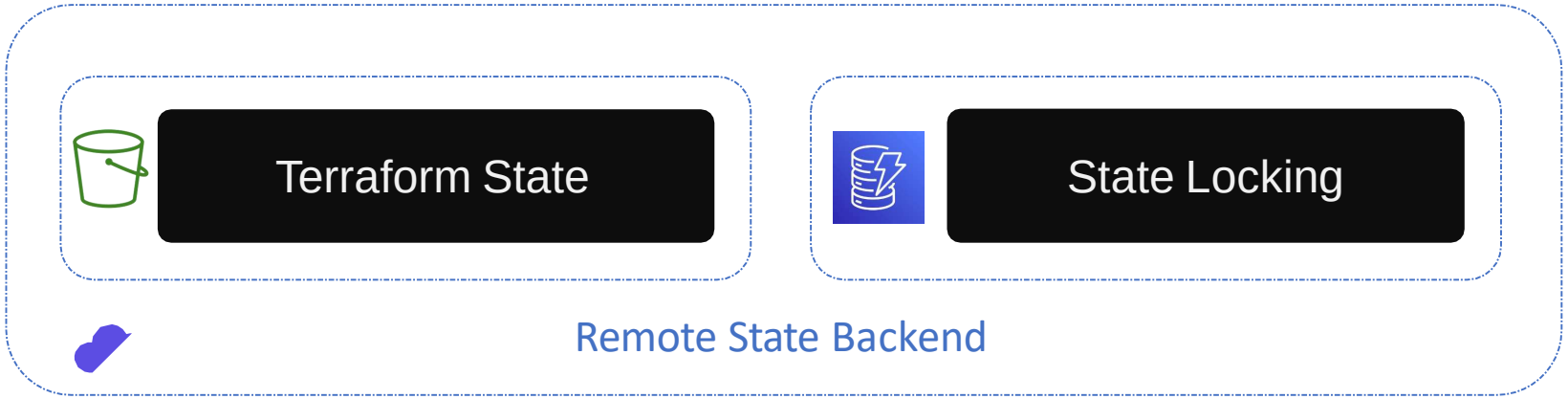
Many Backends Support State Locking

Security

Remote Backends with S3

Lokeshkumar

Remote Backend



Object	Value
Bucket	kodekloud-terraform-state-bucket01
Key	finance/terraform.tfstate
Region	us-west-1
DynamoDB Table	state-locking

main.tf

```
resource "local_file" "pet" {
  filename = "/root/pets.txt"
  content = "We love pets!"
}



terraform {
  backend "s3" {
    bucket         = "kodekloud-terraform-state-bucket01"
    key            = "finance/terraform.tfstate"
    region         = "us-west-1"
    dynamodb_table = "state-locking"
  }
}
```

>_

```
$ ls
main.tf  terraform.tfstate
```

Object	Value
Bucket	kodekloud-terraform-state-bucket01
Key	finance/terraform.tfstate
Region	us-west-1
DynamoDB Table	state-locking

main.tf

```
resource "local_file" "pet" {
  filename = "/root/pets.txt"
  content = "We love pets!"
}
```

terraform.tf

```
terraform {
  backend "s3" {
    bucket         = "kodekloud-terraform-state-bucket01"
    key            = "finance/terraform.tfstate"
    region         = "us-west-1"
    dynamodb_table = "state-locking"
  }
}
```

>_

```
$ terraform apply
Backend reinitialization required. Please run "terraform init". Reason: Initial configuration of the requested backend "s3"

The "backend" is the interface that Terraform uses to store state, perform operations, etc. If this message is showing up, it
means that the Terraform configuration you're using is using a custom configuration for the Terraform backend.

Changes to backend configurations require reinitialization. This allows Terraform to setup the new configuration, copy existing
state, etc. This is only done during "terraform init". Please run that command now then try again.

Error: Initialization required. Please see the error message above.
```

```
$ terraform init
Initializing the backend...
Do you want to copy existing state to the new backend?
  Pre-existing state was found while migrating the previous "local" backend to the newly configured "s3" backend. No existing
state was found in the newly configured "s3" backend. Do you want to copy this state to the new "s3"
  backend? Enter "yes" to copy and "no" to start with an empty state.

  Enter a value: yes

Successfully configured the backend "s3"! Terraform will automatically use this backend unless the backend configuration

changes. Initializing provider plugins...
- Using previously-installed hashicorp/aws v3.7.0
.
.[Output Truncated]
```

```
$ rm -rf terraform.tfstate
```

```
$ terraform apply
Acquiring state lock. This may take a few moments...
aws_s3_bucket.terraform-state: Refreshing state... [id=kodekloud-terraform-state-bucket01]
aws_dynamodb_table.state-locking: Refreshing state... [id=state-locking]

Apply complete! Resources: 0 added, 0 changed, 0 destroyed.
Releasing state lock. This may take a few moments.
```

```
$ ls
main.tf  provider.tf  terraform.tfstate.d  variables.tf



$ tree terraform.tfstate.d/
terraform.tfstate.d/
|-- ProjectA
|   `-- terraform.tfstate
`-- ProjectB
    `-- terraform.tfstate

2 directories, 2 files
```