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Division: D15C **Roll No: 28**

Aim: To Build, change, and destroy AWS / GCP /Microsoft Azure/ DigitalOcean infrastructure Using Terraform. (S3 bucket or Docker)fdp.

Terraform: Terraform is an open-source infrastructure as code (IaC) tool that allows you to define, provision, and manage cloud resources across various providers using a declarative configuration language. It enables consistent and repeatable infrastructure deployments, supports multi-cloud environments, and maintains state files to track resource changes. Terraform automates the creation and management of infrastructure, making it easier to scale and modify resources.

Creating a docker image using Terraform :

Prerequisite:

Download and Install Docker Desktop from https://www.docker.com/

Step 1: Run docker command in cmd to check the functionality of docker and also run docker --version to check which docker version is installed on your system.

Command Prompt

```
Microsoft Windows [Version 10.0.22631.4037]
(c) Microsoft Corporation. All rights reserved.

C:\Users\bhush>docker

Usage:  docker [OPTIONS] COMMAND

A self-sufficient runtime for containers

Common Commands:
  run         Create and run a new container from an image
  exec        Execute a command in a running container
  ps          List containers
  build       Build an image from a Dockerfile
  pull        Download an image from a registry
  push        Upload an image to a registry
  images      List images
  login       Log in to a registry
  logout      Log out from a registry
  search      Search Docker Hub for images
  version     Show the Docker version information
  info        Display system-wide information

Management Commands:
  builder     Manage builds
  buildx*     Docker Buildx
  checkpoint  Manage checkpoints
  compose*    Docker Compose
  container   Manage containers
  context     Manage contexts
  debug*      Get a shell into any image or container
  desktop*    Docker Desktop commands (Alpha)
  dev*        Docker Dev Environments
  extension*  Manages Docker extensions
  feedback*   Provide feedback, right in your terminal!
  image       Manage images
  init*       Creates Docker-related starter files for your project
  manifest    Manage Docker image manifests and manifest lists
  network     Manage networks
  plugin      Manage plugins
  sbom*       View the packaged-based Software Bill Of Materials (SBOM) for an image
  scout*      Docker Scout
  system      Manage Docker
  trust       Manage trust on Docker images
  volume      Manage volumes

Swarm Commands:
  config      Manage Swarm configs
  node        Manage Swarm nodes
  secret      Manage Swarm secrets
  service     Manage Swarm services
  stack       Manage Swarm stacks
  swarm       Manage Swarm

Commands:
  attach      Attach local standard input, output, and error streams to a running container
```

Command Prompt

```
Commands:
  attach      Attach local standard input, output, and error streams to a running container
  commit      Create a new image from a container's changes
  cp          Copy files/folders between a container and the local filesystem
  create      Create a new container
  diff        Inspect changes to files or directories on a container's filesystem
  events      Get real time events from the server
  export      Export a container's filesystem as a tar archive
  history     Show the history of an image
  import      Import the contents from a tarball to create a filesystem image
  inspect     Return low-level information on Docker objects
  kill        Kill one or more running containers
  load        Load an image from a tar archive or STDIN
  logs        Fetch the logs of a container
  pause       Pause all processes within one or more containers
  port        List port mappings or a specific mapping for the container
  rename      Rename a container
  restart     Restart one or more containers
  rm          Remove one or more containers
  rmi         Remove one or more images
  save        Save one or more images to a tar archive (streamed to STDOUT by default)
  start       Start one or more stopped containers
  stats       Display a live stream of container(s) resource usage statistics
  stop        Stop one or more running containers
  tag         Create a tag TARGET_IMAGE that refers to SOURCE_IMAGE
  top         Display the running processes of a container
  unpause     Unpause all processes within one or more containers
  update      Update configuration of one or more containers
  wait        Block until one or more containers stop, then print their exit codes

Global Options:
      --config string      Location of client config files (default
                           "C:\\Users\\bhush\\.docker")
  -c, --context string     Name of the context to use to connect to the
                           daemon (overrides DOCKER_HOST env var and
                           default context set with "docker context use")
  -D, --debug              Enable debug mode
  -H, --host list          Daemon socket to connect to
  -l, --log-level string   Set the logging level ("debug", "info",
                           "warn", "error", "fatal") (default "info")
      --tls                Use TLS; implied by --tlsverify
      --tlscacert string   Trust certs signed only by this CA (default
                           "C:\\Users\\bhush\\.docker\\ca.pem")
      --tlscert string     Path to TLS certificate file (default
                           "C:\\Users\\bhush\\.docker\\cert.pem")
      --tlskey string      Path to TLS key file (default
                           "C:\\Users\\bhush\\.docker\\key.pem")
      --tlsverify          Use TLS and verify the remote
  -v, --version            Print version information and quit

Run 'docker COMMAND --help' for more information on a command.

For more help on how to use Docker, head to https://docs.docker.com/go/guides/

C:\Users\bhush>
```

```
C:\Users\bhush>docker --version
Docker version 27.0.3, build 7d4bcd8

C:\Users\bhush>
```

Now, create a folder named 'Terraform Scripts' in which we save our different types of scripts which will be further used in this experiment.

Step 2: Now create a new folder named 'Docker' in the 'TerraformScripts' folder. Then create a new docker.tf file using Atom editor or Vscode and write the following contents into it to create a Ubuntu Linux container.

(Note part of the script highlighted is a must to get the image otherwise it will give an error.)

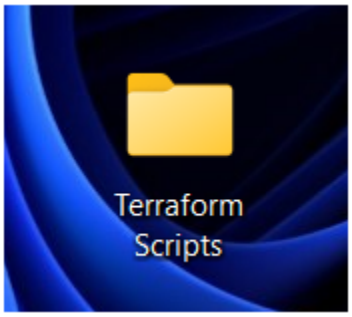
Script:

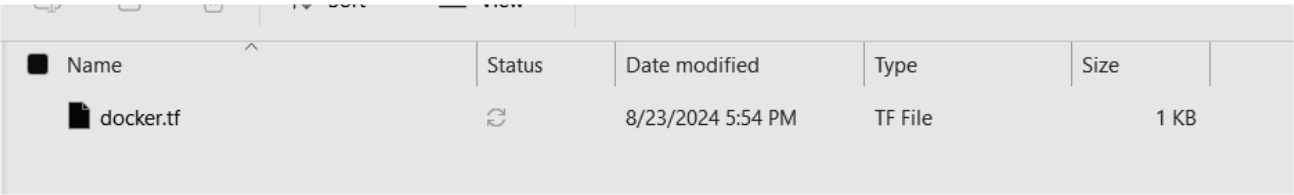
```
terraform {
  required_providers {
    docker = {
      source  = "kreuzwerker/docker"
      version = "3.0.2"
    }
  }
}

provider "docker" {
  host =  "npipe:////.//pipe//docker_engine"
}

# Pulls the image
resource "docker_image" "ubuntu" {
  name = "ubuntu:latest"
}

# Create a container
resource "docker_container" "foo" {
  image = docker_image.ubuntu.image_id
  name  = "foo"
  command = ["sleep", "infinity"]
}
```





Name	Status	Date modified	Type	Size
docker.tf		8/23/2024 5:54 PM	TF File	1 KB

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```
terraform {
  required_providers {
    docker = {
      source  = "kreuzwerker/docker"
      version = "3.0.2"
    }
  }
}

provider "docker" {
  host =  "npipe:////.//pipe//docker_engine"
}

# Pulls the image
resource "docker_image" "ubuntu" {
  name = "ubuntu:latest"
}

# Create a container
resource "docker_container" "foo" {
  image = docker_image.ubuntu.image_id
  name  = "foo"
  command = ["sleep", "infinity"]
}
```

Step 3: Now open the terminal in the Terraform Scripts folder and Execute the terraform init command to initialize resources. This will initialize terraform in directory.

```
PS C:\Users\bhush\one drive 2\OneDrive\Desktop\Terraform Scripts> terraform init
Initializing the backend...
Initializing provider plugins...
- Finding kreuzwerker/docker versions matching "3.0.2"...
- Installing kreuzwerker/docker v3.0.2...
- Installed kreuzwerker/docker v3.0.2 (self-signed, key ID BD080C4571C6104C)
Partner and community providers are signed by their developers.
If you'd like to know more about provider signing, you can read about it here:
https://www.terraform.io/docs/cli/plugins/signing.html
Terraform has created a lock file .terraform.lock.hcl to record the provider
selections it made above. Include this file in your version control repository
so that Terraform can guarantee to make the same selections by default when
you run "terraform init" in the future.

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.
```

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Step 4: Run the command terraform plan. This will create an execution plan and let you overview changes that are going to happen in your infrastructure.

```
PS C:\Users\bhush\one drive 2\OneDrive\Desktop\Terraform Scripts> terraform plan

Terraform used the selected providers to generate the following execution plan. Resource actions are indicated with the
following symbols:
  + create

Terraform will perform the following actions:

  # docker_container.foo will be created
  + resource "docker_container" "foo" {
      + attach                                      = false
      + bridge                                      = (known after apply)
      + command                                     = [
          + "sleep",
          + "infinity",
        ]
      + container_logs                              = (known after apply)
      + container_read_refresh_timeout_milliseconds = 15000
      + entrypoint                                  = (known after apply)
      + env                                         = (known after apply)
      + exit_code                                   = (known after apply)
      + hostname                                    = (known after apply)
      + id                                          = (known after apply)
      + image                                       = (known after apply)
      + init                                        = (known after apply)
      + ipc_mode                                    = (known after apply)
      + log_driver                                  = (known after apply)
      + logs                                        = false
      + must_run                                    = true
      + name                                        = "foo"
      + network_data                                = (known after apply)
      + read_only                                   = false
      + remove_volumes                              = true
      + restart                                     = "no"
      + rm                                          = false
      + runtime                                     = (known after apply)
      + security_opts                               = (known after apply)
      + shm_size                                    = (known after apply)
      + start                                       = true
      + stdin_open                                  = false
      + stop_signal                                 = (known after apply)
      + stop_timeout                                = (known after apply)
      + tty                                         = false
      + wait                                        = false
      + wait_timeout                                = 60

      + healthcheck (known after apply)

      + labels (known after apply)
    }

  # docker_image.ubuntu will be created
  + resource "docker_image" "ubuntu" {
      + id          = (known after apply)
      + image_id    = (known after apply)
      + name        = "ubuntu:latest"
      + repo_digest = (known after apply)
    }

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

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Note: You didn't use the -out option to save this plan, so Terraform can't guarantee to take exactly these actions if
you run "terraform apply" now.
```

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Step 5: Now, run the command terraform apply to carry out the changes that
We have made when terrafrom plan command was executed.After running the command it will ask for a value for confirmation that time type yes.(Before step 5 run command docker images for next step)

```
PS C:\Users\bhush\one drive 2\OneDrive\Desktop\Terraform Scripts> terraform apply

Terraform used the selected providers to generate the following execution plan. Resource actions are indicated with the
following symbols:
  + create

Terraform will perform the following actions:

  # docker_container.foo will be created
  + resource "docker_container" "foo" {
      + attach                                      = false
      + bridge                                      = (known after apply)
      + command                                     = [
          + "sleep",
          + "infinity",
        ]
      + container_logs                              = (known after apply)
      + container_read_refresh_timeout_milliseconds = 15000
      + entrypoint                                  = (known after apply)
      + env                                         = (known after apply)
      + exit_code                                   = (known after apply)
      + hostname                                    = (known after apply)
      + id                                          = (known after apply)
      + image                                       = (known after apply)
      + init                                        = (known after apply)
      + ipc_mode                                    = (known after apply)
      + log_driver                                  = (known after apply)
      + logs                                        = false
      + must_run                                    = true
      + name                                        = "foo"
      + network_data                                = (known after apply)
      + read_only                                   = false
      + remove_volumes                              = true
      + restart                                     = "no"
      + rm                                          = false
      + runtime                                     = (known after apply)
      + security_opts                               = (known after apply)
      + shm_size                                    = (known after apply)
      + start                                       = true
      + stdin_open                                  = false
      + stop_signal                                 = (known after apply)
      + stop_timeout                                = (known after apply)
      + tty                                         = false
      + wait                                        = false
      + wait_timeout                                = 60

      + healthcheck (known after apply)

      + labels (known after apply)
    }

  # docker_image.ubuntu will be created
  + resource "docker_image" "ubuntu" {
      + id          = (known after apply)
      + image_id    = (known after apply)
```

```
      + name       = "ubuntu:latest"
      + repo_digest = (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

docker_image.ubuntu: Creating...
docker_image.ubuntu: Still creating... [10s elapsed]
docker_image.ubuntu: Still creating... [20s elapsed]
docker_image.ubuntu: Still creating... [30s elapsed]
docker_image.ubuntu: Still creating... [40s elapsed]
docker_image.ubuntu: Creation complete after 42s [id=sha256:edbfe74c41f8a3501ce542e137cf28ea04dd03e6df8c9d66519b6ad761c2598aubuntu:latest]
docker_container.foo: Creating...
docker_container.foo: Creation complete after 3s [id=2157b0fa12aed015eaaf4b3686ce28eca721f409d1256450da2512f0830374c3]

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

Step 6: Now run the command docker images before terraform apply command and after terraform apply command.And see the changes.

Before Terraform apply Command :

```
PS C:\Users\bhush\one drive 2\OneDrive\Desktop\Terraform Scripts> docker images
REPOSITORY   TAG       IMAGE ID   CREATED   SIZE
PS C:\Users\bhush\one drive 2\OneDrive\Desktop\Terraform Scripts>
```

After Terraform apply Command :

```
PS C:\Users\bhush\one drive 2\OneDrive\Desktop\Terraform Scripts> docker images
REPOSITORY   TAG       IMAGE ID       CREATED       SIZE
ubuntu       latest    edbfe74c41f8   3 weeks ago   78.1MB
```

Step 7: From above command we can clearly see that the ubuntu image is created.Now we have to destroy it, so we will use terraform destroy command.After running the command it will ask for a value for confirmation that time type yes.

```
PS C:\Users\bhush\one drive 2\OneDrive\Desktop\Terraform Scripts> terraform destroy
docker_image.ubuntu: Refreshing state... [id=sha256:edbfe74c41f8a3501ce542e137cf28ea04dd03e6df8c9d66519b6ad761c2598aubuntu:latest]
docker_container.foo: Refreshing state... [id=2157b0fa12aed015eaaf4b3686ce28eca721f409d1256450da2512f0830374c3]

Terraform used the selected providers to generate the following execution plan. Resource actions are indicated with the
following symbols:
  - destroy

Terraform will perform the following actions:

  # docker_container.foo will be destroyed
  - resource "docker_container" "foo" {
      - attach                                      = false -> null
      - command                                     = [
          - "sleep",
          - "infinity",
        ] -> null
      - container_read_refresh_timeout_milliseconds = 15000 -> null
      - cpu_shares                                  = 0 -> null
      - dns                                         = [] -> null
      - dns_opts                                    = [] -> null
      - dns_search                                  = [] -> null
      - entrypoint                                  = [] -> null
      - env                                         = [] -> null
      - group_add                                   = [] -> null
      - hostname                                    = "2157b0fa12ae" -> null
      - id                                          = "2157b0fa12aed015eaaf4b3686ce28eca721f409d1256450da2512f0830374c3"
 -> null
      - image                                       = "sha256:edbfe74c41f8a3501ce542e137cf28ea04dd03e6df8c9d66519b6ad761c2598a" -> null
      - init                                        = false -> null
      - ipc_mode                                    = "private" -> null
      - log_driver                                  = "json-file" -> null
      - log_opts                                    = {} -> null
      - logs                                        = false -> null
      - max_retry_count                             = 0 -> null
      - memory                                      = 0 -> null
      - memory_swap                                 = 0 -> null
      - must_run                                    = true -> null
      - name                                        = "foo" -> null
      - network_data                                = [
          - {
              - gateway                   = "172.17.0.1"
              - global_ipv6_prefix_length = 0
              - ip_address                = "172.17.0.2"
              - ip_prefix_length          = 16
              - mac_address               = "02:42:ac:11:00:02"
              - network_name              = "bridge"
              # (2 unchanged attributes hidden)
            },
        ] -> null
      - network_mode                                = "bridge" -> null
      - privileged                                  = false -> null
      - publish_all_ports                           = false -> null
      - read_only                                   = false -> null
      - remove_volumes                              = true -> null
      - restart                                     = "no" -> null
```

```
      - remove_volumes                              = true -> null
      - restart                                     = "no" -> null
      - rm                                          = false -> null
      - runtime                                     = "runc" -> null
      - security_opts                               = [] -> null
      - shm_size                                    = 64 -> null
      - start                                       = true -> null
      - stdin_open                                  = false -> null
      - stop_timeout                                = 0 -> null
      - storage_opts                                = {} -> null
      - sysctls                                     = {} -> null
      - tmpfs                                       = {} -> null
      - tty                                         = false -> null
      - wait                                        = false -> null
      - wait_timeout                                = 60 -> null
        # (8 unchanged attributes hidden)
    }

  # docker_image.ubuntu will be destroyed
  - resource "docker_image" "ubuntu" {
      - id          = "sha256:edbfe74c41f8a3501ce542e137cf28ea04dd03e6df8c9d66519b6ad761c2598aubuntu:latest" -> null
      - image_id    = "sha256:edbfe74c41f8a3501ce542e137cf28ea04dd03e6df8c9d66519b6ad761c2598a" -> null
      - name        = "ubuntu:latest" -> null
      - repo_digest = "ubuntu@sha256:8a37d68f4f73ebf3d4efafbcf66379bf3728902a8038616808f04e34a9ab63ee" -> null
    }

Plan: 0 to add, 0 to change, 2 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

docker_container.foo: Destroying... [id=2157b0fa12aed015eaaf4b3686ce28eca721f409d1256450da2512f0830374c3]
docker_container.foo: Destruction complete after 1s
docker_image.ubuntu: Destroying... [id=sha256:edbfe74c41f8a3501ce542e137cf28ea04dd03e6df8c9d66519b6ad761c2598aubuntu:latest]
docker_image.ubuntu: Destruction complete after 1s

Destroy complete! Resources: 2 destroyed.
```

Again Run docker image command to verify image is deleted or not.

```
PS C:\Users\bhush\one drive 2\OneDrive\Desktop\Terraform Scripts> docker images
REPOSITORY   TAG       IMAGE ID   CREATED   SIZE
PS C:\Users\bhush\one drive 2\OneDrive\Desktop\Terraform Scripts>
```

Step 7: Done You have successfully created a docker image of Ubuntu using Terraform and also destroyed it.