https://linkedin.com/in/prafulpatel16 | https://github.com/prafulpatel16 | https://medium.com/@prafulpatel16

https://www.youtube.com/@prafulpatel16

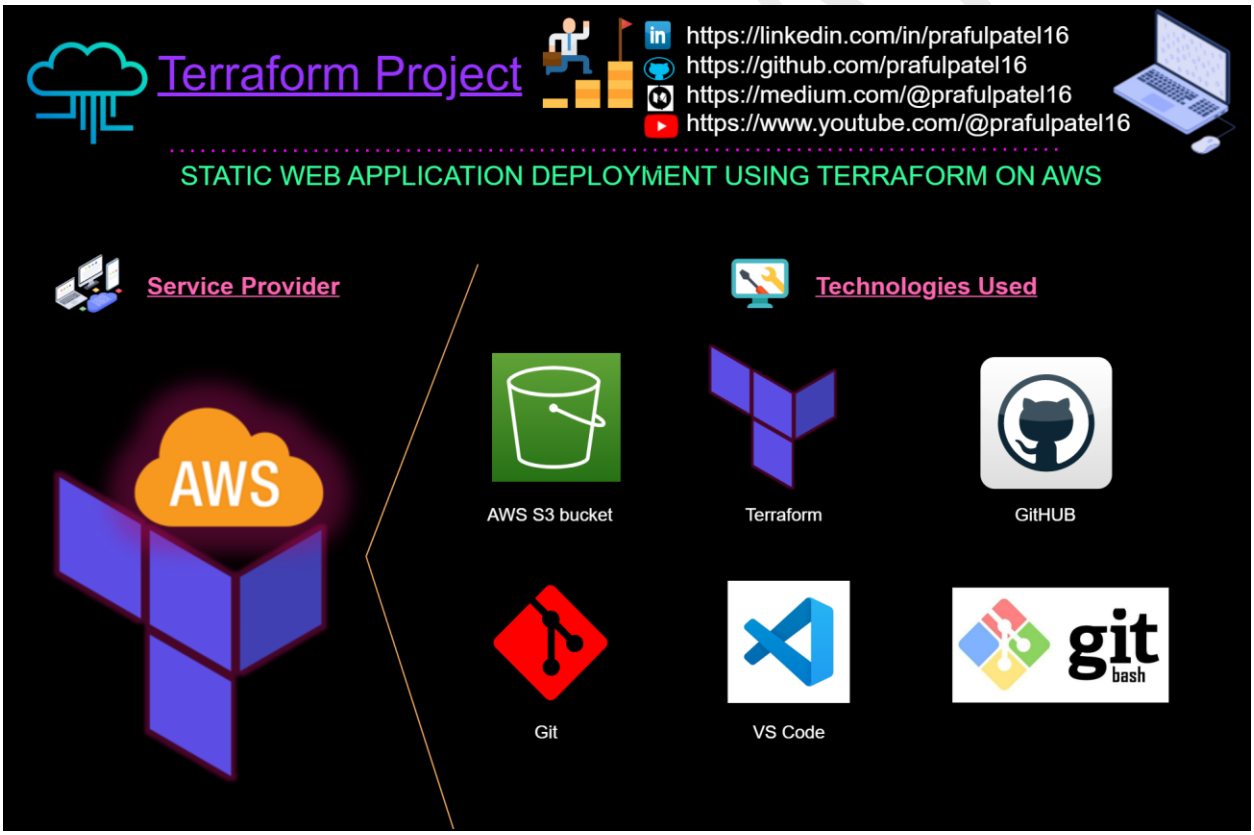
PROJECT

Prafect.cloud

Way To Go, Cloud Is Future!

TERRAFORM-AWS: STATIC WEB APPLICATION DEPLOYMENT ON AWS S3 AUTOMATED WAY USING TERRAFORM (INFRASTRUCUTRE AS CODE)

By: PRAFUL PATEL



Prafect.cloud
Way To Go, Cloud Is Future!

➢ Project

IT services Provider Company **Prafect.cloud** is engaged into providing software development solutions. Currently, they are working and finding some solution to automate and provisioning the cloud services automated way. The company has requirement to deploy a **static web application on AWS S3** an automated way.
The management has also decided to leverage an automated tool which can scale up in the future on multi-cloud without any dependencies and vendor locking rules.

An infrastructure team has started figuring out the cloud agnostic tool which is named as **"Terraform"** and it's a cloud agnostic open source tool which supports multi cloud without any vendor locking constraints.

➢ Solution:

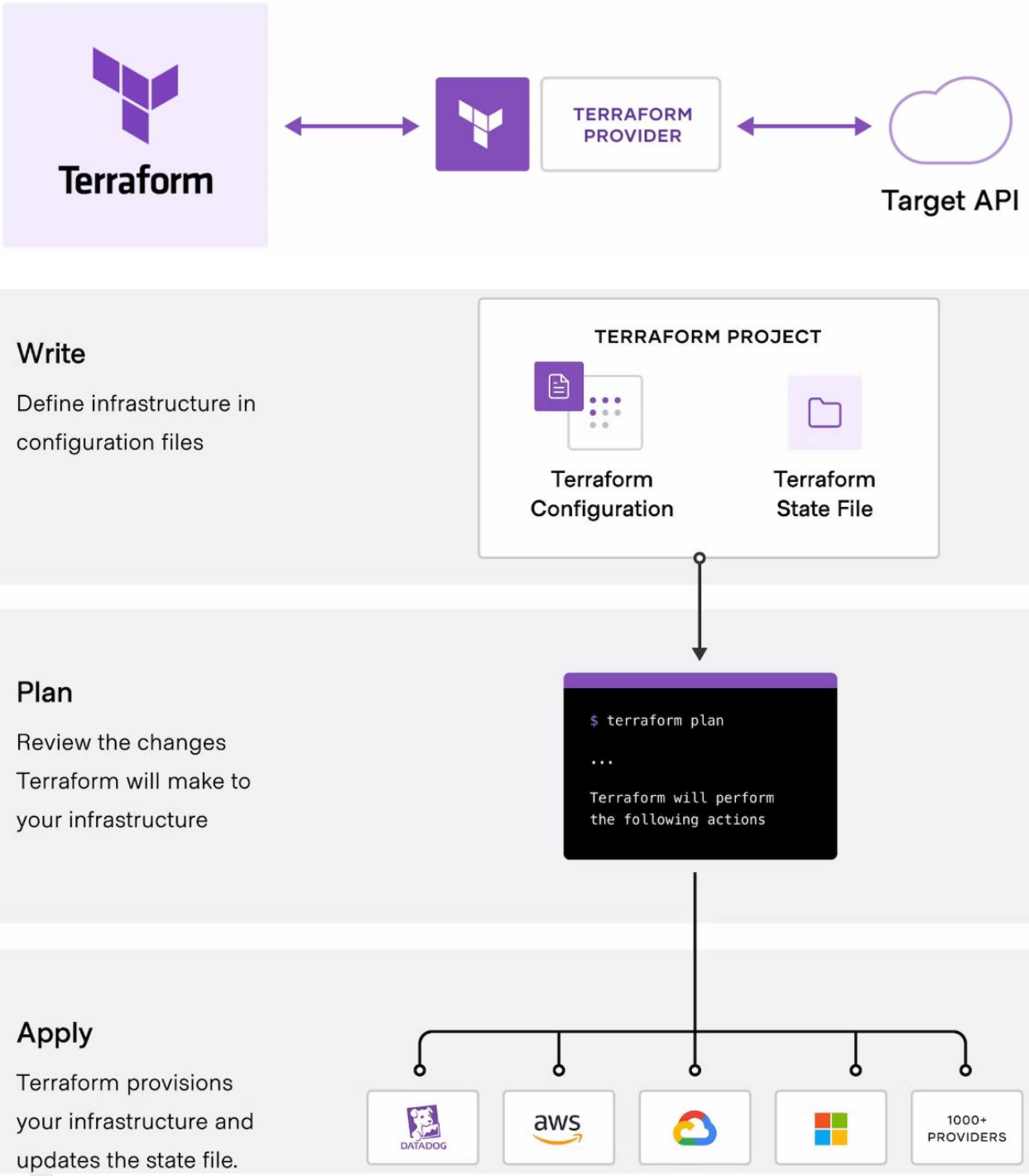
WHAT IS TERRAFORM ?

HashiCorp Terraform is an infrastructure as code tool that lets you define both cloud and on-prem resources in human-readable configuration files that you can version, reuse, and share. You can then use a consistent workflow to provision and manage all of your infrastructure throughout its lifecycle. Terraform can manage low-level components like compute, storage, and networking resources, as well as high-level components like DNS entries and SaaS features.

How does Terraform work?

HashiCorp and the Terraform community have already written **thousands of providers** to manage many different types of resources and services. You can find all publicly available providers on the Terraform Registry, including Amazon Web Services (AWS), Azure, Google Cloud Platform (GCP), Kubernetes, Helm, GitHub, Splunk, DataDog, and many more.

The core Terraform workflow consists of three stages:



- **Write:** You define resources, which may be across multiple cloud providers and services. For example, you might create a configuration to deploy an application on virtual machines in a Virtual Private Cloud (VPC) network with security groups and a load balancer.
- **Plan:** Terraform creates an execution plan describing the infrastructure it will create, update, or destroy based on the existing infrastructure and your configuration.
- **Apply:** On approval, Terraform performs the proposed operations in the correct order, respecting any resource dependencies. For example, if you update the properties of a VPC and change the number of virtual

machines in that VPC, Terraform will recreate the VPC before scaling the virtual machines.

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

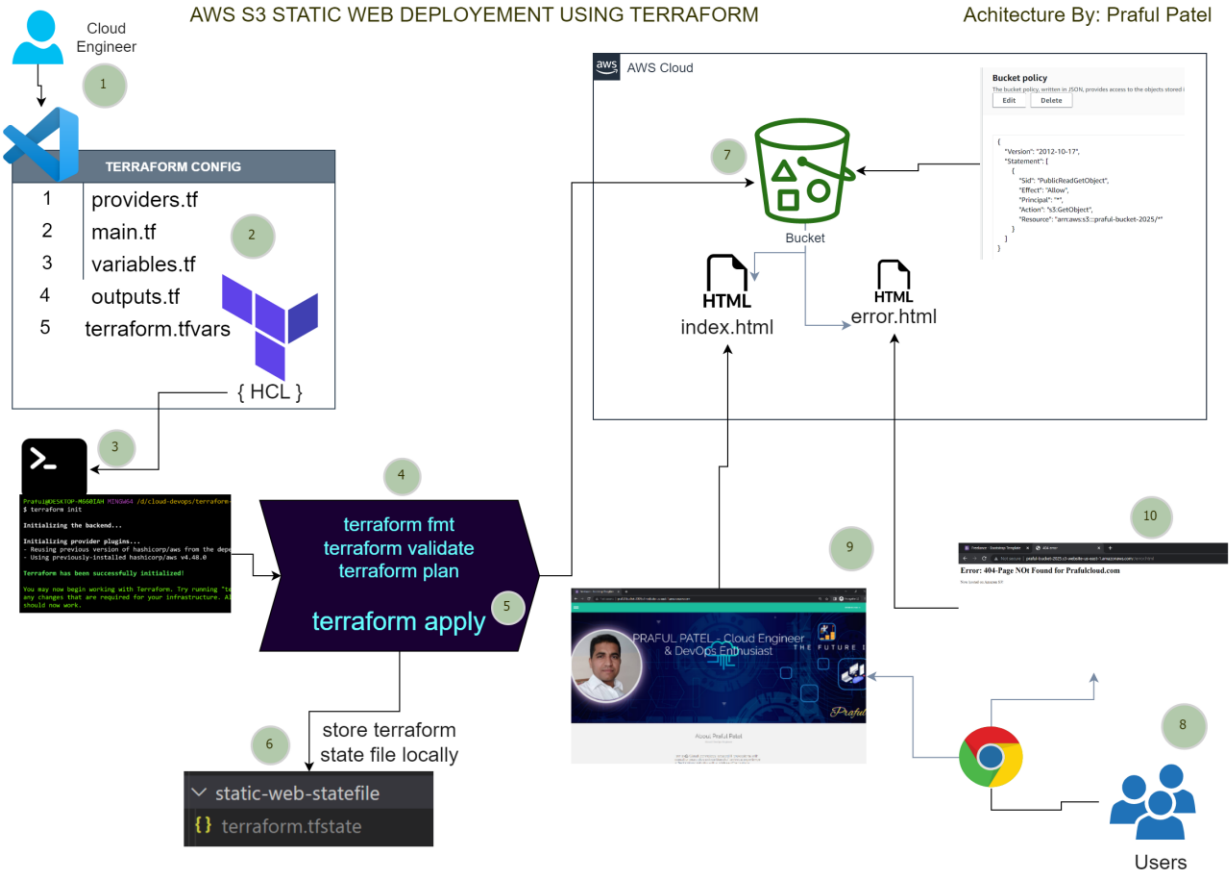
- **Project Cost Estimation:**

(Note: This cost is Not any actual cost, it's just an estimation based on high level requirement. Price may be vary based on adding and removing services based on requirement.)
Ref: https://calculator.aws/#/addService

- **Tools & Technologies covered:**

  - Terraform (Infrastructure as Code)
  - AWS Cloud Services
  - AWS S3
  - VS Code IDE
  - GitHub

➢ Solution Architecture:



➢ Pre-requisite:

1) AWS Free tier Account
2) AWS IAM User created with programmatic access
3) VS Code configured
4) Latest Terraform version is installed
5) GitHub Account
6) Gitbash installed on desktop
7) Web application source code ready

This project will be completed in following implementation phases.

- **Project implementation Phase:**

  Phase 1: AWS cloud configuration via terminal
  Phase 2: Create terraform project and define Terraform files and folders
  Phase 3: Configure and write terraform resources into respective files
  Phase 4: Terraform fmt, terraform validate, terraform plan
  Phase 5: Terraform apply
  Phase 6: Verify that resources are created In cloud
  Phase 7: Verify that web application accessible successfully

- **Implementation:**

  - **Phase 1: AWS cloud configuration via terminal**
    1. Go to gitbash terminal and hit "aws configure"
    2. Provide secret key and secret access key for the IAM user created
    3. Provide region " us-east-1"
    4. Provide output type " json"

  - **Phase 2: Create terraform project and define Terraform files and folders**
    1. Go to VS Code and create a new folder name "tf-static-web"
    2. Create a file structure for terraform project
       a. Create a new file "01-providers.tf"
       b. Create a new file "02-main.tf"
       c. Create a new file "03-variables.tf"
       d. Create a new file "04-outputs.tf"
       e. Create a new file "terraform.tfvars"
       f. Create a folder for web app source code "webfiles" and upload web application files into it
    3. Save all the files into VS code

  - **Phase 3: Configure and write terraform resources into respective files**
    1. Go to file "01-providers.tf" and mention terraform and provider block
    2. Go to "02-main.tf" and write all the required s3 resources
    3. Go to "03-variables.tf" and write the variables for dynamic access
    4. Go to "04-outputs.tf" and write required outputs
    5. Go to "terraform.tfvars" and write the variables for dynamic access which will override the default variables value.

  - **Phase 4: Terraform fmt, terraform validate, terraform plan**
    1. Go to git bash terminal and apply the terraform commands
    2. Terraform init
    3. Terraform fmt
    4. Terraform validate
    5. Terraform apply
    6. Observe that "terraform.tfstate" is stored locally

- **Phase 5: Verify that resources are created In AWS cloud**
    1. Go to AWS S3 and verify that bucket is created
    2. Verify that web files are uploaded into bucket
    3. Verify that permission has been created
    4. Verify that web endpoint is created

- **Phase 6: Verify that web application accessible successfully**
    1. Go to terminal and observe the outputs value
    2. Copy the endpoint url and access from web browser
    3. Verify that "index.html" is displayed the web page
    4. Verify that "error.html" is displayed the error page

➢ **Implementation in an Action:**

- **Phase 1:** AWS cloud configuration via terminal
    1) Go to gitbash terminal and hit "aws configure"
    2) Provide secret key and secret access key
    3) Provide region " us-east-1"
    4) Provide output type " json"

AWS Configuration:

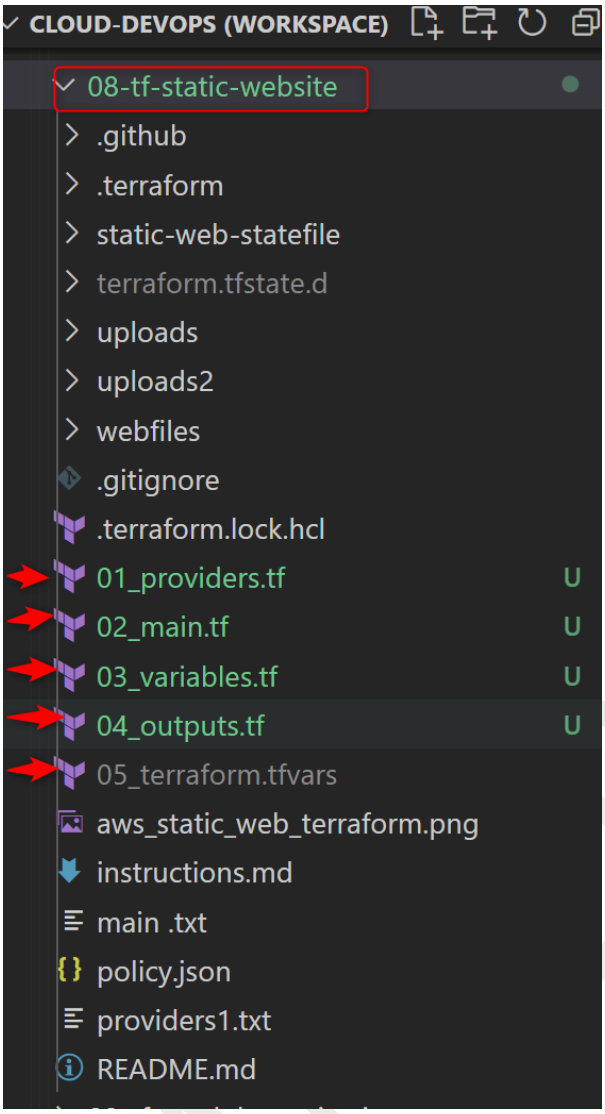
Access Key Id:
AKIAWEYWGFCJC3IK25WS
Secret Access Key:
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

Go to terminal and type
$aws configure

```
Praful@DESKTOP-M660IAH MINGW64 /d/cloud-devops/terraform-aws-tests/gocloud-test/08-tf-static-website (master)
$ aws configure
AWS Access Key ID [****************3NMH]: AKIA46G7T7645707RREU 1
AWS Secret Access Key [****************SQhB]: QFGsGe5WbY0k5QWA5LVvqgQIoYmHWP2d7+/11nIu 2
Default region name [us-east-1]: us-east-1 3
Default output format [json]: json 4
```

- **Phase 2: Create terraform project and define Terraform files and folders**
    1) Go to VS Code and create a new folder name "tf-static-web"
    2) Create a file structure for terraform project
        a. Create a new file "01-providers.tf"
        b. Create a new file "02-main.tf"
        c. Create a new file "03-variables.tf"
        d. Create a new file "04-outputs.tf"
        e. Create a new file "terraform.tfvars"
        f. Create a folder for web app source code "webfiles" and upload web application files into it
    3) Save all the files into VS code

Terraform file structure:



Phase 3: Configure and write terraform resources into respective files

1) Go to file "01-providers.tf" and mention terraform and provider block
2) Go to "02-main.tf" and write all the required s3 resources
3) Go to "03-variables.tf" and write the variables for dynamic access
4) Go to "04-outputs.tf" and write required outputs
5) Go to "terraform.tfvars" and write the variables for dynamic access which will override the default variables value.

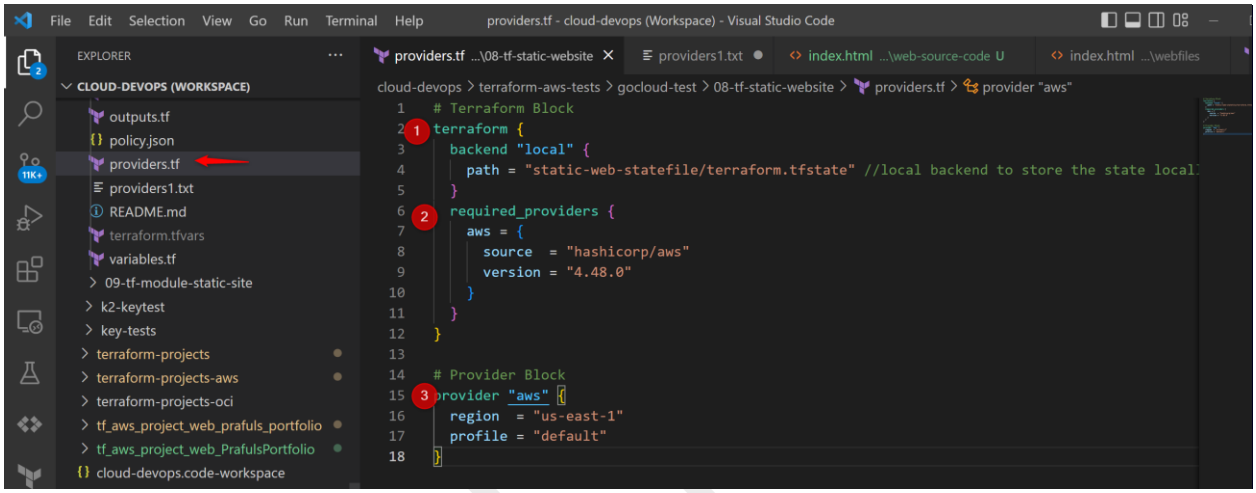
01_Providers.tf

- Terraform block
- Providers block
- Terraform block

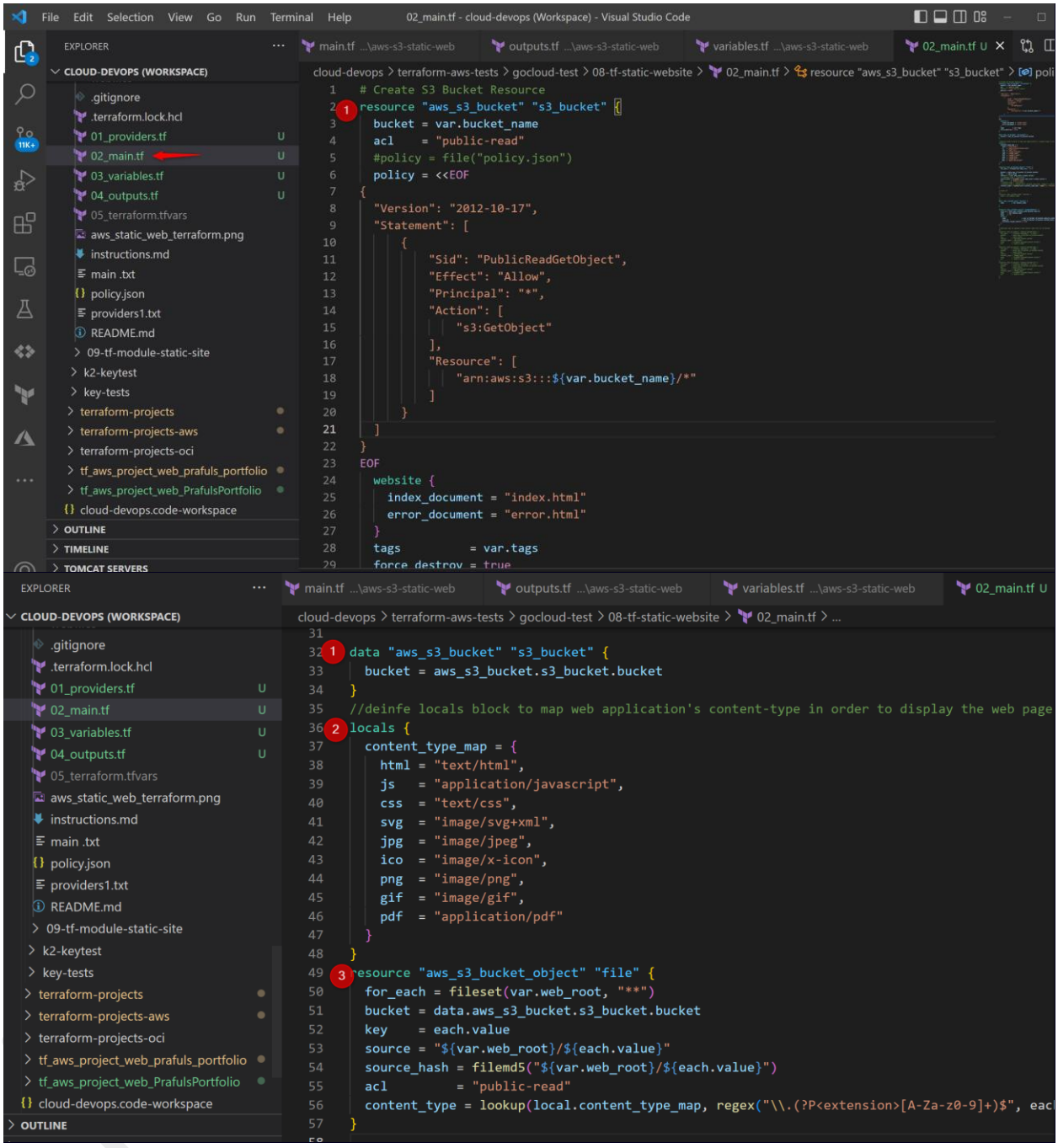
Providers file contains terraform block which includes a "backend" configurations for state file storage and also "required_provisioners" contains a source and version of the terraform provider.

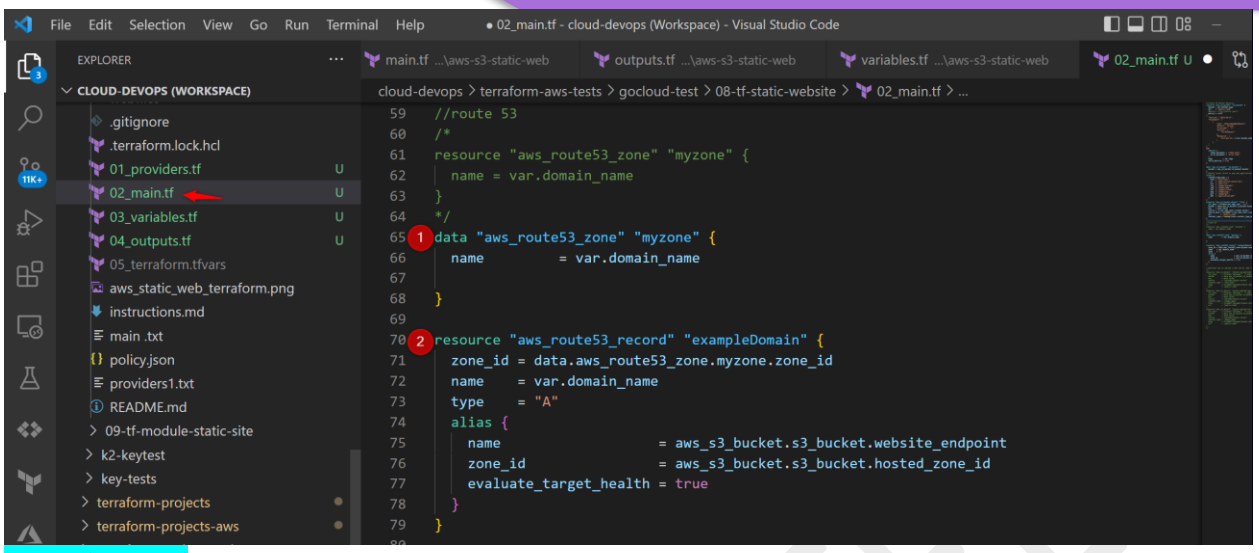
- Providers block

This block contains a cloud providers information about region and profile on which the cloud services needs to be provisioned.

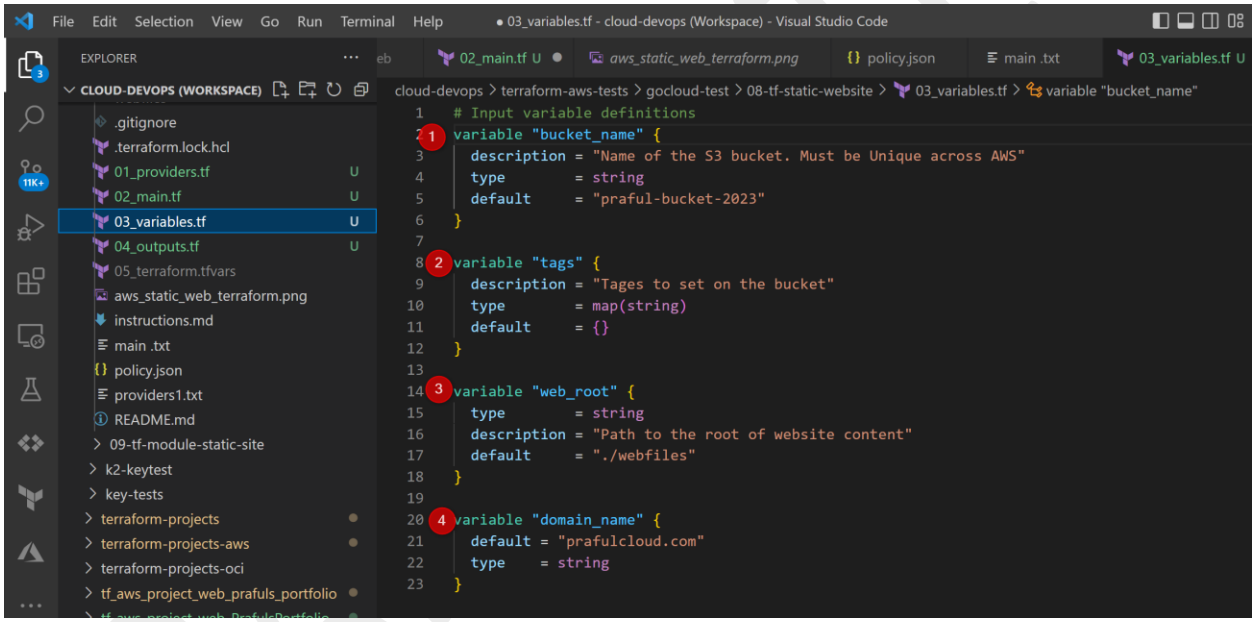


02_main.tf

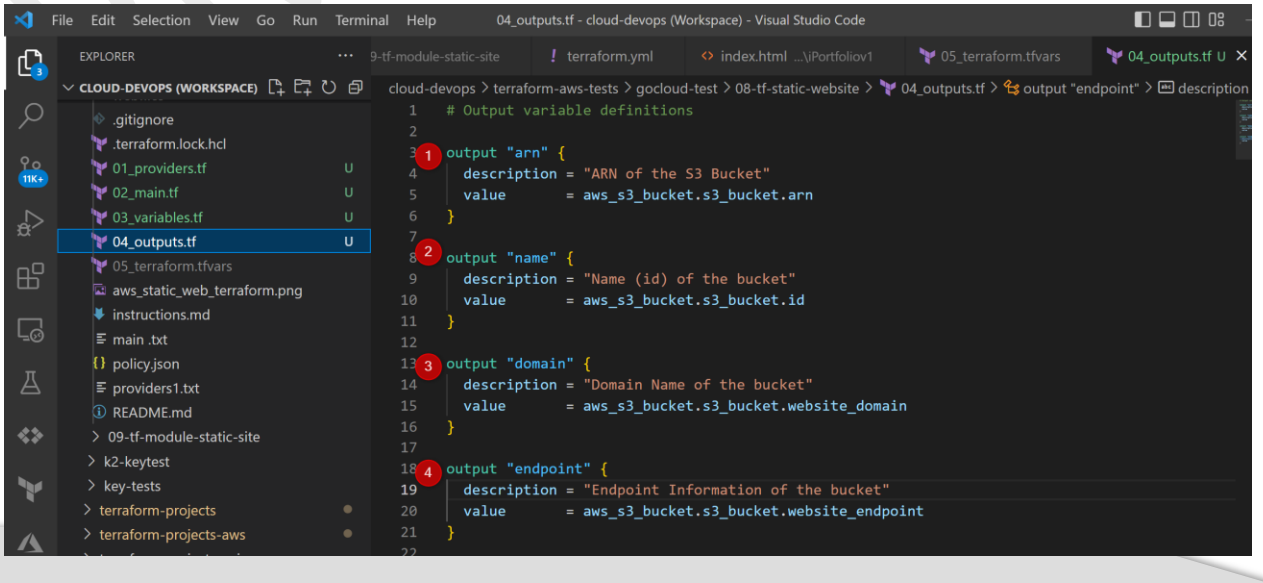

File Edit Selection View Go Run Terminal Help
02_main.tf - cloud-devops (Workspace) - Visual Studio Code
EXPLORER
CLOUD-DEVOPS (WORKSPACE)
.gitignore
.terraform.lock.hcl
01_providers.tf
02_main.tf
03_variables.tf
04_outputs.tf
05_terraform.tfvars
aws_static_web_terraform.png
instructions.md
main .txt
policy.json
providers1.txt
README.md
09-tf-module-static-site
k2-keytest
key-tests
terraform-projects
terraform-projects-aws
terraform-projects-oci
tf_aws_project_web_prafuls_portfolio
tf_aws_project_web_PrafulsPortfolio
cloud-devops.code-workspace
OUTLINE
TIMELINE
TOMCAT SERVERS
main.tf ...\aws-s3-static-web
outputs.tf ...\aws-s3-static-web
variables.tf ...\aws-s3-static-web
02_main.tf U
cloud-devops > terraform-aws-tests > gocloud-test > 08-tf-static-website > 02_main.tf > resource "aws_s3_bucket" "s3_bucket"
# Create S3 Bucket Resource
1 resource "aws_s3_bucket" "s3_bucket" {
bucket = var.bucket_name
acl = "public-read"
#policy = file("policy.json")
policy = <<EOF
{
"Version": "2012-10-17",
"Statement": [
{
"Sid": "PublicReadGetObject",
"Effect": "Allow",
"Principal": "*",
"Action": [
"s3:GetObject"
],
"Resource": [
"arn:aws:s3:::${var.bucket_name}/*"
]
}
]
}
EOF
website {
index_document = "index.html"
error_document = "error.html"
}
tags = var.tags
force_destroy = true
cloud-devops > terraform-aws-tests > gocloud-test > 08-tf-static-website > 02_main.tf > ...
1 data "aws_s3_bucket" "s3_bucket" {
bucket = aws_s3_bucket.s3_bucket.bucket
}
//deinfe locals block to map web application's content-type in order to display the web page
2 locals {
content_type_map = {
html = "text/html",
js = "application/javascript",
css = "text/css",
svg = "image/svg+xml",
jpg = "image/jpeg",
ico = "image/x-icon",
png = "image/png",
gif = "image/gif",
pdf = "application/pdf"
}
}
3 resource "aws_s3_bucket_object" "file" {
for_each = fileset(var.web_root, "**")
bucket = data.aws_s3_bucket.s3_bucket.bucket
key = each.value
source = "${var.web_root}/${each.value}"
source_hash = filemd5("${var.web_root}/${each.value}")
acl = "public-read"
content_type = lookup(local.content_type_map, regex("\\.(?P<extension>[A-Za-z0-9]+)$", eac
}



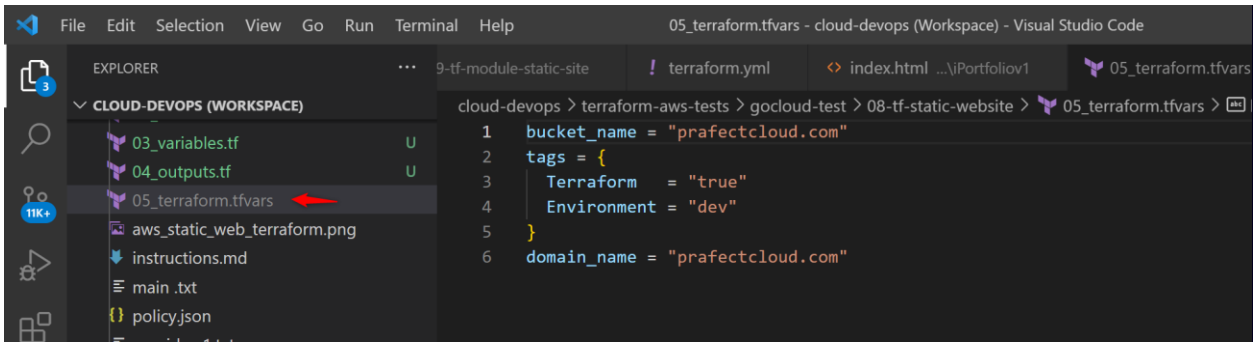
03_variables.tf



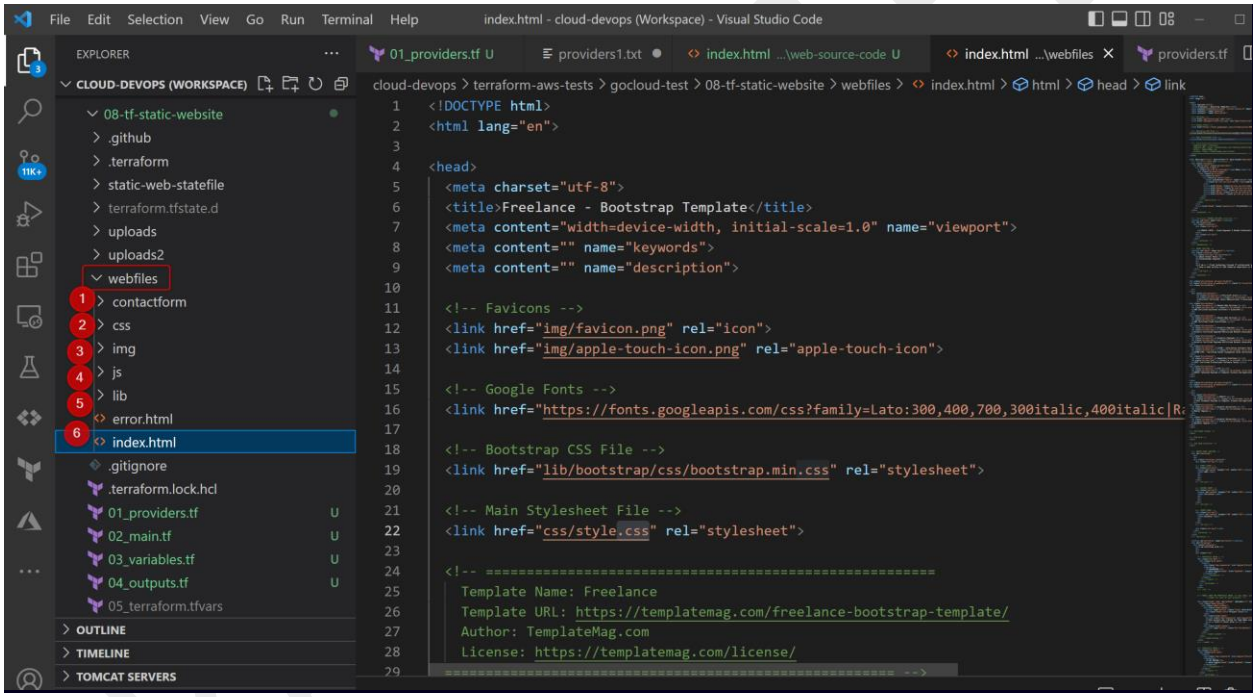
04_outputs.tf



05_terraform.tfvars.tf



Webfiles




```
Praful@DESKTOP-M660IAH MINGW64 /d/cloud-devops/terraform-aws-tests/gocloud-test/08-tf-static-website (master)
$ aws configure
AWS Access Key ID [****************KYPM]: AKIAWEYWGFCJC3IK25WS
AWS Secret Access Key [****************1zTb]: 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
Default region name [us-east-1]: us-east-1
Default output format [json]: json
```

AWS configured successfully

- **Phase 4: Terraform fmt, terraform validate, terraform plan**
  1) Go to git bash terminal and apply the terraform commands
  2) Terraform init
  3) Terraform fmt
  4) Terraform validate
  5) Terraform apply
  6) Observe that "terraform.tfstate" is stored locally

Terraform init

```
1 Welcome   2 devops@DESKTOP-M6...   3 MINGW64:/d/cloud-de...

Praful@DESKTOP-M660IAH MINGW64 /d/cloud-devops/terraform-aws-tests/gocloud-test/08-tf-static-website (master)
$ terraform init

Initializing the backend...

Initializing provider plugins...
- Reusing previous version of hashicorp/aws from the dependency lock file
- Using previously-installed hashicorp/aws v4.48.0

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 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.

Praful@DESKTOP-M660IAH MINGW64 /d/cloud-devops/terraform-aws-tests/gocloud-test/08-tf-static-website (master)
$
```

Terraform fmt

```
Praful@DESKTOP-M660IAH MINGW64 /d/cloud-devops/terraform-aws-tests/gocloud-test/08-tf-static-website (master)
$ terraform fmt
02_main.tf

Praful@DESKTOP-M660IAH MINGW64 /d/cloud-devops/terraform-aws-tests/gocloud-test/08-tf-static-website (master)
$
```

Terraform validate

```
Praful@DESKTOP-M660IAH MINGW64 /d/cloud-devops/terraform-aws-tests/gocloud-test/08-tf-static-website (master)
$ terraform validate

Warning: Argument is deprecated

  with aws_s3_bucket.s3_bucket,
  on 02_main.tf line 2, in resource "aws_s3_bucket" "s3_bucket":
   2: resource "aws_s3_bucket" "s3_bucket" {

Use the aws_s3_bucket_website_configuration resource instead

(and one more similar warning elsewhere)


Warning: Deprecated attribute

  on 02_main.tf line 75, in resource "aws_route53_record" "exampleDomain":
  75:     name                   = aws_s3_bucket.s3_bucket.website_endpoint

The attribute "website_endpoint" is deprecated. Refer to the provider documentation for details.

(and 2 more similar warnings elsewhere)

Success! The configuration is valid, but there were some validation warnings as shown above.
```

Terraform plan

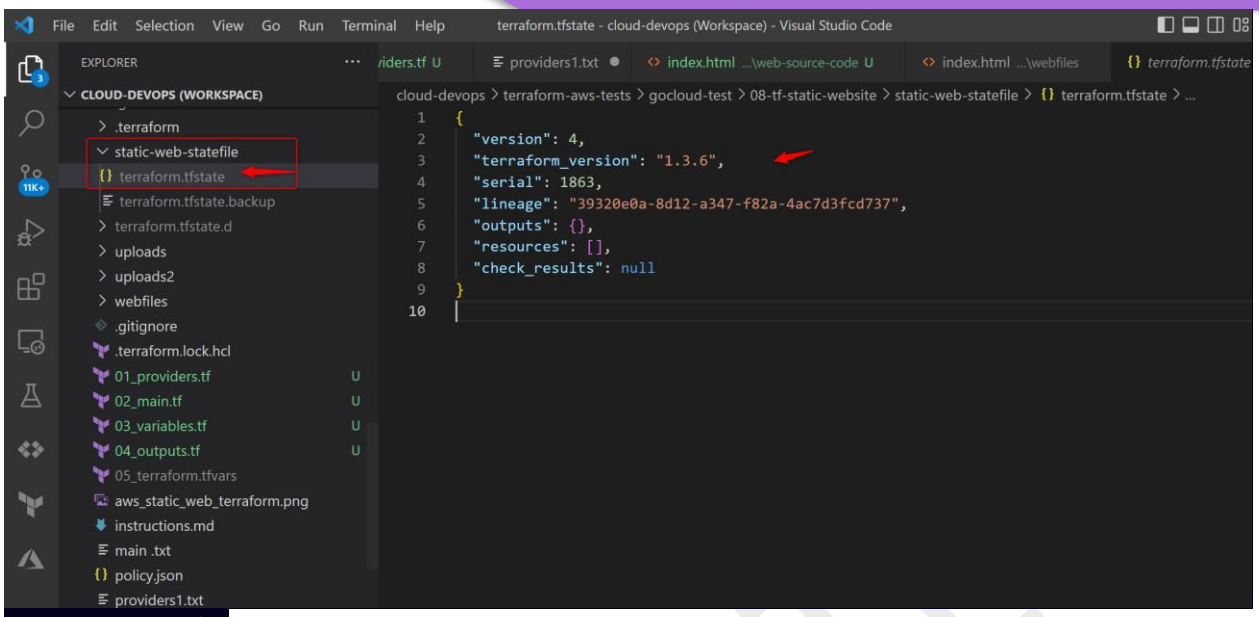
```
Praful@DESKTOP-M660IAH MINGW64 /d/cloud-devops/terraform-aws-tests/gocloud-test/08-tf-static-website (master)
$ terraform plan

Terraform used the selected providers to generate the following execution plan. Resource actions are indicated
with the following symbols:
  + create
 <= read (data resources)

Terraform will perform the following actions:

  # data.aws_s3_bucket.s3_bucket will be read during apply
  # (depends on a resource or a module with changes pending)
 <= data "aws_s3_bucket" "s3_bucket" {
      + arn                         = (known after apply)
      + bucket                      = "praful-bucket-2023"
      + bucket_domain_name          = (known after apply)
      + bucket_regional_domain_name = (known after apply)
      + hosted_zone_id              = (known after apply)
      + id                          = (known after apply)
      + region                      = (known after apply)
      + website_domain              = (known after apply)
      + website_endpoint            = (known after apply)
    }
      + server_side_encryption = (known after apply)
      + source                 = "./webfiles/lib/php-mail-form/validate.js"
      + source_hash            = "48e28fea3f12ef0ef338510a77163d69"
      + storage_class          = (known after apply)
      + tags_all               = (known after apply)
      + version_id             = (known after apply)
    }

Plan: 43 to add, 0 to change, 0 to destroy.

Changes to Outputs:
  + arn      = (known after apply)
  + domain   = (known after apply)
  + endpoint = (known after apply)
  + name     = (known after apply)
```

Terraform apply

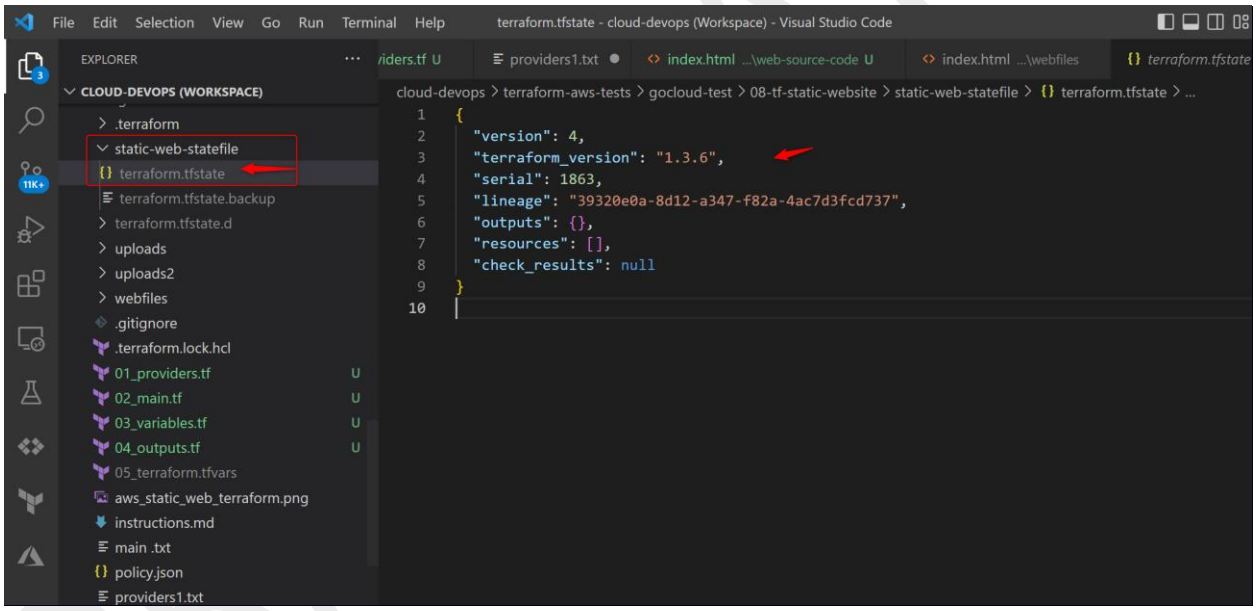
```
Praful@DESKTOP-M660IAH MINGW64 /d/cloud-devops/terraform-aws-tests/gocloud-test/08-tf-static-website (master)
$ terraform apply -auto-approve

Terraform used the selected providers to generate the following execution plan. Resource actions are indicated
with the following symbols:
  + create
 <= read (data resources)

Terraform will perform the following actions:

  # data.aws_s3_bucket.s3_bucket will be read during apply
  # (depends on a resource or a module with changes pending)
 <= data "aws_s3_bucket" "s3_bucket" {
      + arn                         = (known after apply)
      + bucket                      = "praful-bucket-2023"
      + bucket_domain_name          = (known after apply)
      + bucket_regional_domain_name = (known after apply)
      + hosted_zone_id              = (known after apply)
      + id                          = (known after apply)
      + region                      = (known after apply)
      + website_domain              = (known after apply)
      + website_endpoint            = (known after apply)


Apply complete! Resources: 43 added, 0 changed, 0 destroyed.

Outputs:

arn = "arn:aws:s3:::praful-bucket-2023"
domain = "s3-website-us-east-1.amazonaws.com"
endpoint = "praful-bucket-2023.s3-website-us-east-1.amazonaws.com"
name = "praful-bucket-2023"
```

static-web-statefile

Terraform.tfstate

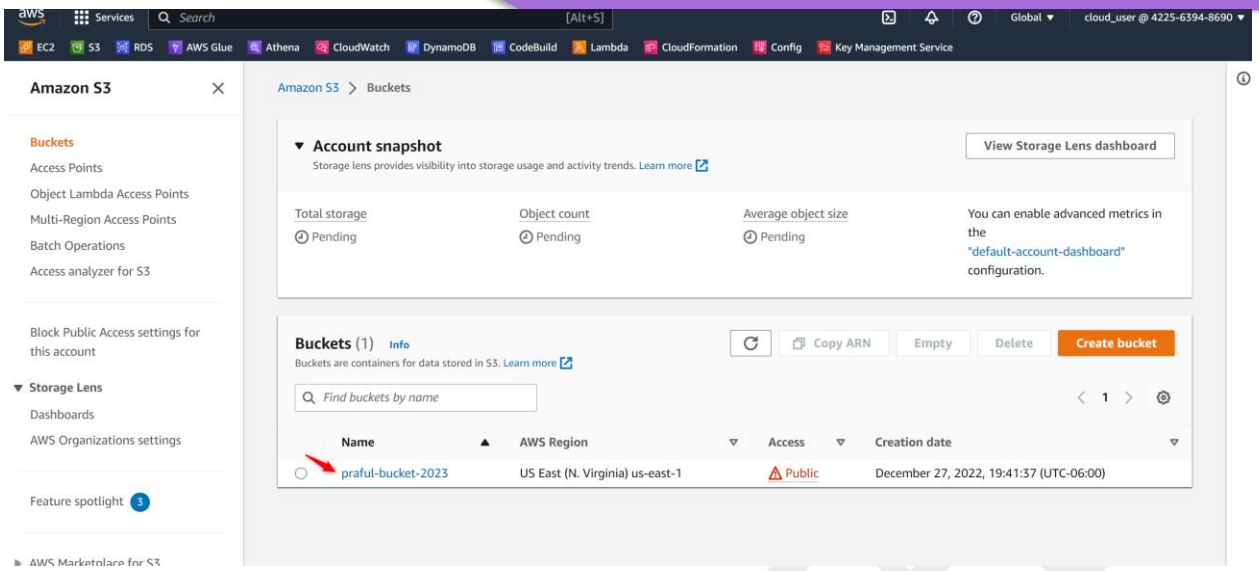


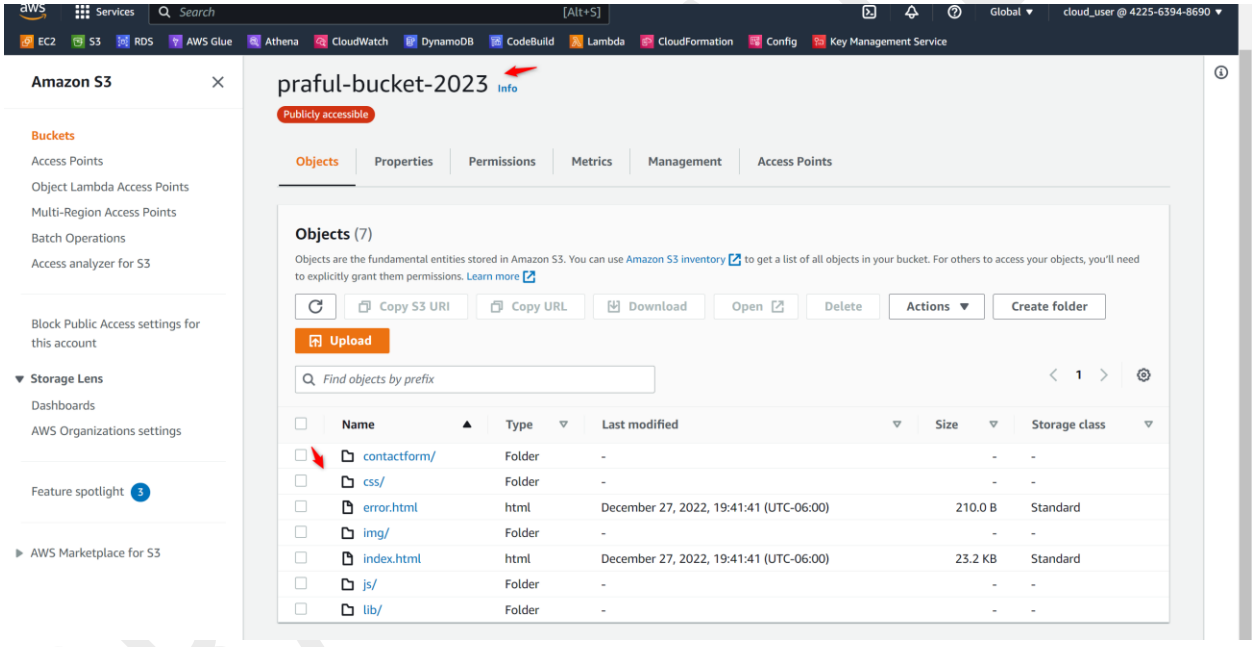
static-web-statefile
Terraform.tfstate

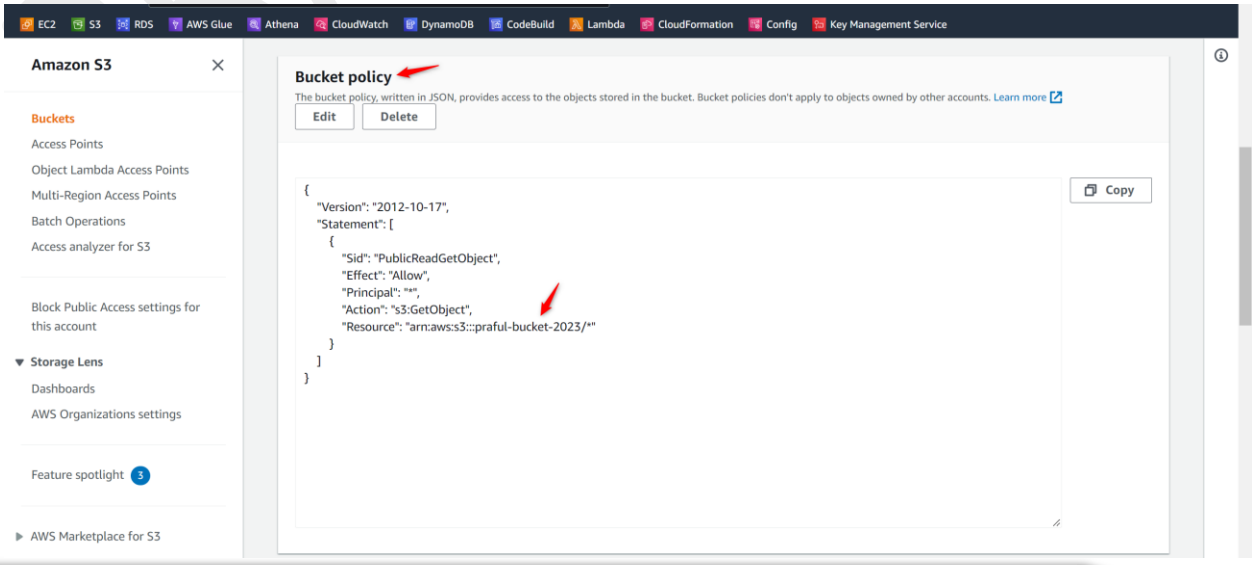


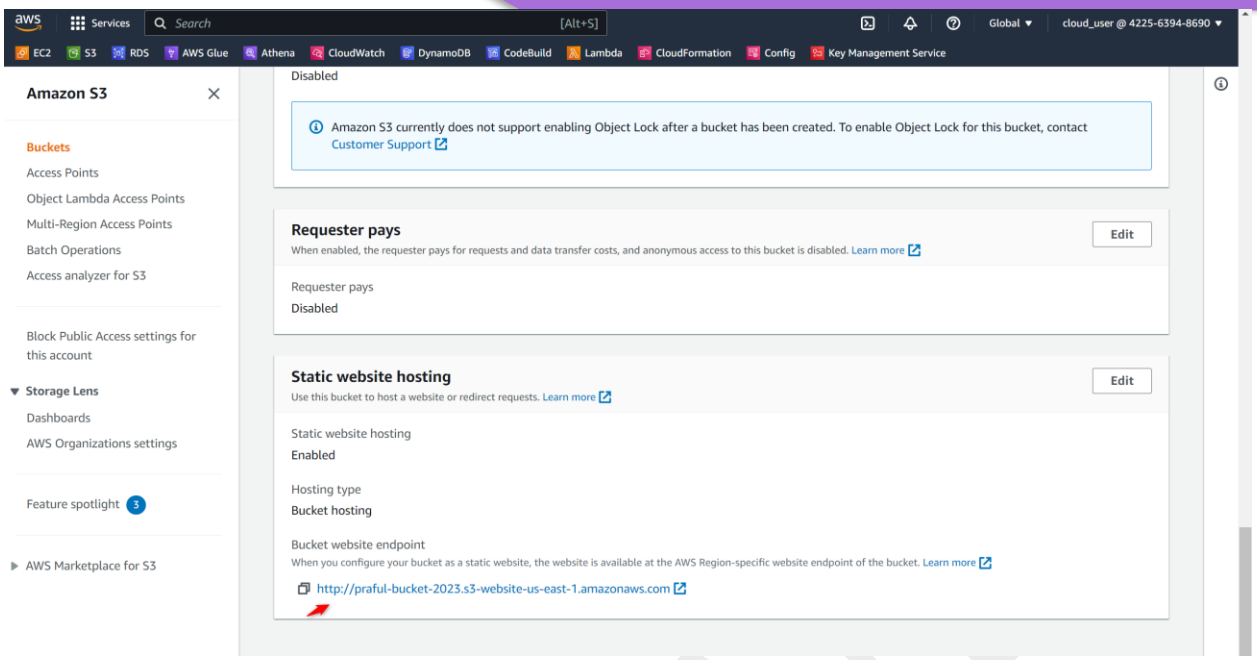
- **Phase 5: Verify that resources are created In AWS cloud**
  1) Go to AWS S3 and verify that bucket is created
  2) Verify that web files are uploaded into bucket
  3) Verify that permission has been created
  4) Verify that web endpoint is created

Verify the resources are created in AWS


Amazon S3
Buckets
Access Points
Object Lambda Access Points
Multi-Region Access Points
Batch Operations
Access analyzer for S3
Block Public Access settings for this account
Storage Lens
Dashboards
AWS Organizations settings
Feature spotlight
Amazon S3 > Buckets
Account snapshot
Storage lens provides visibility into storage usage and activity trends. Learn more
View Storage Lens dashboard
Total storage
Pending
Object count
Pending
Average object size
Pending
You can enable advanced metrics in the "default-account-dashboard" configuration.
Buckets (1) Info
Buckets are containers for data stored in S3. Learn more
Copy ARN
Empty
Delete
Create bucket
Find buckets by name
Name
AWS Region
Access
Creation date
praful-bucket-2023
US East (N. Virginia) us-east-1
Public
December 27, 2022, 19:41:37 (UTC-06:00)


praful-bucket-2023 Info
Publicly accessible
Objects
Properties
Permissions
Metrics
Management
Access Points
Objects (7)
Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more
Copy S3 URI
Copy URL
Download
Open
Delete
Actions
Create folder
Upload
Find objects by prefix
Name
Type
Last modified
Size
Storage class
contactform/ Folder
css/ Folder
error.html html December 27, 2022, 19:41:41 (UTC-06:00) 210.0 B Standard
img/ Folder
index.html html December 27, 2022, 19:41:41 (UTC-06:00) 23.2 KB Standard
js/ Folder
lib/ Folder


Bucket policy
The bucket policy, written in JSON, provides access to the objects stored in the bucket. Bucket policies don't apply to objects owned by other accounts. Learn more
Edit
Delete
Copy
{
"Version": "2012-10-17",
"Statement": [
{
"Sid": "PublicReadGetObject",
"Effect": "Allow",
"Principal": "*",
"Action": "s3:GetObject",
"Resource": "arn:aws:s3:::praful-bucket-2023/*"
}
]
}


aws
Services
Search
[Alt+S]
Global
cloud_user @ 4225-6394-8690
EC2
S3
RDS
AWS Glue
Athena
CloudWatch
DynamoDB
CodeBuild
Lambda
CloudFormation
Config
Key Management Service
Amazon S3
Buckets
Access Points
Object Lambda Access Points
Multi-Region Access Points
Batch Operations
Access analyzer for S3
Block Public Access settings for this account
Storage Lens
Dashboards
AWS Organizations settings
Feature spotlight
3
AWS Marketplace for S3
Disabled
Amazon S3 currently does not support enabling Object Lock after a bucket has been created. To enable Object Lock for this bucket, contact Customer Support
Requester pays
When enabled, the requester pays for requests and data transfer costs, and anonymous access to this bucket is disabled. Learn more
Edit
Requester pays
Disabled
Static website hosting
Use this bucket to host a website or redirect requests. Learn more
Edit
Static website hosting
Enabled
Hosting type
Bucket hosting
Bucket website endpoint
When you configure your bucket as a static website, the website is available at the AWS Region-specific website endpoint of the bucket. Learn more
http://praful-bucket-2023.s3-website-us-east-1.amazonaws.com

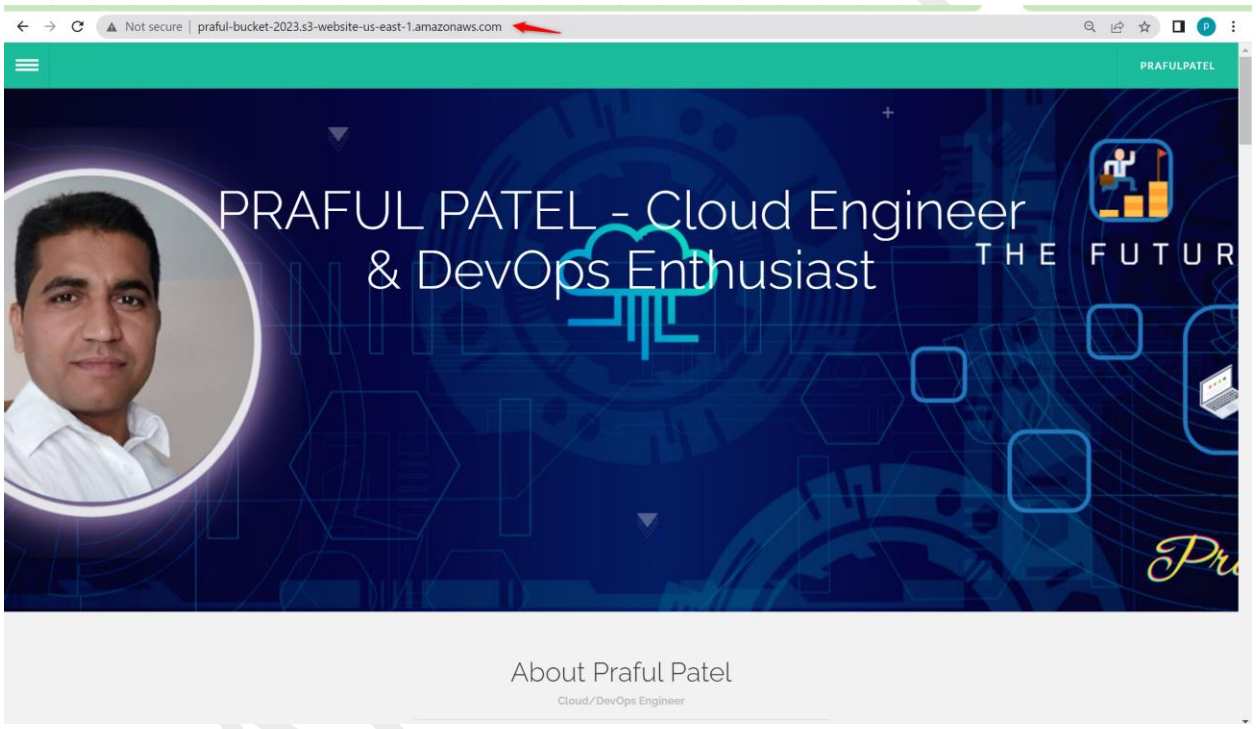
- **Phase 6: Verify that web application accessible successfully**
  1) Go to terminal and observe the outputs value
  2) Copy the endpoint url and access from web browser
  3) Verify that "index.html" is displayed the web page
  4) Verify that "error.html" is displayed the error page

Access web page using endpoint

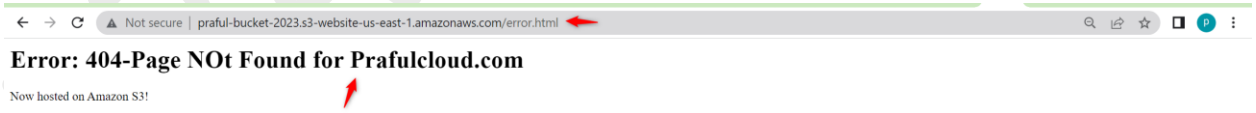
S3 endpoint:

```
praful-bucket-2023.s3-website-us-east-1.amazonaws.com
```

index.html



Access "error.html"



CHALLENGE

Congratulations!!!! 🔥🚀