Case Study 7: Kubernetes Cluster Management with Terraform

- **Concepts Used: Kubernetes, Terraform, AWS Cloud9.**
- **Problem Statement: "Use Terraform to provision a Kubernetes cluster on AWS. Then, use AWS Cloud9 IDE to deploy a sample application on the cluster using kubectl."**
- **Tasks:**
    - **Write a Terraform script to create a Kubernetes cluster on AWS.**
    - **Use AWS Cloud9 to configure kubectl for the newly created cluster.**
    - **Deploy a simple application (e.g., a Python Flask app) on the Kubernetes cluster and verify its deployment.**

Introduction:

Overview:

The following case study uses a number of services that would help the user to deploy the application onto Kubernetes using AWS Services such as EKS (Elastic Kubernetes Service), VPC (Virtual Private Cloud), etc. For creating this, we will be taking the help of Terraform (Infrastructure as Code). This is used to define the infrastructure of the required cluster and which in turn can be used by many users. This cluster will be then used to add and deploy a flask application.

Key Features:

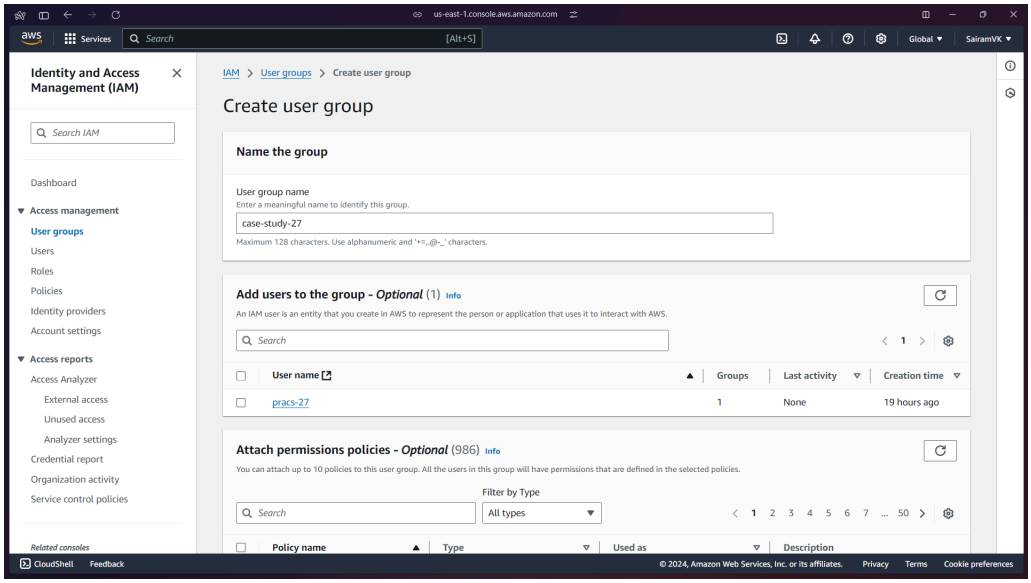
1) Use of Terraform to provide Infrastructure of EKS to be formed on AWS.
2) Using Docker to containerize the application.
3) Use of kubectl to manage cluster from terminal.
4) LoadBalancing to expose the application from container to local system.

Application:

The same case study could be used to deploy a larger scale flask project that could be used in various web applications. Not only that, other than flask, the projects working on different tech stacks could also be used in place of flask. This would give the main advantage that kubernetes allows to maintain Scalability, Reliability and Efficieny.

Step by Step Explanation:

Step 1:
Create a IAM user group and add the following inbuilt policies and a few inline policies.



AWS Managed Policies:

1) AmazonEKSClusterPolicy
2) AmazonEKSWorkerNodePolicy
3) AmazonVPCFullAccess
4) IAMFullAccess

Customer Managed Policies:

1) DescribeInstance
   JSON:

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

2) EKSNodeGroup

JSON:

```
{
	"Version": "2012-10-17",
	"Statement": [
		{
			"Effect": "Allow",
			"Action": [
				"eks:CreateNodegroup",
				"eks:DescribeNodegroup",
				"eks:DeleteNodegroup",
				"eks:CreateCluster",
				"eks:DescribeCluster",
				"eks:DeleteCluster",
				"iam:PassRole"
			],
			"Resource": "*"
		}
	]
}
```

3) EKSFullAccess

JSON

```
{
	"Version": "2012-10-17",
	"Statement": [
		{
			"Effect": "Allow",
			"Action": [
				"eks:CreateCluster",
				"eks:DescribeCluster",
				"eks:ListClusters",
				"eks:DeleteCluster",
				"ec2:DescribeSubnets",
				"ec2:DescribeVpcs",
				"iam:CreateServiceLinkedRole",
				"iam:PassRole"
			],
			"Resource": "*"
		}
	]
}
```

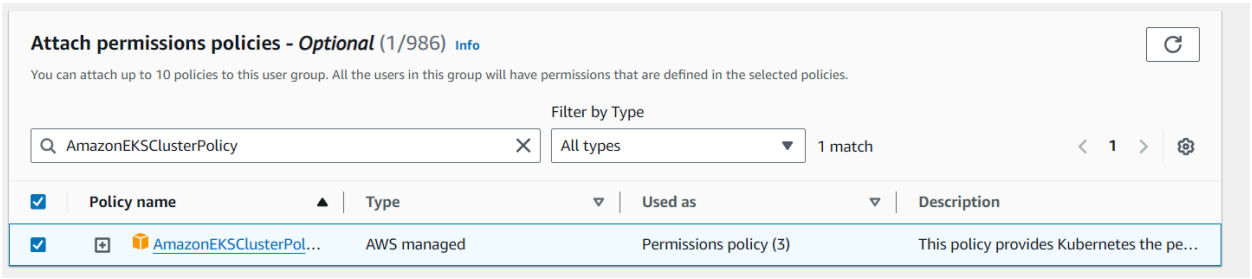
4) InstancePolicy

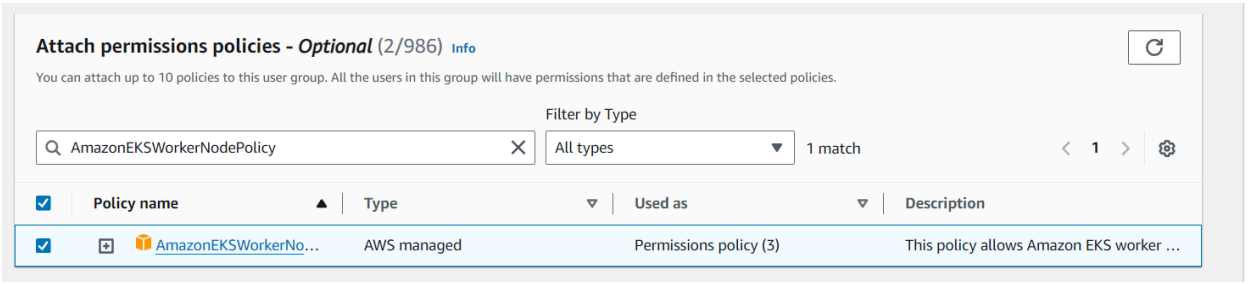
JSON:

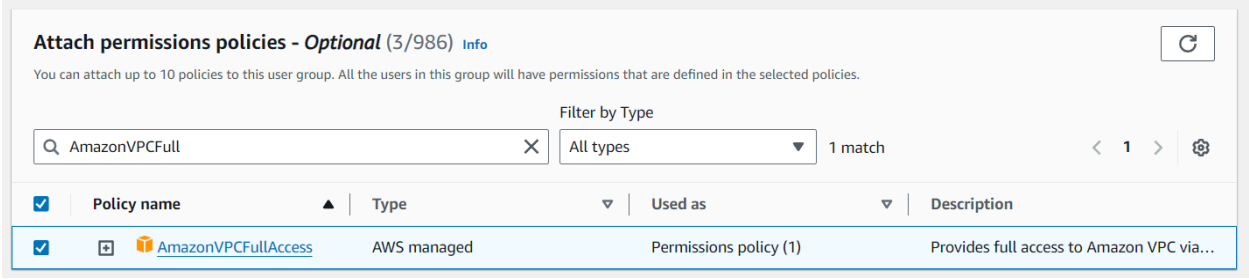
```
{
	"Version": "2012-10-17",
	"Statement": [
		{
			"Effect": "Allow",
			"Action": [
				"ec2:RunInstances",
				"ec2:DescribeInstances",
				"ec2:TerminateInstances",
				"ec2:CreateTags",
				"ec2:DescribeKeyPairs"
			],
			"Resource": "*"
		}
	]
}
```

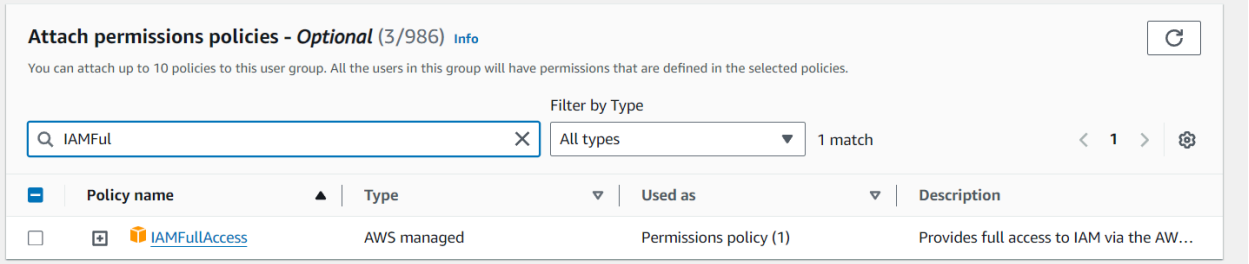
To add the AWS Managed Policies:

1) On the create User Group menu, give a name to your user group, then scroll down to Attach Permission Policies. Search for the listed policies and click on the checkbox next to the policy.

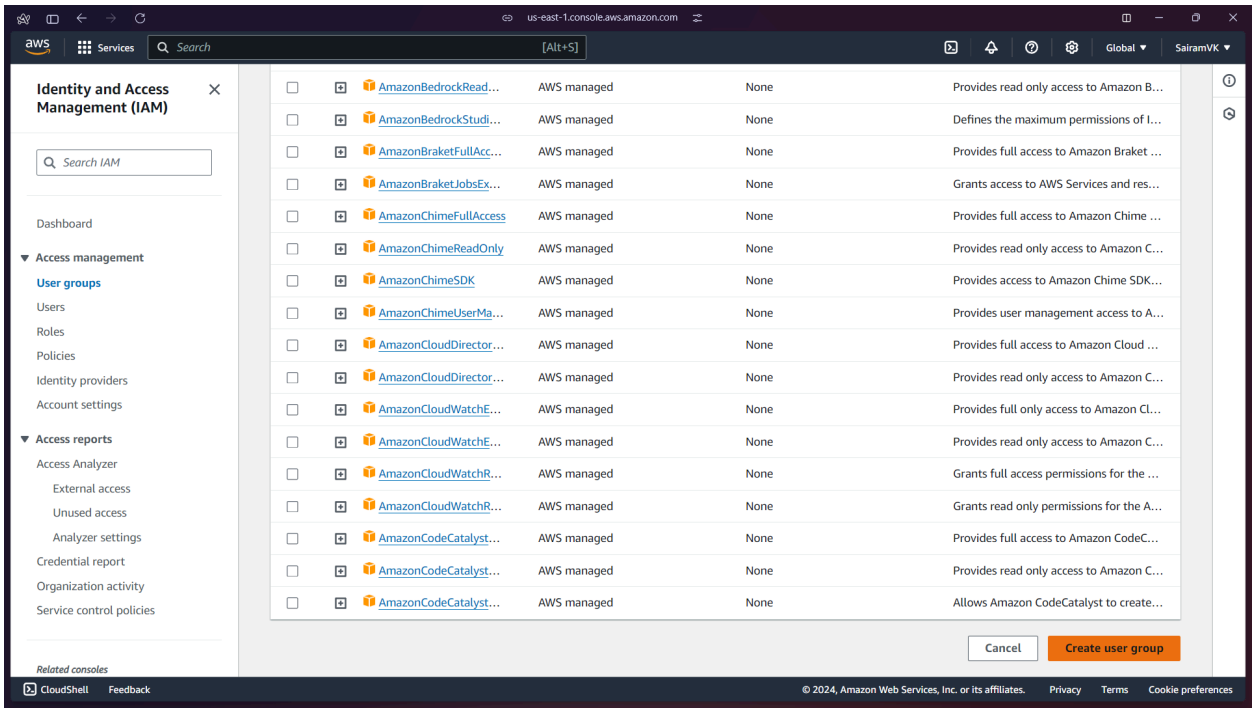








2) Now click on Create Group.



3) Here, you can see your user group created.

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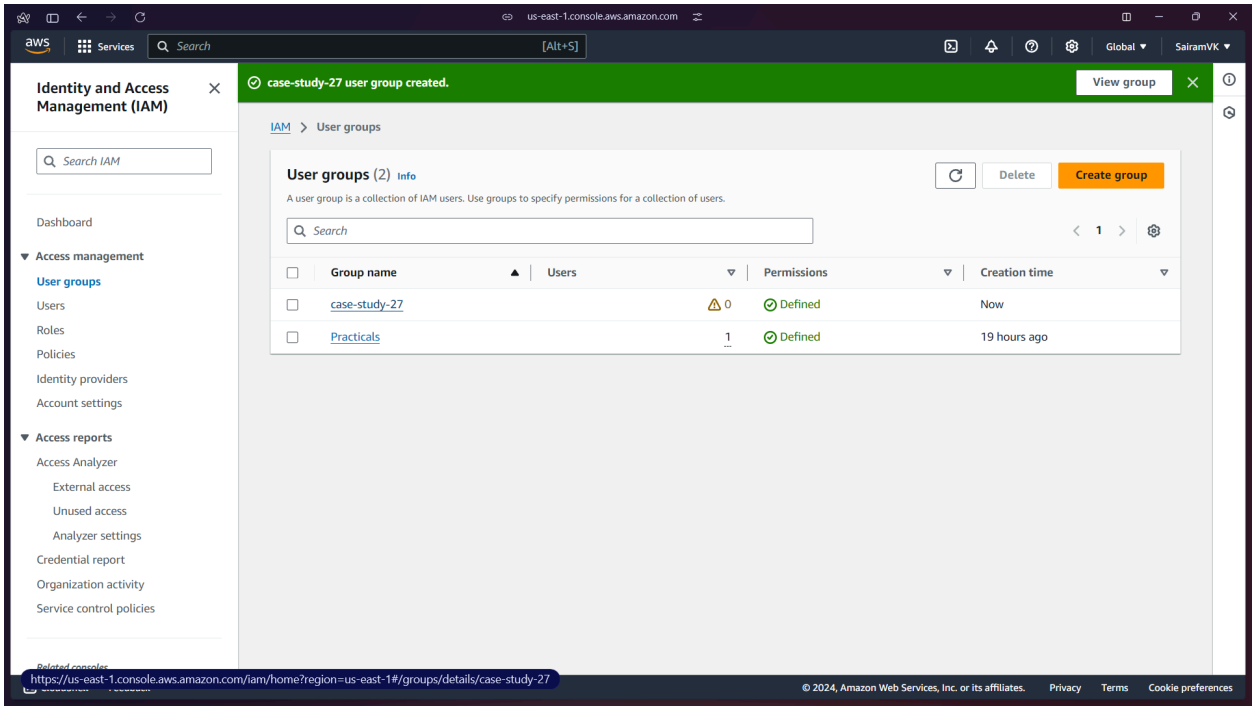
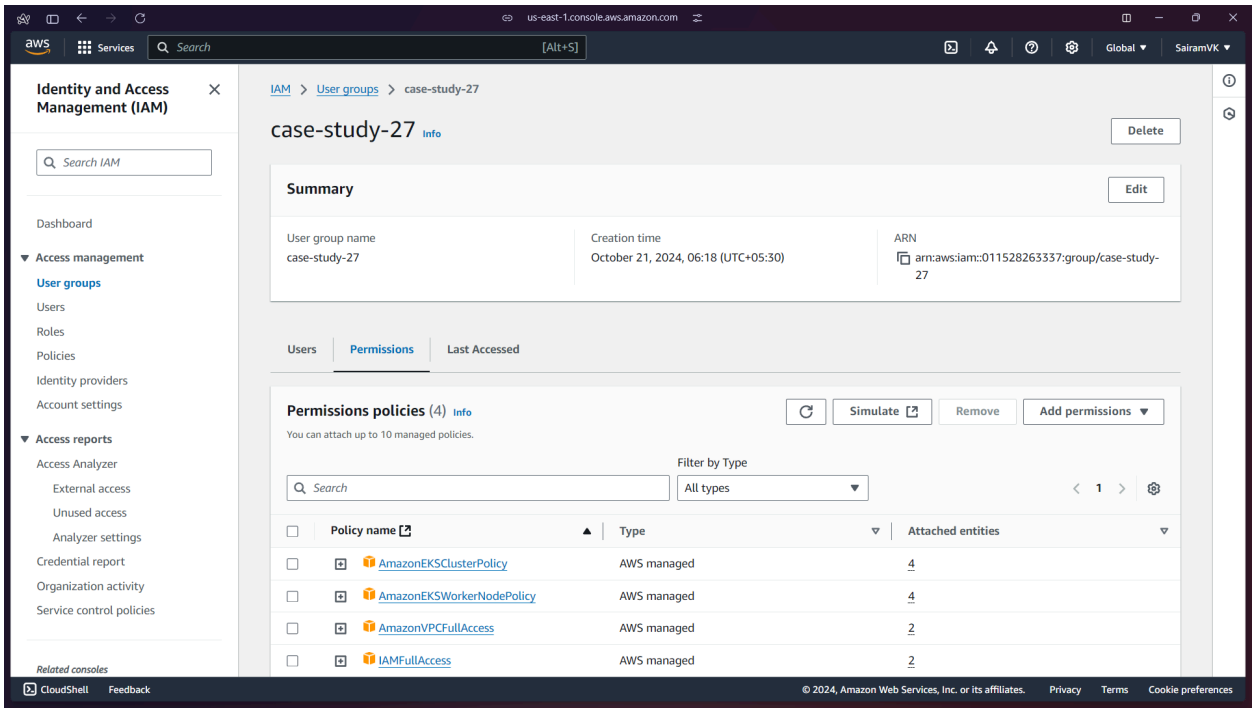
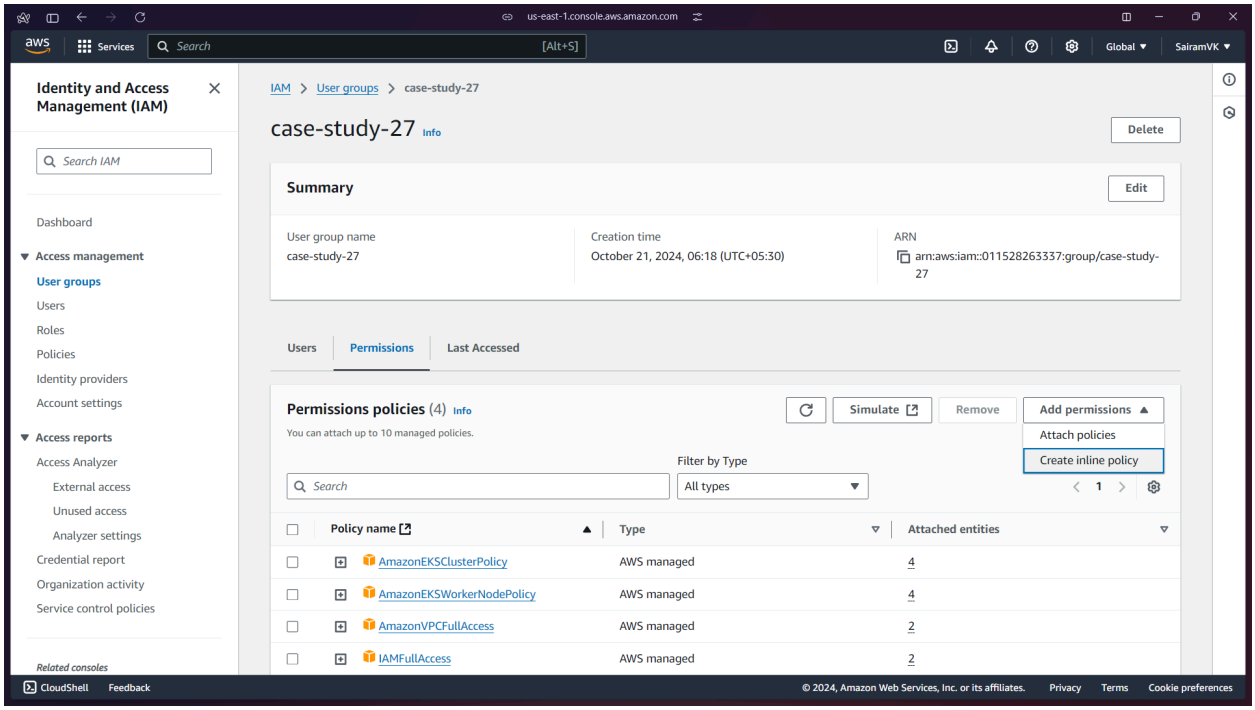


To add the Customer Managed Policies, follow the following steps:

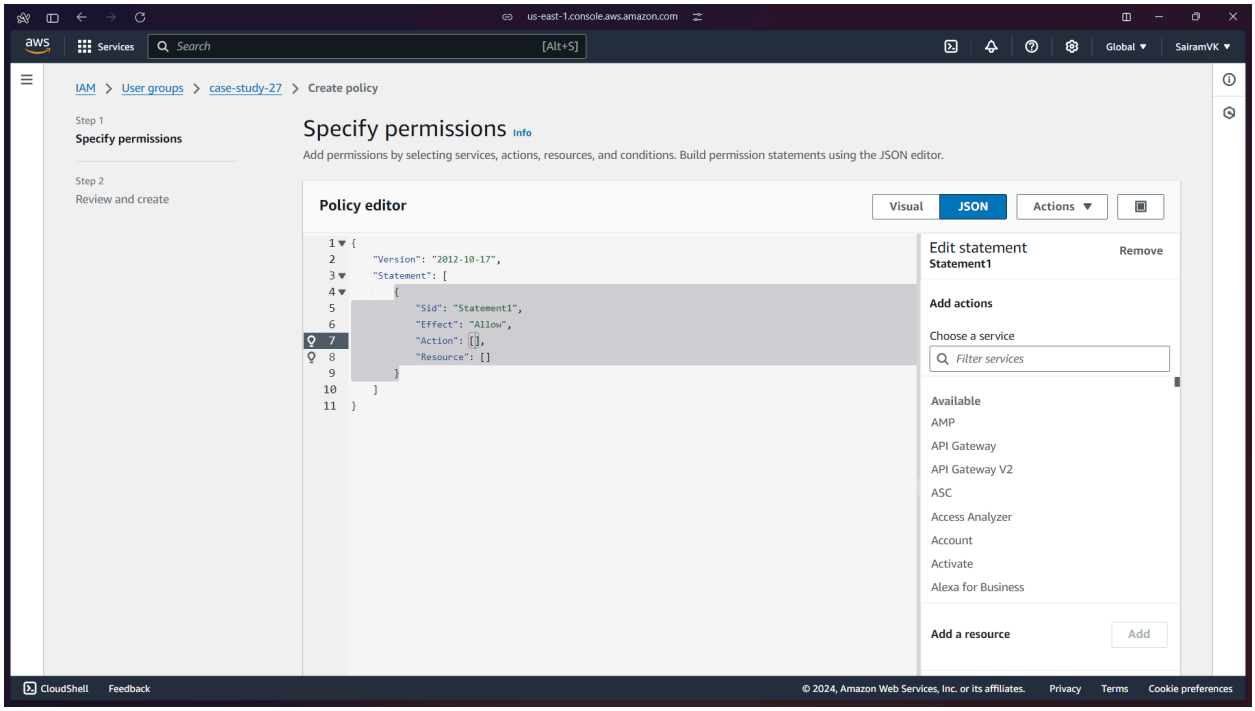
1) Click on the name of the group. Then, navgate to the Permissions tab.



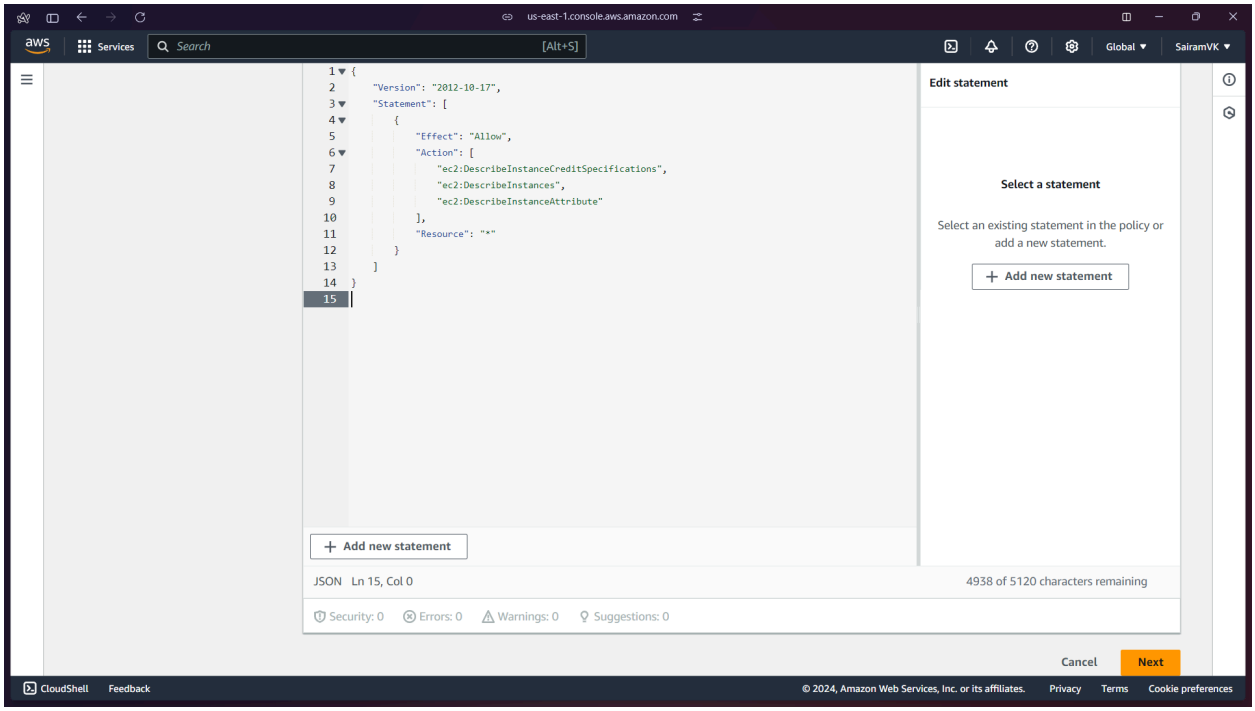
2) Here, click on the Add Permissions dropdown and click on Create Inline Policy



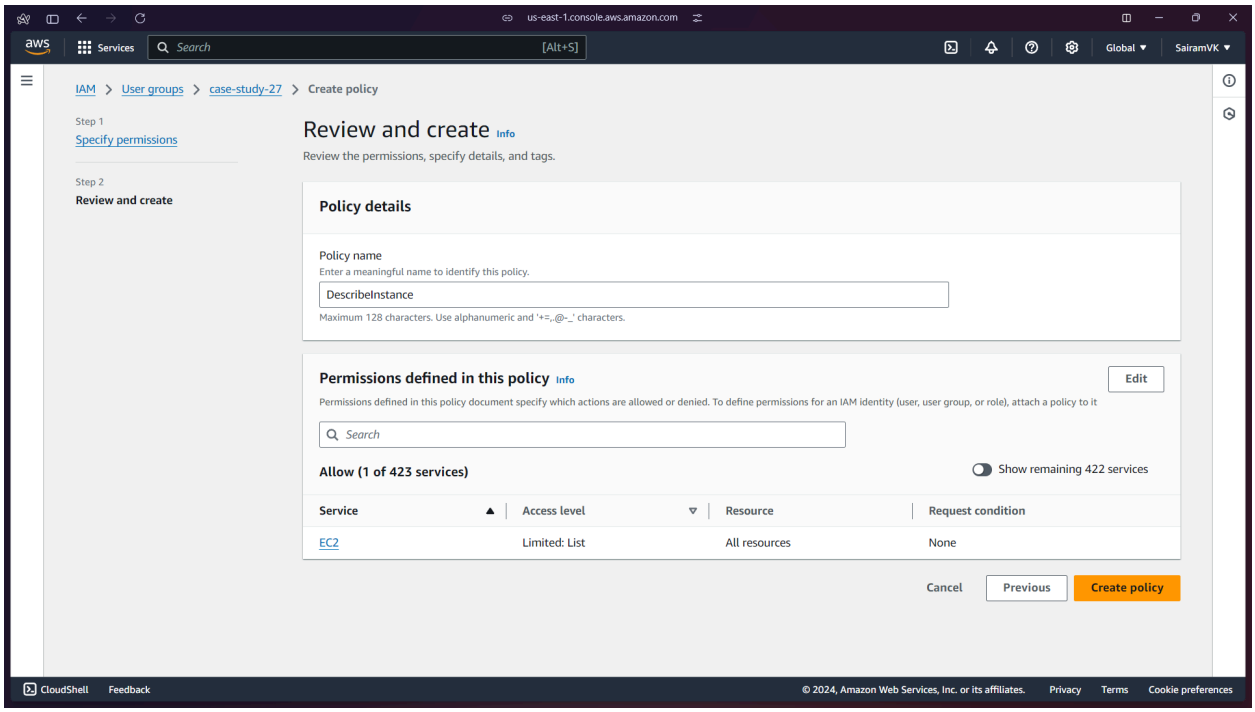
3) Switch to the JSON editor and replace the old code with the codes provided above.



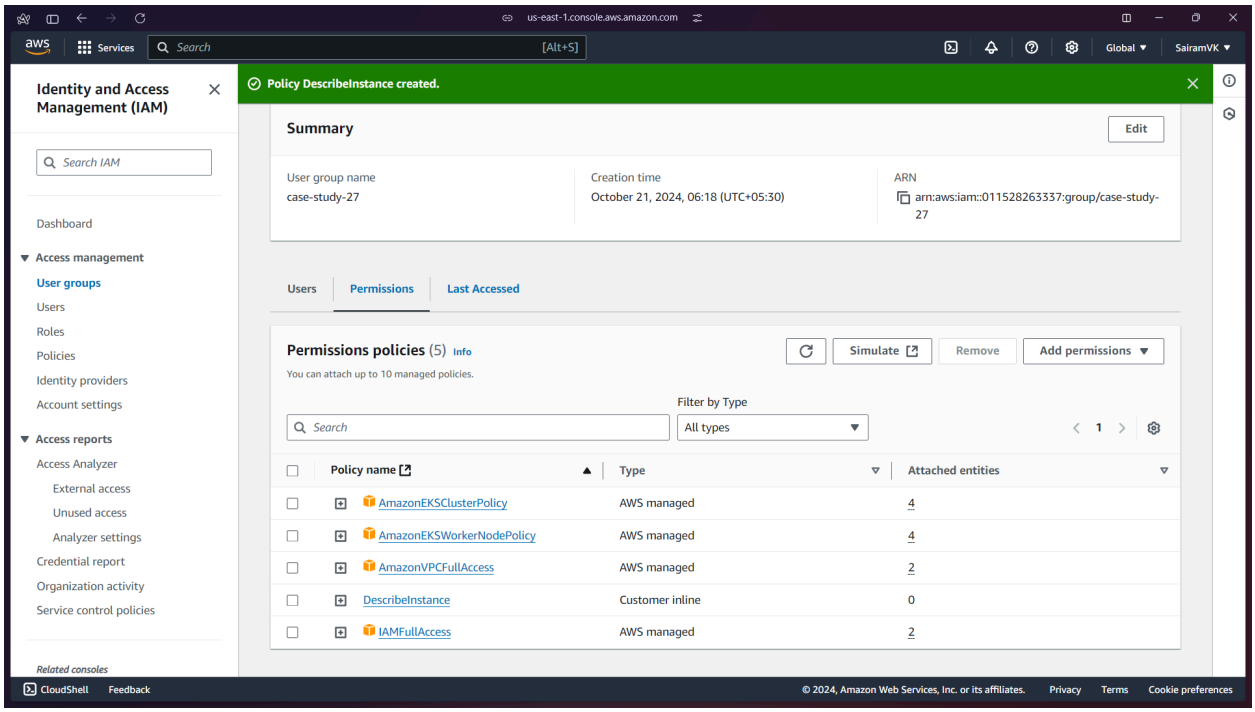
4) After pasting our code, click on Next.



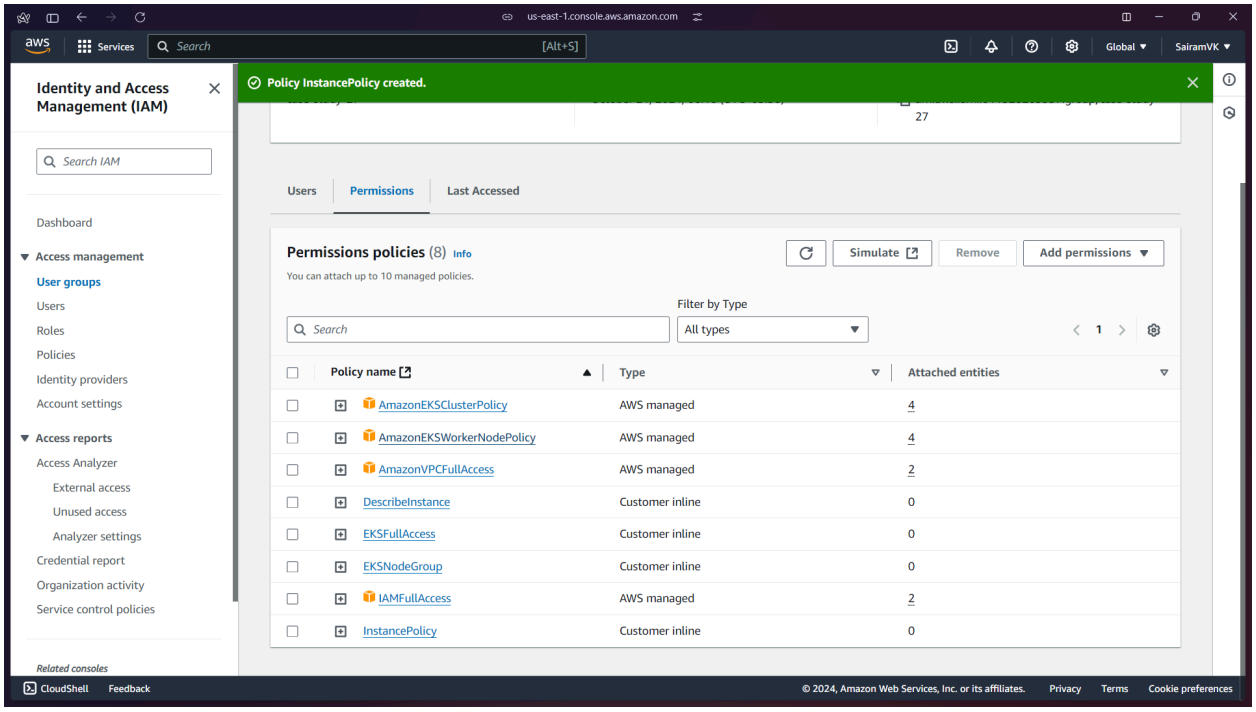
5) Give a name to your policy and click on Create Policy.



6) This adds the DescribeInstance policy as a permission. Repeat the same steps for the remaining 3 Customer Managed Policies.

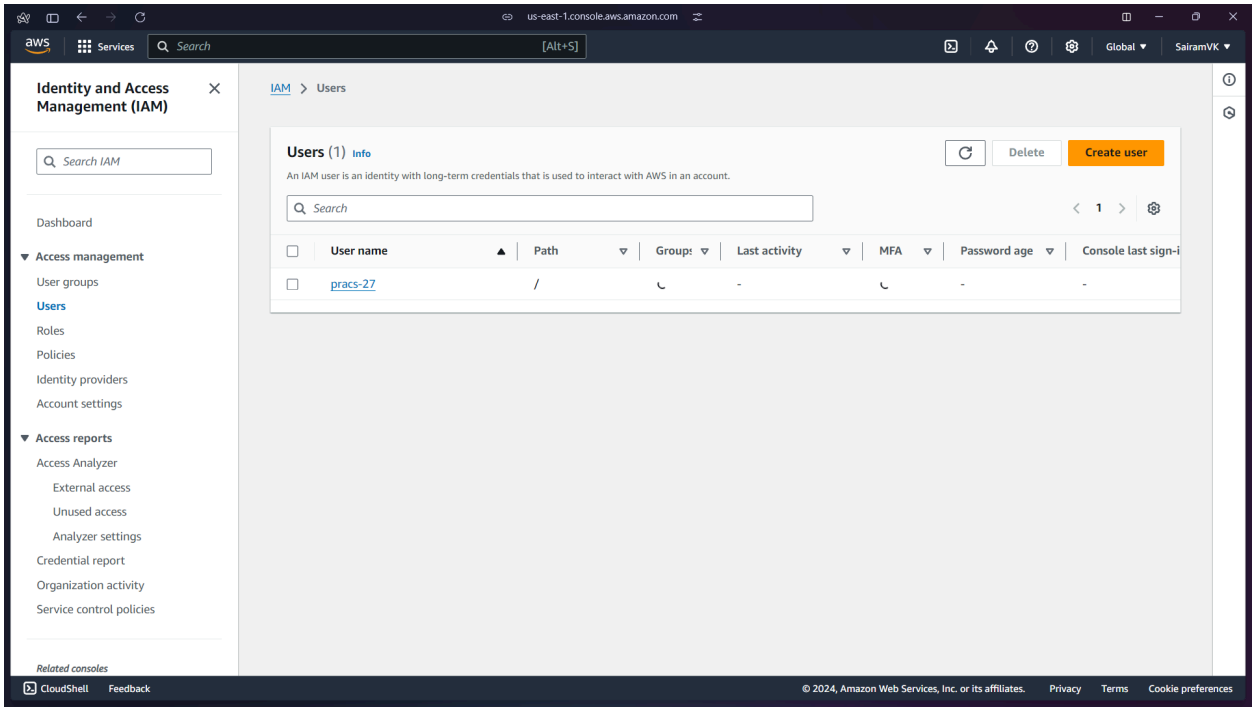


All the policies are added to the user group.

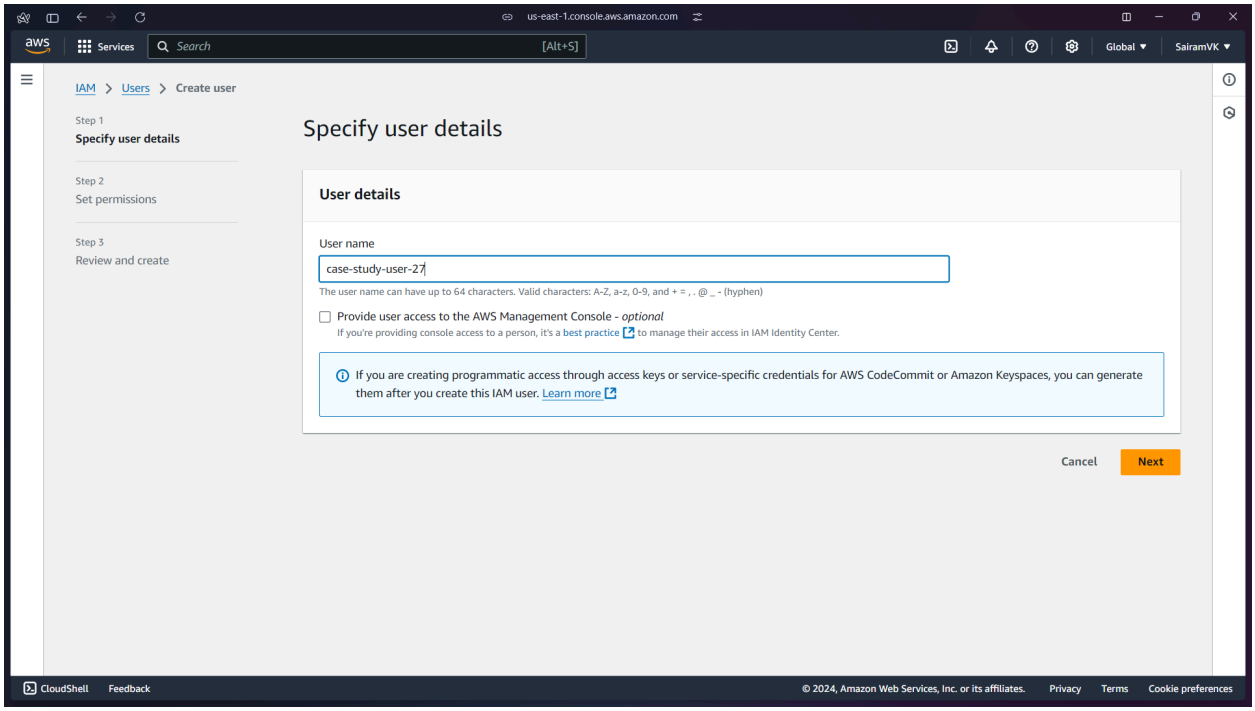


Step 2:
Add a user to this user group

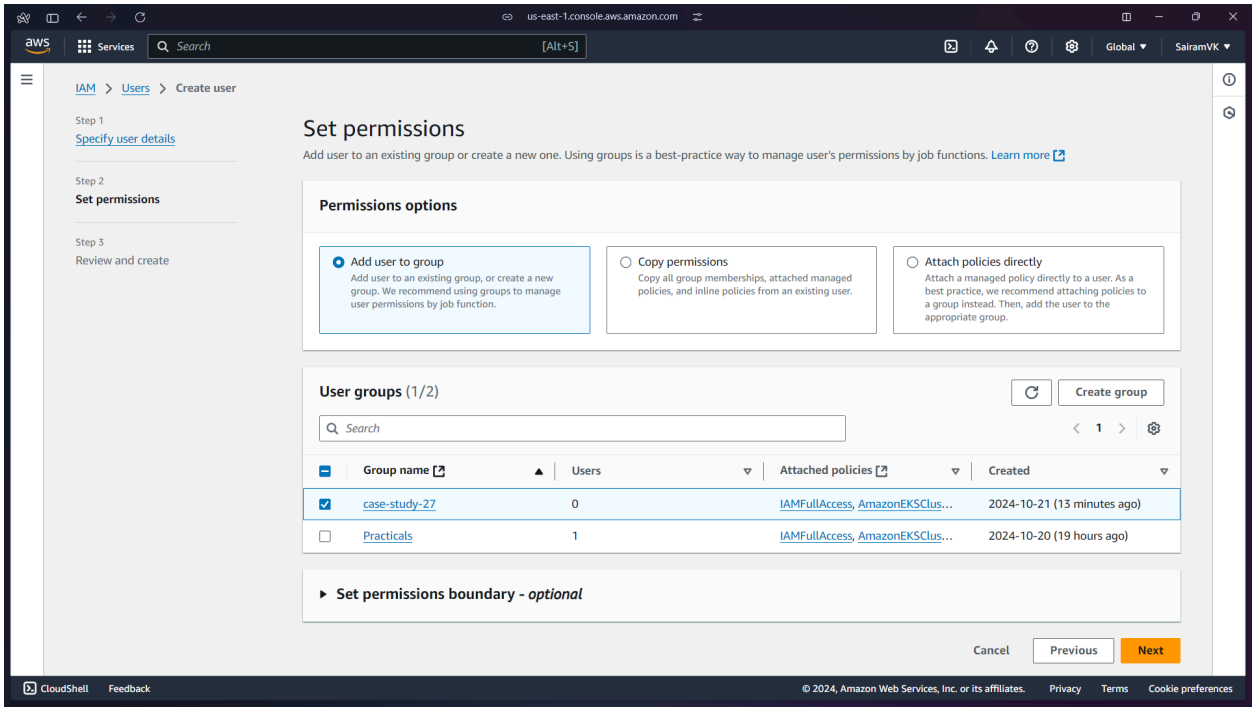
1. Go to users form the left navigation pane.



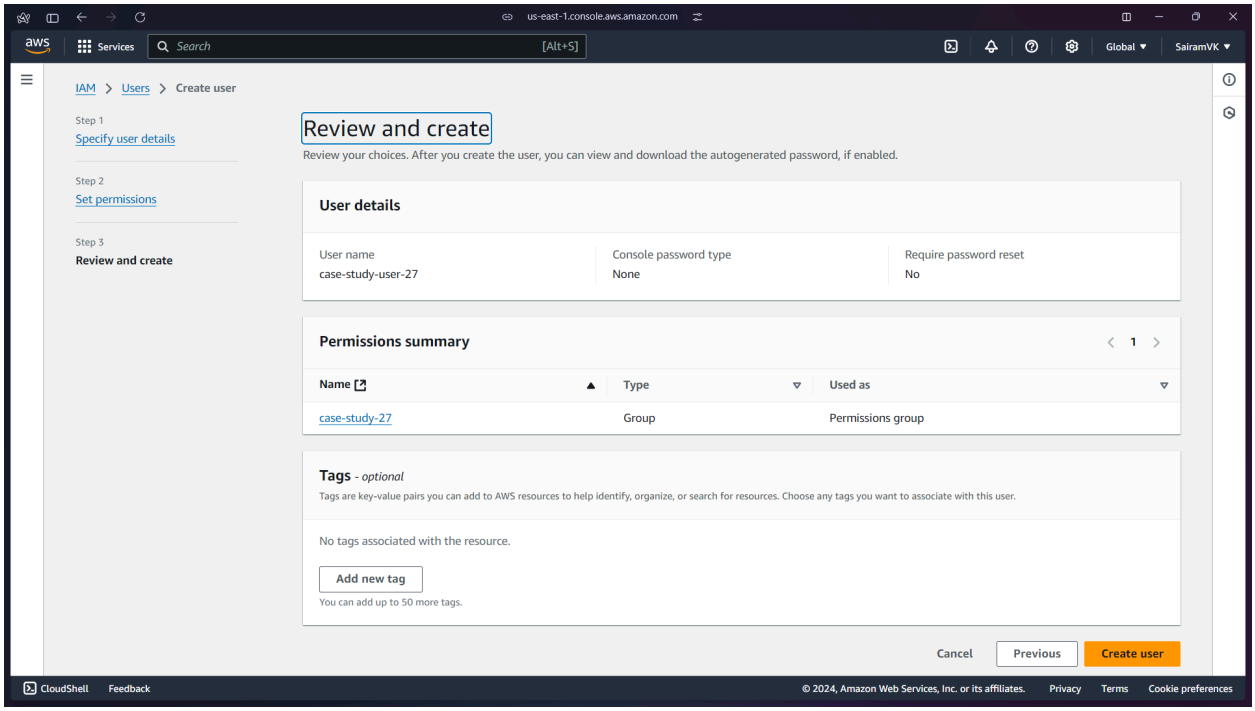
2. Click on Create User. Give a name to your user and click Next.



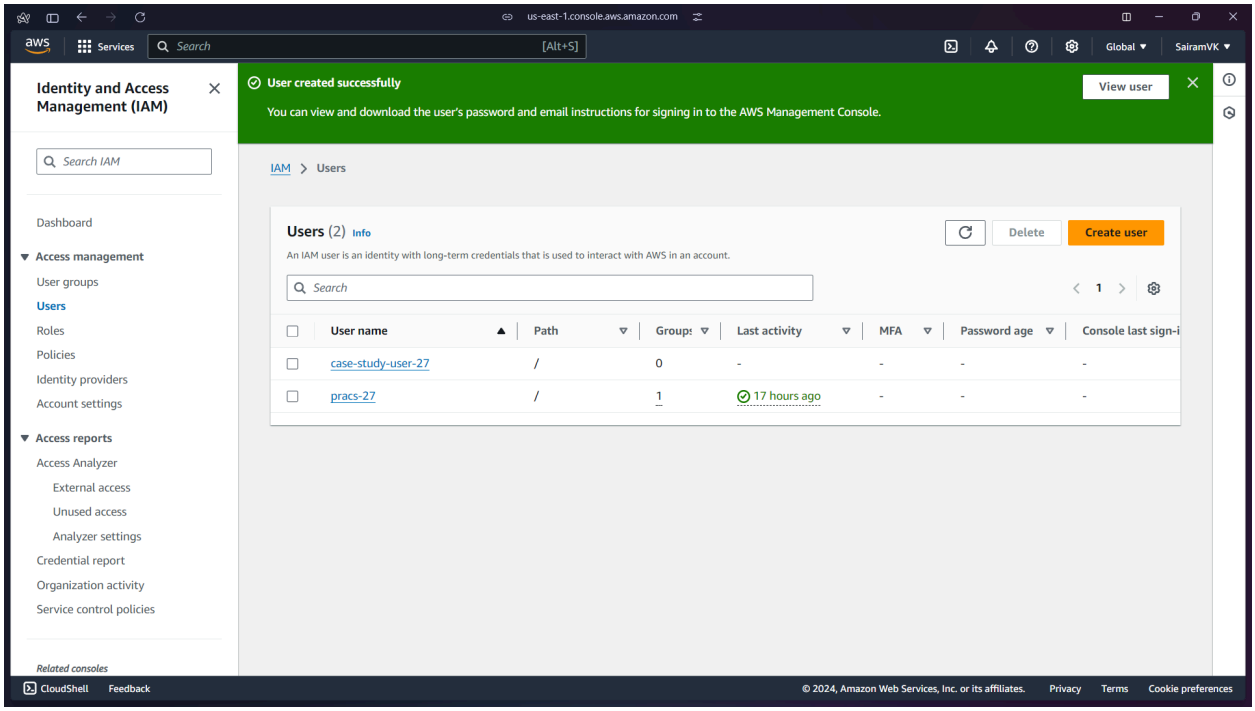
3. To set the permissions, keep the option on Add User to Group and select the group we just created. Then click on Next.



4. Click on Create User.

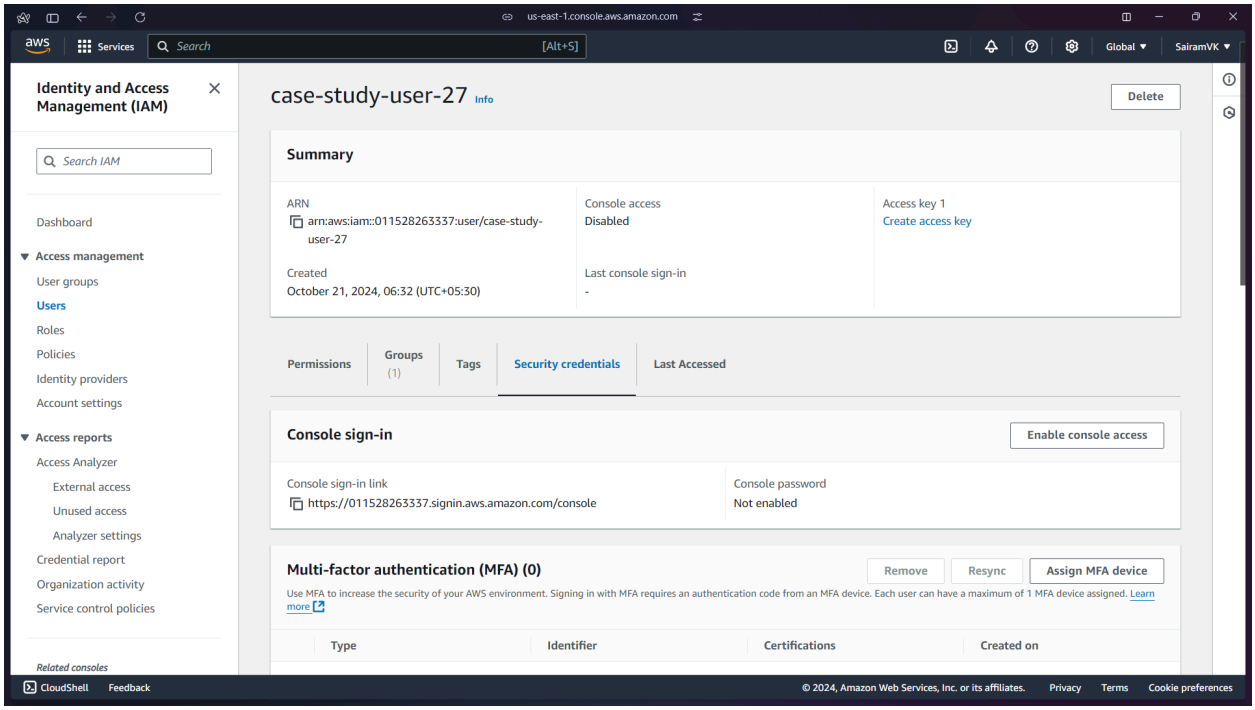


5. The user has been created successfully.

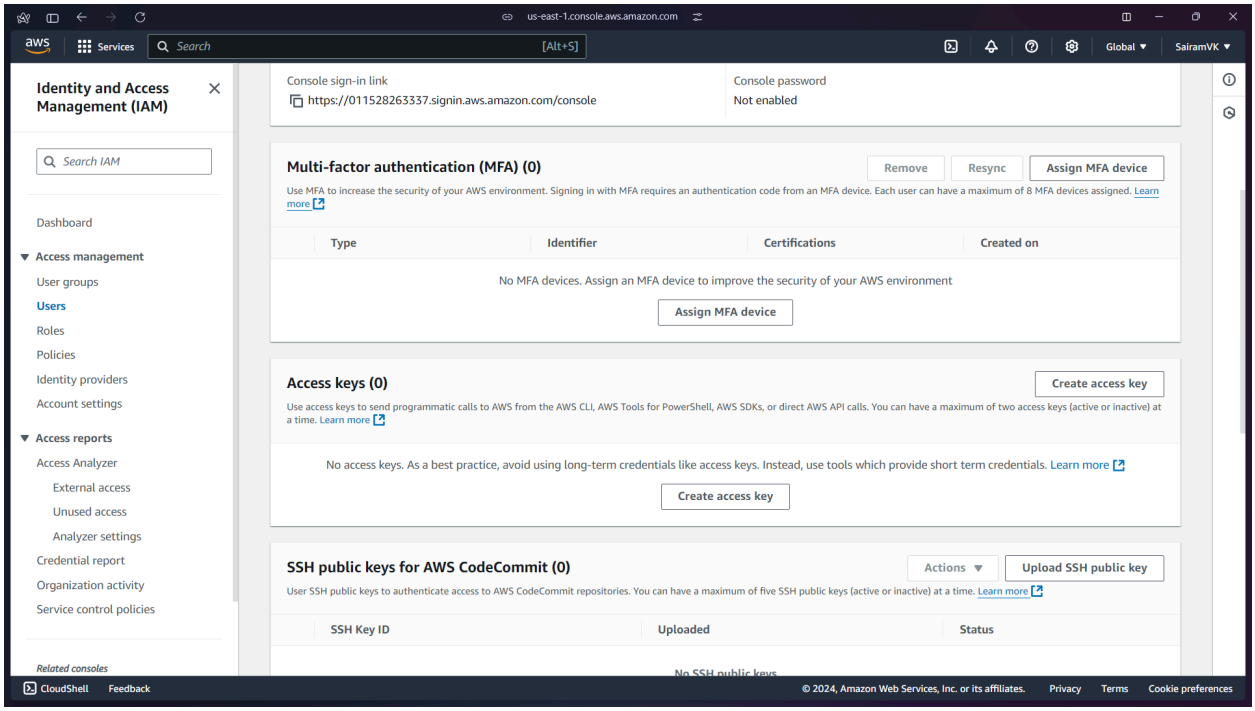


Step 3:
Generate access key (Normal and Secret) for the user.

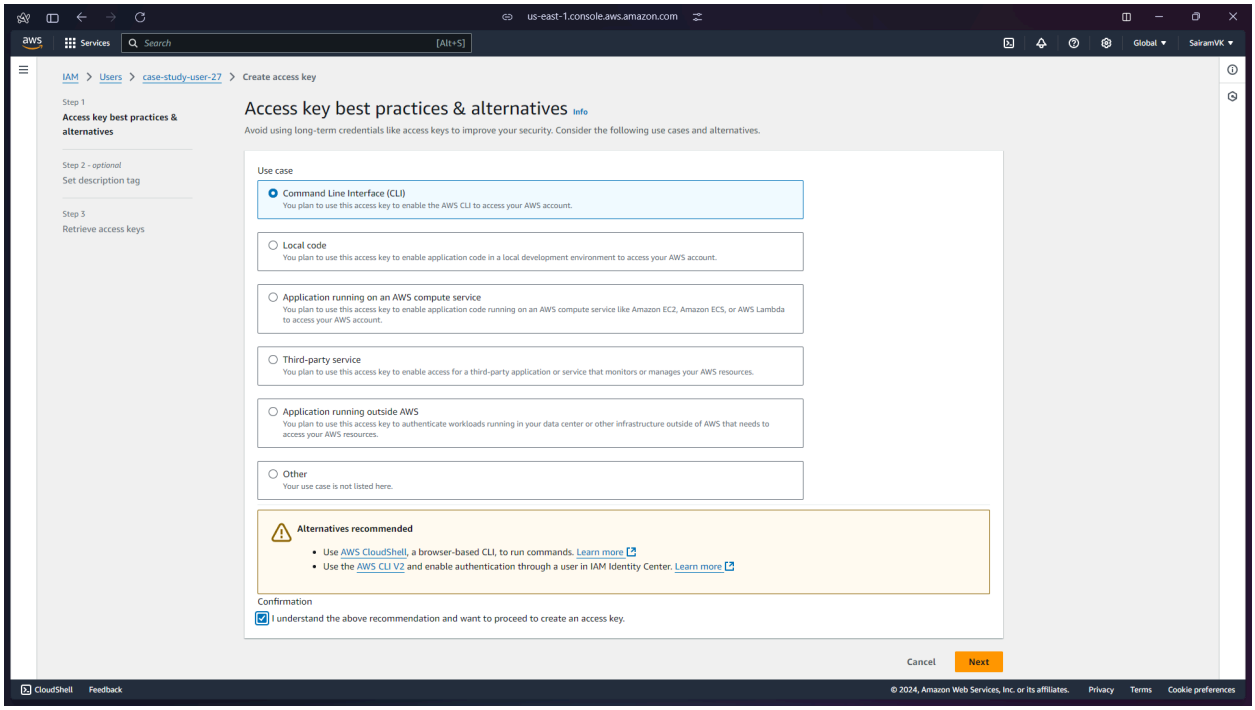
1) Click on the name of the user just created. Here, go to Security Credentials.



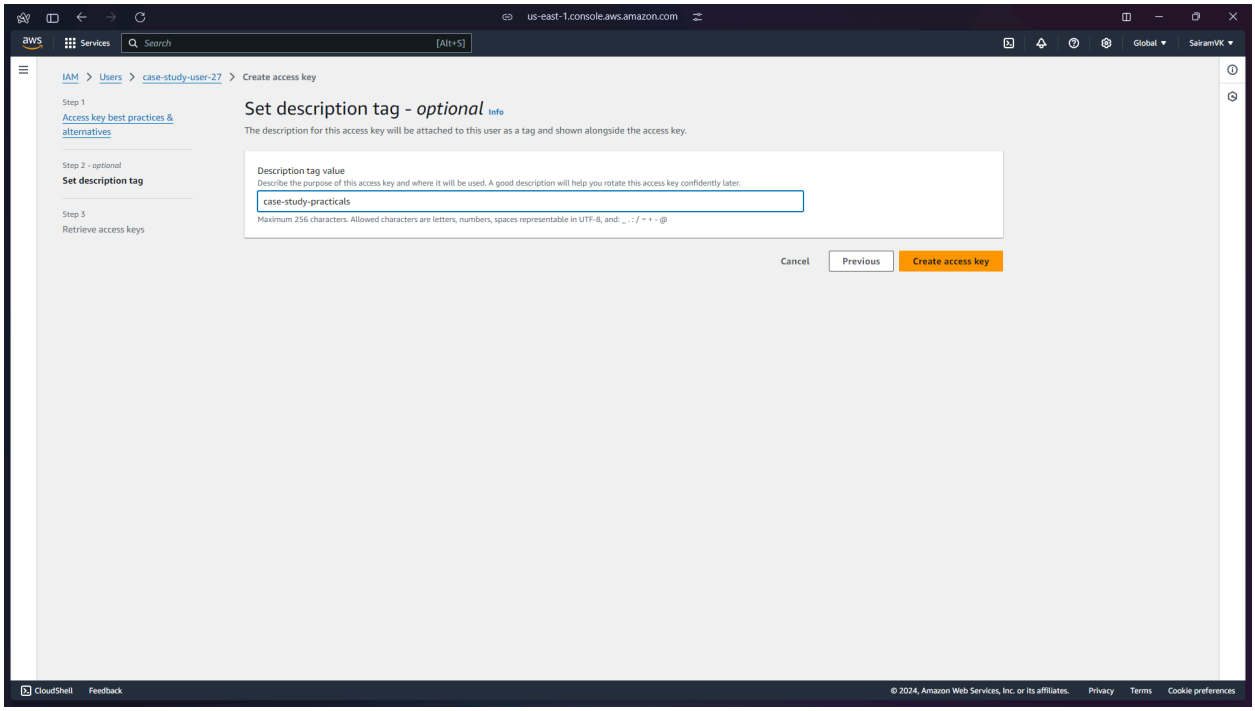
2) Scroll down to the Access Keys and click on select Access Key.



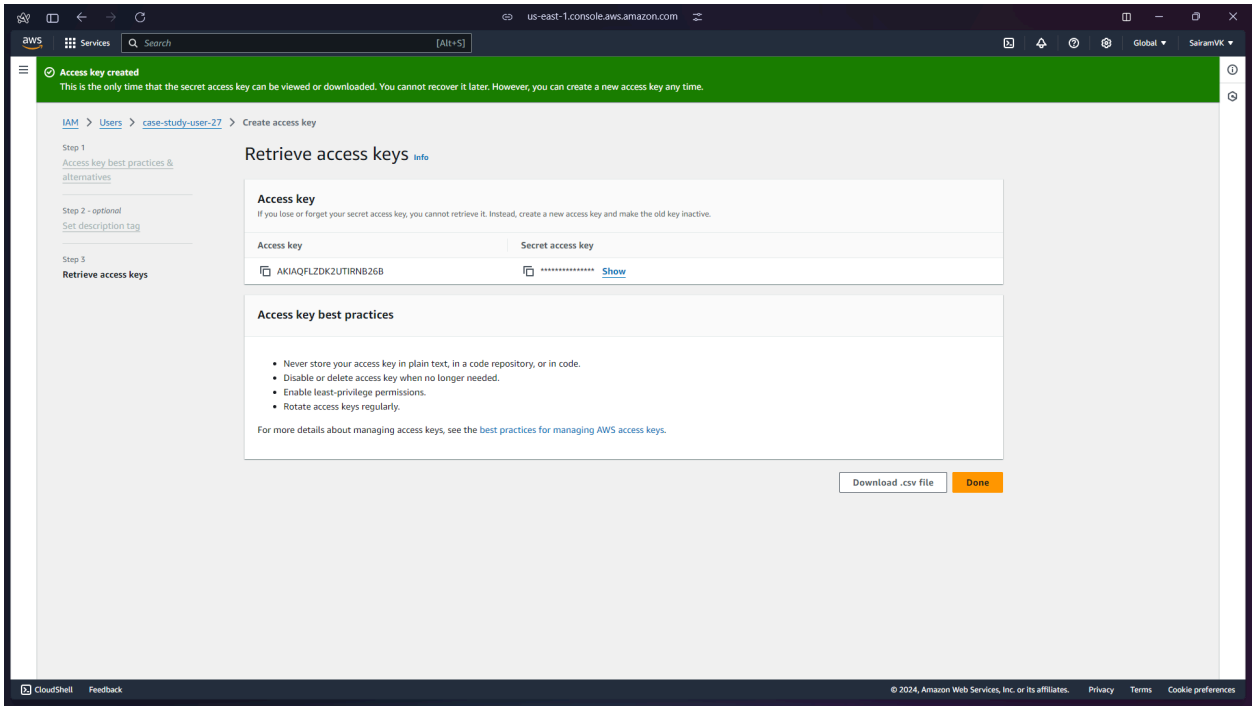
3) Select Command Line Interface (CLI) as use case, check the confirmation and click on next.



4) Give a description to your access key.

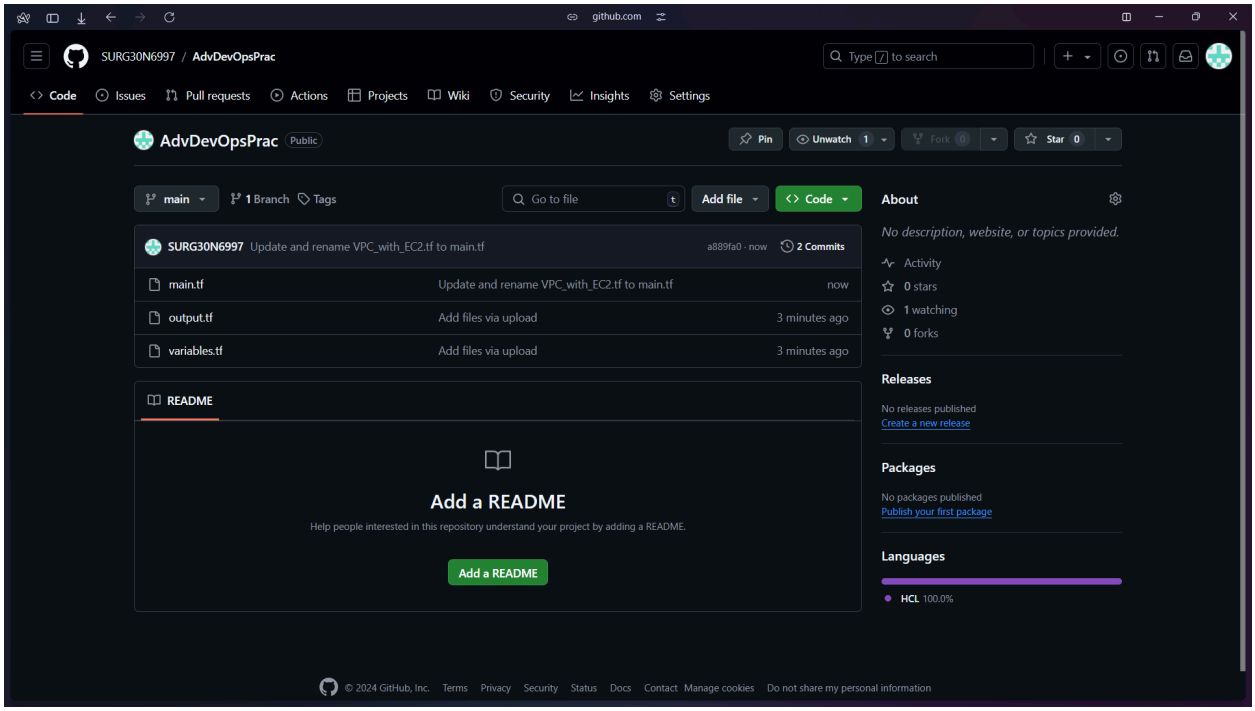


5) This has created you access key pair. Now, download it as a .csv file to use it later. Then click on done.

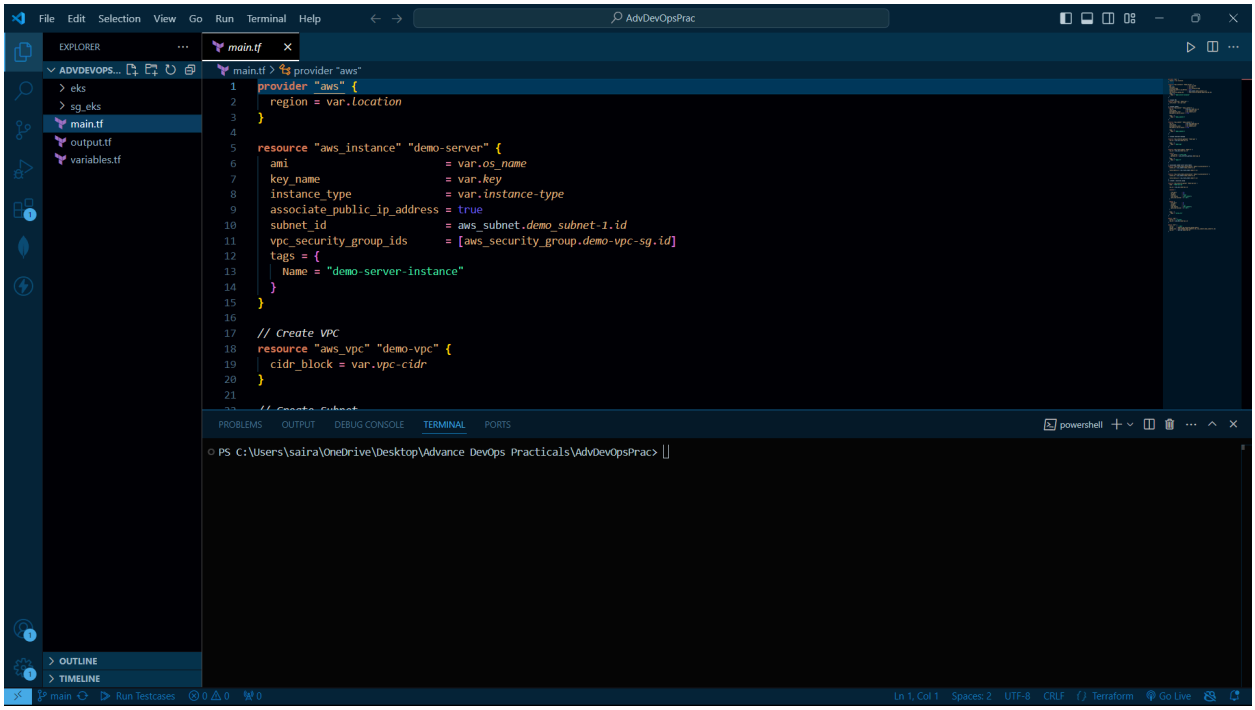


Step 4:
Set up a terraform script for creating a Kubernetes cluster on AWS (Elastic Kubernetes Cluster)

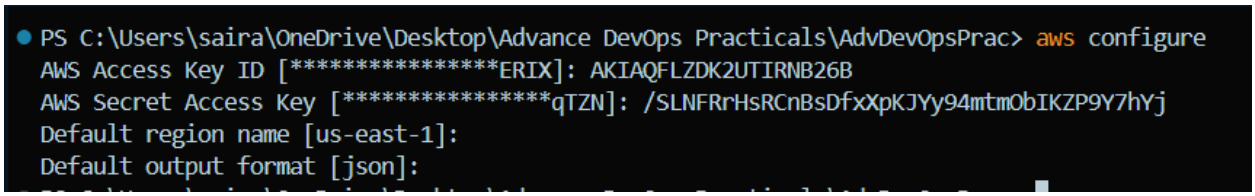
1) Visit the following github link. Here, you will find the required files for the scripts.



2) Clone the github.



3) First, we will setup our IAM user on this script. For that, run the command **aws configure**



Here, paste the Access Key ID and Secret Access Key ID from the .csv file.
If for region name and output format, it shows default, give input as us-east-1 (or your region) and output as json.

4) Now the user is configured. We need to run the terraform scripts. For this, first run **terraform init**

```
Default output format [json]:
PS C:\Users\saira\OneDrive\Desktop\Advance DevOps Practicals\AdvDevOpsPrac> terraform init
Initializing the backend...
Initializing modules...
- eks in eks
- sgs in sg_eks
Initializing provider plugins...
- Finding latest version of hashicorp/aws...
- Installing hashicorp/aws v5.72.1...
- Installed hashicorp/aws v5.72.1 (signed by HashiCorp)
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.
PS C:\Users\saira\OneDrive\Desktop\Advance DevOps Practicals\AdvDevOpsPrac>
```

This command will create a .terraform and .terraform.lock.hcl

5) Now run command
terraform plan

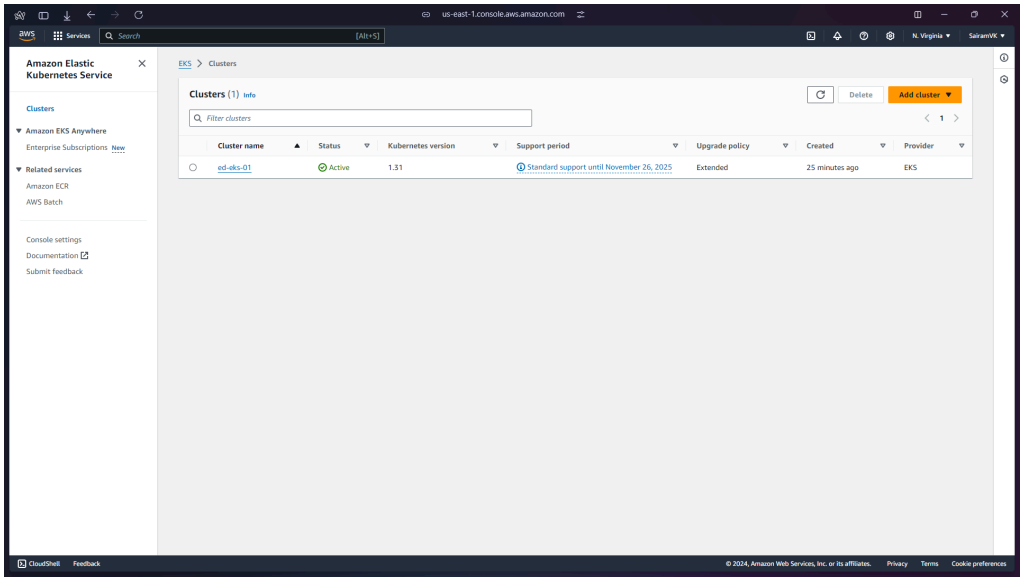
```
PS C:\Users\saira\OneDrive\Desktop\Advance DevOps Practicals\AdvDevOpsPrac> terraform plan

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:
```

```
        },
      ]
    + name                   = "eks-test"
    + name_prefix            = (known after apply)
    + owner_id               = (known after apply)
    + revoke_rules_on_delete = false
    + tags_all               = (known after apply)
    + vpc_id                 = (known after apply)
  }

Plan: 26 to add, 0 to change, 0 to destroy.

Changes to Outputs:
  + private_ip_of_demo_server = (known after apply)
  + public_ip_of_demo_server  = (known after apply)

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.
PS C:\Users\saira\OneDrive\Desktop\Advance DevOps Practicals\AdvDevOpsPrac>
```

6) Now, run command
terraform apply

```
  Enter a value: yes

module.eks.aws_iam_instance_profile.worker: Creating...
module.eks.aws_iam_instance_profile.worker: Creation complete after 2s [id=ed-eks-worker-new-profile]

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

Outputs:

private_ip_of_demo_server = "10.10.4.203"
public_ip_of_demo_server = "54.88.108.201"
```

7) Now if we visit the Elastic Kubernetes Service (EKS) on AWS console, we can see our EKS created.



Step 5:
Use AWS Cloud9 to configure kubectl for the newly created cluster.

As the Cloud9 service is no longer running on AWS, we would be using the EC2 instance created and use SSH to open it on our local terminal.

1) From the above script, an EC2 instance of the name ‘demo-server-instance’ will be created. Click on the name, then on connect and then SSH client.

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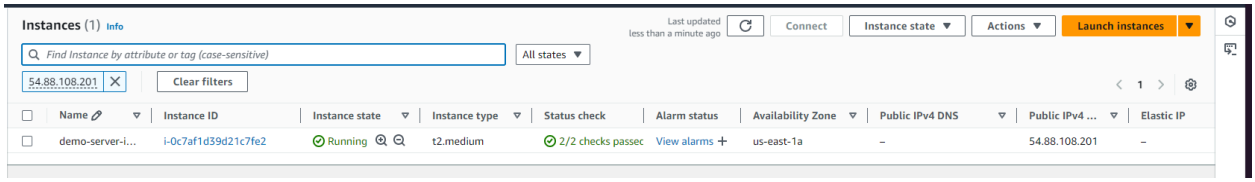
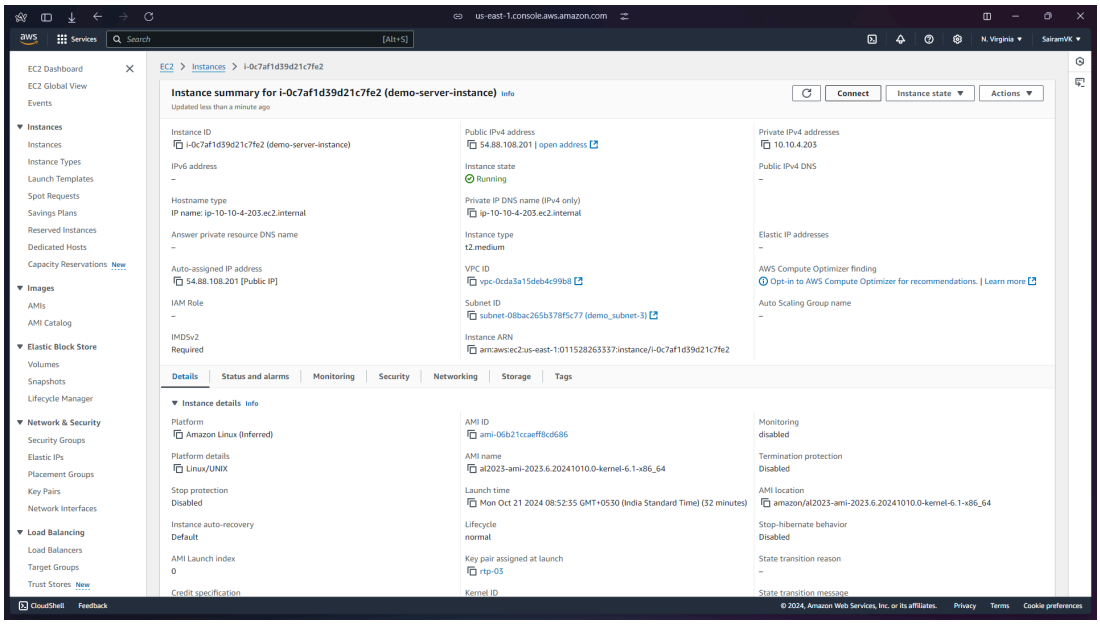
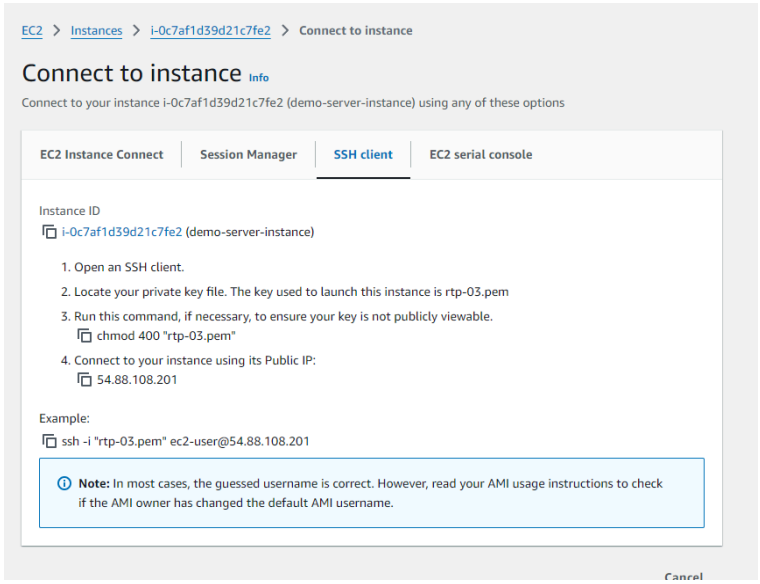






2) Use the ssh command to connect to terminal.

```
C:\Users\saira\OneDrive\Desktop\Advance DevOps Practicals>icacls "C:\Users\saira\OneDrive\Desktop\Advance DevOps Practic
als\rtp-04.pem" /grant "%USERNAME%:F"
processed file: C:\Users\saira\OneDrive\Desktop\Advance DevOps Practicals\rtp-04.pem
Successfully processed 1 files; Failed processing 0 files

C:\Users\saira\OneDrive\Desktop\Advance DevOps Practicals>ssh -i "rtp-04.pem" ec2-user@34.207.181.155
   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
[ec2-user@ip-10-10-4-5 ~]$
```

3) First, update the services on your terminal/instance.
sudo yum update -y
sudo yum install aws-cli

```
[ec2-user@ip-10-10-4-5 ~]$ sudo yum update -y  # If using Amazon Linux
Last metadata expiration check: 0:16:33 ago on Mon Oct 21 04:02:25 2024.
Dependencies resolved.
Nothing to do.
Complete!
[ec2-user@ip-10-10-4-5 ~]$ sudo yum install aws-cli
Last metadata expiration check: 0:16:48 ago on Mon Oct 21 04:02:25 2024.
Package awscli-2-2.15.30-1.amzn2023.0.1.noarch is already installed.
Dependencies resolved.
Nothing to do.
Complete!
[ec2-user@ip-10-10-4-5 ~]$
```

4) Install docker
sudo yum install docker -y

```
[ec2-user@ip-10-10-4-5 ~]$ sudo yum install docker -y
Last metadata expiration check: 0:29:05 ago on Mon Oct 21 04:02:25 2024.
Dependencies resolved.
================================================================================
 Package                 Architecture  Version                    Repository      Size
================================================================================
Installing:
 docker                  x86_64        25.0.6-1.amzn2023.0.2      amazonlinux     44 M
Installing dependencies:
 containerd              x86_64        1.7.22-1.amzn2023.0.2      amazonlinux     36 M
 iptables-libs           x86_64        1.8.8-3.amzn2023.0.2       amazonlinux    401 k
 iptables-nft            x86_64        1.8.8-3.amzn2023.0.2       amazonlinux    183 k
 libcgroup               x86_64        3.0-1.amzn2023.0.1         amazonlinux     75 k
 libnetfilter_conntrack  x86_64        1.0.8-2.amzn2023.0.2       amazonlinux     58 k
 libnfnetlink            x86_64        1.0.1-19.amzn2023.0.2      amazonlinux     30 k
 libnftnl                x86_64        1.2.2-2.amzn2023.0.2       amazonlinux     84 k
 pigz                    x86_64        2.5-1.amzn2023.0.3         amazonlinux     83 k
 runc                    x86_64        1.1.14-1.amzn2023.0.1      amazonlinux    3.2 M

Installed:
  containerd-1.7.22-1.amzn2023.0.2.x86_64
  docker-25.0.6-1.amzn2023.0.2.x86_64
  iptables-libs-1.8.8-3.amzn2023.0.2.x86_64
  iptables-nft-1.8.8-3.amzn2023.0.2.x86_64
  libcgroup-3.0-1.amzn2023.0.1.x86_64
  libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64
  libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64
  libnftnl-1.2.2-2.amzn2023.0.2.x86_64
  pigz-2.5-1.amzn2023.0.3.x86_64
  runc-1.1.14-1.amzn2023.0.1.x86_64

Complete!
[ec2-user@ip-10-10-4-5 ~]$
```

5) Start the docker service.
sudo service docker start

```
[ec2-user@ip-10-10-4-5 ~]$ sudo service docker start
Redirecting to /bin/systemctl start docker.service
[ec2-user@ip-10-10-4-5 ~]$
```

6) Add the user to the docker group
sudo usermod -a -G docker ec2-user

```
[ec2-user@ip-10-10-4-5 ~]$ sudo usermod -a -G docker ec2-user
[ec2-user@ip-10-10-4-5 ~]$
```

7) Use the **exit** command to logout of the ssh terminal. Use ssh again to relogin.

```
[ec2-user@ip-10-10-4-5 ~]$ exit
logout
Connection to 34.207.181.155 closed.

C:\Users\saira\OneDrive\Desktop\Advance DevOps Practicals>ssh -i "rtp-04.pem" ec2-user@34.207.181.155
   '     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
Last login: Mon Oct 21 04:17:36 2024 from 125.99.93.18
[ec2-user@ip-10-10-4-5 ~]$
```

8) Install kubectl
- **VERSION=$(curl -s https://storage.googleapis.com/kubernetes-release/release/stable.txt)**
- **curl -LO "https://storage.googleapis.com/kubernetes-release/release/$VERSION/bin/linux/amd64/kubectl"**
- **chmod +x ./kubectl**
- **sudo mv ./kubectl /usr/local/bin/kubectl**

```
[ec2-user@ip-10-10-4-5 ~]$ VERSION=$(curl -s https://storage.googleapis.com/kubernetes-release/release/stable.txt)
[ec2-user@ip-10-10-4-5 ~]$ curl -LO "https://storage.googleapis.com/kubernetes-release/release/$VERSION/bin/linux/amd64/
kubectl"
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100 53.7M  100 53.7M    0     0  85.9M      0 --:--:-- --:--:-- --:--:-- 86.0M
[ec2-user@ip-10-10-4-5 ~]$ chmod +x ./kubectl
[ec2-user@ip-10-10-4-5 ~]$ sudo mv ./kubectl /usr/local/bin/kubectl
```

9) Verify the kubectl installation by using the command
kubectl version --client

```
[ec2-user@ip-10-10-4-5 ~]$ VERSION=$(curl -s https://storage.googleapis.com/kubernetes-release/release/stable.txt)
[ec2-user@ip-10-10-4-5 ~]$ curl -LO "https://storage.googleapis.com/kubernetes-release/release/$VERSION/bin/linux/amd64/
kubectl"
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100 53.7M  100 53.7M    0     0  85.9M      0 --:--:-- --:--:-- --:--:-- 86.0M
[ec2-user@ip-10-10-4-5 ~]$ chmod +x ./kubectl
[ec2-user@ip-10-10-4-5 ~]$ sudo mv ./kubectl /usr/local/bin/kubectl
```

10) Next, configure the IAM credentials of the user taht we had created before
aws configure

```
[ec2-user@ip-10-10-4-5 ~]$ aws configure
AWS Access Key ID [None]: AKIAQFLZDK2UTIRNB26B
AWS Secret Access Key [None]: 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
Default region name [None]: us-east-1
Default output format [None]: json
[ec2-user@ip-10-10-4-5 ~]$
```

11) Now, we need to get the eks cluster and ink to this kubectl, for that, use the following command
aws eks update-kubeconfig --region us-east-1 --name ed-eks-01

```
[ec2-user@ip-10-10-4-5 ~]$ aws eks update-kubeconfig --region us-east-1 --name ed-eks-01
Added new context arn:aws:eks:us-east-1:011528263337:cluster/ed-eks-01 to /home/ec2-user/.kube/config
[ec2-user@ip-10-10-4-5 ~]$
```

12) Use the following command to verify the kubeconfig setup
kubectl get svc

```
[ec2-user@ip-10-10-4-5 ~]$ kubectl get svc
NAME         TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
kubernetes   ClusterIP   172.20.0.1   <none>        443/TCP   58m
[ec2-user@ip-10-10-4-5 ~]$
```

Step 6:
Create and deploy a simple flask application on this cluster

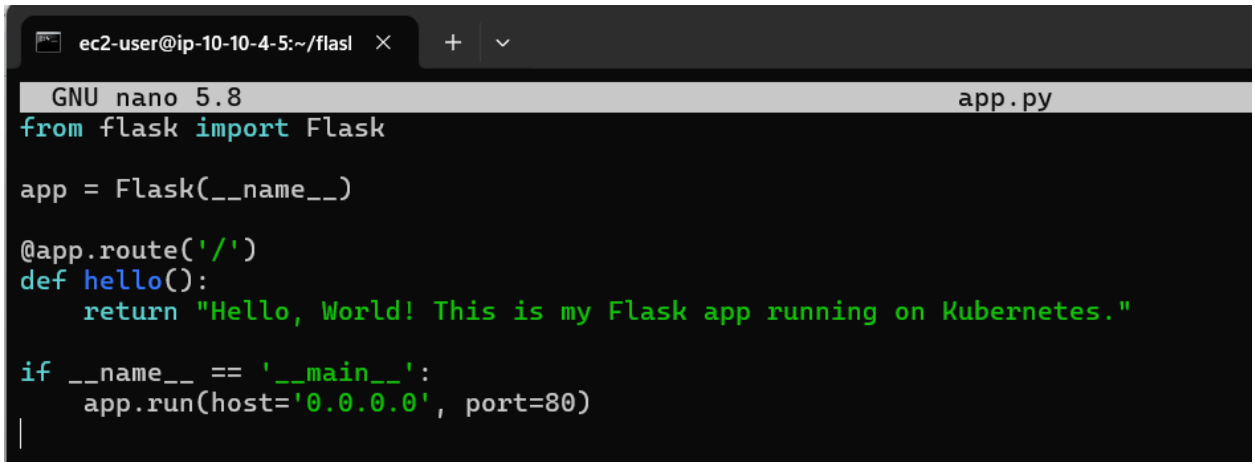
1) On this terminal, create a folder for the flask app and navigate to it
mkdir flask-app
cd flask-app

```
[ec2-user@ip-10-10-4-5 ~]$ mkdir flask-app
[ec2-user@ip-10-10-4-5 ~]$ cd flask-app
[ec2-user@ip-10-10-4-5 flask-app]$
```

2) We need to create a app.py file to make the flask application. Use
nano app.py
to create the file and paste the following code.

```
from flask import Flask

app = Flask(__name__)

@app.route('/')
def hello():
    return "Hello, World! This is my Flask app running on Kubernetes."

if __name__ == '__main__':
    app.run(host='0.0.0.0', port=80)
```

Save the file.

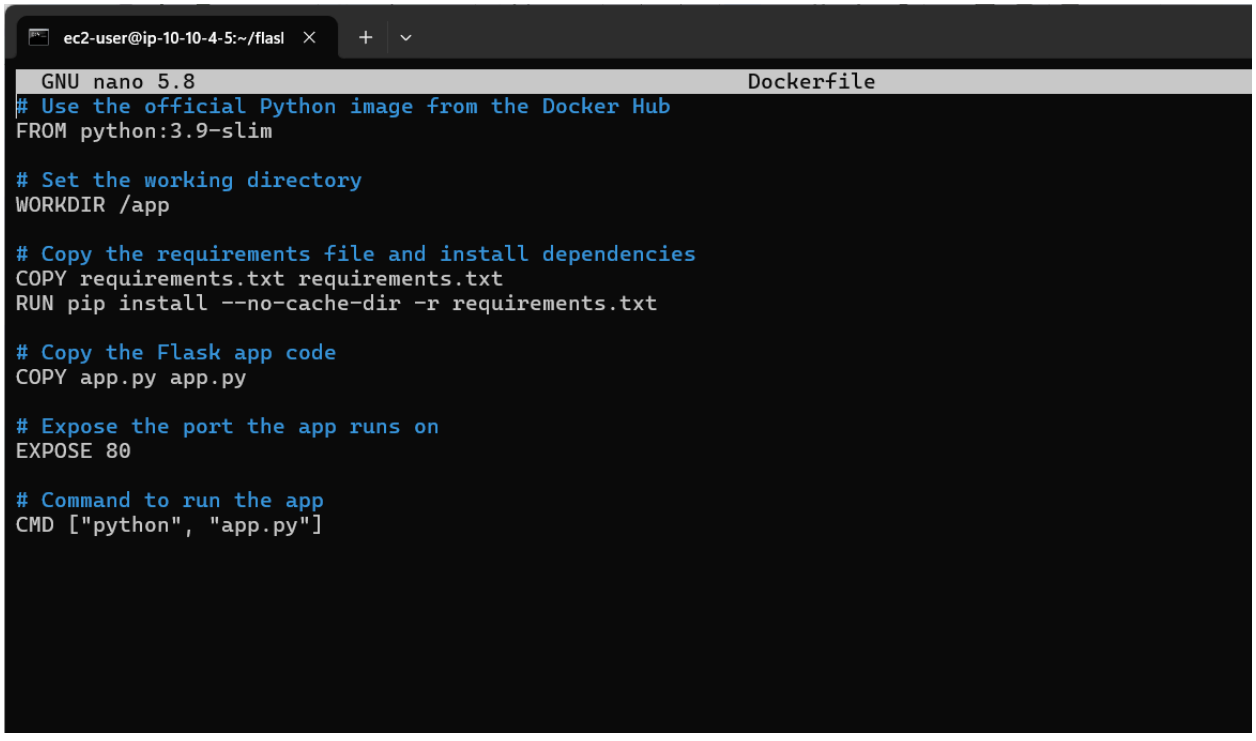


3) Now, a requirements.txt file is required to let docker know which modules are required. Use
nano requirements.txt
to create this file and add the following text.

```
Flask==2.2.2
Werkzeug==2.2.2
```

4) Now, create a Dockerfile that would guide docker on how to run the commands and in what order.
nano Dockerfile
Paste the following code

```
# Use the official Python image from the Docker Hub
FROM python:3.9-slim

# Set the working directory
WORKDIR /app

# Copy the requirements file and install dependencies
COPY requirements.txt requirements.txt
RUN pip install --no-cache-dir -r requirements.txt

# Copy the Flask app code
COPY app.py app.py

# Expose the port the app runs on
EXPOSE 80

# Command to run the app
CMD ["python", "app.py"]
```



5) Build the Docker Image
docker build -t flask-app:latest .

```
[ec2-user@ip-10-10-4-5 flask-app]$ docker build -t flask-app:latest .
[+] Building 8.5s (10/10) FINISHED                                                                                  docker:default
 => [internal] load build definition from Dockerfile                                                                          0.0s
 => => transferring dockerfile: 500B                                                                                          0.0s
 => [internal] load metadata for docker.io/library/python:3.9-slim                                                            0.3s
 => [internal] load .dockerignore                                                                                             0.0s
 => => transferring context: 2B                                                                                               0.0s
 => [1/5] FROM docker.io/library/python:3.9-slim@sha256:7a9cd42706c174cdcf578880ab9ae3b6551323a7ddbc2a89ad6e5b20a             4.1s
 => => resolve docker.io/library/python:3.9-slim@sha256:7a9cd42706c174cdcf578880ab9ae3b6551323a7ddbc2a89ad6e5b20a             0.0s
 => => sha256:7a9cd42706c174cdcf578880ab9ae3b6551323a7ddbc2a89ad6e5b20a28fbfbe 10.41kB / 10.41kB                              0.0s
 => => sha256:e9cf9c2f8005322389697706769696b30e2b270f36289aefbc4d807406d8d198f 1.75kB / 1.75kB                               0.0s
 => => sha256:b9b3c02da6c33a199501e9e4cf8da859d8065718b084ce9ee333e12cfc3b4482 5.43kB / 5.43kB                                0.0s
 => => sha256:a480a496ba95a197d587aa1d9e0f545ca7dbd40495a4715342228db62b67c4ba 29.13MB / 29.13MB                              0.8s
 => => sha256:99b8d55c8acd10aa3901ad6f43d5998b882c1f4acaca51f005625b23893f0367 3.51MB / 3.51MB                                0.2s
 => => sha256:151089ffef3f9093a349049321fa9a4668c29b122d05224e443c5e996fb60da5 14.92MB / 14.92MB                              0.7s
 => => sha256:277f520eee4a7406e307add15a461fa57bfe184f595671f364066ab24264cb1a 250B / 250B                                    0.3s
 => => extracting sha256:a480a496ba95a197d587aa1d9e0f545ca7dbd40495a4715342228db62b67c4ba                                     1.8s
 => => extracting sha256:99b8d55c8acd10aa3901ad6f43d5998b882c1f4acaca51f005625b23893f0367                                     0.2s
 => => extracting sha256:151089ffef3f9093a349049321fa9a4668c29b122d05224e443c5e996fb60da5                                     1.0s
 => => extracting sha256:277f520eee4a7406e307add15a461fa57bfe184f595671f364066ab24264cb1a                                     0.0s
 => [internal] load build context                                                                                             0.0s
 => => transferring context: 440B                                                                                             0.0s
 => [2/5] WORKDIR /app                                                                                                        0.4s
 => [3/5] COPY requirements.txt requirements.txt                                                                              0.0s
 => [4/5] RUN pip install --no-cache-dir -r requirements.txt                                                                  3.5s
 => [5/5] COPY app.py app.py                                                                                                  0.0s
 => exporting to image                                                                                                        0.2s
 => => exporting layers                                                                                                       0.1s
 => => writing image sha256:1daca11c2c8fb7016423fc9f2ddd6efe87d150a4853f2287e426ba5291bdc613                                  0.0s
 => => naming to docker.io/library/flask-app:latest                                                                           0.0s
[ec2-user@ip-10-10-4-5 flask-app]$
```

6) Use **docker login** to login to your docker account

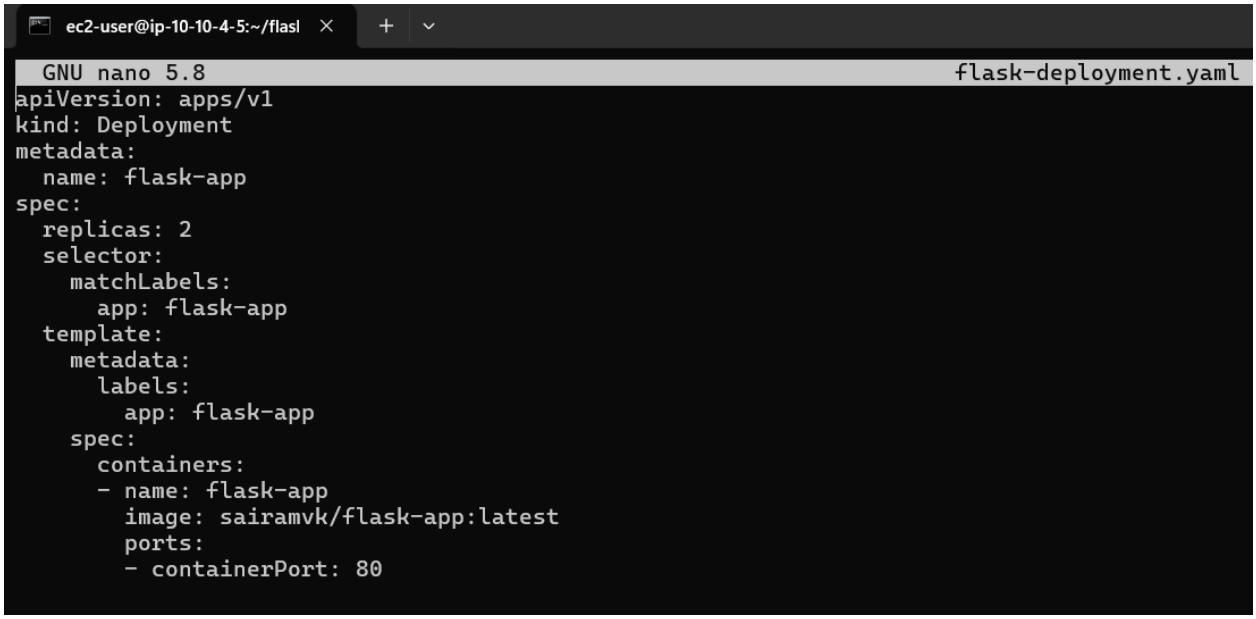
```
[ec2-user@ip-10-10-4-5 flask-app]$ docker login
Log in with your Docker ID or email address to push and pull images from Docker Hub. If you don't have a Docker ID, head over to https://hub.docker.com/ to
create one.
You can log in with your password or a Personal Access Token (PAT). Using a limited-scope PAT grants better security and is required for organizations using
 SSO. Learn more at https://docs.docker.com/go/access-tokens/

Username: sairamvk
Password:
WARNING! Your password will be stored unencrypted in /home/ec2-user/.docker/config.json.
Configure a credential helper to remove this warning. See
https://docs.docker.com/engine/reference/commandline/login/#credentials-store

Login Succeeded
[ec2-user@ip-10-10-4-5 flask-app]$
```

7) Tag the image created and push it.

```
[ec2-user@ip-10-10-4-5 flask-app]$ docker tag flask-app:latest sairamvk/flask-app:latest
[ec2-user@ip-10-10-4-5 flask-app]$ docker push sairamvk/flask-app:latest
The push refers to repository [docker.io/sairamvk/flask-app]
8edf22672b84: Pushed
15b3bb90554b: Pushed
2d36d9d97b39: Pushed
da65f248a99b: Pushed
d86feaf80e98: Layer already exists
19f5accf4683: Layer already exists
0300a07ea341: Layer already exists
98b5f35ea9d3: Layer already exists
latest: digest: sha256:f2e291b655c18c86f7f3e15130226f5544ed1ee181669c1f5518a41dd809eafd size: 1990
[ec2-user@ip-10-10-4-5 flask-app]$
```

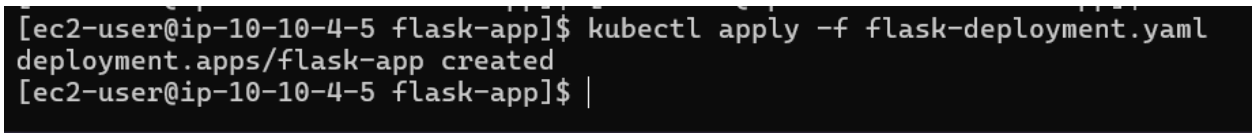
8) Now, deploy the application to kubernetes. Create flask-deployment.yaml file using **nano flask-deployment.yaml** and add the following content.

```
apiVersion: apps/v1
kind: Deployment
metadata:
 name: flask-app
spec:
 replicas: 2
 selector:
  matchLabels:
   app: flask-app
 template:
  metadata:
   labels:
    app: flask-app
  spec:
   containers:
   - name: flask-app
    image: <your-dockerhub-username>/flask-app:latest
    ports:
    - containerPort: 80
```



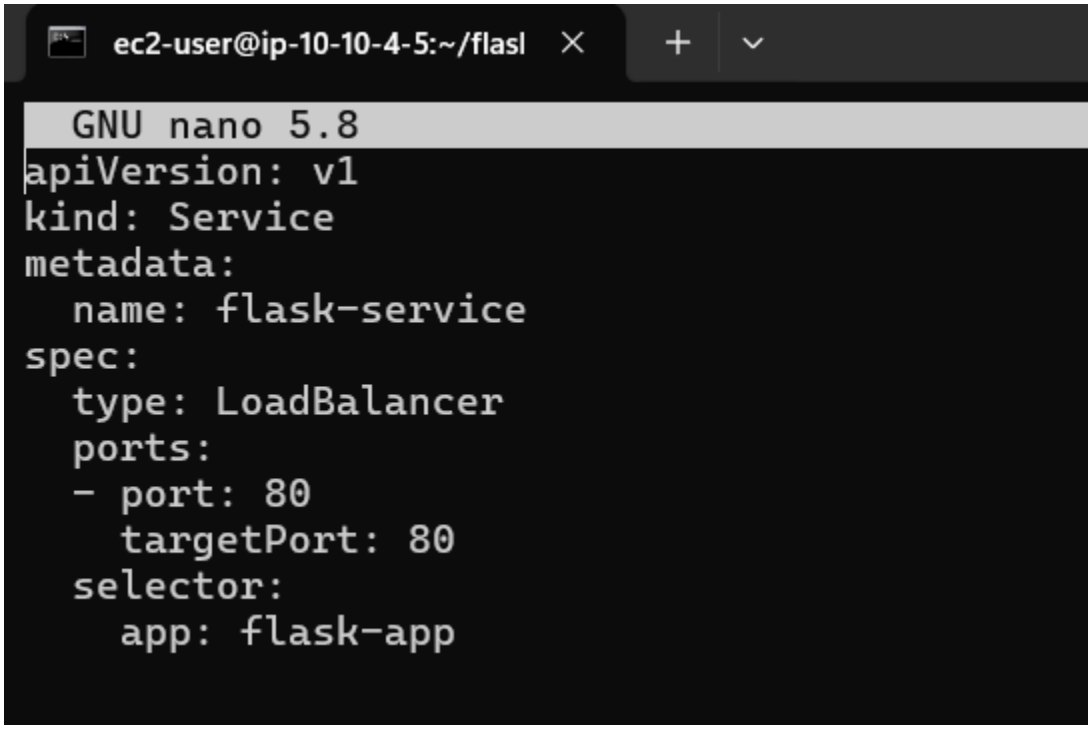
9) Apply the created deployment

kubectl apply -f flask-deployment.yaml



10) To expose this application, we need to create a flask-service.yaml file. Use **nano flask-service.yaml** and add the following code.

```
apiVersion: v1
kind: Service
metadata:
  name: flask-service
spec:
  type: LoadBalancer
  ports:
  - port: 80
    targetPort: 80
  selector:
    app: flask-app
```



11) Apply this service to kubernetes.

kubectl apply -f flask-service.yaml

```
[ec2-user@ip-10-10-4-5 flask-app]$ kubectl apply -f flask-service.yaml
service/flask-service created
[ec2-user@ip-10-10-4-5 flask-app]$
```

12) Get the status of your deployment.
kubectl get deployments

```
[ec2-user@ip-10-10-4-5 flask-app]$ kubectl get deployments
NAME        READY   UP-TO-DATE   AVAILABLE   AGE
flask-app   2/2     2            2           3m19s
[ec2-user@ip-10-10-4-5 flask-app]$
```

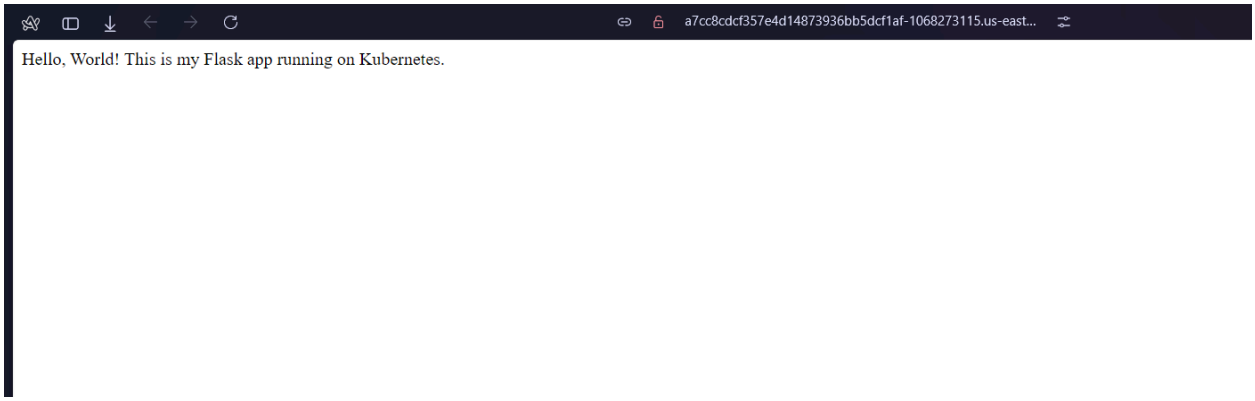
13) Get the status of your service
kubectl get svc

```
[ec2-user@ip-10-10-4-5 flask-app]$ kubectl get svc
NAME            TYPE           CLUSTER-IP      EXTERNAL-IP                                                              PORT(S)        AGE
flask-service   LoadBalancer   172.20.126.231   a7cc8cdcf357e4d14873936bb5dcf1af-1068273115.us-east-1.elb.amazonaws.com   80:30347/TCP   62s
kubernetes      ClusterIP      172.20.0.1       <none>                                                                   443/TCP        90m
[ec2-user@ip-10-10-4-5 flask-app]$
```

14) From the services part, we get the external IP of the service we created. Now run command
curl a7cc8cdcf357e4d14873936bb5dcf1af-1068273115.us-east-1.elb.amazonaws.com
To test the deployment.
It should give output: **"Hello, World! This is my Flask app running on Kubernetes."**

```
[ec2-user@ip-10-10-4-5 flask-app]$ curl a7cc8cdcf357e4d14873936bb5dcf1af-1068273115.us-east-1.elb.amazonaws.com
Hello, World! This is my Flask app running on Kubernetes.[ec2-user@ip-10-10-4-5 flask-app]$
```

Access this link on a browser and check this.



Sairam Konar D15C 27 2024-25

Guidelines:

- The setup of IAM user group and user is required for this case study.
- The user group must have all the permissions required to access and modify various services in AWS.
- Make sure to keep the Access keys of the IAM user safe on your system.
- Keep the .pem file of teh private key safely in a folder that you can access.
- Make sure that the EC2 instance has SSH permissions (Port 22).
- Install all the required services on the instance.

Key Points:

One of the most important things is that in this case study, AWS Cloud9 IDE could not be used as it has been deprecated by AWS themselves from 25th July 2024. To tackle this issue, we have created an EC2 instance that is linked with the VPC linked with the Kubernetes cluster and then with the help of SSH link that instance to our local terminal. On this instance we are setting up the kubectl and flask app deployment.

Conclusion:

Thus, we have understood the interrealtion between various services provided in DevOps such as Terraform, Kubernetes, AWS, Docker, etc. We have seen how Terraform is used to create the cluster on an AWS console with the help of the access keys of an IAM user. Through this, we have understood the meaning of Terraform being a Infrastructure as Code (IaC) service. After the code is run, we access the instance using SSH on our local machine where we install docker. The main reason for Docker is to containerize whatever application that needs to be deployed has to be set up. This is done by using the existing images (in this case, Python) from the Docker registry). After that, to use the Kubernetes cluster that has been set up, we use 2 CLI tools, kubectl and aws cli. With the help of both, we acces the already set up Cluster and deploy our flask application, whose output can be seen using the curl command.