

**A Practical Report Submitted for
SYSTEM PROVISIONING AND CONFIGURATION MANAGEMENT-UCS758-
2024ODDSEM**



THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

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1.1 Infrastructure as Code: Automation of your Infrastructure

Terraform Installation

Step 1: go to <https://www.terraform.io/downloads.html>

Step 2: Scroll down a bit and you can see Windows. There will be 32-bit and 64-bit. As per your processor, click on the link and the zip file will start getting downloaded. It will be downloaded in your Downloads folder

Step 3: Unzip the zip file.

Step 4: Open a command prompt and write the below commands:

```
mkdir terraform  
cd terraform/
```

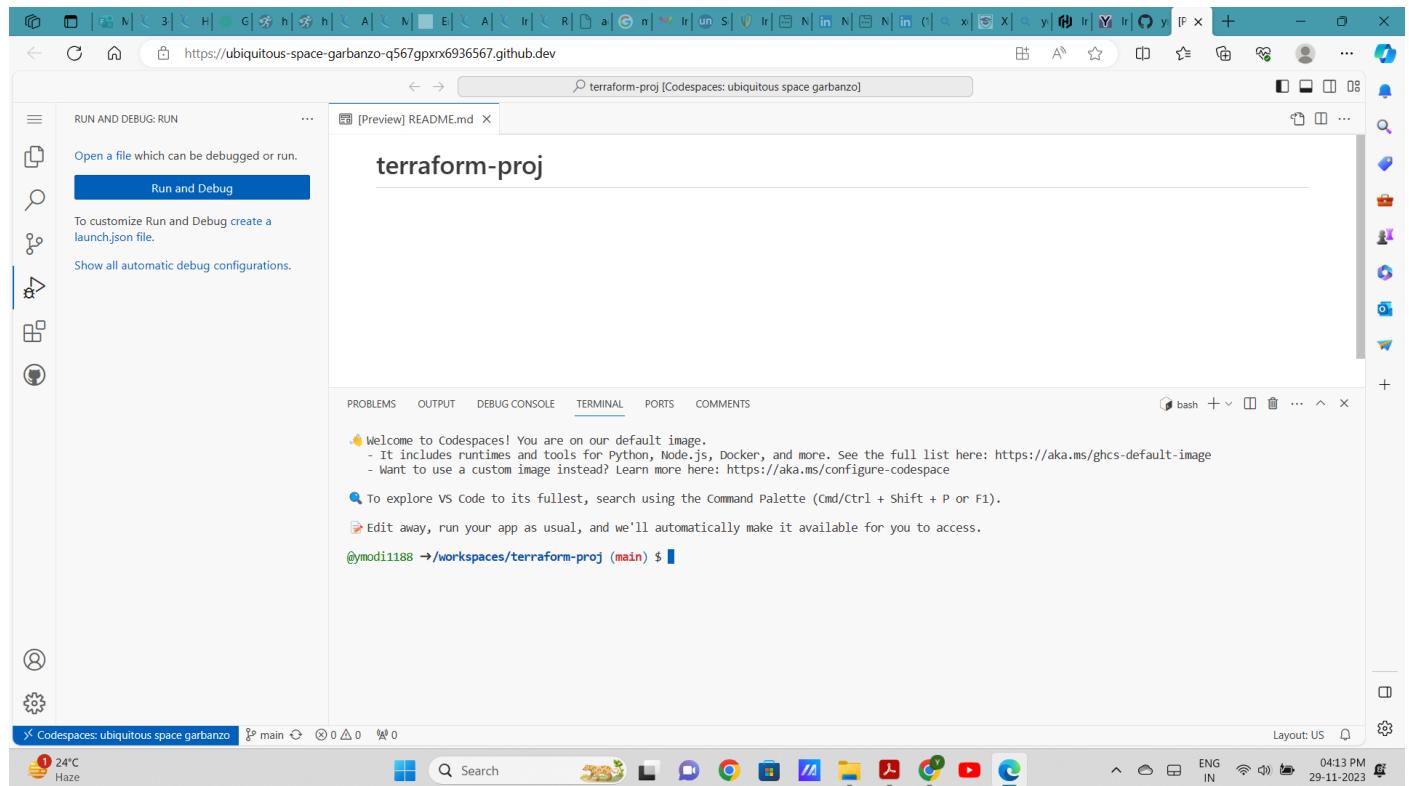
Step 5: The zipped file which has been unzipped in Step 3, copy that file and paste it in the folder directory created in step 4

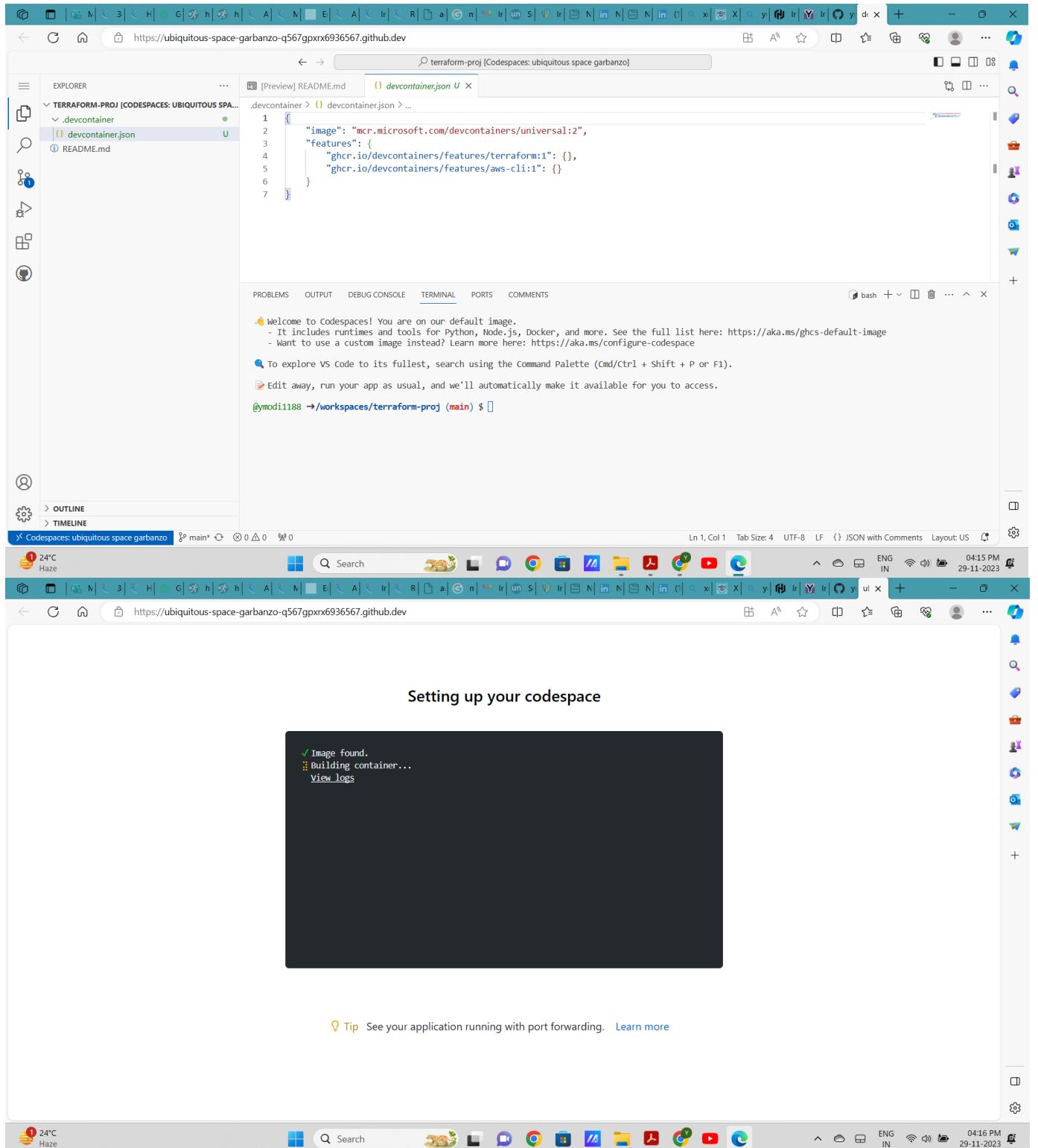
Step 6: In the command prompt window where you entered the commands mentioned in Step 4 just write the below command

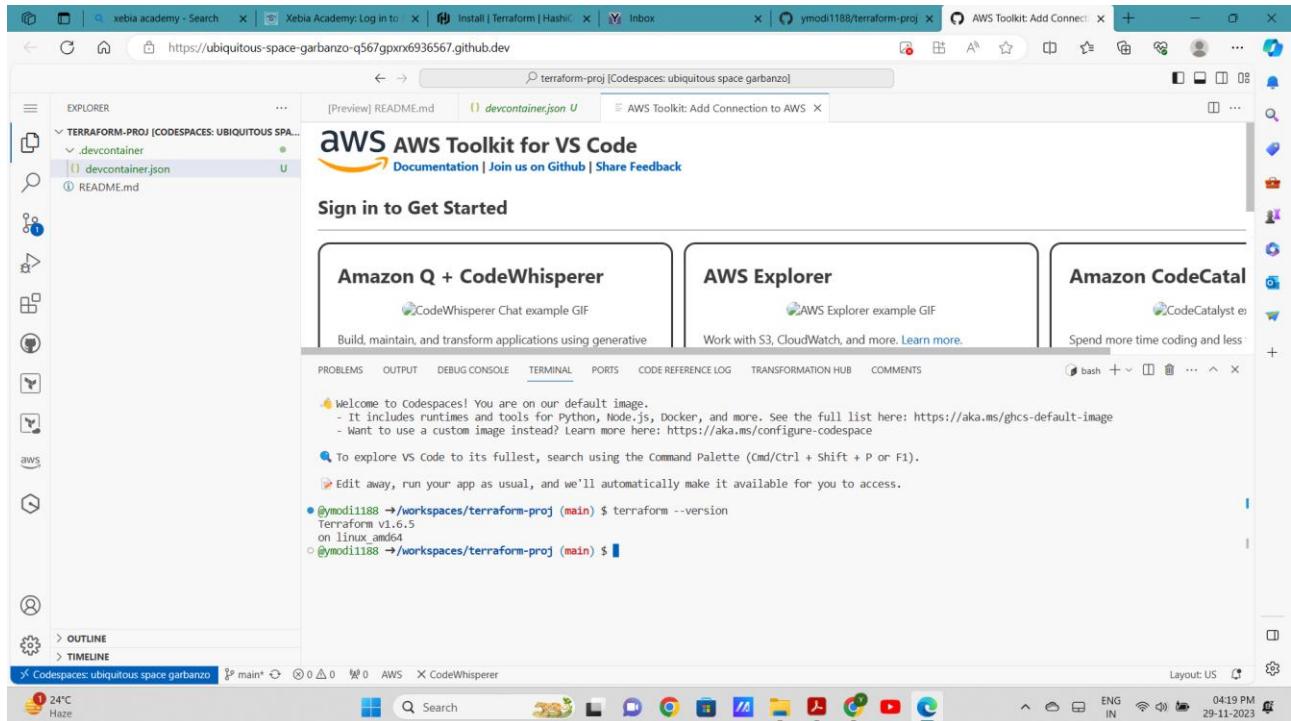
```
set PATH=%PATH%;C:\Users\Asus\terraform
```

Note: The path C:\Users\Asus\terraform is specifically for me as that is my root directory. So you set accordingly.

Step 7: Now write in the command prompt — terraform. Below is the screenshot of what it looks like in the machine.







1.2.1 Open an AWS Account

1. Open an AWS Account
2. Create IAM admin user — terraform
3. Create a group - terraform-administrators

4. Create Security Group

The screenshot shows two overlapping browser windows. The top window is the AWS Management Console Home page, displaying various service links like IAM, EC2, and CloudWatch, along with sections for Welcome to AWS, AWS Health, Cost and usage, and Build a solution. The bottom window is the IAM Dashboard, showing the AWS Account section with account ID and root user information, and the IAM Resources section with statistics for users, roles, policies, and identities.

AWS Management Console Home

- Recently visited: IAM, EC2, Elastic Beanstalk, Billing and Cost Management, Amazon Redshift, S3, Lambda
- Welcome to AWS:
 - Getting started with AWS
 - Training and certification
 - What's new with AWS?
- AWS Health
- Cost and usage
- Build a solution

IAM Dashboard

AWS Account

- Account ID: 26368828833
- Access keys
- Root user URL: https://signin.aws.amazon.com/console?next=https://aws.amazon.com/console#/root

IAM Resources

User Groups	Roles	Policies	Identities
0	5	10	4

Metrics: View all

us-east-1.console.aws.amazon.com/iam/home?region=ap-south-1#/users/create

Review and create

Add user to group
Copy permissions
Attach policies directly

Permissions policies (1/1160)			
Choose one or more policies to attach to your new user.			
Filter by Type			
	Policy name	Type	Attached entities
<input type="checkbox"/>	AccessAnalyzerServiceRolePolicy	AWS managed	0
<input checked="" type="checkbox"/>	AdministratorAccess	AWS managed - job function	2
<input type="checkbox"/>	AdministratorAccess-Amplify	AWS managed	0
<input type="checkbox"/>	AdministratorAccess-AWSElasticBea...	AWS managed	0
<input type="checkbox"/>	AlexaForBusinessDeviceSetup	AWS managed	0
<input type="checkbox"/>	AlexaForBusinessFullAccess	AWS managed	0
<input type="checkbox"/>	AlexaForBusinessGatewayExecution	AWS managed	0
<input type="checkbox"/>	AWSIoTDeviceShadowDeletePolicy	AWS managed	0

CloudShell Feedback

24°C Haze

us-east-1.console.aws.amazon.com/iam/home?region=ap-south-1#/users/create

User created successfully

You can view and download the user's password and email instructions for signing in to the AWS Management Console.

View user

Step 1 Specify user details

Step 2 Set permissions

Step 3 Review and create

Step 4 Retrieve password

Retrieve password

Console sign-in details

Email sign-in instructions

Console sign-in URL: https://263685868839.signin.aws.amazon.com/console

User name: Terraform

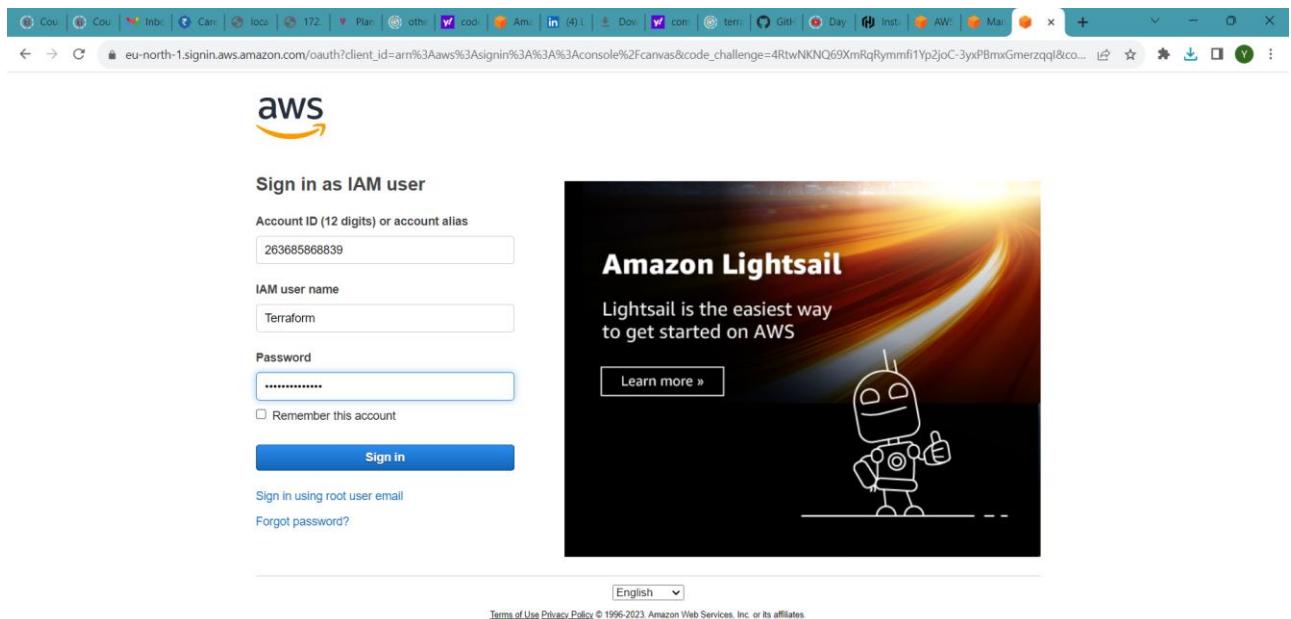
Console password: ***** Show

Cancel Download .csv file Return to users list

CloudShell Feedback

24°C Haze

us-east-1.console.aws.amazon.com/iam/home?region=ap-south-1#/users/create



A screenshot of the AWS Console Home page for the ap-south-1 region. The URL is ap-south-1.console.aws.amazon.com/console/home/?region=ap-south-1#. The page features a dashboard with sections for Recently visited services (Amazon Simple Email Service, CloudWatch, Amazon EventBridge, Simple Queue Service, Lambda, S3, Amazon Redshift, Billing and Cost Management, Elastic Beanstalk, EC2, IAM), Welcome to AWS (Getting started with AWS, Training and certification, What's new with AWS?), AWS Health (Open issues, Scheduled changes, Other notifications), and Build a solution (Launch a virtual machine, Start migrating to AWS). The top navigation bar includes links for Services, Search, and [Alt+S]. The bottom navigation bar includes CloudShell, Feedback, and links for 24°C Haze, ENG IN, 04:27 PM, 29-11-2023, © 2023, Amazon Web Services, Inc. or its affiliates., Privacy, Terms, and Cookie preferences.

1.3 Spinning up EC2 instance - github.com

1. Create terraform file to spin up t2.micro instance

2. Run terraform apply

Create terraform file to spin up t2.micro instance

```
git clone https://github.com/automationhubsarthak/terraform-code
```

```
cd terraform-code
```

```
cd first-steps
```

```
ls
```

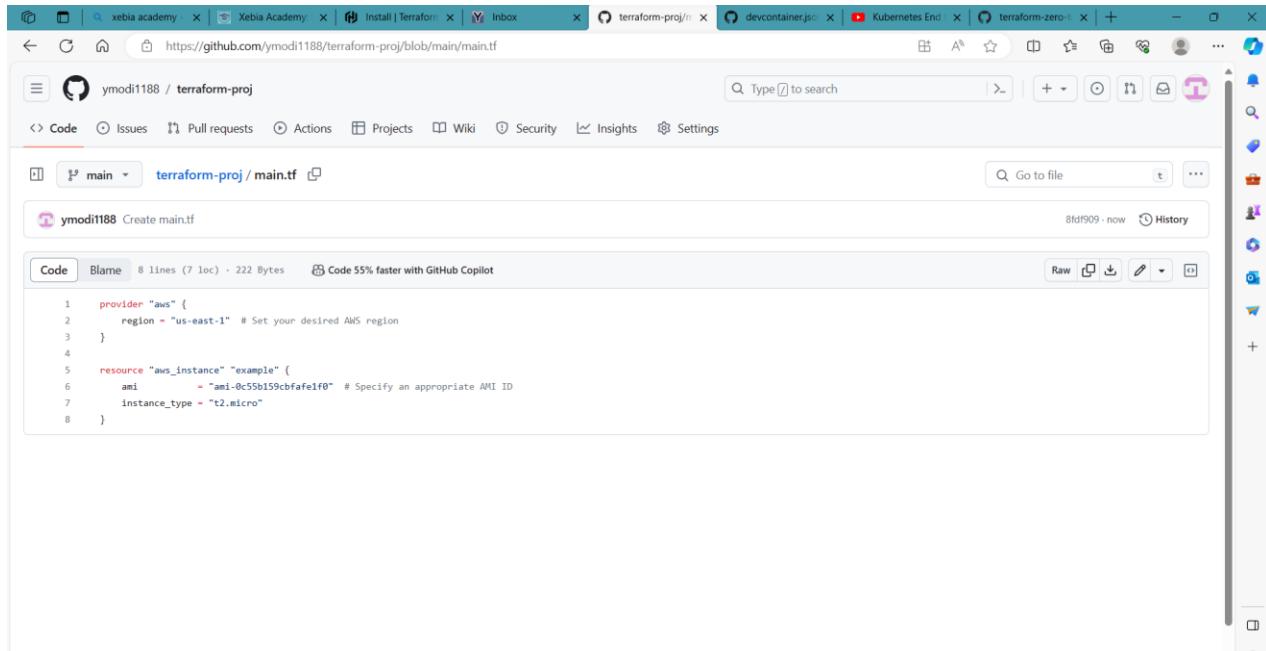
```
cat instance.tf
```

This screenshot shows the AWS IAM Access Key Wizard. The top bar indicates the URL is us-east-1.console.aws.amazon.com/iam/home?region=us-east-1#/security_credentials/access-key-wizard. The main content area has a green header bar with the message "Access key created". Below it, a sub-header says "This is the only time that the secret access key can be viewed or downloaded. You cannot recover it later. However, you can create a new access key any time." The navigation path is IAM > Security credentials > Create access key. On the left, there are three steps: Step 1 (Access key best practices & alternatives), Step 2 - optional (Set description tag), and Step 3 (Retrieve access keys). Step 3 is currently selected. The central panel is titled "Retrieve access keys" and contains a table with two columns: "Access key" and "Secret access key". The "Access key" column shows the value AKIAT2HHBUT2ELPRLW. The "Secret access key" column shows a long string of asterisks followed by a "Show" link. Below this table is a section titled "Access key best practices" with a bulleted list: "Never store your access key in plain text, in a code repository, or in code.", "Disable or delete access key when no longer needed.", "Enable least-privilege permissions.", and "Rotate access keys regularly.". A note at the bottom of this section says "For more details about managing access keys, see the [best practices for managing AWS access keys](#)". At the bottom right of the panel are "Download .csv file" and "Done" buttons.

This screenshot shows a Microsoft Visual Studio Code (VS Code) interface running within a browser window. The browser's address bar shows the URL <https://ubiquitous-space-garbanzo-q567gpnx6936567.github.dev>. The VS Code editor displays a file named "devcontainer.json" with the following content:

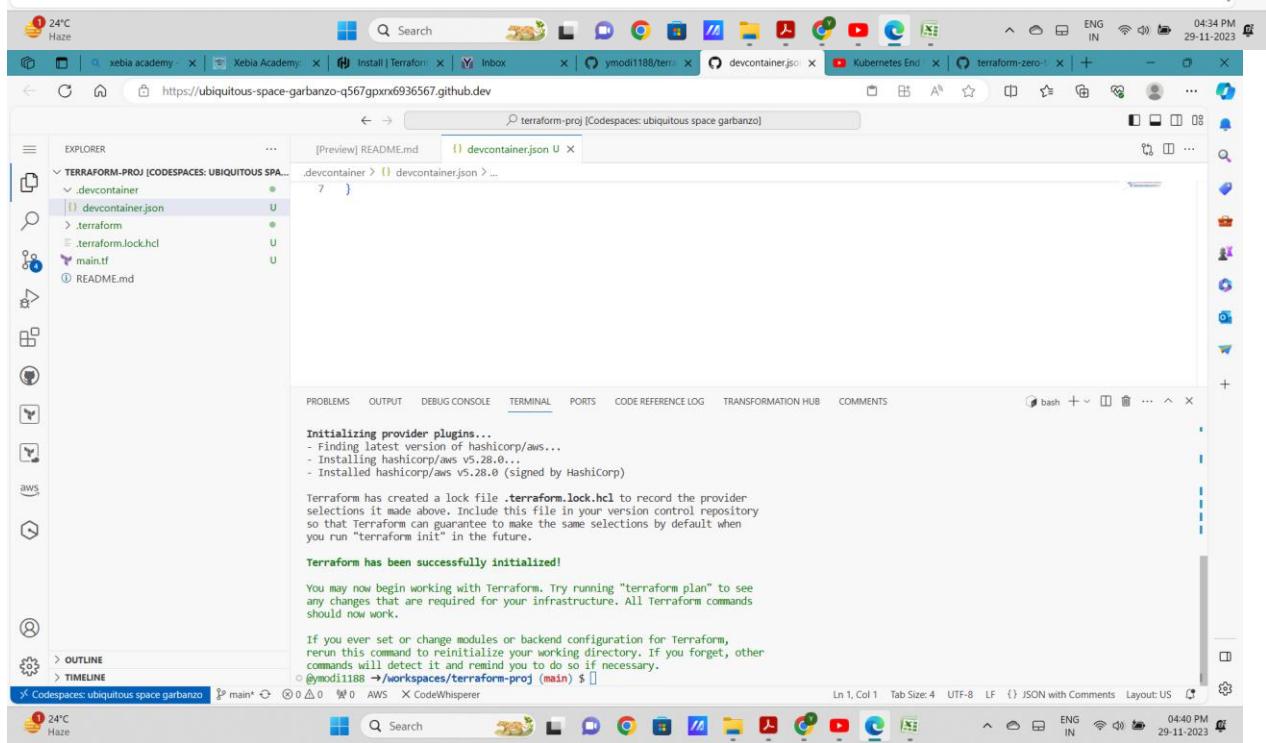
```
1 {  
2   "image": "mcr.microsoft.com/devcontainers/universal:2",  
3   "features": {  
4     "ghcr.io/devcontainers/features/terraform:1": {},  
5     "ghcr.io/devcontainers/features/aws-cli:1": {}  
6   }  
7 }
```

The VS Code interface includes a sidebar with icons for CloudShell, Feedback, Explorer, File, GitHub, Help, Home, Languages, Settings, and Terminal. The terminal tab shows a session with the command "aws s3 ls" and its output. The status bar at the bottom shows the date and time as 29-11-2023 04:31 PM.



```
provider "aws" {
  region = "us-east-1" # Set your desired AWS region
}

resource "aws_instance" "example" {
  ami           = "ami-0c55b159cbfafe1f0" # Specify an appropriate AMI ID
  instance_type = "t2.micro"
}
```



```
Initializing provider plugins...
- Finding latest version of hashicorp/aws...
- Installing hashicorp/aws v5.28.0...
- Installed hashicorp/aws v5.28.0 (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.

Screenshot of a Microsoft Edge browser window showing a Terraform project in a Codespace and the AWS CloudWatch console.

Terraform Project (main.tf):

```

resource "aws_instance" "example" {
  provider "aws" {
    region = "us-east-1" # Set your desired AWS region
  }

  ami           = "ami-0230bd60aa48260c6" # Specify an appropriate AMI ID
  instance_type = "t2.micro"
}

```

CloudWatch Log Stream:

```

+ user_data_replace_on_change      = false
+ vpc_security_group_ids          = (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

aws_instance.example: Creating...
aws_instance.example: Still creating... [10s elapsed]
aws_instance.example: Still creating... [20s elapsed]
aws_instance.example: Still creating... [30s elapsed]
aws_instance.example: Creation complete after 35s [id=i-0a96f24e00e3782de]

Apply complete! Resources: 1 added, 0 changed, 0 destroyed.
@modi1188 → /workspaces/terraform-proj (main) $ 

```

AWS CloudWatch Metrics:

CloudWatch Metrics for EC2 instance i-0a96f24e00e3782de in us-east-1 region.

Metric	Value
Public IPv4 DNS	ec2-34-229-130-12.compute-1.amazonaws.com
Private IPv4 address	172.31.28.197
Public IPv4 address	34.229.130.12

1.8 VPC

Creating an AWS VPC using terraform.

The screenshot displays two side-by-side browser windows illustrating the creation of an AWS VPC using Terraform.

Top Window (Terraform Cloud):

- Left Panel:** Explorer showing the project structure: `main.tf`, `README.md`, `.devcontainer.json`, `.terraform.lock.hcl`, `.terraform.state.lock.info`, and `main.tf`.
- Middle Panel:** Preview of the `main.tf` code:

```
resource "aws_vpc" "my_vpc" {
  provider = "aws"
  region   = "us-east-1" # Set your desired AWS region

  # Create a VPC
  resource "aws_vpc" "my_vpc" {
    cidr_block = "10.10.0.0/16"
    instance_tenancy = "default"
    tags = {
      Name = "my_vpc"
    }
  }
}
```
- Bottom Panel:** Terraform terminal showing the plan output:

```
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
```

Bottom Window (AWS Management Console):

- Left Sidebar:** AWS Services navigation bar, VPC dashboard, EC2 Global View, and various VPC-related options like Subnets, Route tables, Internet gateways, Egress-only internet gateways, Carrier gateways, DHCP option sets, Elastic IPs, Managed prefix lists, Endpoints, Endpoint services, NAT gateways, and Peering connections.
- Main Content:** Your VPCs (1/2) table showing one entry: `my_vpc` (VPC ID: `vpc-04337f1c8f35f8db0`, State: Available, IPv4 CIDR: `10.10.0.0/16`, IPv6 CIDR: `-`). An Actions button is present.
- Details View:** For the selected VPC (`vpc-04337f1c8f35f8db0 / my_vpc`):

VPC ID	State	DNS hostnames	DNS resolution
<code>vpc-04337f1c8f35f8db0</code>	Available	Disabled	Enabled
Tenancy	DHCP option set	Main route table	Main network ACL
Default	<code>dopt-00e3cf912e29f752</code>	<code>rtb-0b4574d95bfe0f643</code>	<code>acl-0e6a9029229c9cc2e</code>
Default VPC	IPv4 CIDR	IPv6 pool	IPv6 CIDR (Network border group)
No	<code>10.10.0.0/16</code>	-	-
Network Address Usage metrics	Route 53 Resolver DNS Firewall rule	Owner ID	
Disabled	<code>resource</code>	<code>267685868920</code>	

1.9 Security Group

Creating an AWS security group using terraform.

```
main.tf > resource "aws_security_group" "allow_tls" {
  provider = "aws"
  region   = "us-east-1" # Set your desired AWS region
  name     = "allow_tls"
  description = "Allow TLS inbound traffic"
  vpc_id    = "${aws_vpc.my_vpc.id}"
  ingress {
    description = "TLS from VPC"
    from_port   = 443
    to_port    = 443
    protocol   = "tcp"
    cidr_blocks = [aws_vpc.my_vpc.cidr_block]
  }
  egress {
    from_port = 0
    to_port   = 0
    protocol  = "-1"
    cidr_blocks = ["0.0.0.0/0"]
  }
  tags = {
    Name = "allow_tls"
  }
}
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS CODE REFERENCE LOG TRANSFORMATION HUB COMMENTS

Apply complete! Resources: 1 added, 0 changed, 1 destroyed.
@mod11188 →/workspaces/terraform-proj (main) \$

21°C Haze

Ln 25, Col 2 Spaces: 4 UTF-8 LF ENG IN 06:18 PM 29-11-2023

Screenshot of a browser window showing a Terraform project in a Codespace. The URL is <https://ubiquitous-space-garbanzo-q567gpxx6936567.github.dev>. The code editor shows `main.tf` with the following content:

```

provider "aws" {
  region = "us-east-1" # Set your desired AWS region
}

resource "aws_vpc" "my_vpc" {
  cidr_block = "10.0.0.0/16" # Example CIDR block, adjust as needed
  tags = {
    Name = "my_vpc"
  }
}

resource "aws_security_group" "allow_tls" {
  name = "allow_tls"
  description = "Allow TLS inbound traffic"
  vpc_id = "${aws_vpc.my_vpc.id}"
  ingress {
    description = "TLS from VPC"
    from_port = 443
  }
}

```

The terminal tab shows the output of a Terraform plan command:

```

Plan: 2 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

```

Screenshot of the AWS Management Console showing the EC2 Security Groups page. The URL is <https://us-east-1.console.aws.amazon.com/ec2/home/?region=us-east-1#SecurityGroups>.

The table displays the following security groups:

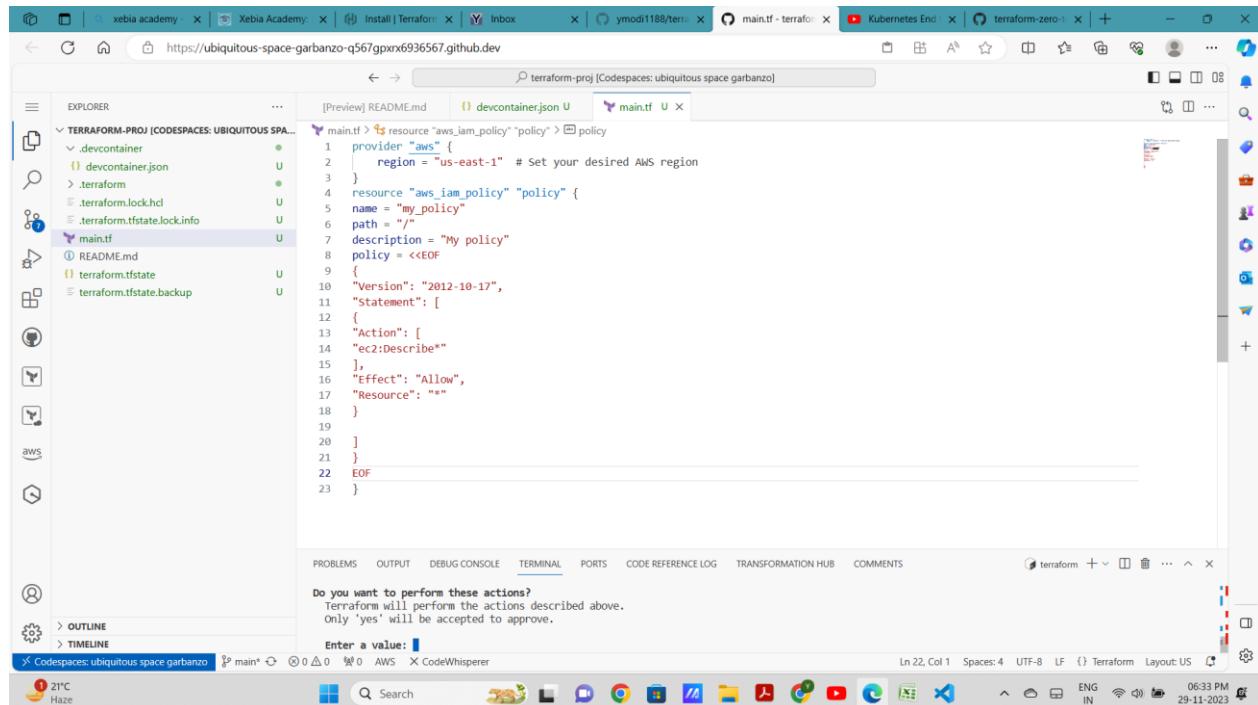
Name	Security group ID	Security group name	VPC ID	Description
<input checked="" type="checkbox"/> allow_tls	sg-01860550e09a21b65	allow_tls	vpc-0a4d1b199d55a52e6	Allow TLS in
<input type="checkbox"/> -	sg-0aaad221c11989a6f	default	vpc-0c89b0bdb18405f6a	default VPC
<input type="checkbox"/> -	sg-05802500ba7b26c39	launch-wizard-3	vpc-0c89b0bdb18405f6a	launch-wiza
<input type="checkbox"/> -	sg-06dd400fca7162c9c	launch-wizard-1	vpc-0c89b0bdb18405f6a	launch-wiza
<input type="checkbox"/> -	sg-055db81dbe860fa04	launch-wizard-2	vpc-0c89b0bdb18405f6a	launch-wiza

The Inbound rules section shows one rule:

Name	Security group rule...	IP version	Type	Protocol	Port range
-	sgr-0312bc6463abf03f	IPv4	HTTPS	TCP	443

1.10 IAM Policy

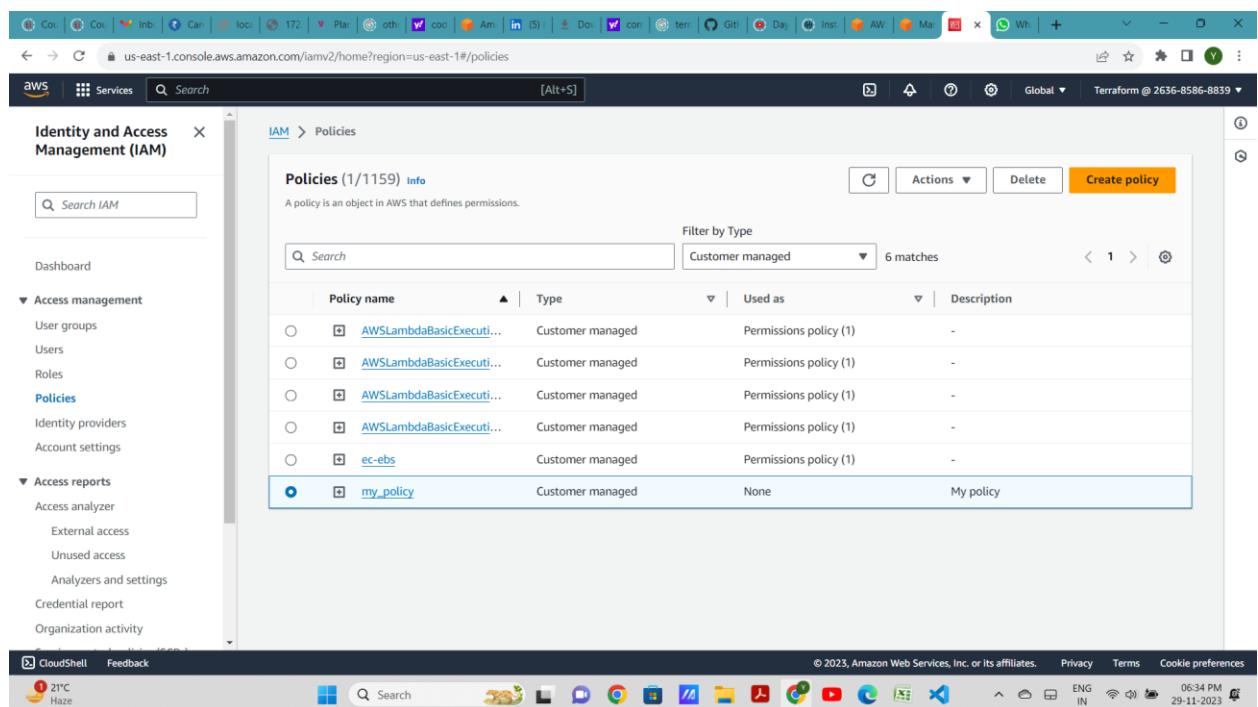
Creating an AWS IAM policy using terraform.



The screenshot shows a browser window with multiple tabs open. The active tab displays the Terraform configuration file `main.tf` for a policy named `my_policy`. The code defines a provider `aws` and a resource `aws_iam_policy` with the name `my_policy`, path `/`, and description `"My policy"`. The policy statement grants `ec2:Describe*` permission to all resources. The browser interface includes an Explorer sidebar, a preview pane for `README.md`, and various developer tools at the bottom.

```
provider "aws" {
  region = "us-east-1" # Set your desired AWS region
}

resource "aws_iam_policy" "policy" {
  name = "my_policy"
  path = "/"
  description = "My policy"
  policy = <>EOF
  "Version": "2012-10-17",
  "Statement": [
    {
      "Action": [
        "ec2:Describe*"
      ],
      "Effect": "Allow",
      "Resource": "*"
    }
  ]
}
EOF
```



The screenshot shows the AWS IAM console. The left sidebar navigation bar is visible, showing options like Identity and Access Management (IAM), Access management, and Access reports. The main content area is titled "Policies (1/1159)" and shows a list of existing policies. One policy, `my_policy`, is highlighted. The list includes columns for Policy name, Type, Used as, and Description. The policy `my_policy` is described as a Customer managed Permissions policy used for "My policy". The browser interface at the bottom includes the AWS logo, CloudShell, Feedback, and various system status icons.

Policy name	Type	Used as	Description
AWSLambdaBasicExecutionRole	Customer managed	Permissions policy (1)	-
AWSLambdaBasicExecutionRole	Customer managed	Permissions policy (1)	-
AWSLambdaBasicExecutionRole	Customer managed	Permissions policy (1)	-
AWSLambdaBasicExecutionRole	Customer managed	Permissions policy (1)	-
ec-ebs	Customer managed	Permissions policy (1)	-
my_policy	Customer managed	None	My policy

1.11 EC2

Creating an AWS EC2 instance using terraform.

Previously demonstrated

1.12 S3 bucket

Creating an AWS S3 bucket instance using terraform.

Screenshot of the AWS S3 console showing the General purpose buckets list:

Amazon S3

Buckets

Total storage: 22.1 MB | Object count: 39 | Average object size: 580.7 KB

You can enable advanced metrics in the "default-account-dashboard" configuration.

General purpose buckets (5)

Buckets are containers for data stored in S3. [Learn more](#)

Name	AWS Region	Access	Creation date
elasticbeanstalk-ap-south-1-263685868839	Asia Pacific (Mumbai) ap-south-1	Objects can be public	November 27, 2023, 18:26:07 (UTC+05:30)
elasticbeanstalk-us-east-1-263685868839	US East (N. Virginia) us-east-1	Objects can be public	September 1, 2023, 16:12:35 (UTC+05:30)
my-bucket1x2y-abc123	US East (N. Virginia) us-east-1	Bucket and objects not public	November 29, 2023, 18:36:15 (UTC+05:30)
smark-web1911	Asia Pacific (Mumbai) ap-south-1	Objects can be public	August 27, 2023, 11:35:22 (UTC+05:30)
snig-portfolio	Asia Pacific (Sydney) ap-southeast-2	Objects can be public	August 27, 2023, 13:42:10 (UTC+05:30)

CloudShell Feedback

CloudShell session details: 21°C Haze

Code Editor (VS Code) showing Terraform configuration:

```

[Preview] README.md | devcontainer.json | main.tf 1, U
main.tf > resource "aws_s3_bucket" "my_bucket" > acl
1 provider "aws" {
2   region = "us-east-1" # Set your desired AWS region
3 }
4 resource "aws_s3_bucket" "my_bucket" {
5   bucket = "my-bucket1x2y-abc123"
6   acl = "private"
7   tags = [
8     Name = "My Bucket"
9     Environment = "Dev"
10   ]
11 }
```

PROBLEMS: 1 output, 0 DEBUG CONSOLE, TERMINAL, PORTS, CODE REFERENCE LOG, TRANSFORMATION HUB, COMMENTS

Enter a value: yes

aws_security_group.allow_tls: Destroying... [id=sg-01860550e09a21b65]
aws_policy_policy: Creating...
aws_iam_policy_policy: Creation complete after 1s [id=arn:aws:iam::263685868839:policy/my_policy]
aws_security_group.allow_tls: Destruction complete after 1s
aws_vpc.my_vpc: Destroying... [id=vpc-0a4d1b199d5a52e6]
aws_vpc.my_vpc: Destruction complete after 2s

Apply complete! Resources: 1 added, 0 changed, 2 destroyed.

Code Editor status bar: Ln 6, Col 16 (15 selected) Spaces: 4 UTF-8 LF Terraform Layout: US

1.13 Variables

Creating an AWS VPC passing CIDR as an input variable. We can also provide default value.

The screenshot shows a browser window with several tabs open, including "main.tf - terraform" and "Kubernetes End". The main content area displays the Terraform configuration file `main.tf`:

```
provider "aws" {
  region = "us-east-1" # Set your desired AWS region
}

variable "vpc_cidr" {
  type = "string"
  default = "10.10.0.0/16"
}

resource "aws_vpc" "my_vpc" {
  cidr_block = var.vpc_cidr
  instance_tenancy = "default"
  tags = {
    Name = "my_vpc"
  }
}
```

Below the code editor, the terminal pane shows the output of the Terraform plan command:

```
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
```

aws_vpc.my_vpc: Creating...
aws_s3_bucket.my_bucket: Destroying... [id=my-bucket1x2y-abc123]

At the bottom, the AWS Lambda function details are shown:

Name	VPC ID	State	IPv4 CIDR	IPv6 CIDR	DHCP options
my_vpc	vpc-07c05d2d3b8a0f8d3	Available	10.10.0.0/16	-	dept-0C
-	vpc-0c89b0bdb18405f6a	Available	172.31.0.0/16	-	dept-0C

Details panel for the first VPC:

VPC ID	State	DNS hostnames	DNS resolution
vpc-07c05d2d3b8a0f8d3	Available	Disabled	Enabled
Tenancy	DHCP option set	Main route table	Main network ACL
Default	dopt-00e3cf912e29f752	rtb-0b84877352cd0af8	acl-049d762aeba6e6512
Default VPC	IPv4 CIDR	IPv6 pool	IPv6 CIDR (Network border group)
No	10.10.0.0/16	-	-
Network Address Usage metrics	Route 53 Resolver DNS Firewall rule groups	Owner ID	
Disabled	-	263685868839	