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Course	Introduction to DevOps
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Lab 02 (Modules 01, 02, and 03)

Create, modify, and destroy resources.

Tariq Khan Ghouri

IT INFRASTRUCTURE, CLOUD AND DEVOPS PROFESSIONAL

Instruc(ons:

1. Log in to Azure Portal with your credentials.
2. Paste all screenshots (highlighted in red) in a single Word document in the correct order.
3. Name the document as YourName-lab02.

Lab Objec(ve:

- Create, modify, and destroy resources.

Lab Descrip(on:

- Create a single Terraform script called lab02.U containing the following:
 - Provider and Terraform blocks.
 - Code to build the required infrastructure.
 - Validate, deploy, expand, analyze, and destroy infrastructure.
-

Part 1: Prepare for the Lab

1. Open a Command Prompt or PowerShell window.
 2. Create a directory called lab02 in your home directory.
 3. Change into the lab02 directory.
 4. Create an empty file called lab02.U.
-

Part 2: Codify the Following in a Single Terraform Script

Make sure to enclose values within double quotation marks.

5. Open lab02.U in a text editor (e.g., Notepad or Visual Studio Code) and define resource blocks as follows:

Define a resource group called lab02-rg using `azurerm_resource_group`.

Define a virtual network called lab02-vnet using `azurerm_virtual_network`.

Add a subnet to the virtual network called lab02-subnet1 using `azurerm_subnet`.

Define a network security group called lab02-nsg1 with an inbound allow TCP rule for port 22 called rule1 with priority 100 using `azurerm_network_security_group`.

Attach the network security group lab02-nsg1 to lab02-subnet1 using `azurerm_subnet_network_security_group_association`.

lab02.tf

```
1 provider "azurerm" {
2   features = {}
3 }
4
5 # Resource Group
6 resource "azurerm_resource_group" "lab02_rg" {
7   name      = "lab02-rg"
8   location  = "eastus"
9 }
10
11 # Virtual Network
12 resource "azurerm_virtual_network" "lab02_vnet" {
13   name            = "lab02-vnet"
14   address_space   = ["10.0.0.0/16"]
15   location        = azurerm_resource_group.lab02_rg.location
16   resource_group_name = azurerm_resource_group.lab02_rg.name
17 }
18
19 # Subnet to the Virtual Network
20 resource "azurerm_subnet" "lab02_subnet1" {
21   name            = "lab02-subnet1"
22   resource_group_name = azurerm_resource_group.lab02_rg.name
23   virtual_network_name = azurerm_virtual_network.lab02_vnet.name
24   address_prefixes   = ["10.0.1.0/24"]
25 }
26
27 # Network Security Group with an inbound rule
28 resource "azurerm_network_security_group" "lab02_nsg1" {
29   name            = "lab02-nsg1"
30   location        = azurerm_resource_group.lab02_rg.location
31   resource_group_name = azurerm_resource_group.lab02_rg.name
32
33   security_rule {
34     name            = "rule1"
35     priority        = 100
36     direction       = "Inbound"
37     access          = "Allow"
38     protocol        = "Tcp"
39     source_port_range = "*"
40     destination_port_range = "22"
41     source_address_prefix = "*"
42     destination_address_prefix = "*"
43   }
44 }
45
46 # Associate the NSG with the Subnet
47 resource "azurerm_subnet_network_security_group_association" "lab02_subnet_nsg_assoc" {
48   subnet_id      = azurerm_subnet.lab02_subnet1.id
49   network_security_group_id = azurerm_network_security_group.lab02_nsg1.id
50 }
51
```

Part 3: Initialize Terraform

6. Initialize Terraform and download plug-ins as required:

```
terraform init
```

7. View the content of the terraform.Ustate file:

```
type terraform..state
```

[illegible]

Part 4: Validate Configuration

8. Validate the configuration to ensure there are no errors or typos in the file:

```
terraform validate
```

9. Fix any issues in the lab02.U file if reported (edit in your text editor).
10. Re-run the validation until no errors are reported.

A terminal window titled 'lab02 --zsh-- 80x24' showing a successful Terraform validation. The prompt is 'ibs@Home lab02 %' and the command entered is 'terraform validate'. The output is 'Success! The configuration is valid.' followed by a new prompt 'ibs@Home lab02 %' with a cursor.

```
lab02 --zsh-- 80x24
ibs@Home lab02 % terraform validate
Success! The configuration is valid.
ibs@Home lab02 %
```

Part 5: Run Simulation

11. Perform a dry run:

```
terraform plan
```

12. Review output and ensure all configuration is as per requirements. Observe the resources with +, -, or /+ signs.

13. Fix any issues in the lab02.U file if reported (edit in your text editor).

14. Redo the dry run until no errors are reported:

```
terraform plan
```

Part 6: Deploy Infrastructure

15. Deploy the infrastructure and monitor progress:

```
terraform apply
```

- Type yes when prompted to confirm.

Part 7: Get Information from Terraform State

16. View and analyze state information:

terraform state list terraform

The screenshot shows the Microsoft Azure portal interface. At the top, there's a search bar and navigation icons. Below the header, the 'All resources' section is active, displaying a table of resources. The table has columns for Name, Type, Resource Group, Location, and Subscription. Three resources are listed: 'lab02-nsg' (Network security group), 'lab02-vnet' (Virtual network), and 'NetworkWatcher_nsg' (Network Watcher). The 'lab02-nsg' resource is highlighted with a blue selection bar. Below the table, there's a pagination bar showing 'Showing 1 - 3 of 3. Display count: 1000'.

Name	Type	Resource Group	Location	Subscription
lab02-nsg	Network security group	lab02-rg	East US	Active for Skopelos
lab02-vnet	Virtual network	lab02-rg	East US	Active for Skopelos
NetworkWatcher_nsg	Network Watcher	NetworkWatcherRG	East US	Active for Skopelos

Part 9: Expand the lab02.S Script

```
terraform lab02 & terraform state list
azures_network_security_group.lab02_nsg
azures_resource_group.lab02_rg
azures_subnet.lab02_subnet1
azures_subnet_network_security_group_association.lab02_subnet_nsg_assoc
azures_virtual_network.lab02_vnet
terraform lab02 & terraform show
# azures_network_security_group.lab02_nsg
resource "azures_network_security_group" "lab02_nsg" {
  id = "/subscriptions/00000000-0000-0000-0000-000000000000/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg"
  location = "eastus"
  name = "lab02-nsg"
  resource_group_name = "lab02-rg"
  security_rule {
    name = "Allow"
    description = "Allow"
    destination_address_prefix = "*"
    destination_address_prefixes = []
    destination_application_security_group_id = []
    destination_port_ranges = ["*"]
    destination_ports_ranges = []
    direction = "Inbound"
    name = "Allow"
    priority = 100
    protocol = "Tcp"
    source_address_prefix = "*"
    source_address_prefixes = []
    source_application_security_group_id = []
    source_port_range = "*"
    source_ports_ranges = []
  }
}

# azures_resource_group.lab02_rg
resource "azures_resource_group" "lab02_rg" {
  id = "/subscriptions/00000000-0000-0000-0000-000000000000/resourceGroups/lab02-rg"
  location = "eastus"
  name = "lab02-rg"
}

# azures_subnet.lab02_subnet1
resource "azures_subnet" "lab02_subnet1" {
  address_prefixes = [
    "10.0.1.0/24",
  ]
  default_outbound_security_rule_id = type
  id = "/subscriptions/00000000-0000-0000-0000-000000000000/resourceGroups/lab02-rg/providers/Microsoft.Network/subnets/lab02-subnet1"
  name = "lab02-subnet1"
  private_endpoint_network_policies = "Disabled"
  private_link_service_network_interfaces_enabled = true
  resource_group_name = "lab02-rg"
  virtual_network_name = "lab02-vnet1"
}

# azures_subnet_network_security_group_association.lab02_subnet_nsg_assoc
resource "azures_subnet_network_security_group_association" "lab02_subnet_nsg_assoc" {
  id = "/subscriptions/00000000-0000-0000-0000-000000000000/resourceGroups/lab02-rg/providers/Microsoft.Network/subnets/lab02-subnet1"
  network_security_group_id = "/subscriptions/00000000-0000-0000-0000-000000000000/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg"
  subnet_id = "/subscriptions/00000000-0000-0000-0000-000000000000/resourceGroups/lab02-rg/providers/Microsoft.Network/subnets/lab02-subnet1"
}

# azures_virtual_network.lab02_vnet
resource "azures_virtual_network" "lab02_vnet" {
  address_spaces = [
    "10.0.0.0/16",
  ]
  dns_servers = []
  flow_isolation_enabled = false
  id = "/subscriptions/00000000-0000-0000-0000-000000000000/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet"
  location = "eastus"
  name = "lab02-vnet"
  private_endpoint_network_policies = "Disabled"
  resource_group_name = "lab02-rg"
  subnet {
    name = "lab02-subnet1"
  }
}
terraform lab02 & terraform
```

Part 8: Confirm Resource Creation in Azure

17. Log in to the Azure Portal. Navigate to the resource group and confirm all resources exist as per the specifications.

SCREENSHOT (capture the Azure Portal showing the resource group and resources).

20. Open lab02.U in your text editor and add the following:

- a. Add another subnet to the virtual network called lab02-subnet2 using `azurerm_subnet`.
- b. Define a network security group called lab02-nsg2 with two inbound allow TCP rules:
 - Port 3389 called rule1 with priority 100.
 - Port 5985 called rule2 with priority 200 using `azurerm_network_security_group`.
- c. Attach the network security group lab02-nsg2 to lab02-subnet2 using `azurerm_subnet_network_security_group_association`.


```

1 provider "azurerm" {
2   subscription_id = "85fd444-8886-4eb3-a878-f5e77a72a888"
3   features {}
4 }
5
6 # Resource Group
7 resource "azurerm_resource_group" "lab02_rg" {
8   name     = "lab02-rg"
9   location = "eastus"
10 }
11
12 # Virtual Network
13 resource "azurerm_virtual_network" "lab02_vnet" {
14   name                = "lab02-vnet"
15   address_space       = ["10.0.0.0/16"]
16   location             = azurerm_resource_group.lab02_rg.location
17   resource_group_name = azurerm_resource_group.lab02_rg.name
18 }
19
20 # Subnet to the Virtual Network
21 resource "azurerm_subnet" "lab02_subnet1" {
22   name                = "lab02-subnet1"
23   resource_group_name = azurerm_resource_group.lab02_rg.name
24   virtual_network_name = azurerm_virtual_network.lab02_vnet.name
25   address_prefixes     = ["10.0.1.0/24"]
26 }
27
28 # Network Security Group with an Inbound rule
29 resource "azurerm_network_security_group" "lab02_nsg1" {
30   name                = "lab02-nsg1"
31   location             = azurerm_resource_group.lab02_rg.location
32   resource_group_name = azurerm_resource_group.lab02_rg.name
33
34   security_rule {
35     name            = "rule1"
36     priority        = 100
37     direction       = "Inbound"
38     access          = "Allow"
39     protocol         = "Tcp"
40     source_port_range = "*"
41     destination_port_range = "22"
42     source_address_prefix = "*"
43     destination_address_prefix = "*"
44   }
45 }
46
47 # Associate the NSG with the Subnet
48 resource "azurerm_subnet_network_security_group_association" "lab02_subnet_nsg_assoc" {
49   subnet_id          = azurerm_subnet.lab02_subnet1.id
50   network_security_group_id = azurerm_network_security_group.lab02_nsg1.id
51 }

```

```

12 # Second Subnet
13 resource "azurerm_subnet" "lab02_subnet2" {
14   name                = "lab02-subnet2"
15   resource_group_name = azurerm_resource_group.lab02_rg.name
16   virtual_network_name = azurerm_virtual_network.lab02_vnet.name
17   address_prefixes     = ["10.0.2.0/24"]
18 }
19
20 # Second NSG with two Inbound rules
21 resource "azurerm_network_security_group" "lab02_nsg2" {
22   name                = "lab02-nsg2"
23   location             = azurerm_resource_group.lab02_rg.location
24   resource_group_name = azurerm_resource_group.lab02_rg.name
25
26   security_rule {
27     name            = "rule1"
28     priority        = 100
29     direction       = "Inbound"
30     access          = "Allow"
31     protocol         = "Tcp"
32     source_port_range = "*"
33     destination_port_range = "3389"
34     source_address_prefix = "*"
35     destination_address_prefix = "*"
36   }
37
38   security_rule {
39     name            = "rule2"
40     priority        = 200
41     direction       = "Inbound"
42     access          = "Allow"
43     protocol         = "Tcp"
44     source_port_range = "*"
45     destination_port_range = "5985"
46     source_address_prefix = "*"
47     destination_address_prefix = "*"
48   }
49 }
50
51 # Associate lab02-nsg2 with lab02-subnet2
52 resource "azurerm_subnet_network_security_group_association" "lab02_subnet2_nsg_assoc" {
53   subnet_id          = azurerm_subnet.lab02_subnet2.id
54   network_security_group_id = azurerm_network_security_group.lab02_nsg2.id
55 }

```

Part 10: Validate Configuration

21. Validate configuration to ensure there are no errors or typos:
22. Fix any issues in the lab02.U file if reported.
23. Re-run the validation until no errors are reported:

```
ibs@Home lab02 % terraform validate
```

Success! The configuration is valid.

```
ibs@Home lab02 % terraform plan
```

Part 11: Run Simulation

24. Perform a dry run:

```
terraform plan
```

25. Observe output closely. Note resources with +, -, or +/- signs.
26. Fix any issues in the lab02.U file if reported.

```
ibs@Home lab02 % terraform plan
azure_resource_group.lab02_rg: Refreshing state... [lib/subscriptions/8076414-8966-4a83-a878-f5e7173d886f/resourcegroups/lab02-rg]
azure_virtual_network.lab02_vnet: Refreshing state... [lib/subscriptions/8076414-8966-4a83-a878-f5e7173d886f/resourcegroups/lab02-rg/providers/Microsoft.Network/virtualnetworks/lab02-vnet]
azure_network_security_group.lab02_nsg1: Refreshing state... [lib/subscriptions/8076414-8966-4a83-a878-f5e7173d886f/resourcegroups/lab02-rg/providers/Microsoft.Network/networksecuritygroups/lab02-nsg1]
azure_subnet.lab02_subnet1: Refreshing state... [lib/subscriptions/8076414-8966-4a83-a878-f5e7173d886f/resourcegroups/lab02-rg/providers/Microsoft.Network/virtualnetworks/lab02-vnet/subnets/lab02-subnet1]
azure_subnet_network_security_group_association.lab02_subnet_nsg_assoc: Refreshing state... [lib/subscriptions/8076414-8966-4a83-a878-f5e7173d886f/resourcegroups/lab02-rg/providers/Microsoft.Network/virtualnetworks/lab02-vnet/subnets/lab02-subnet1]

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:

# azure_resource_group.lab02_rg will be created
+ resource "azure_resource_group" "lab02_rg" {
  id          = (known after apply)
  location    = "australia"
  name        = "lab02-rg1"
  resource_group_name = "lab02-rg"
  security_rule {
    access {
      description = "allow"
      destination_address_prefix = ""
      destination_address_prefixes = []
      destination_application_security_group_id = []
      destination_port_range = "25560"
      destination_port_ranges = []
      direction = "outbound"
      name = "rule1"
      priority = 100
      protocol = "tcp"
      source_address_prefix = ""
      source_address_prefixes = []
      source_application_security_group_id = []
      source_port_range = ""
      source_port_ranges = []
    }
  }
}

# azure_subnet.lab02_subnet1 will be created
+ resource "azure_subnet" "lab02_subnet1" {
  address_prefix = "10.0.3.0/24"
  default_outbound_access_enabled = true
  id = (known after apply)
  name = "lab02-subnet1"
  private_endpoint_network_policies = "disabled"
  private_link_service_network_policies_enabled = true
  resource_group_name = "lab02-rg"
  virtual_network_name = "lab02-vnet"
}

# azure_subnet_network_security_group_association.lab02_subnet_nsg_assoc will be created
+ resource "azure_subnet_network_security_group_association" "lab02_subnet_nsg_assoc" {
  id = (known after apply)
  network_security_group_id = (known after apply)
  subnet_id = (known after apply)
}
```

27. Redo the dry run until no errors are reported:

```

# azure_rm_subnet.lab02_subnet2 will be created
+ resource "azure_rm_subnet" "lab02_subnet2" {
  + address_prefixes      = [
    + "10.0.2.0/24",
  ]
  + default_outbound_access_enabled = true
  + id                          = (known after apply)
  + name                      = "lab02-subnet2"
  + private_endpoint_network_policies = "Disabled"
  + private_link_service_network_policies_enabled = true
  + resource_group_name      = "lab02-rg"
  + virtual_network_name     = "lab02-vnet"
}

# azure_rm_subnet_network_security_group_association.lab02_subnet2_nsg_assoc will be created
+ resource "azure_rm_subnet_network_security_group_association" "lab02_subnet2_nsg_assoc" {
  + id                  = (known after apply)
  + network_security_group_id = (known after apply)
  + subnet_id          = (known after apply)
}

```

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

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.
 ibs@Home lab02 %

Part 12: Deploy Infrastructure

28. Deploy the infrastructure and monitor progress:

```
terraform apply
```

- Type yes when prompted.

```
[lab@mslab02 ~]$ terraform apply
azure_resource_group.lab02_rg: Refreshing state... [id=/subscriptions/907b6144-8956-4ab3-a878-f5e77472eb80/resourceGroups/lab02-rg]
azure_network_security_group.lab02_nsg1: Refreshing state... [id=/subscriptions/907b6144-8956-4ab3-a878-f5e77472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg1]
azure_virtual_network.lab02_vnet: Refreshing state... [id=/subscriptions/907b6144-8956-4ab3-a878-f5e77472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet]
azure_subnet.lab02_subnet1: Refreshing state... [id=/subscriptions/907b6144-8956-4ab3-a878-f5e77472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1]
azure_subnet_network_security_group_association.lab02_subnet1_nsg_assoc: Refreshing state... [id=/subscriptions/907b6144-8956-4ab3-a878-f5e77472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1]

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:

# azure_resource_group.lab02_rg will be created
+ resource "azure_resource_group" "lab02_rg" {
  id           = (known after apply)
  location     = "eastus"
  name         = "lab02-rg"
  resource_group_name = "lab02-rg"
  security_rule = [
    {
      + action          = "allow"
      + description     = ""
      + destination_address_prefix = ""
      + destination_address_prefixes = []
      + destination_application_security_group_id = []
      + destination_port_range      = "3389"
      + destination_port_ranges     = []
      + direction         = "Inbound"
      + name              = "rule1"
      + priority          = 100
      + protocol          = "tcp"
      + source_address_prefix = ""
      + source_address_prefixes = []
      + source_application_security_group_id = []
      + source_port_range    = ""
      + source_port_ranges   = []
    },
    {
      + action          = "allow"
      + description     = ""
      + destination_address_prefix = ""
      + destination_address_prefixes = []
      + destination_application_security_group_id = []
      + destination_port_range      = "3389"
      + destination_port_ranges     = []
      + direction         = "Inbound"
      + name              = "rule2"
      + priority          = 100
      + protocol          = "tcp"
      + source_address_prefix = ""
      + source_address_prefixes = []
      + source_application_security_group_id = []
      + source_port_range    = ""
      + source_port_ranges   = []
    }
  ]
}

# azure_subnet.lab02_subnet2 will be created
+ resource "azure_subnet" "lab02_subnet2" {
  address_prefixes = [
    "10.0.3.0/24",
  ]
  default_outbound_access_enabled = true
  id                             = (known after apply)
  name                          = "lab02-subnet2"
  private_endpoint_network_policies = "Disabled"
  private_link_service_network_policies_enabled = true
  resource_group_name           = "lab02-rg"
  virtual_network_name          = "lab02-vnet"
}

# azure_subnet_network_security_group_association.lab02_subnet2_nsg_assoc will be created
+ resource "azure_subnet_network_security_group_association" "lab02_subnet2_nsg_assoc" {
  id = (known after apply)
  network_security_group_id = (known after apply)
  subnet_id                 = (known after apply)
}

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

Do you want to perform these actions?
Terraform will perform the actions described above.
Only 'yes' will be accepted to approve.

Enter a value: yes

```
azure_subnet.lab02_subnet2: Creating...
azure_network_security_group.lab02_nsg1: Creating...
azure_network_security_group.lab02_nsg1: Creation complete after 7s [id=/subscriptions/907b6144-8956-4ab3-a878-f5e77472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg1]
azure_subnet.lab02_subnet2: Still creating... [10s elapsed]
azure_subnet.lab02_subnet2: Creation complete after 10s [id=/subscriptions/907b6144-8956-4ab3-a878-f5e77472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2]
azure_subnet_network_security_group_association.lab02_subnet2_nsg_assoc: Creating...
azure_subnet_network_security_group_association.lab02_subnet2_nsg_assoc: Creation complete after 0s [id=/subscriptions/907b6144-8956-4ab3-a878-f5e77472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2]

Apply complete! Resources: 5 added, 0 changed, 0 destroyed.
[lab@mslab02 ~]$
```

Part 13: Get Information from Terraform State

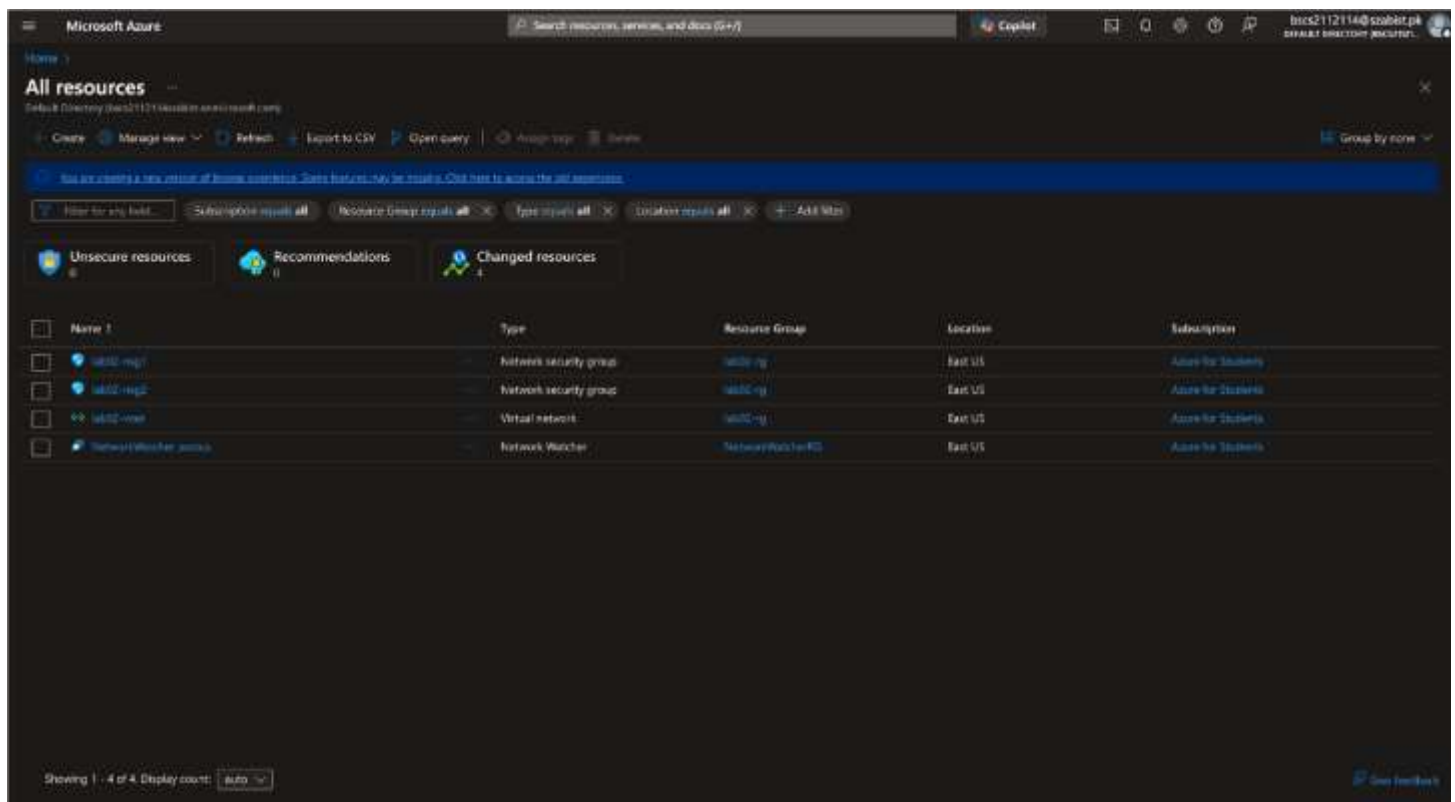
31. View and analyze state information:

terraform state list

```
ibs@Home lab02 % terraform state list
azurerm_network_security_group.lab02_nsg1
azurerm_network_security_group.lab02_nsg2
azurerm_resource_group.lab02_rg
azurerm_subnet.lab02_subnet1
azurerm_subnet.lab02_subnet2
azurerm_subnet_network_security_group_association.lab02_subnet2_nsg_assoc
azurerm_subnet_network_security_group_association.lab02_subnet_nsg_assoc
azurerm_virtual_network.lab02_vnet
ibs@Home lab02 %
```

Part 14: Confirm Resource Creation in Azure

32. Log in to the Azure Portal. Navigate to the resource group and confirm all resources exist as per the specifications.



Part 15: Destroy All Resources and Verify

33. Destroy all the resources:

```
terraform destroy
```

- Type yes when prompted.

34. Verify deletion:

```
terraform state list
```

terraform show

```
ibs@Home lab02 % terraform state list
ibs@Home lab02 % terraform show
The state file is empty. No resources are represented.
ibs@Home lab02 % █
```