



# ***SZABIST***

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# Lab 03 (Modules 04 and 05)

Parametrize lab02 Terraform configura6on

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IT INFRASTRUCTURE, CLOUD AND DEVOPS PROFESSIONAL

## Instructions:

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-lab03.

## Lab Objectives:

There are 5 sections in this lab. Each section has a different set of objectives:

- **Section 1:** Parametrize lab02 Terraform configuration.
  - **Section 2:** Expand the parametrized Terraform configuration from Section 1 and add a Linux virtual machine to the landscape.
  - **Section 3:** Expand Section 2 and define and consume local values.
  - **Section 4:** Expand Section 3 and define output blocks.
  - **Section 5:** Expand Section 4 and add explicit lifecycle rules and dependencies.
- 

## Section 1

### Objectives:

- Move resource values to a separate file as variable blocks.
- Update main Terraform file to use variables.
- Validate, deploy, expand, analyze, and destroy infrastructure.

### Part 1: Prepare for the Lab

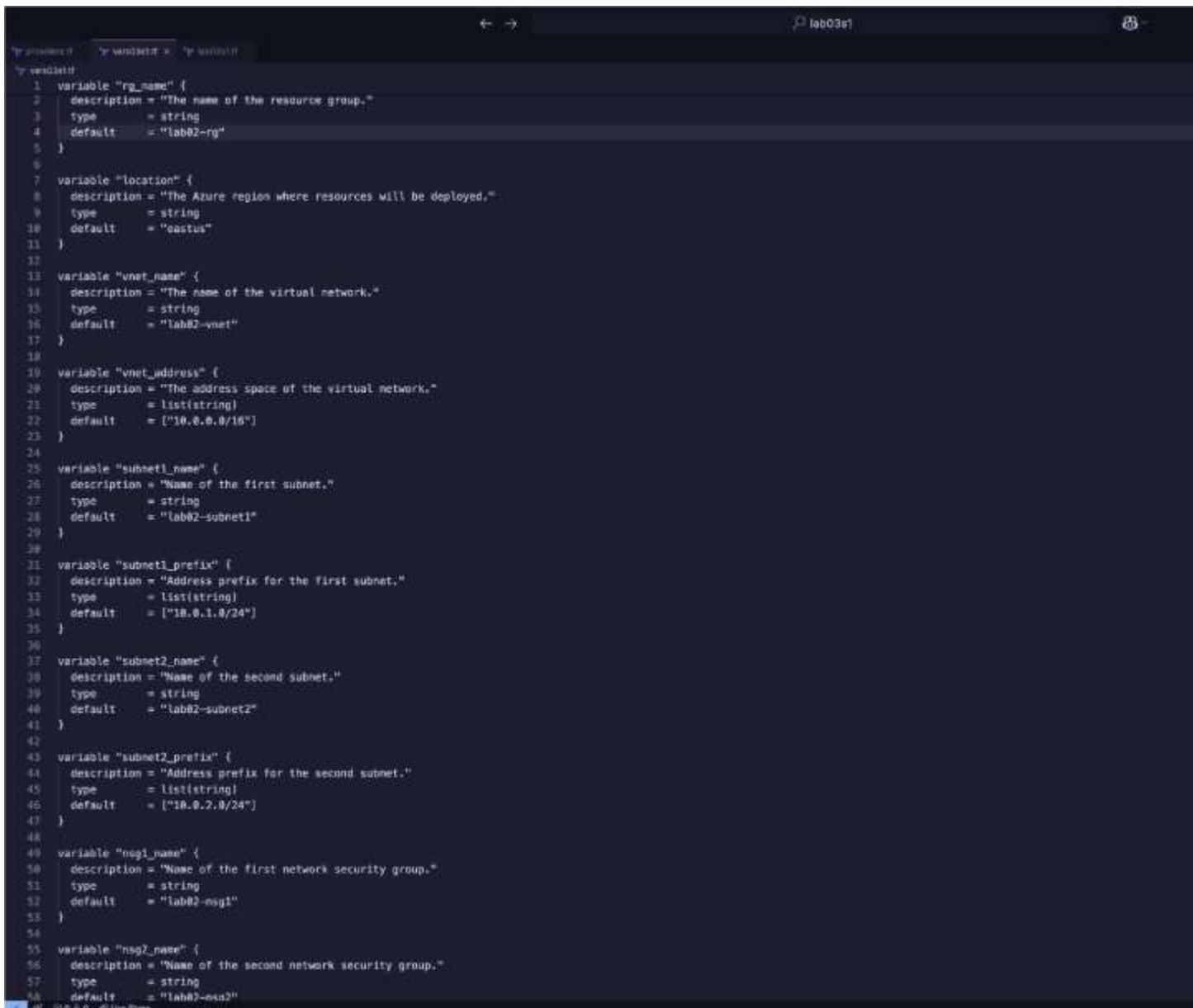
1. Open a Command Prompt or PowerShell window.
2. Create a directory called lab03s1 in your home directory.
3. Copy lab02.' file into lab03s1 directory.
4. Change into the lab03s1 directory.
5. Rename lab02.' as lab03s1.'.
6. Create an empty file called vars03s1.'.
7. Create an empty file called providers.'.

### Part 2: Update vars03s1.A File

8. Copy provider and Terraform blocks from lab03s1.' to providers.' (use a text editor like Notepad or VS Code).
9. Open vars03s1.' in a text editor and define variable blocks as follows. Enclose values in double quotation marks:
  - a. One block for resource group name.
  - b. One block for location.
  - c. One block for virtual network name.
  - d. One block for virtual network address space.
  - e. Two blocks for subnet names (one per subnet).

- f. Two blocks for subnet address spaces (one per address space).
- g. Two blocks for network security groups (one per network security group).

### Part 3: Update lab03s1.A File



```
1 variable "rg_name" {
2   description = "The name of the resource group."
3   type       = string
4   default    = "lab02-rg"
5 }
6
7 variable "location" {
8   description = "The Azure region where resources will be deployed."
9   type       = string
10  default    = "eastus"
11 }
12
13 variable "vnet_name" {
14   description = "The name of the virtual network."
15   type       = string
16   default    = "lab02-vnet"
17 }
18
19 variable "vnet_address" {
20   description = "The address space of the virtual network."
21   type       = list(string)
22   default    = ["10.0.0.0/16"]
23 }
24
25 variable "subnet1_name" {
26   description = "Name of the first subnet."
27   type       = string
28   default    = "lab02-subnet1"
29 }
30
31 variable "subnet1_prefix" {
32   description = "Address prefix for the first subnet."
33   type       = list(string)
34   default    = ["10.0.1.0/24"]
35 }
36
37 variable "subnet2_name" {
38   description = "Name of the second subnet."
39   type       = string
40   default    = "lab02-subnet2"
41 }
42
43 variable "subnet2_prefix" {
44   description = "Address prefix for the second subnet."
45   type       = list(string)
46   default    = ["10.0.2.0/24"]
47 }
48
49 variable "nsg1_name" {
50   description = "Name of the first network security group."
51   type       = string
52   default    = "lab02-nsg1"
53 }
54
55 variable "nsg2_name" {
56   description = "Name of the second network security group."
57   type       = string
58   default    = "lab02-nsg2"
59 }
```

10. Open lab03s1. in a text editor and update as follows:
  - a. Remove provider and Terraform blocks.
  - b. Update all resource blocks to source values from vars03s1.

```

1  # Resource Group
2  resource "azurerm_resource_group" "lab02_rg" {
3      name      = var.rg_name
4      location  = var.location
5  }
6
7
8  # Virtual Network
9  resource "azurerm_virtual_network" "lab02_vnet" {
10     name            = var.vnet_name
11     address_space   = var.vnet_address
12     location        = var.location
13     resource_group_name = azurerm_resource_group.lab02_rg.name
14 }
15
16
17 # Subnet to the Virtual Network
18 resource "azurerm_subnet" "lab02_subnet1" {
19     name                = var.subnet1_name
20     resource_group_name = azurerm_resource_group.lab02_rg.name
21     virtual_network_name = azurerm_virtual_network.lab02_vnet.name
22     address_prefixes    = var.subnet1_prefix
23 }
24
25
26 # Network Security Group with an inbound rule
27 resource "azurerm_network_security_group" "lab02_nsg1" {
28     name            = var.nsg1_name
29     location        = var.location
30     resource_group_name = azurerm_resource_group.lab02_rg.name
31
32     security_rule {
33         name                = "rule1"
34         priority            = 100
35         direction          = "Inbound"
36         access              = "Allow"
37         protocol            = "Tcp"
38         source_port_range   = "*"
39         destination_port_range = "22"
40         source_address_prefix = "*"
41         destination_address_prefix = "*"
42     }
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
52 # Second Subnet
53 resource "azurerm_subnet" "lab02_subnet2" {
54     name                = var.subnet2_name
55     resource_group_name = azurerm_resource_group.lab02_rg.name
56     virtual_network_name = azurerm_virtual_network.lab02_vnet.name
57     address_prefixes     = var.subnet2_prefix
58 }
59
60
61
62 # Second NSG with two inbound rules
63 resource "azurerm_network_security_group" "lab02_nsg2" {
64     name                = var.nsg2_name
65     location             = var.location
66     resource_group_name = azurerm_resource_group.lab02_rg.name
67
68     security_rule {
69         name                = "rule1"
70         priority             = 100
71         direction           = "Inbound"
72         access              = "Allow"
73         protocol            = "Tcp"
74         source_port_range   = "*"
75         destination_port_range = "3389"
76         source_address_prefix = "*"
77         destination_address_prefix = "*"
78     }
79
80     security_rule {
81         name                = "rule2"
82         priority             = 200
83         direction           = "Inbound"
84         access              = "Allow"
85         protocol            = "Tcp"
86         source_port_range   = "*"
87         destination_port_range = "5985"
88         source_address_prefix = "*"
89         destination_address_prefix = "*"
90     }
91 }
92
93
94 # Associate lab02-nsg2 with lab02-subnet2
95 resource "azurerm_subnet_network_security_group_association" "lab02_subnet2_nsg_assoc" {
96     subnet_id                = azurerm_subnet.lab02_subnet2.id
97     network_security_group_id = azurerm_network_security_group.lab02_nsg2.id
98 }
99
100
101

```

#### Part 4: Initialize Terraform

11. Initialize Terraform to download plug-ins as required:

#### Part 5: Validate Configuration

13. Validate the configuration to ensure no errors or typos:

14. Fix any issues in lab03s1.' and/or vars03s1.' files if reported (edit in your text editor).
15. Re-run validation until no errors are reported.



```
PROBLEMS OUTPUT PORTS DEBUG CONSOLE TERMINAL
• ibs@Home lab03s1 % terraform init

Initializing the backend...

Initializing provider plugins...
- Reusing previous version of hashicorp/azurerm from the dependency lock file
- Using previously-installed hashicorp/azurerm v4.26.0

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.
• ibs@Home lab03s1 % terraform validate

Success! The configuration is valid.

❖ ibs@Home lab03s1 %
```

## Part 6: Run Simulation

16. Perform a dry run:

```
terraform plan
```

17. Review output and ensure all configuration meets requirements. Observe resources with +, -, or -/+ signs.
18. Fix any issues in lab03s1.' and/or vars03s1.' files if reported.
19. Redo the dry run until no errors are reported.

## Part 8: Deploy Infrastructure

20. Deploy the infrastructure and monitor progress.
  - Type yes when prompted.

## Part 9: Get Information from Terraform State

22. View and analyze state information:

```
terraform state list terraform
show
```



```

• ibs@Home lab03s1 % 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

```

## Part 10: Confirm Resource Creation in Azure

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

## Part 11: Destroy All Resources and Verify

24. Destroy all resources:

```
terraform destroy
```

- Type yes when prompted.

25. Verify deletion:

```

terraform state list terraform
show

```

```

• ibs@Home lab03s1 % terraform show
# azurerm_network_security_group.lab02_nsg1:
resource "azurerm_network_security_group" "lab02_nsg1" {
  id = "/subscriptions/05f04144-8986-4eb3-a070-f5ef74f2eb06/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg1"
  location = "eastus"
  name = "lab02-nsg1"
  resource_group_name = "lab02-rg"
  security_rule = [
    {
      access = "Allow"
      description = ""
      destination_address_prefix = "4"
      destination_address_prefixes = []
      destination_application_security_group_ids = []
      destination_port_range = "22"
      destination_port_ranges = []
      direction = "Inbound"
      name = "rule1"
      priority = 100
      protocol = "Tcp"
      source_address_prefix = "4"
      source_address_prefixes = []
      source_application_security_group_ids = []
      source_port_range = "4"
      source_port_ranges = []
    }
  ]
}

# azurerm_network_security_group.lab02_nsg2:
resource "azurerm_network_security_group" "lab02_nsg2" {
  id = "/subscriptions/05f04144-8986-4eb3-a070-f5ef74f2eb06/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg2"
  location = "eastus"
  name = "lab02-nsg2"
  resource_group_name = "lab02-rg"
  security_rule = [
    {
      access = "Allow"
      description = ""
      destination_address_prefix = "4"
      destination_address_prefixes = []
      destination_application_security_group_ids = []
      destination_port_range = "3389"
      destination_port_ranges = []
      direction = "Inbound"
      name = "rule1"
      priority = 100
      protocol = "Tcp"
      source_address_prefix = "4"
      source_address_prefixes = []
      source_application_security_group_ids = []
      source_port_range = "4"
      source_port_ranges = []
    }
  ]
}

```



```

        destination_port_range      = "5905"
        destination_port_ranges     = []
        direction                   = "Inbound"
        name                         = "rule2"
        priority                     = 200
        protocol                     = "Tcp"
        source_address_prefixes     = ["*"]
        source_application_security_group_ids = []
        source_port_range           = "5"
        source_port_ranges          = []
    },
)

# azure_rm_resource_group.lab02_rg:
resource "azure_rm_resource_group" "lab02_rg" {
    id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb08/resourceGroups/lab02-rg"
    location = "eastus"
    name = "lab02-rg"
    tags = {}
}

# azure_rm_subnet.lab02_subnet1:
resource "azure_rm_subnet" "lab02_subnet1" {
    address_prefixes = [
        "10.0.1.0/24",
    ]
    default_outbound_access_enabled = true
    id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
    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_rm_subnet.lab02_subnet2:
resource "azure_rm_subnet" "lab02_subnet2" {
    address_prefixes = [
        "10.0.2.0/24",
    ]
    default_outbound_access_enabled = true
    id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2"
    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:
resource "azure_rm_subnet_network_security_group_association" "lab02_subnet2_nsg_assoc" {
    id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2"
    network_security_group_id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg2"
    subnet_id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2"
}

# azure_rm_subnet_network_security_group_association.lab02_subnet1_nsg_assoc:
resource "azure_rm_subnet_network_security_group_association" "lab02_subnet1_nsg_assoc" {
    id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
    network_security_group_id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg1"
    subnet_id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
}

# azure_rm_virtual_network.lab02_vnet:
resource "azure_rm_virtual_network" "lab02_vnet" {
    address_space = [
        "10.0.0.0/16",
    ]
    dns_servers = []
    flow_timeout_in_minutes = 0
    guid = "dd62eaba-79b3-4777-b1ab-45ea63ca6c96"
    id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet"
    location = "eastus"
    name = "lab02-vnet"
    private_endpoint_vnet_policies = "Disabled"
    resource_group_name = "lab02-rg"
    subnet = []
}

~$ ipnetutil lab03s1 % {}

```

## Section 2

**Objectives:** • Use configuration from

Section 1.

- Define resource and variable blocks for virtual machine resources. Validate, deploy, expand, analyze, and destroy infrastructure.

### Part 1: Prepare for the Lab

- Create a directory called lab03s2 in your home directory:
- Copy lab03s1.`, vars03s1.`, and providers.` into lab03s2 directory:
- Change into the lab03s2 directory:
- Create two empty files called lab03s2.` and vars03s2.`:

## Part 2: Update vars03s2.A File

5. Open vars03s2.' in a text editor and define variable blocks for a Linux virtual machine. Enclose values in double quotation marks:
- a. Name (e.g., linux\_name): "lab03s2-db1-u-vm1".
  - b. Size: "Standard\_B1s".
  - c. Admin user name: "<firstname-yourHumberID>" [from Lab 01].
  - d. Public key: "C:\Users\<YourWindowsUsername>\.ssh\id\_rsa.pub" (adjust path to your SSH public key location on Windows).
  - e. OS disk attributes:
    - i. Storage account type: "Premium\_LRS".
    - ii. Disk size: "32".
    - iii. Caching: "ReadWrite".
  - f. Ubuntu Linux OS information:
    - i. Publisher: "Canonical".
    - ii. Offer: "UbuntuServer".
    - iii. Sku: "19.04".
    - iv. Version: "latest".

```
vars03s2.tf  x  lab03s2.tf
vars03s2.tf
1  variable "linux_name" {
2      description = "The name of the Linux virtual machine."
3      type        = string
4      default     = "lab03s2-dbl-u-vm1"
5  }
6
7  variable "vm_size" {
8      description = "The size of the Linux VM instance."
9      type        = string
10     default     = "Standard_B1s"
11 }
12
13 variable "admin_username" {
14     description = "The admin username for the Linux VM."
15     type        = string
16     default     = "ibs"
17 }
18
19 variable "public_key_path" {
20     description = "The path to the SSH public key for the Linux VM admin."
21     type        = string
22     default     = "/Users/ibs/.ssh/id_rsa.pub"
23 }
24
25
26 variable "os_disk_storage_type" {
27     description = "The storage account type for the OS disk."
28     type        = string
29     default     = "Premium_LRS"
30 }
31
32 variable "os_disk_size" {
33     description = "OS disk size in GB."
34     type        = number
35     default     = 32
36 }
37
38 variable "os_disk_caching" {
39     description = "Caching mode for the OS disk."
40     type        = string
41     default     = "ReadWrite"
42 }
43
44 variable "os_publisher" {
45     description = "The publisher of the OS image."
46     type        = string
47     default     = "Canonical"
48 }
```

```

vars03s2.tf
vars03s2.tf
42 }
43
44 variable "os_publisher" {
45   description = "The publisher of the OS image."
46   type        = string
47   default     = "Canonical"
48 }
49
50 variable "os_offer" {
51   description = "The offer for the OS image."
52   type        = string
53   default     = "0001-com-ubuntu-server-focal"
54 }
55
56 variable "os_sku" {
57   description = "The SKU for the OS image."
58   type        = string
59   default     = "20_04-lts"
60 }
61
62 variable "os_version" {
63   description = "The version for the OS image."
64   type        = string
65   default     = "latest"
66 }
67

```

### Part 3: Update lab03s2.A File

6. Open lab03s2.' in a text editor and define resource blocks as follows:
  - a. Define network interface called `${var.linux_name}-nic` with IP configuration name `${var.linux_name}-ipconfig1` using `azurerm_network_interface`. Use Dynamic IP address allocation.
  - b. Define public IP address called `${var.linux_name}-pip` using `azurerm_public_ip`. Use Dynamic IP address allocation method.
  - c. Define virtual machine using `azurerm_linux_virtual_machine`. Use `${var.linux_name}-osdisk` as the OS disk name.

```

vars03s2.tf lab03s2.tf
lab03s2.tf
1 # Network Interface for the Linux VM
2 resource "azurerm_network_interface" "linux_nic" {
3   name = "${var.linux_name}-nic"
4   location = var.location
5   resource_group_name = azurerm_resource_group.lab02_rg.name
6
7   ip_configuration {
8     name = "${var.linux_name}-ipconfig1"
9     subnet_id = azurerm_subnet.lab02_subnet1.id
10    private_ip_address_allocation = "Dynamic"
11    public_ip_address_id = azurerm_public_ip.linux_pip.id
12  }
13 }
14
15 # Public IP for the Linux VM
16 resource "azurerm_public_ip" "linux_pip" {
17   name = "${var.linux_name}-pip"
18   location = var.location
19   resource_group_name = azurerm_resource_group.lab02_rg.name
20   allocation_method = "Dynamic"
21   sku = "Basic"
22 }
23
24 # Linux Virtual Machine
25 resource "azurerm_linux_virtual_machine" "linux_vm" {
26   name = var.linux_name
27   resource_group_name = azurerm_resource_group.lab02_rg.name
28   location = var.location
29   size = var.vm_size
30   admin_username = var.admin_username
31
32   network_interface_ids = [
33     azurerm_network_interface.linux_nic.id,
34   ]
35
36   admin_ssh_key {
37     username = var.admin_username
38     public_key = file(var.public_key_path)
39   }
40
41   os_disk {
42     caching = var.os_disk_caching
43     storage_account_type = var.os_disk_storage_type
44     disk_size_gb = var.os_disk_size
45   }
46
47   source_image_reference {
48     publisher = var.os_publisher
49     offer = var.os_offer
50     sku = var.os_sku
51     version = var.os_version
52   }
53 }
54

```

**Note:** At this point, you should have 5 Terraform files—`providers.<`, `lab03s1.<`, `vars03s1.<`, `lab03s2.<`, and

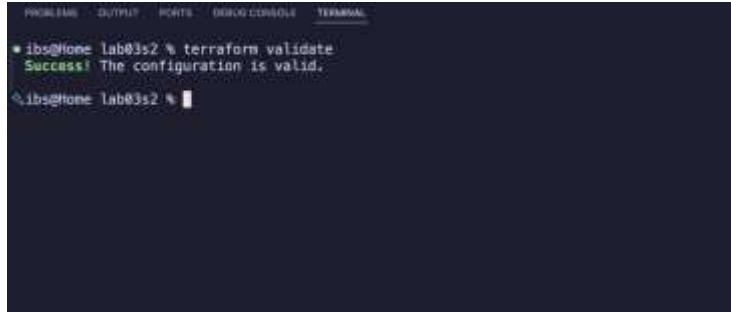
vars03s2.<—under the lab03s2 directory.

#### Part 4: Initialize Terraform

7. Initialize Terraform to download plug-ins as required:

#### Part 5: Validate Configuration

8. Validate the configuration to ensure no errors or typos:



```
ibsg@Home lab03s2 % terraform validate
Success! The configuration is valid.
ibsg@Home lab03s2 %
```

#### Part 6: Run Simulation

11. Perform a dry run:

```
terraform plan
```

12. Review output and ensure all configuration meets requirements. Observe resources with +, -, or -/+ signs.
13. Fix any issues in the Terraform files if reported.
14. Redo the dry run until no errors are reported:

#### Part 7: Deploy Infrastructure

15. Deploy the infrastructure and monitor progress:

#### Part 8: Get Information from Terraform State

17. View and analyze state information:

```
terraform state list terraform
show
```

```

• ibs@Home lab03s2 % terraform state list
azurerm_linux_virtual_machine.linux_vm
azurerm_network_interface.linux_nic
azurerm_network_security_group.lab02_nsg1
azurerm_network_security_group.lab02_nsg2
azurerm_public_ip.linux_pip
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 lab03s2 % terraform show
# azurerm_linux_virtual_machine.linux_vm:
resource "azurerm_linux_virtual_machine" "linux_vm" {
  admin_username = "ibs"
  allow_extension_operations = true
  bypass_platform_safety_checks_on_user_schedule_enabled = false
  computer_name = "lab03s2-dbl-u-vm1"
  disable_password_authentication = true
  encryption_at_host_enabled = false
  extensions_time_budget = "PT1H30M"
  id = "/subscriptions/85fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Compute/virtualMachines/lab03s2-dbl-u-vm1"
  location = "eastus"
  max_bid_price = -1
  name = "lab03s2-dbl-u-vm1"
  network_interface_ids = [
    "/subscriptions/85fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkInterfaces/lab03s2-dbl-u-vm1-nic",
  ]
  patch_assessment_mode = "ImageDefault"
  patch_mode = "ImageDefault"
  platform_fault_domain = -1
  priority = "Regular"
  private_ip_address = "10.0.1.4"
  private_ip_addresses = [
    "10.0.1.4",
  ]
  provision_vm_agent = true
  public_ip_address = "172.172.226.126"
  public_ip_addresses = [
    "172.172.226.126",
  ]
  resource_group_name = "lab02-rg"
  secure_boot_enabled = false
  size = "Standard_B1s"
  tags = {}
  virtual_machine_id = "7f5231c0-c040-4d91-92b7-2ce97350670d"
  vm_agent_platform_updates_enabled = false
  vtpm_enabled = false
}

```

```

  admin_ssh_key {
    public_key = <--EOT
      ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQCAQM0YbSuIYAU1A4wPKFchw0pLyVy2eEcbLv0dnhH/IL/hACF/Ak5p0qvBN55EXJXX1VNjX+3H1j5LHWx9dx7Vw0t
      Blvs2sFxcq3dsYcW4wF3wyhXgIbKKnz4Ir5iQ3ZejtyBbaZLAoPt9a5EWQ0Pv+4hcwv7w0CZf4o7Q1L6ML3vJ3Ggk6XPjECaGfNA5fQ8WbvaJkDKknVyAqilb1r4uA0qMN
      s3NeBldpusDEU3nG+V5/J0R8/RCaR8G1QuG62ITg+C3L7dLPkgie2zJyR8ew7+uuxeyKX5MBj rMhJLf+cv+bpejPju07+/Bt8TY4y8PYclrt0n7H1AAAMeYTWAASKKZrE9FynAQ
      c8kIZi+aiAd0pobkFYMBFxiDh6di5FT675tviR5GcwQ5w93/BQowkYxvWlVKcuuvKv54+BPbpAw/FE8ED3aZ067HFRv0c0ekTdjvWqInXfa6rKkFLu1zx0a6bjp70qsZ1toa5
      V32Cj6dV5f8PnyAQR4HL8keCum6y80kUa0gAKVI67n1LnAqFik6+GSX4n134fDDVAFV0XsnHyR4doIDmkR1NKwaTnJ0JzJ/AZj89KY7sYGdLjgnN2R0aNT0BQxZ4wgQkbP0LxK
      n/0FL6LbXonxMv1jveeoBx1QNH9o9qW0x0Lh5ksb34xAJCLyMyRiRlkhkQ= ibs@home.local
    EOT
    username = "ibs"
  }

  os_disk {
    caching = "ReadWrite"
    disk_size_gb = 32
    id = "/subscriptions/85fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Compute/disks/lab03s2-dbl-u-vm1_disk1_49578bdac6af44afb73189c7fd07102d"
    name = "lab03s2-dbl-u-vm1_disk1_49578bdac6af44afb73189c7fd07102d"
    storage_account_type = "Premium_LRS"
    write_accelerator_enabled = false
  }

  source_image_reference {
    offer = "0001-con-ubuntu-server-focal"
    publisher = "Canonical"
    sku = "20_04-lts"
    version = "latest"
  }
}

# azurerm_network_interface.linux_nic:
resource "azurerm_network_interface" "linux_nic" {
  accelerated_networking_enabled = false
  applied_dns_servers = []
  dns_servers = []
  id = "/subscriptions/85fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkInterfaces/lab03s2-dbl-u-vm1-nic"
  internal_domain_name_suffix = "rlvgfxntphlupnlixvgftntd.bx.internal.cloudapp.net"
  ip_forwarding_enabled = false
  location = "eastus"
}

```



```
PROBLEMS OUTPUT PORTS DEBUG CONSOLE TERMINAL
mac_address = "08-00-3A-4F-68-30"
name = "lab03s2-dbl-u-vml-nic"
private_ip_address = "10.0.1.4"
private_ip_addresses = [
  "10.0.1.4",
]
resource_group_name = "lab02-rg"
tags = {}
virtual_machine_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Compute/virtualMachines/lab03s2-dbl-u-vml"

ip_configuration {
  name = "lab03s2-dbl-u-vml-ipconfig1"
  primary = true
  private_ip_address = "10.0.1.4"
  private_ip_address_allocation = "Dynamic"
  private_ip_address_version = "IPv4"
  public_ip_address_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/publicIPAddresses/lab03s2-dbl-u-vml-pip"
  subnet_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
}

# azure_rm_network_security_group.lab02_nsg1:
resource "azure_rm_network_security_group" "lab02_nsg1" {
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg1"
  location = "eastus"
  name = "lab02-nsg1"
  resource_group_name = "lab02-rg"
  security_rule = [
    {
      access = "Allow"
      description = ""
      destination_address_prefix = "a"
      destination_address_prefixes = []
      destination_application_security_group_ids = []
      destination_port_range = "22"
      destination_port_ranges = []
      direction = "Inbound"
    }
  ]
}

tags = {}
}
```

```
PROBLEMS OUTPUT PORTS DEBUG CONSOLE TERMINAL
name = "rule1"
priority = 100
protocol = "Tcp"
source_address_prefix = "a"
source_address_prefixes = []
source_application_security_group_ids = []
source_port_range = "a"
source_port_ranges = []
},
tags = {}
}

# azure_rm_network_security_group.lab02_nsg2:
resource "azure_rm_network_security_group" "lab02_nsg2" {
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg2"
  location = "eastus"
  name = "lab02-nsg2"
  resource_group_name = "lab02-rg"
  security_rule = [
    {
      access = "Allow"
      description = ""
      destination_address_prefix = "a"
      destination_address_prefixes = []
      destination_application_security_group_ids = []
      destination_port_range = "3389"
      destination_port_ranges = []
      direction = "Inbound"
      name = "rule1"
      priority = 100
      protocol = "Tcp"
      source_address_prefix = "a"
      source_address_prefixes = []
      source_application_security_group_ids = []
      source_port_range = "a"
      source_port_ranges = []
    },
    {
      access = "Allow"
      description = ""
      destination_address_prefix = "a"
      destination_address_prefixes = []
      destination_application_security_group_ids = []
      destination_port_range = "5985"
      destination_port_ranges = []
      direction = "Inbound"
      name = "rule2"
      priority = 200
    }
  ]
}
```



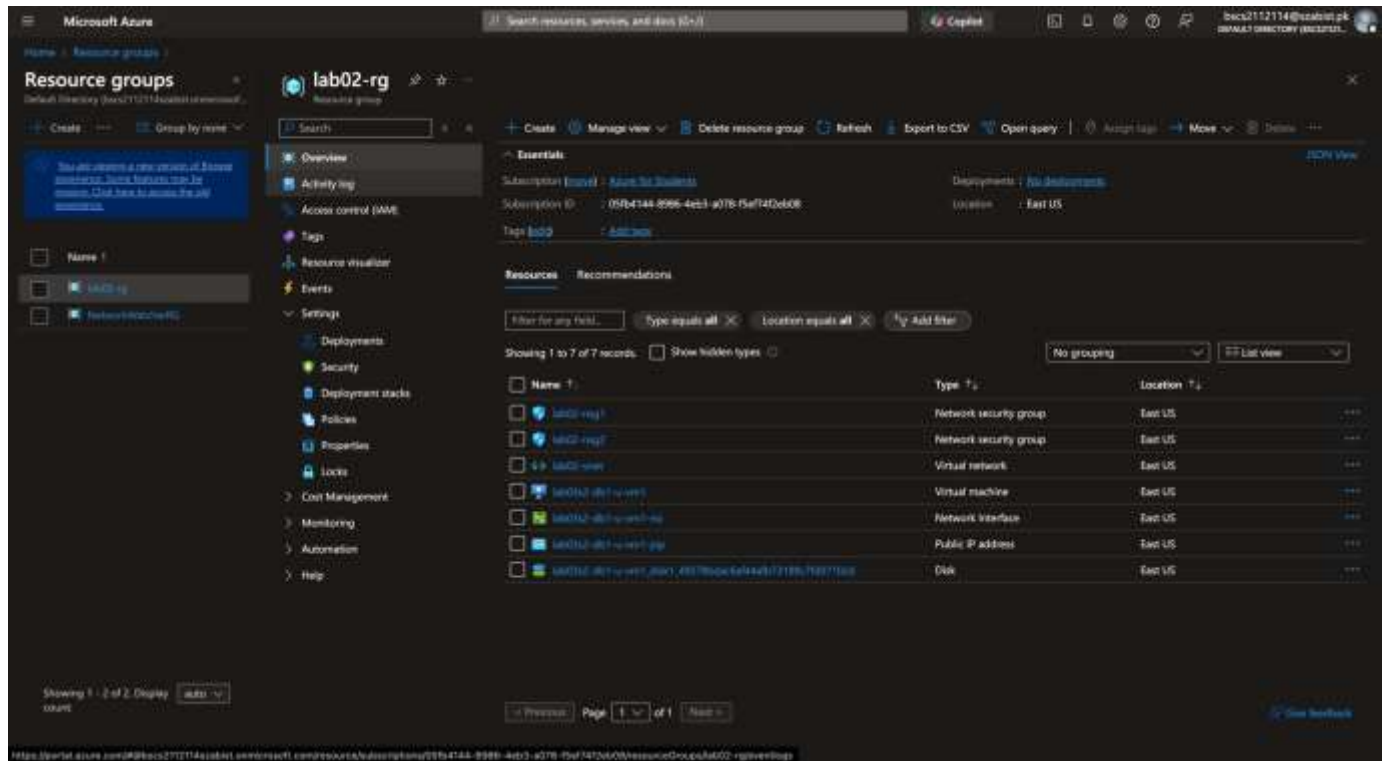
```

    service_endpoints = {}
  },
  {
    address_prefixes = [
      "10.0.0/24",
    ],
    default_outbound_access_enabled = true
  },
  {
    delegation = {
      id = "/subscriptions/85fb1444-8986-4eb3-a878-f5ef7472ab08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/aNetworks/lab02-vnet/subnets/lab02-subnet2"
      name = "lab02-subnet2"
      private_endpoint_network_policies = "Disabled"
      private_link_service_network_policies_enabled = true
      route_table_id = ""
      security_group = "/subscriptions/85fb1444-8986-4eb3-a878-f5ef7472ab08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg4"
      service_endpoint_policy_ids = []
      service_endpoints = {}
    },
  },
  tags = {}
}
}
}

```

## Part 9: Confirm Resource Creation in Azure

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



## Part 10: Destroy All Resources and Verify

19. Destroy all resources:

```
terraform destroy
```

- Type yes when prompted.

20. Verify deletion:

```
terraform state list terraform
```

show

```
Destroy complete! Resources: 11 destroyed.
ibs@Home lab03s2 %
ibs@Home lab03s2 % terraform state list
ibs@Home lab03s2 % terraform show
The state file is empty. No resources are represented.
ibs@Home lab03s2 %
```

---

## Section 3

### Objectives:

- Use configuration from Section 2.
- Define a locals block to assign tags to resources.
- Validate, deploy, expand, analyze, and destroy infrastructure.

### Part 1: Prepare for the Lab

1. Create a directory called lab03s3 in your home directory:
2. Copy lab03s1.`, vars03s1.`, lab03s2.`, vars03s2.`, and providers.` into lab03s3 directory:
3. Change into the lab03s3 directory:
4. Rename lab03s2.` as lab03s3.` and vars03s2.` as vars03s3.`:

### Part 2: Update vars03s3.A File

5. Open vars03s3.` in a text editor and define a locals block at the beginning with the following values. Enclose values in double quotation marks:
  - a. Name: "Terraform-Class".
  - b. Project: "Learning".
  - c. ContactEmail: "youremailaddress".
  - d. Environment: "Lab".

```

1  locals {
2    Name      = "Terraform-Class"
3    Project   = "Learning"
4    ContactEmail = "Iqbalshahnadir1786@gmail.com"
5    Environment = "Lab"
6  }
7
8
9  variable "linux_name" {
10   description = "The name of the Linux virtual machine."
11   type        = string
12   default     = "lab03s2-dbl-u-vm1"
13 }
14
15 variable "vm_size" {
16   description = "The size of the Linux VM instance."
17   type        = string
18   default     = "Standard_B1s"
19 }
20
21 variable "admin_username" {
22   description = "The admin username for the Linux VM."
23   type        = string
24   default     = "ibs"
25 }
26
27 variable "public_key_path" {
28   description = "The path to the SSH public key for the Linux VM admin."
29   type        = string
30   default     = "/Users/ibs/.ssh/id_rsa.pub"
31 }
32 }
33
34 variable "os_disk_storage_type" {
35   description = "The storage account type for the OS disk."
36   type        = string
37   default     = "Premium_LRS"
38 }
39
40 variable "os_disk_size" {
41   description = "OS disk size in GB."
42   type        = number
43   default     = 32
44 }
45
46 variable "os_disk_caching" {
47   description = "Caching mode for the OS disk."
48   type        = string
49   default     = "ReadWrite"
50 }
51
52 variable "os_publisher" {
53   description = "The publisher of the OS image."
54   type        = string
55   default     = "Canonical"
56 }

```

### Part 3: Update lab03s3.A File

- Open lab03s3.' in a text editor and add tags to network interface, public IP, and virtual machine resource blocks using the locals values.

```

1 # Network Interface for the Linux VM
2 resource "azurerm_network_interface" "linux_nic" {
3   name                = "${var.linux_name}-nic"
4   location             = var.location
5   resource_group_name = azurerm_resource_group.lab02_rg.name
6
7   ip_configuration {
8     name                       = "${var.linux_name}-ipconfig1"
9     subnet_id                 = azurerm_subnet.lab02_subnet1.id
10    private_ip_address_allocation = "Dynamic"
11    public_ip_address_id        = azurerm_public_ip.linux_pip.id
12  }
13
14  tags = {
15    Name       = local.Name
16    Project    = local.Project
17    ContactEmail = local.ContactEmail
18    Environment = local.Environment
19  }
20 }
21
22 # Public IP for the Linux VM
23 resource "azurerm_public_ip" "linux_pip" {
24   name                = "${var.linux_name}-pip"
25   location             = var.location
26   resource_group_name = azurerm_resource_group.lab02_rg.name
27   allocation_method    = "Dynamic"
28   sku                  = "Basic"
29
30   tags = {
31     Name       = local.Name
32     Project    = local.Project
33     ContactEmail = local.ContactEmail
34     Environment = local.Environment
35   }
36 }
37
38 # Linux Virtual Machine
39 resource "azurerm_linux_virtual_machine" "linux_vm" {
40   name                = var.linux_name
41   resource_group_name = azurerm_resource_group.lab02_rg.name
42   location             = var.location
43   size                = var.vm_size
44   admin_username      = var.admin_username
45
46   network_interface_ids = [
47     azurerm_network_interface.linux_nic.id,
48   ]
49
50   admin_ssh_key {
51     username = var.admin_username
52     public_key = file(var.public_key_path)
53   }
54
55   os_disk {
56     caching              = var.os_disk_caching
57     storage_account_type = var.os_disk_storage_type
58   }
59
60   source_image_reference {
61     publisher = var.os_publisher
62     offer     = var.os_offer
63     sku       = var.os_sku
64     version   = var.os_version
65   }
66
67   tags = {
68     Name       = local.Name
69     Project    = local.Project
70     ContactEmail = local.ContactEmail
71     Environment = local.Environment
72   }
73 }
74
75 }

```

## Part 4: Initialize Terraform



7. Initialize Terraform to download plug-ins as required:

## Part 5: Validate Configuration

8. Validate the configuration to ensure no errors or typos:
9. Fix any issues in the Terraform files if reported.
10. Re-run validation until no errors are reported:

```
• ibs@Home lab03s3 % terraform init

Initializing the backend...

Initializing provider plugins...
- Finding hashicorp/azurerm versions matching ">= 1.5.7"...
- Installing hashicorp/azurerm v4.26.0...
- Installed hashicorp/azurerm v4.26.0 (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.
• ibs@Home lab03s3 % terraform validate

Success! The configuration is valid.
```

## Part 6: Run Simulation

11. Perform a dry run:

```
terraform plan
```

12. Review output and ensure all configuration meets requirements. Observe resources with +, -, or -/+ signs.
13. Fix any issues in the Terraform files if reported.
14. Redo the dry run until no errors are reported:

## Part 7: Deploy Infrastructure

15. Deploy the infrastructure and monitor progress:

```
terraform apply
```

- Type yes when prompted.

## Part 8: Get Information from Terraform State

17. View and analyze state information:

```
terraform state list terraform
show
```



```

# azure_rm_linux_virtual_machine.state.list
azure_rm_linux_virtual_machine.state.list
azure_rm_network_interface.state.list
azure_rm_network_security_group.state.list
azure_rm_network_security_group_association.state.list
azure_rm_public_ip.state.list
azure_rm_resource_group.state.list
azure_rm_subnet.state.list
azure_rm_subnet_association.state.list
azure_rm_subnet_network_security_group_association.state.list
azure_rm_virtual_network.state.list
# azure_rm_linux_virtual_machine.state.list
resource "azure_rm_linux_virtual_machine" "linux_vm" {
  admin_username = "ubuntu"
  allow_extensions_operations = true
  enable_platform_updates = true
  computer_name = "lab03s2-dbl-u-vm1"
  disable_password_authentication = true
  encryption_at_host_enabled = false
  extensions_time_budget = 7200000
  id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef7472eb80/resourceGroups/lab02-rg/providers/Microsoft.Compute/virtualMachines/lab03s2-dbl-u-vm1"
  location = "eastus"
  max_bid_price = -1
  name = "lab03s2-dbl-u-vm1"
  network_interface_ids = [
    "/subscriptions/85fb4144-8986-4eb3-a878-f5ef7472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/networkInterfaces/lab03s2-dbl-u-vm1-nic",
  ]
  patch_assessment_mode = "ImageDefault"
  patch_mode = "ImageDefault"
  platform_fault_domain = -1
  priority = "Regular"
  private_ip_address = "10.0.1.4"
  private_ip_addresses = [
    "10.0.1.4",
  ]
  provision_vm_agent = true
  public_ip_address = "48.71.43.94"
  public_ip_addresses = [
    "48.71.43.94",
  ]
  resource_group_name = "lab02-rg"
  secure_boot_enabled = false
  size = "Standard_B1s"
  tags = {
    "ContactEmail" = "iqbalshahdir1796@gmail.com"
    "Environment" = "Lab"
    "Name" = "Terraform-Cloud"
    "Project" = "Learning"
  }
  virtual_machine_id = "2527e777-7184-4f83-4855-c8a07f5b99a1"
  vm_agent_platform_updates_enabled = false
  vtpm_enabled = false
  admin_ssh_key {
    public_key = "ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQggn3s2YU1AAwPFCWd,yfz7f3L+QdWn/1/ACp/ANsqqvWd3KX03Vn)X,Jt13URw8x7w0B1vs2uPhq33wv/W4wP3yHqU9Kw
    private_key = "ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQggn3s2YU1AAwPFCWd,yfz7f3L+QdWn/1/ACp/ANsqqvWd3KX03Vn)X,Jt13URw8x7w0B1vs2uPhq33wv/W4wP3yHqU9Kw
  }
}

```

```

# azure_rm_linux_virtual_machine.state.list
resource "azure_rm_linux_virtual_machine" "linux_vm" {
  admin_username = "ubuntu"
  allow_extensions_operations = true
  enable_platform_updates = true
  computer_name = "lab03s2-dbl-u-vm1"
  disable_password_authentication = true
  encryption_at_host_enabled = false
  extensions_time_budget = 7200000
  id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef7472eb80/resourceGroups/lab02-rg/providers/Microsoft.Compute/virtualMachines/lab03s2-dbl-u-vm1"
  location = "eastus"
  max_bid_price = -1
  name = "lab03s2-dbl-u-vm1"
  network_interface_ids = [
    "/subscriptions/85fb4144-8986-4eb3-a878-f5ef7472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/networkInterfaces/lab03s2-dbl-u-vm1-nic",
  ]
  patch_assessment_mode = "ImageDefault"
  patch_mode = "ImageDefault"
  platform_fault_domain = -1
  priority = "Regular"
  private_ip_address = "10.0.1.4"
  private_ip_addresses = [
    "10.0.1.4",
  ]
  provision_vm_agent = true
  public_ip_address = "48.71.43.94"
  public_ip_addresses = [
    "48.71.43.94",
  ]
  resource_group_name = "lab02-rg"
  secure_boot_enabled = false
  size = "Standard_B1s"
  tags = {
    "ContactEmail" = "iqbalshahdir1796@gmail.com"
    "Environment" = "Lab"
    "Name" = "Terraform-Cloud"
    "Project" = "Learning"
  }
  virtual_machine_id = "2527e777-7184-4f83-4855-c8a07f5b99a1"
  vm_agent_platform_updates_enabled = false
  vtpm_enabled = false
  admin_ssh_key {
    public_key = "ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQggn3s2YU1AAwPFCWd,yfz7f3L+QdWn/1/ACp/ANsqqvWd3KX03Vn)X,Jt13URw8x7w0B1vs2uPhq33wv/W4wP3yHqU9Kw
    private_key = "ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQggn3s2YU1AAwPFCWd,yfz7f3L+QdWn/1/ACp/ANsqqvWd3KX03Vn)X,Jt13URw8x7w0B1vs2uPhq33wv/W4wP3yHqU9Kw
  }
}
# azure_rm_network_interface.state.list
resource "azure_rm_network_interface" "linux_nic" {
  accelerated_networking_enabled = false
  applied_dns_servers = [
    "10.0.1.4",
  ]
  id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef7472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/networkInterfaces/lab03s2-dbl-u-vm1-nic"
  internal_domain_name_suffix = "3c513sar354evijbzqrdvgmih.bx.internal.cloudapp.net"
  ip_forwarding_enabled = false
  location = "eastus"
  name = "lab03s2-dbl-u-vm1-nic"
  private_ip_address = "10.0.1.4"
  private_ip_addresses = [
    "10.0.1.4",
  ]
  resource_group_name = "lab02-rg"
  tags = {
    "ContactEmail" = "iqbalshahdir1796@gmail.com"
    "Environment" = "Lab"
    "Name" = "Terraform-Cloud"
    "Project" = "Learning"
  }
  ip_configuration {
    name = "lab03s2-dbl-u-vm1-ipconfig1"
    primary = true
    private_ip_address = "10.0.1.4"
    private_ip_address_allocation = "Dynamic"
    private_ip_address_version = "IPv4"
    public_ip_address_id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef7472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/publicIPAddresses/lab03s2-dbl-u-vm1-pip"
    subnet_id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef7472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
  }
}
# azure_rm_network_security_group.state.list
resource "azure_rm_network_security_group" "lab02_nsg1" {
  id = "/subscriptions/85fb4144-8986-4eb3-a878-f5ef7472eb80/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg1"
  location = "eastus"
  name = "lab02-nsg1"
  resource_group_name = "lab02-rg"
  tags = {
    "ContactEmail" = "iqbalshahdir1796@gmail.com"
    "Environment" = "Lab"
    "Name" = "Terraform-Cloud"
    "Project" = "Learning"
  }
  security_rule {
    direction = "In"
    name = "allow-ssh"
    priority = 100
    protocol = "TCP"
    source_port_range = "*"
    destination_port_range = "22"
    access = "Allow"
    action = "Allow"
  }
}

```

```
# azure_rm_network_security_group.lab02_nsg1:
resource "azurerm_network_security_group" "lab02_nsg1" {
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb00/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg1"
  location = "eastus"
  name = "lab02-nsg1"
  resource_group_name = "lab02-rg"
  security_rule = [
    {
      access = "Allow"
      description = ""
      destination_address_prefix = "a"
      destination_address_prefixes = []
      destination_application_security_group_ids = []
      destination_port_range = "22"
      destination_port_ranges = []
      direction = "Inbound"
      name = "rule1"
      priority = 100
      protocol = "Tcp"
      source_address_prefix = "a"
      source_address_prefixes = []
      source_application_security_group_ids = []
      source_port_range = "a"
      source_port_ranges = []
    }
  ]
}
```

```
# azure_rm_network_security_group.lab02_nsg2:
resource "azurerm_network_security_group" "lab02_nsg2" {
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb00/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg2"
  location = "eastus"
  name = "lab02-nsg2"
  resource_group_name = "lab02-rg"
  security_rule = [
    {
      access = "Allow"
      description = ""
      destination_address_prefix = "a"
      destination_address_prefixes = []
      destination_application_security_group_ids = []
      destination_port_range = "3389"
      destination_port_ranges = []
      direction = "Inbound"
      name = "rule1"
      priority = 100
      protocol = "Tcp"
      source_address_prefix = "a"
      source_address_prefixes = []
      source_application_security_group_ids = []
      source_port_range = "a"
      source_port_ranges = []
    },
    {
      access = "Allow"
      description = ""
      destination_address_prefix = "a"
      destination_address_prefixes = []
      destination_application_security_group_ids = []
      destination_port_range = "3389"
      source_application_security_group_ids = []
      source_port_range = "a"
      source_port_ranges = []
    }
  ]
}
```

```
source_application_security_group_ids = []
source_port_range = "a"
source_port_ranges = []
}
}

# azure_rm_public_ip.linux_pip:
resource "azurerm_public_ip" "linux_pip" {
  allocation_method = "Dynamic"
  dns_registration_enabled = false
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb00/resourceGroups/lab02-rg/providers/Microsoft.Network/publicIPAddresses/lab03-s2-d01-u-v-m1-pip"
  idle_timeout_in_minutes = 4
  ip_version = "IPv4"
  location = "eastus"
  name = "lab03-s2-d01-u-v-m1-pip"
  resource_group_name = "lab02-rg"
  sku = "Basic"
  sku_tier = "Regional"
  tags = {
    "ContactEmail" = "lobalshahadiri786@gmail.com"
    "Environment" = "Lab"
    "Name" = "terraform-class"
    "Project" = "Learning"
  }
}
```

```
# azure_rm_resource_group.lab02_rg:
resource "azurerm_resource_group" "lab02_rg" {
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb00/resourceGroups/lab02-rg"
  location = "eastus"
  name = "lab02-rg"
}
```

```
# azure_rm_subnet.lab02_subnet1:
resource "azurerm_subnet" "lab02_subnet1" {
  address_prefixes = [
    "10.0.1.0/24",
  ]
  default_outbound_access_enabled = true
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb00/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/05fb4144-8986-4eb3-a078-f5ef74f2eb00/subnets/lab02-subnet1"
  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_rm_subnet.lab02_subnet2:
resource "azurerm_subnet" "lab02_subnet2" {
  address_prefixes = [
    "10.0.2.0/24",
  ]
  default_outbound_access_enabled = true
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb00/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/05fb4144-8986-4eb3-a078-f5ef74f2eb00/subnets/lab02-subnet2"
  name = "lab02-subnet2"
  private_endpoint_network_policies = "Disabled"
}
```

```

resources:
  - name: lab02-vnet/subnets/lab02-subnet1
    type: Microsoft.Network/virtualNetworks/subnets
    properties:
      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"
  - name: lab02-vnet/subnets/lab02-subnet2
    type: Microsoft.Network/virtualNetworks/subnets
    properties:
      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"
  - name: lab02-subnet2-nsg-association
    type: Microsoft.Network/networkSecurityGroups
    properties:
      id: "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb88/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2"
      network_security_group_id: "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb88/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg"
      subnet_id: "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb88/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2"
  - name: lab02-subnet1-nsg-association
    type: Microsoft.Network/networkSecurityGroups
    properties:
      id: "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb88/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
      network_security_group_id: "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb88/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg"
      subnet_id: "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb88/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
  - name: lab02-vnet
    type: Microsoft.Network/virtualNetworks
    properties:
      address_space: "10.0.0.0/16"
      dns_servers: []
      flow_timeout_in_minutes: 0
      guid: "c8bbeeb8-ef19-4afc-a121-cc3511dccc99"
      id: "/subscriptions/85fb4144-8986-4eb3-a878-f5ef74f2eb88/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet"
      location: "eastus"
      name: "lab02-vnet"
      private_endpoint_vnet_policies: "Disabled"
      resource_group_name: "lab02-rg"
      subnet: []

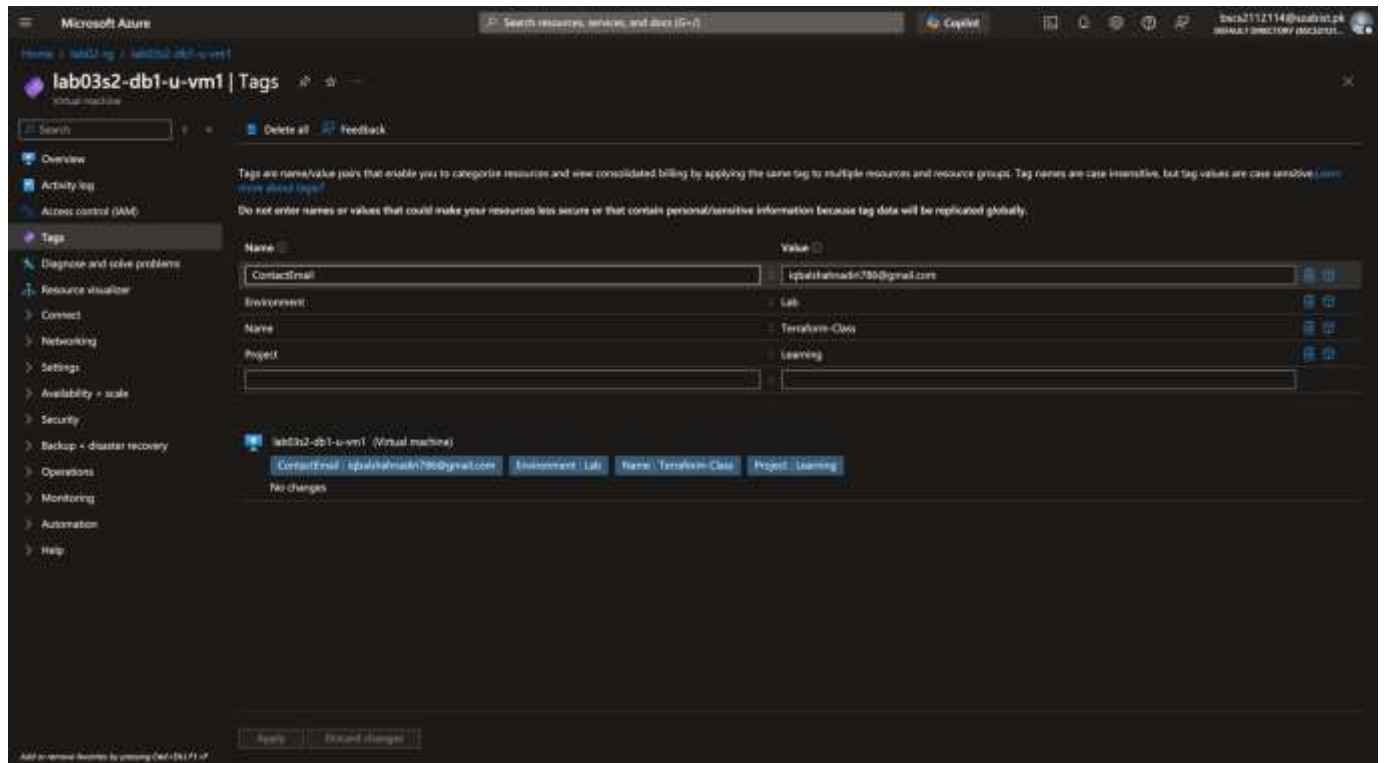
```

## Part 9: Confirm Resource Creation in Azure

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

The screenshot shows the Microsoft Azure portal interface. The top navigation bar includes the 'Microsoft Azure' logo, a search bar, and user information. The main content area displays the 'lab02-rg' resource group. The 'Overview' tab is selected, showing a list of resources. The 'Resources' section lists 7 resources, including two network security groups, a virtual network, a virtual machine, and two virtual machine instances. The 'Tags' section is also visible, showing a list of tags for the resource group.

Name	Type	Location
lab02-nsg1	Network security group	East US
lab02-nsg2	Network security group	East US
lab02-vnet	Virtual network	East US
lab02-vnet-gw	Virtual machine	East US
lab02-vnet-vm	Network interface	East US
lab02-vnet-vm-01	Public IP address	East US
lab02-vnet-vm-02	Disk	East US



## Part 10: Destroy All Resources and Verify

### 19. Destroy all resources:

```
terraform destroy
```

- Type yes when prompted.

### 20. Verify deletion:

```
terraform state list terraform
```

```
show
```

```

• ibs@Home lab03s3 % terraform state list
• ibs@Home lab03s3 % terraform show
  The state file is empty. No resources are represented.
❖ ibs@Home lab03s3 %
```

## Section 4

### Objectives:

- Use configuration from Section 3.
- Define output blocks to display values.
- Validate, deploy, expand, analyze, and destroy infrastructure.

### Part 1: Prepare for the Lab

1. Copy the lab03s3 directory as lab03s4:
2. Change into the lab03s4 directory:
3. Create an empty file called outputs03s4.‘:

### Part 2: Update outputs03s4.A File

4. Open outputs03s4.‘ in a text editor and define output blocks to display:
  - a. VM hostname (1 block).
  - b. Private IP address (1 block) and Public IP address (1 block).
  - c. Virtual network name (1 block) and address space (1 block).
  - d. Subnet names (2 blocks) and address spaces (2 blocks).

```

1 outputs03s4.tf
2
3 // a. VM hostname
4 output "vm_hostname" {
5     description = "The hostname of the virtual machine."
6     value       = azurerm_linux_virtual_machine.linux_vm.computer_name
7 }
8
9 // b. Private and Public IP addresses
10 output "vm_private_ip" {
11     description = "The private IP address of the virtual machine."
12     value       = azurerm_linux_virtual_machine.linux_vm.private_ip_address
13 }
14
15 output "vm_public_ip" {
16     description = "The public IP address of the Linux VM."
17     value       = azurerm_public_ip.linux_pip.ip_address
18 }
19
20 // c. Virtual network name and address space
21 output "vnet_name" {
22     description = "The name of the virtual network."
23     value       = azurerm_virtual_network.lab02_vnet.name
24 }
25
26 // Retrieve a single address space value using element()
27 output "vnet_address_space" {
28     description = "The address space of the virtual network."
29     value       = element(toList(azurerm_virtual_network.lab02_vnet.address_space), 0)
30 }
31
32
33
34 // d. Subnet names and address spaces
35 output "subnet1_name" {
36     description = "The name of the first subnet."
37     value       = azurerm_subnet.lab02_subnet1.name
38 }
39
40 output "subnet1_address_space" {
41     description = "The address space of the first subnet."
42     value       = element(azurerm_subnet.lab02_subnet1.address_prefixes, 0)
43 }
44
45 output "subnet2_name" {
46     description = "The name of the second subnet."
47     value       = azurerm_subnet.lab02_subnet2.name
48 }
49
50 output "subnet2_address_space" {
51     description = "The address space of the second subnet."
52     value       = element(azurerm_subnet.lab02_subnet2.address_prefixes, 0)
53 }
54

```

### Part 3: Validate Configuration

5. Validate the configuration to ensure no errors or typos:
6. Fix any issues in the Terraform files if reported.
7. Re-run validation until no errors are reported:



```
ibs@Home lab03s4 % terraform init

Initializing the backend...

Initializing provider plugins...
- Reusing previous version of hashicorp/azurerm from the dependency lock file
- Using previously-installed hashicorp/azurerm v4.26.0

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.
ibs@Home lab03s4 % terraform validate
Success! The configuration is valid.
```

## Part 4: Run Simulation

8. Perform a dry run:

```
terraform plan
```

9. Review output and ensure all configuration meets requirements. Observe resources with +, -, or -/+ signs.
10. Fix any issues in the Terraform files if reported.
11. Redo the dry run until no errors are reported:

## Part 5: Deploy Infrastructure

12. Deploy the infrastructure and monitor progress:

```
terraform apply
```

- o Type yes when prompted.

13. Confirm output values displayed on the screen at the end of deployment.

## Part 6: Get Information from Terraform State

14. View and analyze state information:

```
terraform state list terraform
show
```



```
ibs@Home lab03s4 % terraform state list
azurerm_linux_virtual_machine.linux_vm
azurerm_network_interface.linux_nic
azurerm_network_security_group.lab02_nsg1
azurerm_network_security_group.lab02_nsg2
azurerm_public_ip.linux_pip
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 lab03s4 % terraform show
# azurerm_linux_virtual_machine.linux_vm:
resource "azurerm_linux_virtual_machine" "linux_vm" {
  admin_username           = "ibs"
  allow_extension_operations = true
  bypass_platform_safety_checks_on_user_schedule_enabled = false
  computer_name            = "lab03s2-db1-u-vm1"
  disable_password_authentication = true
  encryption_at_host_enabled = false
  extensions_time_budget      = "PT1H30M"
  id                          = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Compute/virtualMachines/lab03s2-db1-u-vm1"
  location                   = "eastus"
  max_bid_price              = -1
  name                       = "lab03s2-db1-u-vm1"
  network_interface_ids      = [
    "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkInterfaces/lab03s2-db1-u-vm1-nic",
  ]
  patch_assessment_mode      = "ImageDefault"
  patch_mode                 = "ImageDefault"
  platform_fault_domain      = -1
  priority                   = "Regular"
  private_ip_address         = "10.0.1.4"
  private_ip_addresses       = [
    "10.0.1.4",
  ]
  provision_vm_agent         = true
  public_ip_address          = "172.190.77.214"
  public_ip_addresses        = [
    "172.190.77.214",
  ]
  resource_group_name        = "lab02-rg"
  secure_boot_enabled        = false
  size                       = "Standard_B1s"
  tags                       = {
    "ContactEmail" = "iqbalshahnadiri786@gmail.com"
    "Environment"  = "Lab"
    "Name"         = "Terraform-Class"
    "Project"      = "Learning"
  }
  virtual_machine_id         = "7e4bbf87-26e0-4146-b278-72b1d4155f9d"
  vm_agent_platform_updates_enabled = false
  vtpm_enabled               = false
}

```

```

admin_ssh_key {
  public_key = <<-EOT
    ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQDMYbSuIYAULa4wPKF
    cWQpLyVy2eEcbLvQdhmH/Il/hACF/Ak5gQqvbn55EXJXX1VNjX+JH1j5LNWx9dx7VwQ
    tBlvs2sFxFcq3dsWYcWV4wF3wyHxgibKKmz4IrSiQ3ZejtyBbaZLAoPt9a5EWq0Pv+4
    hcwv7w0CZf4o7Q1LL6ML3vJ3Ggk6XPjECaGHNAfQ8WBvaMJDKKnVyAqilB1r4uA0q
    NNs3NeDLdpusDEU3mG+V5/J0R8/RCaR8G1QuG62ITg+C3L7dLPkgie2zJyR0ew7+uux
    eYkXSMBjrMhjLf+cv+bpejPjuB7+/Bt8TY4y8PYclrt0n7H1AAAMeYTWAAASKKZrE9Fy
    nAQc8kIZi+aiAdM5pabkFYMBFx1dh6diSfT67StviR5GcwQ5w93/BQowkYxvWIVKcu
    uvKvS4+BPbpAw/FE8ED3aZ067HfRv0c0ekTdjvWq1nXfa6rXkFLu1zx0a6bjp7QqsZ1
    toaSV32QCj6dVSFBPnyAQR4HL0keCum6y80kUa0gAKVI67n1LnAqFik6+GSX4nl34fD
    DVAfV0XsnHyR4doIDmkR1NKwaTmJ0JzJ/AZj08KY7sYGdLJgnNZr0oNt0BQxZ4wgQkb
    P0lxKm/0fL6LbxonxMvLjKveeoBx10NH9o9qwDxDLhSksb34xAJCLYMrYiRlkhQ==
  ibs@Home.local
  EOT
  username = "ibs"
}

os_disk {
  caching = "ReadWrite"
  disk_size_gb = 32
  id = "/subscriptions/05fb4144-8986-4
  eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.C
  ompute/disks/lab03s2-dbl-u-vm1_disk1_fc295db76f1a4ad482e791e448e354
  80"
  name = "lab03s2-dbl-u-vm1_disk1_fc295d
  b76f1a4ad482e791e448e35480"
  storage_account_type = "Premium_LRS"
  write_accelerator_enabled = false
}

source_image_reference {
  offer = "0001-com-ubuntu-server-focal"
  publisher = "Canonical"
  sku = "20_04-lts"
  version = "latest"
}
}

# azurerm_network_interface.linux_nic:
resource "azurerm_network_interface" "linux_nic" {
  accelerated_networking_enabled = false
  applied_dns_servers = []
  id = "/subscriptions/05fb4144-8986-
  4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.
  Network/networkInterfaces/lab03s2-dbl-u-vm1-nic"
  internal_domain_name_suffix = "15dq1tlpoo2upjbji2oitkvboh.bx
  .internal.cloudapp.net"
  ip_forwarding_enabled = false
  location = "eastus"
  name = "lab03s2-dbl-u-vm1-nic"
  private_ip_address = "10.0.1.4"
  private_ip_addresses = [
    "10.0.1.4",
  ]
  resource_group_name = "lab02-rg"
  tags = {
    "ContactEmail" = "iqbalshahnadiri786@gmail.com"
    "Environment" = "Lab"
    "Name" = "Terraform-Class"
  }
}

```

```

    "Project"      = "Learning"
  }

  ip_configuration {
    name          = "lab03s2-dbl-u-vm1-ipconfig
1"
    primary       = true
    private_ip_address      = "10.0.1.4"
    private_ip_address_allocation = "Dynamic"
    private_ip_address_version = "IPv4"
    public_ip_address_id     = "/subscriptions/05fb4144-89
86-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microso
ft.Network/publicIPAddresses/lab03s2-dbl-u-vm1-pip"
    subnet_id        = "/subscriptions/05fb4144-89
86-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microso
ft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
  }
}

# azurerm_network_security_group.lab02_nsg1:
resource "azurerm_network_security_group" "lab02_nsg1" {
  id          = "/subscriptions/05fb4144-8986-4eb3-a078-f
5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/net
workSecurityGroups/lab02-nsg1"
  location    = "eastus"
  name        = "lab02-nsg1"
  resource_group_name = "lab02-rg"
  security_rule = [
    {
      access                = "Allow"
      description            = ""
      destination_address_prefix      = "*"
      destination_address_prefixes    = []
      destination_application_security_group_ids = []
      destination_port_range  = "22"
      destination_port_ranges  = []
      direction               = "Inbound"
      name                     = "rule1"
      priority                 = 100
      protocol                 = "Tcp"
      source_address_prefix    = "*"
      source_address_prefixes  = []
      source_application_security_group_ids = []
      source_port_range        = "*"
      source_port_ranges       = []
    }
  ],
}

# azurerm_network_security_group.lab02_nsg2:
resource "azurerm_network_security_group" "lab02_nsg2" {
  id          = "/subscriptions/05fb4144-8986-4eb3-a078-f
5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/net
workSecurityGroups/lab02-nsg2"
  location    = "eastus"
  name        = "lab02-nsg2"
  resource_group_name = "lab02-rg"
  security_rule = [
    {
      access                = "Allow"

```



```

        description = ""
        destination_address_prefix = "*"
        destination_address_prefixes = []
        destination_application_security_group_ids = []
        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_ids = []
        source_port_range = "*"
        source_port_ranges = []
    },
    {
        access = "Allow"
        description = ""
        destination_address_prefix = "*"
        destination_address_prefixes = []
        destination_application_security_group_ids = []
        destination_port_range = "5985"
        destination_port_ranges = []
        direction = "Inbound"
        name = "rule2"
        priority = 200
        protocol = "Tcp"
        source_address_prefix = "*"
        source_address_prefixes = []
        source_application_security_group_ids = []
        source_port_range = "*"
        source_port_ranges = []
    },
    ]
}

# azurerm_public_ip.linux_pip:
resource "azurerm_public_ip" "linux_pip" {
  allocation_method = "Dynamic"
  ddos_protection_mode = "VirtualNetworkInherited"
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/publicIPAddresses/lab03s2-dbl-u-vm1-pip"
  idle_timeout_in_minutes = 4
  ip_version = "IPv4"
  location = "eastus"
  name = "lab03s2-dbl-u-vm1-pip"
  resource_group_name = "lab02-rg"
  sku = "Basic"
  sku_tier = "Regional"
  tags = {
    "ContactEmail" = "iqbalshahnadiri786@gmail.com"
    "Environment" = "Lab"
    "Name" = "Terraform-Class"
    "Project" = "Learning"
  }
}

# azurerm_resource_group.lab02_rg:

```

```

# azurerm_resource_group.lab02_rg:
resource "azurerm_resource_group" "lab02_rg" {
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg"
  location = "eastus"
  name = "lab02-rg"
}

# azurerm_subnet.lab02_subnet1:
resource "azurerm_subnet" "lab02_subnet1" {
  address_prefixes = [
    "10.0.1.0/24",
  ]
  default_outbound_access_enabled = true
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
  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"
}

# azurerm_subnet.lab02_subnet2:
resource "azurerm_subnet" "lab02_subnet2" {
  address_prefixes = [
    "10.0.2.0/24",
  ]
  default_outbound_access_enabled = true
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2"
  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"
}

# azurerm_subnet_network_security_group_association.lab02_subnet2_nsg_assoc:
resource "azurerm_subnet_network_security_group_association" "lab02_subnet2_nsg_assoc" {
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2"
  network_security_group_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg2"
  subnet_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2"
}

# azurerm_subnet_network_security_group_association.lab02_subnet_nsg_assoc:
resource "azurerm_subnet_network_security_group_association" "lab02_subnet_nsg_assoc" {

```

```

resource "azurerm_subnet_network_security_group_association" "lab02_subnet2_nsg_assoc" {
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2"
  network_security_group_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg2"
  subnet_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2"
}

# azurerm_subnet_network_security_group_association.lab02_subnet_nsg_assoc:
resource "azurerm_subnet_network_security_group_association" "lab02_subnet_nsg_assoc" {
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
  network_security_group_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg1"
  subnet_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1"
}

# azurerm_virtual_network.lab02_vnet:
resource "azurerm_virtual_network" "lab02_vnet" {
  address_space = [
    "10.0.0.0/16",
  ]
  dns_servers = []
  flow_timeout_in_minutes = 0
  guid = "cd0dc7df-736f-47b9-a429-471c89aaa177"
  id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet"
  location = "eastus"
  name = "lab02-vnet"
  private_endpoint_vnet_policies = "Disabled"
  resource_group_name = "lab02-rg"
  subnet = []
}

```

#### Outputs:

```

subnet1_address_space = "10.0.1.0/24"
subnet1_name = "lab02-subnet1"
subnet2_address_space = "10.0.2.0/24"
subnet2_name = "lab02-subnet2"
vm_hostname = "lab03s2-db1-u-vm1"
vm_private_ip = "10.0.1.4"
vm_public_ip = ""
vnet_address_space = "10.0.0.0/16"
vnet_name = "lab02-vnet"

```

```

ibs@Home lab03s4 %

```

## Part 7: Display Output Information

### 15. Display output information:

```

terraform output

```



```
ibs@Home lab03s4 % terraform output
subnet1_address_space = "10.0.1.0/24"
subnet1_name = "lab02-subnet1"
subnet2_address_space = "10.0.2.0/24"
subnet2_name = "lab02-subnet2"
vm_hostname = "lab03s2-db1-u-vm1"
vm_private_ip = "10.0.1.4"
vm_public_ip = ""
vnet_address_space = "10.0.0.0/16"
vnet_name = "lab02-vnet"
ibs@Home lab03s4 %
```

## Part 8: Destroy All Resources and Verify

16. Destroy all resources:

```
terraform destroy
```

- Type yes when prompted.

17. Verify deletion:

```
terraform state list terraform
show
```

```
ibs@Home lab03s4 % terraform state list
ibs@Home lab03s4 % terraform show
The state file is empty. No resources are represented.
ibs@Home lab03s4 %
```

---

## Section 5

### Objectives:

- Use configuration from Section 4.
- Define lifecycle rules to prevent updates and resource deletions.
- Define explicit dependency.
- Validate, deploy, expand, analyze, and destroy infrastructure.

### Part 1: Prepare for the Lab

1. Copy the lab03s4 directory as lab03s5:
2. Change into the lab03s5 directory:
3. Rename lab03s3.‘ as lab03s5.‘:

### Part 2: Update lab03s5.A File

4. Open lab03s5.‘ in a text editor and define an explicit dependency rule for the virtual machine to wait for the creation of the resource group.

```
1 # Network Interface for the Linux VM
2 resource "azurerm_network_interface" "linux_nic" {
3   name                = "${var.linux_name}-nic"
4   location             = var.location
5   resource_group_name = azurerm_resource_group.lab02_rg.name
6
7   ip_configuration {
8     name                = "${var.linux_name}-ipconfig1"
9     subnet_id           = azurerm_subnet.lab02_subnet1.id
10    private_ip_address_allocation = "Dynamic"
11    public_ip_address_id        = azurerm_public_ip.linux_pip.id
12  }
13
14  tags = {
15    Name       = local.Name
16    Project    = local.Project
17    ContactEmail = local.ContactEmail
18    Environment = local.Environment
19  }
20 }
21
22 # Public IP for the Linux VM
23 resource "azurerm_public_ip" "linux_pip" {
24   name                = "${var.linux_name}-pip"
25   location             = var.location
26   resource_group_name = azurerm_resource_group.lab02_rg.name
27   allocation_method   = "Dynamic"
28   sku                 = "Basic"
29
30   tags = {
31     Name       = local.Name
32     Project    = local.Project
33     ContactEmail = local.ContactEmail
34     Environment = local.Environment
35   }
36 }
37
38 # Linux Virtual Machine
39 resource "azurerm_linux_virtual_machine" "linux_vm" {
40   name                = var.linux_name
41   resource_group_name = azurerm_resource_group.lab02_rg.name
42   location             = var.location
43   size                = var.vm_size
44   admin_username      = var.admin_username
```

```

lab03s5.tf x
lab03s5.tf
39 resource "azurerm_linux_virtual_machine" "linux_vm" {
40
46     network_interface_ids = [
47         azurerm_network_interface.linux_nic.id,
48     ]
49
50     admin_ssh_key {
51         username   = var.admin_username
52         public_key = file(var.public_key_path)
53     }
54
55     depends_on = [
56         azurerm_resource_group.lab02_rg
57     ]
58
59     os_disk {
60         caching              = var.os_disk_caching
61         storage_account_type = var.os_disk_storage_type
62         disk_size_gb        = var.os_disk_size
63     }
64
65     source_image_reference {
66         publisher = var.os_publisher
67         offer     = var.os_offer
68         sku       = var.os_sku
69         version   = var.os_version
70     }
71
72     tags = {
73         Name           = local.Name
74         Project        = local.Project
75         ContactEmail    = local.ContactEmail
76         Environment     = local.Environment
77     }
78
79 }
80

```

### Part 3: Validate Configuration

5. Validate the configuration to ensure no errors or typos:
6. Fix any issues in the Terraform files if reported.
7. Re-run validation until no errors are reported:

```

ibs@Home lab03s5 % terraform init

Initializing the backend...

Initializing provider plugins...
- Reusing previous version of hashicorp/azurerm from the dependency lock file
- Using previously-installed hashicorp/azurerm v4.26.0

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.
ibs@Home lab03s5 % terraform validate
Success! The configuration is valid.

```

## Part 4: Run Simulation

8. Perform a dry run:

```
terraform plan
```

9. Review output and ensure all configuration meets requirements. Observe resources with +, -, or -/+ signs.
10. Fix any issues in the Terraform files if reported.
11. Redo the dry run until no errors are reported: **Part 5: Deploy Infrastructure**
12. Deploy the infrastructure and monitor progress:

```
terraform apply
```

- Type yes when prompted.
13. Confirm output values displayed on the screen at the end of deployment.

## Part 6: Add and Test a Lifecycle Deletion Rule

16. Edit lab03s5.' in a text editor and add a rule to prevent virtual machine, public IP, and network interface resources from removal (use lifecycle { prevent\_destroy = true }).
17. Run:

```
terraform destroy
```

- Observe the error message generated.

```

- id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2" -> null
- network_security_group_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg2" -> null
- subnet_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet2" -> null
}

# azure_rm_subnet_network_security_group_association.lab02_subnet_nsg_assoc will be destroyed
- resource "azure_rm_subnet_network_security_group_association" "lab02_subnet_nsg_assoc" {
- id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1" -> null
- network_security_group_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkSecurityGroups/lab02-nsg1" -> null
- subnet_id = "/subscriptions/05fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1" -> null
}

Plan: 0 to add, 0 to change, 5 to destroy.

Changes to Outputs:
- subnet1_address_space = "10.0.1.0/24" -> null
- subnet1_name = "lab02-subnet1" -> null
- subnet2_address_space = "10.0.2.0/24" -> null
- subnet2_name = "lab02-subnet2" -> null
- vm_hostname = "lab03s2-db1-u-vm1" -> null
- vm_private_ip = "10.0.1.4" -> null
- vm_public_ip = "20.232.138.174" -> null
- vnet_address_space = "10.0.0.0/16" -> null
- vnet_name = "lab02-vnet" -> null

Error: Instance cannot be destroyed

on lab03s5.tf line 46:
46: resource "azurerm_linux_virtual_machine" "linux_vm" {

Resource azurerm_linux_virtual_machine.linux_vm has lifecycle.prevent_destroy set, but the plan calls for this resource to be destroyed. To avoid this error and continue with the plan, either disable lifecycle.prevent_destroy or reduce the scope of the plan using the -target flag.

```

18. Edit lab03s5.' again and remove the deletion rules. *Do not destroy the infrastructure yet.*

## Part 7: Add and Test a Lifecycle Update Rule

19. Go to the Azure Portal and change some tag values for the virtual machine.

20. Edit lab03s5.' in a text editor and add a rule to prevent tag updates to the virtual machine (use lifecycle { ignore\_changes = [tags] }).

21. Run:

```
terraform plan
```

- Observe the dry run output.

```

azurerm_subnet_network_security_group_association.lab02_subnet_nsg_assoc: Refreshing state... [id=/subscriptions/85fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/virtualNetworks/lab02-vnet/subnets/lab02-subnet1]
azurerm_network_interface.linux_nic: Refreshing state... [id=/subscriptions/85fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/networkInterfaces/lab03s2-dbl-u-vml-nic]
azurerm_linux_virtual_machine.linux_vm: Refreshing state... [id=/subscriptions/85fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Compute/virtualMachines/lab03s2-dbl-u-vml]

Note: Objects have changed outside of Terraform

Terraform detected the following changes made outside of Terraform since the last "terraform apply" which
may have affected this plan:

# azurerm_public_ip.linux_pip has changed
~ resource "azurerm_public_ip" "linux_pip" {
  id = "/subscriptions/85fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/publicIPAddresses/lab03s2-dbl-u-vml-pip"
+ ip_address = "20.232.138.174"
  name = "lab03s2-dbl-u-vml-pip"
  tags = {
    "ContactEmail" = "iqbalshahmiri786@gmail.com"
    "Environment" = "Lab"
    "Name" = "Terraform-Class"
    "Project" = "Learning"
  }
# (5 unchanged attributes hidden)
}

Unless you have made equivalent changes to your configuration, or ignored the relevant attributes using
ignore_changes, the following plan may include actions to undo or respond to these changes.

Terraform used the selected providers to generate the following execution plan, Resource actions are
indicated with the following symbols:
~ update in-place

Terraform will perform the following actions:

# azurerm_public_ip.linux_pip will be updated in-place
~ resource "azurerm_public_ip" "linux_pip" {
  id = "/subscriptions/85fb4144-8986-4eb3-a078-f5ef74f2eb08/resourceGroups/lab02-rg/providers/Microsoft.Network/publicIPAddresses/lab03s2-dbl-u-vml-pip"
  name = "lab03s2-dbl-u-vml-pip"
  ~ tag:
    "ContactEmail" = "iqbalshahmiri786@gmail.com"
    ~ "Environment" = "new Lab" -> "Lab"
    ~ "Name" = "Terraform-Class"
    ~ "Project" = "new Learning" -> "Learning"
  }
# (5 unchanged attributes hidden)
}

Plan: 0 to add, 1 to change, 0 to destroy.

Changes to Outputs:
  ~ vm_public_ip = "" -> "20.232.138.174"

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.

```

22. Edit lab03s5.' again and remove the update rule.

## Part 8: Display Dependency Graph

23. Show dependency tree:

```
terraform graph
```



```

lbs@Home lab03s5 % terraform graph
digraph {
    compound = "true"
    newrank = "true"
    subgraph "root" {
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" [label = "azurelinux_virtual_mac
hine.azurelinux_vm", shape = "box"]
        "[root] azurelinux_network_interface.azurelinux_nic (expand)" [label = "azurelinux_network_interface.li
nux_nic", shape = "box"]
        "[root] azurelinux_network_security_group.azurelinux_nsg1 (expand)" [label = "azurelinux_network_securi
ty_group.azurelinux_nsg1", shape = "box"]
        "[root] azurelinux_network_security_group.azurelinux_nsg2 (expand)" [label = "azurelinux_network_securi
ty_group.azurelinux_nsg2", shape = "box"]
        "[root] azurelinux_public_ip.azurelinux_ip (expand)" [label = "azurelinux_public_ip.azurelinux_ip", shape
= "box"]
        "[root] azurelinux_resource_group.azurelinux_rg (expand)" [label = "azurelinux_resource_group.azurelinux_rg",
shape = "box"]
        "[root] azurelinux_subnet.azurelinux_subnet1 (expand)" [label = "azurelinux_subnet.azurelinux_subnet1", shap
e = "box"]
        "[root] azurelinux_subnet.azurelinux_subnet2 (expand)" [label = "azurelinux_subnet.azurelinux_subnet2", shap
e = "box"]
        "[root] azurelinux_subnet_network_security_group_association.azurelinux_subnet2_nsg_assoc (expand)" [label = "azurelinux_subnet_network_security_group_association.azurelinux_subnet2_nsg_assoc", shape = "box"]
        "[root] azurelinux_subnet_network_security_group_association.azurelinux_subnet_nsg_assoc (expand)" [label = "azurelinux_subnet_network_security_group_association.azurelinux_subnet_nsg_assoc", shape = "box"]
        "[root] azurelinux_virtual_network.azurelinux_vnet (expand)" [label = "azurelinux_virtual_network.azurelinux_vnet", shape = "box"]
        "[root] provider["registry.terraform.io/hashicorp/azurelinux"] [label = "provider["registry
.terraform.io/hashicorp/azurelinux"]", shape = "diamond"]
        "[root] var.admin_username [label = "var.admin_username", shape = "note"]
        "[root] var.azurelinux_name [label = "var.azurelinux_name", shape = "note"]
        "[root] var.location [label = "var.location", shape = "note"]
        "[root] var.nsg1_name [label = "var.nsg1_name", shape = "note"]
        "[root] var.nsg2_name [label = "var.nsg2_name", shape = "note"]
        "[root] var.os_disk_caching [label = "var.os_disk_caching", shape = "note"]
        "[root] var.os_disk_size [label = "var.os_disk_size", shape = "note"]
        "[root] var.os_disk_storage_type [label = "var.os_disk_storage_type", shape = "note"]
        "[root] var.os_offer [label = "var.os_offer", shape = "note"]
        "[root] var.os_publisher [label = "var.os_publisher", shape = "note"]
        "[root] var.os_sku [label = "var.os_sku", shape = "note"]
        "[root] var.os_version [label = "var.os_version", shape = "note"]
        "[root] var.public_key_path [label = "var.public_key_path", shape = "note"]
        "[root] var.rg_name [label = "var.rg_name", shape = "note"]
        "[root] var.subnet1_name [label = "var.subnet1_name", shape = "note"]
        "[root] var.subnet1_prefix [label = "var.subnet1_prefix", shape = "note"]
        "[root] var.subnet2_name [label = "var.subnet2_name", shape = "note"]
        "[root] var.subnet2_prefix [label = "var.subnet2_prefix", shape = "note"]
        "[root] var.vnet_size [label = "var.vnet_size", shape = "note"]
        "[root] var.vnet_address [label = "var.vnet_address", shape = "note"]
        "[root] var.vnet_name [label = "var.vnet_name", shape = "note"]
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] azurelinux_network_interfac
e.azurelinux_nic (expand)"
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] var.admin_username"
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] var.os_disk_caching"
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] var.os_disk_size"
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] var.os_disk_storage_type"
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] var.os_offer"
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] var.os_publisher"
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] var.os_sku"
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] var.os_version"
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] var.public_key_path"
        "[root] azurelinux_virtual_machine.azurelinux_vm (expand)" -> "[root] var.vnet_size"
        "[root] azurelinux_network_interface.azurelinux_nic (expand)" -> "[root] azurelinux_public_ip.azurelinux_ip
(expand)"
        "[root] azurelinux_network_interface.azurelinux_nic (expand)" -> "[root] azurelinux_subnet.azurelinux_subnet
1 (expand)"
        "[root] azurelinux_network_security_group.azurelinux_nsg1 (expand)" -> "[root] azurelinux_resource_grou
p.azurelinux_rg (expand)"
        "[root] azurelinux_network_security_group.azurelinux_nsg1 (expand)" -> "[root] var.nsg1_name"
        "[root] azurelinux_network_security_group.azurelinux_nsg2 (expand)" -> "[root] azurelinux_resource_grou
p.azurelinux_rg (expand)"
    }
}

```

## Part 9: Destroy All Resources and Verify

24. Destroy all resources:

```
terraform destroy
```

- Type yes when prompted.

25. Verify deletion:

```
terraform state list terraform
show
```

```
ibs@Home lab03s5 % terraform state list
ibs@Home lab03s5 % terraform show
The state file is empty. No resources are represented.
ibs@Home lab03s5 %
```