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*Факультет математики та інформатики
Кафедра інформаційних технологій*

Інформатика і програмування

Лабораторна робота № 8

Тема: Управління віртуальними машинами

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Група ІПЗ-43

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Викладач: Поварчук Д.Д

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Лабораторний сценарій

Ваша організація хоче дослідити розгортання та налаштування віртуальних машин Azure. Спочатку ви впроваджуєте віртуальну машину Azure з ручним масштабуванням. Далі ви впроваджуєте набір масштабованих віртуальних машин та досліджуєте автоматичне масштабування. Знову я і знову воно якось важко далось але я всеодно все задеплоїв

Отож, я довго не міг підібрати регіон та розміри SKU щоб воно працювало, та і зараз є кілька нюансів, тому щось робив через azure shell

Також хочу сказати що цього разу я все розкидав по файлах і мав змінну яка відповідає який файл (яке завдання зараз виконується) кидати на деплой

Завдання 1: Розгортання стійких до зон віртуальних машин Azure за допомогою порталу Azure

Не з першого разу запустив тераформ але все ж запустив, тому скріни що воно все відпахало

```
resource "azurerm_windows_virtual_machine" "vm" {
  count           = local.do_vm_pair ? 2 : 0
  name            = "az104-vm${count.index + 1}"
  resource_group_name = azurerm_resource_group.rg.location
  location        = azurerm_resource_group.rg.location
  size            = local.do_vm_resize && count.index == 0 ? "Standard_E2s_v6" : "Standard_E2s_v6"
  admin_username   = var.admin.username
  admin_password   = var.admin.password
  network_interface_ids = [
    azurerm_network_interface.vm_nic[count.index].id
  ]
}
```

PS C:\Users\fedir\Documents\IPZ 43\Cloud technologies\lab8> **terraform plan -out=lab8template**

random_string.suffix: Refreshing state... [id=2bd2]

azurerm_resource_group.rg: Refreshing state... [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8]

azurerm_virtual_network.vnet: Refreshing state... [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Network/virtualNetworks/lab8-vnet]

azurerm_managed_disk.vm1_data[0]: Refreshing state... [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/disks/vm1-disk1]

azurerm_subnet.subnet: Refreshing state... [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Network/virtualNetworks/lab8-vnet/subnets/default]

azurerm_network_interface.vm_nic[0]: Refreshing state... [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Network/networkInterfaces/vm1-nic-zbd]

azurerm_network_interface.vm_nic[1]: Refreshing state... [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Network/networkInterfaces/vm2-nic-zbd]

azurerm_windows_virtual_machine.vm[0]: Refreshing state... [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm1]

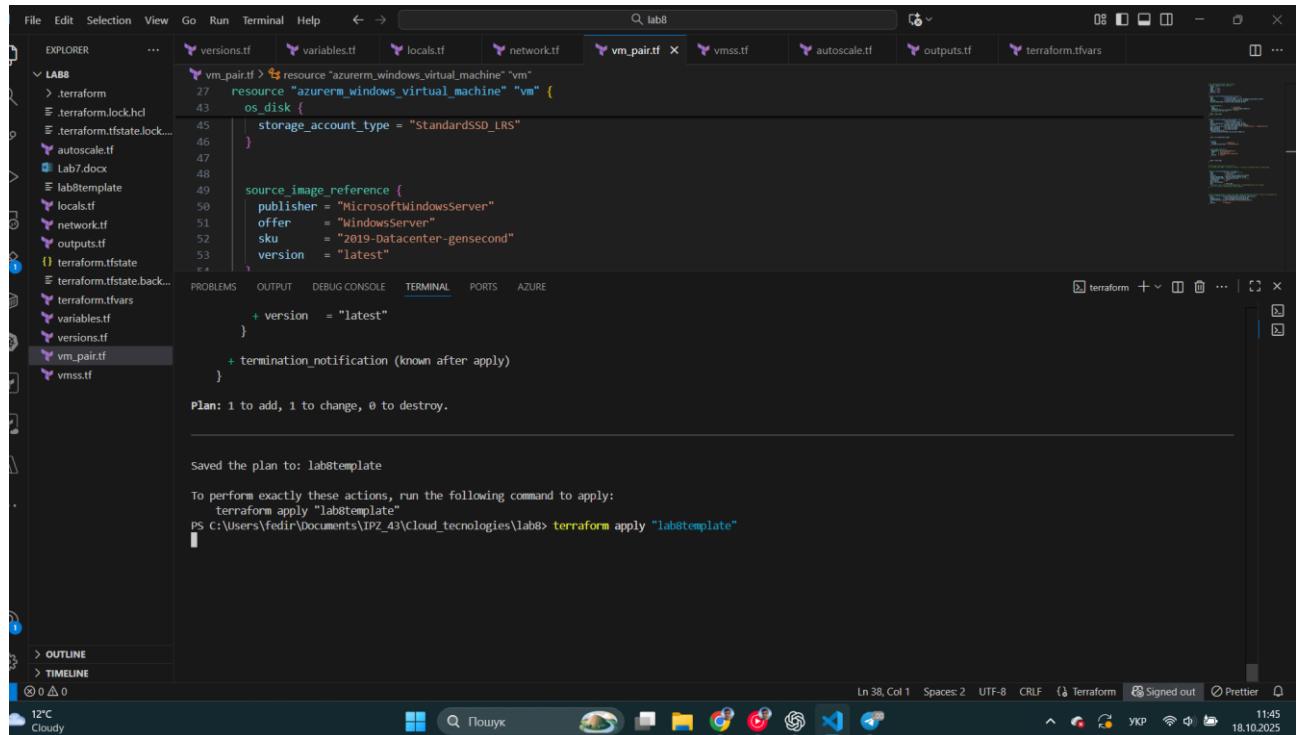
azurerm_virtual_machine_data_disk_attachment.vm1_attach[0]: Refreshing state... [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm1/dataDisks/vm1-disk1]

Terraform used the selected providers to generate the following execution plan. Resource actions are indicated with the following symbols:

- + create
- update in-place

Terraform will perform the following actions:

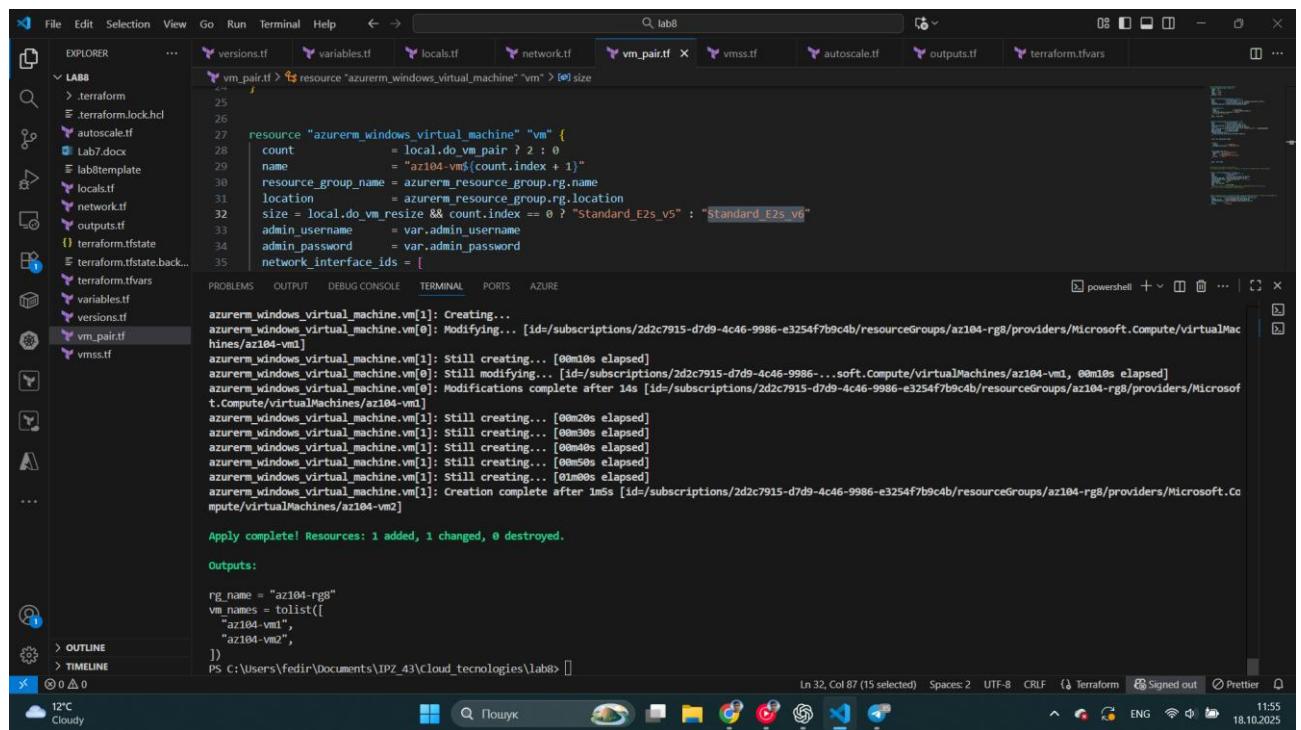
Не перший раз запускаємо, тому мало ресурсів додається



```
File Edit Selection View Go Run Terminal Help <- > lab8
EXPLORER ... versions.tf variables.tf locals.tf network.tf vm_pair.tf vmss.tf autoscale.tf outputs.tf terraform.tfvars
LABB > .terraform > _resource "azurerm_windows_virtual_machine" "vm" {
    resource "azurerm_windows_virtual_machine" "vm" {
        os_disk {
            storage_account_type = "StandardSSD_LRS"
        }
        source_image_reference {
            publisher = "MicrosoftWindowsServer"
            offer     = "WindowsServer"
            sku       = "2019-Datacenter-gensecond"
            version   = "latest"
        }
        + version = "latest"
    }
    + termination_notification (known after apply)
}
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS AZURE
Plan: 1 to add, 1 to change, 0 to destroy.

Saved the plan to: lab8template
To perform exactly these actions, run the following command to apply:
  terraform apply "lab8template"
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform apply "lab8template"
Ln 38, Col 1 Spaces: 2 UTF-8 CRLF Terraform Signed out Prettier
12°C Cloudy 11:45 18.10.2025
```

Успішний деплой



```
File Edit Selection View Go Run Terminal Help <- > lab8
EXPLORER ... versions.tf variables.tf locals.tf network.tf vm_pair.tf vmss.tf autoscale.tf outputs.tf terraform.tfvars
LABB > .terraform > _resource "azurerm_windows_virtual_machine" "vm" {
    resource "azurerm_windows_virtual_machine" "vm" {
        count           = local.do_vm_pair ? 2 : 0
        name            = "az104-vm${count.index + 1}"
        resource_group_name = azurerm_resource_group.rg.name
        location        = azurerm_resource_group.rg.location
        size            = local.do_vm_resize && count.index == 0 ? "Standard_E2s_v6" : "Standard_E2s_v6"
        admin_username   = var.admin_username
        admin_password   = var.admin_password
        network_interface_ids = [
azurerm_windows_virtual_machine.vm[1]: Creating...
azurerm_windows_virtual_machine.vm[0]: Modifying... [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm1]
azurerm_windows_virtual_machine.vm[1]: Still creating... [0m10s elapsed]
azurerm_windows_virtual_machine.vm[0]: Still modifying... [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm1]
azurerm_windows_virtual_machine.vm[1]: Modifications complete after 14s [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm1]
azurerm_windows_virtual_machine.vm[1]: Still creating... [0m20s elapsed]
azurerm_windows_virtual_machine.vm[1]: Still creating... [0m30s elapsed]
azurerm_windows_virtual_machine.vm[1]: Still creating... [0m40s elapsed]
azurerm_windows_virtual_machine.vm[1]: Still creating... [0m50s elapsed]
azurerm_windows_virtual_machine.vm[1]: Still creating... [0m00s elapsed]
azurerm_windows_virtual_machine.vm[1]: Creation complete after 1m5s [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm1]
Apply complete! Resources: 1 added, 1 changed, 0 destroyed.
Outputs:
rg_name = "az104-rg8"
vm_names = tolist([
    "az104-vm1",
    "az104-vm2",
])
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8>
Ln 32, Col 87 (15 selected) Spaces: 2 UTF-8 CRLF Terraform Signed out Prettier
12°C Cloudy 11:55 18.10.2025
```

Ну і тут скріни що все спрацювало як треба

Ресурси в групі ресурсів

The screenshot shows the Microsoft Azure portal interface. The top navigation bar includes links for 'Create', 'Manage view', 'Delete resource group', 'Refresh', and 'Group by none'. The main content area is titled 'az104-rg8 Resource group'. It features an 'Overview' section with a message about the new version of the browse experience. Below this is an 'Essentials' section with tabs for 'Resources' and 'Recommendations'. A table lists resources with columns for 'Name', 'Type', and 'Location'. The table includes entries for 'az104-vm1', 'az104-vm2', 'lab08-vnet', 'vm1-disk1', 'vm1-nic-zbd', and 'vm2-nic-zbd'. The bottom status bar shows the weather as '12°C Cloudy' and the date/time as '18.10.2025'.

Віртуальна машина 1

The screenshot shows the Microsoft Azure portal interface, specifically the details for the 'az104-vm1' virtual machine. The left sidebar shows 'Virtual machine' selected. The main pane displays the VM's configuration, including its resource group ('az104-rg8'), status ('Running'), location ('Poland Central (Zone 1)'), subscription ('Azure subscription 1'), and various networking and security settings. The bottom status bar shows the weather as '12°C Cloudy' and the date/time as '18.10.2025'.

Віртуальна машина 2

The screenshot shows the Microsoft Azure portal interface. The main title bar says "az104-vm2 - Microsoft Azure". The left sidebar shows the navigation path: Home > Azure subscription 1 | Resource groups > az104-rg8 > az104-vm2. The main content area displays the details of the virtual machine "az104-vm2". The "Overview" tab is selected. Key details include:

- Resource group: az104-rg8
- Status: Running
- Location: Poland Central (Zone 2)
- Subscription: Azure subscription 1
- Subscription ID: 2d2c7915-d7d9-4c46-9986-e3254f7b9c4b
- Availability zone: 2
- Tags: lab : az104-lab08
- Operating system: Windows (Windows Server 2019 Datacenter)
- Size: Standard E2s v6 (2 vcpus, 16 GiB memory)
- Primary NIC public IP: (not visible)
- Virtual network/subnet: lab08-vnet/default
- DNS name: (not visible)
- Health state: (not visible)
- Time created: 10/18/2025, 8:54 AM UTC

The "Properties" tab is also visible at the bottom of the main content area.

Накопичував першої віртуальної машини

The screenshot shows the Microsoft Azure portal interface. The main title bar says "vm1-disk1 - Microsoft Azure". The left sidebar shows the navigation path: Home > Azure subscription 1 | Resource groups > az104-rg8 > vm1-disk1. The main content area displays the details of the disk "vm1-disk1". The "Disk" tab is selected. Key details include:

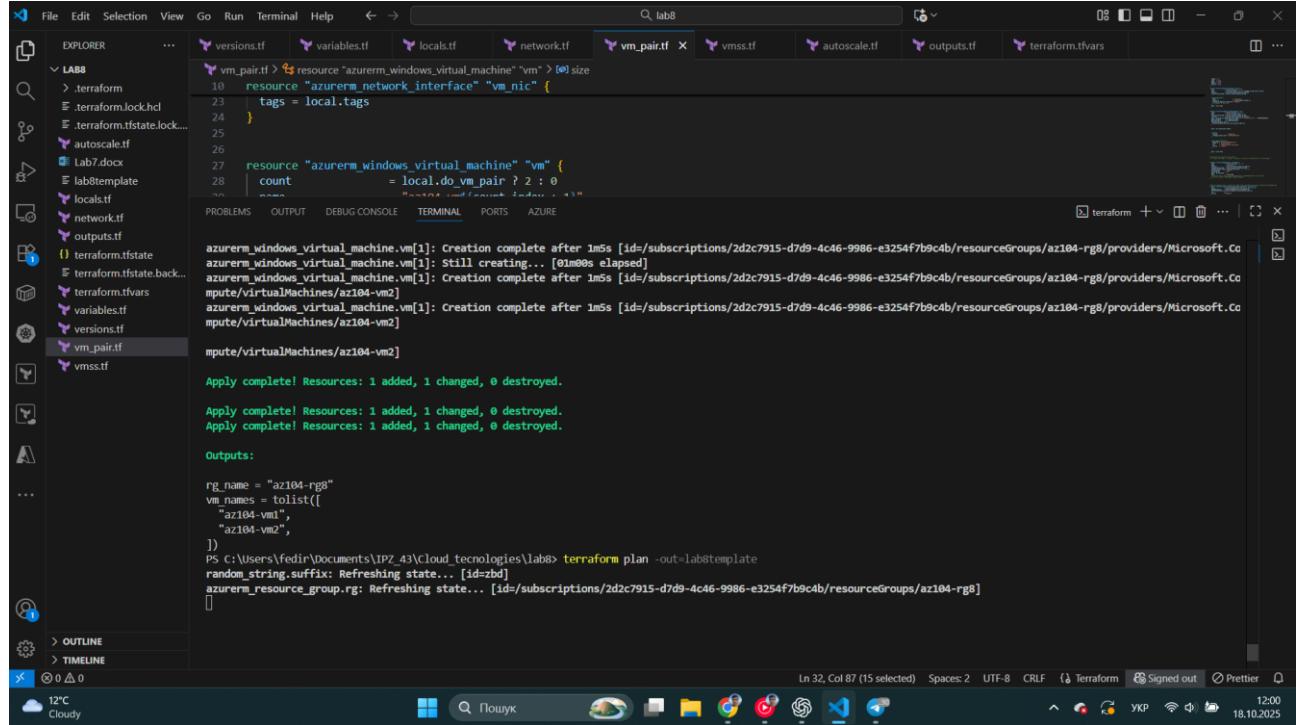
- Resource group: az104-rg8
- Disk state: Attached
- Last ownership update time: 10/18/2025, 11:43:07 AM
- Location: Poland Central
- Subscription: Azure subscription 1
- Subscription ID: 2d2c7915-d7d9-4c46-9986-e3254f7b9c4b
- Time created: 10/18/2025, 11:41:21 AM
- Tags: lab : az104-lab08
- Disk size: 32 GiB
- Storage type: Standard HDD LRS
- Managed by: az104-vm1
- Operating system: (not visible)
- Max shares: 0
- Availability zone: 1
- Security type: Standard

The "Properties" tab is selected at the bottom of the main content area.

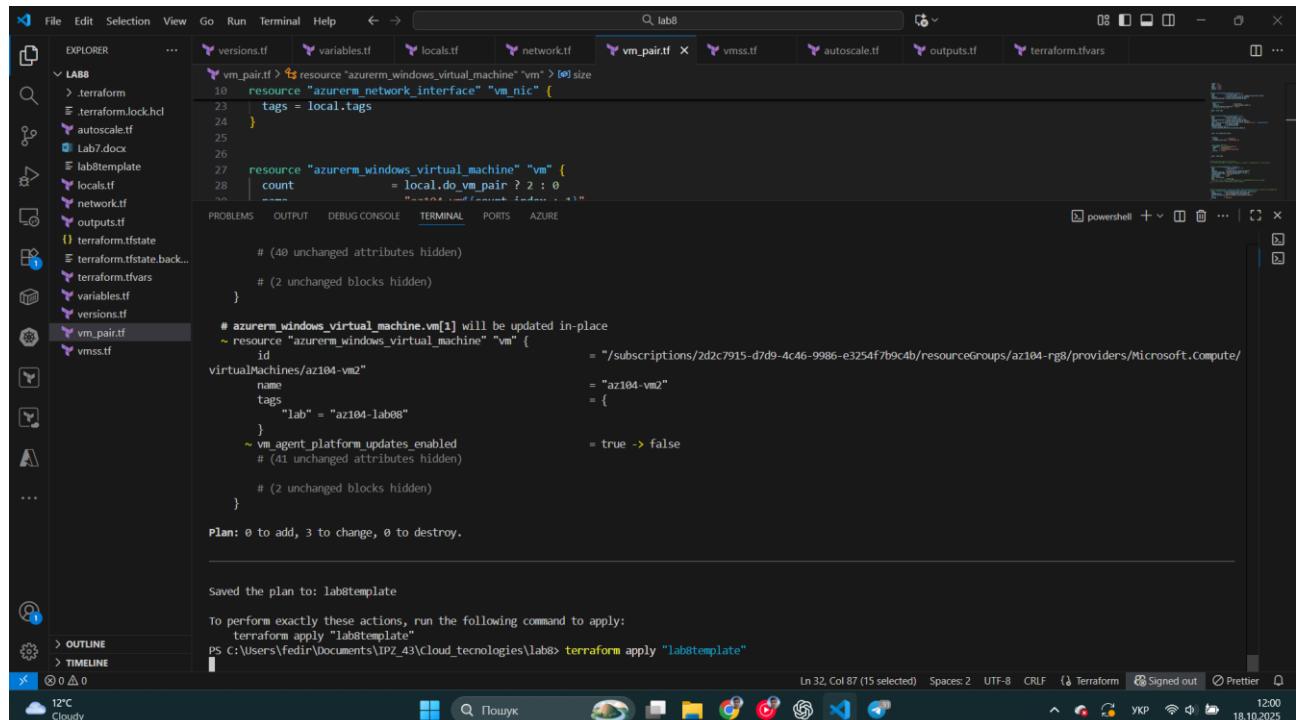
Завдання 2: Керування масштабуванням обчислень та сховища для віртуальних машин

I так, знову запускаємо тераформ

Запускаємо заново terraform plan з новим параметром в змінній lab_phase



```
File Edit Selection View Go Run Terminal Help ← → lab8
EXPLORER ... versions.tf variables.tf locals.tf network.tf vm_pair.tf x vms.tf autoscale.tf outputs.tf terraform.tfvars
.terraform.lock.hcl .terraform.state.lock...
Lab7.docx lab8template locals.tf network.tf outputs.tf terraform.tfstate .terraform.state.back...
variables.tf versions.tf vm_pair.tf vms.tf
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS AZURE
azurerm_windows_virtual_machine.vm[1]: Creation complete after 1m5s [id:/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm2]
azurerm_windows_virtual_machine.vm[1]: Still creating... [0m00s elapsed]
azurerm_windows_virtual_machine.vm[1]: Creation complete after 1m5s [id:/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm1]
azurerm_windows_virtual_machine.vm[1]: Creation complete after 1m5s [id:/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm2]
azurerm_resource_group.rg: Refreshing state... [id:zbd]
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform plan -out=lab8template
random_string.suffix: Refreshing state... [id:zbd]
azurerm_resource_group.rg: Refreshing state... [id:/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8]
[]
```



```
File Edit Selection View Go Run Terminal Help ← → lab8
EXPLORER ... versions.tf variables.tf locals.tf network.tf vm_pair.tf x vms.tf autoscale.tf outputs.tf terraform.tfvars
.terraform.lock.hcl .terraform.state.lock...
Lab7.docx lab8template locals.tf network.tf outputs.tf terraform.tfstate .terraform.state.back...
variables.tf versions.tf vm_pair.tf vms.tf
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS AZURE
# azurerm_windows_virtual_machine.vm[1] will be updated in-place
~ resource "azurerm_windows_virtual_machine" "vm" {
    id = "/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm2"
    name = "az104-vm2"
    tags = {
        "lab" = "az104-lab08"
    }
    ~ vm_agent(platform_updates_enabled) = true -> false
}
# (40 unchanged attributes hidden)
# (2 unchanged blocks hidden)

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

Saved the plan to: lab8template

To perform exactly these actions, run the following command to apply:
  terraform apply "lab8template"
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform apply "lab8template"
[]
```

Далі terraform apply в мене провалився тому я через командний рядок змінив розмір SKU

```
File Edit Selection View Go Run Terminal Help < > lab8

EXPLORER ... versions.tf variables.tf locals.tf network.tf vm_pair.tf x vms.tf autoscale.tf outputs.tf terraform.tfvars

LAB8
> .terraform
terraform.lock.hcl
autoscale.tf
Lab7.doc
Lab8Template
locals.tf
network.tf
outputs.tf
! terraform.state
terraform.state.back...
terrafrom.tfvars
variables.tf
versions.tf
vm_pair.tf
vms.tf

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS AZURE

# azurerm_windows_virtual_machine.vm[1] will be updated in-place
~ resource "azurerm_windows_virtual_machine" "vm" {
    id = "/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/
virtualMachines/az104-vm2"
    name = "az104-vm2"
    tags = {
        "lab" = "az104-lab88"
    }
    ~ vm_agent_platform_updates_enabled = true -> false
    # (41 unchanged attributes hidden)
    # (2 unchanged blocks hidden)
}

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

Saved the plan to: lab8Template

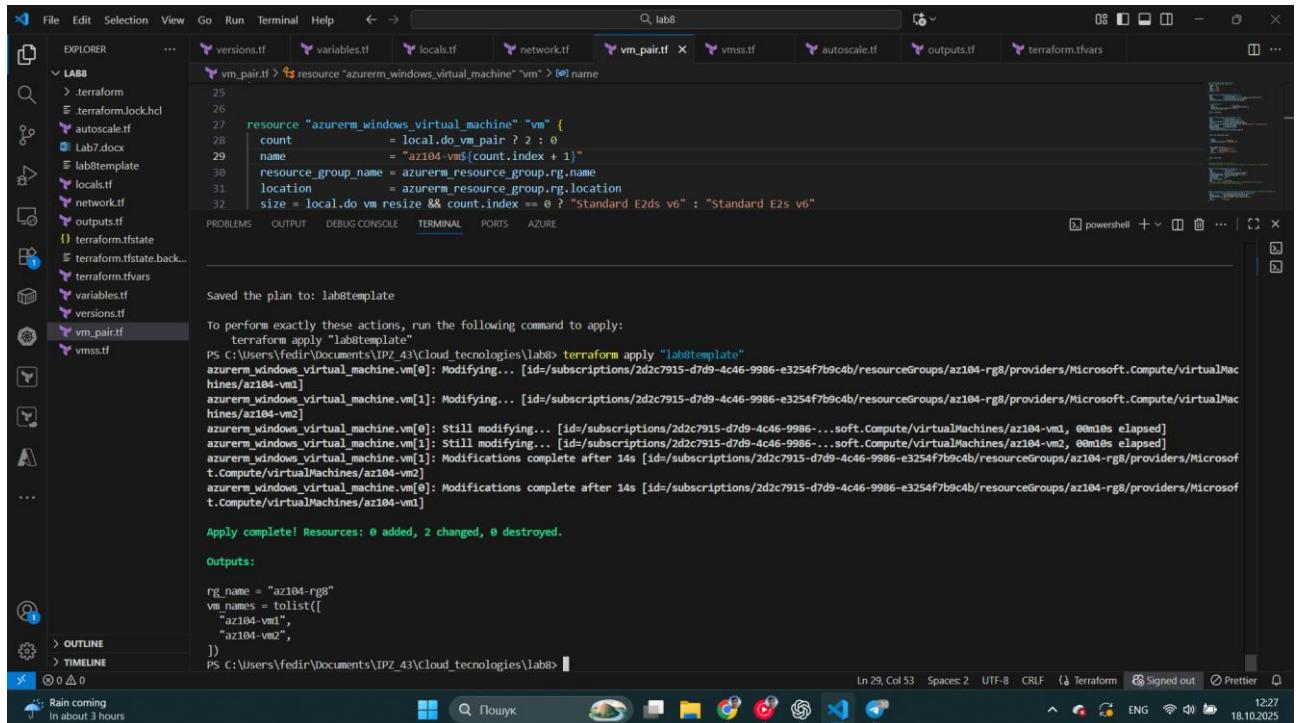
To perform exactly these actions, run the following command to apply:
  terraform apply "lab8Template"
PS C:\Users\fedor\Documents\IPZ_43\Cloud_technologies\lab8> terraform apply "lab8Template"

Ln 32, Col 87 (15 selected) Spaces: 2 UTF-8 CRLF ⓘ Signed out ⓘ Prettier
12:00
18.10.2025
```

The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows files like `.terraform`, `.terraform.lock.hcl`, `Lab7.docx`, `Lab8Template`, `locals.tf`, `network.tf`, `vm_pair.tf` (the active file), `vmss.tf`, `autoscale.tf`, `outputs.tf`, `terraform.tfstate`, `terraform.state.backup`, `variables.tf`, `versions.tf`, and `vmss.tf`.
- Editor:** The `vm_pair.tf` file contains Terraform code to create multiple Windows VMs. It defines a resource block for `azurerm_windows_virtual_machine` with a count of 2. The VMs are named `az104-vm${count.index + 1}`. The `resource_group_name` is `az104-rg8`, and the `location` is `az104-rg8`. The `size` is set to `Standard_E2ds_v6`.
- Terminal:** The terminal shows the command `terraform apply "Lab8Template"` being run. It outputs several status messages for each VM creation, followed by an error message for the second VM due to size conflicts.
- Status Bar:** Shows the current file is `vm_pair.tf`, the file path is `C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8\`, and the command is `az vm resize -g az104-rg8 -n az104-vm1 --size Standard_E2ads_v6`. It also shows the number of lines (122), columns (37), spaces (2), and tabs (4).

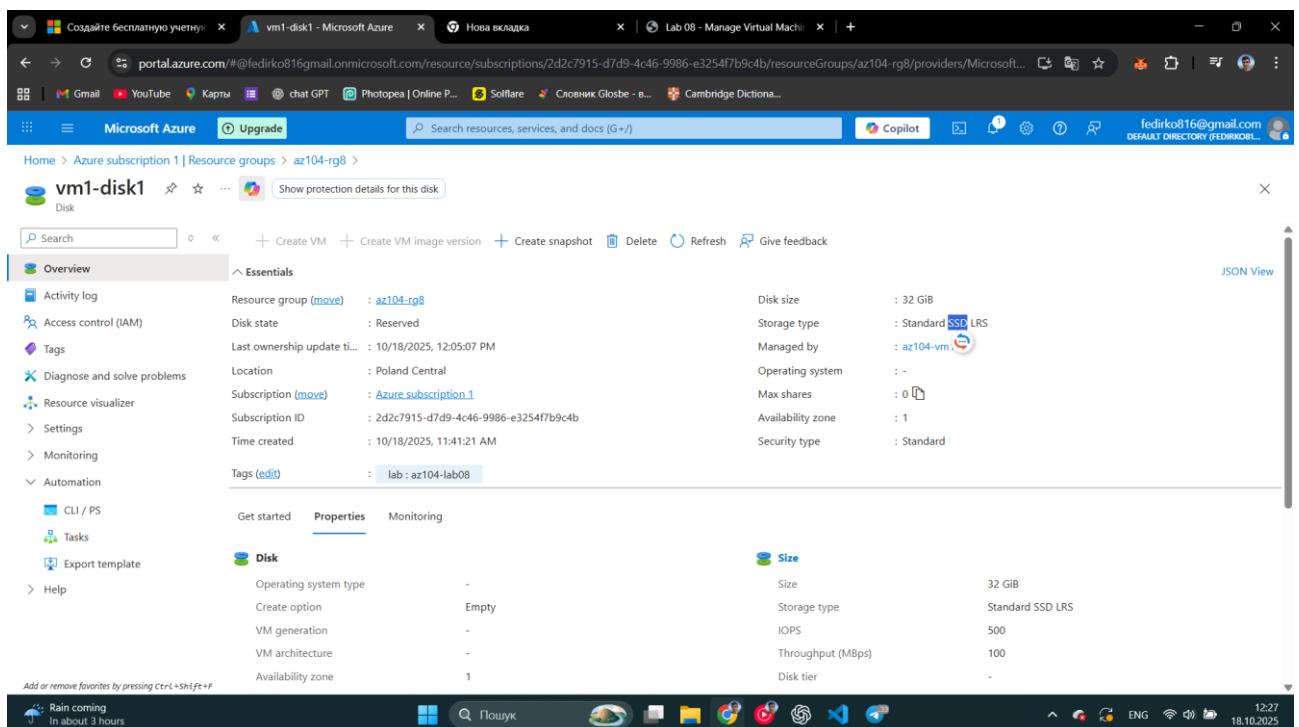
І ще раз запустив terraform щоб він додеплоїв те що треба



```
File Edit Selection View Go Run Terminal Help < - > lab8 PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS AZURE powershell + ... x ...  
EXPLORER ...  
LABB  
> .terraform  
E .terraform.lock.hcl  
autoscale.tf  
Lab7.docx  
E lab8template  
locals.tf  
network.tf  
outputs.tf  
terrafrom.tfstate  
terrafrom.tfstate.backup  
variables.tf  
versions.tf  
vm_pair.tf  
vmss.tf  
  
25  
26  
27 resource "azurerm_windows_virtual_machine" "vm" {  
28   count = local.do_vm_pair ? 2 : 0  
29   name = "az104-vm${count.index + 1}"  
30   resource_group_name = azurerm_resource_group.rg.name  
31   location = azurerm_resource_group.rg.location  
32   size = local.do_vm_resize && count.index == 0 ? "Standard_E2ds_v6" : "Standard_E2s_v6"  
  
Saved the plan to: lab8template  
  
To perform exactly these actions, run the following command to apply:  
  terraform apply "lab8template"  
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform apply "lab8template"  
azurerm_windows_virtual_machine.vm[0]: Modifying... [id:/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm1]  
azurerm_windows_virtual_machine.vm[1]: Modifying... [id:/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm2]  
azurerm_windows_virtual_machine.vm[0]: Still modifying... [id:/subscriptions/2d2c7915-d7d9-4c46-9986...soft.Compute/virtualMachines/az104-vm1, 00m0s elapsed]  
azurerm_windows_virtual_machine.vm[1]: Still modifying... [id:/subscriptions/2d2c7915-d7d9-4c46-9986...soft.Compute/virtualMachines/az104-vm2, 00m0s elapsed]  
azurerm_windows_virtual_machine.vm[1]: Modifications complete after 14s [id:/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm2]  
azurerm_windows_virtual_machine.vm[0]: Modifications complete after 14s [id:/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm1]  
  
Apply complete! Resources: 0 added, 2 changed, 0 destroyed.  
  
Outputs:  
rg_name = "az104-rg8"  
vm_names = tolist([  
  "az104-vm1",  
  "az104-vm2",  
])  
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8>  
Ln 29, Col 53 Spaces: 2 UTF-8 CRLF ⚡ Terraform ⚡ Signed out ⚡ Prettier ⚡  
Rain coming In about 3 hours ⚡  
Помаранчевий ⚡  
Глянути ⚡  
Timeline ⚡  
Outline ⚡  
In about 3 hours ⚡  
ENG ⚡ 12:27 ⚡ 18.10.2025 ⚡
```

Ну і докази ТОГО що все докинулось

Зміни в диску



Создайте бесплатную учетную запись | portal.azure.com | vm1-disk1 - Microsoft Azure | Новая вкладка | Lab-08 - Manage Virtual Machine | +

Home > Azure subscription 1 | Resource groups > az104-rg8 >

vm1-disk1 Disk

Show protection details for this disk

Search Create VM Create VM image version Create snapshot Delete Refresh Give feedback

Overview

Resource group (move)	: az104-rg8	Disk size	: 32 GiB
Access control (IAM)	Disk state	Storage type	: Standard SSD LRS
Tags	Last ownership update ti...	Managed by	: az104-vm
Diagnose and solve problems	Location	Operating system	: -
Resource visualizer	Subscription (move)	Max shares	: 0
Settings	Subscription ID	Availability zone	: 1
Monitoring	Time created	Security type	: Standard
Automation	Tags (edit)		

Get started Properties Monitoring

Disk

Operating system type	Size
Empty	32 GiB
VM generation	Storage type
VM architecture	IOPS
Availability zone	Throughput (Mbps)
1	Disk tier

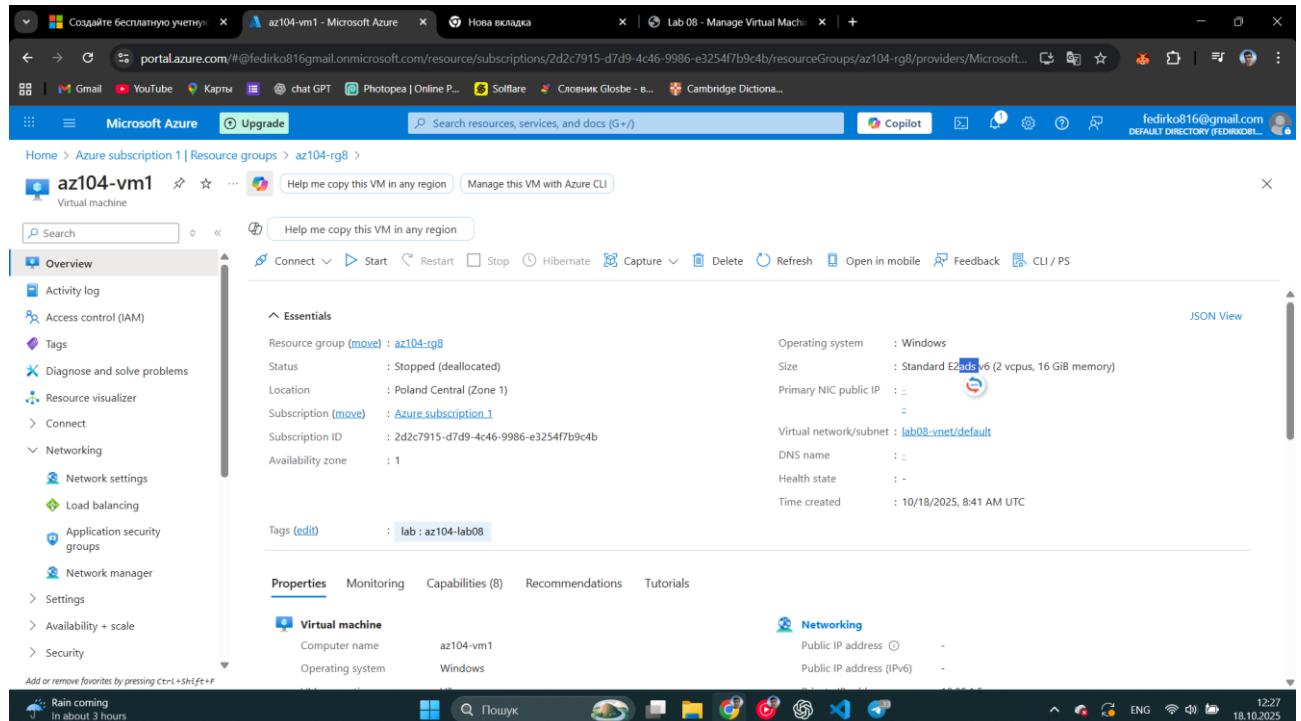
Add or remove favorites by pressing Ctrl+Shift+F+F

Rain coming In about 3 hours ⚡

Пошук ⚡

ENG ⚡ 12:27 ⚡ 18.10.2025 ⚡

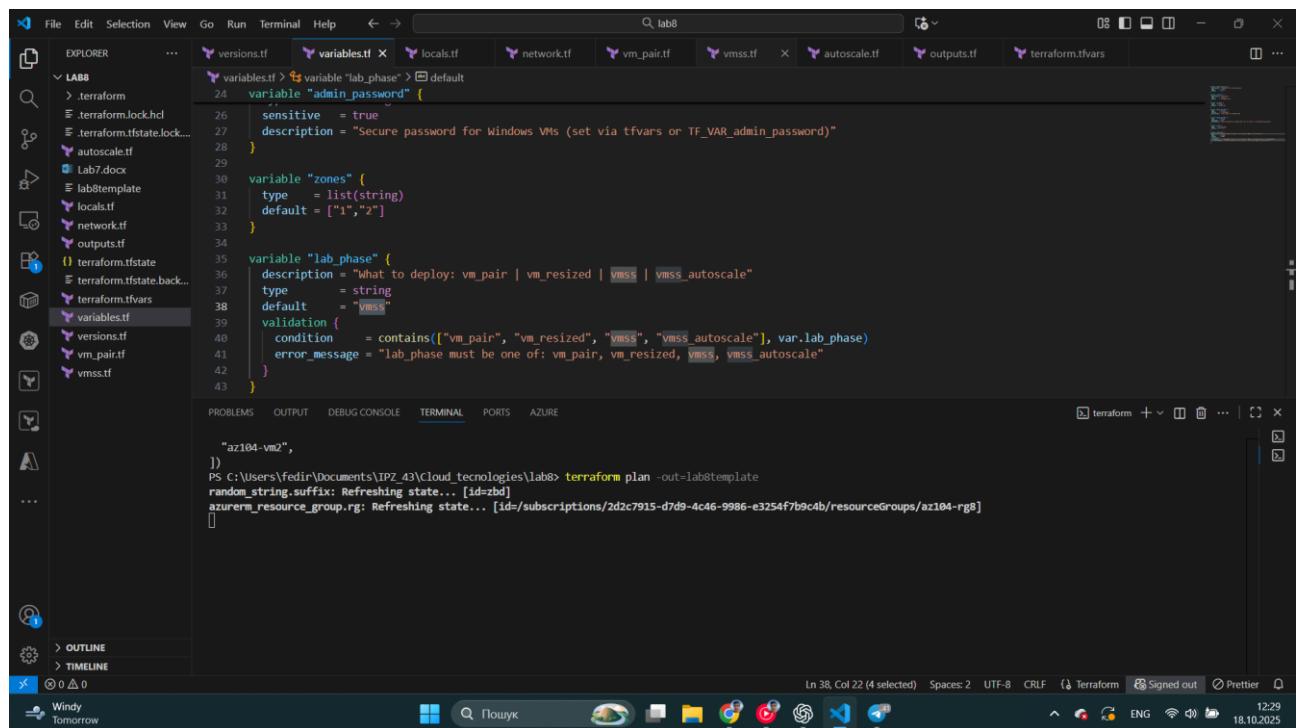
Зміни в віртуалці



Завдання 3: Створення та налаштування масштабованих наборів віртуальних машин Azure

Знову міняємо параметр в змінній `lap_phase` і знову деплоїмо (без нюансів не обійшлося)

Запускаю команди `terraform plan` та `terraform apply`



```

variable "admin_password" {
  sensitive = true
  description = "Secure password for Windows VMs (set via tfvars or TF_VAR_admin_password)"
}

variable "zones" {
  type = list(string)
  default = ["1","2"]
}

variable "lab_phase" {
  description = "What to deploy: vm_pair | vm_resized | vmss | vmss_autoscale"
  type = string
  default = "vmss"
  validation {
    condition = contains(["vm pair", "vm resized", "vmss", "vmss autoscale"], var.lab_phase)
  }
}

Plan: 8 to add, 0 to change, 6 to destroy.

Changes to Outputs:
~ vm_names = [
  - "az104-vm1",
  - "az104-vm2",
]
+ vmss_public_ip = (known after apply)

Saved the plan to: lab8template

To perform exactly these actions, run the following command to apply:
  terraform apply "lab8template"
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform apply "lab8template"

```

Тут в мене ні з першого, ні з друго разу не вийшло (причиною була квота на кількість ядер)

Друга спроба (бачимо що деякі ресурси додались а деякі видалились)

```

resource "azurerm_windows_virtual_machine_scale_set" "vmss" {
  sku {
    upgrade_mode = "Manual"
  }

  admin_username = var.admin_username
  admin_password = var.admin_password

  source_image_reference {
    publisher = "MicrosoftWindowsServer"
    offer     = "WindowsServer"
    sku       = "2019-Datacenter-gensecond"
    version   = "latest"
  }

  + offer      = "WindowsServer"
  + publisher = "MicrosoftWindowsServer"
  + sku        = "2019-Datacenter-gensecond"
  + version    = "latest"
}

+ spot_restore (known after apply)
+ terminate_notification (known after apply)
+ termination_notification (known after apply)

Plan: 1 to add, 0 to change, 3 to destroy.

Saved the plan to: lab8template

To perform exactly these actions, run the following command to apply:
  terraform apply "lab8template"
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform apply "lab8template"

```

Це третя спроба і я знову через azure shell видалив віртуальну машину, бо тепер вона заважала всьому працювати добре

```
To perform exactly these actions, run the following command to apply:  
  terraform apply "lab8template"  
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform apply "lab8template"  
azurerm_windows_virtual_machine.vm[0]: Destroying... [id=subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Compute/virtualMachines/az104-vm1]  
  
Error: powering off Windows Virtual Machine (Subscription: "2d2c7915-d7d9-4c46-9986-e3254f7b9c4b")  
Resource Group Name: "az104-rg8"  
Virtual Machine Name: "az104-vm1": performing PowerOff: unexpected status 409 (409 Conflict) with error: OperationNotAllowed: Operation 'powerOff' is not allowed on VM 'az104-vm1' since the VM is either deallocated or marked to be deallocated. Please refer to https://aka.ms/vmpowersstates to learn about different VM power states.  
  
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> az vm delete -g az104-rg8 -n az104-vm1 --yes  
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform plan -out=lab8template  
random_string.suffix: Refreshing state... [id=zbd]  
|  
Ln 62, Col 38 Spaces:2 UTF-8 CRLF Terraform Signed out Prettier 12:37 18.10.2025
```

Ще раз зробив terraform plan

```
terraform tfvars  
variables.tf  
versions.tf  
vm_pair.tf  
vmsst.tf  
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS AZURE  
- primary  
- private_ip_address  
- private_ip_address_allocation  
- private_ip_address_version  
- subnet_id  
virtualNetworks/lab8-vnet/subnets/default" -> null  
    # (2 unchanged attributes hidden)  
}  
}  
Plan: 0 to add, 0 to change, 2 to destroy.  
  
Saved the plan to: lab8template  
To perform exactly these actions, run the following command to apply:  
  terraform apply "lab8template"  
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform apply "lab8template"  
|  
Ln 62, Col 38 Spaces:2 UTF-8 CRLF Terraform Signed out Prettier 12:37 18.10.2025
```

І нарешті успішний результат

```
File Edit Selection View Go Run Terminal Help ← → 🔍 lab8  
EXPLORER ...  
LABB .terraform .terraform.lock.hcl autoscale.tf Lab7.docx labTemplate locals.tf network.tf outputs.tf terraform.state terraform.state.back.. terraform.tfvars variables.tf versions.tf vm_pair.tf vmsst.tf  
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS AZURE  
resource "azurerm_windows_virtual_machine_scale_set" "vmsst" {  
  sku  
  upgrade_mode = "Manual"  
  admin_username = var.admin.username  
  admin_password = var.admin.password  
  
  source_image_reference {  
    publisher = "MicrosoftWindowsServer"  
    offer = "WindowsServer"  
    sku = "2019-Datacenter-gensecond"  
    version = "latest"  
  }  
}  
  
terrafom apply "lab8template"  
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform apply "lab8template"  
azurerm_network_interface.vm_nic[0]: Destroying... [id=subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Network/networkInterfaces/vml-nic-zbd]  
azurerm_network_interface.vm_nic[1]: Destroying... [id=subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Network/networkInterfaces/vm2-nic-zbd]  
azurerm_network_interface.vm_nic[0]: Still destroying... [id=subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Network/networkInterfaces/vml-nic-zbd, 00m10s elapsed]  
azurerm_network_interface.vm_nic[0]: Still destroying... [id=subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Network/networkInterfaces/vml-nic-zbd, 00m10s elapsed]  
azurerm_network_interface.vm_nic[1]: Destruction complete after 1s  
azurerm_network_interface.vm_nic[0]: Still destroying... [id=subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg8/providers/Microsoft.Network/networkInterfaces/vml-nic-zbd, 00m20s elapsed]  
azurerm_network_interface.vm_nic[0]: Destruction complete after 22s  
  
Apply complete! Resources: 0 added, 0 changed, 2 destroyed.  
  
Outputs:  
rg_name = "az104-rg8"  
vm_names = []  
vmsst_public_ip = "20.218.255.224"  
PS C:\Users\fedor\Documents\IPZ_43\Cloud_tecnologies\lab8>  
Ln 62, Col 38 Spaces:2 UTF-8 CRLF Terraform Signed out Prettier 12:38 18.10.2025
```

Ну і скріни на платформі

Vmss

vmss1 - Microsoft Azure

Home > az104-rg8 >

vmss1

Virtual machine scale set

Search

Overview

Essentials

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Instances

Resource visualizer

Networking

Settings

Availability + scale

Security

Operations

Monitoring

Automation

Help

Tags (edit): lab : az104-lab08

Properties

Monitoring

Capabilities

Recommendations (0)

Virtual machine profile

Operating system: Windows

Capacity reservation group: -

Hibernation: Disabled

Status

Provisioning state: Succeeded

Power state: 2 out of 2 instances running

Networking

Public IP address: 20.215.255.224

Azure Spot

Rainy days ahead 12°C

Search

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Netwok security group

vmss1-nsg - Microsoft Azure

Home > az104-rg8 >

vmss1-nsg

Network security group

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Move

Delete

Refresh

Give feedback

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Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Resource visualizer

Settings

Inbound security rules

Outbound security rules

Network interfaces

Subnets

Properties

Locks

Monitoring

Automation

Help

Tags (edit): lab : az104-lab08

Filter by name

Priority ↑↓ Name ↑↓ Port ↑↓ Protocol ↑↓ Source ↑↓ Destination ↑↓ Action ↑↓

Inbound Security Rules

Priority ↑↓	Name ↑↓	Port ↑↓	Protocol ↑↓	Source ↑↓	Destination ↑↓	Action ↑↓
1010	allow-htp	80	Tcp	Any	Any	Allow
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowAzureLoadBalancerIn	Any	Any	AzureLoadBalancer	Any	Allow
65500	DenyAllInBound	Any	Any	Any	Any	Deny

Outbound Security Rules

Priority ↑↓	Name ↑↓	Port ↑↓	Protocol ↑↓	Source ↑↓	Destination ↑↓	Action ↑↓
65000	AllowVnetOutBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowInternetOutBound	Any	Any	Any	Internet	Allow
65500	DenyAllOutBound	Any	Any	Any	Any	Deny
	AllowAllOutBound	Any	Any	Any	Any	Allow

Rainy days ahead 12°C

Search

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Hy i load balancer

The screenshot shows the Azure portal interface for managing a Load Balancer. The main page displays the 'vmss-lb' resource with its basic properties. Below the main content, there's a section titled 'Configure high availability and scalability for your applications' with three main options: 'Balance IPv4 and IPv6 addresses', 'Build highly reliable applications', and 'Secure your networks'. Each option has a brief description and a 'Learn more' link.

Завдання 4: Масштабування наборів масштабування віртуальних машин Azure

Знову міняємо параметр в `lab_phase` і знову деплоїмо

The screenshot shows the VS Code editor with the 'variables.tf' file open. The code defines two variables: 'zones' (a list of strings with default values '1', '2') and 'lab_phase' (a string with default value 'vmss_autoscale'). The 'PROBLEMS' tab indicates no issues. The bottom terminal window shows the command 'terraform plan -out=lab8template' being executed, with output indicating resources are being destroyed and created.

```

variable "zones" {
  type    = list(string)
  default = ["1", "2"]
}

variable "lab_phase" {
  description = "What to deploy: vm_pair | vm_resized | vmss | vmss_autoscale"
  type        = string
  default     = "vmss_autoscale"
  validation {
    condition = contains(["vm_pair", "vm_resized", "vmss", "vmss_autoscale"], var.lab_phase)
    error_message = "lab_phase must be one of: vm_pair, vm_resized, vmss, vmss_autoscale"
  }
}

scale_action {
  cooldown = "PT5M"
  direction = "Decrease"
  type      = "PercentChangeCount"
  value     = 50
}
}
}

```

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

Saved the plan to: lab8template

To perform exactly these actions, run the following command to apply:

```
terraform apply "lab8template"
```

PS C:\Users\fedir\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform apply "lab8template"

Ну і надіво з першого разу вийшло

```

variable "zones" {
  type    = list(string)
  default = ["1", "2"]
}

variable "lab_phase" {
  description = "What to deploy: vm_pair | vm_resized | vmss | vmss_autoscale"
  type        = string
  default     = "vmss_autoscale"
  validation {
    condition = contains(["vm_pair", "vm_resized", "vmss", "vmss_autoscale"], var.lab_phase)
    error_message = "lab_phase must be one of: vm_pair, vm_resized, vmss, vmss_autoscale"
  }
}

scale_action {
  cooldown = "PT5M"
  direction = "Decrease"
  type      = "PercentChangeCount"
  value     = 50
}
}
}

```

Saved the plan to: lab8template

To perform exactly these actions, run the following command to apply:

```
terraform apply "lab8template"
```

PS C:\Users\fedir\Documents\IPZ_43\Cloud_tecnologies\lab8> terraform apply "lab8template"

azurerm_monitor_autoscale_setting.vmss_auto[0]: Creating...

azurerm_monitor_autoscale_setting.vmss_auto[0]: Creation complete after 5s [id=/subscriptions/2d2c7915-d7d9-4c46-9986-e3254f7b9c4b/resourceGroups/az104-rg/providers/Microsoft.Insights/autoscaleSettings/vmss1-autoscale]

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

Outputs:

```

rg_name = "az104-rg8"
vm_names = []
vmss_public_ip = "20.215.255.224"

```

PS C:\Users\fedir\Documents\IPZ_43\Cloud_tecnologies\lab8>

Ну і показ що autoscale є

The screenshot shows the Microsoft Azure portal interface. The main content area is titled 'Availability + scaling' for a VMSS named 'vmss1'. It lists several configuration parameters:

Setting	Value
Availability zone	1, 2, 3
Extended zone	-
Proximity placement group	-
Colocation status	-
Host group	-
Instance count	2
Scaling	Autoscale
Scale-In policy	Default
Zone balance	Best-effort
Overprovisioning	Enabled
Fault domain count	5
Single placement group	Enabled
Disk controller type	SCSI
Management	
Upgrade policy	Manual
Boot diagnostics	Disabled
System assigned identity	Disabled
Automatic OS upgrade	Disabled

On the right side, there are sections for 'Size', 'Source image details', 'Disk', and 'Extensions'. The 'Size' section shows 'Standard_B1s' with 1 vCPU and 1 GiB RAM. The 'Source image details' section shows 'MicrosoftWindowsServer' Windows Server 2019 Datacenter edition. The 'Disk' section shows 'Premium SSD LRS' with encryption disabled. The 'Extensions' section is currently empty.

Висновок

У ході лабораторної роботи було створено та налаштовано віртуальні машини Azure (VMs) із забезпеченням зональної відмовостійкості (Availability Zones) для досягнення 99.99% SLA.

Було відпрацьовано масштабування обчислювальних ресурсів — як вертикальне (zmіна розміру VM), так і горизонтальне за допомогою Virtual Machine Scale Sets (VMSS).

Створено Scale Set із трьома зонами доступності, налаштовано автоматичне масштабування на основі метрики CPU utilization (розширення при >70%, скорочення при <30%), а також встановлено мінімальну й максимальну кількість екземплярів.

Крім того, було ознайомлено з процесом створення ВМ через PowerShell і Azure CLI, що підвищує гнучкість адміністрування.

У результаті виконання лабораторної роботи отримано практичні навички розгортання, конфігурації, масштабування та моніторингу віртуальних машин і масштабованих груп у Microsoft Azure.