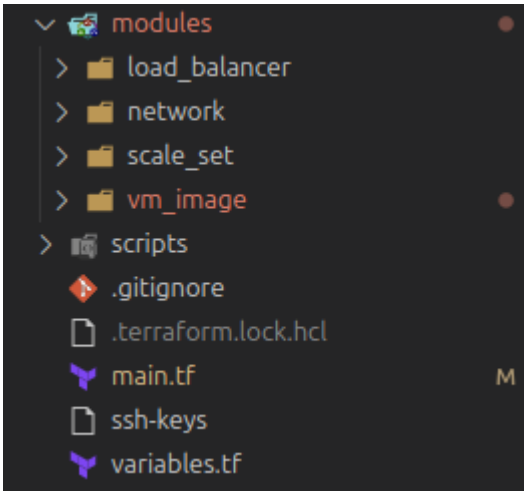
terraform practical task

> ## Practical task
>
> Create a simple cloud infrastructure using Terraform by following the steps provided below:
> 1. Everything should be inside Terraform configuration files, manual changes are not allowed.
> 2. Try to use terraform modules to segregate resources by its types (compute, network).
> 3. Create a temporary VM with metadata script installing HTTP server (Apache) with a simple website inside.
> 4. Create an image from a temporary VM.
> 5. Terraform should create a scale set of 3 instances (use predefined image as source image for VMs), including external load balancer with health checks, everything should be done via terraform tf/tfstate files.
> 6. Every host should display server number/hostname to ensure that load balancer is working.
> 7. Users should be able to connect to the website in High Availability mode via external load balancer IP.
> 8. Add firewall for accessing external load balancer from limited IP addresses range and only for certain ports.
> 9. Use Public Cloud storage service as backend for Terraform state.

Modules

In the project there are 4 modules to decouple overall code structure.



Inputs common to every module are:

- Resource Group name
- Location
- Resources names prefix

Network module

Creates:

- Vnet
- Subnet
- Network Security Group (NSG) with rules
- NSG association to Subnet

VM Image module

Runs Bash script on temporary VM and after that creates an Image out of it. Outputs Image ID.
To create a new Image other temporary resources need to be created (VM, disk...), so there is a boolean `regenerate_image` variable to handle that. When it is set to `false` (default), all the temporary resources that were used to create an image are deleted and only image persist. If it is set to `true` all the temporary resources are created again (but not deleted after) to generate new Image.
So in order to create new Image from blank project using this terraform module we would run terraform apply twice:

```
terraform apply -var 'regenerate_image=true' # Create Image and temp
resources
terraform apply # default regenerate_image=false. Deletes temp resources
```

Load Balancer module

Creates Azure Load Balancer PaaS resource with:

- Public IP
- Load Balancer backend pool
- Health Check probe
- Load Balancer rule

Scale set module

Creates VMs scale set out of given Image with option to run additional Bash script on each instance. Adds scale set to provided Load Balancer backend pool.

Example usage

First create resource group with appropriate location and name:

```
resource "azurerm_resource_group" "rg" {
  name     = "grid-terraform"
  location = "westeurope"
}
```

In the network module add rules to allow SSH and HTTP.

```
module "network_module" {
  source              = "./modules/network"
  resource_group_name = azurerm_resource_group.rg.name
  location            = azurerm_resource_group.rg.location
  nsg_rules = [{
    name                       = "ssh"
    priority                   = 1001
    direction                  = "Inbound"
    access                     = "Allow"
    protocol                   = "Tcp"
    source_port_range          = "*"
    destination_port_range     = "22"
    source_address_prefix      = "*"
    destination_address_prefix = "*"
    },
    {
      name                       = "http"
      priority                   = 1002
      direction                  = "Inbound"
      access                     = "Allow"
      protocol                   = "Tcp"
      source_port_range          = "*"
      destination_port_range     = "80"
      source_address_prefix      = "*"
      destination_address_prefix = "*"
  }]
}
```

In the VM Image module set required params and create Bash script to correctly configure Image.

```
module "vm_image" {
  source                = "./modules/vm_image"
  location              = azurerm_resource_group.rg.location
  resource_group_name   = azurerm_resource_group.rg.name
  provision_script_path = "./scripts/initial.sh"
  temp_vm_subnet_id     = module.network_module.subnet_id
  regenerate_image      = var.regenerate_image
}
```

scripts > initial.sh

```
#!/bin/bash
apt update
apt install -y apache2
echo "<html><body><h1>$(hostname)</h1></body></html>" > /home/azureuser/page.html
cp /home/azureuser/page.html /var/www/html/index.html
```

In the Load Balancer module set up ports used by backend services and port on which to access Load Balancer.

```
module "load_balancer" {
  source              = "./modules/load_balancer"
  resource_group_name = azurerm_resource_group.rg.name
  location            = azurerm_resource_group.rg.location
  lb_backend_port     = 80
  lb_frontend_port    = 80
  health_check_path   = "/"
  health_check_port   = 80
}
```

In the Scale Set module fill params outputted by previous modules and optionally add Bash script to run on every instance. Here I run script to create HTML with machine's hostname in h1 tag to be able to easily check that load balancer works.

```
module "vms_scale_set" {
  source                = "./modules/scale_set"
  location              = azurerm_resource_group.rg.location
  resource_group_name   = azurerm_resource_group.rg.name
  public_key            = file("./ssh-keys")
  subnet_id             = module.network_module.subnet_id
  image_id              = module.vm_image.image_id
  nsg_id                = module.network_module.nsg_id
  lb_backend_pool_id    = module.load_balancer.backend_pool_id
  provision_script_path = "./scripts/landing-page.sh"
  instances_count       = 2
}
```

scripts > landing-page.sh

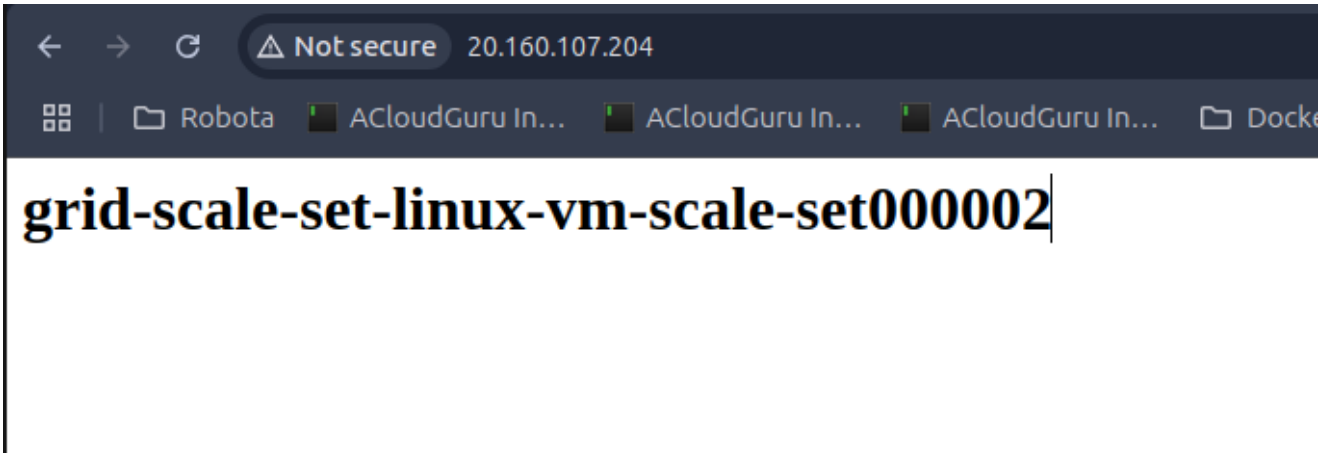
```
#!/bin/bash
echo "<html><body><h1>$(hostname)</h1></body></html>" > /home/azureuser/page.html
cp /home/azureuser/page.html /var/www/html/index.html
```

Running configuration

```
01:30:49 adrwal@olek-desktop-pc terraform-task ±|main ✗|→ terraform apply -var 'regenerate_image=true'

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

Terraform will perform the following actions:

  # azurerm_resource_group.rg will be created
  + resource "azurerm_resource_group" "rg" {
      + id       = (known after apply)
      + location = "westeurope"
```

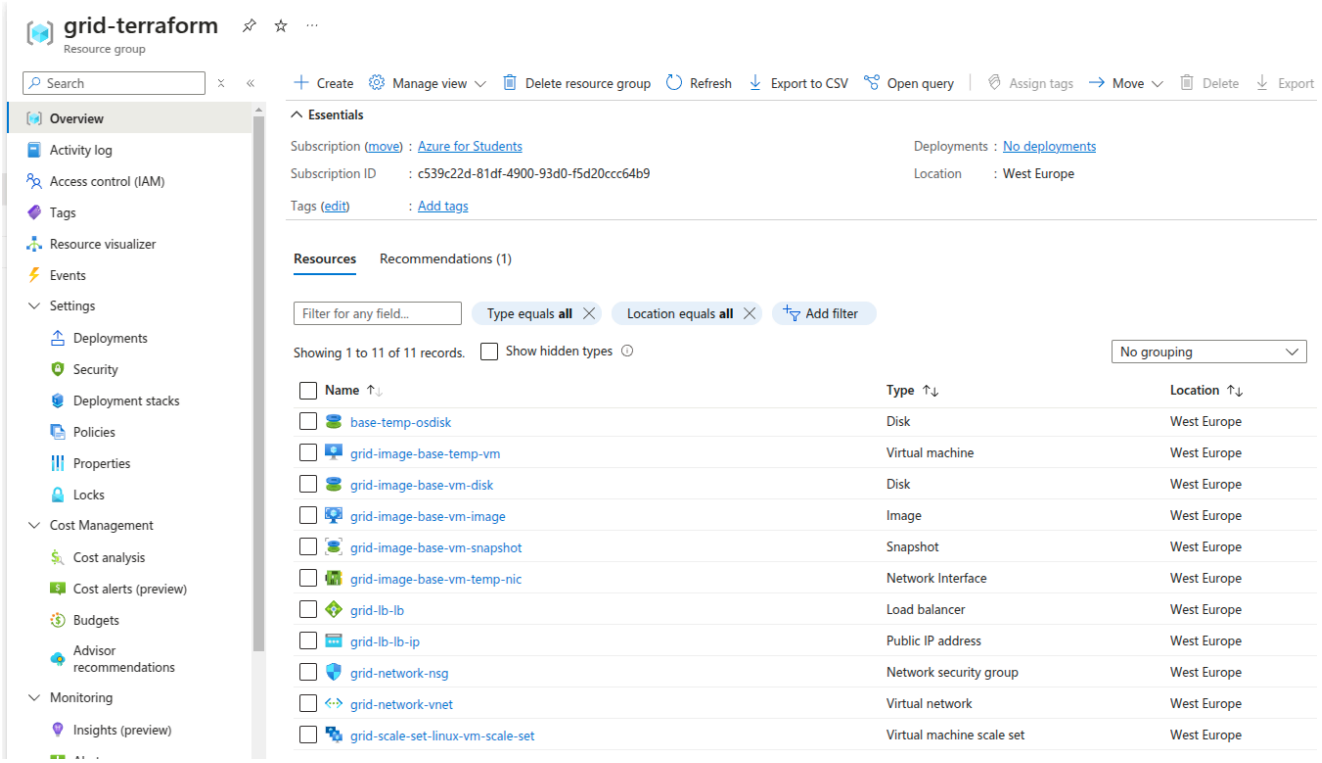
```
Plan: 19 to add, 0 to change, 0 to destroy.

Changes to Outputs:
  + lb_frontend_ip = (known after apply)

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

  Enter a value: yes
```

```
module.vms_scale_set.azurerm_linux_virtual_machine_scale_set.linux_vm_scale_set: Still creating... [50s elapsed]
module.vms_scale_set.azurerm_linux_virtual_machine_scale_set.linux_vm_scale_set: Still creating... [1m0s elapsed]
module.vms_scale_set.azurerm_linux_virtual_machine_scale_set.linux_vm_scale_set: Still creating... [1m10s elapsed]
module.vms_scale_set.azurerm_linux_virtual_machine_scale_set.linux_vm_scale_set: Creation complete after 1m13s [id=/subscriptions/
9/resourceGroups/grid-terraform/providers/Microsoft.Compute/virtualMachineScaleSets/grid-scale-set-linux-vm-scale-set]

Apply complete! Resources: 19 added, 0 changed, 0 destroyed.

Outputs:

lb_frontend_ip = "20.160.107.204"
01:36:03 adrwal@olek-desktop-pc terraform-task ±|main ✗|→
```



Azure Load Balancer uses hash based routing of 5 elements tuple (source IP, source port, dest IP, dest port, protocol). Because of that, after I refresh this page I will get the same response. To see that Load Balancer works I have to get response from other instance and to do that I can modify source port by opening this page from other browser.

In Azure we created 19 resources:

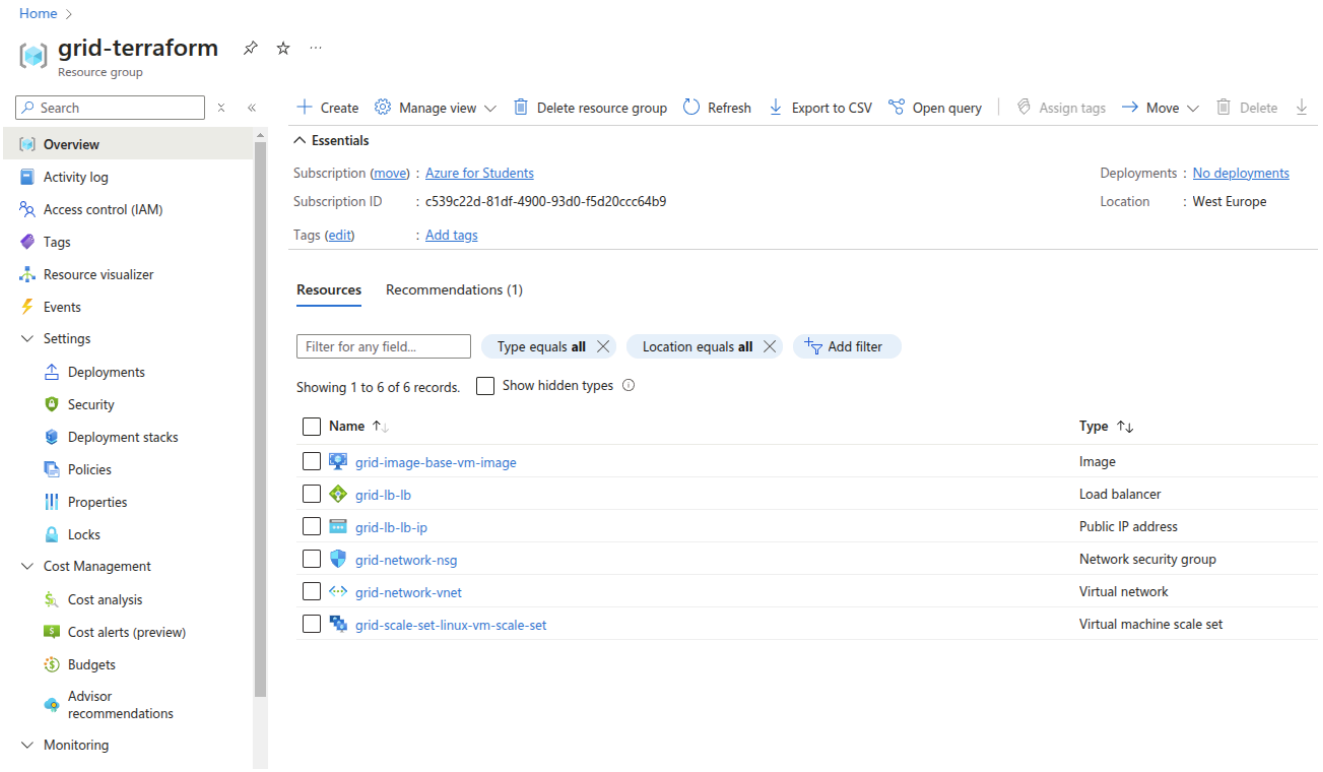


Some of them were used only to create `grid-image-base-vm-image` resource. To remove them I can run `terraform apply` again, with `regenerate_image` variable set to false (default).

```
lb_frontend_ip = "20.160.107.204"
01:36:03 adrwal@olek-desktop-pc terraform-task ±|main ✗|→ terraform apply
azurerm_resource_group.rg: Refreshing state... [id=/subscriptions/c539c22d-8
module.network_module.azurerm_network_security_group.nsg: Refreshing state..
```

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

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

  Enter a value: yes
```

```
module.vm_image.azurerm_network_interface.temp_nic[0]: Still de
elapsed]
module.vm_image.azurerm_network_interface.temp_nic[0]: Destruct

Apply complete! Resources: 0 added, 0 changed, 5 destroyed.

Outputs:

lb_frontend_ip = "20.160.107.204"
01:49:35 adrwal@olek-desktop-pc terraform-task ±|main ✗|→
```



Limiting access from certain ports and IPs

To allow access only from certain ports and IPs change rule in network module allowing http traffic in the subnet.

```
36      {
37        name                       = "http"
38        priority                   = 1002
39        direction                  = "Inbound"
40        access                     = "Allow"
41        protocol                   = "Tcp"
42        source_port_range          = "25565-25570"
43        destination_port_range     = "80"
44        source_address_prefix      = "*"
45        destination_address_prefix = "*"
46    }]
```

Above change limits access to clients with ports in range 25565-25570.
Blocking access for certain IPs is limited when using NSG rules only, so instead of exposing

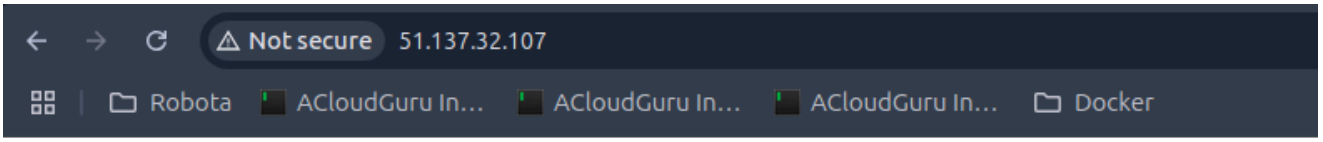
Azure Load Balancer to public I had to create Azure Firewall and make Load Balancer Internal.

In this new setup only firewall has public IP and before traffic is routed to now internal Load Balancer it is filtered by firewall rules.

```
module "firewall" {
  source = "./modules/firewall"
  location = azurerm_resource_group.rg.location
  resource_group_name = azurerm_resource_group.rg.name
  virtual_network_name = module.network_module.vnet_name
  load_balancer_ip = module.load_balancer.private_ip
  resources_subnet_ip = module.network_module.subnet_id
}
```

After this change when running `terraform apply`, firewall IP is outputted instead:

```
Apply complete! Resources: 27 added, 0 changed, 0 destroyed.

Outputs:

firewall_public_ip = "51.137.32.107"
01:48:39 adrwal@olek-desktop-pc terraform-task ±|main ✗|→
```



grid-scale-set-linux-vm-scale-set000003

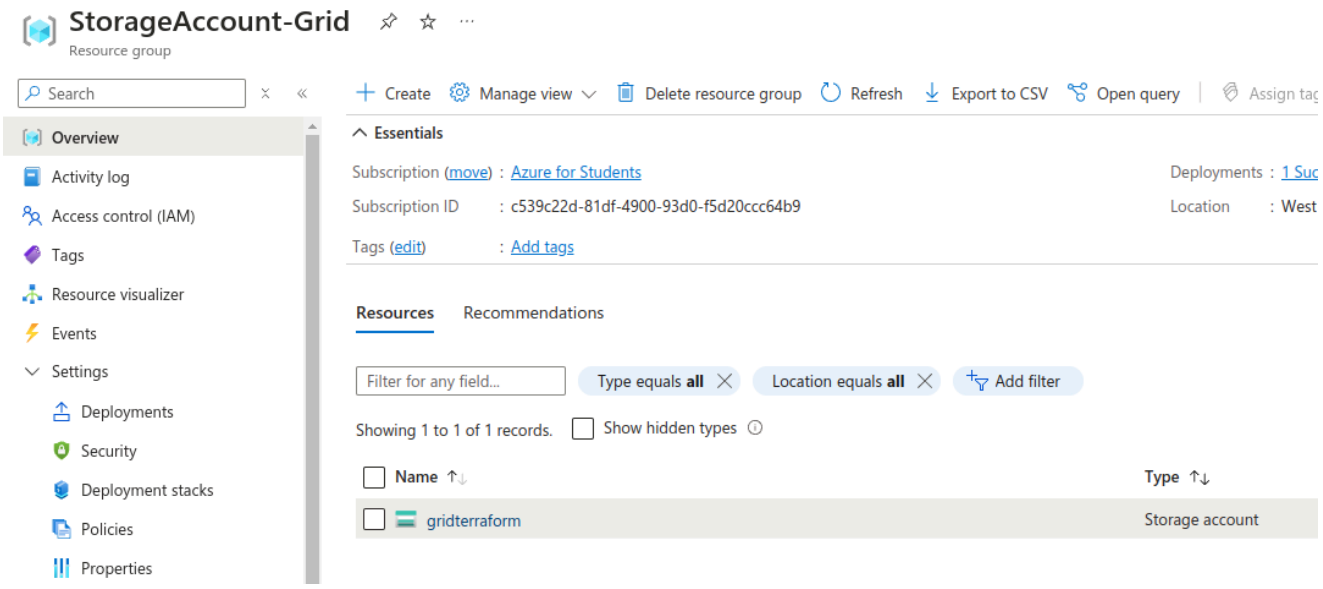
Public Cloud storage service as backend for Terraform state.

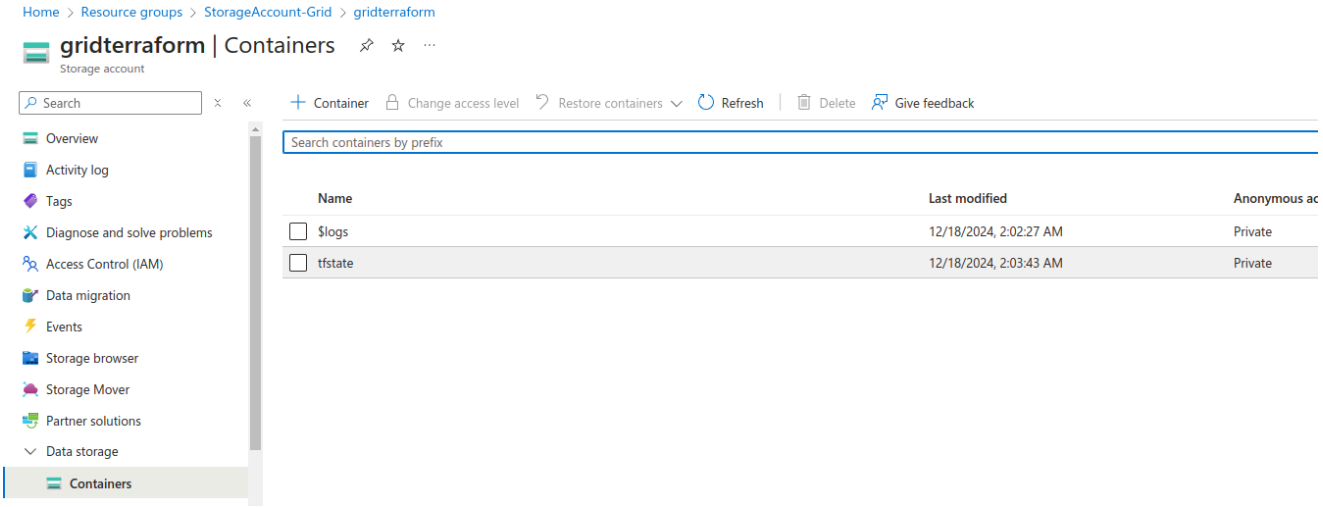
In Terraform update `terraform` block configuration:

```terraform
terraform {
  required_version = ">=1.0.0"
  required_providers {
    azurerm = {
      source  = "hashicorp/azurerm"
      version = "~>3.0"
    }
  }
  backend "azurerm" {
    resource_group_name   = "StorageAccount-Grid"
    storage_account_name  = "gridterraform"
    container_name = "tfstate"
  }
}
```

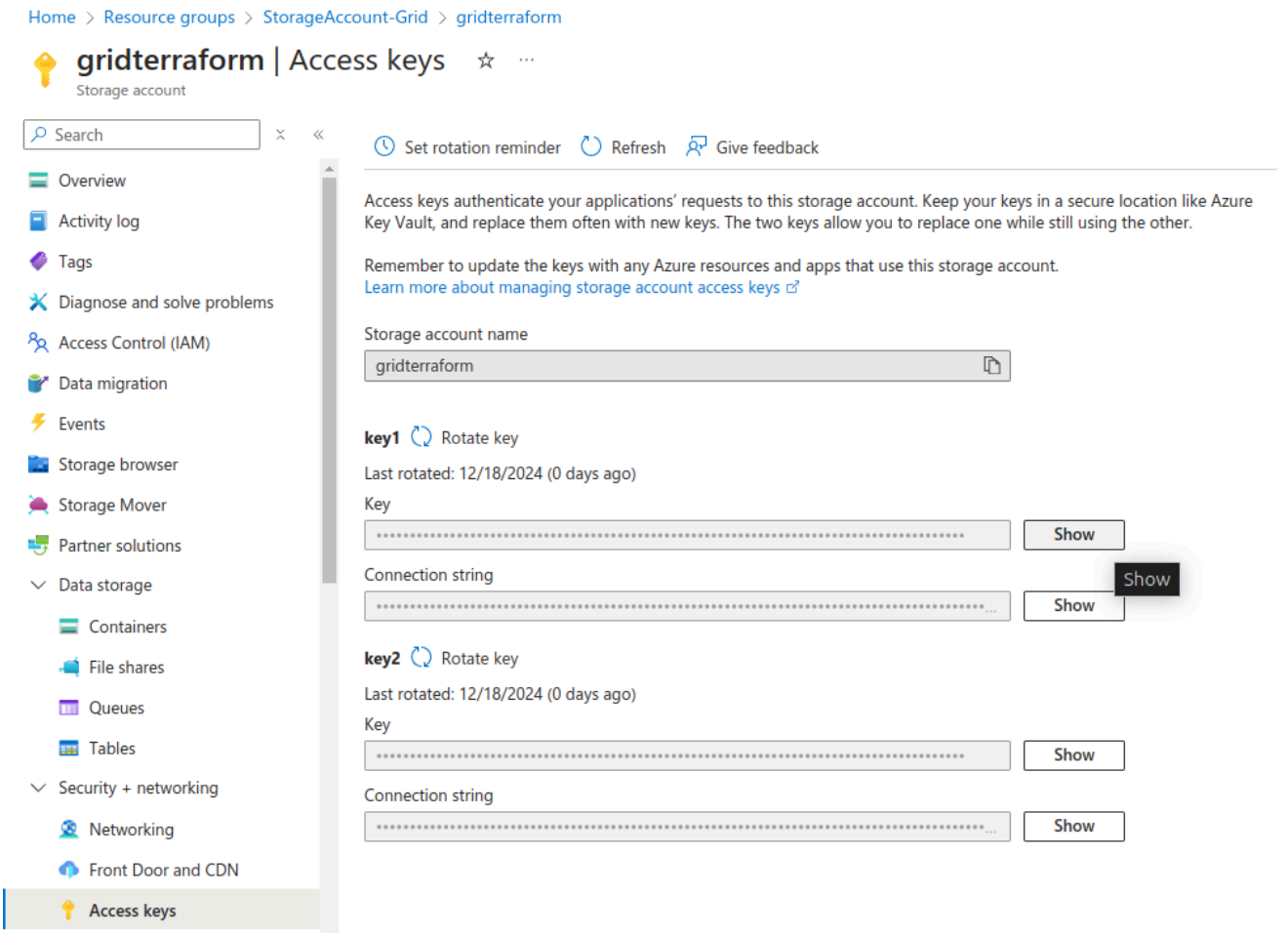
On Azure create new resource group separate from resource group used to manage the infrastructure.

In the resource group add `Storage account` and in it, create a container which will store the state file.





Copy storage account access key. It will be needed when running `terraform init`




```
02:07:53 adrwal@olek-desktop-pc terraform-task ±|main ✗|→ terraform init
Initializing the backend...
key
  The blob key.

  Enter a value: YytwPT8QwY/bT/+uKF8pk84C3j0BKcTlbIGxQb/BrOsLR8LtIgHZgEY2tIVQ7z7yc9WBZGygct5X+ASt3V4lJQ==


Successfully configured the backend "azurerm"! Terraform will automatically
use this backend unless the backend configuration changes.
Initializing modules...
Initializing provider plugins...
- Reusing previous version of hashicorp/azurerm from the dependency lock file
- Using previously-installed hashicorp/azurerm v3.117.0

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.
02:08:23 adrwal@olek-desktop-pc terraform-task ±|main ✗|→
```

After running `terraform apply` state file has been updated and stored in Azure container.

```
● ^[[A02:13:15 adrwal@olek-desktop-pc terraform-task ±|main ✗|→ terraform apply -var 'regenerate_image=true'

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

  Terraform will perform the following actions:

    # azurerm_resource_group.rg will be created
    + resource "azurerm_resource_group" "rg" {
        + id       = (known after apply)
        + location = "westeurope"
        + name     = "grid-terraform"
      }
```

```
module.vms_scale_set.azurerm_linux_virtual_machine_scale_set.linux_vm
ubscriptions/c539c22d-81df-4900-93d0-f5d20ccc64b9/resourceGroups/grid
chineScaleSets/grid-scale-set-linux-vm-scale-set]

Apply complete! Resources: 19 added, 0 changed, 0 destroyed.
02:18:41 adrwal@olek-desktop-pc terraform-task ±|main ✗|→
```