

# AZURE INTERNSHIP PROJECT

By Subham Behera (sic-22bcse85)

**Objective:** To create and deploy a web application using Azure Cloud services.

The Azure cloud platform has more than 200 products and cloud services designed to help us bring new solutions to life—to solve today's challenges and create the future.

The Azure Virtual Machines are primarily used to deploy and manage such applications.

In Azure Cloud, we follow the diagram below to create a Virtual Machine.



**Subscription:** A subscription is an agreement with Microsoft to use one or more Microsoft cloud platforms or services, for which charges accrue based on either a per-user license fee or on cloud-based resource consumption.

**Resource Group:** A resource group is a container that holds related resources for an Azure solution. The resource group can include all the resources for the solution or only those resources that we want to manage as a group.

At first, a Resource Group was created.

- Visited the Microsoft Azure cloud portal. [\[link\]](#)
- Searched for Resource Group in the Search bar.
- Filled in the necessary configuration.
- Clicked on the '+Create' button.

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Azure services More services

Create a resource Resource groups Virtual machines Virtual networks Education Load balancers Public IP addresses Subscriptions Static Web Apps

Resources Recent Favorite

Name	Type	Last Viewed
	No resources have been viewed recently	
	<span>View all resources</span>	

Navigate

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Home > Resource groups >

**Resource groups** ... Default Directory (subhambh14@gmail.onmicrosoft.com)

+ Create Manage view Refresh Export to CSV Open query Assign tags

Filter for any field... Subscription equals all Location equals all Add filter

Showing 0 to 0 of 0 records.

Name	Subscription	Location

 No resource groups to display  
Try changing or clearing your filters.  
+ Create Learn more Give feedback

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Home > Resource groups >

## Create a resource group

Basics Tags Review + create

Resource group - A container that holds related resources for an Azure solution. The resource group can include all the resources for the solution, or only those resources that you want to manage as a group. You decide how you want to allocate resources to resource groups based on what makes the most sense for your organization. [Learn more](#)

**Project details**

Subscription \* Azure for Students  
Resource group \* pro-rg

**Resource details**

Region \* (US) East US 2

[Review + create](#) [< Previous](#) [Next : Tags >](#)

- Entered the necessary configurations.
- Moved to the 'Review + Create' tab.
- After final Validation, It was created.

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Home > Resource groups >

## Create a resource group

Validation passed.

Basics Tags Review + create

**Basics**

Subscription	Azure for Students
Resource group	pro-rg
Region	East US 2

**Tags**

None

[Create](#) [< Previous](#) [Next >](#) [Download a template for automation](#)

The screenshot shows the Microsoft Azure Resource Groups page. At the top right, there is a notification: "Resource group created" with the message "Creating resource group 'pro-rg' in subscription 'Azure for Students' succeeded." Below the notification are two buttons: "Go to resource gr..." and "Pin to dashboard...". The main table lists one resource group, "pro-rg", with details: Subscription "Azure for Students" and Location "East US 2". The table has filters at the top: "Subscription equals all", "Location equals all", and "Add filter". At the bottom left, there are navigation buttons: "< Previous", "Page", "of 0", "Next >". On the far right, there is a "Give feedback" link.

Now we can create and use the services inside the Resource Group.

Thus, all the necessary services were created and configured as per the **Cloud Architecture Diagram**(page 42).

**Azure Virtual Network:** Azure Virtual Network is a service that provides the fundamental building block for your private network in Azure. An instance of the service (a virtual network) enables many types of Azure resources to securely communicate with each other, the internet and on-premises networks. These Azure resources include virtual machines (VMs).

Now We had to create a Virtual Network.

- Searched for Virtual Network from the search bar.
- Clicked on the '+Create' button.
- Entered the desired configurations.
- Created a subnet inside it (by default it creates one)
- Subnets are a logical partition of an Internet Protocol (IP) network broken into multiple, smaller network segments.

Microsoft Azure

Home >

## Resource groups

Default Directory (subhambh14@gmail.onmicrosoft.com)

+ Create Manage view Refresh

Filter for any field... Subscription equal

Show 1 to 1 of 1 records.

Name ↑ pro-rg

Services (54) Marketplace (6) More (4)

Virtual networks  
Virtual network gateways  
Virtual Network Managers  
Virtual Network Terminal Access Points

Virtual network gateway  
Virtual network  
BB Storage and VNet Deployment  
MapleTap Virtual Network Appliance Image

Documentation

Quickstart: Use the Azure portal to create a virtual network - Azure Virtual Net...  
Continue searching in Microsoft Entra ID

No grouping List view

Location ↑↓ East US 2

< Previous Page 1 of 0 Next >

Give feedback

Microsoft Azure

Search resources, services, and docs (G+ /)

subhambh14@gmail.com DEFAULT DIRECTORY (SUBHAMBH...)

Home >

## Virtual networks

Default Directory (subhambh14@gmail.onmicrosoft.com)

+ Create Manage view Refresh Export to CSV Open query Assign tags

Filter for any field... Subscription equals all Resource group equals all Location equals all Add filter

Show 0 to 0 of 0 records.

Name ↑ Resource group ↑ Location ↑ Subscription ↑

No virtual networks to display

Create a virtual network to securely connect your Azure resources to each other. Connect your virtual network to your on-premises network using an Azure VPN Gateway or ExpressRoute.

Create virtual network Learn more ↗ Give feedback

Microsoft Azure Search resources, services, and docs (G+)

Home > Virtual networks > Create virtual network ...

Basics Security IP addresses Tags Review + create

your resources.

Subscription \* Azure for Students

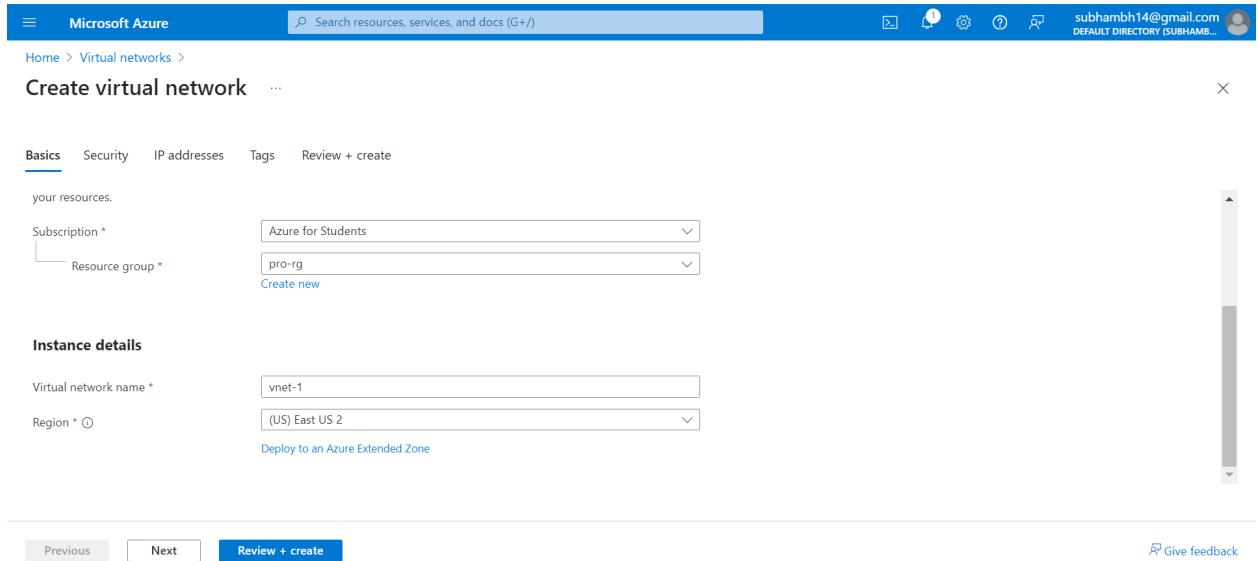
Resource group \* pro-rg [Create new](#)

**Instance details**

Virtual network name \* vnet-1

Region \* (US) East US 2 [Deploy to an Azure Extended Zone](#)

Previous Next Review + create Give feedback



Microsoft Azure Search resources, services, and docs (G+)

Home > Virtual networks > Create virtual network ...

Basics Security IP addresses Tags Review + create

Add IPv4 address space | ▾

11.0.0.0/16  
11.0.0.0 /16  
11.0.0.0 - 11.0.255.255 65,536 addresses  
+ Add a subnet

Subnets	IP address range	Size
default	11.0.0.0 - 11.0.0.255	/24 (256 addresses)

**Edit subnet**

Select an address space and configure your subnet. You can customize a default subnet or select from subnet templates if you plan to add select services later. [Learn more](#)

Subnet purpose Default

Name \* subnet-1

**IPv4**

Include an IPv4 address space  11.0.0.0/16  
11.0.0.0 - 11.0.255.255

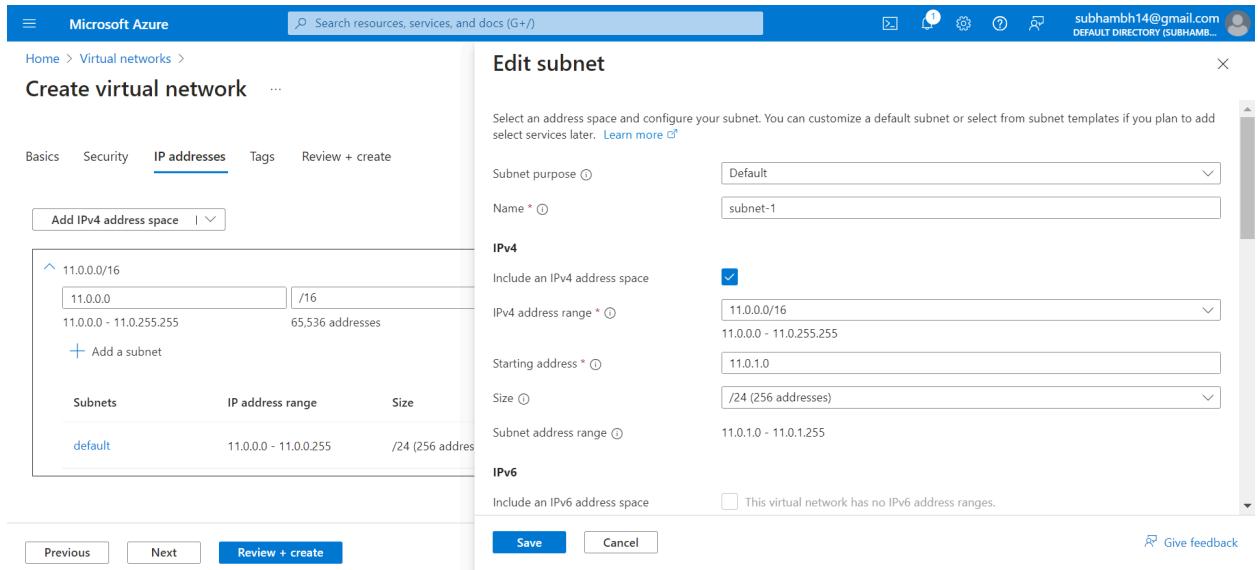
IPv4 address range \* 11.0.1.0  
Starting address \* 11.0.1.0

Size  /24 (256 addresses)  
Subnet address range 11.0.1.0 - 11.0.1.255

**IPv6**

Include an IPv6 address space  This virtual network has no IPv6 address ranges.

Save Cancel Give feedback



Microsoft Azure

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Home > Virtual networks >

## Create virtual network ...

Basics Security IP addresses Tags Review + create

Add IPv4 address space | ↴

11.0.0.0/16

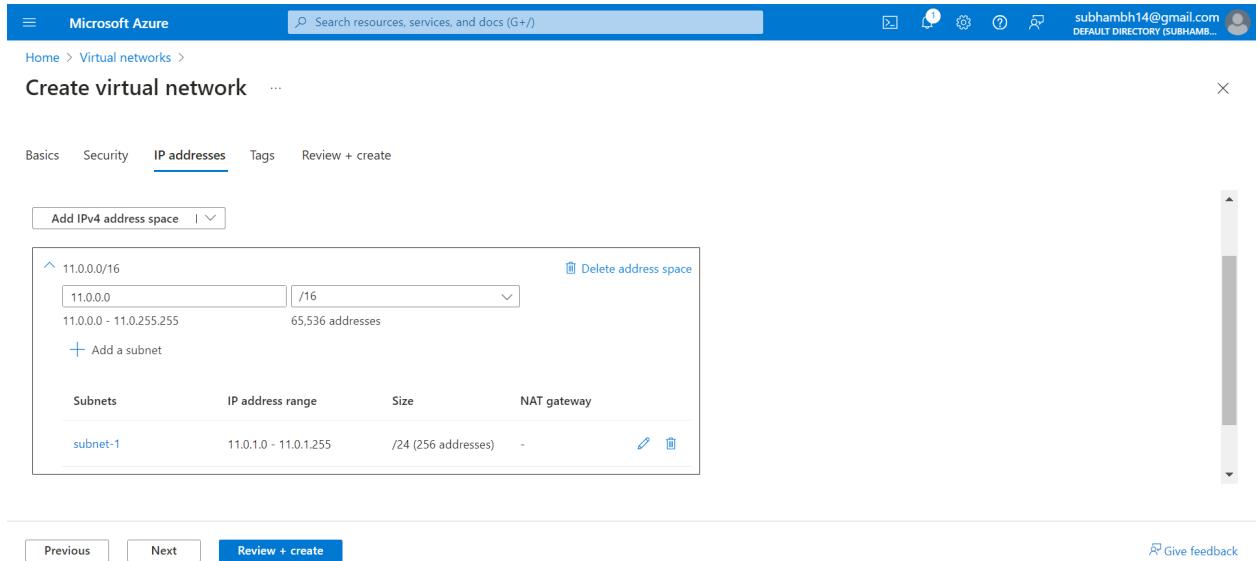
11.0.0.0 /16 Delete address space

11.0.0 - 11.0.255.255 65,536 addresses

+ Add a subnet

Subnets	IP address range	Size	NAT gateway
subnet-1	11.0.1.0 - 11.0.1.255	/24 (256 addresses)	-

Previous Next Review + create Give feedback



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Home > Virtual networks >

## Create virtual network ...

Basics Security IP addresses Tags Review + create

[View automation template](#)

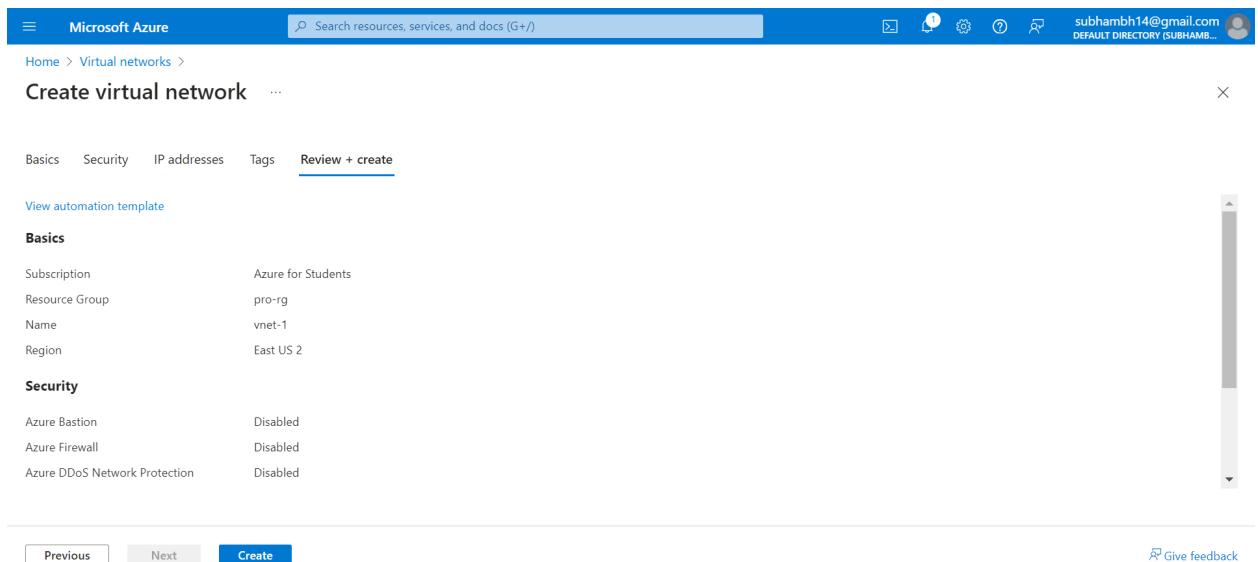
**Basics**

Subscription	Azure for Students
Resource Group	pro-rg
Name	vnet-1
Region	East US 2

**Security**

Azure Bastion	Disabled
Azure Firewall	Disabled
Azure DDoS Network Protection	Disabled

Previous Next Create Give feedback



Next, we had to create 2nd VNET.

Microsoft Azure

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Home > Virtual networks >

## Create virtual network ...

Basics Security IP addresses Tags Review + create

your resources.

Subscription \* Azure for Students

Resource group \* pro-rg

Create new

**Instance details**

Virtual network name \* vnet-2

Region \* (US) East US 2

Deploy to an Azure Extended Zone

Previous Next Review + create Give feedback

Microsoft Azure

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Home > Virtual networks >

## Create virtual network ...

Basics Security IP addresses Tags Review + create

Add IPv4 address space | ▾

12.0.0.0/16

12.0.0.0 /16  
12.0.0.0 - 12.0.255.255 65,536 addresses

+ Add a subnet

Subnets	IP address range	Size
default	12.0.0.0 - 12.0.0.255	/24 (256 addresses)

**Edit subnet**

Select an address space and configure your subnet. You can customize a default subnet or select from subnet templates if you plan to add select services later. [Learn more](#)

Subnet purpose Default

Name \* subnet-2

**IPv4**

Include an IPv4 address space

IPv4 address range \* 12.0.0.0/16  
12.0.0.0 - 12.0.255.255

Starting address \* 12.0.1.0

Size  /24 (256 addresses)

Subnet address range 12.0.1.0 - 12.0.1.255

**IPv6**

Include an IPv6 address space  This virtual network has no IPv6 address ranges.

Save Cancel Give feedback

Microsoft Azure Search resources, services, and docs (G+)

subhambh14@gmail.com DEFAULT DIRECTORY (SUBHAMB...)

Home > Virtual networks > Create virtual network ...

Basics Security IP addresses **IP addresses** Tags Review + create

Add IPv4 address space | ▾

12.0.0.0/16 Delete address space

12.0.0.0 /16 12.0.0.0 - 12.0.255.255 65,536 addresses

+ Add a subnet

Subnets	IP address range	Size	NAT gateway
subnet-2	12.0.1.0 - 12.0.1.255	/24 (256 addresses)	-

Previous Next **Review + create** Give feedback

Microsoft Azure Search resources, services, and docs (G+)

subhambh14@gmail.com DEFAULT DIRECTORY (SUBHAMB...)

Home > Virtual networks > Create virtual network ...

Basics Security IP addresses Tags **Review + create**

**Basics**

Subscription	Azure for Students
Resource Group	pro-rg
Name	vnet-2
Region	East US 2

**Security**

Azure Bastion	Disabled
Azure Firewall	Disabled
Azure DDoS Network Protection	Disabled

**IP addresses**

Previous Next **Create** Give feedback

The screenshot shows the Microsoft Azure Virtual networks dashboard. At the top, there's a search bar and a navigation bar with options like 'Create', 'Manage view', 'Refresh', 'Export to CSV', 'Open query', and 'Assign tags'. Below the search bar are filter buttons for 'Subscription equals all', 'Resource group equals all', 'Location equals all', and a 'Add filter' button. A message indicates 'Showing 1 to 2 of 2 records.' The main table lists two entries:

Name	Resource group	Location	Subscription
vnet-1	pro-rg	East US 2	Azure for Students
vnet-2	pro-rg	East US 2	Azure for Students

At the bottom, there are pagination controls ('< Previous', 'Page 1 of 1', 'Next >') and a 'Give feedback' link.

Once both VNETs were configured, we had to enable VNET peering to make sure that virtual machines in both VNETs were able to communicate with each other.

We could achieve this by going to the peering option in the dashboard of any of the VNET.

Microsoft Azure

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Home > Virtual networks > vnet-1

## Virtual networks

vnet-1 | Peerings

Virtual network

+ Create Manage view ...

Filter for any field...

Name ↑

vnet-1 vnet-2

Diagnose and solve problems

Settings

- Address space
- Connected devices
- Subnets
- Bastion
- DDoS protection
- Firewall
- Microsoft Defender for Cloud
- Network manager
- DNS servers
- Peerings
- Service endpoints

Add Refresh Export to CSV Delete Sync

Virtual network peering enables you to seamlessly connect two or more virtual networks in Azure. The virtual networks appear as one for connectivity purposes. [Learn more](#)

Filter by name...

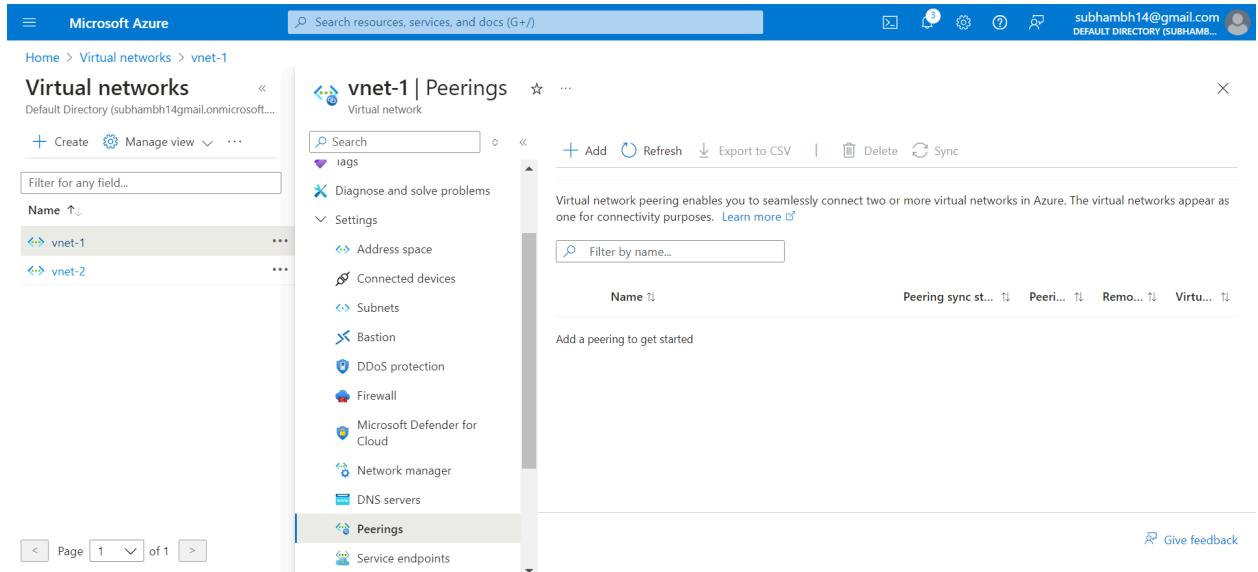
Name ↑

Peering sync st... Peeri... Remo... Virtu...

Add a peering to get started

Page 1 of 1

Give feedback



Microsoft Azure

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Home > Virtual networks > vnet-1 | Peerings >

## Add peering

vnet-1

Virtual network peering enables you to seamlessly connect two or more virtual networks in Azure. This will allow resources in either virtual network to directly connect and communicate with resources in the peered virtual network.

Remote virtual network summary

Peering link name \* vnet1-vnet2

Virtual network deployment model

Resource manager

Classic

I know my resource ID

Subscription \*

Azure for Students

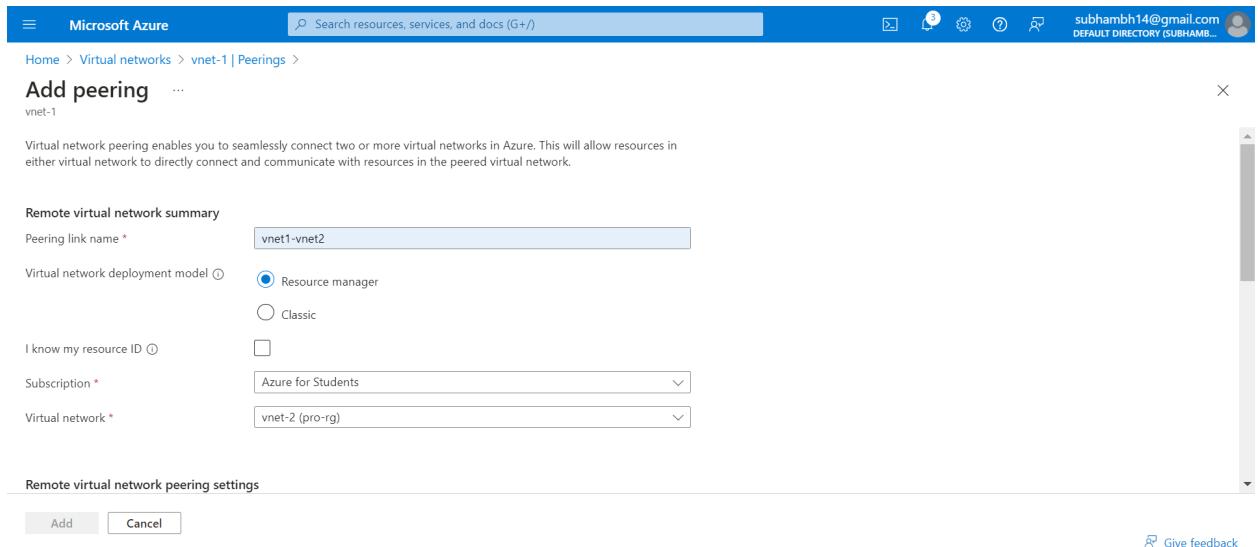
Virtual network \*

vnet-2 (pro-rg)

Remote virtual network peering settings

Add Cancel

Give feedback



The screenshot shows the Microsoft Azure portal interface for managing virtual networks. The left sidebar lists 'Virtual networks' with two entries: 'vnet-1' and 'vnet-2'. The main panel is titled 'vnet-1 | Peerings' and displays a table of network peering configurations. The table has columns for Name, Peering sync state, Peering status, Remote VNet, and Virtual Network. One entry is shown: 'vnet2-vnet1' with 'Fully Synchronized' status, 'Connected' peering, 'vnet-2' as the remote VNet, and 'vnet-1' as the local VNet. The 'Peerings' section is highlighted in the sidebar.

Name	Peering sync state	Peering status	Remote VNet	Virtual Network
vnet2-vnet1	Fully Synchronized	Connected	vnet-2	vnet-1

So far, we had set the environment before creating the Azure Virtual Machine.

**Azure Virtual Machine:** Azure virtual machines (VMs) are one of several types of on-demand, scalable computing resources that Azure offers. Typically, you choose a virtual machine when you need more control over the computing environment than the other choices offer. An Azure virtual machine gives you the flexibility of virtualization without having to buy and maintain the physical hardware that runs it. However, you still need to maintain the virtual machine by performing tasks, such as configuring, patching, and installing the software that runs on it.

So let's continue to create Virtual machines as per the requirements.

Since frontend and backend VMs were not provided with public IPs, so they could not be accessed other than from Jump server.

We had to create a database VM and jump server VM into one VNET and two frontend VMs into the other VNET.

The screenshot shows the Microsoft Azure portal interface. The top navigation bar includes the Microsoft Azure logo, a search bar with the query "virtual machine", and user information (subhambh14@gmail.com, DEFAULT DIRECTORY (SUBHAMB...)).

The main content area is titled "Virtual networks". It displays two entries: "vnet-1" and "vnet-2". Below each entry, there are "Create" and "Manage view" buttons, and a "Filter for any field..." search bar.

A modal window titled "virtual machine" is open, showing a list of services under "All". The "Services" tab is selected, showing "Virtual machines", "Virtual Machine Consoles (Operator Nexus)", "Virtual machine scale sets", and "Virtual Machines (Operator Nexus)". The "Marketplace" tab is also visible. The modal includes buttons for "CSV", "Delete", and "Sync". A tooltip explains that virtual networks can be seamlessly connected.

At the bottom of the modal, there are status indicators for "Peering sync state", "Peerings", "Remote connections", and "Virtual machines". The status for "vnet-2" is shown as "Fully Synchronized" and "Connected".

The screenshot shows the Microsoft Azure portal interface. The top navigation bar includes the Microsoft Azure logo, a search bar with the query "Search resources, services, and docs (G+)", and user information (subhambh14@gmail.com, DEFAULT DIRECTORY (SUBHAMB...)).

The main content area is titled "Virtual machines". It displays a search bar and various filter options: "Subscription equals all", "Type equals all", "Resource group equals all", "Location equals all", and "Add filter".

The table header includes columns: Name (sorted by ascending), Subscription, Resource group, Location, Status, Operating system, Size, Public IP address, and Disks. The "No grouping" and "List view" buttons are also present.

The main content area displays a message: "No virtual machines to display". It encourages users to "Create a virtual machine that runs Linux or Windows. Select an image from the marketplace or use your own customized image." A "Create" button is available, along with a link to "Learn more about Windows virtual machines".

To ensure **Auto Scaling**, we used virtual machine scale set service. Instead, we could also use virtual machine availability set.

Microsoft Azure Search resources, services, and docs (G+)

Home > Virtual machines > Create a virtual machine > Create a virtual machine scale set >

## Create a virtual machine scale set

Basics Spot Disks Networking Management Health Advanced Tags Review + create

Azure virtual machine scale sets let you create and manage a group of load balanced VMs. The number of VM instances can automatically increase or decrease in response to demand or a defined schedule. Scale sets provide high availability to your applications, and allow you to centrally manage, configure, and update a large number of VMs.

[Learn more about virtual machine scale sets](#)

**Project details**

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription \* Azure for Students

Resource group \* pro-rg [Create new](#)

**Scale set details**

Virtual machine scale set name \* frontend

Region \* (US) East US 2

< Previous Next : Spot > Review + create Give feedback

Microsoft Azure Search resources, services, and docs (G+)

Home > Virtual machines > Create a virtual machine > Create a virtual machine scale set >

## Create a virtual machine scale set

Security type Trusted launch virtual machines

Configure security features

**Scaling**

Scaling mode Autoscaling

Manually update the capacity: Maintain a fixed amount of instances.  
 Autoscaling: Scaling based on a CPU metric, on any schedule.  
 No scaling profile: manual attach virtual machines after deployment

Scaling configuration \* Scaling configuration

Scaling condition count: 1  
Predictive autoscaling: Disabled  
Diagnostic logs: Disabled  
Scale-in policy: Default  
Force delete: Disabled

[Configure](#)

⚠ Select configure to review all scaling options prior to creating the virtual machine scale set.

< Previous Next : Spot > Review + create Give feedback

The screenshot shows the Microsoft Azure portal interface for creating a virtual machine scale set. The top navigation bar includes 'Microsoft Azure', a search bar, and user information ('subhambh14@gmail.com'). The main title is 'Create a virtual machine scale set'. The 'Networking' tab is selected. A sub-section titled 'Virtual network configuration' shows a dropdown menu set to 'vnet-1', with options to 'Create virtual network' or 'Manage selected virtual network'. Below this, the 'Network interface' section indicates that a network interface enables communication with the internet, Azure, and on-premises resources. It shows a '+' button to 'Create new nic' and a 'Delete' button. At the bottom are navigation buttons for '< Previous', 'Next : Management >', and 'Review + create'.

The screenshot shows the 'Review + create' tab for the virtual machine scale set creation. A green header bar indicates 'Validation passed'. The 'Review + create' tab is selected. The 'Basics' section displays the following configuration details:

Subscription	Azure for Students
Resource group	pro-rg
Virtual machine scale set name	frontend
Region	East US 2
Orchestration mode	Flexible
Availability zone	None
Image	Windows Server 2019 Datacenter - Gen2
Size	Standard DS1 v2 (1 vcpu, 3.5 GiB memory)
Scaling mode	Autoscaling
Scaling condition count	1
Predictive autoscaling	Disabled

At the bottom, there are navigation buttons for '< Previous', 'Next >', and a prominent blue 'Create' button. There are also links for 'Download a template for automation' and 'Give feedback'.

Next, we created the database and jump server VM in the other VNET.

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Home > Virtual machines > Create a virtual machine ...

This subscription may not be eligible to deploy VMs of certain sizes in certain regions.

**Project details**

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription \*  Resource group \*

**Instance details**

Virtual machine name \*  Region \*  Availability options

< Previous   Give feedback

Microsoft Azure Search resources, services, and docs (G+) subhambh14@gmail.com DEFAULT DIRECTORY (SUBHAMB...)

Home > Virtual machines > Create a virtual machine ...

Basics Disks **Networking** Management Monitoring Advanced Tags Review + create

Define network connectivity for your virtual machine by configuring network interface card (NIC) settings. You can control ports, inbound and outbound connectivity with security group rules, or place behind an existing load balancing solution.  
[Learn more](#)

**Network interface**

When creating a virtual machine, a network interface will be created for you.

Virtual network \*    
Subnet \*    
Public IP    
NIC network security group

< Previous   Give feedback

Microsoft Azure Search resources, services, and docs (G+)

Home > CreateVm-MicrosoftWindowsServer.WindowsServer-201-20240809100926 | Overview

## Create a virtual machine

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription \* Azure for Students

Resource group \* pro-rg Create new

**Instance details**

Virtual machine name \* jumpserver

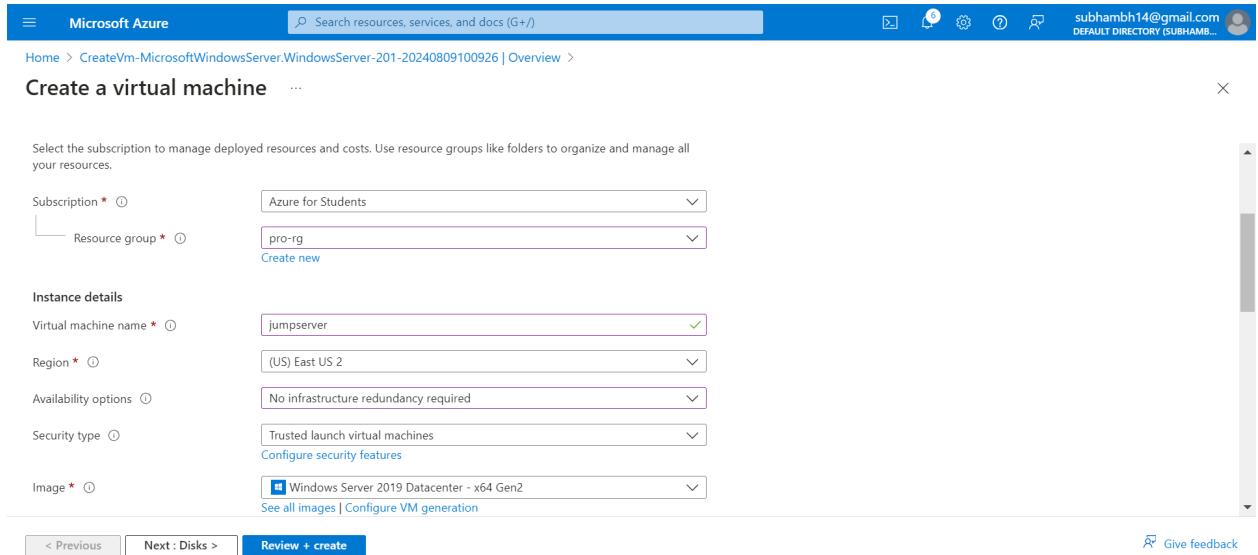
Region \* (US) East US 2

Availability options No infrastructure redundancy required

Security type Trusted launch virtual machines Configure security features

Image \* Windows Server 2019 Datacenter - x64 Gen2 See all images Configure VM generation

< Previous Next : Disks > Review + create Give feedback



Microsoft Azure Search resources, services, and docs (G+)

Home > Virtual machines

## Create a virtual machine

Basics Disks Networking Management Monitoring Advanced Tags Review + create

Define network connectivity for your virtual machine by configuring network interface card (NIC) settings. You can control ports, inbound and outbound connectivity with security group rules, or place behind an existing load balancing solution.

Learn more More

**Network interface**

When creating a virtual machine, a network interface will be created for you.

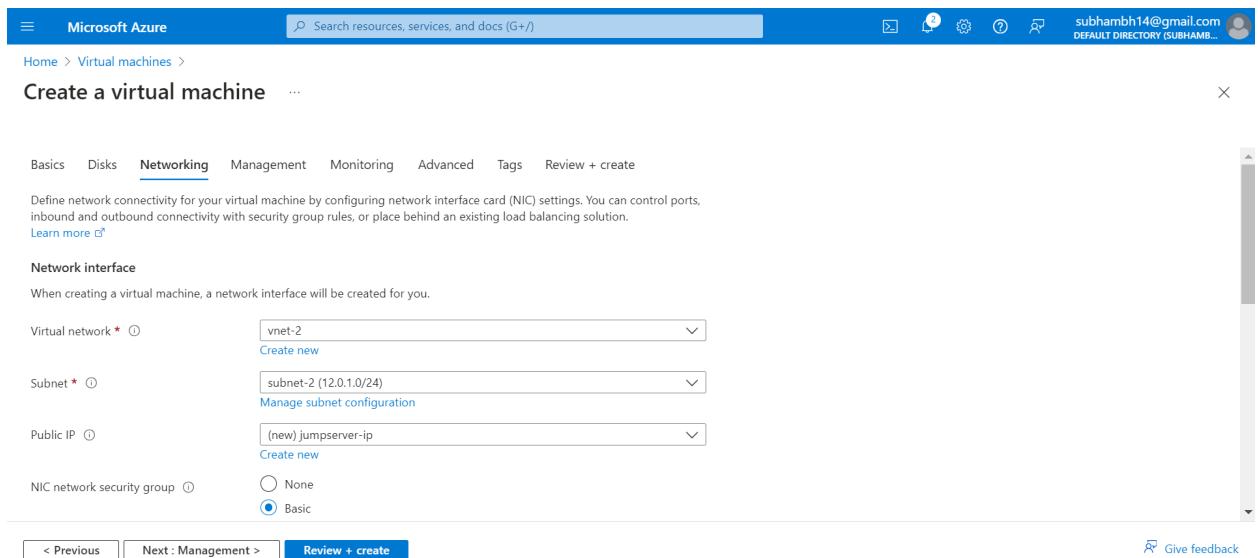
Virtual network \* vnet-2 Create new

Subnet \* subnet-2 (12.0.1.0/24) Manage subnet configuration

Public IP (new) jumpserver-ip Create new

NIC network security group None Basic

< Previous Next : Management > Review + create Give feedback



Clicked on 'Review + Create' to complete the validation and created it.

Once the jump server was created, we could download the RDP file and access the jump server.

After having access to the jump server, we will be able to connect to our backend and frontend virtual machines.

Microsoft Azure

Search resources, services, and docs (G+)

subhambh14@gmail.com

DEFAULT DIRECTORY (SUBHAMBR..)

Home > CreateVm-MicrosoftWindowsServer.WindowsServer-201-20240809101348 | Overview > jumpserver

jumpserver | Connect

Virtual machine

Admin username: jumpserver

Port (change): 3389 Check access

Just-in-time policy: Unsupported by plan

Most common

Native RDP (Local machine)

Connect via native RDP without any additional software needed. Recommended for testing only.

Public IP address: 40.65.206.25

Select Download RDP file

More ways to connect (4)

Remote Desktop Connection

The publisher of this remote connection can't be identified. Do you want to connect anyway?

This remote connection could harm your local or remote computer. Do not connect unless you know where this connection came from or have used it before.

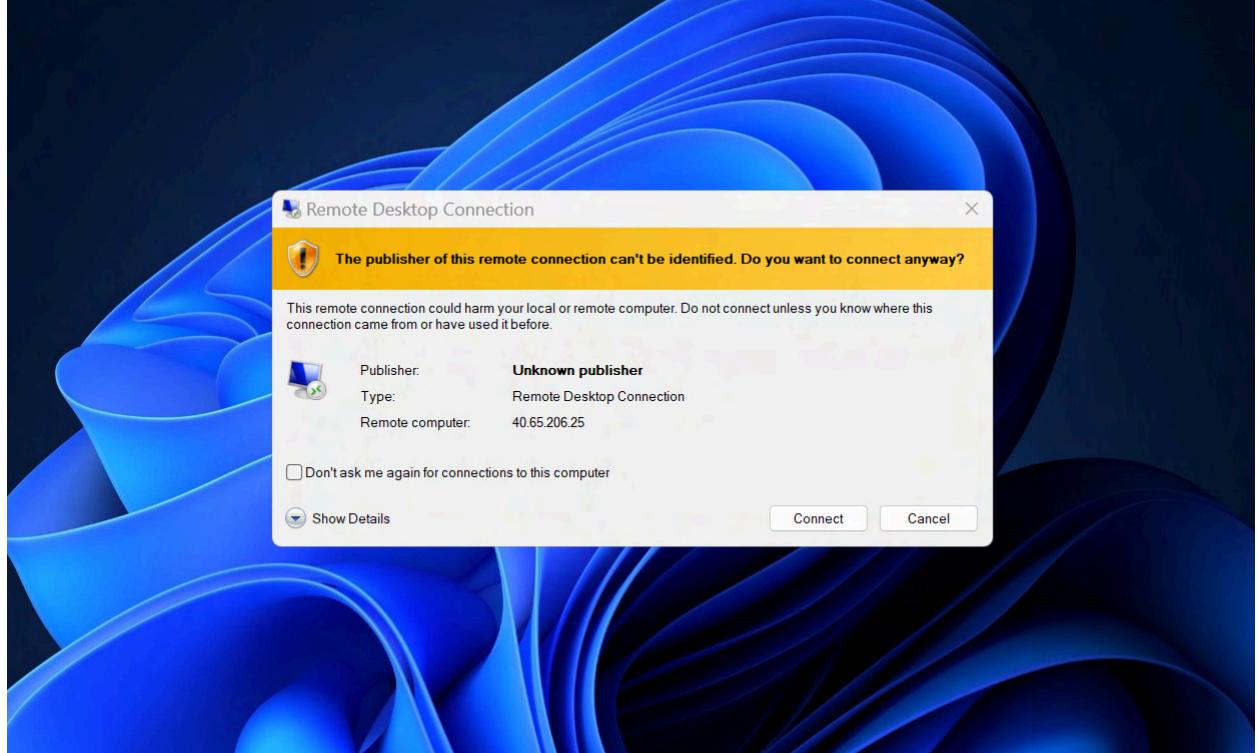
Publisher: Unknown publisher

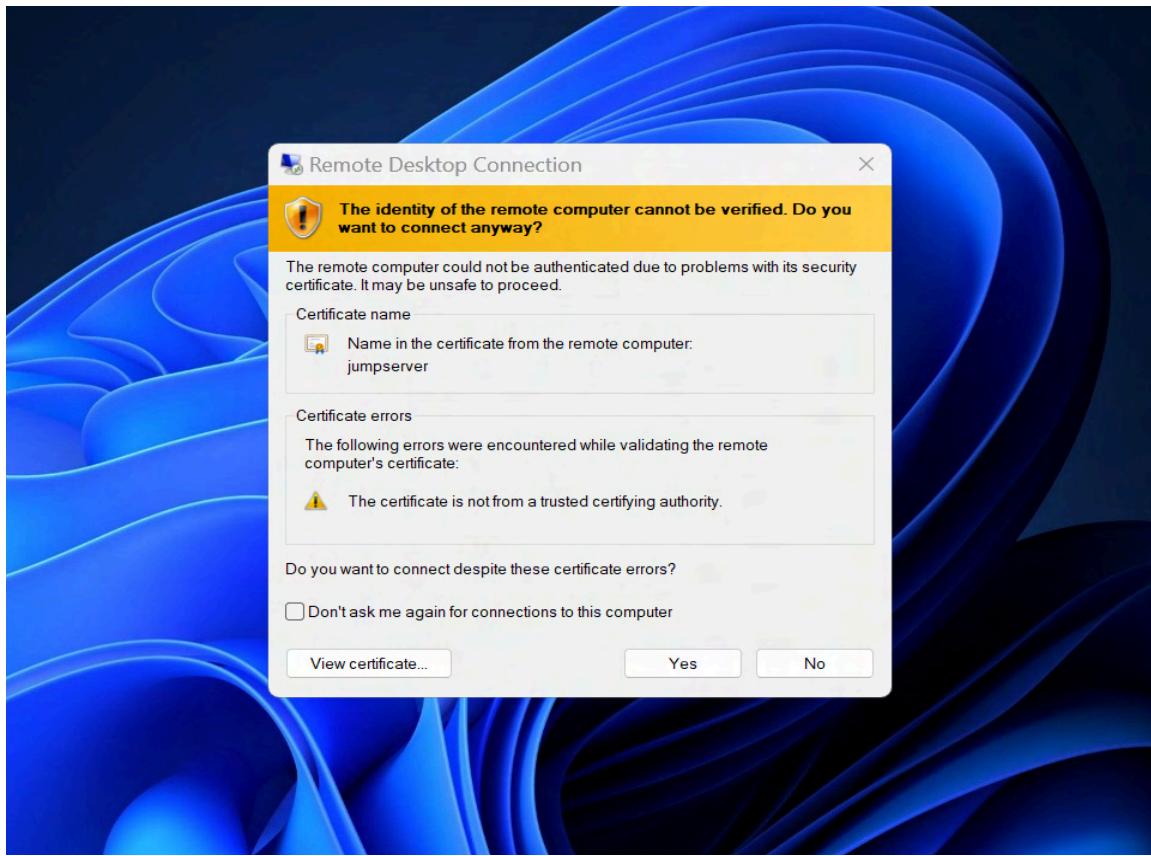
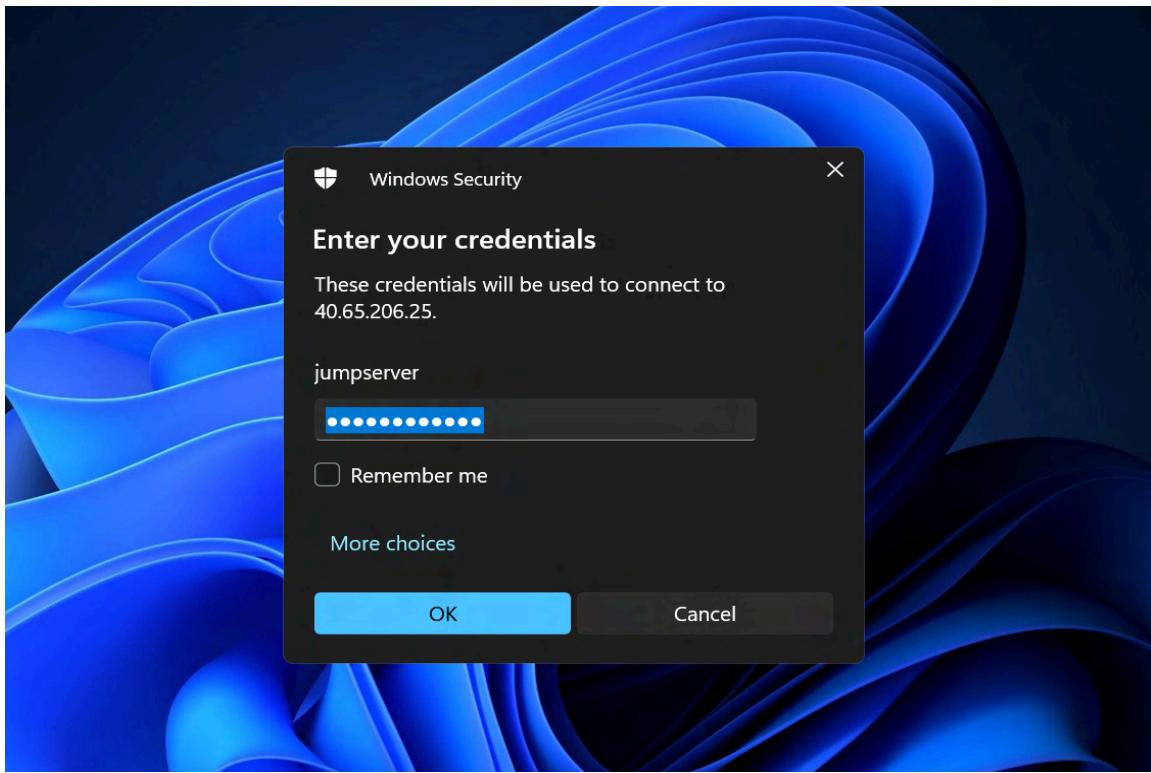
Type: Remote Desktop Connection

Remote computer: 40.65.206.25

Don't ask me again for connections to this computer

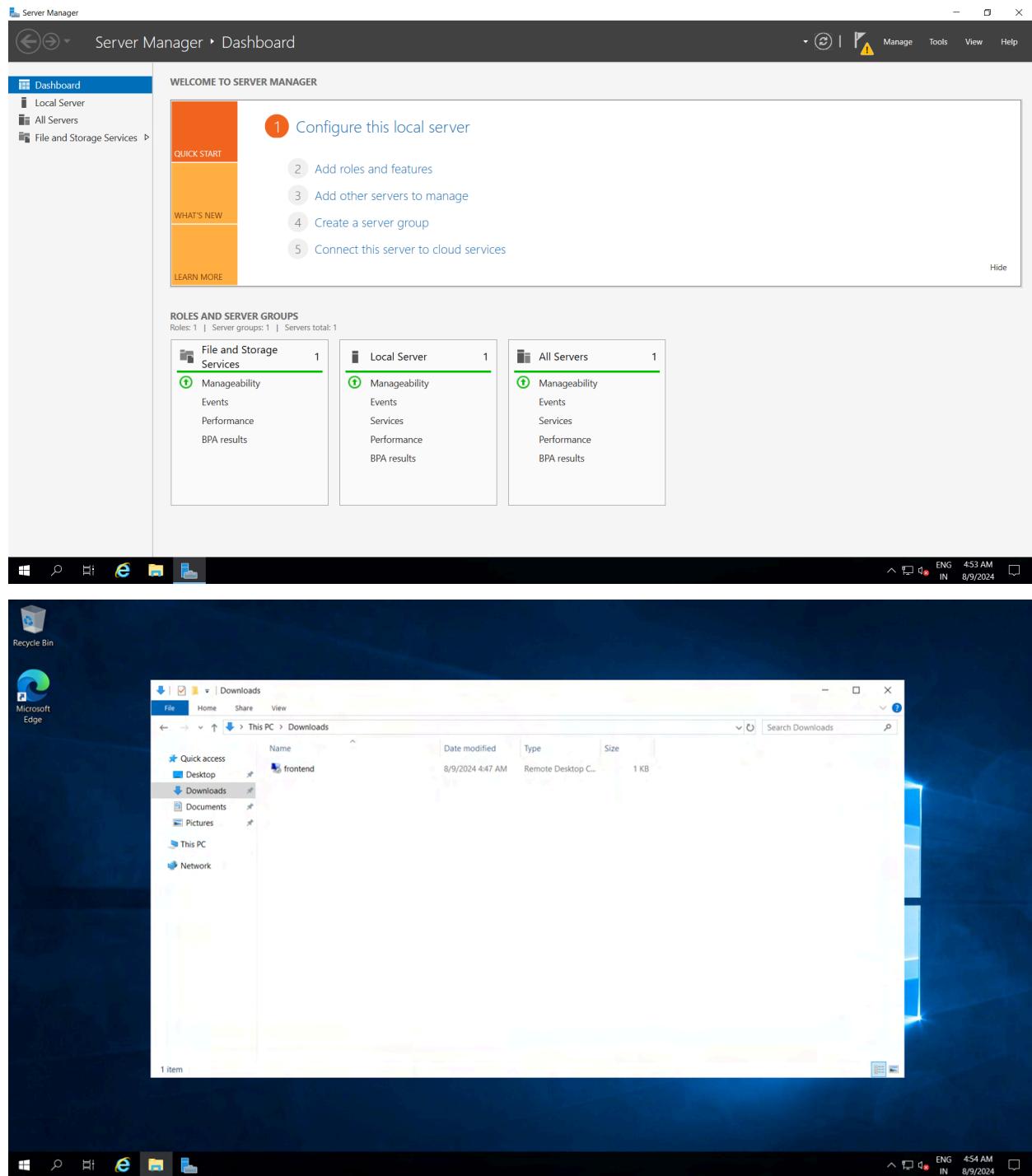
Show Details Connect Cancel

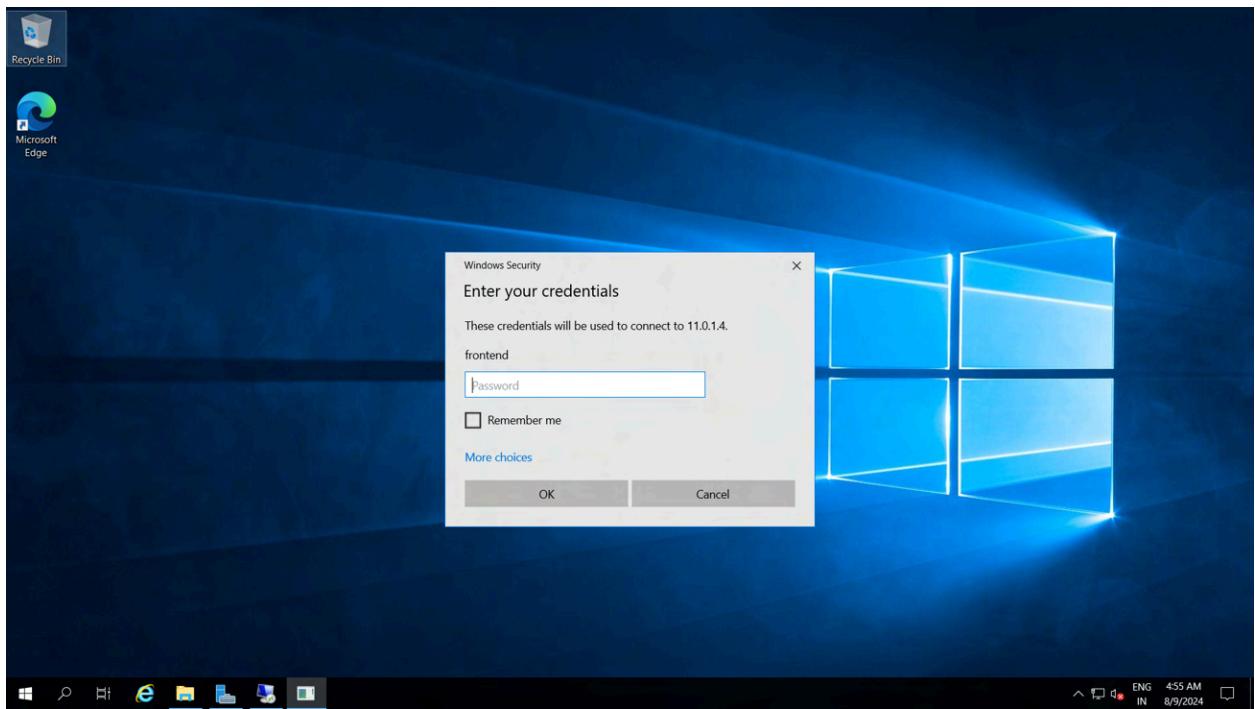
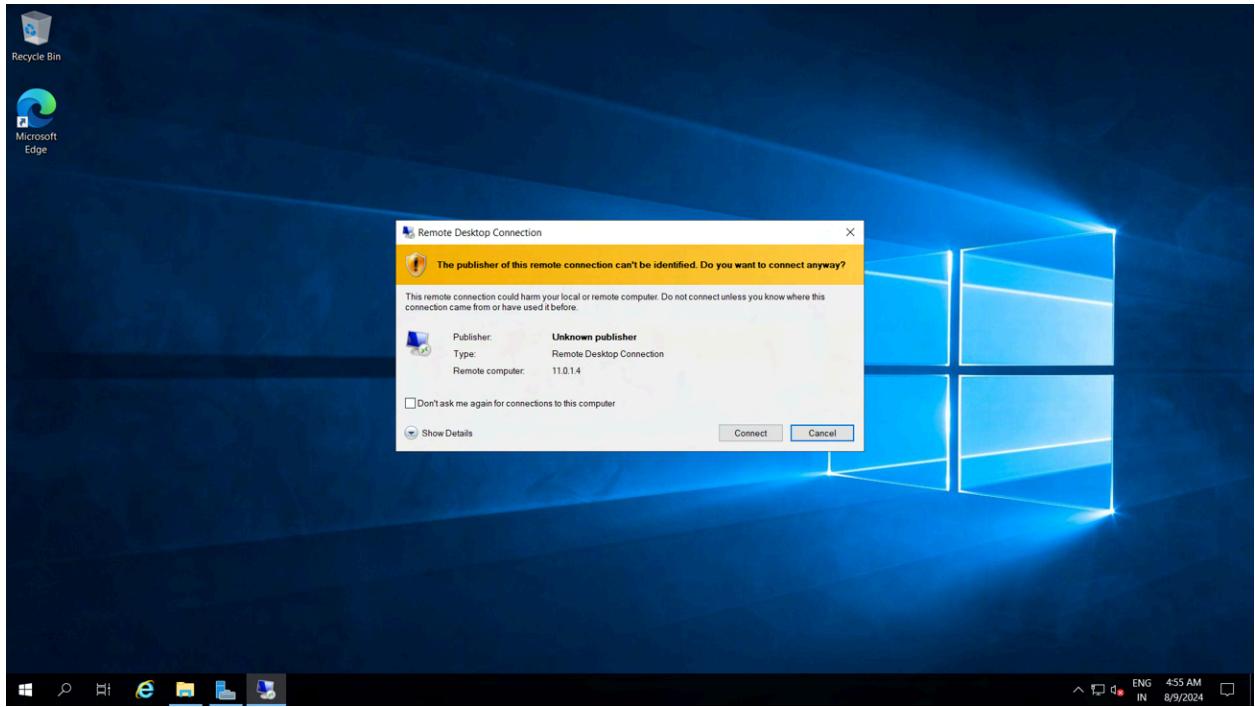




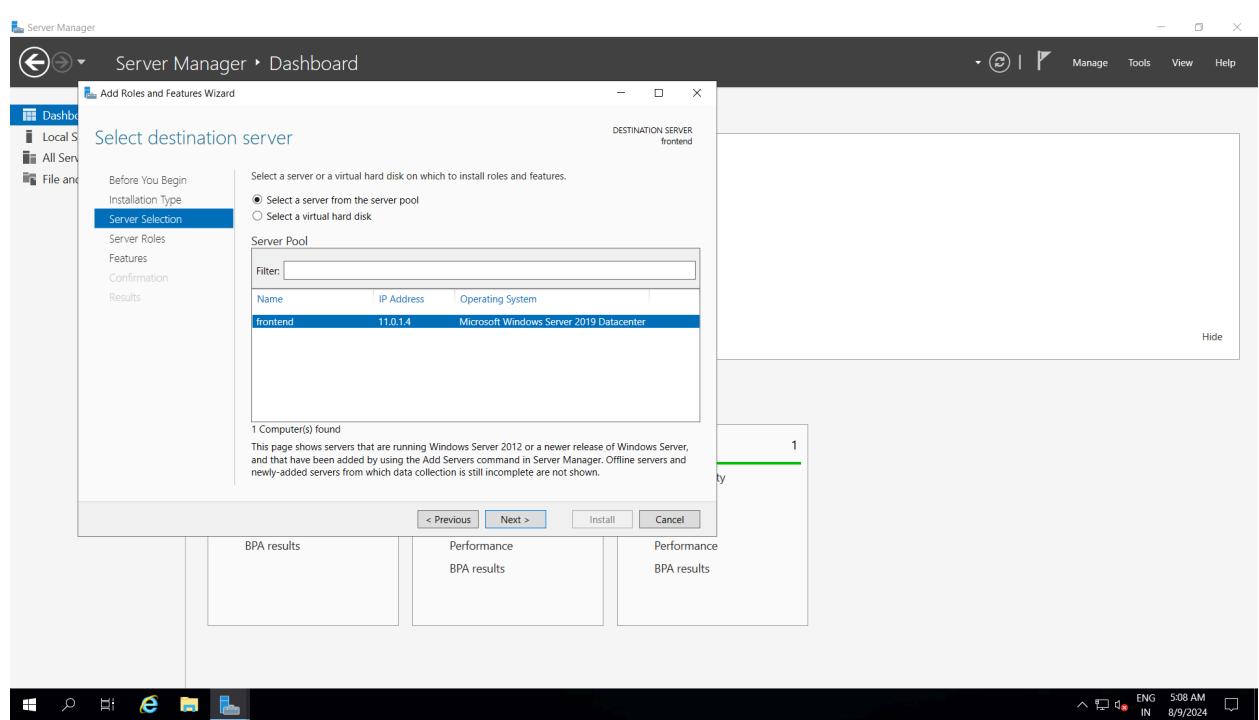
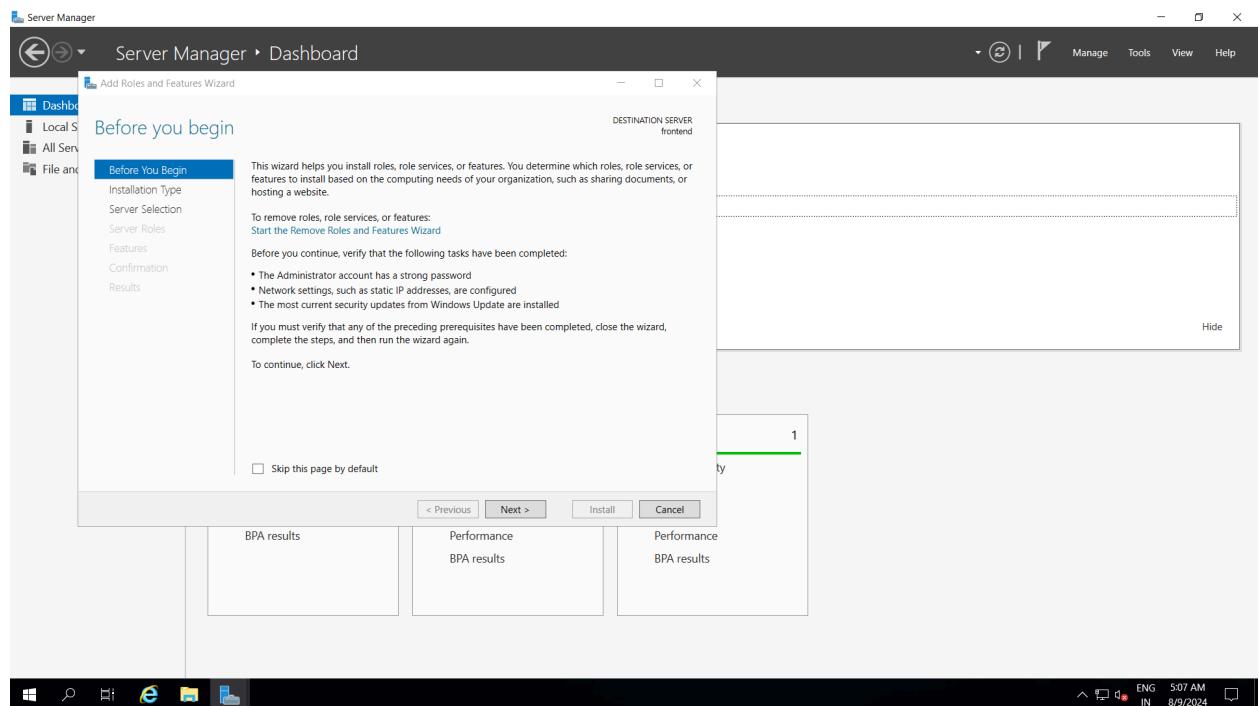
We had to configure the server manager.

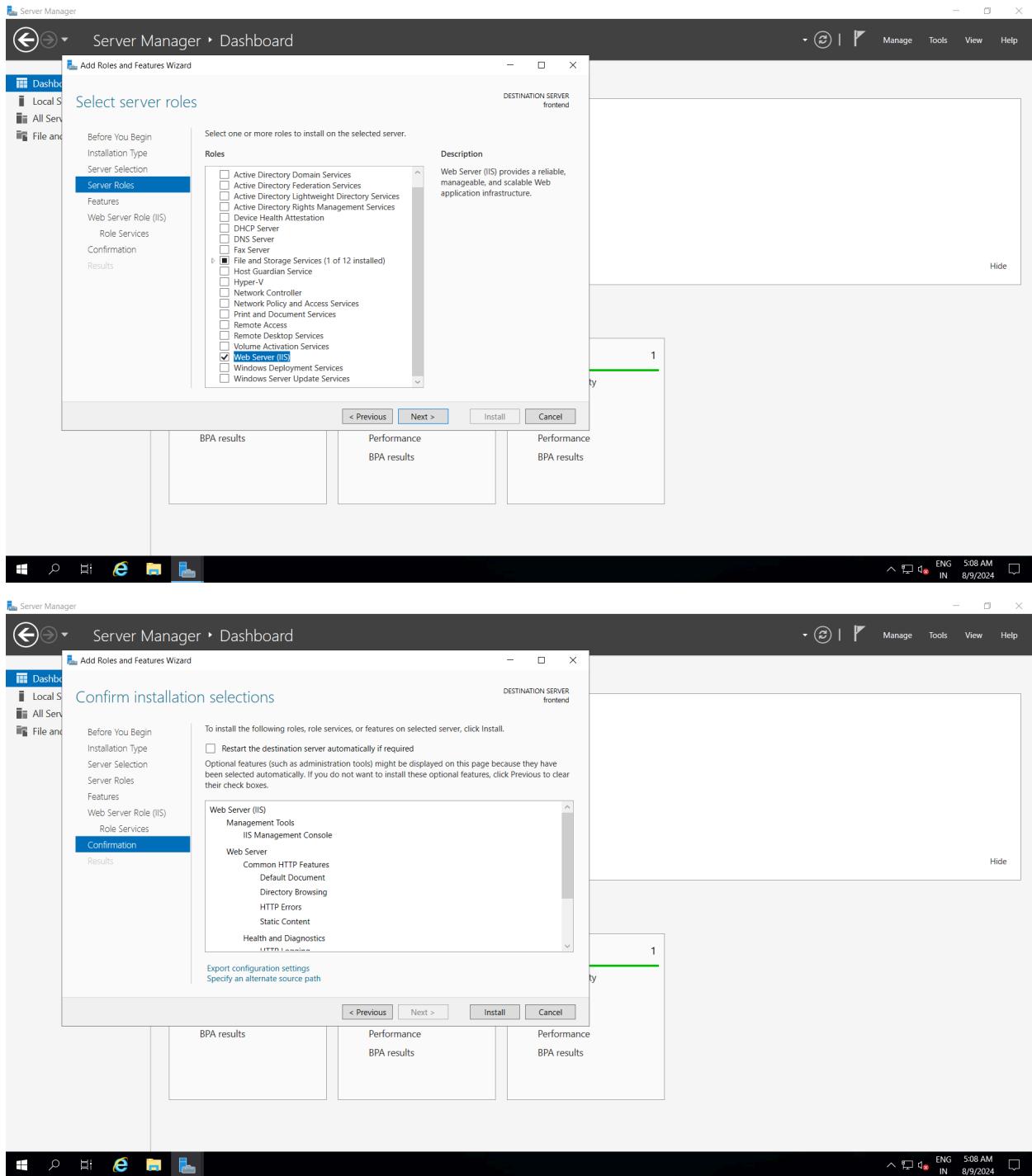
Now we could access our frontend and backend VM.



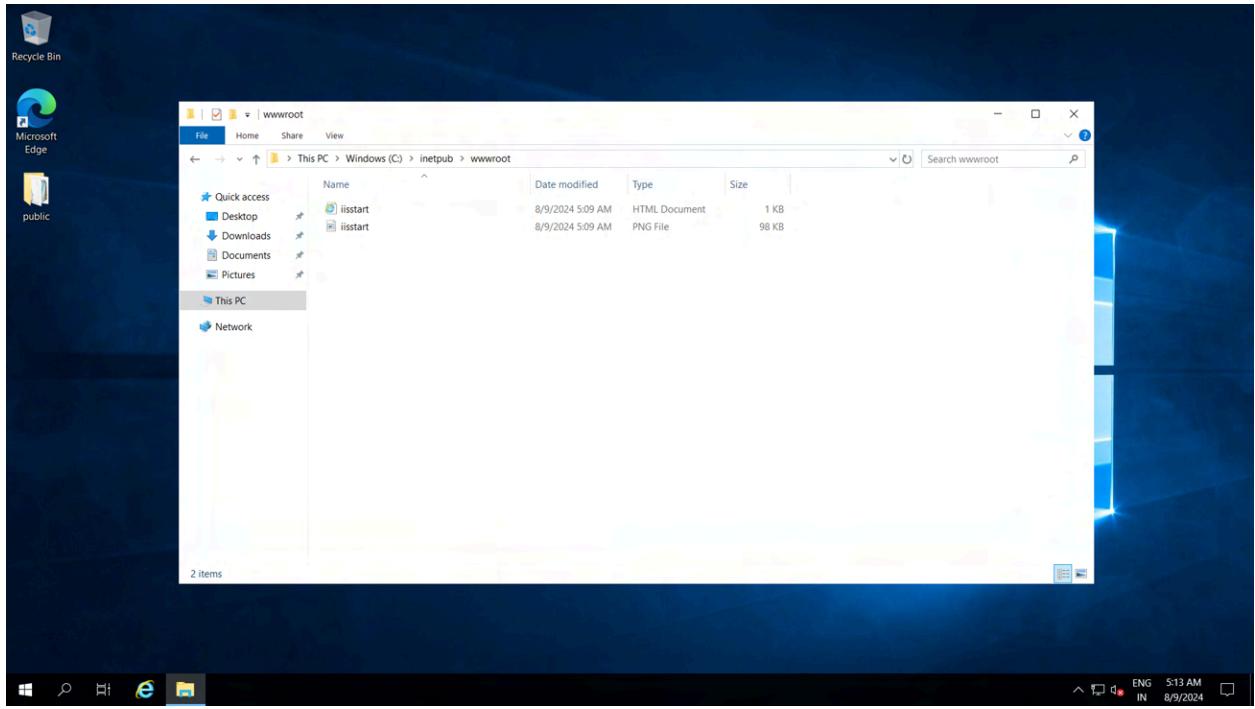


Let's configure the server manager and enable the web server option in the frontend VM.

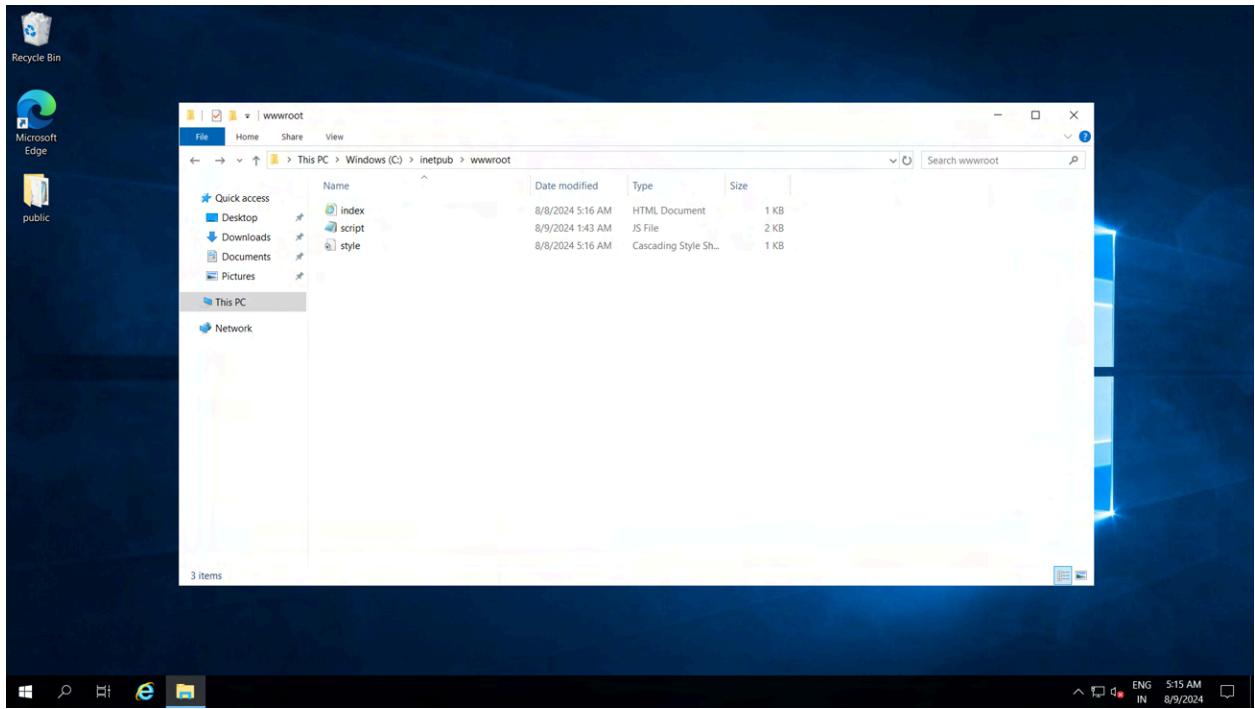




Now we could go to /windows(:c)/inetpub/wwwroot directory and access the web server files.

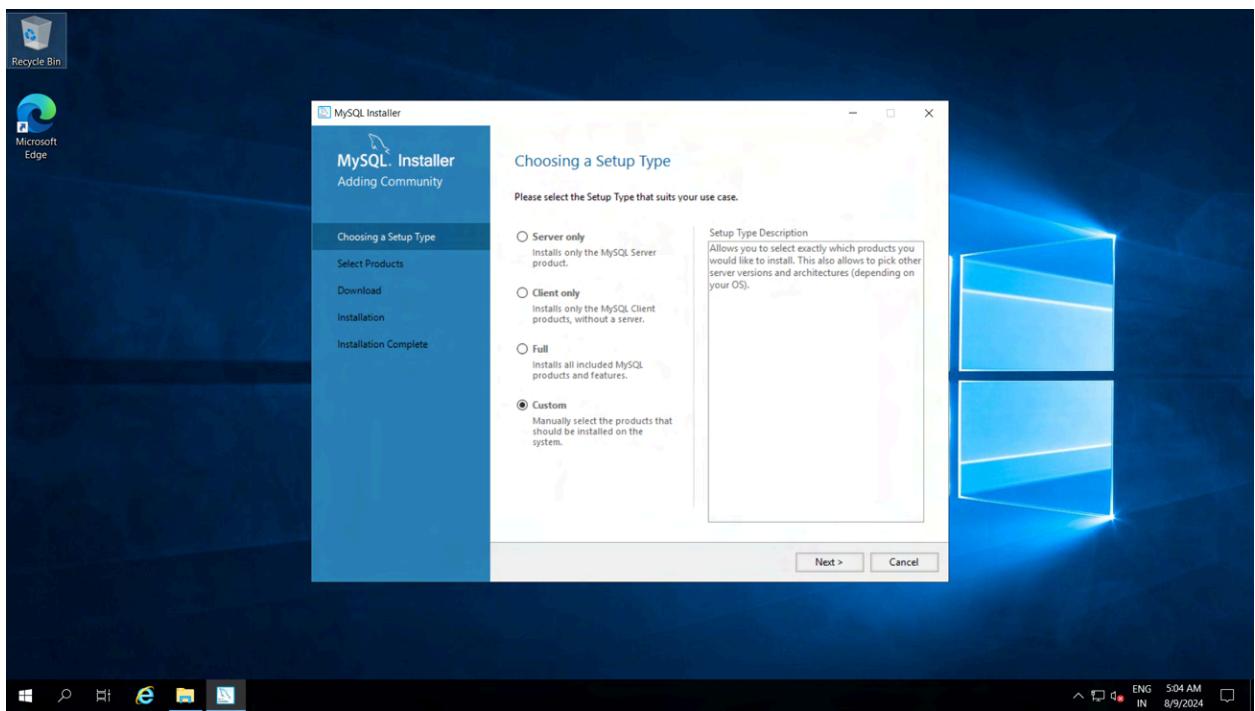
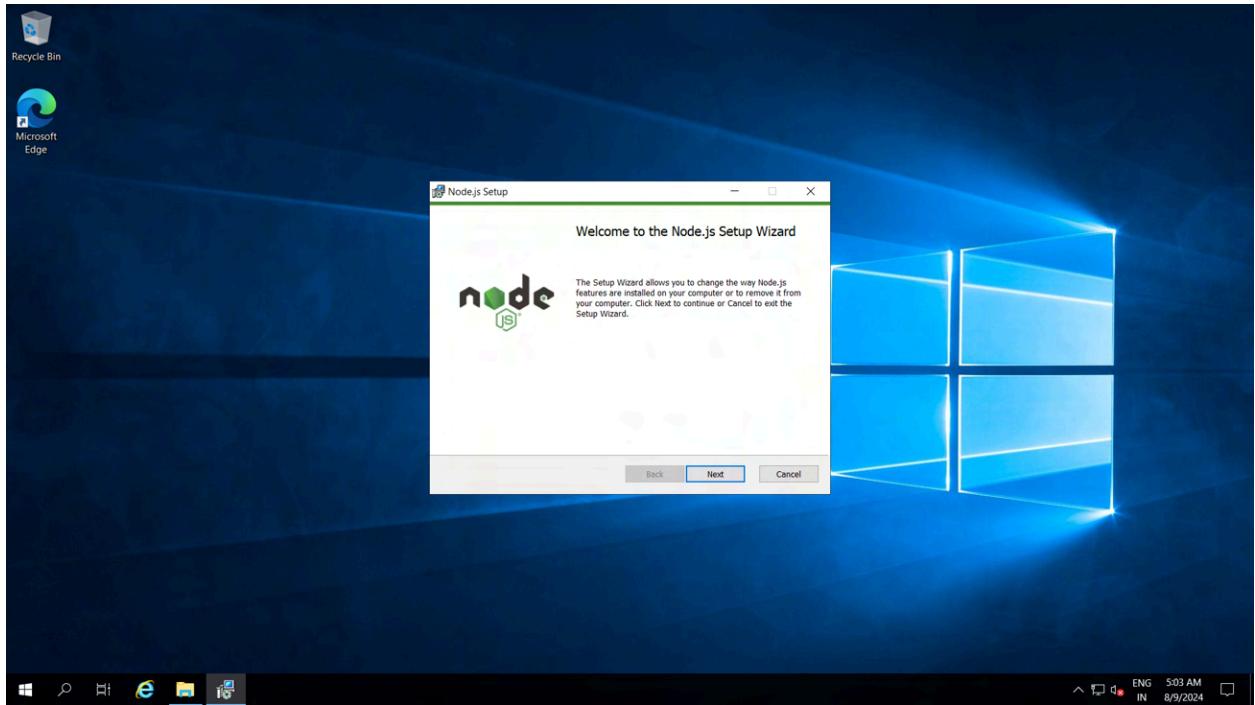


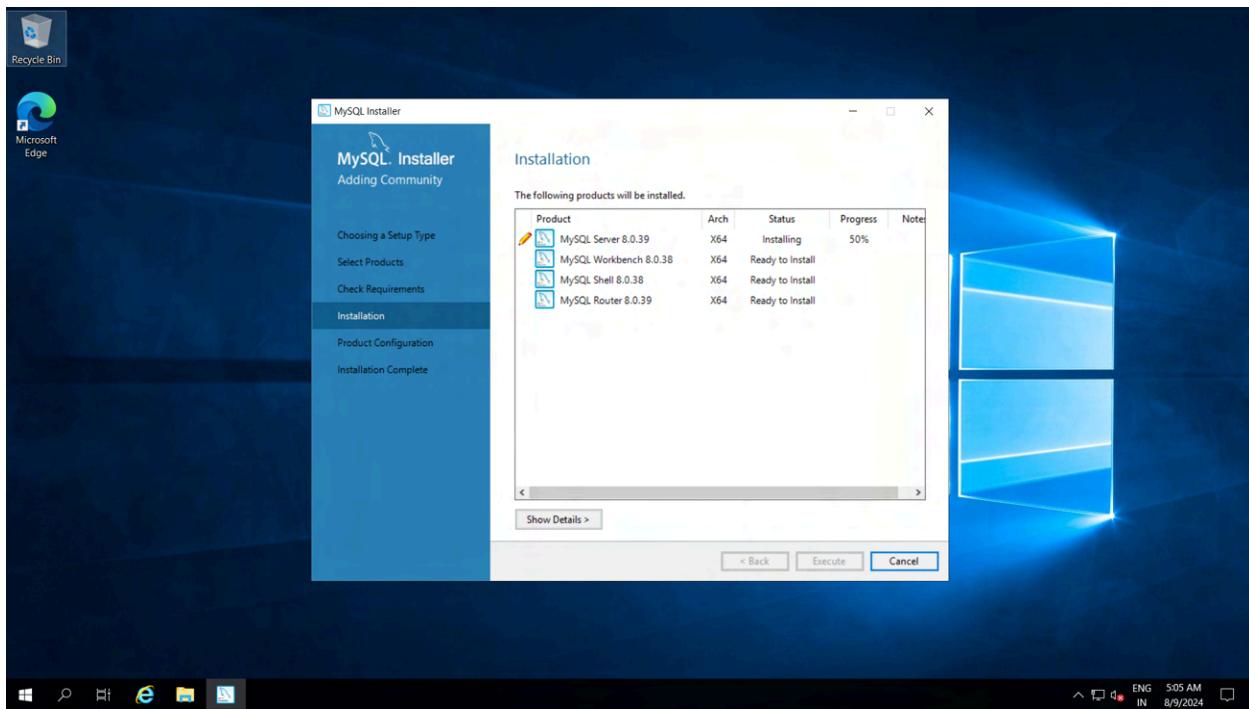
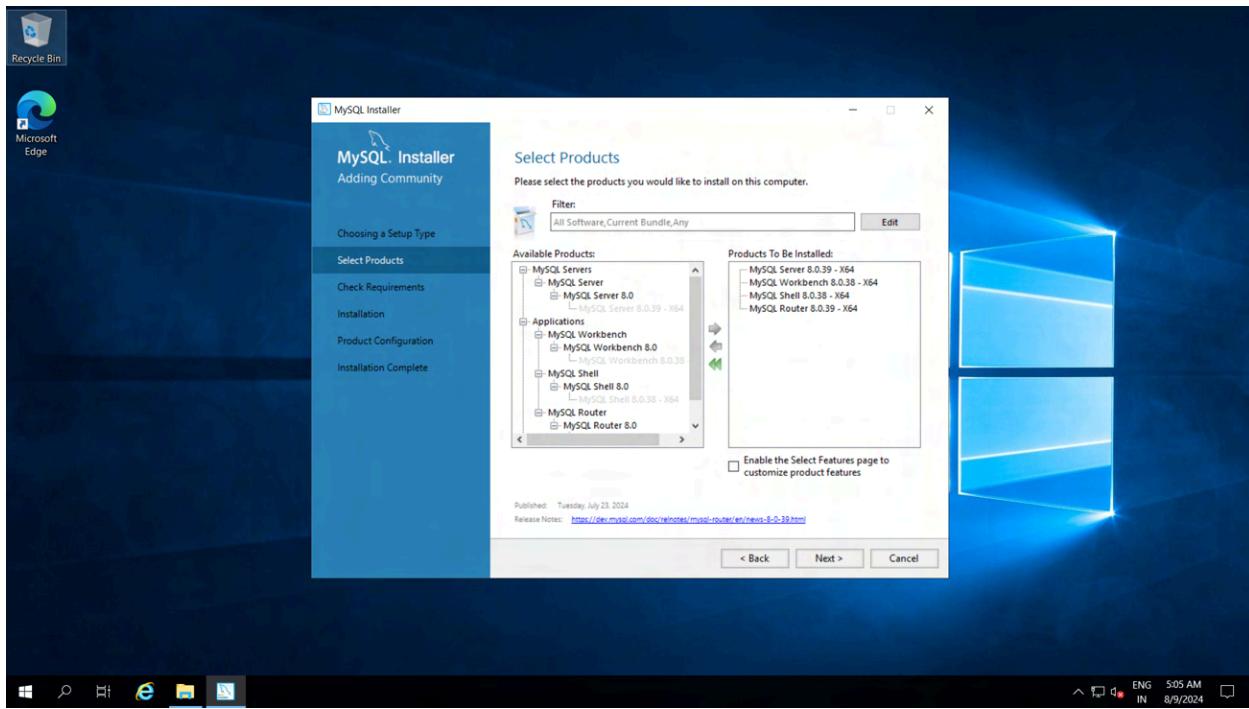
We had to replace these files with our own front-end files.

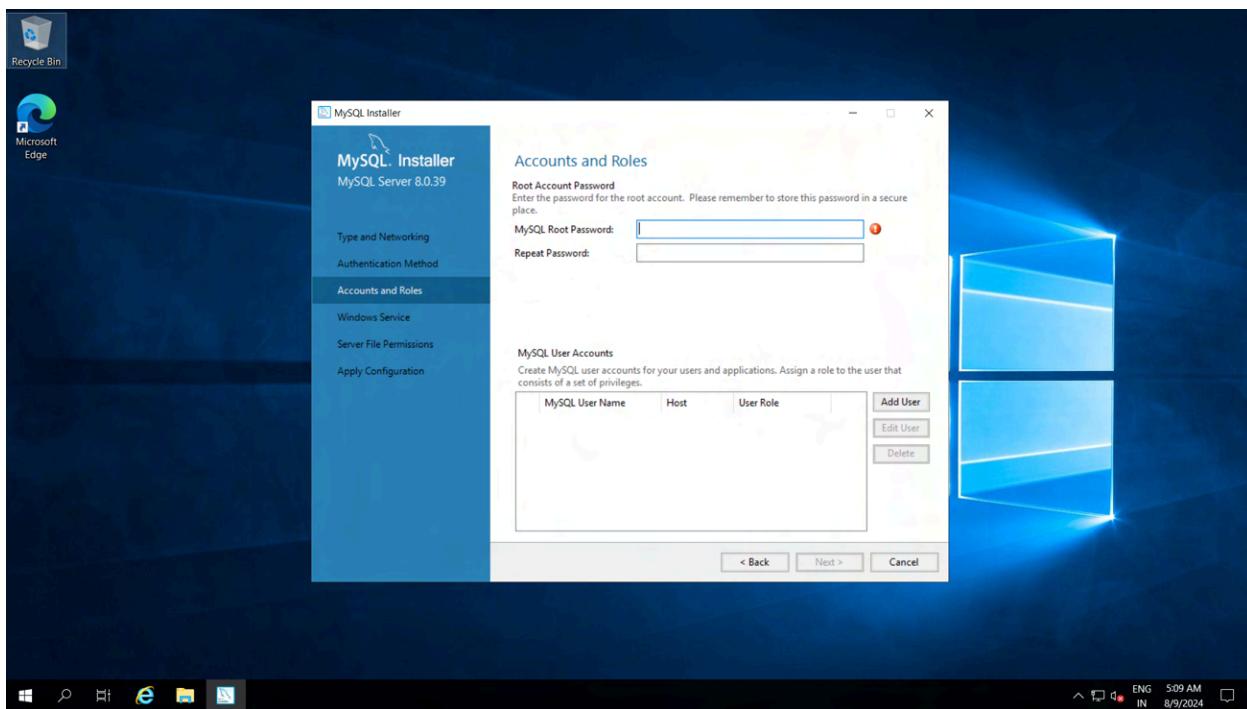
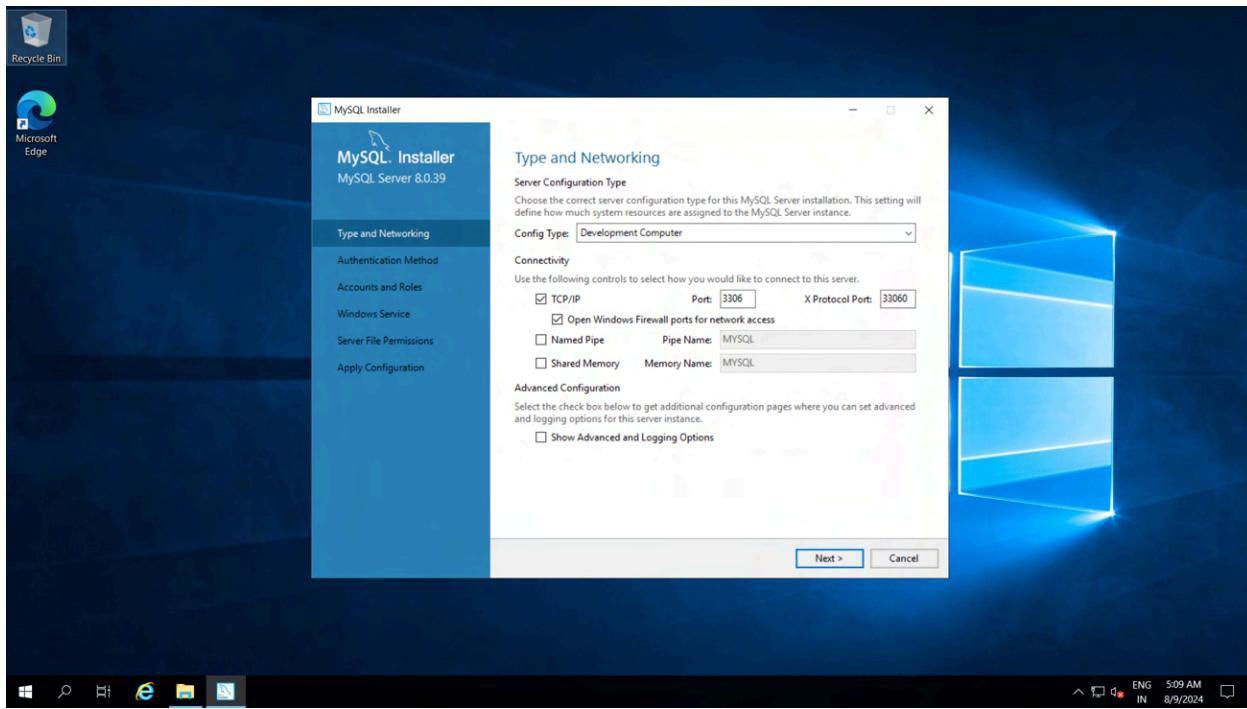


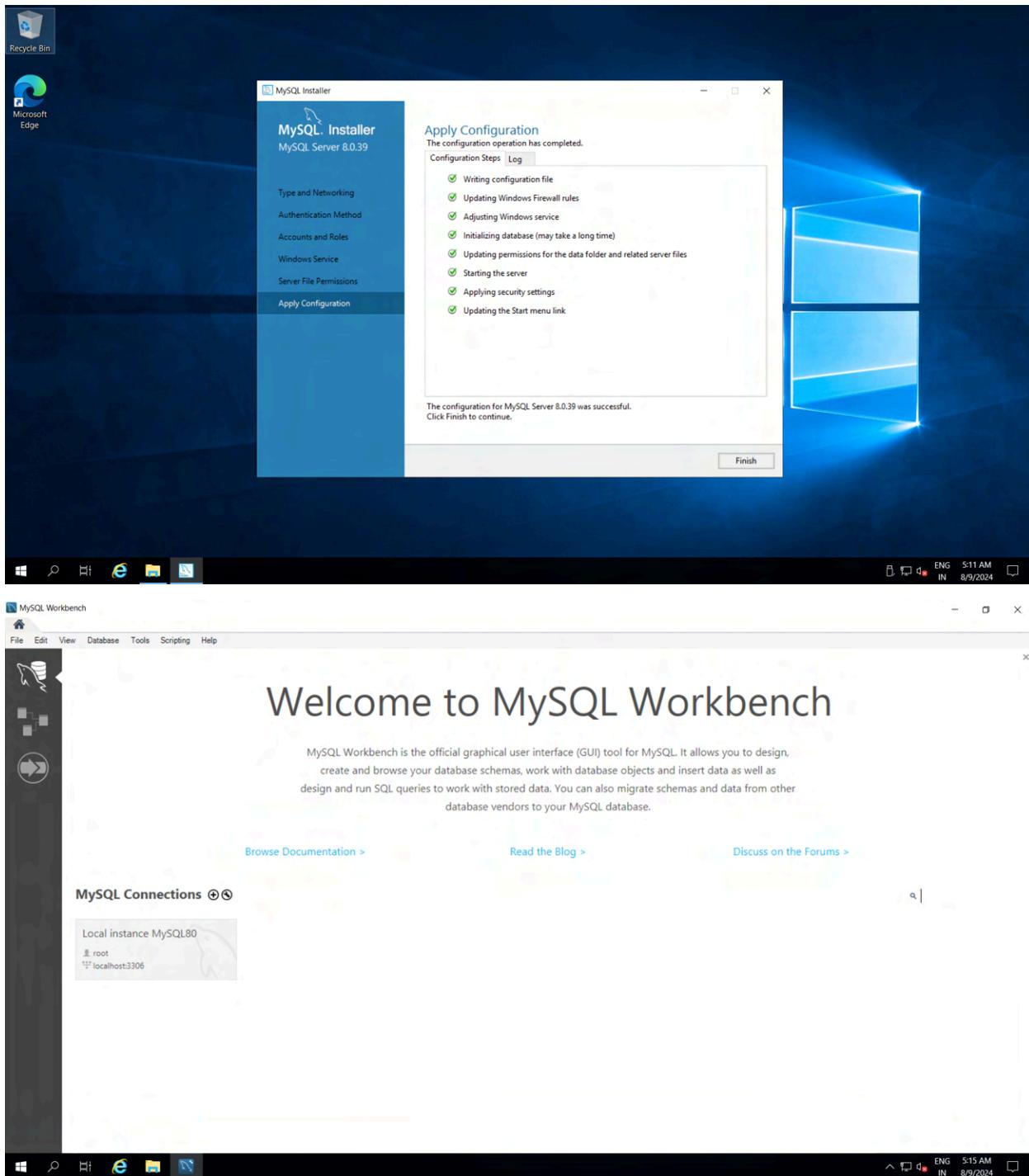
Let's configure the backend server with the server manager. Also, install necessary tools like Node and Mysql.

The image shows two screenshots of a web browser side-by-side. The left screenshot displays the Node.js download page at <https://nodejs.org/en/download/prebuilt-installer>. The page title is "Download Node.js®". It features a navigation bar with "Learn", "About", "Download" (which is highlighted in green), "Blog", "Docs", and "Certification". Below the navigation is a search bar with placeholder text "Start typing...". The main content area has tabs for "Package Manager", "Prebuilt Installer" (which is selected and highlighted in green), "Prebuilt Binaries", and "Source Code". A dropdown menu allows selecting the version (v20.16.0 (LTS)), operating system (Windows), and architecture (x64). A prominent green button labeled "Download Node.js v20.16.0" is centered. Below the button are several links: "Node.js includes npm (10.8.1)", "Read the changelog for this version", "Read the blog post for this version", "Learn how to verify signed SHASUMS", "Check out all available Node.js download options", and "Learn about Node.js Releases". The bottom of the page includes links to "Trademark Policy", "Privacy Policy", "Code of Conduct", and "Security Policy", along with social media icons for GitHub, LinkedIn, and others. The right screenshot shows the MySQL Community Downloads page at <https://dev.mysql.com/downloads/installer/>. The title is "MySQL Community Downloads". It features a breadcrumb trail: "MySQL Installer". The main content area is titled "MySQL Installer 8.0.39". It includes a note: "Note: MySQL 8.0 is the final series with MySQL Installer. As of MySQL 8.1, use a MySQL product's MSI or Zip archive for installation. MySQL Server 8.1 and higher also bundle MySQL Configurator, a tool that helps configure MySQL Server." Below this is a "Select Version:" dropdown set to "8.0.39" and a "Select Operating System:" dropdown set to "Microsoft Windows". Two download options are listed: "Windows (x86, 32-bit), MSI Installer" (size 2.1M) and "Windows (x86, 32-bit), Zip Installer" (size 303.6M). Each download link is preceded by a "Download" button. A note at the bottom encourages users to verify packages using MD5 checksums and GnuPG signatures. The browser interface at the top includes a search bar, a tab for "Node.js — Download Node.js®", and a status bar showing "ENG IN 5:02 AM 8/9/2024".









After the proper installation of the Database, we have to insert some data for testing purposes.

MySQL Workbench

Local instance MySQL80 X

File Edit View Query Database Server Tools Scripting Help

Navigator: MANAGEMENT, INSTANCE, PERFORMANCE, Administration, Schemas, Information, No object selected

Query 1 X

```
1 •  CREATE DATABASE demo;
2
3 •  -- Use the database
4 •  USE demo;
5
6 •  -- Create the items table
7 •  CREATE TABLE IF NOT EXISTS items (
8     id INT AUTO_INCREMENT PRIMARY KEY,
9     name VARCHAR(255) NOT NULL
10 );
11
12 •  -- Insert sample data into the items table
13 •  INSERT INTO items (name) VALUES ('Assignment');
14 •  INSERT INTO items (name) VALUES ('Gym');
15 •  INSERT INTO items (name) VALUES ('Cricket');
16 •  INSERT INTO items (name) VALUES ('Group Study');
17 •  INSERT INTO items (name) VALUES ('Document Verification');
```

SQLAdditions

Automatic context help is disabled. Use the toolbar to manually get help for the current caret position or to toggle automatic help.

Output: Action Output, Message, Duration / Fetch

Object Info Session

Windows Taskbar: ENG IN 5:19 AM 8/9/2024

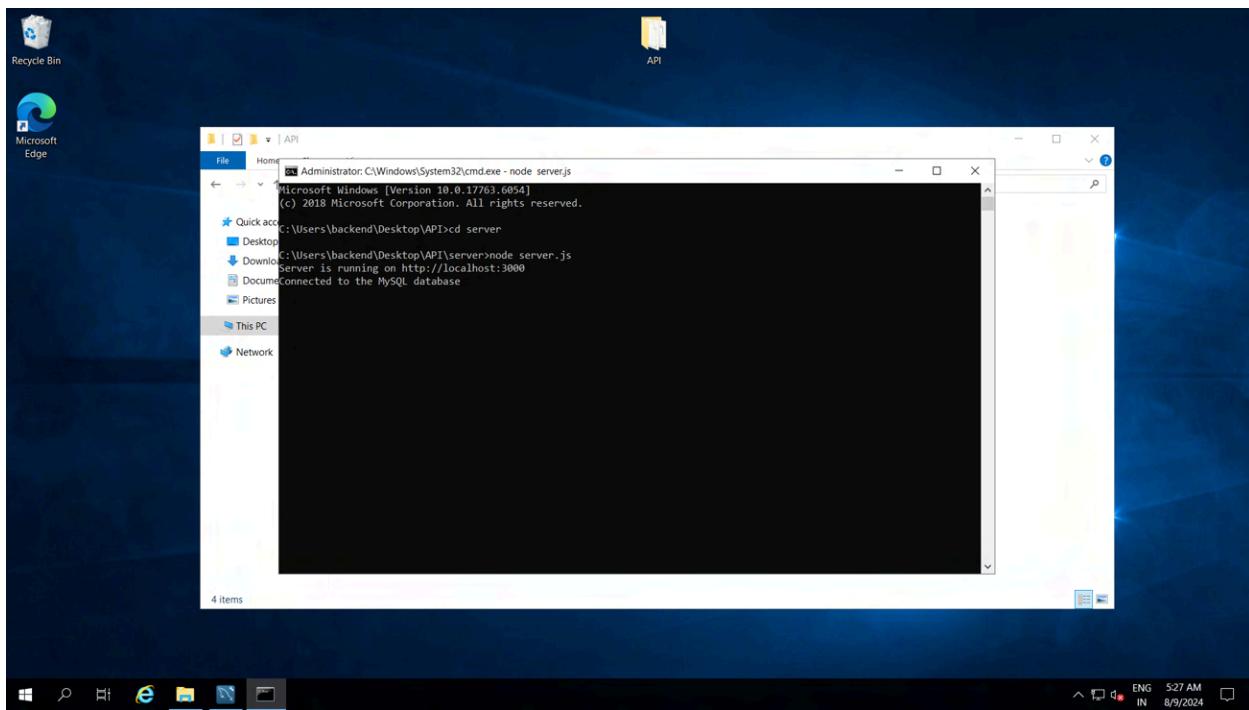
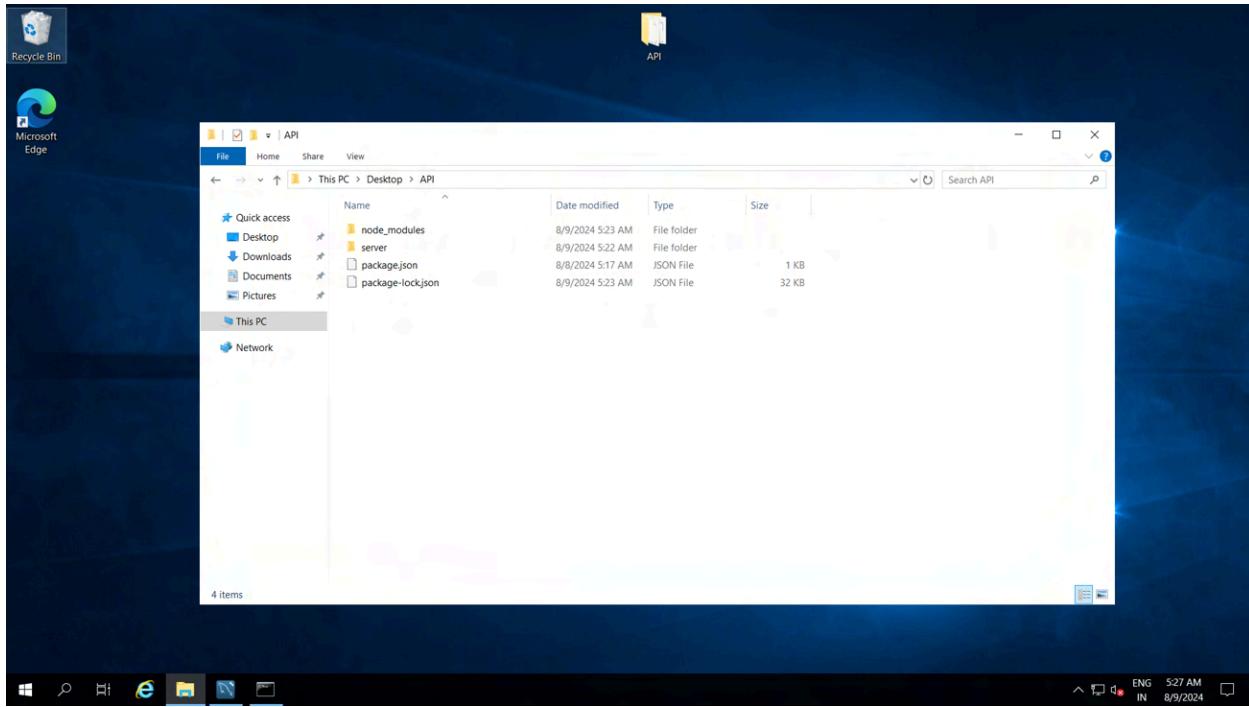
Query 1 X

```
1 •  USE demo;
2
3 •  select * from items;
```

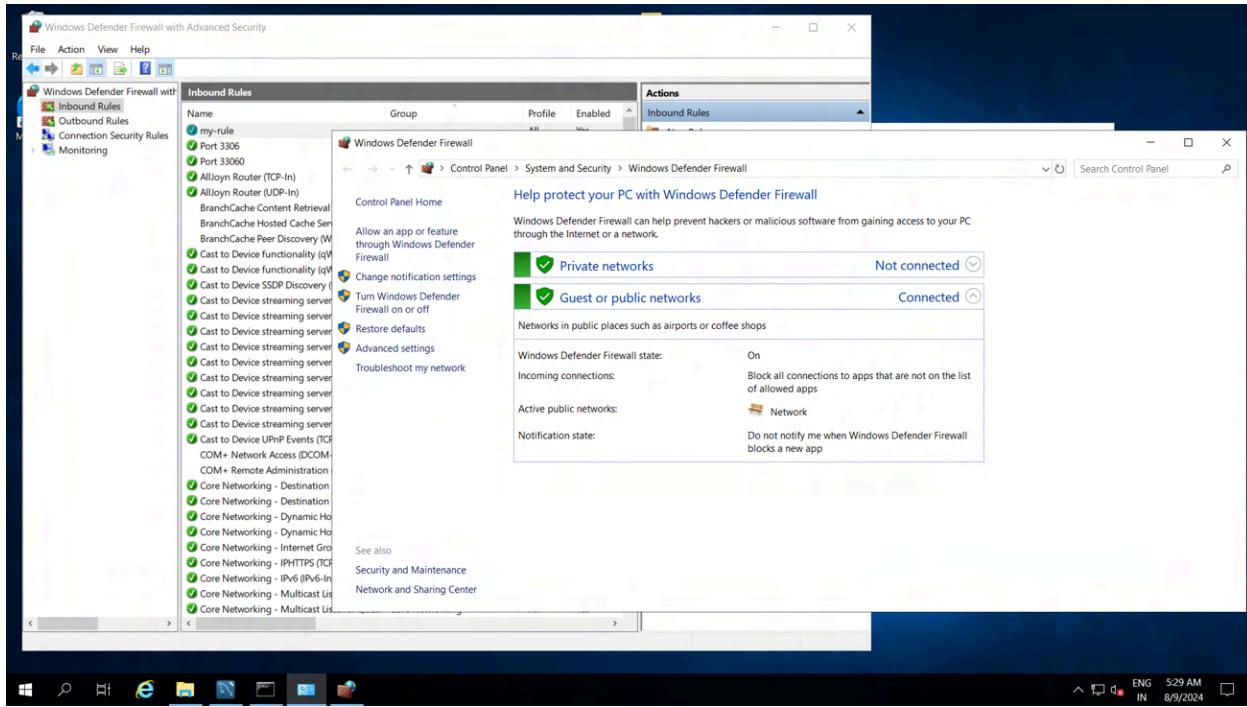
Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content: | Result Grid | Form Editor | Field Types

	id	name
1	1	Assignment
2	2	Gym
3	3	Cricket
4	4	Group Study
5	5	Document Verification
	NULL	NULL

items 1 X Apply Revert



Although the API and Database ran perfectly, we had to enable ports and the firewall to allow VMs and systems outside the network to access the data through the API.



The screenshot shows the Microsoft Azure portal's 'Network settings' for a 'backend' virtual machine. The left sidebar includes options like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Connect (with sub-options for Connect, Bastion, and Windows Admin Center), Networking (with sub-options for Network settings, Load balancing, Application security groups, and Network manager), and a search bar. The main content area shows the 'Essentials' section with details such as Network interface (backend265), Virtual network / subnet (vnet-2 / subnet-2), Public IP address (104.46.194.108), Private IP address (12.0.1.4), and Admin security rules (0). Below this is the 'Rules' section, which lists a single rule associated with a Network security group named 'backend-nsg'. A 'Create port rule' button is visible in the top right of the rules table. The table columns include Priority, Name, Port, Protocol, Source, and Destination.

The screenshot shows the Microsoft Azure portal interface. On the left, there's a navigation sidebar with options like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Connect (with sub-options Connect and Bastion), Networking (with sub-options Network settings, Load balancing, Application security groups, and Network manager), and Windows Admin Center. The 'Network settings' option under Networking is currently selected. The main content area displays 'backend | Network settings' for a virtual machine. It includes sections for Essentials (Network interface: backend265, Virtual network / subnet: vnet-2 / subnet-2, Public IP address: 104.46.194.108, Private IP address: 12.0.1.4, Admin security rules: 0 (Configure)) and Rules (with a 'Collapse all' button). A 'Search rules' bar and filters for Source == all, Destination == all, Priority ↑, Name, and Port are present. To the right, a modal window titled 'Add inbound security rule' is open, showing fields for Source (Any), Source port ranges (\*), Destination (Any), Service (Custom), Destination port ranges (3000), and Protocol (Any). There are also radio buttons for TCP, UDP, and ICMPv4. At the bottom of the modal are 'Add' and 'Cancel' buttons.

After placing the necessary files in directories in both frontend and backend VM, we verified at localhost.

Now we had to configure the Load Balancer.

**Load Balancer:** Azure Load Balancer operates at layer 4 of the Open Systems Interconnection (OSI) model. It's the single point of contact for clients. The load balancer distributes inbound flows that arrive at the load balancer's front end to backend pool instances. These flows are according to configured load-balancing rules and health probes. The backend pool instances can be Azure Virtual Machines or instances in a Virtual Machine Scale Set.

Microsoft Azure

Search resources, services, and docs (G+/)

subhambh14@gmail.com DEFAULT DIRECTORY (SUBHAMB...)

Home > Load balancing

## Load balancing | Load Balancer

Search Overview Create Manage view Refresh Export to CSV Open query Assign tags

Filter for any field... Subscription equals all Resource group equals all Location equals all Add filter

Showing 0 to 0 of 0 records.

Name ↑ Resource group ↑ Location ↑↓ Subscription ↑↓

No grouping List view

No load balancers to display

Azure Load Balancer enables your applications to be highly available and scalable. You can scale up and down based on your traffic patterns. Azure Load Balancer is best suited for network traffic requiring high performance and ultra-low latency.

Create load balancer Give feedback

Microsoft Azure

Search resources, services, and docs (G+/)

subhambh14@gmail.com DEFAULT DIRECTORY (SUBHAMB...)

Home > Load balancing | Load Balancer >

## Create load balancer

Basics Frontend IP configuration Backend pools Inbound rules Outbound rules Tags Review + create

Azure load balancer is a layer 4 load balancer that distributes incoming traffic among healthy virtual machine instances. Load balancers uses a hash-based distribution algorithm. By default, it uses a 5-tuple (source IP, source port, destination IP, destination port, protocol type) hash to map traffic to available servers. Load balancers can either be internet-facing where it is accessible via public IP addresses, or internal where it is only accessible from a virtual network. Azure load balancers also support Network Address Translation (NAT) to route traffic between public and private IP addresses. [Learn more.](#)

**Project details**

Subscription \* Azure for Students

Resource group \* pro-rg Create new

**Instance details**

Name \* my-lb

Region \* East US 2

SKU \* Standard (Recommended)

Review + create < Previous Next : Frontend IP configuration > Download a template for automation Give feedback

Microsoft Azure Search resources, services, and docs (G+) subhambh14@gmail.com

Home > Load balancing | Load Balancer > Create load balancer ...

Basics Frontend IP configuration Backend pools Inbound rules Outbound rules Tags Review + create

A frontend IP configuration is an IP address used for inbound and/or outbound communication as defined within load balancing.

+ Add a frontend IP configuration

Name ↑↓	IP address ↑↓
Add a frontend IP to get started	

Add fronted IP configuration

my-lb

Name \* my-frontend-ip

IP version IPv4

IP type IP address

Public IP address \* (new) my-ip

Gateway Load balancer None

Save Cancel Give feedback

Microsoft Azure Search resources, services, and docs (G+) subhambh14@gmail.com

Home > Load balancing | Load Balancer > Create load balancer > Add backend pool ...

Name \* my-backend

Virtual network vnet-1 (pro-rg)

Backend Pool Configuration NIC

IP configurations

IP configurations associated to virtual machines and virtual machine scale sets must be in same location as the load balancer and be in the same virtual network.

+ Add | X Remove

Resource Name	Resource group	Type	IP configuration	IP Address	Availability Set
frontend	pro-rg	Virtual machine	ipconfig1	11.0.1.4	MY-AVLSET

Save Cancel Give feedback

The screenshot shows the Microsoft Azure portal interface for creating a load balancer. On the left, the 'Create load balancer' blade is open, showing tabs for Basics, Frontend IP configuration, Backend pools, Inbound rules (selected), Outbound rules, Tags, and Review + create. Under the Inbound rules tab, there's a section for 'Load balancing rule' which is currently empty. Below it is an 'Inbound NAT rule' section with a single entry. At the bottom of this blade are buttons for 'Review + create', '< Previous' and 'Next : Outbound rule >', 'Download a template for automation', and 'Give feedback'.

**Add load balancing rule**

my-lb

A load balancing rule distributes incoming traffic that is sent to a selected IP address and port combination across a group of backend pool instances. Only backend instances that the health probe considers healthy receive new traffic. [Learn more.](#)

Name \* my-lb-rule

IP Version \*  IPv4  IPv6

Frontend IP address \* my-frontend-ip (To be created)

Backend pool \* my-backend

Protocol  TCP  UDP

Port \* 80

[Save](#) [Cancel](#) [Give feedback](#)

The screenshot shows the Microsoft Load Balancer overview page for a deployment named 'Microsoft.LoadBalancer-20240809111714'. The 'Overview' tab is selected, displaying deployment details: Deployment name: Microsoft.LoadBalancer-20240809111..., Start time: 8/9/2024, 11:19:49 AM, Subscription: Azure for Students, Correlation ID: cdf3ee86-3254-4029-95d7-e2c969e9d... Resource group: pro-rg. Below this, there are sections for 'Deployment details' and 'Next steps', each with a 'Go to resource' button. To the right, there are promotional links for 'Cost management', 'Microsoft Defender for Cloud', 'Free Microsoft tutorials', and 'Work with an expert'.

Microsoft.LoadBalancer-20240809111714 | Overview

Deployment

Search

Delete Cancel Redeploy Download Refresh

Overview

Your deployment is complete

Deployment name : Microsoft.LoadBalancer-20240809111... Start time : 8/9/2024, 11:19:49 AM  
Subscription : Azure for Students Correlation ID : cdf3ee86-3254-4029-95d7-e2c969e9d...  
Resource group : pro-rg

Deployment details

Next steps

Go to resource

Give feedback

Tell us about your experience with deployment

Cost management

Get notified to stay within your budget and prevent unexpected charges on your bill.  
[Set up cost alerts >](#)

Microsoft Defender for Cloud

Secure your apps and infrastructure  
[Go to Microsoft Defender for Cloud >](#)

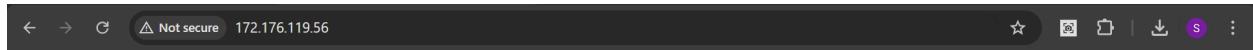
Free Microsoft tutorials

[Start learning today >](#)

Work with an expert

Azure experts are service provider partners

Now we can check our application from the load balancer public IP.



## Items List

Assignment  
Gym  
Cricket  
Group Study  
Document Verification

### Add New Item



## Items List

Assignment  
Gym  
Cricket  
Group Study  
Document Verification

### Add New Item

It was verified from the backend if the changes had happened.

The screenshot shows the MySQL Workbench interface. At the top, there is a toolbar with various icons for database management. Below the toolbar, a query editor window titled "Query 1" contains the following SQL code:

```
1 • USE demo;
2
3 • select * from items;
```

Below the query editor is a results grid titled "Result Grid". The grid displays the following data:

	id	name
▶	1	Assignment
	2	Gym
	3	Cricket
	4	Group Study
	5	Document Verification
	6	Read a Book
	7	Write today's journal
	HULL	HULL

On the right side of the results grid, there is a vertical toolbar with three options: "Result Grid" (selected), "Form Editor", and "Field Types". At the bottom of the results grid, there are "Apply" and "Revert" buttons.

Since it worked perfectly, now we could map it with a domain name.

For this, a domain name was purchased from web hosting platforms like Hostinger, GoDaddy etc and mapped using Azure DNS Service.

**Azure DNS service:** The Domain Name System (DNS) is responsible for translating (resolving) a service name to an IP address. Azure DNS provides DNS hosting, resolution, and load balancing for your applications using the Microsoft Azure infrastructure.

Microsoft Azure

Search resources, services, and docs (G+/)

subhambh14@gmail.com  
DEFAULT DIRECTORY (SUBHAM...)

Home > DNS zones

Default Directory (subhambh14@gmail.onmicrosoft.com)

+ Create Manage view Refresh Export to CSV Open query Assign tags Delete

Filter for any field... Subscription equals all Resource group equals all Location equals all Add filter

Showing 0 to 0 of 0 records.

Name ↑ Numb... ↑ Max n... ↑ Resource group ↑ Subscription ↑

No dns zones to display

Azure DNS is a hosting service for DNS domains that provides name resolution by using Microsoft Azure infrastructure. By hosting your domains in Azure, you can manage your DNS records by using the same credentials, APIs, tools, and billing as your other Azure services.

Create dns zone Give feedback

Microsoft Azure

Search resources, services, and docs (G+/)

subhambh14@gmail.com  
DEFAULT DIRECTORY (SUBHAM...)

Home > DNS zones

Create a DNS Zone

Basics DNS Zone Editor Tags Review + Create

Subscription \*

Resource group \*  Create new

**Instance details**

This zone is a child of an existing zone already hosted in Azure DNS

Name \*

Resource group location \*

Review + create < Previous Next : DNS Zone Editor >

Microsoft Azure

Search resources, services, and docs (G+/)

subhambh14@gmail.com

DEFAULT DIRECTORY (SUBHAM...)

Home > DNS zones >

## Create a DNS Zone

Validation passed

Basics DNS Zone Editor Tags Review + Create

View automation template

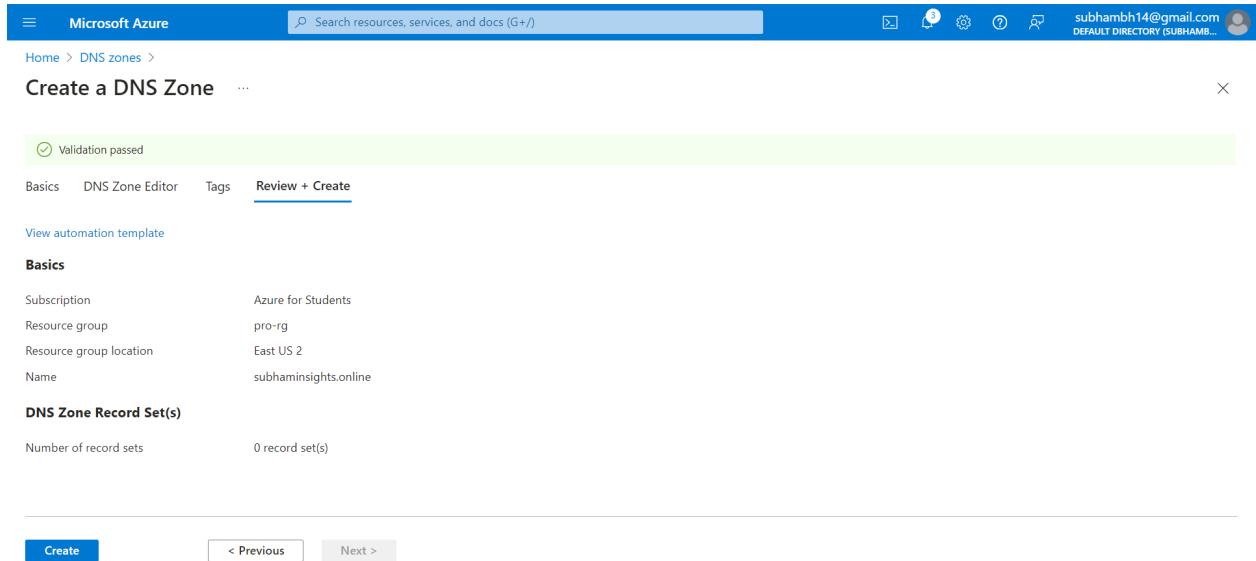
### Basics

Subscription	Azure for Students
Resource group	pro-rg
Resource group location	East US 2
Name	subhaminsights.online

### DNS Zone Record Set(s)

Number of record sets: 0 record set(s)

Create < Previous Next >



Microsoft Azure

Search resources, services, and docs (G+/)

subhambh14@gmail.com

DEFAULT DIRECTORY (SUBHAM...)

Home > subhaminsights.online\_1723183597124 | Overview >

## subhaminsights.online

DNS zone

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Settings

DNS Management

Monitoring

Automation

Help

Child zone Record sets Import Export Move Refresh Delete

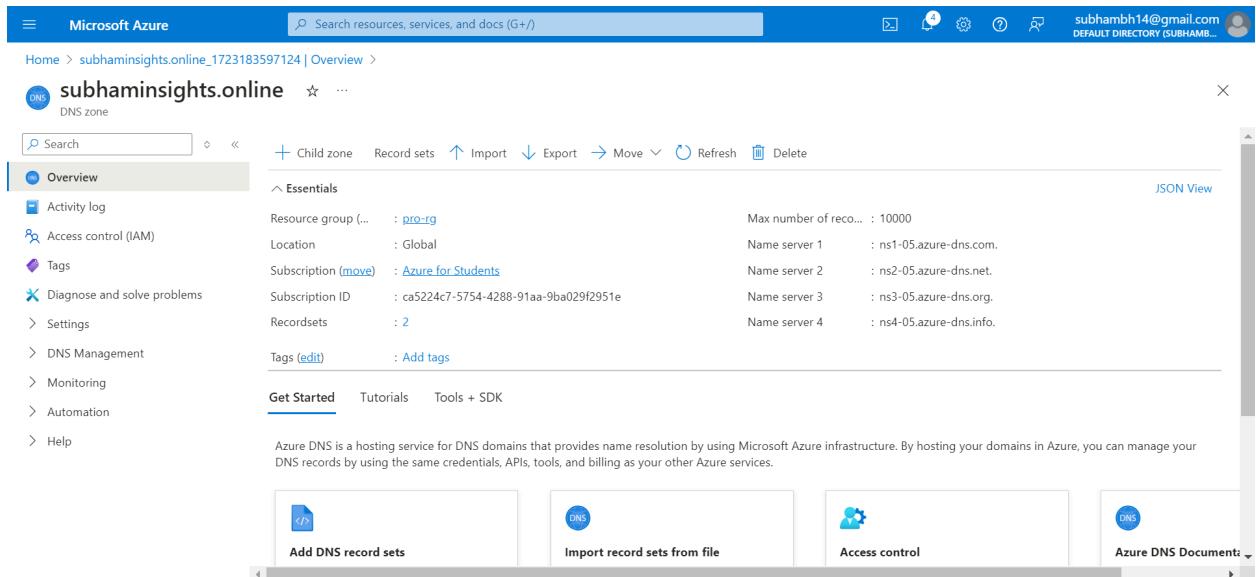
Essentials

Resource group (...): pro-rg	Max number of records: 10000
Location: Global	Name server 1: ns1-05.azure-dns.com.
Subscription (move): Azure for Students	Name server 2: ns2-05.azure-dns.net.
Subscription ID: ca5224c7-5754-4288-91aa-9ba029f2951e	Name server 3: ns3-05.azure-dns.org.
Records: 2	Name server 4: ns4-05.azure-dns.info.
Tags (edit): Add tags	

Get Started Tutorials Tools + SDK

Azure DNS is a hosting service for DNS domains that provides name resolution by using Microsoft Azure infrastructure. By hosting your domains in Azure, you can manage your DNS records by using the same credentials, APIs, tools, and billing as your other Azure services.

Add DNS record sets Import record sets from file Access control Azure DNS Documents



Now that we had configured the domain, we were set to add items to the list as users.

Assignment

Gym

Cricket

Group Study

Document Verification

Read a Book

Write today's journal

## Items List

Assignment

Gym

Cricket

Group Study

Document Verification

Read a Book

Write today's journal

### Add New Item

Assignment

Gym

Cricket

Group Study

Document Verification

Read a Book

Write today's journal

Bring Fruits

## Items List

Assignment

Gym

Cricket

Group Study

Document Verification

Read a Book

Write today's journal

Bring Fruits

### Add New Item

Let us check if the changes happened in the backend database.

Query 1 > [ ]

1 • USE demo;

2

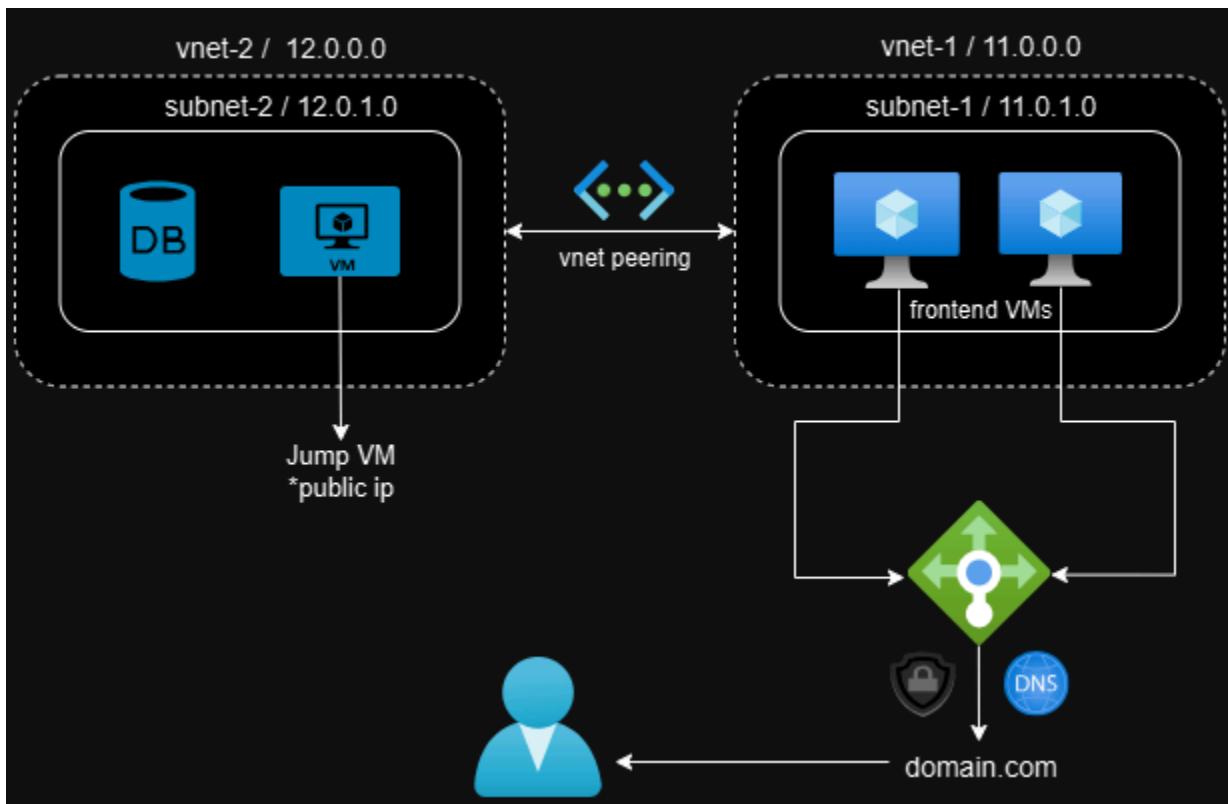
3 • select \* from items;

Result Grid | Filter Rows: [ ] | Edit: [ ] | Export/Import: [ ] | Wrap Cell Content: [ ]

id	name
1	Assignment
2	Gym
3	Cricket
4	Group Study
5	Document Verification
6	Read a Book
7	Write today's journal
8	Bring Fruits
*	NULL
*	NULL

items 5 x Apply Revert

## Cloud Architecture Diagram



This Azure cloud architecture is designed to host a simple web application. It consists of two virtual networks (VNets), each with its own subnet, connected through VNet peering. The VNets are isolated but can communicate securely via the peering connection.

## **VNet-1 (11.0.0.0/16)**

- Subnet-1 (11.0.1.0/24): This subnet contains two frontend VMs that host the web application. These VMs are connected to an Azure Load Balancer, which distributes incoming traffic evenly across the VMs to ensure high availability and reliability. The Load Balancer is assigned a public IP address, making it the point of entry for external users trying to access the application.

## **VNet-2 (12.0.0.0/16)**

- Subnet-2 (12.0.1.0/24): This subnet hosts a Jump VM and a database (DB) server. The Jump VM has a public IP address, making it accessible from the internet. It acts as a secure gateway for administrators to connect to the private resources within VNet-2, such as the database server, which does not have a public IP and is therefore protected from direct internet exposure.

## **Network Security and Traffic Management**

- Load Balancer: The public IP address of the Load Balancer is mapped to a domain name (e.g., domain.com). The Load Balancer is configured with an SSL certificate to secure communication between the clients and the application.
- VNet Peering: This enables secure communication between the resources in VNet-1 and VNet-2 without exposing them to the internet.

## **Access Flow**

1. Administrator Access: Administrators use the Jump VM to securely access the database server or other internal resources in VNet-2.
2. User Access: End-users access the web application via the domain name. The request is routed to the Load Balancer, which directs traffic to one of the frontend VMs in Subnet-1.

---

In this entire process, we considered following some **Industrial practices** as follows:

## 1. Security Practices

- Network Security Groups (NSGs): NSGs must be applied to the subnets and individual VMs to control inbound and outbound traffic. It must be ensured that only necessary ports are open and that traffic is restricted based on IP addresses and protocols.
- Use of Jump Box: It must be ensured the Jump VM is the only entry point to your VNet. Disable direct RDP/SSH access to all other VMs and require administrators to connect via the Jump VM.
- Azure Bastion: Consider using Azure Bastion instead of a traditional Jump VM for secure RDP/SSH access to your VMs without exposing public IPs.
- Encryption: Use Azure Disk Encryption for VMs, SSL/TLS for your Load Balancer, and Azure Key Vault to manage secrets, certificates, and encryption keys.

## 2. Scalability and Availability

- Auto-Scaling: Auto-scaling must be enabled on the frontend VMs to handle varying loads automatically. This ensures the application remains responsive even during peak traffic periods.
- Availability Sets/Zones: Deploying the VMs across availability sets or zones to ensure high availability and redundancy in case of hardware failures or data centre outages.
- Load Balancer Health Probes: Configure health probes on the Load Balancer to automatically remove unhealthy VMs from rotation, ensuring that only healthy instances serve user requests.

## 3. Monitoring and Logging

- Azure Monitor: Use Azure Monitor to collect and analyze telemetry data from the application, infrastructure, and network. Set up alerts for key metrics like CPU usage, memory, and network traffic.

- Application Insights: Integrate Application Insights for detailed application performance monitoring, including request rates, response times, and failure rates.

## 4. Cost Management

- Cost Alerts: Set up cost alerts and budgets in Azure Cost Management to monitor the spending and avoid unexpected expenses.
- Reserved Instances: Consider purchasing reserved instances for VMs with predictable workloads to save on costs over pay-as-you-go pricing.
- Right-Sizing: Regularly evaluate the VM sizes and storage allocations to ensure they match the workload needs, avoiding over-provisioning and unnecessary costs.

## 5. Backup and Disaster Recovery

- Azure Backup: Implement Azure Backup to protect the VMs, databases, and other resources. Regularly test your backup and restore processes to ensure data can be recovered in case of a disaster.
- Azure Site Recovery: Use of Azure Site Recovery to replicate the VMs to another region or data centre, providing a disaster recovery solution that ensures business continuity.

## 6. Compliance and Governance

- Azure Policy: Azure Policy must be used to enforce organizational standards and assess compliance at scale. Policies must be defined to restrict certain actions or to require specific configurations across your resources.
- Role-Based Access Control (RBAC): RBAC must be implemented to control who has access to your resources. Assign permissions based on the principle of least privilege, giving users only the access they need to perform their tasks.

By following these practices, we created a robust, secure, and efficient environment on Azure, ensuring that the application can scale, remain secure, and operate reliably while controlling costs.