



# ACADEMIA INTERNATIONAL COLLEGE

GWARKO, LALITPUR

NEPAL



## **Lab Report On**

### **“Introduction to Cloud Computing”**

#### **Submitted By:**

Name: Ronil Maharjan

Roll No: 34

Faculty: B. Sc. CSIT

Year/ Semester: IV/ VIII

#### **Submitted To:**

Diwakar Upadhaya Sir

Department of computer Science & IT

Academia International College

# Lab 1: Install Oracle VirtualBox and configure Ubuntu on it.

## Objectives:

- To learn about virtualization.
- To create a virtual machine and install Linux (Ubuntu) on it.
- To learn about modifying hardware based on need of user.
- To learn various networking modes in the VM.

## Theory:

Using virtualization, an underlying service can be made virtual. The usage and flexibility of hardware can be increased by using virtualization to run many operating systems and applications simultaneously on the same workstation and hardware. Cloud computing is based on the technique of virtualization, which makes it possible to use actual computer hardware more effectively.

- **Host Machine:** The machine on which the virtual machine is going to be built is known as Host Machine.
- **Guest Machine:** The virtual machine is referred to as a Guest Machine.

Virtualization allows flexible and efficient allocation of resources meaning user can allocate memory, CPU cores to be used by the virtual machine. Users can also change to different network modes:

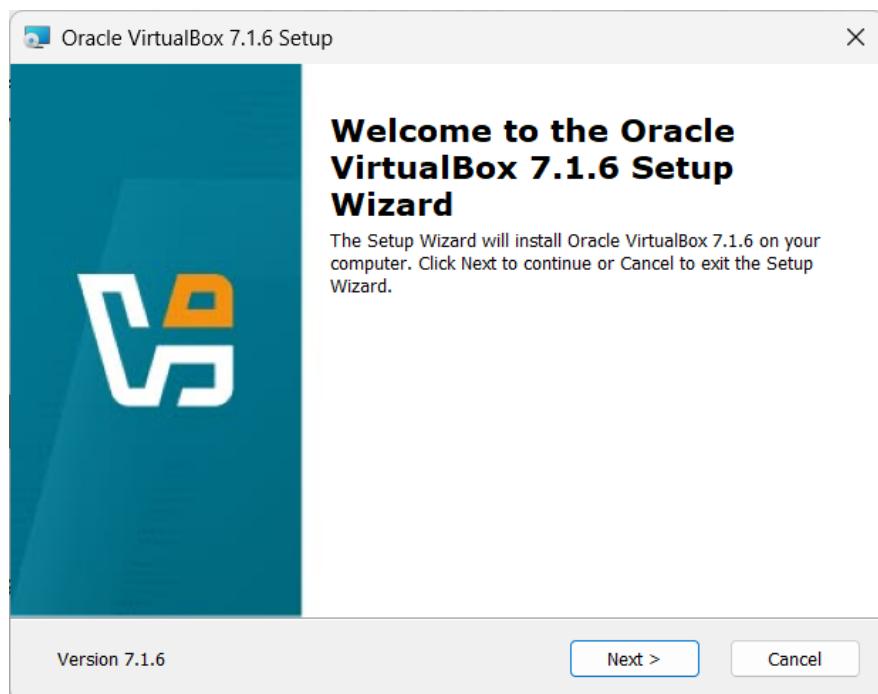
- **NAT Mode:** Network Address Translation allows (NAT) multiple devices to use the same public IP address and access the Internet. In order to give local hosts access to the Internet, Network Address Translation (NAT) converts one or more local IP addresses into one or more global IP addresses and vice versa. Also, it does port number translation, which involves masking the host's port number with a different port number in the packet that will be sent to the destination. After that, it updates the NAT database with the appropriate IP address and port number.
- **Bridged Adapter Mode:** A bridged network is the most permissive of all network connection types. It enables a virtual machine (VM) to connect to every actual machine on the network as well as to other VMs. Although a bridged network gives virtual machines (VMs) access to all networking features, it also drastically reduces security because, like an open physical network, VMs are vulnerable to networking flaws.

## **Procedure:**

Installing Oracle VirtualBox:

Download the Oracle Virtual Box setup file from the official website. And download a suitable Ubuntu (.iso) installation file or image file from the official website.

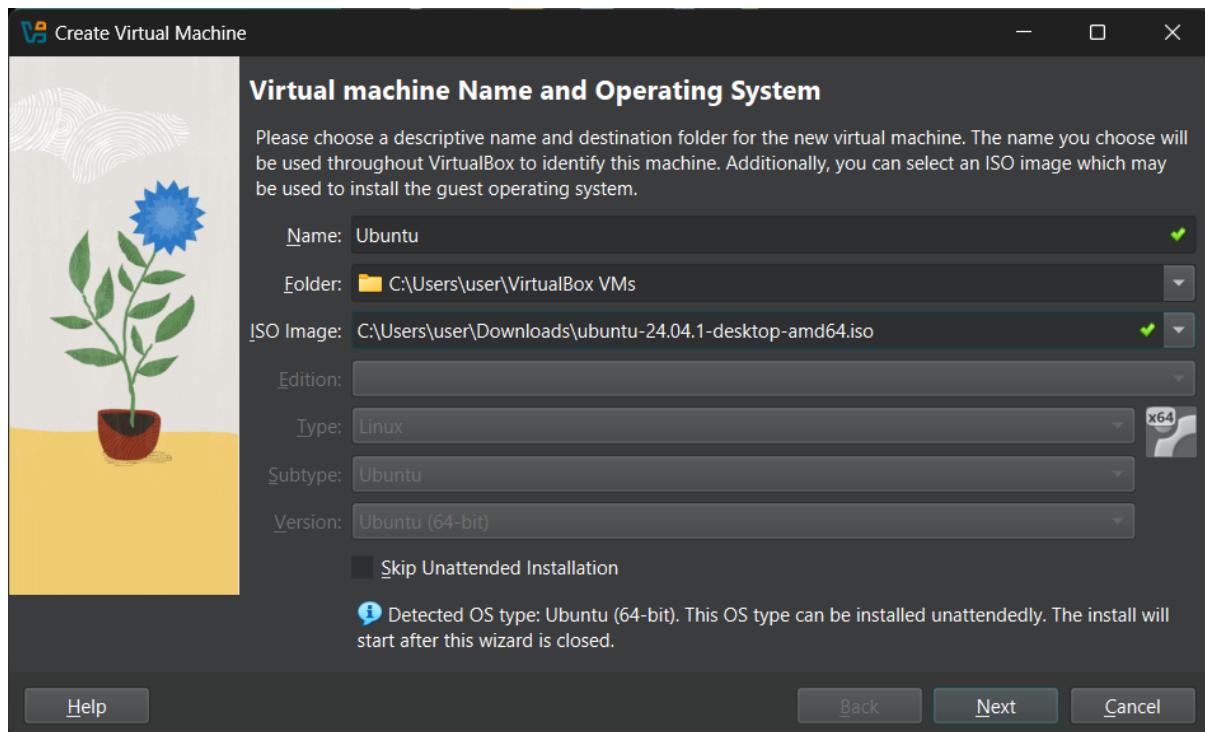
Step 1: Open the setup file and install VB



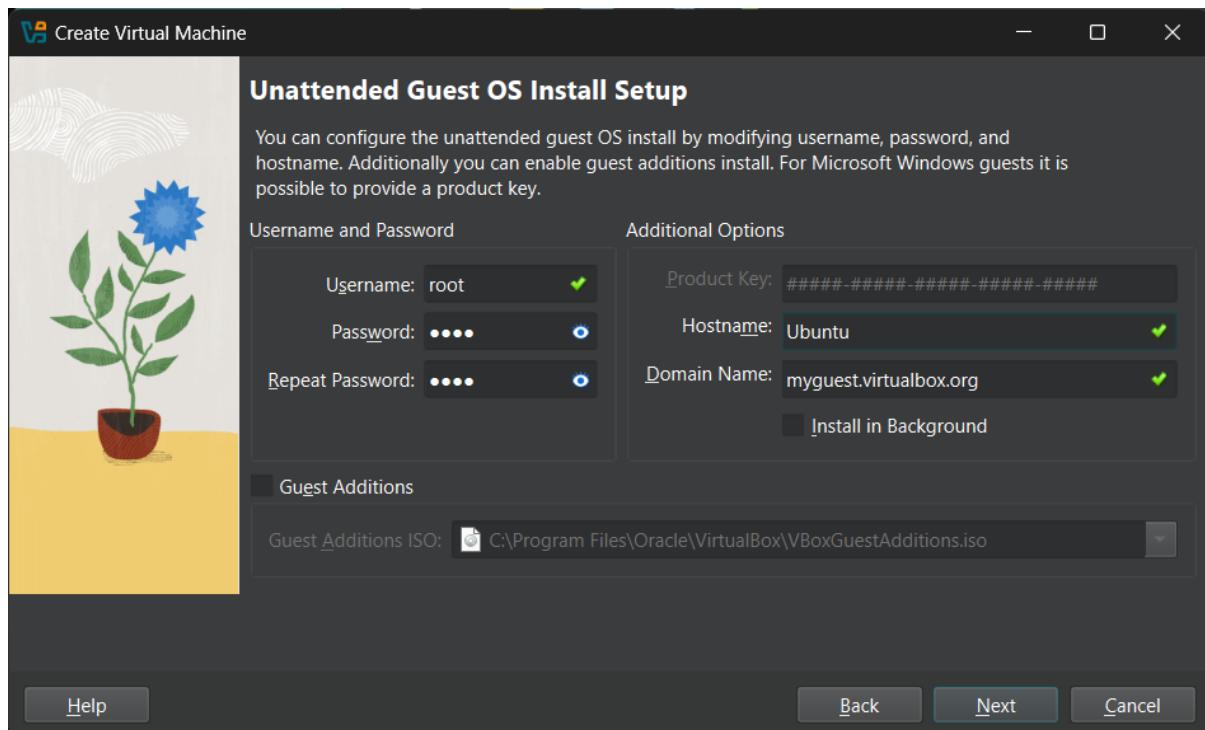
Step 2: After installing Oracle VirtualBox Machine Click on new.



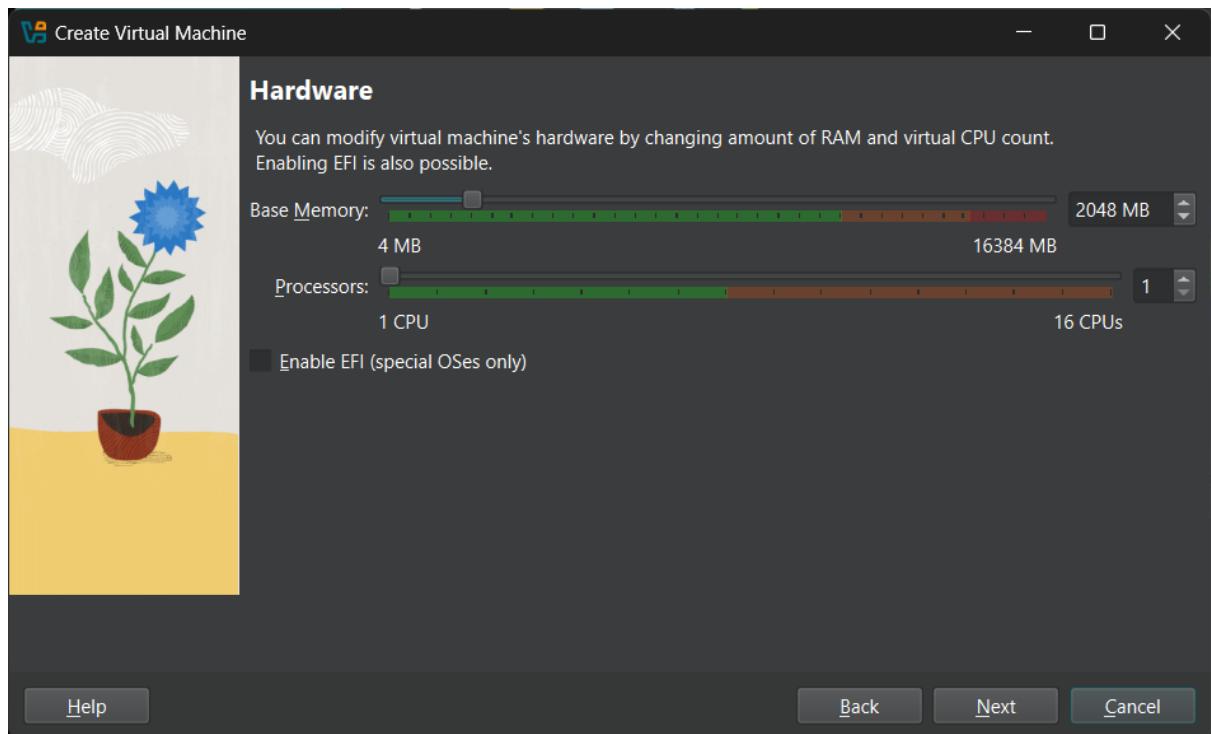
Step 3: Enter name, folder where you want you to install and the ISO image of ubuntu v24.04



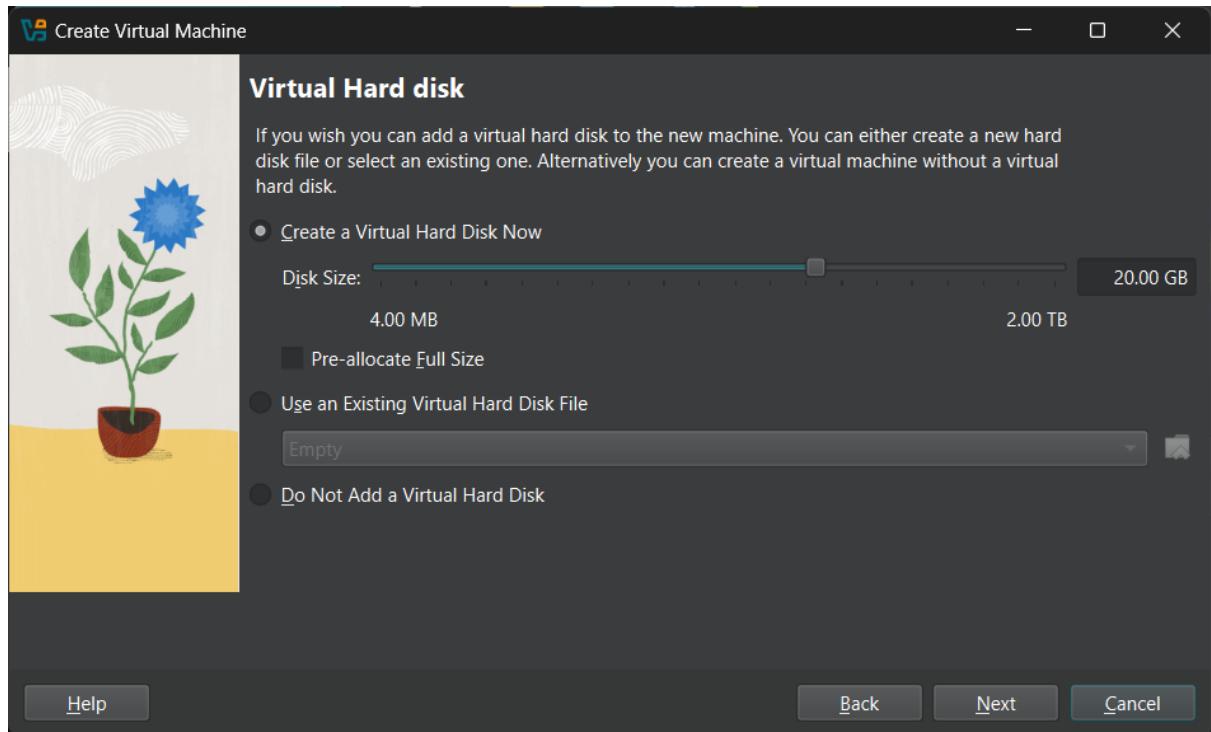
Step 4: Enter your Username and Password and the hostname



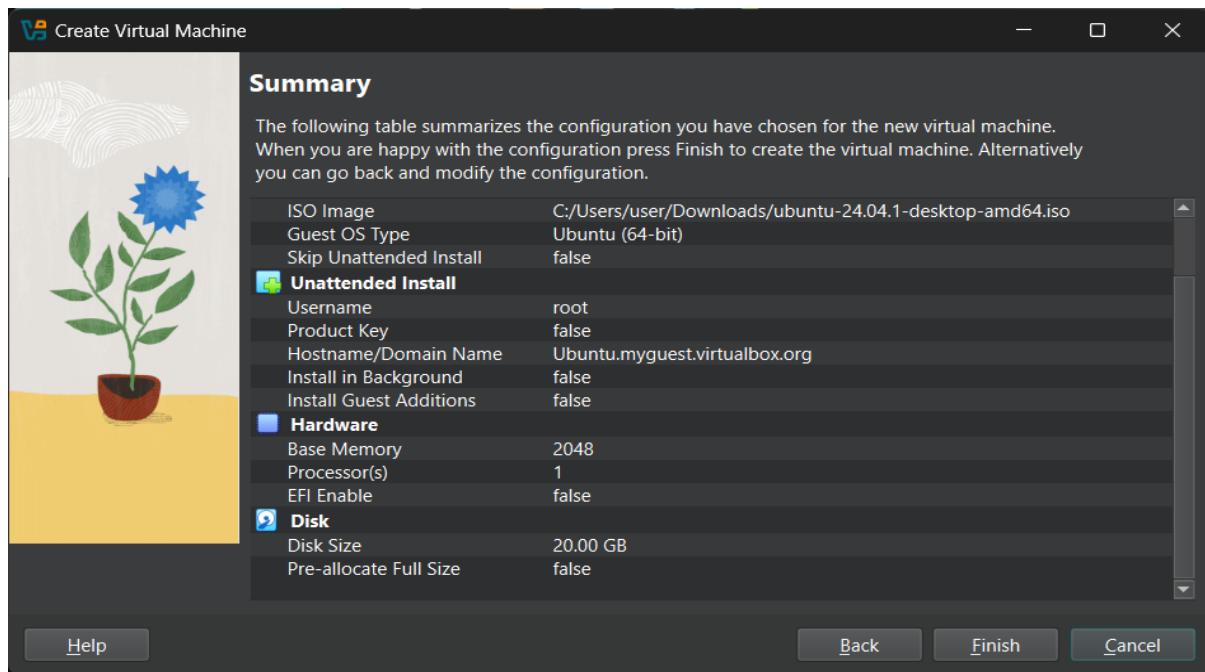
Step 5: Allocate RAM and virtual CPU count for your Virtual Machine.



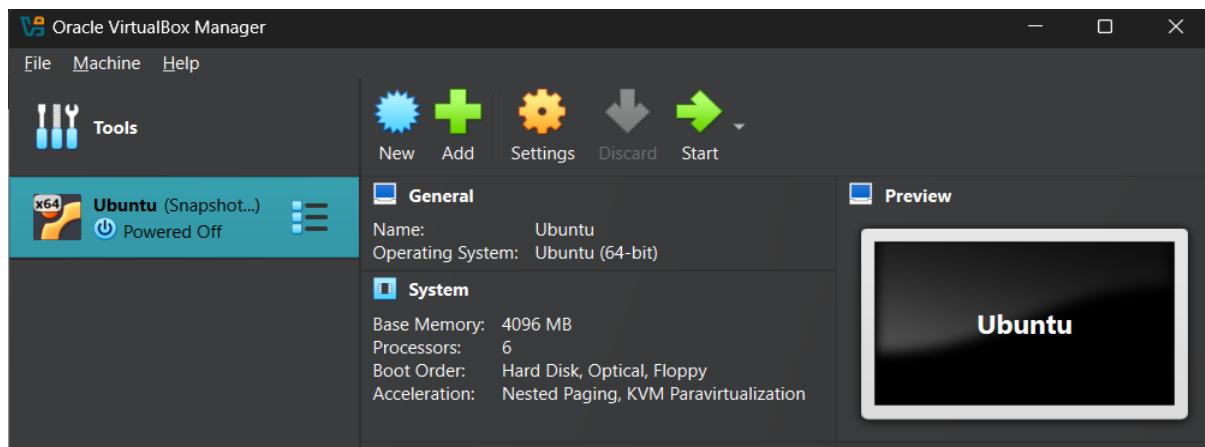
Step 6: Allocate space for you virtual hard disk.



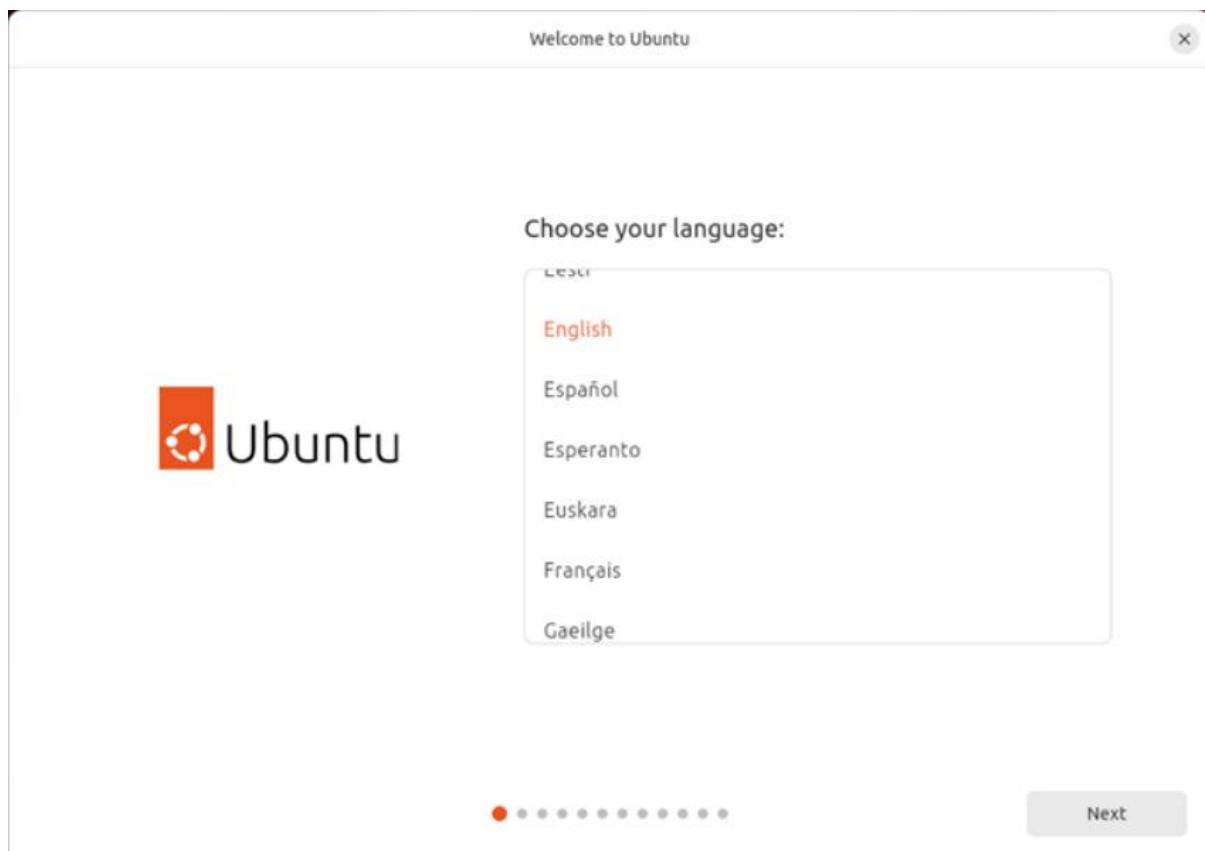
## Step 7: Finish to create your VM.



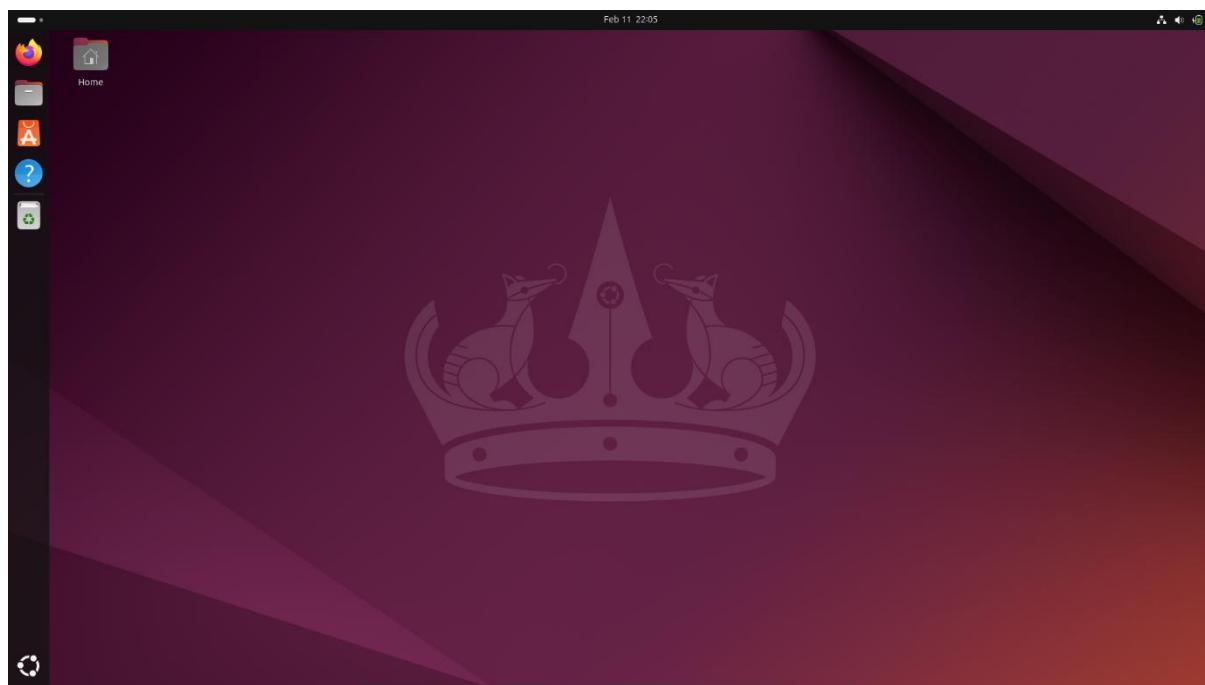
## Step 8: Start your vm.



Step 9: Ubuntu installation will begin.



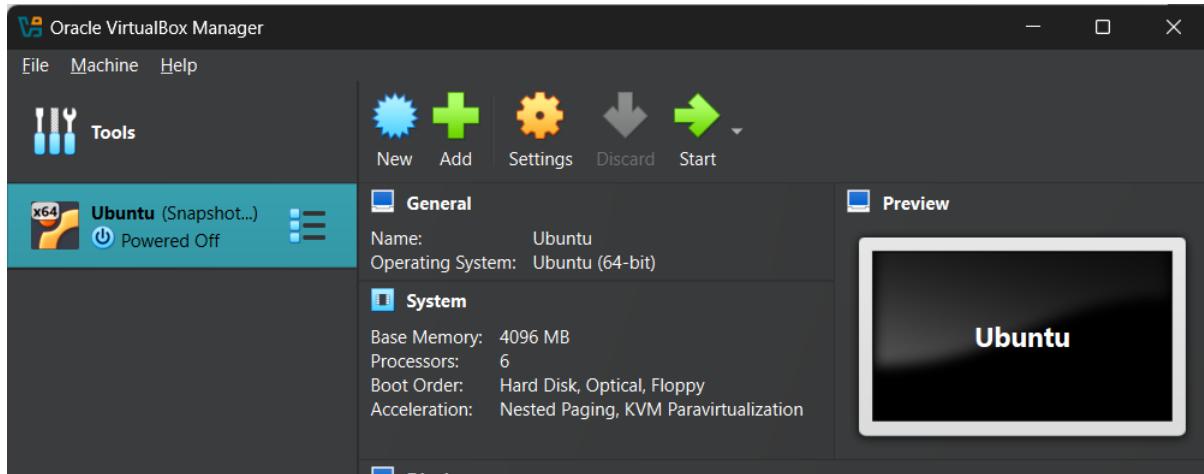
Step 10: Ubuntu is installed



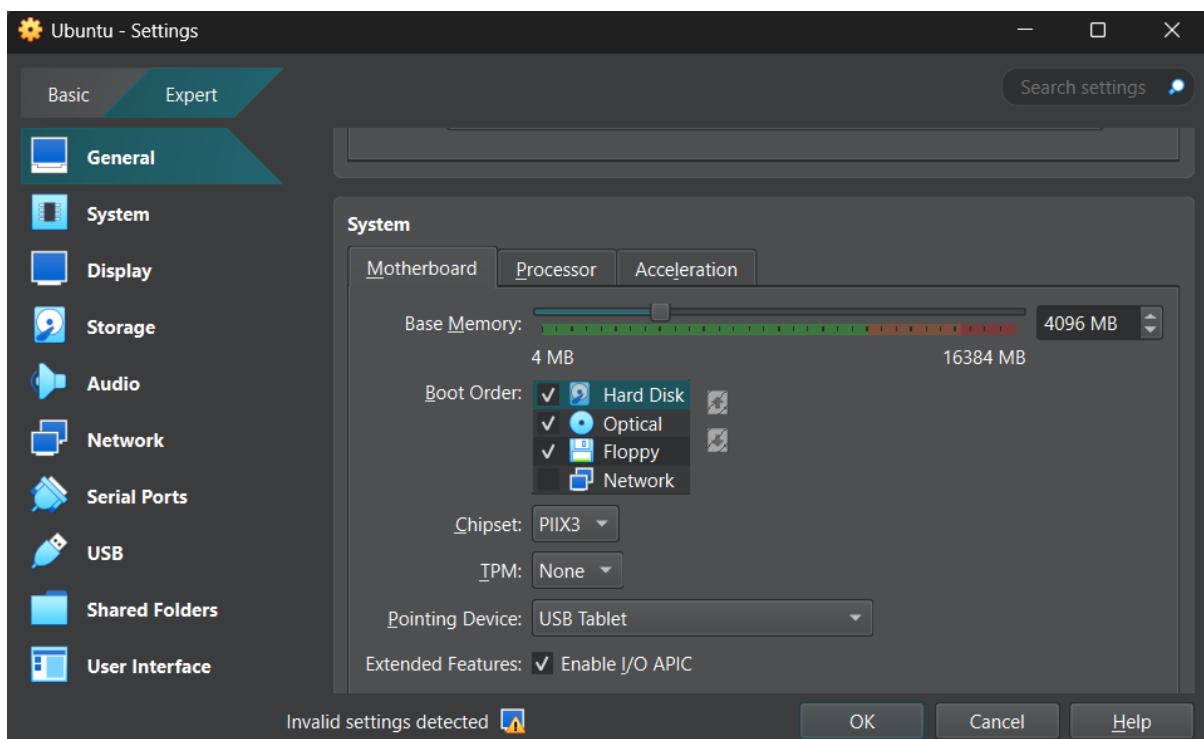
Altering the machine hardware:

To change the hardware provided to the guest machine we follow the following steps:

Step 1: Click on the Settings



Step 2: Under System you can change the system memory, Processor, etc.



## **Lab 2: Fundamentals of Using Virtual Machine**

### **Objectives:**

- To learn about Snapshots

### **Theory:**

**Snapshot:** Snapshot is a saved state of a virtual machine at a specific point in time and allows a user to restore the Virtual Machine to that state. You can go back to that state even if you've made significant changes to the virtual machine after then.

Benefits of snapshots:

**Efficient testing and Development:** Developers can't test software, configurations and scripts without worrying about breaking the system. If any failure occurs, we can restore the VM to its previous working state.

**Backup:** Snapshots are great for short-term backups before making significant changes allowing user to restore data in the event of data loss, corruption, or malware infection.

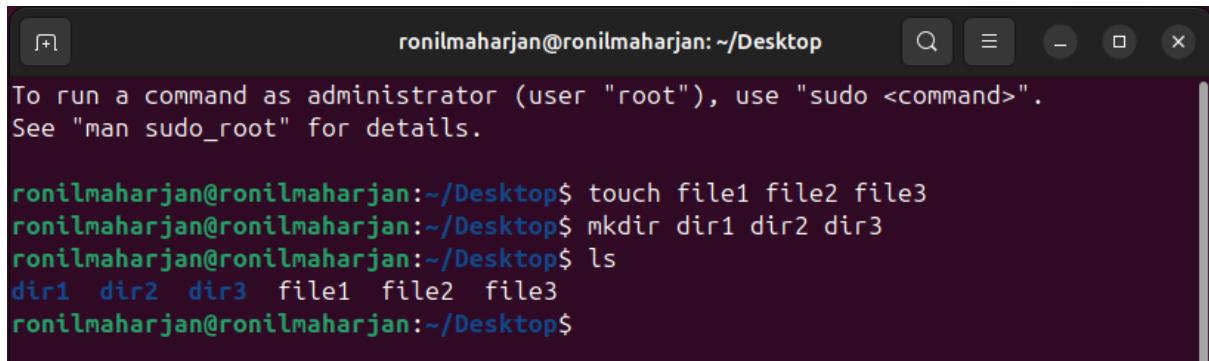
**Efficient Troubleshooting:** By enabling users to compare system states before and after changes, snapshots help identify and isolate problems that may occur throughout the change implementation process, facilitating effective troubleshooting and problem resolution.

**Enhanced Security:** Snapshot creation helps reduce security risks related to modifications that could introduce vulnerabilities or endanger data availability, confidentiality, or integrity by allowing users to return to a known good state.

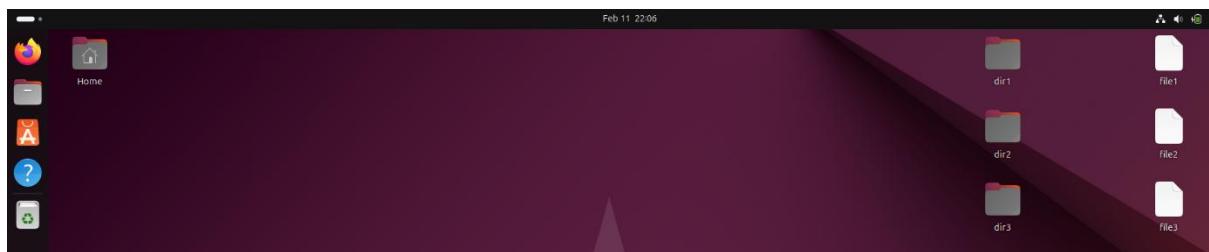
**Time and Cost Saving:** Creating snapshots reduces the effect of errors and the need for manual intervention in recovery operations, saving time and money that would otherwise be spent on data restoration and debugging.

Demonstration of Snapshot:

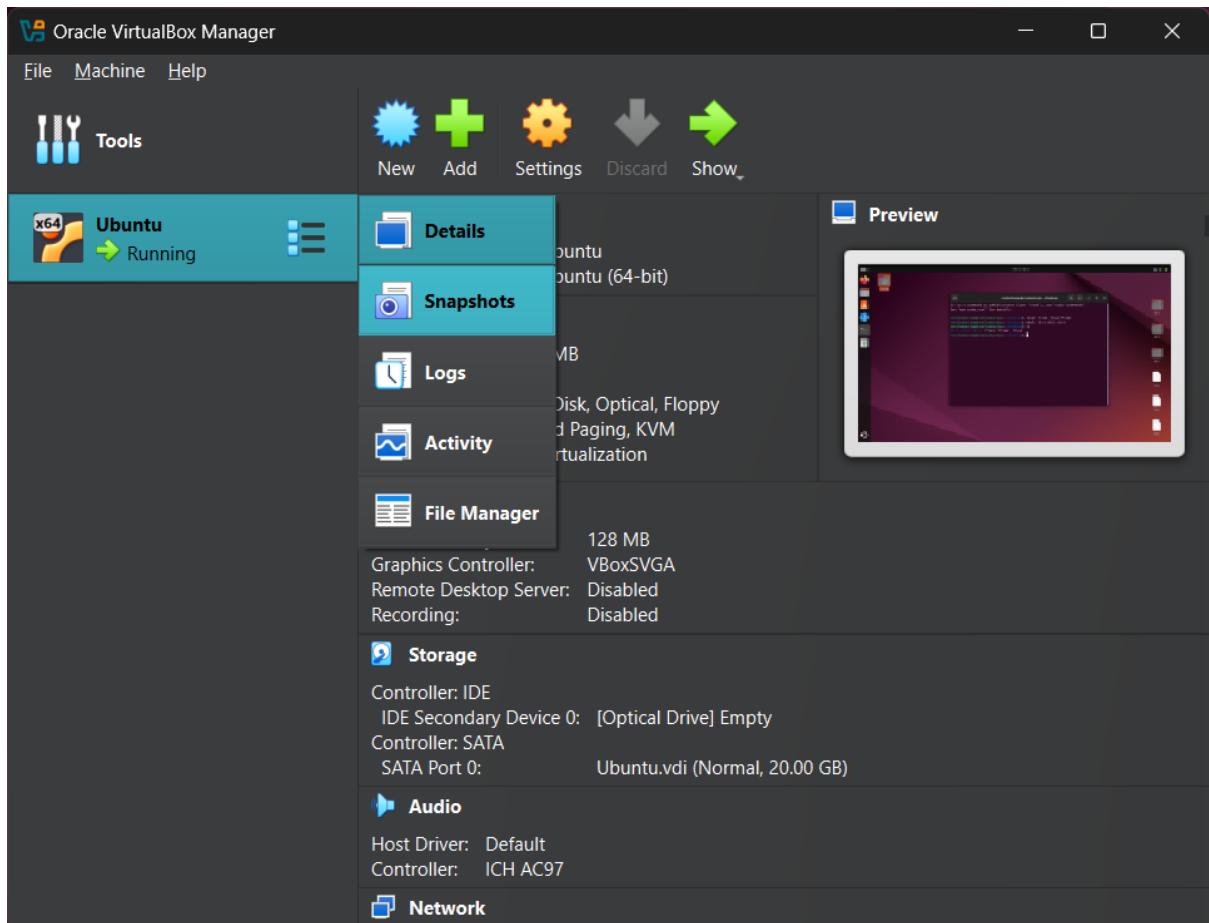
Creating files and folders in desktop.

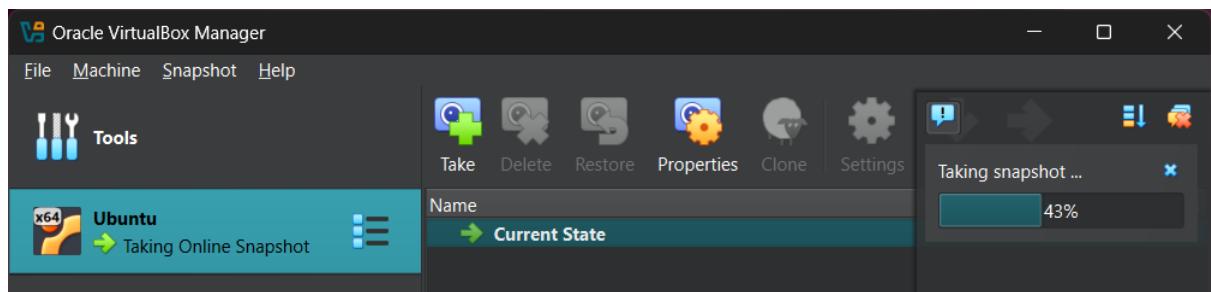
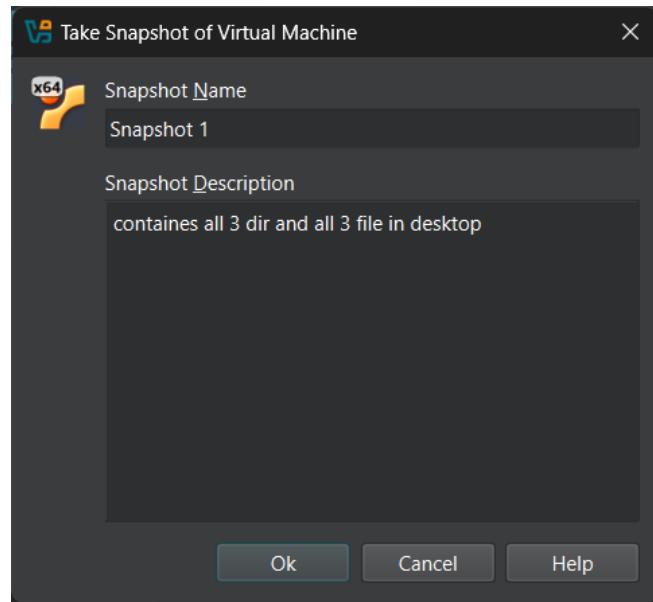


```
ronilmaharjan@ronilmaharjan:~/Desktop$ touch file1 file2 file3
ronilmaharjan@ronilmaharjan:~/Desktop$ mkdir dir1 dir2 dir3
ronilmaharjan@ronilmaharjan:~/Desktop$ ls
dir1 dir2 dir3 file1 file2 file3
ronilmaharjan@ronilmaharjan:~/Desktop$
```

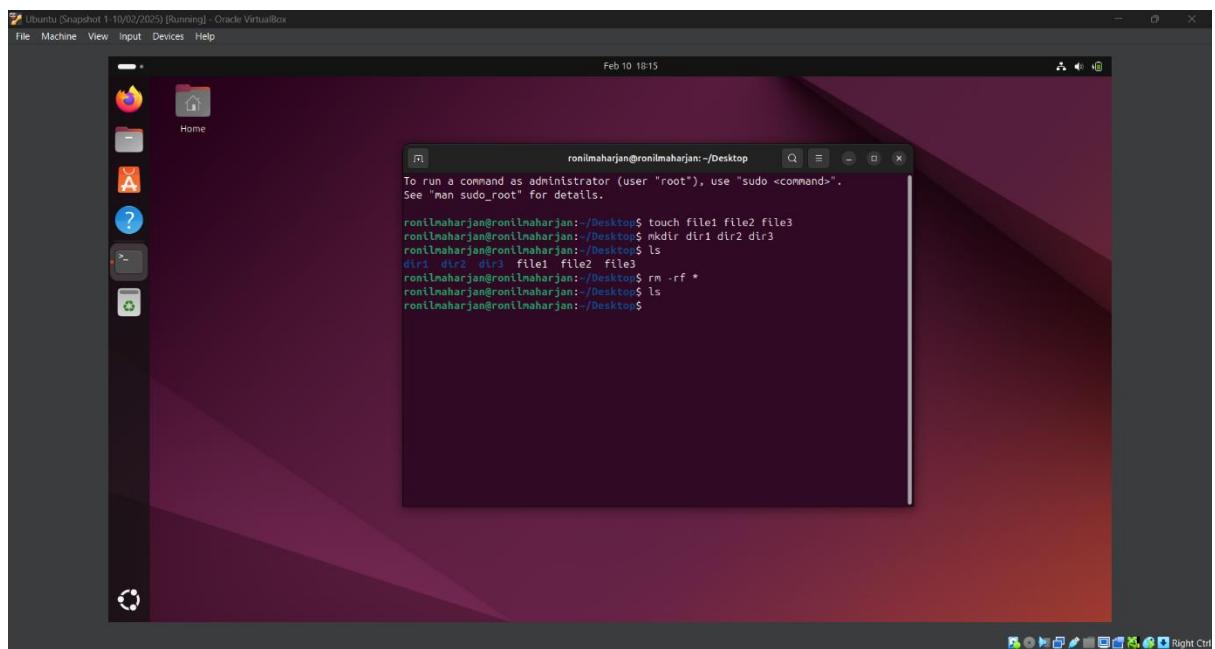


Creating the Snapshot:

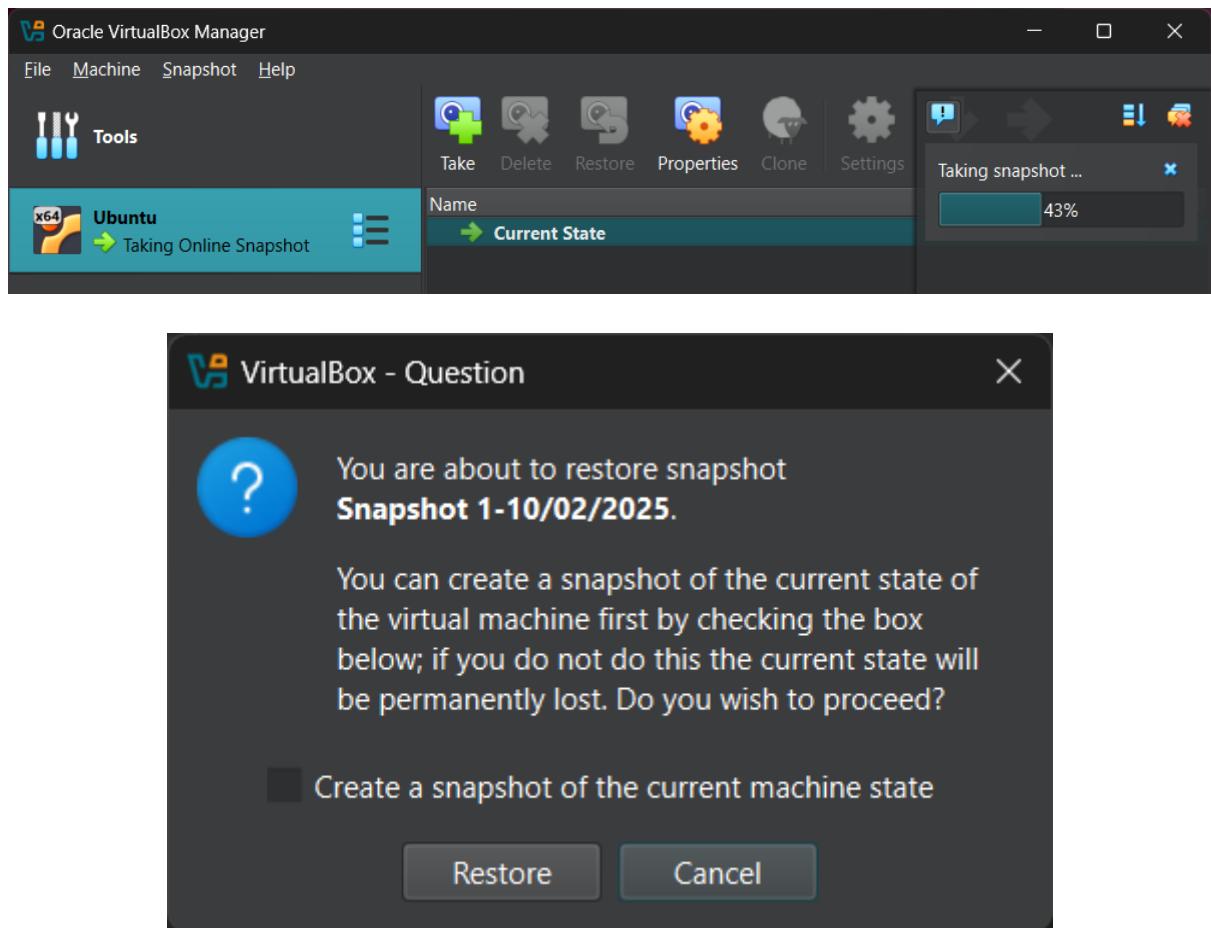




Deleting the files and folders in desktop:



Restoring the vm to previously created snapshot:



After restoring we can see that the deleted files have been restored as well

```
ronilmaharjan@ronilmaharjan:~/Desktop$ ls
dir1 dir2 dir3 file1 file2 file3
ronilmaharjan@ronilmaharjan:~/Desktop$
```

# Lab 3: Hosting a Static Webpage using Apache and Nginx.

## Objectives:

- To learn about hosting a static webpage using Apache and Nginx

## Theory:

**Apache:** Apache HTTP Server is a free and open-source web server that delivers web content through the internet. Apache is a web server software that is responsible for accepting HTTP requests from visitors and sending them back the requested information in the form of web pages.

**Nginx:** nginx ("engine x") is an HTTP web server, reverse proxy, content cache, load balancer, TCP/UDP proxy server, and mail proxy server. It is primarily made for optimal performance and stability and has HTTPS server capabilities. Additionally, it serves as a proxy server for email protocols like SMTP, POP3, and IMAP.

## Procedure:

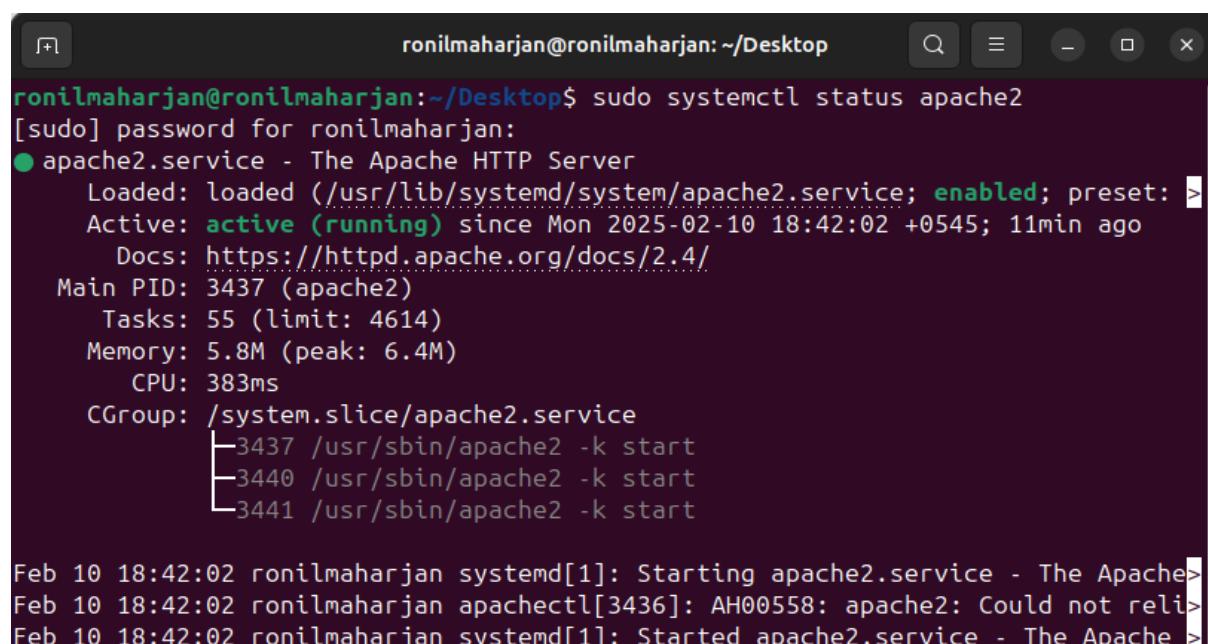
Apache:

We can install Apache server using the following command:

```
sudo apt install apache2
```

Then, checking if the server is running using the following command:

```
sudo systemctl status apache2
```



```
ronilmaharjan@ronilmaharjan:~/Desktop$ sudo systemctl status apache2
[sudo] password for ronilmaharjan:
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; preset: >
   Active: active (running) since Mon 2025-02-10 18:42:02 +0545; 11min ago
     Docs: https://httpd.apache.org/docs/2.4/
 Main PID: 3437 (apache2)
    Tasks: 55 (limit: 4614)
   Memory: 5.8M (peak: 6.4M)
      CPU: 383ms
     CGroup: /system.slice/apache2.service
             └─3437 /usr/sbin/apache2 -k start
                 ├─3440 /usr/sbin/apache2 -k start
                 ├─3441 /usr/sbin/apache2 -k start

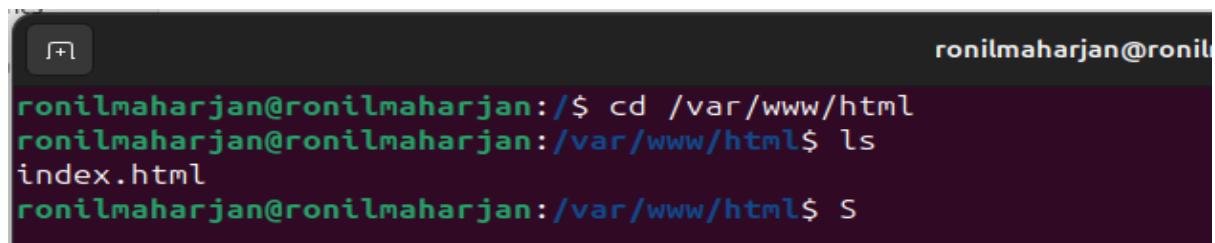
Feb 10 18:42:02 ronilmaharjan systemd[1]: Starting apache2.service - The Apache>
Feb 10 18:42:02 ronilmaharjan apachectl[3436]: AH00558: apache2: Could not reli>
Feb 10 18:42:02 ronilmaharjan systemd[1]: Started apache2.service - The Apache >
```

The apache server listens to port 80 we can view that using the following command:

```
sudo netstat -tulpn
```

```
ronilmaharjan@ronilmaharjan:~/Desktop$ sudo netstat -tulpn
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address          Foreign Address        State      PID/Program name
tcp     0      0 127.0.0.53:53            0.0.0.0:*              LISTEN    490/systemd-resolve
tcp     0      0 127.0.0.54:53            0.0.0.0:*              LISTEN    490/systemd-resolve
tcp     0      0 127.0.0.1:631           0.0.0.0:*              LISTEN    1006/cupsd
tcp6    0      0 :::80                  ::::*                 LISTEN    4463/apache2
tcp6    0      0 ::1:631                ::::*                 LISTEN    1006/cupsd
udp     0      0 127.0.0.54:53            0.0.0.0:*              LISTEN    490/systemd-resolve
udp     0      0 127.0.0.53:53            0.0.0.0:*              LISTEN    490/systemd-resolve
udp     0      0 0.0.0.0:5353            0.0.0.0:*              LISTEN    751/avahi-daemon: r
udp     0      0 0.0.0.0:54626           0.0.0.0:*              LISTEN    751/avahi-daemon: r
udp6    0      0 ::::43125              ::::*                 LISTEN    751/avahi-daemon: r
udp6    0      0 ::::5353               ::::*                 LISTEN    751/avahi-daemon: r
```

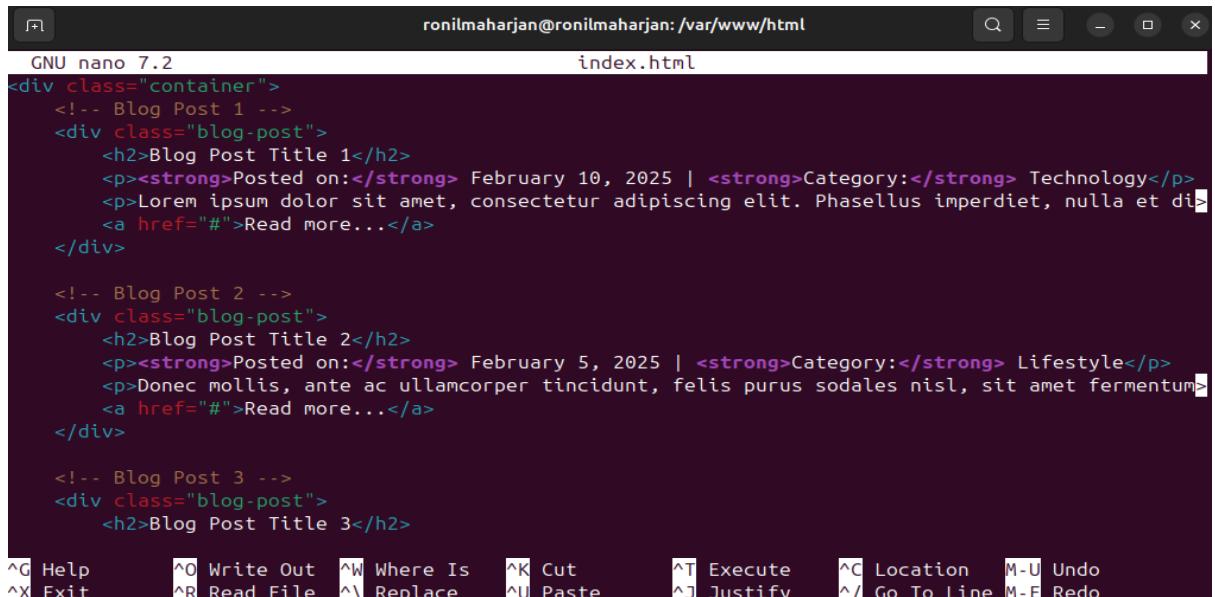
Creating a blog page:



```
ronilmaharjan@ronilmaharjan:~$ cd /var/www/html
ronilmaharjan@ronilmaharjan:/var/www/html$ ls
index.html
ronilmaharjan@ronilmaharjan:/var/www/html$ S
```

After running sudo nano index.html:

Here we code for the blog page.



```
GNU nano 7.2                                         index.html


## Blog Post 1



Posted on: February 10, 2025 | Category: Technology



Lorem ipsum dolor sit amet, consectetur adipiscing elit. Phasellus imperdiet, nulla et di

Read more...



## Blog Post 2



Posted on: February 5, 2025 | Category: Lifestyle



Donec mollis, ante ac ullamcorper tincidunt, felis purus sodales nisl, sit amet fermentum

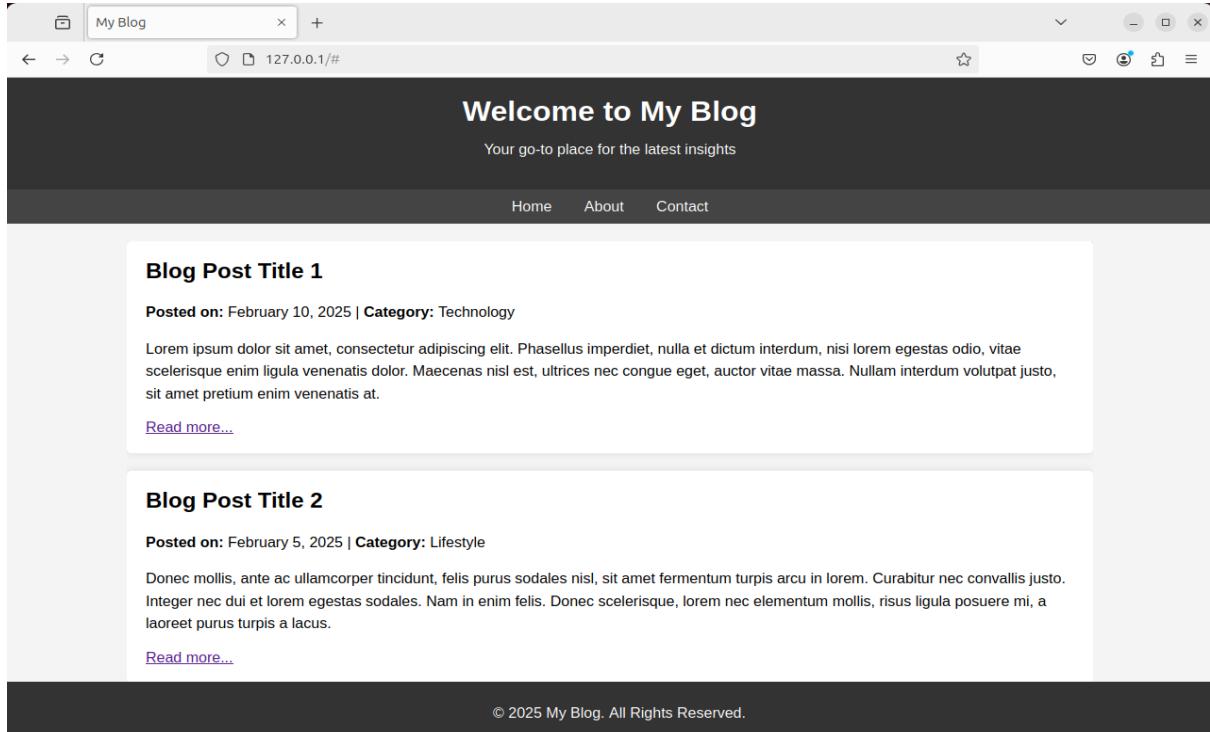
Read more...



## Blog Post 3


^G Help      ^O Write Out   ^W Where Is   ^K Cut       ^T Execute   ^C Location   M-U Undo
^X Exit      ^R Read File   ^\ Replace    ^U Paste     ^J Justify   ^/ Go To Line M-E Redo
```

Going to localhost in web browser we can see the blog page:



Nginx:

Installation of Nginx can be done using the following command:

```
sudo apt install nginx
```

The Nginx server by default also listens on port 80 we stop the Apache server. To stop the server, we run the following command:

```
sudo systemctl stop apache2
```

After running the command and checking the status we see inactive.

```
ronilmaharjan@ronilmaharjan:~/Desktop$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; preset: enabled)
   Active: inactive (dead) since Tue 2025-02-11 22:20:04 +0545; 16min ago
     Duration: 48.099s
       Docs: https://httpd.apache.org/docs/2.4/
    Main PID: 3604 (code=exited, status=0/SUCCESS)
      CPU: 89ms

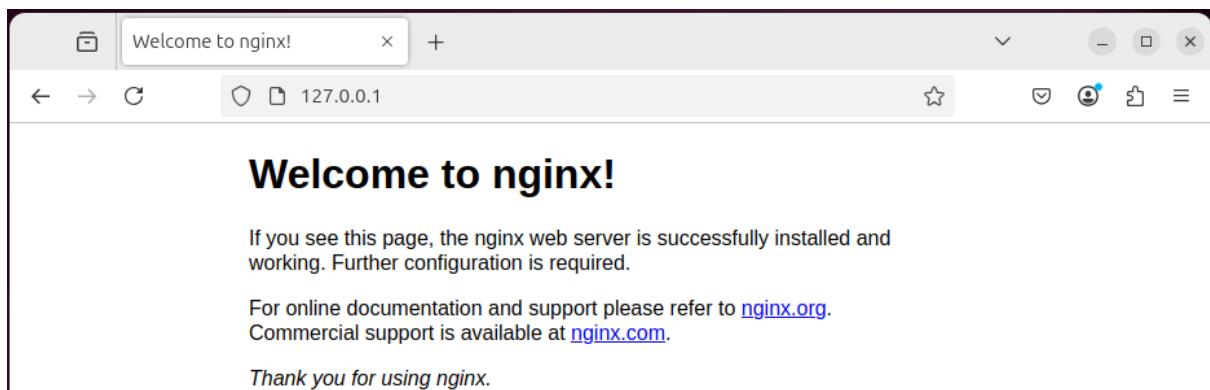
Feb 11 22:19:15 ronilmaharjan systemd[1]: Starting apache2.service - The Apache HTTP Server.>
Feb 11 22:19:15 ronilmaharjan apachectl[3603]: AH00558: apache2: Could not reliably determin>
Feb 11 22:19:15 ronilmaharjan systemd[1]: Started apache2.service - The Apache HTTP Server.
Feb 11 22:20:03 ronilmaharjan systemd[1]: Stopping apache2.service - The Apache HTTP Server.>
Feb 11 22:20:04 ronilmaharjan apachectl[3683]: AH00558: apache2: Could not reliably determin>
Feb 11 22:20:04 ronilmaharjan systemd[1]: apache2.service: Deactivated successfully.
Feb 11 22:20:04 ronilmaharjan systemd[1]: Stopped apache2.service - The Apache HTTP Server.
```

Then starting the nginx server:

```
ronilmaharjan@ronilmaharjan:~/Desktop$ sudo systemctl status nginx
● nginx.service - A high performance web server and a reverse proxy server
   Loaded: loaded (/usr/lib/systemd/system/nginx.service; enabled; preset: en>
   Active: active (running) since Wed 2025-02-12 18:59:15 +0545; 4min 34s ago
     Docs: man:nginx(8)
 Process: 1130 ExecStartPre=/usr/sbin/nginx -t -q -g daemon on; master_proce>
 Process: 1140 ExecStart=/usr/sbin/nginx -g daemon on; master_process on; (c>
 Main PID: 1146 (nginx)
    Tasks: 7 (limit: 4614)
   Memory: 6.4M (peak: 6.8M)
      CPU: 1.223s
     CGroup: /system.slice/nginx.service
             ├─1146 "nginx: master process /usr/sbin/nginx -g daemon on; master>
             ├─1147 "nginx: worker process"
             ├─1148 "nginx: worker process"
             ├─1149 "nginx: worker process"
             ├─1150 "nginx: worker process"
             ├─1151 "nginx: worker process"
             └─1159 "nginx: worker process"

Feb 12 18:59:14 ronilmaharjan systemd[1]: Starting nginx.service - A high perfo>
Feb 12 18:59:15 ronilmaharjan systemd[1]: Started nginx.service - A high perfor>
```

```
ronilmaharjan@ronilmaharjan:~/Desktop$ sudo netstat -tulpn
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address          Foreign Address        State      PID/Program name
tcp        0      0 127.0.0.54:53           0.0.0.0:*          LISTEN     496/systemd-resolve
tcp        0      0 127.0.0.53:53           0.0.0.0:*          LISTEN     496/systemd-resolve
tcp        0      0 127.0.0.1:631          0.0.0.0:*          LISTEN     1081/cupsd
tcp        0      0 0.0.0.0:80            0.0.0.0:*          LISTEN     1146/nginx: master
tcp6       0      0 ::1:631              ::*:*               LISTEN     1081/cupsd
tcp6       0      0 ::::80              ::*:*               LISTEN     1146/nginx: master
udp        0      0 127.0.0.54:53           0.0.0.0:*          LISTEN     496/systemd-resolve
udp        0      0 127.0.0.53:53           0.0.0.0:*          LISTEN     496/systemd-resolve
udp        0      0 0.0.0.0:56417          0.0.0.0:*          LISTEN     760/avahi-daemon: r
udp        0      0 0.0.0.0:5353           0.0.0.0:*          LISTEN     760/avahi-daemon: r
udp6       0      0 ::::33201            ::*:*               LISTEN     760/avahi-daemon: r
udp6       0      0 ::::5353             ::*:*               LISTEN     760/avahi-daemon: r
```



## **Lab 4: Build a static website in Azure ubuntu virtual machine.**

### **Objective:**

- To Customize your static website using Apache2 and nginx.

### **Theory:**

Cloud computing is the delivery of computing services over the internet which allows users to access resources like storage, databases, and software on-demand. Key features of cloud computing are: On-Demand Service, Broad Network Access, Cost Saving, Elasticity as resources scales based on the demand.

Its Service Models include:

- Infrastructure as a Service (IaaS): It provides virtualized computing resources (e.g., AWS EC2, Azure VMs).
- Platform as a Service (PaaS): It offers a platform for application development (e.g., Google App Engine, AWS Elastic Beanstalk).
- Software as a Service (SaaS): It provides software applications over the internet (e.g., Google Workspace, Microsoft 365).

Microsoft Azure is a cloud computing platform that offers services for building, managing, and deploying applications. It is one of the most widely used cloud computing platforms. Cloud services simplify complex infrastructure, making it easy for anyone to develop and scale applications globally. They provide access to the necessary IT resources for building and managing digital systems without the need for extensive technical expertise.

Some Challenges on cloud computing are:

- Security and Privacy Risks: Data is stored on third-party servers.
- Downtime: Service interruptions may impact operations.
- Limited Control: Users depend on cloud providers for infrastructure management.

## Procedure

Creating Virtual Machine in Azure:

Provide appropriate VM name and select a region:

The screenshot shows the 'Create a virtual machine' wizard on the 'Basics' tab. The URL is https://portal.azure.com/#create/Microsoft.VirtualMachine-ARM. The page title is 'Create a virtual machine - Microsoft Azure'. The 'Subscription' dropdown is set to 'Azure for Students' and the 'Resource group' dropdown is set to '(New) UbuntuAcademiaVM\_group'. The 'Virtual machine name' is 'UbuntuAcademiaVM', 'Region' is '(Asia Pacific) Central India', and 'Availability zone' is 'Self-selected zone'. The 'Zone options' section shows 'Zone 1' selected. A note says 'Using an Azure-selected zone is not supported in region 'Central India''. The 'Availability zone' note also says 'You can now select multiple zones. Selecting multiple zones will create one VM per zone.' Navigation buttons at the bottom include '< Previous', 'Next : Disks >', and 'Review + create'.

Select the Ubuntu Server 24.04 LTS – x64 Gen2

The screenshot shows the 'Create a virtual machine' wizard on the 'Basics' tab. The URL is https://portal.azure.com/#create/Microsoft.VirtualMachine-ARM. The page title is 'Create a virtual machine - Microsoft Azure'. The 'Availability zone' dropdown is set to 'Zone 1'. The 'Security type' dropdown is 'Trusted launch virtual machines'. The 'Image' dropdown is set to 'See all images | Configure VM generation'. The 'VM architecture' dropdown is set to 'x64'. The 'Size' dropdown is set to 'Standard\_B1s - 1 vcpu, 1 GiB memory (\$8.18/month) (free services eligible)'. The 'Enable Hibernation' checkbox is checked. The 'Administrator account' section shows 'Authentication type' as 'SSH public key' (selected). The 'Username' field is 'azureuser'. Navigation buttons at the bottom include '< Previous', 'Next : Disks >', and 'Review + create'.

Enter Username and select HTTP, HTTPS and SSH inbound ports.

The screenshot shows the 'Create a virtual machine' wizard on the Microsoft Azure portal. The current step is 'Inbound port rules'. Under 'SSH public key', 'azureuser' is selected as the username. Under 'Key pair name', 'UbuntuAcademiaVM\_key' is selected. In the 'Select inbound ports' dropdown, 'HTTP (80), HTTPS (443), SSH (22)' is chosen. A warning message states: '⚠️ This will allow all IP addresses to access your virtual machine. This is only recommended for testing. Use the Advanced controls in the Networking tab to create rules to limit inbound traffic to known IP addresses.' At the bottom, there are 'Previous', 'Next : Disks >', and 'Review + create' buttons.

Finally Review + create and Create the VM.

The screenshot shows the 'Create a virtual machine' wizard on the Microsoft Azure portal. The current step is 'Review + create'. A green bar at the top indicates 'Validation passed'. The 'Review + create' button is highlighted. Below it, the 'Price' section shows '1 X Standard B1s by Microsoft' and a price of '0.0112 USD/hr'. The 'TERMS' section contains legal agreement text. Under 'Name', 'Preferred e-mail address', and 'Preferred phone number', fields are filled with 'Ronil Maharjan', 'ronil077@academiacollege.edu.np', and '9841330436' respectively. A warning message states: '⚠️ You have set SSH port(s) open to the internet. This is only recommended for testing. If you want to change this setting, go back to Basics tab.' At the bottom, there are '< Previous', 'Next >', and 'Create' buttons.

Click Download Private key and create resource:



The screenshot shows the Azure portal with a deployment named 'CreateVm-canonical.ubuntu-24\_04-lts-server-20250218065600'. The status is 'Your deployment is complete'. Deployment details include a name, subscription ('Azure for Students'), and resource group ('UbuntuAcademiaVM\_group'). Next steps include auto-shutdown, monitoring, and running a script. On the right, there are promotional cards for Cost Management, Microsoft Defender for Cloud, Free Microsoft tutorials, and Work with an expert.

Click Connect to your VM to see the public ip:

The screenshot shows the Azure portal with a virtual machine named 'UbuntuAcademiaVM'. The 'Connect' button is highlighted. The 'Virtual machine' section shows details like computer name, operating system (Ubuntu 24.04), and agent status (Ready). The 'Networking' section shows a public IP address (10.0.0.4). Other tabs include 'Monitoring', 'Capabilities', 'Recommendations', and 'Tutorials'.

Open bash and look for the downloaded pem file:

```
user@LAPTOP-RR2D2RI2 MINGW64 ~/Downloads
$ ls -ltr
total 910974
-rw-r--r-- 1 user 197609      2494 Feb 18 07:03 UbuntuAcademiaVM_key.pem
```

Set file permissions so that only the owner of the file has read access using the following command:

```
user@LAPTOP-RR2D2RI2 MINGW64 ~/Downloads
$ chmod 400 UbuntuAcademiaVM_key.pem
```

Connect to a remote server, using the ssh command followed by the username and Public IP address:

```
user@LAPTOP-RR2D2RI2 MINGW64 ~/Downloads
$ ssh -i UbuntuAcademiaVM_key.pem azureuser@20.193.136.242
The authenticity of host '20.193.136.242 (20.193.136.242)' can't be established.
ED25519 key fingerprint is SHA256:VDrFWKX2BpDfSQYWy4Dktzk6TqRUNX//971/XuZxGwM.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? y
Please type 'yes', 'no' or the fingerprint: yes
Warning: Permanently added '20.193.136.242' (ED25519) to the list of known hosts
.
Welcome to Ubuntu 24.04.1 LTS (GNU/Linux 6.8.0-1021-azure x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/pro

System information as of Tue Feb 18 01:29:53 UTC 2025

  System load:  0.08           Processes:          109
  Usage of /:   5.4% of 28.02GB  Users logged in:     0
  Memory usage: 29%            IPv4 address for eth0: 10.0.0.4
  Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

azureuser@UbuntuAcademiaVM:~$ pwd
/home/azureuser
azureuser@UbuntuAcademiaVM:~$
```

To display information about file system disk space usage:

```
azureuser@UbuntuAcademiaVM:~$ df -H
Filesystem      Size  Used Avail Use% Mounted on
/dev/root       31G  1.9G   29G  7% /
tmpfs          442M     0  442M  0% /dev/shm
tmpfs          177M  1.1M  176M  1% /run
tmpfs          5.3M     0  5.3M  0% /run/lock
efivarfs       132k   36k   91k 29% /sys/firmware/efi/efivars
/dev/sda16      924M   62M  798M  8% /boot
/dev/sda15      110M   6.4M  104M  6% /boot/efi
/dev/sdb1       4.2G   29k  4.0G  1% /mnt
tmpfs          89M   13k   89M  1% /run/user/1000
azureuser@UbuntuAcademiaVM:~$
```

Installing the net-tools and Apache2:

```
azureuser@UbuntuAcademiaVM:~$ sudo apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu noble InRelease
Get:2 http://azure.archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Get:3 http://azure.archive.ubuntu.com/ubuntu noble-backports InRelease [126 kB]
Get:4 http://azure.archive.ubuntu.com/ubuntu noble-security InRelease [126 kB]
Get:5 http://azure.archive.ubuntu.com/ubuntu noble/universe amd64 Packages [15.0 MB]

azureuser@UbuntuAcademiaVM:~$ sudo apt install net-tools
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  net-tools
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 204 kB of archives.
After this operation, 811 kB of additional disk space will be used.
Get:1 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 net-tools amd64 2.10-0.1ubuntu4 [204 kB]
Fetched 204 kB in 0s (5684 kB/s)
Selecting previously unselected package net-tools.
(Reading database ... 67388 files and directories currently installed.)
Preparing to unpack .../net-tools_2.10-0.1ubuntu4_amd64.deb ...
Unpacking net-tools (2.10-0.1ubuntu4) ...

azureuser@UbuntuAcademiaVM:~$ sudo apt install apache2
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  apache2-bin apache2-data apache2-utils libapr1t64 libaprutil1-dbd-sqlite3 libaprutil1-ldap libaprutil1t64 liblua5.4-0 ssl-cert
Suggested packages:
  apache2-doc apache2-suexec-pristine | apache2-suexec-custom www-browser
The following NEW packages will be installed:
  apache2 apache2-bin apache2-data apache2-utils libapr1t64 libaprutil1-dbd-sqlite3 libaprutil1-ldap libaprutil1t64 liblua5.4-0 ssl-cert
0 upgraded, 10 newly installed, 0 to remove and 23 not upgraded.
Need to get 2084 kB of archives.
After this operation, 8094 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 libapr1t64 amd64 1.7.2-3.1ubuntu0.1 [108 kB]
Get:2 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 libaprutil1t64 amd64 1.6.3-1.1ubuntu7 [91.9 kB]
Get:3 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 libaprutil1-dbd-sqlite3 amd64 1.6.3-1.1ubuntu7 [11.2 kB]
Get:4 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 libaprutil1-ldap amd64 1.6.3-1.1ubuntu7 [9116 B]
Get:5 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 liblua5.4-0 amd64 5.4.6-3build2 [166 kB]
Get:6 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2-bin amd64 2.4.58-1ubuntu8.5 [1329 kB]
Get:7 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2-data all 2.4.58-1ubuntu8.5 [163 kB]
Get:8 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2-utils amd64 2.4.58-1ubuntu8.5 [97.1 kB]
Get:9 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 apache2 amd64 2.4.58-1ubuntu8.5 [90.2 kB]
Get:10 http://azure.archive.ubuntu.com/ubuntu noble/main amd64 ssl-cert all 1.1.2ubuntu1 [17.8 kB]
Fetched 2084 kB in 0s (25.4 MB/s)
Preconfiguring packages ...
Selecting previously unselected package libapr1t64:amd64.
(Reading database ... 67436 files and directories currently installed.)
Preparing to unpack .../0-libapr1t64_1.7.2-3.1ubuntu0.1_amd64.deb ...
Unpacking libapr1t64:amd64 (1.7.2-3.1ubuntu0.1) ...
Selecting previously unselected package libaprutil1t64:amd64.
Preparing to unpack .../1-libaprutil1t64_1.6.3-1.1ubuntu7_amd64.deb ...
Unpacking libaprutil1t64:amd64 (1.6.3-1.1ubuntu7) ...
Selecting previously unselected package libaprutil1-dbd-sqlite3:amd64.
Preparing to unpack .../2-libaprutil1-dbd-sqlite3_1.6.3-1.1ubuntu7_amd64.deb ...
Unpacking libaprutil1-dbd-sqlite3:amd64 (1.6.3-1.1ubuntu7) ...
Selecting previously unselected package libaprutil1-ldap:amd64.
Preparing to unpack .../3-libaprutil1-ldap_1.6.3-1.1ubuntu7_amd64.deb ...
```

## Checking the status of apache2:

```
azureuser@UbuntuAcademiaVM:/var/www/html$ sudo netstat -tnlp
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address          Foreign Address        State      PID/Program name
tcp      0      0 127.0.0.53:53           0.0.0.0:*            LISTEN     481/systemd-resolve
tcp      0      0 127.0.0.54:53           0.0.0.0:*            LISTEN     481/systemd-resolve
tcp6     0      0 :::22                 :::*                  LISTEN     1/init
tcp6     0      0 :::80                 :::*                  LISTEN     2844/apache2
azureuser@UbuntuAcademiaVM:/var/www/html$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; preset: enabled)
   Active: active (running) since Tue 2025-02-18 01:33:59 UTC; 1min 57s ago
     Docs: https://httpd.apache.org/docs/2.4/
   Main PID: 2844 (apache2)
      Tasks: 55 (limit: 1004)
     Memory: 5.8M (peak: 6.1M)
        CPU: 39ms
      CGroup: /system.slice/apache2.service
              └─2844 /usr/sbin/apache2 -k start
                  ├─2847 /usr/sbin/apache2 -k start
                  ├─2848 /usr/sbin/apache2 -k start
                  └─2849 /usr/sbin/apache2 -k start

Feb 18 01:33:59 UbuntuAcademiaVM systemd[1]: Starting apache2.service - The Apache HTTP Server...
Feb 18 01:33:59 UbuntuAcademiaVM systemd[1]: Started apache2.service - The Apache HTTP Server.
```

## Creating index.html static page:

```
az user@UbuntuAcademiaVM: /var/www/html
GNU nano 7.2
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<title>John Doe - Portfolio</title>
<style>
* {
    margin: 0;
    padding: 0;
    box-sizing: border-box;
    font-family: 'Arial', sans-serif;
}

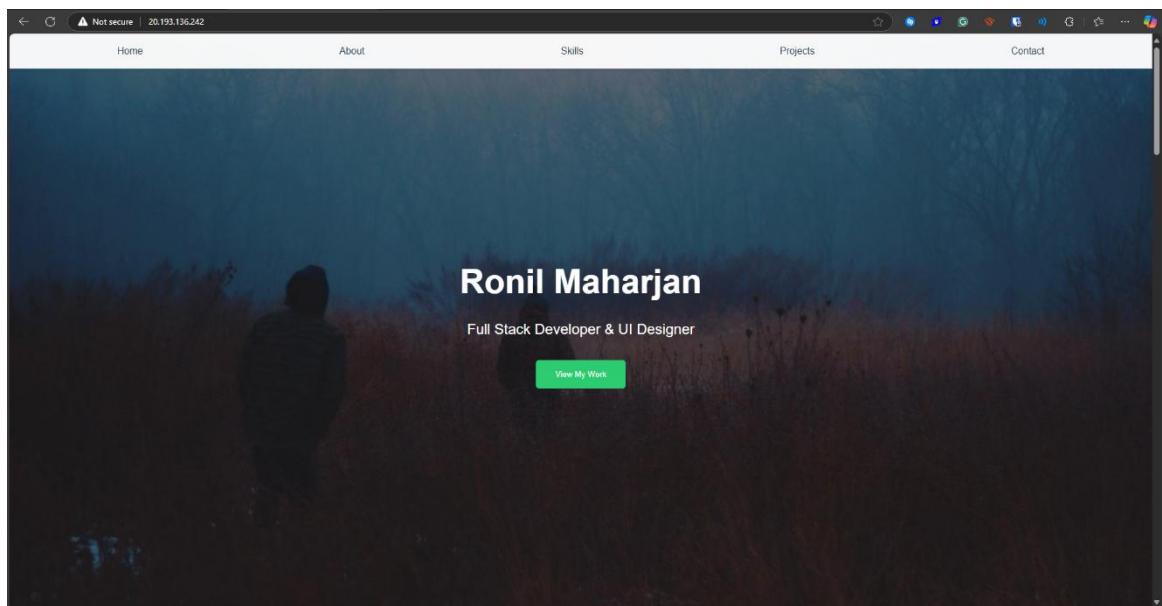
:root {
    --primary-color: #2ecc71;
    --secondary-color: #27ae60;
    --dark-color: #2c3e50;
    --light-color: #ecf0f1;
}

html {
    scroll-behavior: smooth;
}

body {
    line-height: 1.6;
    color: var(--dark-color);
}

/* Navigation */
.navbar {
    position: fixed;
    top: 0;
    width: 100%;
    background-color: rgba(255, 255, 255, 0.95);
    padding: 1rem;
    box-shadow: 0 2px 5px rgba(0,0,0,0.1);
    z-index: 1000;
}
```

Visiting the public ip address in the web browser we can see:



In Nginx:

Installing nginx:

```
azureuser@UbuntuAcademiaVM: ~
azureuser@UbuntuAcademiaVM:~$ sudo apt install nginx
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  nginx-common
Suggested packages:
  fcgiwrap nginx-doc
The following NEW packages will be installed:
  nginx nginx-common
0 upgraded, 2 newly installed, 0 to remove and 23 not upgraded.
Need to get 552 kB of archives.
After this operation, 1596 kB of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 nginx-comm
on all 1.24.0-2ubuntu7.1 [31.2 kB]
Get:2 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 nginx amd6
4 1.24.0-2ubuntu7.1 [521 kB]
Fetched 552 kB in 0s (8360 kB/s)
Preconfiguring packages ...
Selecting previously unselected package nginx-common.
(Reading database ... 68159 files and directories currently installed.)
Preparing to unpack .../nginx-common_1.24.0-2ubuntu7.1_all.deb ...
Unpacking nginx-common (1.24.0-2ubuntu7.1) ...
```

```
azureuser@UbuntuAcademiaVM: ~
No VM guests are running outdated hypervisor (qemu) binaries on this host.
azureuser@UbuntuAcademiaVM:~$ sudo systemctl status nginx
sudo systemctl: command not found
azureuser@UbuntuAcademiaVM:~$ sudo systemctl status nginx
✖ nginx.service - A high performance web server and a reverse proxy server
  Loaded: loaded (/usr/lib/systemd/system/nginx.service; enabled; preset: en>
  Active: failed (Result: exit-code) since Thu 2025-03-06 06:21:02 UTC; 3min>
    Docs: man:nginx(8)
 Process: 1570 ExecStartPre=/usr/sbin/nginx -t -q -g daemon on; master_proce>
 Process: 1573 ExecStart=/usr/sbin/nginx -g daemon on; master_process on; (C>
   CPU: 9ms

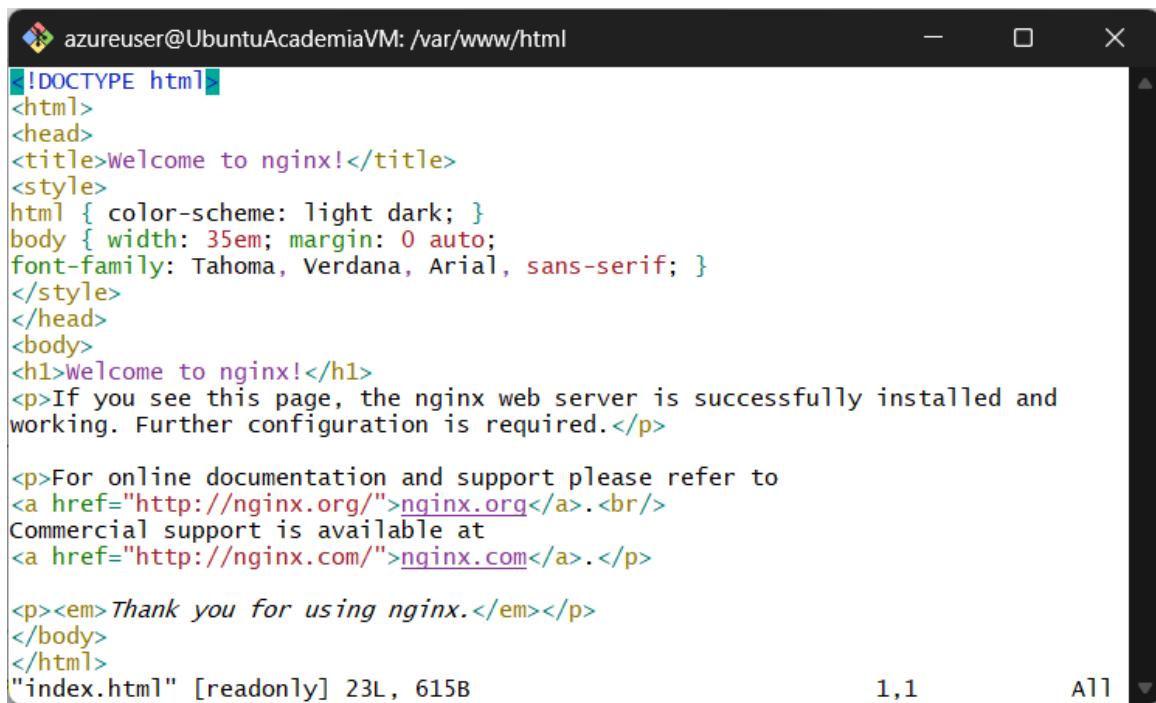
Mar 06 06:21:01 UbuntuAcademiaVM nginx[1573]: nginx: [emerg] bind() to 0.0.0.0:>
Mar 06 06:21:01 UbuntuAcademiaVM nginx[1573]: nginx: [emerg] bind() to [::]:80 >
Mar 06 06:21:01 UbuntuAcademiaVM nginx[1573]: nginx: [emerg] bind() to 0.0.0.0:>
Mar 06 06:21:01 UbuntuAcademiaVM nginx[1573]: nginx: [emerg] bind() to [::]:80 >
Mar 06 06:21:02 UbuntuAcademiaVM nginx[1573]: nginx: [emerg] bind() to 0.0.0.0:>
Mar 06 06:21:02 UbuntuAcademiaVM nginx[1573]: nginx: [emerg] bind() to [::]:80 >
Mar 06 06:21:02 UbuntuAcademiaVM nginx[1573]: nginx: [emerg] still could not bi>
Mar 06 06:21:02 UbuntuAcademiaVM systemd[1]: nginx.service: Control process exit>
Mar 06 06:21:02 UbuntuAcademiaVM systemd[1]: nginx.service: Failed with result >
Mar 06 06:21:02 UbuntuAcademiaVM systemd[1]: Failed to start nginx.service - A >
Lines 1-18/18 (END)
```

Stopping apache2 and starting nginx:

```
azureuser@UbuntuAcademiaVM: ~
azureuser@UbuntuAcademiaVM:~$ sudo systemctl stop apache2
azureuser@UbuntuAcademiaVM:~$ sudo systemctl start nginx
azureuser@UbuntuAcademiaVM:~$ sudo systemctl status nginx
● nginx.service - A high performance web server and a reverse proxy server
  Loaded: loaded (/usr/lib/systemd/system/nginx.service; enabled; preset: en>
  Active: active (running) since Thu 2025-03-06 06:27:58 UTC; 1min 9s ago
    Docs: man:nginx(8)
 Process: 1726 ExecStartPre=/usr/sbin/nginx -t -q -g daemon on; master_proce>
 Process: 1728 ExecStart=/usr/sbin/nginx -g daemon on; master_process on; (C>
 Main PID: 1729 (nginx)
   Tasks: 2 (limit: 1004)
   Memory: 1.7M (peak: 1.9M)
     CPU: 10ms
   CGroup: /system.slice/nginx.service
           └─1729 "nginx: master process /usr/sbin/nginx -g daemon on; master>
             ├─1730 "nginx: worker process"

Mar 06 06:27:58 UbuntuAcademiaVM systemd[1]: Starting nginx.service - A high pe>
Mar 06 06:27:58 UbuntuAcademiaVM systemd[1]: Started nginx.service - A high per>
Lines 1-16/16 (END)
```

## Default html of nginx

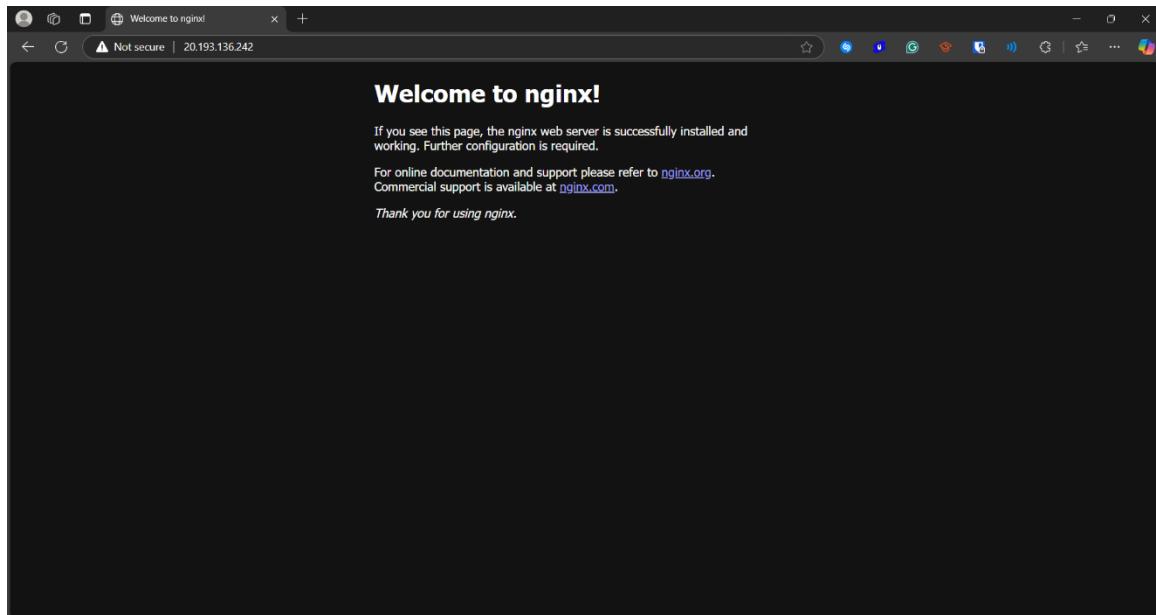


```
azureuser@UbuntuAcademiaVM: /var/www/html
!DOCTYPE html
<html>
<head>
<title>Welcome to nginx!</title>
<style>
html { color-scheme: light dark; }
body { width: 35em; margin: 0 auto;
font-family: Tahoma, Verdana, Arial, sans-serif; }
</style>
</head>
<body>
<h1>Welcome to nginx!</h1>
<p>If you see this page, the nginx web server is successfully installed and
working. Further configuration is required.</p>

<p>For online documentation and support please refer to
<a href="http://nginx.org/">nginx.org</a>.<br/>
Commercial support is available at
<a href="http://nginx.com/">nginx.com</a>.</p>

<p><em>Thank you for using nginx.</em></p>
</body>
</html>
"index.html" [readonly] 23L, 615B
```

Static site using nginx:



## **Lab 5: Build a static website in Azure windows Virtual Machine.**

### **Objective:**

- To customize static website using IIS in Windows VM

### **Theory:**

An Azure Virtual Machine (VM) is a flexible cloud-based computing resource that allows users to run applications and services as needed. Windows-based VMs in Azure, allows users have full control to set up and manage various services, including Internet Information Services (IIS), making it easy to host and customize websites or applications on a Windows Server or Windows OS.

#### Internet Information Services (IIS):

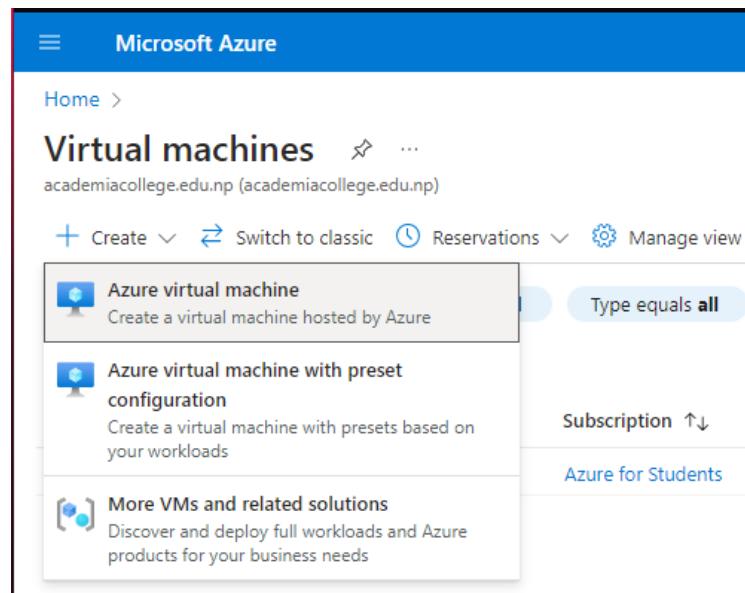
It is a flexible, general-purpose web server from Microsoft that runs on Windows systems to serve requested HTML pages or files. A web server can deliver information to users in several forms, such as static webpages coded in HTML; through file exchanges as downloads and uploads; and text documents, image files, etc. IIS can be installed using PowerShell commands or through the "Add Roles and Features" section in Server Manager.

#### Remote Desktop Protocol:

The Remote Desktop Protocol (RDP) is a protocol, or technical standard, for using a desktop computer remotely. It was initially released by Microsoft and is available for most Windows operating systems, but it can be used with MacOS as well. RDP allows users to connect to an Azure Virtual Machine from their local device.

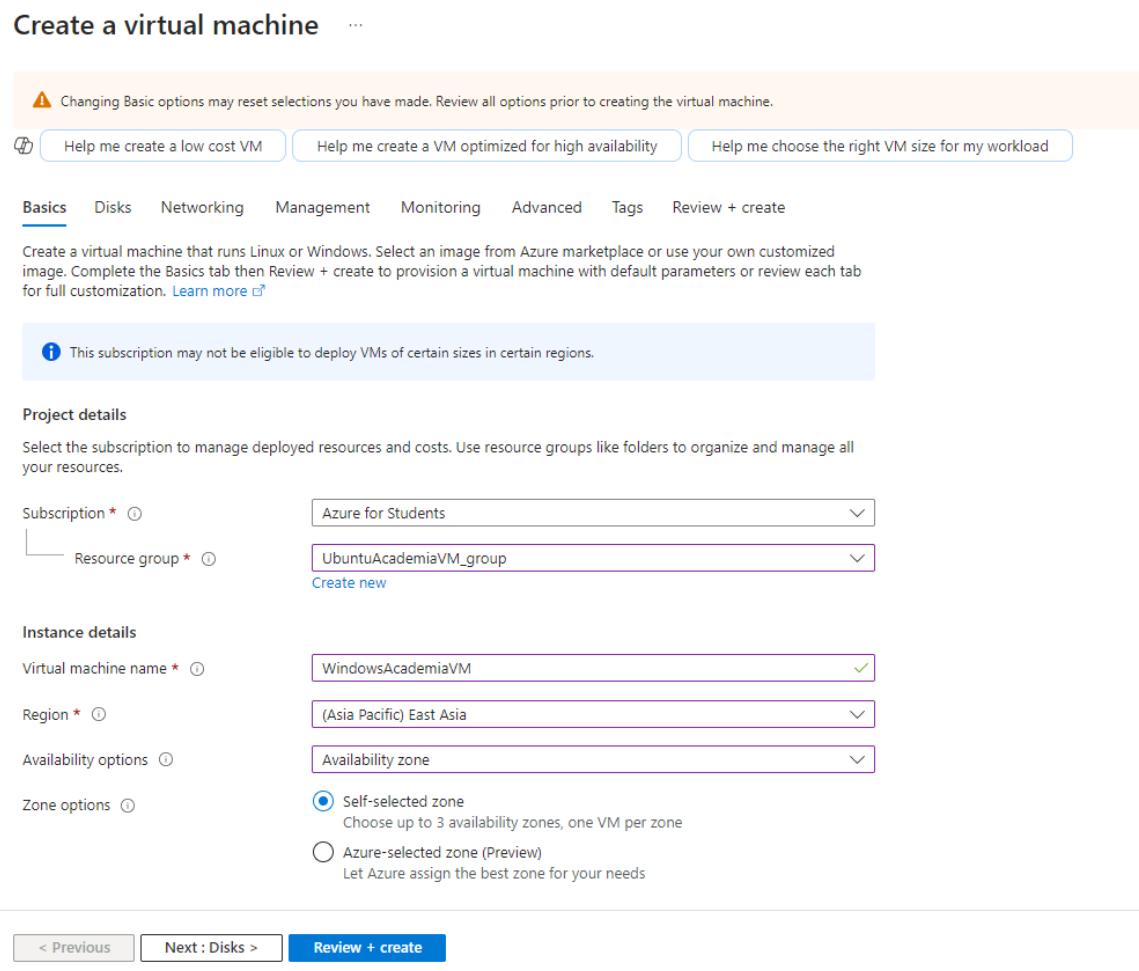
## Procedure:

Creating a new VM:



The screenshot shows the Microsoft Azure portal's 'Virtual machines' section. At the top, there are navigation links: 'Home >', 'Virtual machines', and a search bar containing 'academiacollege.edu.np (academiacollege.edu.np)'. Below these are several buttons: '+ Create' (highlighted with a red box), 'Switch to classic', 'Reservations', and 'Manage view'. A dropdown menu is open under '+ Create', listing three options: 'Azure virtual machine' (selected and highlighted with a red box), 'Azure virtual machine with preset configuration', and 'More VMs and related solutions'. To the right of the dropdown, a filter 'Type equals all' is shown. On the right side of the main area, there are filters for 'Subscription' (set to 'Azure for Students') and 'Azure for Students'.

Name the virtual machine and select a region:



The screenshot shows the 'Create a virtual machine' wizard on the 'Basics' tab. At the top, a warning message says: '⚠️ Changing Basic options may reset selections you have made. Review all options prior to creating the virtual machine.' Below it are three buttons: 'Help me create a low cost VM', 'Help me create a VM optimized for high availability', and 'Help me choose the right VM size for my workload'. The 'Basics' tab is selected. The main content area says: 'Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization. [Learn more](#)'.

**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 \*  [Create new](#)

**Instance details**

Virtual machine name \*  Region \*  Availability options

Zone options  Self-selected zone  
Choose up to 3 availability zones, one VM per zone  
 Azure-selected zone (Preview)  
Let Azure assign the best zone for your needs

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

Select the windows server 2022 Datacenter:Azure Edition -x64 Gen2 Image and select appropriate size (Standard\_DS1\_v2).

#### Create a virtual machine ...

⚠ Changing Basic options may reset selections you have made. Review all options prior to creating the virtual machine.

Help me create a low cost VM     Help me create a VM optimized for high availability     Help me choose the right VM size for my workload

Availability zone \* ⓘ    Zone 1  
You can now select multiple zones. Selecting multiple zones will create one VM per zone. [Learn more ⓘ](#)

Security type ⓘ    Trusted launch virtual machines  
[Configure security features](#)  
Trusted launch virtual machine is required when using 1P Gallery images.

Image \* ⓘ    Windows Server 2022 Datacenter: Azure Edition - x64 Gen2  
[See all images](#) | [Configure VM generation](#)

VM architecture ⓘ     Arm64     x64  
Arm64 is not supported with the selected image.

Run with Azure Spot discount ⓘ   

Size \* ⓘ    Standard\_DS1\_v2 - 1 vcpu, 3.5 GiB memory (US\$121.91/month)  
[See all sizes](#)

Enable Hibernation ⓘ      
Hibernate is not supported by the size that you have selected. Choose a size that is compatible with Hibernate to enable this feature. [Learn more ⓘ](#)

Administrator account

< Previous    Next : Disks >    **Review + create**

Enter Username and Password and select the inbound ports:

#### Create a virtual machine ...

⚠ Changing Basic options may reset selections you have made. Review all options prior to creating the virtual machine.

Help me create a low cost VM     Help me create a VM optimized for high availability     Help me choose the right VM size for my workload

Size \* ⓘ    Standard\_DS1\_v2 - 1 vcpu, 3.5 GiB memory (US\$121.91/month)  
[See all sizes](#)

Enable Hibernation ⓘ      
Hibernate is not supported by the size that you have selected. Choose a size that is compatible with Hibernate to enable this feature. [Learn more ⓘ](#)

Administrator account

Username \* ⓘ    ronil  
Password \* ⓘ       
Confirm password \* ⓘ   

Inbound port rules

Select which virtual machine network ports are accessible from the public internet. You can specify more limited or granular network access on the Networking tab.

Public inbound ports \* ⓘ     None     Allow selected ports

Select inbound ports \* ⓘ    HTTP (80), HTTPS (443), RDP (3389)

⚠ This will allow all IP addresses to access your virtual machine. This is only recommended for testing. Use the Advanced controls in the Networking tab to create rules to limit inbound traffic to known IP addresses.

< Previous    Next : Disks >    **Review + create**

Finally review and create the windows VM:

The screenshot shows the 'Create a virtual machine' wizard in the Azure portal. The 'Review + create' step is active, indicated by a blue underline. At the top, there's a green validation bar with the message 'Validation passed'. Below it are three buttons: 'Help me create a low cost VM', 'Help me create a VM optimized for high availability', and 'Help me choose the right VM size for my workload'. The main area is divided into sections: 'Price' (listing '1 X Standard DS1 v2 by Microsoft'), 'Subscription credits apply' (showing '0.1670 USD/hr'), and 'Pricing for other VM sizes'. A 'TERMS' section contains legal text about agreeing to terms and privacy statements. A warning message in an orange box states: '⚠ You have set RDP port(s) open to the internet. This is only recommended for testing. If you want to change this setting, go back to Basics tab.' Below this, the 'Basics' section shows configuration details: Subscription (Azure for Students), Resource group (UbuntuAcademiaVM\_group), Virtual machine name (WindowsAcademiaVM), Region (East Asia), and Availability options (Availability zone). At the bottom are navigation buttons: '< Previous', 'Next >', and a prominent blue 'Create' button.

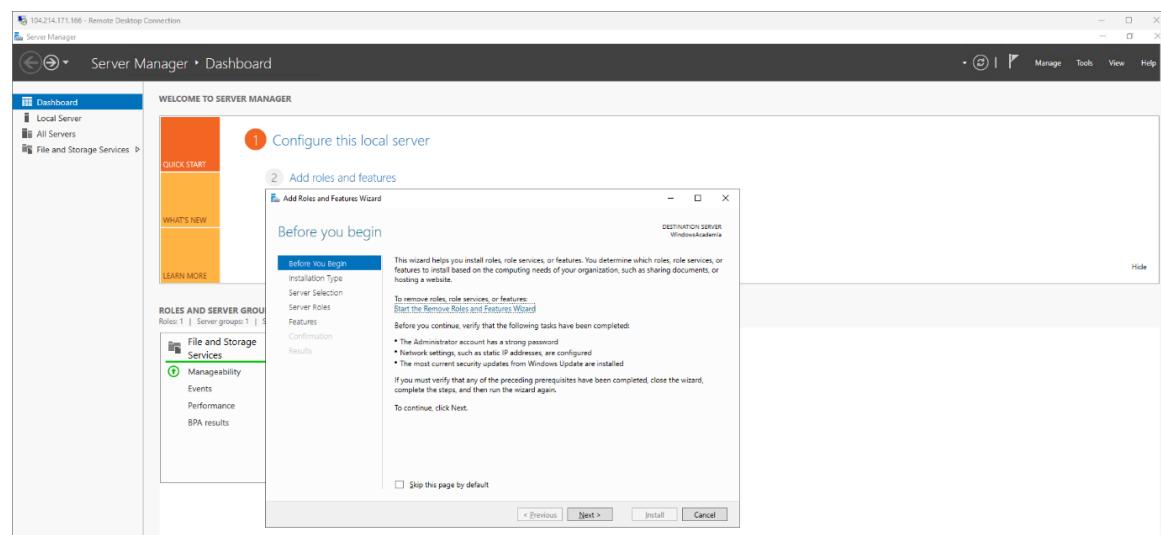
Look up the ip address:

The screenshot shows the Azure portal details page for the 'WindowsAcademiaVM' virtual machine. The 'Connect' tab is selected, highlighted in grey. On the left, a sidebar lists navigation items: Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Connect (expanded), Bastion, Windows Admin Center, Networking, Settings, Availability + scale (expanded), Size, Availability + scaling, Security, and Backup + disaster recovery. The main content area displays connection information: 'Connecting using Public IP address | 104.214.171.166'. Below this, detailed connection settings are shown: Admin username (ronil), Port (change) (3389), and Just-in-time policy (Unsupported by plan). A 'Most common' section shows a 'Native RDP' option with a 'Select' button and a 'Download RDP file' button. There's also a 'Local machine' link and a blue heart icon.

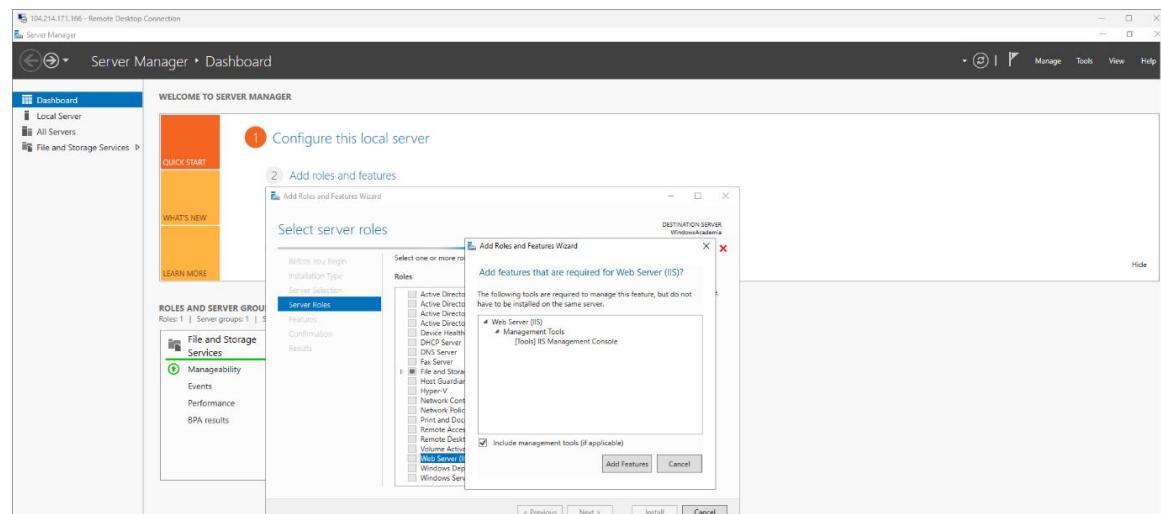
Connect using the remote desktop connection:



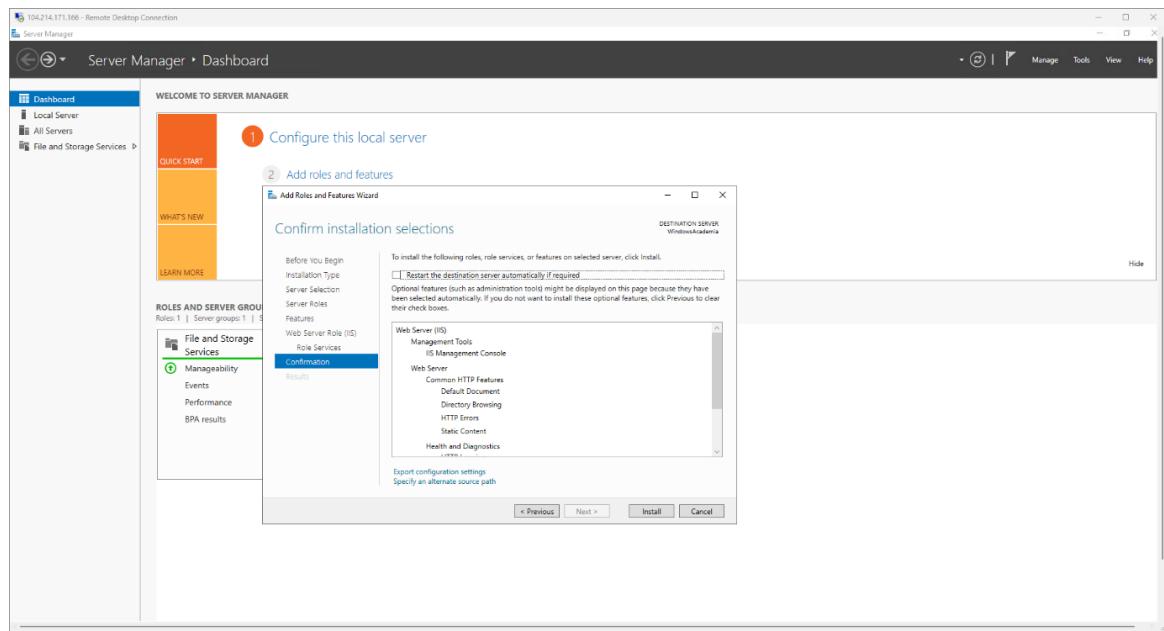
Once connected in the server manager open Add roles and features:



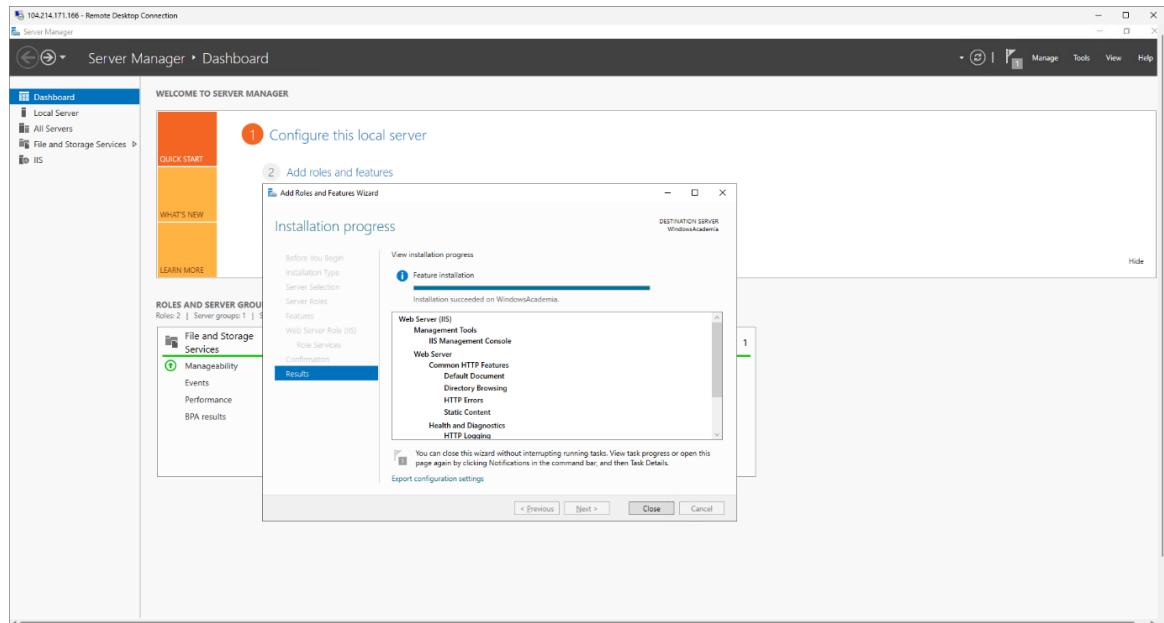
Select the Web Server (IIS) under Server Roles



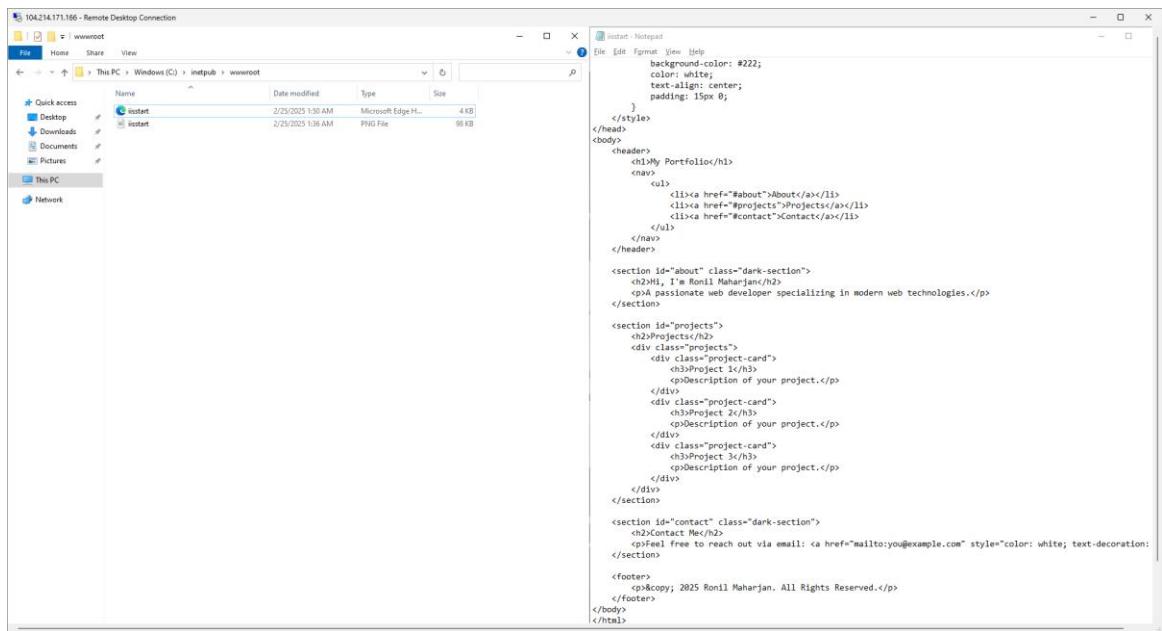
Then under confirmation click install.



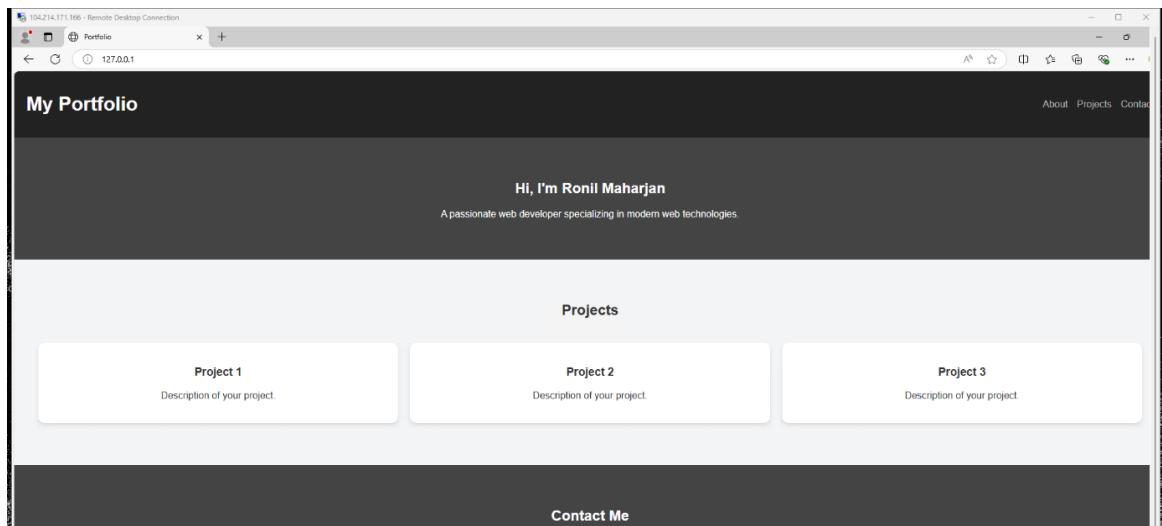
Web Server (IIS) is now installed:



Look for the iisstart.html file under wwwroot and modify it to build your static page.



Visiting the site within the localhost in VM will now show your static page:



# Lab 6: Re-sizing in Azure Virtual Machine.

## Objective:

- To learn about resizing the Virtual Machine to meet system requirements.

## Theory:

One of the most useful things about virtual machines is that you can adjust their size according to your CPU, network, or disk performance requirements. Changing your CPU, RAM, network bandwidth and storage according to the needs help in better utilization of available resource and cost reduction, have good performance, scalability and flexibility etc.

## Process:

Steps to resize a VM:

- Evaluate the current performance of the system and check the requirements to resize. (i.e. whether it's the memory (RAM) that needs to be increased).
- Close the VM if the platform doesn't allow resizing while it's running like Azure.
- Change the VM size based on the need.

Steps to resize Azure Virtual Machine is given below:

1. Choose the vm you want to resize:

The screenshot shows the Microsoft Azure portal's main dashboard. At the top, there's a search bar and a Copilot icon. Below the search bar, there's a row of service icons: Create a resource, Virtual machines, Subscriptions, Resource groups, All resources, Quickstart Center, Azure AI services, Kubernetes services, App Services, and More services. The main area is titled "Resources" and has tabs for "Recent" and "Favorite". Under "Recent", there's a table with four rows:

Name	Type	Last Viewed
WindowsAcademiaVM	Virtual machine	a minute ago
Azure for Students	Subscription	a week ago
UbuntuAcademiaVM_group	Resource group	a week ago

At the bottom of the resources section, there are links for "See all", "Navigate", and "Tools".

2. You can view the size the VM currently has:

The screenshot shows the Azure portal interface for a virtual machine named 'UbuntuAcademiaVM'. The left sidebar contains navigation links like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Connect, Networking, Settings, Availability + scale, Size, Availability + scaling, Security, Backup + disaster recovery, Operations, Monitoring, Automation, Help, and Security. The main content area displays the VM's configuration, including Hibernation (Disabled), Host group (-), Host (-), Proximity placement group (-), Colocation status (N/A), Capacity reservation group (-), Disk controller type (SCSI), Private IP address (IPv6) (-), Virtual network/subnet (UbuntuAcademiaVM-vnet/default), and DNS name (Configure). A callout box highlights the 'Size' section, which shows the current size as Standard\_B1s, with 1 vCPU and 1 GiB of RAM. Other sections shown include Azure Spot (Azure Spot -) and Source image details (Source image publisher canonical, Source image offer ubuntu-24.04-lts, Source image plan server). The bottom of the screen shows the URL https://portal.azure.com/# and the Azure logo.

3. After clicking on the size we can view a list of all available size option and choose the one required:

The screenshot shows the Azure portal interface for selecting a VM size. The left sidebar includes the same navigation links as the previous screenshot. The main content area lists 475 VM sizes, filtered by Type (All), vCPUs (All), RAM (GiB) (All), and Display cost (Monthly). The 'Size' section is highlighted with a red box. The table shows various series: D-Series v4, B-Series, E-Series v4, F-Series v2, D-Series v3, and E-Series v3. Each row provides details such as VM Size, Type, vCPUs, RAM, Data disks, Max IOPS, and Local storage (GiB). A note at the bottom states: 'Prices presented are estimates in USD that include only Azure infrastructure costs and any discounts for the subscription and location. The prices don't include any applicable software costs. Final charges will appear in your local currency in cost analysis and billing views. View Azure pricing calculator.' A 'Give feedback' link is also present.

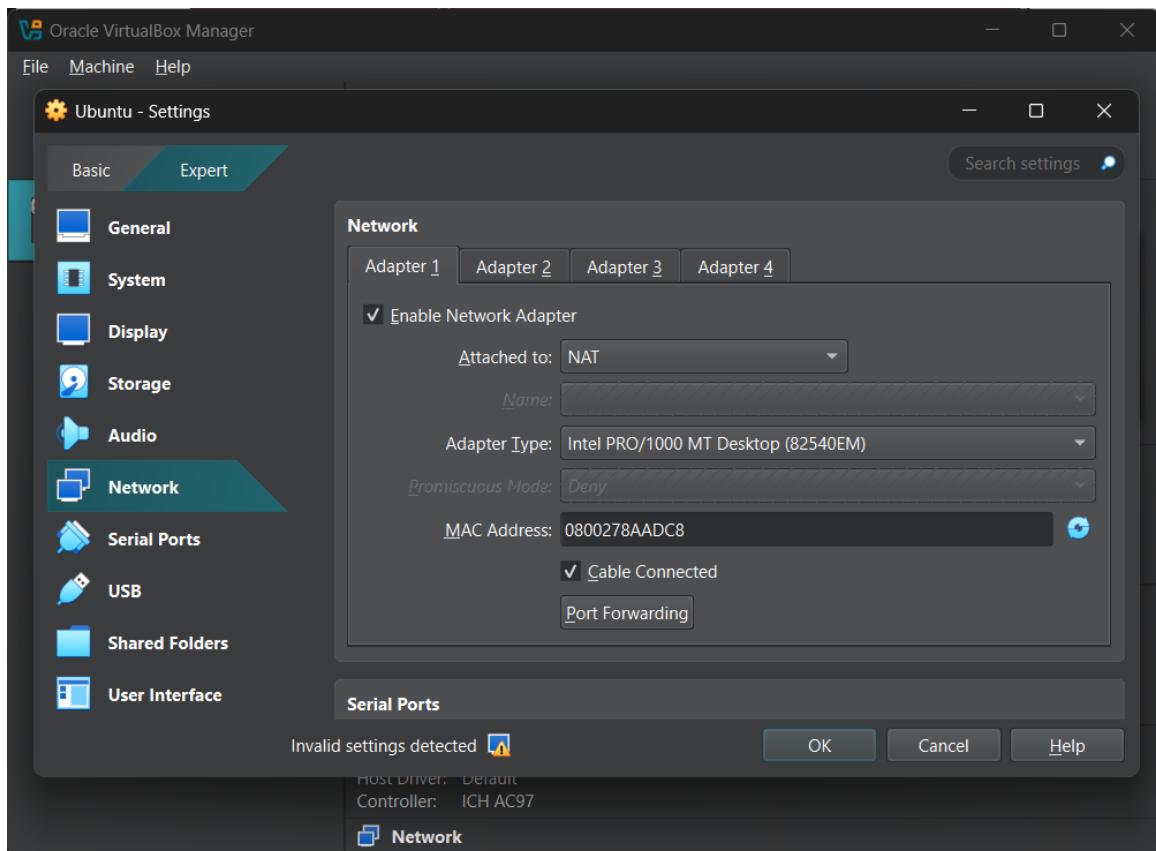
#### 4. You can resize the VM after selecting the suitable size:

The screenshot shows the Microsoft Azure portal interface for resizing a virtual machine. The main title is "UbuntuAcademiaVM | Size". On the left, there's a sidebar with navigation links like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Connect, Networking, Settings, Availability + scale, Size (which is selected and highlighted in blue), Availability + scaling, Security, Backup + disaster recovery, Operations, Monitoring, Automation, and Help. The main content area displays a table of 475 VM sizes. The columns include VM Size, Type, vCPUs, RAM (GiB), Data disks, Max IOPS, and Local storage (GiB). A tooltip at the top right says "Resizing virtual machine 'UbuntuAcademiaVM' to size 'Standard\_B2s'." At the bottom, there's a "Resize" button and a note about prices being estimates in USD.

#### 5. The VM size is changed:

The screenshot shows the Microsoft Azure portal interface for managing a virtual machine. The title is "UbuntuAcademiaVM". The sidebar on the left includes the same navigation items as the previous screenshot. The main content area shows the VM settings. A red box highlights the "Size" section, which shows the current configuration: Size: Standard\_B2s, vCPUs: 2, RAM: 4 GiB. Other sections visible include "Azure Spot" (with Azure Spot and Azure Spot eviction policy), "Availability + scaling" (with Availability zone, Availability set, and Scale Set), "Source image details" (with Source image publisher: canonical, Source image offer: ubuntu-24.04-lts, and Source image plan: server), and "Disk" (with OS disk: UbuntuAcademiaVM\_disk1, Encryption at host: Disabled, and Azure disk encryption: Not enabled).

In NAT mode:



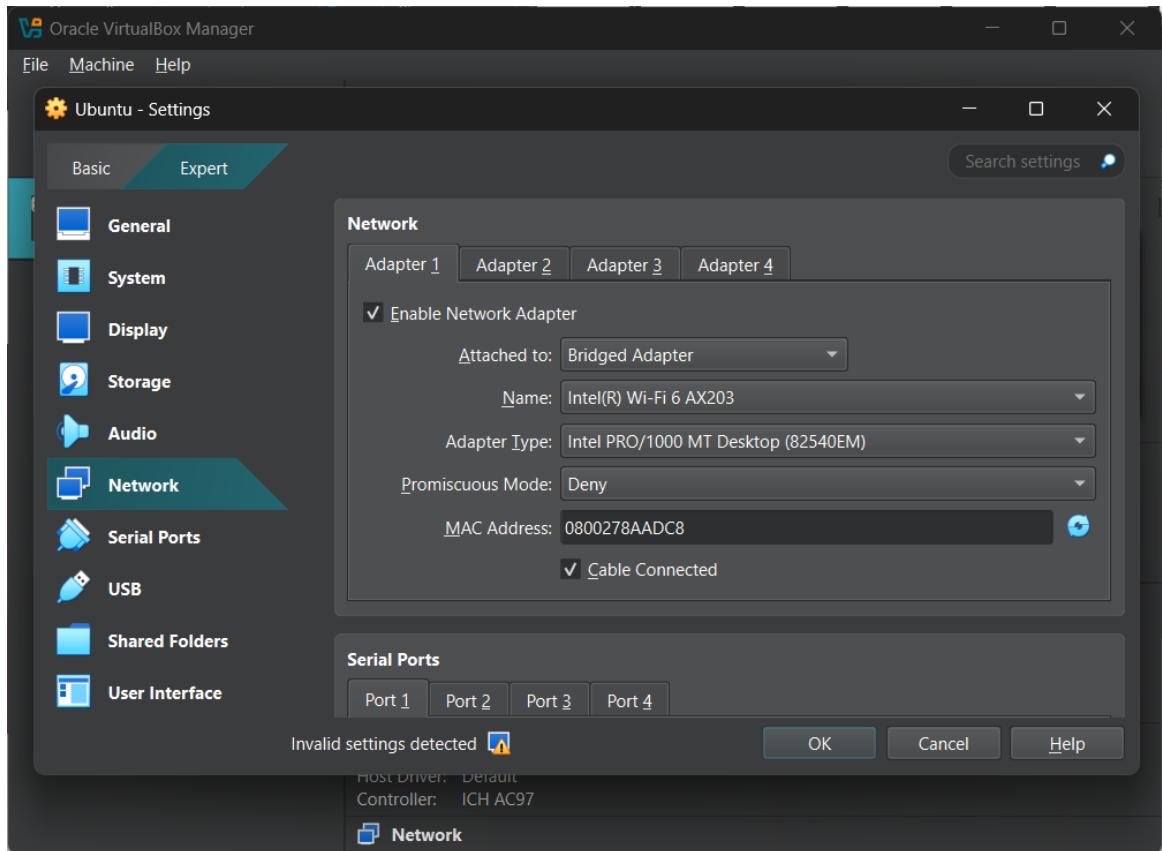
In NAT mode ifconfig gives the following inet:

```
ronilmaharjan@ronilmaharjan:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
        inet6 fd00::23a3:7253:8816:6721  prefixlen 64  scopeid 0x0<global>
        inet6 fe80::a00:27ff:fe8a:adc8  prefixlen 64  scopeid 0x20<link>
        inet6 fd00::a00:27ff:fe8a:adc8  prefixlen 64  scopeid 0x0<global>
        ether 08:00:27:8a:ad:c8  txqueuelen 1000  (Ethernet)
        RX packets 319  bytes 322775 (322.7 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 223  bytes 26077 (26.0 KB)
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 66  bytes 7224 (7.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 66  bytes 7224 (7.2 KB)
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

ronilmaharjan@ronilmaharjan:~$
```

Changing Network from NAT to Bridged Adapter:



In Bridged Adapter Mode we get:

```
ronilmaharjan@ronilmaharjan:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
          inet 192.168.1.65  netmask 255.255.255.0 broadcast 192.168.1.255
          inet6 2400:1a00:b050:1f84:5376:1e43:d93f:31f  prefixlen 64  scopeid 0x0<
global>
          inet6 fe80::a00:27ff:fe8a:adc8  prefixlen 64  scopeid 0x20<link>
          inet6 2400:1a00:b050:1f84:a00:27ff:fe8a:adc8  prefixlen 64  scopeid 0x0<
global>
          ether 08:00:27:8a:ad:c8  txqueuelen 1000  (Ethernet)
          RX packets 145  bytes 18086 (18.0 KB)
          RX errors 0  dropped 0  overruns 0  frame 0
          TX packets 216  bytes 25749 (25.7 KB)
          TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
      inet 127.0.0.1  netmask 255.0.0.0
      inet6 ::1  prefixlen 128  scopeid 0x10<host>
      loop  txqueuelen 1000  (Local Loopback)
      RX packets 174  bytes 19060 (19.0 KB)
      RX errors 0  dropped 0  overruns 0  frame 0
      TX packets 174  bytes 19060 (19.0 KB)
      TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

ronilmaharjan@ronilmaharjan:~$
```

## **Lab 7: Understanding the concept of Blob storage in Azure Cloud**

### **Objective:**

- To understand the concept of Azure Blob Storage and its importance in cloud storage.
- To create a storage account in azure.
- To deploy a static website using Azure Blob Storage and make it publicly accessible.

### **Theory:**

Azure Blob Storage is Microsoft's object storage solution for the cloud. Blob Storage is optimized for storing massive amounts of unstructured data. It is highly scalable, highly secure, and cost-effective object storage in the cloud. Azure Blob Storage helps you create data lakes for your analytics needs and provides storage to build powerful cloud-native and mobile apps. Optimize costs with tiered storage for your long-term data, and flexibly scale up for high-performance computing and machine learning workloads. Storage accounts, containers (which function as folders), and blobs (the actual files) make up the organization of blob storage. A variety of blob kinds are supported, including page blobs for random read/write operations, append blobs for logging, and block blobs for basic file storage. Blob Storage can be used by developers through the Azure Portal, CLI, REST API, or SDKs in Python, C#, and JavaScript.

The ability of Azure Blob Storage to host static webpages is an important benefit. Users can store HTML, CSS, JavaScript, and other static files in a blob container and make them accessible via a public URL by turning on the static website hosting option. This eliminates the need for a separate web server, offering a cost-effective way to host simple websites.

## Procedure:

To utilize the blob storage, it involves the process of creating storage account, configuring the storage container and deploying a static website.

Search for the Storage accounts in azure:

The screenshot shows the Microsoft Azure portal homepage with a search bar at the top containing 'blob storage'. The search results are displayed under the 'Services' tab, showing 'Storage accounts' as the top result. Other results include 'Reservations', 'Storage browser', and 'Storage movers'. To the right of the search results, there are sections for 'Kubernetes services', 'App Services', and 'More services'. Below these are 'Last Viewed' items: 'UbuntuAcademiaVM' (18 hours ago), 'UbuntuAcademiaVM\_group' (a day ago), and two items from 'SFTPGo for Linux' (a week ago). A 'Documentation' section provides links to upload files, work with blob containers, and get started with Azure Blob Storage. At the bottom, there's a 'Give feedback' link and a 'Dashboard' button.

Create a storage account:

The screenshot shows the 'Storage accounts' blade in the Microsoft Azure portal. The top navigation bar has 'Storage accounts' selected. The main area displays a table with columns: Name, Type, Kind, Resource group, Location, and Subscription. A filter bar at the top allows filtering by 'Subscription equals all', 'Resource group equals all', and 'Location equals all'. A message at the bottom states 'No storage accounts to display'. Below the message, there's a brief description of what a storage account is used for, a 'Create storage account' button, and a 'Learn more' link. The bottom right corner has a 'Give feedback' link.

Put in appropriate storage account name, select Primary service as Azure Blob Storage of Azure Data Lake Storage Gen 2:

The screenshot shows the 'Create a storage account' wizard on the Microsoft Azure portal. The 'Subscription' dropdown is set to 'Azure for Students'. The 'Resource group' dropdown is set to 'NetworkWatcherRG'. Under 'Instance details', the 'Storage account name' is 'ronil01', 'Region' is '(Asia Pacific) East Asia', 'Primary service' is 'Azure Blob Storage or Azure Data Lake Storage Gen 2', 'Performance' is 'Standard' (selected), 'Redundancy' is 'Geo-redundant storage (GRS)', and the 'Make read access to data available in the event of regional unavailability' checkbox is checked. At the bottom, there are 'Previous', 'Next', and 'Review + create' buttons.

Click on Review + create and create your storage account:

The screenshot shows the 'Create a storage account' wizard on the Microsoft Azure portal, specifically the 'Review + create' step. The 'Basics' tab is selected, showing the following configuration:

Subscription	Azure for Students
Resource group	NetworkWatcherRG
Location	East Asia
Storage account name	ronil01
Primary service	Azure Blob Storage or Azure Data Lake Storage Gen 2
Performance	Standard
Replication	Read-access geo-redundant storage (RA-GRS)

Below the 'Basics' section, the 'Advanced' section includes:

Enable hierarchical namespace	Disabled
Enable SFTP	Disabled
Enable network file system v3	Disabled
Allow cross-tenant replication	Disabled
Access tier	Hot

At the bottom, there are 'Previous', 'Next', and 'Create' buttons.

The storage account will be deployed:

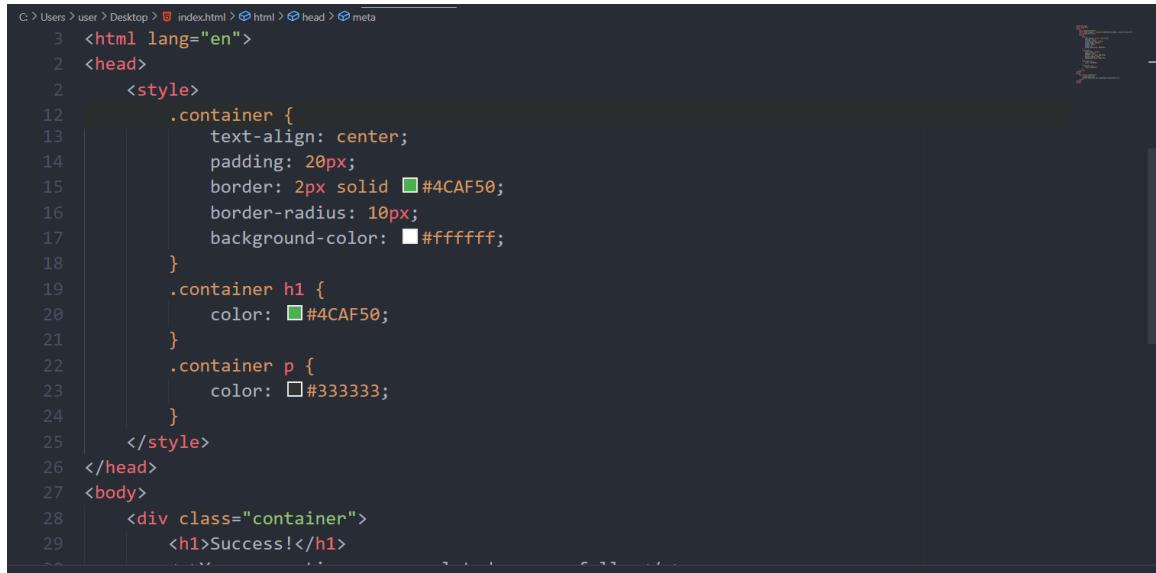
A screenshot of the Microsoft Azure portal. The URL in the address bar is `portal.azure.com/#view/HubsExtension/DeploymentDetailsBlade/~/overview/id/%2Fsubscriptions%2F079c401-87c8-40e2-b322-67892f2d9a8a%2FresourceC`. The page title is "ronil01\_1741309543552 | Overview". On the left, there's a sidebar with icons for Home, Deployment, Inputs, Outputs, and Template. The main content area shows a deployment status: "Deployment is in progress". It lists the deployment name as "ronil01\_1741309543552", subscription as "Azure for Students", and resource group as "NetworkWatcherRG". The start time is "07/03/2025, 06:51:05" and the correlation ID is "ec410a74-3057-4167-8df6-7d1b908d3371". Below this, there's a section titled "Deployment details" with a table header: "Resource", "Type", "Status", and "Operation details". A note says "No results.". To the right, there are promotional banners for Microsoft Defender for Cloud, Free Microsoft tutorials, and Work with an expert.

After deploying the storage account you can see its info under the overview section:

A screenshot of the Microsoft Azure portal showing the "ronil01" storage account overview. The URL in the address bar is `portal.azure.com/#@academiacollege.edu.np/resource/subscriptions/079c401-87c8-40e2-b322-67892f2d9a8a/resourcegroups/NetworkWatcherRG/providers`. The page title is "ronil01 - Microsoft Azure". The left sidebar includes links for Home, Storage account, Overview, Activity log, Tags, Diagnose and solve problems, Access Control (IAM), Data migration, Events, Storage browser, Storage Mover, Partner solutions, Data storage, Security + networking, Data management, Settings, Monitoring, Monitoring (classic), and Automation. The main content area shows the storage account details under the "Essentials" tab. It includes fields for Resource group (NetworkWatcherRG), Location (eastasia), Primary/Secondary Location (Primary: East Asia, Secondary: Southeast Asia), Subscription (Azure for Students), Subscription ID (079c401-87c8-40e2-b322-67892f2d9a8a), Disk state (Primary: Available, Secondary: Available), and Tags (add tags). Below this, there are sections for Properties, Monitoring, Capabilities (7), Recommendations (0), Tutorials, Tools + SDKs, Blob service, Security, and Networking. The Blob service section shows settings like Hierarchical namespace (Disabled), Default access tier (Hot), Blob anonymous access (Disabled), Blob soft delete (Enabled (7 days)), Container soft delete (Enabled (7 days)), Versioning (Disabled), and Change feed (Disabled). The Security section shows settings for REST API operations (Enabled), Storage account key access (Enabled), Minimum TLS version (Version 1.2), and Infrastructure encryption (Disabled). The Networking section shows "Allow traffic from" and "All networks".

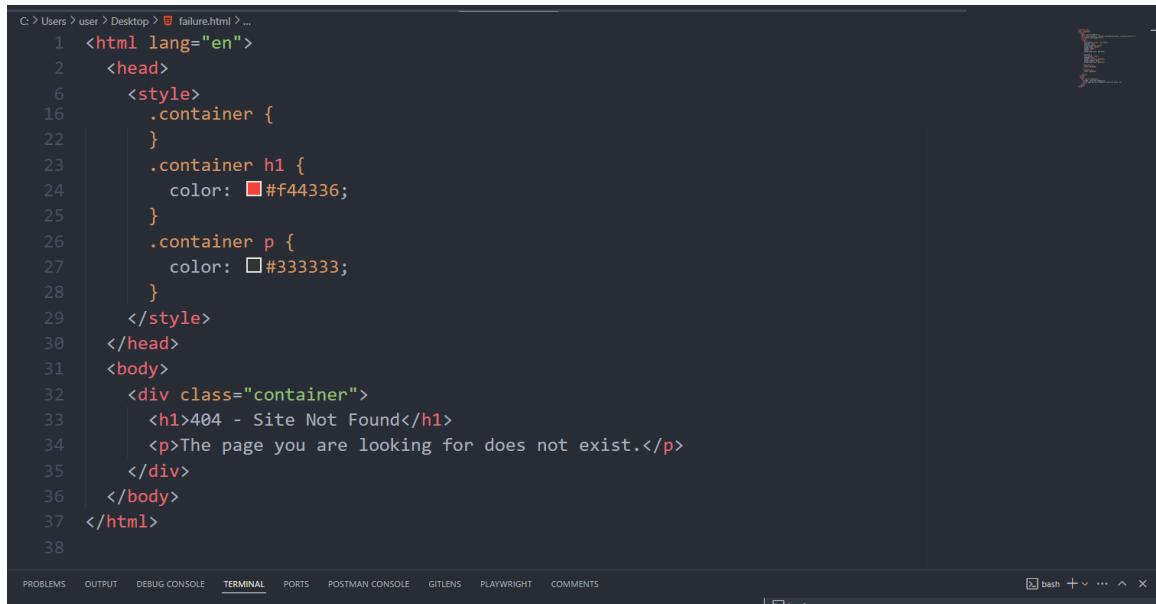
Create two html page one for success and one 404 page.

A simple success page:



```
C:\Users\user\Desktop> index.html > html > head > meta
  3  <html lang="en">
  4  <head>
  5    <style>
  6      .container {
  7        text-align: center;
  8        padding: 20px;
  9        border: 2px solid #4CAF50;
 10        border-radius: 10px;
 11        background-color: #ffffff;
 12      }
 13      .container h1 {
 14        color: #4CAF50;
 15      }
 16      .container p {
 17        color: #333333;
 18      }
 19    </style>
 20  </head>
 21  <body>
 22    <div class="container">
 23      <h1>Success!</h1>
 24    </div>
 25  </body>
 26</html>
```

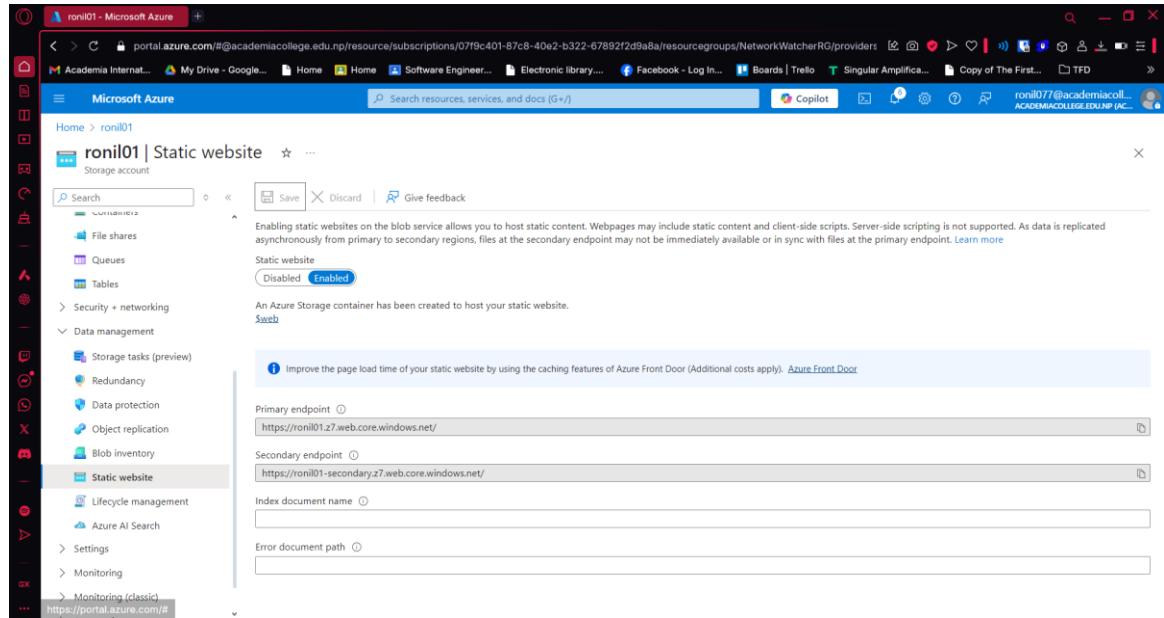
A simple 404 page not found page:



```
C:\Users\user\Desktop> failure.html > ...
  1  <html lang="en">
  2  <head>
  3    <style>
  4      .container {
  5        text-align: center;
  6        padding: 20px;
  7        border: 2px solid #4CAF50;
  8        border-radius: 10px;
  9        background-color: #ffffff;
 10      }
 11      .container h1 {
 12        color: f44336;
 13      }
 14      .container p {
 15        color: #333333;
 16      }
 17    </style>
 18  </head>
 19  <body>
 20    <div class="container">
 21      <h1>404 - Site Not Found</h1>
 22      <p>The page you are looking for does not exist.</p>
 23    </div>
 24  </body>
 25</html>
```

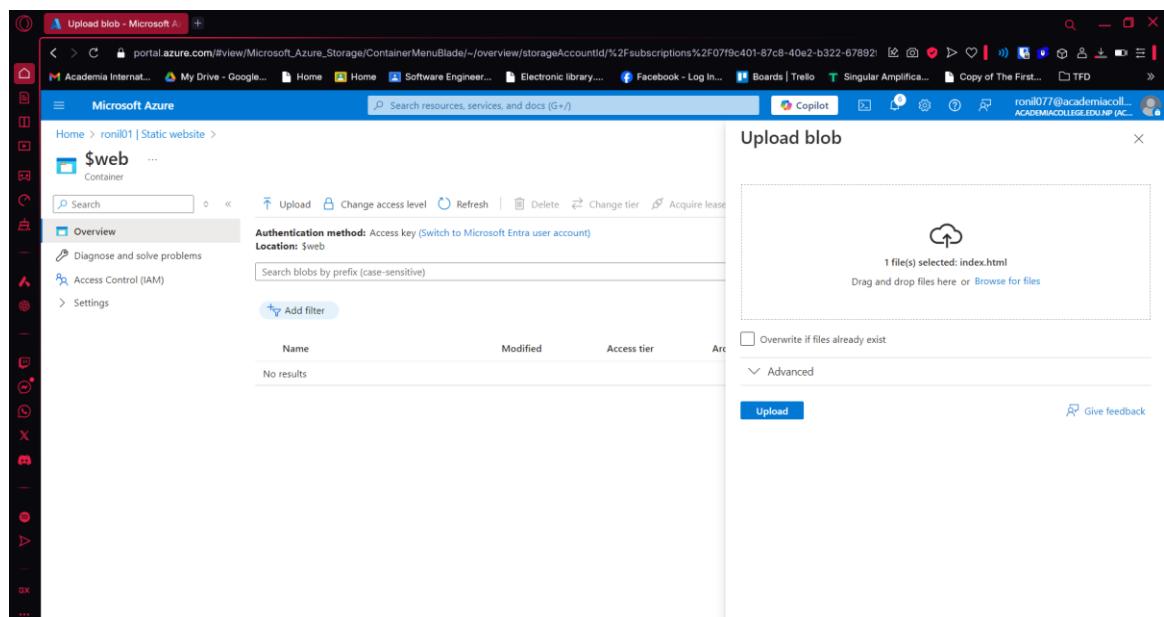
Under “Data Management” click on the static website and enable it.

After saving we can see two url endpoints the primary endpoint and the secondary endpoint. After that click on the “\$web”.



The screenshot shows the Microsoft Azure portal interface for managing a static website. The left sidebar shows the navigation path: Home > ronil01 > ronil01 | Static website. The main content area is titled "ronil01 | Static website". Under the "Static website" section, the status is set to "Enabled". The "Primary endpoint" is listed as "https://ronil01.z7.web.core.windows.net/" and the "Secondary endpoint" is listed as "https://ronil01-secondary.z7.web.core.windows.net/". There are also fields for "Index document name" and "Error document path", both of which are currently empty. A note at the top indicates that enabling static websites allows hosting static content and client-side scripts, but server-side scripting is not supported. A link to "Learn more" is provided.

Clicking on the “\$web” you will see the following interface, click on the upload to upload the two html page we created (index.html and failure.html).



The screenshot shows the Microsoft Azure portal interface for uploading files to a storage container. The left sidebar shows the navigation path: Home > ronil01 | Static website > \$web Container. The main content area is titled "Upload blob". A file named "index.html" is selected for upload, indicated by a cloud icon and the text "1 file(s) selected: index.html". Below this, there is a "Drag and drop files here or Browse for files" input field. At the bottom of the interface, there is a checkbox for "Overwrite if files already exist" and a large blue "Upload" button. The "Advanced" section is collapsed. The overall interface is designed for managing static website content.

Now go back to the static website section and put in the names of the uploaded file:

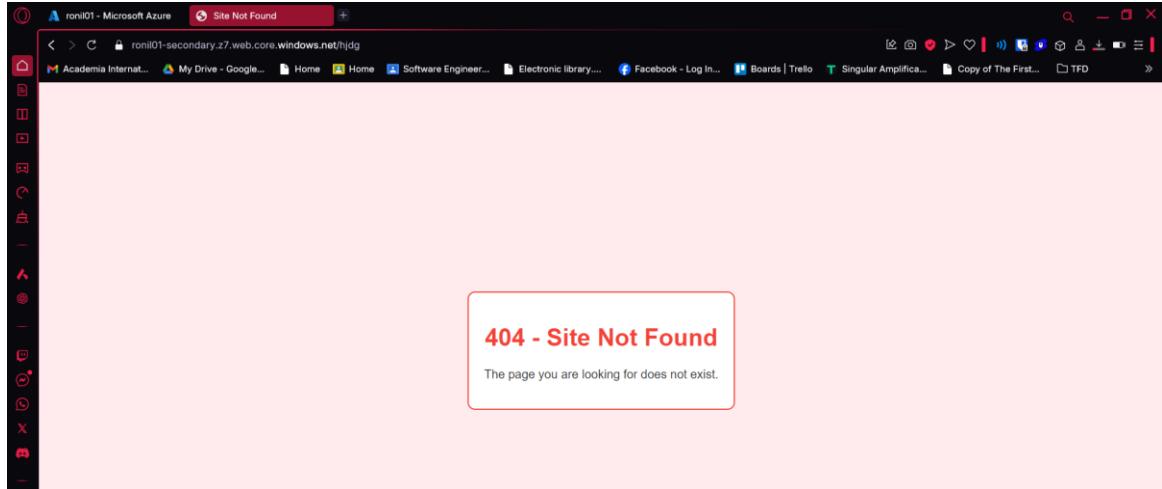
Under Index document name put “index.html” (the success page) and under Error document path put “failure.html” (the 404 page):

The screenshot shows the Microsoft Azure portal interface. The left sidebar has a tree view with 'Home', 'ronil01' (selected), 'Storage account', and other options like 'Overview', 'Activity log', 'Tags', 'Diagnose and solve problems', etc. The main content area is titled 'ronil01 | Static website'. It shows the configuration for a static website on an Azure Storage container. The 'Static website' section has 'Enabled' selected. Below it, 'An Azure Storage container has been created to host your static website.' is displayed. There are fields for 'Primary endpoint' (https://ronil01.z7.web.core.windows.net/), 'Secondary endpoint' (https://ronil01-secondary.z7.web.core.windows.net/), 'Index document name' (index.html), and 'Error document path' (failure.html). A note at the top says 'Improve the page load time of your static website by using the caching features of Azure Front Door (Additional costs apply.)' with a link to 'Azure Front Door'.

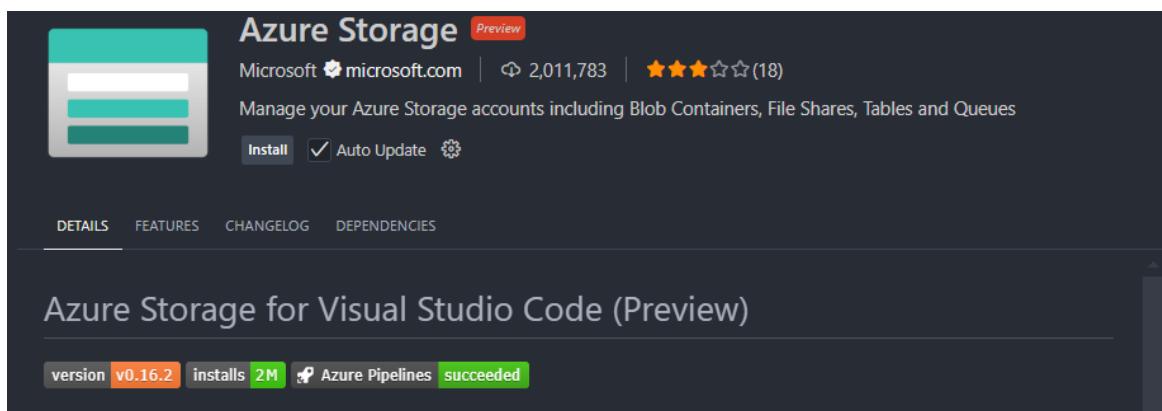
Going to either primary endpoint or secondary endpoint we should see the success page (index.html):

The screenshot shows a browser window with the title 'ronil01 - Microsoft Azure Success'. The main content area displays a green-bordered message box with the word 'Success!' in bold at the top and the text 'Your operation was completed successfully.' below it. The browser's address bar shows the URL https://ronil01-secondary.z7.web.core.windows.net/. The rest of the browser interface, including the toolbar and tabs, is visible.

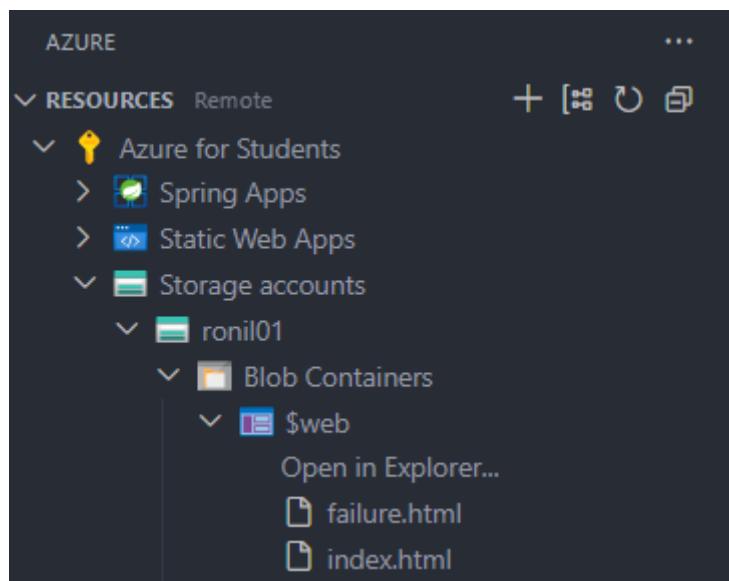
If you try to go to a url path that does not exist you should see the failure.html page (the 404 page):



## Using Azure Storage extension in VS Code:



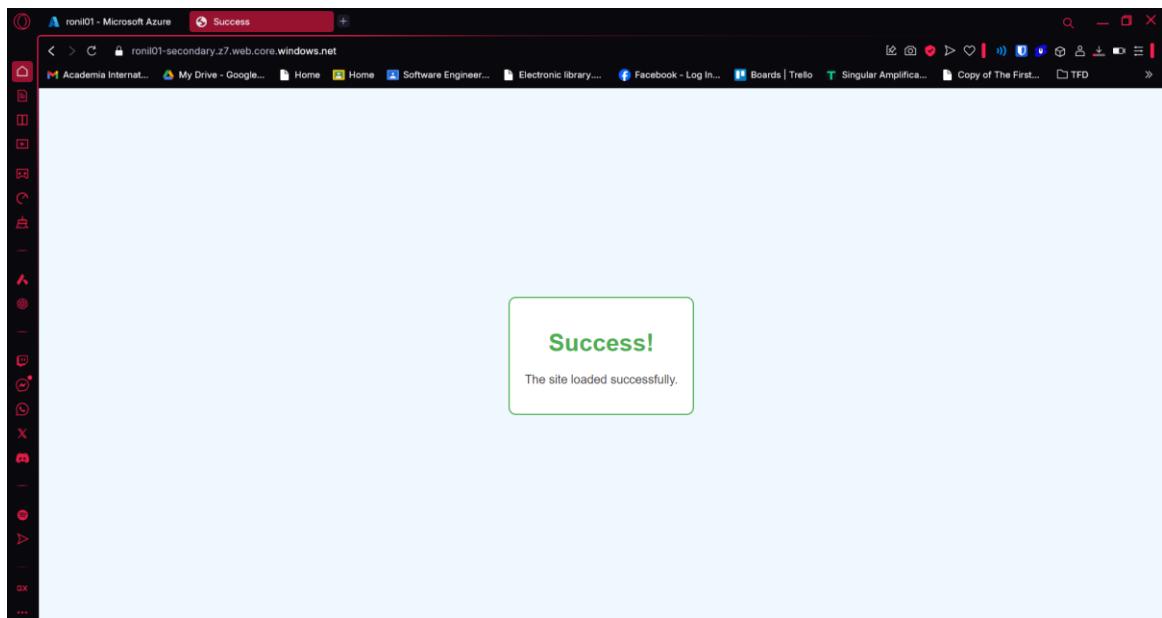
After installing and logging into the Azure Storage extension you should see the following:



Now we can directly edit and save the html pages we created from vscode:

```
<html lang="en">
<head>
<style>
.container {
    border-radius: 10px;
    background-color: #ffffff;
}
.container h1 {
    color: #4CAF50;
}
.container p {
    color: #333333;
}
</style>
</head>
<body>
<div class="container">
<h1>Success!</h1>
<p>The site loaded successfully.</p>
</div>
</body>
</html>
```

After updating and saving the index.html page in vscode we see the updated page after reloading the browser:



## **Lab 8: Understanding concept of Azure Data Lake for Big Data.**

### **Objectives:**

- To understand the fundamentals of Azure Data Lake and its role in big data processing.
- To explore how Azure Data Lake Storage (ADLS) enables scalable and secure storage for large datasets.
- To learn the key features, architecture, and advantages of Azure Data Lake over traditional storage solutions.

### **Theory:**

Azure Data Lake Storage is a secure cloud platform that provides scalable, cost-effective storage for big data analytics. Azure Data Lake includes all the capabilities required to make it easy for developers, data scientists, and analysts to store data of any size, shape, and speed, and do all types of processing and analytics across platforms and languages.

Some of the key features of Azure Data Lakes are:

- Hierarchical Namespace: Azure Data Lake Storage introduces a hierarchical namespace that organizes data into directories and subdirectories, similar to a traditional file system.
- Azure Data Lake Storage is designed to handle massive storage requirements, accommodating data ranging from a few kilobytes to petabytes.
- Optimized Cost and Performance: Azure Data Lake Storage offers features such as automated lifecycle policy management and object-level tiering.
- Security: Azure Data Lake offers robust security features, including encryption and access controls, to protect sensitive data.

## Procedure:

1. Search for the storage accounts:

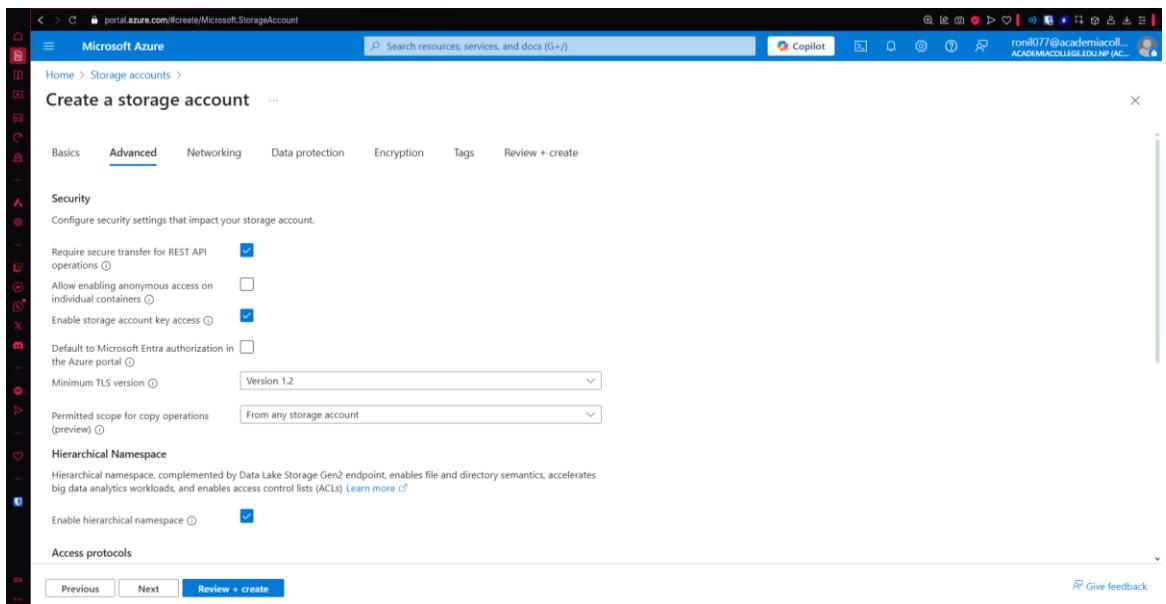
The screenshot shows the Microsoft Azure Storage Accounts page. The URL is <https://portal.azure.com/#browse/Microsoft.Storage%2FStorageAccounts>. The page title is "Storage accounts". There are several filter options at the top: "Subscription equals all", "Resource group equals all", and "Location equals all". Below the filters, it says "Showing 0 to 0 of 0 records." In the center, there is a large gray placeholder icon and the text "No storage accounts to display". A descriptive message follows: "Create a storage account to store up to 500TB of data in the cloud. Use a general-purpose storage account to store object data, use a NoSQL data store, define and use queues for message processing, and set up file shares in the cloud. Use the Blob storage account and the hot or cool access tiers to optimize your costs based on how frequently your object data is accessed." At the bottom, there is a blue button labeled "+ Create storage account" and a link "Learn more".

2. Create a new Storage Account

RE

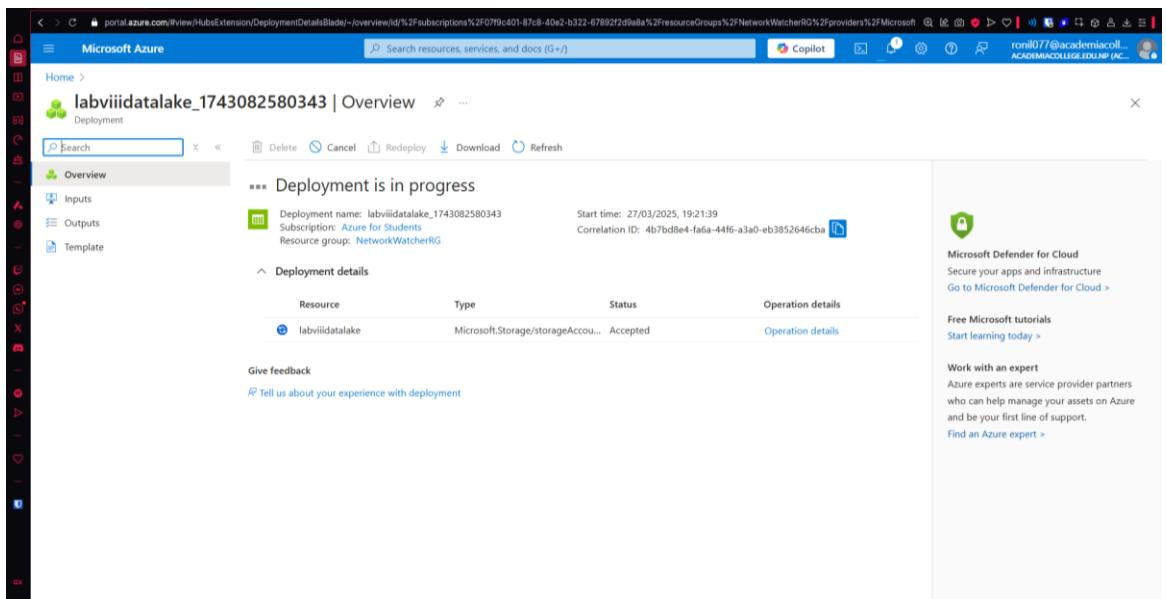
The screenshot shows the "Create a storage account" wizard on the "Basics" step. The URL is <https://portal.azure.com/#create/Microsoft.StorageAccount>. The page title is "Create a storage account". There are tabs for "Basics", "Advanced", "Networking", "Data protection", "Encryption", "Tags", and "Review + create". The "Basics" tab is selected. A descriptive text about Azure Storage follows. Under "Project details", it asks to select a subscription and resource group. The "Subscription" dropdown is set to "Azure for Students" and the "Resource group" dropdown is set to "NetworkWatcherRG". Under "Instance details", it asks for the storage account name ("labv1idatalake"), region ("(Asia Pacific) Central India"), and primary service ("Azure Blob Storage or Azure Data Lake Storage Gen 2"). The "Performance" section shows "Standard" selected as the recommended option. At the bottom, there are buttons for "Previous", "Next", and "Review + create".

### 3. Enable Hierarchical Namespace under the Advanced tab:



The screenshot shows the 'Create a storage account' page in the Microsoft Azure portal. The 'Advanced' tab is selected. In the 'Security' section, the checkbox for 'Enable hierarchical namespace' is checked. Below it, the 'Hierarchical Namespace' section is expanded, providing a brief description of its benefits.

### 4. Create the storage account after reviewing the data:



The screenshot shows the 'Deployment' blade for a deployment named 'labviiidatalake\_1743082580343'. The status is listed as 'Accepted'. The right sidebar contains promotional links for Microsoft Defender for Cloud, Microsoft tutorials, and finding an Azure expert.

## 5. The datalake will start deploying:

The screenshot shows the Microsoft Azure portal interface. The main title bar says "Microsoft Azure". Below it, the specific resource name "labviidatalake\_1743082580343 | Overview" is displayed. A search bar and several navigation icons are on the left. The main content area has a heading "Deployment is in progress". It shows the deployment name, subscription (Azure for Students), and resource group (NetworkWatcherRG). The status is "Accepted". A table titled "Deployment details" lists one item: "Resource" (labviidatalake) and "Type" (Microsoft.Storage/storageAccou...). On the right side, there are promotional banners for Microsoft Defender for Cloud, Free Microsoft tutorials, and Work with an expert.

## 6. Viewing overview of the resource:

The screenshot shows the Microsoft Azure portal interface for a Storage account named "labviidatalake". The title bar says "Microsoft Azure". The main content area shows the storage account overview. The left sidebar has a tree view with categories like "Overview", "Activity log", "Tags", etc. The "Overview" tab is selected. The main pane displays "Essentials" information such as Resource group (NetworkWatcherRG), Location (centralIndia), Primary/Secondary Location (Central India, Secondary: South India), Subscription (Azure for Students), Subscription ID, Disk state, and Tags. Below this, there are tabs for "Properties", "Monitoring", "Capabilities (5)", "Recommendations (0)", "Tutorials", and "Tools + SDKs". Under "Properties", there are sections for "Data Lake Storage" (Hierarchical namespace: Enabled, Default access tier: Hot, Blob anonymous access: Disabled, Blob soft delete: Enabled (7 days), Container soft delete: Enabled (7 days), Versioning: Disabled, Change feed: Disabled, NFS v3: Disabled, SFTP: Disabled) and "Security" (Require secure transfer for REST API operations: Enabled, Storage account key access: Enabled, Minimum TLS version: Version 1.2, Infrastructure encryption: Disabled). There is also a "Networking" section with "Allow access from" set to "All networks" and "Private endpoint connections" count at 0.

## 7. Enable Anonymous Access:

The screenshot shows the Azure Storage Account configuration page for 'labviiidatalake'. The left sidebar has 'Configuration' selected under 'Settings'. The main area shows storage account settings like account kind (StorageV2), performance (Standard), and CORS rules. A key setting here is 'Allow Blob anonymous access', which is currently set to 'Enabled'.

## 8. Creating a new container:

The screenshot shows the Azure Storage Container creation page. A new container named 'files' is being created. The 'Anonymous access level' dropdown is set to 'Container (anonymous read access for containers and blobs)'. A warning message states that all container and blob data can be read by anonymous request. The 'Create' button is visible at the bottom.

## 9. Uploading files to the container:

The screenshot shows the Microsoft Azure Storage Container blade for the 'files' container. On the left, there's a sidebar with navigation links like Home, Overview, Diagnose and solve problems, Access Control (IAM), and Settings. The main area has tabs for Upload, Add Directory, Refresh, Rename, Delete, Change tier, Acquire lease, Break lease, and Give feedback. A search bar at the top says 'Search resources, services, and docs (G+)'.

**Upload blob** dialog box:

- Message: '3 file(s) selected: index.html, sample1.json, sample2.json'
- Text: 'Drag and drop files here or [Browse for files](#)'
- Checkboxes:
  - Overwrite if files already exist
- Advanced settings dropdown
- Upload button
- Give feedback link

**Overview** table:

Name	Modified	Access tier	Archive status	Blob type	Size	Lease state
index.html	27/03/2025, 19:35:38	Hot (Inferred)	-	Block blob	526 B	Available
sample1.json	27/03/2025, 19:35:38	Hot (Inferred)	-	Block blob	576 B	Available
sample2.json	27/03/2025, 19:35:38	Hot (Inferred)	-	Block blob	1.02 KB	Available

## 10. Viewing the public url of the file:

The screenshot shows the Microsoft Azure Storage Blob Properties blade for the 'index.html' blob. The left sidebar includes Home, Overview, Diagnose and solve problems, Access Control (IAM), and Settings. The main area has tabs for Overview, Versions, Edit, and Generate SAS.

**Properties** table:

URL	<a href="https://labviidatalake.blob.core.windows.net/files/index.html">https://labviidatalake.blob.core.windows.net/files/index.html</a>
LAST MODIFIED	27/03/2025, 7:35:38 pm
CREATION TIME	27/03/2025, 7:35:38 pm
VERSION ID	-
TYPE	Block blob
SIZE	526 B
ACCESS TIER	Hot (Inferred)
ACCESS TIER LAST MODIFIED	N/A
ARCHIVE STATUS	-
REHYDRATE PRIORITY	-
SERVER ENCRYPTED	true
ETAG	0x8D6D365B2E5000
VERSION-LEVEL IMMUTABILITY POLICY	Disabled
CACHE-CONTROL	[Empty]
CONTENT-TYPE	text/html
CONTENT-MD5	eUHSPeqMYS69dZdCQ@gp...
CONTENT-ENCODING	[Empty]
CONTENT-LANGUAGE	[Empty]

## 11. Accessing the file using public URL:



## 12. Changing the access tier of the files:

A screenshot of the Azure Storage Blob Properties blade. On the left, there's a list of blobs: 'index.html', 'sample1.json', and 'sample2.json'. The 'sample2.json' blob is selected. On the right, the properties for 'sample2.json' are displayed, including its URL, last modified time, creation time, type (Block blob), size (1.02 KiB), and access tier (Hot (Inferred)). A 'Change tier' dialog is open on the right, showing the current tier as 'Hot (Inferred)' and offering options to change it to 'Cold' or 'Archive'. The dialog also includes a note about optimizing storage costs.