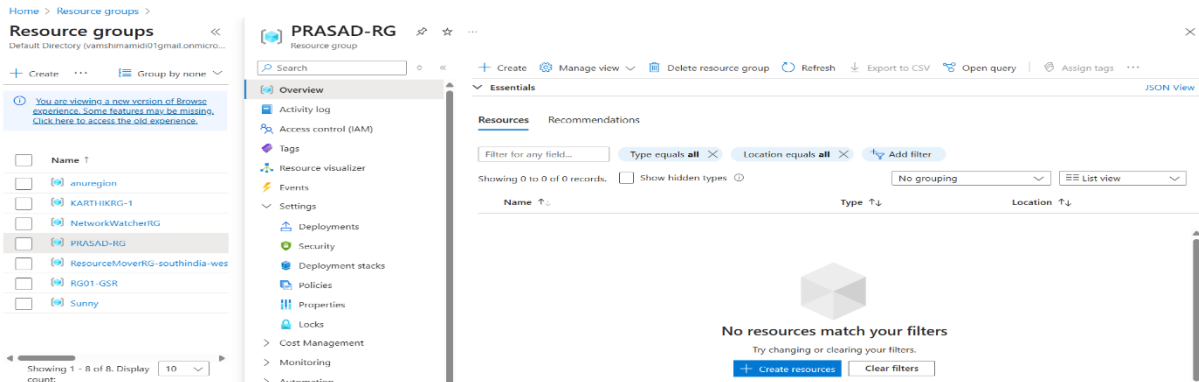


PROJECT OVERVIEW

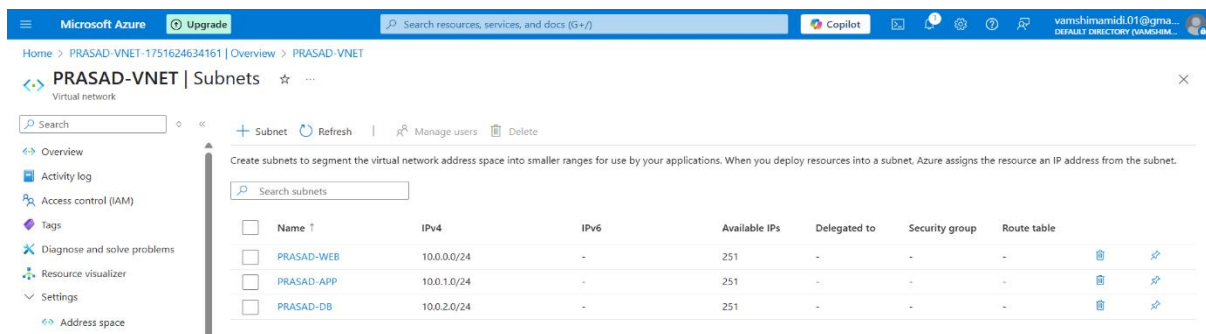
Project Title: 3-tier Azure deployment Project.

Aim: The aim of this project is to design and implement a 3-tier architecture infrastructure that separates the web interface, application logic, and database layers into distinct tiers. This architecture will enhance scalability, security, and manageability of the application environment.

1. Create a Resource Group



2. Create 3 subnets in an Azure Virtual Network (VNet)—one each for a web server, app server, and DB server.

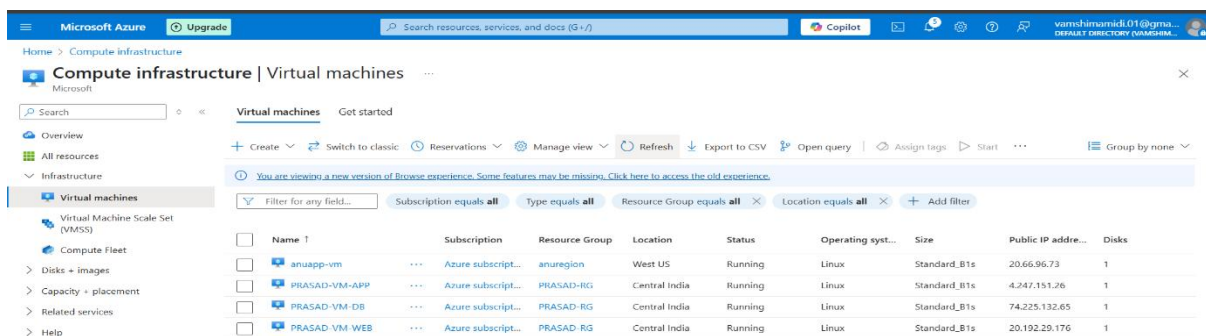


3. Deploy Virtual Machines in Each Subnet:

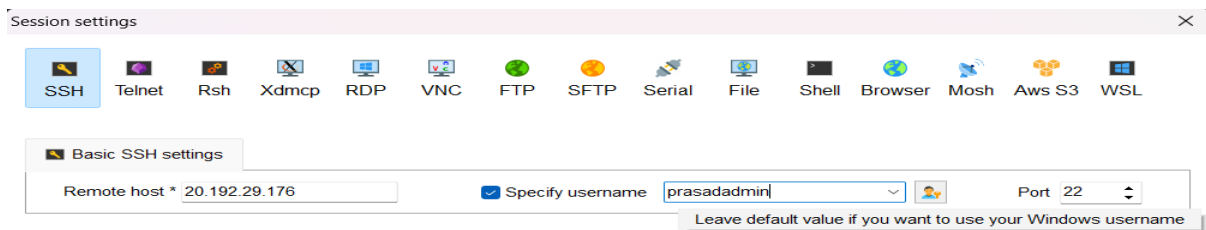
➤ PRASAD-VM-WEB → PRASAD-WEB

➤ PRASAD-VM-APP → PRASAD-APP

➤ PRASAD-VM-DB → PRASAD-DB



4. SSH into the PRASAD-VM-WEB [20.192.29.176] to Connect Mobaxterm:



METHOD-1:

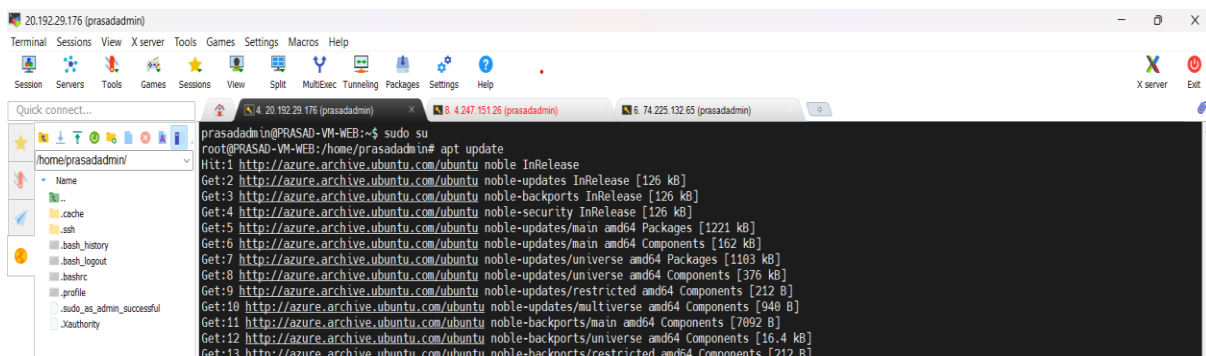
INSTALLATION OF NGINX IN PRASAD-VM-WEB

1: Using sudo su (Recommended)

- **sudo su**
 - a. This switches you to the root user.
 - b. The prompt will change from \$ to #.

2. Update System Packages

• apt update

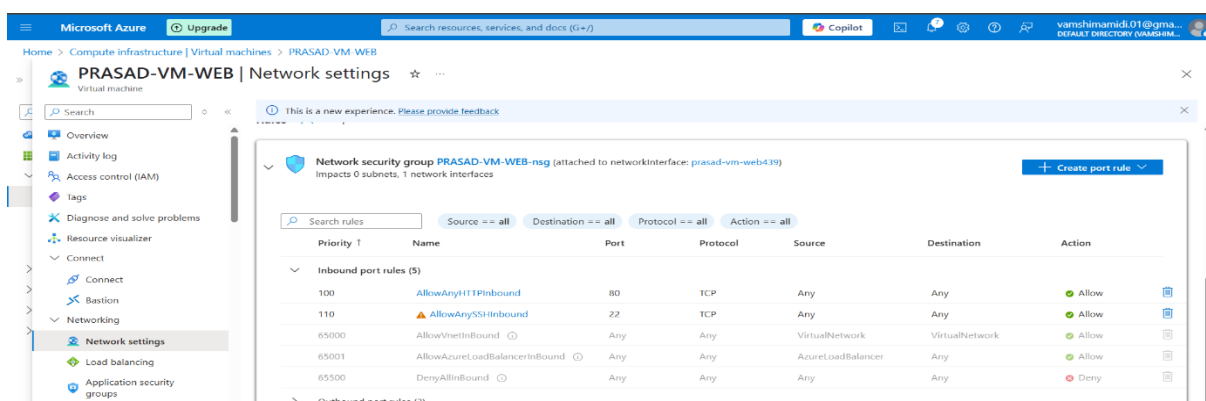


3.Install nginx

•apt install nginx -y

4.Allow HTTP Traffic via NSG

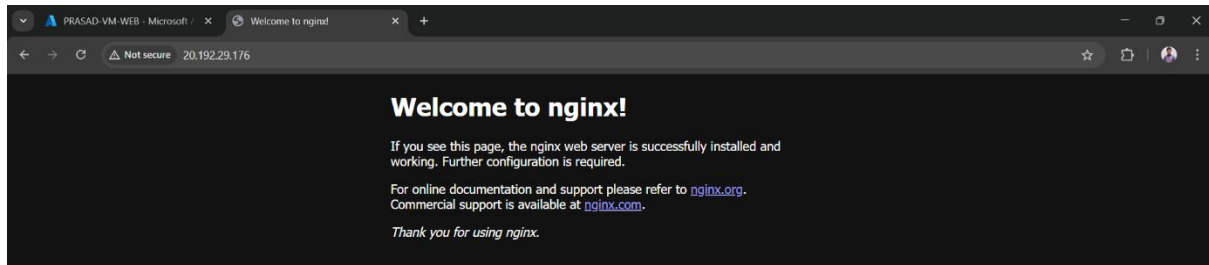
Note: [If you're not seeing the NGINX page, your Network Security Group (NSG) may be blocking port 80. Run this to allow HTTP (port 80) on the NSG]



5. Access NGINX Web Page

Open your browser and go to: PRASAD-VM-WEB <20.192.29.176 > Copy and Paste
http://< 20.192.29.176 >80

You should see the default NGINX welcome page.



METHOD-2:

Installation of tomcat in PRASAD-VM-APP

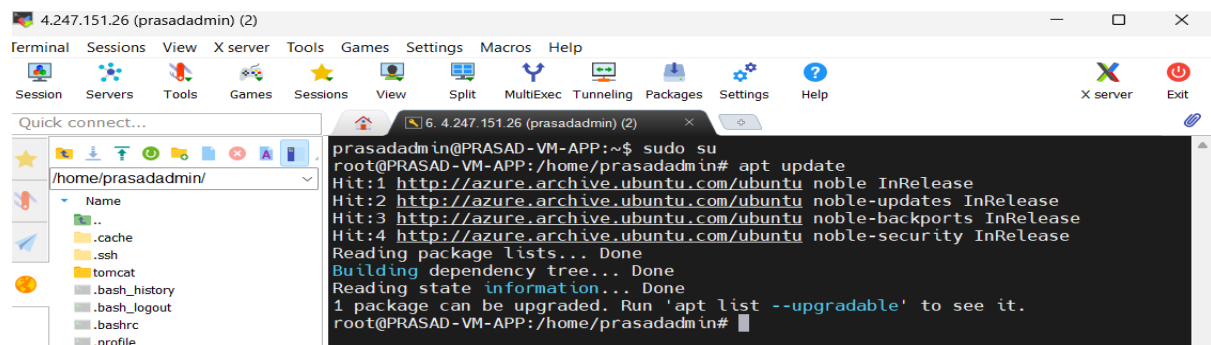
1: Using sudo su (Recommended)

• **sudo su**

- This switches you to the root user.
- The prompt will change from \$ to #.

2. Update System Packages

• **apt update**



3. Install Java

Tomcat requires Java. Install OpenJDK:

• **apt install default-jdk -y**

Verify the installation:

• **java -version**

```

4.247.151.26 (prasadmin) (2)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help

Quick connect...
/home/prasadadmin/
Name
..
.cache
.ssh
tomcat
.bash_history
.bash_logout
.bashrc
.profile
.sudo_as_admin_successful
.Xauthority
apache-tomcat-10.1.42.tar.gz

prasadmin@PRASAD-VM-APP:~$ sudo su
root@PRASAD-VM-APP:/home/prasadadmin# apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://azure.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://azure.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 http://azure.archive.ubuntu.com/ubuntu noble-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
1 package can be upgraded. Run 'apt list --upgradable' to see it.
root@PRASAD-VM-APP:/home/prasadadmin# apt install default-jdk -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
default-jdk is already the newest version (2:1.21-75+exp1).
0 upgraded, 0 newly installed, 0 to remove and 1 not upgraded.
root@PRASAD-VM-APP:/home/prasadadmin# java -version
openjdk version "21.0.7" 2025-04-15
OpenJDK Runtime Environment (build 21.0.7+6-Ubuntu-0ubuntu124.04)
OpenJDK 64-Bit Server VM (build 21.0.7+6-Ubuntu-0ubuntu124.04, mixed mode, shari
ng)
root@PRASAD-VM-APP:/home/prasadadmin#

```

4.Download Tomcat

- Go to the Apache Tomcat official website and get the latest version.

Run:

- **wget https://dlcdn.apache.org/tomcat/tomcat-10/v10.1.41/bin/apache-tomcat-10.1.41.tar.gz**

(Replace the version number with the latest one if needed.)

- **ls** (to list the files)

5. Extract and Configure Tomcat

- **tar -xvzf apache-tomcat-10.1.18.tar.gz**
- **ls**
- **mv apache-tomcat-10.1.18 tomcat**
- **ls**

To start Apache Tomcat manually from the bin directory, follow these steps:

6.Navigate to the Tomcat Directory

- **cd /tomcat/bin**

7. Start Tomcat

Run the startup script: (./ is to execute a command)

- **./startup.sh**

```

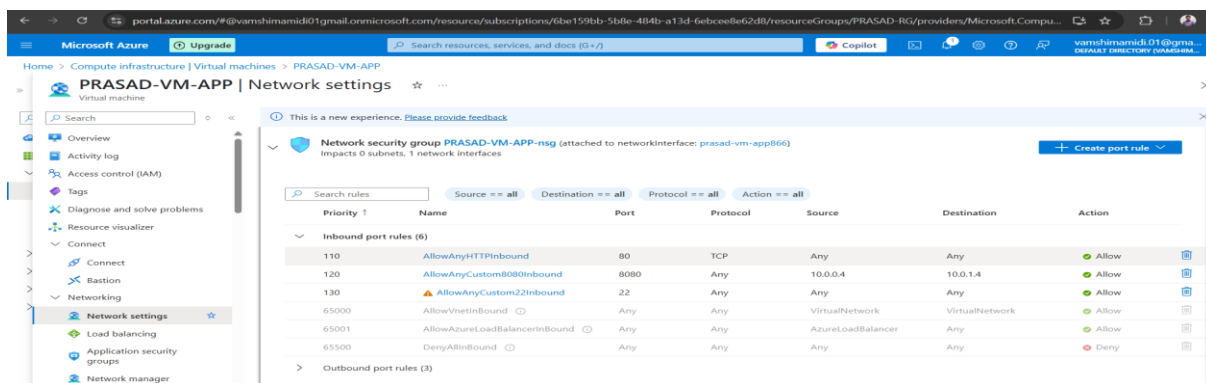
root@PRASAD-VM-APP:/home/prasadadmin# wget https://dlcdn.apache.org/tomcat/tomcat-10/v10.1.42/bin/apache-tomcat-10.1.42.tar.gz
--2025-07-05 06:44:51-- https://dlcdn.apache.org/tomcat/tomcat-10/v10.1.42/bin/apache-tomcat-10.1.42.tar.gz
Resolving dlcdn.apache.org (dlcdn.apache.org)... 151.101.2.132, 2a04:4e42::644
Connecting to dlcdn.apache.org (dlcdn.apache.org)[151.101.2.132]:443... connected.
HTTP request sent, awaiting response... 404 Not Found
2025-07-05 06:44:26 ERROR 404: Not Found.

root@PRASAD-VM-APP:/home/prasadadmin# ls
apache-tomcat-10.1.42 tar.gz apache-tomcat-10.1.42.tar.gz.1 tomcat
root@PRASAD-VM-APP:/home/prasadadmin# cd tomcat/
root@PRASAD-VM-APP:/home/prasadadmin/tomcat# ls
BUILDING.txt CONTRIBUTING.md LICENSE NOTICE README.md RELEASE-NOTES RUNNING.txt apache-tomcat-10.1.42 bin conf lib logs temp webapps work
root@PRASAD-VM-APP:/home/prasadadmin/tomcat/bin# ls
bootstrap.jar ciphers.bat configtest.bat digest.sh migrate.sh shutdown.sh tomcat-native.tar.gz version.sh
catalina-tasks.xml ciphers.sh configtest.sh makebase.bat setclasspath.bat startup.bat tool-wrapper.bat
catalina.bat commons-daemon-native.tar.gz daemon.sh makebase.sh setclasspath.sh startup.sh tool-wrapper.sh
catalina.sh commons-daemon.jar digest.bat migrate.bat shutdown.bat tomcat-juli.jar version.bat
root@PRASAD-VM-APP:/home/prasadadmin/tomcat/bin# ./startup.sh
Using CATALINA_BASE: /home/prasadadmin/tomcat
Using CATALINA_HOME: /home/prasadadmin/tomcat
Using CATALINA_TMPDIR: /home/prasadadmin/tomcat/temp
Using JRE_HOME: /usr
Using CLASSPATH: /home/prasadadmin/tomcat/bin/bootstrap.jar:/home/prasadadmin/tomcat/bin/tomcat-juli.jar
Tomcat started.
root@PRASAD-VM-APP:/home/prasadadmin/tomcat/bin#

```

8. Allow HTTP Traffic via NSG

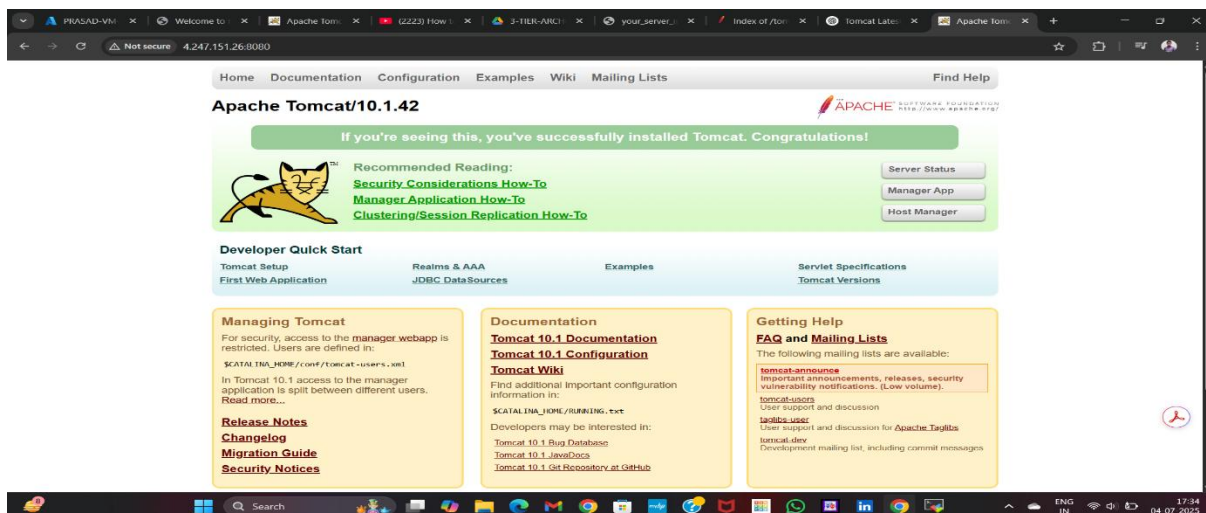
Note: [If you're not seeing the Tomcat page, your Network Security Group (NSG) may be blocking port 8080. Run this to allow HTTP (port 8080) on the NSG]



9. Access Tomcat

Open your browser and go to:

[http:// 4.247.151.26:8080](http://4.247.151.26:8080)



METHOD-3:

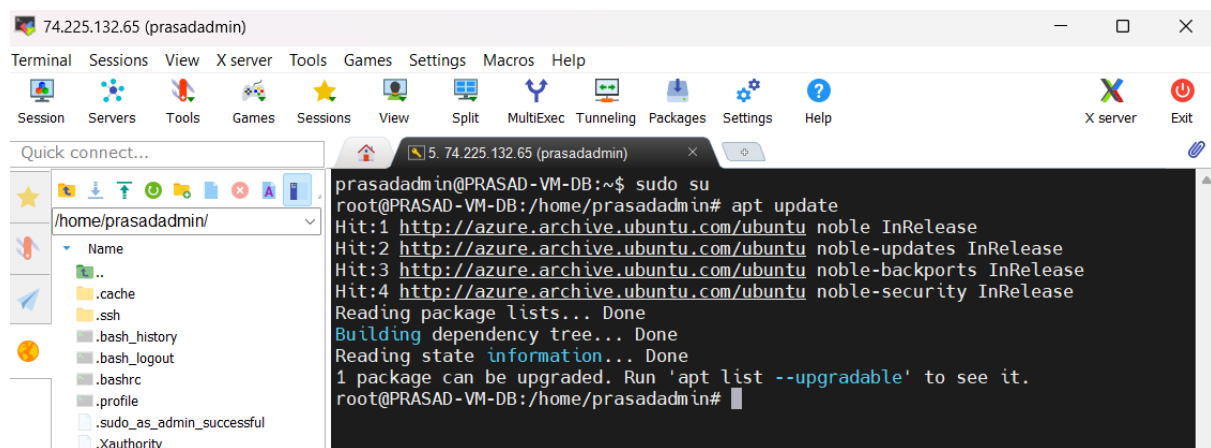
Installation of tomcat in PRASAD-VM-DB

1: Using sudo su (Recommended)

- **sudo su**
 - a. This switches you to the root user.
 - b. The prompt will change from \$ to #.

2. Update System Packages

• apt update



```

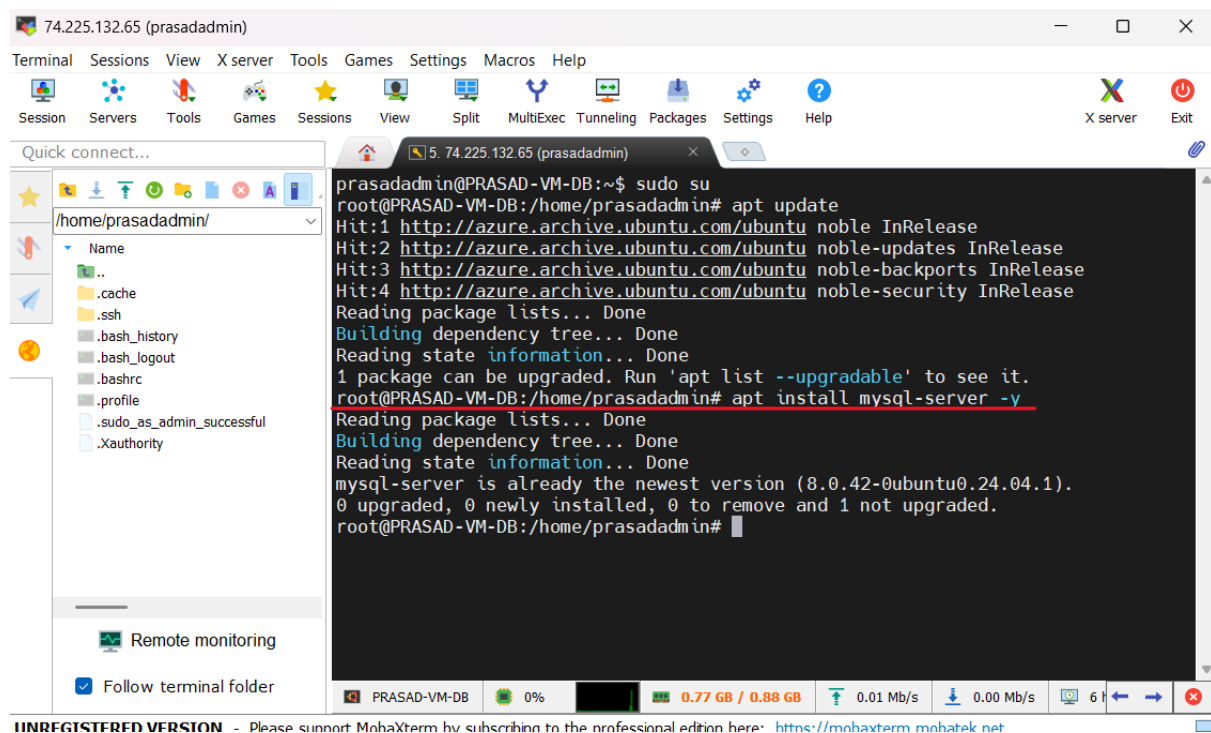
74.225.132.65 (prasadadmin)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help

Quick connect...
/home/prasadadmin/
  Name
  ..
  .cache
  .ssh
  .bash_history
  .bash_logout
  .bashrc
  .profile
  .sudo_as_admin_successful
  .Xauthority

prasadadmin@PRASAD-VM-DB:~$ sudo su
root@PRASAD-VM-DB:/home/prasadadmin# apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://azure.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://azure.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 http://azure.archive.ubuntu.com/ubuntu noble-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
1 package can be upgraded. Run 'apt list --upgradable' to see it.
root@PRASAD-VM-DB:/home/prasadadmin#
  
```

3.Run the following command to install MySQL:

• apt install mysql-server -y



```

74.225.132.65 (prasadadmin)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help

Quick connect...
/home/prasadadmin/
  Name
  ..
  .cache
  .ssh
  .bash_history
  .bash_logout
  .bashrc
  .profile
  .sudo_as_admin_successful
  .Xauthority

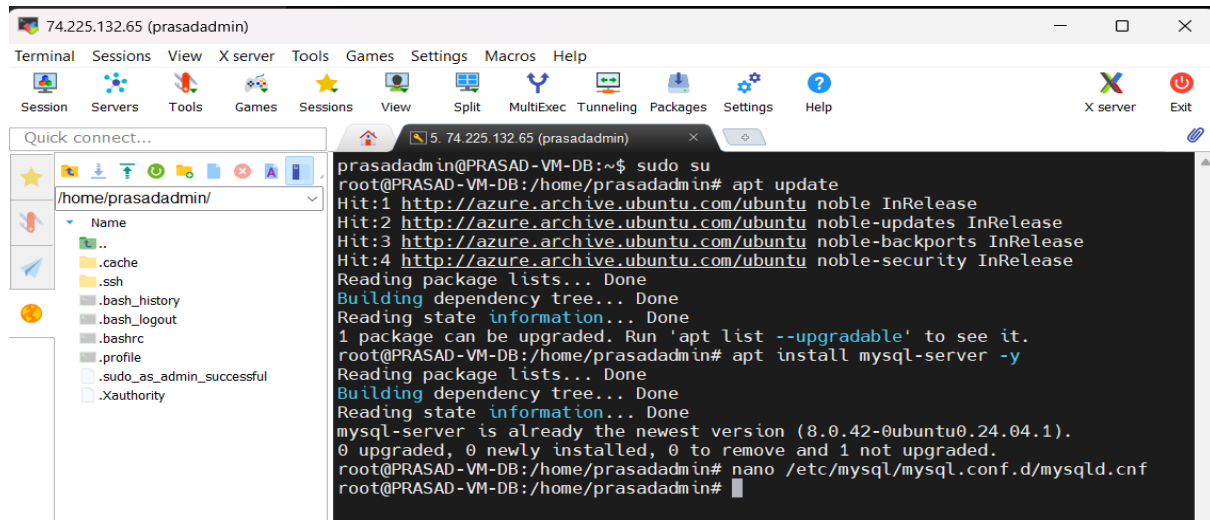
prasadadmin@PRASAD-VM-DB:~$ sudo su
root@PRASAD-VM-DB:/home/prasadadmin# apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://azure.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://azure.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 http://azure.archive.ubuntu.com/ubuntu noble-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
1 package can be upgraded. Run 'apt list --upgradable' to see it.
root@PRASAD-VM-DB:/home/prasadadmin# apt install mysql-server -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
mysql-server is already the newest version (8.0.42-0ubuntu0.24.04.1).
0 upgraded, 0 newly installed, 0 to remove and 1 not upgraded.
root@PRASAD-VM-DB:/home/prasadadmin#
  
```


4.To improve security, run the following command:

- **mysql_secure_installation**

5.Edit the MySQL configuration file using a text editor:

- **nano /etc/mysql/mysql.conf.d/mysqld.cnf**



```

74.225.132.65 (prasadadmin)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
/home/prasadadmin/
Name
.cache
.ssh
.bash_history
.bash_logout
.bashrc
.profile
.sudo_as_admin_successful
.Xauthority
prasadadmin@PRASAD-VM-DB:~$ sudo su
root@PRASAD-VM-DB:/home/prasadadmin# apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://azure.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://azure.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 http://azure.archive.ubuntu.com/ubuntu noble-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
1 package can be upgraded. Run 'apt list --upgradable' to see it.
root@PRASAD-VM-DB:/home/prasadadmin# apt install mysql-server -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
mysql-server is already the newest version (8.0.42-0ubuntu0.24.04.1).
0 upgraded, 0 newly installed, 0 to remove and 1 not upgraded.
root@PRASAD-VM-DB:/home/prasadadmin# nano /etc/mysql/mysql.conf.d/mysqld.cnf
root@PRASAD-VM-DB:/home/prasadadmin#

```

6. Locate the following line: bind-address = 127.0.0.1

- **bind-address = 0.0.0.0**

7. EX: Modify it based on your requirement:

Scenario Configuration

Listen on all interfaces (for remote access) bind-address = 0.0.0.0

Listen on a specific IP (e.g., 192.168.1.100) bind-address = 192.168.1.100

- **Save and exit (CTRL + X, then Y, then Enter).**

8. Apply the changes by restarting MySQL:

- **systemctl restart mysql**

9.Check if MySQL is running:

- **systemctl status mysql**

```

74.225.132.65 (prasadadmin)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
/home/prasadadmin/
Name
..
.cache
.ssh
.bash_history
.bash_logout
.bashrc
.profile
.sudo_as_admin_successful
.Xauthority
Remote monitoring
Follow terminal folder
PRASAD-VM-DB 1% 0.73 GB / 0.88 GB 0.01 Mb/s 0.00 Mb/s 6 f
UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: https://mobaxterm.mobatek.net

Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
mysql-server is already the newest version (8.0.42-0ubuntu0.24.04.1).
0 upgraded, 0 newly installed, 0 to remove and 1 not upgraded.
root@PRASAD-VM-DB:/home/prasadadmin# nano /etc/mysql/mysql.conf.d/mysqld.cnf
root@PRASAD-VM-DB:/home/prasadadmin# systemctl restart mysql
root@PRASAD-VM-DB:/home/prasadadmin# systemctl status mysql
● mysql.service - MySQL Community Server
   Loaded: loaded (/usr/lib/systemd/system/mysql.service; enabled; preset: en>
   Active: active (running) since Fri 2025-07-04 17:06:05 UTC; 13s ago
   Process: 9335 ExecStartPre=/usr/share/mysql/mysql-systemd-start pre (code=e>
   Main PID: 9343 (mysqld)
   Status: "Server is operational"
     Tasks: 38 (limit: 1056)
    Memory: 393.4M (peak: 410.3M)
       CPU: 815ms
    CGroup: /system.slice/mysql.service
            └─9343 /usr/sbin/mysqld

Jul 04 17:06:04 PRASAD-VM-DB systemd[1]: Starting mysql.service - MySQL Commu>
Jul 04 17:06:05 PRASAD-VM-DB systemd[1]: Started mysql.service - MySQL Commu>
lines 1-14/14 (END)

```

Recommended NSG Rules for 3-Tier Setup :

(Network Security Group) is like a firewall for your Azure VMs or subnets. It controls inbound and outbound traffic using allow/deny rules based on:

- Source IP
- Destination IP
- Port
- Protocol (TCP/UDP)

1.PRASAD-VM-WEB Setup NSG:

Home > PRASAD-VM-WEB

PRASAD-VM-WEB | Network settings

Virtual machine

Search

This is a new experience. Please provide feedback

Network security group PRASAD-VM-WEB-nsg (attached to networkInterface: prasad-vm-web-439)

Impacts 0 subnets, 1 network interfaces

Priority	Name	Port	Protocol
100	AllowAnyHTTPInbound	80	TCP
110	AllowAnyCustom22Inbound	22	Any
65000	AllowVnetInbound	Any	Any
65001	AllowAzureLoadBalancerInbound	Any	Any
65500	DenyAllInbound	Any	Any

Outbound port rules (3)

AllowAnyHTTPInbound

Source: Any

Source port ranges: *

Destination: IP Addresses

Destination IP addresses/CIDR ranges: 10.0.0.4

Service: HTTP

Destination port ranges: 80

Protocol: TCP

Save Cancel

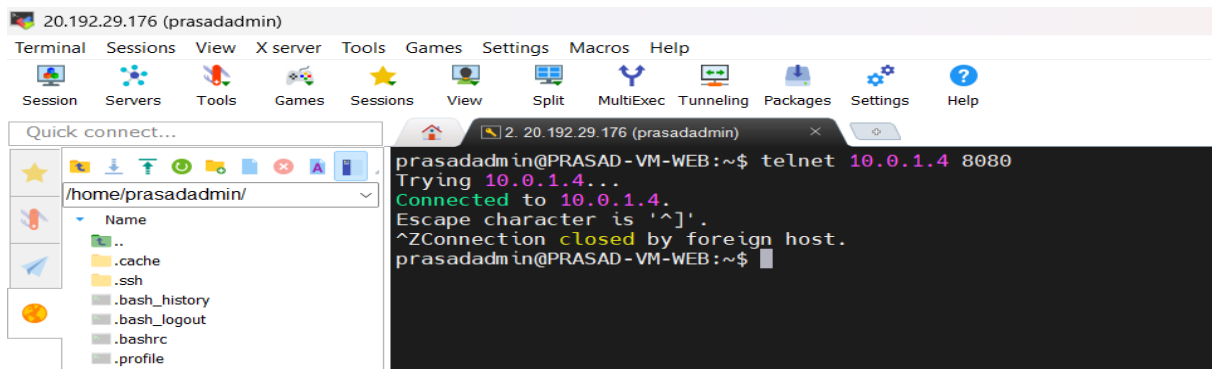
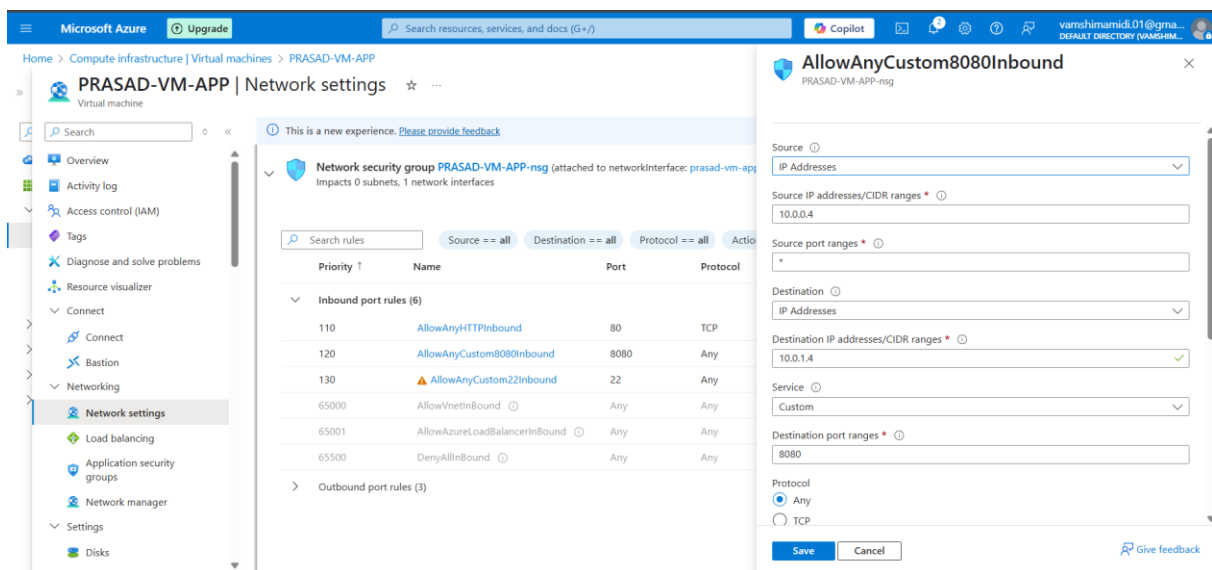
Inbound Rules:

Source: Any

Destination: PRASAD-VM-WEB→ 10.0.0.4

Dport: http,https [80,443]

Action: Allow

telnet<APPVM02>8080**2.PRASAD-VM-APP Setup NSG:****Inbound Rules**

Source: PRASAD-VM-WEB→ 10.0.0.4

Destination: PRASAD-VM-APP→10.0.1.4

Dport: [8080]

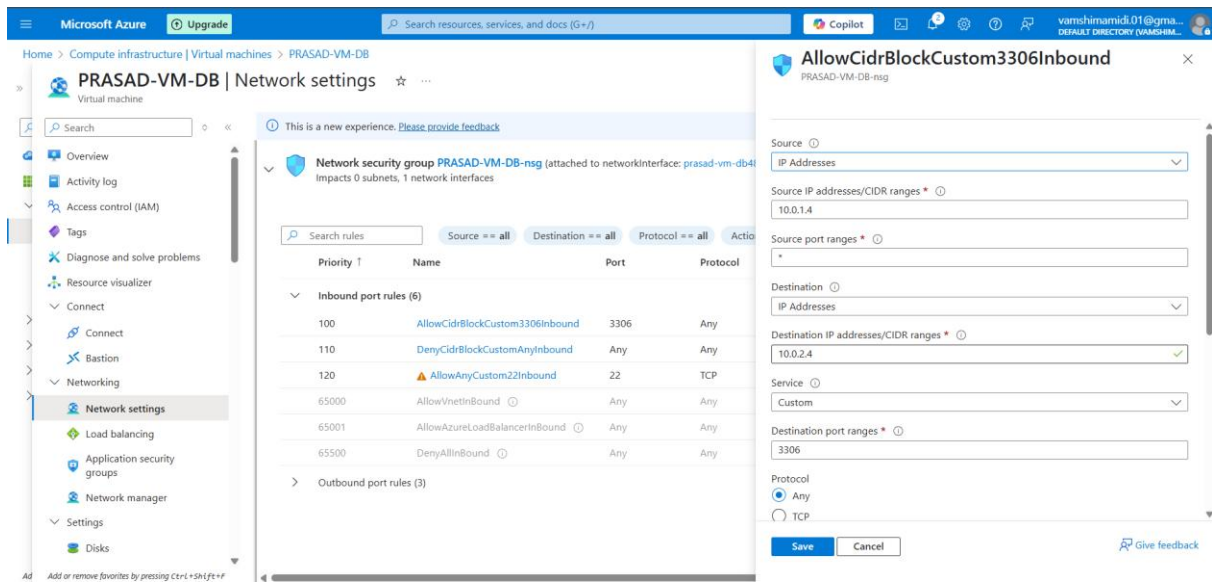
Action: Allow

telnet<PRASAD-VM-DB>3306

```

4.247.151.26 (prasadmin)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
/home/prasadadmin/
Name
.cache
.ssh
prasadmin@PRASAD-VM-APP:~$ telnet 10.0.2.4 3306
Trying 10.0.2.4...
Connected to 10.0.2.4.
Escape character is '^]'.
Host 'prasad-vm-app.internal.cloudapp.net' is not allowed to connect to this MySQL serverConnection closed by foreign host.
prasadmin@PRASAD-VM-APP:~$

```

3.PRASAD-VM-DB Setup NSG:**Inbound Rules :**

Source: PRASAD-VM-APP→ 10.0.1.4

Destination:PRASAD-VM-BD→ 10.0.2.4

Dport:[3306]

Action: Allow

telnet<PRASAD-VM-WEB>80

```

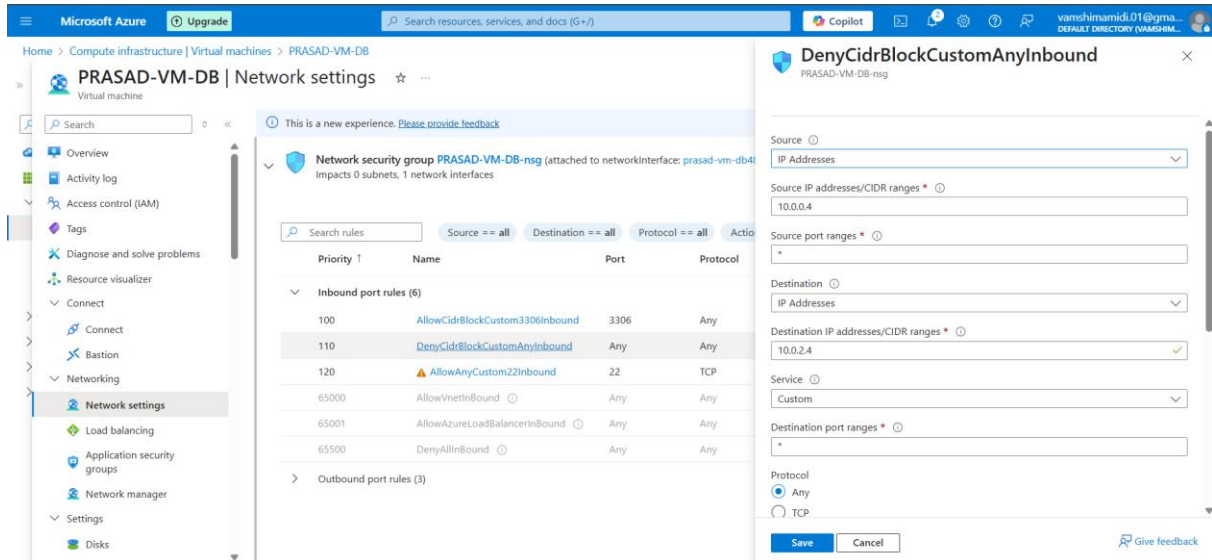
74.225.132.65 (prasadmin)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
/home/prasadadmin/
Name
.cache
.ssh
.bash_history
.bash_logout
.bashrc
.profile
.sudo_as_admin_successful
.Xauthority
prasadmin@PRASAD-VM-DB:~$ telnet 10.0.0.4 80
Trying 10.0.0.4...
Connected to 10.0.0.4.
Escape character is '^]'.
^ZConnection closed by foreign host.
prasadmin@PRASAD-VM-DB:~$

```

Perfect — if your VMs (PRASAD-VM-WEB, PRASAD-VM-APP, and PRASAD-VM-DB) are successfully connecting to each other.

❖ DbVM03 denies access from WebVM01 by design, because the Web tier should not talk to the database. The web tier doesn't need direct access to the database, so we deny it.

❖ This limits the impact of a compromised web server — attackers can't jump straight to your database.



Inbound Rules

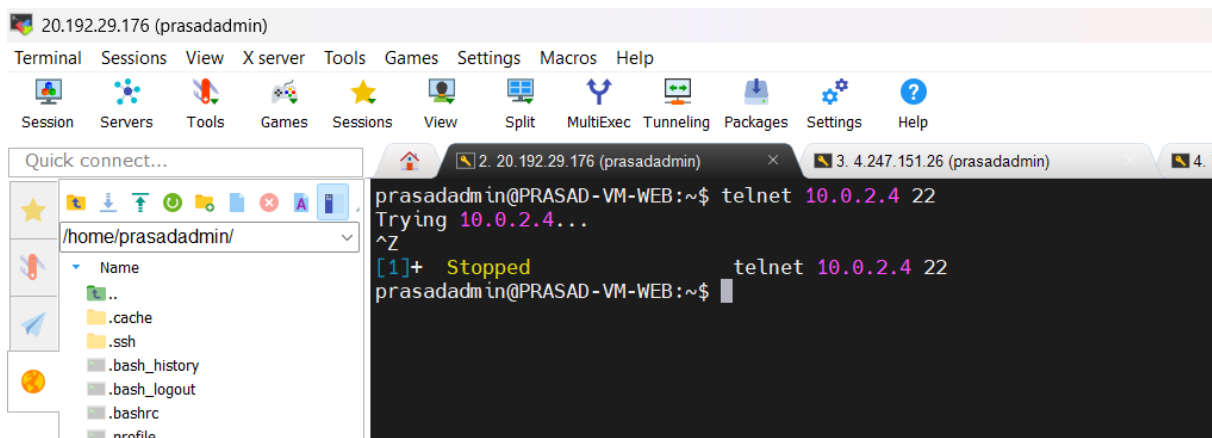
Source: PRASAD-VM-WEB→10.0.0.4

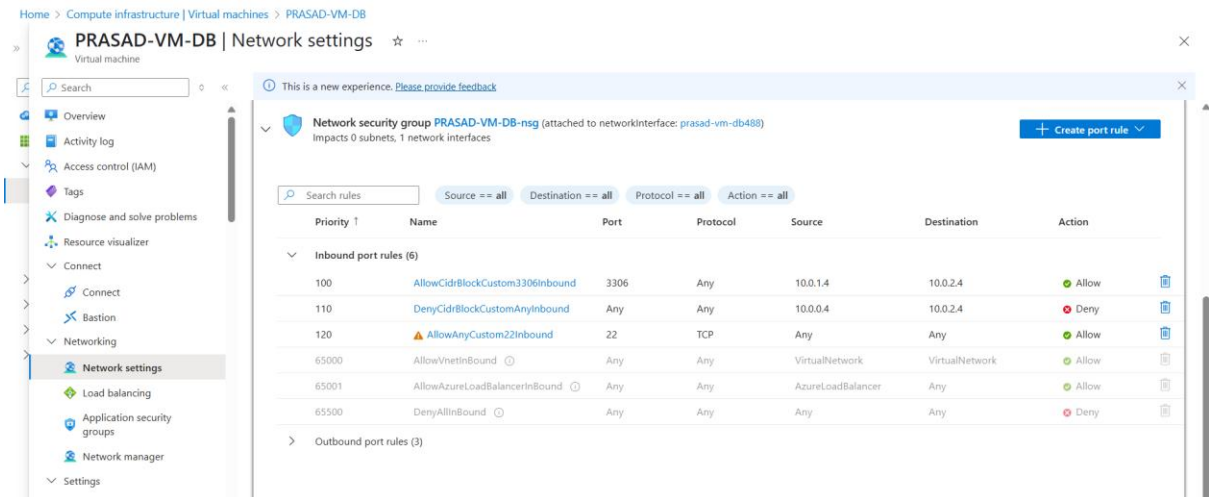
Destination: PRASAD-VM-DB→1.0.2.4

Dport: [*]

Access: Deny

telnet<PRASAD-VM-DB>22





Conclusion:

1. NSGs protect your VMs by controlling which traffic is allowed or denied.
2. Deny rules help block unwanted access between tiers (e.g., Web → DB).
3. This ensures a secure and well-isolated 3-tier architecture in Azure.