Assignment : 1

Practical 1 :

Installation ns3 in Linux, NetAnim, Wireshark, PyViz, tcpdump.
NS-3 (Network Simulator 3) is an open-source discrete-event network simulator used primarily for research, development, and educational purposes in the field of computer networks. It is designed to provide a realistic and flexible environment for simulating and testing various network protocols, systems, and behaviors. NS-3 is widely used to model and analyze network communication, including both wired and wireless networks.

Key features of NS-3 include:

1. **Modular Design**: NS-3 is built in a modular fashion, which allows for easy addition of new modules and functionality.
2. **Support for Various Network Protocols**: It supports a wide variety of networking protocols such as TCP, UDP, IP, HTTP, and many wireless protocols like LTE, WiFi, and Bluetooth.
3. **Realistic Simulation**: NS-3 can simulate both lower-layer protocols (like PHY and MAC) and higher-layer protocols, providing a detailed and realistic network simulation.
4. **Extensibility**: Researchers can extend and modify the simulator according to their needs, making it highly customizable for specialized studies.
5. **Python and C++ Interface**: NS-3 provides a programming interface in both C++ and Python, allowing users to write and run simulations in their preferred language.

NS-3 is a powerful tool for studying the behavior of networks and is commonly used in academic research to test new protocols and network configurations in a simulated environment.

Sudo apt update

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```
bvimit@bvimit:~$ sudo apt update
Hit:1 http://in.archive.ubuntu.com/ubuntu focal InRelease
Hit:2 http://in.archive.ubuntu.com/ubuntu focal-updates InRelease
Hit:3 http://in.archive.ubuntu.com/ubuntu focal-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu focal-security InRelease
Reading package lists... Done
Building dependency tree
Reading state information... Done
All packages are up to date.
```

Minimal requirements for C++ users

Sudo apt-get install g++ python3


```
bvimit@bvimit:~$ sudo apt-get install g++ python3
Reading package lists... Done
Building dependency tree
Reading state information... Done
g++ is already the newest version (4:9.3.0-1ubuntu2).
g++ set to manually installed.
python3 is already the newest version (3.8.2-0ubuntu2).
python3 set to manually installed.
The following packages were automatically installed and are no longer required:
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi libfwupdplugin1 libgstreamer-plugins-bad1.0-0 libva-wayland2
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
bvimit@bvimit:~$
```



```
bvimit@bvimit:~$ sudo apt install python3-gi python3-gi-cairo python3-pygraphviz python3-gi python3-gi-cairo
Reading package lists... Done
Building dependency tree
Reading state information... Done
python3-gi is already the newest version (3.36.0-1).
python3-gi set to manually installed.
python3-gi-cairo is already the newest version (3.36.0-1).
python3-gi-cairo set to manually installed.
The following packages were automatically installed and are no longer required:
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi libfwupdplugin1 libgstreamer-plugins-bad1.0-0 libva-wayland2
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  graphviz libann0 libcdt5 libcgraph6 libgts-0.7-5 libgts-bin libgvc6 libgvpr2 liblab-gamut1 libpathplan4
Suggested packages:
  gsfonts graphviz-doc python-pygraphviz-doc
The following NEW packages will be installed:
  graphviz libann0 libcdt5 libcgraph6 libgts-0.7-5 libgts-bin libgvc6 libgvpr2 liblab-gamut1 libpathplan4 python3-pygraphviz
0 upgraded, 11 newly installed, 0 to remove and 0 not upgraded.
Need to get 1,952 kB of archives.
After this operation, 9,624 kB of additional disk space will be used.
Do you want to continue? [Y/n]
```

Minimal requirements for Python API users sudo apt-get

install g++ python3 python3-dev pkg-config sqlite3

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```
bvimit@bvimit:~$ sudo apt-get install g++ python3 python3-dev pkg-config sqlite3
Reading package lists... Done
Building dependency tree
Reading state information... Done
g++ is already the newest version (4:9.3.0-1ubuntu2).
pkg-config is already the newest version (0.29.1-0ubuntu4).
pkg-config set to manually installed.
python3 is already the newest version (3.8.2-0ubuntu2).
The following packages were automatically installed and are no longer required:
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi libfwupdplugin1 libgstreamer-plugins-bad1.0-0 libva-wayland2
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  libexpat1-dev libpython3-dev libpython3.8-dev python3-distutils python3.8-dev zlib1g-dev
Suggested packages:
  sqlite3-doc
The following NEW packages will be installed:
  libexpat1-dev libpython3-dev libpython3.8-dev python3-dev python3-distutils python3.8-dev sqlite3 zlib1g-dev
0 upgraded, 8 newly installed, 0 to remove and 0 not upgraded.
Need to get 5,748 kB of archives.
After this operation, 26.3 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
```

Netanim animator: qt5 development tools are needed for Netanim animator; sudo apt-get install qt5-default mercurial.

```
bvimit@bvimit:~$ sudo apt-get install qt5-default mercurial
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi libfwupdplugin1 libgstreamer-plugins-bad1.0-0 libva-wayland2
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  libdouble-conversion3 libegl-dev libgl-dev libglu1-mesa-dev libglx-dev libpcre2-16-0 libpthread-stubs0-dev libpython2-stdlib libpython2.7-min
  libpython2.7-stdlib libqt5concurrent5 libqt5core5a libqt5dbus5 libqt5gui5 libqt5network5 libqt5opengl5 libqt5opengl5-dev libqt5printsupport5
  libqt5sql5-sqlite libqt5svg5 libqt5test5 libqt5widgets5 libqt5xml5 libvulkan-dev libx11-dev libxau-dev libxcb-xinerama0 libxcb-xinput0 libxcb
  libxext-dev mercurial-common python2 python2-minimal python2.7 python2.7-minimal qt5-gtk-platformtheme qt5-qmake qt5-qmake-bin qtbase5-dev qt
  qtchooser qttranslations5-l10n x11proto-core-dev x11proto-dev x11proto-xext-dev xorg-sgml-doctools xtrans-dev
Suggested packages:
  qt5-image-formats-plugins qtwayland5 libx11-doc libxcb-doc libxext-doc kdiff3 | kdiff3-qt | kompare | meld | tkcvs | mgdiff qct python-mysqld
  python-pygments wish python2-doc python-tk python2.7-doc binfmt-support default-libmysqlclient-dev firebird-dev libpq-dev libsqlite3-dev unix
The following NEW packages will be installed:
  libdouble-conversion3 libegl-dev libgl-dev libglu1-mesa-dev libglx-dev libpcre2-16-0 libpthread-stubs0-dev libpython2-stdlib libpython2.7-min
  libpython2.7-stdlib libqt5concurrent5 libqt5core5a libqt5dbus5 libqt5gui5 libqt5network5 libqt5opengl5 libqt5opengl5-dev libqt5printsupport5
  libqt5sql5-sqlite libqt5svg5 libqt5test5 libqt5widgets5 libqt5xml5 libvulkan-dev libx11-dev libxau-dev libxcb-xinerama0 libxcb-xinput0 libxcb
  libxext-dev mercurial mercurial-common python2 python2-minimal python2.7 python2.7-minimal qt5-default qt5-gtk-platformtheme qt5-qmake qt5-qm
  qtbase5-dev-tools qtchooser qttranslations5-l10n x11proto-core-dev x11proto-dev x11proto-xext-dev xorg-sgml-doctools xtrans-dev
0 upgraded, 51 newly installed, 0 to remove and 0 not upgraded.
Need to get 23.0 MB of archives.
After this operation, 117 MB of additional disk space will be used.
Do you want to continue? [Y/n]
```

ns-3-pyviz visualizer sudo apt-get

install gir1.2-goocanvas-2.0

Sudo apt-get install python3-gi python3-gi-cairo python3-pygraphviz python3-gi python3-gi-cairo

sudo apt-get install python3-pygraphviz gir1.2-gtk-3.0 ipython3 ipython3

```
bvimit@bvimit:~$ sudo apt-get install python3-pygraphviz gir1.2-gtk-3.0 ipython3 ipython3
Reading package lists... Done
Building dependency tree
Reading state information... Done
python3-pygraphviz is already the newest version (1.5-4build1).
gir1.2-gtk-3.0 is already the newest version (3.24.20-0ubuntu1.1).
gir1.2-gtk-3.0 set to manually installed.
The following packages were automatically installed and are no longer required:
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi libfwupdplugin1 libgstreamer-plugins-bad1.0-0 libva-wayland2
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  python3-backcall python3-decorator python3-ipython python3-ipython-genutils python3-jedi python3-parso python3-pickleshare python3-prompt
  python3-traitlets python3-wcwidth
Suggested packages:
  python-ipython-doc python-pygments-doc ttf-bitstream-vera
The following NEW packages will be installed:
  ipython3 python3-backcall python3-decorator python3-ipython python3-ipython-genutils python3-jedi python3-parso python3-pickleshare pytho
  python3-pygments python3-traitlets python3-wcwidth
0 upgraded, 12 newly installed, 0 to remove and 0 not upgraded.
Need to get 1,990 kB of archives.
After this operation, 12.1 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
```

Debugging:

sudo apt-get install gdb valgrind

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```
bvimit@bvimit:~$ sudo apt-get install gdb valgrind
Reading package lists... Done
Building dependency tree
Reading state information... Done
gdb is already the newest version (9.2-0ubuntu1~20.04.1).
gdb set to manually installed.
The following packages were automatically installed and are no longer required:
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi libfwupdplugin1 libgstreamer-plugins-bad1.0-0 libva-wayland2
Use 'sudo apt autoremove' to remove them.
Suggested packages:
  valgrind-dbg valgrind-mpi kcachegrind alleyoop valkyrie
The following NEW packages will be installed:
  valgrind
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 20.3 MB of archives.
After this operation, 90.0 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 valgrind amd64 1:3.15.0-1ubuntu9.1 [20.3 MB]
17% [1 valgrind 4,323 kB/20.3 MB 21%]
```

Doxygen and related inline documentation:

sudo apt-get install doxygen graphviz imagemagick

```
bvimit@bvimit:~$ sudo apt-get install doxygen graphviz imagemagick
Reading package lists... Done
Building dependency tree
Reading state information... Done
graphviz is already the newest version (2.42.2-3build2).
graphviz set to manually installed.
The following packages were automatically installed and are no longer required:
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi libfwupdplugin1 libgstreamer-plugins-bad1.0-0 libva-wayland2
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  gsfonts imagemagick-6-common imagemagick-6.q16 libclang1-10 libilmbase24 libllvm10 liblqr-1-0 libmagickcore-6.
  libmagickwand-6.q16-6 libnetpbm10 libopenexr24 libxapian30 netpbm
Suggested packages:
  doxygen-latex doxygen-doc doxygen-gui imagemagick-doc autotrace curl enscript ffmpeg gimp gnuplot grads hp2xx
  texlive-base-bin transfig ufraw-batch inkscape libjxr-tools xapian-tools
The following NEW packages will be installed:
  doxygen gsfonts imagemagick-6-common imagemagick-6.q16 libclang1-10 libilmbase24 libllvm10 liblqr-
  libmagickwand-6.q16-6 libnetpbm10 libopenexr24 libxapian30 netpbm
0 upgraded, 16 newly installed, 0 to remove and 0 not upgraded.
Need to get 40.6 MB of archives.
After this operation, 177 MB of additional disk space will be used.
Do you want to continue? [Y/n]
```

sudo apt-get install texlive texlive-extra-utils texlive-latex-extra texlive-font-utils dvipng latexmk

```
bvimit@bvimit:~$ sudo apt-get install texlive texlive-extra-utils texlive-latex-extra texlive-font-utils dvipng latexmk
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi libfwupdplugin1 libgstreamer-plugins-bad1.0-0 libva-wayland2
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  dvisvgm fonts-lato fonts-lmodern fonts-texgyre javascript-common libalgorithm-c3-perl libapache-pom-java libb-hooks-endofscope-perl li
  libclass-c3-perl libclass-c3-xs-perl libclass-data-inheritable-perl libclass-method-modifiers-perl libclass-xsaccessor-perl libcommons
  libcommons-parent-java libdata-optlist-perl libdevel-callchecker-perl libdevel-caller-perl libdevel-globaldestruction-perl libdevel-le
  libdevel-stacktrace-perl libdist-checkconflicts-perl libdynaloader-functions-perl libemail-date-format-perl libeval-closure-perl libex
  libfile-homedir-perl libfile-which-perl libfontbox-java libipc-shareable-perl libjs-jquery liblog-dispatch-perl liblog-log4perl-perl l
  libmime-charset-perl libmime-lite-perl libmime-types-perl libmodule-implementation-perl libmodule-runtime-perl libmro-compat-perl libna
  libnamespace-clean-perl libpackage-stash-perl libpackage-stash-xs-perl libpadwalker-perl libparams-classify-perl libparams-util-perl
  libparams-validationcompiler-perl libpdfbox-java libptexenc1 libreadonly-perl libref-util-perl libref-util-xs-perl librole-tiny-perl li
  libspecio-perl libsub-exporter-perl libsub-exporter-progressive-perl libsub-identify-perl libsub-install-perl libsub-name-perl libsub-
  libsys-hostname-long-perl libtcl8.6 libteckit0 libtexlua53 libtexluajit2 libtk8.6 libunicode-linebreak-perl libvariable-magic-perl lib
  libyaml-tiny-perl libzzip-0-13 lmodern preview-latex-style ps2eps rake ruby ruby-minitest ruby-net-telnet ruby-power-assert ruby-test-
  rubygems-integration t1utils tcl tcl8.6 tex-common tex-gyre texlive-base texlive-binaries texlive-fonts-recommended texlive-latex-base
  texlive-pictures texlive-plain-generic tipa tk tk8.6
Suggested packages:
  apache2 | lighttpd | httpd libavalon-framework-java libcommons-logging-java-doc libexcalibur-logkit-java liblog4j1.2-java libdbd-csv-pe
  liblog-dispatch-filerotate-perl librrds-perl libxml-dom-perl libencode-hanextra-perl libpod2-base-perl default-mta | mail-transport-ag
  libscalar-number-perl libtest-fatal-perl ri ruby-dev bundler tcl-tclreadline debhelper perl-tk xzdec chktex dvidvi fragmaster lacheck t
  lcdf-typetools psutils texlive-fonts-recommended-doc texlive-latex-base-doc icc-profiles libspreadsheet-parseexcel-perl texlive-latex-
  texlive-latex-recommended-doc texlive-luatex texlive-pstricks dot2tex prerex ruby-tcltk | libtcltk-ruby texlive-pictures-doc vprerex d
```

The ns-3 manual and tutorial are written in reStructuredText for Sphinx (doc/tutorial, doc/manual, doc/models), and figures typically in dia (also needs the texlive packages above):

sudo apt-get install python3-sphinx di

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Support for generating modified python bindings sudo
apt-get install cmake libc6-dev libc6-dev-i386 libclang-

6.0-devllvm-6.0-dev automake python3-pip

python3 -m pip install --user cxxfilt

After installing the required packages, create a folder named **workspace** in the home
directory and then put the NS3 tar package into the workspace.

Go to terminal and input these commands consecutively after each command

finishes executing: (go to the folder **workspace** where ns3 is installed) cd

workspace

tarxjf<name of NS3 downloaded file name> (to unzip the file) otherwise you

can unzip by right clicking and selecting **explore** option) cd<name of extracted

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NS3> // go to the ns3allinone folder bvimit@bvimit:~/workspace/ns- allinone-

3.32$

/build.py --enable-examples –enable-tests

It takes time be patient !!

Test the NS3 build and installation success by running test.py in the ns directory using

the following commands:

cd ns-<version number> //go to the folder // ns3 folder

in   ns3allinone   bvimit@bvimit:~/workspace/ns-

allinone-3.32/ns-3.32$

then type,

./test.py

$: ./waf --run hello-simulator

This will display "Hello Simulator" Which indicates that ns3 is installed successfully.

NetAnim : It is a graphical animation tool used in conjunction with NS-3 (Network Simulator 3) to visualize and animate network simulations. It provides a user-friendly interface that helps users to view the dynamics of network nodes, packet transmissions, and interactions within a simulated network.

Key features of NetAnim include:

1. **Visualization of Network Topology:** NetAnim allows users to visualize the network topology, showing how nodes (routers, devices, etc.) are connected and how they interact over time.
2. **Packet Trace Animation:** It displays the movement of packets across the network, providing insight into network traffic and communication patterns.
3. **Real-Time Animation:** The tool provides a real-time animation of the simulation, allowing users to see events unfold during the simulation process.

NetAnim is widely used in academic and research settings for educational purposes and for better understanding the outcomes of network simulations through visual representation.

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Open terminal and type sudo apt upgrade

```
kirtee@kirtee-VirtualBox:~$ sudo apt upgrade
[sudo] password for kirtee:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages were automatically installed and are no longer required:
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi
  libgstreamer-plugins-bad1.0-0 libva-wayland2
Use 'sudo apt autoremove' to remove them.
The following packages will be upgraded:
  base-files evolution-data-server evolution-data-server-common
  firmware-sof-signed fonts-opensymbol gdm3 gir1.2-gdm-1.0
  gir1.2-gnomedesktop-3.0 gir1.2-gtk-4.0 gjs gnome-desktop3-data
  gnome-settings-daemon gnome-settings-daemon-common libcamel-1.2-63
  libebackend-1.2-10 libebook-1.2-20 libebook-contacts-1.2-3 libecal-2.0-1
  libedata-book-1.2-26 libedata-cal-2.0-1 libedataserver-1.2-26
  libedataserverui-1.2-3 libgdm1 libgjs0g libgnome-bg-4-1
```

Sudo apt update

```
kirtee@kirtee-VirtualBox:~$ sudo apt update
[sudo] password for kirtee:
Hit:1 http://in.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://in.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:3 http://in.archive.ubuntu.com/ubuntu jammy-backports InRelease
Get:4 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]
Get:5 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages [185
 kB]
Get:6 http://security.ubuntu.com/ubuntu jammy-security/main Translation-en [43.
6 kB]
Get:7 http://security.ubuntu.com/ubuntu jammy-security/main amd64 DEP-11 Metada
ta [11.4 kB]
Fetched 350 kB in 3s (129 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
1 package can be upgraded. Run 'apt list --upgradable' to see it.
```

sudo ./waf configure

```
lab2@lab2-B250M-D2V:~$ cd workspace
lab2@lab2-B250M-D2V:~/workspace$ cd ns-allinone-3.32/ns-3.32
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/ns-3.32$ sudo ./waf configure
[sudo] password for lab2:
Setting top to                          : /home/lab2/workspace/ns-allinone-3.32/ns-3.32
Setting out to                          : /home/lab2/workspace/ns-allinone-3.32/ns-3.32/build
Checking for 'gcc' (C compiler)         : /usr/bin/gcc
Checking for cc version                 : 9.4.0
```

sudo ./waf build

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cd netanim-3.108 & ls

./NetAnim

Successfully the NetAnim will be installed

./NetAnim

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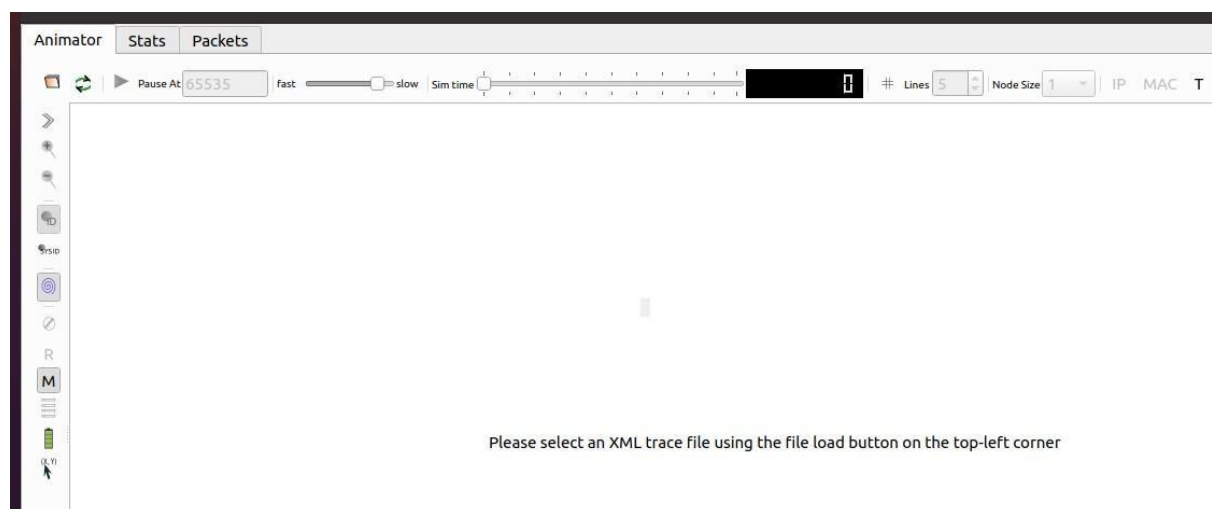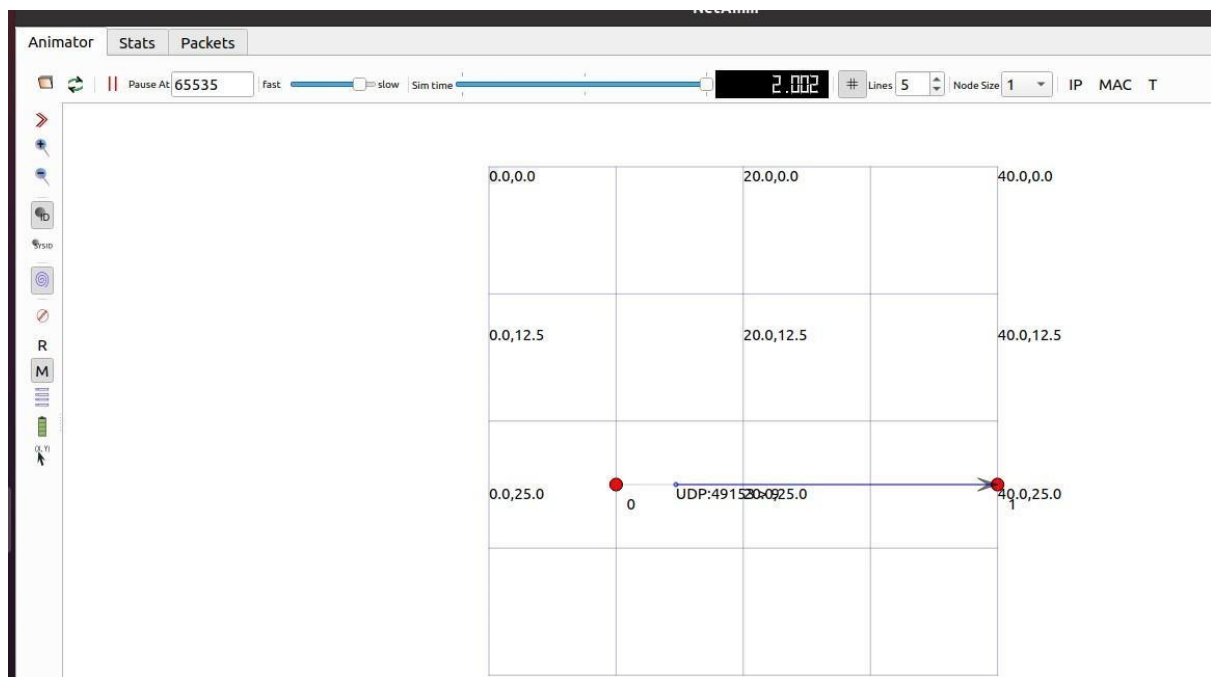
Open the folder->ns-3.32->first.xml.

Then Start the simulation

WireShark : It is a widely used open-source network protocol analyzer that allows users to capture and inspect the data flowing through a computer network in real time. It is an essential tool for network administrators, security professionals, and developers for troubleshooting, analyzing, and understanding network traffic.
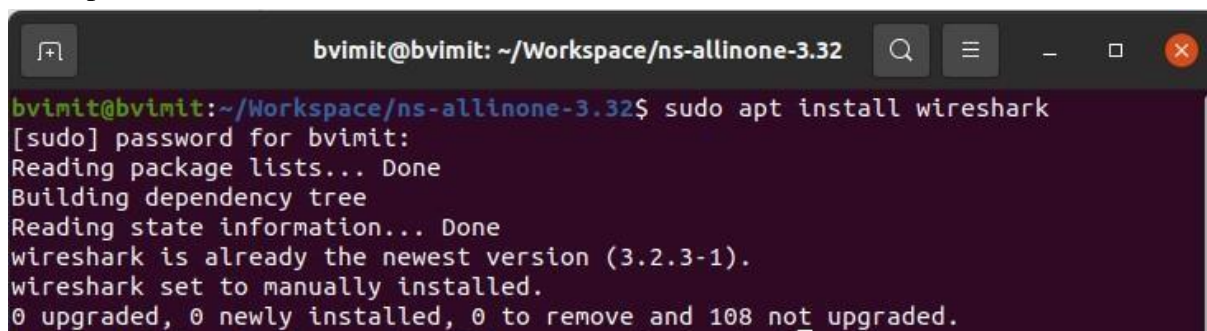
Key features of Wireshark include:

1. **Packet Capture:** Wireshark captures data packets transmitted over a network and provides detailed insights into each packet's contents.
2. **Protocol Analysis:** It supports a vast range of network protocols, allowing users to decode and analyze the structure of the packets, from lower layers (like Ethernet and IP) to higher layers (like HTTP, FTP, etc.).
3. **Real-Time Monitoring:** Wireshark provides real-time monitoring of network traffic, enabling users to capture live data streams and troubleshoot network issues as they occur.
4. **Filter and Search:** Wireshark offers powerful filtering capabilities, allowing users to zoom in on specific traffic, protocols, or hosts, making it easier to analyze specific network issues.
5. **Cross-Platform:** It is available on multiple platforms, including Windows, macOS, and Linux.
6. **Graphical Interface:** It has an intuitive graphical user interface (GUI) that makes it easier for users to navigate and interpret the captured data, though it also supports command-line tools for advanced users.

Wireshark is extensively used for network troubleshooting, protocol development, security analysis, and educational purposes, as it helps users visualize and understand how data flows through a network and where potential issues might arise.
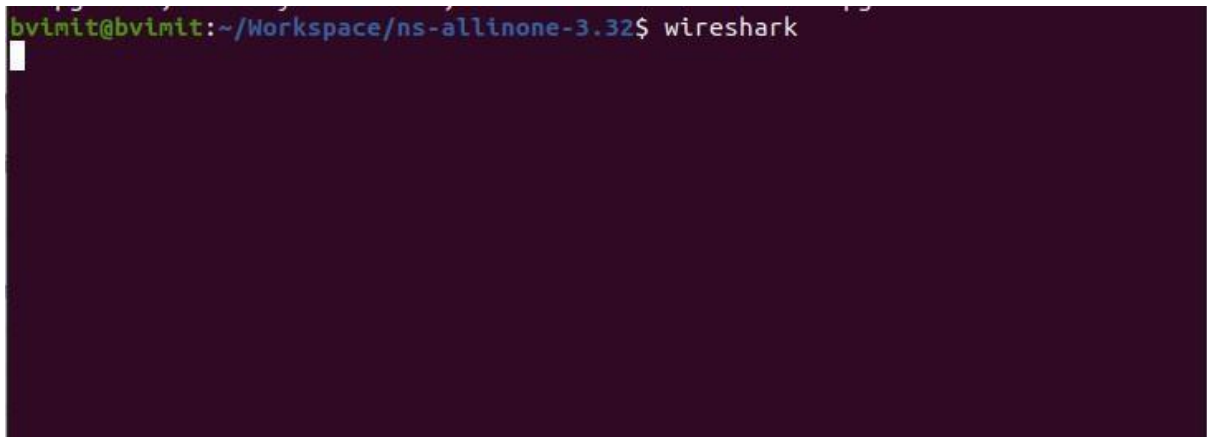
Open Terminal and type the command
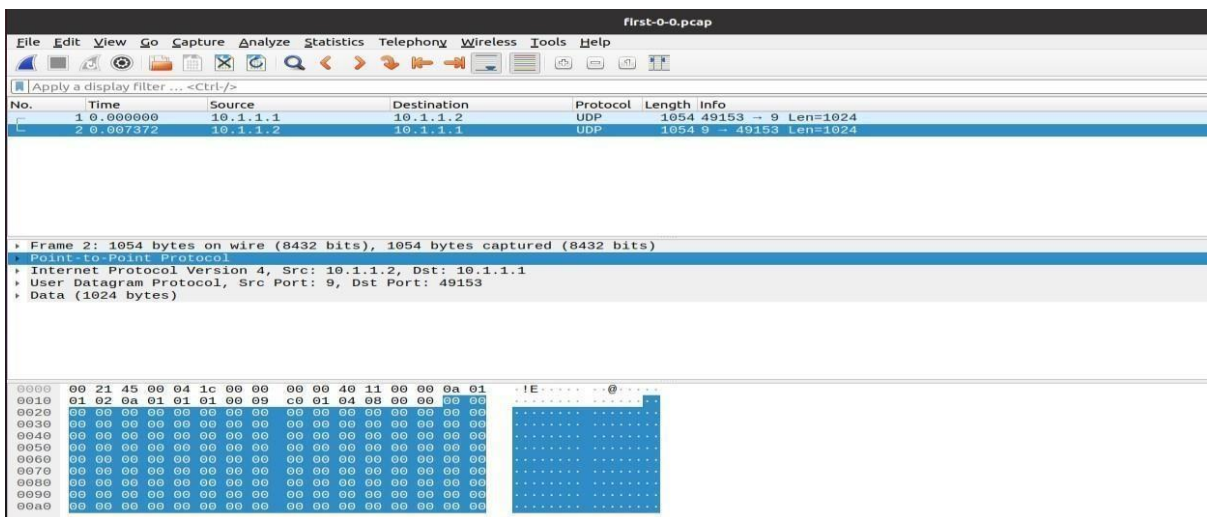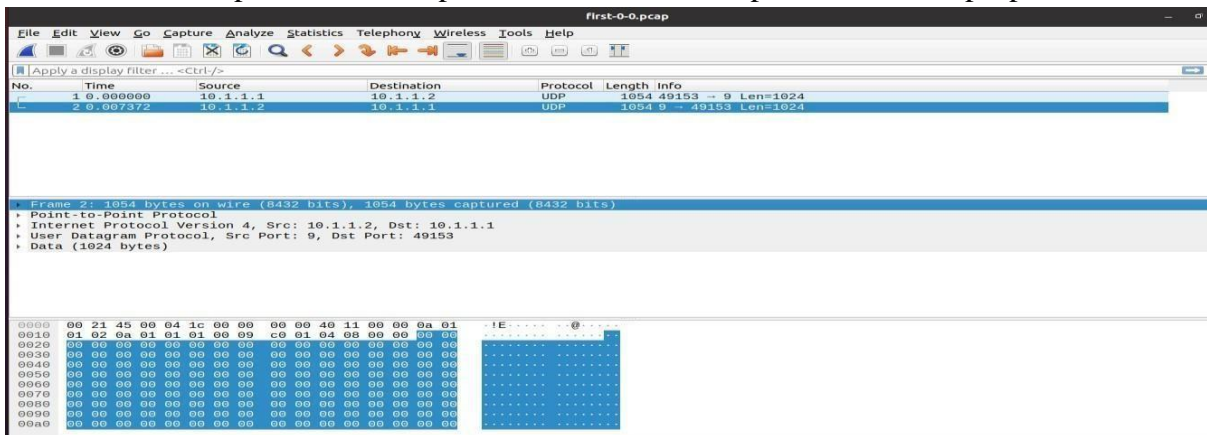sudo apt install wireshark

Then again type wireshark in terminal then directly it will open the wireshark

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```
bvimit@bvimit:~/Workspace/ns-allinone-3.32$ wireshark
```
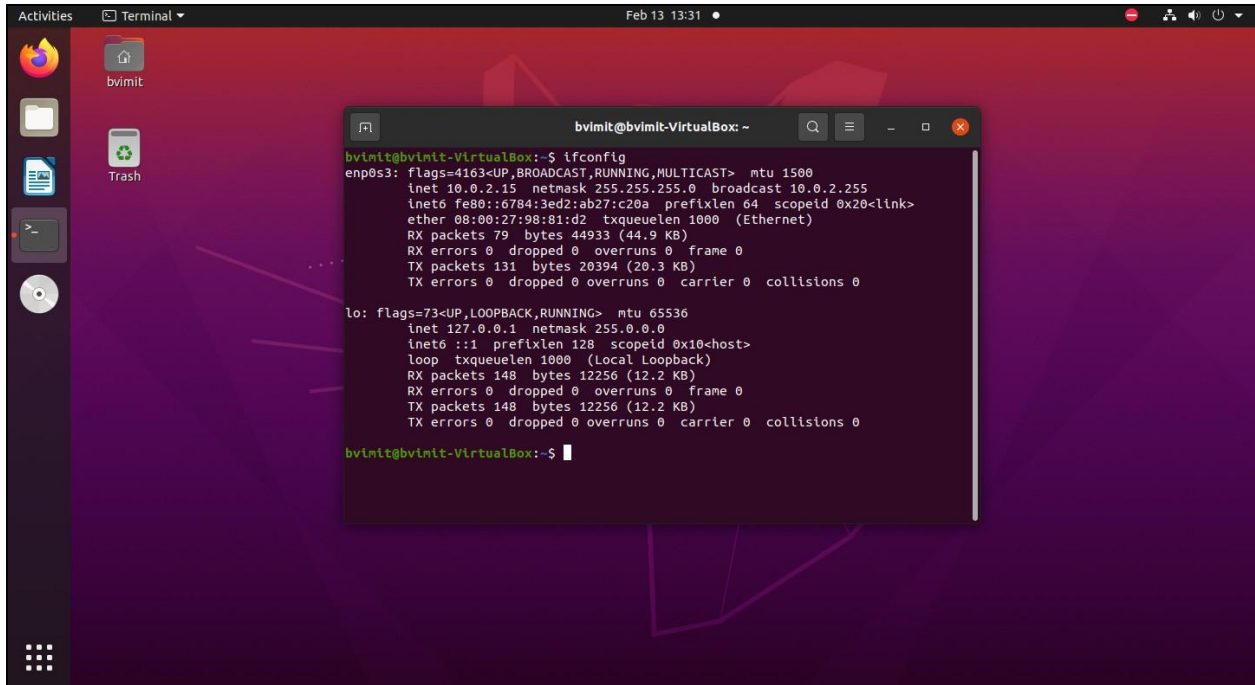
When wireshark open then file->open->Go to ns-3.2 and open the first-0-0.pcap folder.

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Practical No -2
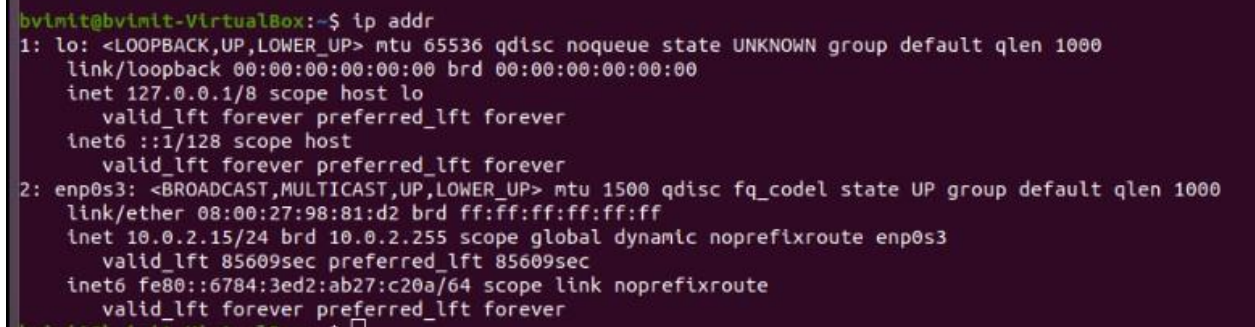
Linux Network Commands -
ifconfig:- To view IP configuration in Linux, use the `ifconfig` or `ip addr show` commands in the terminal. Both will display details for all network interfaces.

IP Route:- This command provides information about the network routes configured on your system.

IP link:- It allows users to interact with various networking components such as network interfaces, routing tables, addresses, etc.

```
bvimit@bvimit-VirtualBox:~$ ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mode DEFAULT group default qlen 1000
    link/ether 08:00:27:98:81:d2 brd ff:ff:ff:ff:ff:ff
```

enp0s3: This is the specific network interface name you want to view information about.

```
bvimit@bvimit-VirtualBox:~$ ip addr show  enp0s3
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:98:81:d2 brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic noprefixroute enp0s3
       valid_lft 85251sec preferred_lft 85251sec
    inet6 fe80::6784:3ed2:ab27:c20a/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
```

Ping: -
To check network connectivity in Linux, use the `ping` command followed by the target hostname or IP address. This sends ICMP echo requests to the specified address and displays the round-trip time and other statistics.

```
bvimit@bvimit-VirtualBox:~$ ping -c 5 chatgpt.com
PING chatgpt.com (104.18.32.47) 56(84) bytes of data.
64 bytes from 104.18.32.47 (104.18.32.47): icmp_seq=1 ttl=52 time=6.72 ms
64 bytes from 104.18.32.47 (104.18.32.47): icmp_seq=2 ttl=52 time=7.85 ms
64 bytes from 104.18.32.47 (104.18.32.47): icmp_seq=3 ttl=52 time=6.95 ms
64 bytes from 104.18.32.47 (104.18.32.47): icmp_seq=4 ttl=52 time=6.90 ms
64 bytes from 104.18.32.47 (104.18.32.47): icmp_seq=5 ttl=52 time=7.37 ms
```

Netstat:-

netstat (Network Statistics) is a command-line tool in Linux used to display network connections, routing tables, interface statistics, and more. It helps in monitoring network activity and troubleshooting network-related issues. Since it's deprecated in some systems, ss is often recommended as an alternative.

```
bvimit@bvimit-VirtualBox:~$ netstat
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address          Foreign Address         State
udp        0      0 bvimit-VirtualBo:bootpc _gateway:bootps         ESTABLISHED
Active UNIX domain sockets (w/o servers)
Proto RefCnt Flags       Type       State         I-Node   Path
unix  2      [ ]         DGRAM                    34962    /run/user/1000/systemd/notify
unix  3      [ ]         DGRAM      CONNECTED     15867    /run/systemd/notify
unix  2      [ ]         DGRAM                    15881    /run/systemd/journal/syslog
unix  16     [ ]         DGRAM      CONNECTED     15891    /run/systemd/journal/dev-log
unix  8      [ ]         DGRAM      CONNECTED     15895    /run/systemd/journal/socket
unix  3      [ ]         STREAM     CONNECTED     35231
unix  3      [ ]         STREAM     CONNECTED     37152    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     22919    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     25912
unix  3      [ ]         STREAM     CONNECTED     38176    @/tmp/.X11-unix/X0
unix  3      [ ]         STREAM     CONNECTED     34588    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     35711
unix  3      [ ]         DGRAM      CONNECTED     34964
unix  3      [ ]         STREAM     CONNECTED     39222    /run/user/1000/bus
unix  2      [ ]         STREAM     CONNECTED     26762
unix  3      [ ]         STREAM     CONNECTED     24871    /run/dbus/system_bus_socket
unix  2      [ ]         DGRAM      CONNECTED     21389
unix  2      [ ]         DGRAM      CONNECTED     24164
unix  2      [ ]         DGRAM      CONNECTED     23728
unix  3      [ ]         STREAM     CONNECTED     35846    /run/user/1000/bus
unix  3      [ ]         STREAM     CONNECTED     35105    /run/user/1000/bus
unix  3      [ ]         STREAM     CONNECTED     34222
```

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Netstat -a:-

netstat -a displays all active network connections, including both listening and non-listening (established) sockets. It helps in identifying open ports and ongoing connections on the system.

```
bvimit@bvimit-VirtualBox:~$ netstat -a
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address          Foreign Address         State
tcp        0      0 localhost:domain       0.0.0.0:*               LISTEN
tcp        0      0 localhost:ipp          0.0.0.0:*               LISTEN
tcp6       0      0 ip6-localhost:ipp      [::]:*                  LISTEN
udp        0      0 localhost:domain       0.0.0.0:*
udp        0      0 bvimit-VirtualBo:bootpc _gateway:bootps        ESTABLISHED
udp        0      0 0.0.0.0:631            0.0.0.0:*
udp        0      0 0.0.0.0:58234          0.0.0.0:*
udp        0      0 0.0.0.0:mdns           0.0.0.0:*
udp6       0      0 [::]:38025             [::]:*
udp6       0      0 [::]:mdns              [::]:*
raw6       0      0 [::]:ipv6-icmp         [::]:*                  7
Active UNIX domain sockets (servers and established)
Proto RefCnt Flags       Type       State         I-Node   Path
unix  2      [ ACC ]     STREAM     LISTENING     33781    @/tmp/.ICE-unix/1686
unix  2      [ ]         DGRAM                    34962    /run/user/1000/systemd/notify
unix  3      [ ]         DGRAM      CONNECTED     15867    /run/systemd/notify
unix  2      [ ACC ]     STREAM     LISTENING     34965    /run/user/1000/systemd/private
unix  2      [ ACC ]     STREAM     LISTENING     15870    /run/systemd/private
unix  2      [ ACC ]     STREAM     LISTENING     34970    /run/user/1000/bus
unix  2      [ ACC ]     STREAM     LISTENING     15872    /run/systemd/userdb/io.systemd.DynamicUser
unix  2      [ ACC ]     STREAM     LISTENING     34971    /run/user/1000/gnupg/S.dirmngr
unix  2      [ ACC ]     STREAM     LISTENING     34972    /run/user/1000/gnupg/S.gpg-agent.browser
unix  2      [ ]         DGRAM                    15881    /run/systemd/journal/syslog
unix  2      [ ACC ]     STREAM     LISTENING     34973    /run/user/1000/gnupg/S.gpg-agent.extra
unix  2      [ ACC ]     STREAM     LISTENING     15883    /run/systemd/fsck.progress
```

Netstat-tun: -

netstat -tuln displays all listening ports with details, focusing on TCP (-t) and UDP (-u) protocols, while showing output in numeric (-n) format (IP addresses instead of hostnames). The -l option ensures that only listening sockets are shown, making it useful for checking open ports on a server.

```
bvimit@bvimit-VirtualBox:~$ netstat -tuln
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address          Foreign Address         State
tcp        0      0 127.0.0.53:53          0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.1:631          0.0.0.0:*               LISTEN
tcp6       0      0 ::1:631                :::*                    LISTEN
udp        0      0 127.0.0.53:53          0.0.0.0:*
udp        0      0 0.0.0.0:631            0.0.0.0:*
udp        0      0 0.0.0.0:58234          0.0.0.0:*
udp        0      0 0.0.0.0:5353           0.0.0.0:*
udp6       0      0 :::38025               :::*
udp6       0      0 :::5353                :::*
bvimit@bvimit-VirtualBox:~$
```

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Netstat-tulnp:-

netstat -tulnp displays all listening TCP (-t) and UDP (-u) ports along with their corresponding process IDs (PIDs) and program names (-p). The -l option ensures only actively listening ports are shown, while -n forces numeric output. This command is useful for identifying which processes are using specific network ports.

```
bvimit@bvimit-VirtualBox:~$ netstat -tulnp
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
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      -
tcp        0      0 127.0.0.1:631           0.0.0.0:*               LISTEN      -
tcp6       0      0 ::1:631                 :::*                    LISTEN      -
udp        0      0 127.0.0.53:53           0.0.0.0:*                           -
udp        0      0 0.0.0.0:631             0.0.0.0:*                           -
udp        0      0 0.0.0.0:58234           0.0.0.0:*                           -
udp        0      0 0.0.0.0:5353            0.0.0.0:*                           -
udp6       0      0 :::38025                :::*                                -
udp6       0      0 :::5353                 :::*                                -
```

Netstat -r :-

netstat -r displays the kernel's IP routing table, showing how network traffic is directed. The output includes destination addresses, gateways, netmasks, and interface details. It is useful for troubleshooting network routes and checking default gateway settings.

```
bvimit@bvimit-VirtualBox:~$ netstat -r
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
default         _gateway        0.0.0.0         UG        0 0          0 enp0s3
10.0.2.0        0.0.0.0         255.255.255.0   U         0 0          0 enp0s3
link-local      0.0.0.0         255.255.0.0     U         0 0          0 enp0s3
bvimit@bvimit-VirtualBox:~$ netstat -i
Kernel Interface table
Iface      MTU    RX-OK RX-ERR RX-DRP RX-OVR    TX-OK TX-ERR TX-DRP TX-OVR Flg
enp0s3     1500     225      0      0 0           303      0      0      0 BMRU
lo        65536     186      0      0 0           186      0      0      0 LRU
```

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Netstat -s :-

netstat -s displays detailed network statistics for various protocols, including TCP, UDP, ICMP, and IP. It provides information on packet transmission, errors, dropped packets, and other networking metrics, making it useful for diagnosing network issues.

```
bvimit@bvimit-VirtualBox:~$ netstat -s
Ip:
    Forwarding: 2
    420 total packets received
    1 with invalid addresses
    0 forwarded
    0 incoming packets discarded
    417 incoming packets delivered
    416 requests sent out
    20 outgoing packets dropped
Icmp:
    104 ICMP messages received
    0 input ICMP message failed
    ICMP input histogram:
        destination unreachable: 40
        echo replies: 64
    170 ICMP messages sent
    0 ICMP messages failed
    ICMP output histogram:
        destination unreachable: 40
        echo requests: 130
```

Traceroute:

traceroute is a network diagnostic tool used to track the path that packets take from the source to the destination. It shows each hop (router) along the way and measures the time taken for packets to reach each hop. This helps in identifying network congestion or routing issues.

```
bvimit@bvimit-VirtualBox:~$ traceroute amazon.com
traceroute to amazon.com (54.239.28.85), 30 hops max, 60 byte packets
 1  _gateway (10.0.2.2)  0.544 ms  0.456 ms  0.391 ms
 2  _gateway (10.0.2.2)  2.479 ms  2.440 ms  2.391 ms
```

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traceroute -n :-

traceroute -n runs the traceroute command but displays IP addresses instead of resolving hostnames. This makes the output faster and avoids delays caused by DNS lookups. It's useful for quickly analyzing network paths without relying on domain name resolution.

```
bvimit@bvimit-VirtualBox:~$ traceroute -n facebook.com
traceroute to facebook.com (31.13.79.35), 30 hops max, 60 byte packets
 1  10.0.2.2  1.100 ms  1.013 ms  0.941 ms
 2  10.0.2.2  3.881 ms  2.380 ms  2.325 ms
```

Nslookup:-

nslookup (Name Server Lookup) is a command-line tool used to query DNS servers and obtain domain name or IP address information. It helps in troubleshooting DNS-related issues by checking domain name resolution and retrieving DNS records.

```
bvimit@bvimit-VirtualBox:~$ nslookup deepthink.com
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
Name:   deepthink.com
Address: 13.248.169.48
Name:   deepthink.com
Address: 76.223.54.146
```

Nslookup -type= -a

Retrieves the IPv4 address of the domain.

```
bvimit@bvimit-VirtualBox:~$ nslookup -type=a google.com
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
Name:   google.com
Address: 142.250.182.206
```

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nslookup -type=NS example.com
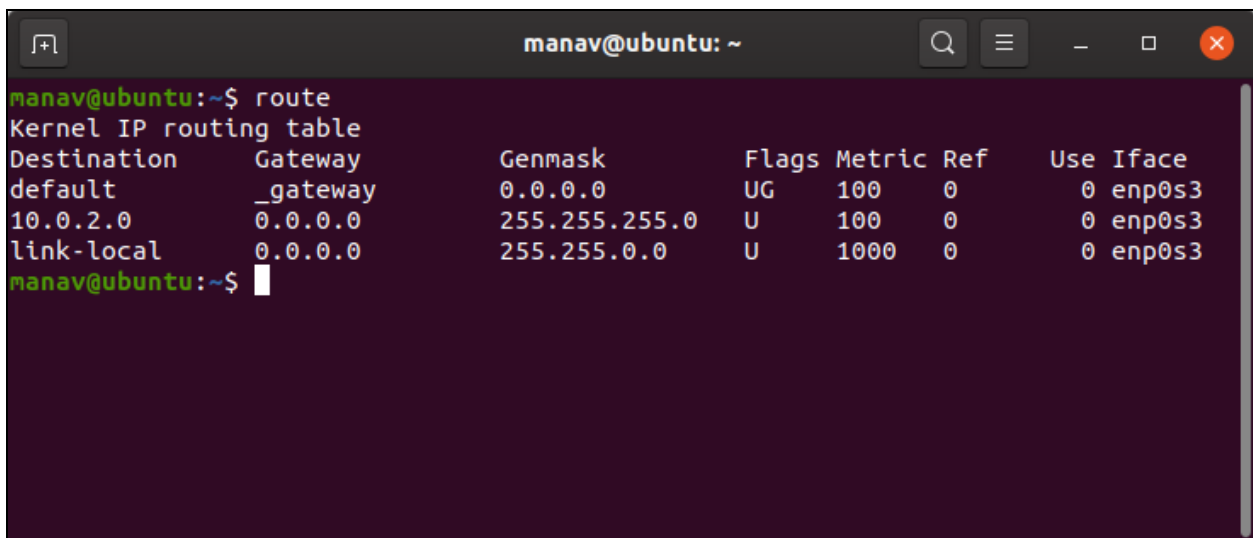
Retrieves the nameservers for the domain.

```
bvimit@bvimit-VirtualBox:~$ nslookup -type=mx google.com
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
google.com      mail exchanger = 10 smtp.google.com.

Authoritative answers can be found from:
```
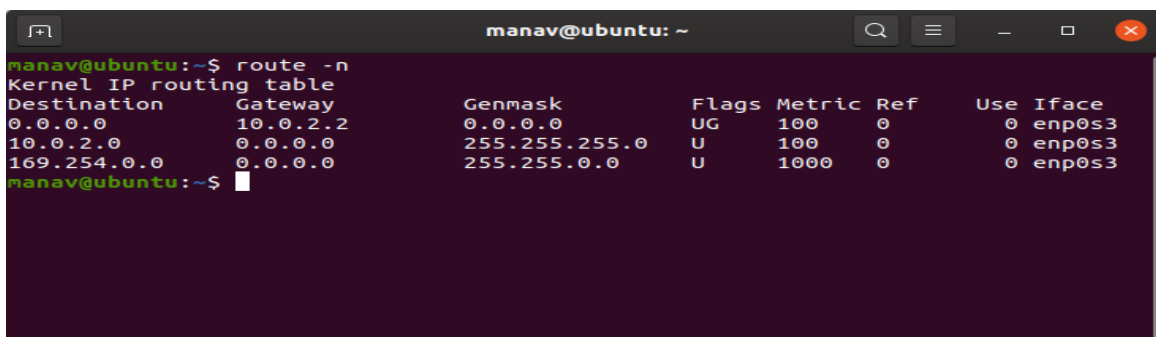
Route:- To display the IP/kernel routing table.

```
manav@ubuntu: ~

manav@ubuntu:~$ route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         _gateway        0.0.0.0         UG    100    0        0 enp0s3
10.0.2.0        0.0.0.0         255.255.255.0   U     100    0        0 enp0s3
link-local      0.0.0.0         255.255.0.0     U     1000   0        0 enp0s3
manav@ubuntu:~$
```

Route -n:- To display the routing table in full numeric form.

```
manav@ubuntu: ~

manav@ubuntu:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         10.0.2.2        0.0.0.0         UG    100    0        0 enp0s3
10.0.2.0        0.0.0.0         255.255.255.0   U     100    0        0 enp0s3
169.254.0.0     0.0.0.0         255.255.0.0     U     1000   0        0 enp0s3
manav@ubuntu:~$
```

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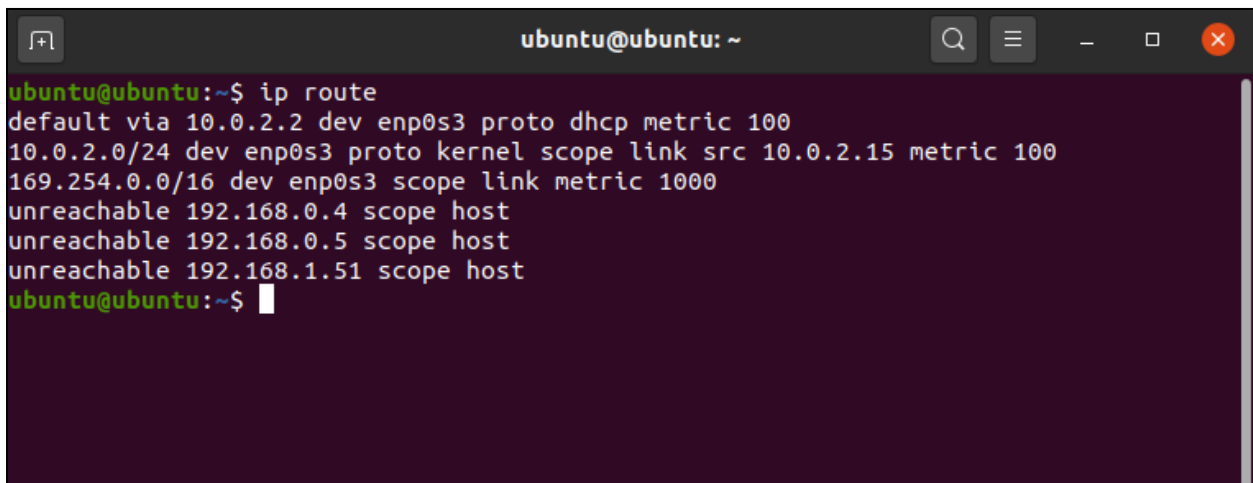
sudo route add default gw 169.254.0.0:-

To add a default gateway.

IP route: - To get details of the kernel/IP routing table using the IP command.
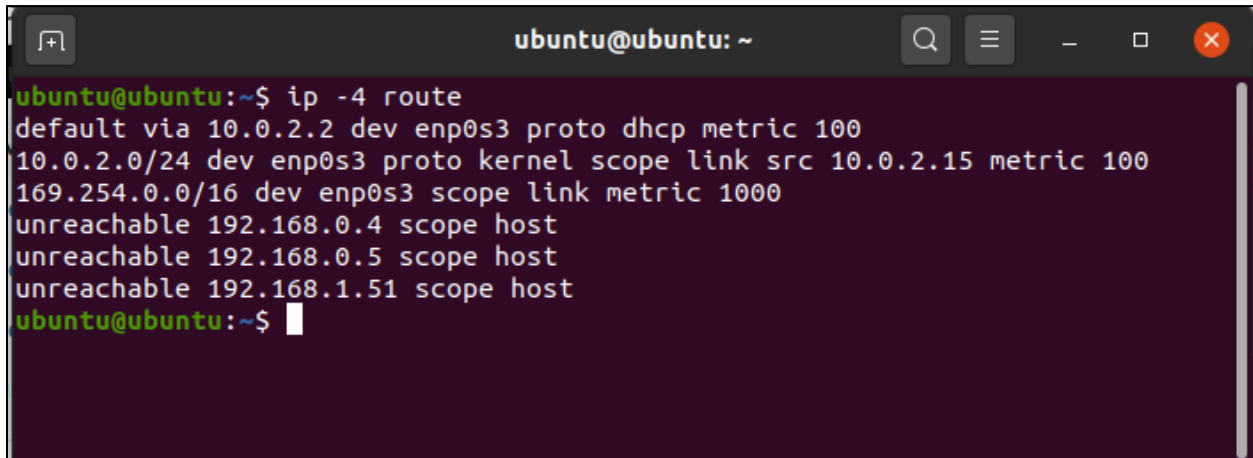
route del default:- To delete the default gateway.

ip -4 route :- To get output related to IPv4.

Hostname command:-

The hostname command is used to display or set the unique name of your machine on a network. This name helps identify your computer within a local network and is essential for network communication and management.

```
bvimit@bvimit-VirtualBox:~$ traceroute -n  google.com
traceroute to google.com (142.251.42.14), 30 hops max, 60 byte packets
 1  10.0.2.2  0.259 ms  0.232 ms  0.222 ms
 2  10.0.2.2  1.598 ms  1.587 ms  1.498 ms
bvimit@bvimit-VirtualBox:~$
```

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