

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

```
bvimit@bvimit: ~  
bvimit@bvimit:~$ sudo apt upgrade  
[sudo] password for bvimit:  
Reading package lists... Done  
Building dependency tree  
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 libfwupdplugin1  
libgstreamer-plugins-bad1.0-0 libva-wayland2  
Use 'sudo apt autoremove' to remove them.  
The following NEW packages will be installed:  
libfwupdplugin5 libpenglo  
The following packages will be upgraded:  
alsa-ucm-conf apport apport-gtk bash bind9-dnssutils bind9-host bind9-libs  
bolt command-not-found firefox fonts-opensymbol fwupd fwupd-signed  
gir1.2-gtk-3.0 gir1.2-javascriptcoregtk-4.0 gir1.2-polkit-1.0  
gir1.2-webkit2-4.0 gtk-update-icon-cache gzip klibc-utils libarchive13  
libc-bin libdrm-amdgpu1 libdrm-common libdrm-intel1 libdrm-nouveau2  
libdrm-radeon1 libdrm2 libegl-mesa0 libegl1 libevdev2 libexpat1  
libfprint-2-2 libfprint-2-tod1 libfribidi0 libfwupd2 libgbm1 libgl1  
libgl1-mesa-dri libglapi-mesa libgles2 libglvnd0 libglx-mesa0 libglx0  
libgtk-3-0 libgtk-3-bin libgtk-3-common libinput-bin libinput10  
libjavascriptcoregtk-4.0-18 libjcat1 libjuh-java libjurt-java libklibc
```

```

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-vaaapi 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:~$ 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-vaaapi 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


```

bvmitt@bvmitt:~$ 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:
 libxpat-dev libpython3-dev libpython3.8-dev python3-distutils python3-dev zlib1g-dev
Suggested packages:
 sqlite3-doc
The following NEW packages will be installed:
 libxpat-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.

```

bvmitt@bvmitt:~$ 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-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-mysqldb
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] Y

```

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

```

bvmitt@bvmitt:~$ 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

```

bvinit@bvinit:~$ 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

```

bvinit@bvinit:~$ 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 liblilmbase24 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 liblilmbase24 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] Y

```

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

```

bvinit@bvinit:~$ 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:
  dvipng fonts-lato fonts-lmodern fonts-texgyre javascript-common libalgorithm-c3-perl libapache-pom-java libb-hooks-endofscope-perl lib
  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 libdynamoloader-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 libn
  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 l
  libspecio-perl libsub-exporter-perl libsub-exporter-progressive-perl libsub-identify-perl libsub-install-perl libsub-name-perl libsub
  libsys-hostname-long-perl libtk8.6 libteckit0 libtexlua53 libtexlua53t2 libtk8.6 libunicode-linebreak-perl libvariable-magic-perl lib
  libyaml-tiny-perl libzip-0.13 lmodern preview-latex-style ps2eps rake ruby ruby-minitest ruby-net-telnet ruby-power-assert ruby-test-
  rubygems-integration tiutils 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-p
  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
  lcdf-typeutils psutils texlive-fonts-recommended-doc texlive-latex-base-doc lcc-profiles libspreadsheet-parseexcel-perl texlive-latex-
  texlive-latex-recommended-doc texlive-luatex texlive-nstricks dot2tex prerex ruby-tcltk | libtcltk-ruby texlive-pictures-doc vncserver 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


```

bvimit@bvimit:~$ sudo apt-get install python3-sphinx dia
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-b
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  dia-common dia-shapes docutils-common gsfonts-x11 libart-2.0-2 libjs-sphinxdoc libjs-u
python3-docutils python3-imagesize python3-jinja2 python3-packaging python3-pyparsing
Suggested packages:
  docutils-doc fonts-linuxlibertine | ttf-linux-libertine texlive-lang-french python-jin
python3-stemmer sphinx-doc
The following NEW packages will be installed:
  dia dia-common dia-shapes docutils-common gsfonts-x11 libart-2.0-2 libjs-sphinxdoc lib
python3-docutils python3-imagesize python3-jinja2 python3-packaging python3-pyparsing
0 upgraded, 19 newly installed, 0 to remove and 0 not upgraded.
Need to get 14.9 MB of archives.
After this operation, 68.4 MB of additional disk space will be used.
Do you want to continue? [Y/n]

```

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

```

bvimit@bvimit:~$ sudo apt-get install cmake libc6-dev libc6-dev-i386 libclang-6.0-dev llvm-6.0-dev automake python3-p
Reading package lists... Done
Building dependency tree
Reading state information... Done
libc6-dev is already the newest version (2.31-0ubuntu9.7).
libc6-dev 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:
  autoconf autotools-dev binfmt-support cmake-data gcc-9-multilib gcc-multilib lib32asan5 lib32atomic1 lib32gcc-9-dev
lib32stdc++6 lib32ubsan1 libc6-dev-x32 libc6-i386 libc6-x32 libclang-common-6.0-dev libclang1-6.0 libffi-dev libjs-
libobjc4 liblhash0 libsigsegv2 libtinfo-dev libx32asan5 libx32atomic1 libx32gcc-9-dev libx32gcc-s1 libx32gomp1 libx
libx32ubsan1 llvm-6.0 llvm-6.0-runtime m4 python-pip-whl python3-setuptools python3-wheel
Suggested packages:
  autoconf-archive gnu-standards autoconf-doc libtool gettext cmake-doc ninja-build ncurses-doc m4-doc python-setupto
The following NEW packages will be installed:
  autoconf automake autotools-dev binfmt-support cmake cmake-data gcc-9-multilib gcc-multilib lib32asan5 lib32atomic1
lib32quadmath0 lib32stdc++6 lib32ubsan1 libc6-dev-i386 libc6-dev-x32 libc6-i386 libc6-x32 libclang-6.0-dev libclang
libjsoncpp1 libllvm6.0 libncurses-dev libobjc-9-dev libobjc4 liblhash0 libsigsegv2 libtinfo-dev libx32asan5 libx32a
libx32itm1 libx32quadmath0 libx32stdc++6 libx32ubsan1 llvm-6.0 llvm-6.0-dev llvm-6.0-runtime m4 python-pip-whl pyth
0 upgraded, 50 newly installed, 0 to remove and 0 not upgraded.
Need to get 107 MB of archives.
After this operation, 780 MB of additional disk space will be used.

```

python3 -m pip install --user cxxfilt

```

bvimit@bvimit:~$ python3 -m pip install --user cxxfilt
Collecting cxxfilt
  Downloading cxxfilt-0.3.0-py2.py3-none-any.whl (4.6 kB)
Installing collected packages: cxxfilt
Successfully installed cxxfilt-0.3.0
bvimit@bvimit:~$

```

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

NS3> // go to the ns3allinone folder bvimit@bvimit:~/workspace/ns- allinone-3.32\$

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

```
bvimit@bvimit:~/workspace/ns-allinone-3.32$ ./build.py --enable-examples --enable-tests
# Build NetAnim
Entering directory `netanim-3.108'
=> qmake -v
QMake version 3.1
Using Qt version 5.12.8 in /usr/lib/x86_64-linux-gnu
qmake found
=> qmake NetAnim.pro
Info: creating stash file /home/bvimit/workspace/ns-allinone-3.32/netanim-3.108/.qmake.stash
=> make
g++ -c -pipe -O2 -Wall -W -D_REENTRANT -fPIC -DNS3_LOG_ENABLE -DQT_NO_DEBUG -DQT_PRINTSUPPORT -DQT_WIDGETS_LIB -DQT_GUI_LIB -DQT_CORE_LIB -I. -Iqtpropertybrowser/src -isystem /usr/include/x86_64-linux-gnu/qt5 -isystem /usr/include/x86_64-linux-gnu/qt5/QtPrintSupport -isystem /usr/include/x86_64-linux-gnu/qt5/QtWidgets -isystem /usr/include/x86_64-linux-gnu/qt5/QtGui -isystem /usr/include/x86_64-linux-gnu/qt5/QtCore -I. -I/usr/lib/x86_64-linux-gnu/qt5/mkspecs/linux-g++ -o main.o main.cpp
g++ -c -pipe -O2 -Wall -W -D_REENTRANT -fPIC -DNS3_LOG_ENABLE -DQT_NO_DEBUG -DQT_PRINTSUPPORT -DQT_WIDGETS_LIB -DQT_GUI_LIB -DQT_CORE_LIB -I. -Iqtpropertybrowser/src -isystem /usr/include/x86_64-linux-gnu/qt5 -isystem /usr/include/x86_64-linux-gnu/qt5/QtPrintSupport -isystem /usr/include/x86_64-linux-gnu/qt5/QtWidgets -isystem /usr/include/x86_64-linux-gnu/qt5/QtGui -isystem /usr/include/x86_64-linux-gnu/qt5/QtCore -I. -I/usr/lib/x86_64-linux-gnu/qt5/mkspecs/linux-g++ -o main.o main.cpp
```

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

```

bvimit@bvimit:~/Workspace/ns-allinone-3.32/ns-3.32$ ./test.py
Waf: Entering directory `/home/bvimit/Workspace/ns-allinone-3.32/ns-3.32/build'
Waf: Leaving directory `/home/bvimit/Workspace/ns-allinone-3.32/ns-3.32/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (10.047s)

Modules built:
antenna          aodv              applications
bridge           buildings         config-store
core             csma              csma-layout
dsvd             dsr               energy
fd-net-device    flow-monitor      internet
internet-apps    lr-wpan           lte
mesh             mobility          netanim
network          nix-vector-routing olsr
point-to-point   point-to-point-layout propagation
sixlowpan        spectrum          stats
tap-bridge       test (no Python)  topology-read
traffic-control  uan               virtual-net-device
visualizer       wave              wifi
wimax

Modules not built (see ns-3 tutorial for explanation):
brite            click             dpdk-net-device

```

\$: ./waf --run hello-simulator

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

```

bvimit@bvimit:~/Workspace/ns-allinone-3.32/ns-3.32$ ./waf --run hello-simulator
Waf: Entering directory `/home/bvimit/Workspace/ns-allinone-3.32/ns-3.32/build'
Waf: Leaving directory `/home/bvimit/Workspace/ns-allinone-3.32/ns-3.32/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (4.136s)
Hello Simulator
bvimit@bvimit:~/Workspace/ns-allinone-3.32/ns-3.32$

```

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.

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-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
  libbackend-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-bq-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


```

lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/ns-3.32$ sudo ./waf build
waf: Entering directory '/home/lab2/workspace/ns-allinone-3.32/ns-3.32/build'
waf: Leaving directory '/home/lab2/workspace/ns-allinone-3.32/ns-3.32/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (0.670s)

Modules built:
antenna          aodv          applications
bridge          buildings    config-store
core            csma         csma-layout
dsdv           dsr          energy
fd-net-device   flow-monitor internet
internet-apps  lr-wpan      lte
mesh           mobility     netanim
network        nix-vector-routing olsr
point-to-point point-to-point-layout propagation
sixlowpan      spectrum     stats
tap-bridge     test (no Python) topology-read
traffic-control uan          virtual-net-device
visualizer     wave         wifi
wimax

```

cd netanim-3.108 & ls

```

lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/ns-3.32$ cd
lab2@lab2-B250M-D2V:~$ cd workspace/ns-allinone-3.32
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32$ cd netanim-3.108
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/netanim-3.108$ cd scratch
bash: cd: scratch: No such file or directory
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/netanim-3.108$ ls
abort.h          moc_fileedit.cpp
animatorconstants.h  moc_fileeditfactory.cpp
animator_fileopen.svg  moc_fileeditfactory.o

```

./NetAnim

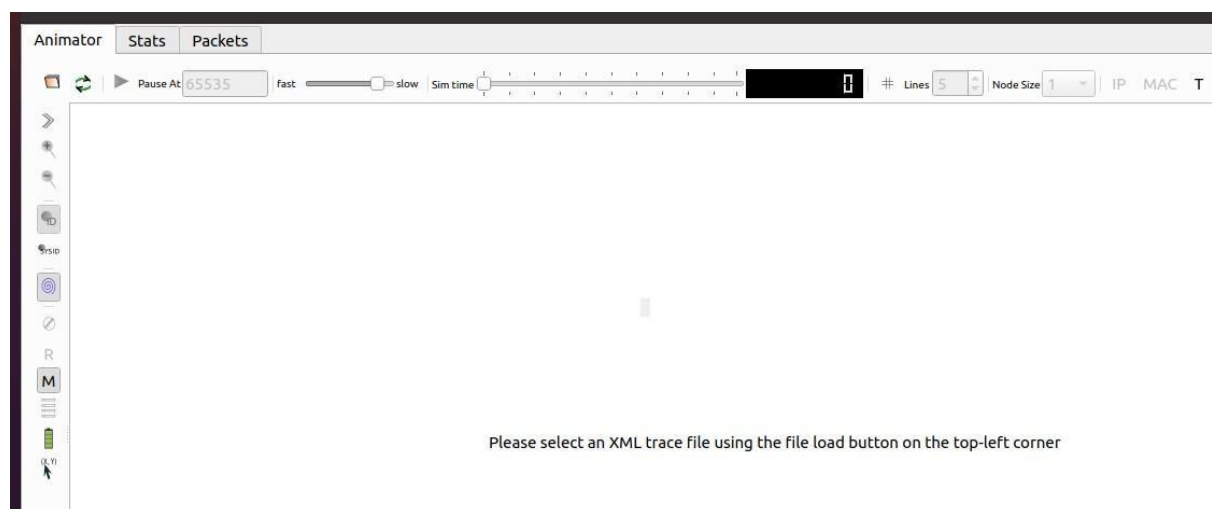
```

lab2-114@lab2114-B250M-D2V:~/workspace/ns-allinone-3.32$ cd netanim-3.108
lab2-114@lab2114-B250M-D2V:~/workspace/ns-allinone-3.32/netanim-3.108$ ./NetAnim

```

Successfully the NetAnim will be installed

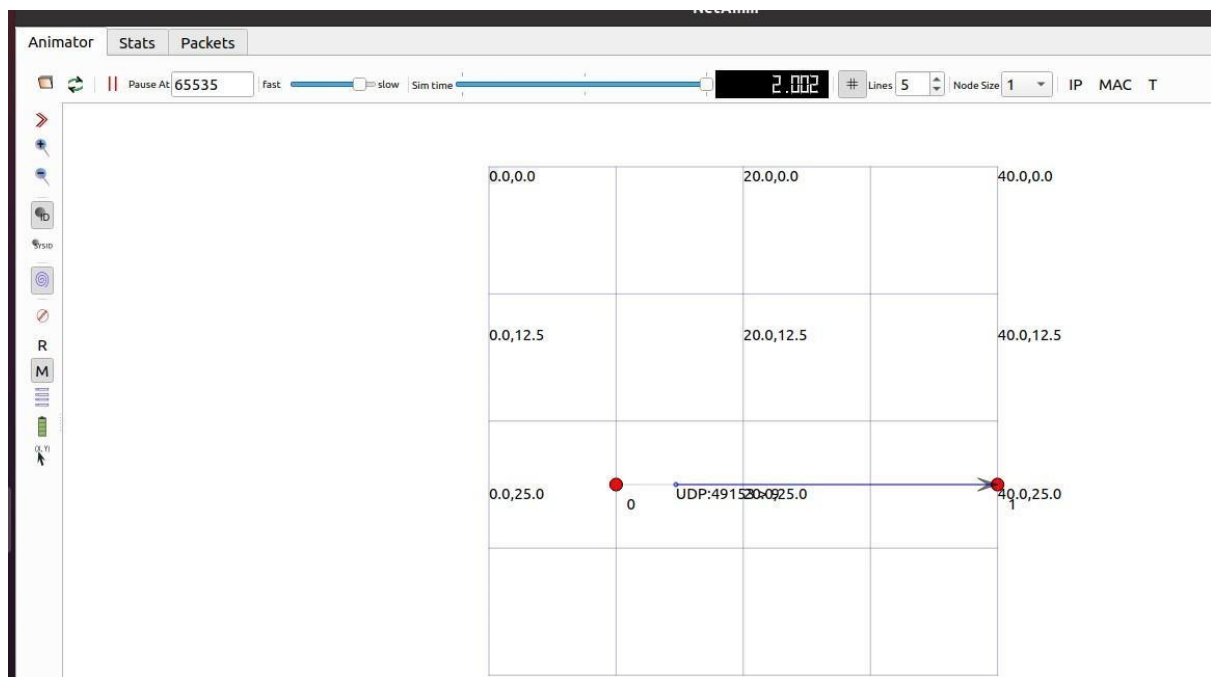
./NetAnim



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.

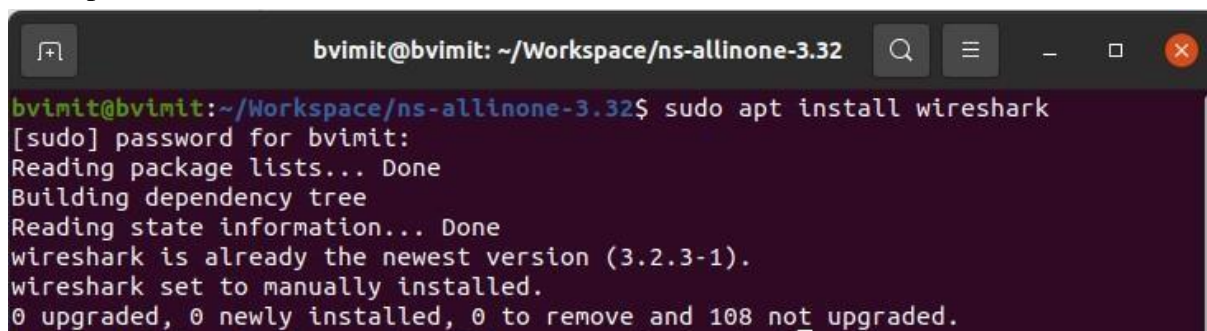
Key features of Wireshark include:

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.

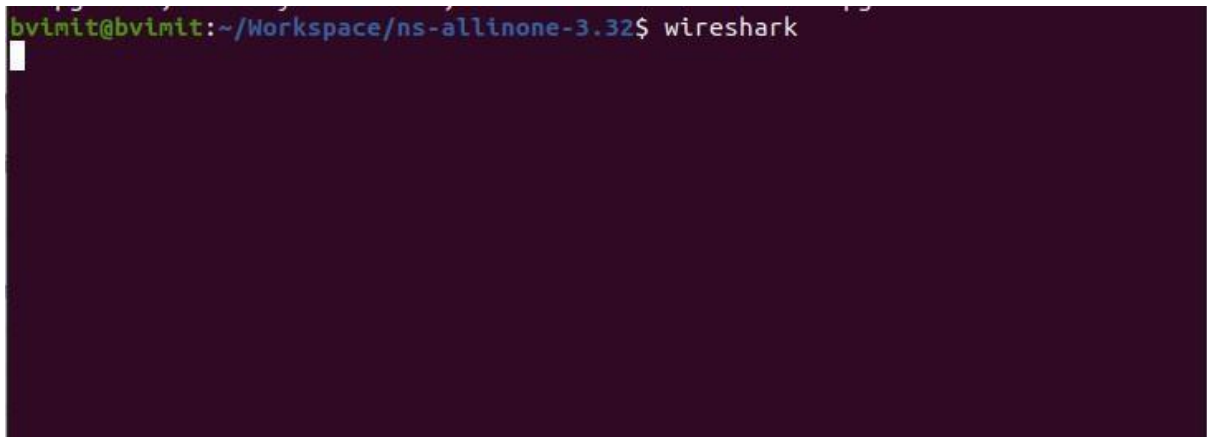
Open Terminal and type the command

`sudo apt install wireshark`

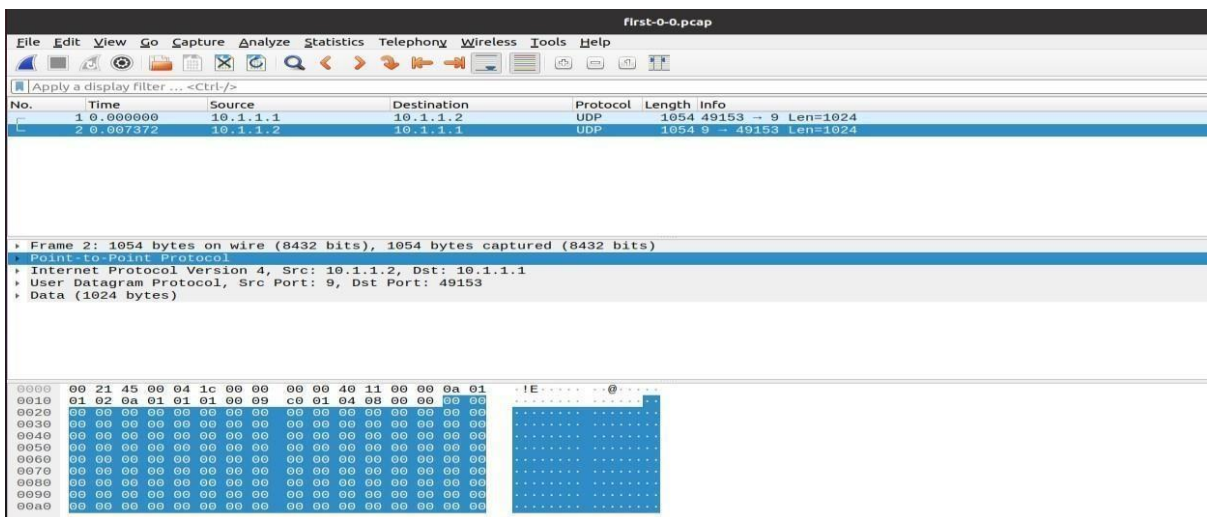
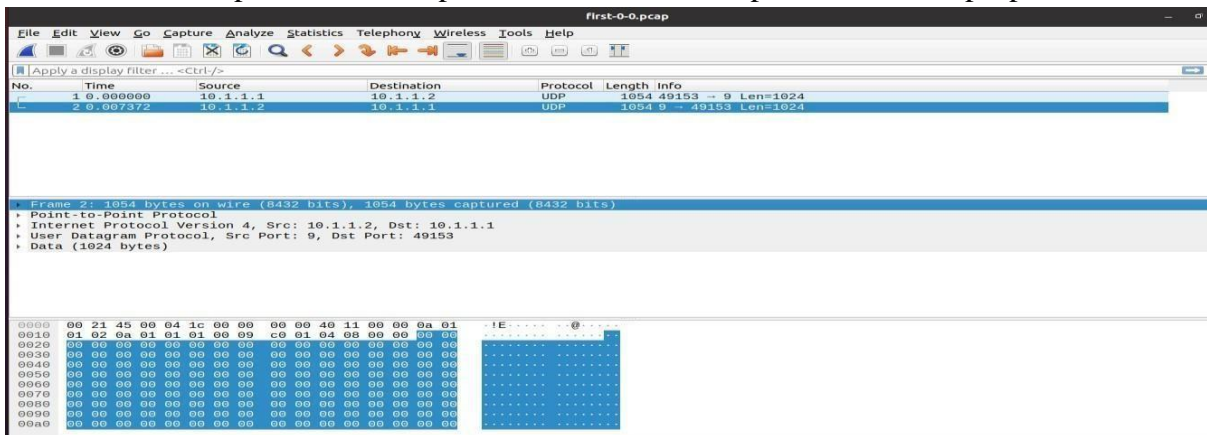
A terminal window with a dark background. The title bar shows 'bvimit@bvimit: ~/Workspace/ns-allinone-3.32'. The terminal text is as follows:

```
bvimit@bvimit:~/Workspace/ns-allinone-3.32$ sudo apt install wireshark
[sudo] password for bvimit:
Reading package lists... Done
Building dependency tree
Reading state information... Done
wireshark is already the newest version (3.2.3-1).
wireshark set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 108 not upgraded.
```

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



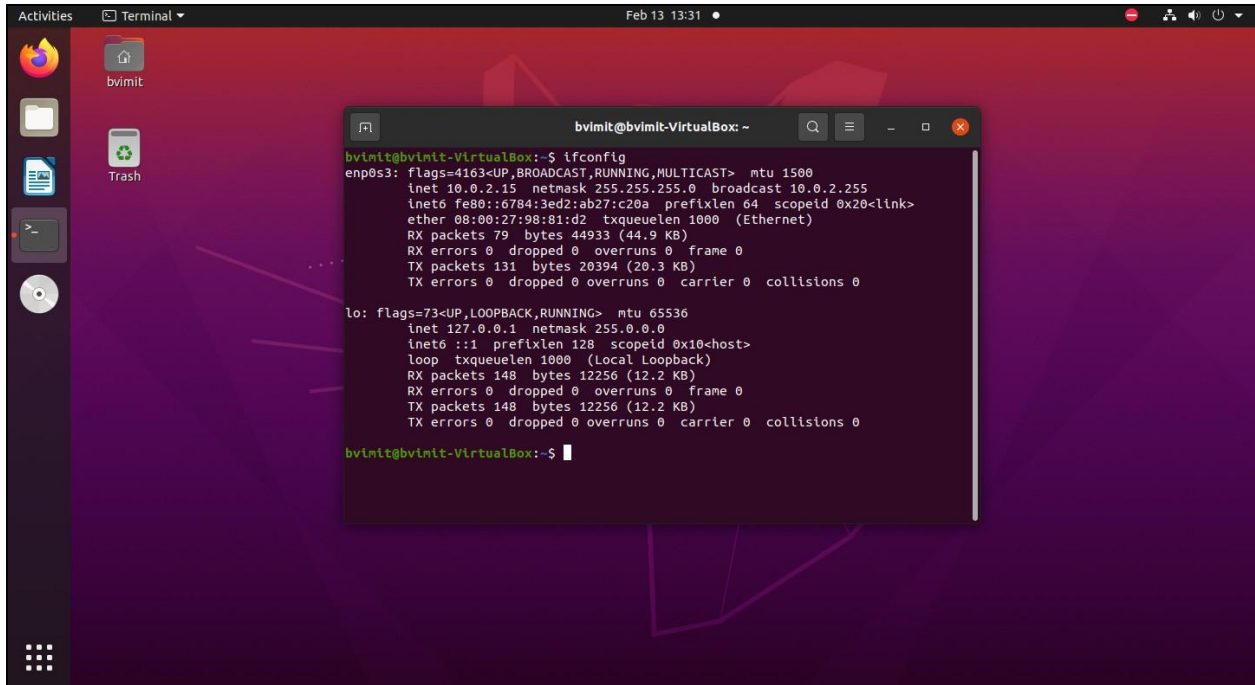
When wireshark open then file->open->Go to ns-3.2 and open the first-0-0.pcap folder.



Practical No -2

Linux Network Commands -

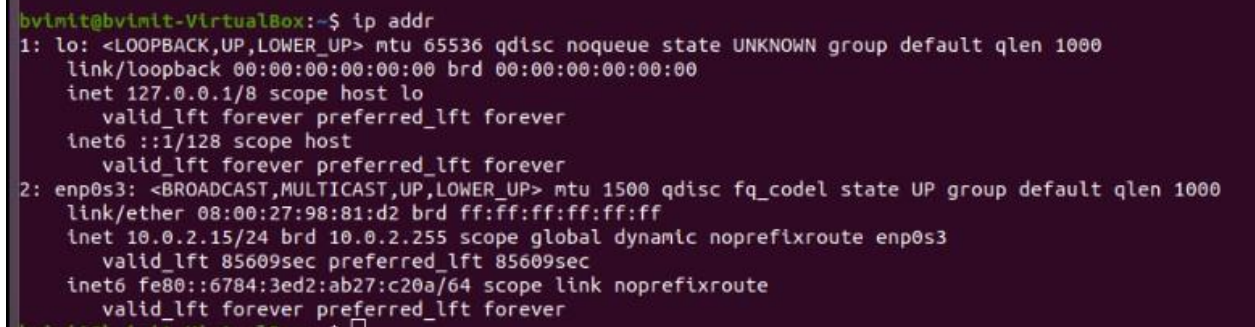
ifconfig:- To view IP configuration in Linux, use the `ifconfig` or `ip addr show` commands in the terminal. Both will display details for all network interfaces.



```
bvimit@bvimit-VirtualBox:~$ 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 fe80::6784:3ed2:ab27:c20a prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:98:81:d2 txqueuelen 1000 (Ethernet)
    RX packets 79 bytes 44933 (44.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 131 bytes 20394 (20.3 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

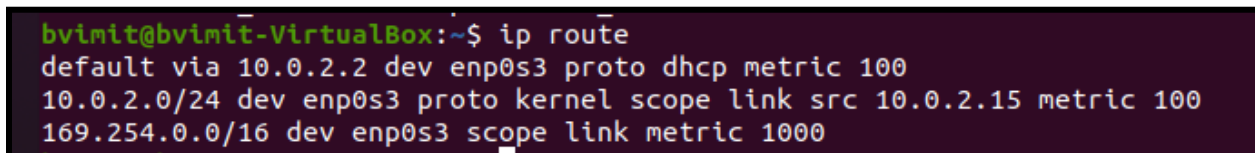
lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 148 bytes 12256 (12.2 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 148 bytes 12256 (12.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

bvimit@bvimit-VirtualBox:~$
```



```
bvimit@bvimit-VirtualBox:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
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 85609sec preferred_lft 85609sec
    inet6 fe80::6784:3ed2:ab27:c20a/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
```

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



```
bvimit@bvimit-VirtualBox:~$ ip route
default via 10.0.2.2 dev enp0s3 proto dhcp metric 100
10.0.2.0/24 dev enp0s3 proto kernel scope link src 10.0.2.15 metric 100
169.254.0.0/16 dev enp0s3 scope link metric 1000
```

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      CONNECTED  34962   /run/user/1000/systemd/notify
unix    3      [ ]          DGRAM      CONNECTED  15867   /run/systemd/notify
unix    2      [ ]          DGRAM      CONNECTED  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
```

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:*               ESTABLISHED
udp        0      0 bvimit-VirtualBo:bootpc _gateway:bootps        ESTABLISHED
udp        0      0 0.0.0.0:631            0.0.0.0:*               ESTABLISHED
udp        0      0 0.0.0.0:58234          0.0.0.0:*               ESTABLISHED
udp        0      0 0.0.0.0:mdns            0.0.0.0:*               ESTABLISHED
udp6       0      0 [::]:38025             [::]:*                  ESTABLISHED
udp6       0      0 [::]:mdns               [::]:*                  ESTABLISHED
raw6       0      0 [::]:ipv6-icmp          [::]:*                  ESTABLISHED
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/lsck/progress
```

Netstat -tun: -

netstat -tun 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 -tun
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:*               LISTEN
udp        0      0 0.0.0.0:631            0.0.0.0:*               LISTEN
udp        0      0 0.0.0.0:58234          0.0.0.0:*               LISTEN
udp        0      0 0.0.0.0:5353           0.0.0.0:*               LISTEN
udp6       0      0 :::38025               :::*                     LISTEN
udp6       0      0 :::5353                :::*                     LISTEN
bvimit@bvimit-VirtualBox:~$
```


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
```

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
```

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
```


nslookup -type=NS example.com

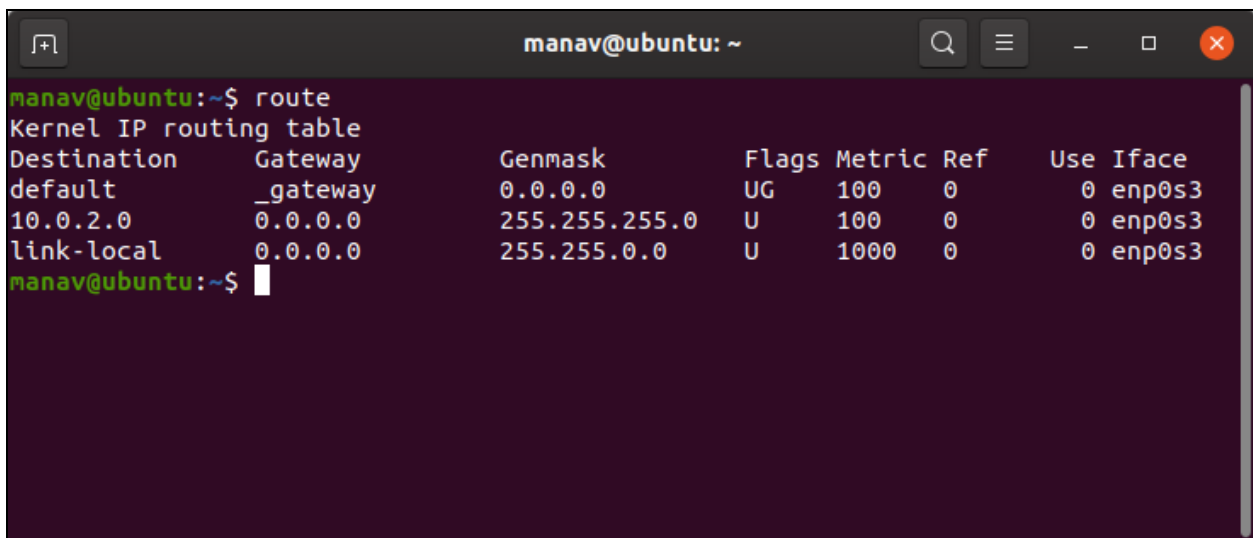
Retrieves the nameservers for the domain.

```
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:
```

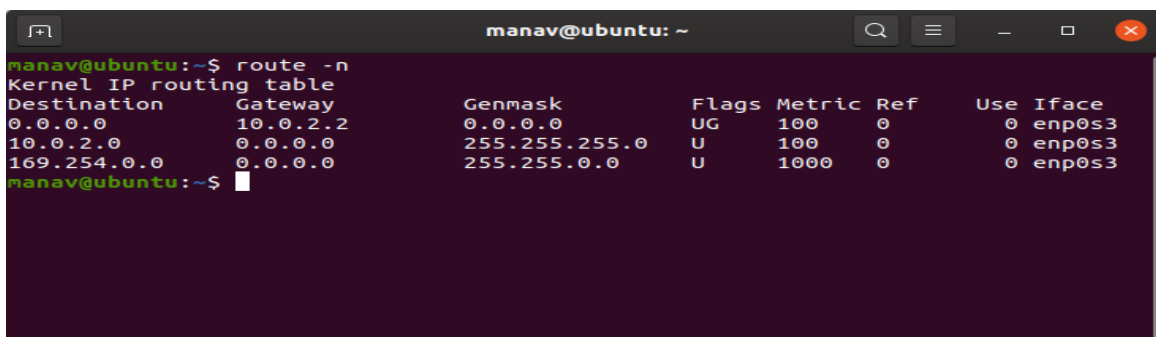
Route:- To display the IP/kernel routing table.



A terminal window titled "manav@ubuntu: ~" showing the output of the `route` command. The output displays the kernel IP routing table with columns for Destination, Gateway, Genmask, Flags, Metric, Ref, Use, and Iface.

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

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

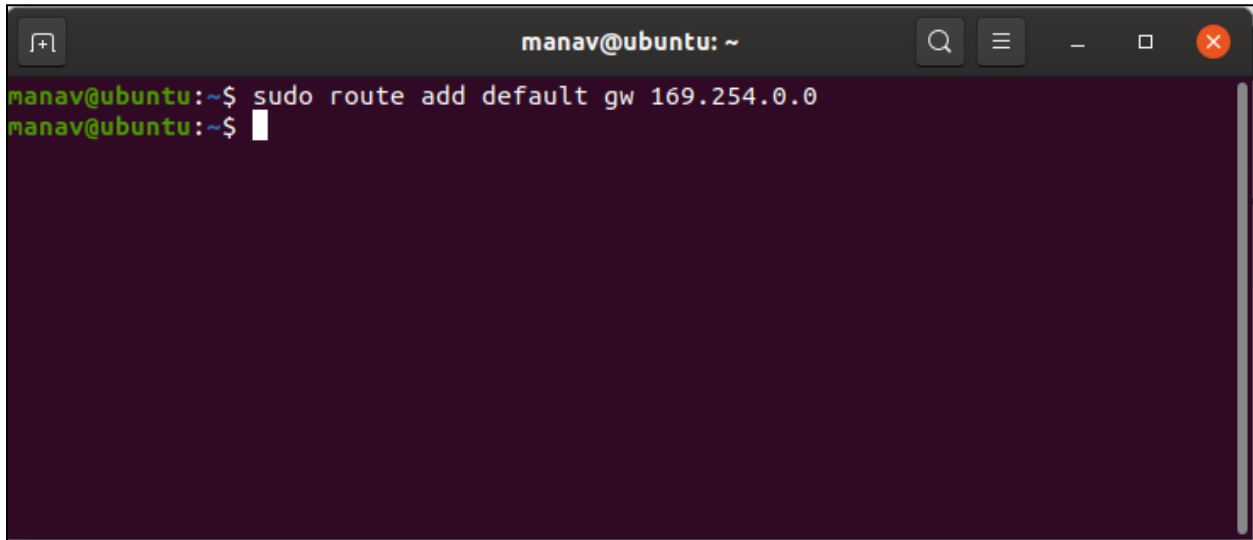


A terminal window titled "manav@ubuntu: ~" showing the output of the `route -n` command. The output displays the routing table in full numeric form, with columns for Destination, Gateway, Genmask, Flags, Metric, Ref, Use, and Iface.

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

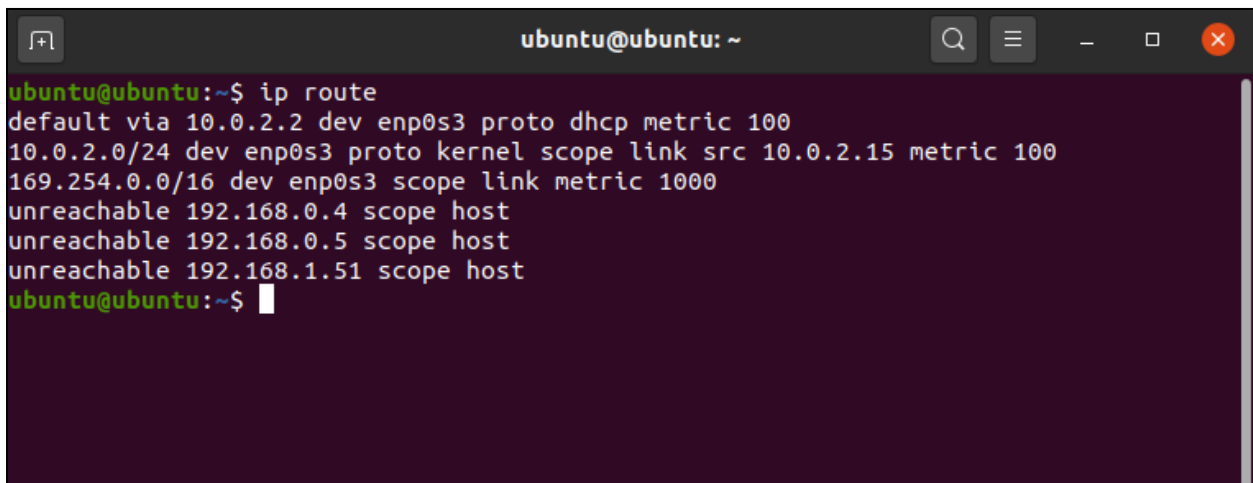
sudo route add default gw 169.254.0.0:-

To add a default gateway.

A terminal window titled 'manav@ubuntu: ~' with search, menu, and window control icons. The command 'sudo route add default gw 169.254.0.0' has been entered and executed, resulting in a new prompt.

```
manav@ubuntu:~$ sudo route add default gw 169.254.0.0
manav@ubuntu:~$
```

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

A terminal window titled 'ubuntu@ubuntu: ~' with search, menu, and window control icons. The command 'ip route' has been entered and executed, displaying the current routing table.

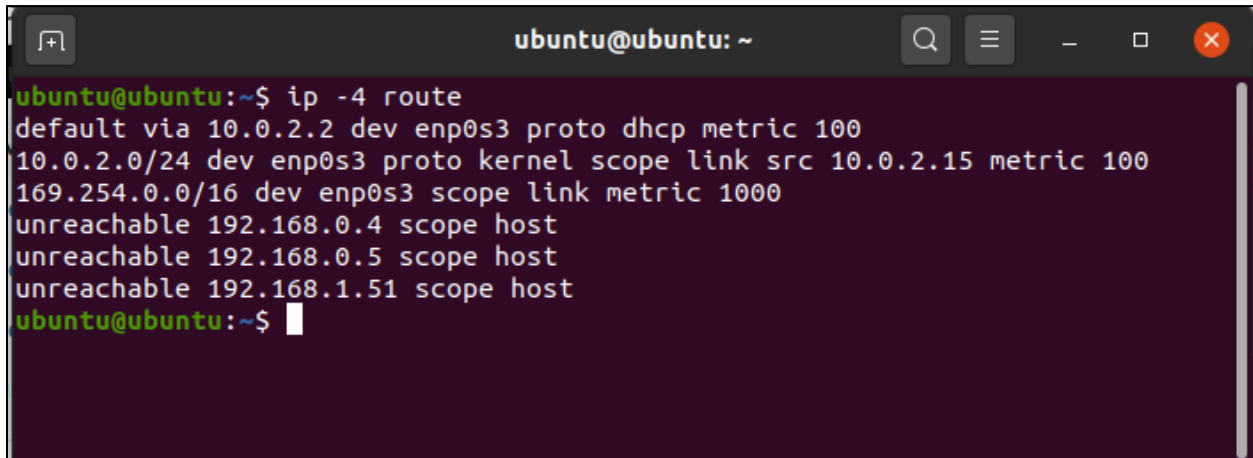
```
ubuntu@ubuntu:~$ ip route
default via 10.0.2.2 dev enp0s3 proto dhcp metric 100
10.0.2.0/24 dev enp0s3 proto kernel scope link src 10.0.2.15 metric 100
169.254.0.0/16 dev enp0s3 scope link metric 1000
unreachable 192.168.0.4 scope host
unreachable 192.168.0.5 scope host
unreachable 192.168.1.51 scope host
ubuntu@ubuntu:~$
```

route del default:- To delete the default gateway.

A terminal window titled 'ubuntu@ubuntu: ~' with search, menu, and window control icons. The prompt is 'ubuntu@ubuntu:~\$'. The command 'sudo route del default' has been entered and executed, resulting in a new prompt 'ubuntu@ubuntu:~\$' with a cursor.

```
ubuntu@ubuntu:~$ sudo route del default
ubuntu@ubuntu:~$
```

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

A terminal window titled 'ubuntu@ubuntu: ~' with search, menu, and window control icons. The prompt is 'ubuntu@ubuntu:~\$'. The command 'ip -4 route' has been entered and executed, showing the following output: 'default via 10.0.2.2 dev enp0s3 proto dhcp metric 100', '10.0.2.0/24 dev enp0s3 proto kernel scope link src 10.0.2.15 metric 100', '169.254.0.0/16 dev enp0s3 scope link metric 1000', 'unreachable 192.168.0.4 scope host', 'unreachable 192.168.0.5 scope host', and 'unreachable 192.168.1.51 scope host'. A new prompt 'ubuntu@ubuntu:~\$' with a cursor follows.

```
ubuntu@ubuntu:~$ ip -4 route
default via 10.0.2.2 dev enp0s3 proto dhcp metric 100
10.0.2.0/24 dev enp0s3 proto kernel scope link src 10.0.2.15 metric 100
169.254.0.0/16 dev enp0s3 scope link metric 1000
unreachable 192.168.0.4 scope host
unreachable 192.168.0.5 scope host
unreachable 192.168.1.51 scope host
ubuntu@ubuntu:~$
```


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:~$
```