

Chapter 1

A. Yang sudah dipelajari :

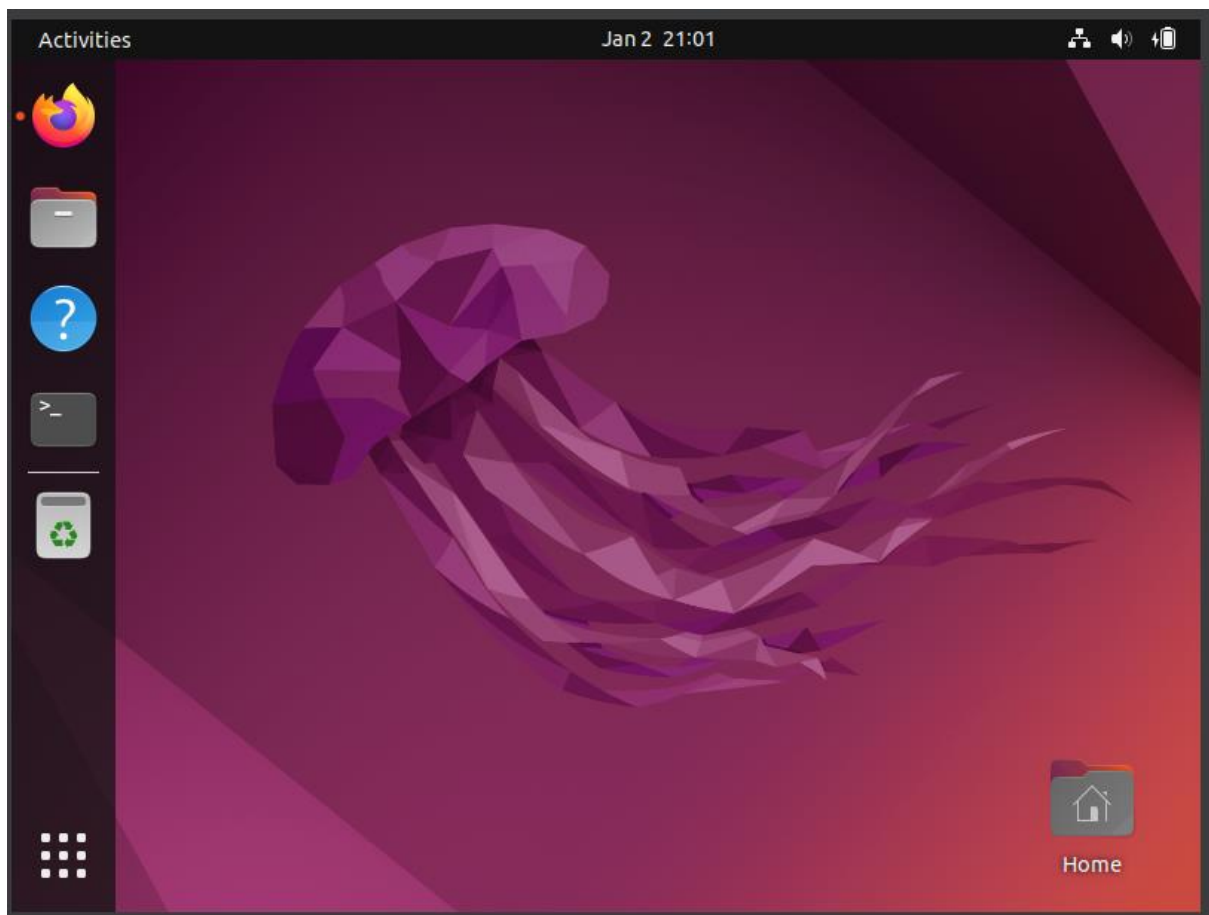
Para ahli robotika sekarang sangat menyukai ROS, atau Sistem Operasi Robot. Jika berencana untuk mengembangkan karir sebagai insinyur robotika, memahami dan menguasai ROS akan sangat penting. Bab ini membahas dasar-dasar ROS, yang mungkin menyegarkan bagi mereka yang sudah tahu tentangnya. Dimulai dengan membahas mengapa mempelajari ROS penting, dan mengapa kerangka kerja ini unggul di antara platform perangkat lunak robotika lainnya. Kami membahas konsep-konsep dasar seperti master ROS dan parameter server, dan juga menjelaskan bagaimana roscore, pusat kontrol utama ROS, berfungsi.

Bab berikutnya akan membahas manajemen paket ROS, yang merupakan bagian penting dari ekosistem ROS. Untuk memberikan pemahaman yang lebih baik tentang bagaimana robot-robot dalam ekosistem ROS berinteraksi satu sama lain, kita akan menjelajahi bagaimana sistem komunikasi ROS berfungsi.

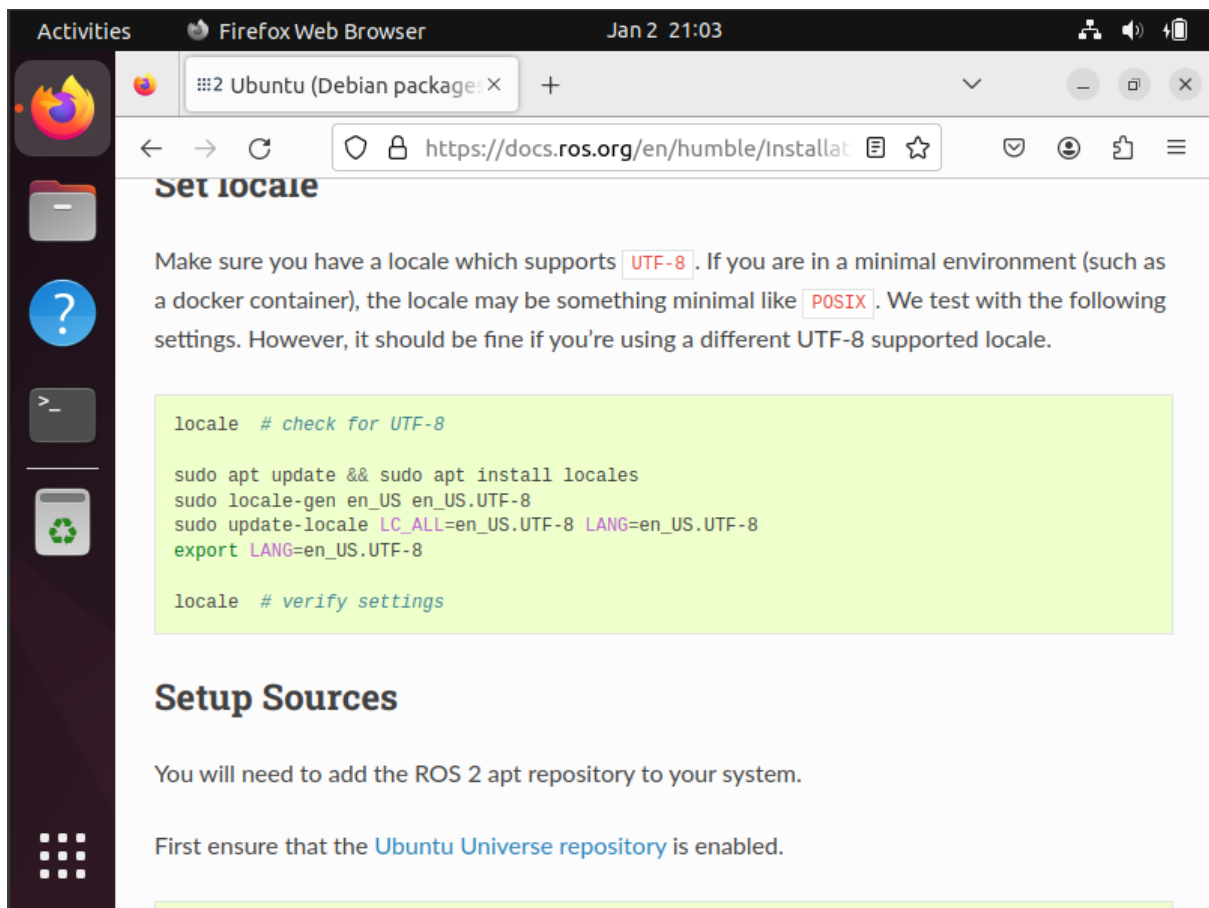
ROS mengubah cara kita merancang, mengembangkan, dan berinteraksi dengan robot secara signifikan. Memahami kerangka kerja ini dapat menawarkan banyak peluang di dunia robotika, mulai dari pengembangan robot eksperimental hingga aplikasi lebih lanjut di industri.

B. Ros 2 Instalasi :

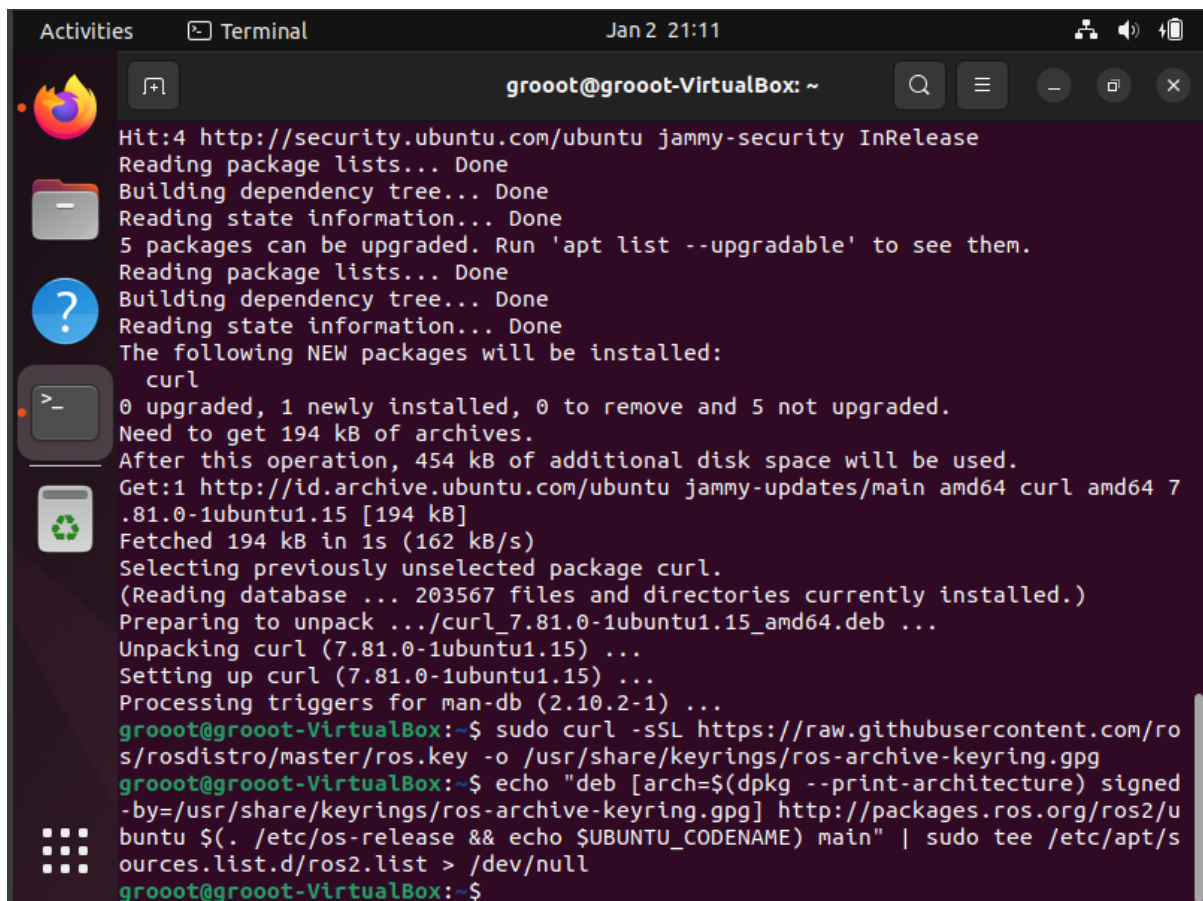
1. Buka VM ubuntu



2. akses internet dan cari instalasi ros 2 humble Debian Packages dan ikuti perinrah instalasinya



3. menyiapkan persiapan sumber-sumber dari ros2



The image shows a terminal window titled "grooot@grooot-VirtualBox: ~" with a search bar and window controls. The terminal output shows the following sequence of events:

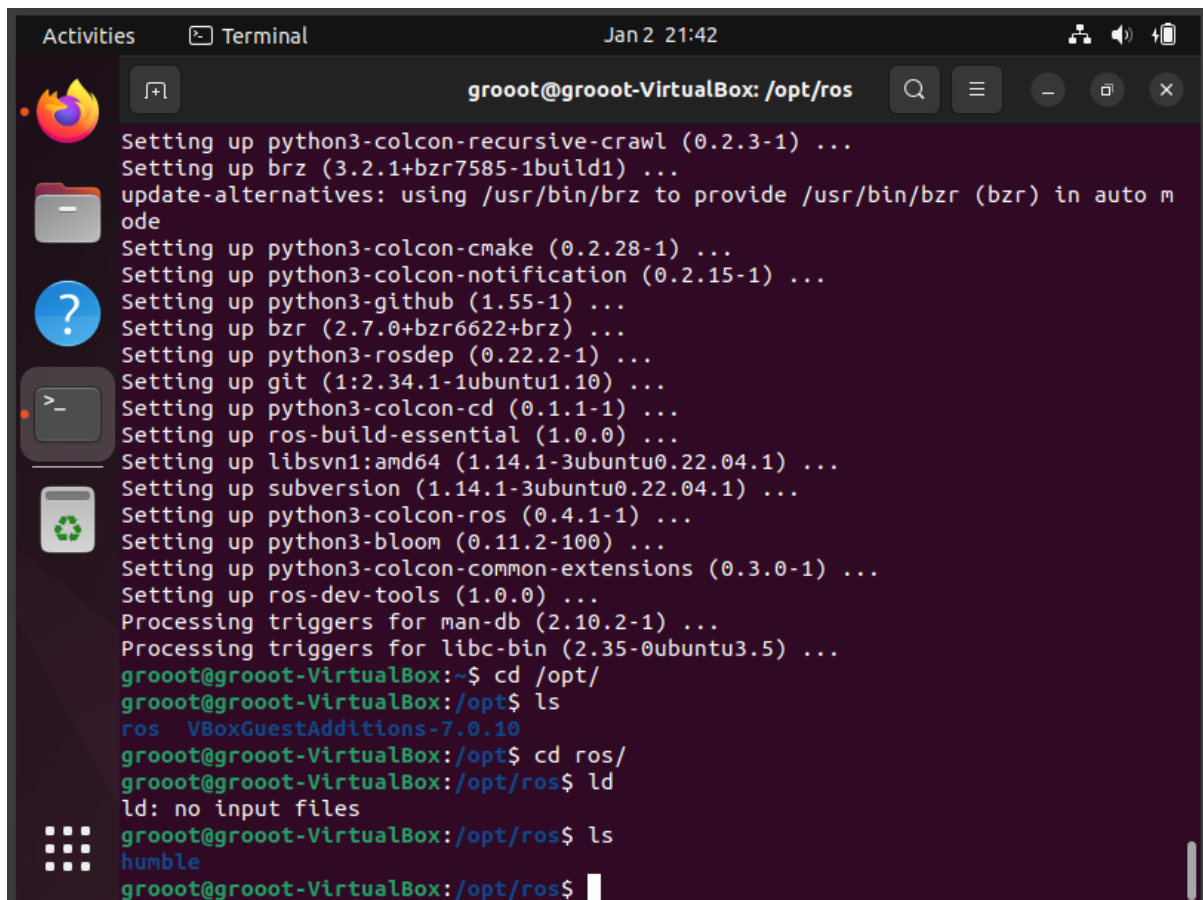
```
Hit:4 http://security.ubuntu.com/ubuntu jammy-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
5 packages can be upgraded. Run 'apt list --upgradable' to see them.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  curl
0 upgraded, 1 newly installed, 0 to remove and 5 not upgraded.
Need to get 194 kB of archives.
After this operation, 454 kB of additional disk space will be used.
Get:1 http://id.archive.ubuntu.com/ubuntu jammy-updates/main amd64 curl amd64 7.81.0-1ubuntu1.15 [194 kB]
Fetched 194 kB in 1s (162 kB/s)
Selecting previously unselected package curl.
(Reading database ... 203567 files and directories currently installed.)
Preparing to unpack .../curl_7.81.0-1ubuntu1.15_amd64.deb ...
Unpacking curl (7.81.0-1ubuntu1.15) ...
Setting up curl (7.81.0-1ubuntu1.15) ...
Processing triggers for man-db (2.10.2-1) ...
grooot@grooot-VirtualBox:~$ sudo curl -sSL https://raw.githubusercontent.com/ros/rosdistro/master/ros.key -o /usr/share/keyrings/ros-archive-keyring.gpg
grooot@grooot-VirtualBox:~$ echo "deb [arch=$(dpkg --print-architecture) signed-by=/usr/share/keyrings/ros-archive-keyring.gpg] http://packages.ros.org/ros2/ubuntu $(. /etc/os-release && echo $UBUNTU_CODENAME) main" | sudo tee /etc/apt/sources.list.d/ros2.list > /dev/null
grooot@grooot-VirtualBox:~$
```

4. Instal ROS 2

```
Activities Terminal Jan 2 21:22 grooot@grooot-VirtualBox: ~
Selecting previously unselected package libstdl2-2.0-0:amd64.
Preparing to unpack .../558-libstdl2-2.0-0_2.0.20+dfsg-2ubuntu1.22.04.1_amd64.de
b ...
Unpacking libstdl2-2.0-0:amd64 (2.0.20+dfsg-2ubuntu1.22.04.1) ...
Selecting previously unselected package libsndio7.0:amd64.
Preparing to unpack .../559-lisndio7.0_1.8.1-1.1_amd64.deb ...
Unpacking libsndio7.0:amd64 (1.8.1-1.1) ...
Selecting previously unselected package libsndio-dev:amd64.
Preparing to unpack .../560-lisndio-dev_1.8.1-1.1_amd64.deb ...
Unpacking libsndio-dev:amd64 (1.8.1-1.1) ...
Selecting previously unselected package libudev-dev:amd64.
Preparing to unpack .../561-libudev-dev_249.11-0ubuntu3.11_amd64.deb ...
Unpacking libudev-dev:amd64 (249.11-0ubuntu3.11) ...
Selecting previously unselected package libxrender-dev:amd64.
Preparing to unpack .../562-libxrender-dev_1%3a0.9.10-1build4_amd64.deb ...
Unpacking libxrender-dev:amd64 (1:0.9.10-1build4) ...
Selecting previously unselected package libxfixes-dev:amd64.
Preparing to unpack .../563-libxfixes-dev_1%3a6.0.0-1_amd64.deb ...
Unpacking libxfixes-dev:amd64 (1:6.0.0-1) ...
Selecting previously unselected package libxcursor-dev:amd64.
Preparing to unpack .../564-libxcursor-dev_1%3a1.2.0-2build4_amd64.deb ...
Unpacking libxcursor-dev:amd64 (1:1.2.0-2build4) ...
Selecting previously unselected package libxi-dev:amd64.
Preparing to unpack .../565-libxi-dev_2%3a1.8-1build1_amd64.deb ...
Unpacking libxi-dev:amd64 (2:1.8-1build1) ...
Selecting previously unselected package libxinerama-dev:amd64.
Preparing to unpack .../566-libxinerama-dev_2%3a1.1.4-3_amd64.deb ...
Progress: [ 28%] [#####.....]
```

```
Activities Terminal Jan 2 21:32 grooot@grooot-VirtualBox: ~
Setting up python3-colcon-bash (0.5.0-1) ...
Setting up libserf-1-1:amd64 (1.3.9-10ubuntu2) ...
Setting up python3-breezy (3.2.1+bzr7585-1build1) ...
Setting up python3-pytest-cov (3.0.0-1) ...
Setting up python3-colcon-parallel-executor (0.3.0-1) ...
Setting up python3-colcon-argcomplete (0.3.3-1) ...
Setting up python3-colcon-recursive-crawl (0.2.3-1) ...
Setting up brz (3.2.1+bzr7585-1build1) ...
update-alternatives: using /usr/bin/brz to provide /usr/bin/bzr (bzr) in auto m
ode
Setting up python3-colcon-cmake (0.2.28-1) ...
Setting up python3-colcon-notification (0.2.15-1) ...
Setting up python3-github (1.55-1) ...
Setting up brz (2.7.0+bzr6622+brz) ...
Setting up python3-rosdep (0.22.2-1) ...
Setting up git (1:2.34.1-1ubuntu1.10) ...
Setting up python3-colcon-cd (0.1.1-1) ...
Setting up ros-build-essential (1.0.0) ...
Setting up libsvn1:amd64 (1.14.1-3ubuntu0.22.04.1) ...
Setting up subversion (1.14.1-3ubuntu0.22.04.1) ...
Setting up python3-colcon-ros (0.4.1-1) ...
Setting up python3-bloom (0.11.2-100) ...
Setting up python3-colcon-common-extensions (0.3.0-1) ...
Setting up ros-dev-tools (1.0.0) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.5) ...
grooot@grooot-VirtualBox:~$
```

Sudah terinstal ROS 2 Humble

A terminal window titled 'Terminal' with a timestamp of 'Jan 2 21:42'. The window shows the installation progress of ROS 2 Humble. The terminal output lists various packages being set up, including python3-colcon-recursive-crawl, brz, python3-colcon-cmake, python3-colcon-notification, python3-github, bzip2, python3-rosdep, git, python3-colcon-cd, ros-build-essential, libsvn1:amd64, subversion, python3-colcon-ros, python3-bloom, python3-colcon-common-extensions, and ros-dev-tools. It also shows the processing of triggers for man-db and libc-bin. The user then navigates to the /opt directory, lists its contents (showing 'ros' and 'VBoxGuestAdditions-7.0.10'), changes to the 'ros' directory, and lists its contents (showing 'humble'). The terminal window has a sidebar with icons for Activities, Terminal, and a search bar. The title bar of the window shows 'grooot@grooot-VirtualBox: /opt/ros' and standard window controls.

```
Activities Terminal Jan 2 21:42 grooot@grooot-VirtualBox: /opt/ros

Setting up python3-colcon-recursive-crawl (0.2.3-1) ...
Setting up brz (3.2.1+bzr7585-1build1) ...
update-alternatives: using /usr/bin/brz to provide /usr/bin/bzr (bzr) in auto mode
Setting up python3-colcon-cmake (0.2.28-1) ...
Setting up python3-colcon-notification (0.2.15-1) ...
Setting up python3-github (1.55-1) ...
Setting up bzip2 (2.7.0+bzr6622+brz) ...
Setting up python3-rosdep (0.22.2-1) ...
Setting up git (1:2.34.1-1ubuntu1.10) ...
Setting up python3-colcon-cd (0.1.1-1) ...
Setting up ros-build-essential (1.0.0) ...
Setting up libsvn1:amd64 (1.14.1-3ubuntu0.22.04.1) ...
Setting up subversion (1.14.1-3ubuntu0.22.04.1) ...
Setting up python3-colcon-ros (0.4.1-1) ...
Setting up python3-bloom (0.11.2-100) ...
Setting up python3-colcon-common-extensions (0.3.0-1) ...
Setting up ros-dev-tools (1.0.0) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.5) ...
grooot@grooot-VirtualBox:~$ cd /opt/
grooot@grooot-VirtualBox:/opt$ ls
ros  VBoxGuestAdditions-7.0.10
grooot@grooot-VirtualBox:/opt$ cd ros/
grooot@grooot-VirtualBox:/opt/ros$ ld
ld: no input files
grooot@grooot-VirtualBox:/opt/ros$ ls
humble
grooot@grooot-VirtualBox:/opt/ros$
```

```
Activities Terminal Jan 2 21:45
grooot@grooot-VirtualBox: ~

options:
-h, --help            show this help message and exit
--use-python-default-buffering
                        Do not force line buffering in stdout and instead use
                        the python default buffering, which might be affected
                        by PYTHONUNBUFFERED/-u and depends on whatever stdout
                        is interactive or not

Commands:
action                Various action related sub-commands
bag                   Various rosbag related sub-commands
component             Various component related sub-commands
daemon               Various daemon related sub-commands
doctor               Check ROS setup and other potential issues
interface             Show information about ROS interfaces
launch               Run a launch file
lifecycle             Various lifecycle related sub-commands
multicast            Various multicast related sub-commands
node                 Various node related sub-commands
param               Various param related sub-commands
pkg                  Various package related sub-commands
run                  Run a package specific executable
security             Various security related sub-commands
service              Various service related sub-commands
topic                Various topic related sub-commands
wtf                  Use 'wtf' as alias to 'doctor'

Call 'ros2 <command> -h' for more detailed usage.
grooot@grooot-VirtualBox:~$
```

C. Noetic installation :

```
Activities Terminal Jan 4 00:50
grooot@grooot-VirtualBox: ~

M: Target DEP-11-Icons (main/depi11/Icons-64x64.tar) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11-Icons-hidpi (main/depi11/Icons-64x64@2.tar) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target CNF (main/cnf/Commands-and4) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target CNF (main/cnf/Commands-all) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
Warning: apt-key is deprecated. Manage keyring files in trusted.gpg.d instead (see apt-key(8)).
OK
grooot@grooot-VirtualBox:~$ sudo apt update
Hit:1 http://id.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://id.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:3 http://id.archive.ubuntu.com/ubuntu jammy-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu jammy-security InRelease
Ign:5 http://packages.ros.org/ros/ubuntu jammy InRelease
Hit:6 http://packages.ros.org/ros2/ubuntu jammy InRelease
Err:7 http://packages.ros.org/ros/ubuntu jammy Release
404 Not Found [IP: 140.211.166.134 80]
Reading package lists... Done
E: The repository 'http://packages.ros.org/ros/ubuntu jammy Release' does not have a Release file.
N: Updating from such a repository can't be done securely, and is therefore disabled by default.
N: See apt-secure(8) manpage for repository creation and user configuration details.
M: Target Packages (main/binary-all/Packages) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target Packages (main/binary-all/Packages) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target Translations (main/l18n/Translation-en US) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target Translations (main/l18n/Translation-en) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11 (main/depi11/Components-and4.yml) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11 (main/depi11/Components-all.yml) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11-Icons-small (main/depi11/Icons-48x48.tar) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11-Icons (main/depi11/Icons-64x64.tar) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11-Icons-hidpi (main/depi11/Icons-64x64@2.tar) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target CNF (main/cnf/Commands-and4) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target CNF (main/cnf/Commands-all) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target Packages (main/binary-all/Packages) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target Packages (main/binary-all/Packages) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target Translations (main/l18n/Translation-en US) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target Translations (main/l18n/Translation-en) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11 (main/depi11/Components-and4.yml) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11 (main/depi11/Components-all.yml) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11-Icons-small (main/depi11/Icons-48x48.tar) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11-Icons (main/depi11/Icons-64x64.tar) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target DEP-11-Icons-hidpi (main/depi11/Icons-64x64@2.tar) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target CNF (main/cnf/Commands-and4) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
M: Target CNF (main/cnf/Commands-all) is configured multiple times in /etc/apt/sources.list.d/ros2-latest.list:1 and /etc/apt/sources.list.d/ros2.list:1
grooot@grooot-VirtualBox:~$ sudo apt install ros-noetic-desktop-full
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
E: Unable to locate package ros-noetic-desktop-full
grooot@grooot-VirtualBox:~$
```

Analisis : saya sudah mencoba untuk install ros noetic di ubuntu 20.04 seperti perintah di buku mastering ros, tetapi gagal, saya telah mencoba untuk mencari Solusi di komunitas ros, dan

hasilnya bahwa ros noetic sudah tidak kompitabel di ubuntu 20.04, lalu saya cari Solusi lain dan ketemu bahwa bisa untuk mencari source di ubuntu 20.04, tetapi masih eror :

```
grooot@grooot-VirtualBox: ~/ros_noetic_base
Or undo this operation with:
  git switch -
Turn off this advice by setting config variable advice.detachedHead to false

grooot@grooot-VirtualBox:~/ros_noetic_base$ cd ..
git clone https://github.com/ros-infrastructure/catkin_pkg.git -b 1.0.0
git clone https://github.com/ros-infrastructure/rospkg.git -b 0.5.2
Cloning into 'catkin_pkg'...
remote: Enumerating objects: 2907, done.
remote: Counting objects: 100% (277/277), done.
remote: Compressing objects: 100% (127/127), done.
remote: Total 2907 (delta 139), reused 209 (delta 102), pack-reused 2630
Receiving objects: 100% (2907/2907), 666.16 KiB | 452.00 KiB/s, done.
Resolving deltas: 100% (1630/1630), done.
Note: switching to 'fb2468e6c2565802bc3ef6134a76db76ae9f3632'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by switching back to a branch.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -c with the switch command. Example:

  git switch -c <new-branch-name>

Or undo this operation with:
  git switch -
Turn off this advice by setting config variable advice.detachedHead to false

Cloning into 'rospkg'...
fatal: Remote branch 0.5.2 not found in upstream origin
grooot@grooot-VirtualBox:~/ros_noetic_base$ cd catkin_ws/src/ros_comm
git apply --ignore-whitespace ros_comm.patch
cd ../roscconsole
git apply --ignore-whitespace roscconsole.patch
bash: cd: catkin_ws/src/ros_comm: No such file or directory
error: can't open patch '-': No such file or directory
bash: cd: ../roscconsole: No such file or directory
error: can't open patch 'roscconsole.patch': No such file or directory
grooot@grooot-VirtualBox:~/ros_noetic_base$

do so (now or later) by using -c with the switch command. Example:
  git switch -c <new-branch-name>

Or undo this operation with:
  git switch -
Turn off this advice by setting config variable advice.detachedHead to false

Cloning into 'rospkg'...
fatal: Remote branch 0.5.2 not found in upstream origin
grooot@grooot-VirtualBox:~/ros_noetic_base$ cd catkin_ws/src/ros_comm
git apply --ignore-whitespace ros_comm.patch
cd ../roscconsole
git apply --ignore-whitespace roscconsole.patch
bash: cd: catkin_ws/src/ros_comm: No such file or directory
error: can't open patch '-': No such file or directory
bash: cd: ../roscconsole: No such file or directory
error: can't open patch 'roscconsole.patch': No such file or directory
grooot@grooot-VirtualBox:~/ros_noetic_base$ FROM ubuntu:22.04

RUN apt-get update && \
  apt-get install -y \
  cmake \
  build-essential \
  python3 \
  pip
FROM: command not found
RUN: command not found
grooot@grooot-VirtualBox:~/ros_noetic_base$ sudo docker build -t ros_noetic_base .
sudo docker run -it --rm -v .:/ros_noetic_base ros_noetic_base bash
cd /ros_noetic_base/catkin_pkg && python3 setup.py install
cd /ros_noetic_base/rospkg && python3 setup.py install
cd /ros_noetic_base/catkin_ws
./src/catkin/bin/catkin_make_isolated \
  -DCMAKE_BUILD_TYPE=Release \
  -DPYTHON_EXECUTABLE=/usr/bin/python3
sudo: docker: command not found
sudo: docker: command not found
bash: cd: /ros_noetic_base/catkin_pkg: No such file or directory
bash: cd: /ros_noetic_base/rospkg: No such file or directory
bash: cd: /ros_noetic_base/catkin_ws: No such file or directory
bash: ./src/catkin/bin/catkin_make_isolated: No such file or directory
grooot@grooot-VirtualBox:~/ros_noetic_base$
```

D. Pertanyaan :

1. Protokol Komunikasi antar Node yang Didukung oleh ROS:

ROS mendukung beberapa protokol komunikasi antar node, di antaranya adalah:

- A. ROS Topics (Topik ROS): Digunakan untuk komunikasi berbasis pub/sub (publisher/subscriber), di mana node-node dapat mengirim dan menerima data secara tidak langsung melalui topik yang sama.
- B. ROS Services (Layanan ROS): Menggunakan pendekatan client/server, di mana node klien meminta layanan dari node server dan menerima respon.

- C. ROS Actions (Tindakan ROS): Dikhususkan untuk tugas-tugas yang memerlukan umpan balik dan pemantauan progres, berbeda dengan services yang bersifat sinkron, actions menyediakan mekanisme asinkron untuk tugas yang memakan waktu.

2. Perbedaan antara Perintah rosrun dan roslaunch:

rosrun digunakan untuk menjalankan sebuah package atau executable pada ROS.

roslaunch digunakan untuk meluncurkan (launch) satu atau lebih file launch (berkas konfigurasi yang dapat memuat banyak perintah rosrun, rosparam, dll.) secara bersamaan.

3. Perbedaan antara ROS Topics dan Services dalam Operasionalnya:

ROS Topics: Digunakan untuk komunikasi pub/sub, di mana node-node dapat mempublikasikan data ke topik dan node-node lain bisa berlangganan untuk menerima data yang dipublikasikan pada topik yang sama.

ROS Services: Beroperasi dalam paradigma client/server, di mana node klien dapat memanggil layanan yang disediakan oleh node server untuk melakukan tugas tertentu dan menerima respons.

4. Perbedaan antara ROS Services dan Actionlib dalam Operasionalnya:

ROS Services: Bersifat sinkron, artinya node klien menunggu hingga layanan yang diminta selesai dilakukan sebelum melanjutkan eksekusi.

Actionlib: Dirancang untuk tugas-tugas yang memerlukan umpan balik, seperti tugas-tugas yang memakan waktu yang lama, dan menyediakan kemampuan untuk memantau progres dan menerima umpan balik selama eksekusi. Actionlib bekerja dalam mode asinkron, memungkinkan eksekusi di latar belakang sambil memantau kemajuan tugas.