EE478
Introduction to Multi-disciplinary Robotics

Introduction to Ubuntu & ROS

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Introduction to Ubuntu OS and ROS

- What is Operating System (OS)?
  - You might thinking about…

Windows™

or …

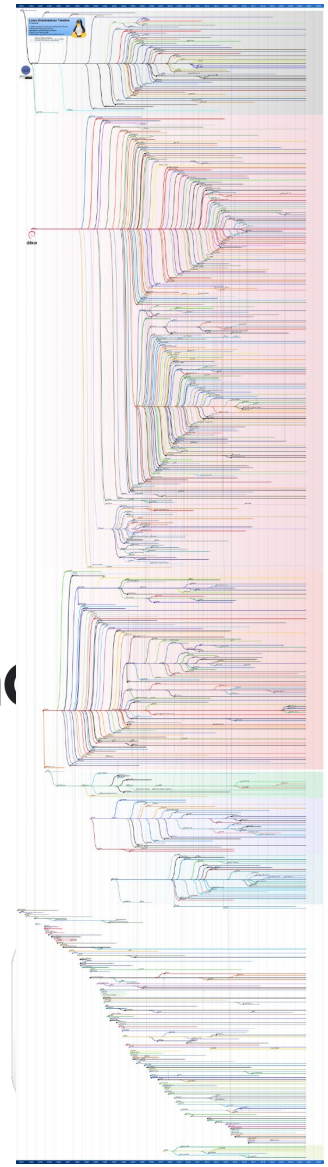
mac OS

Introduction to Ubuntu OS and ROS

- What is Operating System (OS)?
  - But they are not the only operating systems.
    - Windows

Windows

There are a lot of Linux distributions… :



    - Linux-based

Ubuntu CentOS fedora Ar

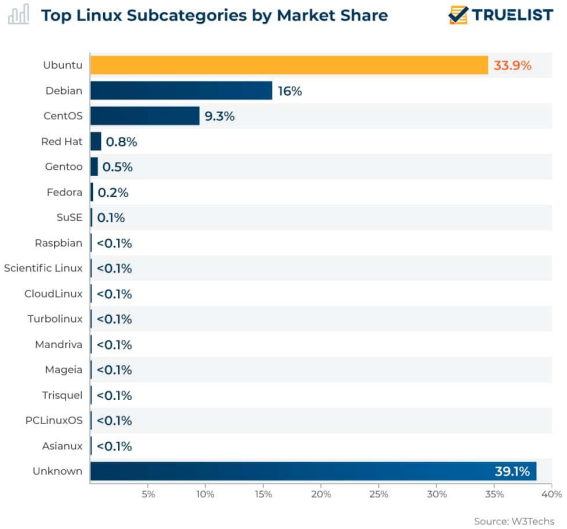
UNIX® An Open Group Standard

    - Unix-based

mac OS FreeBSD solaris

Introduction to Ubuntu OS and ROS

- Why do we use ROS with Ubuntu?
  - Community support
    - Large and active community
    - Extensive Reference Materials Available

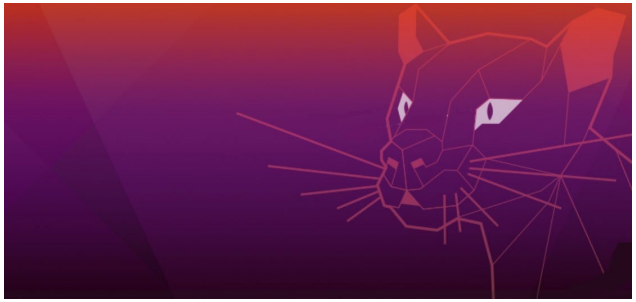


  - Package management
    - Easy to install ROS packages and dependencies with **Ubuntu's package management system (APT)**
      - You will do a lot of "**apt install SOMETHING**" to install packages
  - Compatibility
    - ROS packages and library are commonly developed and tested on Ubuntu

→ So we will use ROS1 Noetic version on the Ubuntu 20.04.

Introduction to Ubuntu OS and ROS

- ROS and Ubuntu distros will be used in this lecture
  - Ubuntu: **Ubuntu 20.04 LTS** (Long Term Service)
    - We will use Ubuntu 20.04 that is the most recent version of Ubuntu still maintained while capable with ROS1.
      - https://releases.ubuntu.com/focal/



  - ROS: **ROS1 Noetic** (which is for Ubuntu 20)
    - Also, the latest version with maintained in ROS1.
      - https://www.ros.org/

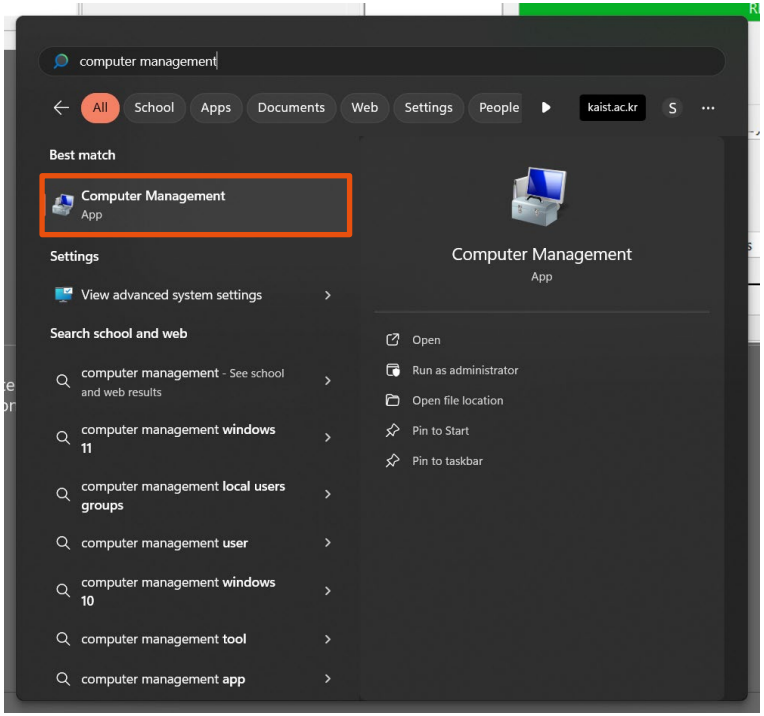
Introduction to Ubuntu OS and ROS

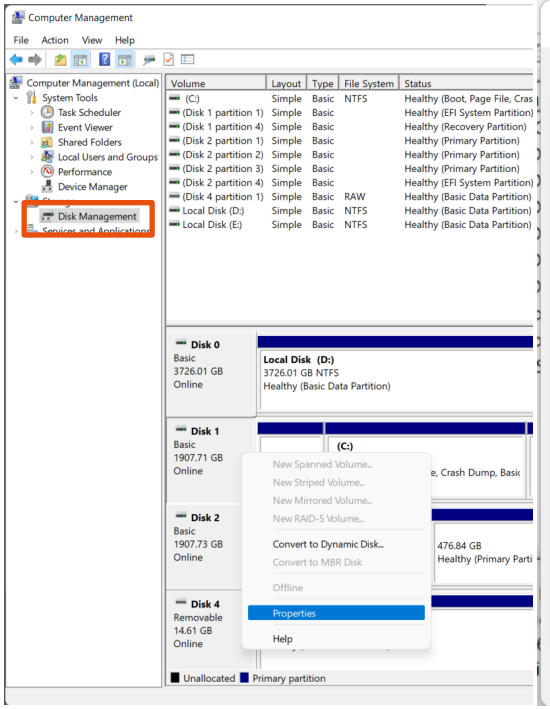
- Installing Ubuntu OS on your computer
  - If you have a Windows computer and want to keep Windows while installing Ubuntu alongside, follow these steps:
    - **Make backups of your files on Windows.** Installing Ubuntu with error may potentially disrupt the Windows file system.
    - Follow the instructions on the following slide.
    - **Consider using a computer in the lab-session lecture room.**
  - Those who don't mind deleting Windows and their saved files,
    - Follow instructions starting from the **slide 14.**
  - If you are using a Mac computer,
    - **Consider using a computer in the lab-session lecture room.**
    - If possible, borrow or acquire a blank or Windows computer.
    - If unavailable, please search and follow instructions about using ROS in Mac available on the internet (not recommended).

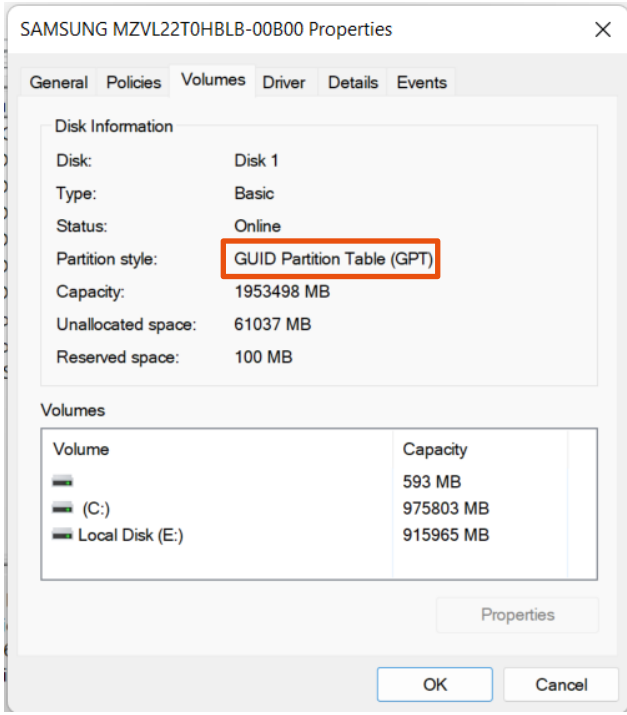
Introduction to Ubuntu OS and ROS

❖ Installing Ubuntu OS on your computer

- ❑ Before start to install, check style of your disk partition
  - ➢ Open **Computer Management → Disk Management**
  - ➢ Check **Partition style** of your disk that Windows installed (C:)
    - ▪ Check whether style is **MBR** or **GPT**.





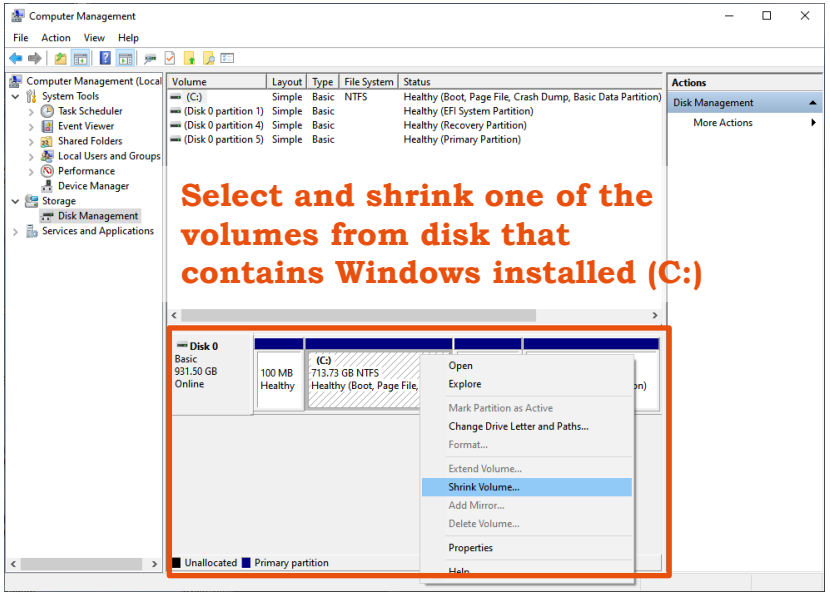


Introduction to Ubuntu OS and ROS

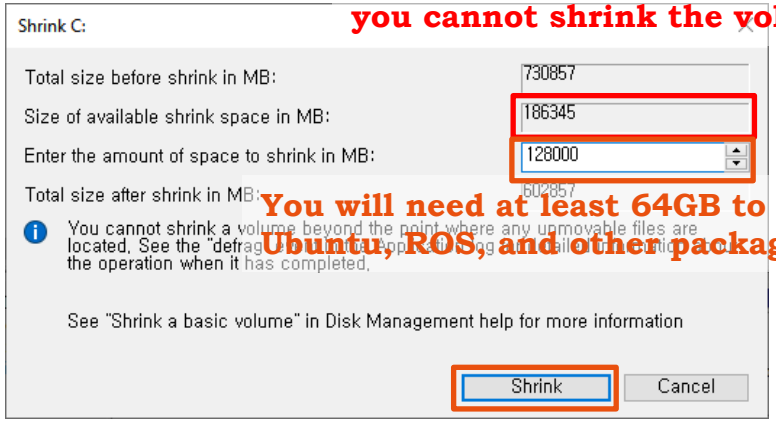
❖ Installing Ubuntu OS on your computer

❑ Making free space for installing Ubuntu

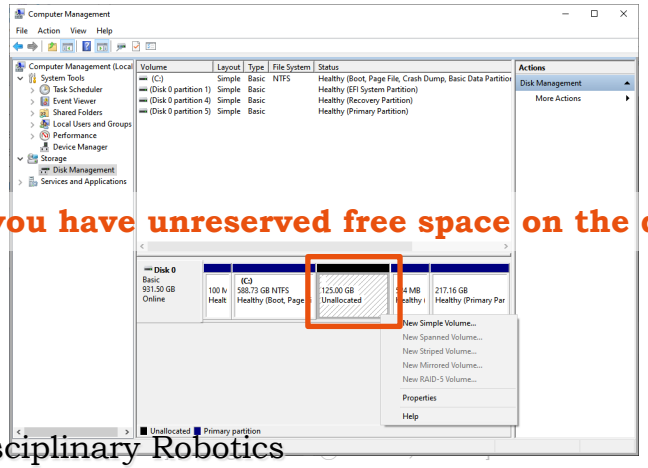
- ➢ If you want to keep Windows while installing, you need to shrink the volume size of the Windows partition is already reserved.



If volume is fulled with file, you cannot shrink the volume



You will need at least 64GB to install Ubuntu, ROS, and other packages



Now you have unreserved free space on the disk

Introduction to Ubuntu OS and ROS

- Installing Ubuntu OS on your computer
  - Download latest Ubuntu 20.04 OS image file.
    - https://releases.ubuntu.com/focal/

ubuntu releases

Ubuntu 20.04.6 LTS (Focal Fossa)

Select an image

Ubuntu is distributed on three types of images described below.

Desktop image

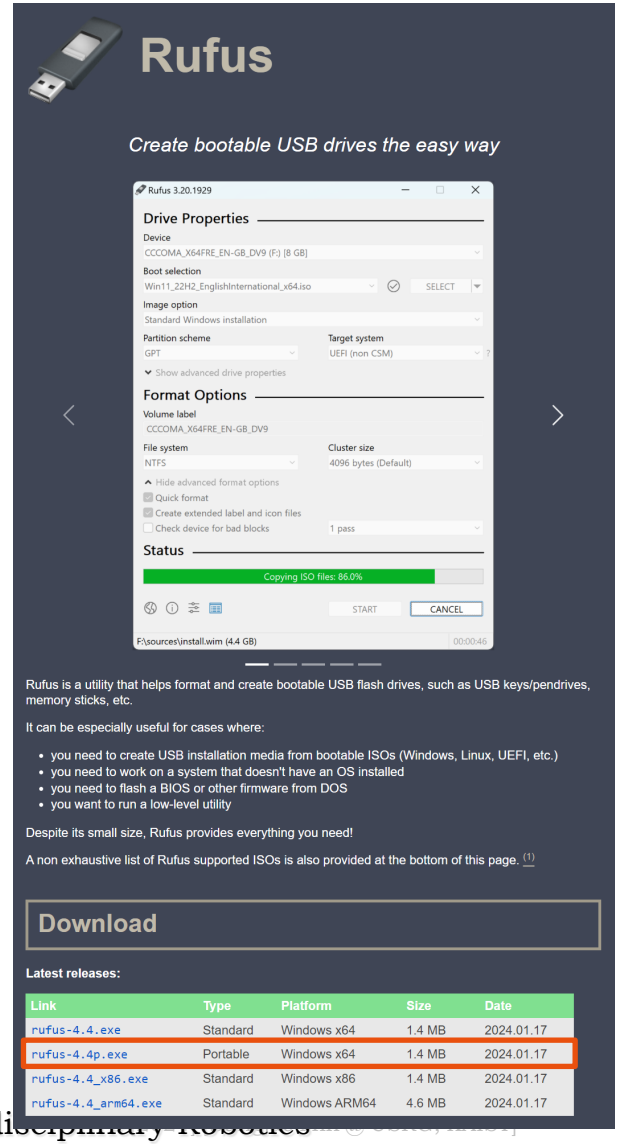
The desktop image allows you to try Ubuntu without changing your computer at all, and at your option to install it permanently later. This type of image is what most people will want to use. You will need at least 1024MiB of RAM to install from this image.

64-bit PC (AMD64) desktop image

Choose this if you have a computer based on the AMD64 or EM64T architecture (e.g., Athlon64, Opteron, EM64T Xeon, Core 2). Choose this if you are at all unsure.

Introduction to Ubuntu OS and ROS

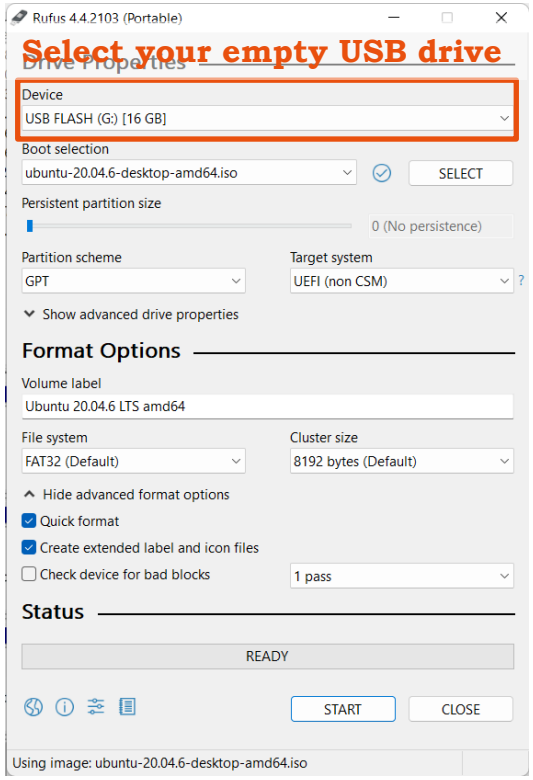
- Installing Ubuntu OS on your computer
  - Download disk image writer
    - https://rufus.ie/

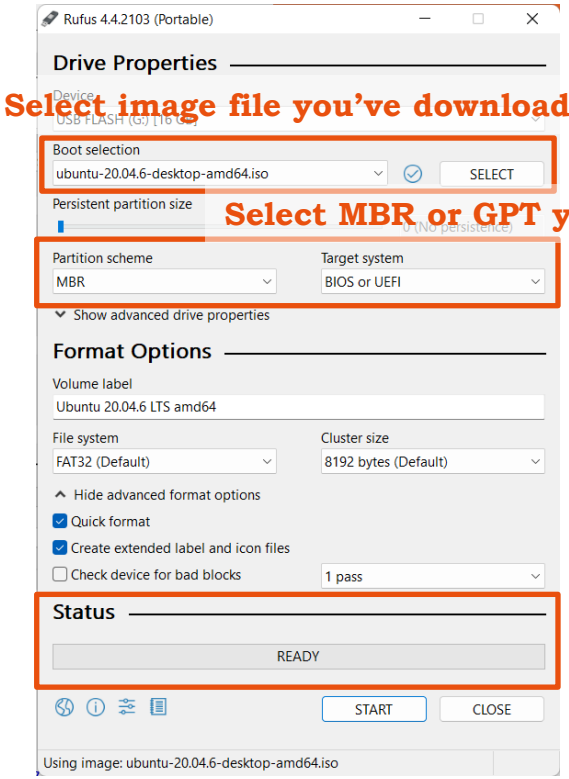


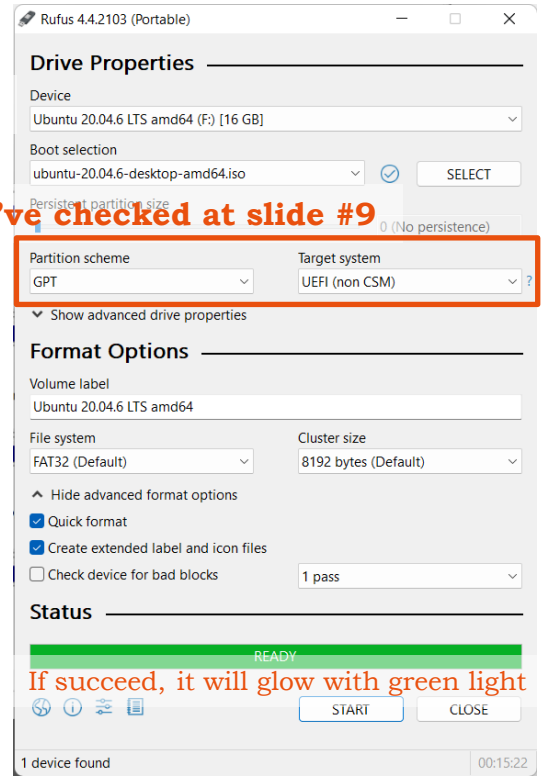
Introduction to Ubuntu OS and ROS

❖ Installing Ubuntu OS on your computer

- ❑ Write Ubuntu image file into empty USB drive
  - ➢ Backup files in the USB drive before writing. This procedure will erase it all inside.

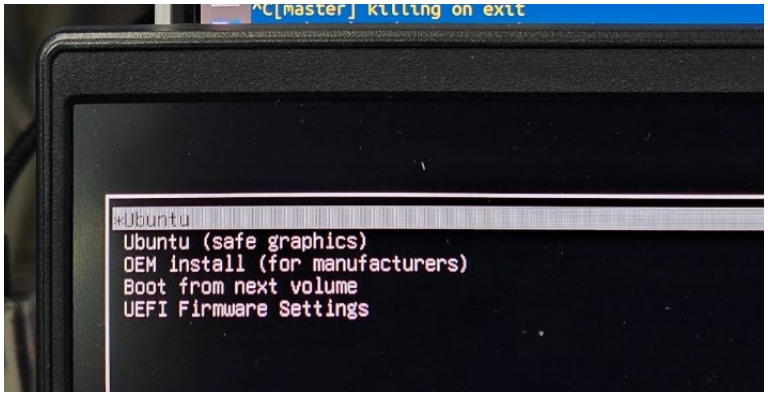




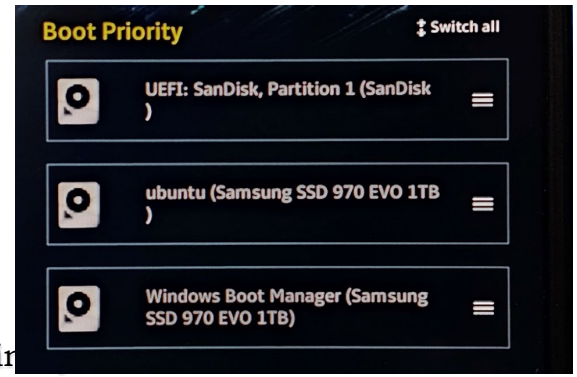


Introduction to Ubuntu OS and ROS

- Installing Ubuntu OS on your computer
  - Plug written USB flash to the computer you want to install
    - Reboot the computer and select **Ubuntu** or **Install Ubuntu** option

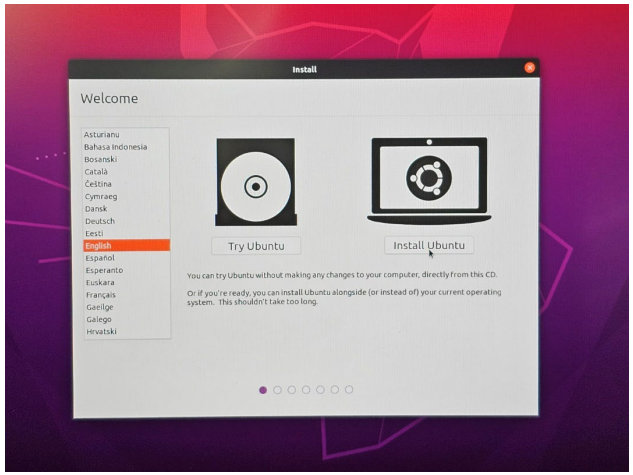


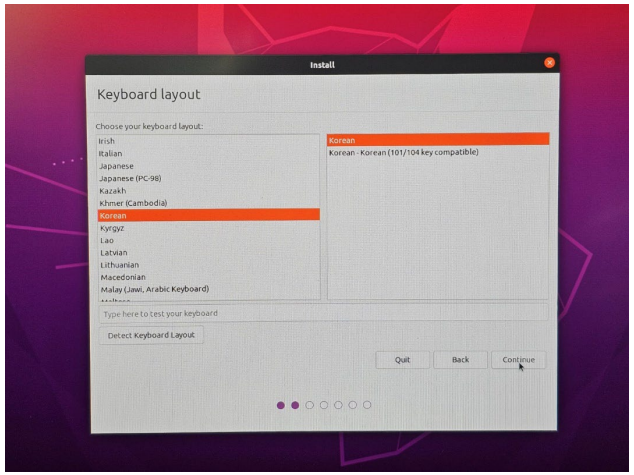
    - If it does not shows up like this kind of screen,
      - Reboot and dive into BIOS settings (with pressing F2, F12, or Del while booting up, key is depending on computers manufacture)
      - Go to Boot Priority setup
      - Set drive to the first priority with UEFI with your USB drive name

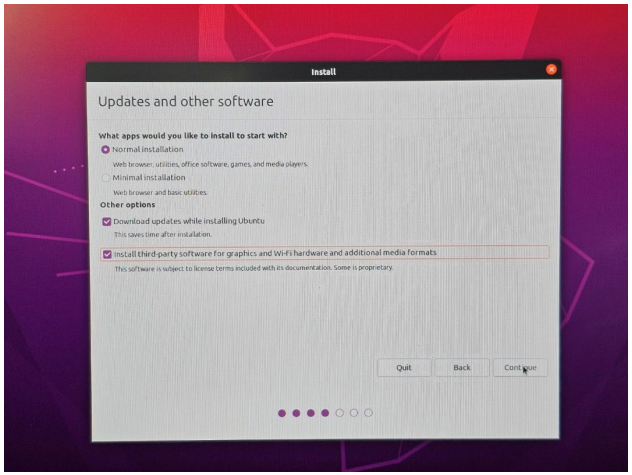


Introduction to Ubuntu OS and ROS

- Installing Ubuntu OS on your computer
  - Installing Ubuntu 20.04
    - **Use English as a system language** for software compatibility
    - Set keyboard layout as match with your computer
    - Connect computer to the internet if it available
    - Check true **Normal installation** and **third-party software** option

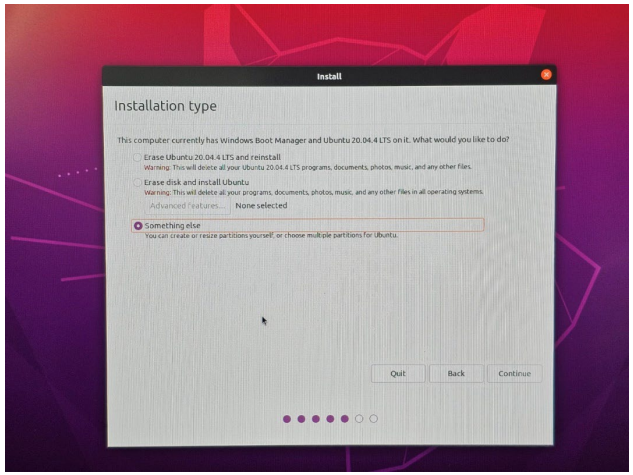


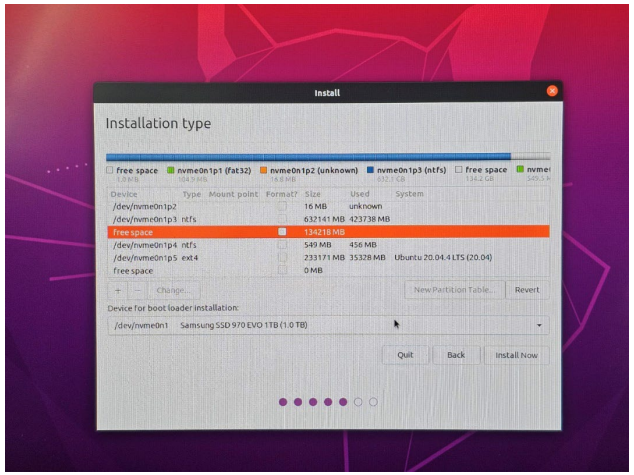


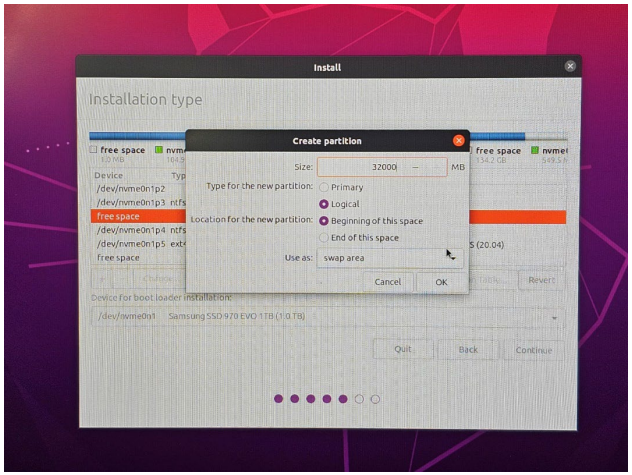


Introduction to Ubuntu OS and ROS

- Installing Ubuntu OS on your computer
  - Installing Ubuntu 20.04
    - Choose **Something else** option
    - **Alongside Windows:** Find a **free space** you've shrieked to install Ubuntu at the slide #*
      Deleting Windows: Delete **current partition with –**
    - Make **swap partition** (partition that will be used like a system memory in case of memory shortage)
      - Do not set as a swap memory more than 8000MB if your original free space was under 64GB

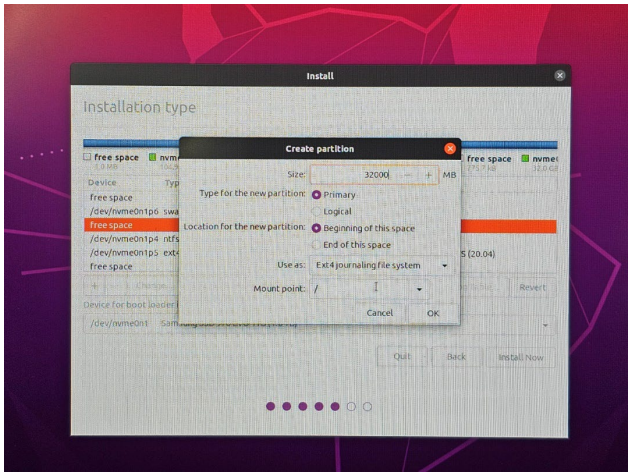


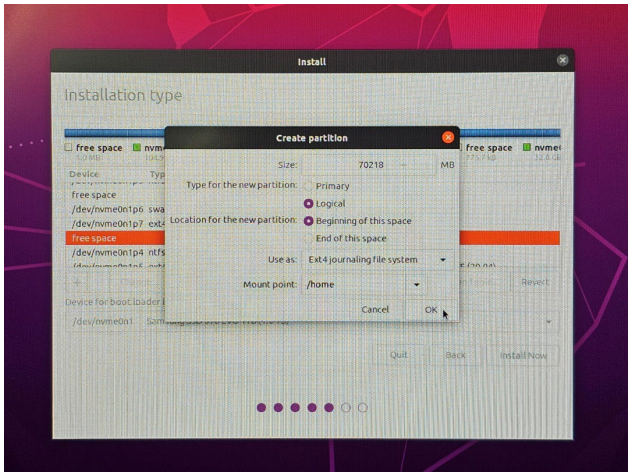


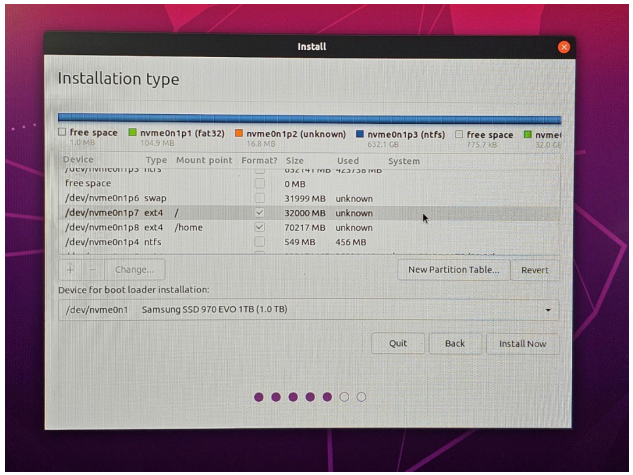


Introduction to Ubuntu OS and ROS

- Installing Ubuntu OS on your computer
  - Installing Ubuntu 20.04
    - Make **/ (root) partition** over than 32000MB and less than 64GB
      - It will be used as a system drive
    - Make **/home partition** with the size of rest free space
      - It will be used as a your workspace
    - Now, check the partition tables whether it shows three partitions
    - DO NOT make change in the **Device for boot loader installation**

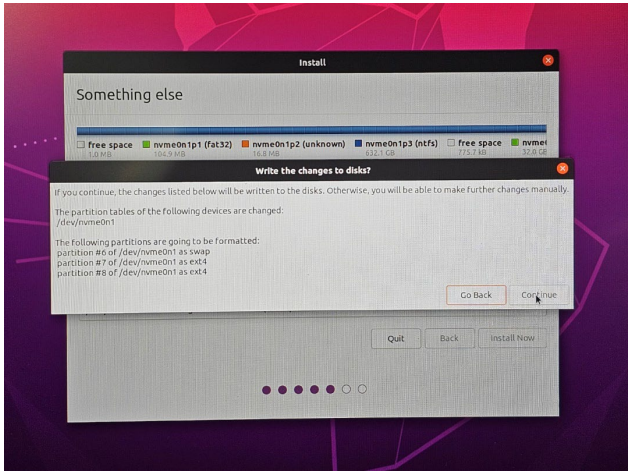


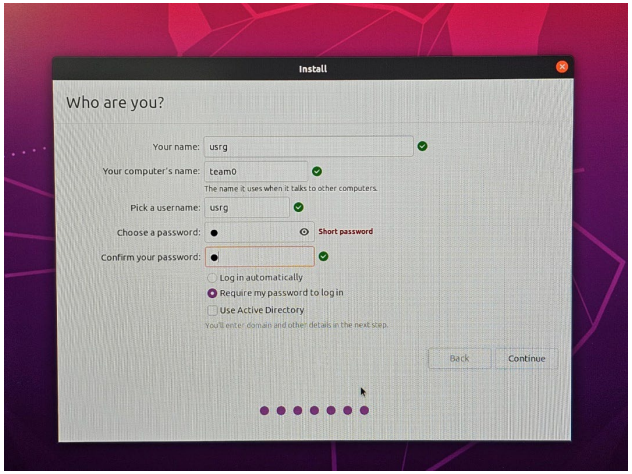


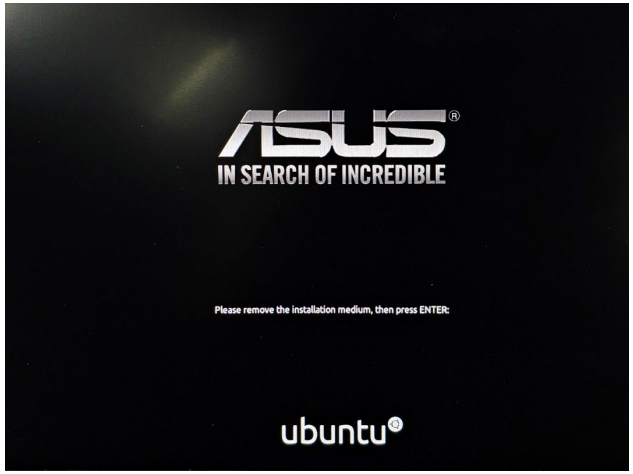


Introduction to Ubuntu OS and ROS

- Installing Ubuntu OS on your computer
  - Installing Ubuntu 20.04
    - Press **Install Now** and **Continue** to install the Ubuntu.
    - Make your system account. A **Short password is recommended** because you have to type it hundred times along semester.
    - After installation, unplug USB flash from computer and reboot.





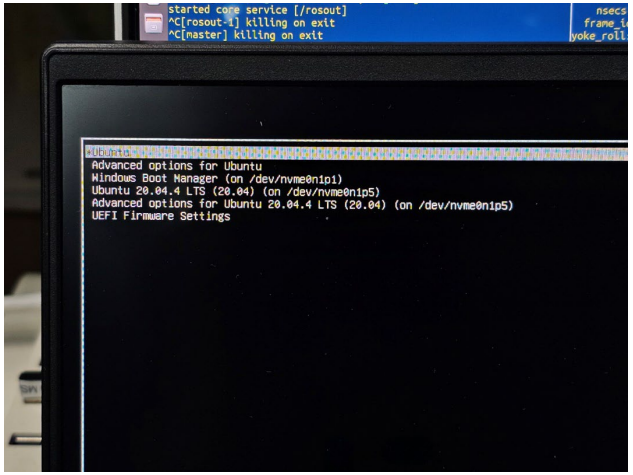


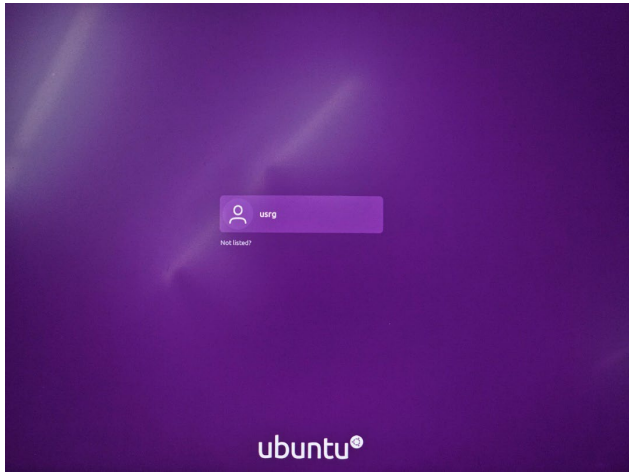
Introduction to Ubuntu OS and ROS

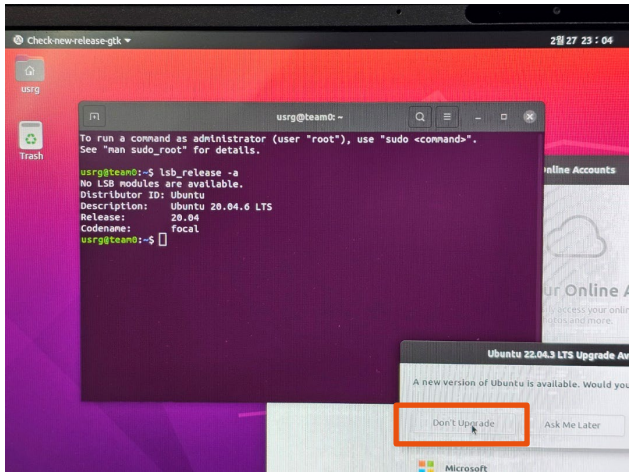
❖ Installing Ubuntu OS on your computer

❑ Installing Ubuntu 20.04

- ➢ After rebooting, you will see the Grub boot-options for the OS if you installed Ubuntu alongside Windows.
  - ▪ If the option does not appear, then find and follow solutions using the following keyword: "*Windows Ubuntu dual boot grub not showing.*"
- ➢ If you deleted Windows and installed Ubuntu, it will directly boot with Ubuntu.
- ➢ Finally, Ubuntu is installed on your computer.
  - ▪ Please **DO NOT upgrade** your version.







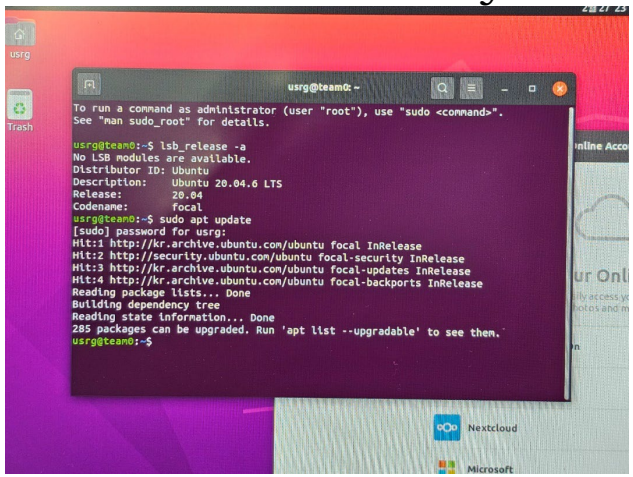
Introduction to Ubuntu OS and ROS

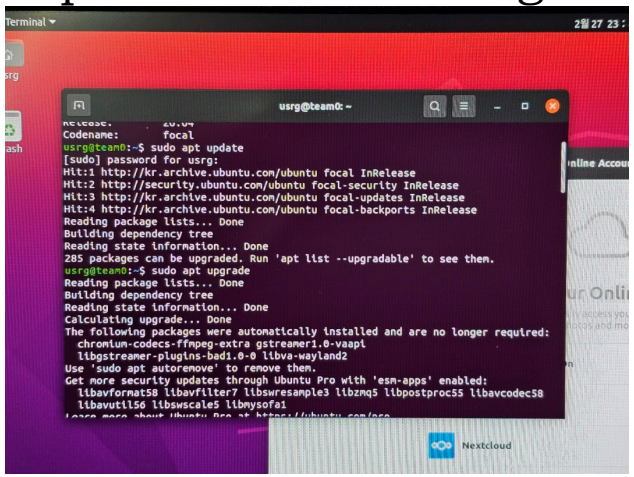
❖ Installing Ubuntu OS on your computer

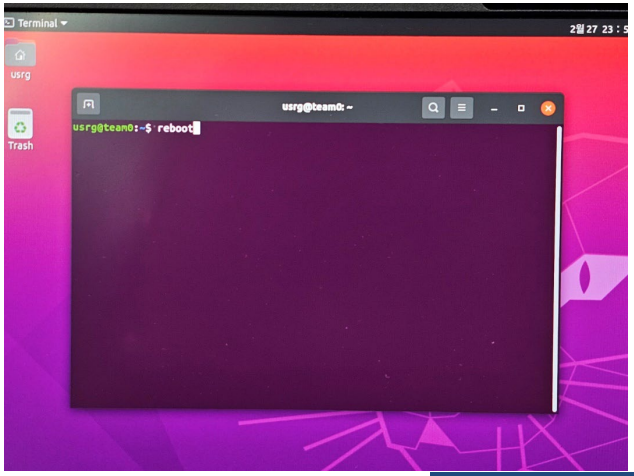
- ❑ Initial setup for Ubuntu
  - ➢ **Basic: Press ctrl+alt+t as a shortcut to open the terminal**
  - ➢ First, update your system libraries with following command:

```
sudo apt update
sudo apt upgrade
```

  - ➢ Install your graphics card driver depending on your computer's hardware if the screen does not display correctly
    - ▪ Find the driver appropriate for your computer's graphics card
  - ➢ Reboot your computer before starting to install ROS

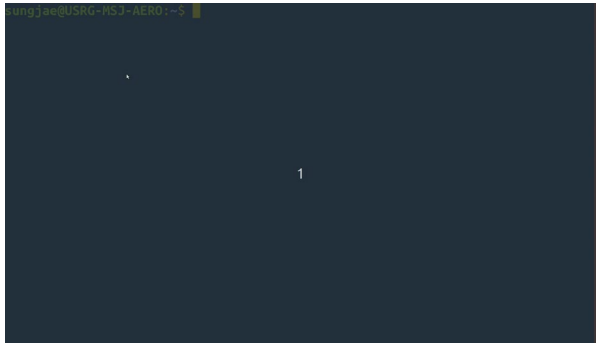


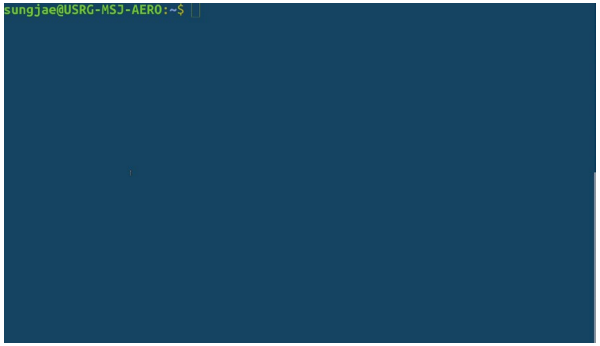


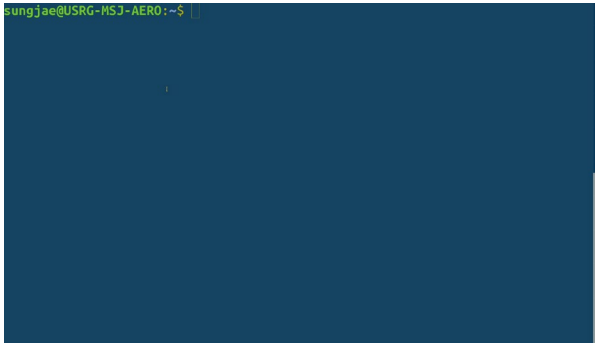


Introduction to Ubuntu OS and ROS

- Linux basics
  - Basic terminal commands on the Linux
    - **ls: :** List the files and directories in the current directory.
    - **pwd:** Prints the current working directory path.
    - **cd:** Changes the directory to the specified path.
    - **mv:** Moves or renames files and directories.
    - **cp:** Copies files and directories
    - **|(shift \):** Passes the output of one command as input to another command for further processing
    - **grep:** Searches for patterns in text and prints lines that match the specified pattern







Introduction to Ubuntu OS and ROS

- Linux tips
  - Useful software
    - **Terminator:** Terminal emulator that provides configurable multiple terminal panels in single window https://gnome-terminator.org/
      - **ctrl+shift+o:** Split horizontally
      - **ctrl+shift+e:** Split vertically
      - **ctrl+shift+w:** Close current terminal
      - **alt+[ARROW_KEY]:** Move on to directed terminal
    - **Visual Studio Code:** Code editor that commonly used for various language over operating systems and install-able extensions to help code styling https://code.visualstudio.com/download
      - C++
      - Python
      - ROS
      - XML Tools

Introduction to Ubuntu OS and ROS

- Installing ROS
  - Follow installation procedures from ROS Wiki
    - https://wiki.ros.org/noetic/Installation/Ubuntu

```
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" >
/etc/apt/sources.list.d/ros-latest.list'
```

```
sudo apt install curl
curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc | sudo apt-key add -
```

```
sudo apt update
```

```
sudo apt install ros-noetic-desktop-full
```

```
echo "source /opt/ros/noetic/setup.bash" >> ~/.bashrc
source ~/.bashrc
```

```
sudo apt install python3-rosdep python3-rosinstall python3-rosinstall-generator python3-wstool
build-essential
```

```
sudo rosdep init
rosdep update
```

Introduction to Ubuntu OS and ROS

❖ Installing ROS

- ❑ Configuring ROS environment and first workspace
  - ➢ https://wiki.ros.org/ROS/Tutorials/InstallingandConfiguringROSEnvironment

Source .bashrc before following below command with command "source ~/.bashrc" or Open new terminal and follow (it will automatically source your updated ~/.bashrc

```
mkdir -p ~/catkin_ws/src
cd ~/catkin_ws/
catkin_make
```

This is your first ROS workspace!
with Catkin build system

```
source devel/setup.bash
```

```
echo $ROS_PACKAGE_PATH
```

You can configure another workspace with

```
mkdir –p ~/mine_ws/src
cd ~/mine_ws
catkin_make
```

If you have multiple workspace, you have to source in workspace that ros programs you want to start are included

```
source  ~/mine_ws/devel/setup.bash
```

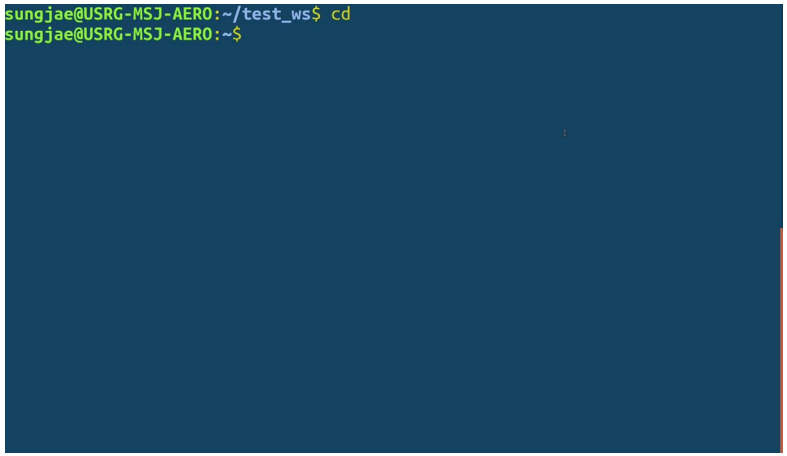
- ➢ If it is correctly configured, than it will shows like this

```
sungjae@USRG-MSJ-AERO:~$ echo $ROS_PACKAGE_PATH
/home/sungjae/catkin_ws/src:/opt/ros/melodic/share
```

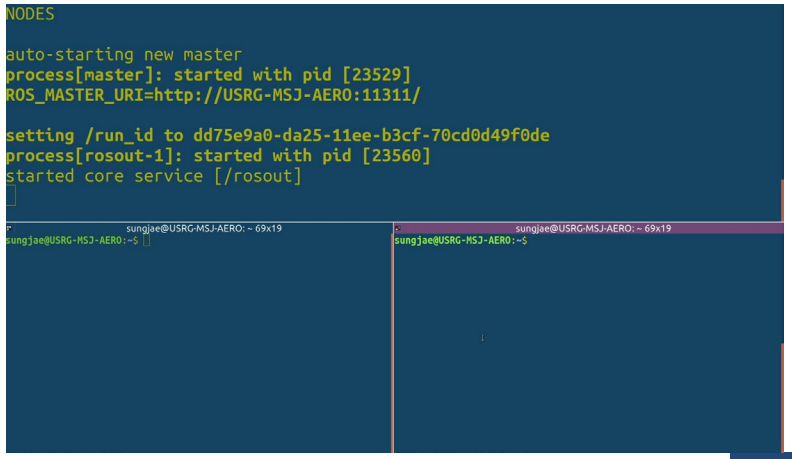
noetic not melodic for your distro

Introduction to Ubuntu OS and ROS

- ROS Basics
  - Basic command
    - **roscore**: Launches ROS Master and debugging logger (rosout)
    - **rostopic**: Command-line tool for Topics
      - http://wiki.ros.org/rostopic
    - **rosservice**: Command-line tool for Servies
      - https://wiki.ros.org/rosservice
  - Simple Topic publisher and subscriber example on the command-line
    - **Basic:**



When if ROS Master died:



Introduction to Ubuntu OS and ROS

❖ ROS Basics

- ❑ Hands-on learning with practice
  - ➢ https://wiki.ros.org/ROS/Tutorials
- ❑ Follow the tutorials and try them yourself, one by one, starting from section 1.1.2 to 1.1.18.
  - ➢ This will greatly help you with your assignments and projects.
- ❑ Examples are available in both C++ and Python, and we recommend trying both languages since you will need to use both while working on the final project.
- ❑ Self evaluation with practice skeleton code.
  - ➢ https://github.com/Guri-cccc/KAIST_EE405A_2024_1/tree/main/Week2/practice

1. Core ROS Tutorials

1.1 Beginner Level

1. Installing and Configuring Your ROS Environment
   This tutorial walks you through installing ROS and setting up the ROS environment on your computer.
2. Navigating the ROS Filesystem
   This tutorial introduces ROS filesystem concepts, and covers using the roscd, rosls, and rospack commandline tools.
3. Creating a ROS Package
   This tutorial covers using roscreate-pkg or catkin to create a new package, and rospack to list package dependencies.
4. Building a ROS Package
   This tutorial covers the toolchain to build a package.
5. Understanding ROS Nodes
   This tutorial introduces ROS graph concepts and discusses the use of roscore, rosnode, and rosrun commandline tools.
6. Understanding ROS Topics
   This tutorial introduces ROS topics as well as using the rostopic and rqt_plot commandline tools.
7. Understanding ROS Services and Parameters
   This tutorial introduces ROS services, and parameters as well as using the rosservice and rosparam commandline tools.
8. Using rqt_console and roslaunch
   This tutorial introduces ROS using rqt_console and rqt_logger_level for debugging and roslaunch for starting many nodes at once. If you use `ROS fuerte` or ealier distros where rqt isn't fully available, please see this page with this page that uses old `rx` based tools.
9. Using rosed to edit files in ROS
   This tutorial shows how to use rosed to make editing easier.
10. Creating a ROS msg and srv
    This tutorial covers how to create and build msg and srv files as well as the rosmsg, rossrv and roscp commandline tools.
11. Writing a Simple Publisher and Subscriber (C++)
    This tutorial covers how to write a publisher and subscriber node in C++.
12. Writing a Simple Publisher and Subscriber (Python)
    This tutorial covers how to write a publisher and subscriber node in python.
13. Examining the Simple Publisher and Subscriber
    This tutorial examines running the simple publisher and subscriber.
14. Writing a Simple Service and Client (C++)
    This tutorial covers how to write a service and client node in C++.
15. Writing a Simple Service and Client (Python)
    This tutorial covers how to write a service and client node in python.
16. Examining the Simple Service and Client
    This tutorial examines running the simple service and client.
17. Recording and playing back data
    This tutorial will teach you how to record data from a running ROS system into a .bag file, and then to play back the data to produce similar behavior in a running system
18. Reading messages from a bag file
    Learn two ways to read messages from desired topics in a bag file, including using the `ros_readbagfile` script.

It is homework but you don't have to submit it.

Thank you!