THE UNIVERSITY OF HONG KONG

Department of Data and Systems Engineering

DASE4136 Intelligent Transportation and Autonomous Driving

Tutorial: Ubuntu Installation and Environment Setup

Objectives:

- By following the instructions in this tutorial sheet, you should have properly installed Ubuntu 22.04 on a virtual machine (VMware Workstation 17 Pro).
- A basic understanding of how a virtual Ubuntu works on Windows.
- Some additional exercises for dual boot and ROS basics are available in the last section with references (optional reading).

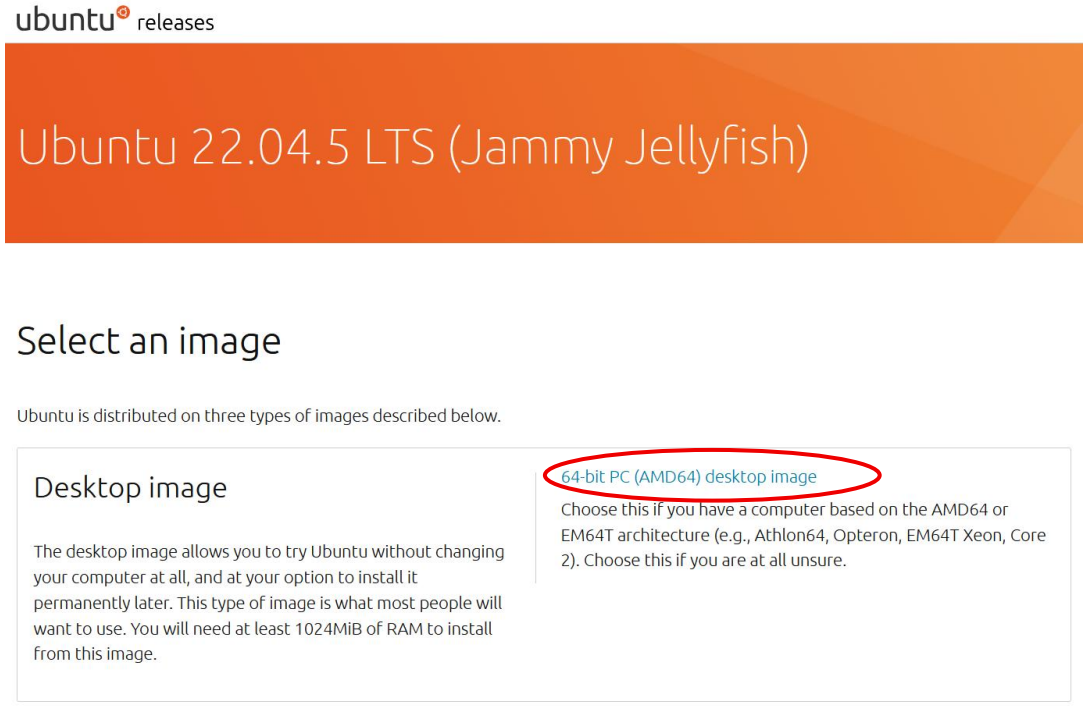
Equipment and Systems Requirements:

- A PC with Windows as the operating system (please note that this solution was for Windows environments, **another version for MacOS is attached in another file**)
- Disk space: 40 GB
- RAM: 8-16 GB
- CPU @ least 10 GHz in total (~ 4 cores)

Step-by-Step Instructions:

1. Follow the link to Ubuntu release website:
   https://releases.ubuntu.com/jammy/

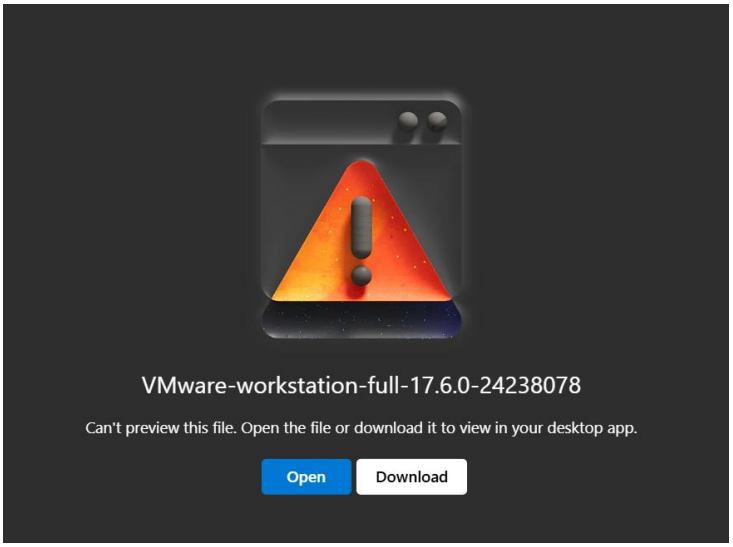
   You should see the download page in as bellows. Click “64-bit PC (AMD64) desktop image” and it will start downloading the desktop image automatically. (you don’t need to touch the file for this stage)



2. Follow the link to download the VMware Workstation 17 (Since it's not easy to directly install from the web which requires the license key, you may download this version from the Microsoft OneDrive using you **HKU connect email account and password**)

   https://connecthkuhk-my.sharepoint.com/:u:/g/personal/u3012789_connect_hku_hk/IQAe70h5zRZeTaK38qMHmWbjAeCFZv56QxwdmNiC-o93WxI?e=DtmPur

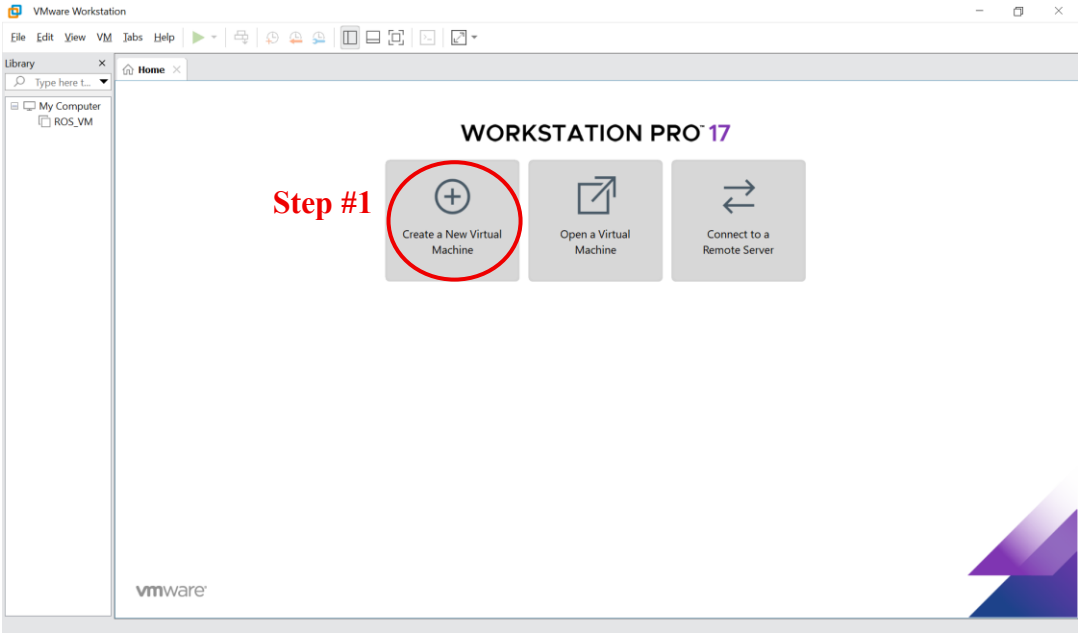
   After clicking the link, you may see this page:



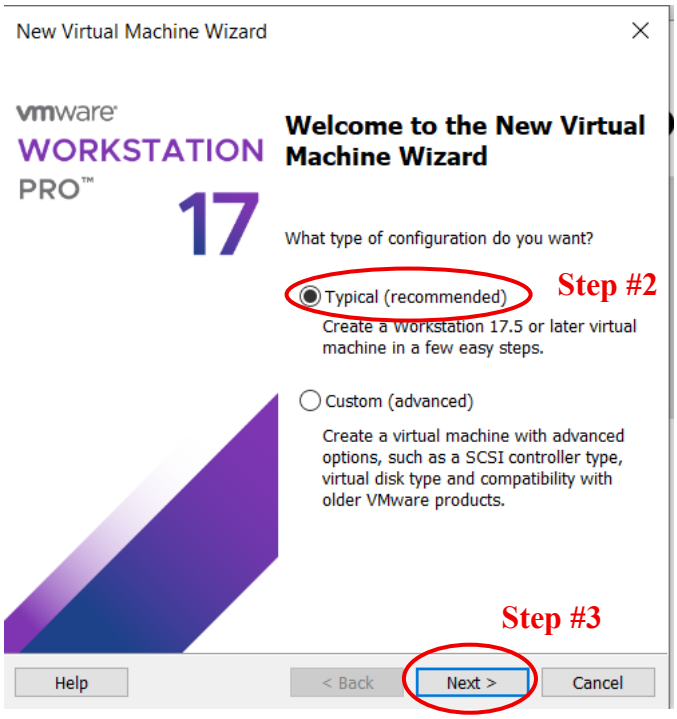
   Click "Download" and then it will be stored into your home PC.

3. After downloading from the OneDrive, you may start to setup the application by following the setup wizard and keep the default settings. After setting up, you may open the

application by just type ‘VMware” from Search panel or the desktop shortcut directly. The initial page of the application is as:

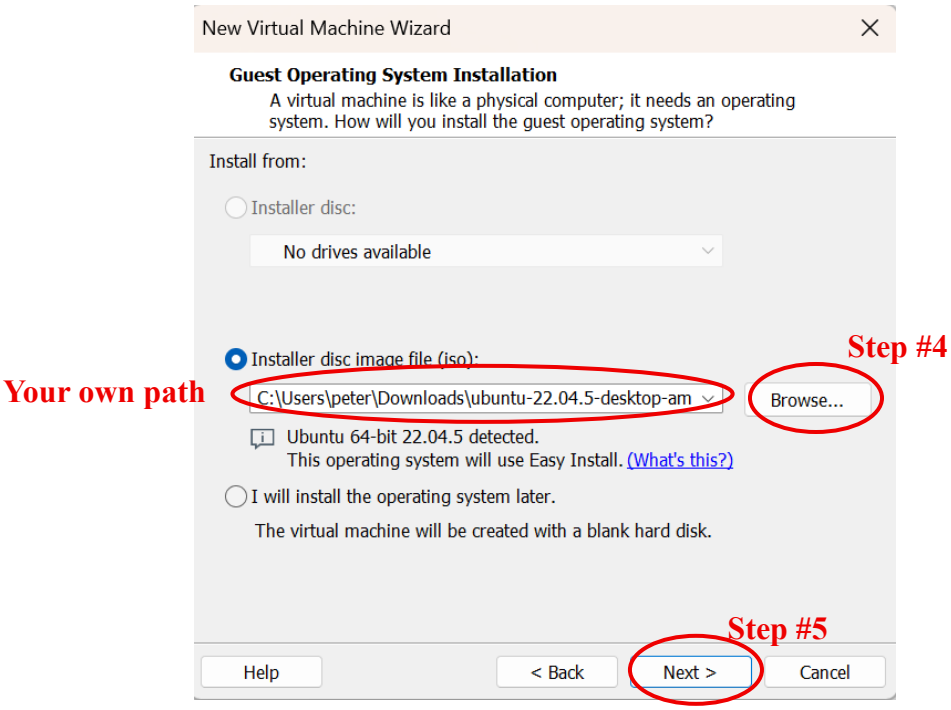


4. Click “Create a New Virtual Machine” and then select “Typical” for the configuration selection, then click “Next”.

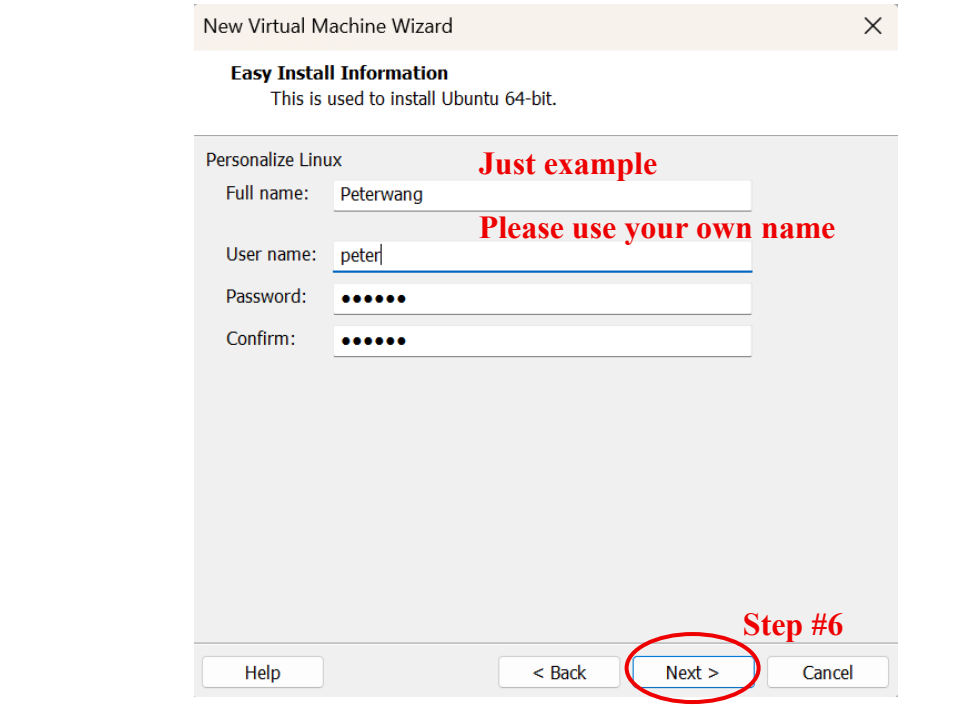


5. Now you can import the Ubuntu desktop image already downloaded before. Bear in mind that the correct directory path is expected and it should be in the format of “iso”.

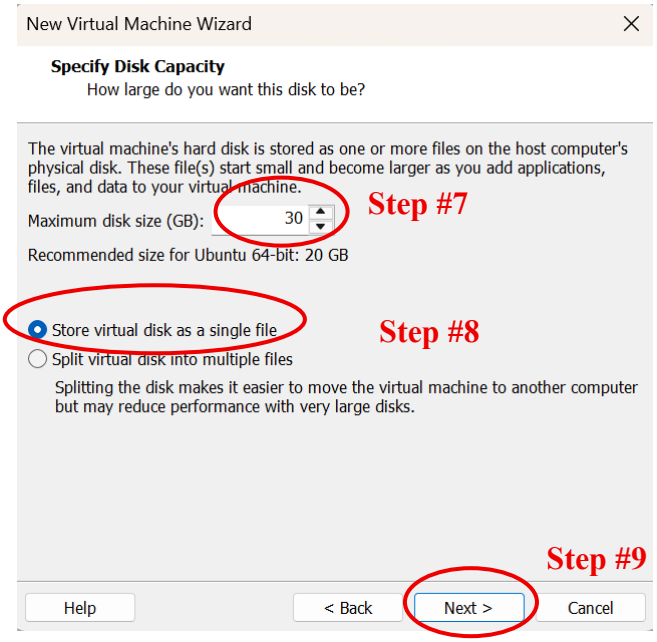
Remarks: For students interested in ROS development, we recommend setting your PC's operating system language to English. This prevents common Unicode path errors that occur when directory names mix Chinese and English characters, which is a frequent issue when using the terminal in Linux. Adopting an English environment will also ease your transition into Ubuntu and other open-source development ecosystems.



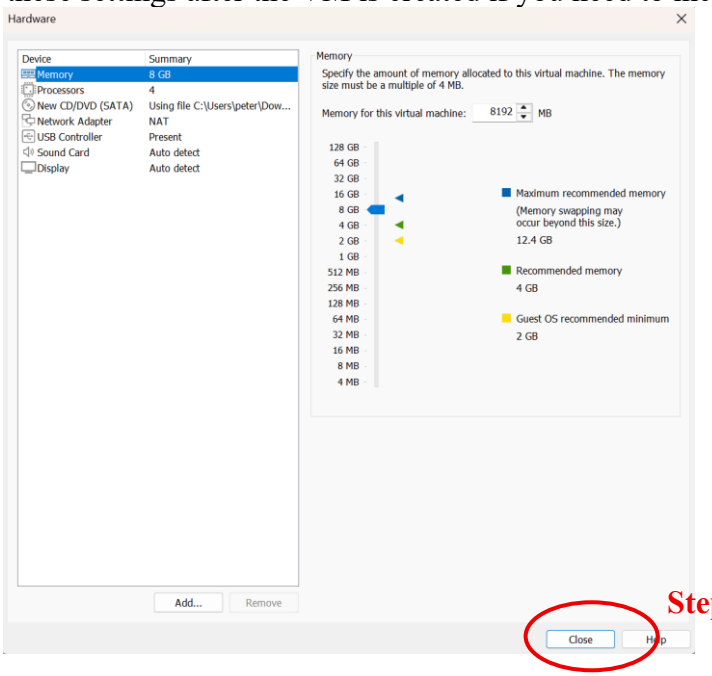
Select "Next" and then you will see the following page for customizing the Linux OS information. This step will not make big difference since **you will need to set the login username and password for the Ubuntu systems after initializations (see later instructions and video demo).**



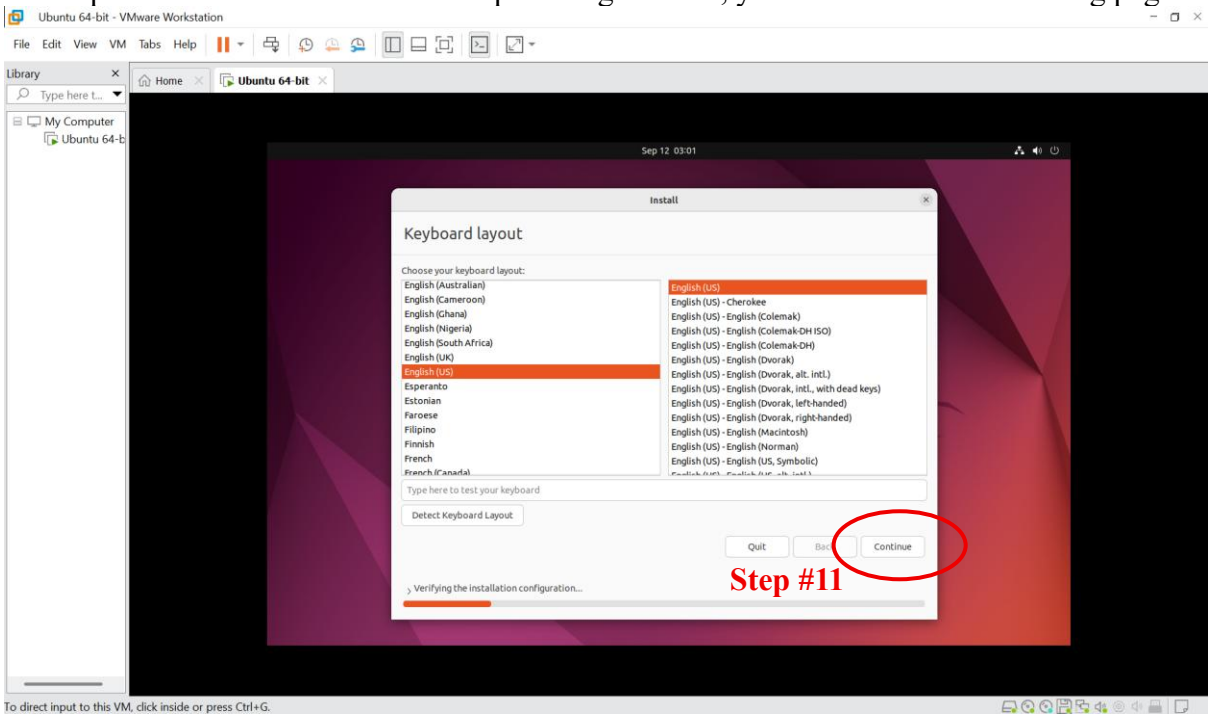
6. Select "Next" and follow the Wizard instructions until you reach "Specify Disk Capacity". As shown below, changes the settings under "Specify Disk Capacity" to be:
    - 30 (or more if you wish) in "Maximum disk size (GB)" instead of 25.
    - "Store virtual disk as a single file" for the virtual disk setting instead of multiple files.



7. Select "Next", you will see a summary of your settings. Click on "Customize Hardware…". The window below will open. Here you can select computational resources you want to reserve to your virtual machine. It is recommended to provide at least 4GB of RAM (8 if possible, depending on your host machine, you can see on the window the recommendations by VMWare based on the host machine), and 2 processor cores (4 if possible, depending on host machine, do not use all or more cores than your host has). You can also change these settings after the VM is created if you need to increase or decrease.



8. Close the Customize Hardware window, and then click on “Finish”. VMware should open and Ubuntu installation will start automatically. This step will take some time and please be patient. When the initialization process goes well, you should see the following page:



Follow the setup for the keyboard layout and other basic elements (just like your PC), and you should not need to change any default setting.

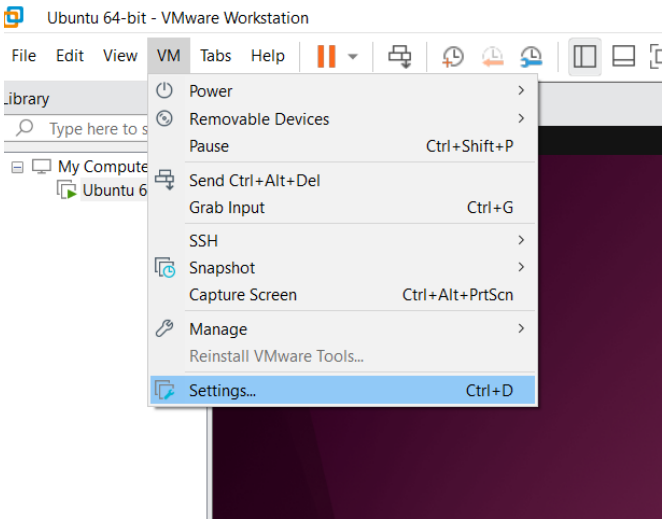
9. To make sure you installed everything correctly, open a terminal Ctrl + Shift + T, and type the following command in the terminal:

```
$> sudo apt update && sudo apt install lsb-core lsb-release
$> lsb_release -a
```

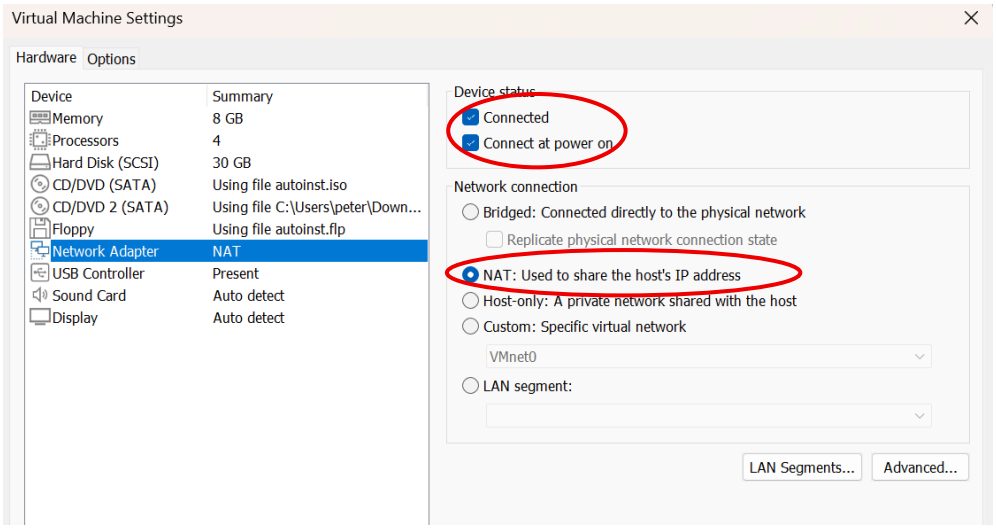
If the terminal works well, it should output the following messages:

```
peterwang@peterwang-virtual-machine:~$ lsb_release -a
LSB Version:    core-11.1.0ubuntu4-noarch:security-11.1.0ubuntu4-noarch
Distributor ID: Ubuntu
Description:    Ubuntu 22.04.5 LTS
Release:        22.04
Codename:       jammy
peterwang@peterwang-virtual-machine:~$
```

10. Check the internet settings: Go to VMware settings: Click “VM” at the top left and choose “Settings”, as shown below:



In the left menu, select “Network Adapter”. By default, NAT should be selected:



Make sure that under Device Status, you have ‘Connected’ and ‘Connected at power on’ both selected. Now you can click the Firefox browser to see whether you can connect to the internet.

ROS Setup

11. Open your installed Ubuntu from the VMware Workstation and open the terminal. (It would be a good habit to check the internet connection by using the methods we introduced in the last tutorial).

12. The relevant guidelines are accessible in the GitHub repository: https://github.com/PeterWANGHK/DASE7505_student.git

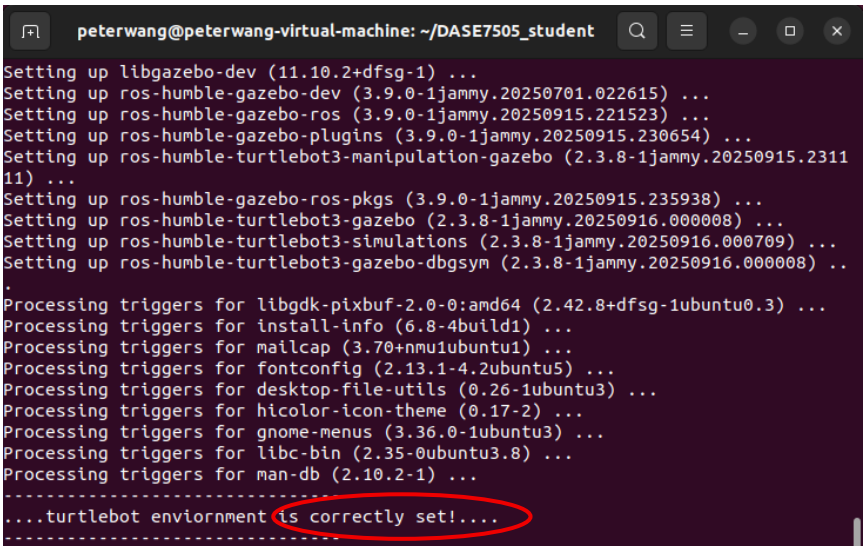
13. Type the following commands in terminal step-by-step to enable git and clone the repository to the Ubuntu home:
```
sudo apt install git
```

```
git clone https://github.com/PeterWANGHK/DASE7505_student.git
```

```
peterwang@peterwang-virtual-machine:~/DASE7505_student$ git clone https://github.com/PeterWANGHK/DASE7505_student.git
Cloning into 'DASE7505_student'...
remote: Enumerating objects: 39, done.
remote: Counting objects: 100% (39/39), done.
remote: Compressing objects: 100% (36/36), done.
remote: Total 39 (delta 9), reused 0 (delta 0), pack-reused 0 (from 0)
Receiving objects: 100% (39/39), 113.45 KiB | 1001.00 KiB/s, done.
Resolving deltas: 100% (9/9), done.
```

14. In this repository, we have different branches after the main branch. Since we are about to perform ROS setup, we need to change the branch to "setup" and then install relevant file by the following commands one by one: (change to the right directory first)
    ```
    cd DASE7505_student
    git checkout setup
    ```

15. Run the script to install the relevant packages for ROS development:
    ```
    sh setup_dase7505.sh
    ```
    It will automatically start the collection of all required packages for ROS2 and you would see this result if everything went smoothly:

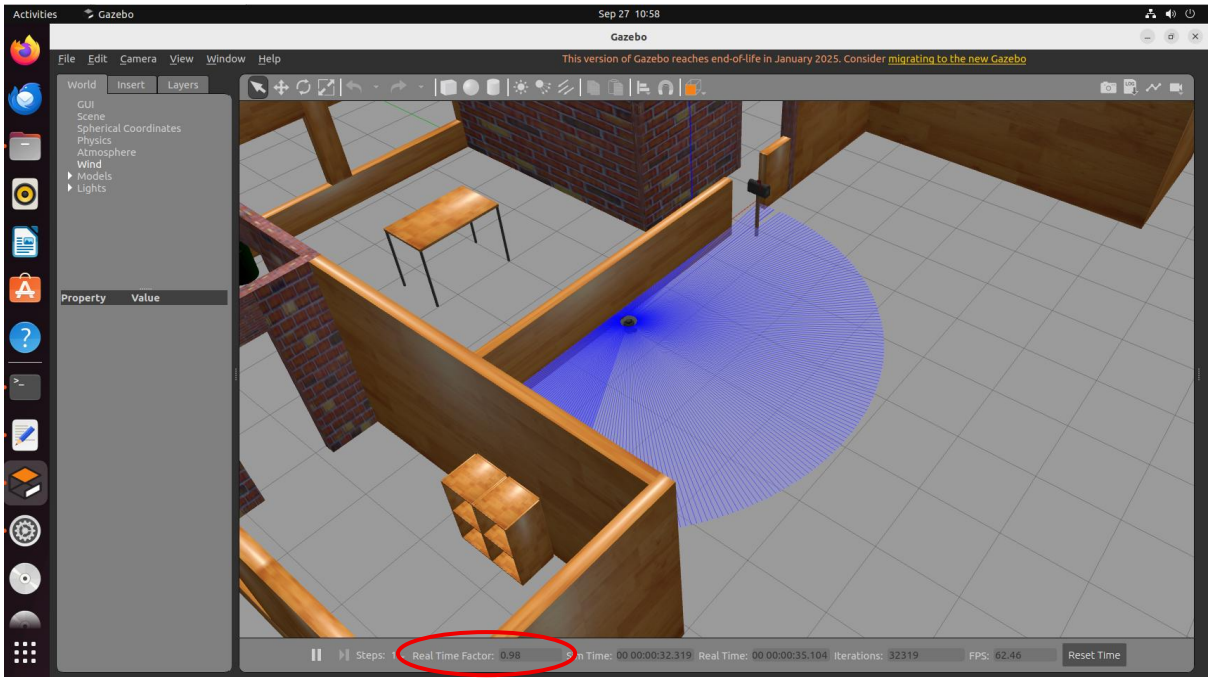


    A quick check of the ROS version could be performed by typing the following command:
    ```
    ls /opt/ros/
    ```
    In our case, it should output "humble"

16. Check the installation by running a demonstration program by the following commands step-by-step (remark: it really differs from one to another for the PC capability, while some will wait a long time and others may have a faster opening, so please be patient)
    ```
    . /usr/share/gazebo/setup.sh
    export TURTLEBOT3_MODEL=burger
    ros2 launch turtlebot3_gazebo turtlebot3_house.launch.py
    ```

    Here are some tips for visualizing in Gazebo:
    - Left-click: select entity.
    - Right-click: opens menu with options:
    - Left-click and drag: pan around the scene.

- Right-click and drag: zoom in and out.
- Scroll wheel forward/backward: zoom in and out.
- Scroll wheel click and drag: rotate the scene.



At the bottom of the Gazebo window, you will see the Real Time Factor, if this number is consistently below 0.5 (assuming you are not running anything else heavy on your VM or on your computer), this means that your simulation will likely be quite slow, and you may want to consider utilizing one of the alternative systems proposed (you may still use your system for code development and connecting with the real robot, just the testing in simulation might be slow).

17. (Optional) To check the latency of the topics in TurtleBot (needed when you will be using the physical robot to check the latency in the communications)

```
./latency_check.py topic msgType
# for example for scan topic
./latency_check.py /scan LaserScan
```

Questions:

Any technical issues may be contacted via emails to out TA team (email addresses enclosed in lecture note).

References and Optional Readings:

- Using commands in terminal is an essential requirement for ROS development. To better familiarize yourself with the basic operations, you may read this guideline: https://www.geeksforgeeks.org/linux-unix/basic-linux-commands/

or watch some introductory videos on YouTube.

- Dual boot for Ubuntu could be learned from this video: https://youtu.be/QKn5U2esuRk?si=4O7Vov9eNprvNg5T
- For students interested in ROS, you may watch some video courses given by GYH.AI. (only in Chinese and an older version of Ubuntu, but very useful for new ROS learners): https://class.guyuehome.com/p/t_pc/goods_pc_detail/goods_detail/p_5e0ed4a96f471_cDGnHkoh?content_app_id=

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