



ELEG4701

Intelligent Interactive Robot Practice

Introduction to Linux

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Outline

- Linux Overview
- How to install Ubuntu on Virtual Machine (VM)
- Linux Interaction
- File System



Linux Overview

Linux













What, Who, When, Where, and Why



Linux Overview

What is Linux?

- Unix-like computer **operating system** assembled under the model of **free** and **open-source** software development and distribution
- These operating systems share the **Linux kernel**
- Comes in several “distributions” to serve different purposes

Beginner-friendly	Intermediate	Hard mode
		
 Ubuntu Based on Debian	 Garuda Linux Based on Arch	 Arch [Independent] – DIY
 Pop!_OS Based on Ubuntu	 EndeavourOS Based on Arch	 Gentoo [Independent] – DIY
 elementary OS Based on Ubuntu (LTS)	 Manjaro Based on Arch	 Slackware [Independent]
 Mint Based on Ubuntu	 MX Linux Based on Debian	 Linux From Scratch [Independent] – DIY
 Zorin Based on Ubuntu	 Fedora Based on Red Hat	 Qubes OS Based on Fedora – Security
 Solus [Independent]	 OpenSUSE [Independent]	 NixOS [Independent] – DIY



Three Major Operating Systems

Initial
Release

1985



Advantages

- Security
- **Support for commercial software**
- Affordable
- Easy upgrades
- Battery life

Disadvantages

- Crashing
- Costs
- Mystery features

2001



- File system types (like Windows)
- Fast
- Security (It's a member of the UNIX family of OS)
- Multi-user
- Easy installation

- Limited game creation
- Expensive
- Limited modification

1991



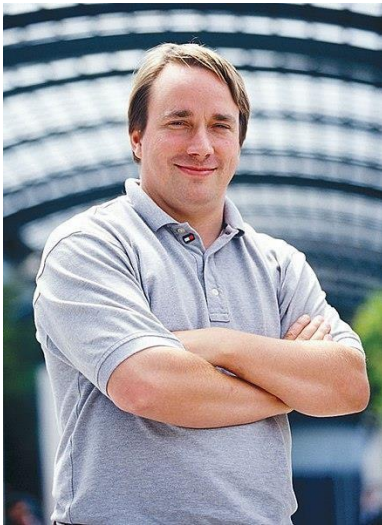
- Multitasking
- Open source
- Supports desktop environments
- Secure and high performance
- Ideal for businesses

- Not user-friendly
- Long installation
- Poor graphics



Linux Overview

Who made Linux?



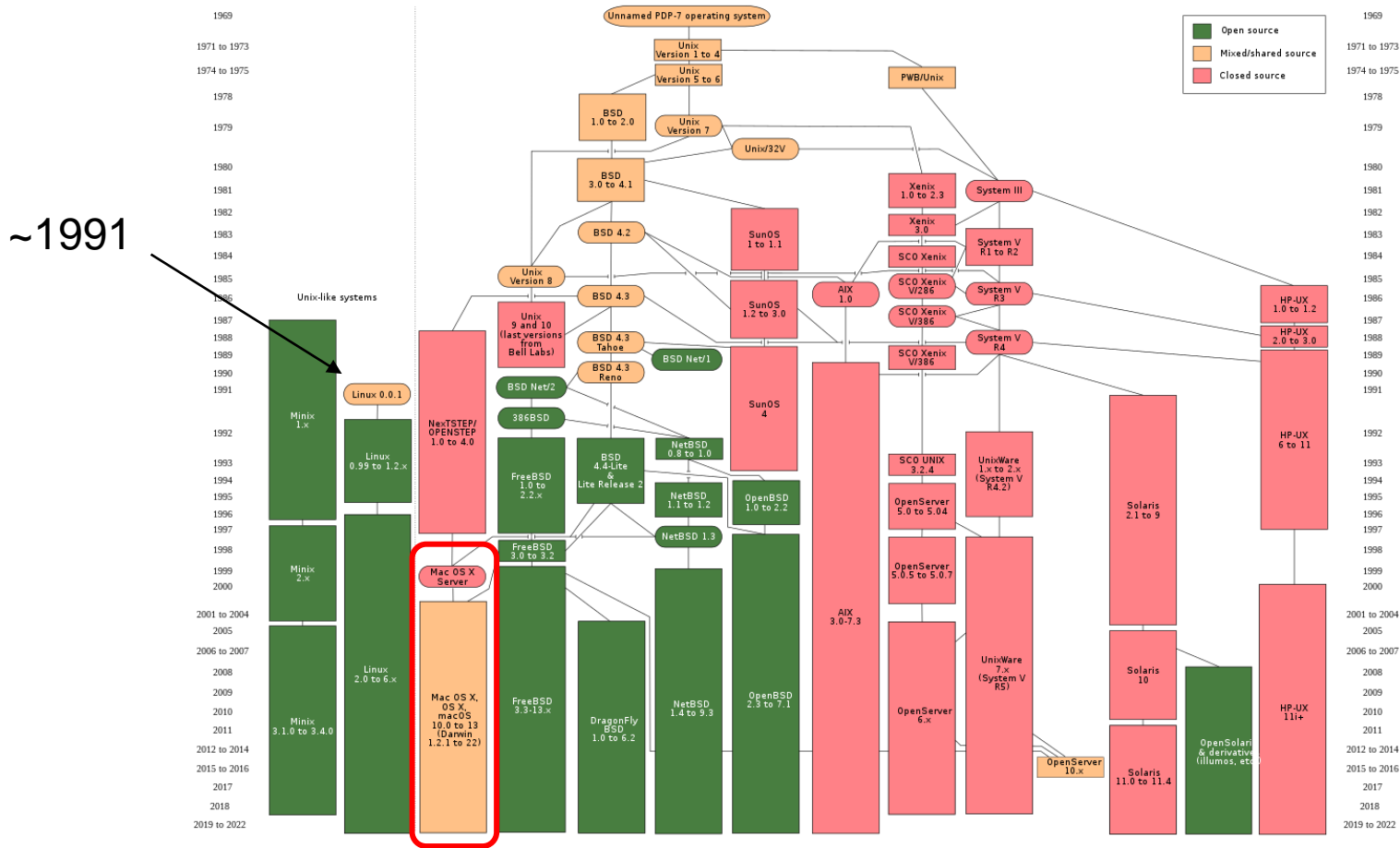
Linux is an O/S core originally written by **Linus Torvalds**. Now, almost 10,000 developers, including major technology companies like INTEL and IBM.



A set of programs written by **Richard Stallman** and others. They are the GNU utilities.

Linux Overview

When did Linux start?

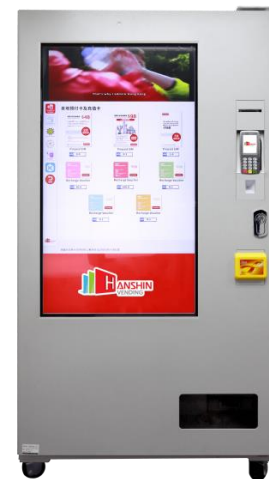




Linux Overview

Where is Linux?

- **Internet**
 - 67% of the world's web servers run Linux (*2016)
- **Research / High-Performance Computing**
 - Google, Amazon, NASA, etc.,
 - 100% of the World's Top 500 super-computers run Linux
- **Modern Smartphones and devices**
 - Android phones
 - Amazon Kindle
 - Smart TVs/ Devices
 - Most Vending Machines





Linux Overview

Why Linux?

- Free and open-source
- Powerful for research
- Personal for desktops and phones
- Universal
- Community (and business) driven



How to install Ubuntu on a Virtual Machines



Ubuntu

Currently supported releases

Version ↕	Code name ↕	Release date ↕	General support until ↕	Security support (ESM) until ↕
14.04 LTS	Trusty Tahr	2014-04-17 ^[95]	2019-04-25 ^[95]	2024-04
16.04 LTS	Xenial Xerus ^[96]	2016-04-21 ^[97]	2021-04-30 ^[98]	2026-04
18.04 LTS	Bionic Beaver	2018-04-26 ^[99]	2023-05-31 ^[100]	2028-04
20.04 LTS	Focal Fossa	2020-04-23 ^[101]	2025-05-29 ^[102]	2030-04
22.04 LTS	Jammy Jellyfish ^[103]	2022-04-21 ^[104]	2027-06-01	2032-04
23.04	Lunar Lobster	2023-04-20	2024-01-25	unavailable
23.10	Mantic Minotaur	2023-10-12	2024-07-11	unavailable
24.04 LTS	Noble Numbat	2024-04-25 ^[105]	2029-05-31	2034-04-25
Legend: Old version Older version, still maintained Latest version Future release				

- **Ubuntu is a Linux distribution** based on **Debian** and composed mostly of **free and open-source software**
- LTS: Long-term support (released every 2 years)
- We will use **20.04.06 LTS**.



Installing Ubuntu on VM

Download **Virtual Machine**: VMWare Workstation Player 17 (540 MB)

- <https://www.vmware.com/hk/products/workstation-player/workstation-player-evaluation.html>

Download **Ubuntu 20.04.06 LTS**, desktop version

- <https://releases.ubuntu.com/focal/>



ubuntu-20.04.6-desktop-amd64.iso

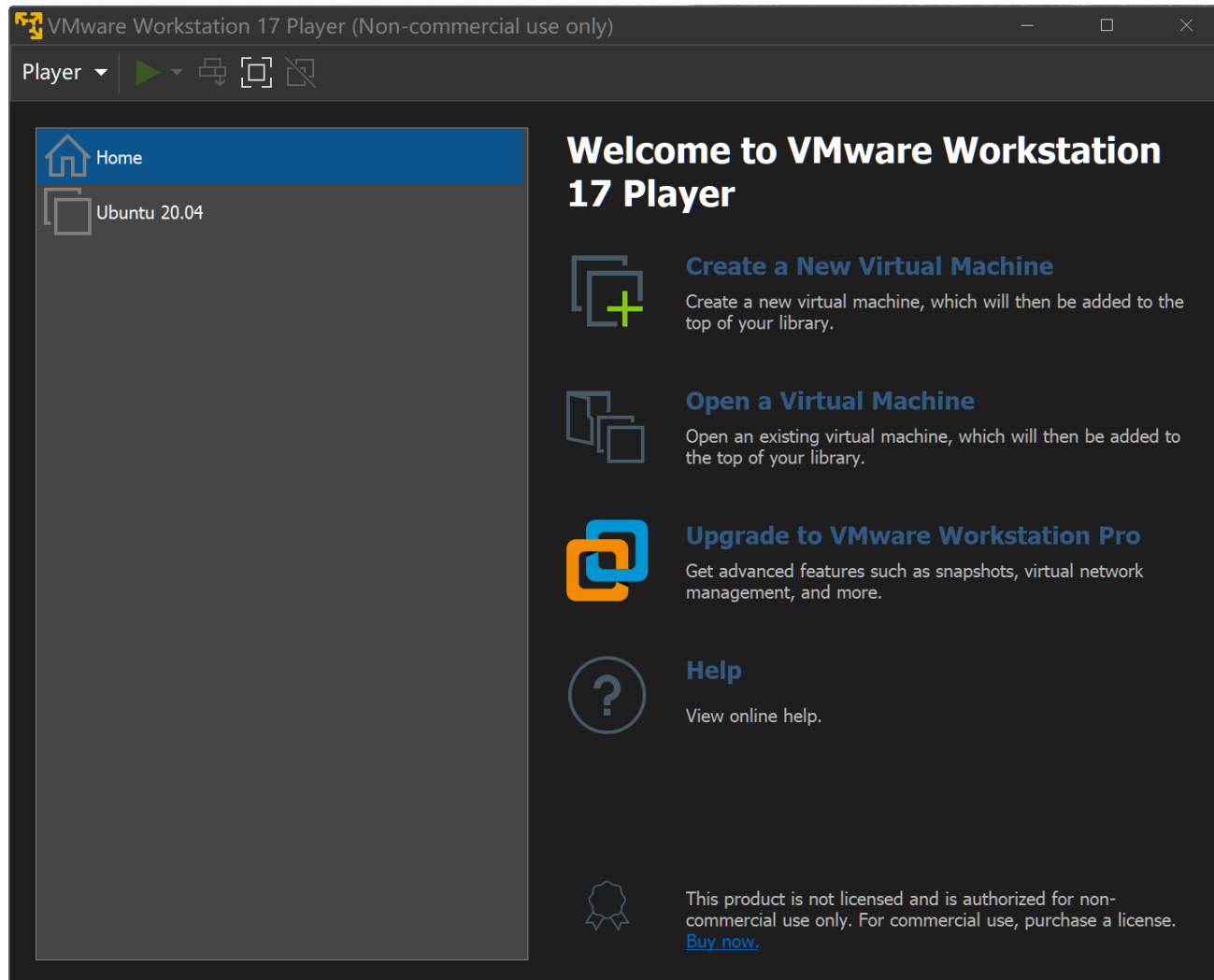
2023-03-16 15:58

4.1G

Desktop image for 64-bit PC (AMD64)
computers (standard download)

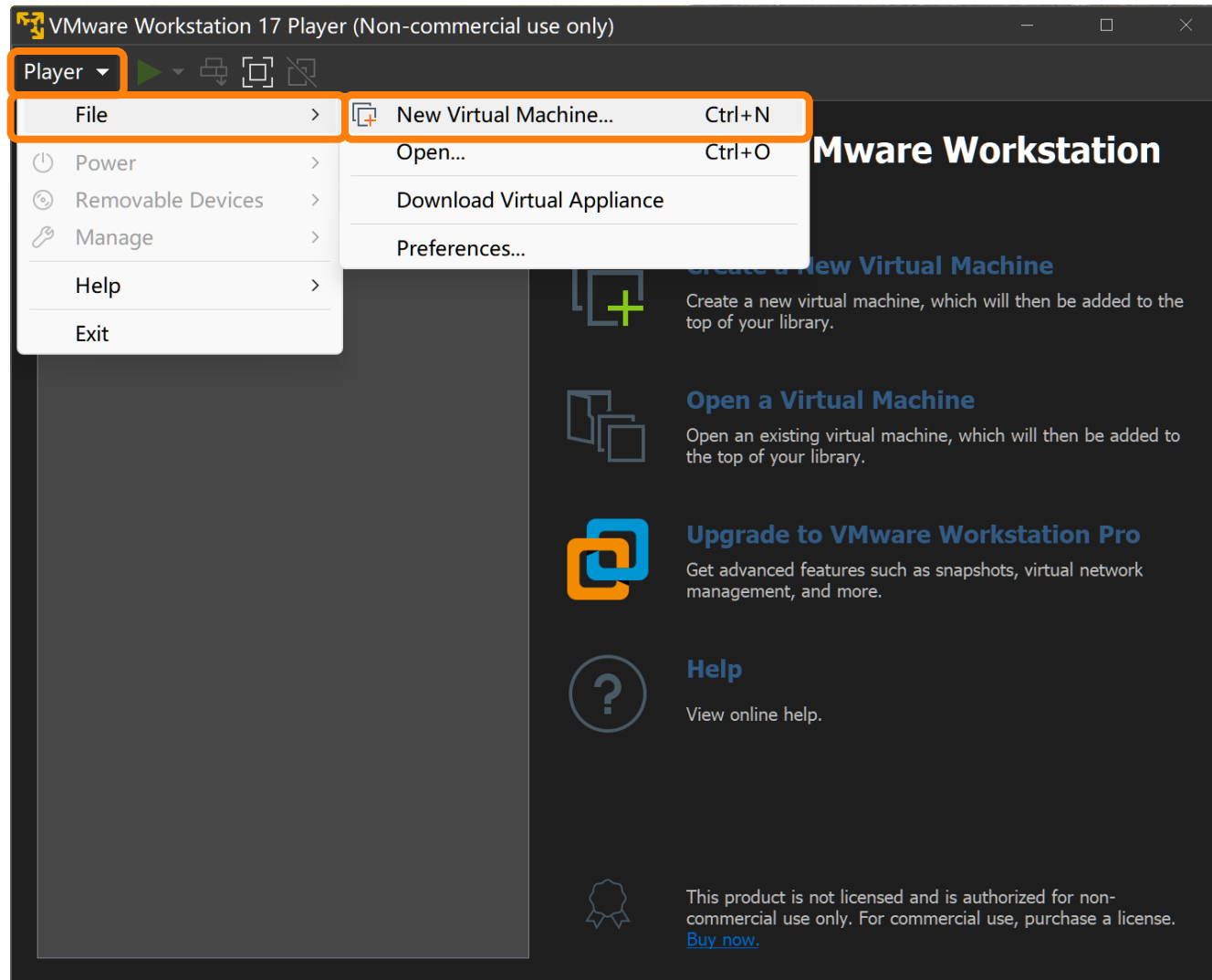


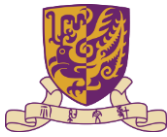
VMware Workstation Interface



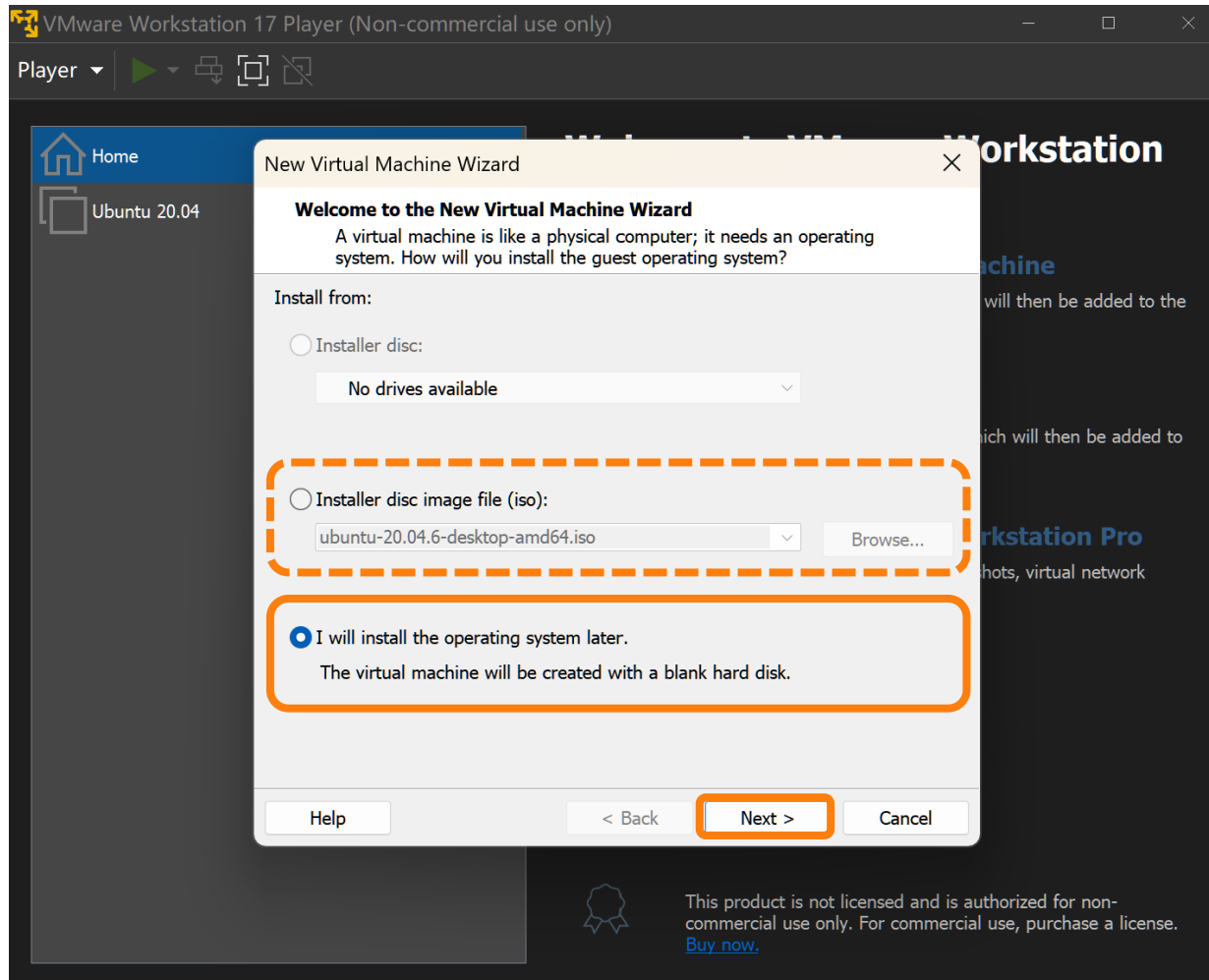


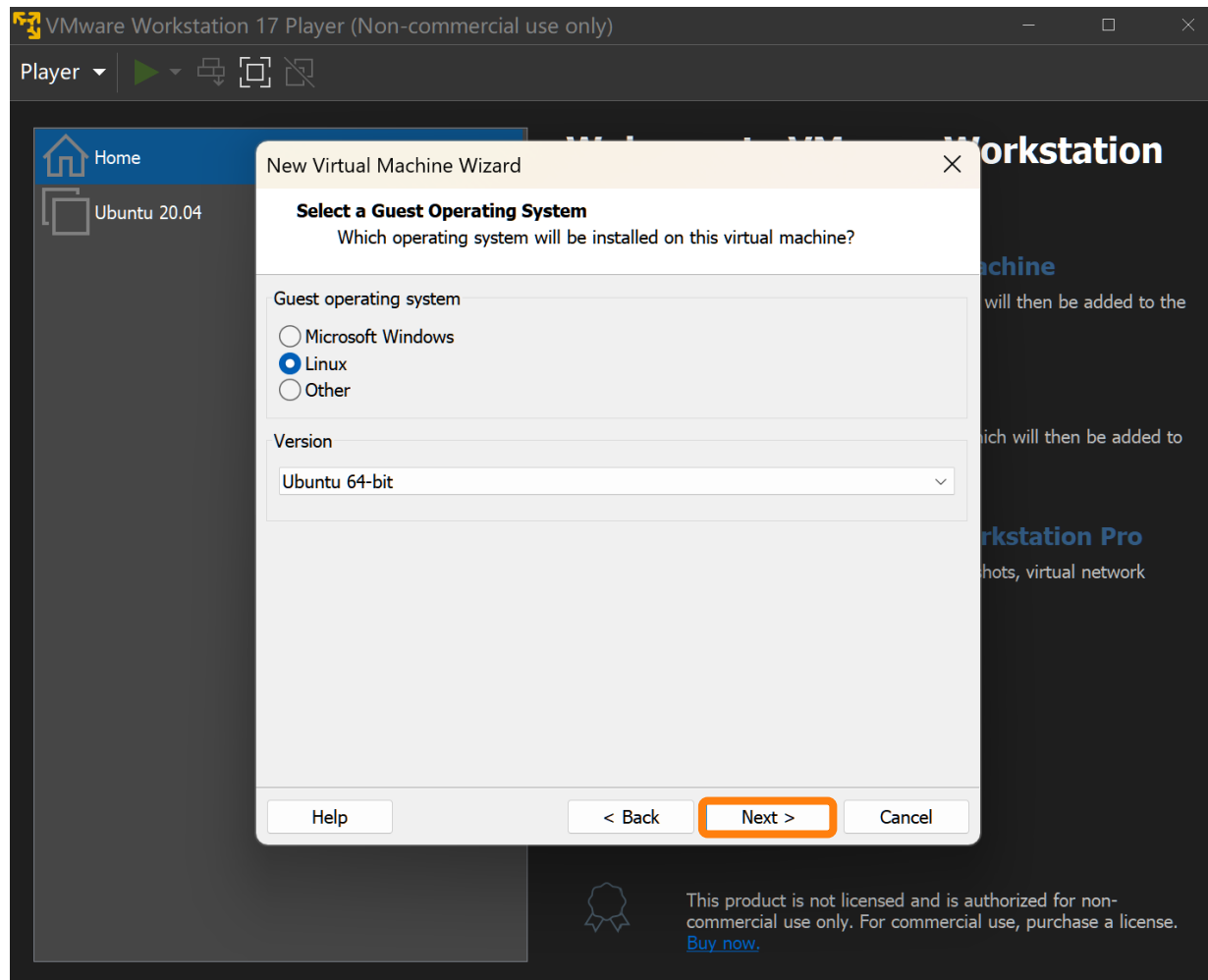
Create New VM

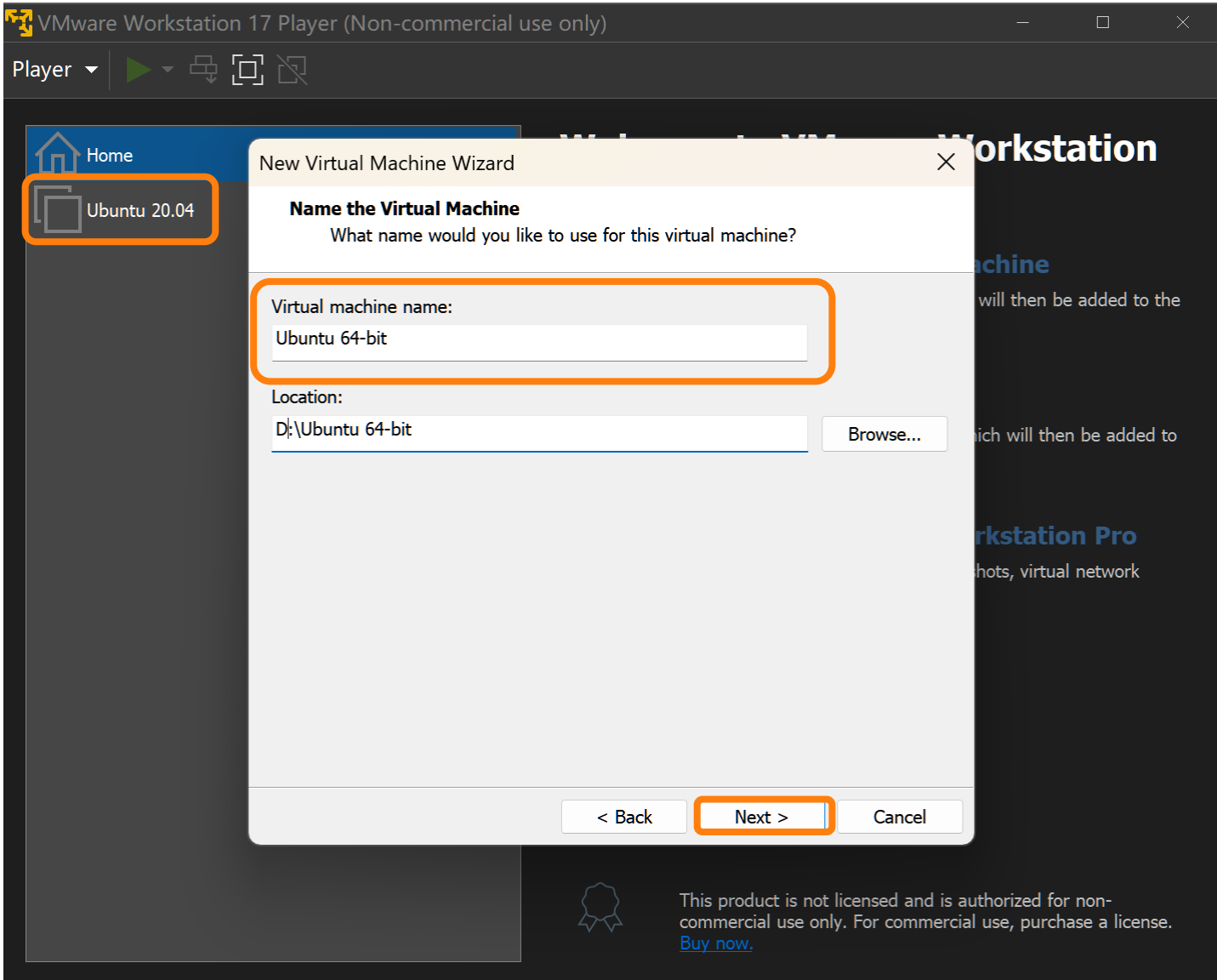


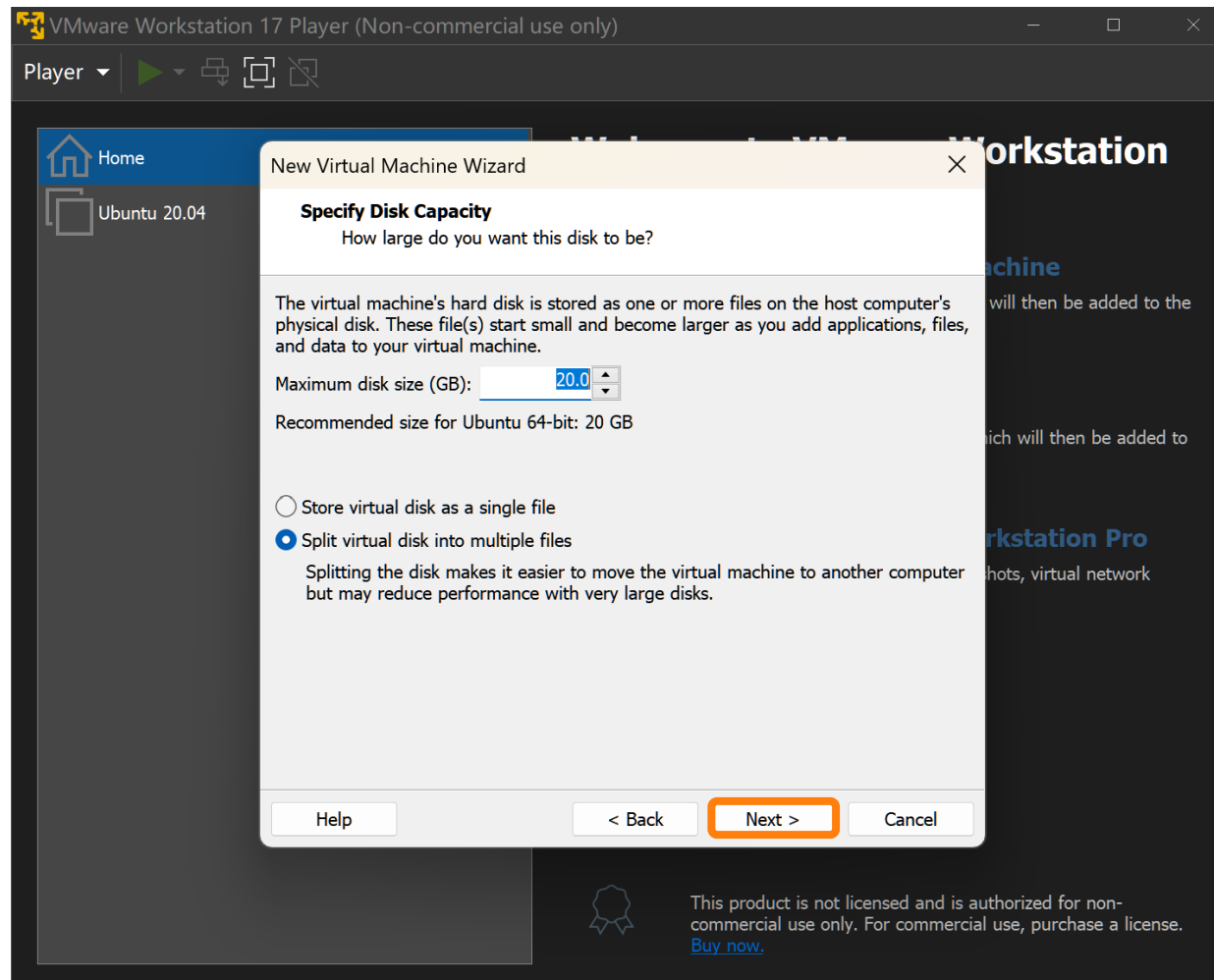


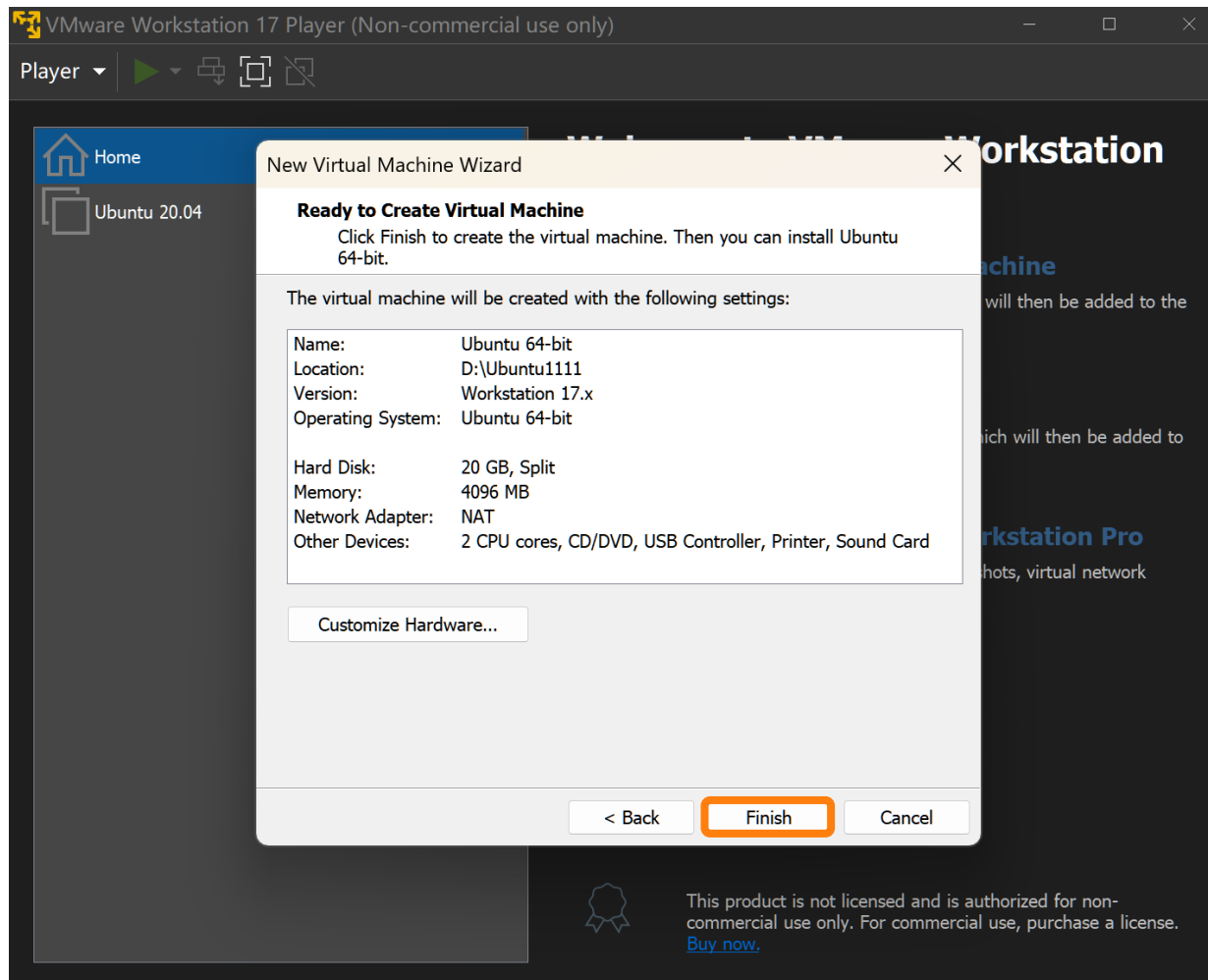
Install Ubuntu with ISO file / later





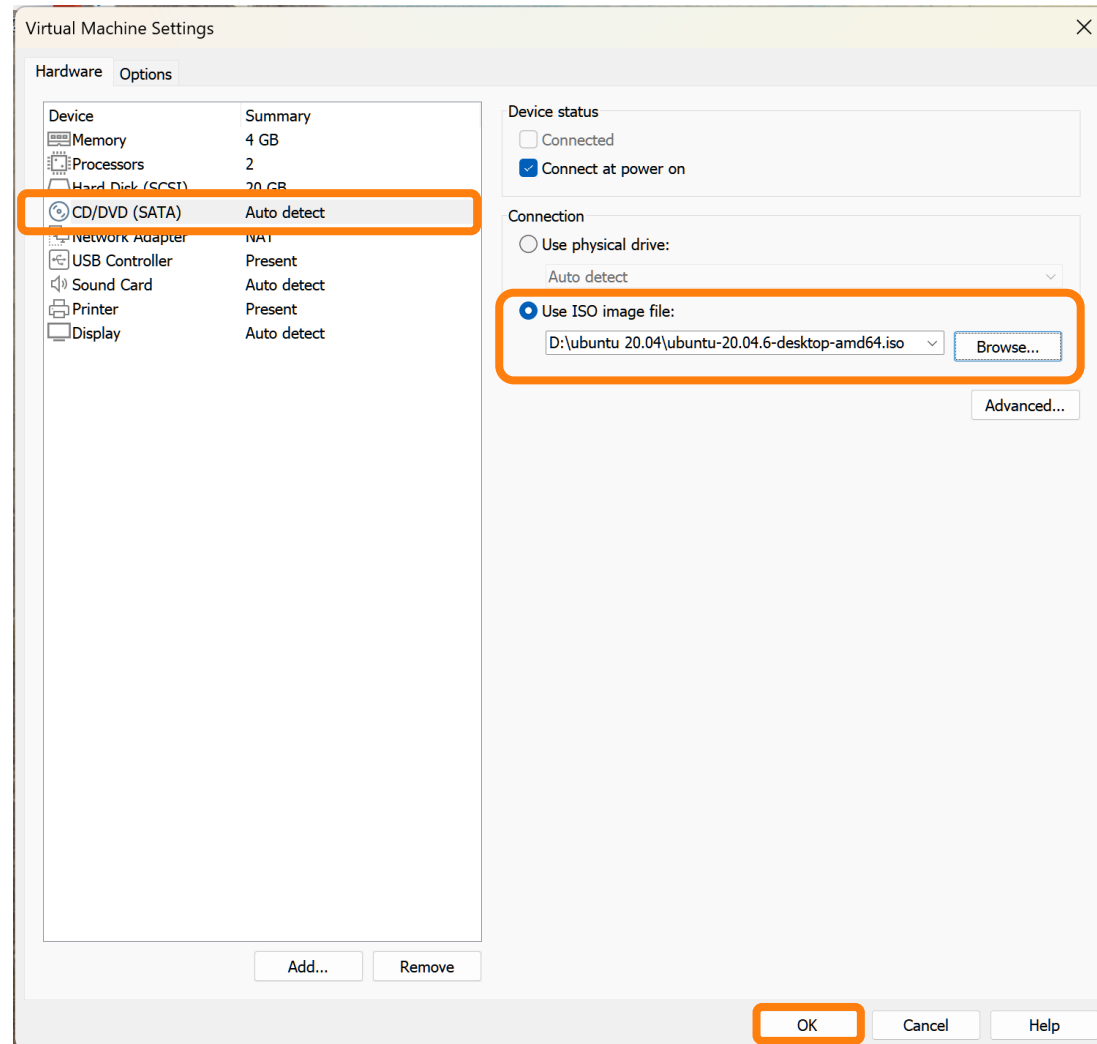








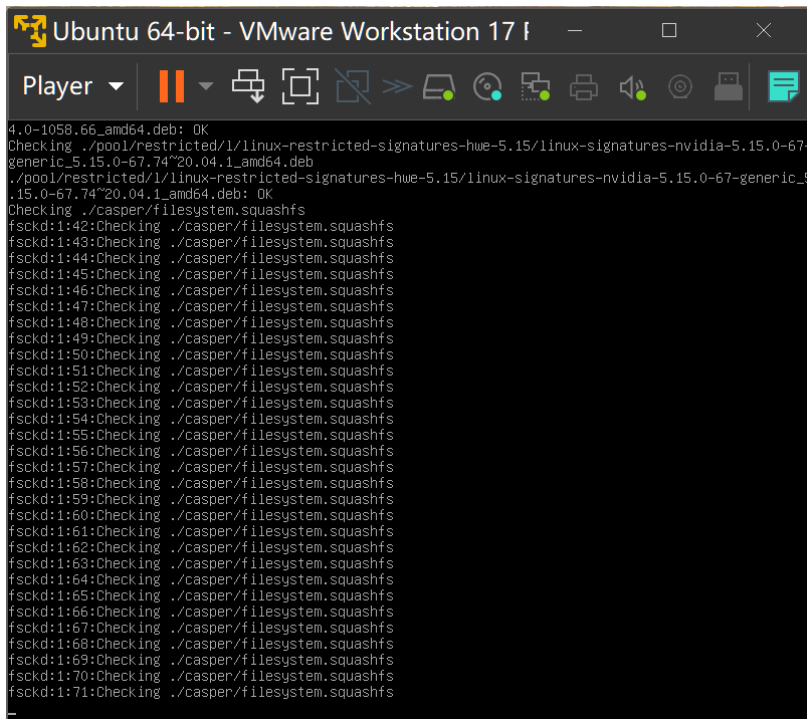
Edit VM Setting -> ISO image file



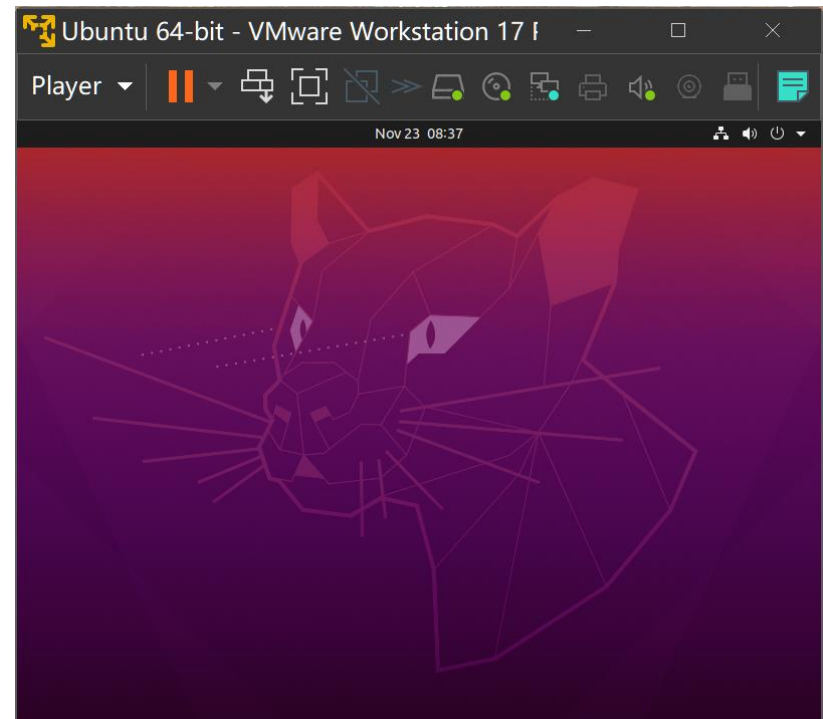


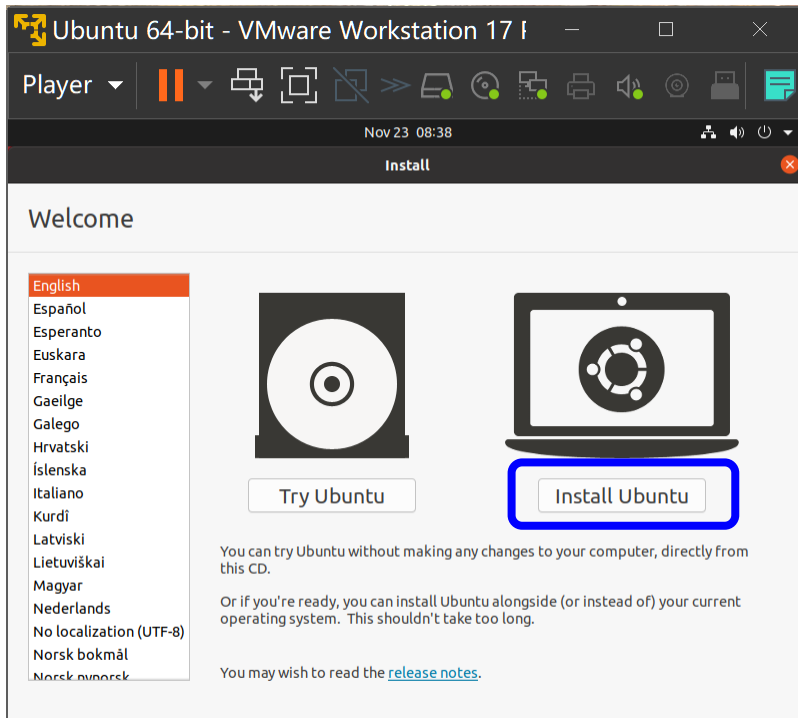
Click Play

- Click **Play** then launch the OS installation

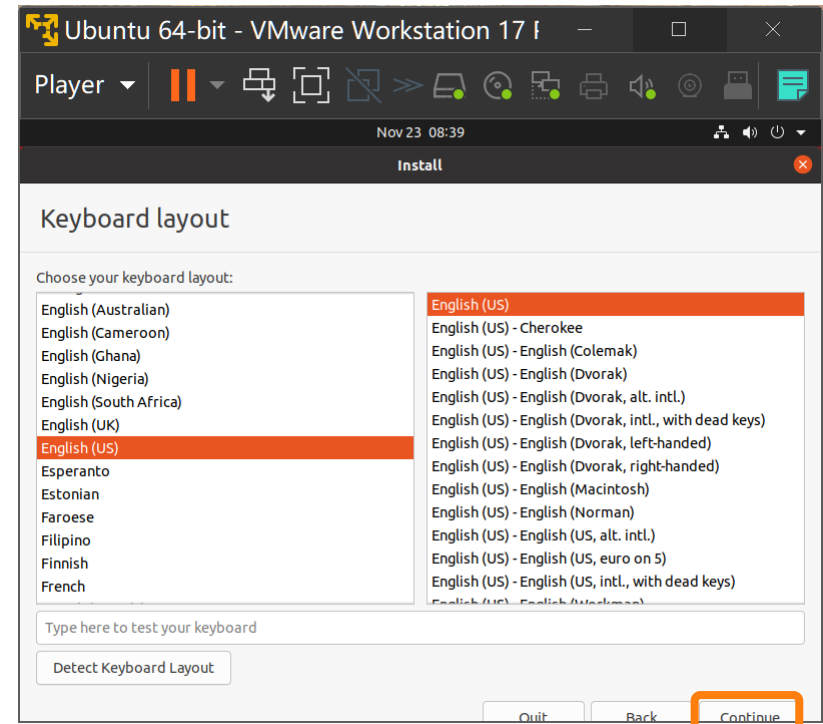


```
4.0-1058.66_amd64.deb: OK
Checking ./pool/restricted/linux-restricted-signatures-hwe-5.15/linux-signatures-nvidia-5.15.0-67-
generic-5.15.0-67.74*20.04.1_amd64.deb
./pool/restricted/linux-restricted-signatures-hwe-5.15/linux-signatures-nvidia-5.15.0-67-generic_5
.15.0-67.74*20.04.1_amd64.deb: OK
Checking ./casper/filesystem.squashfs
fsckd:1:42:Checking ./casper/filesystem.squashfs
fsckd:1:43:Checking ./casper/filesystem.squashfs
fsckd:1:44:Checking ./casper/filesystem.squashfs
fsckd:1:45:Checking ./casper/filesystem.squashfs
fsckd:1:46:Checking ./casper/filesystem.squashfs
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fsckd:1:68:Checking ./casper/filesystem.squashfs
fsckd:1:69:Checking ./casper/filesystem.squashfs
fsckd:1:70:Checking ./casper/filesystem.squashfs
fsckd:1:71:Checking ./casper/filesystem.squashfs
```

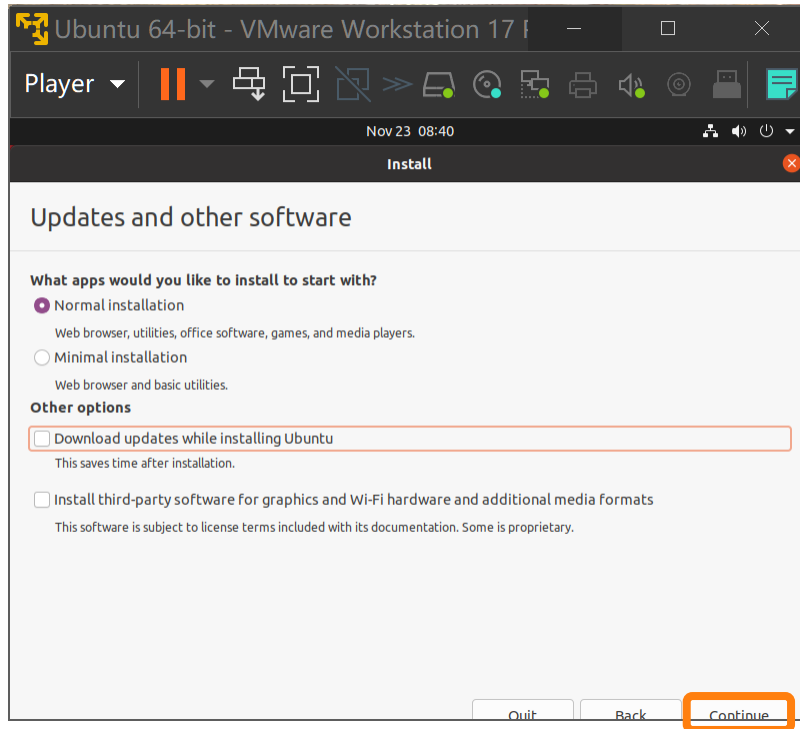
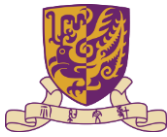




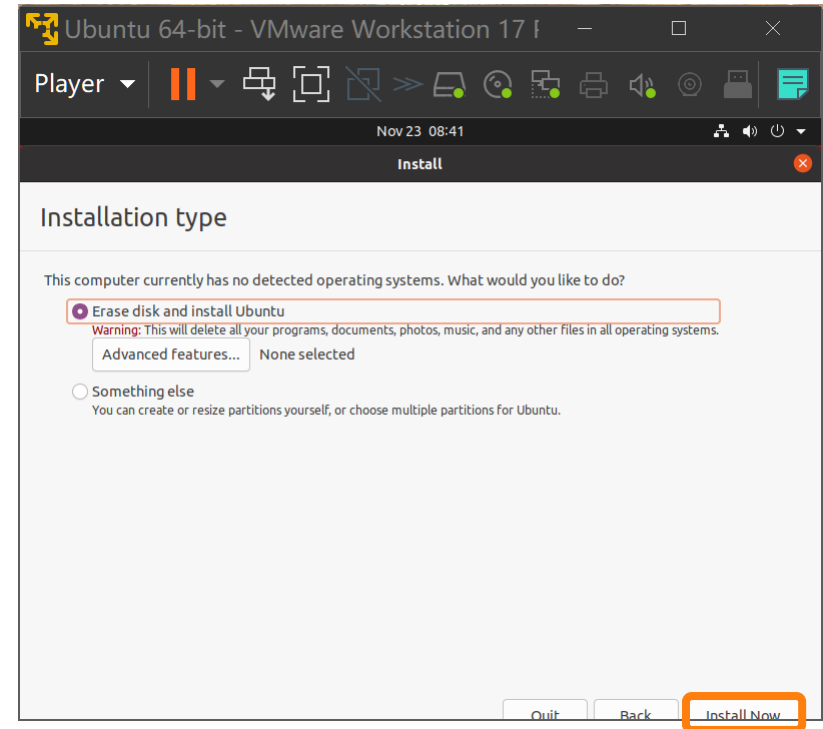
Install Ubuntu



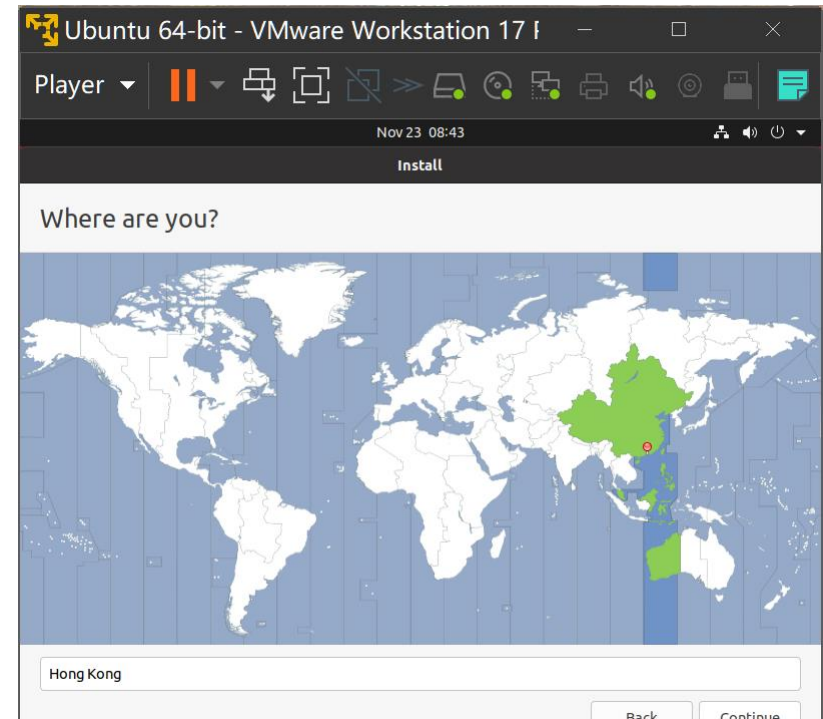
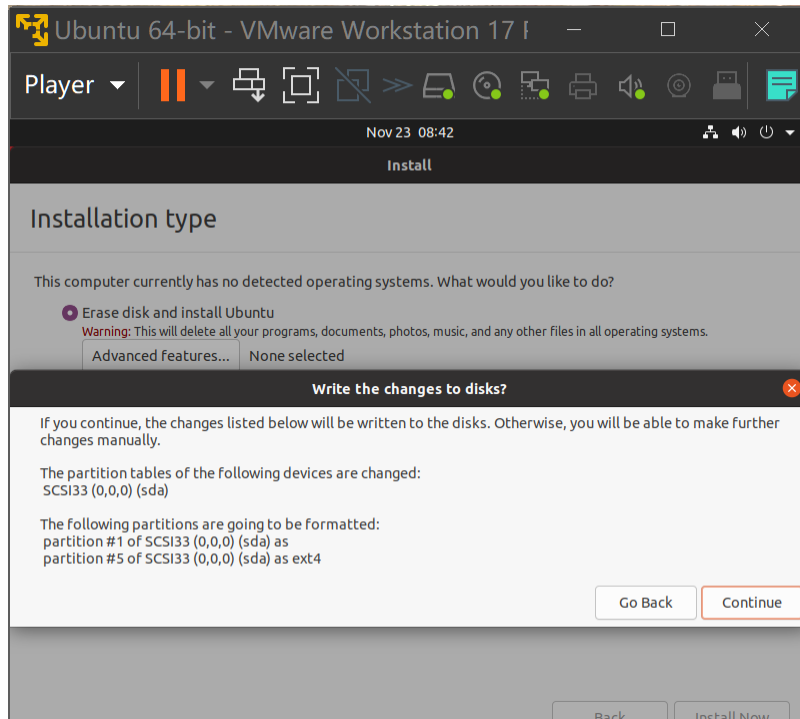
Keyboard setting



Disable the updates option

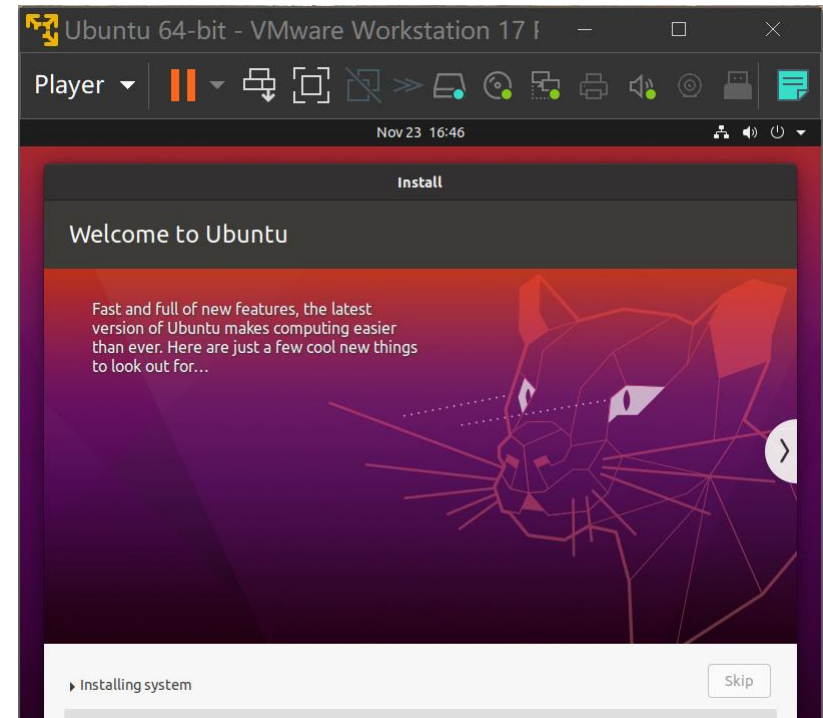


**It will not really erase your disk, because you are using a VM

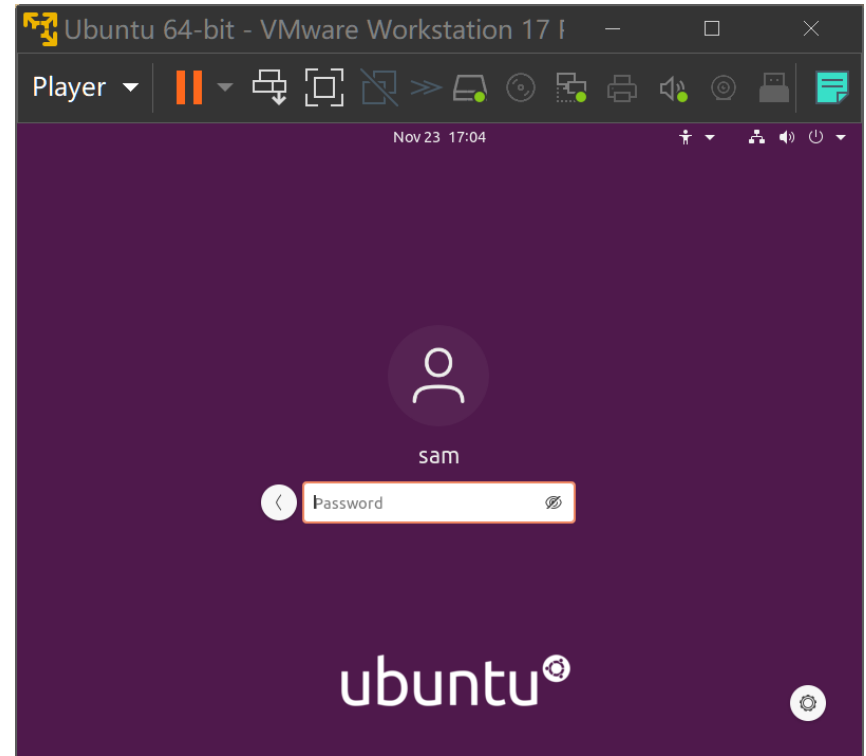
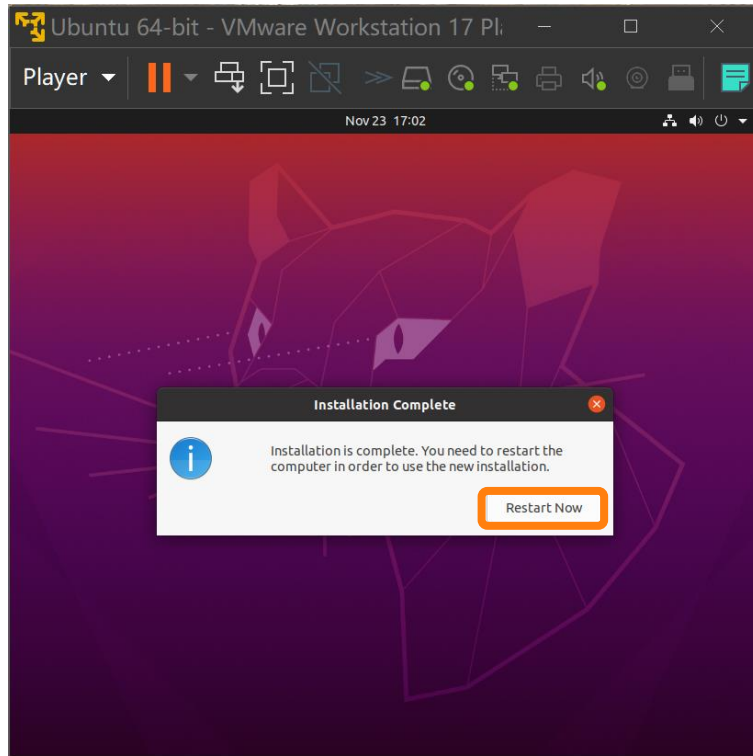


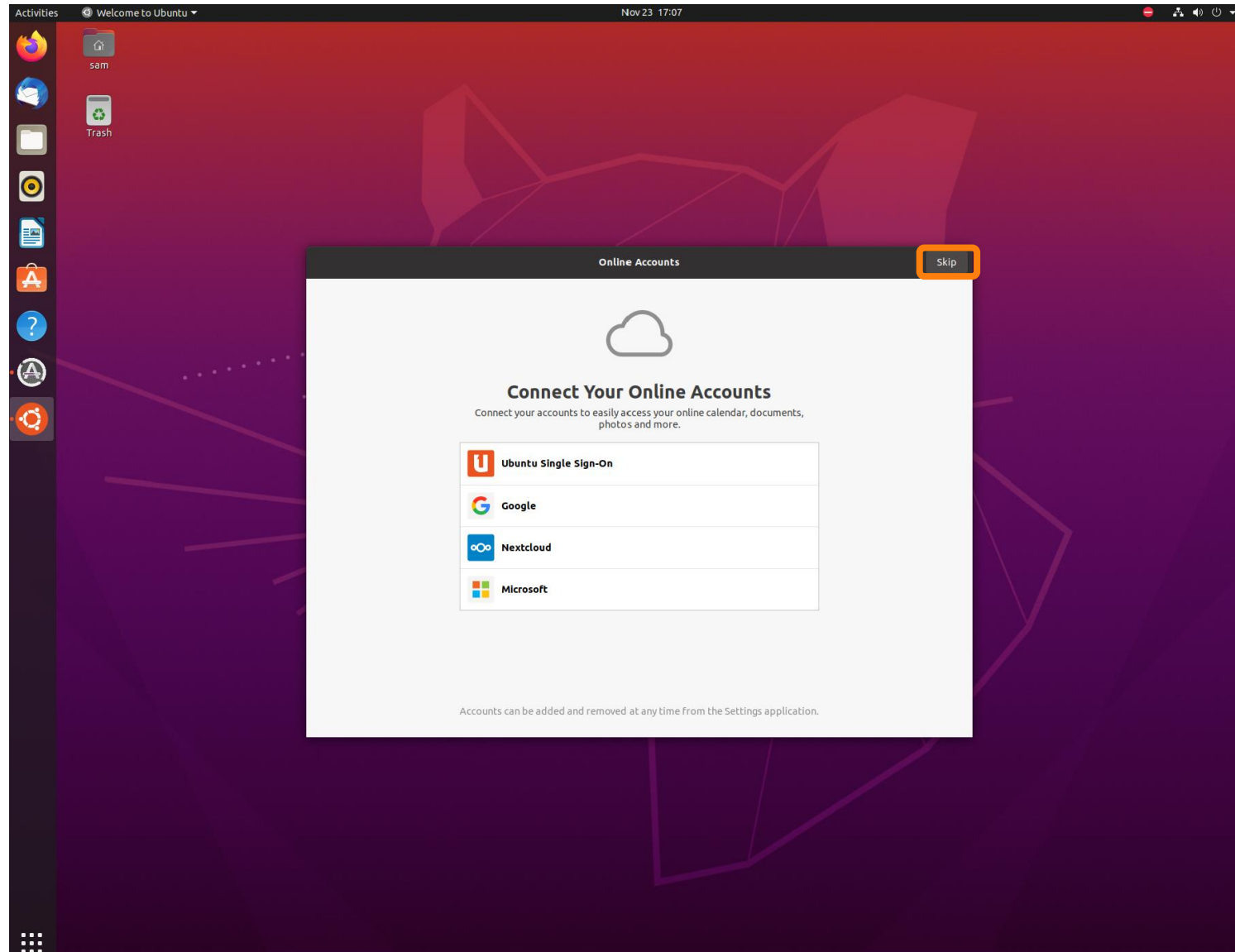


Password is something you will often use in the prompt – so make it short



Installation launched
Takes 10-30 minutes








[Previous](#)[Next](#)

Livepatch




Canonical Livepatch helps keep your computer secure, by applying some updates that would normally require restarting.

Would you like to set up Livepatch now?

[Set Up Livepatch...](#)[Legal notice](#)

[Previous](#)[Next](#)

Help improve Ubuntu



Ubuntu can report information that helps developers improve it. This includes things like the computer model, what software is installed, and the approximate location you chose (Asia/Hong_Kong).

[Show the First Report](#)[Legal notice](#)

Would you like to send this information?

☐ Yes, send system info to Canonical

☒ No, don't send system info

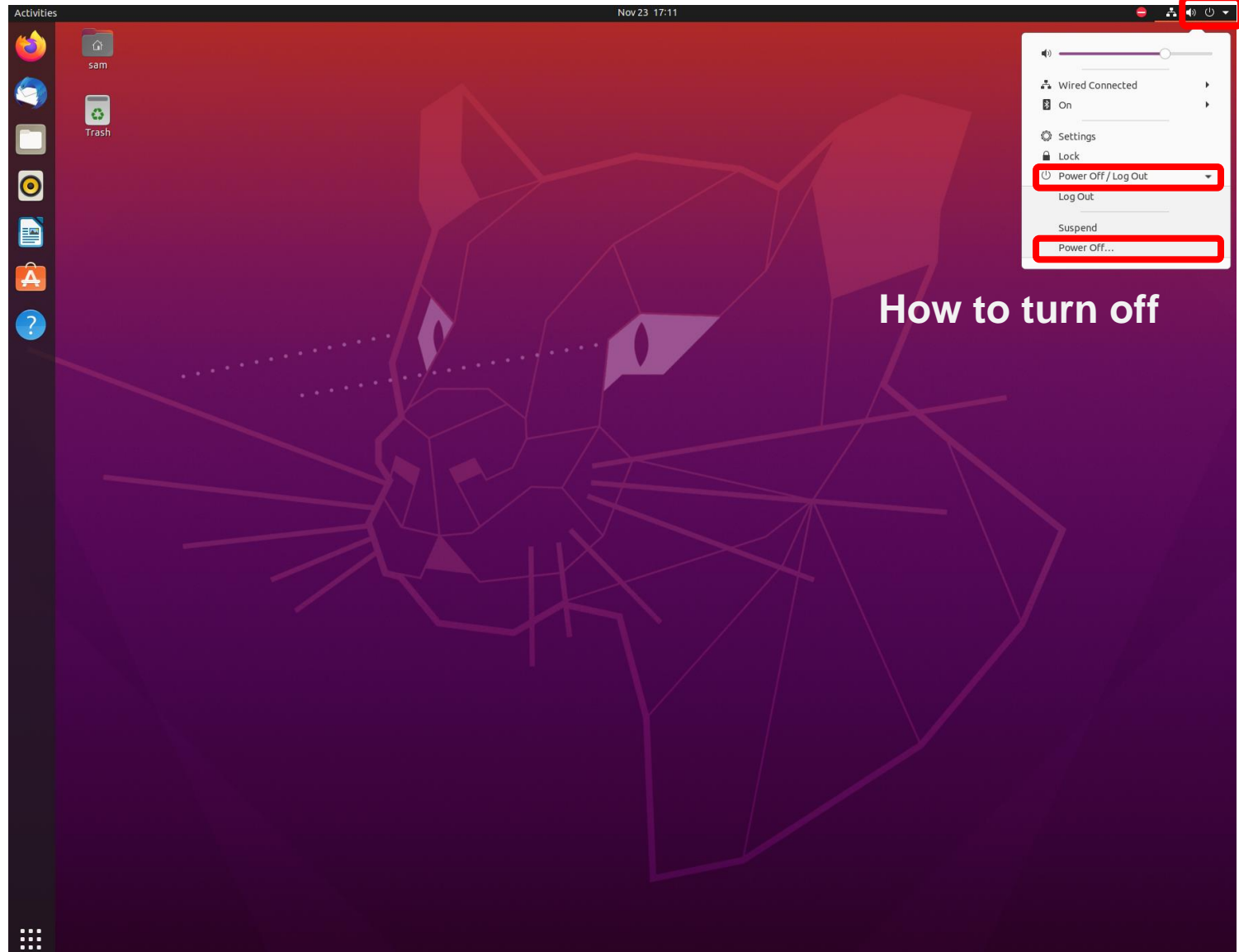
Ubuntu 22.04.3 LTS Upgrade Available

A new version of Ubuntu is available. Would you like to upgrade?

Don't Upgrade

Ask Me Later

Yes, Upgrade Now



How to turn off



Now, you may follow the steps to install:

- **VM**
- **Ubuntu**

Account: **ELEG4701**
Password: **robot**

* You can also install one on your own laptop

Download **Virtual Machine**: VMWare Workstation Player 17 (540 MB)

- <https://www.vmware.com/hk/products/workstation-player/workstation-player-evaluation.html>

Download **Ubuntu 20.04.06 LTS**, desktop version

- <https://releases.ubuntu.com/focal/>

TA will check whether you have successfully installed Ubuntu



Linux Interaction

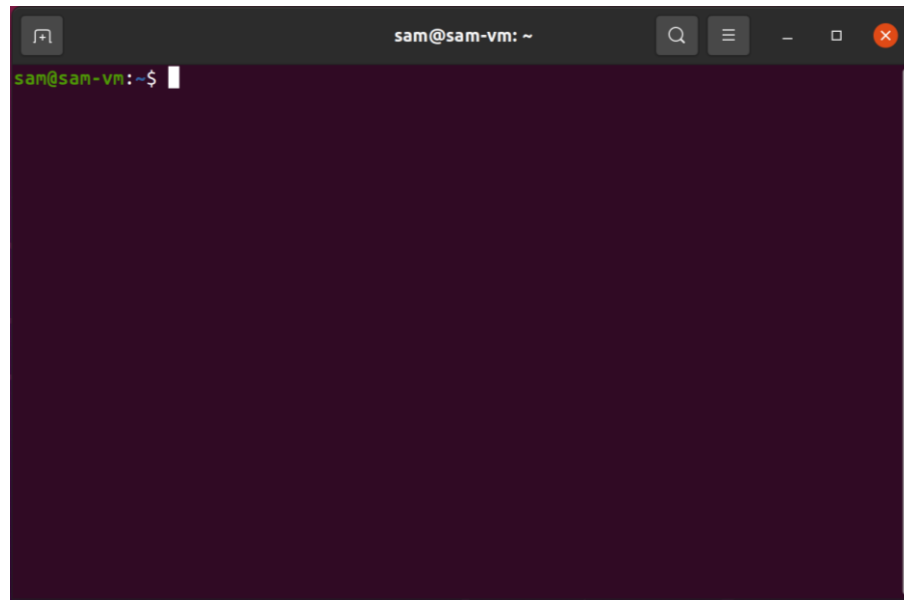
Prompts & Commands



Linux Interaction

Terminal

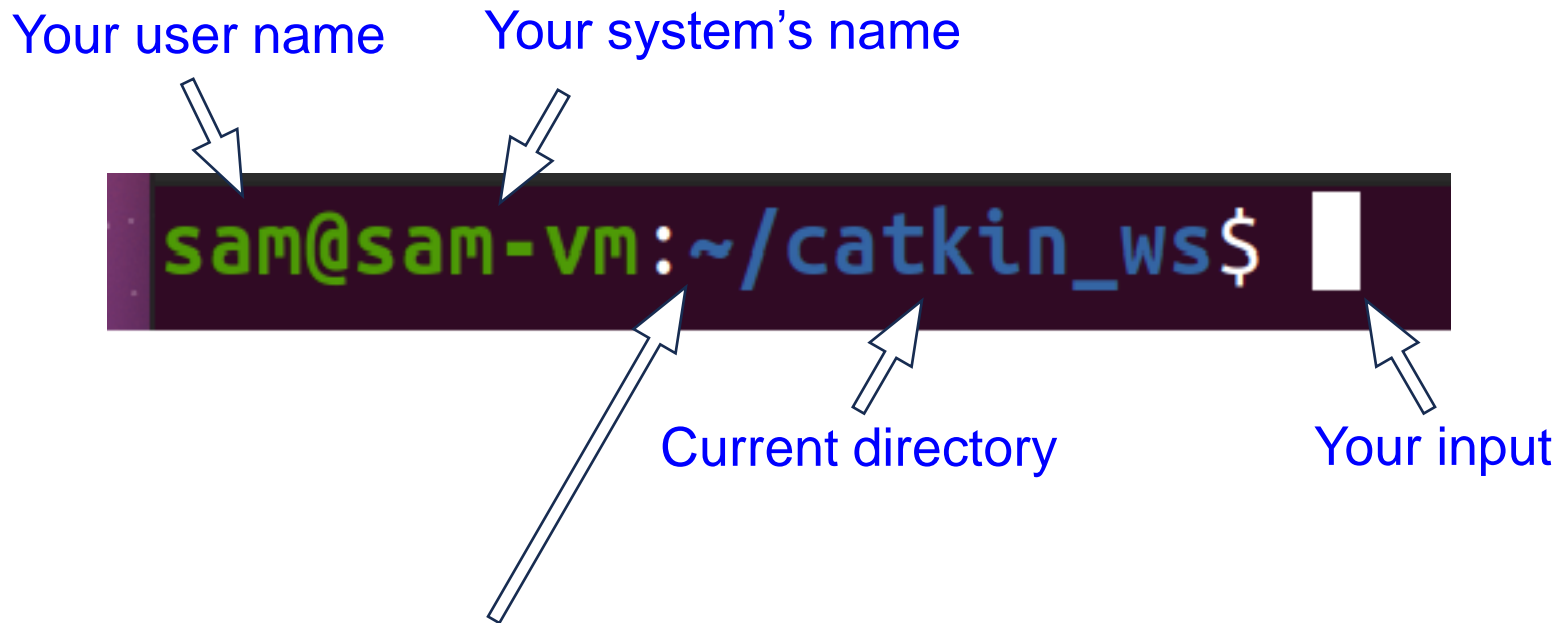
- Press **Ctrl + Alt + T** at the same time, the terminal will come out
- Can also call terminal using GUI: [Show Applications](#) (like the “START” in Windows) – Terminal





Linux Interaction

Prompt



In Linux, the tilde sign “~” is a shorthand for your home directory



Linux Interaction

Linux: Command Basics

```
[username@scc1 ~]$ command --option argument
```

- **Command:** Command/program that does one thing
- **Options:** Change the way a command does that one thing
 - Short form: Single-dash and one letter e.g. **ls -a**
 - Long form: Double-dash and a word e.g. **ls --all**
- **Argument:** Provides the input/output that the command interacts with.

For more information about any command, use **man** or **info** (e.g. "**man ls**")



Linux Interaction

Commands: Hands-On Options

- Commands have three parts; command, options and arguments/parameters.

Example: `cal -j 3 1999`. “cal” is the command, “-j” is an option (or switch), “3” and “1999” are arguments/parameters.

```
[username@scc1 ~]$ cal -j 3 1999
```

- What is the nature of the prompt?
- What was the system’s response to the command?



Linux Interaction

SYNOPSIS

`cal [options] [[[day] month] year]`

DESCRIPTION

`cal` displays a simple calendar. If no arguments are specified, the current month is displayed.

OPTIONS

- `-1, --one` Display single month output. (This is the default.)
- `-3, --three` Display prev/current/next month output.
- `-s, --sunday` Display Sunday as the first day of the week.
- `-m, --monday` Display Monday as the first day of the week.
- `-j, --julian` Display Julian dates (days one-based, numbered from January 1).
- `-y, --year` Display a calendar for the current year.
- `-V, --version` Display version information and exit.
- `-h, --help` Display help screen and exit.

```
sam@sam-vm:~$ cal 12 1993
```

December 1993

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

```
sam@sam-vm:~$ cal -j 12 1993
```

December 1993

Su	Mo	Tu	We	Th	Fr	Sa
			335	336	337	338
339	340	341	342	343	344	345
346	347	348	349	350	351	352
353	354	355	356	357	358	359
360	361	362	363	364	365	

[https://www.linux.org/docs/man1/cal.html#:~:text=%2Dj%2C%20%2D%2Djulian%20Display%20Julian,%2C%20numbered%20from%20January%201\).](https://www.linux.org/docs/man1/cal.html#:~:text=%2Dj%2C%20%2D%2Djulian%20Display%20Julian,%2C%20numbered%20from%20January%201).)



Linux Interaction

Command History and Command Line Editing

- Try the `history` command
- Choose from the command history using the up \uparrow and down \downarrow arrows
- To redo your last command, try `!!`
- To go further back in the command history try `!`, then the number as shown by history (e.g., `!132`). Or, `!ls`, for example, to match the most recent 'ls' command.
- What do the left \leftarrow and right \rightarrow arrow do on the command line?
- Try the `` and `<Backspace>` keys



Linux Interaction

Help with Commands

- Type

- `date --help`
- `man date`
- `info date`

- BASH built-ins

- A little different from other commands
- Just type the command `'help'`
- Or `'man bash'`

```
BASH(1)                                General Commands Manual                                BASH(1)

NAME
    bash - GNU Bourne-Again SHell

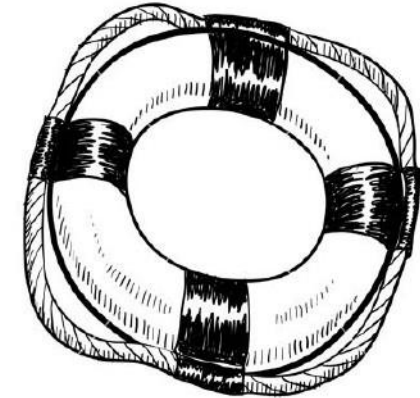
SYNOPSIS
    bash [options] [command_string | file]

COPYRIGHT
    Bash is Copyright (C) 1989-2018 by the Free Software Foundation, Inc.

DESCRIPTION
    Bash is an sh-compatible command language interpreter that executes
    commands read from the standard input or from a file. Bash also incor-
    porates useful features from the Korn and C shells (ksh and csh).

    Bash is intended to be a conformant implementation of the Shell and
    Utilities portion of the IEEE POSIX specification (IEEE Standard
    1003.1). Bash can be configured to be POSIX-conformant by default.

OPTIONS
    All of the single-character shell options documented in the description
    of the set builtin command, including -o, can be used as options when
    Manual page bash(1) line 1 (press h for help or q to quit)
```



Yes, you can always Google it.



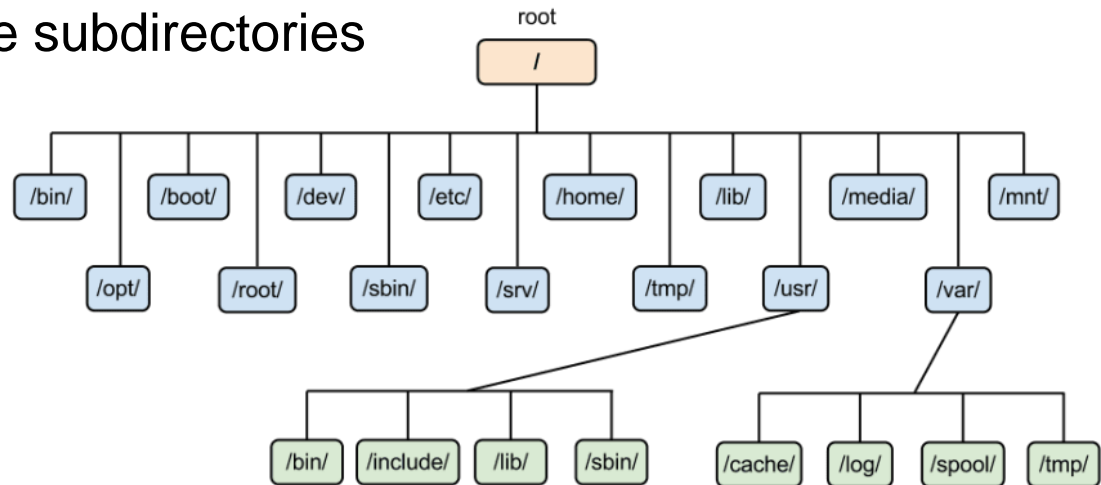
File System



File System

The Linux File system

- The structure resembles an upside-down tree
- Directories (a.k.a. folders) are collections of files and other directories
- Every directory has a parent except for the root directory
- Many directories have subdirectories





File System

Navigating the File System

- Essential navigation commands:
 - `pwd` print current directory
 - `ls` list files
 - `cd` change directory



File System

Navigating the File System

We use path names to refer to files and directories in the Linux file system.

- There are TWO types of pathnames:
 - **Absolute** – The full path to a directory or file; begins with /
 - **Relative** – A partial path that is relative to the current working directory; does not begin with /



File System

Navigating the File System

Special characters interpreted by the shell for filename expansion:

- `~` your home directory (e.g., `~/cuhk/eleg4701/LT1`)
- `.` Current directory
- `..` Parent directory (previous level)
- `*` wildcard matching any filename
- `?` Wildcard matching any character
- **TAB** Try to complete (partially typed) filename



File System

Navigating the File System

Examples:

- `cd /usr/local` Change directory to **usr/local**
- `cd ~` Change to home directory (could just type **cd**)
- `pwd` Print working (current) directory
- `cd ..` Change directory to the “parent” directory
- `cd -` Return to the previous dir
- `cd /` Change directory to the “root”
- `ls -d pro*` Listing of only the directories starting with “pro”



File System

The `ls` command

Useful **options** for the `ls` command:

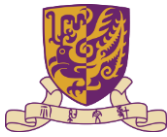
- `ls -a` List all files, including hidden files beginning with a “.”
- `ls -ld *` List details about a directory and not its contents
- `ls -F` Put an indicator character at the end of each name
- `ls -l` Simple long listing
- `ls -lR` Recursive long listing
- `ls -lh` Give human-readable file size
- `ls -ls` Sort files by file size
- `ls -lt` Sort files by modification times (very useful!)



File System

Some Useful File Commands

- `cp [file1] [file2]` copy file
- `mkdir [name]` make directory
- `rmdir [name]` remove (empty) directory
- `mv [file] [destination]` move file to destination
- `rm [file]` remove file (-r for recursive)
- `file [file]` identify file type
- `less [file]` display files content one screen at a time
- `head -n N [file]` display first N lines
- `tail -n N [file]` display last N lines
- `ln -s [file] [new]` create symbolic link
- `cat [file] [file2...]` concatenate, display file(s)
- `tac [file] [file2...]` display file in reverse order
- `touch [file]` create a file without any content
- `od [file]` octal dump: display contents in hexadecimal., octal, ASCII

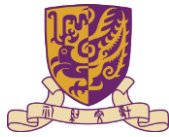


File System

Manipulating files and directories

Examples:

- `cd` # same as `cd ~`
- `mkdir test`
- `cd test`
- `echo 'Hello World' > myfile.txt`
- `echo 'Goodbye' >> myfile.txt`
- `Less myfile.txt`
- `mkdir subdir1/subdir2` # Fails. Why?
- `mkdir -p subdir1/subdir2` # Succeeds
- `mv myfile.txt subdir1/subdir2`
- `cd ..`
- `rmdir test`
- `rm -rf test` # Succeeds



Lab Task: Try the following tasks!

1. Use the **command** line to create a folder called **catkin_ws** in your home directory
2. Print the calendar of March of 17XX (XX = the last 2 digits of your SID), name 17XX.txt
3. Export this calendar as a text file to the **catkin_ws** folder
4. Write a simple Python code that can print this calendar by reading the txt file
5. Use the command line to run this py file

When you are done, ask the TA to check

(Learning how to google is important in programming)



More reading

- Augustine Abaris, Research Computing Services, Information Services & Technology, Boston University:

<https://www.bu.edu/tech/files/2018/05/2018-Summer-Tutorial-Intro-to-Linux.pdf>