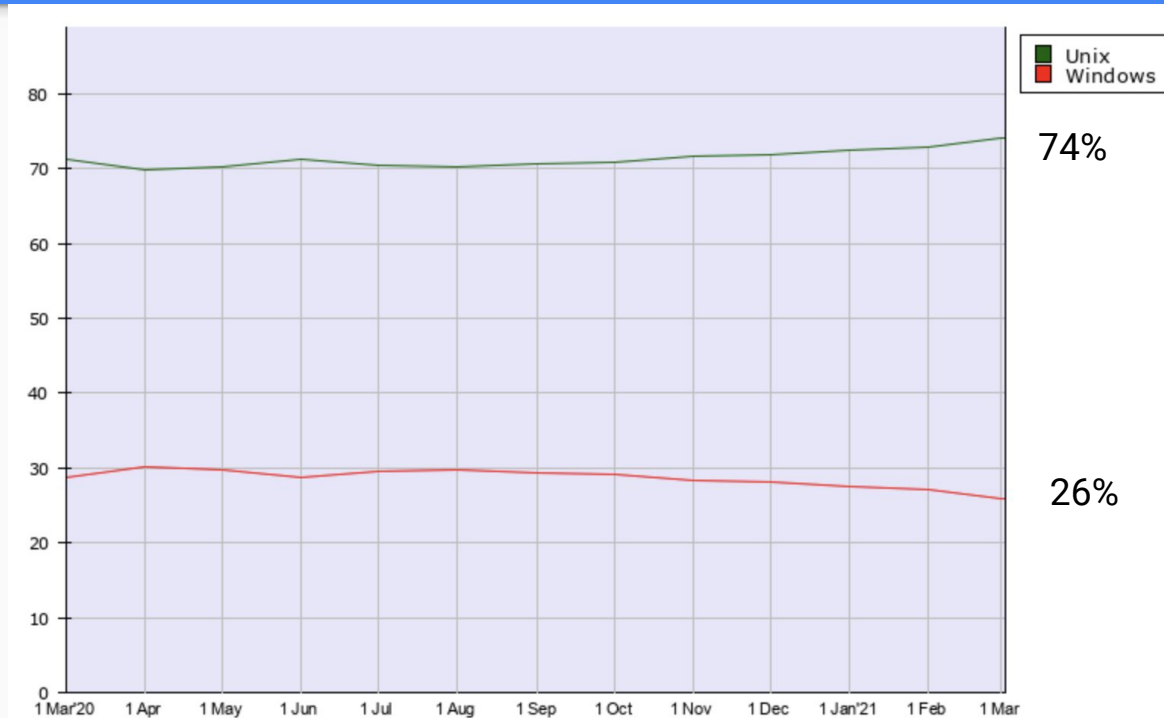


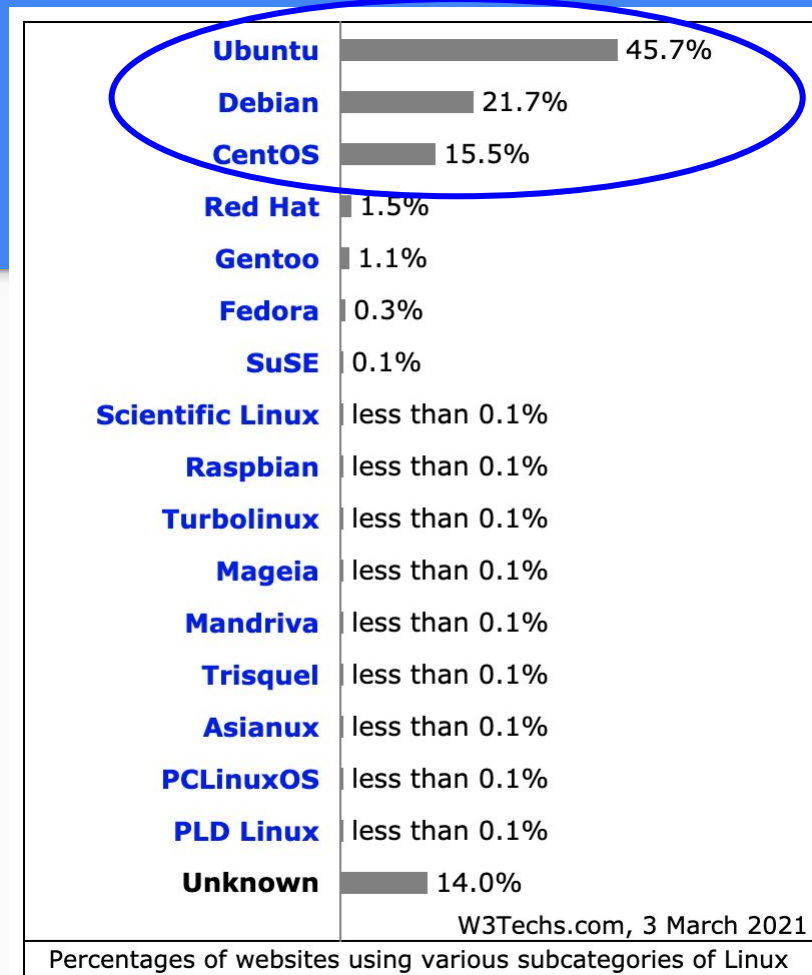
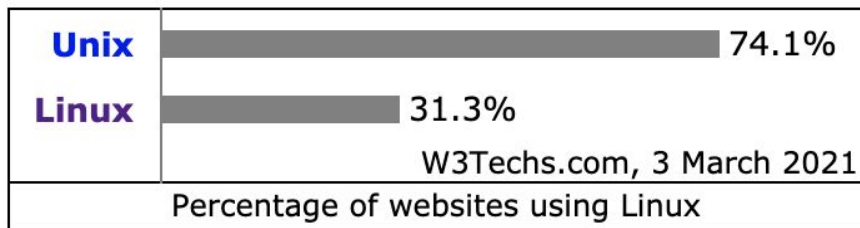
Computer System & Network Administration

Lecture 02. Linux installation & basic usage

Usage of OSs for Websites



Linux subcategories



Outline

- Install Linux
 - Ubuntu Desktop 20.04
 - Ubuntu Server 20.04 (lab)
 - Fedora 33
- Basic usage
- Install application

Install Linux

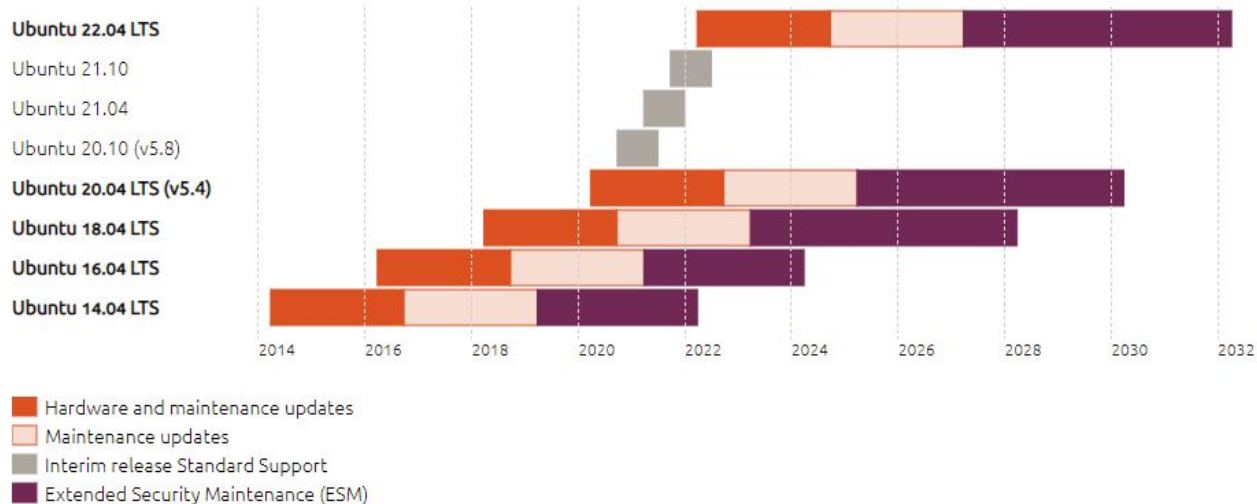
Install Linux - Ubuntu

- Ubuntu Desktop
 - For your **desktop / laptop / tablet**...etc
 - **Includes GUI, browser, OpenOffice**...etc
 - Designed to use everyday
- Ubuntu Server
 - For your **server / Raspberry Pi / embedded device**...etc
 - **Consumes less resource**, but **don't have GUI, everything** is done **via command-line**
 - Designed for "**headless**" environment

Ubuntu Release History

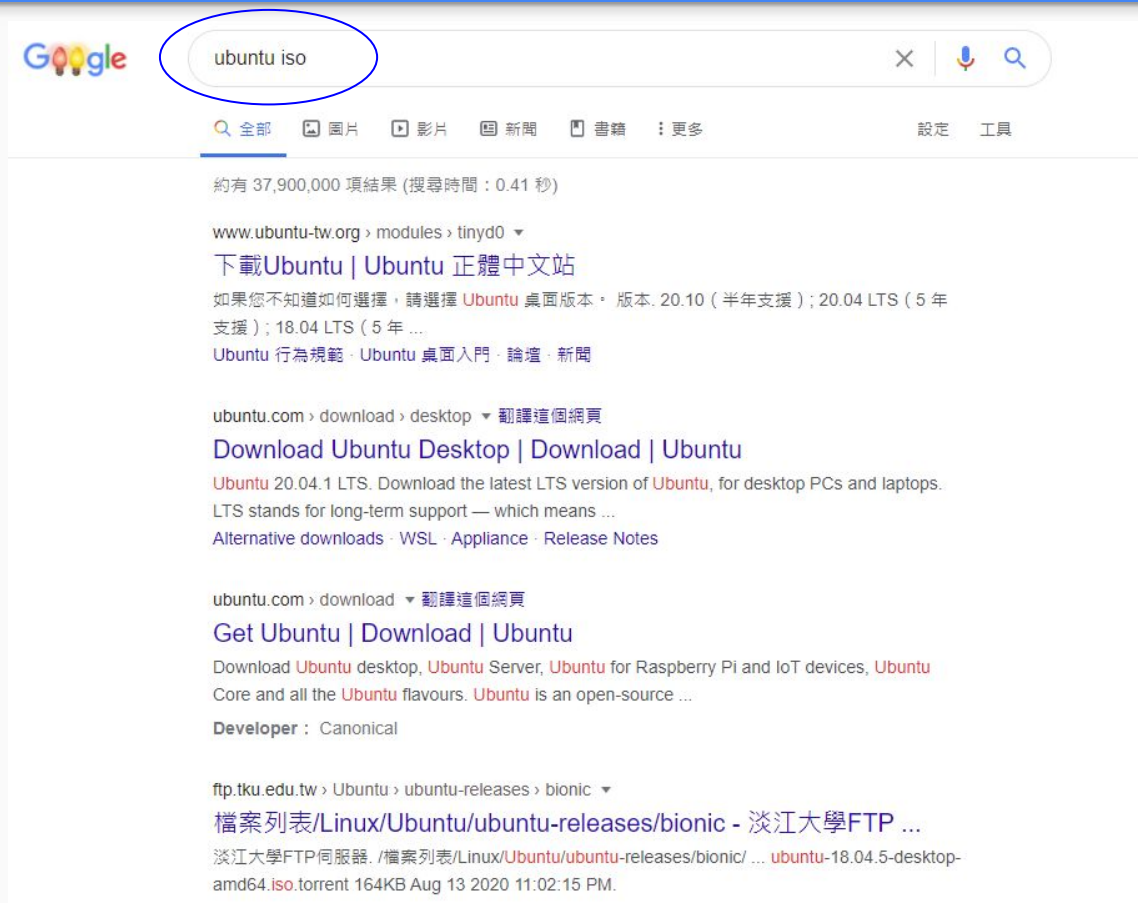
- Ubuntu 20.10 (Groovy Gorilla)
- **Ubuntu 20.04 (Focal Fossa)**
- **Ubuntu 18.04 (Bionic Beaver)**
- **Ubuntu 16.04 (Xenial Xerus)**

- LTS releases are published **every two years**
- Canonical release a new version **twice a year**



Install Linux - Ubuntu Desktop 20.04

To download Ubuntu iso...



A screenshot of a Google search results page for the query "ubuntu iso". The search bar at the top contains the text "ubuntu iso" and is circled in blue. Below the search bar, the results are displayed. The first result is from "www.ubuntu-tw.org" and is titled "下載Ubuntu | Ubuntu 正體中文站". The second result is from "ubuntu.com" and is titled "Download Ubuntu Desktop | Download | Ubuntu". The third result is also from "ubuntu.com" and is titled "Get Ubuntu | Download | Ubuntu". The fourth result is from "ftp.tku.edu.tw" and is titled "檔案列表/Linux/Ubuntu/ubuntu-releases/bionic - 淡江大學FTP ...".

Google

ubuntu iso

全部 圖片 影片 新聞 書籍 更多 設定 工具

約有 37,900,000 項結果 (搜尋時間：0.41 秒)

www.ubuntu-tw.org > modules > tinyd0 ▾

下載Ubuntu | Ubuntu 正體中文站

如果您不知道如何選擇，請選擇 **Ubuntu** 桌面版本。版本: 20.10 (半年支援) ; 20.04 LTS (5 年支援) ; 18.04 LTS (5 年 ...

[Ubuntu 行為規範](#) · [Ubuntu 桌面入門](#) · [論壇](#) · [新聞](#)

ubuntu.com > download > desktop ▾ [翻譯這個網頁](#)

Download Ubuntu Desktop | Download | Ubuntu

Ubuntu 20.04.1 LTS. Download the latest LTS version of **Ubuntu**, for desktop PCs and laptops. LTS stands for long-term support — which means ...

[Alternative downloads](#) · [WSL](#) · [Appliance](#) · [Release Notes](#)

ubuntu.com > download ▾ [翻譯這個網頁](#)

Get Ubuntu | Download | Ubuntu

Download **Ubuntu** desktop, **Ubuntu** Server, **Ubuntu** for Raspberry Pi and IoT devices, **Ubuntu** Core and all the **Ubuntu** flavours. **Ubuntu** is an open-source ...

Developer : Canonical

ftp.tku.edu.tw > Ubuntu > ubuntu-releases > bionic ▾

檔案列表/Linux/Ubuntu/ubuntu-releases/bionic - 淡江大學FTP ...

淡江大學FTP伺服器. /檔案列表/Linux/Ubuntu/ubuntu-releases/bionic/ ... **ubuntu-18.04.5-desktop-amd64.iso.torrent** 164KB Aug 13 2020 11:02:15 PM.

You can use the mirror site in NCKU

<http://ubuntu.csie.ncku.edu.tw/ubuntu-cd/>

ubuntu[®] releases

These releases of Ubuntu are available

Ubuntu 18.04.5 LTS (Bionic Beaver) ›

Ubuntu 20.04.1 LTS (Focal Fossa) ›

Ubuntu 16.04.7 LTS (Xenial Xerus) ›

Ubuntu 20.10 (Groovy Gorilla) ›

These older Ubuntu releases are now in Extended Maintenance (ESM):

- Ubuntu 14.04.6 LTS (Trusty Tahr) ›
- Ubuntu 12.04.5 LTS (Precise Pangolin) ›

Ubuntu 20.04.1 LTS (Focal Fossa) download page

ubuntu[®] releases

Ubuntu 20.04.1 LTS (Focal Fossa)

Select an image

Ubuntu is distributed on two 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.

Server install image

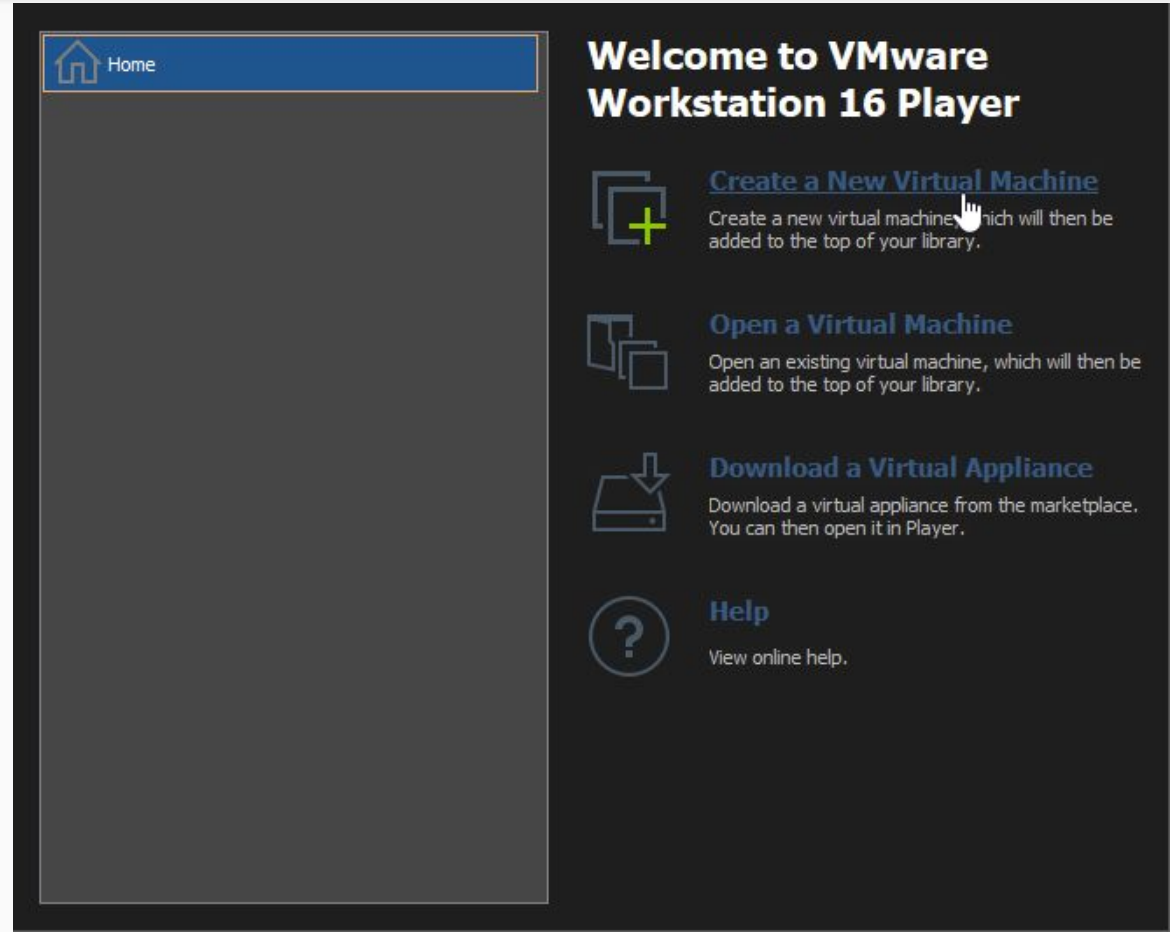
The server install image allows you to install Ubuntu permanently on a computer for use as a server. It will not install a graphical user interface.

64-bit PC (AMD64) server install 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.

Install Ubuntu Linux in VM

You can choose [VMware](#),
[VirtualBox](#) or [QEMU](#).



Install Ubuntu Linux in VM (cont.)

Welcome to the New Virtual Machine Wizard

A virtual machine is like a physical computer; it needs an operating system. How will you install the guest operating system?

Install from:

☐ Installer disc:

No drives available

☐ Installer disc image file (iso):

C:\Intel\Logos\IntelBTCoin.log

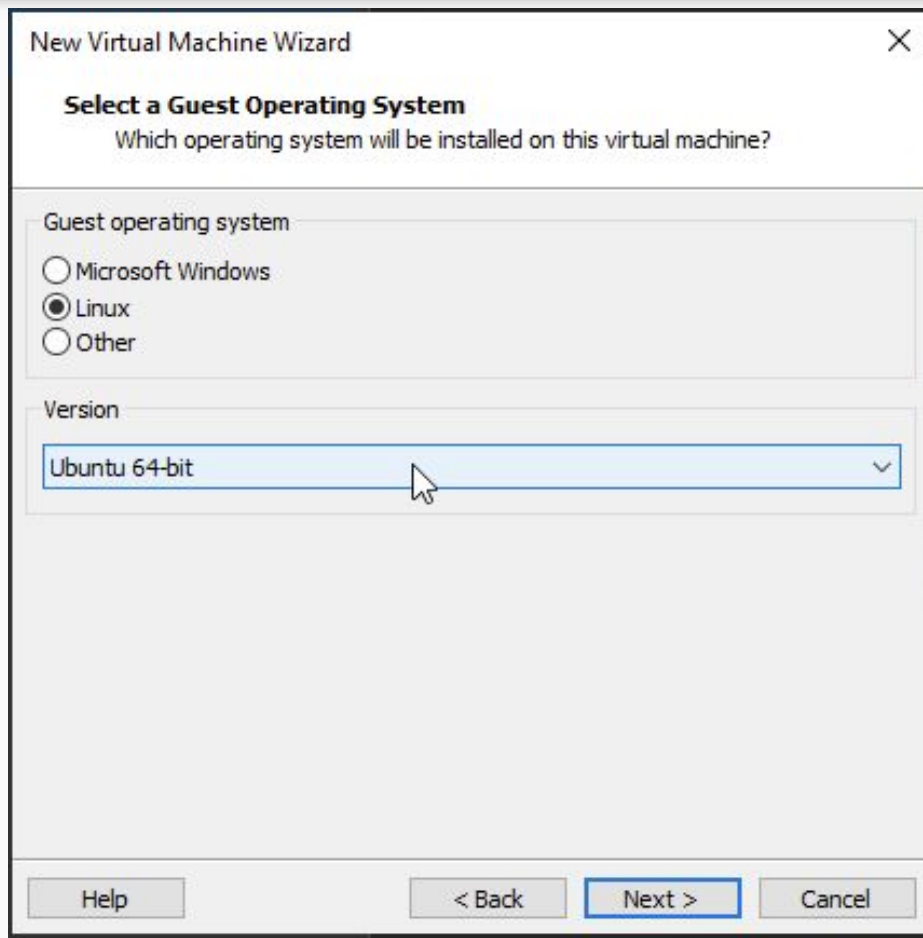
Browse...

☒ I will install the operating system later.

The virtual machine will be created with a blank hard disk.

Help < Back Next > Cancel

Install Ubuntu Linux in VM (cont.)



The screenshot shows a 'New Virtual Machine Wizard' window. The title bar says 'New Virtual Machine Wizard' with a close button. The main heading is 'Select a Guest Operating System' with a subtitle 'Which operating system will be installed on this virtual machine?'. There are two sections: 'Guest operating system' with three radio buttons ('Microsoft Windows', 'Linux' (selected), 'Other') and 'Version' with a dropdown menu showing 'Ubuntu 64-bit'. At the bottom are buttons for 'Help', '< Back', 'Next >' (highlighted), and 'Cancel'.

New Virtual Machine Wizard

Select a Guest Operating System
Which operating system will be installed on this virtual machine?

Guest operating system

☐ Microsoft Windows
☒ Linux
☐ Other

Version

Ubuntu 64-bit

Help < Back Next > Cancel

Install Ubuntu Linux in VM (cont.)

New Virtual Machine Wizard

Name the Virtual Machine
What name would you like to use for this virtual machine?

Virtual machine name:

Location:

< Back **Next >** Cancel

Install Ubuntu Linux in VM (cont.)

New Virtual Machine Wizard

Specify Disk Capacity
How large do you want this disk to be?

The virtual machine's hard disk is stored as one or more files on the host computer's physical disk. These file(s) start small and become larger as you add applications, files, and data to your virtual machine.

Maximum disk size (GB):

Recommended size for Ubuntu 64-bit: 20 GB

☐ Store virtual disk as a single file

☒ Split virtual disk into multiple files

Splitting the disk makes it easier to move the virtual machine to another computer but may reduce performance with very large disks.

Help < Back Next > Cancel

Install Ubuntu Linux in VM (cont.)

Ready to Create Virtual Machine

Click Finish to create the virtual machine. Then you can install Ubuntu 64-bit.

The virtual machine will be created with the following settings:

Name:	Ubuntu 64-bit
Location:	C:\Users\star0\Documents\Virtual Machines\Ubuntu ...
Version:	Workstation 16.x
Operating System:	Ubuntu 64-bit
Hard Disk:	20 GB, Split
Memory:	4096 MB
Network Adapter:	NAT
Other Devices:	2 CPU cores, CD/DVD, USB Controller, Printer, Sound...

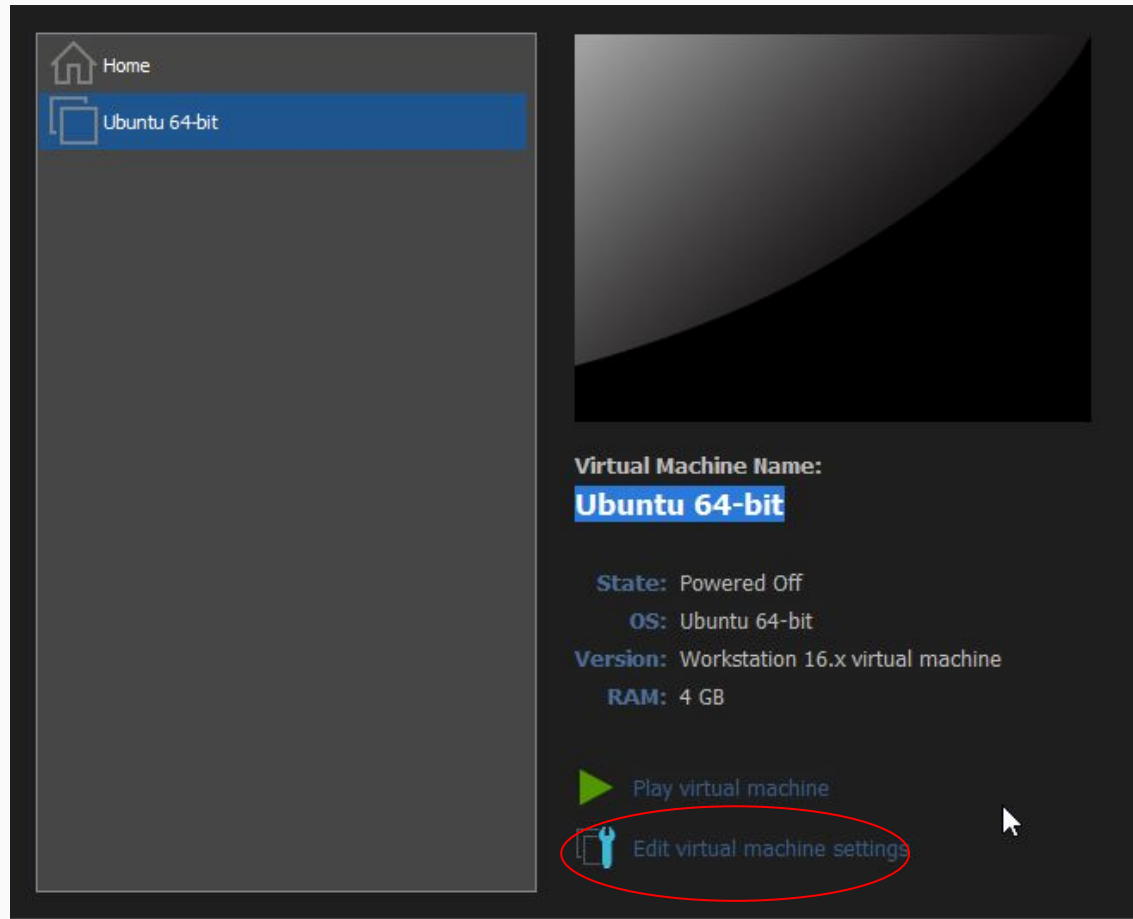
Customize Hardware...

< Back

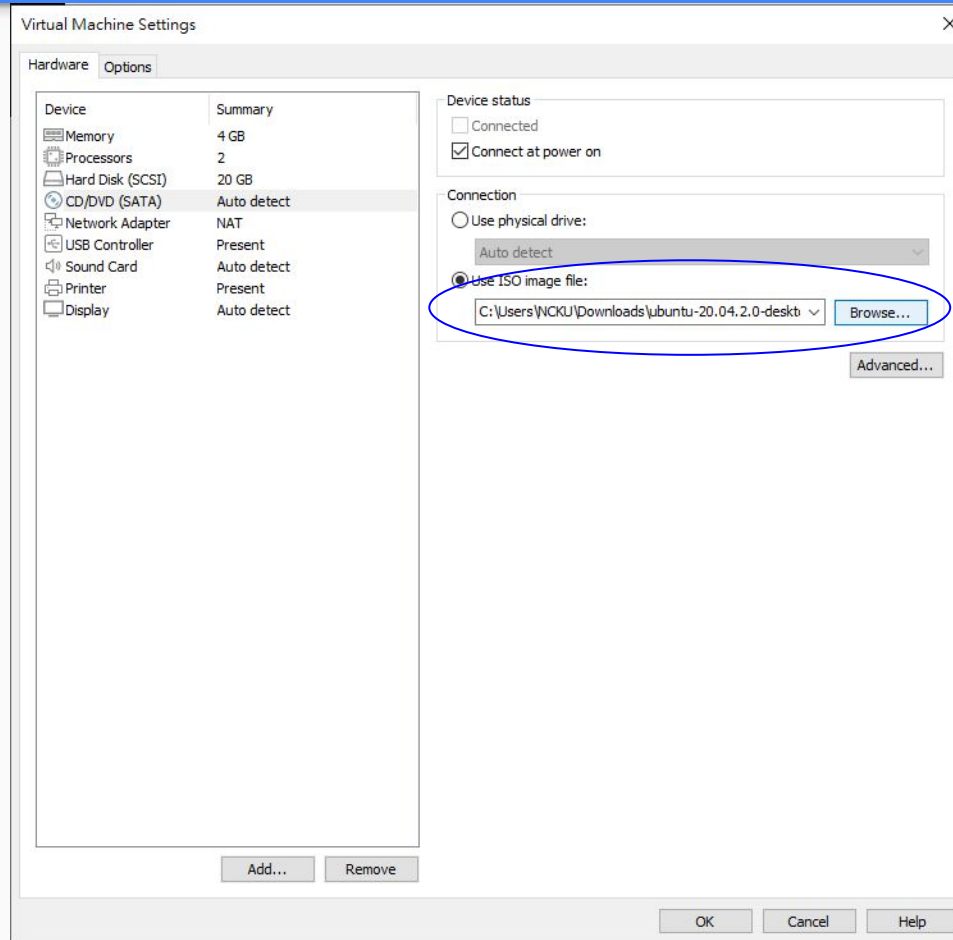
Finish

Cancel

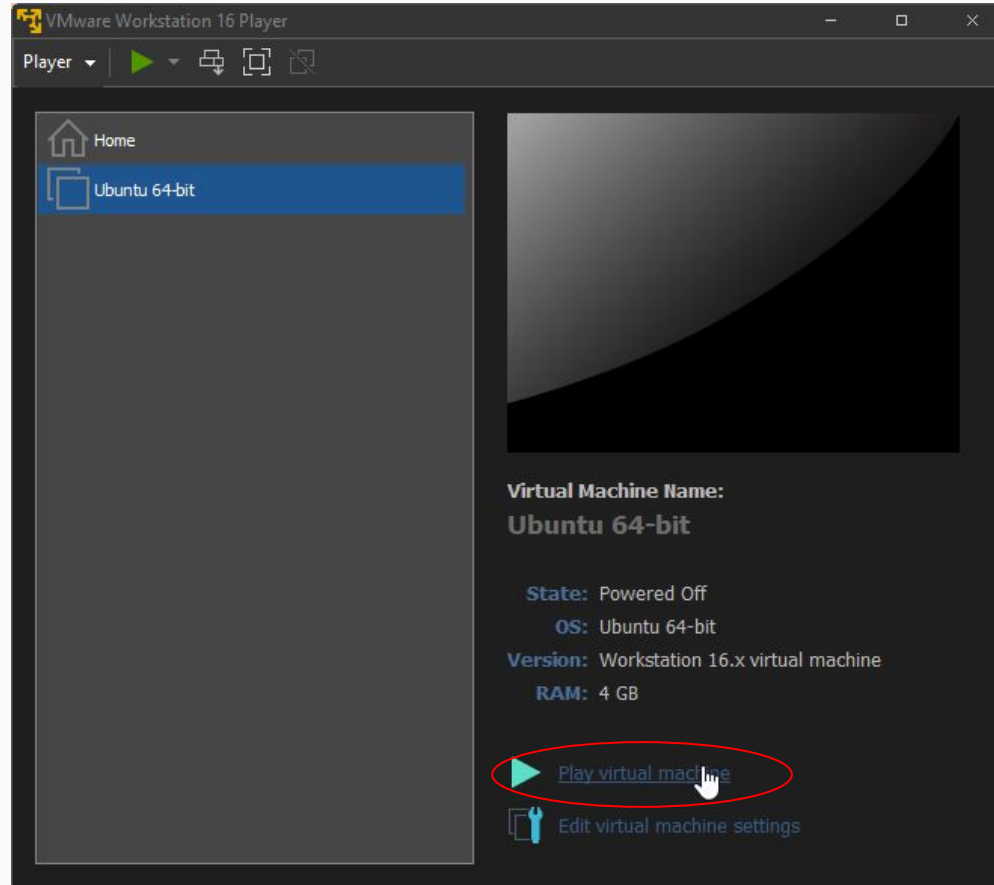
Install Ubuntu Linux in VM (cont.)



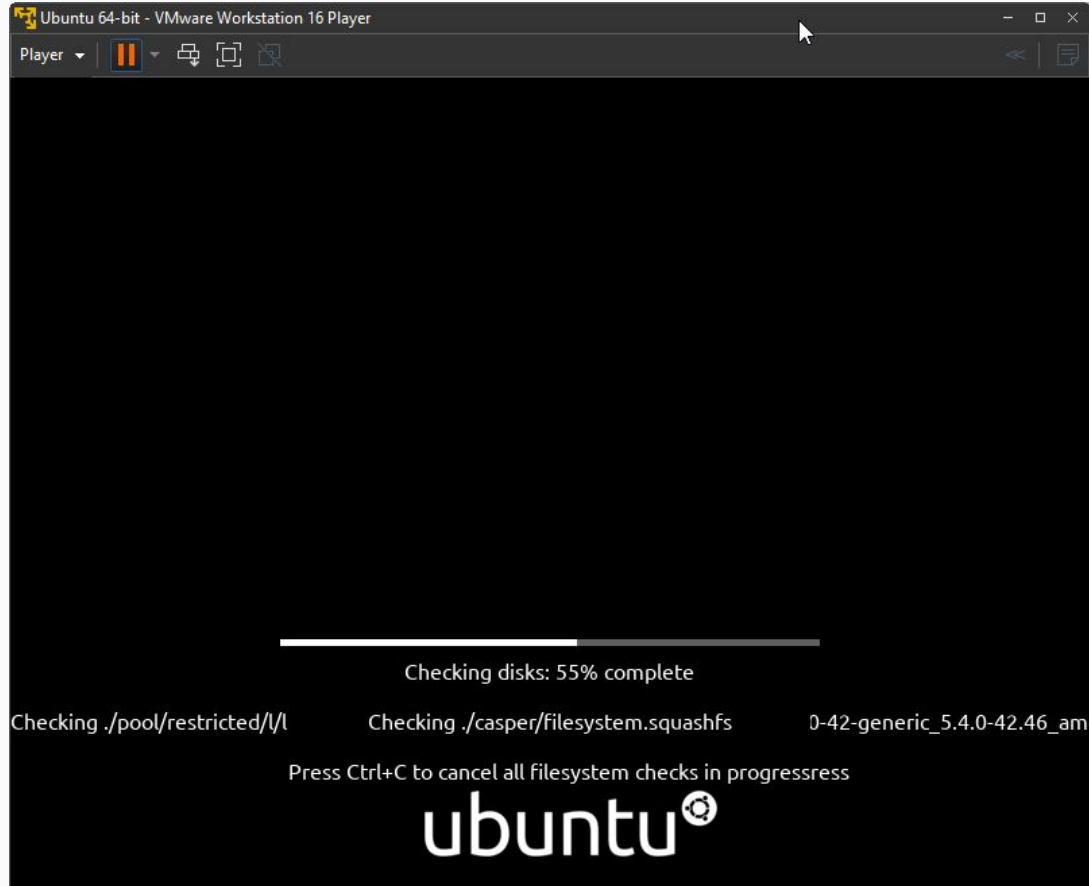
Install Ubuntu Linux in VM (cont.)



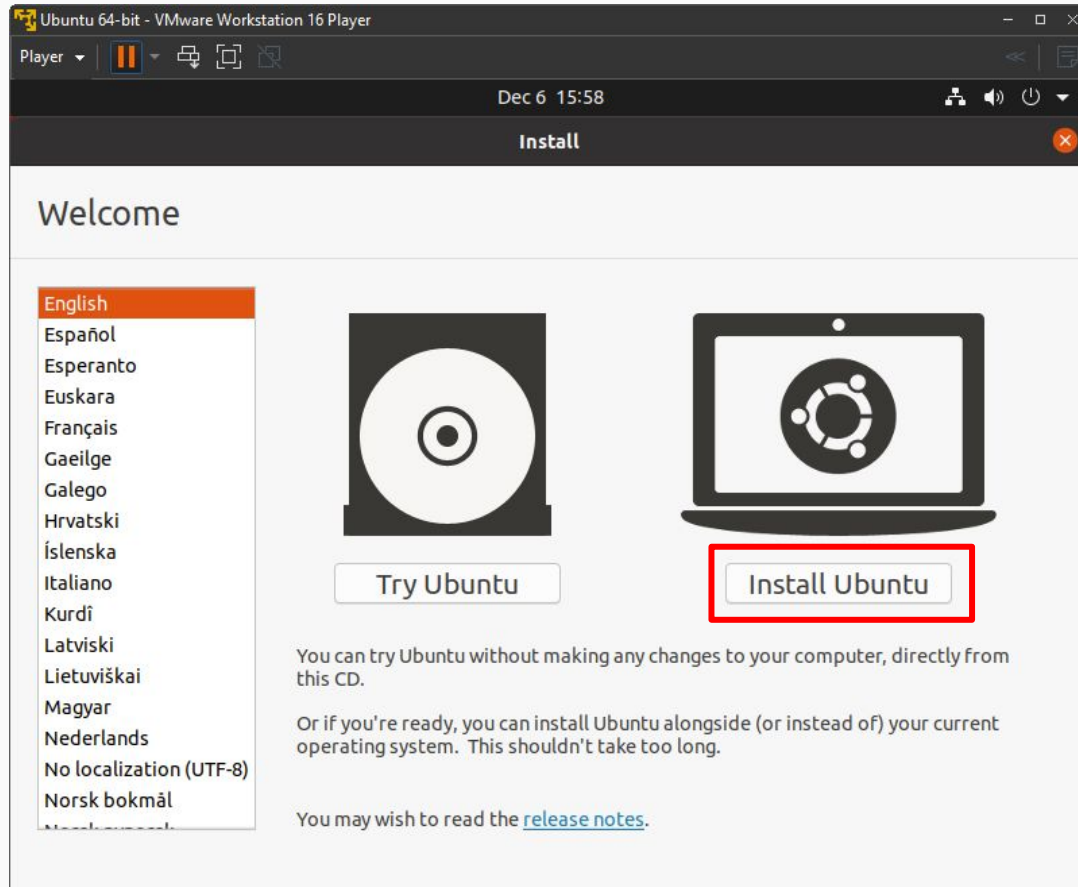
Install Ubuntu Linux in VM (cont.)



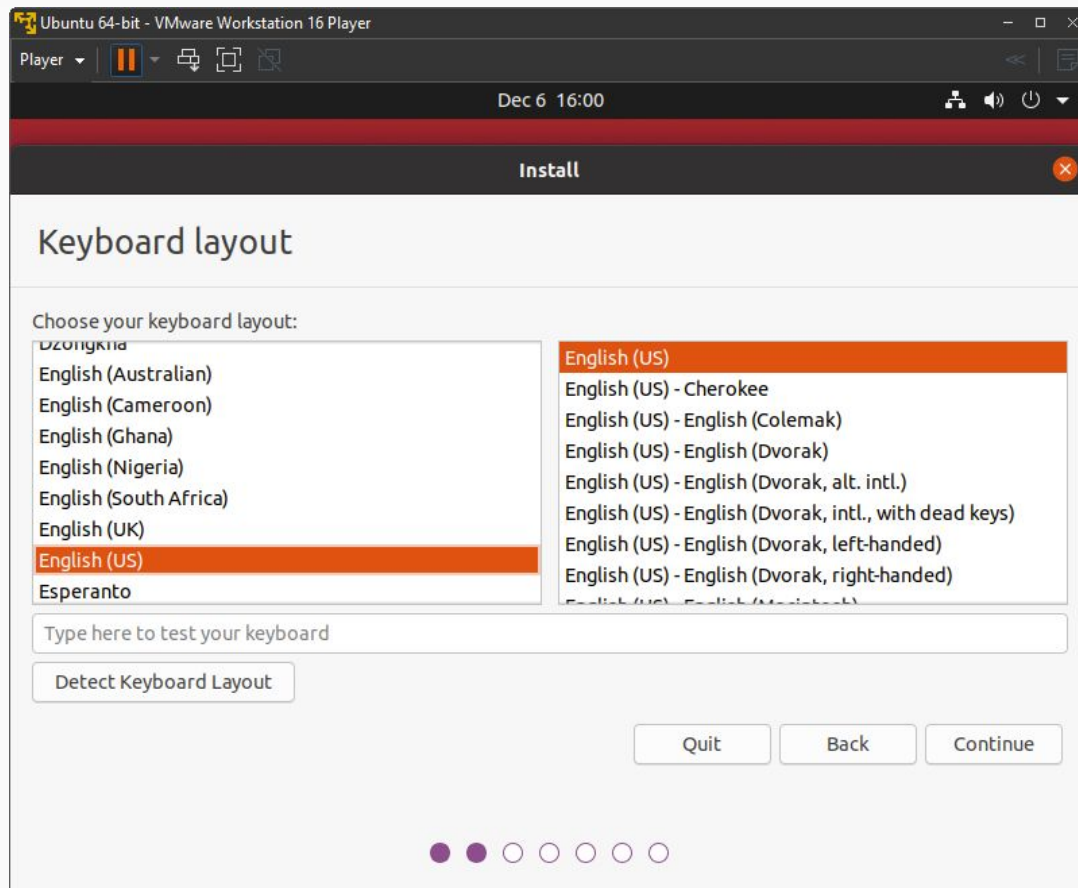
Install Ubuntu Linux in VM (cont.)



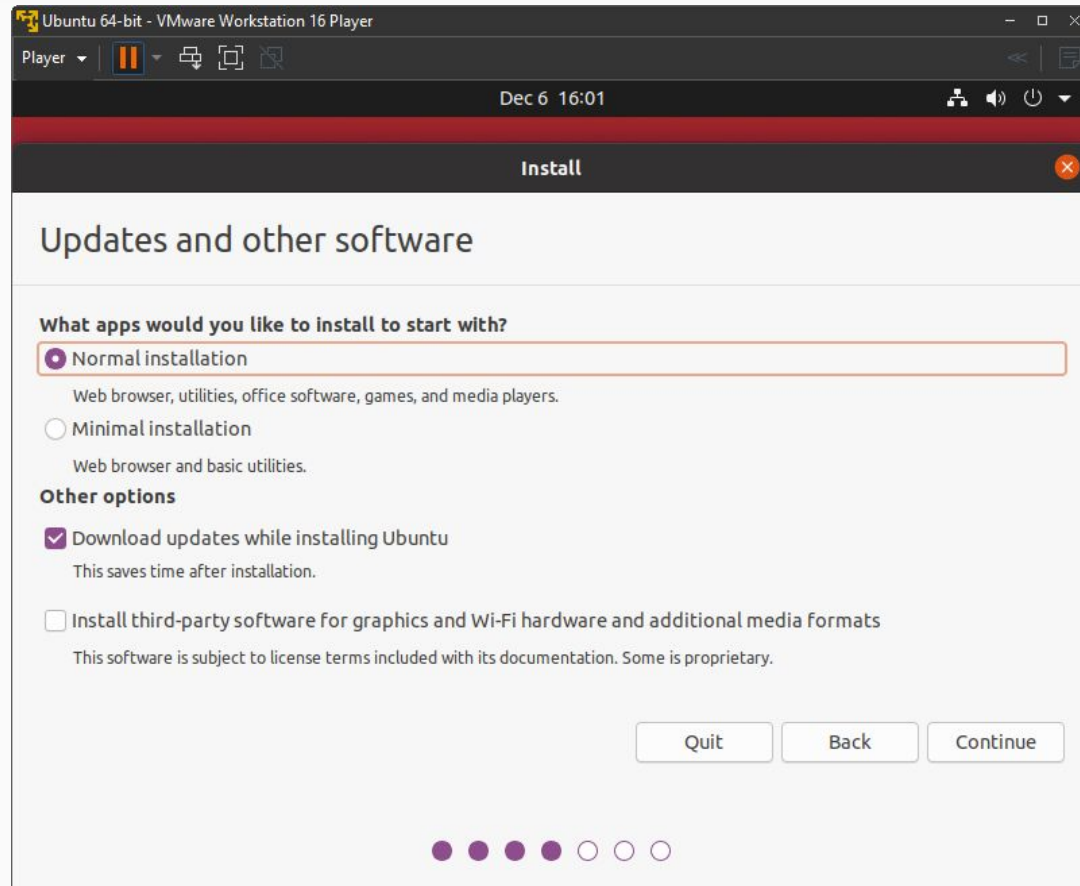
Install Ubuntu Linux in VM (cont.)



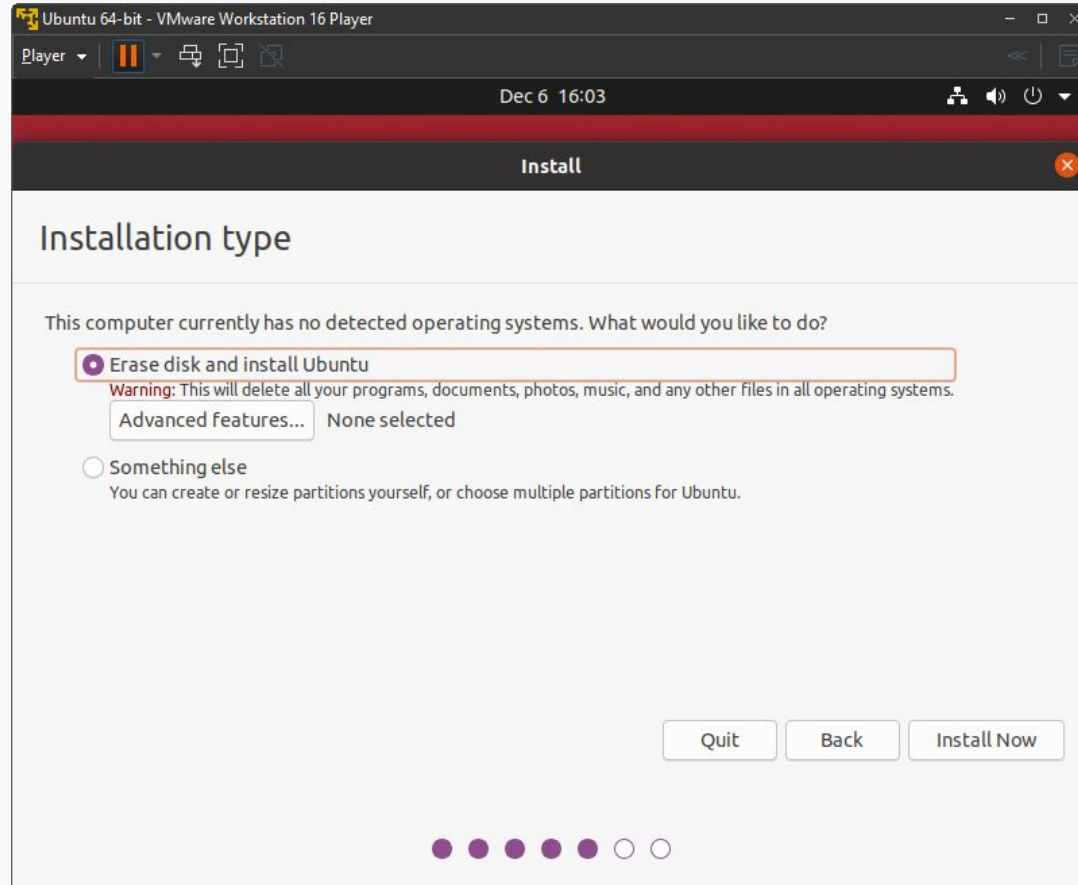
Install Ubuntu Linux in VM (cont.)



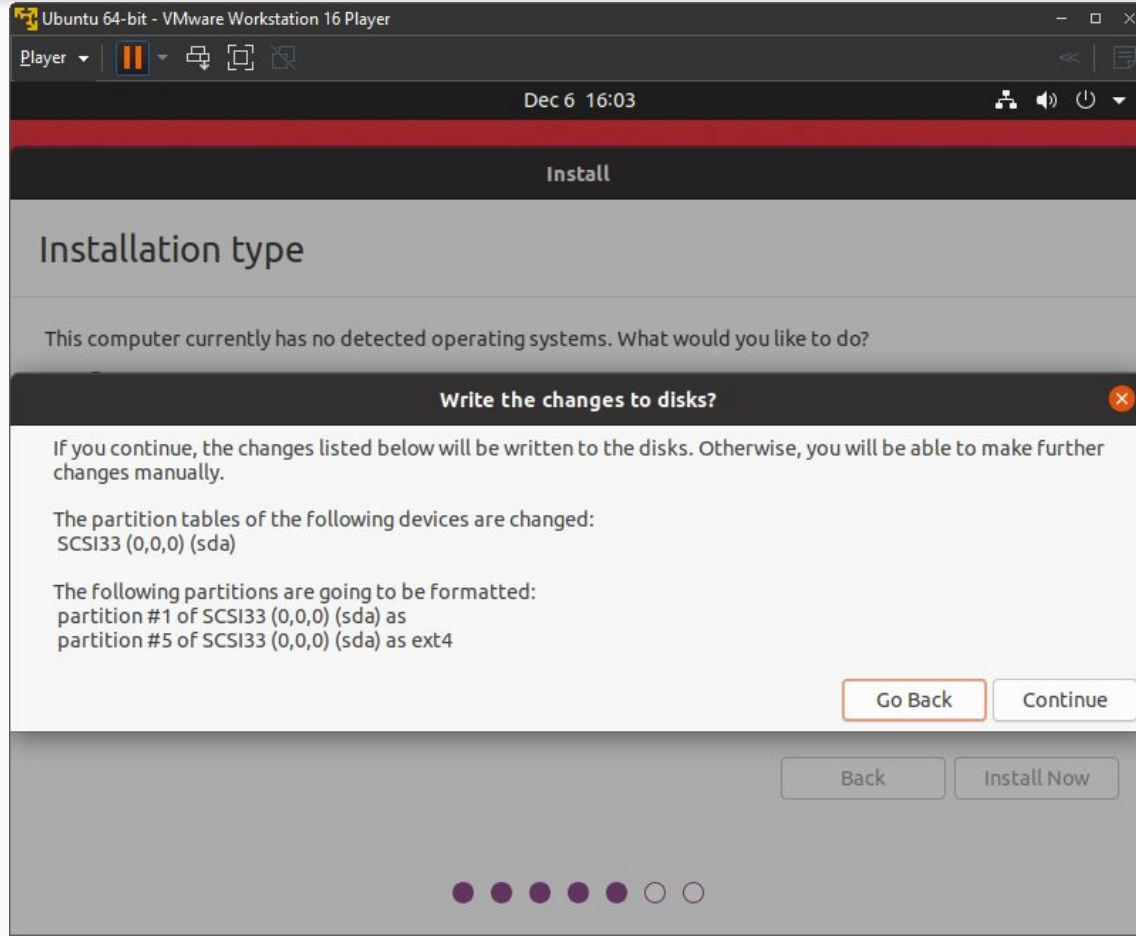
Install Ubuntu Linux in VM (cont.)



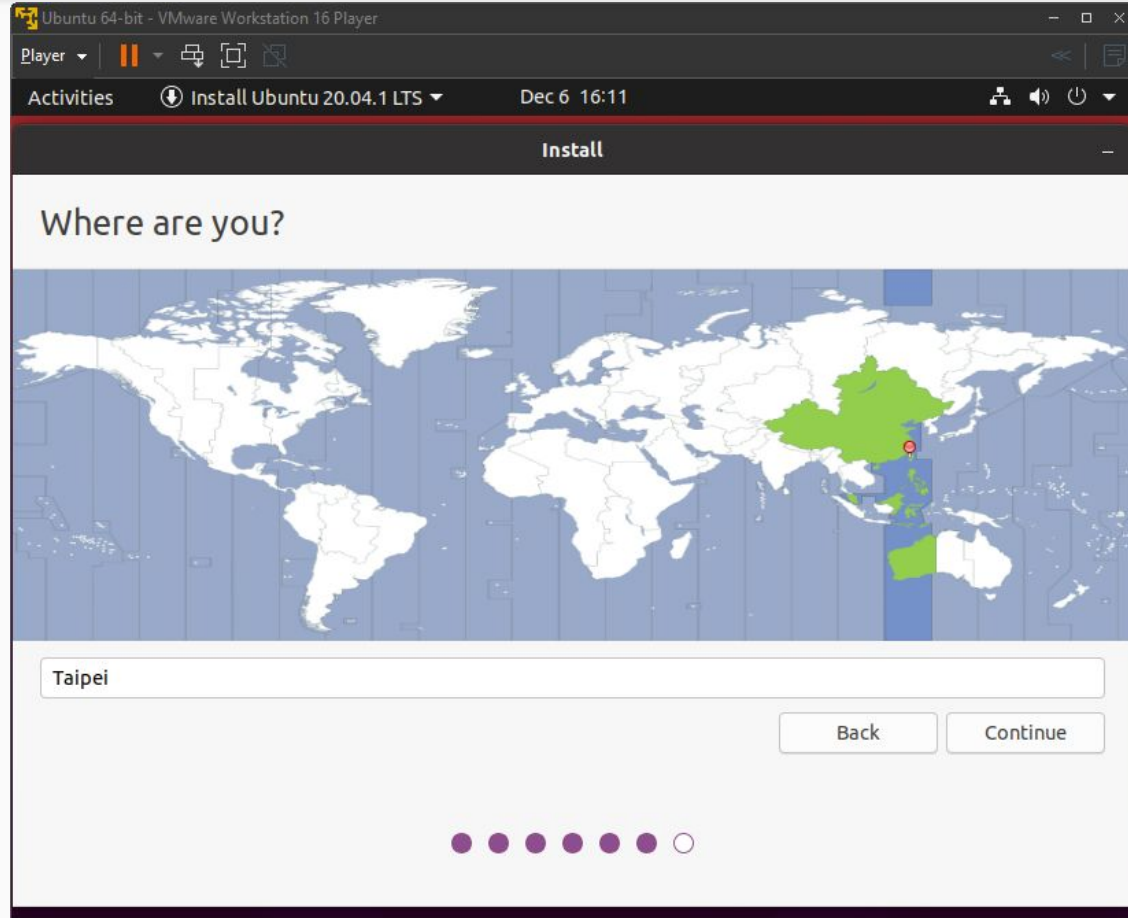
Install Ubuntu Linux in VM (cont.)



Install Ubuntu Linux in VM (cont.)



Install Ubuntu Linux in VM (cont.)



Install Ubuntu Linux in VM (cont.)

Ubuntu 64-bit - VMware Workstation 16 Player

Player ▾ | [Icons] | << | [Icon]

Activities | Install Ubuntu 20.04.1 LTS ▾ | Dec 7 00:12 | [Icons]

Install

Who are you?

Your name: ✓

Your computer's name: ✓
The name it uses when it talks to other computers.

Pick a username: ✓

Choose a password: Weak password

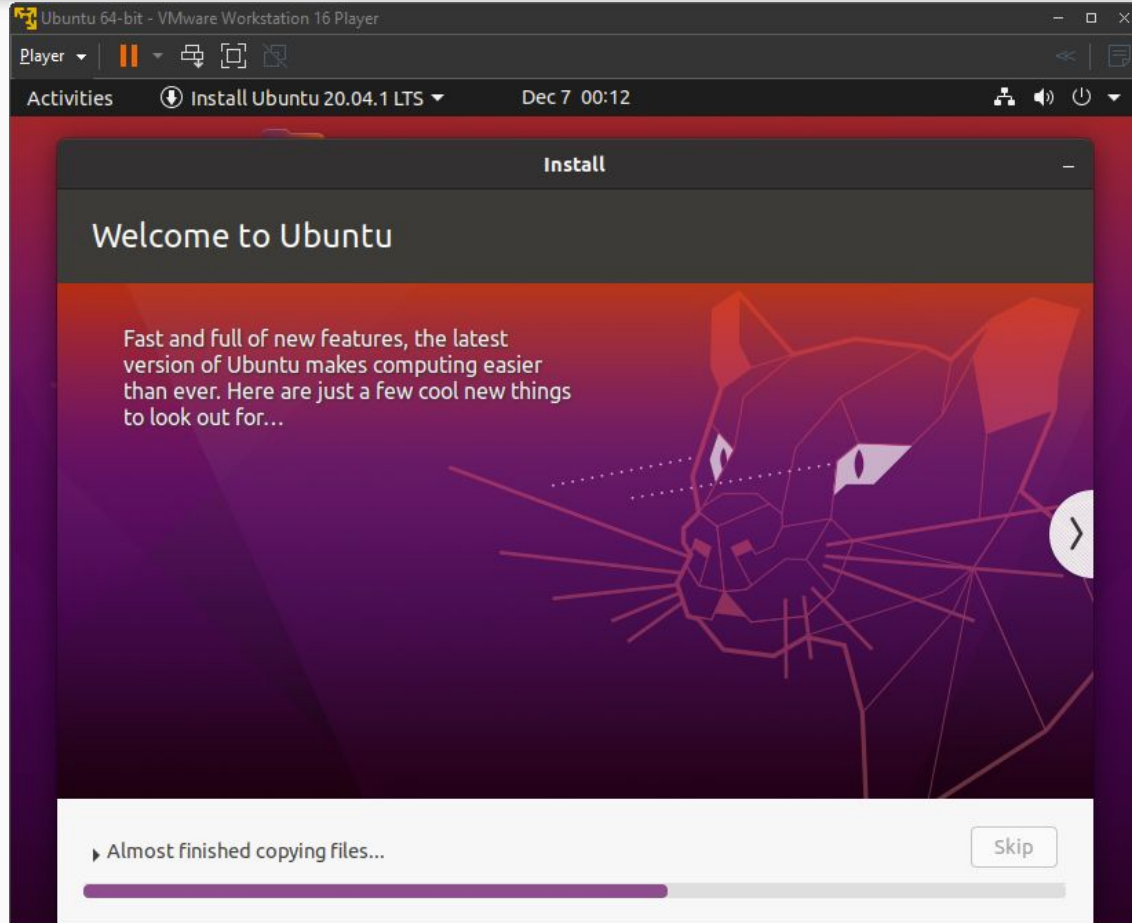
Confirm your password: ✓

☐ Log in automatically

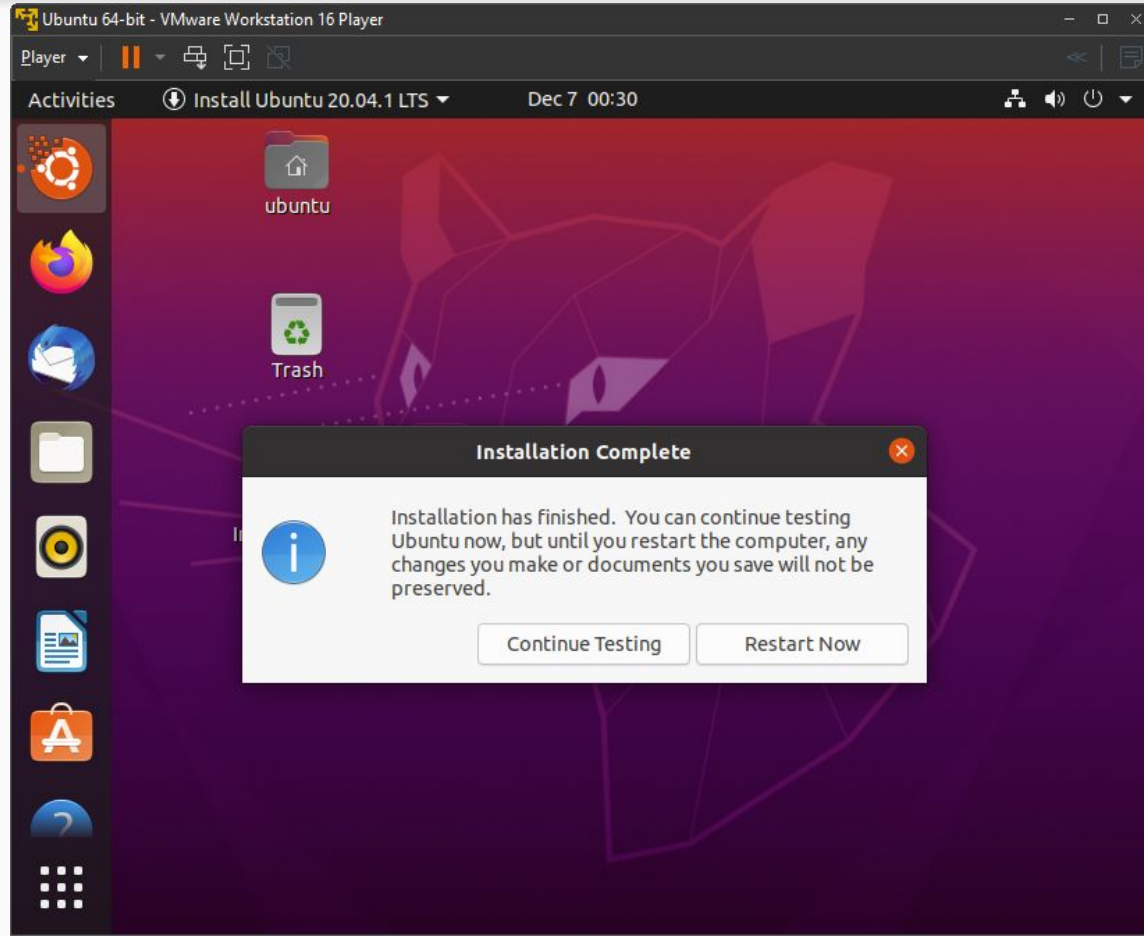
☒ Require my password to log in

● ● ● ● ● ● ● ●

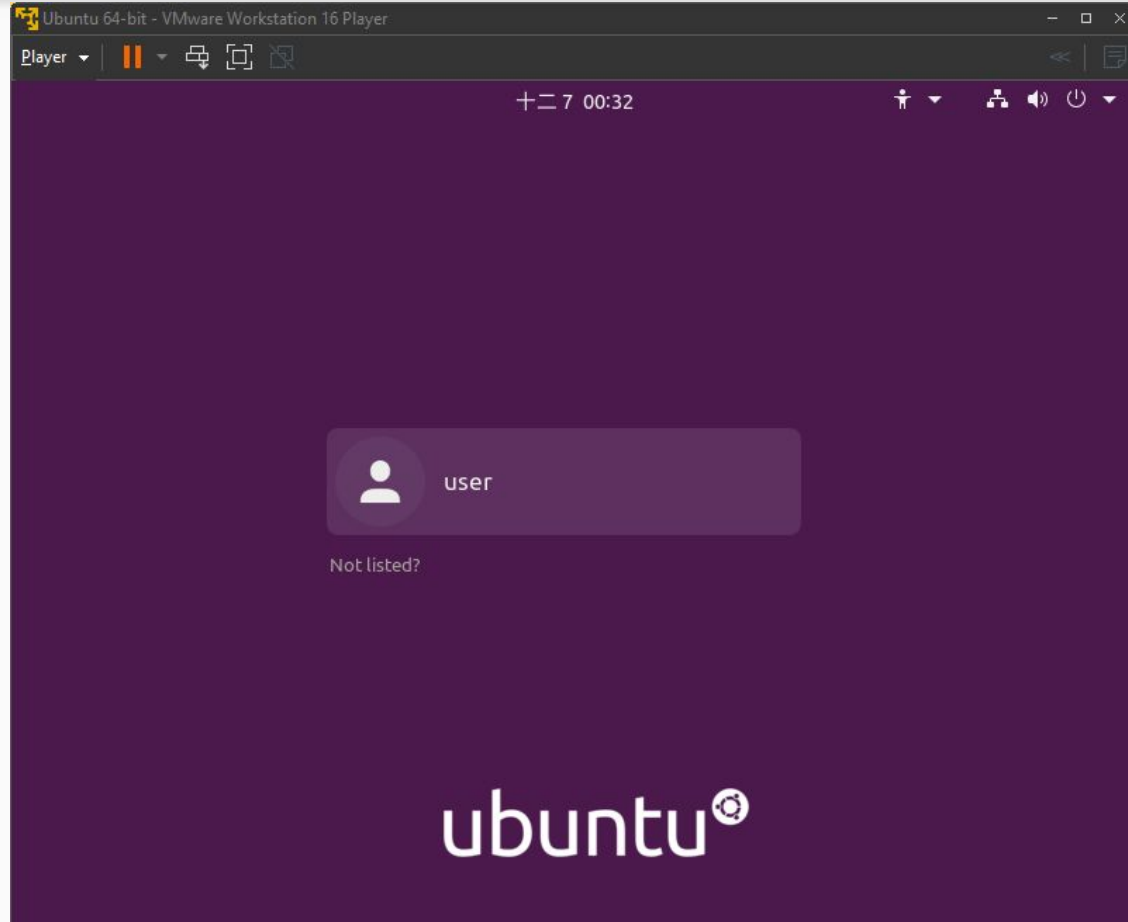
Install Ubuntu Linux in VM (cont.)



Install Ubuntu Linux in VM (cont.)



Install Ubuntu Linux in VM (cont.)



Install Linux - Ubuntu Server 20.04

Lab for you!

Install Linux - Fedora Linux 33 (Installation Demo Purpose Only)

Fedora Linux

- Maintained by **Fedora** Community
Sponsored by **Red Hat**
- Upstream source of commercial **RHEL**
and **CentOS (R.I.P.)**
- Release new version **twice a year**
- Provides
 - Workstation
 - Server
 - IoT
 - CoreOS
 - Silverblue





Welcome to Freedom.

Fedora creates an innovative, free, and open source platform for hardware, clouds, and containers that enables software developers and community members to build tailored solutions for their users.



fedora WORKSTATION

OFFICIAL
EDITION

Fedora Workstation is a polished, easy to use operating system for laptop and desktop computers, with a complete set of tools for developers and makers of all kinds.

[Learn more.](#)

[Download Now](#)



fedora SERVER

OFFICIAL
EDITION

Fedora Server is a powerful, flexible operating system that includes the best and latest datacenter technologies. It puts you in control of all your infrastructure and services.

[Learn more.](#)

[Download Now](#)



fedora IoT

OFFICIAL
EDITION

Fedora IoT provides a trusted open source platform as a strong foundation for IoT ecosystems.

Download Fedora 33 Workstation.

We're so glad you've decided to give Fedora Workstation a try. We know you'll love it.

On Windows or MacOS?

Get started by using **Fedora Media Writer**, which makes it super easy to give Fedora a try.

Fedora Media Writer



On Linux or just want an ISO file?

Not sure how to use this file? [Learn here](#)

For x86_64:

Fedora 33: x86_64 DVD ISO

Download

For ARM* aarch64:

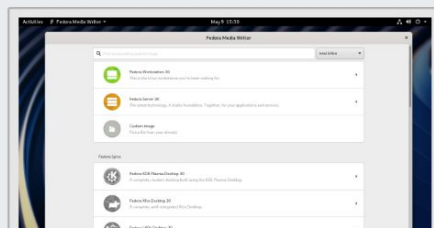
Fedora 33: aarch64 raw image

Download

Learn more about Fedora Media Writer.

Getting going with Fedora is easier than ever. All you need is a 2GB USB flash drive, and Fedora Media Writer.

Once Fedora Media Writer is installed, it will set up your flash drive to run a "Live" version of Fedora Workstation, meaning that you can boot it from your flash drive and try it out right away without making any permanent changes to your computer. Once you are hooked, installing it to your hard drive is a matter of clicking a few buttons*.



Fedora installer boot screen

Fedora-Workstation-Live 33

Start Fedora-Workstation-Live 33

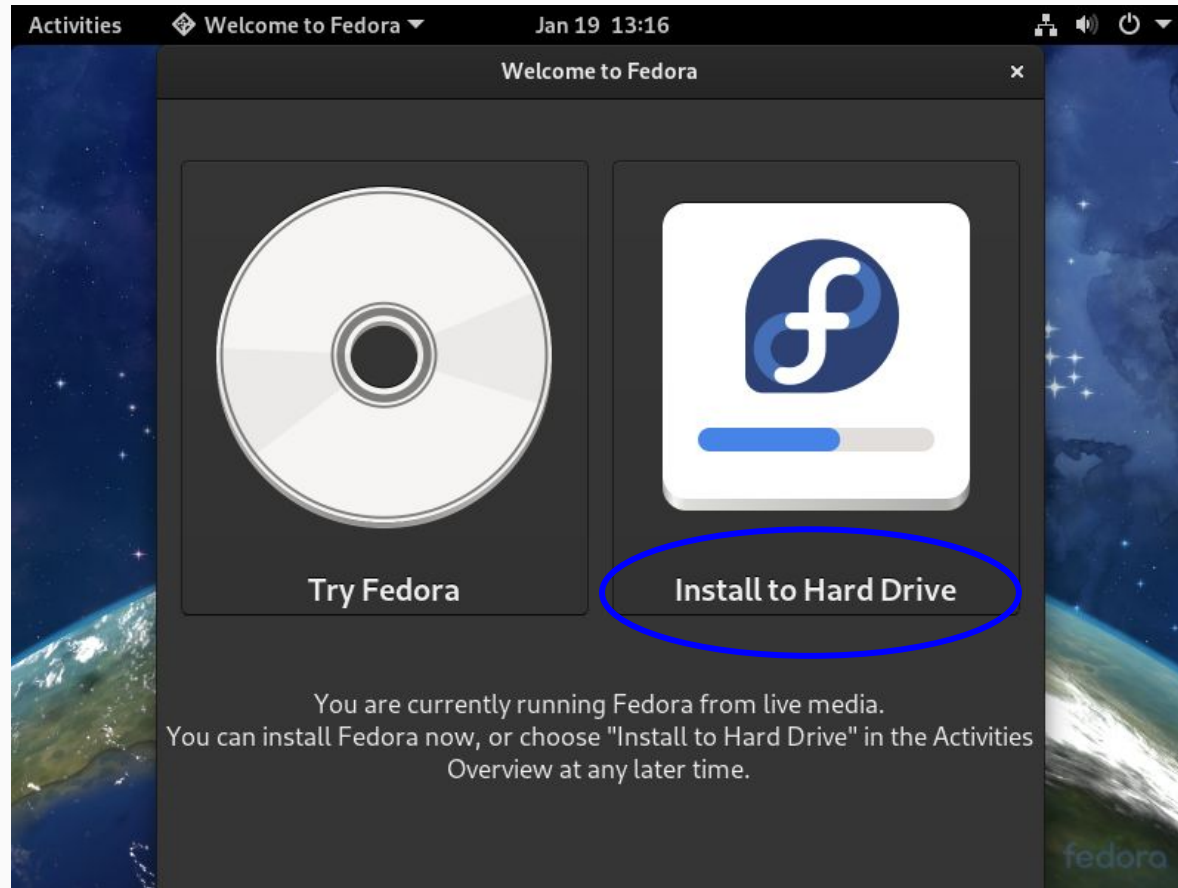
Test this media & start Fedora-Workstation-Live 33

Troubleshooting

>

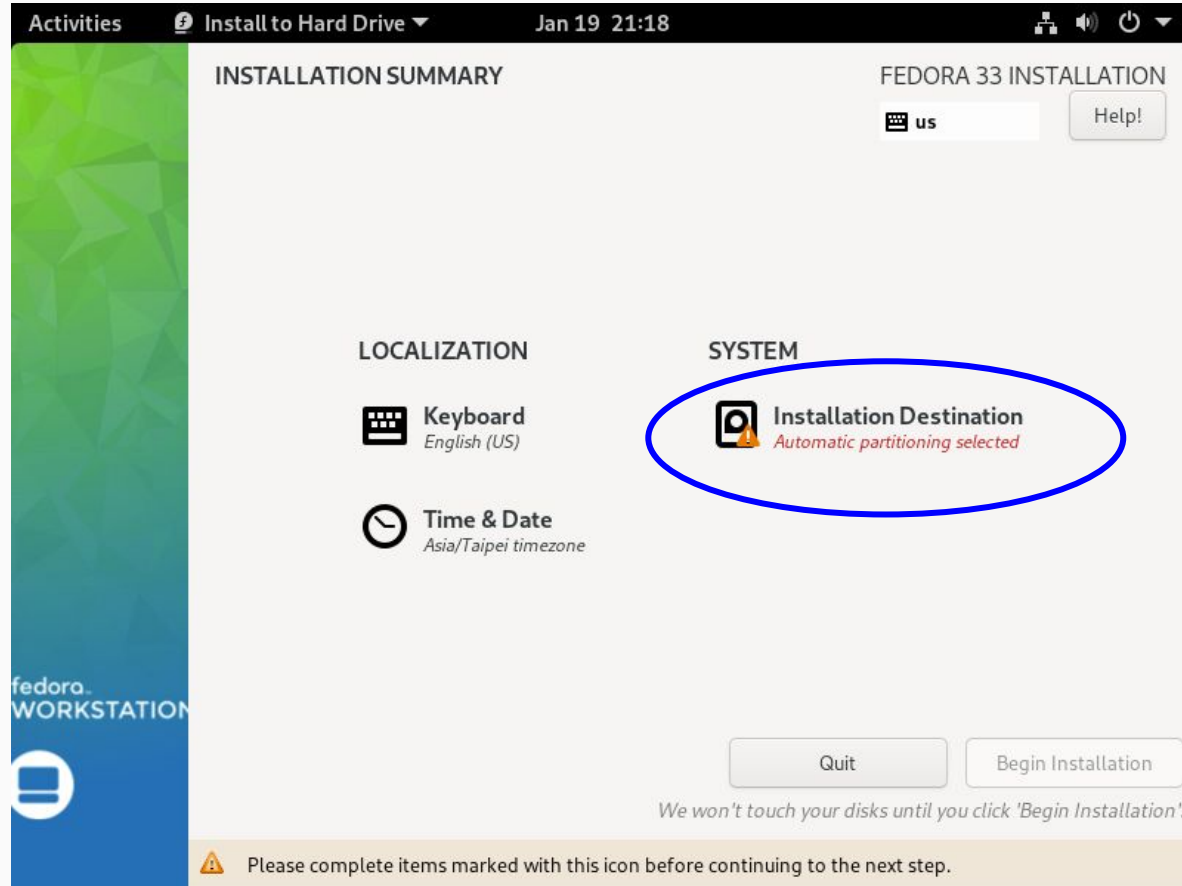
Press Tab for full configuration options on menu items.

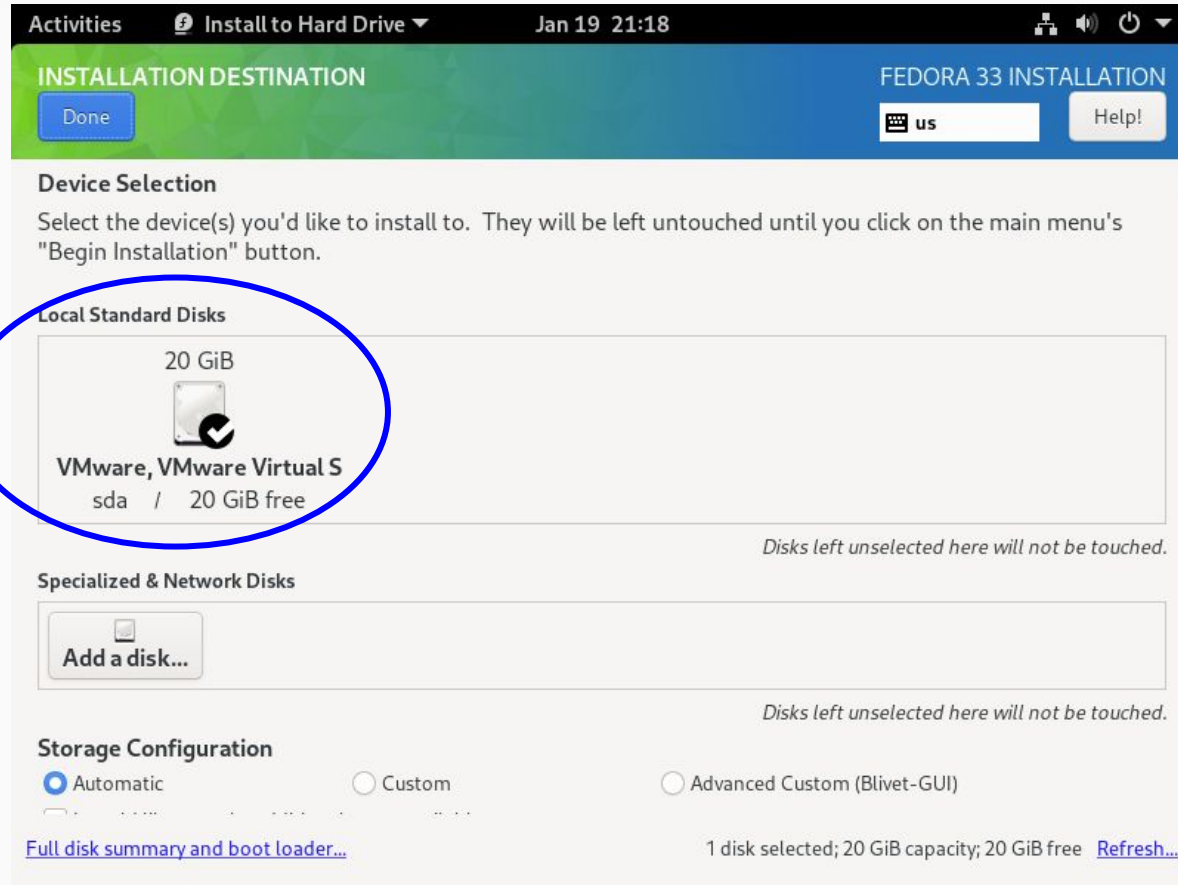
Fedora installer screen



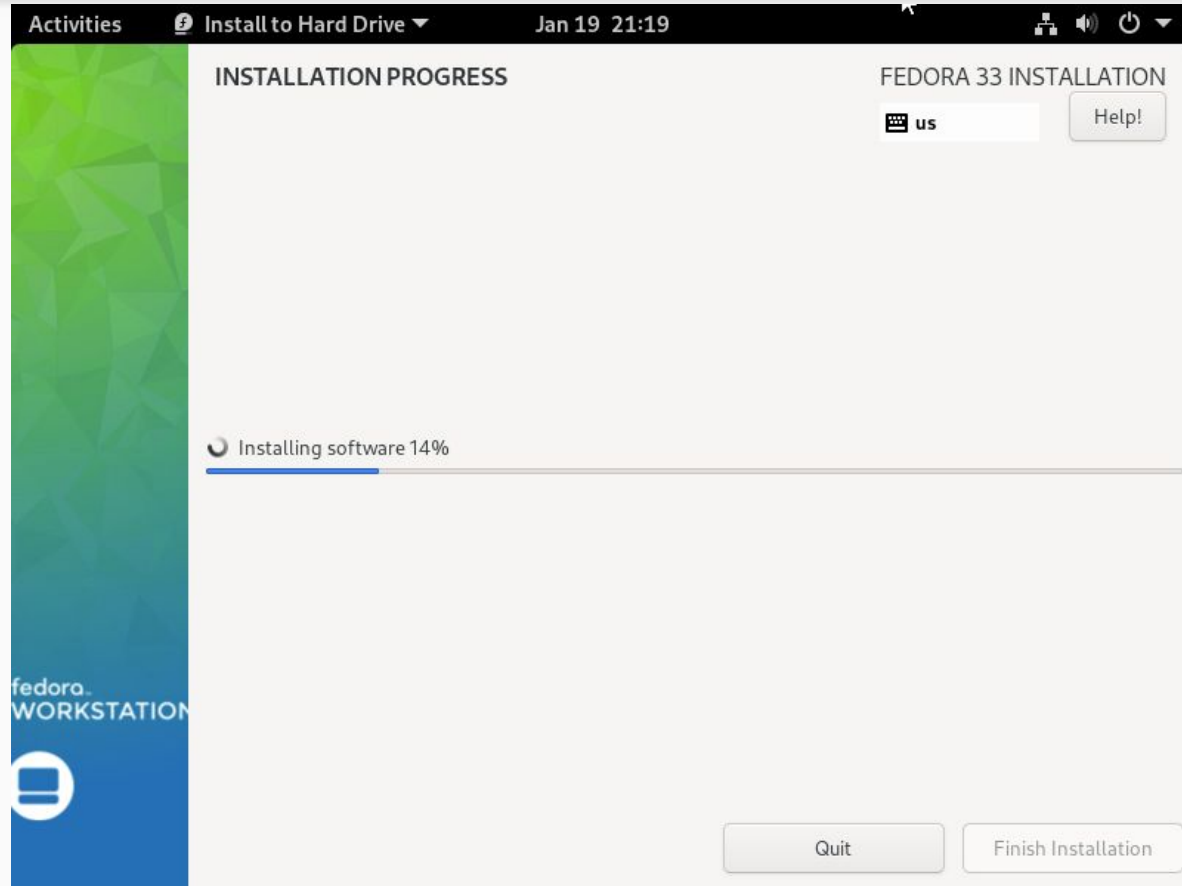
Fedora installer



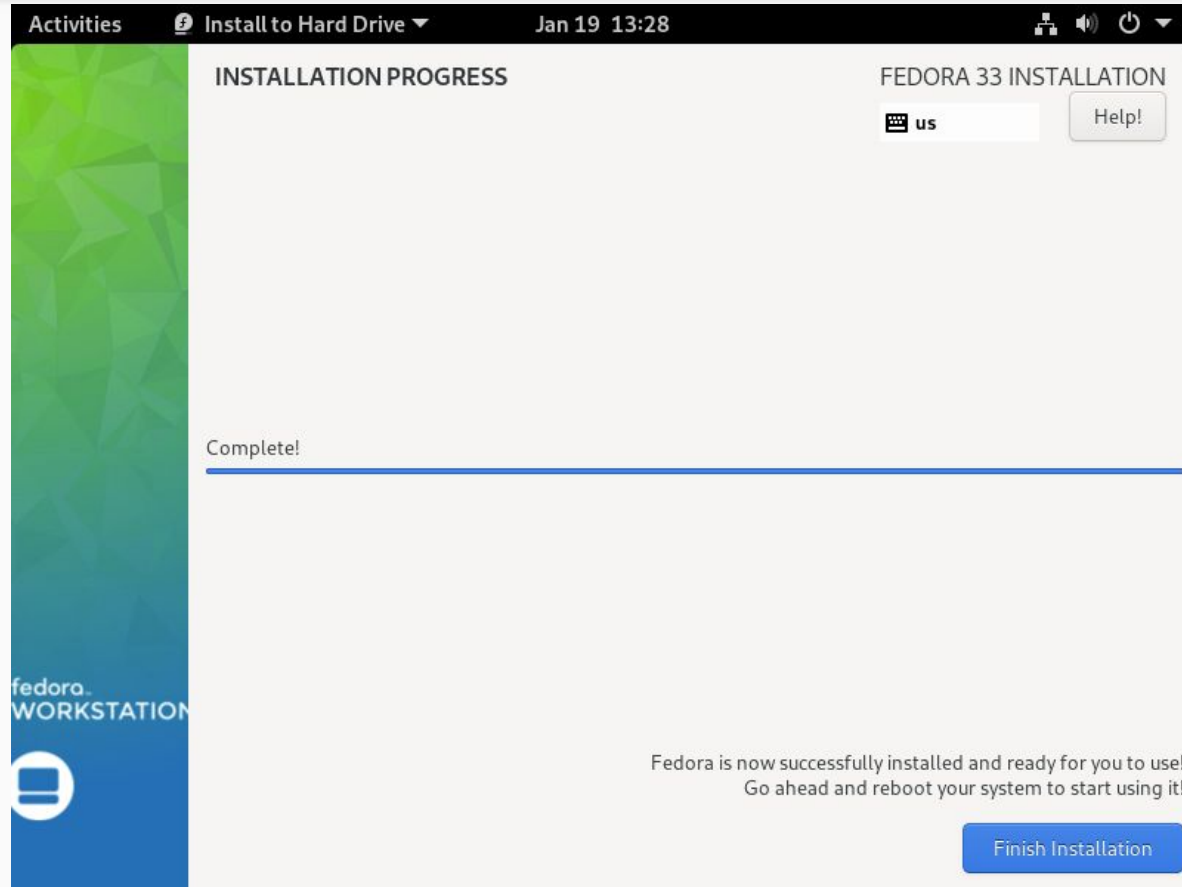




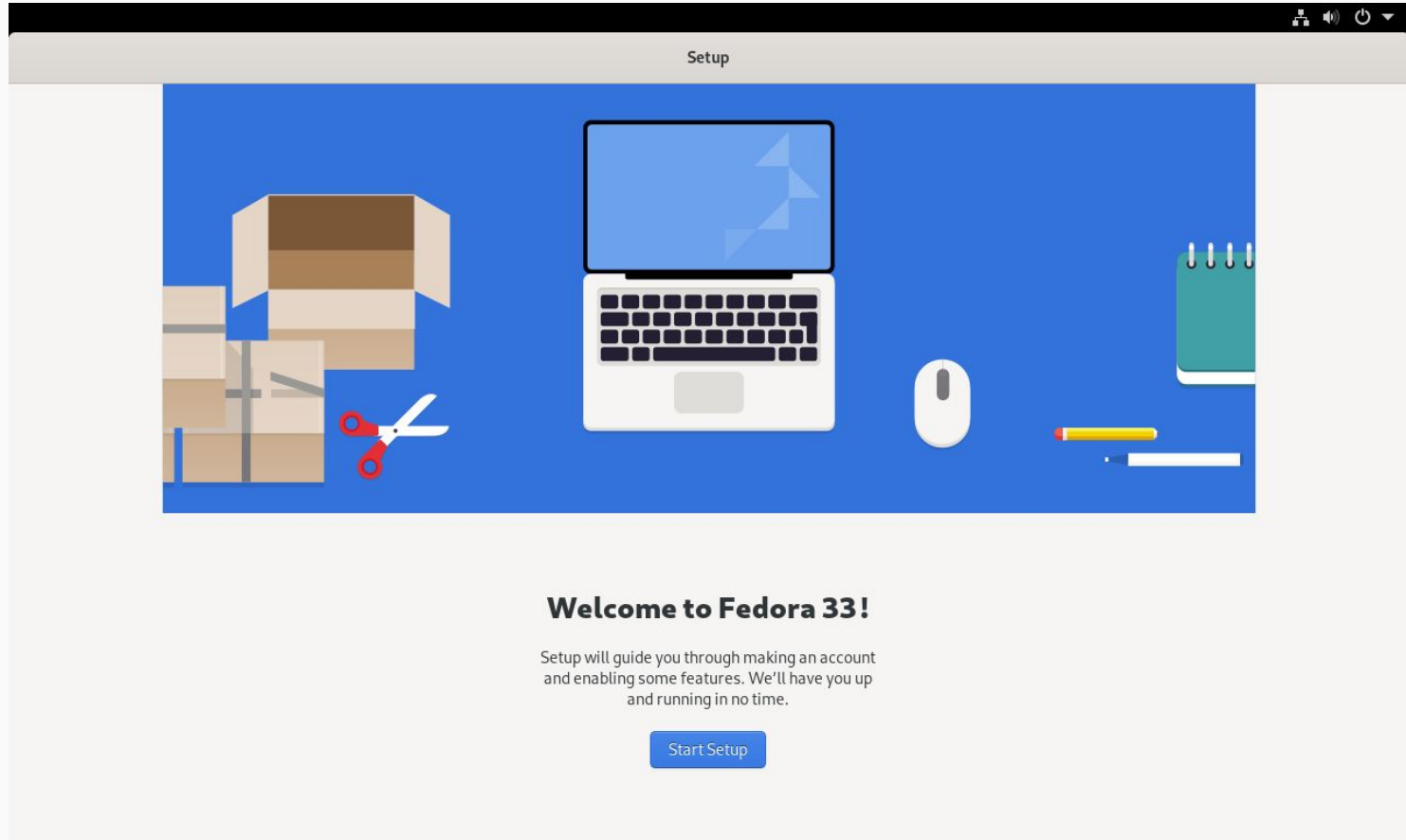
Fedora installer



Fedora installer

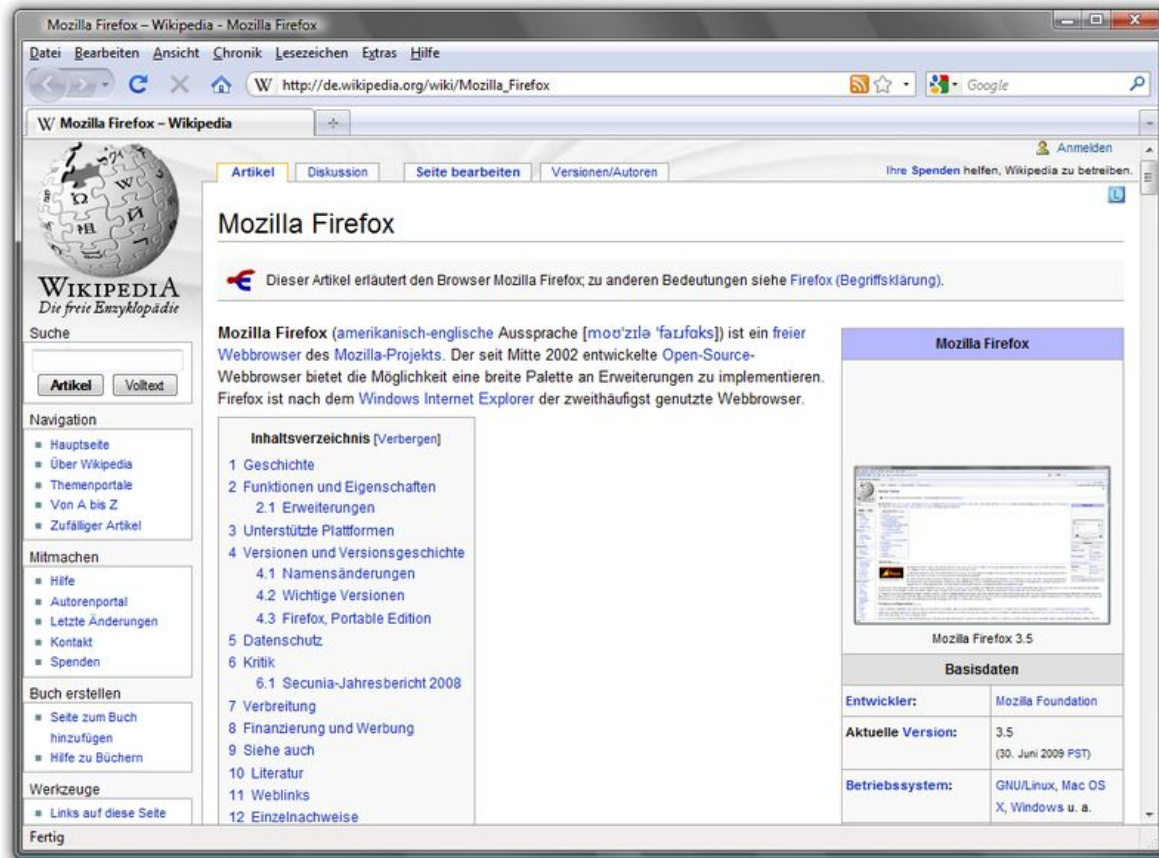


Fedora 33 Workstation

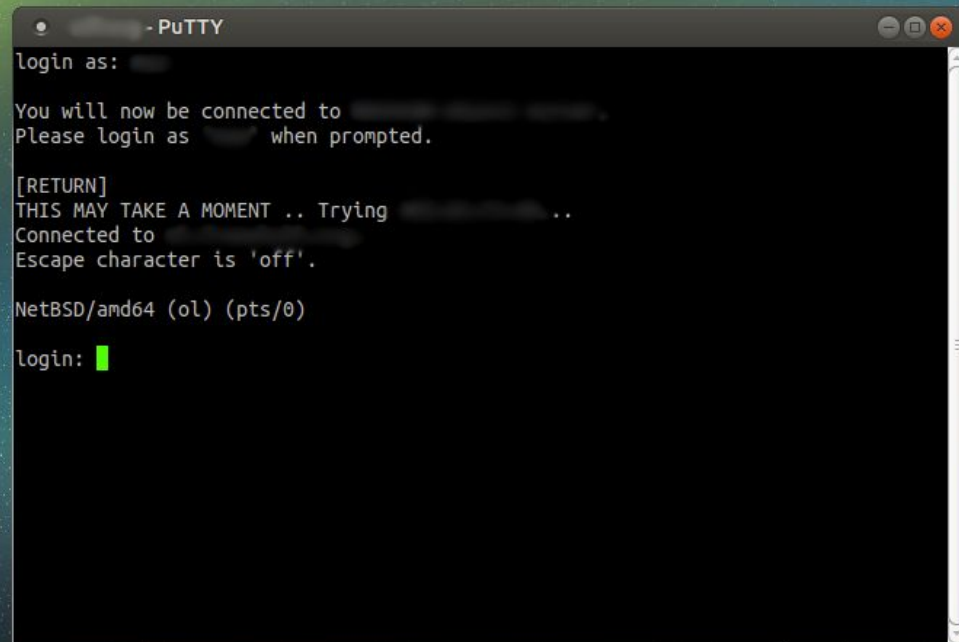


Basic Usage

We usually use GUI to interact with computer



But to interact with system, we use terminal

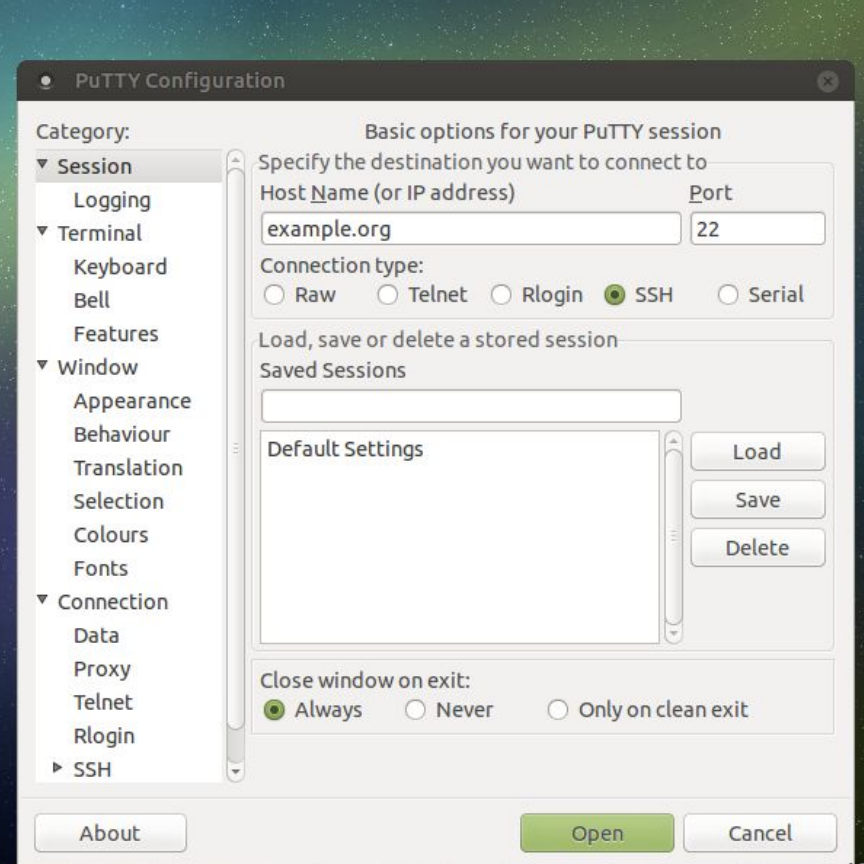


```
- PuTTY
login as: 
You will now be connected to 
Please login as  when prompted.

[RETURN]
THIS MAY TAKE A MOMENT .. Trying ..
Connected to 
Escape character is 'off'.

NetBSD/amd64 (ol) (pts/0)

login: █
```



PuTTY Configuration

Category: Basic options for your PuTTY session

▼ Session

Specify the destination you want to connect to

Host Name (or IP address) Port

Connection type:

☐ Raw ☐ Telnet ☐ Rlogin ☒ SSH ☐ Serial

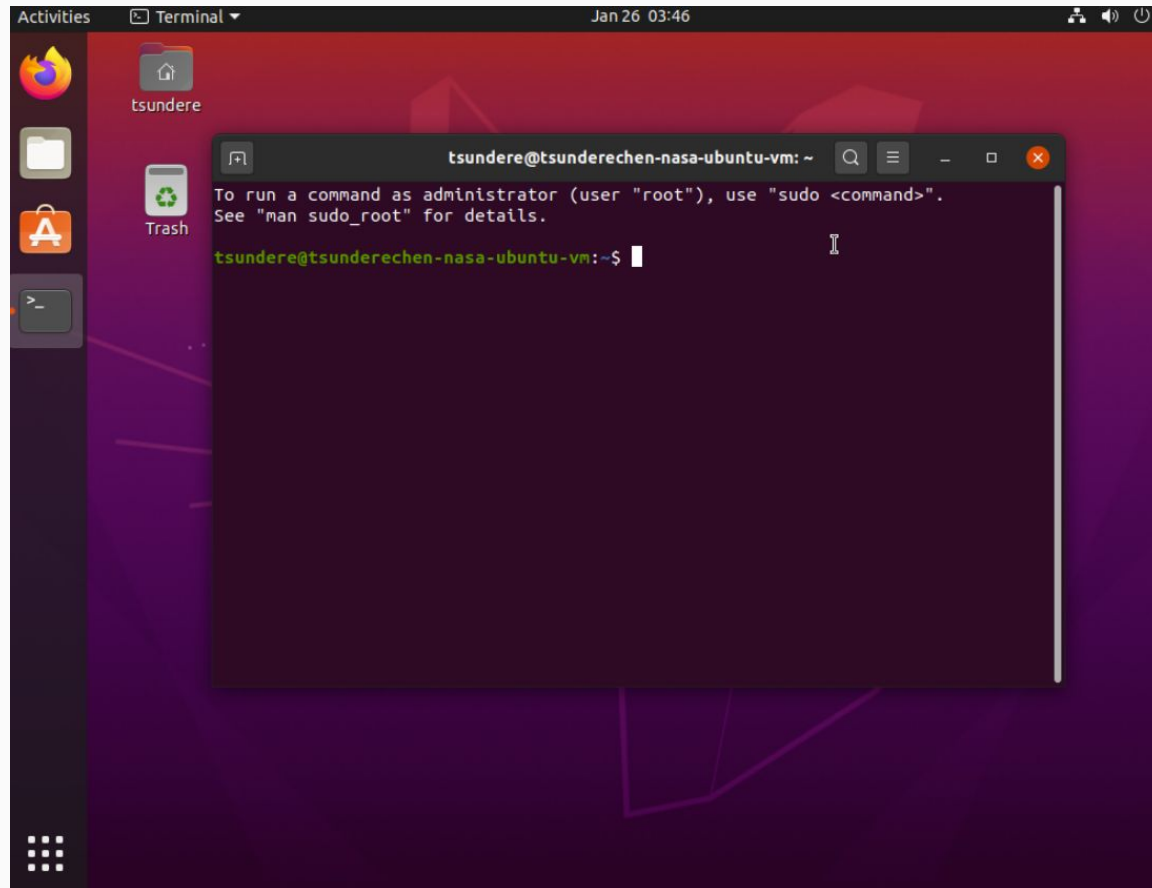
Load, save or delete a stored session

Saved Sessions

Close window on exit:

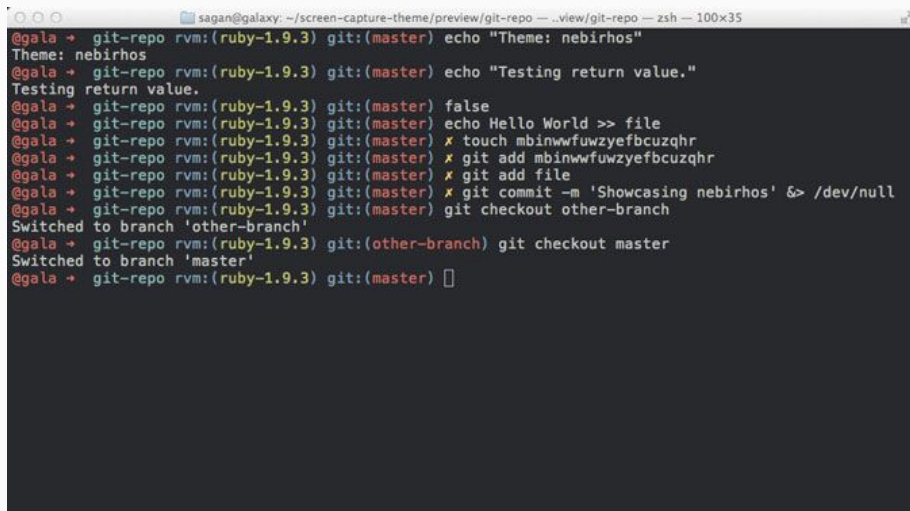
☒ Always ☐ Never ☐ Only on clean exit

Terminal is your friend.



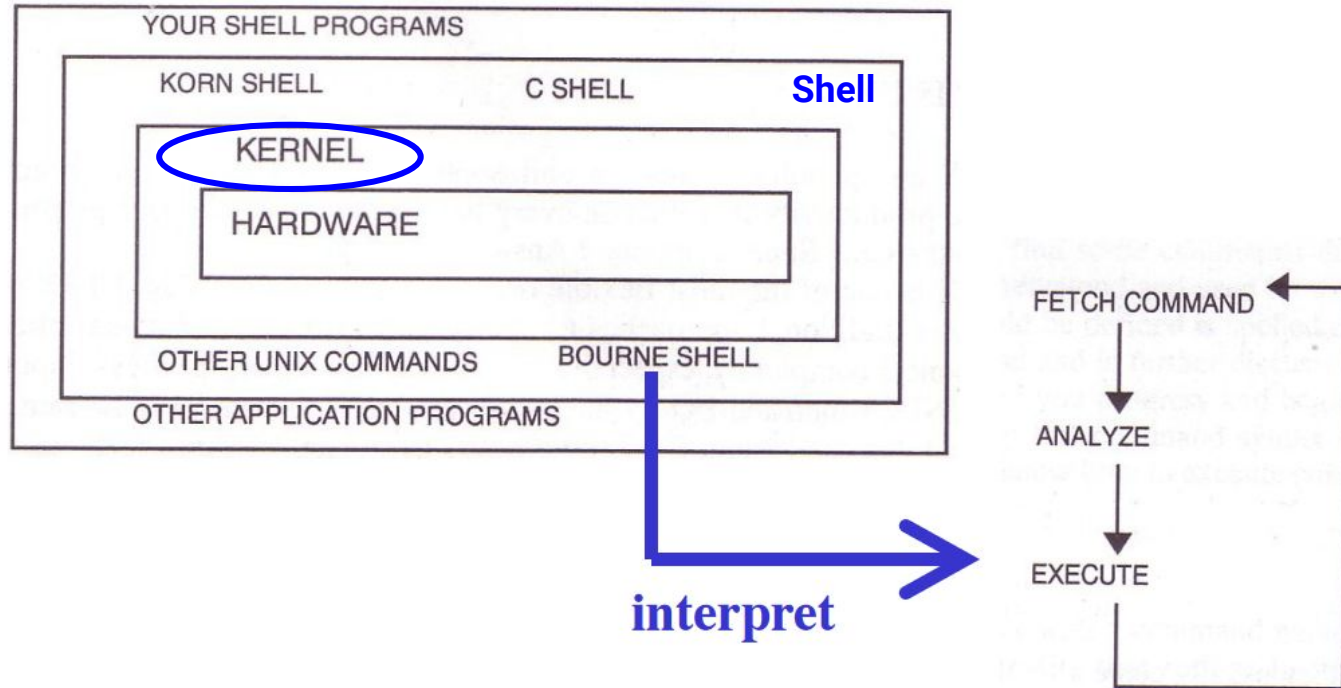
Shell

- Interface to interact with your system



```
sagan@galaxy: ~/screen-capture-theme/preview/git-repo — ..view/git-repo — zsh — 100x35
@gala → git-repo rvm:(ruby-1.9.3) git:(master) echo "Theme: nebirhos"
Theme: nebirhos
@gala → git-repo rvm:(ruby-1.9.3) git:(master) echo "Testing return value."
Testing return value.
@gala → git-repo rvm:(ruby-1.9.3) git:(master) false
@gala → git-repo rvm:(ruby-1.9.3) git:(master) echo Hello World >> file
@gala → git-repo rvm:(ruby-1.9.3) git:(master) x touch mbinwwfwuzyefbcuzqhr
@gala → git-repo rvm:(ruby-1.9.3) git:(master) x git add mbinwwfwuzyefbcuzqhr
@gala → git-repo rvm:(ruby-1.9.3) git:(master) x git add file
@gala → git-repo rvm:(ruby-1.9.3) git:(master) x git commit -m 'Showcasing nebirhos' &> /dev/null
@gala → git-repo rvm:(ruby-1.9.3) git:(master) git checkout other-branch
Switched to branch 'other-branch'
@gala → git-repo rvm:(ruby-1.9.3) git:(other-branch) git checkout master
Switched to branch 'master'
@gala → git-repo rvm:(ruby-1.9.3) git:(master) []
```

Kernel and Shell



Common Shells

Shell	Creator	Name	Prompt
Bourne-Again Shell (Most common)	Brian Fox GNU Project	bash	\$
Bourne Shell	Stephen Bourne Bell Labs	sh	\$
Z Shell (Default in macOS)	Paul Falstad	zsh	%
Busybox (Embedded Devices)	Bruce Perens	busybox	\$

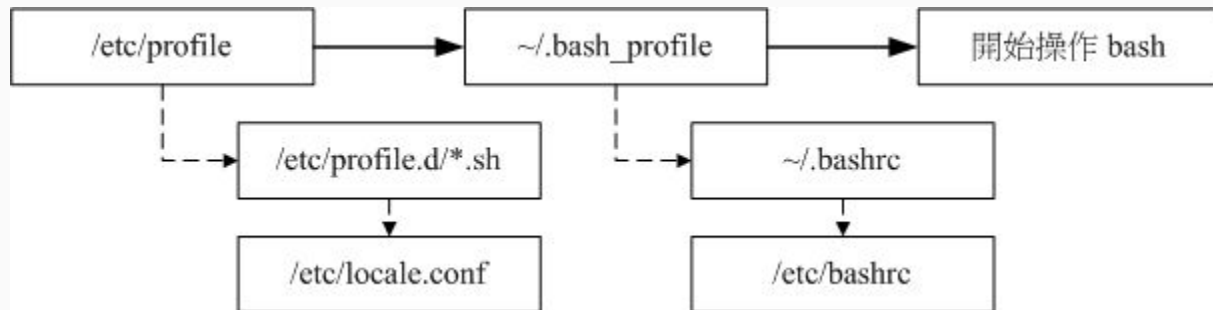
Windows Shell

- **cmd.exe**
 - Released in 1987
 - For Windows NT / Windows CE
 - Still widely used in modern Windows
- **PowerShell**
 - Released in 2006
 - Provide same functionality as UNIX shells
 - [Released for macOS / Linux](#)

Shell Startup Files

<code>/etc/profile</code>	System-wide login shell
<code>~/.profile</code>	Shell profile per user (Shell wide)
<code>~/.bash_profile</code>	Shell profile per user (Only for bash)
<code>~/.bash_login</code>	Shell profile per user (Execute when log in)
<code>~/.bash_logout</code>	Shell profile per user (Execute when log out)
<code>~/.bashrc</code>	Shell profile per user (Execute when using non-login shell)

Shell Startup File Load Order



Shell Environment Variables

- Controllign shell behaviors
- To dump variables
 - ``env``

```
tsundere@tsunderechen-nasa-ubuntu-vm:~$ env
SHELL=/bin/bash
SESSION_MANAGER=local/tsunderechen-nasa-ubuntu-vm:@/tmp/.ICE-unix/1620,unix/tsunderechen-nasa-ubuntu-vm:/tmp/.ICE-unix/1620
QT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=gnome-
```


Shell Variables & String Quotes

Char	Purpose
var=value	Assign value to var
\$var, \${var}	Get variable var
`cmd`	Get stdout from cmd
'string'	Quote string without substitution
"string"	Quote string with substitution

```
tsundere:~/ $ foo=bar
tsundere:~/ $ echo $foo
bar
tsundere:~/ $ echo ${foo}
bar
tsundere:~/ $ echo `/bin/date`
Tue Jan 26 04:32:32 AM CST 2021
tsundere:~/ $ echo `a`
zsh: command not found: a

tsundere:~/ $ echo '$foo'
$foo
tsundere:~/ $ echo "$foo"
bar
```

Global variable vs. Local variable

	bash
Local variable	foo=bar date=`date +%m/%d`
Global variable	export foo=bar export EDITOR=/usr/bin/vim

Shell Special Characters

Characters	Description
*	Match any string of characters
?	Match any single alphanumeric character
[...]	Match any single character within []
[!...]	Match any single character not in []
~	Home directory

- If following files:
test1 test2 test3 test4
test-5 testmess
are in current directory.

Command	Result
% ls test*	test1 test2 test3 test4 test-5 testmess
% ls test?	test1 test2 test3 test4
% ls test[123]	test1 test2 test3
% ls test[!345]*	test1 test2 test-5 testmess
% ls ~	List files under your home

Shell Special Characters (cont.)

Character	Purpose
#	Comment
;	Separate two commands
&&	AND (Think what would happen when you use AND in shell)
	OR (Think what would happen when you use OR in shell)
\	<ol style="list-style-type: none">1. Escape Character2. Command continuation indicator
&	Background execution

Shell Built-in Commands

Bash	Description
set/unset	Set or unset options and positional parameters
(empty)/unset	Set local variable
export	Set global variable
set	Show global + local variable
env	Show global variable
exit	Exit shell
dirs	Print directory stack
popd/pushd	Pop / Push directory stack
echo	Write arguments to stdout
alias/unalias	Command alias

Shell Built-in Commands (cont.)

Bash	Description
fg / bg	Bring task to foreground / background
jobs	List active jobs
%[job no.]	Bring job to foreground
kill	Send signal to process
exec	Execute arguments
nice	Change niceness to process
history	Show command history
![hist. no.]	Re-run the command
source	Read and execute a file

Input / Output Redirection

- 3 default file descriptors
 - 0 (stdin)
 - 1 (stdout)
 - 2 (stderr)

Input / Output Redirection

Method	Description
<code>cmd < file</code>	Open the file as stdin of cmd
<code>cmd > file</code>	Write stdout of cmd to the file. Truncates existing file
<code>cmd >> file</code>	Append stdout of cmd to the file
<code>2>&1</code>	Merge stderr with stdout
<code>cmd1 cmd2</code>	Pipe stdout of cmd1 as stdin of cmd2

File and Directory Related Command

Command	Description
ls	List a directory's content
pwd	Print working directory
cd	Change directory
mkdir	Create directory
rmdir	Remove directory
cat	Show the content of the file
cp	Copy file

File and Directory Related Command (cont.)

Command	Description
ln	Create the link to the file
mv	Move the file from location A to B
rm	Remove the file
stat	Display file status

File Processing Related Command

Command	Description
head	Print the beginning of the file
tail	Print the end of the file
more	Display file content, one screenful at a time
less	Like more, but add forward/backward movement
grep	Print line matches pattern
diff	Compare content in two files
wc	Print newline, word, and byte counts for each file
uniq	Report or omit repeated lines
cut	Remove sections from each line of files

File Processing Related Command (cont.)

Command	Description
sort	Sort and merge line of files
sed	Stream editor for filtering and transforming text
awk	Pattern scanning and processing language

Hands-on!

- Let's try those commands with this webserver log
 - <https://ncku-nasa.s3-ap-northeast-1.amazonaws.com/archlinux.ccns.ncku.edu.tw.access.log>

Head / Tail

- Head
 - ``head -n 30 <FILE>``
- Tail
 - ``tail -n 25 <FILE>``

Grep

- Did anyone download package vim?
 - ``grep vim <FILE>``
- Which line have the string `Googlebot`?
 - ``grep -n Googlebot <FILE>``

cut

- Let's find out what IP Google used to crawl this website
 - ``grep Googlebot <FILE> | cut -f1 -d\ ``
 - ``-d``: Separation symbol
- We can achieve the same result using awk
 - How?

sort

- Sort the IP by dictionary
 - ``grep Googlebot <FILE> | awk '{ print $1 }' | sort`
- Options
 - `-r` : reverse
 - `-u` : unique keys
 - `-n` : numeric key sort
 - `-k` : specific column to sort with
 - `-t` : field separator

uniq

- How many requests each IP sent?
 - Lab!

xargs

- Construct argument list(s) and execute utility
 - -n max-args
 - -l replystr (every)
 - -J replystr (first)
 - -s size
 - [man xargs](#)

❑ xargs – construct argument list(s) and execute utility

- n number
- I replstr (every)
- J replstr (first)
- s size
- ...

```
% ls
2.sh  3.csh  4.csh  4.sh  bsd1.ping  testin
% ls | xargs echo
2.sh 3.csh 4.csh 4.sh bsd1.ping testin
% ls | xargs -n1 echo
2.sh
3.csh
4.csh
4.sh
bsd1.ping
testin
```

```
% ls | xargs -I % -n1 echo % here %
2.sh here 2.sh
3.csh here 3.csh
4.csh here 4.csh
4.sh here 4.sh
bsd1.ping here bsd1.ping
testin here testin
```

```
% ls | xargs -J % -n1 echo % here %
2.sh here %
3.csh here %
4.csh here %
4.sh here %
bsd1.ping here %
testin here %
```

- Example : ping all hosts in file

```
$ cat host  
www.google.com  
bsd1.cs.nctu.edu.tw  
linux3.cs.nctu.edu.tw  
cs.nctu.edu.tw
```

```
$ cat host | xargs -n1 ping -c 1 | grep "bytes from"  
64 bytes from 64.233.188.103: icmp_seq=0 ttl=47 time=6.944 ms  
64 bytes from 140.113.235.135: icmp_seq=0 ttl=57 time=1.451 ms  
64 bytes from 140.113.235.153: icmp_seq=0 ttl=57 time=1.612 ms  
64 bytes from 140.113.235.47: icmp_seq=0 ttl=57 time=1.856 ms
```

UNIX philosophy

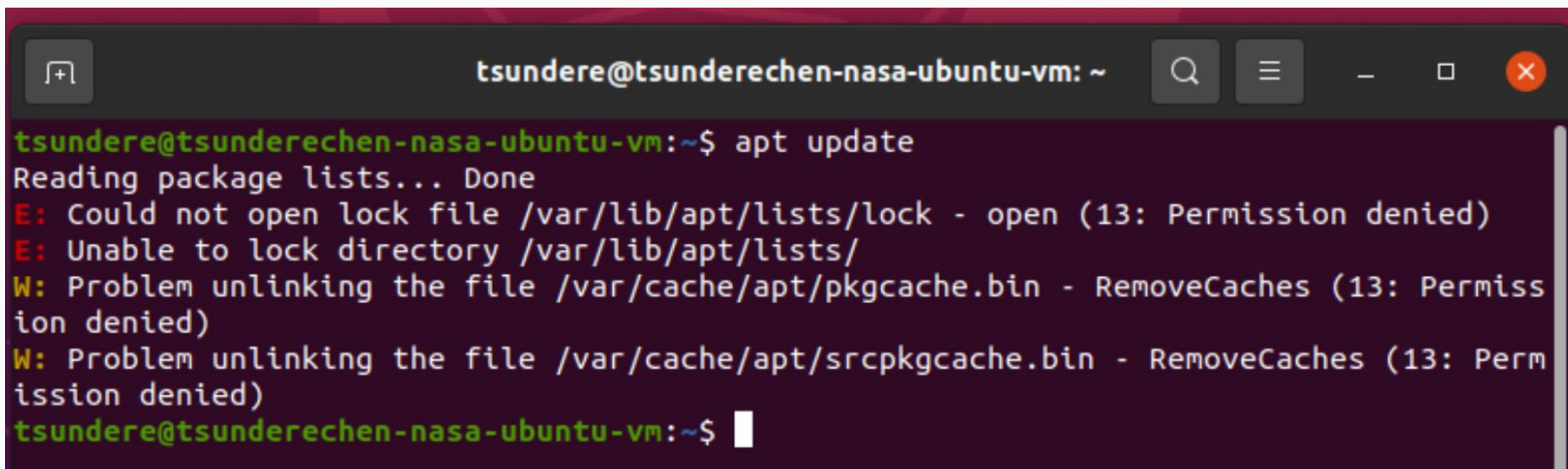
- UNIX philosophy
- Lots of little tools, each good at one thing
 - Use them together to achieve your goal
- You can try other shell / framework
 - zsh
 - oh-my-zsh
 - Zsh Improved Framework
 - fish
- Shell preference is different on every person, there's no right or wrong.

Package Management

Ubuntu - Package Management

- Before Ubuntu 14.04
 - ``apt-get``
 - Since Ubuntu 14.04, ``apt`` is introduced
 - Higher level of ``apt-get``
 - One application to rule them all
-
- Before you can install package, you need to **update package list**

Permission denied...?



```
tsundere@tsunderechen-nasa-ubuntu-vm: ~  
tsundere@tsunderechen-nasa-ubuntu-vm:~$ apt update  
Reading package lists... Done  
E: Could not open lock file /var/lib/apt/lists/lock - open (13: Permission denied)  
E: Unable to lock directory /var/lib/apt/lists/  
W: Problem unlinking the file /var/cache/apt/pkgcache.bin - RemoveCaches (13: Permission denied)  
W: Problem unlinking the file /var/cache/apt/srcpkgcache.bin - RemoveCaches (13: Permission denied)  
tsundere@tsunderechen-nasa-ubuntu-vm:~$
```

root / Permission issue

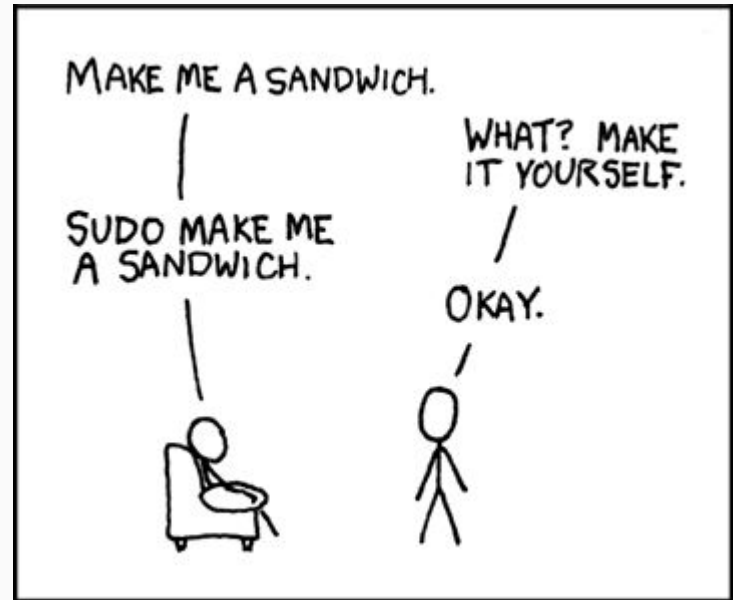
- **root: Superuser**
 - In UNIX/UNIX-like system, root is the conventional name of the user who has all rights or permissions (for all files and directories) in all modes(single-user or multi-user)
- **Do not execute command as root directly**
- You need root permission to perform specific tasks, like
 - Software management
 - System settings
 - User management
 - ...etc
 - Basically all tasks that can affect other users in the same machine

Become root

- Two methods
 - Log in as root
 - Use `sudo`
- Log in as root (NOT RECOMMENDED)
 - Set a password for root
 - Then log in as root directly
- Use **sudo**

sudo

- Run command with other user's permission
- Can limit what command you can use with sudo / whose permission you can use with sudo...etc
- Just a brief introduction here, will be explained in later lecture



sudo (cont.)

- `sudo whoami`
 - A prompt to enter your password
- Get **root's permission by default**
- You won't need to type your password for sudo tasks for **15 min**, then you will need to **enter your password again**

```
tsundere@tsunderechen-nasa-ubuntu-vm:~$ sudo apt update
Hit:1 http://ubuntu.ccns.ncku.edu.tw/ubuntu focal InRelease
Hit:2 http://ubuntu.ccns.ncku.edu.tw/ubuntu focal-updates InRelease
Hit:3 http://ubuntu.ccns.ncku.edu.tw/ubuntu focal-backports InRelease
Hit:4 http://ubuntu.ccns.ncku.edu.tw/ubuntu focal-security InRelease
Reading package lists... Done
Building dependency tree
Reading state information... Done
All packages are up to date.
```

Ubuntu - apt

- Specifically, **apt** doesn't install/remove package for you
 - It keeps a list of packages installed on your system, and dependencies
 - And compare with upstream, update the package if needed
- The **install/remove part is handled by dpkg**
 - You can use dpkg to install/remove packages on your own
 - But not recommended, since you don't have a method to track package you installed

Dependency check

- **Most programs** can't run on it's own, it **need other programs**.
 - It's call **dependency**
 - If dependency need isn't met, you'll not be able to install package
 - Even if you forced the installation, the program is going to fail at some point
- **apt handles this part for you**

Ubuntu - Package distribution

- In older days, when people want to install new program, they need to...
 - Get the source code
 - Install the dependency first
 - Compile
 - Install the binary into their system
- It's messy, and it's easy to lose track
- What about updating program?

Ubuntu - Package distribution (cont.)

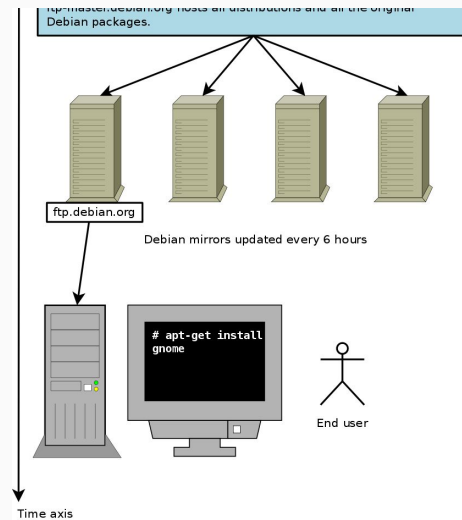
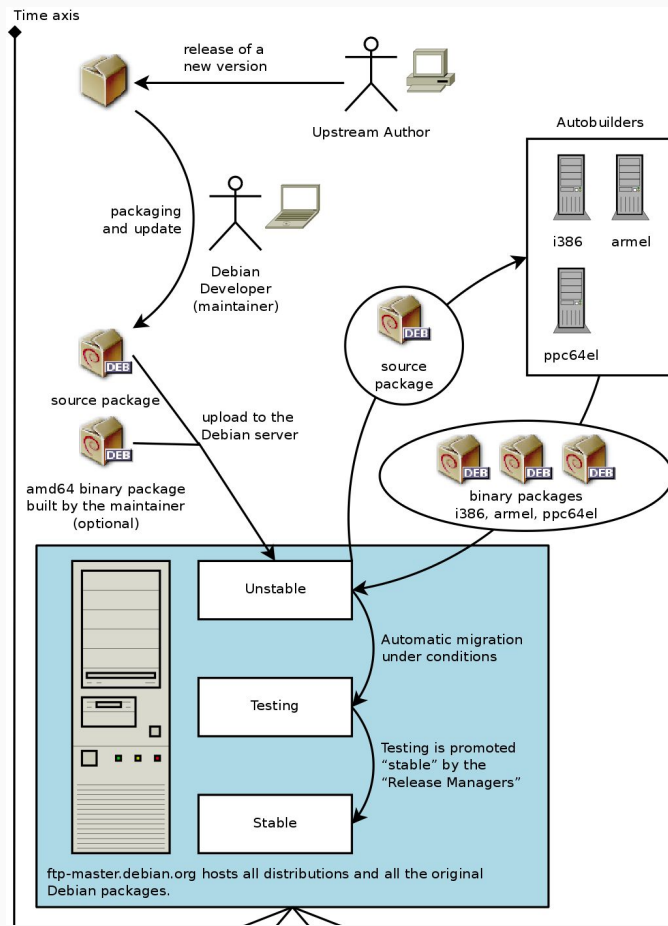
- Solve the problem one at a time
- First, compile issue
 - Compile can take lots of time, and lots of resource
 - Your computer may not need that much resource to run the program, but it may need lots of resource to compile the program
 - It's not worth it to get resources just to compile a program
- Let others compile the program, **you just need to get the binary**
- This is the **basic concept of dpkg**

Ubuntu - Package distribution (cont.)

- Second, package distribution & tracking
- Everyone can help build the program, and everyone can distribute the program
 - But it's too much work to get the program from EVERYONE
 - It would be better if we can get all the program from one place
- And you need a program to help you **track the dependencies, solve it and install the package** for you
- **It's the concept of** **apt**

Ubuntu - Package distribution (cont.)

- A centralized server called “**mirror**”
 - Verified user can put the program they compiled into mirror
 - So other user can get the program easily
- But the server may be far from you, causing slow download speed
 - So there are lots of mirror around the globe
 - [NCKU CSIE Ubuntu Mirror](#)
 - **Synchronized** with upstream **several times a day**
 - Get the package from the server **closest to you**



apt usage

- apt update
- apt upgrade
- apt install
- apt reinstall
- apt remove
- apt autoremove

apt usage

- apt list
- apt search
- apt show
- apt moo

apt install <PACKAGE>

```
tsundere@tsunderechen-nasa-ubuntu-vm:~$ sudo apt install vim
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  vim-runtime
Suggested packages:
  ctags vim-doc vim-scripts
The following NEW packages will be installed:
  vim vim-runtime
0 upgraded, 2 newly installed, 0 to remove and 0 not upgraded.
Need to get 7,111 kB of archives.
After this operation, 34.6 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://ubuntu.ccns.ncku.edu.tw/ubuntu focal/main amd64 vim-runtime all 2:8.1.2269-1ubuntu5 [5,873 kB]
Get:2 http://ubuntu.ccns.ncku.edu.tw/ubuntu focal/main amd64 vim amd64 2:8.1.2269-1ubuntu5 [1,238 kB]
Fetched 7,111 kB in 0s (15.4 MB/s)
Selecting previously unselected package vim-runtime.
(Reading database ... 159227 files and directories currently installed.)
Preparing to unpack .../vim-runtime_2%3a8.1.2269-1ubuntu5_all.deb ...
Adding 'diversion of /usr/share/vim/vim81/doc/help.txt to /usr/share/vim/vim81/doc/help.txt.vim-tiny by vim-runtime'
Adding 'diversion of /usr/share/vim/vim81/doc/tags to /usr/share/vim/vim81/doc/tags.vim-tiny by vim-runtime'
Unpacking vim-runtime (2:8.1.2269-1ubuntu5) ...
```

What if you can't find the package using apt?

- Try PPA
 - Personal Package Archives
 - You can compile / build / push / update the package by yourself, for yourself
- Find if there's any **dpkg** built by others
- Use **snap**
- Build from source

Snap

- A new **package management system** introduced by Canonical
- Pack everything you need to run the program together, so you won't have dependency issue
- Still **not recommended**, since this **may mess your system**

Try install these packages by yourself!

- git
- vim / emacs
- screen
- tmux
- wget / curl
- w3m
- sl

Questions?