CS 332/532 Systems Programming

Lecture 14

Linux Crash Course

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Agenda

- Command line arguments
  - argc
  - argv
- Linux Crash Course

Command-Line Arguments

- In C, command-line arguments allow users to pass inputs to a program when it is executed.
- Two parameters are used in the main function to handle these inputs:
- **int argc** (argument count): It represents the number of command-line arguments.
- **char *argv[]** (argument vector): It is an array of strings (pointers to characters) representing each argument.

- **argc:** Holds the number of arguments passed. It always includes the program's name as the first argument, so argc is at least 1.
- argv[]: An array of strings where:argv[0]: The name of the program or the path to the executable.
  - argv[1], argv[2], …, argv[argc-1]: The additional arguments passed by the user.

C hello.c

```c
#include <stdio.h>

int main(int argc, char *argv[]) {
    printf("Number of arguments: %d\n", argc);
    for (int i = 0; i < argc; i++) {
        printf("Argument %d: %s\n", i, argv[i]);
    }
    return 0;
}
```

```
(base) mahmutunan@Mahmuts-MacBook-Pro c_practice % gcc hello.c -o hello
(base) mahmutunan@Mahmuts-MacBook-Pro c_practice % ls
hello   hello.c
(base) mahmutunan@Mahmuts-MacBook-Pro c_practice % ./hello
Number of arguments: 1
Argument 0: ./hello
(base) mahmutunan@Mahmuts-MacBook-Pro c_practice % ./hello somefilename someparameter somethingelse
Number of arguments: 4
Argument 0: ./hello
Argument 1: somefilename
Argument 2: someparameter
Argument 3: somethingelse
(base) mahmutunan@Mahmuts-MacBook-Pro c_practice %
```

C additionProgram.c

```c
#include <stdio.h>
#include <stdlib.h>

int main(int argc, char *argv[]) {
    if (argc != 3) {
        printf("Usage: %s num1 num2\n", argv[0]);
        return 1;
    }
    int num1 = atoi(argv[1]);
    int num2 = atoi(argv[2]);
    printf("Sum: %d\n", num1 + num2);
    return 0;
}
```

```
(base) mahmutunan@Mahmuts-MacBook-Pro c_practice % gcc -o additionProgram additionProgram.c
(base) mahmutunan@Mahmuts-MacBook-Pro c_practice % ls
additionProgram         additionProgram.c
(base) mahmutunan@Mahmuts-MacBook-Pro c_practice % ./additionProgram 35 55
Sum: 90
(base) mahmutunan@Mahmuts-MacBook-Pro c_practice %
```

C additionProgram.c

```c
#include <stdio.h>
#include <stdlib.h>

int main(void) {
    if (argc != 3) {
        printf("Usage: %s num1 num2\n", argv[0]);
        return 1;
    }
    int num1 = atoi(argv[1]);
    int num2 = atoi(argv[2]);
    printf("Sum: %d\n", num1 + num2);
    return 0;
}
```

```
(base) mahmutunan@Mahmuts-MacBook-Pro c_practice % gcc -o additionProgram addit
additionProgram.c:5:9: error: use of undeclared identifier 'argc'
    if (argc != 3) {
        ^
additionProgram.c:6:41: error: use of undeclared identifier 'argv'
        printf("Usage: %s num1 num2\n", argv[0]);
                                        ^
additionProgram.c:9:21: error: use of undeclared identifier 'argv'
    int num1 = atoi(argv[1]);
                    ^
additionProgram.c:10:21: error: use of undeclared identifier 'argv'
    int num2 = atoi(argv[2]);
                    ^
4 errors generated.
```

Linux Certifications

- Most of the hiring manager are looking to recruit Linux professionals.
- The emergence of open cloud platforms is creating increasing demand for Linux professionals who have the right expertise
- Linux-certified professionals always be a better position in the job market
- Employers are looking for more Linux talent.
- Better salary increments for Linux certified professionals
- Some famous certificates
  - Red Hat Linux SuSE Linux
  - Linux Professional Institute (LPIC)
  - CompTIA
  - Linux Foundation
  - Oracle

https://www.guru99.com/best-linux-certifications.html

Linux

- Linux and Unix are different, but they do have a relationship with each other
  - Linux is derived from Unix.
- Linux is just the kernel and not the complete OS. This Linux kernel is generally packaged in Linux distributions which thereby makes it a complete OS
- There are many different versions of Linux, and the core of Linux is free to distribute and use.
- Normally, distributions are made for specific reasons and have been tailored to address a series of concerns

https://www.softwaretestinghelp.com/unix-vs-linux/#:~:text=Linux%20refers%20to%20the%20kernel,family%20of%20derived%20operating%20systems.
https://www.linux.org/forums/linux-beginner-tutorials.123/

Linux

- Popular Linux distributions
  - Ubuntu
  - Debian
  - CentOS
  - Red Hat

Installation

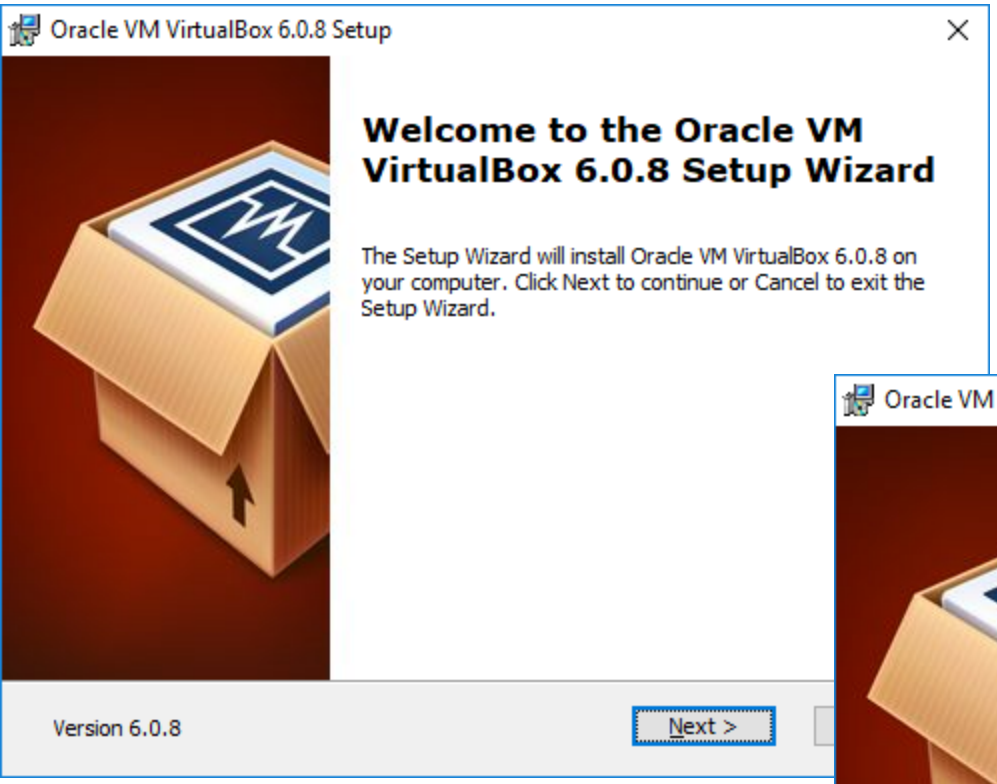
- Fresh Install
- Dual Booting
- Live CD/DVD
- Linux as a VM

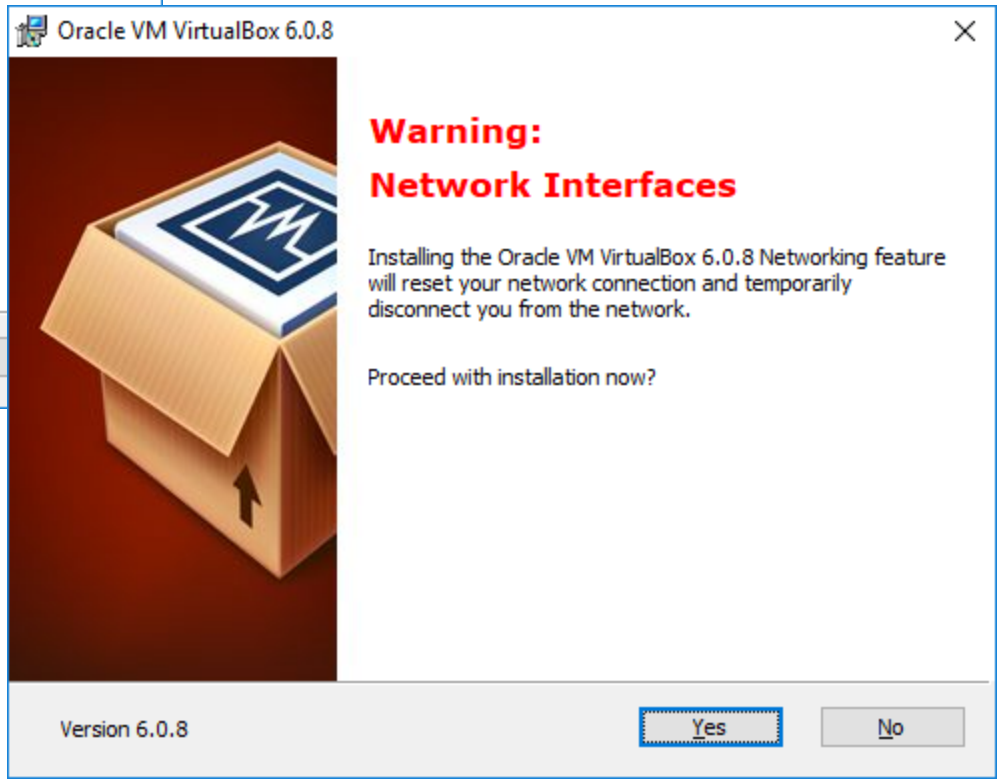
VirtualBox

. Download VirtualBox from https://www.virtualbox.org/wiki/Downloads .

(win, osx, or linux)

2. Install VirtualBox with default setting.



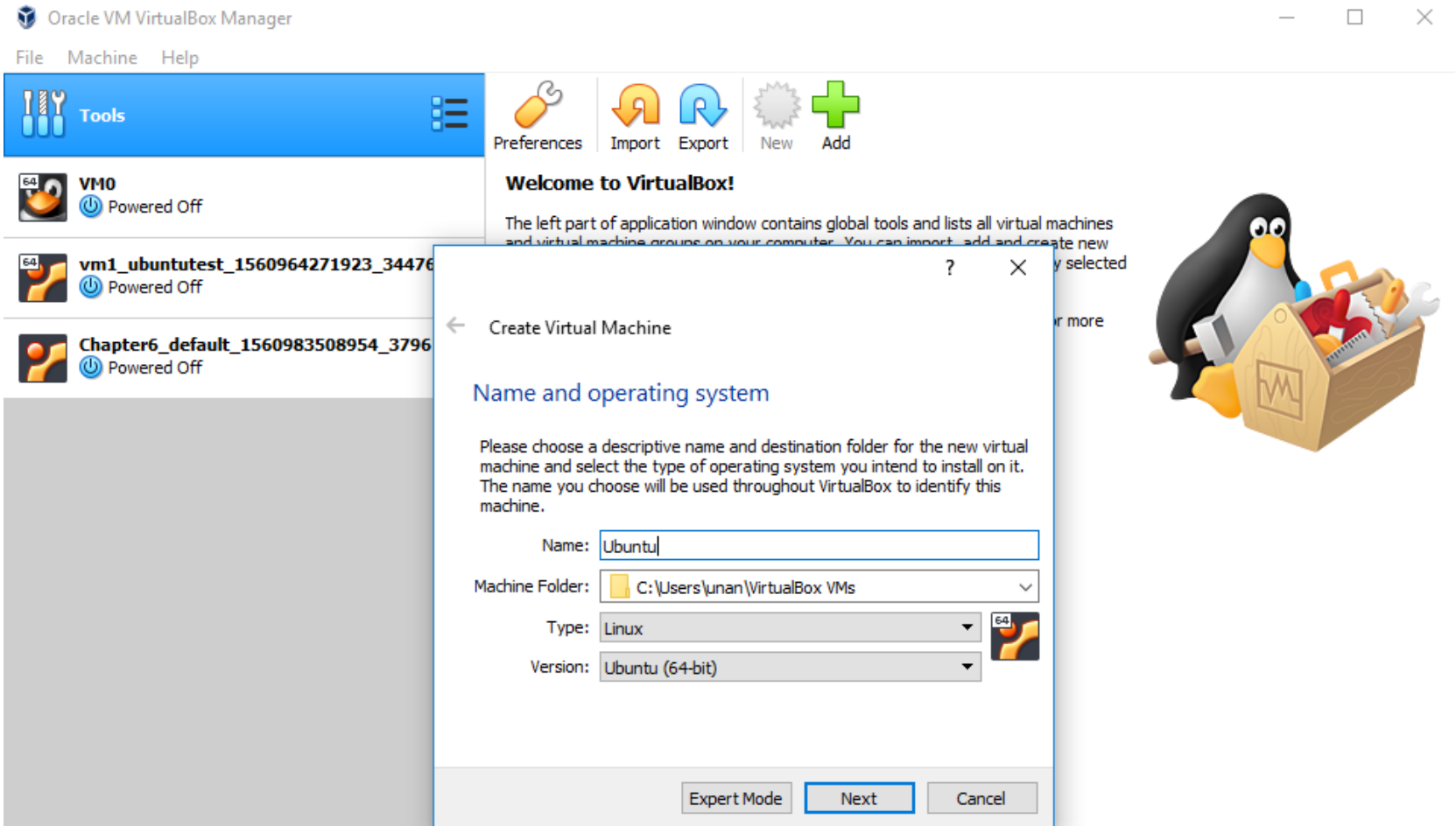


Ubuntu - Desktop

- We will download the ISO file of the Linux distribution.
- Download the Ubuntu for Desktop;
- https://ubuntu.com/desktop

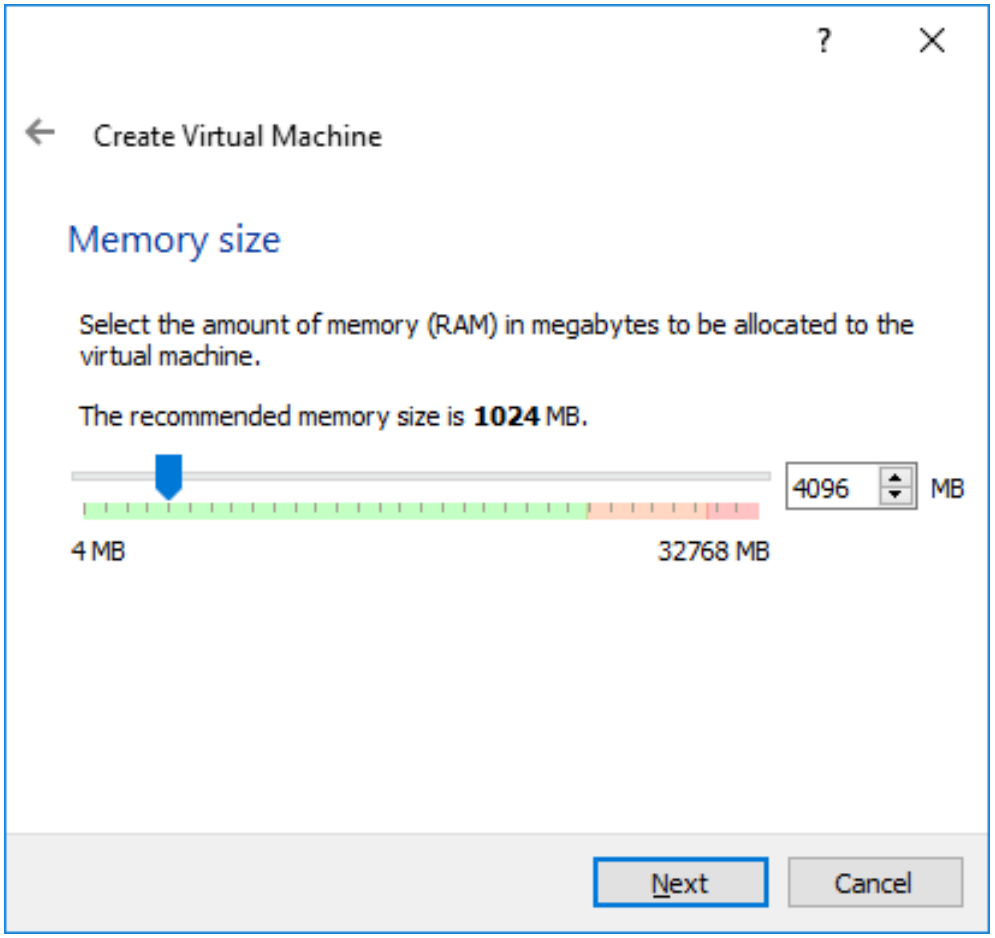
Install Ubuntu on VM

- Start the VirtualBox and click on the New symbol. Give the virtual OS a relevant name.



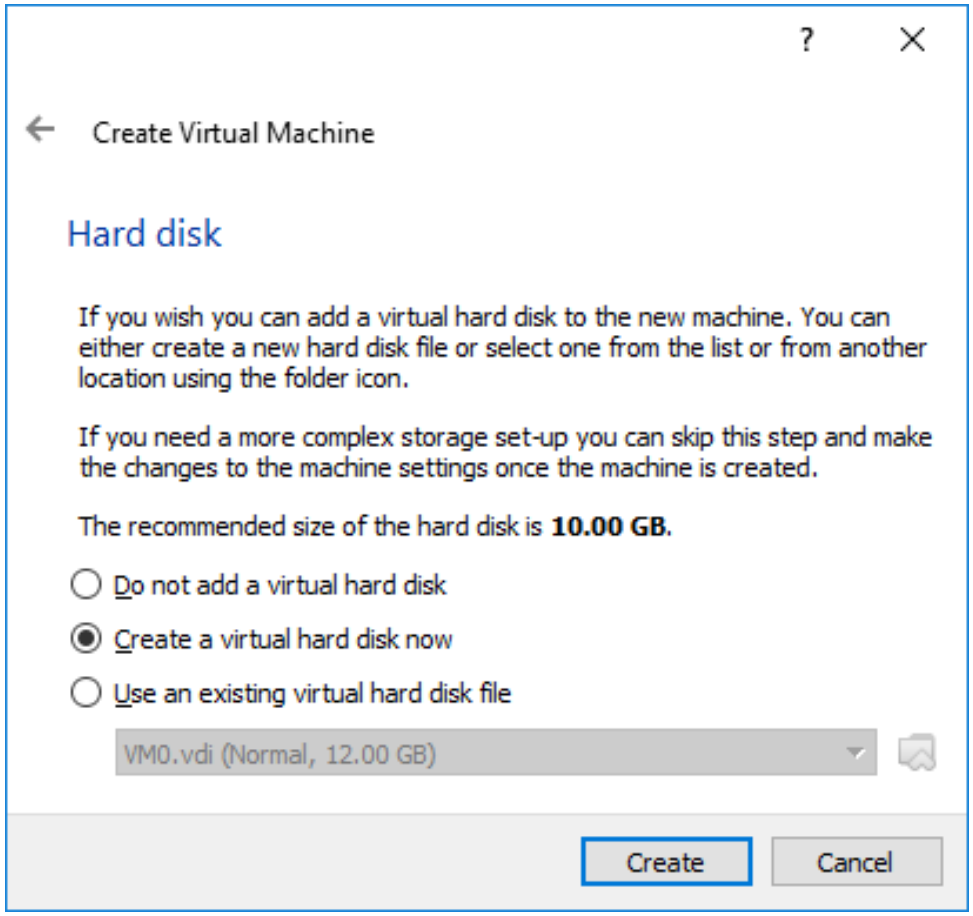
Allocate RAM

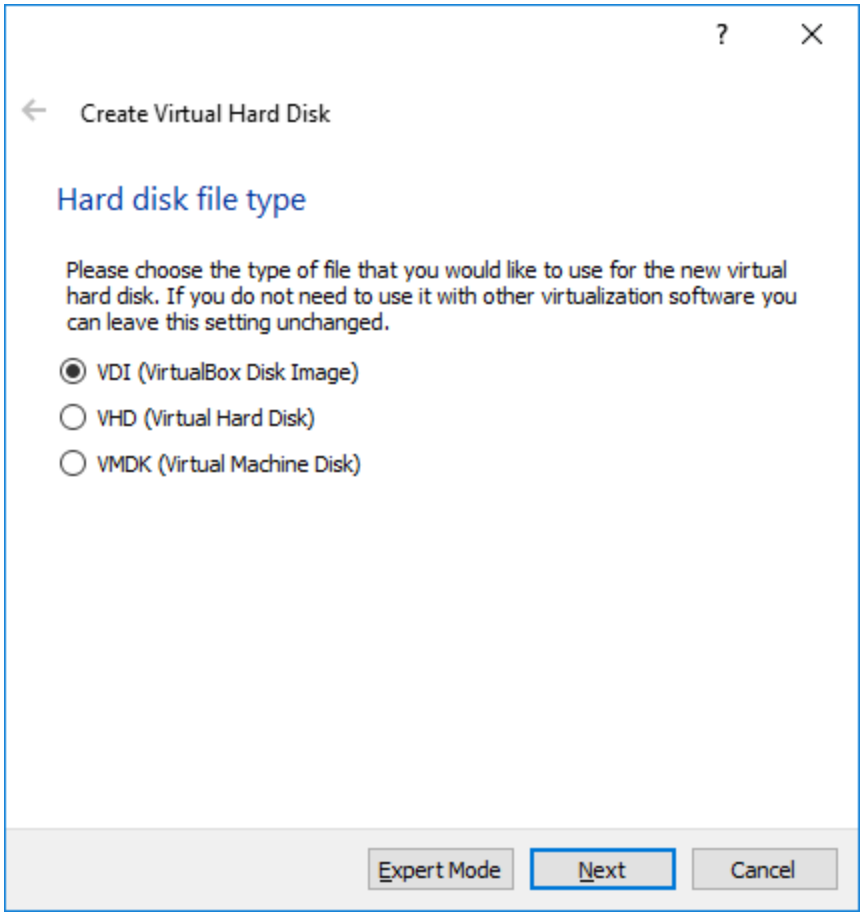
Allocate RAM to the virtual OS. My system has 32GB of RAM and I decided to allocate 4GB of RAM to it. You can use more RAM if your system has enough extra RAM.



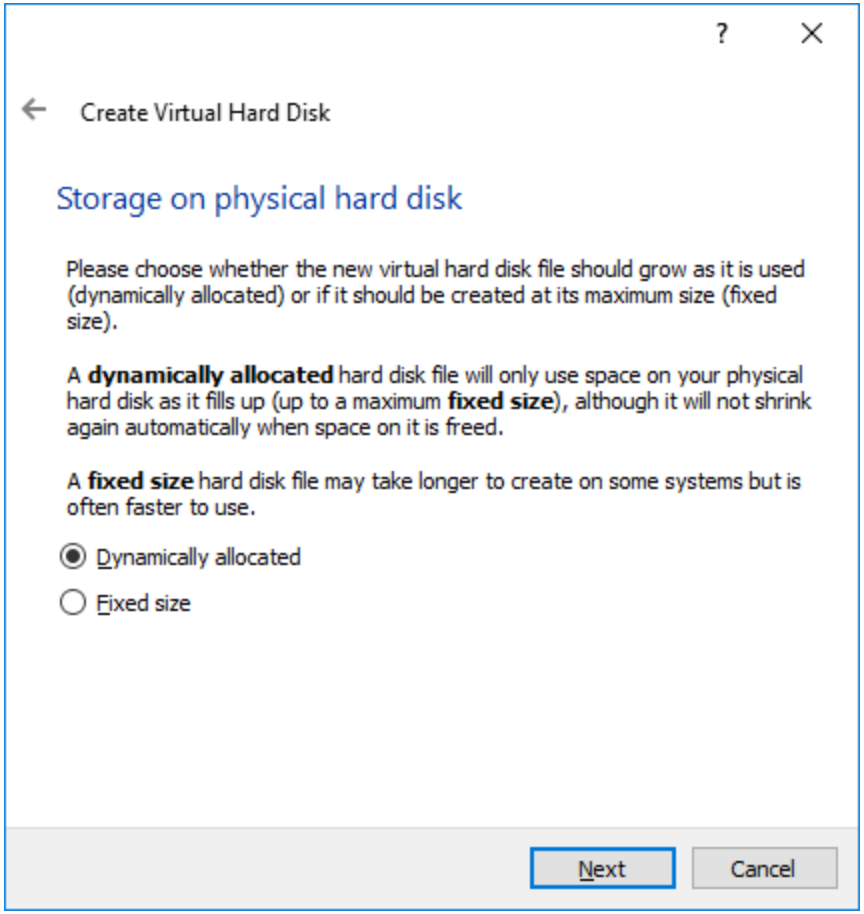
Virtual Disk

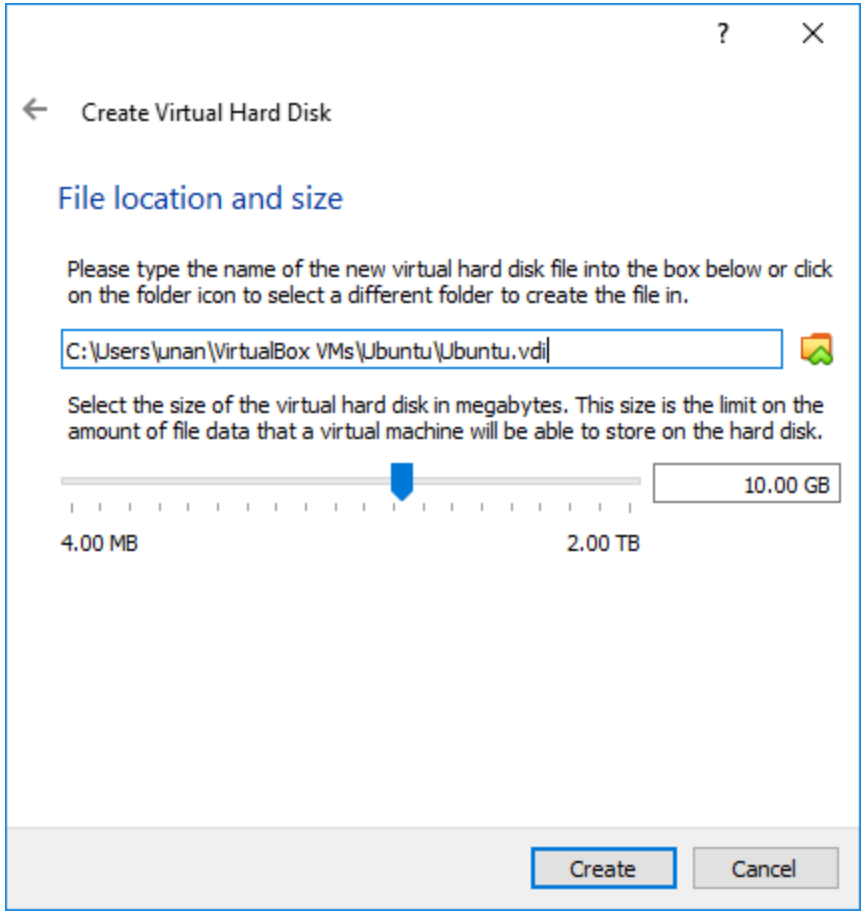
- Create a virtual disk. This works as the hard disk of the virtual Linux system. This is where the virtual system will store its files.





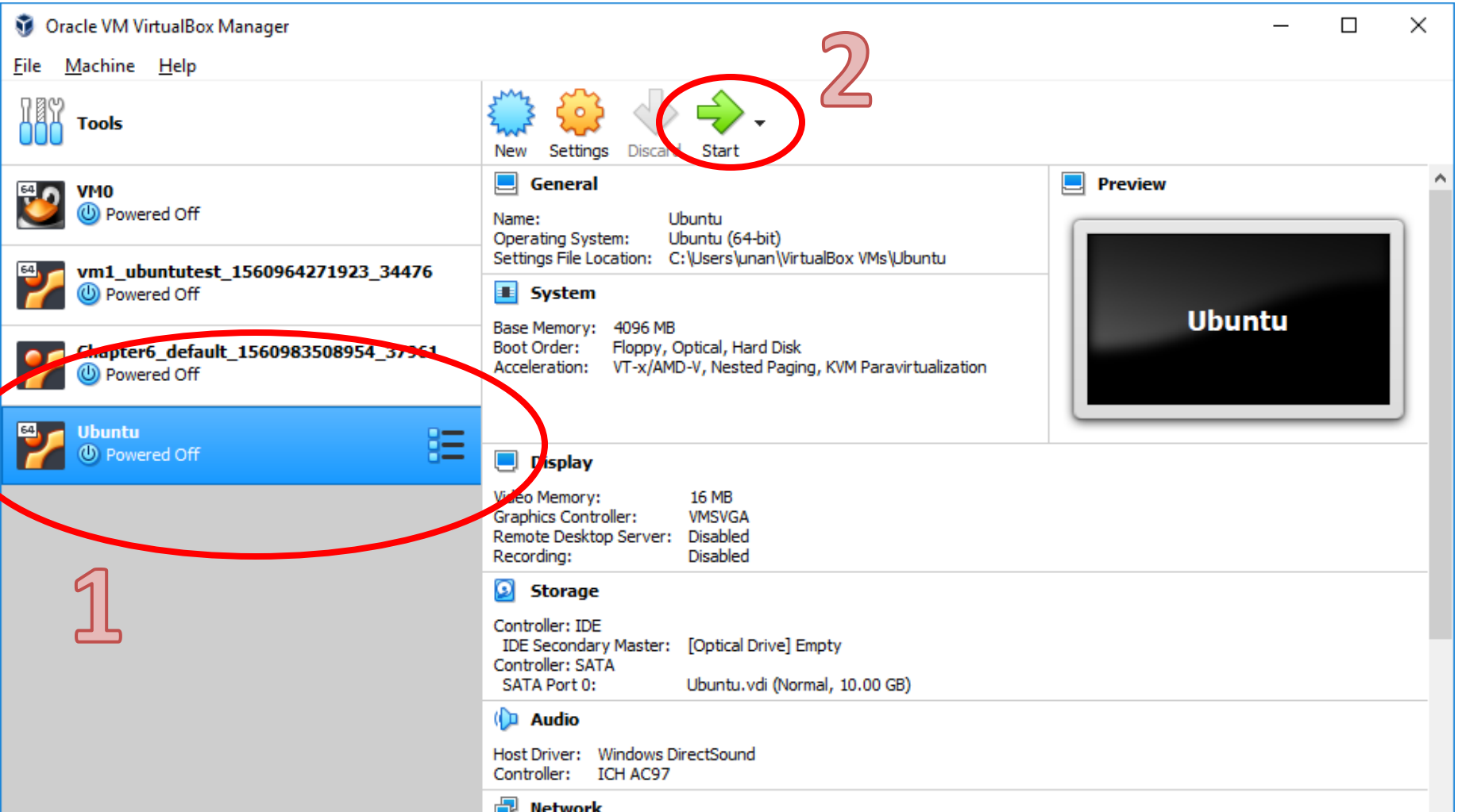
Dynamically Allocate / Size





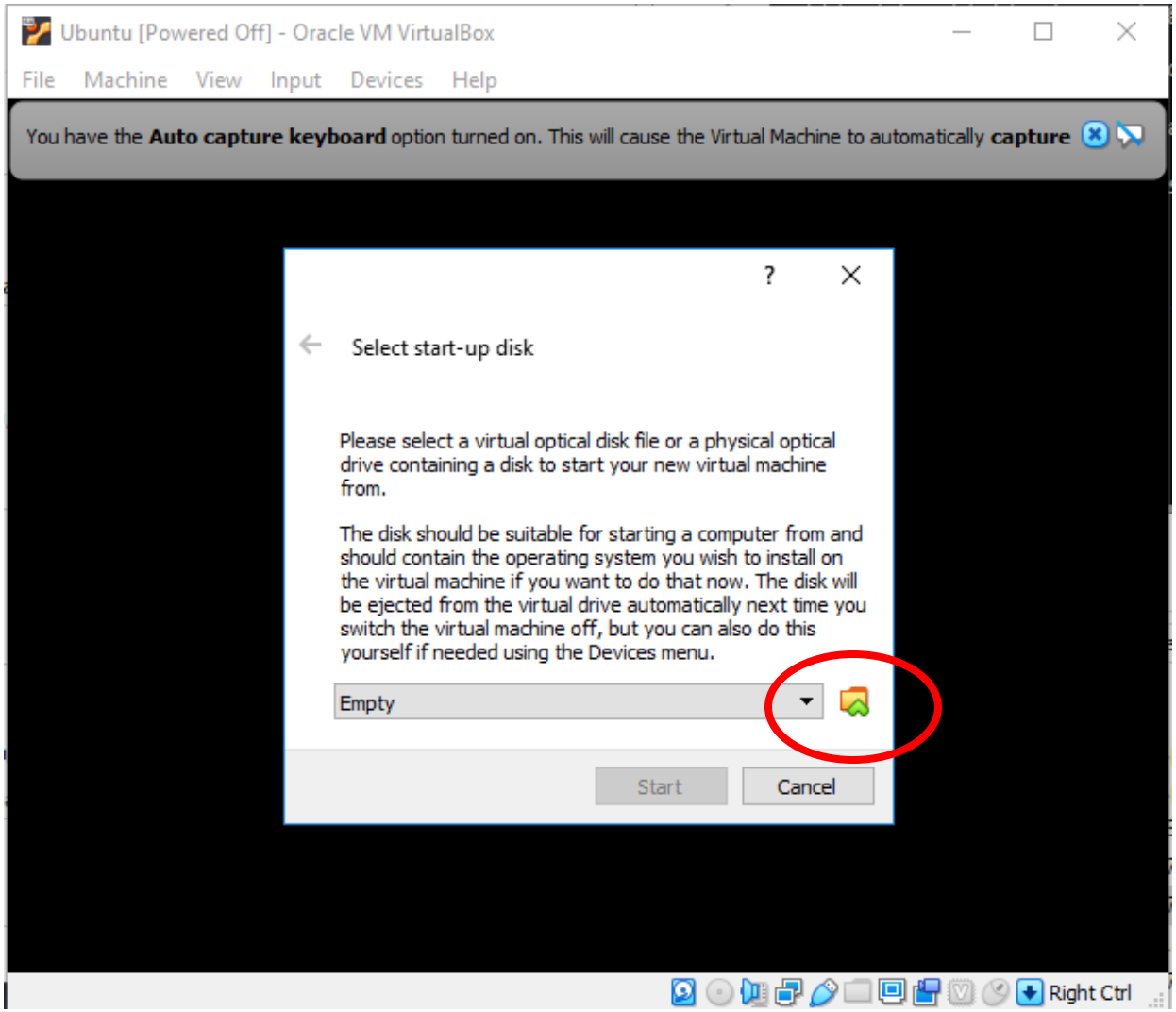
Boot the ISO

- Once everything is in place, it's time to boot that ISO and install Linux as a virtual operating system.



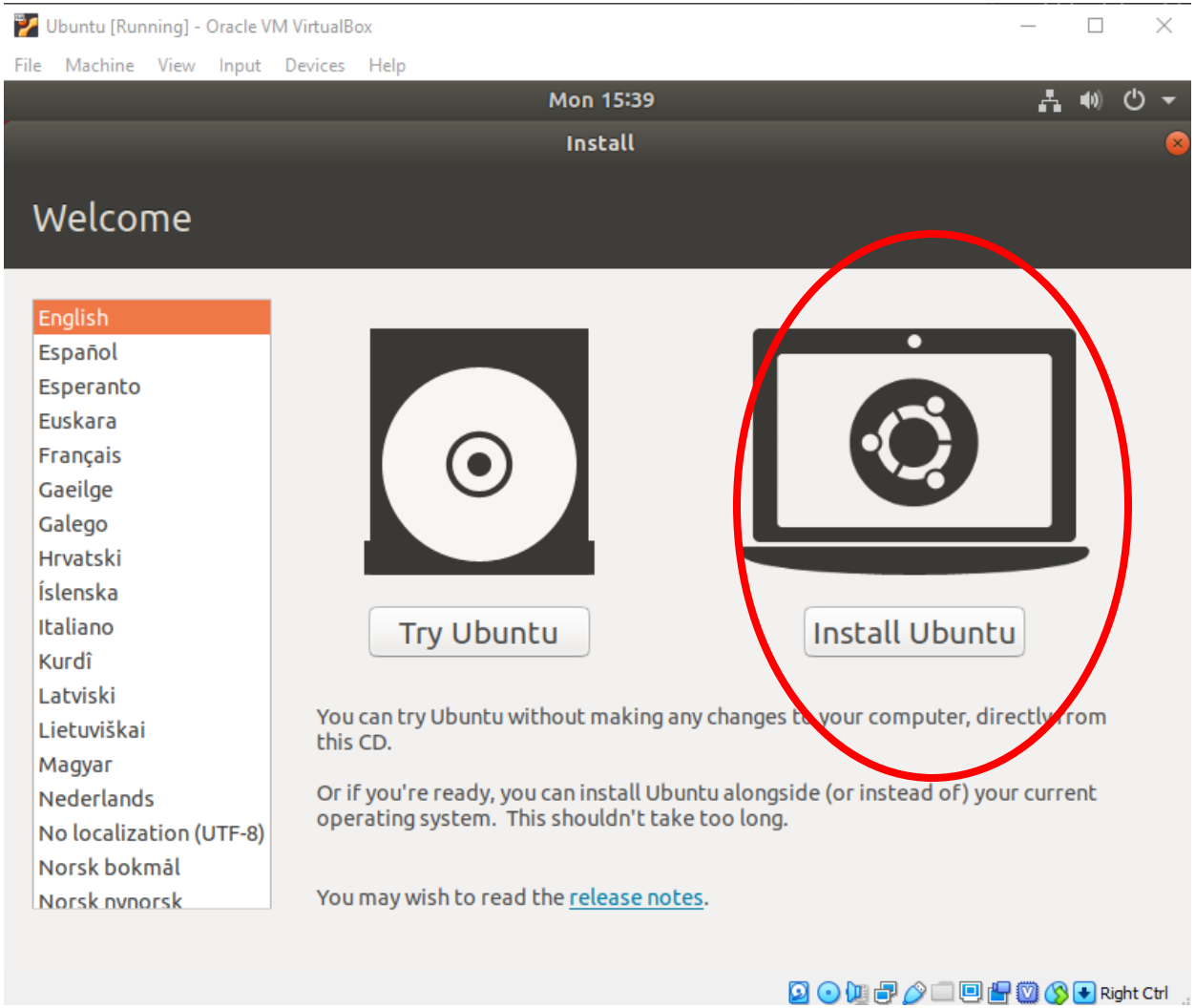
Select Start-up Disk

- If VirtualBox doesn't detect the Linux ISO, browse to its location by clicking the folder icon as shown in the picture below:

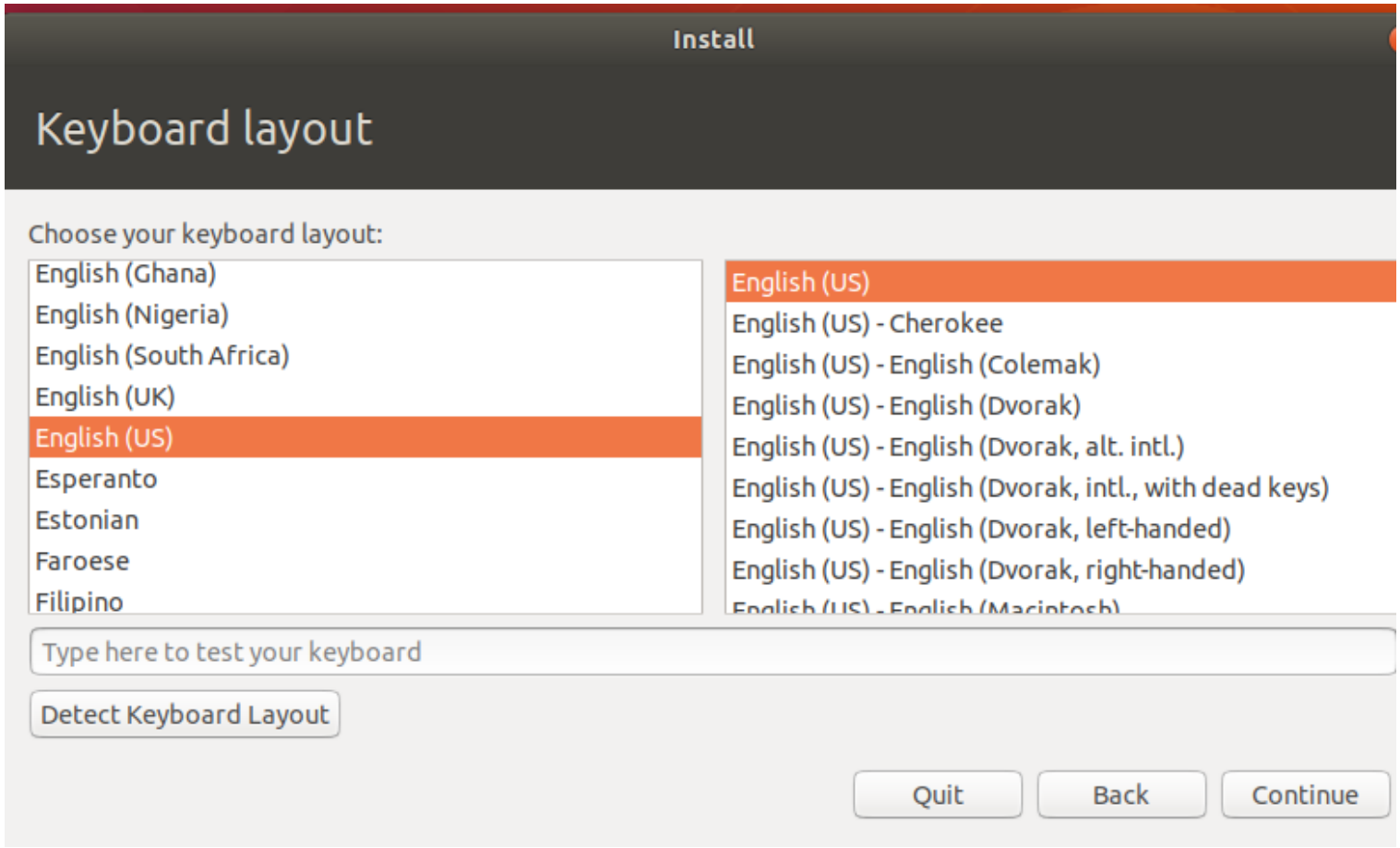


Install Ubuntu

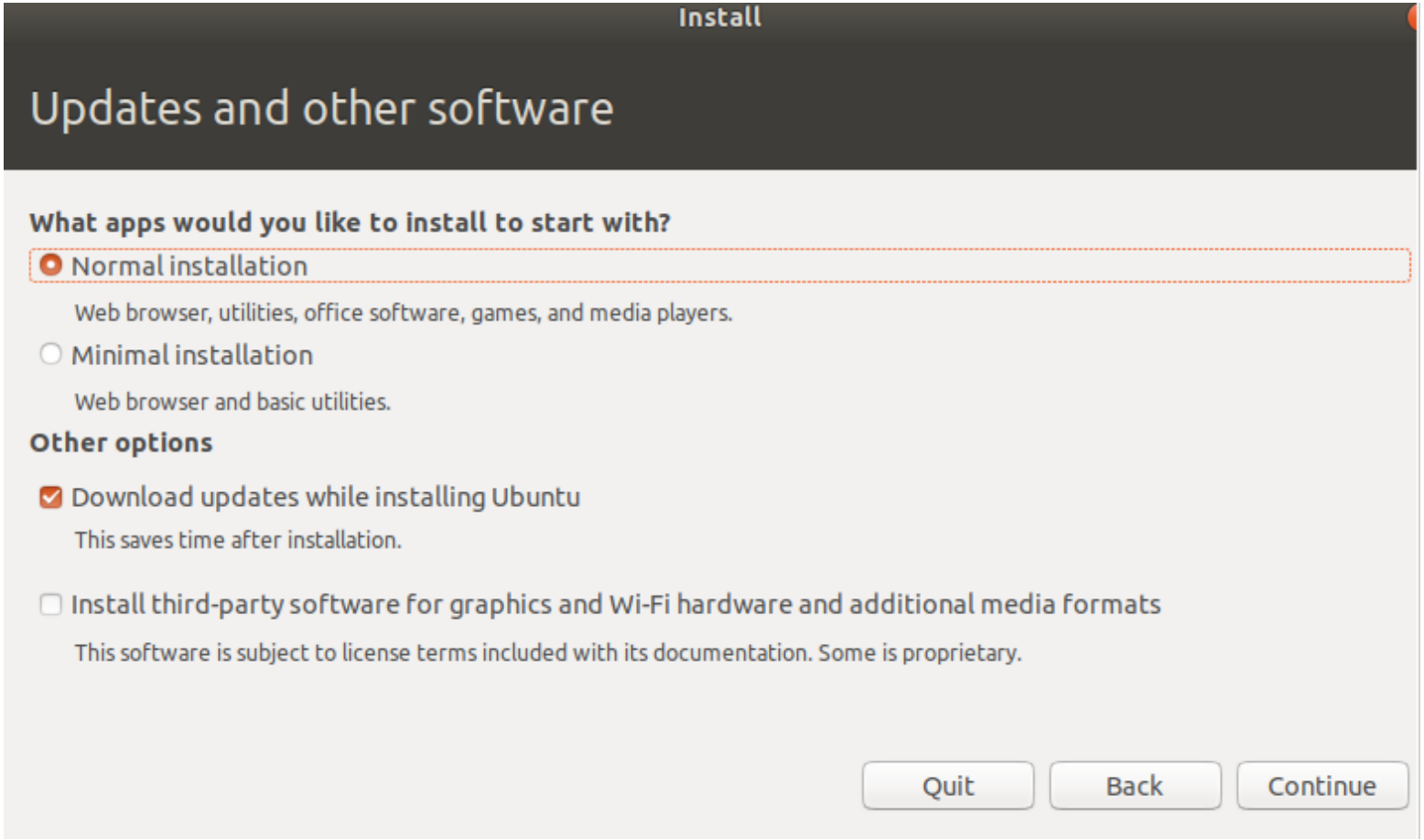
- Soon you'll find yourself inside Linux. You should be presented with the option to install it.



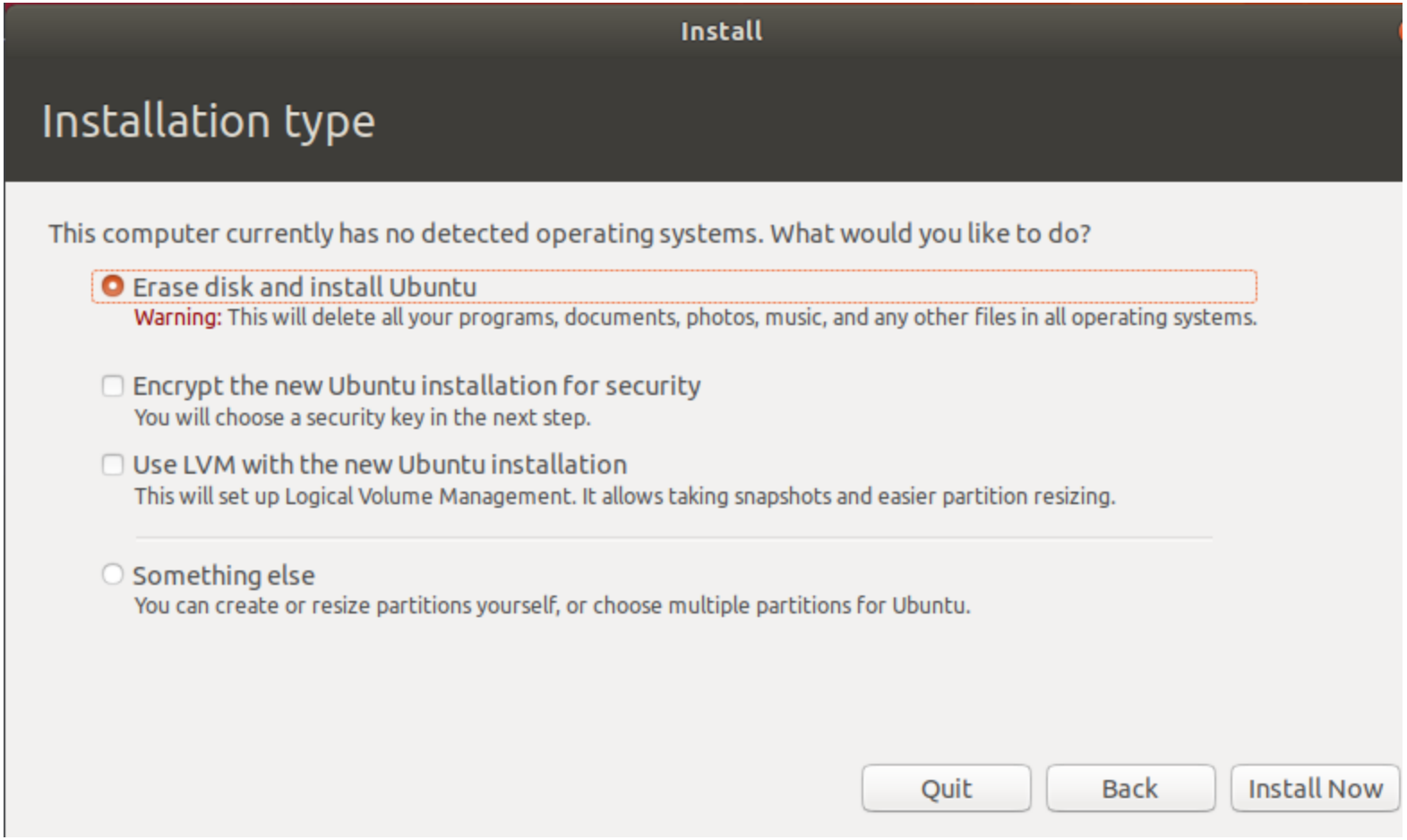
Select Language



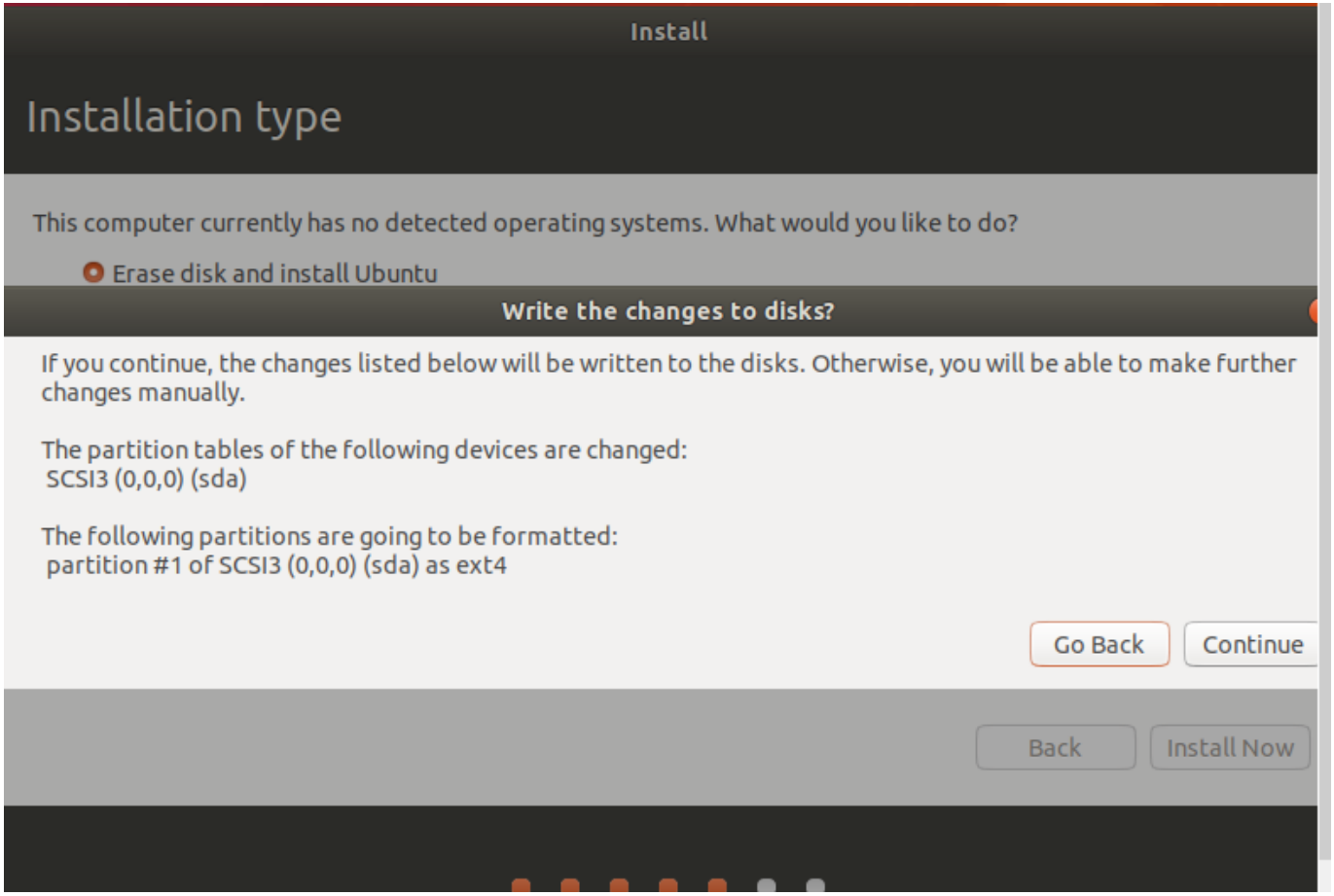
Normal Installation / Download Updates



Select ‘Erase disk and install Ubuntu’. Don’t worry. It won’t delete anything on your Windows operating system. You are using the virtual disk space of 15-20GB that we created in previous steps. It won’t impact the real operating system.



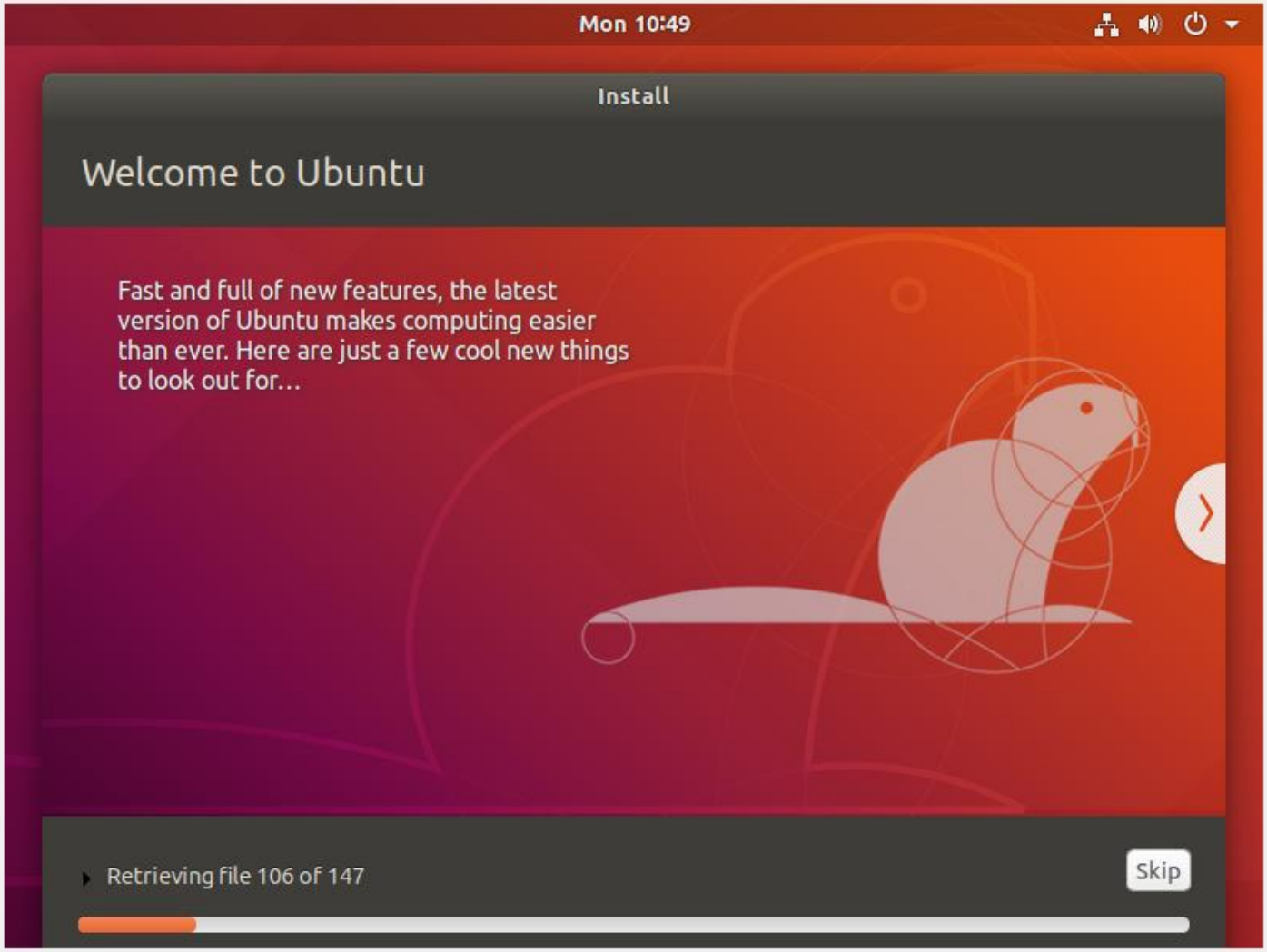
Continue


Install
Installation type
This computer currently has no detected operating systems. What would you like to do?
Erase disk and install Ubuntu
Write the changes to disks?
If you continue, the changes listed below will be written to the disks. Otherwise, you will be able to make further changes manually.
The partition tables of the following devices are changed:
SCSI3 (0,0,0) (sda)
The following partitions are going to be formatted:
partition #1 of SCSI3 (0,0,0) (sda) as ext4
Go Back
Continue
Back
Install Now

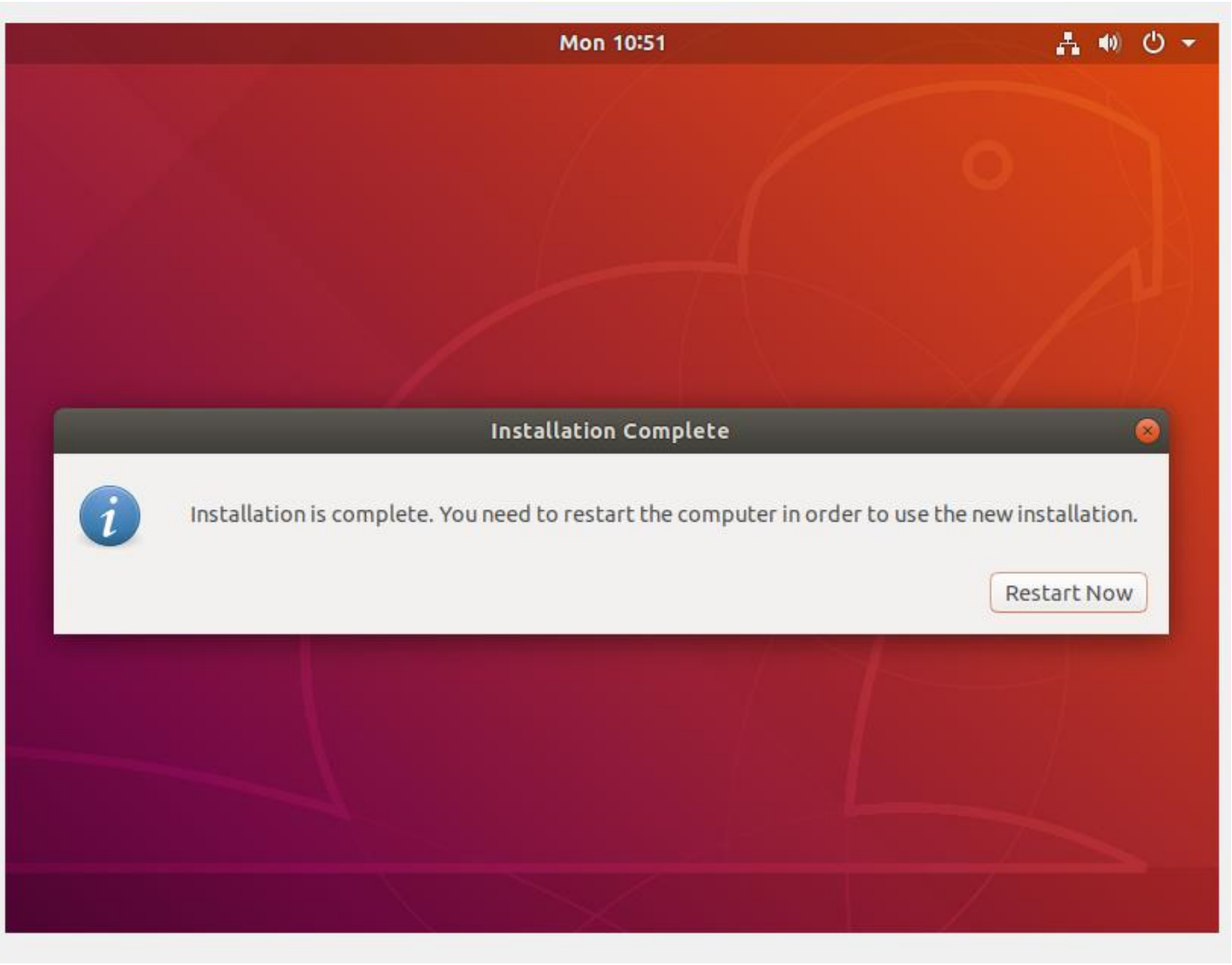
where are you ?

Choose a password you can remember (Yes, I choose 1234 ☺)

You are almost done!

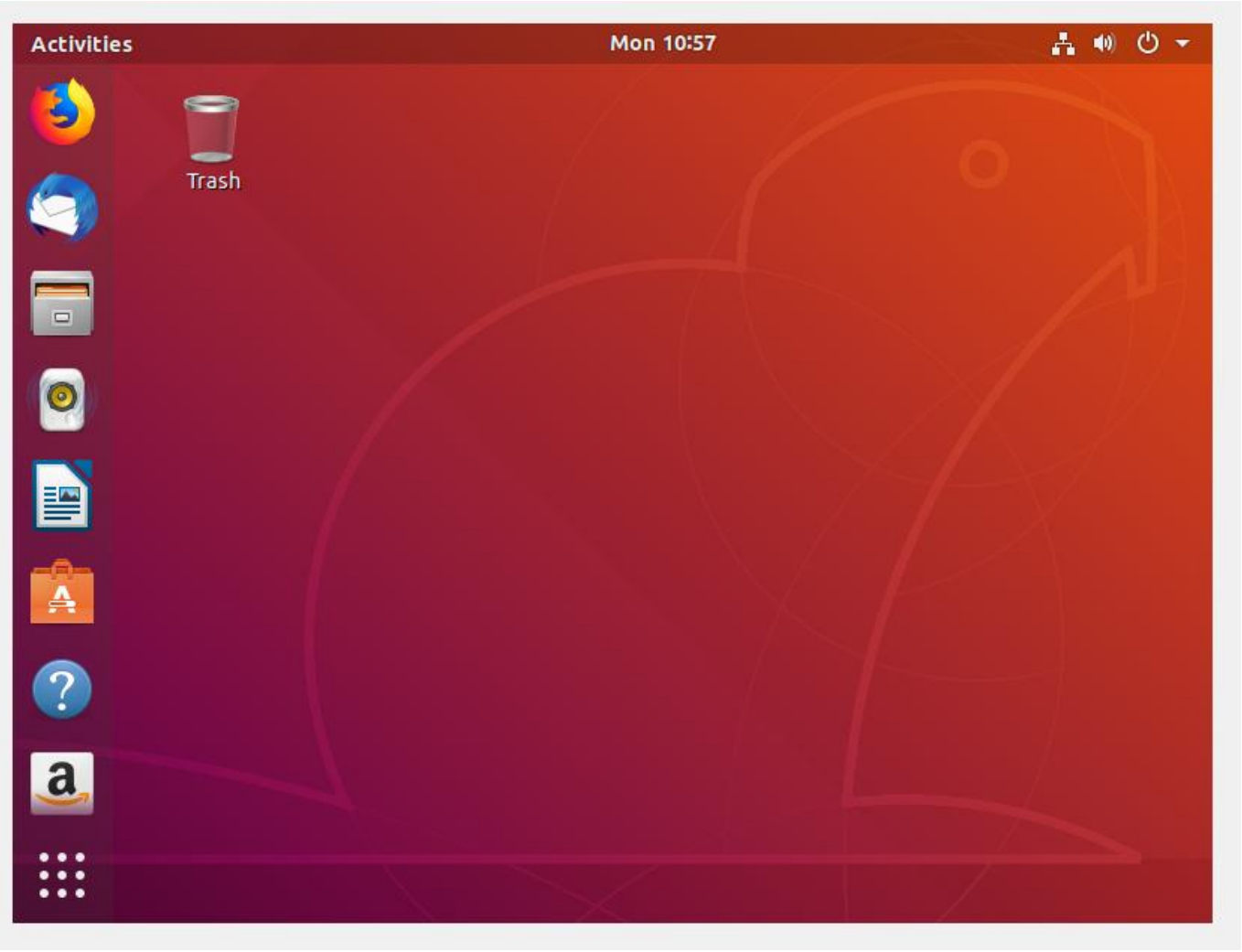


Restart Your Computer (VM)

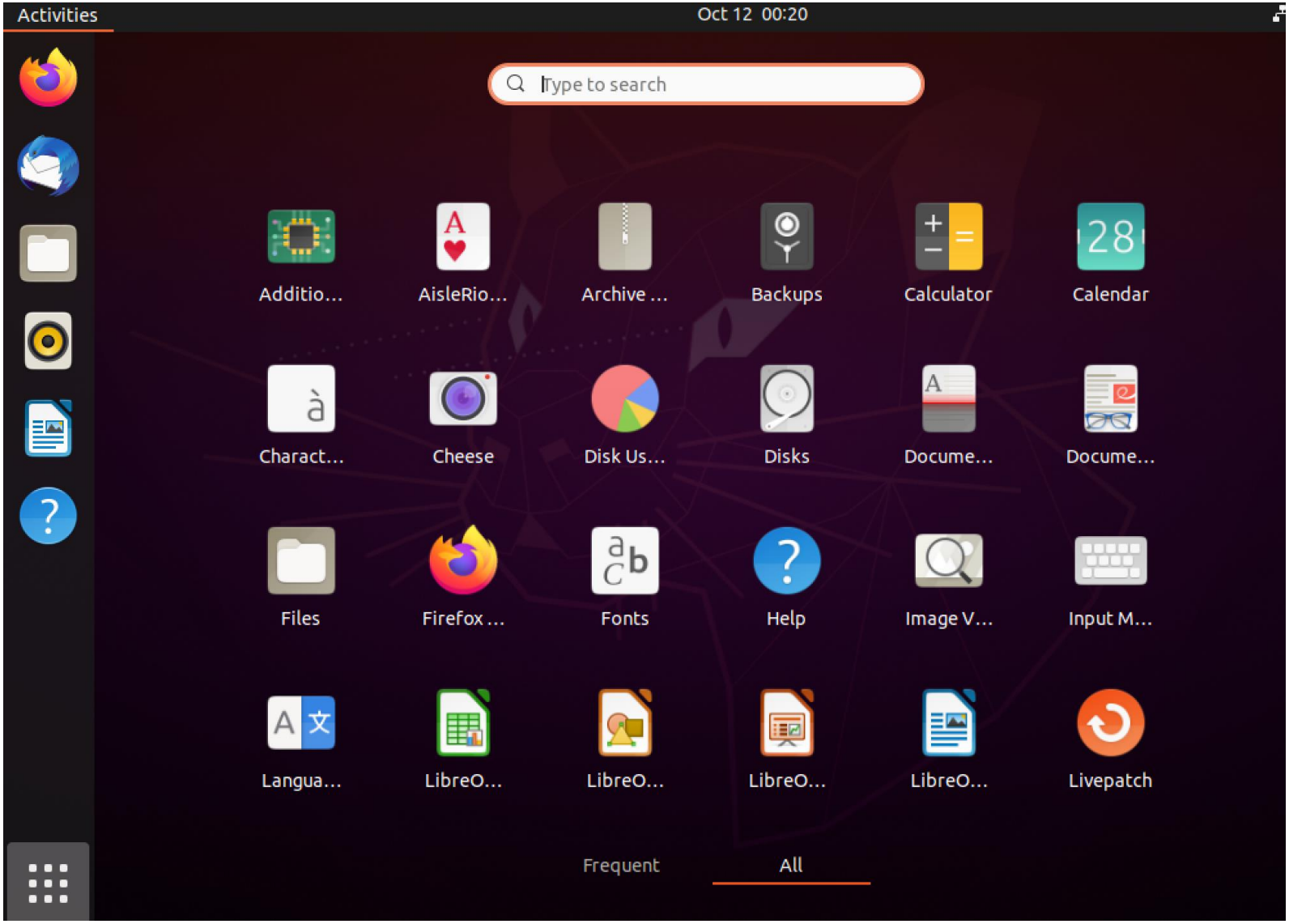


If it gets stuck on the screen below, you may close the VirtualBox.

Ready To Go!!!

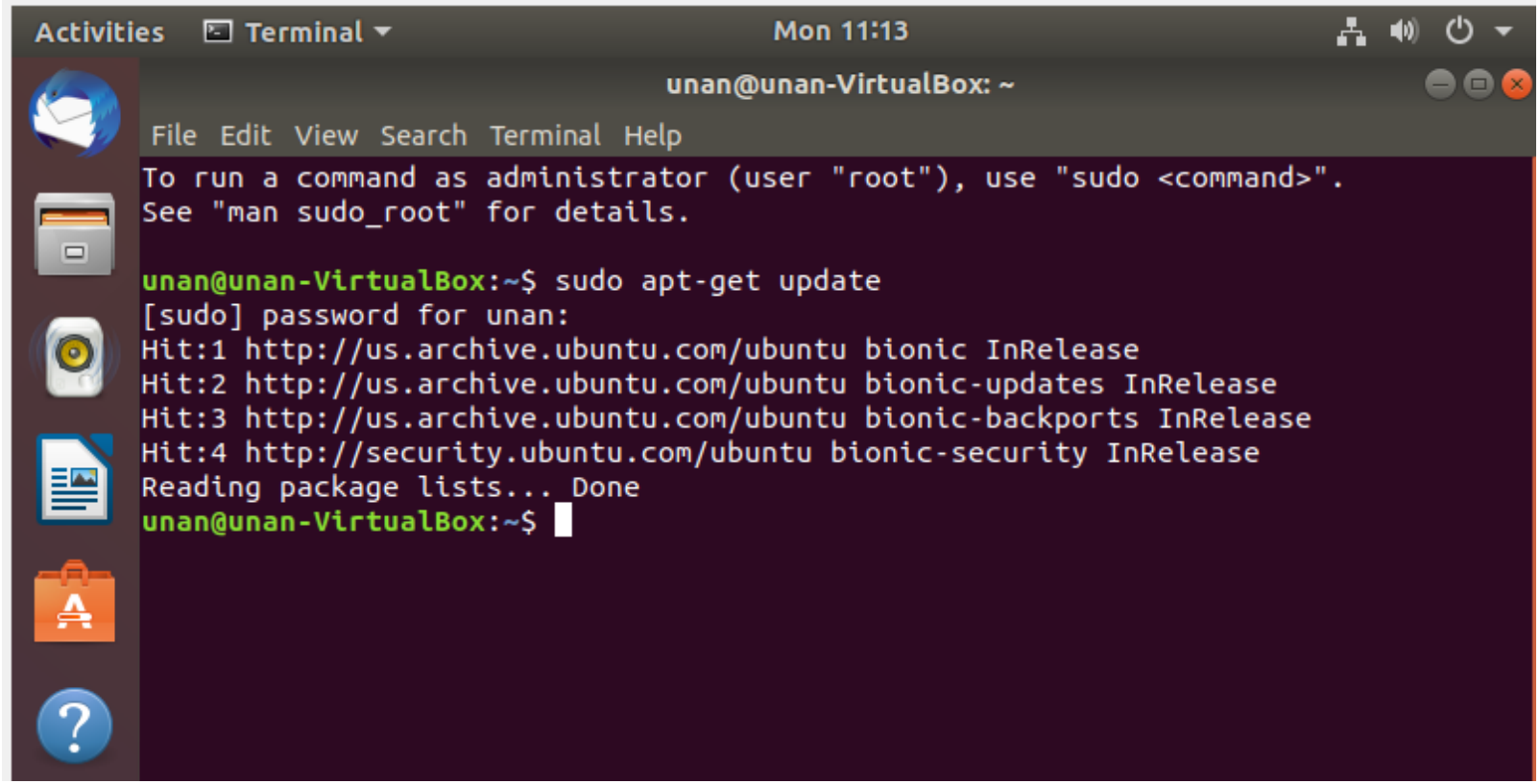


You can start terminal



Linux

- Start Linux Terminal and install the updates
  - `sudo apt-get update`



  - `sudo apt-get upgrade`

What we have learned so far…

- ls
- cd
- rm
- ps
- cat
- touch
- …….
- ……..

Copying a file or directory

- `cp [options] <source> <destination>`

```
unan@unan-VirtualBox:~/lecture36$ ls
dir1  dir2  somefile.txt
unan@unan-VirtualBox:~/lecture36$ cp somefile.txt dir1
unan@unan-VirtualBox:~/lecture36$ ls
dir1  dir2  somefile.txt
unan@unan-VirtualBox:~/lecture36$ cd dir1
unan@unan-VirtualBox:~/lecture36/dir1$ ls
file1.txt  somefile.txt
unan@unan-VirtualBox:~/lecture36/dir1$
```

Moving a File or Directory

- `mv [options] <source> <destination>`

```
unan@unan-VirtualBox:~/lecture36$ mkdir dir3
unan@unan-VirtualBox:~/lecture36$ mv dir1 dir3
unan@unan-VirtualBox:~/lecture36$ ls
dir2  dir3  somefile.txt
unan@unan-VirtualBox:~/lecture36$
```

```
unan@unan-VirtualBox:~/lecture36$ mv ./dir2 ./dir2new
unan@unan-VirtualBox:~/lecture36$ ls
dir2new  dir3  somefile.txt
unan@unan-VirtualBox:~/lecture36$
```

nl - line numbers

- `nl [-options] [path]`

```
unan@unan-VirtualBox:~/lecture36$ cat somefile.txt
Mahmut Unan 55
John Smith 45
John doe 67
Julie Doe 99
Zack Zetta 88
unan@unan-VirtualBox:~/lecture36$ nl somefile.txt
     1  Mahmut Unan 55
     2  John Smith 45
     3  John doe 67
     4  Julie Doe 99
     5  Zack Zetta 88
```

cut

- `cut [-options] [path]`

```
unan@unan-VirtualBox:~/lecture36$ cut -f 1 -d ' ' somefile.txt
Mahmut
John
John
Julie
Zack
unan@unan-VirtualBox:~/lecture36$
```

other useful data ops

- sed
  - sed stands for **Stream Editor** and it effectively allows us to do a search and replace on our data. It is quite a powerful command but we will use it here in it's basic format.
  - **sed <expression> [path]**
- uniq
  - uniq stands for **unique** and it's job is to remove duplicate lines from the data. One limitation however is that those lines must be adjacent (ie, one after the other
  - **uniq [options] [path]**

https://ryanstutorials.net/linuxtutorial/filters.php

diff

```
unan@unan-VirtualBox:~/lecture36$ cat somefile.txt
Mahmut Unan 55
John Smith 45
John doe 67
Julie Doe 99
Zack Zetta 88
unan@unan-VirtualBox:~/lecture36$ cat somefile2.txt
Mahmut Unan 55
John Smith 45
John doe 67
Julie Doe 99
Zack Zetta 88
some extra line
unan@unan-VirtualBox:~/lecture36$ diff somefile.txt somefile2.txt
5a6
> some extra line
unan@unan-VirtualBox:~/lecture36$
```

grep / egrep

- `grep [options] <pattern> [files]`
- `egrep [options] <pattern> [files]`

```
unan@unan-VirtualBox:~/lecture36$ grep 'o' somefile.txt
John Smith 45
John doe 67
Julie Doe 99
unan@unan-VirtualBox:~/lecture36$ grep -c 'o' somefile.txt
3
```

https://ryanstutorials.net/linuxtutorial/cheatsheetgrep.php

Wildcards

- ***** - zero or more characters
- **?** - a single character
- **[ ]** - a range of characters

Networking / Communication

- SSH
  - SSH username@ip-address or hostname

- Ping
  - ping hostname
  - ping ipaddress

```
unan@unan-VirtualBox:~/lecture36$ ping www.google.com
PING www.google.com (64.233.185.99) 56(84) bytes of data.
64 bytes from yb-in-f99.1e100.net (64.233.185.99): icmp_seq=1 ttl=63 time=23.2 m
s
64 bytes from yb-in-f99.1e100.net (64.233.185.99): icmp_seq=2 ttl=63 time=24.8 m
s
64 bytes from yb-in-f99.1e100.net (64.233.185.99): icmp_seq=3 ttl=63 time=22.6 m
```

- ftp hostname

```
unan@unan-VirtualBox:~/lecture36$ ftp ftp.javatutorialhub.com
Connected to javatutorialhub.com.
220---------- Welcome to Pure-FTPd [privsep] [TLS] ----------
220-You are user number 1 of 50 allowed.
220-Local time is now 15:39. Server port: 21.
220-This is a private system - No anonymous login
220-IPv6 connections are also welcome on this server.
220 You will be disconnected after 15 minutes of inactivity.
Name (ftp.javatutorialhub.com:unan):
```

- telnet
  - telnet hostname

Linux Administrator

- Add new user
  - sudo adduser mynewuser
- Disable an account
  - sudo passwd -l mynewuser
- Delete an account
  - sudo userdel -r mynewuser
- Add user to usergroup
  - sudo usermod -a -G home mynewuser

finger

- This command is used to **procure information of the users on a Linux machine**.
- You can use it on both local & remote machines
- The syntax 'finger' gives data on all the logged users on the remote and local machine.
- The syntax 'finger username' specifies the information of the user.

https://www.guru99.com/linux-admin.html

date /cal / time

```
unan@unan-VirtualBox:~/lecture36$ date
Fri 20 Nov 2020 01:54:12 PM CST
unan@unan-VirtualBox:~/lecture36$ date  +'%a %d-%m-%y'
Fri 20-11-20
unan@unan-VirtualBox:~/lecture36$ time ls
dir2new  dir3  somefile2.txt  somefile.txt

real    0m0.002s
user    0m0.001s
sys     0m0.000s
unan@unan-VirtualBox:~/lecture36$ cal
    November 2020
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

unan@unan-VirtualBox:~/lecture36$
```

wget / curl

- wget https://cdn.kernel.org/pub/linux/kernel/v4.x/linux-4.17.2.tar.xz

- curl https://www.example.com/

https://curl.se/docs/manual.html

https://linuxize.com/post/wget-command-examples/

gzip / tar/ bzip2

- gzip filename
- gzip -k filename
- gunzip

- tar [options] [archive-file] [file or directory to be archived]

- bzip2 somefilename
- bunzip2 somefilename

su / sudo

- su **<username>**
- su root
- sudo apt install curl

mount

- mount -t type **<device> <directory>**

```
unan@unan-VirtualBox:~/lecture36$ mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
udev on /dev type devtmpfs (rw,nosuid,noexec,relatime,size=1987276k,nr_in
6819,mode=755)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620,
e=000)
tmpfs on /run type tmpfs (rw,nosuid,nodev,noexec,relatime,size=403088k,mo
/dev/sda5 on / type ext4 (rw,relatime,errors=remount-ro)
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexe
ime)
```

shred


unan@unan-VirtualBox:~/lecture36$ ls
dir2new dir3 somefile2.txt somefile.txt
unan@unan-VirtualBox:~/lecture36$ shred somefile.txt
unan@unan-VirtualBox:~/lecture36$ ls
dir2new dir3 somefile2.txt somefile.txt
unan@unan-VirtualBox:~/lecture36$ cat somefile.txt

verbose info / delete

- shred -u -v **<fileName>**

```
unan@unan-VirtualBox:~/lecture36$ ls
dir2new  dir3  somefile2.txt  somefile.txt
unan@unan-VirtualBox:~/lecture36$ shred -u -v somefile.txt
shred: somefile.txt: pass 1/3 (random)...
shred: somefile.txt: pass 2/3 (random)...
shred: somefile.txt: pass 3/3 (random)...
shred: somefile.txt: removing
shred: somefile.txt: renamed to 000000000000
shred: 000000000000: renamed to 00000000000
shred: 00000000000: renamed to 0000000000
shred: 0000000000: renamed to 000000000
shred: 000000000: renamed to 00000000
shred: 00000000: renamed to 0000000
shred: 0000000: renamed to 000000
shred: 000000: renamed to 00000
shred: 00000: renamed to 0000
shred: 0000: renamed to 000
shred: 000: renamed to 00
shred: 00: renamed to 0
shred: somefile.txt: removed
unan@unan-VirtualBox:~/lecture36$ ls
dir2new  dir3  somefile2.txt
unan@unan-VirtualBox:~/lecture36$
```

last

```
unan@unan-VirtualBox:~/lecture36$ last
unan     :0           :0                Thu Nov 19 22:47    gone - no logout
reboot   system boot  5.4.0-42-generic Thu Nov 19 22:47   still running
unan     :0           :0                Thu Nov 19 20:13 - crash  (02:34)
reboot   system boot  5.4.0-42-generic Thu Nov 19 20:12   still running
unan     :0           :0                Mon Oct 12 00:19 - crash (38+20:53)
reboot   system boot  5.4.0-42-generic Mon Oct 12 00:18   still running
unan     :0           :0                Mon Sep 14 16:52 - crash (27+07:26)
reboot   system boot  5.4.0-42-generic Mon Sep 14 16:51   still running
unan     :0           :0                Tue Jul 28 11:49 - crash (48+05:02)
reboot   system boot  5.4.0-42-generic Tue Jul 28 11:49   still running

wtmp begins Tue Jul 28 11:49:20 2020
```

ifconfig

- The command ifconfig stands for interface configurator. This command enables us to initialize an interface, assign IP address, enable or disable an interface. It display route and network interface.
- You can view IP address, MAC address and MTU (Maximum Transmission Unit) with ifconfig command.
- A newer version of ifconfig is ip command. ifconfig command works for all the versions.

Syntax:

ifconfig

https://www.javatpoint.com/linux-ifconfig

ip

```
unan@unan-VirtualBox:~/lecture36$ ip
Usage: ip [ OPTIONS ] OBJECT { COMMAND | help }
       ip [ -force ] -batch filename
where  OBJECT := { link | address | addrlabel | route | rule | neigh | ntable |
                   tunnel | tuntap | maddress | mroute | mrule | monitor | xfrm
|
                   netns | l2tp | fou | macsec | tcp_metrics | token | netconf |
 ila |
                   vrf | sr | nexthop }
       OPTIONS := { -V[ersion] | -s[tatistics] | -d[etails] | -r[esolve] |
                    -h[uman-readable] | -iec | -j[son] | -p[retty] |
                    -f[amily] { inet | inet6 | mpls | bridge | link } |
                    -4 | -6 | -I | -D | -M | -B | -0 |
                    -l[oops] { maximum-addr-flush-attempts } | -br[ief] |
                    -o[neline] | -t[imestamp] | -ts[hort] | -b[atch] [filename]
|
                    -rc[vbuf] [size] | -n[etns] name | -N[umeric] | -a[ll] |
                    -c[olor]}
```

Linux Certifications

- Most of the hiring manager are looking to recruit Linux professionals.
- The emergence of open cloud platforms is creating increasing demand for Linux professionals who have the right expertise
- Linux-certified professionals always be a better position in the job market
- Employers are looking for more Linux talent.
- Better salary increments for Linux certified professionals
- Some famous certificates
  - Red Hat Linux SuSE Linux
  - Linux Professional Institute (LPIC)
  - CompTIA
  - Linux Foundation
  - Oracle

https://www.guru99.com/best-linux-certifications.html

Useful resources

- https://www.guru99.com/best-linux-books-beginners.html
- https://ubuntu.com/tutorials?page=2
- https://ubuntu.com/tutorials/create-your-first-snap#1-overview