Introduction of Linux

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PART I

- Brief Introduction
- Basic Conceptions & Environment
- Install & Configure a Virtual Machine
- Basic Commands

PART II

- Shell Script
- Compile & Debug (for C)
- Text Editor (Vim, Sublime text, Atom)

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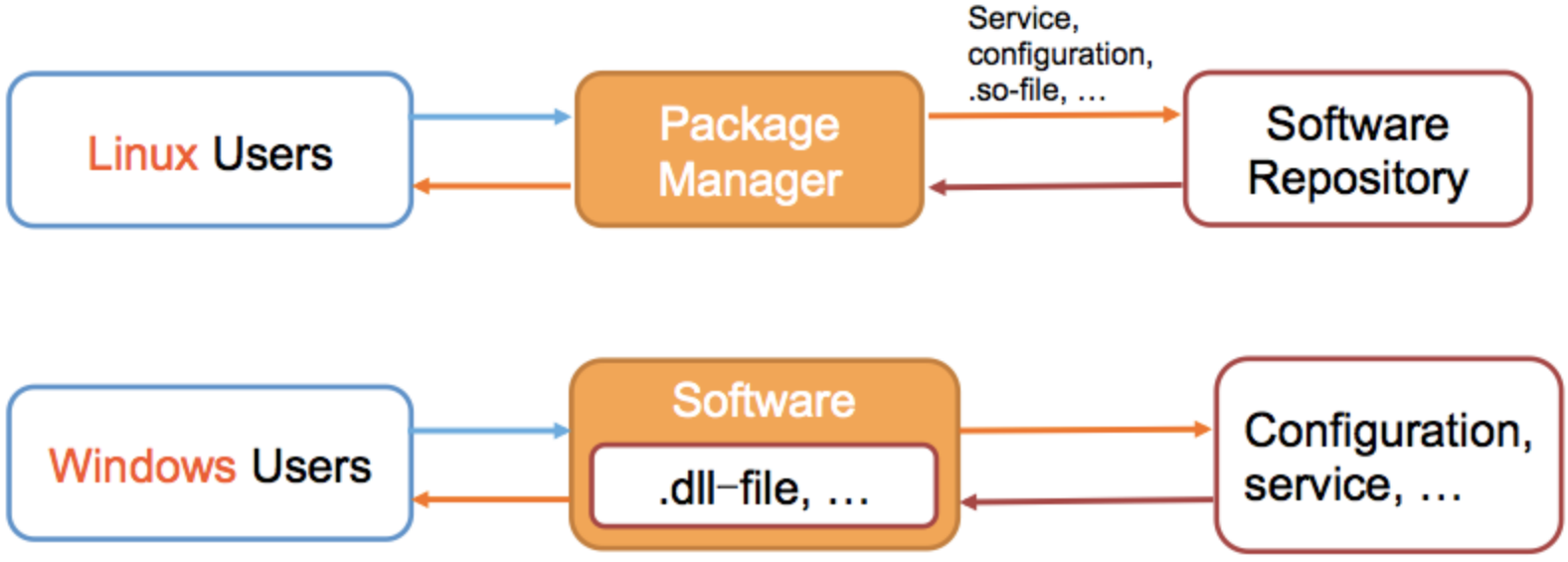
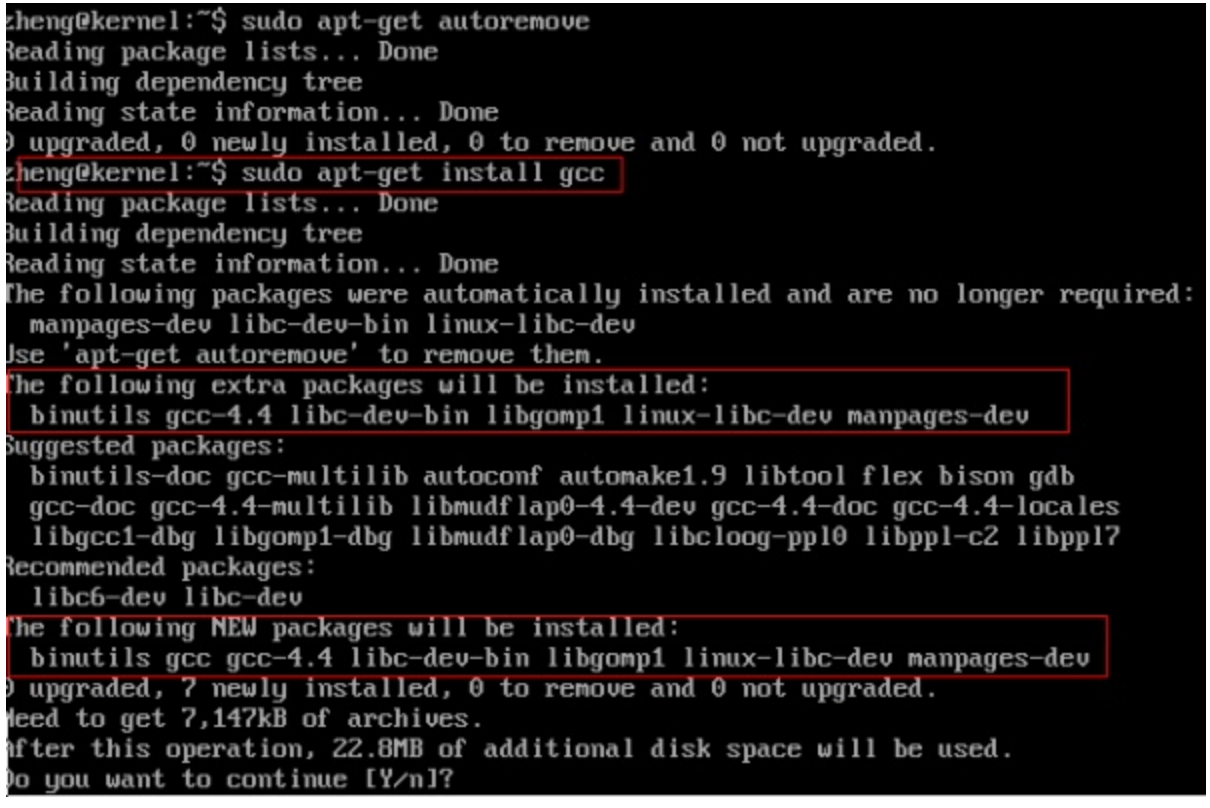
Linux vs Windows Software



Linux install software

Package Manager： `apt-get` (Advanced Package Tool)



Windows install software

msvcr80.dll

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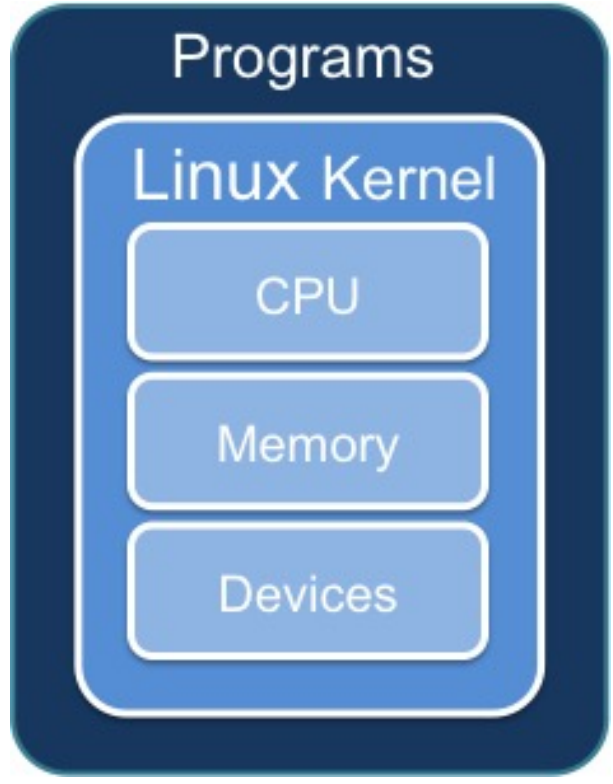
Linux Kernel

The most important component of Linux OS, containing all the operating system's core functions and the device drivers.

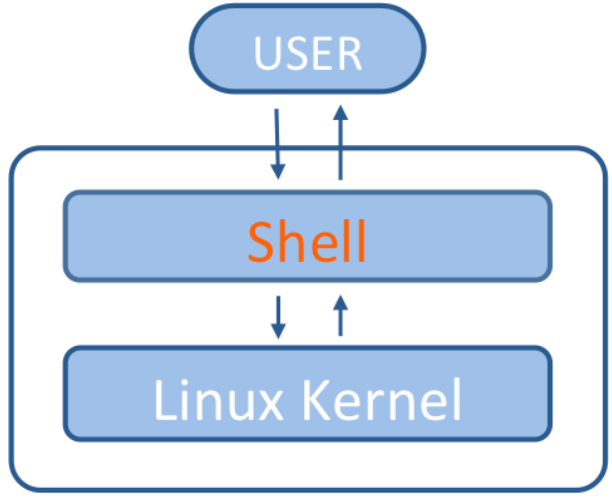
- memory management
- process scheduling
- file system
- ...



Shell (CLI shell)

Command Line Interface

A program which accepts commands as text input and converts commands to appropriate operating system functions.



Terminal ↔ Shell

The terminal send information to the shell, receive and display the information from the shell.

`cd` (change directory)

```
cd
cd ~
cd -
cd ..
```

`pwd` (print working directory)

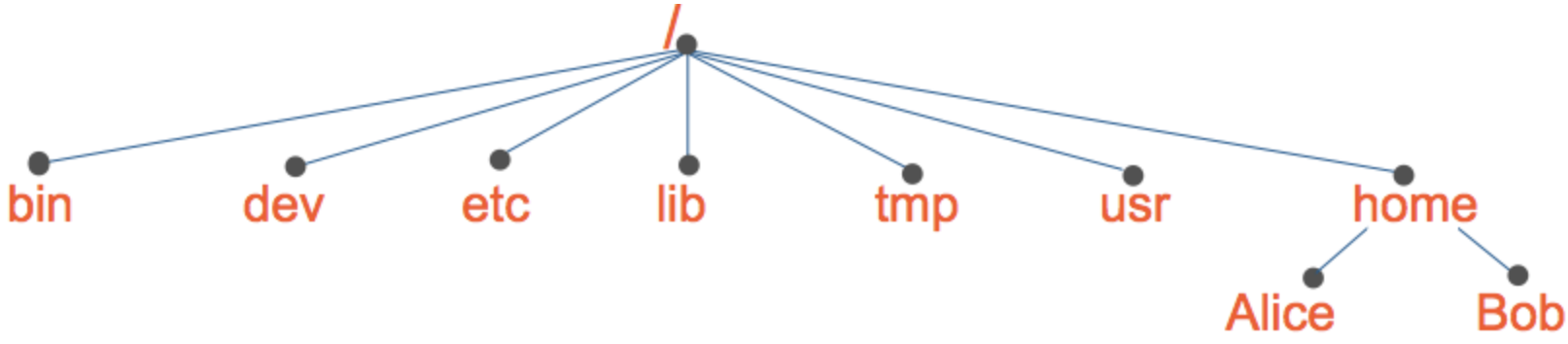
```
pwd
```

`ls` (list segment)

`-l`	long - Displaying long format
`-a`	all - Lists all files in the given directory
`-R`	recursive - Recursively lists subdirectories.
`-d`	directory - Shows information about a directory

```
ls
ls -l
ls -a
ls -R
ls -d
ls -la
ls -ld
...
```

File System



Tree structure, with the root directory " / "

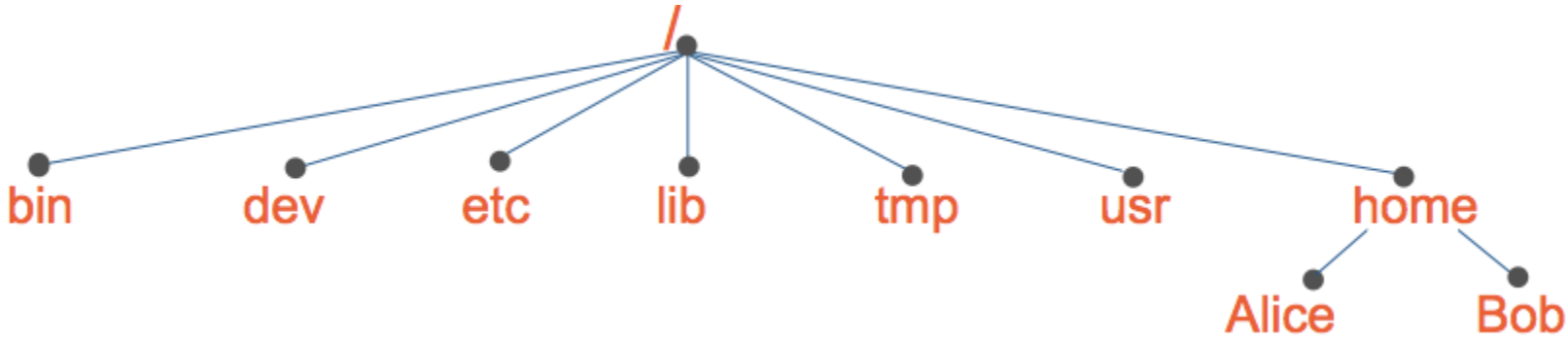
`/home/Alice/...`

`~` = `/home/Alice`

`.`

`..`

File System



`/bin` : essential tools and other programs

`/dev` : files representing the system's hardware devices

`/etc` : system configuration files

`/home` : the home directory for all system's users

`/lib` : essential system library files

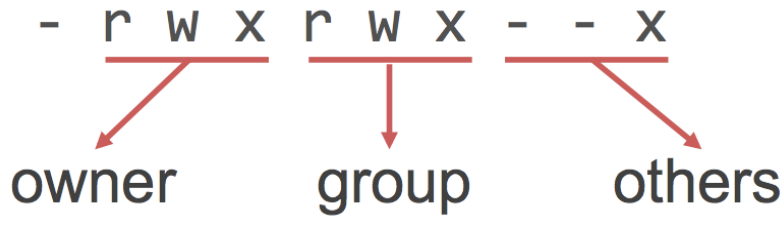
`/proc` : files that give information about current system

`/usr` : files related to user tools and applications

User & Group

The system determines whether or not a user or group can access a file or directory.
There is a special user called Super User or the root which has permission to access any file and directory.
Three Permissions:

- `r` = read
- `w` = write
- `x` = execute



`sudo` (superuser do)

`groupadd`

```
sudo groupadd TA
sudo groupadd boys
sudo groupadd girls
```

`useradd`

```
sudo useradd jt  -m -g TA -G boys  -s /bin/bash
sudo useradd lyh -m -g TA -G girls -s /bin/bash
```

`passwd`

```
sudo passwd jt
sudo passwd lyh
```

`su` (switch user)

```
su jt
```

`chmod` (change mode)

```
chmod 660 class1.txt
chmod g-w class1.txt
```

`cat` (concatenate)

```
cat class1.txt
cat jt.txt
```

Environment Variables

Environment variables are a set of values that can affect the way running processes will behave on a computer.

- `PATH` -- Contains a colon-separated list of directories that the shell searches for commands that do not contain a slash in their name.
- `HOME` -- Contains the location of the user's home directory.
- ...

Set The Environment Variables:

```
export VARIABLE = value     # temporary
/etc/profile                # permanent, all users

~/.profile                  # permanent, one user
~/.bashrc
```

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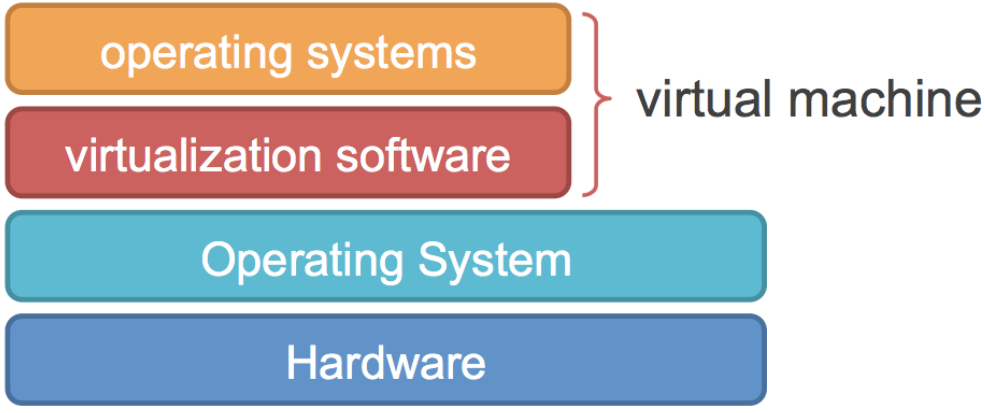
Virtual Machine

A virtual machine is an emulation of a particular computer system.



Virtualization Software provide (hardware) resources virtually to the new OS.

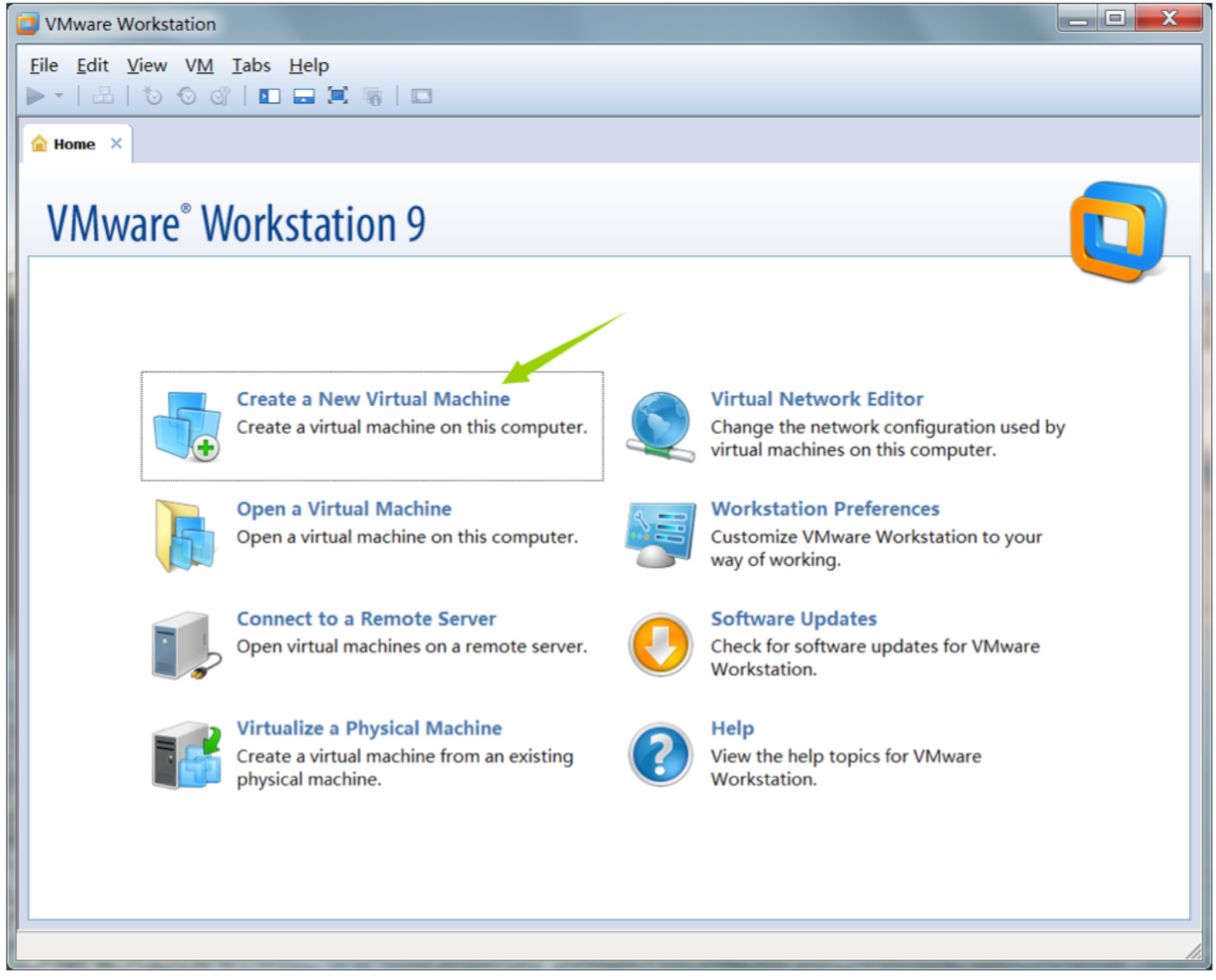
- VMware
- Virtual Box
- Virtual PC

Install the Virtual Machine

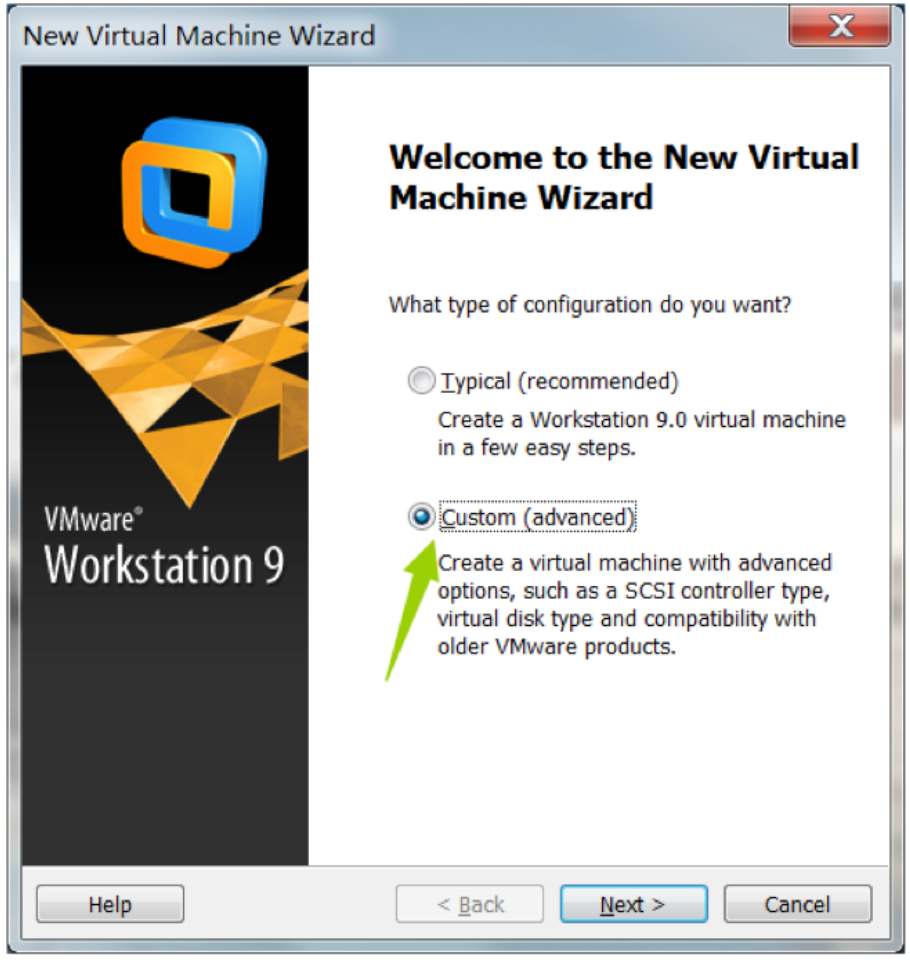
VMware Workstation 9.0 + Ubuntu 14.04 LTS (kernel 3.19)

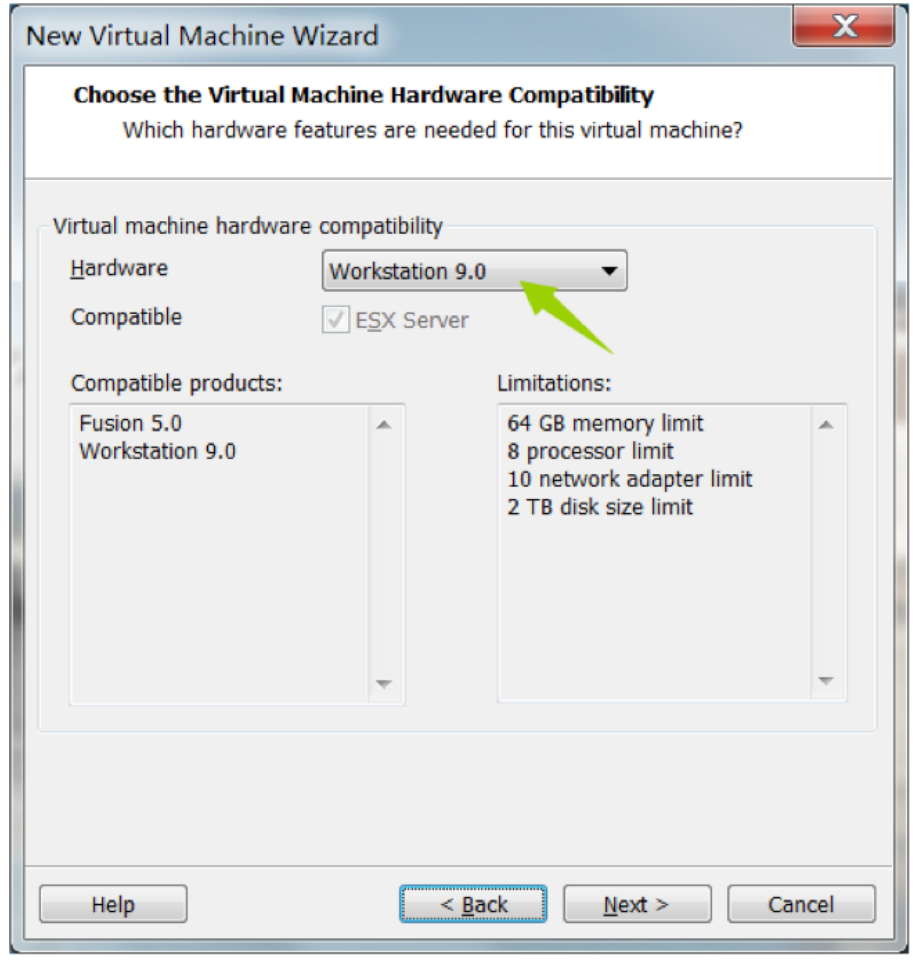
1. Download the Setup File of Vmware 9.0
2. Download the Ubuntu Ubuntu 14.04 LTS from the official website www.ubuntu.com/download/desktop
3. Install VMware 9.0
4. Create a Virtual Machine in the VMware

Create a Virtual Machine

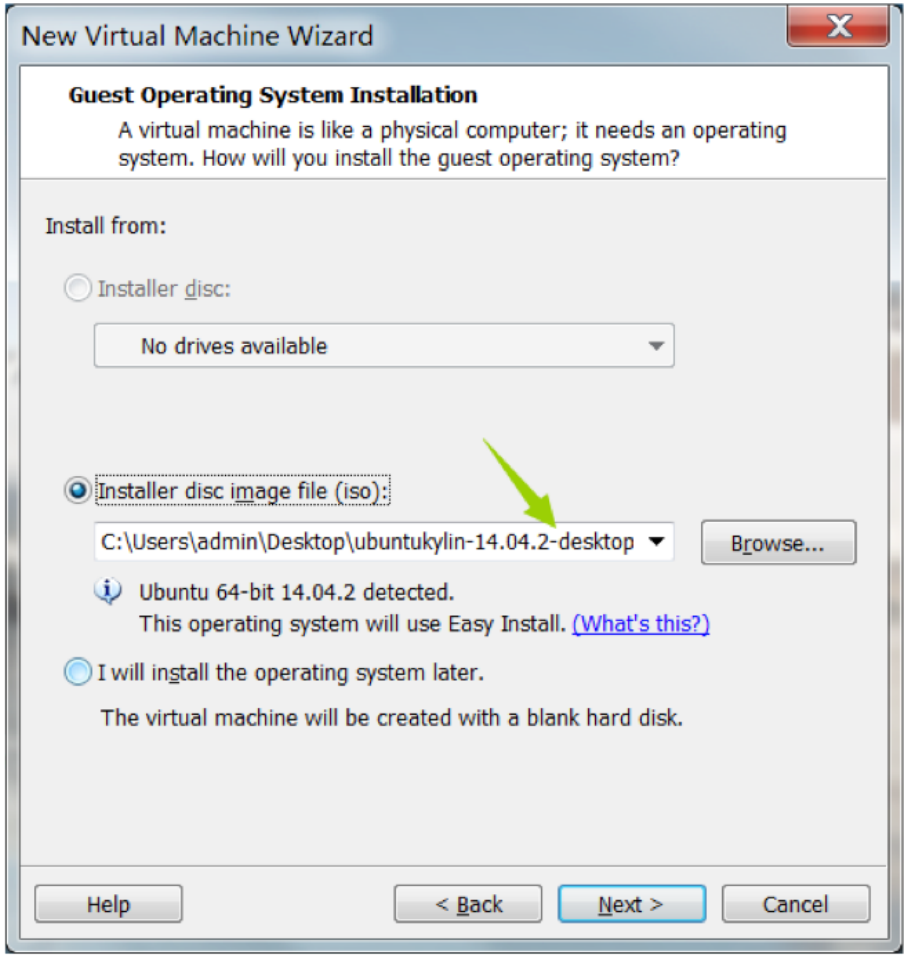


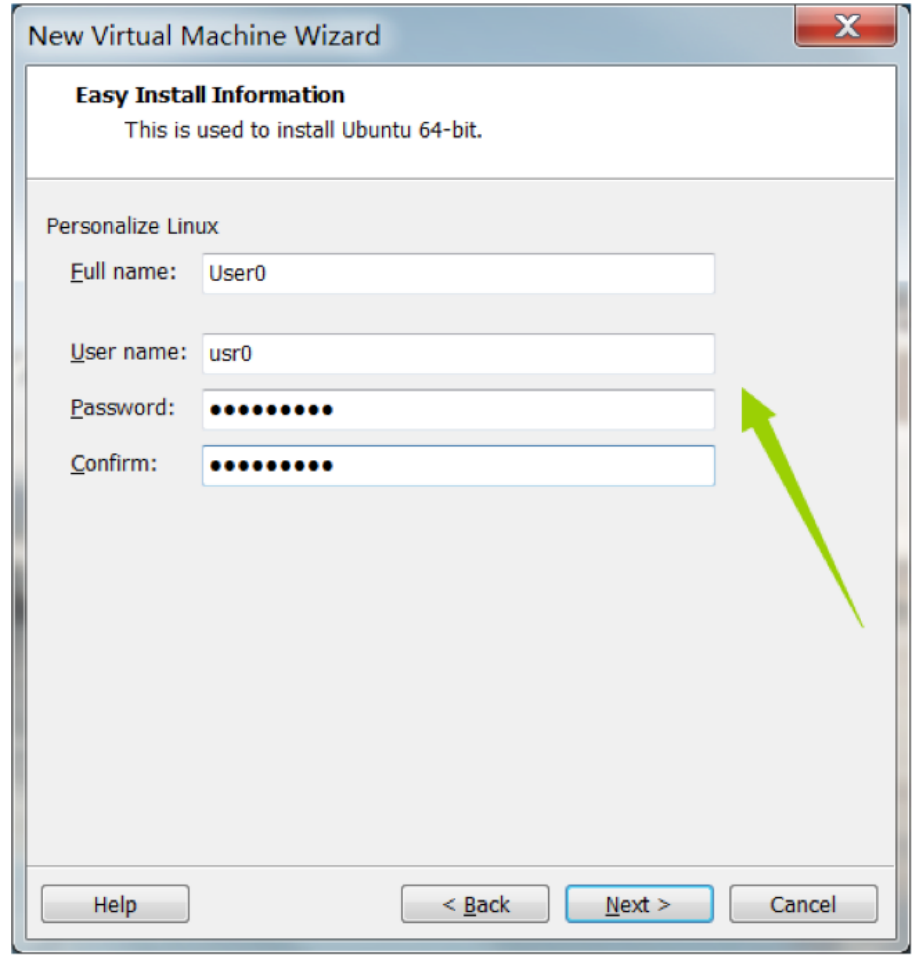
Create a Virtual Machine





Create a Virtual Machine





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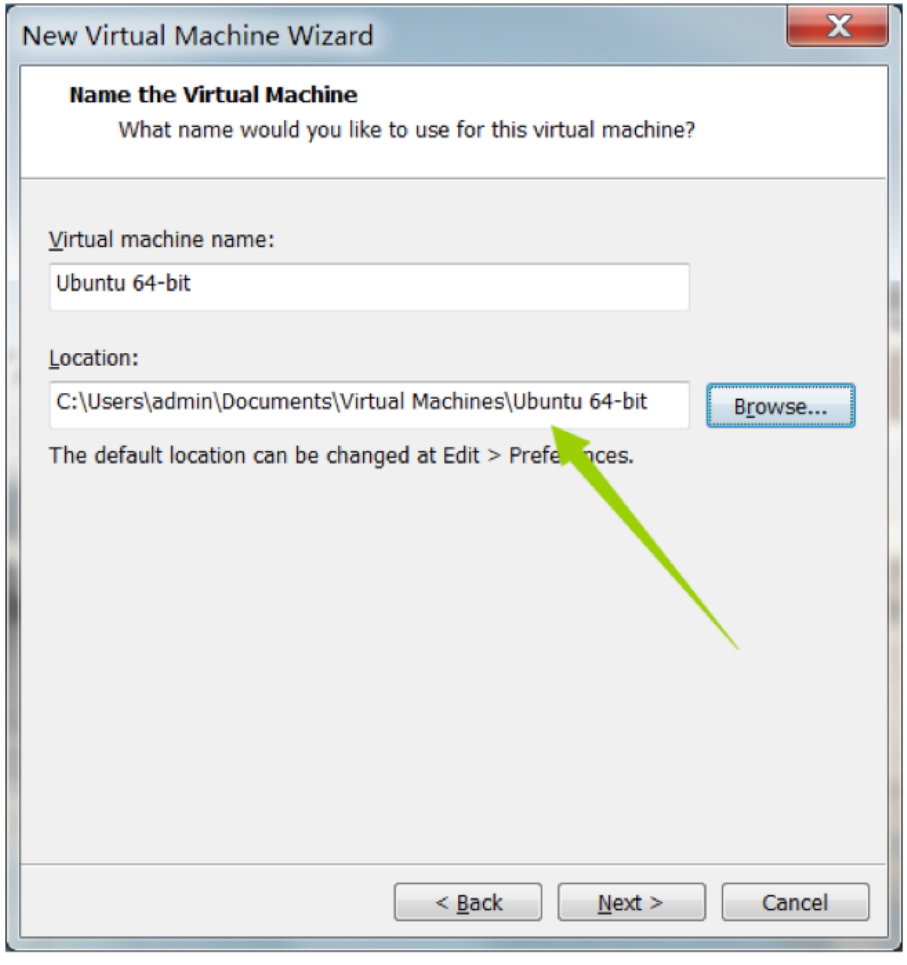
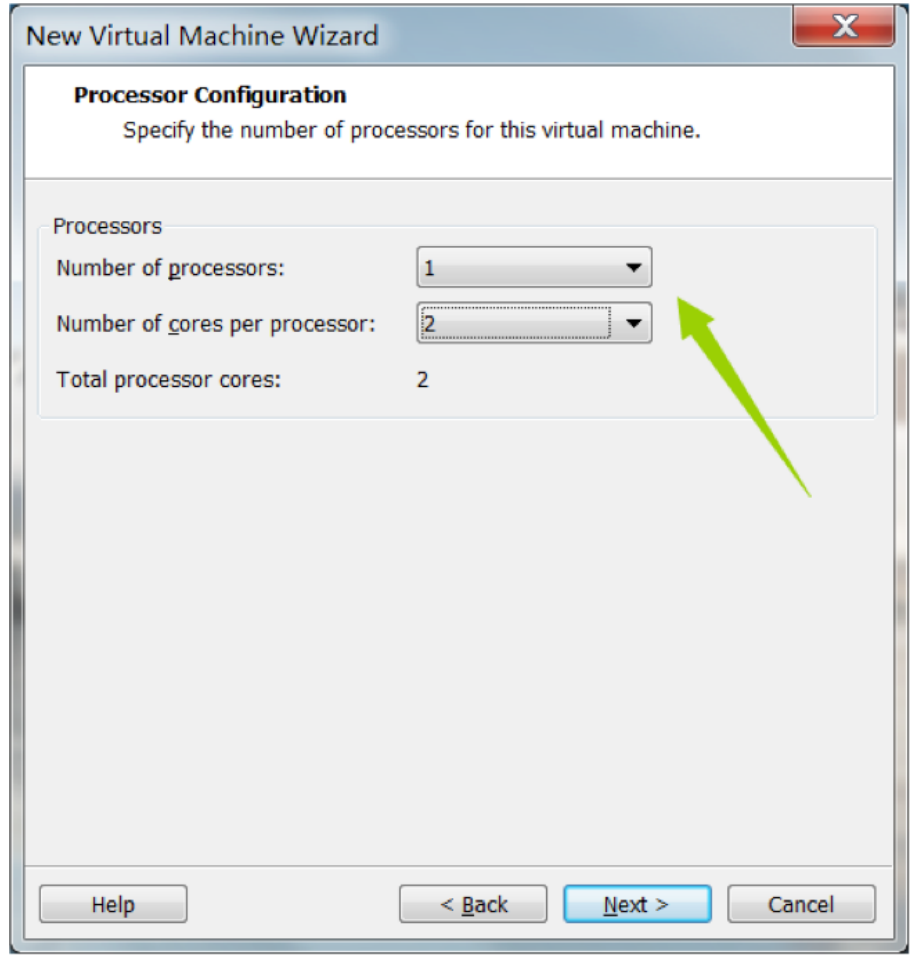
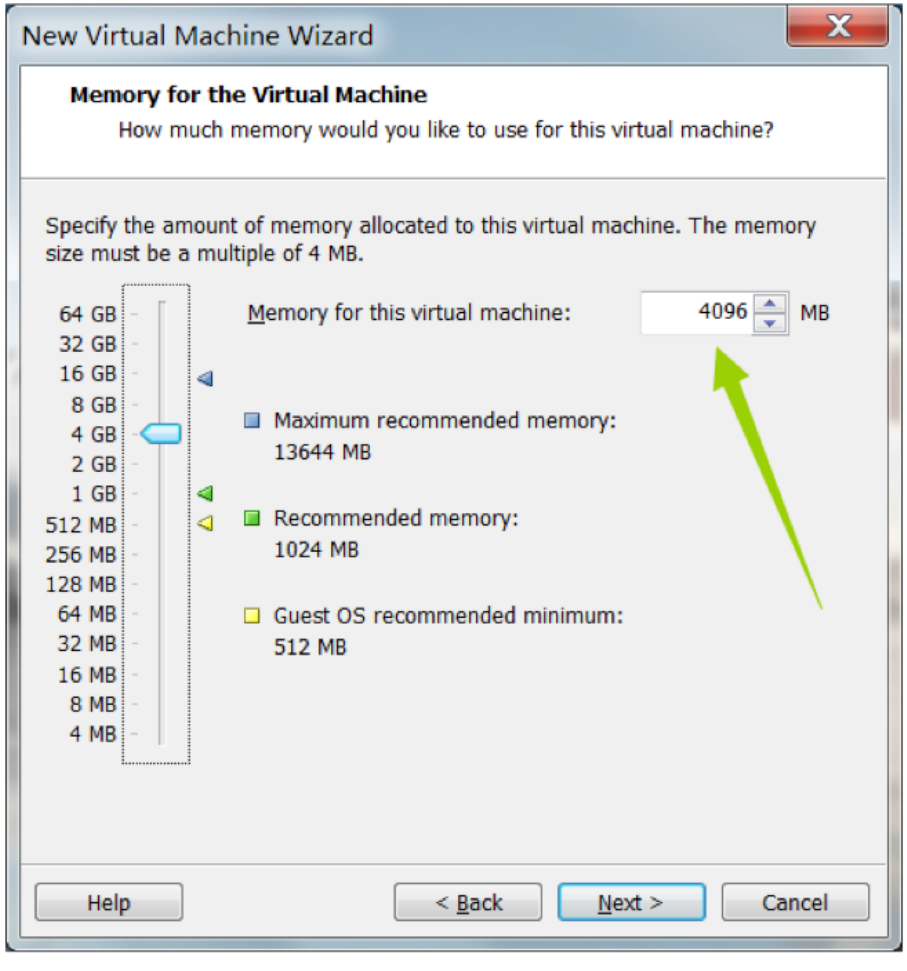
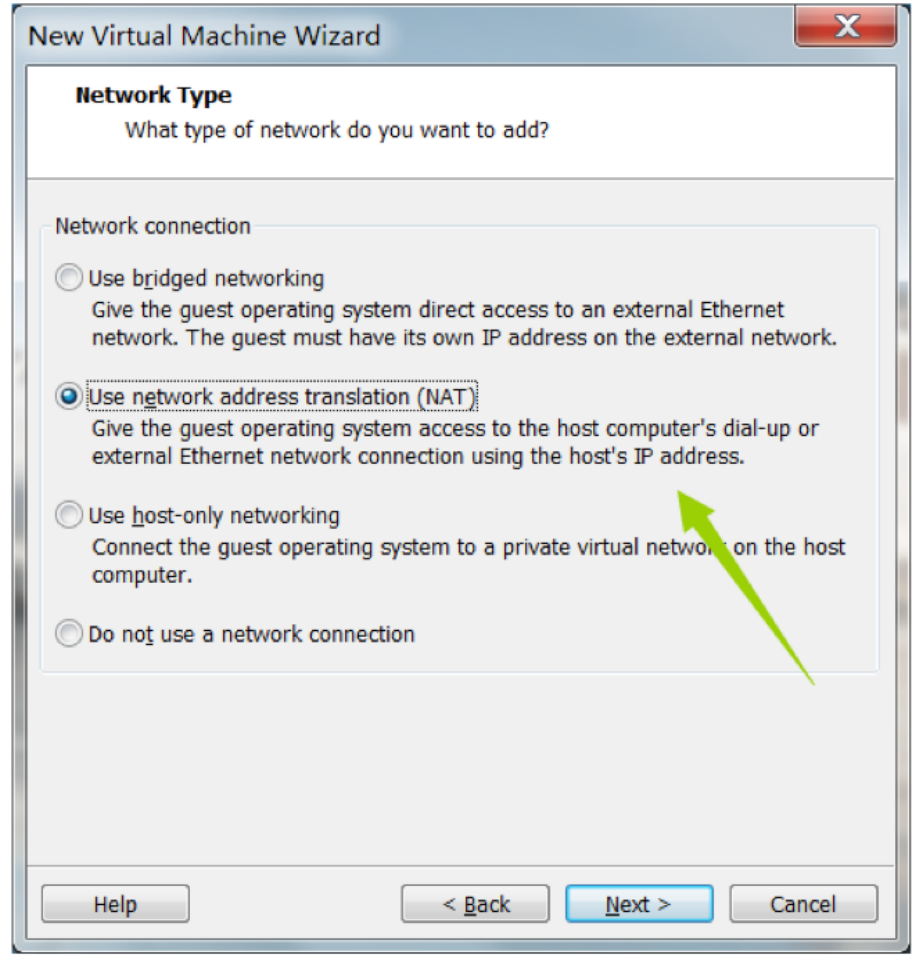


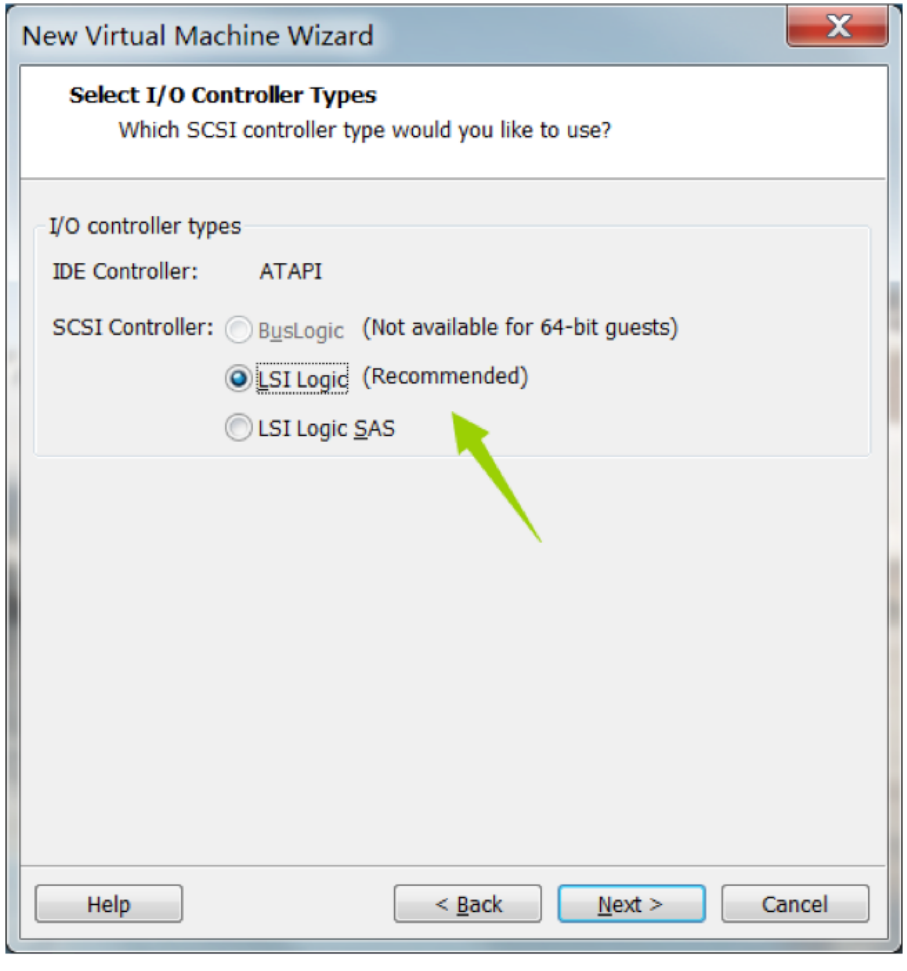


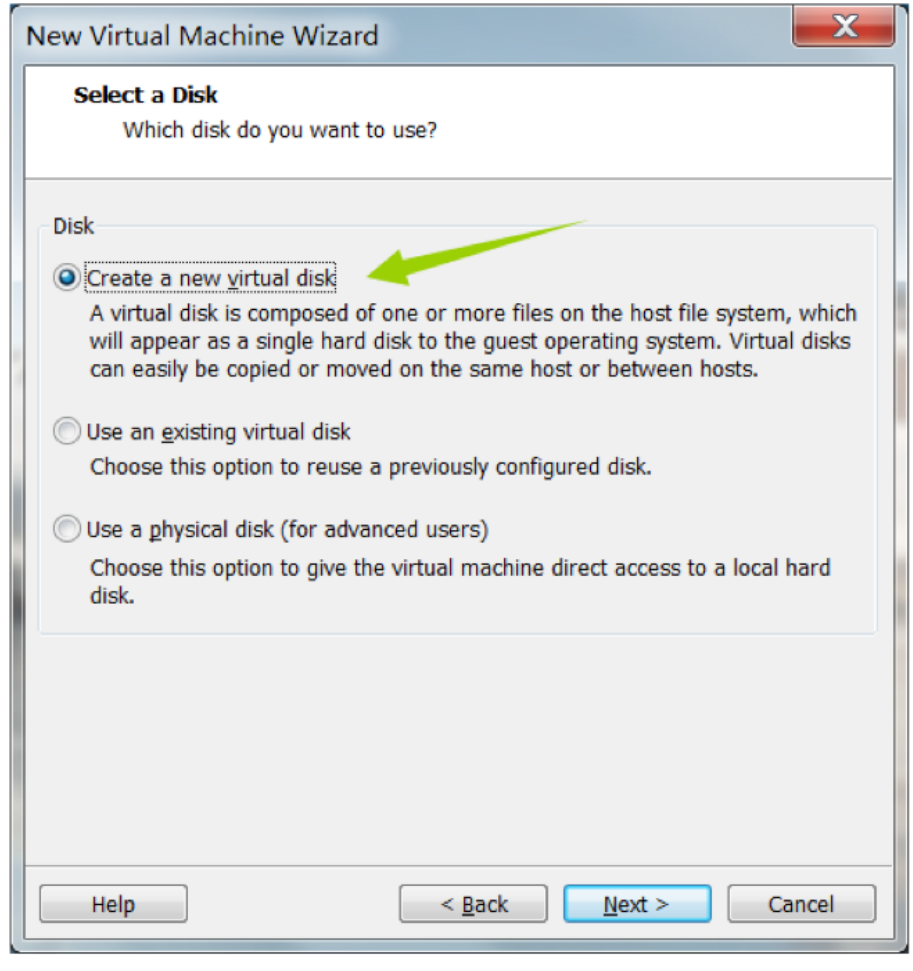
Create a Virtual Machine





Create a Virtual Machine





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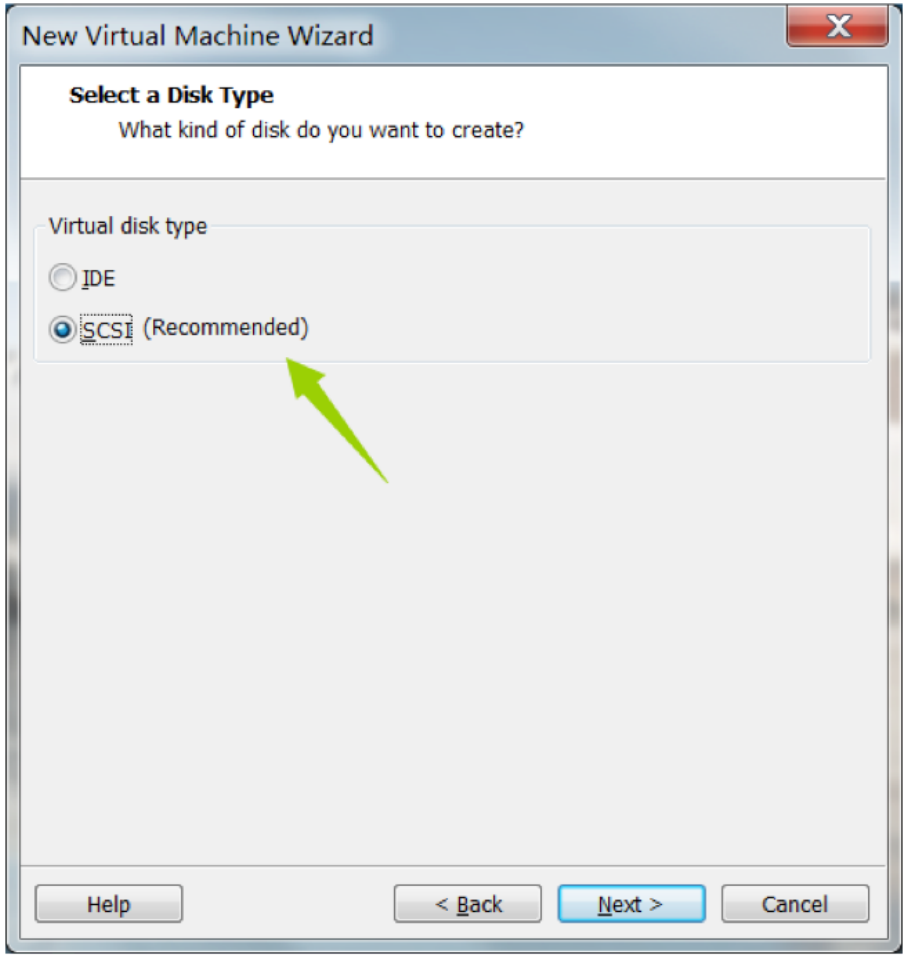

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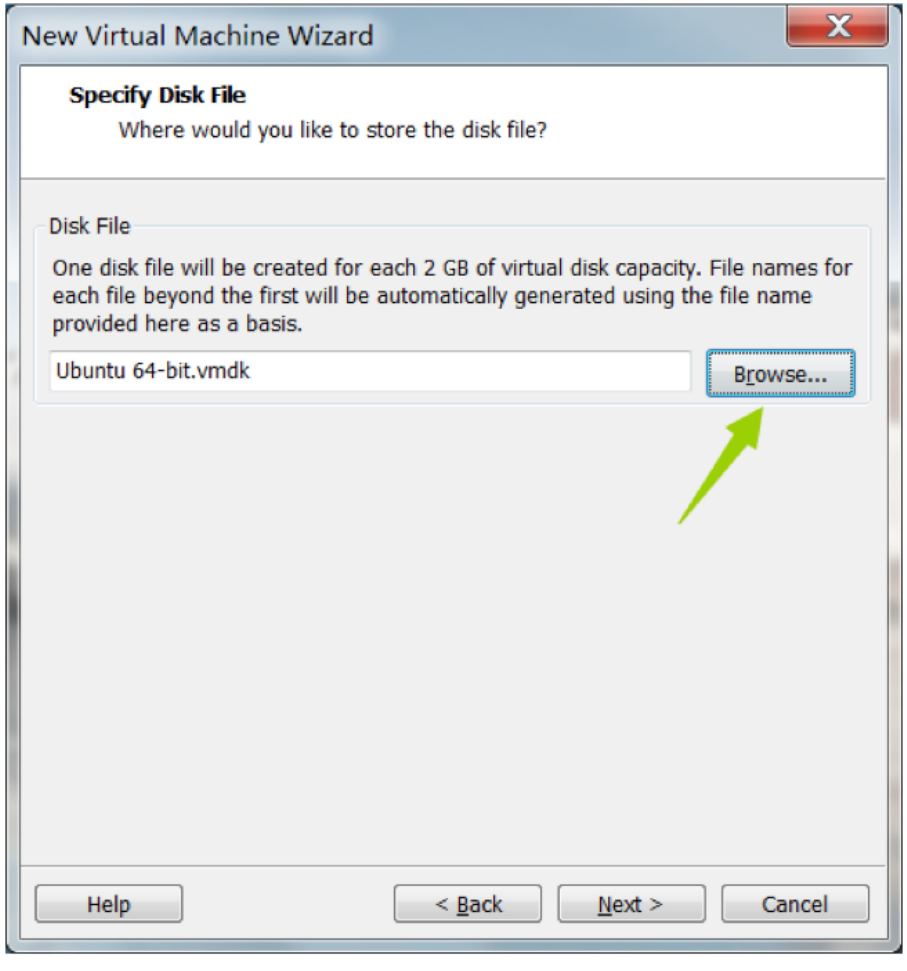

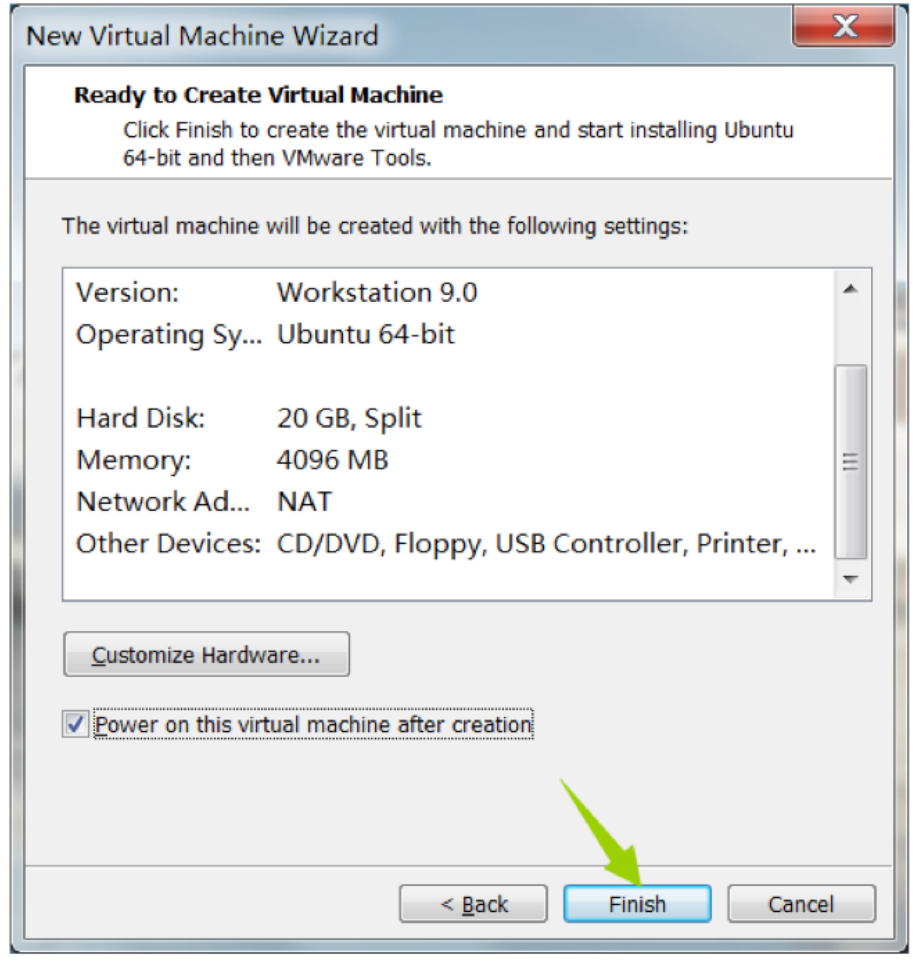

Create a Virtual Machine (Mac)

Mac Virtual Machine -- Parallels desktop

Parallels desktop

```
magnet:?
xt=urn:btih:B219AFA0B62595C6E303DCB2BCA7D23EC7B0CE35
```

ubuntu-14.04.5-desktop-i386.iso

```
magnet:?
xt=urn:btih:5EE7E1DC3E01F362B0E53BFEE9E4D6DCDEDAD61B
```

Create a Virtual Machine (Mac)

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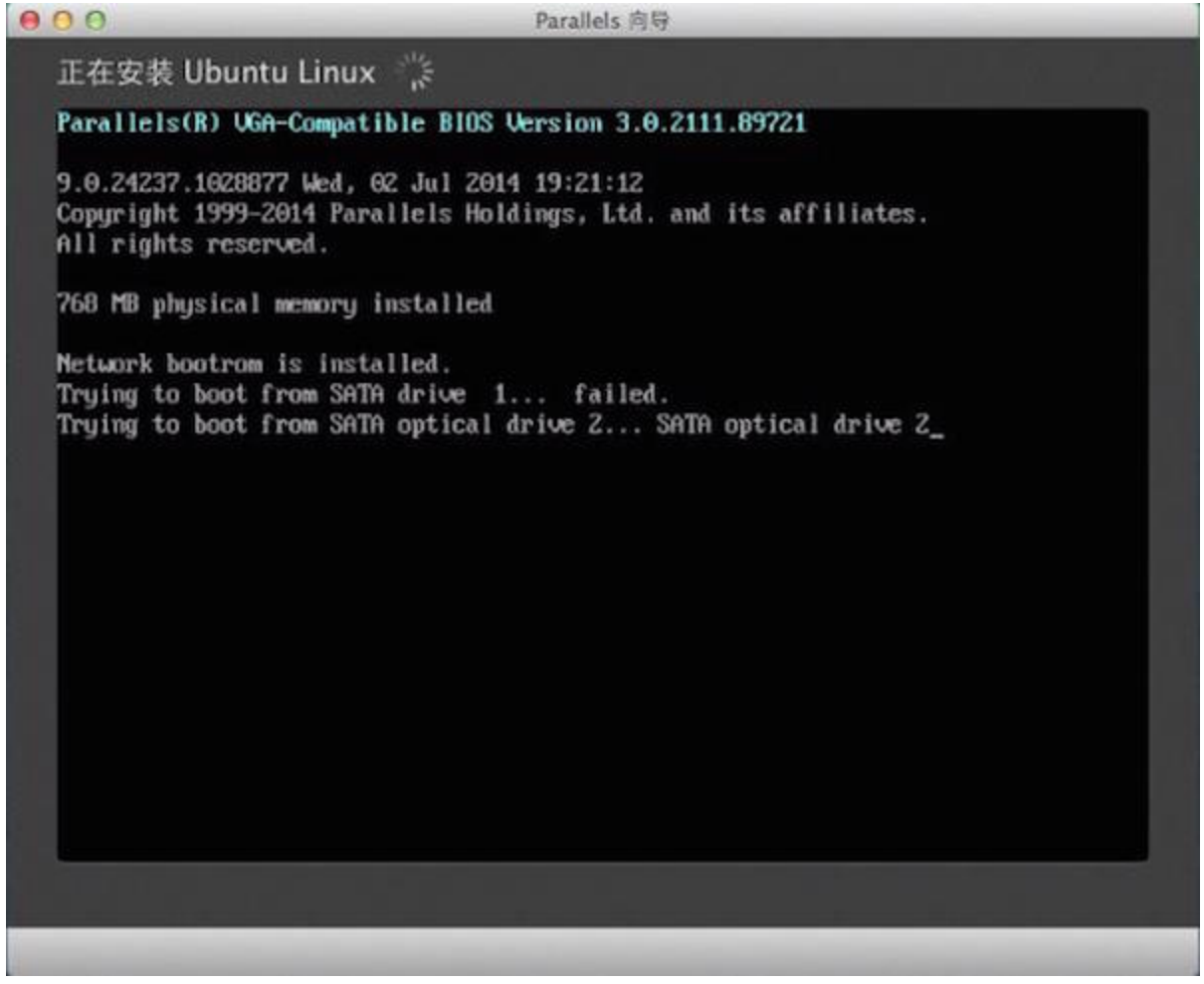

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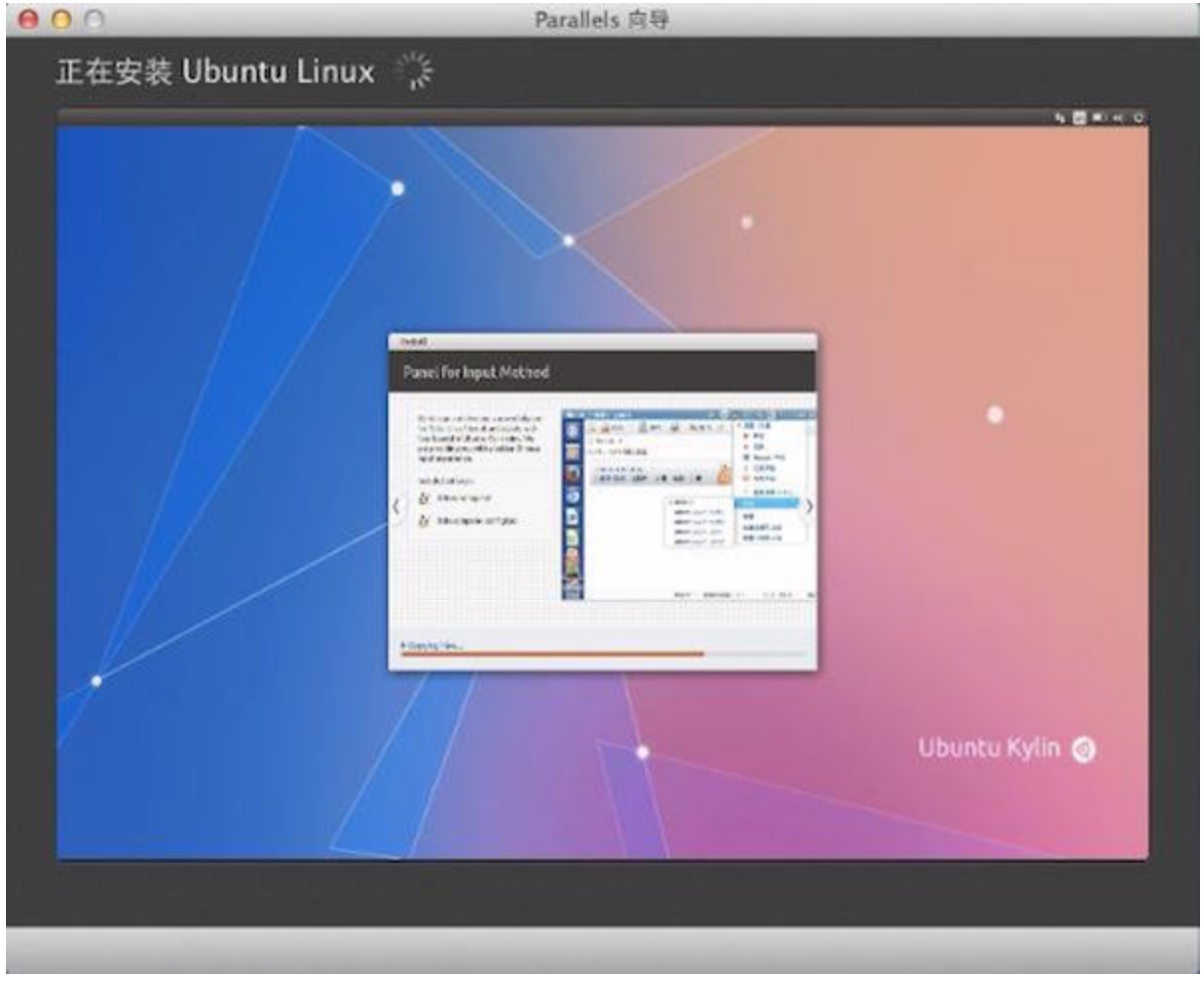

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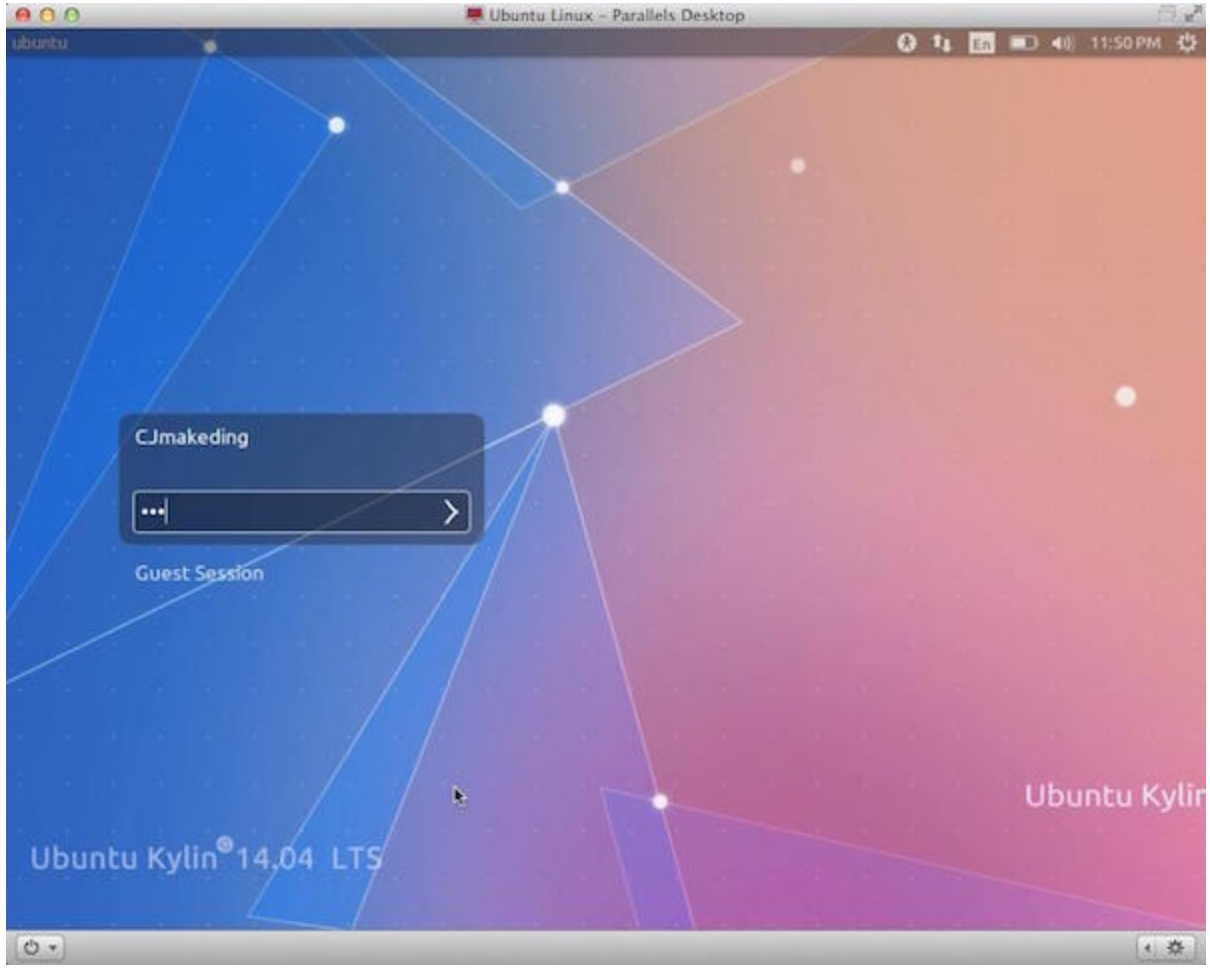

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Basic Commands

> command [-options] [arguments]

- `touch` `rename` `mv` `cp`
- `mkdir` `rmdir` `rm`
- `find` `grep`
- `>` `>>` `|` `xargs`
- `awk`
- `man` `help` `--help`

touch

```
touch class1.txt
```

rename

```
rename 's/oslab/oslab0/'  o*b?.txt
```

mv (move)

```
mv oslab.txt oslab1.txt
mv oslab01.txt oslab02.txt /home/oslab
```

cp (copy)

```
cp oslab03.txt /home/oslab
```

`mkdir` (make directory)

```
mkdir Lesson1/rename
```

`rmdir` (remove empty directory)

```
rmdir empty_directory
```

`rm` (remove)

`-r`	recursive
`-i`	interactive
`-f`	force

```
rm -rf ~/Lesson1/*
rm -i oslab04.txt
```

find

```
find ~ -name "*.txt"
```

grep

> globally search a regular expression and print

```
grep match_pattern file_name
grep apple oslab05.txt
grep -i apple oslab05.txt
```

`>` & `>>` (redirection)

```
cat oslab06.txt oslab07.txt > oslab08.txt
cat oslab06.txt oslab07.txt >> oslab08.txt
```

`|` (pipeline)

```
command1 | command2
cat oslab09.txt | grep jt
```

`xargs`

```
cat oslab09.txt | ls -l
cat oslab09.txt | xargs ls -l
```

`awk` (Aho, Weinberg & Kernighan)

AWK is a programming language designed for text processing and typically used as a data extraction and reporting tool.

> pattern { action }
> BEGIN、regular expression、END
> { function calls, variable assignments, calculations }

```
awk 'BEGIN { print "Hello, world!" }'
```

`man` (manual)

```
man ls
```

`help`

```
help cd
```

`--help`

```
ls --help
```

Wikipedia

> https://en.wikipedia.org/wiki/AWK

PART II

- Shell Script
- Compile & Debug (for C)
- Text Editor (Vim, Sublime text, Atom)

Variable

Define, Assignment & Read

```
VariableName=value
read VariableName
```

- no space between VarName and the equality sign
- first letter: a-z A-Z
- no keywords of shell

Use a variable

```
$VariableName
${VariableName}
```

Special Variables

```
$0  # filename of the script
$n  # the n-th argument
$#  # the number of the arguments
$HOME  # user directory
$$  # PID
```

Examples：

test1.sh

```
#!/bin/bash
read a
read b
c=$[($a+$b)**$a]
echo $c
```

with arguments

```
#!/bin/bash
echo $[($1+$2)**$1]
```

String

single quotes

```
str='no variables or escape character'
```

double quotes

```
v='variables'
str="$v or \"escape character\""
```

connecting

```
str1="connecting strings"
str2="simple"
str3=$str1" is "$str2
```

string length

```
${#string}
```

substring

```
${string:begin:len}
```

Example:

```
#!/bin/bash
str="alibaba is a great company"
echo ${#str}
echo ${str:1:4}
echo ${#str:1:4}
```

printf

differences from “printf” in C

- no ( )
- using space between two arguments

if the number of arguments is greater than the number of % in format, the format-string will be reused repeatedly

```
printf  “%s %s\n” 1 2 3 4
```

output:

```
1   2
3   4
```

Branches

```
if  [condition]
  then
    …
  else
    …
fi
```

or

```
if  [condition1]; then
  …
elif  [condition2]; then
  …
else
  …
fi
```

Operator

Numerical Comparison Operators

Operator	Remark
-eq	==
-ne	!=
-gt	>
-lt	<
-ge	>=
-le	<=

Other Operators

Operator	Remark
=	== for string
!=	!= for string
-z	If the string is empty
-f / -d	is file / is dir.
-r / -w / -x	check permission
-e	if a file/dir. exists

Example:

```
#!/bin/bash
YACCESS=`date -d yesterday +%Y%m%d`
FILE="access_$YACCESS.log.tgz"
if [ -f "$FILE" ];then
    echo "OK"
  else
    echo "error $FILE"
fi
```

Loop

```
for variable in list
  do
    …
done
```

```
while [ condition ]
  do
    …
done
```

```
break
continue
```

Example:

```
for FILE in $HOME/*
  do
    echo $FILE
done

count=0
while [ $count -lt 5 ]
  do
    count=$[$count+1]
    echo $count
done
```

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- Shell Script
- Compile & Debug (for C)
- Text Editor (Vim, Sublime text, Atom)

Compilation & Execution

`GCC` (GNU C Compiler → GNU Compiler Collection)

```
gcc test.c      # compile the C source file
```

produce an executable file named (by default) `a.out`

```
./a.out         # run the program a.out
```

Useful Options

```
gcc -o test test.c
gcc -g -o test test.c
gcc test.c -g -o test
```

Separate Compilation

complie a program with several separate files

```
gcc -c test1.c
gcc -c test2.c
gcc test1.o test2.o -o test
```

`-c` : compile to produce an object file, which is not executables just machine-level representations of the source code.

Linking with Libraries

Library

`lib+name.a`	(-static)
`lib+name.so`	(default)
`-l+name`	Link with libraries manually
`-L+lib's dir`	Give the directory manually

```
gcc hello.c -shared -o libhello.so
gcc test.c -lhello -L. -o test
export LD_LIBRARY_PATH=.:$LD_LIBRARY_PATH
```

```
gcc hello.c -c hello.o
ar -r libhello.a hello.o
gcc test.c -lhello -L. -static -o test
```

make↔Makefile

Build the program automatelly according to the makefile.

Makefiles are based on rules as:

```
target [target ...]: [component ...]
Tab↹ [command 1]
.
.
.
Tab↹ [command n]
```

```
hello.o: hello.c hello.h
Tab↹ gcc hello.c -c -g
```

Debugging with GDB (GNU debugger)

`gdb` Enter the gdb environment.

Command	Remark
file [file name]	load a excutable file
r	run
c	continue
b [line number] b [function name]	set Breakpoint
s, n	excute a line of source code
p [variable name]	print the value of a variable
q	quit
help [command]	

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Recommanded Editors

Sublime

Atom

Vim(CLI)

Superorities

Cross-platform

Extensible

Lightweight

Sublime

A sophisticated text editor for code, markup and prose

source: http://www.sublimetext.com/

Installation for Linux

via Package Manager(apt-get)

Install the GPG key:

```
wget -qO - https://download.sublimetext.com/
           sublimehq-pub.gpg | sudo apt-key add -
```

Select the channel to use:

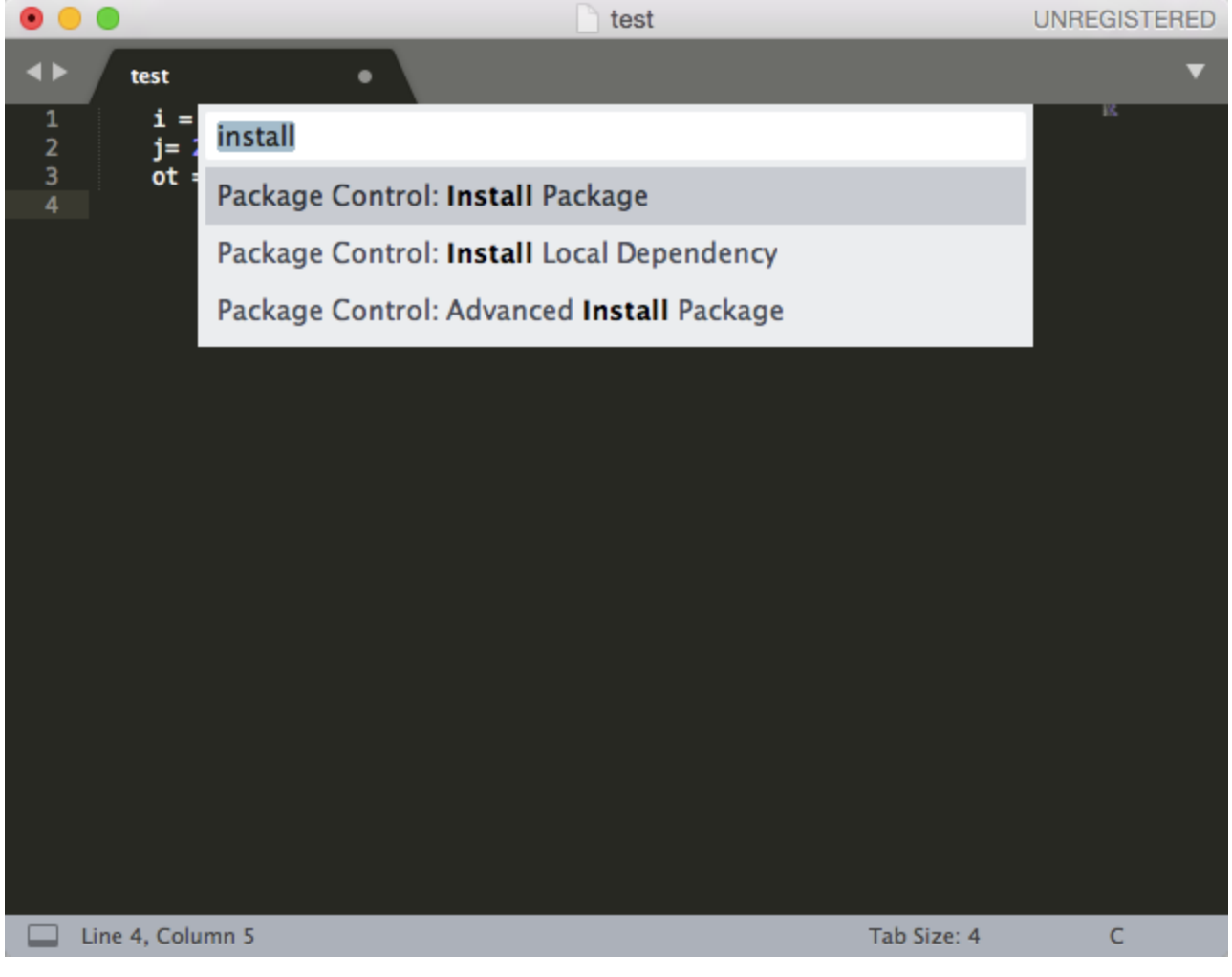
```
echo "deb https://download.sublimetext.com/ apt/stable/"
| sudo tee /etc/apt/sources.list.d/sublime-text.list
```

Update apt sources and install Sublime Text:

```
sudo apt-get update
sudo apt-get install sublime-text
```

Package Control

- go to Command Palette (ctrl+shift+p)
- type *install*
- you will see a list of plugins



Plugins

To see the list of plugins(Preferences=>Package Settings)

Alignment

For code alignment(ctrl+alt+a)

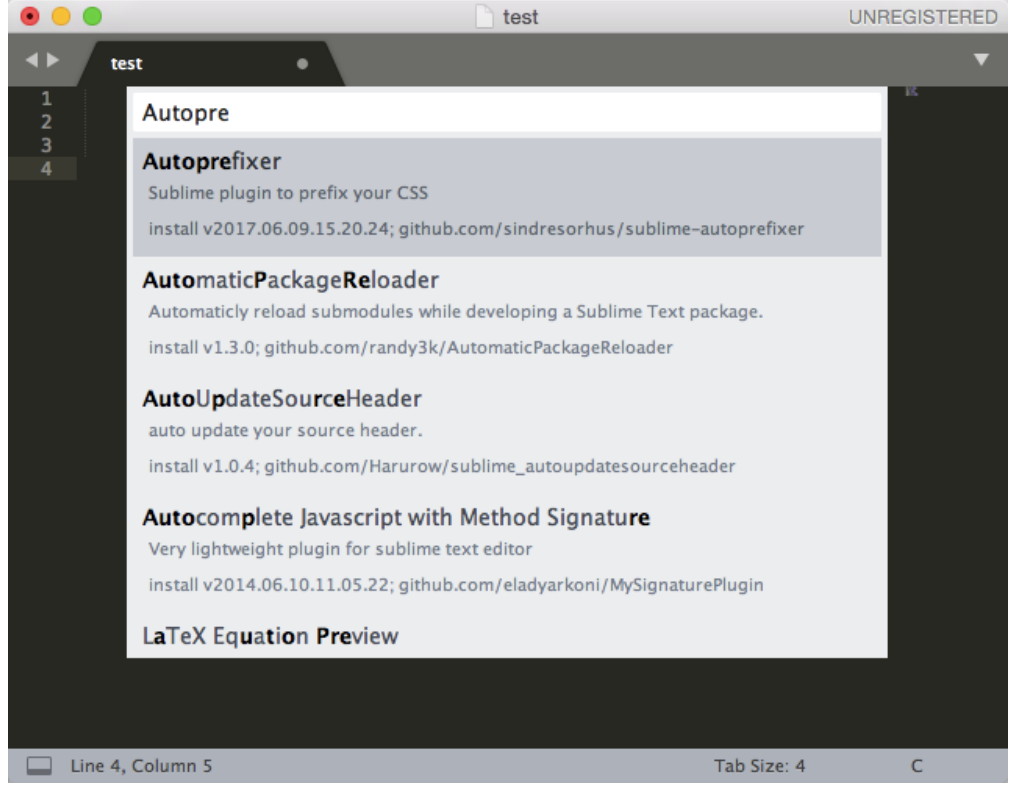
BracketHighlighter

For code highlighting

DictionaryAutoComplete

For dictionary completing

...



Atom

A hackable text editor for the 21st Century

source: https://atom.io/

Similar to Sublime

Installation for Linux

via Package Manager(apt-get)

```
sudo add-apt-repository ppa:webupd8team/atom
sudo apt-get update
sudo apt-get install atom
```

Vim 

Vim is a highly configurable text editor built to make creating and changing any kind of text very efficient.

Installation for Linux

via Package Manager(apt-get)

```
sudo apt-get install vim
vimtutor # obtain a vim tutorial
```

Creat a file

```
vim filename
```

Three Modes

Command Mode

all the keys are bound to commands (typing "j" -- it will move the cursor down one line)

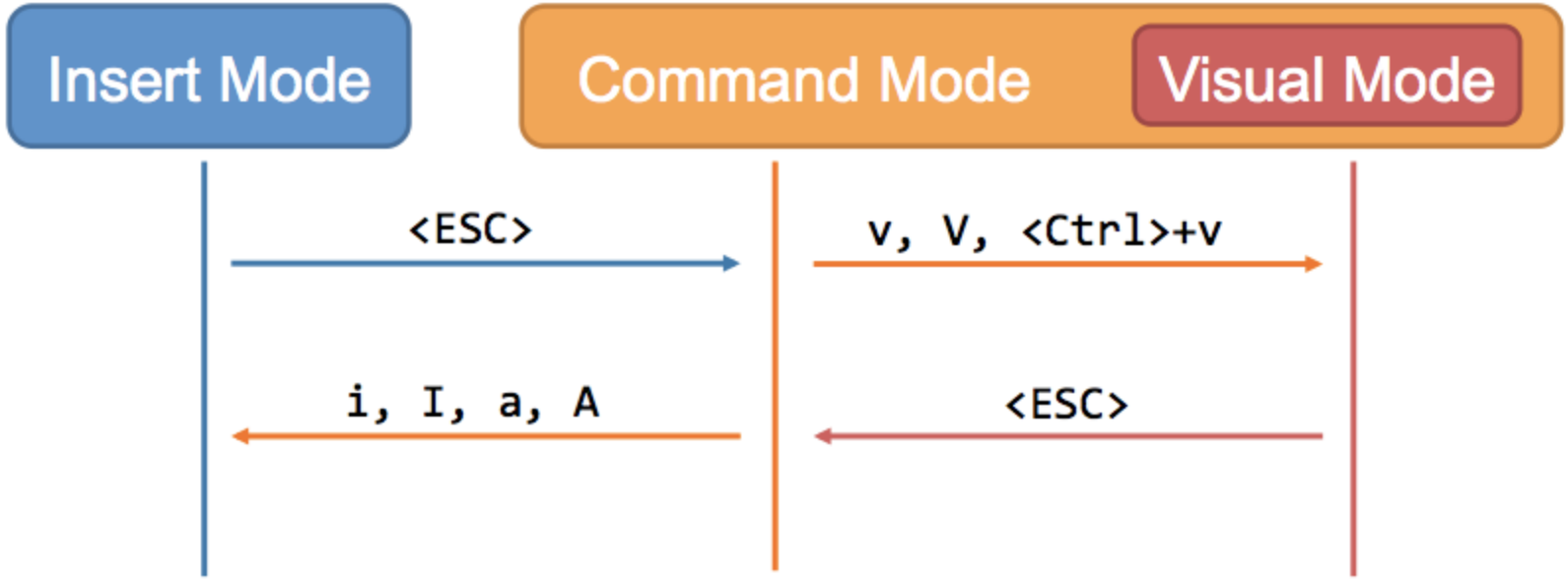
Insert Mode

all the keys are exactly keys (typing "j" -- inserting "j")

Visual Mode

helps to visually select some text, may be seen as a submode of the the command mode

Three Modes



Keys in command mode

Quit and Save

- `w` write the current buffer to disk (save)
- `q` close the current window
- `x` or `wq` save and close
- `q!` close without save

Scroll the Screen

downwards

- `ctrl+f` 1 page
- `ctrl+d` 1/2 page
- `ctrl+e` 1 line

upwards

- `ctrl+y` 1 page
- `ctrl+u` 1/2 page
- `ctrl+b` 1 line

Movement of the Cursor

- `h` moves the cursor one character to the left.
- `j` moves the cursor down one line.
- `k` moves the cursor up one line.
- `l` moves the cursor one character to the right.
- `0` moves the cursor to the beginning of the line.
- `$` moves the cursor to the end of the line.
- `w` moves forward one word.
- `b` moves backward one word.
- `G` moves to the end of the file.
- `gg` moves to the beginning of the file.
- `` `. `` moves to the last edit.