Lab 01: Linux Environment and C Programming – Compile/Run

CSCI3150 - Introduction to Operating Systems

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Linux Environment Installation

We provide you an image with the following configurations:

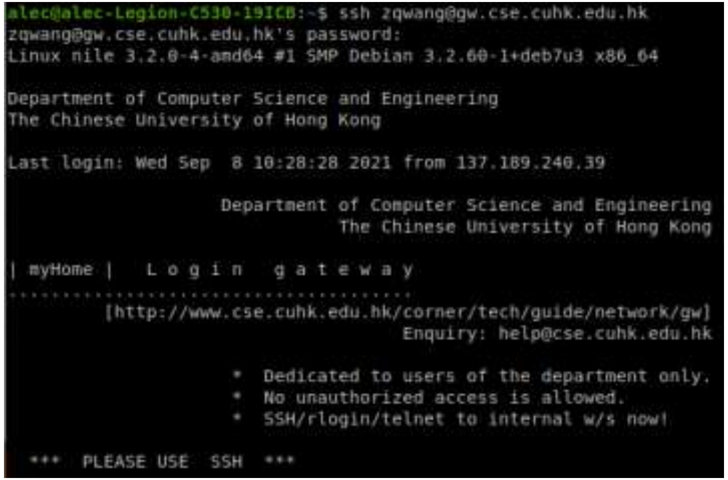
OS:	XUbuntu 18.04LTS (32 bit)
CPU:	4
Memory:	1GB
Disk:	10 GB
gcc:	7.4.0

- Please follow this link to install. Normally we will grade your assignments in this environment.
- Try to Google first when your see any error message.

Other Options to Access Linux – Remote Access

If you really cannot use VirtualBox in your computer:

- **CSE Linux server**
  - Mac Users
    1. Open a terminal
    2. Type "ssh YourUnixName@gw.cse.cuhk.edu.hk", and enter your unix password.
    3. Type "ssh linux2" to connect to the Linux server.



```
alec@alec-Legion-C530-19ICB:~$ ssh zqwang@gw.cse.cuhk.edu.hk
zqwang@gw.cse.cuhk.edu.hk's password:
Linux nile 3.2.0-4-amd64 #1 SMP Debian 3.2.60-1+deb7u3 x86_64

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Last login: Wed Sep  8 10:28:28 2021 from 137.189.240.39

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| myHome |   L o g i n   g a t e w a y
--------------------------------------
         [http://www.cse.cuhk.edu.hk/corner/tech/guide/network/gw]
                                     Enquiry: help@cse.cuhk.edu.hk

                      *  Dedicated to users of the department only.
                      *  No unauthorized access is allowed.
                      *  SSH/rlogin/telnet to internal w/s now!

  ***  PLEASE USE  SSH  ***
```

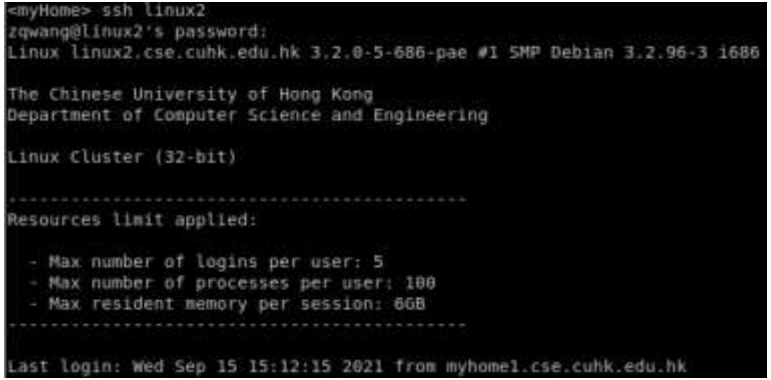

```
<myHome> ssh linux2
zqwang@linux2's password:
Linux linux2.cse.cuhk.edu.hk 3.2.0-5-686-pae #1 SMP Debian 3.2.96-3 i686

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Linux Cluster (32-bit)

--------------------------------------------
Resources limit applied:

  - Max number of logins per user: 5
  - Max number of processes per user: 100
  - Max resident memory per session: 6GB
--------------------------------------------

Last login: Wed Sep 15 15:12:15 2021 from myhome1.cse.cuhk.edu.hk
```
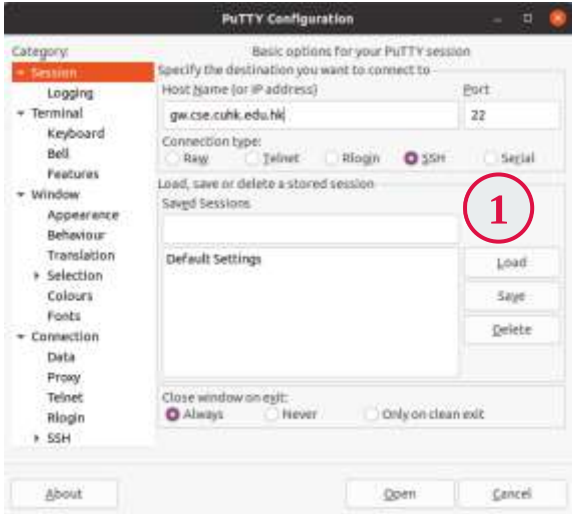

Other Options to Access Linux

If you really cannot use VirtualBox in your computer:

- CSE Linux server
  - Windows Users
    1. Install Putty
    2. Follow the steps in the Figures.



1

PuTTY Configuration

Basic options for your PuTTY session

Specify the destination you want to connect to

Host Name (or IP address): gw.cse.cuhk.edu.hk

Port: 22

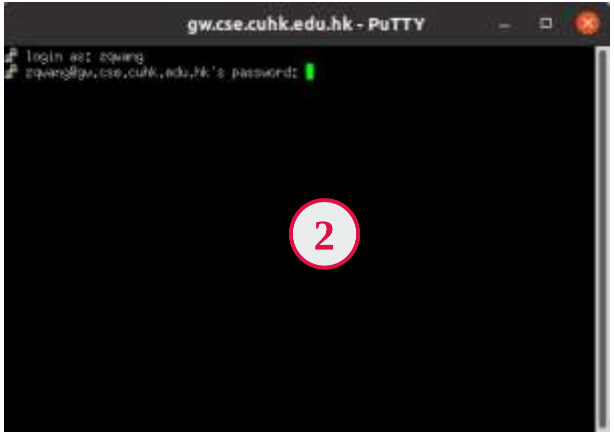
Connection type: ○ Raw ○ Telnet ○ Rlogin ● SSH ○ Serial

Load, save or delete a stored session

Saved Sessions

Default Settings

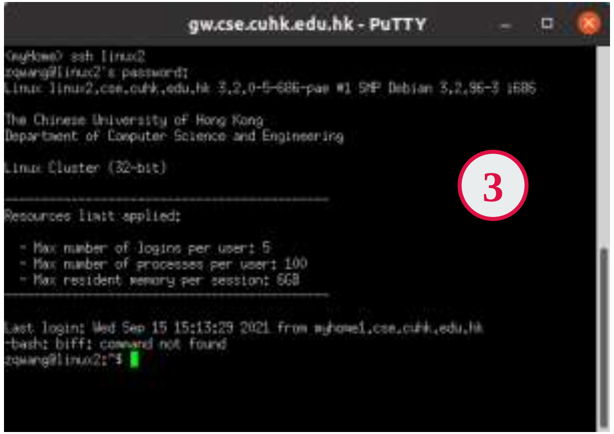
Close window on exit: ● Always ○ Never ○ Only on clean exit



2

gw.cse.cuhk.edu.hk - PuTTY

```
login as: zqwang
zqwang@gw.cse.cuhk.edu.hk's password:
```



3

gw.cse.cuhk.edu.hk - PuTTY

```
(myHome) ssh linux2
zqwang@linux2's password:
Linux linux2.cse.cuhk.edu.hk 3.2.0-5-686-pae #1 SMP Debian 3.2.96-3 i686

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Linux Cluster (32-bit)

--------------------------------------------------------
Resources limit applied:

  - Max number of logins per user: 5
  - Max number of processes per user: 100
  - Max resident memory per session: 6GB
--------------------------------------------------------

Last login: Wed Sep 15 15:13:29 2021 from myhome1.cse.cuhk.edu.hk
-bash: biff: command not found
zqwang@linux2:~$
```

Other Options to Access Linux

If you still cannot connect to CSE Linux server, other options may be:

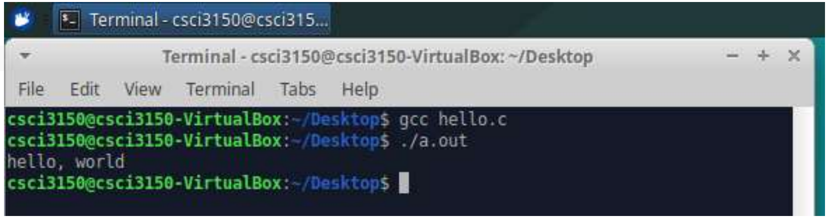
- Install a Linux distribution on your computer (Ubuntu, Debian, CentOS, Arch, etc.)
- Use Docker to access Linux (e.g. There are many materials on the Internet to access Ubuntu with Docker)
- ...

C Programing Review - Compile/Run

```c
/* header files go up here */
/* note that C comments are enclosed within a slash and a star, and may wrap
over lines */
// if you use gcc, two slashes will work too (and may be preferred)
#include <stdio.h>
/* main returns an integer */
int main(int argc, char *argv[])
{
        /* printf is our output function; by default, writes to standard
*/
        /* printf returns an integer, but we ignore that */
        printf("hello, world\n");
        /* return 0 to indicate all went well */
        return(0);
}
```

Compile the program:

```
prompt> gcc hello.c
prompt> ./a.out
```


Terminal - csci3150@csci315...
Terminal - csci3150@csci3150-VirtualBox: ~/Desktop
File
Edit
View
Terminal
Tabs
Help

```
csci3150@csci3150-VirtualBox:~/Desktop$ gcc hello.c
csci3150@csci3150-VirtualBox:~/Desktop$ ./a.out
hello, world
csci3150@csci3150-VirtualBox:~/Desktop$ 
```

Useful flags in gcc

```
gcc -o hw hello.c             # -o: to specify the executable name
gcc -Wall hello.c             # -Wall: gives much better warnings
gcc -g hello.c                # -g: to enable debugging with gdb
gcc -O hello.c                # -O: to turn on optimization
gcc –o hw -g -Wall hello.c    # Combine these flags
```

Makefile tutorial

```c
// hellomake.c

#include “hellomake.h”

int main() {
    // call a function in another file
    myPrintHelloMake();
    return(0);
}
```

```c
// hellofunc.c

#include <stdio.h>
#include <hellomake.h>

void myPrintHelloMake(void)
{
    printf("Hello makefiles!\n");
    return;
}
```

```c
// hellomake.h

void myPrintHelloMake(void);
```

To compile them:

```
gcc -o hellomake hellomake.c hellofunc.c -I .
```

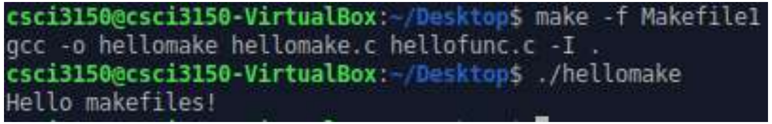
Makefile (first approach)

```
target:  dependency1 dependency2 ...

<tab> command
```

```
hellomake: hellomake.c hellofunc.c
	gcc -o hellomake hellomake.c hellofunc.c -I .
```

Suppose we name it Makefile1, then we compile with it:
make -f Makefile1



```
csci3150@csci3150-VirtualBox:~/Desktop$ make -f Makefile1
gcc -o hellomake hellomake.c hellofunc.c -I .
csci3150@csci3150-VirtualBox:~/Desktop$ ./hellomake
Hello makefiles!
```

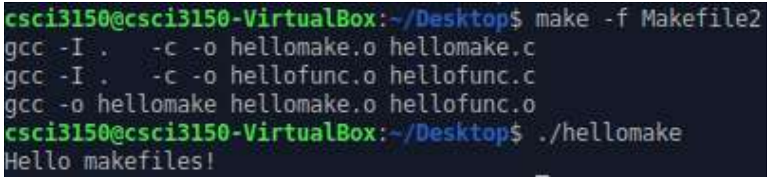
Makefile (second approach)

```
CC=gcc
CFLAGS=-I .

hellomake: hellomake.o hellofunc.o
        $(CC) -o hellomake hellomake.o hellofunc.o

clean:
        rm hellomake
```

Suppose we name it Makefile2, then we compile with it:
`make -f Makefile2`



```
csci3150@csci3150-VirtualBox:~/Desktop$ make -f Makefile2
gcc -I .   -c -o hellomake.o hellomake.c
gcc -I .   -c -o hellofunc.o hellofunc.c
gcc -o hellomake hellomake.o hellofunc.o
csci3150@csci3150-VirtualBox:~/Desktop$ ./hellomake
Hello makefiles!
```

Exercise (Deadline: Sep. 21 2022 23:59)

In the folder exercise, you can find a file ***main.c*** and two sub-folders: (1) foo; (2) bar. The ***main*** function in ***main.c*** will call the functions defined in foo/foo.c and bar/bar.c.

Under the folder exercise, there is a Makefile that will compile the main.c together with foo/foo.c and bar/bar.c and generate an executable file ***lab1***. You need to fill your code in Makefile.

Please only submit the ***Makefile*** to blackboard after you finish.