CSC9006 Real-Time Systems (Spring 2020) Homework 0

** **Submission deadline: 9PM, March 11th, 2021.** **

1. Introduction

Throughout this semester, each student will individually work on homework assignments on a native Linux operating system. In Homework 0 (i.e., this one), we will go through the process of setting up the needed environment.

2. Linux Installation and Setup

2.1 Linux Installation

Follow the instruction on Ubuntu's website to download and install Ubuntu Linux Desktop 20.04 LTS on your PC/Laptop. I recommend installing via a USB flash drive. Note that **you should NOT use virtual machines or WSL** – in this course we will measure the timing of program execution, and using VM or WSL may lead to a very different result. Click here for download link and installation guide for Ubuntu Linux.

You might need to disable the "secure boot" option in BIOS in order to boot from your USB flash drive. For example, take a look at this guide. You may re-enable the secure boot after installation.

If you're trying to install Ubuntu Linux alongside with Windows 10 (if not, you may skip the rest of this subsection), it might take some more effort to make it work. The following steps work for me on my Windows 10 laptop. **It is safer to first back up your data to some other disk/cloud storage**. Keep in mind that, depending on your hardware/software configuration, you might need to do some extra steps:

1. First, in Windows 10, either save the BitLocker recovery key (for example, see 2:11-3:00 in this video), or turn off the BitLocker (example instruction).
2. Follow the instruction to allocate some free disk space and set up for dual-boot. *Perform Step 1 only*: https://www.tecmint.com/install-ubuntu-alongside-with-windows-dual-boot/ For this course, 70GB free disk space is well enough.
3. Follow the official installation guide. At step #6, different from the screenshot on the web page, you might see an option saying "Install Ubuntu alongside Windows Boot Manager", which will install Ubuntu using the free space you allocated.
4. After the installation, if your Linux machine froze before reboot, no worry. You may recover your machine by pressing these key combinations.

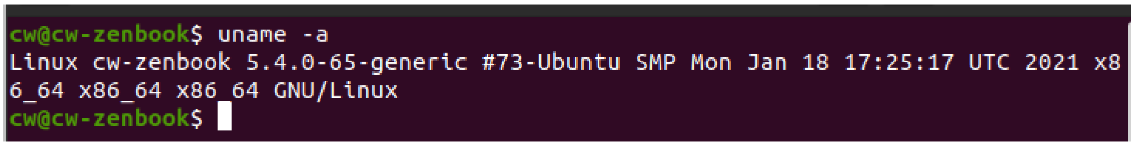
5. After the first reboot, if you found that you cannot log in Windows 10, don't panic. If you've saved the BitLocker recovery key, you may use the key to fix the issue. Otherwise, you may follow this video to reboot into the BIOS (0:25-1:02 in the video). In the BIOS make sure you've re-enabled the secure boot. Change the boot priority to boot Windows 10 first. Then you should be able to log in Windows again. Save the BitLocker recovery key, reboot into the BIOS, change the boot priority to boot Ubuntu first, and then upon reboot use the recovery key to fix the issue.

2.2 Verify Your Installation

After installation, boot into the Ubuntu desktop, click "Activities" on the top-left corner of the screen, and search for "terminal" to open a window of command-line interface. This is the environment we will work on throughout this semester.

Now, do the following three steps in the terminal:

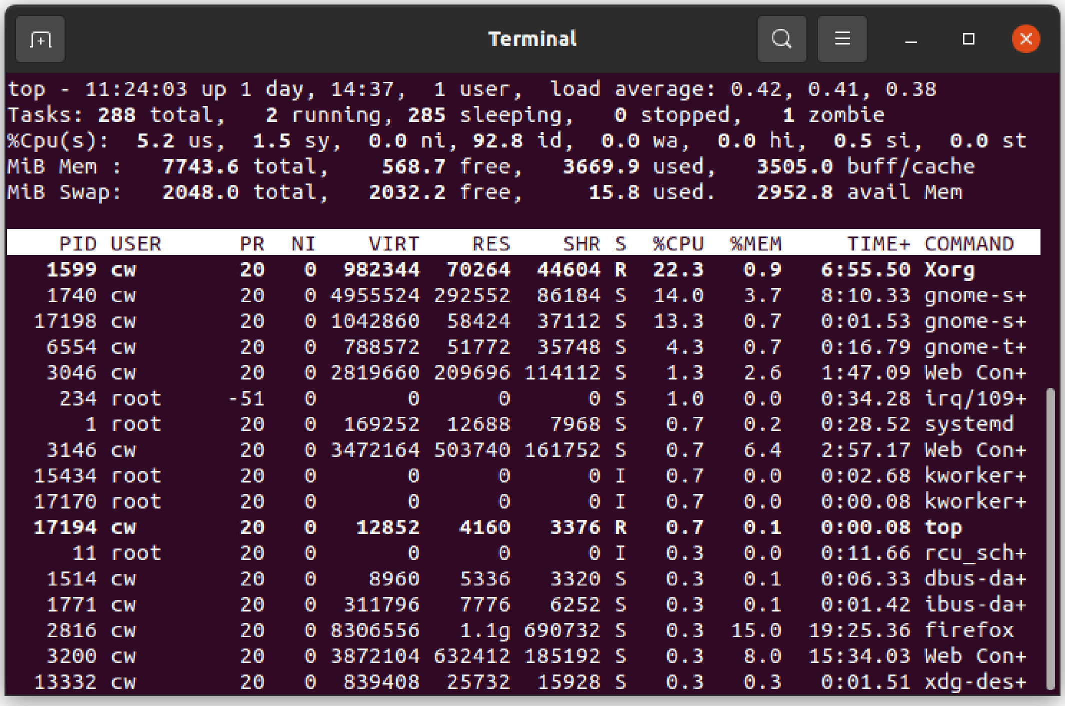
1. First, type `uname -a`, hit the Enter key, and take a screenshot and name it **shot1.png** (There is a built-in App for taking screenshots; search for it in "Activities"):



```
cw@cw-zenbook$ uname -a
Linux cw-zenbook 5.4.0-65-generic #73-Ubuntu SMP Mon Jan 18 17:25:17 UTC 2021 x8
6_64 x86_64 x86_64 GNU/Linux
cw@cw-zenbook$ 
```

   `uname` is a Linux utility that shows system information. Type `man uname` at the terminal prompt to learn more about how to use `uname`. `man` is a shorthand for manual pages.

2. Then, type `top`, hit the Enter key, and take a screenshot and name it **shot2.png**:

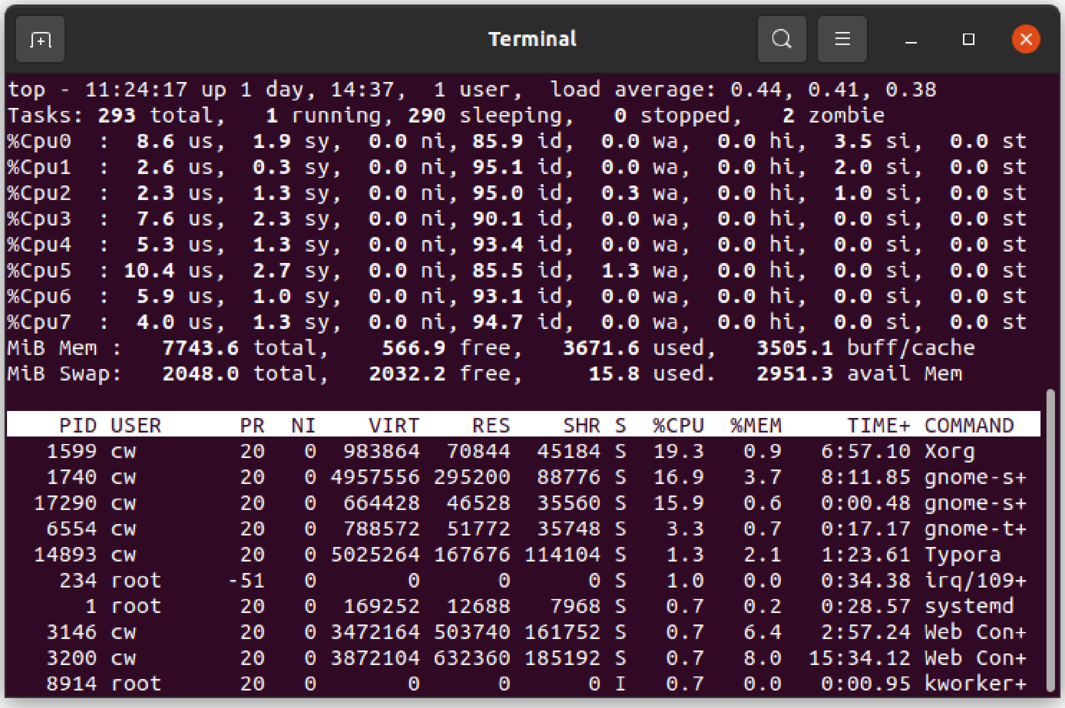


```
top - 11:24:03 up 1 day, 14:37,  1 user,  load average: 0.42, 0.41, 0.38
Tasks: 288 total,   2 running, 285 sleeping,   0 stopped,   1 zombie
%Cpu(s):  5.2 us,  1.5 sy,  0.0 ni, 92.8 id,  0.0 wa,  0.0 hi,  0.5 si,  0.0 st
MiB Mem :   7743.6 total,   568.7 free,   3669.9 used,   3505.0 buff/cache
MiB Swap:   2048.0 total,  2032.2 free,     15.8 used.   2952.8 avail Mem

    PID USER      PR  NI    VIRT    RES    SHR S  %CPU  %MEM     TIME+ COMMAND
   1599 cw        20   0  982344  70264  44604 R  22.3   0.9   6:55.50 Xorg
   1740 cw        20   0 4955524 292552  86184 S  14.0   3.7   8:10.33 gnome-s+
  17198 cw        20   0 1042860  58424  37112 S  13.3   0.7   0:01.53 gnome-s+
   6554 cw        20   0  788572  51772  35748 S   4.3   0.7   0:16.79 gnome-t+
   3046 cw        20   0 2819660 209696 114112 S   1.3   2.6   1:47.09 Web Con+
    234 root     -51   0       0      0      0 S   1.0   0.0   0:34.28 irq/109+
      1 root      20   0  169252  12688   7968 S   0.7   0.2   0:28.52 systemd
   3146 cw        20   0 3472164 503740 161752 S   0.7   6.4   2:57.17 Web Con+
  15434 root      20   0       0      0      0 I   0.7   0.0   0:02.68 kworker+
  17170 root      20   0       0      0      0 I   0.7   0.0   0:00.08 kworker+
  17194 cw        20   0   12852   4160   3376 R   0.7   0.1   0:00.08 top
     11 root      20   0       0      0      0 I   0.3   0.0   0:11.66 rcu_sch+
   1514 cw        20   0    8960   5336   3320 S   0.3   0.1   0:06.33 dbus-da+
   1771 cw        20   0  311796   7776   6252 S   0.3   0.1   0:01.42 ibus-da+
   2816 cw        20   0 8306556   1.1g 690732 S   0.3  15.0  19:25.36 firefox
   3200 cw        20   0 3872104 632412 185192 S   0.3   8.0  15:34.03 Web Con+
  13332 cw        20   0  839408  25732  15928 S   0.3   0.3   0:01.51 xdg-des+
```

   `top` is a Linux utility to display current system activities. Type `man top` to learn more about the usage of `top`.

3. Finally, hit key "1" when running `top`, and take a screenshot and name it **shot3.png**. This displays the utilization of each CPU core:



```
top - 11:24:17 up 1 day, 14:37,  1 user,  load average: 0.44, 0.41, 0.38
Tasks: 293 total,   1 running, 290 sleeping,   0 stopped,   2 zombie
%Cpu0  :  8.6 us,  1.9 sy,  0.0 ni, 85.9 id,  0.0 wa,  0.0 hi,  3.5 si,  0.0 st
%Cpu1  :  2.6 us,  0.3 sy,  0.0 ni, 95.1 id,  0.0 wa,  0.0 hi,  2.0 si,  0.0 st
%Cpu2  :  2.3 us,  1.3 sy,  0.0 ni, 95.0 id,  0.3 wa,  0.0 hi,  1.0 si,  0.0 st
%Cpu3  :  7.6 us,  2.3 sy,  0.0 ni, 90.1 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu4  :  5.3 us,  1.3 sy,  0.0 ni, 93.4 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu5  : 10.4 us,  2.7 sy,  0.0 ni, 85.5 id,  1.3 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu6  :  5.9 us,  1.0 sy,  0.0 ni, 93.1 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu7  :  4.0 us,  1.3 sy,  0.0 ni, 94.7 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
MiB Mem :   7743.6 total,    566.9 free,   3671.6 used,   3505.1 buff/cache
MiB Swap:   2048.0 total,   2032.2 free,     15.8 used.   2951.3 avail Mem

    PID USER      PR  NI    VIRT    RES    SHR S  %CPU  %MEM     TIME+ COMMAND
   1599 cw        20   0  983864  70844  45184 S  19.3   0.9   6:57.10 Xorg
   1740 cw        20   0 4957556 295200  88776 S  16.9   3.7   8:11.85 gnome-s+
  17290 cw        20   0  664428  46528  35560 S  15.9   0.6   0:00.48 gnome-s+
   6554 cw        20   0  788572  51772  35748 S   3.3   0.7   0:17.17 gnome-t+
  14893 cw        20   0 5025264 167676 114104 S   1.3   2.1   1:23.61 Typora
    234 root     -51   0       0      0      0 S   1.0   0.0   0:34.38 irq/109+
      1 root      20   0  169252  12688   7968 S   0.7   0.2   0:28.57 systemd
   3146 cw        20   0 3472164 503740 161752 S   0.7   6.4   2:57.24 Web Con+
   3200 cw        20   0 3872104 632360 185192 S   0.7   8.0  15:34.12 Web Con+
   8914 root      20   0       0      0      0 I   0.7   0.0   0:00.95 kworker+
```

2.3 Set Up a Programming Environment

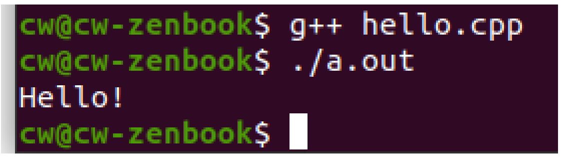
On your terminal, type the following to install the needed packages:

`sudo apt install build-essential`

Create a hello-world C++ program that prints out "Hello!". Name your source code as hello.cpp, and compile it by typing

`g++ hello.cpp`

Execute the compiled file, and take a screenshot and name it **shot4.png**:



```
cw@cw-zenbook$ g++ hello.cpp
cw@cw-zenbook$ ./a.out
Hello!
cw@cw-zenbook$ 
```

Congratulations! Now you have successfully set up a working environment for this course.

3. Things to Submit to Moodle

First, package the following items into one .tar.gz file:

```
1. Your four screenshots as instructed above;
```

2. Your hello.cpp.

Type the following to pack them into a single archive:

`tar zcvf [your_student_ID.tar.gz] [filenames, seprated by space and/or using regular expressioin]`

For example, in your homework folder, type

`tar zcvf 60740000.tar.gz *.png hello.cpp`

Submit the resulting single package to Moodle and you are done. You will receive zero score if you failed to do so.

You may type the following to verify the content of your package ('l' for list):

```
tar l 60745678.tar.gz
```

Type `man tar` to learn more about how to use `tar`.

4. Optional: Working with Git

Your are encouraged to use Git the version control system for all homework assignments. We will do a lot of programming, and it is a good idea to use tools like Git to manage your code.

GitHub is a very useful online repository for Git. In the following we briefly introduce how to use Git and GitHub:

First, create a free account on GitHub: https://github.com/

Then complete this tutorial: https://guides.github.com/activities/hello-world/ and create a repository.

Now, type the following command in your terminal to install Git:

```
$ sudo apt install git
```

Then clone your GitHub repo by typing

```
$ git clone [the URL to your GitHub repo]
```

Some example commands:

Add files to your local repo by typing

```
$ git add [filename]
```

Look up the current status of the repo by typing

```
$ git status
```

To undo the change made to a certain file that is not committed yet, you can type

```
$ git checkout [filename]
```

Commit your changes by typing

```
$ git commit -m "[your note message for this commit]"
```

Push to your GitHub repo your commit by typing

```
$ git push origin master
```

Learn more about Git and its use online, e.g., https://backlog.com/git-tutorial/tw/intro/intro1_1.html

Should you have any questions, post them on Moodle. We are CSC9006 community!

That's all for this homework assignment.