CS 322 - Operating Systems
Homework 1
Exploring Unix and OS Processes
Due: February 5, 11:30 PM

Please type up your answers to these questions and submit on gradescope.

1. I would like you to explore the behavior of some programs and begin to see the difference between user programs and kernel programs. To do this, we will use the Activity Monitor application on Mac OS. Its icon looks like ![Activity Monitor]. You will either find it in the Dock, or in the Applications/Utilities folder. Start Activity Monitor. Activity Monitor displays information about processes including their name, the user who is running the program, the percent of CPU time being used by the process and the amount of memory used by the process.

You can sort the process list by clicking on any of its column titles.

Below the list of processes you will see some summary information. Above the list of processes, you will see some buttons that control what is displayed in the summary. The buttons are CPU, Memory, etc.

For this question, I would like you to explore what your computer is spending its time and memory doing.

a. (1 point) Please give some identifying information about your computer. What model computer is it? Do you own it or is it owned by the college? If it is owned by the college, what room is the computer in?

b. (1 point) How many processes are running? You should see your user id listed as the User for many processes. What other user ids show up frequently?

c. (2 points) Click on the %CPU column. This will sort the processes by the %CPU time each process is using. What are the top 5 processes on the list and how much CPU time is each using? Do the order of the processes and amount of time change much? Are these processes that you are actively using?

d. (2 points) In the summary window, what % time is used by User? By System? What % of the time is the CPU idle? You should see that the CPU is idle a lot. If that is not the case, please investigate further to identify what the processes are doing that are using most of the CPU time.

e. (2 points) Now click on the Memory button and sort by the Memory column. Which processes are at the top? Does this list change much? Why do you think you see the behavior that you see?

f. (1 point) How much memory does this computer have (shown in the summary)? How much of that memory is being used?

g. (1 point) Which of the resources, CPU or Memory, is used closer to its capacity?

2. Start the Terminal application. (You can do this on Mac or on Linux.)

a. (3 points) Enter the command "ls" and then the command "ls &". In the first case Terminal is running ls in the "foreground", while in the second case Terminal is running ls in the "background". What is different about these two commands from the
user’s perspective? What is the shell doing differently to execute these two commands?

b. (3 points) Enter the command “exec bash”. Then enter the command “exec ls”. You should observe that you can execute more shell commands after ”exec bash” but you cannot enter more shell commands after ”exec ls”. Why is that?

3. (4 points) Do questions 4-7 in the text at the end of chapter 4. These are excellent exercises to help you understand how the CPU gets shared between multiple processes. To do the exercise you will need to download a Python script from the textbook’s website. The homework page is http://pages.cs.wisc.edu/~remzi/OSTEP/Homework/home-work.html. You can run the simulator on any computer that has Python 2. (The scripts do not work with Python 3.) The Linux VM that you installed last week has Python 2. Use the -c flag to check your understanding. The only answer that I want you to turn in is the answer to the ”why” part of question 7.