CSE-381: Systems 2

Homework #3: Part B

Due: Tuesday September 25 2018 before 11:59 PM (Midnight)

Email-based help Cutoff: 5:00 PM on Sun, Sept 23 2018

Maximum Points for This Part: 25

Objective

The objective of this part of the homework is to develop 1 C++ program to:

- Print process hierarchy for a given PID (process ID)
- Gain familiarity with developing a C++ class
- Continue to gain familiarity with development and testing of C++ programs
- Continue to bolster concepts of stream/file processing.
- Review basics of string processing & problem solving
- Continue to gain familiarity with the use of `std::unordered_map`

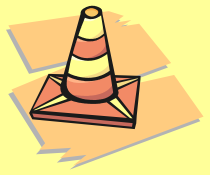
Submission Instructions

This part of the homework assignment must be turned-in electronically via Canvas using the CODE plugin. See video for using the plug-in at: https://youtu.be/P2bWUt5KqbU. Ensure your program compiles without any warnings or style violations. Ensure you have tested operations of your program as indicated. Once you have tested your implementation, upload the following onto Canvas:

- Just the one C++ header file and 1 C++ source file with the naming convention `MUID_hw3.h` and `MUID_hw3.cpp`, where `MUID` is your Miami unique ID.

General Note: Upload each file associated with homework (or lab exercises) individually to Canvas. Do not upload archive file formats such as zip/tar/gz/7zip/rar etc.

Grading Rubric:



The programs submitted for this homework **must pass necessary base case test(s) in order to qualify for earning any score at all.** Programs that do not meet base case requirements will be assigned zero score!
Program that do not compile, have a method longer than 25 lines, or just some skeleton code will be assigned zero score.

- **Base case points**: 5 points
- **Additional tests**: 15 points
- **Overall C++ class design, code quality, design, code reuse, documentation etc.**: 5 points. These points are typically the hardest to earn in more advanced courses.

Develop a C++ program to print full process hierarchy

Objective

The objective of this program (developed as a C++ class) is to print the full hierarchy of processes (starting with `/sbin/init`) for a given PID (process ID, specified as a command-line argument). The data about processes is read from a given text file (as command-line argument).

Essentially this program automates the manual process of tracing the Linux process hierarchy that was done as part of an earlier lab exercise. Refer to the earlier lab exercise of using the output of `ps -fe` to trace processes to recollect the manual process of tracing the process hierarchy.

Background

In Linux, processes are organized as a tree, rooted at `/sbin/init`, which is the first process that the Linux kernel starts running. Each process is identified by a unique ID called PID (short for process ID). Furthermore, each process has a PPID (short for parent process ID). The process hierarchy can be determined manually, by recursively tracing the PPID in the output of `ps -fe` command. However, this program is designed to automate this task of tracing the process hierarchy.

Data file formats

Prior to solving any problem is important to study the supplied data. So ensure you view the data files (yes, of course you can do this in `NetBeans`). The supplied data files are exactly the output of `ps -fe` command, also reviewed in lab exercise(s).

Program requirements & Tips:

- This program should be developed as a C++ class with the following 2 files:
    - **`MUID_hw3.h`**: This header file should contain the class declaration. You will need 2 public methods – ❶ a method that loads process data from a given file into 2 unordered maps (discussed below) ❷ a method that prints the process tree for a given PID. You may add any private helper methods as you see fit. It is up to you to decide meaningful names for methods and their arguments.
    - **`MUID_hw3.cpp`**: This source file should contain the implementation for the methods you have defined in the header file (ensure you `#include "MUID_hw3.h"` in your source file). This file will also contain the implementation for the `main` method. Your `main` method should create an object and calls methods on the object with suitable parameters.
- To ease printing the process hierarchy, in your class use 2 `unordered_maps` as instance variables in your class to store the following:
    1. `pid⇔ppid` information to ease look-up of parent process ID.
    2. `pid⇔cmd` information to ease look-up the command associated with a PID.
- Use `std::istringstream` to process each line. Even if you don't use a specific column of data, it is still easier to read it and simply not use it.

- Note the order in which processes are listed in the sample output. It is top-down (and not bottom-up)
- For printing the process hierarchy in a top-down manner, you may use an iterative or a recursive solution as you see fit. However, the recursive solution will most likely be shorter than an iterative solution.

Sample outputs

One you have completed your program, you can test its operation using the command shows below and compare your output to the output shown below. Note that for the 3 column output, each column is separated by 1 tab (i.e., `"PID\tPPID\tCMD"`) character

Base case #1:

```
$ ./raodm_hw3 proc_info1.txt 1
Process tree for PID: 1
PID	PPID	CMD
1	0	/sbin/init
```

Test case #2 [Must pass to earn full points]:

```
$ ./raodm_hw3 proc_info1.txt 27426
Process tree for PID: 27426
PID	PPID	CMD
1	0	/sbin/init
949	1	/usr/sbin/sshd -D
27282	949	sshd: salvucwa [priv]
27323	27282	sshd: salvucwa@pts/31
27324	27323	-bash
27425	27324	script
27426	27425	bash -i
```

Test case #3 [Must pass to earn full points]:

```
$ ./raodm_hw3 proc_info1.txt 27535
Process tree for PID: 27535
PID	PPID	CMD
1	0	/sbin/init
949	1	/usr/sbin/sshd -D
25640	949	sshd: raodm [priv]
25681	25640	sshd: raodm@pts/22
25697	25681	-bash
27535	25697	ps -fe
```

Submit to Canvas

This homework assignment must be turned-in electronically via Canvas via the `CODE Plugin`. Ensure your program compiles without any warnings or style violations and operates correctly, at least for the base case. Once you have tested your implementation, upload just one C++ source file via the `CODE plugin`.