415 Operating Systems

Project 2 Report Collection

Submitted to:
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Report

Introduction:

Project 2 was designed as a way to introduce the concepts of scheduling, and the use of multiple processes. This was broken into four parts in order to give a step by step demonstration of increased complexity. Part 1 was a more basic program where you got a program to fork processes to individually select from a list of lines in a file. Part 2 introduced basic signal scheduling with SIGSTOP, SIGCONT and sleep() commands. Part 3 elaborated on Part 2, doing away with sleep() commands and replacing them with an alarm and signal_handlers in order to have more complex scheduling that isn't interruptible with signals like it would be with sleep commands. Part 4 capped it off by elaborating the information given per process with information from files in /proc.

Background:

I was a complete novice to the concepts of forking or using signals, as such this project was a very difficult experience for me. I originally had the fork in multiple loops which had a big issue where everything functioned, however the last two lines were repeating one more time than expected, due to this I had to start from scratch when I was all the way in part 3, wasting a significant portion of time. During this time I deconstructed the command_list type, looked at a few man pages and lurked in more than a few stackoverflow pages in order to see how different required commands worked and I had a eureka moment on the 6th where I've been working on the project since. I finally realized that the children are being interrupted in the loop and are terminated there and the parent keeps on going, knowing that I had a much easier time. Though Part 3 and Part 4 seemed a bit ambiguous as to the end requirements so I worked on those as well as I could given the information as I had understood it.

Implementation:

I had many issues implementing the project, I realized I worked myself into a corner fairly late and I had to restart from scratch. That being said, it wasn't as though I didn't have any smart moments. This loop saved me so much time.

```
For (int i = 0; i < count; i++)
{
   line_buf_array[i] = malloc(len);
   getline(&line_buf_array[i], &len, fp);
   token_buffer = str_filler(line_buf_array[i], " ");
   command_list_array[i] = token_buffer.command_list;
   token_buffer_array[i] = token_buffer;
}
```

I had so many memory leaks and so many issues where I would get double frees, just a massive annoyance the whole way through. During my eureka moment I realized "Why can't I just keep the reassigned values in arrays and then just free them later?" So I did just that, I kept an array of all the line_bufs all the token_buffers and made a token_buffer.command_list array

called command_list_array that kept all the strings of the token_buffers. Because of this I could always access old data if need be and freeing everything was super easy. Additionally I had smaller moments of smart ideas like a global struct that kept data to be used in the signal_handler, or a cleanup function that just freed everything without issue.

Performance Results and Discussion:

So, given how I understood the information of the project given, I think the project runs okay. I think there is definitely some wonkiness in Part 3 and Part 4, but the whole project does run, gets the expected output, uses the required commands and has no leaks or errors with the tests I have done. That being said that's what I THINK are the expected outputs, I honestly have no idea and I was winging a lot about it. A lot of what I wrote was assuming that if I got the right output given the right commands I probably am at least on the right track. For example, in Part 3 and Part 4 when I run the commands, oftentimes I have control again before the program is finished. This implies that the parent exited a little early, and despite all my efforts I could not seem to fix that, but I believe my solution is *very* close considering the rest of the code executes what I believe to be perfectly.

Conclusion:

This project was a doozy, I had a lot of stuff scheduled around the same time, three midterms and another project in CIS 443 all took up a massive portion of my time so I may have made dumb mistakes I otherwise wouldn't have made. That being said I believe that I learn best when my nose is right to the grinder and my nose was certainly sanded off at this point. One thing I really thought was interesting was how much wait and kill commands let you kind of break the order of the code that otherwise seems intuitive.

```
edison@edison-VirtualBox:~/CIS415Proj2$ make
gcc -c part1.c
gcc -c string_parser.c
gcc -o part1 part1.o string_parser.o
gcc -c part2.c
gcc -o part2 part2.o string_parser.o
gcc -c part3.c
gcc -o part3 part3.o string_parser.o
gcc -c part4.c
gcc -o part4 part4.o string_parser.o
gcc -c iobound.c
gcc -o iobound iobound.o
gcc -c cpubound.c
gcc -o cpubound cpubound.o
edison@edison-VirtualBox:~/CIS415Proj2$
```

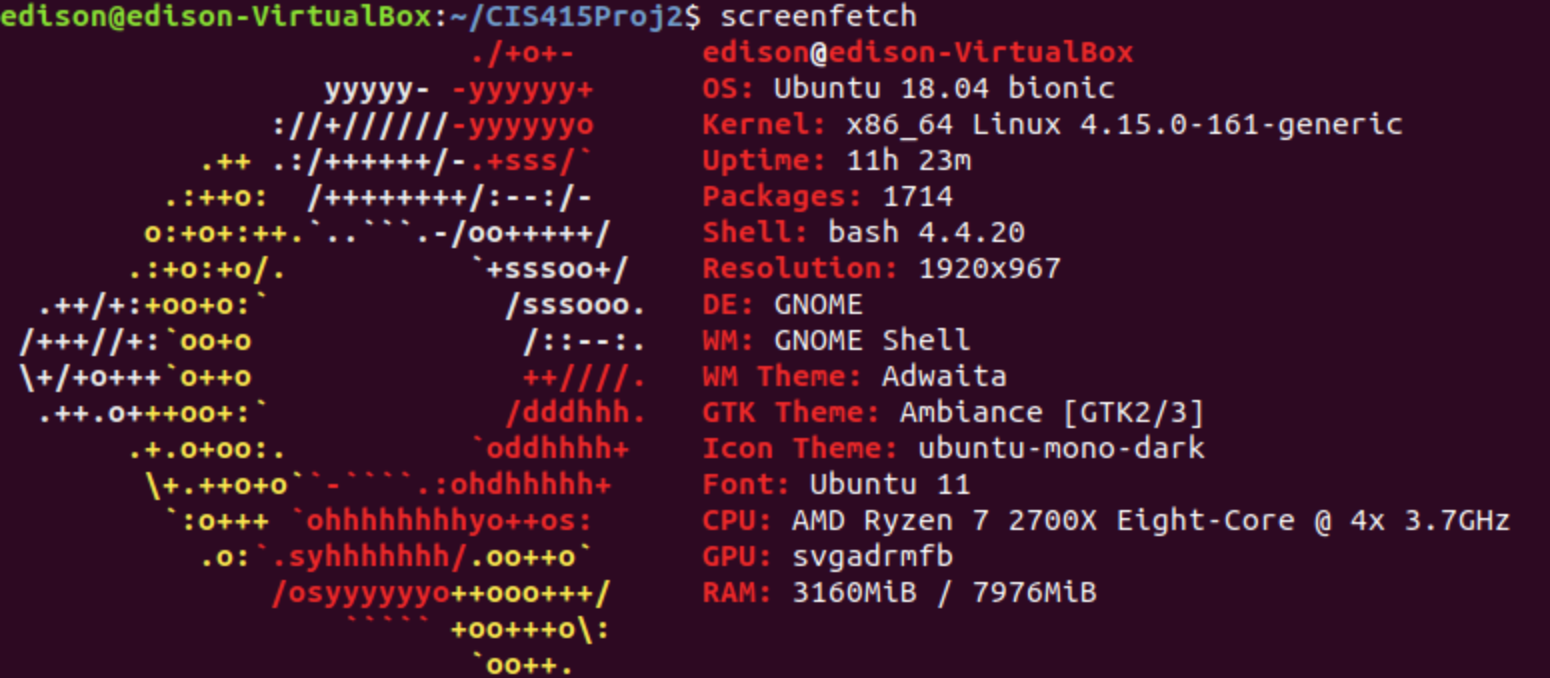
```
edison@edison-VirtualBox:~/CIS415Proj2$ make clean
rm -f core *.o iobound cpubound part1 part2 part3 part4
edison@edison-VirtualBox:~/CIS415Proj2$
```

```
edison@edison-VirtualBox:~/CIS415Proj2$ ./part1 input.txt
Error!: No such file or directory
Process: 27440 - Begining to write to file.
total 220
 4 top_script.sh     4 string_parser.c  20 part4    16 part3    16 part2    16 part1        4 log4.txt    4 log1.txt     4 iobound.c    4 .git         12 cpubound
 4 string_parser.o   8 part4.o          8 part3.o    8 part2.o    8 part1.o    4 output.txt    4 log3.txt    4 lab4.c      12 iobound      4 cpubound.o    4 ..
 4 string_parser.h   8 part4.c          4 part3.c    4 part2.c    4 part1.c    4 Makefile      4 log2.txt    4 iobound.o    4 input.txt    4 cpubound.c    4 .
Process: 27441 - Begining calculation.
Process: 27441 - Finished.
Process: 27440 - Finished.
edison@edison-VirtualBox:~/CIS415Proj2$
```

```
edison@edison-VirtualBox:~/CIS415Proj2$ ./part2 input.txt
Error!: No such file or directory
Process: 27446 - Begining to write to file.
total 220
Process: 27447 - Begining calculation.
 4 top_script.sh     4 string_parser.c  20 part4    16 part3    16 part2    16 part1        4 log4.txt    4 log1.txt     4 iobound.c    4 .git         12 cpubound
 4 string_parser.o   8 part4.o          8 part3.o    8 part2.o    8 part1.o    4 output.txt    4 log3.txt    4 lab4.c      12 iobound      4 cpubound.o    4 ..
 4 string_parser.h   8 part4.c          4 part3.c    4 part2.c    4 part1.c    4 Makefile      4 log2.txt    4 iobound.o    4 input.txt    4 cpubound.c    4 .
Process: 27446 - Finished.
Process: 27447 - Finished.
edison@edison-VirtualBox:~/CIS415Proj2$
```

```
edison@edison-VirtualBox:~/CIS415Proj2$ ./part3 input.txt
Error!: No such file or directory
Process: 27457 - Begining calculation.
Process: 27456 - Begining to write to file.
total 220
 4 top_script.sh     4 string_parser.c  20 part4    16 part3    16 part2    16 part1        4 log4.txt   4 log1.txt    4 iobound.c   4 .git        12 cpubound
 4 string_parser.o   8 part4.o           8 part3.o   8 part2.o   8 part1.o   4 output.txt    4 log3.txt   4 lab4.c     12 iobound     4 cpubound.o   4 ..
 4 string_parser.h   8 part4.c           4 part3.c   4 part2.c   4 part1.c   4 Makefile      4 log2.txt   4 iobound.o   4 input.txt   4 cpubound.c   4 .
edison@edison-VirtualBox:~/CIS415Proj2$ Process: 27456 - Finished.
Process: 27457 - Finished.
```

```
edison@edison-VirtualBox:~/CIS415Proj2$ ./part4 input.txt
Process 27469 Started:
User Mode Processes: 558920 | Kernel Mode Processes: 133026 | Processes Running: 5 |

Process 27470 Started:
User Mode Processes: 558920 | Kernel Mode Processes: 133026 | Processes Running: 5 |

Process 27471 Started:
User Mode Processes: 558920 | Kernel Mode Processes: 133026 | Processes Running: 5 |

Process 27472 Started:
User Mode Processes: 558920 | Kernel Mode Processes: 133026 | Processes Running: 6 |

Process 27473 Started:
User Mode Processes: 558920 | Kernel Mode Processes: 133026 | Processes Running: 7 |

Process: 27473 - Begining calculation.
Process: 27472 - Begining to write to file.
total 220
 4 top_script.sh     4 string_parser.c  20 part4    16 part3    16 part2    16 part1        4 log4.txt    4 log1.txt     4 iobound.c    4 .git         12 cpubound
 4 string_parser.o   8 part4.o           8 part3.o    8 part2.o    8 part1.o    4 output.txt    4 log3.txt    4 lab4.c      12 iobound      4 cpubound.o    4 ..
 4 string_parser.h   8 part4.c           4 part3.c    4 part2.c    4 part1.c    4 Makefile      4 log2.txt    4 iobound.o    4 input.txt    4 cpubound.c    4 .
edison@edison-VirtualBox:~/CIS415Proj2$ Error!: No such file or directory
Process: 27473 - Finished.
Process: 27472 - Finished.
```


edison@edison-VirtualBox:~/CIS415Proj2$ screenfetch
edison@edison-VirtualBox
OS: Ubuntu 18.04 bionic
Kernel: x86_64 Linux 4.15.0-161-generic
Uptime: 11h 23m
Packages: 1714
Shell: bash 4.4.20
Resolution: 1920x967
DE: GNOME
WM: GNOME Shell
WM Theme: Adwaita
GTK Theme: Ambiance [GTK2/3]
Icon Theme: ubuntu-mono-dark
Font: Ubuntu 11
CPU: AMD Ryzen 7 2700X Eight-Core @ 4x 3.7GHz
GPU: svgadrmfb
RAM: 3160MiB / 7976MiB