CSCI4730/6730 – Operating Systems

Project #1: Multi-process and IPC

Due date: 11:59pm, 9/13/2017

Description

In this project, you will design and implement a multi-process word counting program. The code of the single-process word counting[1] is provided in ELC. You will convert it into the multi-process architectures.

Multi-process Word Counting Program

The main problem of a single-process program is a scalability. It cannot scale up to large numbers of input files.

To address the problem, you will convert the word counting program into the multi-process model. The main process creates the child processes and each child process reads and counts a single input file. The child process sends the result to the main process via Inter-process communication channel (e.g., pipe or shared memory). The main process waits all children processes and reads the result via IPC channel, and prints out the total on the screen.

- You will modify "wc_mul.c" to build a multi-process model.
- The program receives two command-line arguments; 1) the number of input files(N), 2) the number of child processes(M). Your program will create M processes and each process will handle "N/M" or "N/M + 1" files.
- You can use "time ./wc 10" and "time ./wc_mul 10 10" to see the performance of single and multi-process models.
- The main process waits until all child processes terminate, then prints out the accumulated result.
- The main process prints out the exit status of each child process. If the child process is terminated by a signal, print out the signal number.
- Explain your program structure and IPC in README file. Only "pdf" or plain-text formats will be accepted. Do not submit MS word file (or other format).
- Test input files are located in /tmp/CSCI4730/books/ in nike and vcf servers. The file path is hardcoded in the project file. If you are using your own machine, you can copy /tmp/CSCI4730/books/ files from the nike server, unzip it, and modify the file path (#define FILEPATH "xxx") in wc.c and wc_mul.c file.
- Please use vcf0 – vcf5 clusters for this project. Use your nike password to ssh into any of the cluster nodes vcf0-vcf5.

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[1] It is slightly modified from the code in http://www.opentechguides.com/how-to/article/c/72/c-file-counts.html

Example Output 1:

```
[kyuhlee~/Proj1]./wc_mul 10 4
counting 10 files in 4 processes..
Child Proc 0, read 3 files (0 ~ 2)
Child Proc 1, read 3 files (3 ~ 5)
Child Proc 2, read 2 files (6 ~ 7)
Child Proc 3, read 2 files (8 ~ 9)
[pid 37974] read: /tmp/CSCI4730/books/text.00
[pid 37975] read: /tmp/CSCI4730/books/text.03
[pid 37976] read: /tmp/CSCI4730/books/text.06
[pid 37977] read: /tmp/CSCI4730/books/text.08
[pid 37975] read: /tmp/CSCI4730/books/text.04
[pid 37977] read: /tmp/CSCI4730/books/text.09
[pid 37974] read: /tmp/CSCI4730/books/text.01
[pid 37976] read: /tmp/CSCI4730/books/text.07
[pid 37977] send the result to the parent 37973.
[pid 37976] send the result to the parent 37973.
[pid 37974] read: /tmp/CSCI4730/books/text.02
[pid 37975] read: /tmp/CSCI4730/books/text.05
[pid 37974] send the result to the parent 37973.
The child process 37974 terminated normally. The Exit status 0
[pid 37975] send the result to the parent 37973.
The child process 37975 terminated normally. The Exit status 0
The child process 37976 terminated normally. The Exit status 0
The child process 37977 terminated normally. The Exit status 0
========================================
Total Lines : 16177972
Total Words : 151538006
Total Characters : 665714062
========================================
```

Example Output 2: one process killed by signal 9

```
[kyuhlee~/Proj1]./wc_mul 10 5
counting 10 files in 5 processes..
Child Proc 0, read 2 files (0 ~ 1)
Child Proc 1, read 2 files (2 ~ 3)
Child Proc 2, read 2 files (4 ~ 5)
Child Proc 3, read 2 files (6 ~ 7)
Child Proc 4, read 2 files (8 ~ 9)
[pid 44935] read: /tmp/CSCI4730/books/text.00
[pid 44936] read: /tmp/CSCI4730/books/text.02
[pid 44937] read: /tmp/CSCI4730/books/text.04
[pid 44939] read: /tmp/CSCI4730/books/text.08
[pid 44938] read: /tmp/CSCI4730/books/text.06
[pid 44937] read: /tmp/CSCI4730/books/text.05
[pid 44936] read: /tmp/CSCI4730/books/text.03
[pid 44939] read: /tmp/CSCI4730/books/text.09
[pid 44935] read: /tmp/CSCI4730/books/text.01
[pid 44938] read: /tmp/CSCI4730/books/text.07
[pid 44938] send the result to the parent 44934.
[pid 44939] send the result to the parent 44934.
[pid 44935] send the result to the parent 44934.
The child process 44935 terminated normally. The Exit status 0
The child process 44936 terminated by a signal 9.
[pid 44937] send the result to the parent 44934.
The child process 44937 terminated normally. The Exit status 0
The child process 44938 terminated normally. The Exit status 0
The child process 44939 terminated normally. The Exit status 0
========================================
Total Lines : 12177970
Total Words : 115519430
Total Characters : 506838645
========================================
```

Submission

Submit a tarball file using the following command
%tar czvf p1.tar.gz README.pdf Makefile wc_multi.c

1. README file with:
    a. Your name
    b. Explain your design of multi-process structure and IPC.
2. Your code should be compiled in **vcf0-vcf5** machine.
3. Submit a tarball through ELC.