Vivian Do
CSC 4320
Feb 05 2023

Spring 2023 – 4320/6320 Section 006 Operating Systems

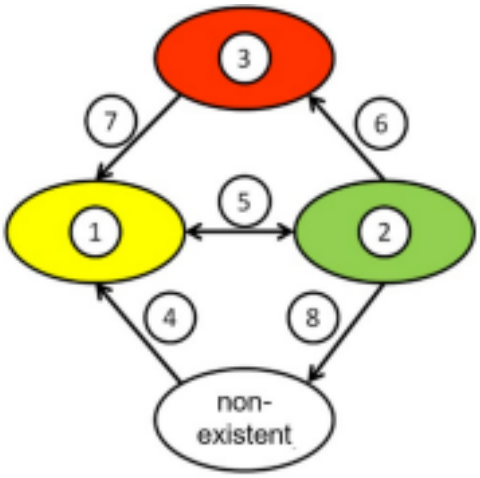
Homework 2: Due 02/05/2023 at 11:59 PM

Your programs – if requested – must compile with gcc and execute on snowball.cs.gsu.edu! Please see https://cscit.cs.gsu.edu/sp/guide/snowball for more details. You may use whatever IDEs / text editors you like, but you must submit your responses on iCollege.

1. Interruptions: Correctly arrange the following steps to handle an interruption of a running user process by assigning them the correct step number from 1 to 9 (9 points):

Step	**Step number from 1 to 9**
Handle further interrupts (if existing).	7
The appropriate interrupt service routine is identified and started based on the source of the interrupt.	4
The interrupt service routine is terminated with a special command (return from interrupt, RTI).	5
Switch to kernel mode.	2
The state of the running process is saved.	1
Switch to user mode and continue the execution of the interrupted process.	9
The possibly established blocking of further interrupts is released again.	6
If necessary, the handling of further interrupt requests is stopped (blocked).	3
The state of the interrupted process is restored.	8

2. a) Process states: In this task, we work with the process state model known from the lecture. For reasons of clarity, the state "non-existent" has been represented somewhat more compactly than in the lecture (represents two states at once). Likewise, state transition 5 subsumes two activities. Assign the following terms to the respective numbered elements in the process state model (8 points).



Term	Numbered element
scheduler dispatch or interrupt	5
ready	1
wait for I/O or event	6
admitted	4
waiting	3
I/O or event completion	7
exit	8
running	2

b) Explain why there is no direct transition from the state “waiting” to the “running” state. (3 points)

The process schedule chooses the process to be executed only at the “running” state. Since there is no possibility to process from bypassing the running state, there is no direct transition from “waiting” to “running” state. In “waiting” state, processes wait for an event to happen via its required external device or wait for its I/O to complete.

3. a) Implement a system of three processes which read and write numbers to a file. Each of the three processes P1, P2, and P3 must obtain 200 times an integer from the file. The file only holds one integer at any given time. Given a file F, containing a single integer N, each process must perform the following steps (25 points):

    1. Open F
    2. Read the integer N from the file
    3. Close F
    4. Output N and the process' PID (either on screen or test file)
    5. Increment N by 1
    6. Open F
    7. Write N to F (overwriting the current value in F)
    8. Close F

My Code:

vdo10@gsuad.gsu.edu@snowball:~/OS

```
[vdo10@gsuad.gsu.edu@snowball OS]$ cat hw2.c
/*
Vivian Do
CSC 4320
Feb 05 2023
*/

// adding libraries to use in program
#include <stdio.h>
#include <sys/types.h>
#include <unistd.h>
#include <sys/wait.h>
#include <stdlib.h>

// creating text file
const char* path = "file.txt";

// starting processes
int main() {
        if (fork() == 0) {
                printf("Starting P1\n");
                if (fork() == 0) {
                        printf("Starting P2\n");
                        if (fork() == 0) {
                                printf("Starting P3\n");
                        }
                }
        }

        // adding variables
        pid_t pid = getpid();
        int i;
        FILE* fp;
        int num;

        // loop to increment number until getting 200
        for (i = 0; i < 200; i++) {
                // opening file
                fp = fopen(path, "r");
                // reading number from file
                fscanf(fp, "&d", &num);
                // closing file
                fclose(fp);
                // printing number with its process id
                printf("N: %d | Process ID: %d\n", num, pid);
                // incrementing number by 1
                num++;
                // opening file again
                fp = fopen(path, "w");
                // writing number into file
                fprintf(fp, "%d", num);
                // closing file again
                fclose(fp);
        }
        exit(0);
}
[vdo10@gsuad.gsu.edu@snowball OS]$
```

```
[vdo10@gsuad.gsu.edu@snowball OS]$ cat file.txt
1
[vdo10@gsuad.gsu.edu@snowball OS]$
```

Screenshots:

```
[vdo10@gsuad.gsu.edu@snowball OS]$ cc hw2.c
[vdo10@gsuad.gsu.edu@snowball OS]$ ./a.out
N: 0 | Process ID: 27132
N: 1 | Process ID: 27132
Starting P1
Starting P2
Starting P3
N: 0 | Process ID: 27133
N: 2 | Process ID: 27132
N: 1 | Process ID: 27133
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N: 195 | Process ID: 27132
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N: 198 | Process ID: 27132
N: 199 | Process ID: 27132
[vdo10@gsuad.gsu.edu@snowball OS]$
```

```
[vdo10@gsuad.gsu.edu@snowball OS]$ cat file.txt
200
[vdo10@gsuad.gsu.edu@snowball OS]$
```

b) Briefly describe why the processes P1, P2, and P3 obtain/read duplicates of numbers (why does a particular integer x appear in the output of more than one process)? (3 points.)

The processes P1, P2, and P3 obtain/read duplicates of numbers due to how the same data can be represented in different ways. The child process starts first. The number N is incremented until it has reached 200. Once it has finished, the next process will start incrementing until it stops, and so on.

c) Suggest a solution (you do not need to implement it) to guarantee that no duplicate numbers are ever obtained by the processes. In other words, each time the file is read by any process, that process reads a distinct integer. (2 points)

Create each process as their own calling method. Each process will read the file. Once the file has been read by one process, increment the number, add the number into the file, and the next process starts. The next process will read the file, increment the number again, add the number into the file, and the next process will start again. This continues until all processes have reached 200 and have finished.

NOTE: Programs must compile and execute on the Snowball Server. Submit all .c code files along with the word document or pdf with your answers to questions 1 & 2 onto iCollege.