Operating Systems Course (CS39001)

Spring Semester 2020-2021

Take home assignment 2

Assignment given on: March 21, 2021
Assignment deadline: April 01, 2021, 11:55 PM
Total marks: 60
Weightage: 15% of theory

Submission instructions

- This is a time-bound take home assignment to test your understanding of the concepts developed in the course so far.

- YOU HAVE TO USE PEN AND PAPER TO COMPLETE ALL QUESTIONS OF THE ASSIGNMENT (including the coding questions).

- You need to submit your INDIVIDUAL solutions to CSE Moodle in the following way: Scan and put all the pages sequentially in a pdf file and upload the pdf to CSE Moodle.

- The pdf file should be named "Take_home_Assgn2_<roll no>_submission.pdf"

- Note that, if we face problems with your answer script e.g., cannot open your submitted pdf file, cannot read the text (due to bad resolution), cannot determine the page order (i.e., the pages in the pdf are jumbled up), or if we find you copying from other students, it will affect your marks.

Problems

1. Consider a situation where a parent process forks a child process; the child counts the number of words stored in a text file (whose name is already known to the parent process) and returns the number of words back to the parent. Implement the situation with a C code segment. [7 marks]

2. Explain the differences in how much the following scheduling algorithms discriminate *in favour of short processes*: (a) FCFS, (b) Round Robin, (c) Multi-level feedback queue. [2 + 2 + 2 = 6 marks]

3. A program contains a single loop that executes 50 times. The loop contains a computation that lasts 50 msec followed by an I/O operation that consumes 200 msec. This program is executed in a time-sharing system with 9 other identical programs. All programs start their execution at the same time. The scheduling overhead of the OS is 3 msec. Compute the response time in the first and subsequent iterations if (a) The time slice is 50 msec, and (b) The time slice is 20 msec. [4 + 4 = 8 marks]

4. Consider the following set of processes, with all times specified in milliseconds.

Process	P1	P2	P3	P4	P5
Arrival time	0	2	4	6	7
Burst time	4	1	8	4	2

(a) Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: (i) FCFS, (ii) SJF, (iii) pre-emptive SJF, and (iv) RR (with time quantum = 2).

(b) Compute the (i) average turnaround time, and (ii) average waiting time for all the cases. [8 + 8 = 16 marks]

5. Consider a demand paged system with a 64-bit address space, 8 KB page size, and 128 GB RAM. What would be the total size of the page table(s) for one process if we use (a) a 1-level page table, (b) a 2-level page table? Show all the calculations. You can ignore the presence of additional information such as valid/invalid bit, dirty bit, etc. in the page tables. [4 + 6 = 10 marks]

6. State all (as many as possible) optimizations used for (a) minimizing page faults, and (b) speeding up the time to service a page fault. Write two-line descriptions of each optimization that you state. Also, for each optimization, mention whether it is usually implemented in hardware or software. [4 + 4 = 8 marks]

7. Suppose that a process P suffers a page fault and there are no free page frames. The page-replacement algorithm chooses a page containing data of another process Q for replacement. Clearly list the steps that will be taken by the OS for the page fault to be handled. [5 marks]