

Homework Assignment 01
CPU Processes and Scheduling

Assigned: Tue 20 JAN 2026
Due: Sun 01 FEB 2026

Instructions:

- The assignment is to be uploaded to Canvas by the due date, which is scheduled for 11:59pm ET that day since solutions will be distributed soon after.
- We expect that you will study with friends and often work out problem solutions together, but *you must write up your own solutions, in your own words*. **Cheating will not be tolerated**. Professors and TAs will be available to answer questions but will not do your homework for you. One of our course goals is to teach you how to think on your own and solve your own problems using your resources. Cut and paste from Google or ChatGPT will be considered plagiarism.
- We require that all homework submissions be neat and organized. You may either type your solutions in a word processor and print to an Adobe PDF or write them by hand and submit a legible scanned copy in Adobe PDF. Do write and submit your answers as if they were a professional report. **There will be point deductions if the submission is not neat** (is disordered, difficult to read, scanned upside down, etc.).
- To achieve full credit, **show INTERMEDIATE steps, if applicable**, leading to your answers throughout.

Problem Set 1 [100 points: 10, 30, 20, 40]: CPU Scheduling

1. Why is it important for the scheduler to distinguish I/O-bound programs from CPU-bound programs?
2. Discuss how the following pairs of scheduling criteria conflict in certain settings:
 - a. CPU utilization and response time
 - b. Average turnaround time and maximum waiting time
 - c. I/O device utilization and CPU utilization
3. A variation of the round-robin scheduler is the regressive round-robin scheduler. This scheduler assigns each process a time quantum and a priority. The initial value of a time quantum is 50 milliseconds. However, every time a process has been allocated to the CPU and uses its entire time quantum (does not block for I/O), 10 milliseconds is added to its time quantum, and its priority level is boosted. (The time quantum for a process can be increased to a maximum of 100 milliseconds.) When a process blocks before using its entire time quantum, its time quantum is reduced by 5 milliseconds, but its priority remains the same. What type of process (I/O-bound or CPU-bound) does the regressive round-robin scheduler favor? Explain your answer.
4. Which of the following scheduling algorithms could result in starvation? Explain your reasoning.
 - a. First-come, first-served
 - b. Shortest job first
 - c. Round robin
 - d. Priority

Problem Set 2 [50 points: 10, 10, 30]: Processes

5. When a process creates a new process using the `fork()` operation, which of the following states is shared between the parent process and the child process?
 - a. Stack
 - b. Heap
 - c. Shared memory segments
6. Including the initial parent process, how many processes are created by the program shown below?

```
#include <stdio.h>
#include <unistd.h>

int main() {
    /* fork a child process */
    fork();

    /* fork another child process */
    fork();

    /* and fork another */
    fork();

    return 0;
}
```

7. Original versions of Apple's mobile iOS operating system provided no means of concurrent processing. Discuss three major complications that concurrent processing adds to an operating system.