

# CS492 Spring 2020 – Homework 1

No handwritten submissions will be accepted, or graded. Your submission must be a pdf (not doc, docx, tex, html, rtf and any other format, but **pdf**) file with the typed solutions to the 6 problems included in this document.

This is an individual assignment. Individual assignments, as the word indicate, are to be done INDIVIDUALLY. Any sign of collaboration will result in a 0 and being reported to the Honor Board.

## Problem 1. (10 pts)

Consider a multiprogrammed system with degree of 6 (i.e., six programs in memory at the same time). Assume that each process spends 40% of its time waiting for I/O. What will be the CPU utilization?

## Problem 2. (10 pts)

What are the benefits of threads vs processes? What is the biggest advantage of implementing threads in user space? What is the biggest disadvantage?

## Problem 3. (10 pts)

Assume we have a system with a single-core CPU. Multiple jobs can run in parallel (multiprogramming) and finish faster than if they had run sequentially. Suppose that two jobs, each needing 20 minutes of CPU time, start simultaneously. How long will the last one take to complete if they run sequentially? How long if they run in parallel? Assume 50% I/O wait.

## Problem 4. (10 pts)

If a multithreaded process forks, a problem occurs if the child gets copies of all the parent's threads. Suppose that one of the original threads was waiting for keyboard input. Now two threads are waiting for keyboard input, one in each process. Does this problem ever occur in single-threaded processes?

## Problem 5. (10 pts)

Assume that you are trying to download a large 2-GB file from the Internet. The file is available from a set of mirror servers, each of which can deliver a subset of the file's bytes; assume that a given request specifies the starting and ending bytes of the file. Explain how you might use threads to improve the download time. Are there any possible bottlenecks in your proposed solution?

## Problem 6. (10 pts)

What are the two main functions of an operating system? What is the main function of a hypervisor? What are the differences between hypervisors and operating systems?