CS 314 Operating Systems
Spring 2023
Quiz #7 on March 28, 2023 (SOLUTIONS)

Your Last Three Digits: ________________
(please do NOT write all of your student ID or your name)

Grade: ______

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(1) How do threads reduce the high context switching overhead in processes?

Threads reduce the context-switching overhead from processes by switching only a subset of PCB (Process Control Block), which is smaller than PCB in the size of data. Since each context-switching requires switching smaller amount of data, context switching in the thread level should be faster.

(2) How do threads reduce the high overhead of processes when processes try to share data in shared memory?

Sharing data among threads should be faster than doing the same among processes. It is because sharing data among threads (in the same process though) can be performed through the global data area (i.e., as global variables), which does not require a content switching to OS (therefore, there is no mode change in processor), while sharing data among processes always require OS to involve (which implies that the mode of a processor should be changed to OS).
(3) As we discussed in the classroom, “threads” are introduced after many system programmers were using “processes” for multi-tasking (we even discussed that “threads” were introduced to avoid two problems in “processes”). After all, while “processes” and “threads” have many things in common (and “threads” seem to be better than “processes”). Then why do we still use “processes” (mention the most primary reason)?

Although threads are faster than processes for context-switching and sharing data, data protection in threads are much weaker than that of processes. While illegally accessing protected data in another process is almost impossible (except for hard bugs in processors or software bugs in operating systems, which are very rare), it is not actually hard for threads to access data private for other threads in a process (using pointers). Thus, multi-threaded programs should be carefully used (recommended to avoid using threads for any security-sensitive applications).

(4) Which of the following items in the PCB for a process should belong to the global PCB or TCB (private PCB)?

(a) Processor registers TCB  
(b) Program Counter (PC) register TCB  
(c) User ID PCB  
(d) Process ID PCB  
(e) The list of opened files PCB  
(f) The list of the assigned I/O devices PCB  
(g) Stack Pointer (SP) register TCB

(5) What is the primary role of a “kernel mode”?

= What is the kernel-mode of processors for?

The kernel-mode (of a processor) is for performing any operations/commands/tasks without any limitation, such as executing the operating system codes (for managing user processes, and protecting hardware resources in a computer system).