**CS 4345: Operating Systems**

**Homework 2 (Spring 2017)**

Due date: Sunday, 19 February 2017, 11:00 p.m.

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**Answer the following:**

1. A computer has 4 GB (4096 MB) of RAM of which the OS occupies 1024 MB. For simplicity, let us assume that the processes are all 512 MB and have the same characteristics. If the system’s goal is 97% CPU utilization, what is the maximum I/O wait that can be tolerated? Explain (or, show your work). [5 points]

6 processes at most can be in memory simultaneously (4096-1024 = 3072/512 = 6). Assume the probability that the process is waiting for I/O is p. There for the probability that all the processes are waiting on I/O is p6. If the goal is 97% utilization, then we set p6 = 0. 03 => p = .56. Therefor, processes with up to a 56% I/O wait can be tolerated.

1. Discuss two scheduling criteria that can conflict with each other (that is, optimizing one would hinder optimizing the other). [5 points]

Two scheduling criteria that could conflict with each other could be trying to optimize user experience in the sense of responsiveness and CPU utilization. To increase CPU utilization, we must try to minimize the overhead from context switching. One way to achieve this could be to execute context switching less frequently, but this would increase response time for user processes.

1. Explain advantages and disadvantages of designing an OS kernel in layers (‘ring’ structure). [5 points]

The main disadvantages to a layered OS kernel is it typically will perform slower because of high overhead due to passing parameters. It often is difficult to design a layer hierarchy as well. The main advantage of using a layered OS kernel is they are typically easy to debug due to the separation of services. They can also be quite flexible OS.

1. Measurements of a certain system have shown that the average process runs for a time R before blocking on I/O. A context-switch requires a time C. The processes are scheduled using a round-robin scheduler with quantum Q, which has length at least R. If a context-switch requires a time C, give a formula for the CPU efficiency in terms of R, Q, and C. Explain how you derived your expression. [6 points]

Ratio =

This is because the (R/Q)-1 is the number of times the process will have to switch to complete. We multiply this by C to get the context switch overhead.

1. Consider a preemptive-priority scheduling algorithm based on dynamically changing priorities. The priority values are positive integers with 1 being the lowest priority value. When a process is waiting for the CPU (in the ready queue, but not running), its priority changes at a rate W; when it is running, its priority changes at a rate R. All new processes are assigned lowest priority when they enter the ready queue. Explain how the processes are scheduled (that is, how they are ordered) when W < R. [5 points]

This algorithm is ordered the processes as a First Come First Serve Scheduling. The processes that have been waiting the longest in the ready queue will have the highest priority values, besides the currently running process because it’s priority rate increases faster than the others. So when no process is running, the one waiting the longest will run. The fact that R > W means that a process will complete execution, because the priority will not be surpassed by a process in the ready queue.

1. What type of application programs are not suitable for multi-threading? Explain. [4 points]

Programs that will be accessing and updating the same resources sometimes are not well suited for multi threading because of the chance for conflicts to occur when trying to access resources. Also programs that will be running on single core processors suffer from hardware context switch overhead between threads. Other situations where multi threading may not be ideal is in situations where precise timing is critical because threads can run longer than expected and have overhead timing costs.

**Submission instructions:** write your name at the top and include answer to each question on this document preferably after each question. Please do not write your answers on a separate document or file. Submit the file through BlazeVIEW dropbox.