

Homework 1

1. The probability that all processes are waiting for I/O is $0.4^6 = 0.004096$. Therefore, CPU utilization: $1 - 0.004096 = 0.995904$.
2. Processes are not very efficient and do not share memory with each having its own address space. Conversely, a thread is an independent sequential execution stream within a process. Since programs can use multiple threads per process, the work is split up and the address space is shared. This allows for higher performance and increased efficiency due to overlapping I/O and computation. The biggest advantage of implementing threads in user space is efficiency. No traps to the kernel are needed to switch threads and the fact that threads have their own scheduler can help efficiency for certain applications. However, the biggest disadvantage is that if one thread blocks, the entire process blocks.
3. Each job needs 20 minutes of CPU time, and since each job has 50% I/O waiting time/50% CPU waiting time, each job will consequently take 40 minutes total. Since it is single-core, one job will use the memory of the CPU and then will trade off access to the other; the processes will run sequentially. Since there are two processes, the whole operation will finish 80 minutes after the start of the first process. The processes cannot run in parallel because of the single-core CPU. Since it is single-core, only one job can have access to the memory at one time.
4. No, because if a single-threaded process is blocked on the keyboard it cannot fork.
5. The client process could create separate threads in which each thread grabs a different part of the file from one of the mirror servers. This helps improve download time by splitting up the task into a divide and conquer approach. Since there is a single network link shared between all the threads, this in itself can become a bottleneck as the number of threads increases.
6. The two main functions of an operating system are Extended machine and Resource management. The Extended machine contains the instruction set, memory organization, I/O devices and the bus structures. It also details the usage of hardware and provides a stable environment for the user to support hardware functionalities consistently. The operating system provides Resource management through managing different types of hardware devices like CPU, memory, printers, timers, and network interfaces so that they are all available to the user to perform operations. Additionally, the operating system prevents program starvation by sharing the processor between multiple programs. The operating system also facilitates the storing and retrieving of data by making the input output devices active whenever the user requests. The operating system facilitates the management of shared memory between multiple programs and ensures that the desired memory is able to be accessed when each program needs to. A hypervisor's main

function is to allocate system resources properly to each virtual machine it manages, ensuring they all operate properly and efficiently. A hypervisor enables multiple operating systems (virtual machines) to be run simultaneously on a PC by creating a software version of required hardware. An operating system enables existing PC hardware in the system to run user applications.

I pledge my honor that I have abided by the Stevens Honor System.

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