Gasser Ahmed
gasser18@vt.edu
ECE 5484, Homework 6

1. $f = 0.65$, $k = 2.25$
   $S = 1 / ((1 - f) + (f / k)) = 1 / ((1 – 0.65) + (0.65 / 2.25)) = 36 / 23 =$ 1.57 or 57%

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2. $S = 25\%$ or 1.25, $f_{cpu} = 0.6$, $f_{disk} = 0.4$
   Since $S = 1 / ((1 - f) + (f / k))$, therefore $S ((1 - f) + (f / k)) = 1 \dashrightarrow k = Sf / (1 - S (1 - f))$
   a. $k_{cpu} = (1.25 \times 0.6) / (1 – 1.25 (1 – 0.6)) =$ 1.5 or 150%
   b. $k_{disk} = (1.25 \times 0.4) / (1 – 1.25 (1 – 0.4)) =$ 2 or 200%

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3. $f_{cpu} = 0.7$, $f_{disk} = 0.3$, $k_{cpu} = 1.5$, $k_{disk} = 2.75$
   $S_{cpu} = 1 / ((1 - f) + (f / k)) = 1 / ((1 – 0.7) + (0.7 / 1.5)) = 1.30$ or 30%
   $S_{disk} = 1 / ((1 - f) + (f / k)) = 1 / ((1 – 0.3) + (0.3 / 2.75)) = 1.24$ or 24%

   a. Cost per percentage of speedup for CPU = $2000/30% = $66.68
      Cost per percentage of speedup for disk = $1500/24% = $62.50
      Since cost per percentage of speedup for disk is lower than that of CPU, therefore I would choose disk to yield the best performance improvement for the least amount of money
   b. Since $S_{cpu} > S_{disk}$, therefore, I would choose CPU for a faster system.
   c. The break-even point would be a disk upgrade costing $1,600.32 ($66.68 x 24) or a CPU upgrade costing $1,875 ($62.50 x 30).

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4. a. Programmed I/O - good for control applications. We use it so that we have programmatic control over the behavior of each device. By modifying a few lines of code, we can adjust the number and types of devices in the system, as well as their polling priorities and intervals.

   b. Interrupt-driven I/O - used in personal systems. They are used so Instead of the CPU continually asking its attached devices whether they have any input, the devices tell the CPU when they have data to send. The CPU proceeds with other tasks until a device requesting service sends an interrupt to the CPU.

   c. Direct Memory Access (DMA) - good for small medium-sized systems. We use it so the CPU offloads execution of tedious I/O instructions.

   d. Channel I/O - used in the largest enterprise-class- systems. We use it so one or more I/O processors control various I/O pathways allowing management of several of these devices through only one controller.

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5. a. RAID-0 cannot tolerate a single disk failure because the data is split up amongst all the drives in the array and there is no redundancy.
   b. RAID-1, RAID-2 and RAID-6. RAID-1 can tolerate multiple disk failures only if the failure does not involve a disk and its mirror image.

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6. a. Multiprogramming keeps several programs in main memory at the same time and execute them concurrently utilizing single CPU which makes jobs taking more time to be processed. Multiprocessing refers to processing of multiple processes at same time by multiple CPUs which makes jobs taking less time to be processed.

   b. Multiprogramming is a form of parallel processing in which several programs run at the same time on a single processor. Since there is only one processor, there can be no true simultaneous execution of different programs. Instead, the operating system executes part of one program, then part of another, and so on. To the user it appears that all programs are executing at the same time. Multithreading is the ability of a program or an operating system process to manage its use by more than one user at a time and to even manage multiple requests by the same user without having to have multiple copies of the program running in the computer. That is, multiprogramming is time-sliced execution of different programs and multithreading is concurrent execution of a single program.

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7. Java Virtual Machine is a virtual machine and like real machine it has its own set of memory (heap), method area and native method area, and all are shared among all processes running within the virtual machine. So, the execution environment of a Java class called a virtual machine. Besides, a real machine is a computer and we run it right on the computer itself, however, the virtual machine sits between the code and computer and runs the code that is written.

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8. If you run a program in another program (VM) that's running, something has to give in order to get the program through the program to the hardware which is why generally a compiled language like C is going to be faster because it's not running through the virtual machine. That is, after compiling, Java programs run on a Java virtual machine (JVM) rather than directly on the computer's processor as native code, as do C and C++ programs which is why a Java program running in JVM.

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9. a) 52.230.7.1 = 00110100. 11100110. 111.1 ---> 0… falls into Class A Network
   b) 222.17.44.39 = 11011110.10001.101100.100111 ---> 110… falls into Class C Network
   c) 129.255.255.255 = 10000001.11111111.11…. ---> 10… falls into Class B Network

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10. Vinton Cerf is Widely known as one of the "Fathers of the Internet," Cerf is the co-designer of the TCP/IP protocols and the architecture of the Internet. In 2004, he won the ACM Turing Award for pioneering work on internetworking, including the design and implementation of the Internet's basic communications protocols, TCP/IP, and for inspired leadership in networking.
