CS3401 -- SPRING 2007
Assignment #10

1. Suppose the daytime processing load consists of 55% CPU activity and 45% disk activity. Your customers are complaining that the system is slow. After doing some research, you have learned that you can upgrade your disks for $8,000 to make them 2.5 times as fast as they are currently. You have also learned that you can upgrade your CPU to make it 1.4 as fast for $5,000.
   a. Which would you choose to yield the best performance improvement for the least amount of money?

   b. Which option would you choose if you don't care about the money, but want a faster system?

   c. What is the break-even point for the upgrades? That is, what price would we need to charge for the CPU (or the disk – change only one) so the result was the same cost per 1% increase for both?

2. Of programmed I/O, interrupt-driven I/O, DMA, or channel I/O, which is not suitable for processing the I/O of a:
   a. Mouse
   b. Modem
   c. CD
   d. Thumb drive or memory stick

   Explain your answers.

3. If an address bus needs to be able to address eight devices, how many conductors will be required? What if each of those devices also needs to be able to talk back to the I/O control device?

4. Suppose a disk drive has the following characteristics:
    1. 8 surfaces
    2. 1024 tracks per surface
    3. 256 sectors per track
    4. 512 bytes/sector
    5. Track-to-track seek time of 8 milliseconds
    6. Rotational speed of 7500 RPM.

    a. What is the capacity of the drive?

    b. What is the access time?

5. A particular high-performance computer system has been functioning as an e-business server on the Web. This system supports $10,000 per hour in gross business volume. It has been estimated that the net profit per hour is $1,200. In other words, if the system goes down, the company will lose $1,200 every hour until repairs are made. Furthermore, any data on the damaged disk would be lost. Some of this data could be retrieved from the previous night's backups, but the rest would be gone forever. Conceivably, a poorly-timed disk crash could cost your company hundreds of thousands of dollars in immediate revenue loss, and untold thousands in permanent business loss. The fact that this system is not using any type of RAID is disturbing to you. Although your chief concern is data integrity and system availability, others in your group are obsessed with system performance. They feel that more revenue would be lost in the long run if the system slows down after RAID is installed. They have stated specifically that a system with RAID performing at half the speed of the current system would result in gross revenue dollars per hour declining to $5,000 per hour. In total, 80% of the system e-business activity involves a database transaction. The database transactions consist of 60% reads and 40% writes. On average, disk access time is 20ms. The disks on this system are nearly full and are nearing the end of their expected life, so new ones must be ordered soon. You feel that this is a good time to try to install RAID, even though you'll need to buy extra disks. The disks that are suitable for your system cost $2000 for each 10 gigabyte spindle. The average access time of these new disks is 15ms with a MTTF of 20,000 hours and a MTTR of 4 hours. You have projected that you will need 60 gigabytes of

storage to accommodate the existing data as well as the expected data growth over the next 5 years. (All of the disks will be replaced.)

a. Are the people who are against adding RAID to the system correct in their assertion that 50% slower disks will result in revenues declining to $5,000 per hour? Justify your answer.

b. What would be the average disk access time on your system if you decide to use RAID-1?

c. What would be the average disk access time on your system using a RAID-5 array with two sets of 4 disks if 25% of the database transactions must wait behind one transaction for the disk to become free?

d. Which configuration has a better cost-justification, RAID-1 or RAID-5? Explain your answer.