SHEET Number 3

Answer the following Questions.

1. Calculate the overall speedup of a system that spends 65% of its time on I/O with a disk upgrade that provides for 50% greater throughput.

2. Calculate the overall speedup of a system that spends 40% of its time in calculations with a processor upgrade that provides for 100% greater throughput.

3. Suppose your company has decided that it needs to make certain busy servers 50% faster. Processes in the workload spend 60% of their time using the CPU and 40% on I/O. To achieve an overall system speedup of 25%:

   a) How much faster does the CPU need to be?
   b) How much faster does the disk need to be?

4. Suppose your company has decided that it needs to make certain busy servers 30% faster. Processes in the workload spend 70% of their time using the CPU and 30% on I/O. To achieve an overall system speedup of 30%:

   a) How much faster does the CPU need to be?
   b) How much faster does the disk need to be?

5. Suppose that you are designing a game system that responds to players' pressing buttons and toggling joysticks. The prototype system is failing to react in time to these input events, causing noticeable annoyance to the gamers. You have calculated that you need to improve overall system performance by 50%. This is to say that the entire system needs to be 50% faster than it is now. You know that these I/O events account for 75% of the system workload. You figure that a new I/O interface card should do the trick. If the system's existing I/O card runs at 10 kHz (pulses per second), what is the speed of the I/O card that you need to order from the supplier?

6. Suppose that you are designing an electronic musical instrument. The prototype system occasionally produces off-key notes, causing listeners to wince and grimace. You have determined the cause of the problem is that the system becomes overwhelmed in processing the complicated input. You are thinking that if you could boost overall system performance by 12% (making it 12% faster than it is now), you could eliminate the problem. One option is to use a faster processor. If the processor accounts for 25% of the workload of this system, and you need to boost performance by 12%, how much faster does the new processor need to be?

7. Your friend has just bought a new personal computer. She tells you that her new system runs at 1GHz, which makes it over three times faster than her old 300 MHz system. What would you tell her? (Hint: Consider how Amdahl's Law applies.)

8. Suppose the daytime processing load consists of 60% CPU activity and 40% 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?

♦ 9. How would you answer exercise 8 if the system activity consists of 55% processor time and 45% disk activity?

10. Amdahl's Law is as applicable to software as it is to hardware. An oft-cited programming truism states that a program spends 90% of its time executing 10% of its code. Thus, tuning a small amount of program code can often time have an enormous affect on the overall performance of a software product. Determine the overall system speedup if:
    a) 90% of a program is made to run 10 times as fast (900% faster).
    b) 80% of a program is made to run 20% faster.

11. Name the four types of I/O architectures. Where are each of these typically used and why are they used there?

♦12. A CPU with interrupt-driven I/O is busy servicing a disk request. While the CPU is midway through the disk-service routine, another I/O interrupt occurs.
    ♦ a) What happens next?
    ♦ b) Is it a problem?
    ♦ c) If not, why not? If so, what can be done about it?

13. A generic DMA controller consists of the following components:
    - Address generator
    - Address bus interface
    - Data bus interface
    - Bus requestor
    - Interrupt signal circuits
    - Local peripheral controller.

    The local peripheral controller is the circuitry that the DMA uses to select among the peripherals connected to it. This circuit is activated right after the bus is requested. What is the purpose of each of the other components listed above and when are they active? (Use Figure 7.6 as a guide.)

14. 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) Game controller
    c) CD
    d) Thumb drive or memory stick

    Explain your answers.

15. Why are I/O buses provided with clock signals?

16. 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