

Department of Electrical and Computer Engineering

Computer Engineering

Course ECSE-322B

Problem Set 6

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1. Programmed input and output provides a mechanism for matching the speeds of a peripheral device and a CPU. Describe the features that must be present on a terminal interface for such a system to work.
2. In a system using programmed input and output to communicate with a printer, the printer is connected to the interface via a serial line. The printer can print 80 characters per second and it is assumed that all characters take the same time to print. The interface sends characters to the printer at a rate of 80 characters per second, when there is something to print. If a program designed to print the string "Hello world" executes in 0.3 seconds, what percentage of its time (in this particular program) does the CPU spend in a programmed I/O loop? If the time taken to do useful work, i.e. actually output a character to the interface is 10 microseconds, what is the ratio of overhead time (i.e. non-useful time) in the I/O process to useful work time?
3. In a system which does not have a capability for vectored interrupts, it is decided to implement a polled interrupt system, i.e. when an interrupt arrives at the CPU, the service routine first checks each device interface to determine which device interrupted.
 - a) Describe how a device priority structure might be set up in such a system. How does this compare with the method for implementing priorities in a vectored interrupt system? (Answers in point form)
 - b) Consider a system having 12 interrupting devices. After jumping to the common interrupt service routine (ISR), the CPU takes 20 microseconds to read and examine the status of each device. How much time is wasted in polling when the lowest priority device causes an interrupt?

c) Suppose that the rate at which interrupts are generated is the same for all 12 devices. What is the average length of time wasted for device polling?

4. A particular system takes (on the average) 20 microseconds to get to the pertinent ISR after the interrupt is received and the FETCH and EXECUTE cycle is broken. On the average, an ISR takes 130 microseconds to execute. However, servicing of an I/O device actually takes 120 microseconds. The remaining 10 microseconds are taken up with restoring the contents of the CPU registers and for other operations associated with returning to the interrupted program.

a) Determine (in percent) the total overhead associated with an interrupt, considering that the only productive time is the time consumed for device servicing.

b) Measurements on the real system indicate an average of 750 interrupts per second. Calculate what fraction of CPU time is spent on interrupts.

5. A computer system uses a laser printer as its output device. This printer can output a page of 3500 characters of text in 15 seconds and has no internal buffering, i.e. characters are processed as they arrive from the computer. The computer is designed to use a programmed input/output system for handling the printer interface. The complete programmed input output set of instructions takes 100 microseconds to execute if a character is moved; if the interface is busy, the system will continuously check the device status register and each check takes only 25 microseconds. How many times will the device status register be checked by the CPU in outputting one full page of text to the printer?

6. In designing a dot matrix printer, list the factors which control the speed of operation. Why is this important? What effect will it have on the overall operation of a computer system?