Problems

1.1 You are to write an IAS program to compute the results of the following equation.

$$Y = \sum_{X=1}^{N} X$$

Assume that the computation does not result in an arithmetic overflow and that X, Y, and N are positive integers with $N \geq 1$. *Note*: The IAS did not have assembly language, only machine language.

a. Use the equation $\text{Sum}(Y) = \dfrac{N(N+1)}{2}$ when writing the IAS program.

b. Do it the "hard way," without using the equation from part (a).

1.2 **a.** On the IAS, what would the machine code instruction look like to store the contents of an accumulator to memory address 8?

b. On the IAS, what would the machine code instruction look like to add the contents of memory address 16 to the accumulator?

1.3 The IAS operates by repetitively performing an instruction cycle, which consists of two sub cycles: a fetch cycle and an execute cycle. On the IAS, describe in English the tasks accomplished during the fetch cycle and those accomplished during the execute cycle.

1.4 Given the memory contents of the IAS computer shown below,

Address	Contents
08A	010FA210FB
08B	010FA0F08D
08C	020FA210FB

show the assembly language code for the program, starting at address 08A. Explain what this program does.

1.5 During the fetch cycle in Figure 1.8, why is an instruction always taken from the IBR?

1.6 In the IBM 360 Models 65 and 75, addresses are staggered in two separate main memory units (e.g., all even-numbered words in one unit and all odd-numbered words in another). What might be the purpose of this technique?

1.7 The relative performance of the IBM 360 Model 75 is 50 times that of the 360 Model 30, yet the instruction cycle time is only 5 times as fast. How do you account for this discrepancy?

1.8 While browsing at Billy Bob's computer store, you overhear a customer asking Billy Bob what is the fastest computer in the store that he can buy. Billy Bob replies, "You're looking at our Macintoshes. The fastest Mac we have runs at a clock speed of 1.2 GHz. If you really want the fastest machine, you should buy our 2.4-GHz Intel Pentium IV instead." Is Billy Bob correct? What would you say to help this customer?

1.9 The ENIAC, a precursor to the ISA machine, was a decimal machine, in which each register was represented by a ring of 10 vacuum tubes. At any time, only one vacuum tube was in the ON state, representing one of the 10 decimal digits. Assuming that ENIAC had the capability to have multiple vacuum tubes in the ON and OFF state simultaneously, why is this representation "wasteful" and what range of integer values could we represent using the 10 vacuum tubes?

1.10 For each of the following examples, determine whether this is an embedded system, explaining why or why not.

a. Are programs that understand physics and/or hardware embedded? For example, one that uses finite-element methods to predict fluid flow over airplane wings?

b. Is the internal microprocessor controlling a disk drive an example of an embedded system?

c. I/O drivers control hardware, so does the presence of an I/O driver imply that the computer executing the driver is embedded?
d. Is a PDA (Personal Digital Assistant) an embedded system?
e. Is the microprocessor controlling a cell phone an embedded system?
f. Are the computers in a big phased-array radar considered embedded? These radars are 10-story buildings with one to three 100-foot diameter radiating patches on the sloped sides of the building.
g. Is a traditional flight management system (FMS) built into an airplane cockpit considered embedded?
h. Are the computers in a hardware-in-the-loop (HIL) simulator embedded?
i. Is the computer controlling a pacemaker in a person's chest an embedded computer?
j. Is the computer controlling fuel injection in an automobile engine embedded?