HW 1 Solutions

1. (5 pts) What are the essential building blocks for a computer?
   See Section "The Main Components of a Computer".
2. (5 pts) What is the difference between computer organization and computer architecture?
   See Section "OVERVIEW"
3. (5 pts) Technical societies such as IEEE and ACM as well as other entities organize contests for computer science and engineering students. Name a few such contests.
   See Section "Standards Organizations"
4. (5 pts) What are Charles Babbage and Ada Gordon famous for in the history of computers?
   See Section "Generation Zero: Mechanical Calculating Machines (1642-1945)".
5. (10 pts)
   a) How many milliseconds (ms) are in 2 second? (2,000)
   b) How many microseconds (μs) are in 5 second? (5,000,000)
   c) How many nanoseconds (ns) are in 3 millisecond? (3,000,000)
   d) How many microseconds are in 2 millisecond? (2,000)
   e) How many nanoseconds are in 13 microsecond? (13,000)
   f) How many kilobytes (KB) are in 2 gigabyte (GB)? (2,000,000 or 2^{21})
   g) How many kilobytes are in 6 megabyte (MB)? (6,000 or $6 * 2^{10}$)
   h) How many megabytes are in 10 gigabyte (GB)? (10,000 or $10 * 2^{10}$)
   i) How many bytes are in 10 megabytes? (10,000,000 or $10 * 2^{20}$)
   j) How many kilobytes are in 5 gigabytes? (5,000,000 or $5 * 2^{20}$)
6. (5 pts) In the von Neumann model, explain the purpose of the a) processing unite, b) program counter.

   Ans.
   a) The processing unit performs all of the arithmetic and logic functions.
   b) The program counter is responsible for keeping track of the next instruction to fetch.
7. (5 pts) Under the von Neumann architecture, a program and its data are both stored in memory. It is therefore possible for a program, thinking a memory location holds a piece of data when it actually holds a program instruction, to accidentally (or on purpose) modify itself. What implications does this present to you as a programmer?

Ans.

Care must be taken when programming to make sure the code doesn't modify itself in some way. For example, if a memory location holds an instruction (which is represented by a binary number), and a value is added to that instruction, the result could be a valid instruction that is later executed, resulting in an error that is very difficult to track down. The modification of an instruction could also cause a program to crash.

8. (5 pts) State Moore's law and Rock's Law. How is Rock's Law related to Moore's Law?
   See Section "Moore's Law"

9. (5 pts) How does the fetch-decode-execute cycle work?
   See Section "THE VON NEUMANN MODEL"

10. (5 pts) Explain why modern computers consist of multiple levels of virtual machines.

Ans.

The virtual machines abstract out the tasks each layer of the machine performs. This allows us to use a "divide and conquer" approach and view the computer organization as separate layers, each built upon the ones below it. We can study one layer and get a detailed understanding on what it does and what it provides to the next higher layer.