Homework Chapters 3 and 5 (17 points)
Due: Monday, February 25th, in class

1. Give an example of an interpreted, compiled, and mark-up language. What is an advantage of interpreted and an advantage of compiled languages?

2. What does RAM stand for? What does ROM stand for? Briefly describe one key difference between the two.

3. Suppose memory has 16384 bytes. How many bits are needed for the memory addresses? (1/2 point)

4. If we have a 5-bit opcode, how many different instructions are possible? (1/2 point)

5. List the four subsystems of the von Neumann Architecture and briefly define what each does.

6. If the average access time for RAM is 32 nsec and the average access time for cache memory is 6 nsec, what is the overall average access time if our cache hit rate is 60%?

7. List one thing that can be done to increase the cache hit rate. (1/2 point)

8. Suppose a, b, c, and d are in memory locations M[100], M[101], M[110], and M[111], respectively. Write an equation that represents the following assembly language instructions:
   
   ADD M[100] M[100] M[100]

\[
\begin{align*}
\text{ADD} & \ M[1] \ M[2] \ M[1] \\
\text{ADD} & \ M[1] \ M[1] \ M[1] \\
\end{align*}
\]

10. Assume that the variables \( v, w, x, y, \) and \( z \) are stored in memory locations \( M[000], M[001], M[010], M[011], \) and \( M[100], \) respectively. Using the machine language instructions shown in Section 3.2, translate the following algorithmic operations into their machine language equivalents. You can overwrite a memory location for an intermediate calculation, if that location is no longer needed. See activity 3.2.2 for an example. (2 points)

a. Set \( v \) to the value of \( (w + y) + (x + z) \)

b. Input \( v \) from the user, then display \( v \times 5 \)

11. Provide one main difference between CRT, LCD, and Plasma displays. What is one pro and one con for each type of technology?

12. Zybooks mentions four different types of computers. For each one, give a possible use case where that type would be better than the others.
13. Given a clock with a clock cycle frequency of 2 GHz, how long would it take an instruction set of 1 million instructions to run if each instruction takes 3 clock cycles?

14. Rank the following programming languages from the lowest level to the highest level: Python, Machine language, and Assembly language. (1/2 point)

15. Sort the following memory types from slowest to fastest, then by cost from cheapest to most expensive: Hard Drive, Cache, RAM, and Solid State Drive. Discuss the relationship between cost and speed.

16. If a computer had 16 transistors in an integrated circuit, how many transistors could it have according to Moore’s law after 10 years? Assume that the number of transistors doubles every 2 years.


18. Consider the following structure of the instruction register.

<table>
<thead>
<tr>
<th>Op code</th>
<th>Address-1</th>
<th>Address-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 bits</td>
<td>17 bits</td>
<td>17 bits</td>
</tr>
</tbody>
</table>

a. What is the maximum number of distinct operations that can be recognized and executed by the processor on this machine?

b. What is the maximum memory size on this machine?

c. How many bytes are required for each operation?