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CMIS 310
HOMEWORK #3 – Week #3 (UPDATED)

This homework is worth 10% of your course grade.

Read each problem carefully. Failure to follow the instructions for a problem will result in a zero score for that problem.

Submit the completed Homework via Assignment in LEO.

1. How many bits are required to address a 4M X 16 main memory if

   a) Main memory is byte addressable? Byte = 8 bits. 16 bits = 2 Bytes. 4M = 4 * M * 8= 2^2 * 2^20 * 2^1= 2^(2+20+1) = 2^23. **23 bits are required.**

   b) Main memory is word addressable? 4M words = 4*M = 2^2 * 2^20 = 2^22. **22 bits are required**

2. Suppose that a 16M X 16 main memory is built using 512K X 8 RAM chips and memory is word addressable.

   a) How many RAM chips are necessary? 16M words by 16 bits/word. 16M/512K = 2^4 * 2^20 / 2 ^ 9 * 2^10 = 2^24/2^19 = 2^5 = 32. 16 = 2*8. 2*32 = **64 RAM chips.**

   b) How many RAM chips are needed for each memory word? 1 RAM Chip = 8 bits/Word. Memory word = 16 bits. **2 RAM chips are required per word**

   c) How many address bits are needed for each RAM chip? 512K = 2^9 * 2^10 = 2 ^ 19. **19 address bits are needed**

   d) How many address bits are needed for all memory? 16M = 16*M = 2^4 = 2^20 = 2^24. **24 address bits are needed**

3. A digital computer has a memory unit with 24 bits per word. The instruction set consists of 150 different operations. All instructions have an operation code part (opcode), and an address part (allowing for only one address). Each instruction is stored in one word of memory.

   a. How many bits are needed for the opcode? 2^7 = 128 < 150. 2^8 = 256 >150. **8 bits are needed**

b) How many bits are left for the address part of the instruction? 24 bits per word -8 bits per opcode =**16 bits for the address of the instruction**
c) What is the maximum allowable size for memory? 2^16 (from b) = **65,536 bits**

4. Write the following MARIE assembly language equivalent of the following machine language instructions

1	Load X
2	Store X
3	Add X
4	Subt X
5	Input
6	Output
7	Halt
8	Skipcond
9	Jump X

4 bits opcode, 12 bits address

a) 0010 0000 0000 0111 = 0x2007 = **STORE X at location 0x007**

b) 1001 0000 0000 1011 = 0x500B = **JUMP X at location 0x00B**

c) 0011 0000 0000 1001 = 0x3009 = **ADD X at location 0x009**

5. What is the difference between hardwired control and microprogrammed control?

Hardwired control units use hardware while microprogrammed control units use microcode stored in firmware (Null & Lobur, 2003). Hardwired control units are advantageous in their speed, while microprogrammed control units are advantageous in their monetary costs and ability to handle complex instruction sets. Both have their sets of disadvantages. Hardwired control units have a difficult time managing complex instruction sets and can not easily modify them after they are set due to the physical components. The physical components are also more expensive. Microprogrammed control units use interpreters for processing the code which causes a disadvantage with speed. Additionally, there are specific software tools that have to be used in order to program the microprogrammed control units.

References

Null, L. & Lobur, J. (2003). The essentials of computer organization and architecture. [E-Book]. Retrieved from http://library.books24x7.com.ezproxy.umgc.edu/toc.aspx?bookid=5893.