林筆君(1) 滿分

Introduction to Information Engineering-Midterm exam. #1(Fall 2013)

1. (6%) What is the main difference between Turing model and von Neumanm model of a computer?
2. (6%) In which of the following situations does an overflow never occur? Justify the answer.
   a. Adding two positive integers.
   b. Adding one positive integer to a negative integer.
   c. Subtracting one positive integer from a negative integer.
   d. Subtracting two negative integers
3. (6%) What is the advantage and disadvantage of using indexed color compared with using true color to encode the color of a pixel?
4. (9%) Compare and contrast the representation of zero in sign-and-magnitude, two's complement, and Excess formats.
5. (4%) We need to unset the two leftmost bits and set the three rightmost bits of an 8-bit pattern. Show the masks and operations.
6. (4%) A computer has 256MB (megabytes) of memory. Each word is 2 bytes. How many bits are required to address each single word in memory?
7. (6%) What are the advantages and disadvantages of memory-mapped I/O compared with isolated I/O?
8. (12%) Describe the operation of direct memory access (DMA).
9. (8%) How does a DMA controller increase the efficiency of transferring data between memory and an I/O device?
10. (8%) Suppose that a program consists of n instructions in sequential order. A machine cycle consists of three phases, namely, phase 1, phase 2, and phase 3. All phases require the same amount of time, T, to complete.
    (a) Calculate the total amount of time to complete the execution of the program using a CPU with no pipelining.
    (b) Calculate the total amount of time to complete the execution of the program using a CPU with pipelining.
11. (12%) An imaginary computer has 16 data registers (R0 to R15), 4M words in memory, and 64 different instructions.
    (a) Consider a typical instruction uses the following format:

        instruction M R1

        where M denotes a memory address. What is the minimum size of an instruction in bits?
    (b) What is the minimum size of the instruction register?
    (c) What is the size of the program counter?

(d) What is the size of the address bus?

12. (20%) Using the instruction set of the simple computer in Section 5.7, write a program and convert it into a set of binary codes that performs the following calculation:

$$D \leftarrow A + B + C$$

A, B, C are integers in two's complement format. The keyboard is mapped to memory location $(FE)_{16}$ and the monitor is mapped to memory location $(FF)_{16}$. The user types the value of A, B, and C, and the value of D is displayed on the monitor.

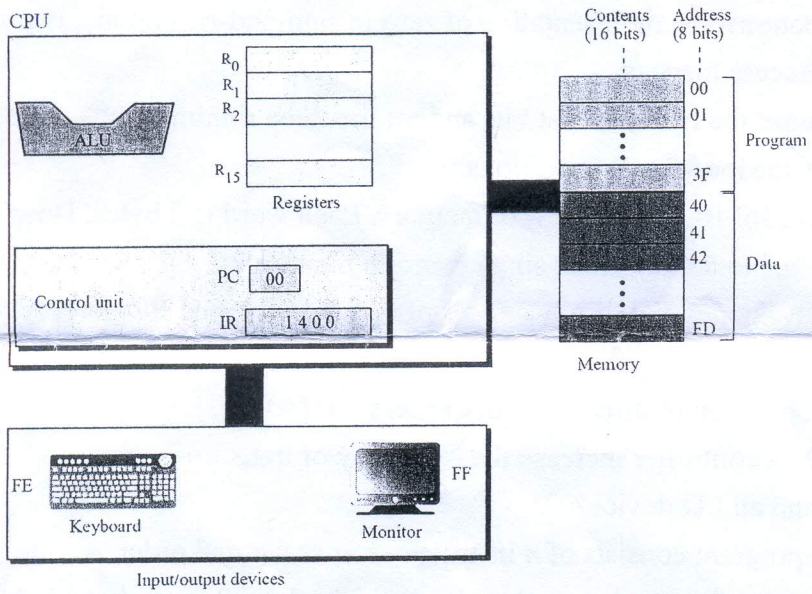
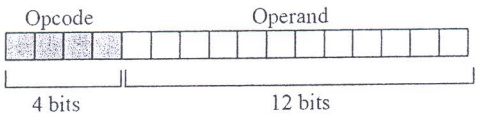


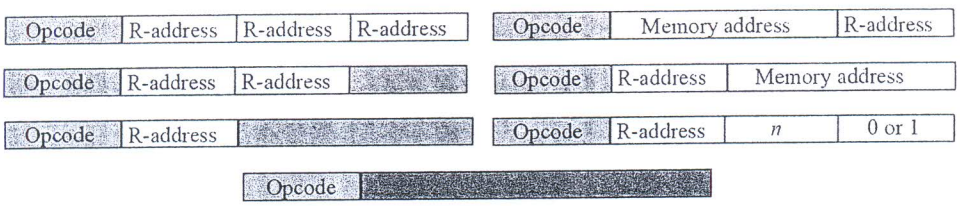
Table 5.4 List of instructions for the simple computer

Instruction	*Code*	*Operands*				*Action*
	d_1	d_2	d_3	d_4		
HALT	0					Stops the execution of the program
LOAD	1	R_D	M_S			$R_D \leftarrow M_S$
STORE	2	M_D		R_S		$M_D \leftarrow R_S$
ADDI	3	R_D	R_{S1}	R_{S2}		$R_D \leftarrow R_{S1} + R_{S2}$
ADDF	4	R_D	R_{S1}	R_{S2}		$R_D \leftarrow R_{S1} + R_{S2}$
MOVE	5	R_D	R_S			$R_D \leftarrow R_S$
NOT	6	R_D	R_S			$R_D \leftarrow \overline{R_S}$
AND	7	R_D	R_{S1}	R_{S2}		$R_D \leftarrow R_{S1}$ AND R_{S2}
OR	8	R_D	R_{S1}	R_{S2}		$R_D \leftarrow R_{S1}$ OR R_{S2}
XOR	9	R_D	R_{S1}	R_{S2}		$R_D \leftarrow R_{S1}$ XOR R_{S2}
INC	A	R				R $\leftarrow$ R + 1
DEC	B	R				R $\leftarrow$ R – 1
ROTATE	C	R	n	0 or 1		Rot_n R
JUMP	D	R	n			IF $R_0 \neq$ R then PC = *n*, otherwise continue

Key: R_S, R_{S1}, R_{S2}: Hexadecimal address of source registers
R_D: Hexadecimal address of destination register
M_S: Hexadecimal address of source memory location
M_D: Hexadecimal address of destination memory location
n: hexadecimal number
d_1, d_2, d_3, d_4: First, second, third, and fourth hexadecimal digits



a. Instruction format



b. Instruction types