

Introduction to Computer Science: Homework 1

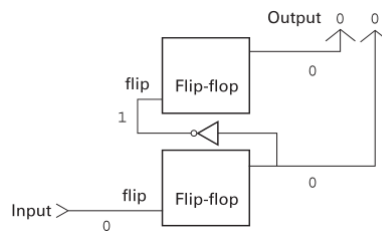
Instructed by *Longbo Huang*

Due on Oct 7, 2013

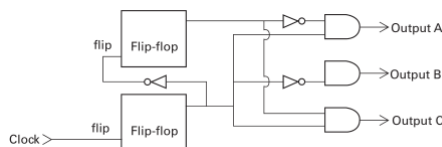
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Problem 3

- a. If we were to purchase a flip-flop circuit from an electronic component store, we may find that it has an additional input called flip. When this input changes from a 0 to 1, the output flips state (if it was 0 it is now 1 and vice versa). However, when the flip input changes from 1 to a 0, nothing happens. Even though we may not know the details of the circuitry needed to accomplish this behavior, we could still use this device as an abstract tool in other circuits. Consider the circuitry using two of the following flip-flops. If a pulse were sent on the circuit's input, the bottom flip-flop would change state. However, the second flip-flop would not change, since its input (received from the output of the NOT gate) went from a 1 to a 0. As a result, this circuit would now produce the outputs 0 and 1. A second pulse would flip the state of both flip-flops, producing an output of 1 and 0. What would be the output after a third pulse? After a fourth pulse?



- b. It is often necessary to coordinate activities of various components within a computer. This is accomplished by connecting a pulsating signal (called a clock) to circuitry similar to part a. Additional gates (as shown) will then send signals in a coordinated fashion to other connected circuits. On studying this circuit you should be able to confirm that on the 1st, 5th, 9th ... pulses of the clock, a 1 will be sent on output A. On what pulses of the clock will a 1 be sent on output B? On what pulses of the clock will a 1 be sent on output C? On which output is a 1 sent on the 4th pulse of the clock?



Answer:

- a. After a third pulse, the output will be 1 and 1. After a fourth pulse, the output will be 0 and 0.

- b. On the 2^{nd} , 4^{th} , 6^{th} , ... pulses of the clock, a 1 will be sent on output B. On the 3^{rd} , 7^{th} , 11^{th} , ... pulses of the clock, a 1 will be sent on output C. On the 4^{th} pulse of the clock a 1 is sent on output B.

Problem 6

How many cells can be in a computers main memory if each cells address can be represented by two hexadecimal digits? What if four hexadecimal digits are used?

Answer: If each cell's address can be represented by 2 hexadecimal digits, 256 cells can be in a computer's main memory. For 4 hexadecimal digits used, the answer is 65536.

Problem 9

Express the following bit patterns in hexadecimal notation:

- a. 101000001010
- b. 110001111011
- c. 000010111110

Answer:

- a. $(101000001010)_2 = 0xA0A$
- b. $(110001111011)_2 = 0xC7B$
- c. $(000010111110)_2 = 0xBE$

Problem 15

How many bytes of storage space would be required to store a 400-page novel in which each page contains 3500 characters if ASCII were used? How many bytes would be required if Unicode were used?

Answer: 1400000 bytes will be needed for ASCII. 2800000 bytes will be needed for Unicode.

Problem 19

Here is a message in ASCII. What does it say?

01010111 01101000 01100001 01110100 00100000 01100100 01101111 01100101 01110011 00100000
01101001 01110100 00100000 01110011 01100001 01111001 00111111

Answer: "What does it say?"

Problem 26

Convert each of the following binary representations to its equivalent base ten representation:

- a. 1111 b. 0001 c. 10101 d. 1000 e. 10011 f. 000000 g. 1001 h. 10001 i. 100001
j. 11001 k. 11010 l. 11011

Answer:

a: 15

b: 1

c: 21

d: 8

e: 19

f: 0

g: 9

h: 17

i: 33

j: 25

k: 26

l: 27

Problem 33

Solve each of the following problems by translating the values into twos complement notation (using patterns of 5 bits), converting any subtraction problem to an equivalent addition problem, and performing that addition. Check your work by converting your answer to base ten notation. (Watch out for overflow.)

| | | |
|---|---|--|
| a. 5 | b. 5 | c. 12 |
| $\begin{array}{r} +1 \\ \hline \end{array}$ | $\begin{array}{r} -1 \\ \hline \end{array}$ | $\begin{array}{r} -5 \\ \hline \end{array}$ |
| d. 8 | e. 12 | f. 5 |
| $\begin{array}{r} -7 \\ \hline \end{array}$ | $\begin{array}{r} +5 \\ \hline \end{array}$ | $\begin{array}{r} -11 \\ \hline \end{array}$ |

Answer:

| | | |
|---|---|---|
| a. 00101 | b. 00101 | c. 01100 |
| $\begin{array}{r} +00001 \\ \hline 00110 \end{array}$ | $\begin{array}{r} +11111 \\ \hline 00100 \end{array}$ | $\begin{array}{r} +11011 \\ \hline 00111 \end{array}$ |
| d. 01000 | e. 01100 | f. 00101 |
| $\begin{array}{r} +11001 \\ \hline 00001 \end{array}$ | $\begin{array}{r} +00101 \\ \hline 10001 \end{array}$ | $\begin{array}{r} +10101 \\ \hline 11010 \end{array}$ |

Problem 42

One of the bit patterns 01011 and 11011 represents a value stored in excess 16 notation and the other represents the same value stored in twos complement notation.

- What can be determined about this common value?
- What is the relationship between a pattern representing a value stored in twos complement notation and the pattern representing the same value stored in excess notation when both systems use the same bit pattern length?

Answer: a. It must be 11 or -5.

- They are different in high-order end and are the same at the other positions.

Problem 47

What would be the encoded version of the message

xyx yx xy xy yx

if LZW compression, starting with the dictionary containing x, y, and a space (as described in Section 1.8), were used?

Answer: 1123221343435

Problem 52

The following message was originally transmitted with odd parity in each short bit string. In which strings have errors definitely occurred?

11001 11011 10110 00000 11111 10001 10101 00100 01110

Answer: In 11011, 00000, 10001.

Problem 54

Using the error-correcting code described in Figure 1.30, decode the following words:

Answer:

- HE
- FED
- DEAD
- CABBAGE
- CAFE