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## **CS/ECE 252 Introduction to Computer Engineering**

Spring 2018 Instructor: Adil Ibrahim

## Homework 2 Deadline: February 2<sup>nd</sup> 2018

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This Homework covers problems from chapter 2 of the textbook and is worth 44 points. For each question below you need to show the complete working to receive full points. Please utilize the space provided under each question. Please upload a PDF version on canvas.

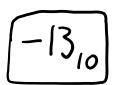
Problem 1 (12 pts)

Convert these decimal numbers to 8-bit Signed Magnitude, 1's Complement and 2's Complement binary number:

Integer	Signed Magnitude	1's Complement	2's Complement
10	0000 1010	0000 1010	0000 1010
107	0110 1011	0110 1011	0110 1011
-1	1000 0001	1111 1110	1111
-127	1111 1111	1000 0000	1000 0001

Problem 2 (2 pts)

Convert the 2's complement integer 111100112 to a decimal integer value.



Problem 3 (10 pts)

a) Add the following 2's complement numbers together.



b.  $10011100_2 + 0101_2$ 



c. For part (a), check your answer by translating the operands and results into

d. Which of the above (if any) create overflow?

b) Why is sign-extension important when performing arithmetic with 2's complement number?

Sign extension is important when performing arithmetic with 2's complement because we can represent numbers so they have the same amount of bits. We can only perform operations on numbers with the same amount of him

c) Solve for 23 – 11 using binary subtraction.

$$23_{10} = 00010111_{2} | 23_{10} = 00010111_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{10}) = 11110101_{2} | (-11_{$$

Problem 4: (2 pts)

Compute the following operations:

1. NOT (11101100<sub>2</sub>) OR NOT (01010001<sub>2</sub>)

2. (0011<sub>2</sub> AND 1001<sub>2</sub>) AND 1111<sub>2</sub>

3. NOT (10011110<sub>2</sub>) XOR 11110011<sub>2</sub>

Problem 5: (4 pts)

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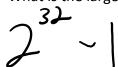
Convert the following IEEE floating point number into decimal.

$$N = (-1) \times 1.10111 \times 2^{4}$$

$$-1. (0111 \times 2^{4} + 2^{-3} + 2^{-4} + 2^{-5} + 2^{-4} + 2^{-5} + 2^{-4} + 2^{-5} + 2^{-4} + 2^{-5} + 2^{-4} + 2^{-5} + 2^{-4} + 2^{-5} + 2^{-4} + 2^{-5} + 2^{-4} + 2^{-5}$$

**Problem 6** (4 pts)

- a) In 2's complement, how many distinct numbers can be represented using 32 bits?
- b) What is the largest unsigned integer that may be represented using 32 bits?



c) Convert the following to their hex equivalent.

a. The decimal number 23 
$$23_{10} = 17_{16}$$

b. The ASCII string **GOLDFISH** 

G 47

0 4F

L 4C

n 44

F 46

T 49

5 53

H 48

GOLDFISH = 47 4 F 4 C 44 46 49 53 48 16