

COMP 3350 Project #1

Possible points: 100

Due: September 3, 2021 (Friday) **11:59pm CST (Central Standard Time)**

Goals:

- Get you familiar with data representation and simple logic operations for this course.

Requirements:

- Finish the questions section below. Points for each question included in parenthesis.
- Show your work to get full credit. **ZERO** point without steps for a result.
- Please start early. ZERO point for late submission. After the **11:59pm** on the due day, you can't submit your assignment anymore.
- Check deliverables section below. ZERO point for hand-written or scanned homework.

Deliverables:

- Save your solutions of questions as a **pdf** document. You can use this document as worksheet.
- Name document as a "**Firstname_Lastname.pdf**".
- Submit your "**Firstname_Lastname.pdf**" through the Canvas system. You do not need to submit hard copies.

Rebuttal period:

- You will be given a period of **2 business days** to read and respond to the comments and grades of your homework or project assignment. The TA may use this opportunity to address any concern and question you have. The TA also may ask for additional information from you regarding your homework or project.

Questions:

1. (9 points) Convert the following unsigned base 2 numbers (binary) to base 16 numbers (hexadecimal):

A. 0110 0001 1111

Hexadecimal: 6 | 1 | F = 61F (This was done by the grouping method)

B. 1000 1111 1100

Hexadecimal: 8 | F | C = 8FC (This was done by the grouping method)

C. 0001 0110 0100 0101

Hexadecimal: 1 | 6 | 4 | 5 = 1645 (This was done by the grouping method)

2. (27 points)

(2.1) Convert the following binary numbers into base 10 numbers (decimal), binary numbers are represented in signed magnitude representation.

a. 1100 1010

Decimal: $(2^6 + 2^3 + 2^1) = 64 + 8 + 2 = 74 = \underline{-74}$

b. 1111 0010

Decimal: $(2^6 + 2^5 + 2^4 + 2^1) = 64 + 32 + 16 + 2 = 114 = \underline{-114}$

c. 1000 0111

Decimal: $(2^2 + 2^1 + 2^0) = 4 + 2 + 1 = 7 = \underline{-7}$

(2.2) Redo the question 2.1, if the binary number are represented in One's complement representation.

a.) ORIGINAL: 1100 1010

1's complement: 1011 0101

b.) ORIGINAL: 1111 0010

1's complement: 1000 1101

c.) ORIGINAL: 1000 0111

1's complement: 1111 1000

(2.3) Redo the question 2.1, if the binary number are represented in Two's complement representation.

a.) ORIGINAL: 1100 1010

2's complement: 1011 0110

b.) ORIGINAL: 1111 0010

2's complement: 1000 1110

c.) ORIGINAL: 1000 0111

2's complement: 1111 1001

For example, question (2.1), if 1100 1010 is a binary number represented in signed magnitude representation, what is the decimal value? Also do it again if 1100 1010 is a binary number in one's complement representation and two's complement representation. There 9 questions in total.

3. (36 points, answer 12 questions in total.)

(3.1) Convert the following base 10 (decimal) values to binary numbers (8-bits):

a. -100_d

Binary: $100/2 = 50$ R0, $50/2 = 25$ R0, $25/2 = 12$ R1, $12/2 = 6$ R0, $6/2 = 3$ R0, $3/2 = 1$ R1, $1/2 = 0$ R1
= 1110 0100

b. -16_d

Binary: $16/2 = 8$ R0, $8/2 = 4$ R0, $4/2 = 2$ R0, $2/2 = 1$ R0, $1/2 = 0$ R1
= 1001 0000

c. -21_d

Binary: $21/2 = 10$ R1, $10/2 = 5$ R0, $5/2 = 2$ R1, $2/2 = 1$ R0, $1/2 = 0$ R1
= 1001 0101

d. -0_d

Binary: 1000 0000

Each binary result represented in Signed magnitude representation.

(3.2) Redo the question (3.1), convert binary into in One's complement representation.

a.) Binary: 1110 0100

1's complement: 1001 1011

b.) Binary: 1001 0000

1's complement: 1110 1111

c.) Binary: 1001 0101

1's complement: 1110 1010

d.) Binary: 1000 0000

1's complement: 1111 1111

(3.3) Redo the question (3.1), convert binary into in Two's complement representation.

a.) Binary: 1110 0100

2's complement: 1001 1100

b.) Binary: 1001 0000

2's complement: 1111 0000

c.) Binary: 1001 0101

2's complement: 1110 1011

d.) Binary: 1000 0000

2's complement: 1000 0000

4. (4 points) What is the range of:

A. An unsigned 7-bit number? **0 - 127**

B. A signed 7-bit number? **-64 - 63**

5. (12 points) Provide the answer to the following problems (\wedge = AND, \vee = OR)

1. $1000 \wedge 1110$

1000

1110

----- (AND)

1000

2. $1000 \vee 1110$

1000

1110

----- (OR)

1110

3. $(1000 \wedge 1110) \vee (1001 \wedge 1110)$

1000

1110

----- (AND)

1000

1001

1110

------(AND)

1000

1000

1000

------(OR)

1000

6. (9 points) Please demonstrate each step in the calculation of the arithmetic operation $25 - 65$. (both 25 and 65 are signed decimal numbers)

1. DECIMAL REORIENTATION:

$$25 + (-65) = -40_{10}$$

2. CONVERSION to 2's complement:

Signed Magnitude:

$$25 = 0001\ 1001$$

$$-65 = 1100\ 0001$$

1's complement:

$$25 = 0001\ 1001$$

$$-65 = 1011\ 1110$$

2's complement:

$$25 = 0001\ 1001$$

$$-65 = 1011\ 1111$$

3. ADDITION of 2's complement:

0001 1001
1011 1111 +

1101 1000 = 2's complement

7. (3 points) Mathematically the answer in Q6 is -40₁₀. Please verify your answer in Q6 using a conversion of 2's and decimal numbers.

1101 1000 = 2's complement

1101 0111 = 1's complement

1010 1000 = Signed Magnitude

Decimal: $(2^5 + 2^3) = 40 = \underline{-40}$