CS2026 ASSIGNMENT 9 (Due Date: May 15, 2026)

Instructions: You have to answer all of them. Put your answers in a MS WORD file, or other word processing file, and then submit the file to the course Gmail account.

Table 1 shows four different number formats for your reference. For those questions with programs, please refer to the Section 9 in the lecture note *Processor and Computer (20260426)* for the syntax of the instructions.

Question 1

In the following questions, X and Y are two 8-bit unsigned integers. Find out their sum. If their sum cannot be represented in eight bit, you should answer 'overflow'.

(a) $X = 00001111$ and $Y = 01010101$.

(b) $X = 01000101$ and $Y = 00101010$.

(c) $X = 01000111$ and $Y = 01010000$.

(d) $X = 10001111$ and $Y = 01111000$.

Question 2

Given a non-negative integer is represented in 8-bit unsigned integer format.

(a) What is the maximum number that can be represented?

(b) What is the minimum number that can be represented?

(c) What is the range of the numbers that can be represented?

(d) How many distinct numbers that can be represented?

Question 3

Given a non-negative integer is represented in n-bit unsigned integer format, where n is a positive integer larger than eight.

(a) What is the maximum number that can be represented?

(b) What is the minimum number that can be represented?

(c) What is the range of the numbers that can be represented?

(d) How many distinct numbers that can be represented?

Question 4

Given an integer is represented in n-bit signed magnitude format, where n is a positive integer larger than eight.

(a) What is the maximum number that can be represented?

(b) What is the minimum number that can be represented?

(c) What is the range of the numbers that can be represented?

(d) How many distinct numbers that can be represented?

Question 5

In the following questions, X and Y are two integers represented in 8-bit signed magnitude format. Note that some results might not be representable.

`sxxxxxxx`

Find out their sum.

(a) $X = 00001111$ and $Y = 01010101$.

(b) $X = 01000101$ and $Y = 00101010$.

(c) $X = 01000111$ and $Y = 01010000$.

(d) $X = 10001111$ and $Y = 01111000$.

Question 6

Given a non-negative number is represented in 8-bit unsigned integer format as follows.

`xxxxxxxy`

The binary pattern of the number is with the leftmost seven bits for integral part and the last bit as the fractional part. The value in the factional part is given by $y \times 2^{-1}$.

(a) What is the maximum number that can be represented?

(b) What is the minimum number that can be represented?

(c) What is the range of the numbers that can be represented?

(d) How many distinct numbers that can be represented?

Question 7

Given a number is represented in 8-bit signed magnitude format as follows.

`sxxxxxxy`

The leftmost bit is the sign bit. The binary number represented from the second bit to the 7^{th} bit is the integral part and the last bit as the fractional part. The value in the factional part is given by $y \times 2^{-1}$.

(a) What is the maximum number that can be represented?

(b) What is the minimum number that can be represented?

(c) What is the range of the numbers that can be represented?

(d) How many distinct numbers that can be represented?

Question 8

Given a number is represented in 8-bit signed magnitude format as follows.

`sxxxxxyy`

The leftmost bit is the sign bit. The binary number represented from the second bit to the 6^{th} bit is the integral part and the rightmost two bits as the fractional part. The value second rightmost bit is $y \times 2^{-1}$ and the value of the rightmost bit is $y \times 2^{-2}$. Given the number is given by 00000111. Find out its integer value based on different rounding method.

(a) What is its value if it is based on the method of round-up?

(b) What is its value if it is based on the method of round-down?

(c) What is its value if it is based on the method of banker rounding?

Question 9

Given a number is represented in 8-bit signed magnitude format as follows.

`sxxxxxyy`

The leftmost bit is the sign bit. The binary number represented from the second bit to the 6^{th} bit is the integral part and the rightmost two bits as the fractional part. The value second rightmost bit is $y \times 2^{-1}$ and the value of the rightmost bit is $y \times 2^{-2}$. Given the number is given by 00001110. Find out its integer value based on different rounding method.

(a) What is its value if it is based on the method of round-up?

(b) What is its value if it is based on the method of round-down?

(c) What is its value if it is based on the method of banker rounding?

Question 10

Given a number is represented in 8-bit signed magnitude format as follows.

`sxxxxxyy`

The leftmost bit is the sign bit. The binary number represented from the second bit to the 6^{th} bit is the integral part and the rightmost two bits as the fractional part. The value second rightmost bit is $y \times 2^{-1}$ and the value of the rightmost bit is $y \times 2^{-2}$. Given the number is given by 00001010. Find out its integer value based on different rounding method.

(a) What is its value if it is based on the method of round-up?

(b) What is its value if it is based on the method of round-down?

(c) What is its value if it is based on the method of banker rounding?

Table 1: Four number representation formats.

Bits	Unsigned Integer	Signed Magnitude	2′S Complement	Excess-8
0000	0	0	0	−8
0001	1	1	1	−7
0010	2	2	2	−6
0011	3	3	3	−5
0100	4	4	4	−4
0101	5	5	5	−3
0110	6	6	6	−2
0111	7	7	7	−1
1000	8	−0	−0	0
1001	9	−1	−7	1
1010	10	−2	−6	2
1011	11	−3	−5	3
1100	12	−4	−4	4
1101	13	−5	−3	5
1110	14	−6	−2	6
1111	15	−7	−1	7

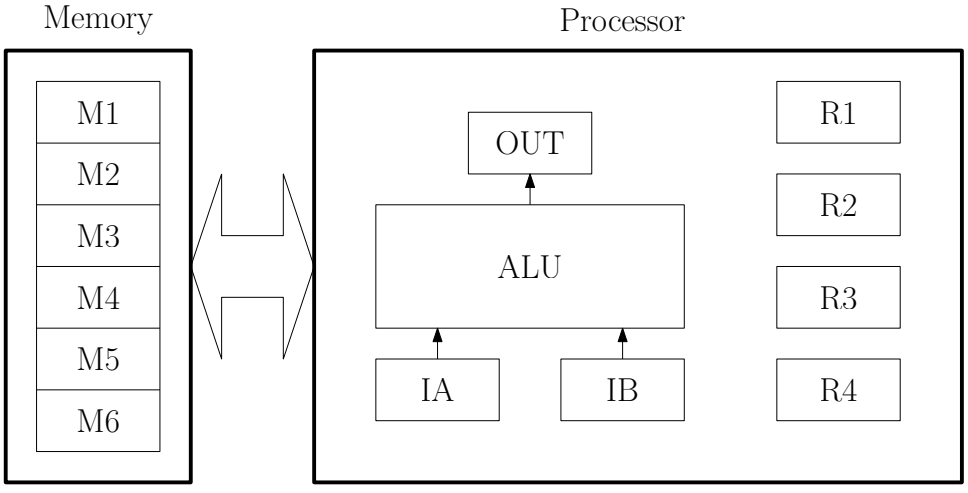

Figure 1: A memory device with six memory spaces and a processor with seven registers IA, IB, OUT, R1, R2, R3 and R4. Here, all memory locations and the registers are eight-bit. Their number representation format is signed magnitude integer.

Question 11

With reference to Figure 1, what are the contents of $M4, M5, M6$ once the following program is executed. It is assumed that $M1 = 4$, $M2 = 2$, $M3 = 9$, $M4 = 0$, $M5 = 0$ and $M6 = 0$.

```
MOV IA M1
MOV IB M2
MUL IA IB
MOV IA OUT
MOV IB M3
MUL IA IB
MOV IA OUT
SUB IA IB
MOV M4 OUT
```

Question 12

With reference to Figure 1, what are the contents of $M4, M5, M6$ once the following program is executed. It is assumed that $M1 = 4$, $M2 = 2$ and $M3 = 9$, $M4 = 0$, $M5 = 0$ and $M6 = 0$.

```
MOV IA M1
MOV IB M2
MUL IA IB
MUL IA IB
MOV IA OUT
MOV IB M3
MUL IA IB
MUL IA IB
MOV IA OUT
SUB IA IB
MOV M4 OUT
```