# Introduction to Computing Systems Homework 1

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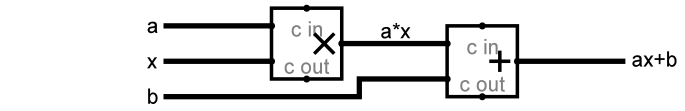
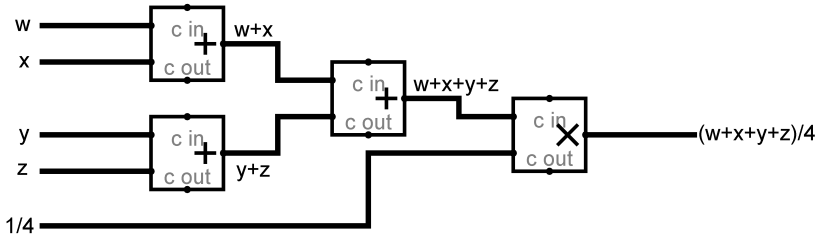
October 4, 2021

## Question 1.

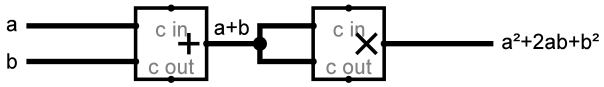
See Figure 1. Input numbers are on the left and output numbers are on the right, while boxes are being connected in the center.



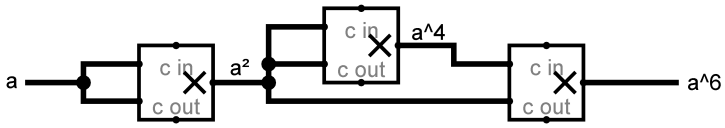

(a)




(b)




(c)




(d)

Figure 1: Answer to Question 1.(Made by Logisim)

## Question 2.

**a.** Because $256 = 2^8 < 400 < 2^9 = 512$, the minimum number of required bits is $\underline{9}$.

**b.** $512 - 400 = \underline{112}$ more students can be admitted to the class without requiring additional bits for each student's unique bit pattern.

**Question 3.**

**a.** 0001 0110

**b.** 1111 1101

**c.** 1111 1000

**d.** 0000 0001

**Question 4.**

**a.** $01 + 1011 = 0001 + 1011 = \underline{1100}$, the demical representation is $\underline{-4}$.

**b.** $11 + 0101\ 0101 = 1111\ 1111 + 0101\ 0101 = \underline{0101\ 0100}$, the demical representation is $\underline{84}$.

**c.** $0101 + 110 = 0101 + 1110 = \underline{0011}$, the demical representation is $\underline{3}$.

**d.** $01 + 10 = \underline{11}$, the demical representation is $\underline{-1}$.

**Question 5.**

The demical representation is :

**a.** 85

**b.** -115

**c.** -128

**d.** -1

**Question 6.**

$(0.3)_D = -1^0 \times (1.\dot{0}01\dot{1})_B \times 2^{(125-127)}$, so value 0.3 in the 32-bit floating point format is:

0 01111101 00110011... (There's a 4-bit recurring 0011 in the fraction bits.)

**Question 7.**

The demical equivalent is $\underline{-13.296875}$.

**Question 8.**

x90A's binary representation is 1001 0000 1010. After sign-extension, its equivalent is xF90A. So we get

$$\text{x90A} + \text{x4123} = \text{xF90A} + \text{x4123} = \underline{\text{x3A2D}}$$

And the demical representation of the answer is 14893, and the binary form is 0011 1010 0010 1101.

**Question 9.**

**a.** xBBFF

**b.** x0000

**c.** x4000

**Question 10.**

See Table 1.

Table 1: Truth table of question 10.

| X | Y | Z | $Q_1$ | $Q_2$ |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 |

**Question 11.**

The hexadecimal representation is

**a.** x644B

**b.** x4428E800

**c.** x48656C6C6F