Code Jam 3

Names:

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$3.7 \times 5 / 4$

Complete the following exercises in 40 minutes. This activity is open book, open computer. All work should be your own group.

Question 1

Unsigned integers

Compute the results of the following decimal expressions using *unsigned* 4-bit integers. Indicate whether there is overflow. Express your final answer in hexadecimal. Show your work.

Expression	Result			Overflow or not?
5 << 3	1000	0x8 ✓	Revision	yes/no ✗

0101 → 1000

$-1/8$

| 1 ^ 5 | 0100 | 0x4 ✓ | | yes/no ✓ |

```
    0001
XOR 0101
-------
    0100
```

5 - 6   yes/no

$5 - 6 = 5 + (-6)$ 0x F ✓   ✓

```
  0101        0101
- 0110   →  + 1010
  _____      _____
              1111   -1
            ( 1111 )
```

Signed integers

Compute the results of the following decimal expressions using *signed* 4-bit integers. Indicate whether there is overflow. Express your final answer in hexadecimal. Show your work.

Expression	Result		Overflow or not?

7 >> 1

```
0111 → 0011
```
        0x 3 ✓   yes/no ✓

1 | -5

```
  0001
  1011
  _____
  1011
```
        0x B ✓   yes/no ✓

-2 + 5

```
  1110
+ 0101
  _____
1 0011
```
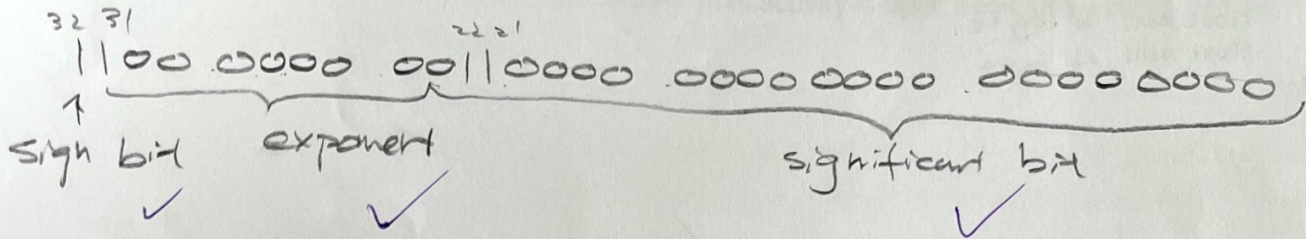   0x 3 ✓   yes/no ✓

Floating-point

Consider the following floating-point number in hexadecimal format

```
0x C0 30 00 00
```

1 2 0   3 0   0 0   0 0

A) What is the above number in binary?

$\overset{32\;31}{}$

1100 0000 0011 0000 0000 0000 0000 0000

↑

sign bit   exponent   significant bit

✓   ✓   ✓

B) Using your answer from part A, label which bits represent the sign, the exponent, and the significant bits.

C) What decimal value does the above number correspond to? Show your work.

$$2^7 = 128 \checkmark$$

$$2^{128-127} = 2^1 = 2 \checkmark$$

$$0(2^{-1}) + 1(2^{-2}) + 1(2^{-3})$$

$$= \tfrac{1}{4} + \tfrac{1}{8}$$

$$= \tfrac{3}{8} = 0.375$$

$$1.375$$
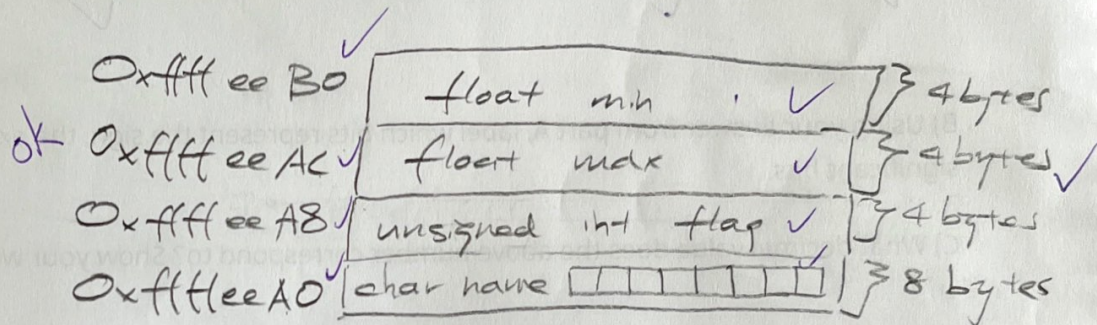
$$2 \times 1.375 \times -1 = -2.75 \checkmark$$

Question 3

Consider the following struct. Draw the contents and layout of a variable of this struct type, assuming the variable is placed in memory starting at address 0xffffeeA0.

```
struct foo {
    char name[8];        8 bytes
    unsigned int flag;   4 byte
    float max;           4 byte
    float min;           4 byte
};
```

(handwritten memory layout diagram)

```
            0xffff ee B0  | float     min      ✓  |  4 bytes
    ok →    0xffff ee AC ✓| float     max         |  4 bytes ✓
            0xffff ee A8 ✓| unsigned int  flag ✓  |  4 bytes
            0xffff ee A0  | char name [_____]  |  8 bytes
```

Question 4

Write a program, `scramble.c`, that swaps the 2nd and 3rd bits of every character in a message.

(handwritten: 4)

```
$ ./scramble
Please enter a phrase: lol
scramble: joj
```

(handwritten: 0 1 0 0   0 0 0 0   0 0 0 0   0 0 0 0
4000
40
20)

```
$ ./scramble
Please enter a phrase: joj
scramble: lol

$ ./scramble
Please enter a phrase: What does the cat say?
scramble: Whar bocu rhc ear uay?

$ ./scramble
Please enter a phrase: Whar bocu rhc ear uay?
scramble: What does the cat say?
```

(handwritten notes: really good, don't forget trailing char, -1/10)

(handwritten: Revision — character added — Caesar's Github)