

Assignment 2

Problem 1 (1.5 points) (Show all intermediate steps. No intermediate steps will receive 0 point)

Convert integer -3 to 8 digit TC Binary. (0.5 point)

First, convert 3 to binary: $3 = 2^1 + 2^0 = 0b\ 0000\ 0011$.

Then negate it:

```
0b 0000 0011    (3 in binary)
0b 1111 1100    (flip bits)
+ 0b 0000 0001  (add one)
-----
0b 1111 1101    (-3)
```

—3 in an 8-bit two's complement binary is $0b\ 1111\ 1101$.

Convert decimal -1 to 8 digit TC Hex. (0.5 point)

First, convert 1 to hexadecimal: $1 = 1(16^0) = 0x\ 0000\ 0001$.

Then, negate it:

```
0x FFFF FFFF
- 0x 0000 0001    (1 in hex)
-----
0x FFFF FFFE    (subtract from 0x FFFF FFFF)
+ 0x 0000 0001  (add one)
-----
0x FFFF FFFF    (-255)
```

—1 in an 8-digit two's complement hexadecimal is $0x\ FFFF\ FFFF$.

Convert integer -255 to 8 digit Hex (Hint: You can either convert 255 to Hex then negate with TC Hex rule, or you can convert -255 to TC Bin, then convert it to Hex) (0.5 point)

I'm doing the former, so: $255 = 15(16^1) + 15(15^0) = 0x\ 0000\ 00FF$.

```
0x FFFF FFFF
- 0x 0000 00FF    (255 in hex)
```

```

-----
0x FFFF FF00    (subtract from 0x FFFF FFFF)
+ 0x 0000 0001    (add one)
-----
0x FFFF FF01    (-255)

```

−255 in an 8-digit two's complement hexadecimal is `0x FFFF FF01` .

Problem 2 Convert the 2-digit two's complement hexadecimal integer 0x6e to decimal. Show all intermediate steps clearly. (0.5 point)

First, we note that `0x6e` is a positive integer because the leading digit here is less than eight. So, we can just convert it to decimal where `E` correspond to 14.

As such, $0x6e = 6(16^1) + 14(16^0) = 110$.

Problem 3 Convert the decimal integer -61 to an 8-bit two's complement binary integer. Show all intermediate steps clearly. (0.5 point)

First, convert 61 into hexadecimal: $61 = 3(16^1) + 13(16^0) = 0x 0000 003D$.

Using a reference table, we convert `0x 0000 003D` to binary: `0b 0011 1101` .

| Dec | Bin | Hex |
|-----|-------------------|----------------|
| 3 | <code>0011</code> | <code>3</code> |
| 13 | <code>1101</code> | <code>D</code> |

Then, negate it.

```

0b 0011 1101    (61 in binary)
0b 1100 0010    (flip bits)
+ 0b 0000 0001    (add one)
-----
0b 1100 0011    (-61)

```

−61 in an 8-bit two's complement binary is `0b 1100 0011` .

Problem 4 You're given two 4-digit, 2's complement hexadecimal numbers X = `0xa731` and Y = `0xe6a2` . Compute X-Y. Remember to indicate overflow if it

occurs. Show all intermediate steps clearly. (1 point)

First, negate Y to find $-Y$.

```

    0x FFFF
-   0x E6A2      (Y)
-----
    0x 195D      (subtract from 0x FFFF)
+   0x 0001      (add one)
-----
    0x 195E      (-Y)
```

Then, $X - Y = X + (-Y)$. So:

```

      1
    0x A731      (X)
+   0x 195E      (-Y)
-----
    0x C08F
```

In a 4-digit two's complement hexadecimal system, $X - Y =$ `0x C08F` .

Sanity check

| | X | Y | $-Y$ | $X - Y$ |
|-----|-------------------|-------------------|-------------------|-------------------|
| Hex | <code>A731</code> | <code>E6A2</code> | <code>195E</code> | <code>C08F</code> |
| Dec | -22735 | -6494 | 6494 | -16241 |

$$\begin{aligned} X - Y &= -22735 - (-6494) \\ &= -22735 + 6494 \\ &= X + (-Y) \\ &= -22735 + 6494 \\ &= -16241 \end{aligned}$$