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	`0011`	`3`
13	`1101`	`D`

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	`A731`	`E6A2`	`195E`	`C08F`
Dec	-22735	-6494	6494	-16241

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