Exercise 1: Conversion

1. hex 4F25 into binary
   Convert the hex to decimal

   $$4(16^3) + 15(16^2) + 2(16^1) + 5(16^0) = 20261$$

   Convert 20261 into Binary

   - $20261 = 2(10130) + 1$
   - $10130 = 2(5065) + 0$
   - $5065 = 2(25332) + 1$
   - $2532 = 2(1266) + 0$
   - $1266 = 2(633) + 0$
   - $633 = 2(316) + 1$
   - $316 = 2(158) + 0$
   - $158 = 2(79) + 0$
   - $79 = 2(39) + 1$
   - $39 = 2(19) + 1$
   - $19 = 2(9) + 1$
   - $9 = 2(4) + 1$
   - $4 = 2(2) + 0$
   - $2 = 2(1) + 0$
   - $1 = 2(0) + 1$

   Answer $4F25_{16} = 100111100100101_2$

2. hex 81A into decimal

   $$8(16^2) + 1(16^1) + 10(16^0) = 2048 + 16 + 10 = 2074$$

   Answer: 2074_{10}

3. binary 1101011100110 into hex

$$2^{12} + 2^{11} + 0(2^{10} + 2^9 + 0(2^8) + 2^7 + 2^6 + 2^5 + 0(2^4) + 0(2^3) + 2^2 + 2^1 + 0(2^0)$$

$$= 4096 + 2048 + 512 + 128 + 64 + 32 + 4 + 2. = 6886$$

Convert the decimal to hex

- $6886 = 16(430) + 6$
- $430 = 16(26) + 14$
- $26 = 16(1) + 10$
- $1 = 16(0) + 1$
- 1AE6

Answer: $1AE6_{16}$

4. binary 0101110 into decimal

$$0(2^6) + 2^5 + 0(2^4) + 2^3 + 2^2 + 2^1 + 0(2^0) = 32 + 8 + 4 + 2 = 46$$

Answer: 46_{10}

5. decimal 149 into binary

- $149 = 2(74) + 1$
- $74 = 2(37) + 0$
- $37 = 2(18) + 1$
- $18 = 2(9) + 0$
- $9 = 2(4) + 1$
- $4 = 2(2) + 0$
- $2 = 2(1) + 0$
- $2 = 2(0) + 1$

$149_{10} \rightarrow 10010101_2$
Answer 10010101_2

6. decimal 417 into hex

- $417 = 16(26) + 1$
- $26 = 16(1) + 10$
- $1 = 16(0) + 1$

$417_{10} \rightarrow 1A1_{16}$

Exercise 2 Binary and Hex Arithmetic

1. 110100 + 10110111

			1		1			
			1	1	0	1	0	0
+	1	0	1	1	0	1	1	1
	1	1	1	0	1	0	1	1

Answer 11101011

2. 82D11FFA + 5821DB22

	1				1	1		
	8	2	D	1	1	F	F	A
+	5	8	2	1	D	B	2	2
	D	A	F	2	F	B	1	C

Answer DAF2FB1C

Exercise 3 Two's Complement

1. 159
   Find the appropriate binary value

   - $159 = 2(79) + 1$
   - $79 = 2(39) + 1$
   - $39 = 2(19) + 1$
   - $19 = 2(9) + 1$
   - $9 = 2(4) + 1$
   - $4 = 2(2) + 0$
   - $2 = 2(1) + 0$
   - $1 = 2(0) + 1$

   Positive number so the binary 16 bit value is 0000000010011111

2. -2
   -2 is a negative value so find the binary representation of the positive value (2)
   Binary representation of 2 is: 0000000000000010
   Then take the complement: 1111111111111101
   Add 1 to the complement: 1111111111111110
   Answer 1111111111111110

3. -51
   Find the Binary Representation of the positive digit: 51

   - $51 = 2(25) + 1$
   - $25 = 2(12) + 1$
   - $12 = 2(6) + 0$
   - $6 = 2(3) + 0$
   - $3 = 2(1) + 1$
   - $1 = 2(0) + 1$

   0000000000110011
   Take the Complement of the Binary Representation: 1111111111001100
   Add 1 to the complement: 111111111100100 + 1 = 1111111111001101
   Answer 1111111111001101

Exercise 4 Two's Complement

1. -9
   Given is a negative so find the corresponding hexadecimal of the positive value 9:

   $$9_{10} \rightarrow 9_{16}$$

   Take the complement of it

	F	F	F	F	F	F	F	F
-								9
	F	F	F	F	F	F	F	6

   Then add 1 to the complement

   $$\text{FFFF FFF6} + 1 = \text{FFFF FFF7}$$

   Answer FFFF FFF7

2. -169
   A negative decimal so find the hexadecimal value of the positive version:

   - $169 = 16(10) + 9$
   - $10 = 16(0) + 10$

   The hexadecimal value of 169 is 0000 00A9.
   Take the complement of the hexadecimal value:

	F	F	F	F	F	F	F	F
-	0	0	0	0	0	0	A	9
	F	F	F	F	F	F	5	6

   Then add one to the complement

   $$\text{FFFF FF56} + 1 = \text{FFFF FF57}$$

   Answer FFFF FF57_{16}

3. 373
   A positive number so simply convert the decimal to hexadecimal

   - $373 = 16(23) + 5$
   - $23 = 16(1) + 7$
   - $1 = 16(0) + 1$

   Answer: $0000\ 0175_{16}$

Exercise 5: Two's Complement

1. C27
   A negative hex value so take the complement of it

$$\begin{array}{cccc} & F & F & F \\ - & C & 2 & 7 \\ \hline & 3 & D & 8 \end{array}$$

   Add one to it

$$3D8 + 1 = 3D9$$

   Convert the hexadecimal value into decimal then

$$3D9 \rightarrow 3 \times 16^2 + 14 \times 16^1 + 9 \times 16^0 = 985$$

   The decimal value of 2's complement is 985.
   Answer 985_{10}

2. 7F3
   A positive hex value so just convert it to decimal

$$7F3 \rightarrow 7 \times 16^2 + 15 \times 16^1 + 3 \times 16^0 = 2035$$

   Answer: 2035_{10}