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Homework 1

Microprocessor System Design- ELEN 120
Due 9/25/2023
34 points

These problems are to be solved without a calculator or computer. There is a table of powers of 2 in decimal at the end that may be helpful.

Binary number representations:

1) Without using a calculator or computer, properly represent each of the numbers in column 1 as a **16-bit unsigned binary** number in column 2 and as a **16-bit unsigned hexadecimal** number in column 3. (2 points each)

Decimal	16-bit unsigned binary	16-bit unsigned hexadecimal
(Example) 1	0000000000000001	0x0001
127	0000000001111111	0x007F
4097	0001000000000001	0x1001
60000	1110101011100000	0xEA60

four zeros

2) Without using a calculator or computer, properly represent each of the hexadecimal numbers in column 1 as a **decimal number** in column 2. (2 points each)

16-bit unsigned hexadecimal	Decimal
(Example) 0x0001	1
0x0111	273
0x0fff	4095
0x1023	4131

0000 0001 0001 0001
2^8 2^4
256 + 16 + 1

0fff = $2^{12} - 1 = 4095$

0001 0000 0010 0011

$2^{12} + 2^5 + 2^1 + 2^0$

4096 + 32 + 2 + 1

4131

3) Without using a calculator or computer, properly represent each of the numbers in column 1 as a **32-bit signed hexadecimal** number in column 2. (2 points each)

Decimal	32-bit signed hexadecimal
(Example) 1	0x00000001
100	0x00000064
-100	0xFFFFFF9C
-2	0xFFFFFFFE
8,388,607	0x007FFFFF
-2,147,483,648	0x80000000

100 = 01100100 = 64

-100 = 10011100 = 9C

00... 0111...111 (2^{31}, 2^{23}, 2^0; 0, 7, F)

range -2147,483,648 to 2147,483,647

100... to 0111... plus 1 forces carry all the way to the front so 2147483648 unsigned => -2147483648 signed

4) Without using a calculator or computer, properly represent each of the **32-bit signed hexadecimal** numbers in column 1 as a **decimal** number in column 2. (2 points each)

32-bit signed hexadecimal	Decimal
(Example) 0xFFFFFFFF	-1
0xFFFFFFFD	-3
0x00080000	524,288
0xE0000000	-536,870,912

E → 1110 0000000

2147483648
1073741824
536870912
3758096384 ← if unsigned

000, 1000, 0000 (8)
524,288

0001 FFFFFFF +1
-0010 0000000 = -536,870,912