

The University of Alabama in Huntsville
ECE Department
CPE 221 01
Fall 2019
Homework #2 Solution

1.0 (10*), 2.6(20), 1.8(10), 1.20(25), 1.99(20) * point values for these problems.

1.0 Represent -35,000 and 4968 as signed 16-bit numbers

The range of numbers that can be represented in 16-bit signed two's complement representation is -2^{15} through $+2^{15} - 1$, or -32768 through +32767. So, -35,000 cannot be represented.

2	0	1
2	1	0
2	2	0
2	4	1
2	9	1
2	19	0
2	38	1
2	77	1
2	155	0
2	310	1
2	621	0
2	1242	0
2	2484	0
2	4968	

4968 = 1 0011 0110 1000

1.8 Convert the decimal number 3682 to binary in two ways: (a) convert directly to binary; (b) convert first to hexadecimal and then from hexadecimal to binary. Which method is faster?

2	0	1
2	1	1
2	3	1
2	7	0
2	14	0
2	28	1
2	57	1
2	115	0
2	230	0
2	460	0
2	920	1
2	1841	0
2	3682	

3682 = 1110 0110 0010

16	0	E
16	14	6
16	230	2
16	3682	

3682 = 1110 0110 0010

The hexadecimal method is faster.

- 1.20** Convert decimal +864 and +673 to binary, using the signed-2's complement representation and enough digits to accommodate the numbers. Then perform the binary equivalent of (+864) + (-673), (-864) + (+673), and (-864) + (-673). Convert the answers back to decimal and verify that they are correct.

2	0	1		2	0	1
2	1	1		2	1	0
2	3	0		2	2	1
2	6	1		2	5	0
2	13	1		2	10	1
2	27	0		2	21	0
2	54	0		2	42	0
2	108	0		2	84	0
2	216	0		2	168	0
2	432	0		2	336	1
2	864			2	673	

+864 =	011 0110 0000	+673 =	010 1010 0001
-864 =	100 1010 0000	-673 =	101 0101 1111

+864	011 0110 0000
-673	101 0101 1111
<hr/>	
	000 1011 1111 = 128 + 32 + 16 + 8 + 4 + 2 + 1 = 191 ✓

-864	100 1010 0000
+673	010 1010 0001
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	111 0100 0001 = -1024 + 512 + 256 + 64 + 1 = -191 ✓

-864	100 1010 0000
-673	101 0101 1111
<hr/>	
	001 1111 1111 = 256 + 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 511, Overflow has occurred

- 1.99** The following numbers are represented in signed 2's complement. What is their value in decimal?

- $1110\ 0011 = -1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 = -128 + 64 + 32 + 0 + 0 + 2 + 1 = -29$
- $0011\ 0101 = -0 \times 2^7 + 0 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = -0 + 0 + 32 + 16 + 0 + 4 + 0 + 1 = +53$
- $1101\ 1011 = -1 \times 2^7 + 1 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 = -128 + 64 + 0 + 16 + 8 + 0 + 2 + 1 = -37$
- $0101\ 1101 = -0 \times 2^7 + 1 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = -0 + 64 + 0 + 16 + 8 + 0 + 4 + 0 + 1 = +93$

- 2.6** What are the decimal equivalents of the following values (assume positional notation and unsigned integer formats)?

- $11001100_6 = 1 \times 6^7 + 1 \times 6^6 + 0 \times 6^5 + 0 \times 6^4 + 1 \times 6^3 + 1 \times 6^2 + 0 \times 6^1 + 0 \times 6^0 = 279936 + 46656 + 0 + 0 + 216 + 36 + 0 + 0 = 326844$
- $11001100_3 = 1 \times 3^7 + 1 \times 3^6 + 0 \times 3^5 + 0 \times 3^4 + 1 \times 3^3 + 1 \times 3^2 + 0 \times 3^1 + 0 \times 3^0 = 2187 + 729 + 0 + 0 + 27 + 9 + 0 + 0 = 2952$
- $11001100_4 = 1 \times 4^7 + 1 \times 4^6 + 0 \times 4^5 + 0 \times 4^4 + 1 \times 4^3 + 1 \times 4^2 + 0 \times 4^1 + 0 \times 4^0 = 16384 + 4096 + 0 + 0 + 64 + 16 + 0 + 0 = 20560$
- $11001100_7 = 1 \times 7^7 + 1 \times 7^6 + 0 \times 7^5 + 0 \times 7^4 + 1 \times 7^3 + 1 \times 7^2 + 0 \times 7^1 + 0 \times 7^0 = 823543 + 117649 + 0 + 0 + 343 + 49 + 0 + 0 = 941584$