

HW #1

Sunday, September 1, 2019 2:03 PM

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1. Give the sign-magnitude binary form:

(a) $+17_{10} = \underline{\hspace{1cm}} 010001 \underline{\hspace{1cm}}$

(b) $-17_{10} = \underline{\hspace{1cm}} 110001 \underline{\hspace{1cm}}$

(c) $-124_{10} = \underline{\hspace{1cm}} 11111100 \underline{\hspace{1cm}}$

2. Convert to two's-complement binary form.

(a) $+17_{10} = \underline{\hspace{1cm}} 00010001 \underline{\hspace{1cm}}$

(b) $-17_{10} = \underline{\hspace{1cm}} 11101111 \underline{\hspace{1cm}}$

(c) $-124_{10} = \underline{\hspace{1cm}} 10000100 \underline{\hspace{1cm}}$

3. Convert the following decimal numbers to binary form with 4 bits before and 4 bits after the floating point.

(a) $6.250 = \underline{\hspace{1cm}} 0110.0100 \underline{\hspace{1cm}}$

(b) $13.376 = \underline{\hspace{1cm}} 1101.0110 \underline{\hspace{1cm}}$

4. Binary addition and subtraction in 9-bit sign-magnitude form, check for overflow.

(a)

$$\begin{array}{r} 001100101 \\ - 001011111 \\ \hline 00000110 \end{array}$$

Answer: 00000110
or 0110

(b)

$$\begin{array}{r} \overset{1}{0}\overset{1}{0} | \overset{1}{0}\overset{1}{0}\overset{1}{0}\overset{1}{0} | \\ - 001111010 \\ \hline 111111011 \rightarrow \text{overflow} \end{array}$$

Answer: 111111011

(c)

$$\begin{array}{r} 011010011 \quad 101101001 \\ + 111010001 \rightarrow -111010001 \\ \hline 1100000001 \rightarrow \text{overflow} \end{array}$$

Answer: 1000000001

(d)

$$\begin{array}{r} \overset{1}{0} \overset{1}{1} \overset{1}{1} \overset{1}{1} \overset{1}{0} \overset{1}{0} \overset{1}{0} \overset{1}{1} \\ + 0 \overset{1}{1} \overset{1}{1} \overset{1}{0} \overset{1}{0} \overset{1}{1} \overset{1}{} \\ \hline 1 \overset{1}{1} \overset{1}{1} \overset{1}{0} \overset{1}{0} \overset{1}{0} \overset{1}{0} \overset{1}{0} \end{array}$$

Answer: 111101000

5. Perform the following additions of 2's complement numbers, showing all the carries, check for overflow. Verify the addition by converting to decimal.

(a)

$$\begin{array}{r} \overset{1}{0} \overset{1}{0} \overset{1}{1} \overset{1}{0} \overset{1}{1} \overset{1}{1} \overset{1}{1} \\ + 0 \overset{1}{0} \overset{1}{0} \overset{1}{1} \overset{1}{1} \overset{1}{0} \overset{1}{1} \overset{1}{0} \\ \hline 1 \overset{1}{1} \overset{1}{0} \overset{1}{0} \overset{1}{0} \overset{1}{1} \overset{1}{0} \overset{1}{1} \end{array}$$
$$\begin{array}{r} 111 \\ + 118 \\ \hline 229 \end{array}$$

Answer: 011100101

(b)

$$\begin{array}{r}
 \begin{array}{ccccccc}
 & 1 & & 1 & & 1 & \\
 1 & 1 & 0 & 1 & 0 & | & 0 & 1 & 1 \\
 + & 0 & 1 & 1 & 0 & 0 & 1 & 1 & 0 & 1 \\
 \hline
 1 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & \rightarrow \text{overflow}
 \end{array}
 \end{array}$$

$$\begin{array}{r}
 -85 \\
 +205 \\
 \hline
 120
 \end{array}$$

Answer: 001111000

(c)

$$\begin{array}{r}
 \begin{array}{ccccccccccc}
 & 1 & & 1 & & 1 & & 1 & & 1 & & 1 & & 1 & & 1 & \\
 0 & (& 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & & & & & & & \\
 + & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & & & & & & \\
 \hline
 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & & & & & &
 \end{array}
 \end{array}$$

$$\begin{array}{r}
 511 \\
 + 1 \\
 \hline
 512
 \end{array}$$

Answer: 1000000000

(d)

$$\begin{array}{r}
 \begin{array}{cccccccc}
 & 1 & & & & & & \\
 & & 1 & 1 & & 1 & 1 & 1 \\
 1 & 0 & 1 & 1 & 0 & 1 & 1 & 1 \\
 + & 1 & 0 & 1 & 0 & 0 & 1 & 1 \\
 \hline
 1 & 0 & 1 & 0 & 1 & 1 & 1 & 0
 \end{array}
 \end{array}$$

$$\begin{array}{r}
 -145 \\
 + -178 \\
 \hline
 -323
 \end{array}$$

$101011101 \rightarrow \text{Overflow}$

Answer: 101011101

(e)

$$\begin{array}{r}
 \begin{array}{cccccccc}
 & 1 & 1 & 1 & & 1 & 1 & \\
 & & 1 & 1 & 0 & & 1 & 0 \\
 1 & 0 & 1 & 1 & 0 & 1 & 0 & 0 \\
 + & 1 & 0 & 0 & 1 & 0 & 1 & 1 \\
 \hline
 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0
 \end{array}
 \end{array}$$

$$\begin{array}{r}
 211 \\
 - 210 \\
 \hline
 2
 \end{array}$$

$1000000001 \rightarrow \text{Overflow}$

Answer: 000000001

(f)

	'	'	'	'	'	'	'		-1
+ 10	1	0	0	1	1	1	0		+ -178
<hr/>									-179
1	1	0	1	0	0	1	1	0	-> overflow

Answer: 101001101

6. (a) What is the largest 7-bit sign-magnitude number? 63 10
 (b) What is the smallest (i.e., negative) 9-bit sign-magnitude number? -511 10
 (c) What is the largest 12-bit 2's complement number? 2047 10
 (d) What is the smallest 12-bit 2's complement number? -2047 10
 (e) At most how many different values can be represented with 12 bits? 4096 10

HW #1 Re-submission

2B: $-17_{10} = \underline{\hspace{2cm}}_2$

$$\begin{array}{r} 17_{10} \rightarrow 10001_2 \\ 10110_2 \\ + \quad \quad \quad 1_2 \\ \hline 10111_2 \end{array}$$

Answer = 10111_2

~~4B:~~

$$\begin{array}{r} 010100101 \\ + 010100101 \\ \hline 101011010 \end{array}$$

~~4B:~~

$$\begin{array}{r} 010100101 \\ + 010100101 \\ \hline 101011010 \end{array}$$

4B:

$$\begin{array}{r} 010110101 \\ - 001000101 \\ \hline 100110101 \end{array}$$

Answer: 100110101_2

$$\begin{array}{r}
 4C: 011010011 \\
 + 111010001 \\
 \hline
 000000000
 \end{array}$$

Answer: 000000000₂

$$\begin{array}{r}
 4D: 011110011 \\
 + 011110101 \\
 \hline
 011101000 \rightarrow \text{overflow}
 \end{array}$$

Answer: ~~011110011~~ 011101000₂

$$\begin{array}{r}
 5C: 011111111 \\
 + 000000001 \\
 \hline
 100000000 \rightarrow \text{overflow}
 \end{array}$$

$$\begin{array}{r}
 21 \\
 + (-21) \\
 \hline
 1
 \end{array}$$

Answer: 00000000₂

$$\begin{array}{r}
 5D: 101101111 \\
 + 101001110 \\
 \hline
 101011110 \rightarrow \text{overflow}
 \end{array}$$

Answer: 01011101₂

$$6B: 000000000,$$

$$\begin{aligned}
 & \times 2^8 = 256 \text{ possibilities} \\
 & -(2^8 - 1) = -255
 \end{aligned}$$

Answer: -255

$$6D: 000000000000,$$

$$\begin{aligned}
 & 2^{12} = 2048 \text{ possibilities} \\
 & -(2^{12}) = -2048 \rightarrow \text{smallest number}
 \end{aligned}$$

Answer: -2048