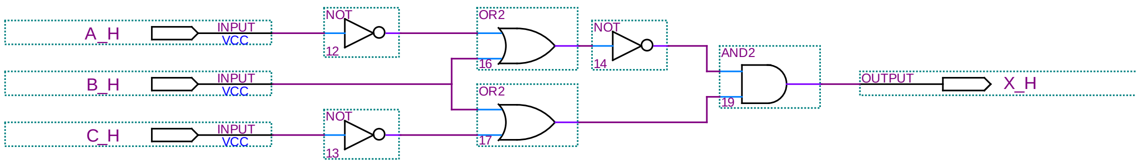
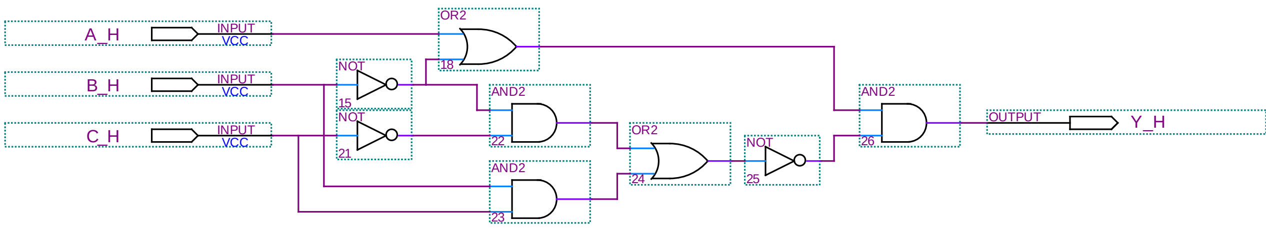
Homework 3 Solutions

Problem 1:

1 a) X = /(/A + B) * (B + /C)

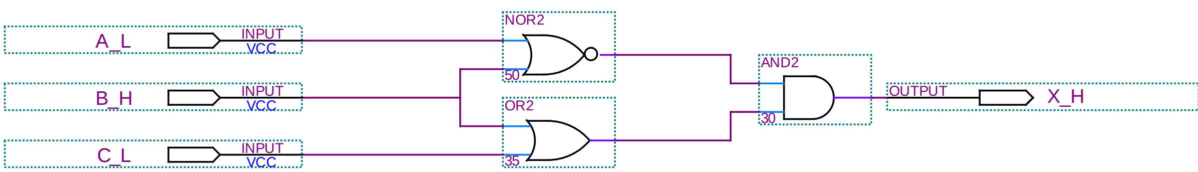


1 b) Y = (A + /B) * /(/B * /C + B * C)

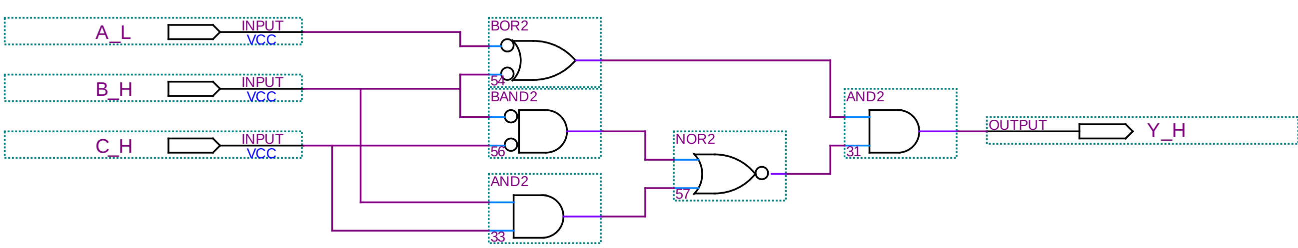


Problem 2:

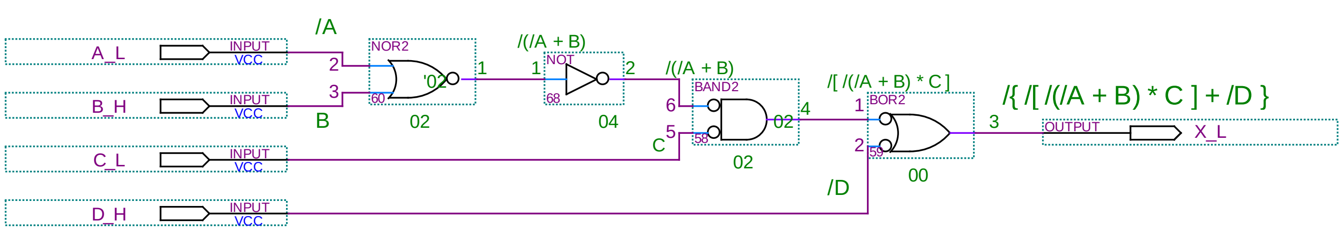
2 a) X = /(/A + B) * (B + /C)



2 b) Y = (A + /B) * /(/B * /C + B * C)



Problem 3:



Problem 4:

a) 12-bit unsigned binary = 1010 1111 1111 = 2048+512+255 = 2815
b) 12-bit sign magnitude = -(512+255) = -767
c) 12-bit 1's complement = -(0101 0000 0000) = -(1024+256) = -1280
d) 12-bit 2's complement = -(0101 0000 0001) = -(1024+256+1) = -1281
e) 12-bit BCD = not a valid BCD number

Homework 3 Solutions

Problem 5:

	3 bit signed	3 bit 1's compl	3 bit 2's compl
000	0	0	0
001	1	1	1
010	2	2	2
011	3	3	3
100	(-)0	-3	-4
101	-1	-2	-3
110	-2	-1	-2
111	-3	(-)0	-1

Problem 6:

```
           1 1001            25
        *  1 0110           *22
          11 0010            50
         110 01              50
      1 1001                550
     10 0010 0110
```

Problem 7:

```
a)    1001 0101         149
    + 0111 1111        +127
    1 0001 0100         276

b)  8 bit 2's complement:
     1001 0101         -107
   + 0111 1111         +127
 (1) 0001 0100           20  Ignore the(1)

c)  8 bit signed complement:
      1001 0101         -21
    + 0111 1111        +127
                        106
```

Since the first number is negative and the second number is positive, I'll subtract the first number (unsigned) from the second.

```
       0111 1111         +127
     - 0001 0101          -21
       0110 1010          106
```

Since the answer is positive, I'll leave the sign bit as a zero.

d) Problem a) is **not** valid 276 > 2^8 (256). Problems b) and c) **are** valid.

Homework 3 Solutions

$\boxed{1.1}$ A) $16\overline{)757}$ = 47 r5 $\qquad .25\times 16 = 4.00$

$16\overline{)47}$ = 2 r15 = F

$16\overline{)2}$ = 0 r2

$757.25_{10} = 2F5.40_{16}$

= 0010 1111 0101. 0100 0000
2 F 5 4 0

B) $16\overline{)123}$ = 7 r11 = B_{16} $\qquad .17\times 16 = \underline{2}.72$

$16\overline{)7}$ = 0 r7 = 7 $\qquad .72\times 16 = \underline{11}.52 \qquad 11_{10} = B_{16}$

$.52\times 16 = 8.32$

$123.17_{10} = 7B.2B_{16}$

= 0111 1011 . 0010 1011
7 B 2 B

$\boxed{1.2}$ A) 111 010 110 001 . 011
7 2 6 1 3 → 7261.3_8

$7\times 8^3 + 2\times 8^2 + 6\times 8 + 1 + 3\times 8^{-1} = 3761.375_{10}$

EQUAL

1110 1011 0001 . 011
E B 1 . 6 → $EB1.6_{16}$

$14\times 16^2 + 11\times 16^1 + 1 + 6\times 16^{-1} = 3761.375_{10}$

$\boxed{1.3}$ $3BA.25_{14}$

$$3\times14^2+11\times14^1+10+2\times14^{-1}+5\times14^{-2}=752.1684_{10}$$

$752 \div 6 = 125$ r 2

$125 \div 6 = 20$ r 5

$20 \div 6 = 3$ r 2

$3 \div 6 = 0$ r 3

$.1684\times6=1.0104$

$.010\times6=.06$

$.06\times6=.36$

$.36\times6=2.16$

$3BA.25_{14} = 3252.1002_6$

$\boxed{1.5}$ A)

```
  1111        1111        1111
+ 1010      - 1010      x 1010
------      ------      --------
 11001        0101          0000
                           11110
                          000000
                         1111000
                        --------
                        10010110
```

B)

```
  110110      110110      110110
+ 011101    - 011101    x 011101
--------    --------    ----------------
 1010011      011001           110110
                              0000000
                             (0110110) Sum
                             11011000
                           (100001110) Sum
                            110110000
                          (1010111110) Sum
                           1101100000
                         ------------
                         110000111110 → FINAL ANS
```

C)

```
  100100
+ 010110
  ------
  111010
```

```
  100100
- 010110
```

2's COMP

```
  101001
+      1
  ------
  101010
```

NOW ADD

```
  100100
  101010
  ------
 1[001110]
```

```
        100100
      x 010110
      --------
       0000000
       1001000
      --------
      (1001000) Sum
      10010000
      --------
      (11011000) Sum
      000000000
      ---------
      (011011000) Sum
      1001000000
      ----------
      1100011000  → FINAL ANS
```

1.6

A)

```
  11110100
  01000111
  --------
  10101101
```

B)

```
   110110
  -011101
  -------
   011001
```

1.7

A) 21+11

```
  010101
+ 001011
  ------
  100000  → OVERFLOW
```

B) (-14)+(-32)

```
   110010
   100000
  -------
(1)010010  → OVERFLOW
```

C) (-25)+18

```
  100111
+ 010010
  ------
  111001
```

D) (-12)+13

```
   110100
   001101
  -------
(1)000001
```

E) (-11)+(-21)

```
   110101
   101011
  -------
(1)100000
```

$\boxed{1.8}$ FOR A WORD LENGTH OF N, THE RANGE OF 2'S COMPLEMENT NUMBERS THAT CAN BE REPRESENTED IS -2^{N-1} TO $2^{N-1}-1$

SO, FOR A WORD LENGTH OF 8, THE RANGE IS -2^7 TO 2^7-1, OR -128 TO 127. BECAUSE 1'S COMPLEMENT HAS A "NEGATIVE ZERO" (11111111) IN ADDITION TO ZERO (00000000), THE VALUES THAT CAN BE REPRESENTED RANGE FROM $-(2^7-1)$ TO 2^7-1, OR -127 TO 127

$\boxed{1.10}$ C) 301.12_{10}

$16\overline{)301}$ = 18 r 13 = D_{16}

$16\overline{)18}$ = 1 r 2

$16\overline{)1}$ = 0 r 1

$.12 \times 16 = 1.92$

$.92 \times 16 = 14.72$ → E_{16}

$.72 \times 16 = 11.52$ → B_{16}

$$\underset{1}{0001}\ \underset{2}{0010}\ \underset{D}{1101}\ .\ \underset{1}{0001}\ \underset{E}{1110}\ \underset{B}{1011}_2 \quad (12D.1EB_{16})$$

$\boxed{1.11}$ A)

$$\underbrace{101}_{5}\,\underbrace{111}_{7}\,\underbrace{010}_{2}\,\underbrace{100}_{4}.\underbrace{101}_{5} = 5724.5_8$$

$$5\times 8^3 + 7\times 8^2 + 2\times 8^1 + 4 + 5\times 8^{-1} = 3028.625_{10}$$

$$\underbrace{1011}_{B}\,\underbrace{1101}_{D}\,\underbrace{0100}_{4}.\underbrace{1010}_{A} = BD4.A$$

$$11\times 16^2 + 13\times 16 + 4 + 10\times 16^{-1} = 3028.625_{10}$$

EQUAL

$\boxed{1.15}$ A)

Roth 6th: 1.17

$$\begin{array}{r} 111 \\ 1111 \\ +\ 1001 \\ \hline 11000 \end{array} \qquad \begin{array}{r} 1111 \\ -\ 1001 \\ \hline 0110 \end{array} \qquad \begin{array}{r} 1111 \\ 1001 \\ \hline 1111 \\ 0000 \\ \hline (01111)\text{ sum} \\ 0000 \\ \hline (00111)\text{ Sum} \\ 1111 \\ \hline 10000111 \end{array}$$

$\rightarrow$ Final Ans

$\boxed{1.17}$ A)

Roth 6th: 1.20

$$\begin{array}{r} 101110 \\ 101 \overline{)\,1110100 1} \\ 101 \\ \hline 1001 \\ 101 \\ \hline 1000 \\ 101 \\ \hline 110 \\ 101 \\ \hline 11 \end{array}$$

101110 $\rightarrow$ Quotient

11 $\rightarrow$ Remainder

$\boxed{1.25}$ A) 222.22_{10}

Roth 6th: 1.32

$16 \overline{)222} = 13$ r14 $\rightarrow E_{16}$

$16 \overline{)13} = 0$ r13 $\rightarrow D_{16}$

$.22 \times 16 = 3.52$

$.52 \times 16 = 8.32$

$.32 \times 16 = 5.12$

$\rightarrow DE.385_{16}$

1000100	1000101	0101110	011011	0111000
D	E	.	3	8

$\boxed{1.27}$

Roth 6th: 1.34

A) 1's COMP

$$\begin{array}{r} 01001 \\ -\ 11010 \end{array} \rightarrow \begin{array}{r} 01001 \\ +\ 00101 \\ \hline 01110 \end{array}$$

2's COMP

$$\begin{array}{r} 01001 \\ 11010 \end{array} \rightarrow \begin{array}{r} 00101 \\ 1 \\ \hline 00110 \end{array} \rightarrow \begin{array}{r} 01001 \\ +\ 00110 \\ \hline 01111 \end{array}$$

B)

$$\begin{array}{r} 11010 \\ -\ 11001 \end{array} \rightarrow \begin{array}{r} 11010 \\ +\ 00110 \\ \hline 100000 \\ 1 \\ \hline 00001 \end{array}$$

$$\begin{array}{r} 11010 \\ 11001 \end{array} \rightarrow \begin{array}{r} 00110 \\ 1 \\ \hline 00111 \end{array} \rightarrow \begin{array}{r} 11010 \\ +\ 00111 \\ \hline (1)00001 \end{array}$$

C)

$$\begin{array}{r} 10110 \\ -\ 01101 \end{array} \rightarrow \begin{array}{r} 10110 \\ +\ 10010 \\ \hline 101000 \\ 1 \\ \hline 01001 \end{array} \rightarrow \text{OVERFLOW}$$

$$\begin{array}{r} 10110 \\ 01101 \\ \hline \end{array} \rightarrow \begin{array}{r} 10010 \\ 1 \\ \hline 10011 \end{array} \rightarrow \begin{array}{r} 10110 \\ +\ 10011 \\ \hline (1)01001 \end{array} \text{ OVERFLOW}$$