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# HW3 COMP ARCH

① $91_{10} + C6_{16}$

$91_{10} = 64 + 27 = 64 + 16 + 11 = 64 + 16 + 8 + 2 + 1$

$91_{10} = 2^6 + 2^4 + 2^3 + 2^1 + 2^0$

$= b1011011$

$C6_{16} = 12 \times 16^1 + 4 + 2 = b11000110$

$91_{10} + C6_{16} =$

$$\begin{array}{r} b01011011 \\ + b11000110 \\ \hline b100100001 \end{array}$$

$b100100001 =$

$2^0 + 2^5 + 2^8 = 1 + 32 + 256$

$\boxed{289_{10}}$

② $11_8 - 11_{10}$

$11_8 = 1 \times 8^1 + 1 \times 1 = b1001$

$11_{10} = 8 + 2 + 1 = b1011$

$-11_{10} = b0100 + 1 = b0101$

$11_8 = b01001$

$-11_{10} = b10101$ 2's complement

$$\begin{array}{r} b01001 \\ + b10101 \\ \hline b11110 \end{array} \Rightarrow \boxed{-2_{10}}$$

(3) $12.3125_{10} + 0110_{I2Q2}$

$.3125 = \underset{2^{-2}}{.25} + \underset{2^{-4}}{.0625}$

$12.3125_{10} = b1100.0101$

$I4Q4$

$0110_{I2Q2} = b\,01.10$ fixed point

sign extend

$$\begin{array}{r} b1100.0101 \\ +\,b0001.1000 \\ \hline b1101.1101 \end{array}$$

$b1101.1101 =$

$2^3+2^2+2^0+2^{-1}+2^{-2}+2^{-4}$

$8+4+1+.5+.25+.0625$

$\boxed{13.8125_{10}}$

(9) $5.75_{10} + -7.125_{10}$

$.5 \quad .125$

$.25$

$+5.75_{10} = b101.11$

$+7.125_{10} = b111.001$

$-7.125_{10} = b000.110 + .001$

$= b\,000.111$

$$\begin{array}{r} b\,101.110 \\ +\,b\,000.111 \\ \hline b\,110.101 \end{array}$$

negative so check 2's complement

$$\begin{array}{r} 001.010 \\ + \quad\quad 1 \\ \hline 001.011 \end{array}$$

$= -(1.25+.125)$

$= \boxed{-1.375_{10}}$

(5) $9_{10} \cdot 3_{10}$

$9_{10} = b1001$ $\qquad$ $3_{10} = b11 = b0011$

$$\begin{array}{r} b1001 \\ \times\ b0011 \\ \hline 1001 \\ 1001\times \\ \hline b11011 \end{array}$$

$b11011 = 2^0 + 2^1 + 2^3 + 2^4$
$= 1 + 2 + 8 + 16$
$= \boxed{27_{10}}$

(6) $(-5)_{10} \cdot (-6)_{16}$

$^+5_{10} = b101$ $\qquad$ $-5 = b010 + 1 = b011$

$^+6_{10} = b110$ $\qquad$ $-6 = b001 + 1 = b010$

Sign extend to 8 bits: $-5 = b1011 = b11111011$

$-6 = b1010 = b11111010$

$$\begin{array}{r} 11111011 \\ \times\ 11111010 \\ \hline 0 \\ 1111011\times \\ 0\times\times \\ 11111011\times\times\times \\ 1111011\times\times\times\times \\ 111011\times\times\times\times\times \\ 11011\times\times\times\times\times\times \\ 1011\times\times\times\times\times\times\times \\ \hline 1111\,0101\,\underbrace{00011110}_{8\text{ bits}} \end{array}$$

$b00011110 =$
$2^1 + 2^2 + 2^3 + 2^4 =$
$2 + 4 + 8 + 16 =$
$\boxed{30_{10}}$

(7) $9.5_{10} \cdot 2.625_{10}$

$9.5_{10} = b1001.1$

$2.625_{10} = b10.101$

```
     b10.101
   x b1001.1
   ---------
  +1   10101
   1 01 01 x
        0x x
+1 +1  0xxx
1010 1xxxx
-----------
11000.1111
```

fixed point

b11000.1111

$2^4 + 2^3 + 2^{-1} + 2^{-2} + 2^{-3} + 2^{-4}$

$16 + 8 + .5 + .25 + .125 + .0625$

$24 + .75 + .1875$

$\boxed{24.9375_{10}}$

8) $(-1.25)_{10} - (3.5)_{10}$

$+3.5_{10} = b11.1 \rightarrow$ sign extend $000011.10$

$+1.25_{10} = b1.01$

$-1.25_{10} = b0.10 + .001$

$= b0.11$

sign extend to 8 bits $= b111110.11$

$$
\begin{array}{r}
111110.11 \\
\times\ 000011.10 \\
\hline
2\ 2\ 1\ 1\ 1\ 1\quad 0 \\
2\ 1\ 1\ 1\ 1\ 1\ 0\ 1\ 1\ X \\
2\ 1\ 1\ 1\ 1\ 1\ 0\ 1\ 1\ X\ X \\
1\ 1\ 1\ 1\ 1\ 0\ 1\ 1\ X\ X\ X \\
\hline
1101\underbrace{1011\ 1010}_{8\ \text{bits}}
\end{array}
$$

$b1011.1010$

begins w/ 1, so negative 2's complement

$\Downarrow$

$-(0100.0101)$

$-(2^2 + 2^{-2} + 2^{-4})$

$\boxed{-4.375_{10}}$