

# Computer Architecture HW3: Computer Arithmetic

See Kim

1.  $91_{10} = 1011011_2$  (u7)

$66_{16} = 11000110_2$  (u8)

$001011011_2 + 011000110_2 = 100100001_2$  (u9)

$= 2^8 + 2^5 + 1$

$= 289$

2.  $11_8 = 001001_2$  (from  $001_2 = 1_8$ ) (u6)

$11_{10} = 1011_2$  (u4)

$= 10101_2$  (2's complement) (15)

$11_8 + (-11_{10}) = 01001_2 + 10101_2$  (15)

$= 11110_2$

$= -(00010_2)$

$= -2_{10}$

3.  $12.3125_{10} = 1100\ 0101$  (u4Q4)

$1100\ 0101_2 + 0001\ 1000_2 = 1101\ 1101_2$  (u4Q4)

$= 13.8125_{10}$

4.  $5.75_{10} = 101\ 11$  (u3Q2)

$= 0101\ 11$  (14Q2)

$7.125_{10} = 111\ 001$  (u3Q3)

$= 0111\ 001$  (14Q3)

$-7.125_{10} = 1000\ 111$  (14Q3)

$5.75_{10} + (-7.125_{10}) = 0101\ 110 + 1000\ 111$  (14Q3)

$= 1110\ 101$

$= -(0001011_2)$

$= -1.375_{10}$

Working

$$\begin{array}{r} 91 \\ 45 \overline{) 1} \\ 22 \overline{) 1} \\ 11 \overline{) 0} \\ 5 \overline{) 1} \\ 2 \overline{) 1} \\ 1 \overline{) 0} \end{array}$$

$$\begin{array}{r} 1 \\ 2 \\ 8 \\ 16 \\ + 64 \\ \hline 91 \end{array}$$

$2^5 = 16 \times 2 = 32$   
 $2^8 = 16^2 = 256$

$\overset{12}{C_{16}} = 1100_2$   
 $6_{16} = 0110_2$

$$\begin{array}{r} 011000110 \\ 001011011 \\ \hline 100100001 \end{array}$$

$$\begin{array}{r} 11 \\ 5 \overline{) 1} \\ 2 \overline{) 1} \\ 1 \overline{) 0} \end{array}$$

$$\begin{array}{r} 01001 \\ 10101 \\ \hline 11110 \end{array}$$

$$\begin{array}{r} 12 \\ 6 \overline{) 0} \\ 3 \overline{) 0} \\ 1 \overline{) 1} \end{array}$$

$.3125$   
 $.6250$   
 $1.25$   
 $.50$   
 $1.0$

$1100_2 = 12_{10}$

$\therefore 1101_2 = 13_{10}$

$0.5 + 0.25 + 0.0625$   
 $= 0.8125$

$$\begin{array}{r} 5 \\ 2 \overline{) 1} \\ 1 \overline{) 0} \end{array}$$

$.75 = .5 + .25$

$$\begin{array}{r} 7 \\ 3 \overline{) 1} \\ 1 \overline{) 1} \end{array}$$

$.125 = 2^{-3}$

$$\begin{array}{r} 0101110 \\ 1000111 \\ \hline 1110101 \end{array}$$

$0001_2 = 1_{10}$

$2^{-2} + 2^{-3} = .375$

$$5. \quad 9_{10} = 1001_2 \quad (U4)$$

$$3_{10} = 11_2 \quad (U2)$$

$$1001_2 \times 11_2 = 11011_2 \quad (U5)$$

$$= 27_{10}$$

$$6. \quad 5_{10} = 101_2 \quad (U3)$$

$$(-5)_{10} = 1011_2 \quad (U4)$$

$$6_{10} = 101_2 + 1_2$$

$$= 110_2$$

$$(-6)_{10} = 1010_2 \quad (U4)$$

$$1011_2 \times 1010_2 = 00011110_2 \quad (U8)$$

$$= 11110_2 \quad (U5)$$

$$= 30_{10}$$

$$7. \quad 9.5_{10} = 1001.1_2 \quad (U4Q1)$$

$$2.625_{10} = 10.101_2 \quad (U2Q3)$$

$$1001.1_2 \times 10.101_2 = 11000.1111 \quad (U5Q4)$$

$$= 24.9375_{10}$$

$$8. \quad 1.25_{10} = 1.01_2 \quad (U1Q2)$$

$$(-1.25)_{10} = 10.11_2 \quad (U2Q2)$$

$$3.5_{10} = 11.1_2 \quad (U2Q1)$$

$$= 011.1 \quad (U3Q1)$$

$$(-1.25)_{10} \cdot 3.5_{10} = 011.10_2 \times 110.11_2 \quad (U3Q2)$$

$$= 111011.1010_2 \quad (U6Q4)$$

$$= 1011.101_2 \quad (U4Q3)$$

$$= -(0100.011)_2 \quad (U4Q3)$$

$$= -4.375_{10}$$

$$\text{or } 1011 \times 11.1 = 1011101 \quad (U4Q2) \quad (U2Q1) \quad (U4Q3)$$

$$\begin{array}{r} 3 \\ 1 \end{array} \quad \begin{array}{r} 9 \\ 4 \\ 2 \\ 1 \end{array}$$

$$\begin{array}{r} 1001 \\ \times \quad 11 \\ \hline 1001 \\ 1001 \\ \hline 11011 \end{array}$$

$$1 + 2 + 8 + 16 = 27$$

$$5 = 2^0 + 2^2$$

$$\begin{array}{r} 11111011 \\ \times 1111010 \\ \hline 11111011 \\ \dots 111011 \\ \dots 11011 \\ \dots 1011 \\ \dots 011 \\ \dots 11 \\ \dots 1 \\ \hline 000011110 \end{array}$$

$$2 + 4 + 8 + 16 = 30$$

$$.5_{10} = 2^{-1}$$

$$.625 = .5 + .125$$

$$2 = 2^1$$

$$\begin{array}{r} 1001.1 \\ 10.101 \\ \hline 1001.1 \times 10.101 \\ \hline 1001.1 \\ 1001.1 \\ 1001.1 \\ 1001.1 \\ \hline 11000.1111 \end{array}$$

$$2^2 + 2^4 = 24 \quad .5 + .25 + .125 + .0625$$

$$= .9375$$

$$\begin{array}{r} .75 \\ + .1875 \\ \hline .9375 \end{array}$$

$$\begin{array}{r} 011.10 \\ \times 11111011 \\ \hline 1110 \\ \dots 1110 \\ \dots 1110 \\ \dots 1110 \\ \dots 1110 \\ \dots 1110 \\ \dots 1110 \\ \dots 1110 \\ \hline 1110111010 \end{array}$$

$$2^2 = 4$$

$$.25 + .125 = .375$$