

Given:  $-26.05$

$$-26.05 = \underline{-1} \underline{1} \underline{0} \underline{1} \underline{0} . \overline{000011}$$

$$0.05 \times 2 = 0.1$$

$$0.1 \times 2 = 0.2$$

$$\rightarrow 0.2 \times 2 = 0.4$$

$$0.4 \times 2 = 0.8$$

$$0.8 \times 2 = 1.6$$

$$0.6 \times 2 = 1.2$$

$$0.2 \times 2 =$$

Normalize:

$$-1.1010 \overline{000011}$$

$$= -1.1010 \overline{000011} \times 2^4$$

$$\begin{array}{c} \underline{1} \quad \underline{1} \underline{0} \underline{0} \underline{0} \underline{0} \underline{1} \underline{1} \\ \uparrow \\ \text{sign} \\ \text{negative} \end{array}$$

exponent  
 $4 + 127$   
 $= 131$

$$\begin{array}{l} \overline{10100000110011} \\ 001100110 \end{array}$$

fraction

IEEE -754  $\rightarrow$  Normalized form

$$1) (-1)^0 * 1.011 \times 2^{131-127}$$

sign                      fraction                      exponent

$$= +1.011 \times 2^4$$

$$2) (-1)^1 * 1.0 \times 2^{128-127}$$

$$= -1.0 \times 2^1$$

1-127

$$3) (-1)^0 * 1.1001 \times 2^{-126}$$

$$= +1.1001 \times 2^{-126}$$

Assume 2's complement  
for all signed integers  
when performing arithmetic  
operations. 5 bit

$$\begin{array}{r} +5 \\ -3 \\ \hline \end{array} \Rightarrow \begin{array}{r} +5 \\ +(-3) \\ \hline +2 \end{array}$$

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

~~1~~ 00010  
throw out!

$$\begin{array}{r} +3 = 00011 \\ \downarrow \\ 11100 \\ + 1 \\ \hline -3 = 11101 \end{array}$$

$$\begin{array}{r}
 +5 \\
 -(-3) \\
 \hline
 +8
 \end{array}$$

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

$$-3 = 11101$$



$$00010$$

$$+1$$

$$\begin{array}{r}
 00010 \\
 +1 \\
 \hline
 00011
 \end{array}$$



$$\begin{array}{r}
 1011 = -5 \\
 \downarrow \\
 0100 \\
 +1 \\
 \hline
 0101 = 5
 \end{array}$$

$$\begin{array}{r}
 001111 = +13 \\
 001101 = -5
 \end{array}$$

~~011000~~  
WRONG!

Need sign extension

$$\begin{array}{cccccc}
 1 & 1 & 1 & 1 & 1 & \\
 0 & 0 & 1 & 1 & 0 & 1 \\
 1 & 1 & 0 & 0 & 1 & \\
 1 & 1 & 1 & 0 & 1 & 1
 \end{array}
 \begin{array}{l}
 +13 \\
 -5
 \end{array}$$

~~$$0 \ 0 \ 1 \ 0 \ 0 \ 0 = +8$$~~

Correct !

5-bit 2's comp

Range: -16 to +15

$$\begin{array}{r} +15 \\ +1 \\ \hline +16 \end{array}$$

$$\begin{array}{r} 1111 \\ 0111 \\ 0001 \\ \hline 1000 \end{array}$$

↑ negative

overflow

$$\begin{array}{r} -15 = 10001 \\ -2 = 11110 \\ \hline -17 \end{array}$$

~~1~~ 01111

↑ positive

throw