

Assignment 1.1

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1.
$$\begin{array}{r|l} n & 0.110101 \\ i & 0.110101 \\ b_i & 1 \frac{1}{2} \frac{1}{4} \frac{1}{8} \frac{1}{16} \frac{1}{32} \frac{1}{64} \\ m_i & 0 \frac{1}{2} \frac{1}{4} 0 \frac{1}{16} 0 \frac{1}{64} \\ & \frac{32}{64} \frac{16}{64} \frac{4}{64} \frac{1}{64} = \frac{53}{64} = 0.828125_{10} \end{array}$$

2. $8.625_{10} = 8_{10} + 0.625_{10}$

a.
$$\begin{array}{r} 2\sqrt{8} \quad 2\sqrt{4} \quad 2\sqrt{2} \quad 2\sqrt{1} \\ -8 \quad -4 \quad -2 \quad -0 \\ \hline 0 \quad 0 \quad 0 \quad 1 \end{array}$$

$8_{10} = 1000_2 \rightarrow 1000.101_2$

$$\begin{array}{r} 0.625 \\ \times 2 \\ \hline 1.250 \\ 1 \end{array}$$

$$\begin{array}{r} 0.250 \\ \times 2 \\ \hline 0.50 \\ 0 \end{array}$$

$$\begin{array}{r} 0.5 \\ \times 2 \\ \hline 1 \\ 1 \end{array}$$

$0.625_{10} = 101_2$

b.
$$\begin{array}{c} 1000.1010_2 \\ \underbrace{\hspace{1cm}} \quad \underbrace{\hspace{1cm}} \\ 8_{16} \quad A_{16} \end{array}$$

$8.625_{10} = 1000.1010_2 = 8.A_{16}$

3.

a.
$$\begin{array}{r|l} n & 2 \text{ T D} \\ E_n & 2 \text{ 21 13} \\ i & 2 \text{ 1 0} \\ b_i & 32^2 \text{ 32}^1 \text{ 32}^0 \\ & 1 \text{ 3} \\ & 9 \text{ 2 8} \\ & \hline & 2 \text{ 0 4 8} \\ & 2 \text{ 9 8 9} \end{array}$$

$$\begin{array}{r|l} n & 0 \text{ 3 F} \\ E_n & 24 \text{ 3 15} \\ i & -1 \text{ -2 -3} \\ b_i & 32^2 \text{ 32}^1 \text{ 32}^0 \end{array}$$

$2989.753387451171875_{10}$

$2989 \leq 2^n - 1$
 $2990 \leq 2^n$
 $\log_2(2990) \leq n$
 $11.5 \leq n$

$$\begin{array}{r|l} i & 11 \text{ 10 9 8 7 6 5 4 3 2 1 0} \\ b_i & 2^{11} \text{ 2}^{10} \text{ 2}^9 \text{ 2}^8 \text{ 2}^7 \text{ 2}^6 \text{ 2}^5 \text{ 2}^4 \text{ 2}^3 \text{ 2}^2 \text{ 2}^1 \text{ 2}^0 \\ s & 2048 \text{ 1024 512 256 128 64 32 16 8 4 2 1} \\ a_i & 1 \text{ 0 1 1 1 0 1 0 1 1 0 1} \end{array}$$

$2989_{10} = 101110101101_2$

$$\begin{array}{r} 2048 \sqrt{2989} \\ -2048 \\ \hline 941 \end{array}$$

$$\begin{array}{r} 512 \sqrt{941} \\ -512 \\ \hline 429 \end{array}$$

$$\begin{array}{r} 256 \sqrt{429} \\ -256 \\ \hline 173 \end{array}$$

$$\begin{array}{r} 128 \sqrt{173} \\ -128 \\ \hline 45 \end{array}$$

$$\begin{array}{r} 32 \sqrt{45} \\ -32 \\ \hline 13 \end{array}$$

$$\begin{array}{r} 8 \sqrt{13} \\ -8 \\ \hline 5 \end{array}$$

$$\begin{array}{r} 4 \sqrt{5} \\ -4 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 1 \sqrt{1} \\ -1 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 0.753387451171875 \\ \times 2 \\ \hline 1.50677 \end{array}$$

$$\begin{array}{r} 0.5067749 \\ \times 2 \\ \hline 1.01355 \end{array}$$

$$\begin{array}{r} 0.01355 \\ \times 2 \\ \hline 0.0271 \end{array}$$

$$\begin{array}{r} 0.0217 \\ \times 2 \\ \hline 0.0434 \end{array}$$

$$\begin{array}{r} 0.0542 \\ \times 2 \\ \hline 0.1084 \end{array}$$

$$\begin{array}{r} 0.1084 \\ \times 2 \\ \hline 0.2168 \end{array}$$

$$\begin{array}{r} 0.2168 \\ \times 2 \\ \hline 0.4336 \end{array}$$

$$\begin{array}{r} 0.4336 \\ \times 2 \\ \hline 0.8672 \end{array}$$

$$\begin{array}{r} 0.8672 \\ \times 2 \\ \hline 1.7344 \end{array}$$

$$\begin{array}{r} 0.73438 \\ \times 2 \\ \hline 1.46876 \end{array}$$

$$\begin{array}{r} 0.46875 \\ \times 2 \\ \hline 0.9375 \end{array}$$

$$\begin{array}{r} 0.9375 \\ \times 2 \\ \hline 1.875 \end{array}$$

$$\begin{array}{r} 0.875 \\ \times 2 \\ \hline 1.75 \end{array}$$

$$\begin{array}{r} 0.75 \\ \times 2 \\ \hline 1.5 \end{array}$$

$$\begin{array}{r} 0.5 \\ \times 2 \\ \hline 1.0 \end{array}$$

$0.753387451171875_{10} = 0.110000001111_2$

$2989.753387451171875_{10} = 101110101101.110000001111_2$

b.
$$\begin{array}{c} 101110101101.1100000011011110_2 \\ \underbrace{\hspace{1cm}} \quad \underbrace{\hspace{1cm}} \quad \underbrace{\hspace{1cm}} \quad \underbrace{\hspace{1cm}} \quad \underbrace{\hspace{1cm}} \quad \underbrace{\hspace{1cm}} \\ B \quad A \quad D \quad C \quad O \quad D \quad E \end{array}$$

$10110101101.1100000011011110_2 = \text{BAD.CODE}_{16}$

4.
$$\begin{array}{r|l} i & 8 \text{ 7 6 5 4 3 2 1 0} \\ E_n & 2 \text{ 1 2 3 3 6 6 1 4} \\ b_i & 7^8 \text{ 7}^7 \text{ 7}^6 \text{ 7}^5 \text{ 7}^4 \text{ 7}^3 \text{ 7}^2 \text{ 7}^1 \text{ 7}^0 \\ s & 11521602 \text{ 823543 117649 50421 7203 2658 294 7 4} \end{array}$$

$$\begin{array}{r} 12353145 \\ 12588443 \\ 12622057 \\ 12638864 \\ 1264067 \\ 12648125 \\ 12648419 \\ 12648422 \end{array}$$

$12648430 \leq 16^n - 1$
 $12648431 \leq 16^n$
 $\log_{16}(12648431) \leq n$
 $5.898 \leq n$

$$\begin{array}{r|l} i & 5 \text{ 4 3 2 1 0} \\ E_n & 16^5 \text{ 16}^4 \text{ 16}^3 \text{ 16}^2 \text{ 16}^1 \text{ 16}^0 \\ b_i & 1048576 \text{ 65536 4096 256 16 1} \\ a_i & 12 \text{ 0 15 15 14 14} \end{array}$$

$$\begin{array}{r} 1048576 \sqrt{12648430} \\ -1048576 \\ \hline 2162670 \\ -2097152 \\ \hline 65518 \end{array}$$

$$\begin{array}{r} 15 \sqrt{65518} \\ -1516 \\ \hline 24358 \\ -24096 \\ \hline 4078 \end{array}$$

$$\begin{array}{r} 15 \sqrt{4078} \\ -1516 \\ \hline 1519 \\ -1280 \\ \hline 238 \end{array}$$

$$\begin{array}{r} 14 \sqrt{238} \\ -1416 \\ \hline 78 \\ -64 \\ \hline 14 \end{array}$$

12646067
12648125
12648414
12648426
12648430₁₀



256 $\sqrt{4076}$
- 256
1519
1280
238

16 $\sqrt{238}$
16
78
64
14

14
1 $\sqrt{14}$
- 14
- 14

212336614₇ = COFFEE₁₆

5. $25062 \leq 2^n - 1$ i 19 1 17 16 15 14 13 12 11 10 9 7 6 5 4 3 2 1 0
 $25906 \leq 2^n$ a_i 0 0 1 1 1 1 1 0 0 1 1 1 1 1 0 1 1 0
 $\log_2(25063) \leq n$ q_i 1 1 0 0 0 0 0 0 1 1 0 0 0 0 0 1 0 0 1
 $17.9 \leq n$ $+1$ 1 1 0 0 0 0 0 0 1 1 0 0 0 0 0 1 0 1 0

20 bit Signed = 11000000110000001010₂

11000000110000001010₂
 C 0 C 0 A

11000000110000001010₂ = C0C0A₁₆

$259062/2 = 129531 + 0$ $505/2 = 252 + 1$
 $12951/2 = 64765 + 1$ $252/2 = 126 + 0$
 $64765/2 = 32382 + 1$ $126/2 = 63 + 0$
 $32382/2 = 16191 + 0$ $63/2 = 31 + 1$
 $16191/2 = 8095 + 1$ $31/2 = 15 + 1$
 $8095/2 = 4047 + 1$ $15/2 = 7 + 1$
 $4047/2 = 2023 + 1$ $7/2 = 3 + 1$
 $2023/2 = 1011 + 1$ $3/2 = 1 + 1$
 $1011/2 = 505 + 1$ $1/2 = 0 + 1$

6. $-4.625_{10} = 100.101_2$
 Normalized = $1.00101 \cdot 2^2$

S = 1

L = $2 + 127 = 129$ $129/2 = 64 + 1$

$64/2 = 32 + 0$

$129_{10} = 10000001_2$ $32/2 = 16 + 0$

$16/2 = 8 + 0$

$8/2 = 4 + 0$

$4/2 = 2 + 0$

$2/2 = 1 + 0$

$1/2 = 0 + 1$

S E F
 1 1 0 0 0 0 0 0 1 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 C 0 9 4 0 0 0 0

$-4.625_{10} = C0940000_6$

This representation is accurate as -4.625 does not repeat, which, if it did, would result in precision error when using IEEE-754 standard

F = 00101 + 18 0's