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Assignment 1

1. Number Representation

① 0.110101_2 to decimal

$0.110101_2 = 0\times2^{0} + 1\times2^{-1} + 1\times2^{-2} + 0\times2^{-3} + 1\times2^{-4} + 0\times2^{-5} + 1\times2^{-6}$

$= 0 + \frac{1}{2_{10}} + \frac{1}{4_{10}} + \frac{1}{16_{10}} + \frac{1}{64_{10}}$

$= 0.828125_{10}$

②

a. 8.625_{10} to binary

$8.625 = 8 + 0.625$

For the integer part: $8 < 2^k - 1$

$k > 3$

Therefore:

i	3	2	1	0
b_i	8	4	2	1
a_i	1	0	0	0

$\Rightarrow 1000_2$

For the floating part:

$0.625\times2 = 1.25$ $\quad 0.25\times2 = 0.5$ $\quad 0.5\times2 = 1$

$0.625_{10} = 0.101_2$

$\therefore 8.625_{10} = 1000_2 + 0.101_2 = 1000.101_2$

b. 8.625_{10} to hexadecimal

$8.625_{10} = 1000.101_2 = 1000.1010_2 = 8.A_{16}$

③ a. $2TD.03F_{32}$ to binary & hexadecimal

$2TD.03F_{32} = 00010\ 11101\ 01101.11000\ 00011\ 01111_2$

$= 1011\ 1010\ 1101.1100\ 0000\ 1101\ 1110_2$

$= B\ A\ D.C\ 0\ D\ E_{16}$

④ 212336614_7 to hexadecimal

$= 2\times7^8 + 1\times7^7 + 2\times7^6 + 3\times7^5 + 3\times7^4 + 6\times7^3 + 6\times7^2 + 1\times7^1 + 4\times7^0$

$= 12648430_{10}$

$\therefore 12648430 < 16^k - 1$

$k > 5 \rightarrow k = 6$

i	5	4	3	2	1	0
bi	1048576	65536	4096	256	16	1
ai	C	0	F	F	E	E

$\Rightarrow C0FFEE_{16}$

⑤ -259062_{10} to 20 bit binary

$259062 < 2^k - 1$

$k \approx 18$

i	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
bi	131072	65536	32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1
ai	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	1	1	0

Therefore, 20-bit binary is 00111111001111110110_2

By using 2's complement: 11000000110000001001

$+ \quad 1$

11000000110000001010

We get $-25062_{10} = 1100\,0000\,1100\,0000\,1010_2$

binary to hexadecimal: $1100\ 0000\ 1100\ 0000\ 1010_2$

$= C\ 0\ C\ 0\ A$

$= C0C0A_{16}$

(b) -4.625_{10} to IEEE Single Precision

- Sign = 1
- 4.625_{10} to binary

  for the floating part, $0.625 \times 2 = 1.25$ $0.25 \times 2 = 0.5$ $0.5 \times 2 = 1$

  $= 0.101_2$

$\therefore 4.625_{10} = 100.101_2 = 1.00101 \times 2^2{}_{10}$

Exponent $= 127 + 2 = 129_{10} = 1000\,0001_2$

- $4.625_{10} = 1.00101 \times 2^{-2}$

$\therefore F = 00101\underbrace{0000 \cdots 0}_{18\ 0s}$

$\therefore -4.625_{10} =$

$\underbrace{1}_{S}\ \underbrace{1000\,0001}_{E}\ \underbrace{00101000000000000000000}_{F}{}_2$

$= 1100\ 0000\ 1001\ 0100\ 0000\ 0000\ 0000\ 0000$

$= C\ 0\ 9\ 4\ 0\ 0\ 0\ 0_{16}$

Yes, the representation is exact.

2. Seven Segment Decoder

A_3	A_2	A_1	A_0	S_6	S_5	S_4	S_3	S_2	$\overline{S_1}$	S_0
0	0	0	0	0	1	1	1	1	0	1
0	0	0	1	1	1	1	0	1	1	1
0	0	1	0	1	1	1	1	1	1	0
0	0	1	1	1	1	1	1	1	1	1
0	1	0	0	1	1	0	1	1	1	1
0	1	0	1	1	1	1	1	1	1	1
0	1	1	0	1	1	0	1	1	0	1
0	1	1	1	1	1	1	1	1	1	0
1	0	0	0	1	1	0	1	1	0	1
1	0	0	1							
1	0	1	0							
1	0	1	1							
1	1	0	0							
1	1	0	1							
1	1	1	0							
1	1	1	1							

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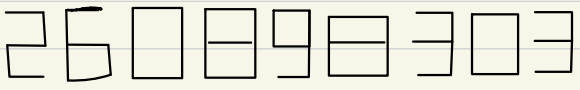

$S_6 = A_3 A_2 A_1 A_0$

$S_5 = (A_3 + \overline{A_3}) \cdot (A_2 + \overline{A_2}) \cdot (A_1 + \overline{A_1}) \cdot (A_0 + \overline{A_0})$

$S_4 = A_3 \cdot \overline{A_2} \cdot A_1 \cdot A_0 + A_3 \overline{A_2} \overline{A_1} A_0 + \overline{A_2} A_2 A_1 A_0$

$S_3 = A_3 \cdot A_2 \cdot A_1 \cdot \overline{A_0}$

$S_2 = S_5$

$S_1 = A_3 A_2 A_1 A_0 + A_3 \overline{A_2} \overline{A_1} A_0 + \overline{A_3} A_2 A_1 A_0$

$S_0 = A_3 A_2 \overline{A_1} A_0 + A_3 \overline{A_2} \overline{A_1} \overline{A_0}$