Computer Architecture
Tutorial 4 – Floating Point Numbers - Answers

1) Binary fractions are:

a) 5.5 is **101.1**

b) 8.25 is **1000.01**

c) 9 is 1001

0.3 ⇒ **0**.6, **1**.2, **0**.4, **0**.8, **1**.6, **1**.2 → 01001 1001 1001 etc.

9.3 is **1001. 01001 1001 <u>1001</u>** repeating etc.

d) 11.46875 is **1011.01111**

2) Convert the binary number 1001.1010101 to decimal.

1001 binary is 9 decimal

.	1	0	1	0	1	0	1	
128	64	32	16	8	4	2	1	Sum=85

Fraction = 85 /128 = 0.6640625

Number = **9.6640625**

3) a) 101.1 = **1.011 x 2^{2}**

b) 1000.01 = **1.00001 x 2^{3}**

c) 0.00010101 = **1.0101 x 2^{-4}**

4) Convert –31.3 to IEEE Single Precision format.

First convert to a binary number -31.3 = -11111.01001 1001 <u>1001</u>

Next Normalise

1.11110 1001 1001 1001 1001 1001 x 2^{4}

Significand field is **1111 0100 1100 1100 1100 110 (23 bits with 1. omitted)**

Exponent field is 4+127 = 131 =**1000 0011**
Number is -ve therefore Sign field is **1**

Sign	Exponent	Significand
1	**1000 0011**	**1111 0100 1100 1100 1100 110**

5) Convert the IEEE Single Precision format hex value C154 0000 to decimal.

C154 0000 = 1100 0001 0101 0100 0000 0000 0000 00000

Sign	Exponent	Significand
1	1000 0010	1010 1000 0000 0000 0000 000

Exponent field = 1000 0010 = 130 => Exponent = 130 - 127 = 3

Significand field = 10101 Adding Hidden Bit => 1.10101

Therefore number is 1.10101×2^{3} = 1101.01 = Decimal 13.25

Sign is 1 therefore number is **-13.25**

6) Carry out the operation 31.3 + 13.25 in IEEE single precision arithmetic

Number	Sign	Exponent	Significand
31.3	0	1000 0011	1111 0100 1100 1100 1100 110
13.25	0	1000 0010	1010 1000 0000 0000 0000 000

Significand of Larger Number = 1.1111 0100 1100 1100 1100 110
Significand of Smaller Number= 1.1010 1000 0000 0000 0000 000

Exponents differ by 1. Therefore shift binary point of Smaller Number 1 place.

Significand of Larger Number = 1.1111 0100 1100 1100 1100 1100
Significand of Smaller Number= 0.1101 0100 0000 0000 0000 0000

Significand of Sum = 10.1100 1000 1100 1100 1100 1100

Sum = $10.1100\ 1000\ 1100\ 1100\ 1100\ 1100 \times 2^{4}$

Normalise $1.01100\ 1000\ 1100\ 1100\ 1100\ 1100 \times 2^{5}$

Sign	Exponent	Significand
0	**1000 0100**	**0110 0100 0110 0110 0110 011**

7)

Fraction	**Binary**	**Decimal**
1/4	0.01	0.25
3/8	0.011	0.375
23/16	1.0111	1.4375
45/16	10.1101	2.8125
11/8	1.011	1.375
45/8	101.101	5.625
49/16	11.0001	3.0625