## Computer Architecture Tutorial 4 – Floating Point Numbers - Answers

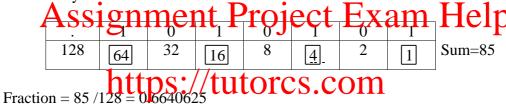
- 1) Binary fractions are:
  - a) 5.5 is **101.1**
  - b) 8.25 is **1000.01**
  - c) 9 is 1001

 $0.3 \Rightarrow 0.6, 1.2, 0.4, 0.8, 1.6, 1.2 \Rightarrow 01001 1001 1001$  etc.

9.3 is **1001.01001 1001 1001** repeating etc.

- d) 11.46875 is **1011.01111**
- 2) Convert the binary number 1001.1010101 to decimal.

1001 binary is 9 decimal



Number = 9.6640625 eChat: cstutorcs

3) a)  $101.1 = 1.011 \times 2^{2}$ 

- b)  $1000.01 = 1.00001 \times 2^3$
- c)  $0.00010101 = 1.0101 \times 2^{-4}$
- 4) Convert –31.3 to IEEE Single Precision format.

First convert to a binary number -31.3 = -11111.01001 1001 1001

**Next Normalise** 

1.11110 1001 1001 1001 1001 1001 x 2<sup>4</sup>

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

Exponent field is 4+127 = 131 = 1000 0011Number 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.

 $C154\ 0000 = 1100\ 0001\ 0101\ 0100\ 0000\ 0000\ 0000\ 0000$ 

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

Exponent field =  $1000\ 0010 = 130 \implies$  Exponent = 130 - 127 = 3

Significand field = 10101 Adding Hidden Bit => 1.10101

Therefore number is 1.10101 x  $2^3 = 1101.01 = Decimal 13.25$ 

Sign is 1 therefore number is -13.25

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

| Numbe | r 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 = Significand of Smaller Number=

1.1114 0100 1100 1100 1100 110

Exponents differ at the control of t

Significand of Larger Number = 1.1111 0100 1100 1100 1100 1100 Significand of Sig

Significand of Sum =  $\boxed{10.1100\ 1000\ 1100\ 1100\ 1100\ 1100}$ 

Sum = 10.1100 1000 1100 1100 1100 1100 x 2<sup>4</sup>

Normalise 1.01100 1000 1100 1100 1100 1100 x 2<sup>5</sup>

| 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  |