REG No: 19BCS0012

NAME: G.Nithish

Computer Architecture :-

Digital Assignment-2

(1) Express the following number in IEEE 32-bit floating Point formate

a) -1.5

Ans

-1.5 → Binary $(-1.1)_2$

Sign bit | mantissa ⇒ 7
S = 1 | E = 0

decimal	Binary
1	01
0.5	.1
1.5	→ 1.1

exp bias = 127

-1.1 ⇒ it doesn't need normalization.

X | XXXXXXXX | XXX XXX ... XX

X → Sign bit

8 exp bits → 127 + 0 → 127 → Binary $(1111111)_2$ → 11111111

23 fraction bits → 10000000000...00 → 10000000000000000...00

1 | 11111111 | 10000000000000000...00

Sign bit | exponent (8) | fraction bits (23)

(b) $(38)_{10}$

↓

Binary $(100000000)_2$

Normalize

1.10000000×2^8

Sign bit

$S = 0$

mantissa

M = 10000000

exp bias : 127 for 32 bit

Exponent(E): 8

$E' = 8 + \text{exp bias}$

$E' = 8 + 127$

$E' = 135$

$(135)_{10} \rightarrow (10000111)_2$

sign bit | 8 exponent bits | 23 fraction bits:-

X | XXXXXXXX | XXXXXXXXXXXXXXXXXXXXXXX

↓ | ↓ | ↓

0 | 10000111 | 10000000000000000000000

---

(2) The following numbers use the IEEE 32 bit floating point format. What is the equivalent decimal value?

or 1 | 10000011 | 11000000000000000000000

↓ | ↓ | fraction bits (23)

Sign (S) = 1 bit | $E = (10000011)_2 \Rightarrow (131)_{10}$

Ebias = 127 for 32 bit

$E = 137 - 127$

$\Rightarrow 4_{//}$

$1\times2^{-1} + 1\times2^{-2} + 0\times2^{-3} + \cdots\cdots$

1 1 0 0 0 0 0 0 . . . . . 0 0

mantissa(m)

Exponent = 4//

$\Rightarrow 1 + 2^{-1} + 1\times2^{-2} \Rightarrow 2^{-1} + 2^{-2}$

Mantissa → 0.75

$$(-1)^s \times (1+m) \times 2^e$$

$\Rightarrow (-1)^0 \times (1+0.75) \times 2^4$

$\Rightarrow (1) \times (1.75) \times 2^4 \Rightarrow 28$

Equivalent decimal value $= (28)_{10}$

(b)

0 | 01111110 | 10100000000000000000000

Sign bit | Exponent bit (8) | fraction bit (23)

$E = (01111110)_2 \rightarrow 126$ **Sign bit = 0**

exp bias for 32 bit Ebias = 127

$E' = E - Ebias$

$E' = 126 - 127$

E' = -1

mantissa

1 0 1 0 0 0 0 0 . . . . . 0 0

1×2^{-1} 0×2^{-2} 1×2^{-3}

$2^{-1} + 2^{-3} \Rightarrow 0.625$

Mantissa = 0.625

$(-1)^S \times (1+m) \times 2^e$ ⇒ equivalent formula(decimal)

⇒ $(-1)^0 \times (1+0.625) \times 2^{-1}$ ⇒ 0.8125

∴ the equivalent decimal value for the given binary 32 bit format ⇒ 0.8125

---

(3) show step by step process using sing magnitude multiplication algorithm and Both multiplication algorithm for the following numbers:-

a) 7 * 3

Multiplicand (B) = $(7)_{10}$ → $(0111)_2$ 7x3=21

Multiplier (Q) = $(3)_{10}$ → $(0011)_2$

Comment	E	A	Q	SC
Qn=1; EA ← A+B	0	0000 +B 0111 0111	0011	4
Shr EAQ	0			
SC ← SC-1	0	0011	1001	3
Qn=1; EA ← A+B	0	+B 0111 1010		
shr EAQ				
SC ← SC-1	0	0101	0100	2
shr EAQ Qn=0	0	0010	1010	1
Qn=0 shr EAQ	0	0001	0101	0

7 * 3

+21 = = 010101

(b) +7 +3

Booth multiplication algorithm

Multiplicand (BR) = $(+7)_{10} \rightarrow (0\ 0\ 1\ 1)_2$

Multiplier (QR) = $(+3)_{10} \rightarrow (0\ 0\ 1\ 1)_2$

$\bar{B}R+1 \Rightarrow 1001$

Comment	AC	QR	Qn+1	SC
QR = 1 and Qn+1 = 0 AC ← AC + $\bar{B}R+1$	0000 1001 1001	0011	0	4
Ashr (AC & QR) SC ← SC − 1	1100	1001	1	3
QR = 1 & Qn+1 = 1 Ashr (AC & QR) SC ← SC − 1	1110 +BR 0111 0101	0100	1	2
QR = 0 & Qn+1 = 1 AC ← AC + BR Ashr (AC & QR) SC ← SC − 1	0010	1010	0	1
Ashr (AC & QR) QR = 0 Qn+1 = 0	0001	0101	0	1

0001 0101 ⇒ +21

1×16 1×4 1×1

16+4+1 ⇒ 21

using Booth multiplication algorithm:-

we got yinial result as +21

9(b)

-7 #3

Booth multiplication Algorithm

1011
0100
1
0101

QR = 3 = 0011

BR = -7 = 1001

$\overline{BR}+1$ = 0111

-(7) = 0111
1's 1000
+1
1001

1001
2's 0110
+1
0111

Comment	Ac	QR	Q_{n-1}	Sc
QR=1 Q_{n-1}=0 Ac ← Ac-BR	0000 0111 0111	0011	0	4
Ashr	0011	1001	1	3
QR=1 Q_{n-1}=1 Ashr	0001 1001	1100	1	2
QR=0 Q_{n-1}=1 Sc ← Sc-1	1010 1101	0110	0	1
Ashr	1110	1011	0	0

AC QR
1110 1011 ⇒ 1's → 00010100 ⇒ -21
2's → 00010101

16 + 4 + 1 ⇒ 16+4+1 ⇒ 21

1110 1011
00010100 1

- I#3

(3b) Sign magnitude

multiplicand (B) ~~(7)10~~ $= -(7) \Rightarrow -(0111)_2$

the sign bit of (B) and (Q) are store in

Bs and Qs, $\boxed{Bs = 1}$ $\boxed{Qs = 0}$ $\boxed{Bs \oplus Qs = 1}$

multiplier (Q) $= (3)_{10} \Rightarrow 0011)_2$

Comment	E	A	Q	Sc
Qn=1; E	0	0000	0011	4
+B 0111 EA ← A+B Shr EAQ Sc ← Sc-1	0	0111 0011	1001	3
Qn=1; EA ← A+B	0	+B 0111 1010		
Shr EAQ Sc ← Sc-1	0	0101	0100	2
Shr EAQ	0	0010	1010	1
Qn=0 Shr EAQ	0	0001	0101	0

$Bs \oplus Qs = 1$

$\boxed{1 \oplus 0 = 1}$,

sing bit = 1//

$\underline{1}\ 0010101 \Rightarrow -(21)$//

Using sing magnitude the we obtains

$-(21)$//

(4)

Address	Value
PC	100
R0	200
R1	300
100	200
104	300
108	400
200	500
300	600
500	700

Instruction	Addressing mode	Value in R0
Load r0, #200	Immediate	200
Load r0, 200	Direct	500
Load r0, (200)	Indirect	700
Load r0, r1	Register	300
Load r0, [r1]	Register Indirect	600
Load r0 -100[r1]	Based	500
Load r0, 200[PC]	Relative	600

(5) Write a short note on different types of memory?

Memory :-

↳ Complete programs and data sets are held in memory external to the processor.

↳ two fundamental types :-

Main memory :-

↳ main memory is sometimes called Volatile because it looses its information when power is removed.

* Secondary memory is usually nonvolatile because it retains its information when power is removed.

* Main memory is sometimes called main storage.

* Main memory sometimes called RAM.

RAM stands for Random Access Memory.

"Random" means means that the memory cells can be accessed in any order.

Secondary Memory:-

- Secondary memory is where programs and data are kept on a long-term basis.
- Common secondary storage devices are the hard disk and optical disks.
- The hard disk has enormous storage capacity compared to main memory.
- The hard disk is usually contained inside the case of a computer.
- The hard disk is used for long-term storage of programs and data.