Vidyavardhini's College of Engineering and Technology

Department of Artificial Intelligence & Data Science

AY: 2024-25

Class:	SE	Semester:	III
Course Code:	CSC302	Course Name:	DIGITAL LOGIC & COMPUTER ARCHITECTURE

Name of Student:	SHRUTI GAUCHANDRA
Roll No. :	15
Assignment No.:	02
Title of Assignment:	Apply the arithmetic algorithms to solve ALU operations
Date of Submission:	16/08/24
Date of Correction:	16/08/24

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Completeness	5	3
Demonstrated Knowledge	3	3
Legibility	2	2
Total	10	8

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Completeness	5	3-4	1-2
Demonstrated Knowledge Legibility	3	2	1
Legibility	2	1	0

Checked by

Name of Faculty : MS. KSHITIJA GHARAT

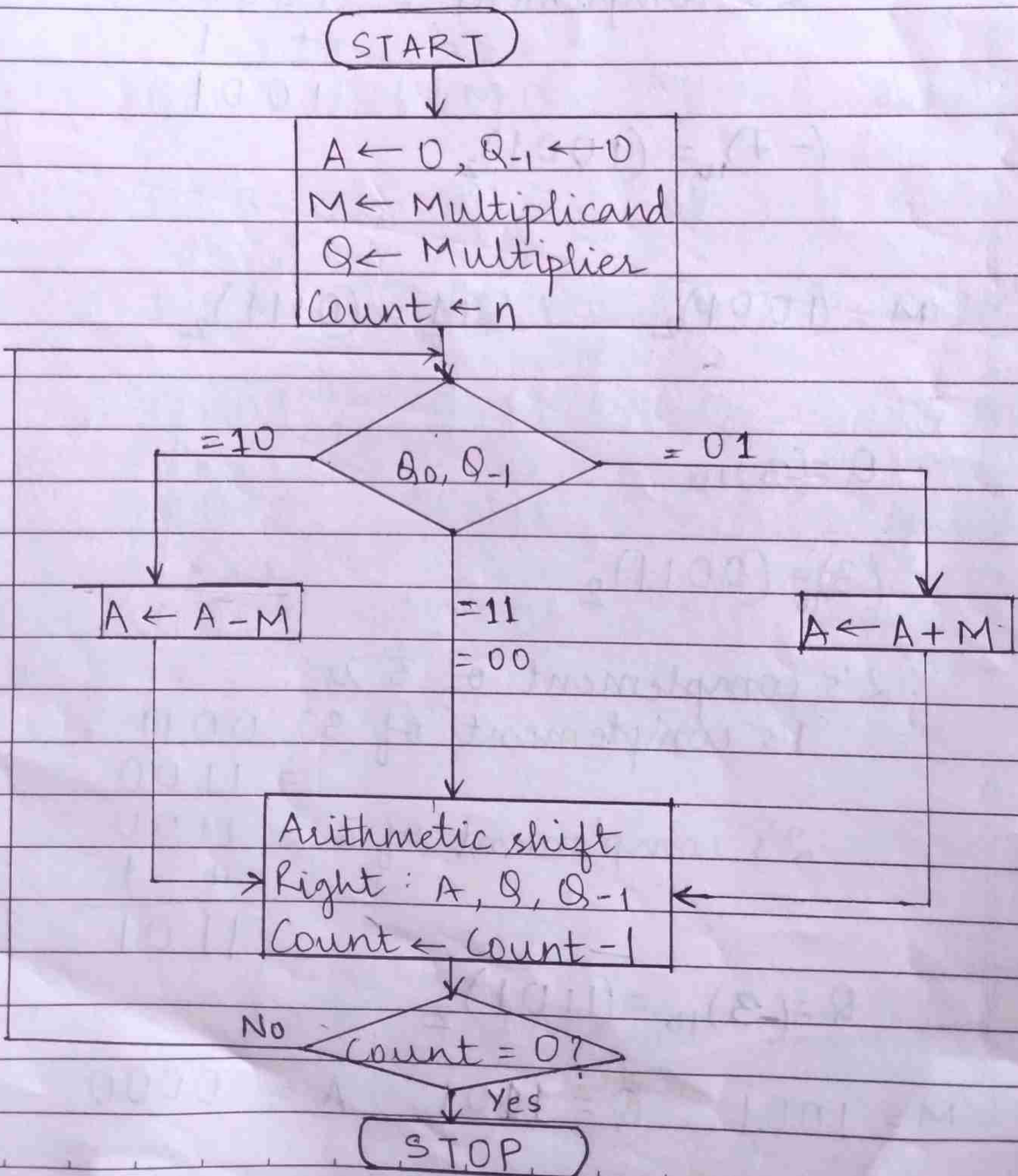
Signature : Gharat

Date : 16/8/24

CO2 Apply the arithmetic algorithm to solve ALU operations

Q1 Draw flowchart of Booth's multiplication algorithm and Multiply (-7) and (-3) using Booth's algorithm

→ Flowchart of Booth's multiplication is as follows:



Multiplication of -7 & -3

$-7 * -3$

$M = (-7)_{10} = (1001)_2$ $\therefore -M = 0111$

$(7)_{10} = (0111)_2$

2's complement of ~~+0~~ 7 = 0111

1's complement = 1000

2's complement = 1000
+ 1
1001

$\therefore (-7)_{10} = (1001)_2$

$M = (1001)_2$ $-M = (0111)_2$

$\therefore Q = (-3)_{10}$

$(3)_{10} = (0011)_2$

$\therefore$ 2's complement of 3 is :

1's complement of 3 0011
= 1100

2's complement of 3 = 1100
+ 1
1101

$\therefore Q = (-3)_{10} = (1101)_2$

M = 1001 Q = 1101 A = 0000 $Q_{-1} = 0$

∴ $M = 1001$ $Q = 1101$ $A = 0000$ $Q_{-1} = 0$
$-M = 0111$

n	A	Q	Q_{-1}	Operation:
4	0000	1101	0	Initialization
	0111	1101	0	A = A − M
3	0011	1110	1	Right shift
	1100	1110	1	A = A + M
2	1110	0111	0	Right shift
	0101	0111	0	A = A − M
1	0010	1011	1	Right shift
0	0001	0101	1	Right shift

∴ $(00010101)_2 = (21)_{10}$

∴ $-7 * -3 = 21$

Q2. Perform Division Restoring Algorithm for Dividend = 13 and Divisor = 5

M = 00101 $\quad$ $-M = 00101$

→ $\quad$ 1's complement = 11010

2's complement = 11010
$\quad + 1$
$\quad$ 11011

$-M = (11011)_2$ $\quad$ $M = (00101)_2 = (5)_{10}$

~~+M =~~ .

$Q = (13)_{10} = (1101)_2$

$\therefore (13)_{10} \div (5)_{10}$

M = 00101
-M = 11011
A = 00000
Q = 1101

M = 00101   −M = 11011

n	M	A	Q	Operation
4	00101	00000	1101	Initialization
	00101	00001	101?	Shift left AQ
	00101	11010	101?	A = A − M
3	00101	00001	1010	Q[0] ← 0 Restore A
	00101	00011	010?	Shift left AQ
	00101	11110	010?	A = A − M
2	00101	00011	0100	Q[0] ← 0 Restore A
	00101	00110	100?	Shift left AQ
	00101	00001	100?	A = A − M
1	00101	00001	1001	Q[0] ← 1
	00101	00011	001?	Shift left AQ
	00101	11110	001?	A = A − M
0	00101	$\underbrace{00011}_{(3)_{10}}$	$\underbrace{0010}_{(2)_{10}}$	Q[0] ← 0 Restore A

$\therefore A = (3)_{10}$ & $Q = (2)_{10}$

Q3. Represent $(543.21)_{10}$ in single precision format and double precision format

Step 1: Convert decimal number to binary

$(543)_{10} = (1000011111)_2$

$(0.21)_{10} = (0.0011010111)_2$

$(543.21)_{10} = (1000011111.0011010111...)_2$

$0.21 \times 2 = 0.42 \quad 0$
$0.42 \times 2 = 0.84 \quad 0$
$0.84 \times 2 = 1.68 \quad 1$
$0.68 \times 2 = 1.36 \quad 1$
$0.36 \times 2 = 0.72 \quad 0$
$0.72 \times 2 = 1.44 \quad 1$
$0.44 \times 2 = 0.88 \quad 0$
$0.88 \times 2 = 1.76 \quad 1$
$0.76 \times 2 = 1.52 \quad 1$
$0.52 \times 2 = 1.04 \quad 1$

2	543	1
2	271	1
2	135	1
2	67	1
2	33	1
2	16	0
2	8	0
2	4	0
2	2	0
	1	1

$(0.21)_{10} = (0011010111...)_2$

$(543)_{10} = (1000011111)_2$

Step 2: Normalise the number

$(1.N)\,2^{E-127}$ for single & $(1.N)\,2^{E-1023}$ for double

$(543.21)_{10} = (1000011111.0011010111...)_2$

1| 000011111.0011010111....

$1.0000111110011010111... \times 2^9$

Step 3:

(1) Single Precision format

$(1.N)\,2^{E-127}$

$1.0000111110011010111... \times 2^9$

comparing both we get

$E - 127 = 9$

$E = 127 + 9$

$E = 136$

Now convert from decimal to binary

$(136)_{10} = (10001000)_2$

Single Precision $N = 0000111110011010111...$

Sign bit	Exponent	Mantissa
0	10001000	0000111110011...00..
1 bit	8 bits	23 bit

(2) For Double Precision

$(1.N)2^{E-1023}$

$1.0000111110011010111 \times 2^{9}$

$E - 1023 = 9$

$E = 1023 + 9$

$E = 1032$

Convert 1032 from decimal to binary

$(1032)_{10} = (10000001000)_2$

Sign bit	Exponent	Mantissa
0	10000001000	0000111110011...00..
1 bit	11 bit	52 bit

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