INSTRUCTION TYPES

- Data movement
- Arithmetic
- Boolean
- Bit manipulation (shift and rotate)
- I/O
- Transfer of control
- Special purpose

Data Transfer and Manipulation

1) Data transfer- Data transfer instruction cause transfer of data from one location to another

2) Data manipulation- Data manipulation performs arithmetic, logic and shift operations.

3) Program control instructions -Program control instructions provide decision making capabilities and change the path taken by the program when executed in computer.

Data Transfer Instruction

- LD » Load
- ST » Store
- MOV » Move
- XCH » Exchange
- IN/OUT » Input/Output
- PUSH/POP » Push/Pop

Data Manipulation Instruction

1) Arithmetic

2) Logical and bit manipulation

3) Shift Instruction

Arithmetic Instructions :

NAME	MNEMONIC
Increment	INC
Decrement	DEC
Add	ADD
Subtract	SUB
Multiply	MUL
Divide	DIV
Add with Carry	ADDC
Subtract with borrow	SUBB
Negate (2's complement)	NEG

- Logical and Bit Manipulation Instructions :

NAME	MNEMONIC
Clear	CLR
Complement	COM
AND	AND
OR	OR
Exclusive-OR	XOR
Clear Carry	CLRC
Set Carry	SETC
Complement Carry	COMC
Enable Interrupt	EI
Disable Interrupt	DI

- Shift Instructions :

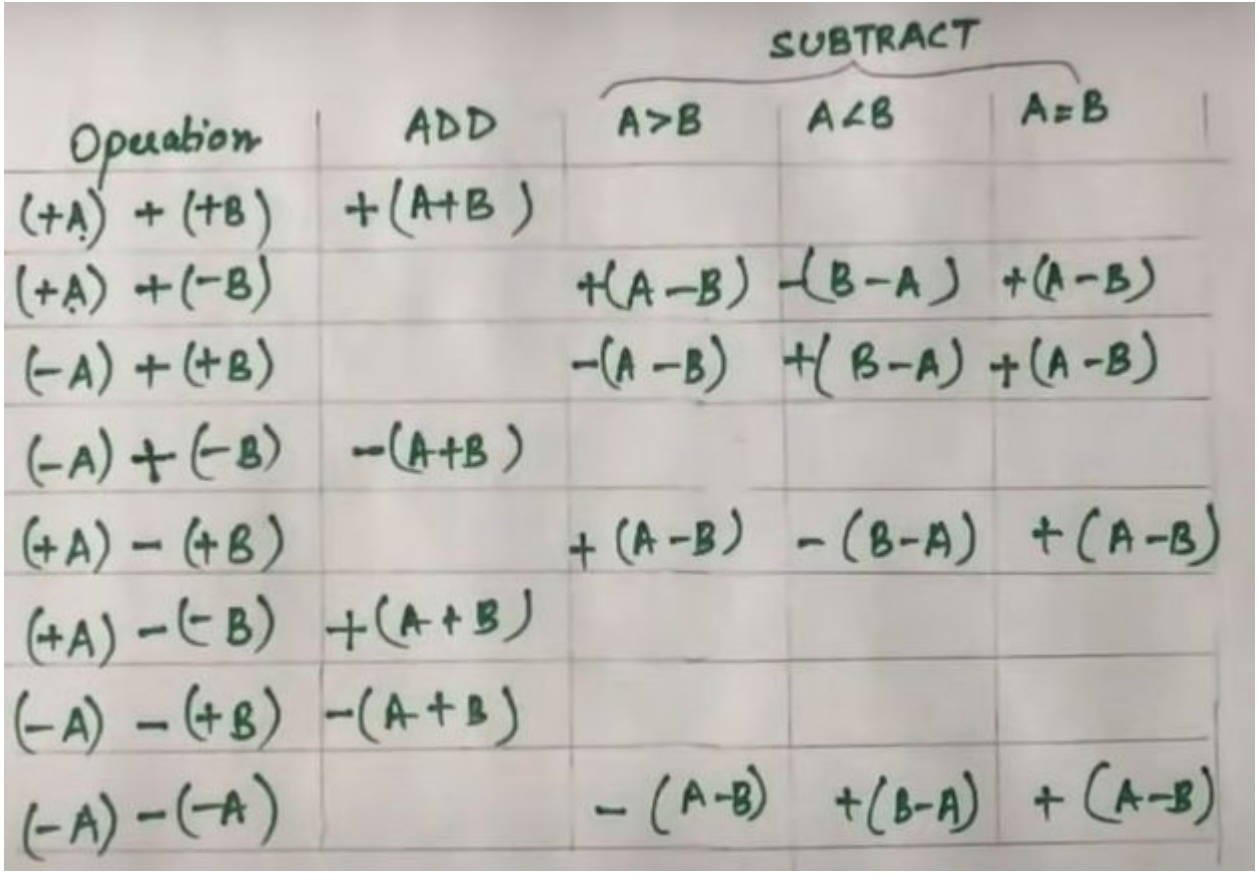
NAME	MNEMONIC
Logical Shift Right	SHR
Logical Shift left	SHL
Arithmetic shift right	SHRA
Arithmetic shift left	SHLA
Rotate right	ROR
Rotate left	ROL
Rotate right with carry	RORC
Rotate left with carry	ROLC

Program Control Instruction

Branch and Jump instructions are used interchangeably to mean the same thing

NAME	MNEMONIC
Branch	BR
Jump	JMP
Skip	SKP
Call	CALL
Return	RET
Compare (by subtraction)	CMP
Test (by ANDing)	TST

Computer Arithmetic: Addition and subtraction



Operation	ADD	SUBTRACT		
		A>B	A<B	A=B
(+A) + (+B)	+(A+B)			
(+A) + (−B)		+(A−B)	−(B−A)	+(A−B)
(−A) + (+B)		−(A−B)	+(B−A)	+(A−B)
(−A) + (−B)	−(A+B)			
(+A) − (+B)		+(A−B)	−(B−A)	+(A−B)
(+A) − (−B)	+(A+B)			
(−A) − (+B)	−(A+B)			
(−A) − (−A)		−(A−B)	+(B−A)	+(A−B)

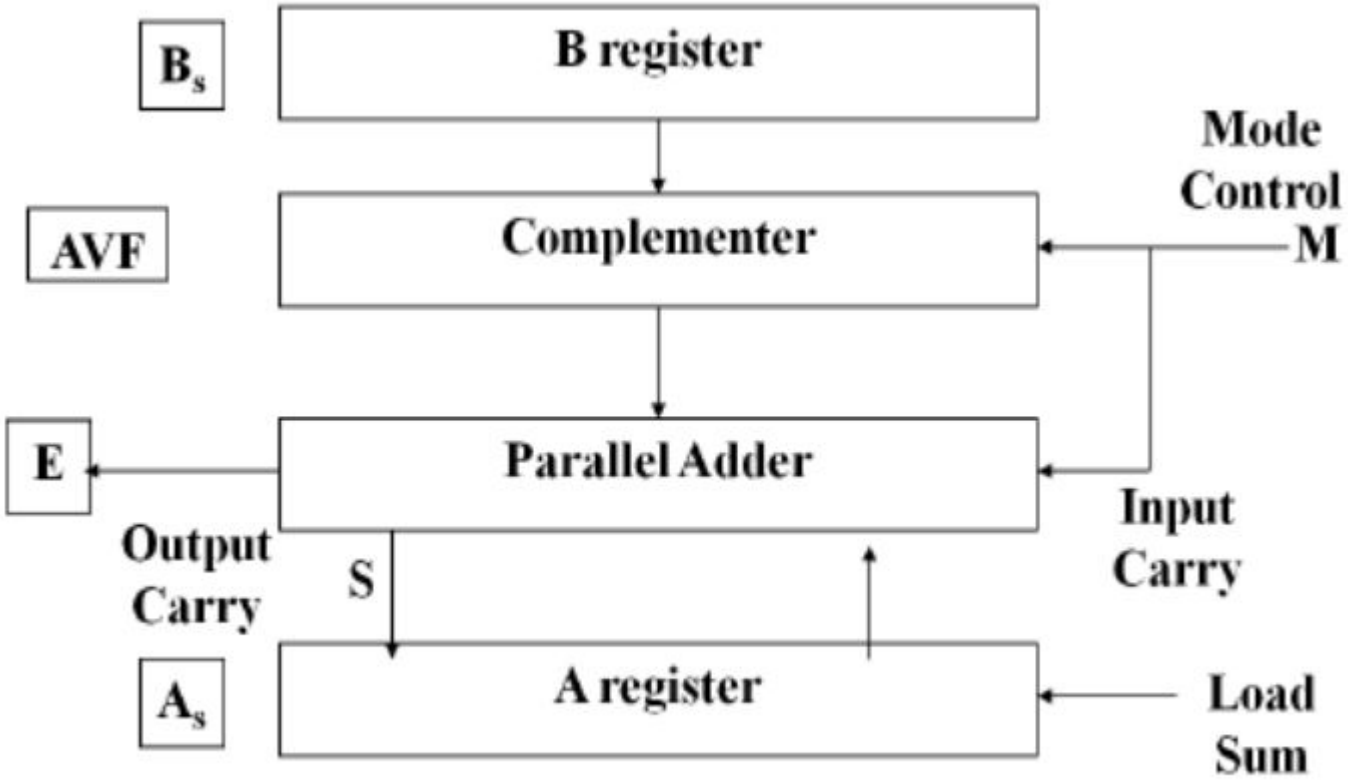
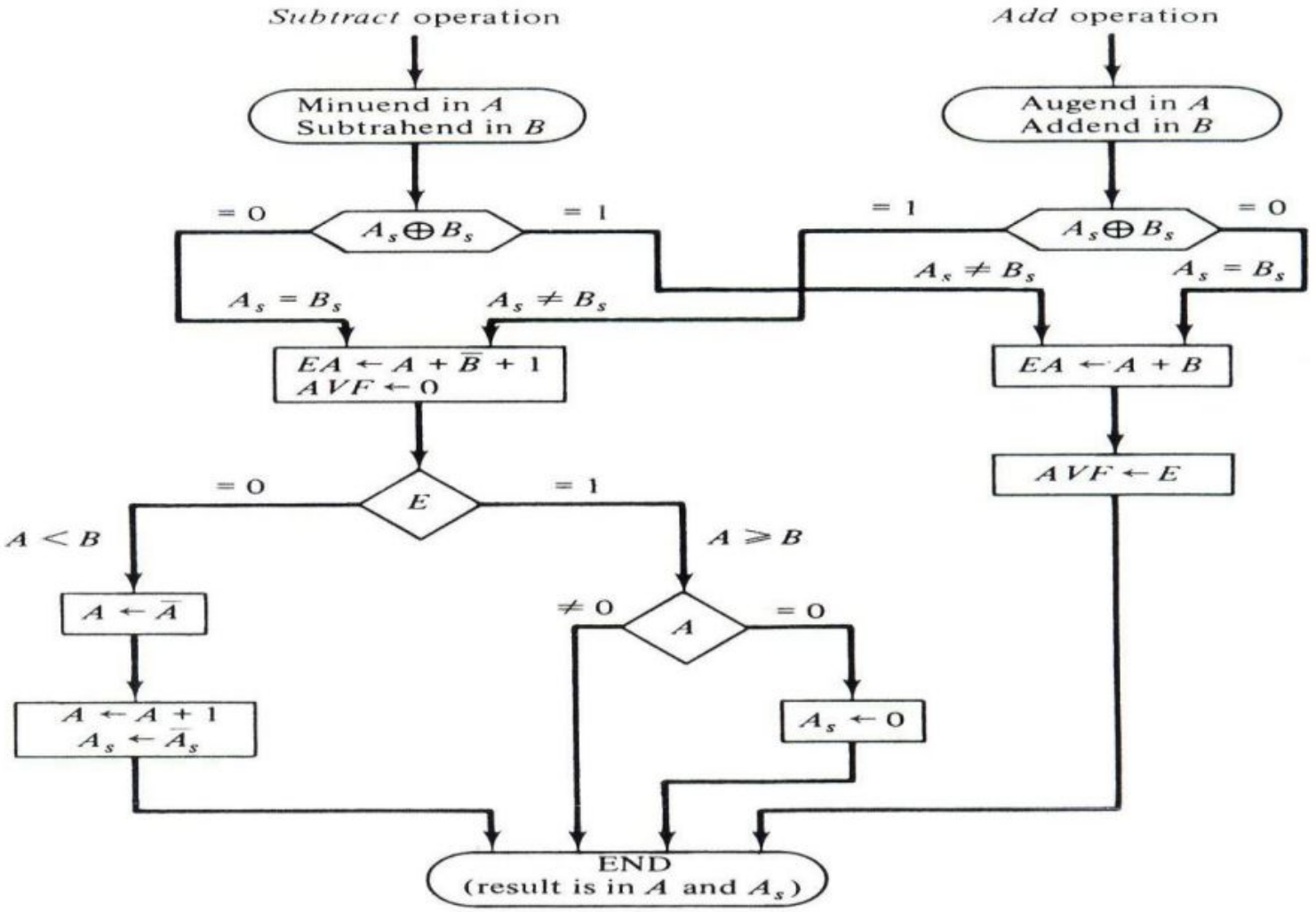
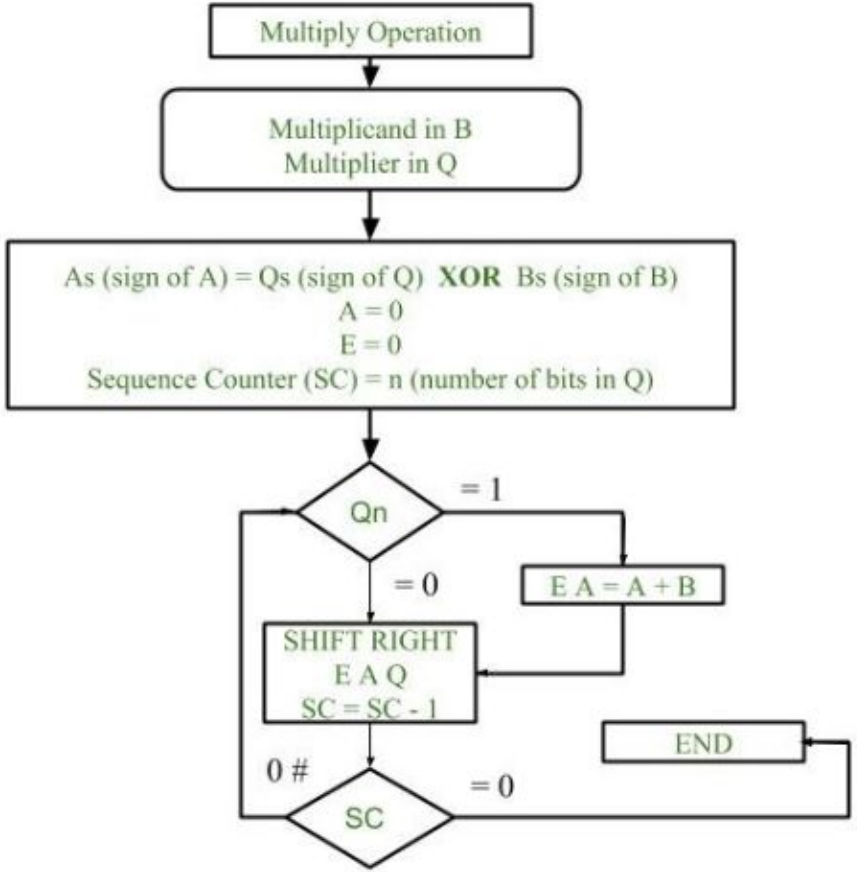


Fig: Hardware for signed-magnitude data addition and subtraction


Subtract operation
Minuend in A
Subtrahend in B
= 0
$A_s \oplus B_s$
= 1
$A_s = B_s$
$A_s \neq B_s$
$EA \leftarrow A + \overline{B} + 1$
$AVF \leftarrow 0$
= 0
E
= 1
$A < B$
$A \geqslant B$
$A \leftarrow \overline{A}$
$A \leftarrow A + 1$
$A_s \leftarrow \overline{A}_s$
≠ 0
A
= 0
$A_s \leftarrow 0$
END
(result is in A and A_s)
Add operation
Augend in A
Addend in B
= 1
$A_s \oplus B_s$
= 0
$A_s \neq B_s$
$A_s = B_s$
$EA \leftarrow A + B$
$AVF \leftarrow E$

Multiplication - signed numbers are handled separately



Multiplication - signed numbers are not handled separately