PROGRAMMING USING 8085

Simple examples

Program

- LXI H, 2500H : "Initialize memory pointer 1"
- LXI D, 2600H : "Initialize memory pointer2"
- MVI C, 32H : "Initialize counter"
- BACK:MOV A, M : "Get the number"
- ANI 01H : "Check for even number"
- JNZ SKIP : "If ODD, don't store"
- MOV A, M : "Get the number"
- STAX D : "Store the number **in** result list"

8085 program to add two 8 bit numbers

Problem – Write an assembly language program to add two 8 bit numbers stored at address 2050 and address 2051 in 8085 microprocessor. The starting address of the program is taken as 2000.

Algorithm –

1. Load the first number from memory location 2050 to accumulator.
2. Move the content of accumulator to register H.
3. Load the second number from memory location 2051 to accumulator.
4. Then add the content of register H and accumulator using “ADD” instruction and storing result at 3050
5. The carry generated is recovered using “ADC” command and is stored at memory location

MEMORY ADDRESS	MNEMONICS	COMMENT
2000	LDA 2050	A<-[2050]
2003	MOV H, A	H<-A
2004	LDA 2051	A<-[2051]
2007	ADD H	A<-A+H

2006	MOV L, A	L←A
2007	MVI A 00	A←00
2009	ADC A	A←A+A+carry
200A	MOV H, A	H←A
200B	SHLD 3050	H→3051, L→3050
200E	HLT	

Explanation –

1. **LDA 2050** moves the contents of 2050 memory location to the accumulator.
2. **MOV H, A** copies contents of Accumulator to register H to A
3. **LDA 2051** moves the contents of 2051 memory location to the accumulator.
4. **ADD H** adds contents of A (Accumulator) and H register (F9). The result is stored in A itself. **For all arithmetic instructions A is by default an operand and A stores the result as well**
5. **MOV L, A** copies contents of A (34) to L
6. **MVI A 00** moves immediate data (i.e., 00) to A
7. **ADC A** adds contents of A(00), contents of register specified (i.e A) and carry (1). As ADC is also an arithmetic operation, A is by default an operand and A stores the result as well
8. **MOV H, A** copies contents of A (01) to H
9. **SHLD 3050** moves the contents of L register (34) in 3050 memory location and contents of H register (01) in 3051 memory location
10. **HLT** stops executing the program and halts any further execution

Program to Subtract two 8 Bit numbers in 8085 Microprocessor

Problem Statement −

Write an 8085 Assembly language program to subtract two 8-bit numbers and store the result at locations **8050H and 8051H**.

Discussion −

In 8085, the SUB instruction is used 2’s complemented method for subtraction. When the first operand is larger, the result will be positive. It will not enable the carry flag after completing the subtraction. When the result is negative, then the result will be in 2’s complemented form and carry flag will be enabled.

We are using two numbers at location 8000H and 8001H. When the numbers are 78H and 5DH, then the result will be (78 – 5D = 1B) and when the numbers are 23H and CFH, then the result will be (23 – CF = 154) Here 1 indicates the number is negative. The actual result is 54H. It is in 2’s complemented form.

Input

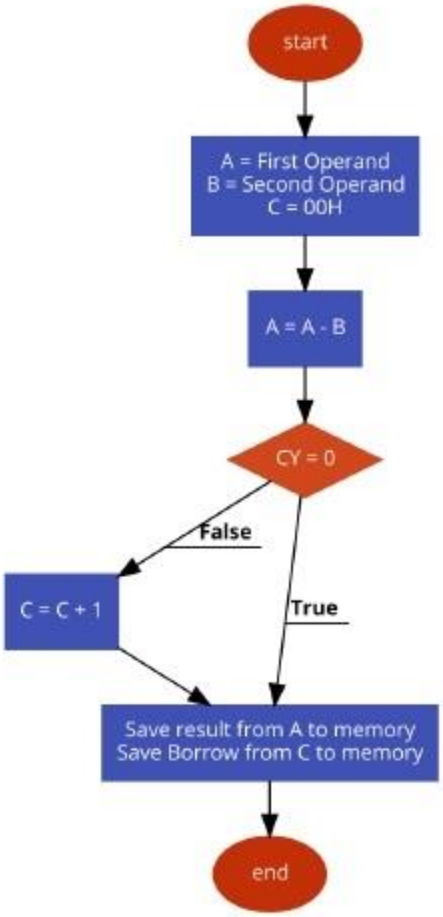
first input

Address	Data
…	…
8000	78
8001	5D
…	…

second input

Address	Data
…	…
8000	23
8001	CF
…	…

Flow Diagram



Program

Address	HEX Codes	Labels	Mnemonics	Comments
F000	0E, 00		MVI C,00H	Clear C register
F002	21, 00, 80		LXI H,8000H	Load initial address to get operand

Address	HEX Codes	Labels	Mnemonics	Comments
F005	7E		MOV A,M	Load Acc with memory element
F006	23		INX H	Point to next location
F007	46		MOV B,M	Load B with second operand
F008	90		SUB B	Subtract B from A
F009	D2, 0D, F0		JNC STORE	When CY = 0, go to STORE
F00C	0C		INR C	Increase C by 1
F00D	21, 50, 80	STORE	LXI H,8050H	Load the destination address
F010	77		MOV M,A	Store the result
F011	23		INX H	Point to next location
F012	71		MOV M,C	Store the borrow
F013	76		HLT	Terminate the program

Output

first output

Address	Data
…	…
8050	1B
8051	00
…	…

second output

Address	Data
…	…
8050	54
8051	01
…	…

8085 program to add two 16 bit numbers

Problem Statement

Write8085 Assembly language program to add two 16-bit number stored in memory location 8000H – 8001H and 8002H – 8003H.

Discussion

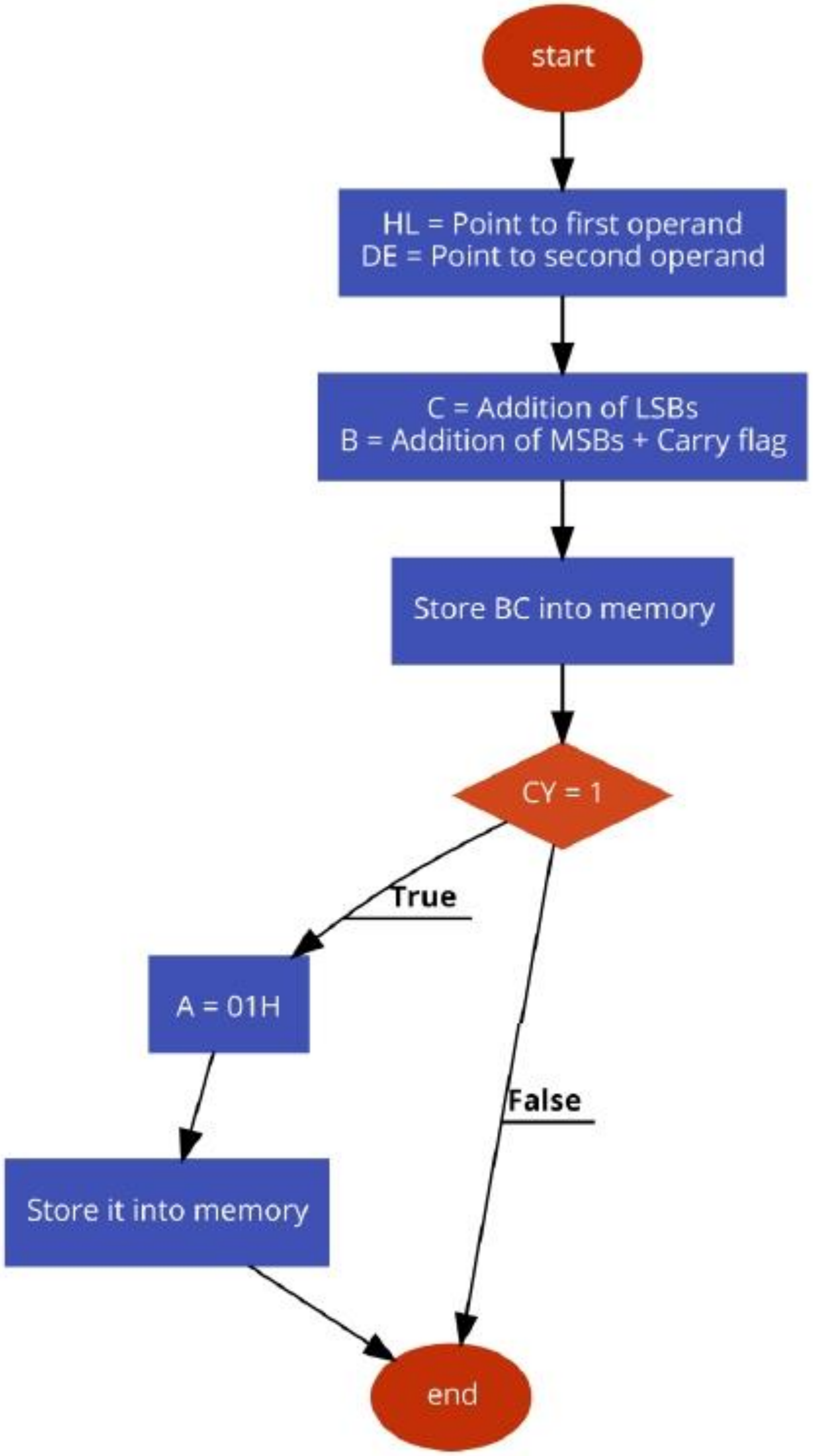
In this program we are pointing the operand addresses using HL and DE register pair. Then adding LSBytes by ADD operator, and after that adding MSBytes using ADC operator to consider the carry flag result. The 16-bit result will be stored at BC register, and by checking the carry bit after addition we can simply put 1 into memory.

We are taking two numbersBCAD + FE2D = 1BADA

Input

Address	Data
...	...
8000	AD
8001	BC
8002	2D
8003	FE
...	...

Flow Diagram



Program

Address	HEX Codes	Labels	Mnemonics	Comments
F000	21, 00, 80		LXI H,8000H	Point to LSB of first operand
F003	11, 02, 80		LXI D,8002H	Point to LSB of second address
F006	1A		LDAX D	Load Acc with content pointed by DE
F007	86		ADD M	Add memory element pointed by HL with Acc
F008	4F		MOV C, A	Store LSB result at C
F009	23		INX H	Point to next byte of first operand
F00A	13		INX D	Point to next byte of second operand
F00B	1A		LDAX D	Load Acc with content pointed by DE
F00C	8E		ADC M	Add memory element pointed by HL with Acc+ Carry
F00D	47		MOV B,A	Store the MSB at B
F00E	60		MOV H,B	Move B to H

Address	HEX Codes	Labels	Mnemonics	Comments
F00F	69		MOV L,C	Move C to L
F010	22, 50, 80		SHLD 8050H	Store the result at 8050H and 8051H
F013	D2, 1B, F0		JNC DONE	Skip to end
F016	3E, 01		MVI A, 01H	Load 1 to Acc
F018	32, 52, 80		STA 8052H	Store Acc content into 8052H
F01B	76	DONE	HLT	Terminate the program

Output

Address	Data
...	...
8050	DA
8051	BA
8052	01
...	...

8085 program to subtract two 8-bit numbers with or without borrow

Problem – Write a program to subtract two 8-bit numbers with or without borrow where first number is at **2500** memory address and second number is at **2501** memory address and store the result into **2502** and borrow into **2503** memory address.

Algorithm –

1. Load 00 in a register C (for borrow)
2. Load two 8-bit number from memory into registers
3. Move one number to accumulator
4. Subtract the second number with accumulator
5. If borrow is not equal to 1, go to step 7
6. Increment register for borrow by 1
7. Store accumulator content in memory
8. Move content of register into accumulator
9. Store content of accumulator in other memory location
10. Stop

Program –

MEMORY	MNEMONICS	OPERANDS	COMMENT
2000	MVI	C, 00	[C] <- 00
2002	LHLD	2500	[H-L] <- [2500]
2005	MOV	A, H	[A] <- [H]
2006	SUB	L	[A] <- [A] – [L]
2007	JNC	200B	Jump If no borrow
200A	INR	C	[C] <- [C] + 1
200B	STA	2502	[A] -> [2502], Result

MEMORY	MNEMONICS	OPERANDS	COMMENT
200E	MOV	A, C	[A] <- [C]
2010	STA	2503	[A] -> [2503], Borrow
2013	HLT		Stop

Explanation – Registers A, H, L, C are used for general purpose:

1. **MOV** is used to transfer the data from memory to accumulator (1 Byte)
2. **LHLD** is used to load register pair directly using 16-bit address (3 Byte instruction)
3. **MVI** is used to move data immediately into any of registers (2 Byte)
4. **STA** is used to store the content of accumulator into memory(3 Byte instruction)
5. **INR** is used to increase register by 1 (1 Byte instruction)
6. **JNC** is used to jump if no borrow (3 Byte instruction)
7. **SUB** is used to subtract two numbers where one number is in accumulator(1 Byte)
8. **HLT** is used to halt the program

8085 program to find 1's and 2's complement of 8-bit number

Last Updated: 03-10-2018

Problem – Write a program to find 1's and 2's complement of 8-bit number where starting address is **2000** and the number is stored at **3000** memory address and store result into **3001** and **3002** memory address.

Algorithm –

1. Load the data from memory 3000 into A (accumulator)
2. Complement content of accumulator
3. Store content of accumulator in memory 3001 (1's complement)
4. Add 01 to Accumulator content
5. Store content of accumulator in memory 3002 (2's complement)
6. Stop

Program –

MEMORY	MNEMONICS	OPERANDS	COMMENT
2000	LDA	[3000]	[A] <- [3000]
2003	CMA		[A] <- [A^]

MEMORY	MNEMONICS	OPERANDS	COMMENT
2004	STA	[3001]	1’s complement
2007	ADI	01	[A] <- [A] + 01
2009	STA	[3002]	2’s complement
200C	HLT		Stop

Explanation –

1. **A** is an 8-bit accumulator which is used to load and store the data directly
2. **LDA** is used to load accumulator direct using 16-bit address (3 Byte instruction)
3. **CMA** is used to complement content of accumulator (1 Byte instruction)
4. **STA** is used to store accumulator direct using 16-bit address (3 Byte instruction)
5. **ADI** is used to add data into accumulator immediately (2 Byte instruction)
6. **HLT** is used to halt the program

8085 program to find 1’s and 2’s complement of 16-bit number

Problem – Write a program to find 1’s and 2’s complement of 16-bit number where starting address is **2000** and the number is stored at **3000** memory address and store result into **3002** and **3004** memory address.

Algorithm –

1. Load a 16-bit number from memory 3000 into a register pair (H-L)
2. Move content of register L to accumulator
3. Complement content of accumulator
4. Move content of accumulator to register L
5. Move content of register H to accumulator
6. Complement content of accumulator
7. Move content of accumulator to register H
8. Store content of register pair in memory 3002 (**1’s** complement)
9. Increment content of register pair by 1
10. Store content of register pair in memory 3004 (**2’s** complement)
11. Stop

Program –

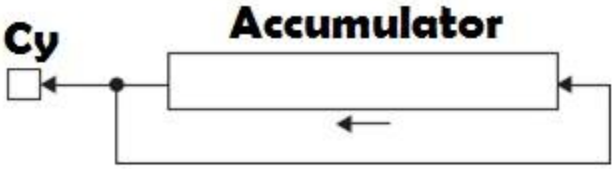
MEMORY	MNEMONICS	OPERANDS	COMMENT
2000	LHLD	[3000]	[H-L] <- [3000]
2003	MOV	A, L	[A] <- [L]
2004	CMA		[A] <- [A^]
2005	MOV	L, A	[L] <- [A]
2006	MOV	A, H	[A] <- [H]
2007	CMA		[A] <- [A^]
2008	MOV	H, A	[H] <- [A]
2009	SHLD	[3002]	1’s complement
200C	INX	H	[H-L] <- [H-L] + 1
200D	SHLD	[3004]	2’s complement
2010	HLT		Stop

Explanation –

1. **A** is an 8-bit accumulator which is used to load and store the data
2. **LHLD** is used to load register pair H-L direct using 16-bit address (3 Byte instruction)
3. **MOV** is used to transfer the data from accumulator to register(any) or register(any) to accumulator (1 Byte)
4. **CMA** is used to complement content of accumulator (1 Byte instruction)
5. **SHLD** is used to store data from register pair H-L into memory direct using 16-bit address (3 Byte instruction)
6. **INX** is used to increase H-L register pair by 1 (1 Byte instruction)
7. **HLT** is used to halt the program

Instruction type RLC in 8085 Microprocessor

In 8085 Instruction set, there is one mnemonic **RLC** stands for “Rotate Left Accumulator”. It rotates the Accumulator contents to the left by 1-bit position. The following Fig. shows the operation explicitly.



In this fig. it has been depicted that the most significant bit of the Accumulator will come out and left rotate will create an empty space at the least significant bit place and this come out bit will be copied at the empty bit place and also on the Cy bit in the flag register. Thus, Cy flag gets a copy of the bit moved out from the MS bit position. Notice that Cy flag is not involved in the rotation, and it is only 8-bit rotation of Accumulator contents. Only Cy flag is affected by this instruction execution.

Mnemonics, Operand	Opcode(in HEX)	Bytes
RLC	07	1

This instruction can be used in following different case studies.

- To check whether the number is positive or negative. As the most significant of the Accumulator content holds the sign bit.
- To perform multiplication by 2, rotate the Accumulator to left. It works correctly for unsigned numbers, as long as the MS bit of Accumulator is a 0 before rotation. As we know that multiplication by 2^n results n-bit left shift of the number.

Let us discuss some examples on this mnemonic usage.

Example 1

```
35H --->    0011 0101
          0 0110 1010 ---> 6AH
```

	Before	After
(A)	35H	6AH

(Cy)	Any value	0

Address	Hex Codes	Mnemonic	Comment
2002	07	RLC	Rotate Left Accumulator

Here the accumulation content has been doubled as we had 1-bit left shift and the MSB was 0.

8085 program to find maximum of two 8 bit numbers

Problem – Write a assembly language program to find maximum of two 8 bit numbers in 8085 microprocessor.
Assumptions – Starting memory locations and output memory locations are 2050, 2051 and 3050 respectively.
Algorithm –

1. Load value in the accumulator
2. Then, copy the value to any of the register
3. Load next value in the accumulator
4. Compare both values
5. Check carry flag, if reset then jump to the required address to store the value
6. Copy the result in the accumulator
7. Store the result at the required address

Program –

MEMORY ADDRESS	MNEMONICS	COMMENTS
2000	LDA 2050	A<-25
2003	MOV B, A	B<-25
2004	LDA 2051	A<-15

MEMORY		
ADDRESS	MNEMONICS	COMMENTS
2007	CMP B	A-B
2008	JNC 200C	Jump if Carry flag is Reset(Carry flag = 0)
200B	MOV A, B	A<-25
200C	STA 3050	3050<-25
200F	HLT	Terminates the program

Explanation –

1. **LDA 2050:** loads value at memory location 2050
2. **MOV B, A:** assigns value of A to B
3. **LDA 2051:** loads value at memory location 2051
4. **CMP B:** compare values by subtracting B from A
5. **JNC 200C:** jump at memory location 200C if carry flag is Reset(Carry flag = 0)
6. **STA 3050:** store result at memory location 3050
7. **HLT:** terminates the program

Assembly language program to find largest number in an array

Problem – Determine largest number in an array of n elements. Value of n is stored at address 2050 and array starts from address 2051. Result is stored at address 3050. Starting address of program is taken as 2000.

Algorithm –

1. We are taking first element of array in A
2. Comparing A with other elements of array, if A is smaller then store that element in A otherwise compare with next element
3. The value of A is the answer

Program –

MEMORY ADDRESS	MNEMONICS	COMMENT
2000	LXI H 2050	H←20, L←50
2003	MOV C, M	C←M
2004	DCR C	C←C-01
2005	INX H	HL←HL+0001
2006	MOV A, M	A←M
2007	INX H	HL←HL+0001
2008	CMP M	A-M
2009	JNC 200D	If Carry Flag=0, goto 200D
200C	MOV A, M	A←M
200D	DCR C	C←C-1
200E	JNZ 2007	If Zero Flag=0, goto 2007
2011	STA 3050	A→3050
2014	HLT	

Explanation – Registers used: **A, H, L, C**

1. **LXI 2050** assigns 20 to H and 50 to L
2. **MOV C, M** copies content of memory (specified by HL register pair) to C (this is used as a counter)
3. **DCR C** decrements value of C by 1

4. **INX H** increases value of HL by 1. This is done to visit next memory location
5. **MOV A, M** copies content of memory (specified by HL register pair) to A
6. **INX H** increases value of HL by 1. This is done to visit next memory location
7. **CMP M** compares A and M by subtracting M from A. **Carry flag and sign flag becomes set if A-M is negative**
8. **JNC 200D** jumps program counter to 200D if carry flag = 0
9. **MOV A, M** copies content of memory (specified by HL register pair) to A
10. **DCR C** decrements value of C by 1
11. **JNZ 2007** jumps program counter to 2007 if zero flag = 0
12. **STA 3050** stores value of A at 3050 memory location
13. **HLT** stops executing the program and halts any further execution

8085 program to find the sum of a series

Problem – Write a program to find the sum of a series where series starts from **3001**memory address and count of series is at **3000** memory address where starting address of the given program is **2000** store result into **4000** memory address.

Algorithm –

1. Move 00 to register B immediately for carry
2. Load the data of memory [3000] into H immediately
3. Move value of memory into register C
4. Decrease C by 1
5. Increase H-L pair by 1
6. Move value of memory into accumulator
7. Increase H-L pair by 1
8. Add value of memory with accumulator
9. Jump if no carry to step 11
10. Increase value of register B by one
11. Decrease register C by 1
12. Jump if not zero to step-7
13. Store content of accumulator into memory [4000] (**result**)
14. Move content of register B into accumulator
15. Store content of accumulator into memory [4001] (**carry**)
16. Stop

Program –

MEMORY	MNEMONICS	OPERANDS	COMMENT
2000	MVI	B, 00	[B] <- 00
2002	LXI	H, [3000]	[H-L] <- [3000]

MEMORY	MNEMONICS	OPERANDS	COMMENT
2005	MOV	C, M	[C] <- [M]
2006	DCR	C	[C] <- [C] – 1
2007	INX	H	[H-L] <- [H-L] + 1
2008	MOV	A, M	[A] <- [M]
2009	INX	H	[H-L] <- [H-L] + 1
200A	ADD	M	[A] <- [A] + [M]
200B	JNC	200F	jump if no carry
200E	INR	B	[B] <- [B] + 1
200F	DCR	C	[C] <- [C] – 1
2010	JNZ	2009	jump if not zero
2013	STA	[4000]	result
2016	MOV	A, B	[A] <- [B]
2017	STA	[4001]	carry
201A	HLT		Stop

Explanation – Registers A, B, C, H are used for general purpose.

1. **MVI** is used to load an 8-bit given register immediately (2 Byte instruction)
2. **LXI** is used to load register pair immediately using 16-bit address (3 Byte instruction)
3. **MOV** is used to transfer the data from accumulator to register(any) or register(any) to accumulator (1 Byte)

4. **RAR** is used to shift ‘A’ right with carry (1 Byte instruction)
5. **STA** is used to store data from accumulator into memory direct using 16-bit address (3 Byte instruction)
6. **INR** is used to increase given register by 1 (1 Byte instruction)
7. **JNC** is used to jump to the given step if their is no carry (3 Byte instruction)
8. **JNZ** is used to jump to the given step if their is not zero (3 Byte instruction)
9. **DCR** is used to decrease given register by 1 (1 Byte instruction)
10. **INX** is used to increase register pair by 1 (1 Byte instruction)
11. **ADD** is used to add value of accumulator with the given value (1 Byte instruction)
12. **HLT** is used to halt the program

8085 Program to multiply two 8-bit numbers (shift and add method)

Problem Statement:

Write 8085 Assembly language program to multiply two 8-bit numbers using shift and add method.

Discussion:

The shift and add method is an efficient process. In this program, we are taking the numbers from memory location 8000H and 8001H. The 16 bit results are storing into location 8050H onwards.

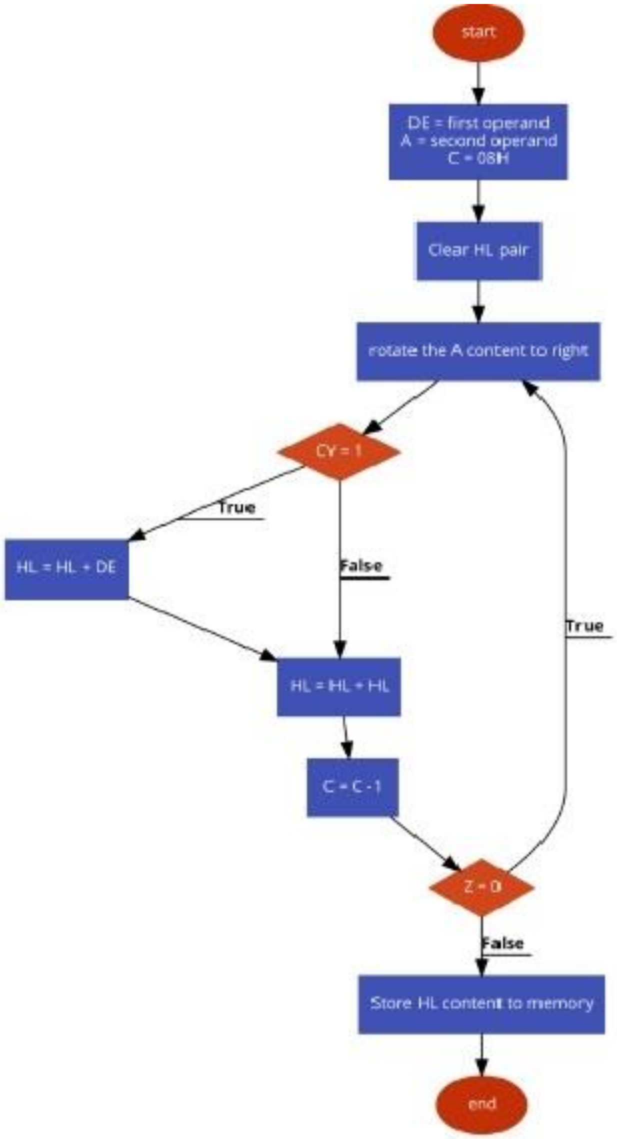
In this method we are putting the first number into DE register pair. The actual number is placed at E register, and D is holding 00H. The second number is taken into A. As the numbers are 8-bit numbers, then we are shifting the Accumulator contents eight times. When the carry flag is set while rotating, then the DE content is added with HL. Initially HL pair will hold 0000H. Then HL is also added with HL itself. Thus the result will be generated.

Input:

Address	Data
. **.** **.**	. . .
8000	25

Address	Data
8001	2A
. **.** **.**	. . .

Flow Diagram:



Program:

Address	**HEX Codes**	**Labels**	**Mnemonics**	**Comments**
F000	21, 00, 80		LXI H,8000H	Point to first operand
F003	5E		MOV E,M	Load the first operand to E
F004	16, 00		MVI D,00H	Clear the register D
F006	23		INX H	Point to next location
F007	7E		MOV A,M	Get the next operand
F008	0E, 08		MVI C,08H	Initialize counter with 08H
F00A	21, 00, 00		LXI H, 0000H	Clear the HL pair
F00D	0F	LOOP	RRC	Rotate the acc content to right
F00E	D2, 12, F0		JNC SKIP	If carry flag is 0, jump to skip
F011	19		DAD D	Add DE with HL
F012	EB	SKIP	XCHG	Exchange DE and HL
F013	29		DAD H	Add HL with HL itself
F014	EB		XCHG	Exchange again the contents of

Address	HEX Codes	Labels	Mnemonics	Comments
				DE and HL
F015	0D		DCR C	Decrease C register
F016	C2, 0D, F0		JNZ LOOP	if Z = 0, jump to LOOP
F019	22, 50, 80		SHLD 8050H	Store the result
F01C	76		HLT	Terminate the program

Output:

Address	Data
. . .	. . .
8050	12
8051	06
. . .	. . .

8085 Program to Divide two 8 Bit numbers

Problem Statement

Write 8085 Assembly language program to divide two 8-bit numbers and store the result at locations **8020H** and **8021H**.

Discussion

The 8085 has no division operation. To get the result of the division, we should use the repetitive subtraction method.

By using this program, we will get the quotient and the remainder. 8020H will hold the quotient, and 8021H will hold the remainder.

We are saving the data at location 8000H and 8001H. The result is storing at location 8050H and 8051H.

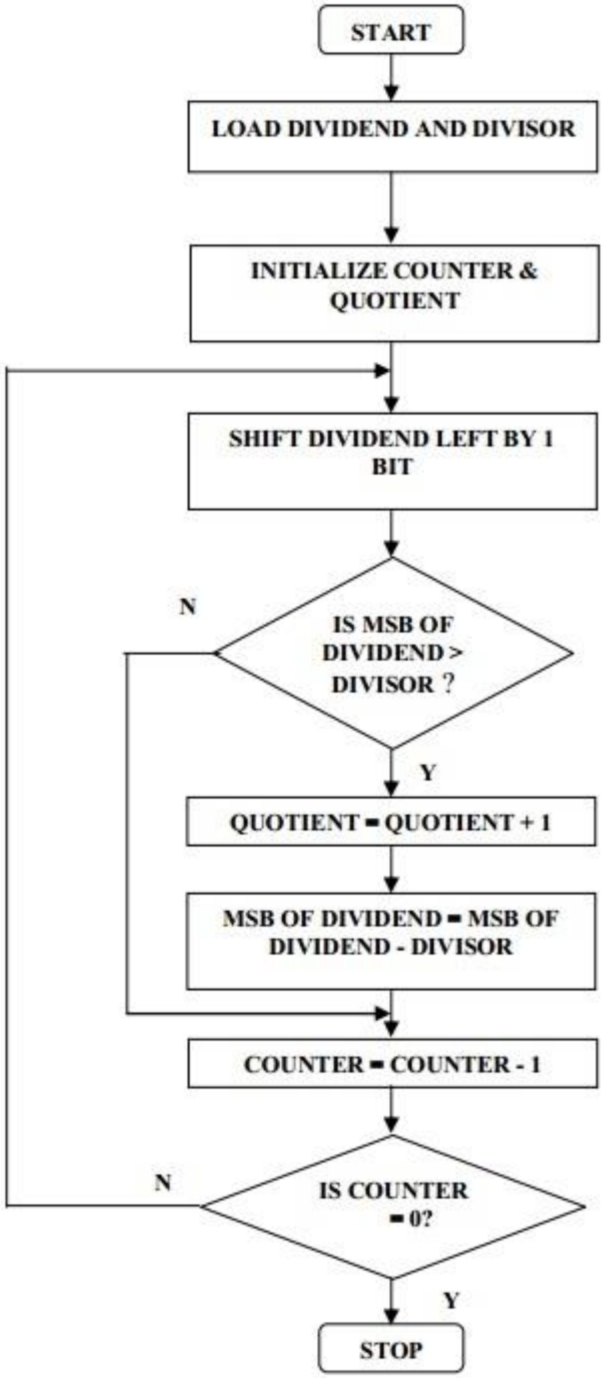
Input

```
The Dividend: 0EH

The Divisor 04H

The Quotient will be 3, and the remainder will be 2
```

Flow Diagram


START
LOAD DIVIDEND AND DIVISOR
INITIALIZE COUNTER & QUOTIENT
SHIFT DIVIDEND LEFT BY 1 BIT
IS MSB OF DIVIDEND > DIVISOR ?
N
Y
QUOTIENT = QUOTIENT + 1
MSB OF DIVIDEND = MSB OF DIVIDEND - DIVISOR
COUNTER = COUNTER - 1
IS COUNTER = 0?
N
Y
STOP

Program

Address	HEX Codes	Labels	Mnemonics	Comments
F000	21,0E, 00	START	LXIH,0CH	Load 8-bit dividend in HL register pair
F003	06,04		MVIB,04H	Load divisor in B to perform num1 / num2
F005	0E,08		MVIC, 08	Initialize the counter
F007	29	UP	DADH	Shifting left by 1 bit HL = HL + HL
F008	7C		MOVA, H	Load H in A
F009	90		SUB B	perform A = A – B
F00A	DA,0F, F0		JC DOWN	If MSB < divisor then shift to left
F00D	67		MOVH, A	If MSB > divisor, store the current value of A in H
F00E	2C		INR L	Tracking quotient
F00F	0D	DOWN	DCRC	Decrement the counter
F010	C2,07, F0		JNZ UP	If not exhausted then go again
F013	22,20,		SHLD 8020	Store the result at 8020 H

Address	HEX Codes	Labels	Mnemonics	Comments
	80			
F016	76		HLT	Stop

Output

Address	Data
. . .	. . .
8020	03
8021	02
. . .	. . .