Experiment-3:

August 25, 2020.

Aim: Subtraction of two 8 bit numbers:
a) First number is greater than second.
b) First number is less than second number

Software Used: GNUsim 8085.

Theory: The Intel 8085 is an 8-bit processor produced by Intel and introduced in March 1976. It is a software binary comp. with the more famous Intel 8080 with only 2 minor inst. added to support its added interrupt & serial I/O features.

The Programmer writes a program in assembly lang using these instructions. These instructions have been classified into following groups:

1. DATA Transfer Group:
   Ex: MOV, MVI, LXI, LDA, STA

2. ARITHMETIC GROUP:
   Ex: ADD, SUB, INR, DAD.

3. LOGICAL GROUP:
   Ex: ANA, XRA, ORA, CMP & RAL.

4. BRANCH CONTROL GROUP:
   Ex: JMP, JC, JZ, CALL, CZ, RST

5. I/O & Machine Control Group:
   Ex: IN, OUT, PUSH, POP, & HLT.

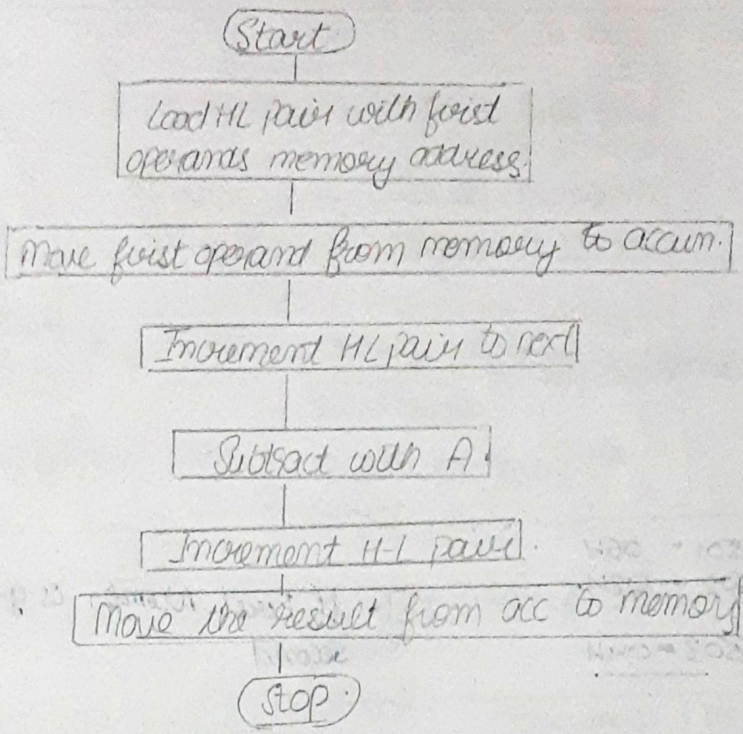
ALGORITHM:-

1. First number is greater than second number.
   - Get address of 1st number in H-L Pair
   - 1st number in accumulator
   - Content of H-L pair increases from 2501 to 2502H.
   - 1st number - 2nd number.
   - Content of H-L pair becomes 2503H.
   - Stored Result in 2503H.
   - HLT.

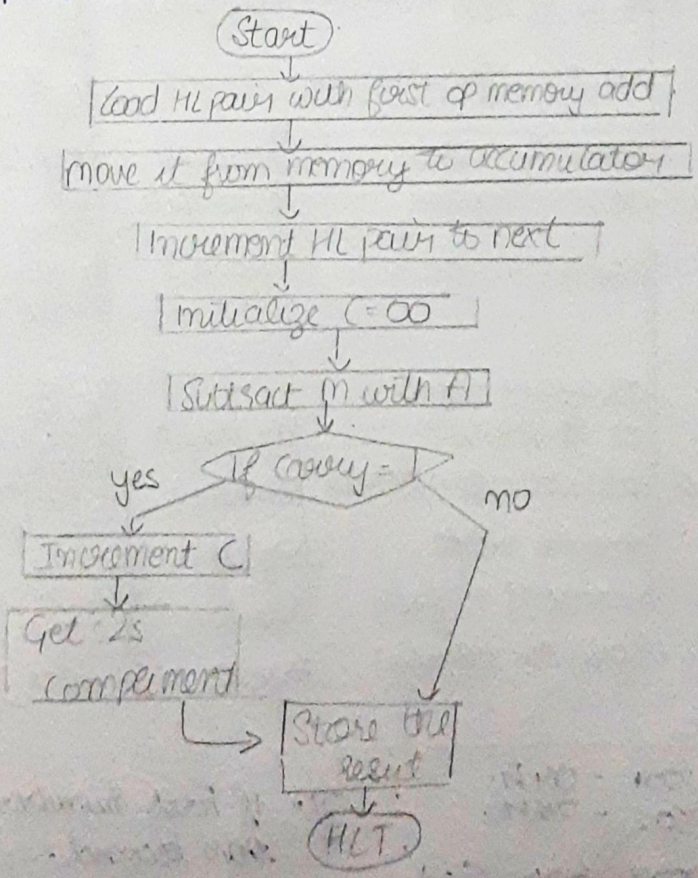
2. First number is less than second number.
   - Clear reg C to store Sign bit
   - Get the first no. from memory location
   - Get the second no. from memory location
   - Subtract second no. from first no.
   - If carry equal one,
   - Then increment reg C,
   - Get 2's complement result & store the result.
   - Else.
   - Store the result.
   - Halt.

Flow Chart:

1° First number is greater than second number



2° First number is less than second number.



Program & Output.

Address	Mnemonic	Operand	Comments	Addressing mode	Machine Cycle	T-States
2000	LXI H	2501H	Load HL pair with address 2501 H	Immediate	op fetch + 2 mem read	10
2003	MOV A,M		Move first operand from mem to accumulator	Indirect	op fetch + mem read	7
2004	INX H		Increment HL pair	Register	op fetch	6
2005	SUB M		Subtract M with A	Register	op fetch + mem read	7
2006	INX		Increment HL pair	Register	op fetch	6
2007	MOV M,A		Move from Acc to memory	Indirect	op fetch + mem write	7
2008	HLT		HALT	-	op fetch	4

Output Data: 2501 - 06H
2502 - 02H.

Result: 2503 = 04H

I. If First Number is greater than second.

Address	Mnemonic	operand	Comments	Addressing mode	Machine cycle	T-state
2000	LXI H	2501H	Load HL pair	Immediate	op fetch + 2mem read	10
2003	MOV A,M		Load accumulator with memory	Indirect	op fetch + mem read	7
2004	INX H		Increment HL pair	Register	op fetch	6
2005	MVI C	00H	Clear C register	Immediate	op fetch + memory read	7
2006	SUB M		Subtract M with A	Indirect	op fetch + memory read	7
2007	JNC STORE					
2008	INR C		Increment register C		op code fetch	6
2009	ADI	01	2's compliment	Immediate	op fetch + memory	6
2010	LXI H	2050H	Load destination address	Immediate	op fetch + 2mem read	10
2011	MOV M,A		Store the result	Register	op fetch + mem read	7
2012	INX H		Increment HL pair	Register	op fetch.	6
2013	MOV M,C		Store the Borrow	Register	op fetch	4
2014	HLT					4

Output: Data : 2501 - 04H.
2502 - 06H.

Result: 2503 - 02H C:1

II. If first number is less than second.

Calculation:

Time Required:-

a) First number is greater than second

For 8085: Crystal frequency = 6MHz

Clock frequency = $\frac{\text{Crystal frequency}}{2}$

= 3MHz.

$$T = \frac{1}{3MHz} = 0.333\mu s.$$

Total no. of Tstates = (10+7+6+7+10+4) Tstate

= 44 Tstates

∴ Total Time = $0.333 \times 10^{-6} \times 44$

= 14.652 μs.

b) Total no. of Tstates = 10+7+6+7+7+6+10+7+6+4+4

= 74 states

= 24.642 μs.

Result: The program were written to subtract 2 8bit numbers.