Arithmetic and logical Instructions Related with Memory

Once we transfer date from memory to microprocessor, we can use ordinary arithmetic and logical instructions with them. Beside of these instructions, there is other arithmetic and logical instructions can be applied with data stored in memory if we use HL as pointer, these instructions are:-

No	Inst.	Type	No. of Bytes	Function	Effect
1.	INR M	Arithmetic	1	$M_{HL}= M_{HL} +1$	All but CY
2.	DCR M	Arithmetic	1	$M_{HL}= M_{HL} -1$	All but CY
3.	ADD M	Arithmetic	1	$A=A+ M_{HL}$	ALL
4.	ADC M	Arithmetic	1	$A=A+ M_{HL}+CY$	ALL
5.	SUB M	Arithmetic	1	$A=A-M_{HL}$	ALL
6.	SBB M	Arithmetic	1	$A=A- M_{HL}-CY$	ALL
7.	ANA M	Logical	1	$A=A \text{ AND } M_{HL}$	ALL
8.	ORA M	Logical	1	$A=A \text{ OR } M_{HL}$	ALL
9.	XRA M	Logical	1	$A=A \text{ XOR } M_{HL}$	ALL
10.	CMP M	Logical	1	$A- M_{HL}$	ALL

M: Memory location (byte) pointed by HL then $M= M_{HL}=[HL]$

Example
Increment 5 bytes in memory started at address 2070

Using DE as pointer	Using HL as pointer
``` LXI D,2070 ; DE=2070 MVI C,5 ;C=5 NEXT: LDAX D ; A=[DE] INR A ; A=A+1 STAX D ; [DE]=A INX D ;DE=DE+1 DCR C ; C=C-1 JNZ NEXT HLT ```	``` LXI H,2070 ; HL=2070 MVI C,5 ; C=5 NEXT: INR M ; [HL]=[HL+1 INX H ;HL=HL+1 DCR C ; C=C-1 JNZ NEXT HLT ```

Class Work

1) [2075] = ([2070] + [2072]) or [2074]

Address	HexCode	Label	Opcode	Operands	Comments
2000			LDA	2070	; A=[2070]
2001	70				
2002	20				
2003			MOV	B,A	; B=A=[2070]
2004			LDA	2072	; A=[2072]
2005	72				
2006	20				
2007			ADD	B	; A=A+B
2008			MOV	B,A	; B=A
2009			LDA	2074	; A=[2074]
200A	74				
200B	20				
200C			ORA	B	; A=A OR B
200D			STA	2075	[2075]=A
200E	75				
200F	20				
2010			RST1		; END

OR

Address	HexCode	Label	Opcode	Operands	Comments
2000			LXI	H,2070	; HL=2070
2001	70				
2002	20				
2003			MOV	A,M	; A=M_{HL}=[HL]
2004			INX	H	; HL=HL+1
2005			INX	H	; HL=HL+1
2006			ADD	M	; A=A + M_{HL}
2007			INX	H	; HL=HL+1
2008			INX	H	; HL=HL+1
2009			ORA	M	; A=A OR M_{HL}
200A			INX	H	; HL=HL+1
200B			MOV	M,A	; [HL]=M_{HL} =A
200C			RST1		; END

2) Write a program to compare the content of location (2070H) with the content of (2071H).
   - If the content of location (2070H) is greater, make register C contain FFH.
   - If the content of location (2071H) is greater, make register C contain 11H.
   - If they are equal, make register C equal 00H.

Address	HexCode	Label	Opcode	Operands	Comments
2000			LHLD	2070	; L=[2070], H=[2071]
2001	70				
2002	20				
2003			MOV	A,L	; A=L
2004			CMP	H	; A-H
2005			JNC	GROREQ	; IF CY=0 then PC=200B
2006	0B				
2007	20				
2008			MVI	C,11	; C=11
2009	11				
200A			RST1		; END
200B		GROREQ:	JNZ	GRATER	; IF Z=0 then PC=2011
200C	11				
200D	20				
200E			MVI	C,0	; C=0
200F	00				
2010			RST1		; END
2011		GRATER:	MVI	C,FF	; C=FF
2012	FF				
2013			RST1		; END

3) Subtract value 5 from 10 bytes stored in memory in sequence starting at address 2070.

Address	HexCode	Label	Opcode	Operands	Comments
2000			LXI	H,2070	; HL=2070
2001	70				
2002	20				
2003			LXI	B,50A	; BC=50A
2004	0A				
2005	05				
2006		NEXT:	MOV	A,M	; A=M_{HL}=[HL]
2007			SUB	B	; A=A-B=A-5
2008			MOV	M,A	; M_{HL}=A
2009			INX	H	; HL=HL+1
200A			DCR	C	; C=C-1
200B			JNZ	NEXT	; if Z=0 then pc=2006
200C	06				
200D	20				
200E			RST1		; End

4) Exclusive or 5 bytes of memory started at address 2070 and store the result after the last byte.

Address	HexCode	Label	Opcode	Operands	Comments
2000 2001 2002	 70 20		LXI	H,2070	; HL=2070
2003			MOV	A,M	; A=M_{HL}=[HL]
2004			INX	H	; HL=HL+1
2005 2006	 04		MVI	C,4	; C=4
2007		NEXT:	XRA	M	; A=A XOR M_{HL}
2008			INX	H	; HL=HL+1
2009			DCR	C	; C=C-1
200A 200B 200C	 07 20		JNZ	NEXT	; if Z=0 then pc=2007
200D			MOV	M,A	; M_{HL}=[HL]=A
200E			RST1		; End

5) Find the largest byte in a block of data starting at address (2070H). The block length is in memory location (2085H). Store the largest byte in memory location (2086H).

Address	HexCode	Label	Opcode	Operands	Comments
2000 2001 2002	 85 20		LDA	2085	; A=[2085]=No. of bytes
2003			MOV	C,A	; C=A
2004			DCR	C	; C=C-1
2007 2008 2009	 70 20		LXI	H,2070	; HL=2070
200A			MOV	A,M	; A=M_{HL}=[HL]
200B			INX	H	; HL=HL+1
200C		NEXT:	CMP	M	; A-M_{HL}
200D 200E 200F	 11 20		JNC	LESSOREQ	; IF CY=0 then PC=2011
2010			MOV	A,M	; A=M_{HL}=[HL]
2011		LESSOREQ:	INX	H	; HL=HL+1
2012			DCR	C	; C=C-1
2013 2014 2015	 0C 20		JNZ	NEXT	; IF Z=0 then PC=200C
2016 2017 2018	 86 20		STA	2086	; [2086]=A
2019			RST1		; END

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Homework

1) Add (5 numbers stored in memory started at 2070 with 5 numbers stored in memory started at 2080) and the result stored in memory started at 2090
2) Square 5 bytes of memory started at address 2070
3) Write a program to add the following five data bytes stored in memory location starting from (2060H). If the sum generates a carry, stop the addition and store (01H) in memory location (2070H), otherwise, continue adding and store the sum in memory location (2070H). Data: (1a,32,4f,12,27)
4) Write a program to add two (8-bit) numbers, the first number is stored in location (2090H) and the low and high bytes of the address of the second number are stored in locations (2091H), (2092H). Finally store the result at memory location (20A0H).
5) Arrange 10 numbers stored in memory started at 2070 in ascending order