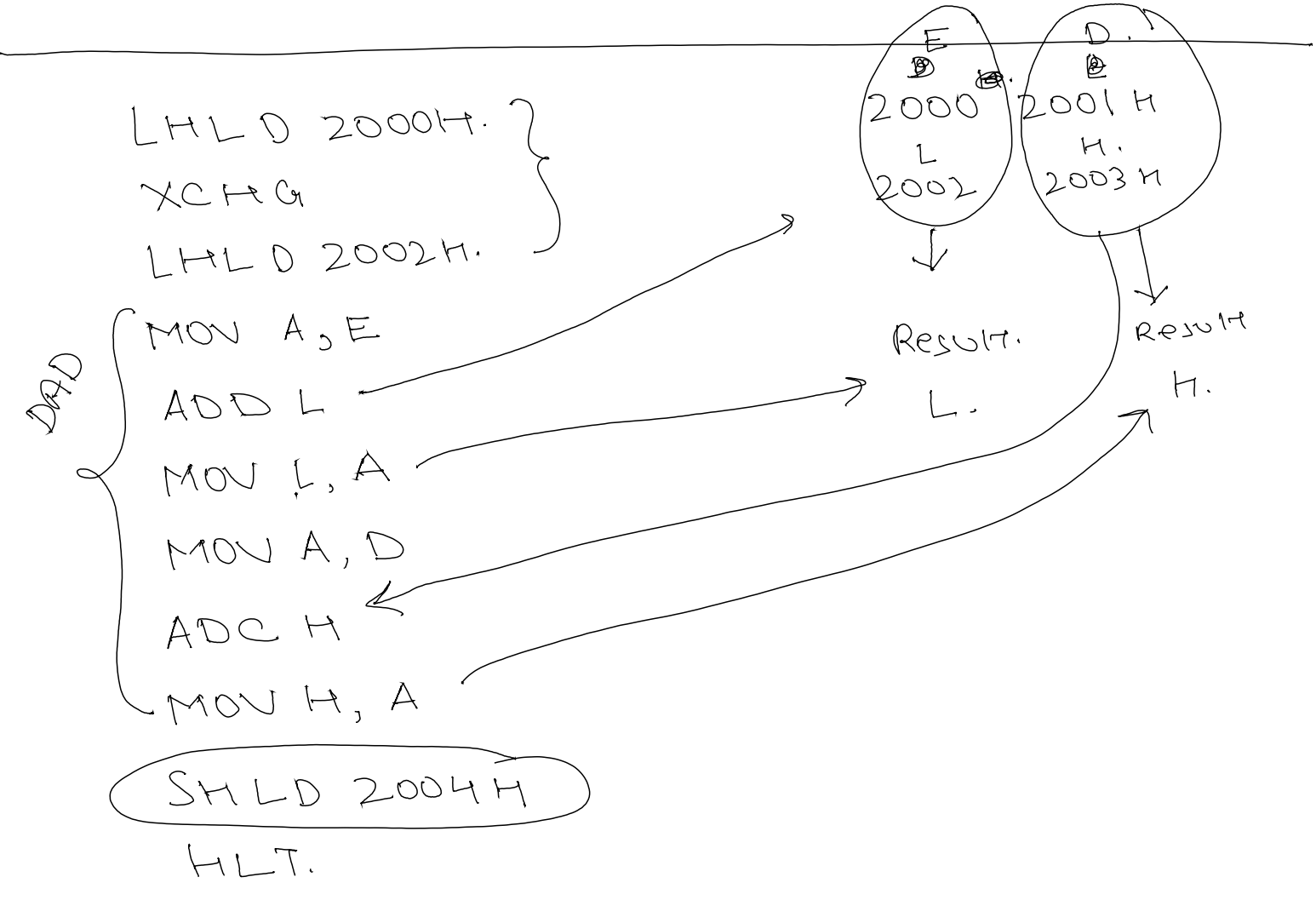
16/11/2021

MICROPROCESSOR

Addition of two 16-bit numbers

Hitesh.

```
LHLD 2000H      →   L ← 2000H    H ← 2001H.
XCHG            →   E ← L        D ← H.
LHLD 2002H      →   L ← 2002H    H ← 2003H.
DAD D           →   HL + DE → HL.
SHLD 3000H      →   L → 3000H.   H → 3001H
HLT.
```



Logic Group

① AND operation.

ANA r → register (A, B, C, D, E, H, L)

ANA M → Memory whose address is pointed by HL reg. pair

ANI 8-bit data → direct data.

{All flags are affected.}

Example ① ANA B

A ← (A) and (B)

↓

and operation

② LXI H, 2000H

ANA M.

A ← (A) AND (2000H)

③ ANI 4FH.

A ← (A) AND 4FH.

(2) ANA A → (A) AND (A) → A

(2) OR operation.

ORA R ORA M ORI 8-bit data.

(3) Ex-OR operation.

XRA R XRA M XRI 8-bit data.

(4) NOT operation

CMA → Complement Accumulator.

$A \leftarrow \overline{A}$ (No Flags are changed)

Example:

MVI A, 2FH.
CMA.
HLT.

} 1's Complement.

A = 0010 1111 $\overline{A}$ = 1101 0000

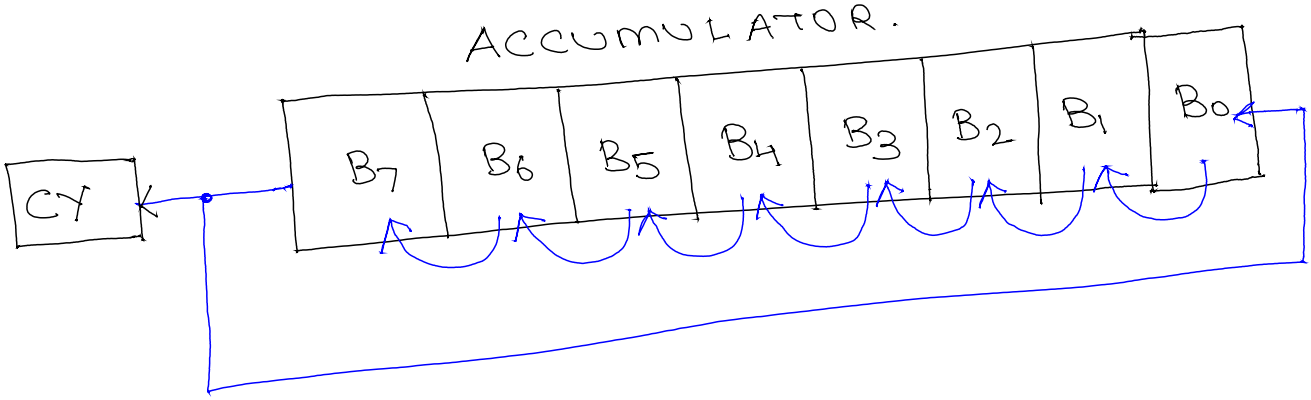
MVI A, 2FH
CMA
ADI 01H
HLT.

} 2's Complement of 2FH.

Rotate Instruction

① RLC ② RRC ③ RAL ④ RAR.

1. RLC → This instruction rotates the content of Accumulator left by one position. Bit B_7 (MSB) is placed in bit B_0 (LSB) as well as CY flag.



For example :

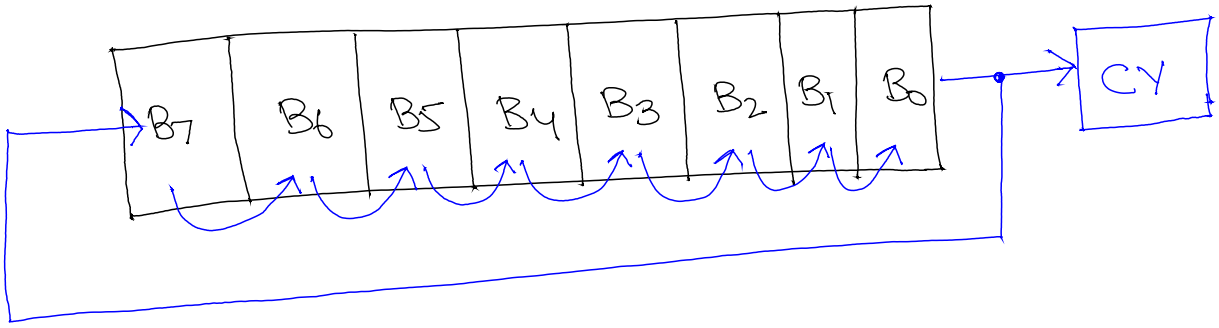
```
MVI A, 57H.
RLC
HLT.
```

A = 0101 0111

A = 1010 1110

CY = 0

(2) RRC → This instruction rotates the content of Accumulator right by one position. Bit B_0 (LSB) is placed in B_7 (MSB) as well as in CY Flag.



Example:

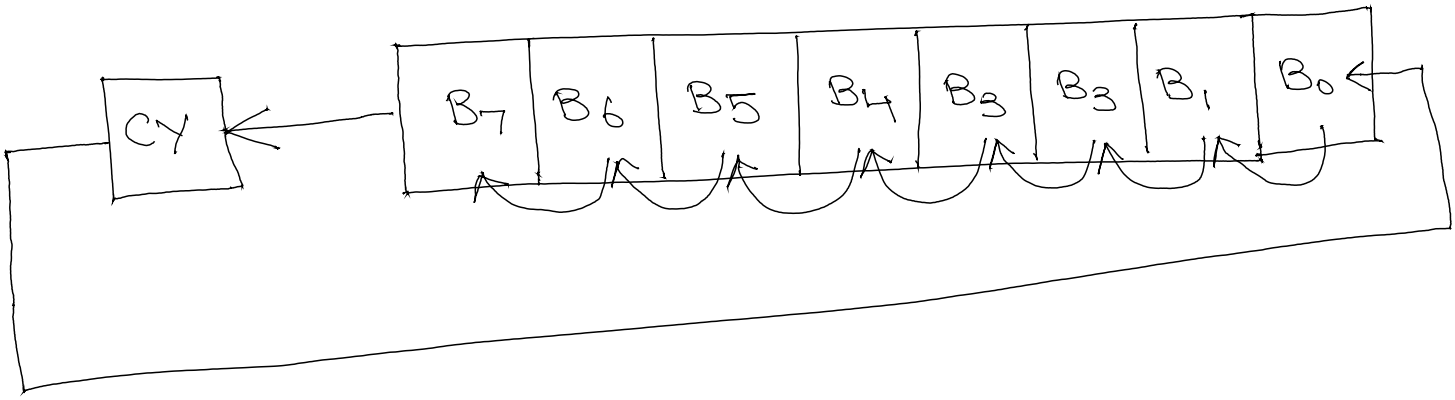
```
MVI A, 9AH.
RRC
HLT.
```

A = 4DH CY = 0

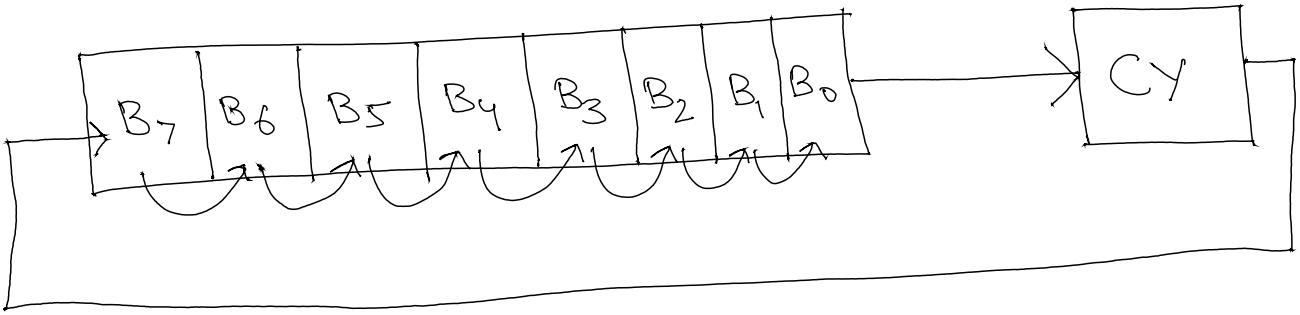
A = 1001 1010 → CY.

A = 0100 1101

(3) RAL → This instruction rotates the content of Accumulator left by one position. Bit B_7 (MSB) is placed in CY flag and CY flag is placed in bit B_0 (LSB).



(4) RAR → This instruction rotates the content of Accumulator right by one position. Bit B_0 (LSB) is placed in CY flag and CY flag is placed in bit B_7 (MSB).



Q Assume A = 9AH and CY = 1. What is the value of A and CY after the following instructions.

CMA
RLC
RLC
RAR
HLT.

Abhinay.

Soln : A = 0011 0100 CY = 0

CMA
BE : A = 1001 1010
AE : $\bar{A}$ = 0110 0101

RLC
BE : A = 0 1 1 0 0 1 0 1
CY = 0
AE : A = 1100 1010

RLC
A = 1001 0101
CY = 1

RAR
A = 1 0 0 1 0 1 0 1 CY

A = 1100 1010 CY = 1

Q6. b.

Rotate instructions finds application in multiplication and division by 2.

0100 → 4 (RRC) ÷2.

0010 → 2 (RRC) ÷2.

0001 → 1 (RLC) ×2.

0010 → 2 (RLC) ×2.

0100 → 4 (RLC) ×2.

1000 → 8