Rotate Instruction in 8086 microprocessor

Rotate instruction means to Place bits right and left inside an operand positions.

The following are some of rotate instructions types to rotate register/memory location values:-

1. **ROL:-** **Ro**tate **L**eft
2. **ROR:-** **Ro**tate **R**ight
3. **RCL:-** **R**otate **C**arry **L**eft
4. **RCR:-** **R**otate **C**arry **R**ight

1. ROL(**Ro**tate **L**eft) Instruction

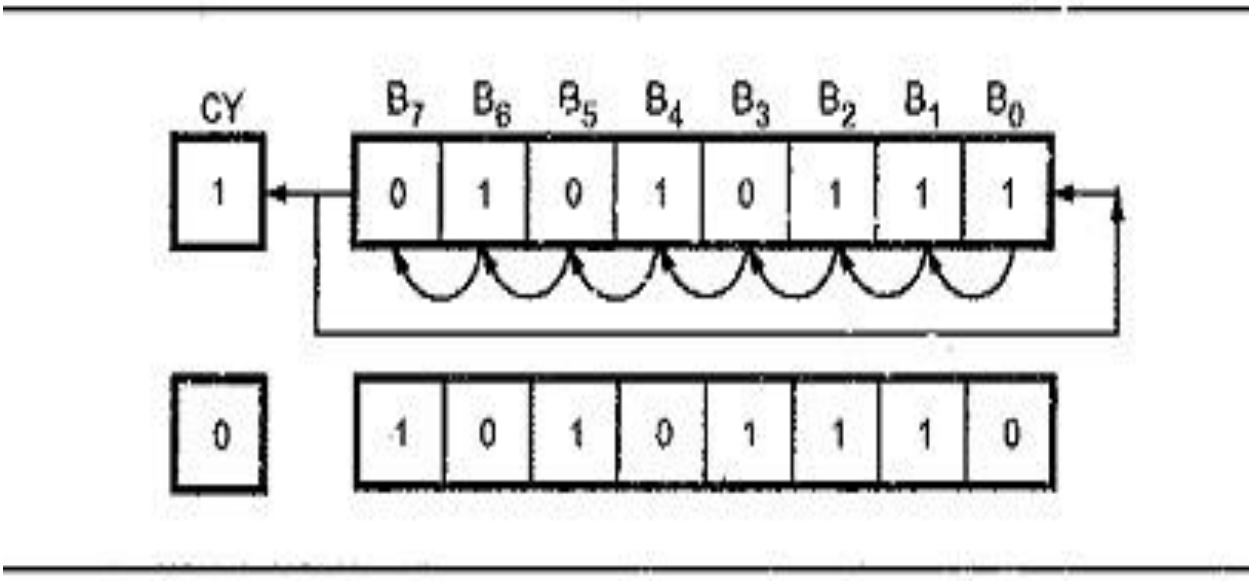
Syntax:

ROL destination, count

This Rotate Instruction in 8086 with example all bits in a specified byte or word to the left some number of bit positions.

- ✓ MSB is placed as a new LSB and a new CF.

Diagram shows ROL instruction for byte rotation.



- ✓ The destination can be a byte or a word. It can be in a register or in a memory location.
- ✓ The number of shifts are indicated by count.

- ✓ If number of shifts required is one you can place 1 in the count position.

- ✓ If number of shifts are greater than 1 then shift count must be loaded in CL register and CL must be placed in the count position of the instruction.

Examples :

```
ROL  CX,  1          ;  Word  in  CX  one  bit  position  left,  MSB  to
                     ;  LSB  and  CF
MOV  CL,  03H        ;  Load desired number of bits to rotate in CL.
ROL  BL,  CL         ;  Rotate  BL  three  positions.
```

2. ROR(**Ro**tate **R**ight) Instruction

Syntax:

ROR destination, count

This Rotate Instruction in 8086 with example all bits in a specified byte or word to the left some number of bit positions.

- ✓ LSB is placed as a new MSB and a new CF.

- ✓ The destination can be a byte or a word.

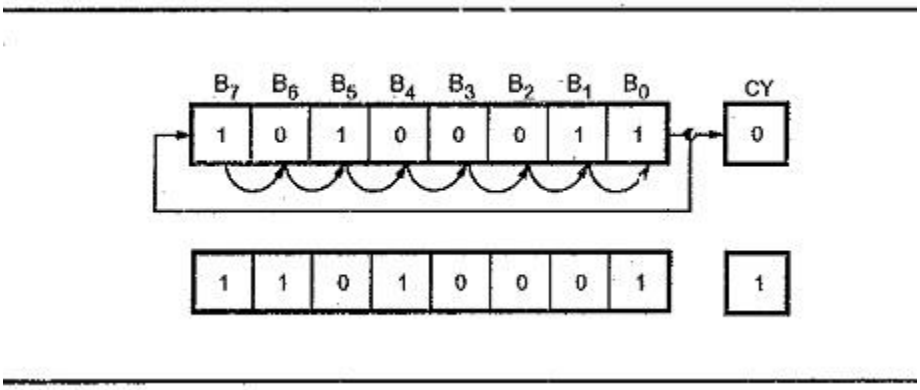
- ✓ It can be in a register or in a memory location.

- ✓ The number of shifts are indicated by count.

- ✓ If number of shifts required is one, you can place 1 in the count position.

- ✓ If number of shifts are greater than 1 then shift count must be loaded in CL register and CL must be placed in the count position of the instruction.

Diagram shows ROR instruction for byte rotation.



Examples :

```
ROR  CX,  1          ;  Rotated word in CX one bit position
                     ;  left, LSB to MSB and CF.
MOV  CL,  03H        ;  Load number of bits to rotate in CL.
ROR  BL,  CL         ;  Rotate BL three positions.
```

3. RCL(**R**otate **C**arry **L**eft) Instruction

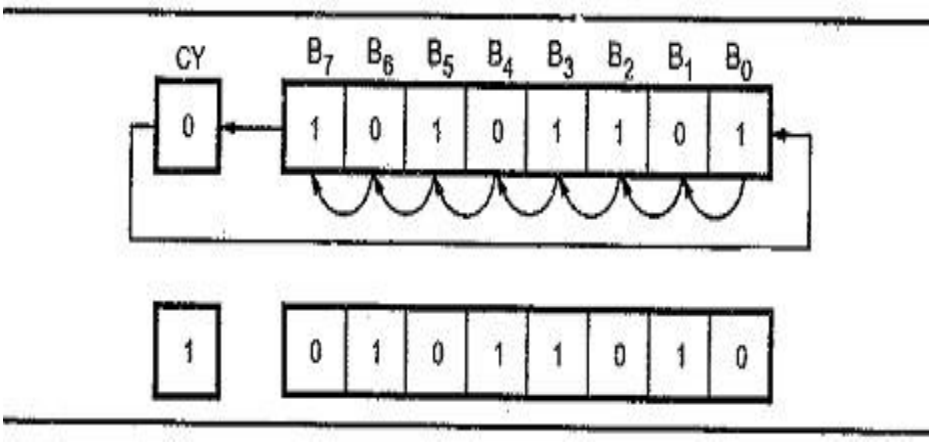
Syntax

RCL destination, count

This Rotate Instruction in 8086 with example all of the bits in a specified word or byte some number of bit positions to the left along with the carry flag.

- ✓ MSB is placed as a new carry and previous carry is placed as a new LSB.
- ✓ The destination can be a byte or a word.
- ✓ It can be in a register or in a memory location.
- ✓ The number of shifts are indicated by count.
- ✓ If number of shifts required is one, you can place 1 in the count position.
- ✓ If number of shifts are greater than 1 then shift count must be loaded in CL register and CL must be placed in the count position of the instruction.

Diagram shows RCL instruction for byte rotation.



Examples :

```
RCL  CX,  1          ;  Rotated word in CX 1 bit left, MSB to
                     ;  CF, CF to LSB.
MOV  CL,  04H        ;  Load number of bit positions to rotate
                     ;  in CL.
RCL  AL;  CL         ;  Rotate AL 4 bits left.
```

4. RCR(**R**otate **C**arry **R**ight) Instruction

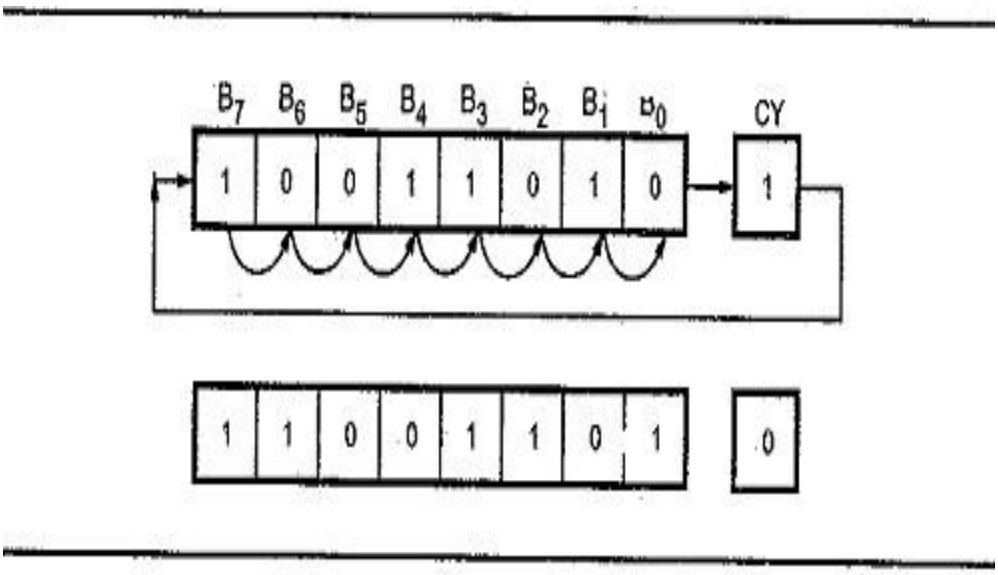
Syntax

RCR destination, count

This Rotate Instruction in 8086 with example all of the bits in a specified word or byte some number of bit positions to the left along with the carry flag.

- ✓ LSB is placed as a new carry and previous carry is placed as a new MSB.
- ✓ The destination can be a byte or a word.
- ✓ It can be in a register or in a memory location.
- ✓ The number of shifts are indicated by count.
- ✓ If number of shifts required is one you can place 1 in the count position.
- ✓ If number of shifts are greater than 1 then shift count must be loaded in CL register and CL must be placed in the count position in the instruction.

Diagram shows RCR instruction for byte rotation.



Examples :

```
RCR  CX,  1    ;  Word in CX 1 bit right, LSB to CF, CF to MSB.
MOV  CL,  04H  ;  Load number of bit positions to rotate in CL.
RCR  AL,  CL   ;  Rotate AL 4 bits right.
```

Shift Instructions in 8086:

Shifting means to move bits right and left inside an operand.

The Shift Instructions in 8086 are follows:-

1. **SAL/SHL:-** **S**hift **A**rithmetic **L**eft/**Sh**ift **L**eft
2. **SHR:-** **Sh**ift **R**ight
3. **SAR :-** **S**hift **A**rithmetic **R**ight

1. SAL/SHL (Shift Arithmetic Left/Shift Left)Instruction:

Syntax:

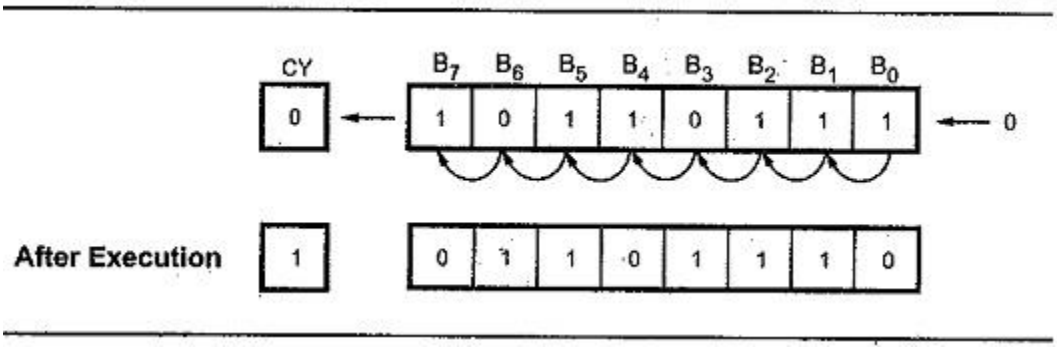
SAL/SHL destination, count

SAL and SHL are two mnemonics for the same instruction.

- ✓ This instruction shifts each bit in the specified destination to the left and 0 is stored at LSB position.

- ✓ The MSB is shifted into the carry flag.
- ✓ The destination can be a byte or a word.
- ✓ It can be in a register or in a memory location.
- ✓ The number of shifts are indicated by count.
- ✓ But if the number of shifts required is one, you can place 1 in the count position.
- ✓ If number of shifts are greater than 1 then shift count must be loaded in CL register and CL must be placed in the count position of the instruction.

Diagram shows SAL instruction for byte operation.



Flags: All flags are affected.

Examples :

```
SAL  CX,  1          ; Shift word in CX 1 bit position
                     ; left, 0 in LSB
MOV  CL,  05H        ; Load desired number of shifts in CL
SAL  AX,  CL         ; Shift word in AX left 5 times
                     ; 0s in 5 least-significant bits.
```

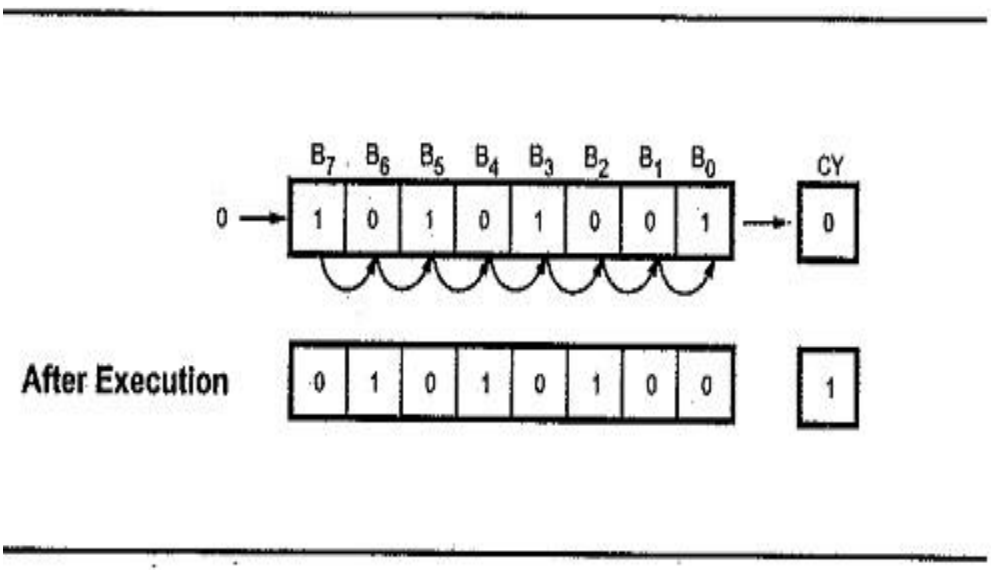
2. SHR (**Sh**ift **R**ight)Instruction:

Syntax:

SHR destination, count

- ✓ This Shift Instructions in 8086 each bit in the specified destination to the right and 0 is stored at MSB position.
- ✓ The LSB is shifted into the carry flag.
- ✓ The destination can be a byte or a word.
- ✓ It can be in a register or in a memory location.
- ✓ The number of shifts are indicated by count.
- ✓ If number of shifts required is one, you can place 1 in the count position.
- ✓ But if the number of shifts are greater than 1 then shift count must be loaded in CL register and CL must be placed in the count position of the instruction.

Diagram shows SHR instruction for byte operation.



- ✓ Flags: All flags are affected.

Examples :

```
SHR CX, 1              ; Shift word in CX 1 bit position
                       ; right, 0 in MSB.
MOV CL, 05H            ; Load desired number of shifts in CL.
SHR AX, CL             ; Shift word in AX right 5 times
                       ; 0's in 5 most significant bits.
```

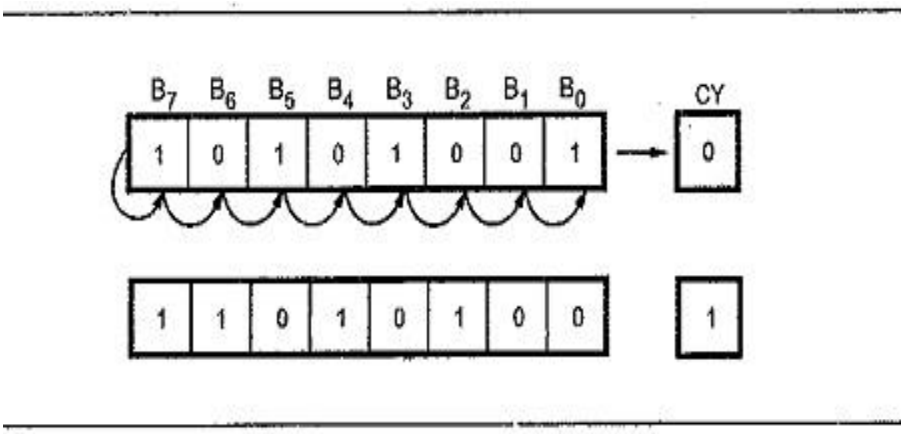
3. SAR(Shift Arithmetic Right) Instruction:

Syntax:

SAR destination, count

- ✓ This Shift Instructions in 8086 each bit in the specified destination some number of bit positions to the right.
- ✓ As a bit is shifted out of the MSB position, a copy of the old MSB is put in the MSB position.
- ✓ The LSB will be shifted into CF.
- ✓ In the case of multiple shifts, CF will contain the bit most recently shifted in from the LSB.
- ✓ Bits shifted into CF previously will be lost.
- ✓ The destination can be a byte or a word.
- ✓ It can be in a register or in a memory location.
- ✓ The number of shifts are, indicated by count.
- ✓ If number of shifts required is one, you can place 1 in the count position.
- ✓ If number of shifts are greater than 1 then shift count must be loaded in CL register and CL must be placed in the count position of the instruction.

Diagram shows SAR instruction for byte operation.



- ✓ Flags: All flags are affected.

Examples :

```
SAR  BL,  1·        ; Shift byte in BL one bit position right.
MOV  CL,  04H       ; Load desired number of shifts in CL.
SAR  DX,  CL        ; Shift word stored in DX 4 bit positions
                    ; right.
```