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EEE 302

Microprocessors and Interfacing

Experiment 3

Rotate, Shift and LOOPs in assembly language

Department of Electrical and Electronic Engineering, EWU

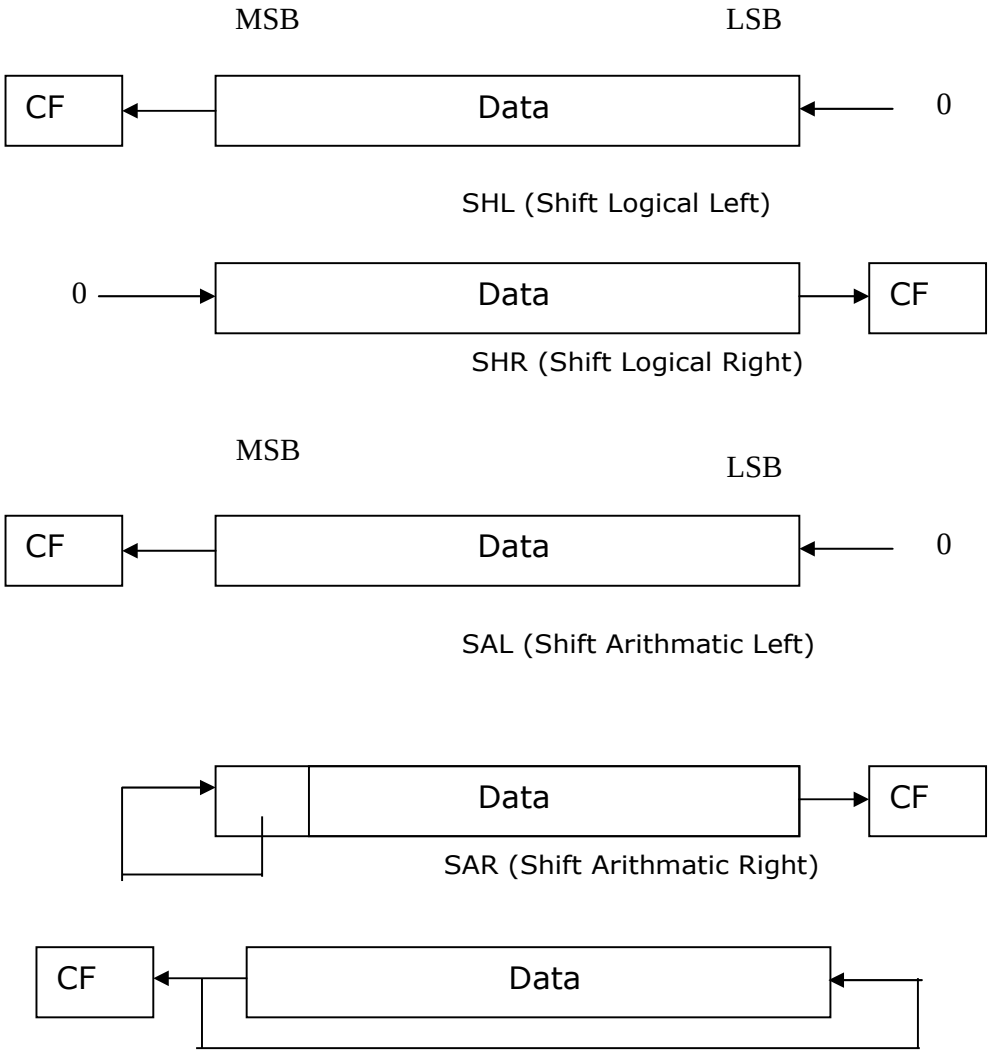
Objective:

To get familiar with Rotate and Shift commands in assembly langiage.
To use loops in complex problems.

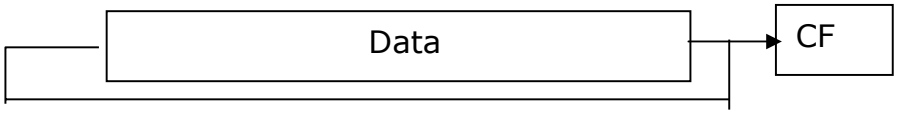
Introduction:

Shift and Rotate command:

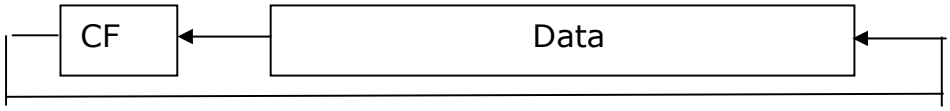
Shift and Rotate commands are used to convert a number to another form where some bits are shifted or rotated. Basic difference between shift and rotate is shift command makes "fall of" bits at the end of register. Where rotate command makes "Wrap around" at the end of the register. There are both arithmatic (SAL and SAR) and logical (SHL and SHR) shift instructions. Graphical operation for these commands are shown below.



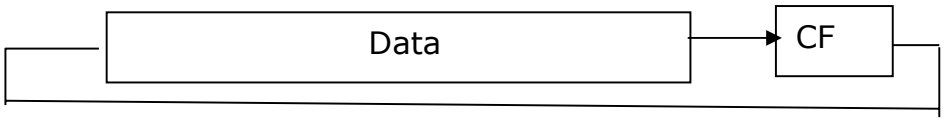
ROL (Rotate Left)



ROR (Rotate Right)



RCL (Rotate Through Carry Left)



RCR (Rotate Through Carry Right)

Some simple codes can be given to clarify the idea.

```
MOV CL,03H          ;
MOV AX,02F3H        ; In binary 0000 0010 1111 0011
SHR AX,CL           ; In binary 0000 0000 0101 1110
```

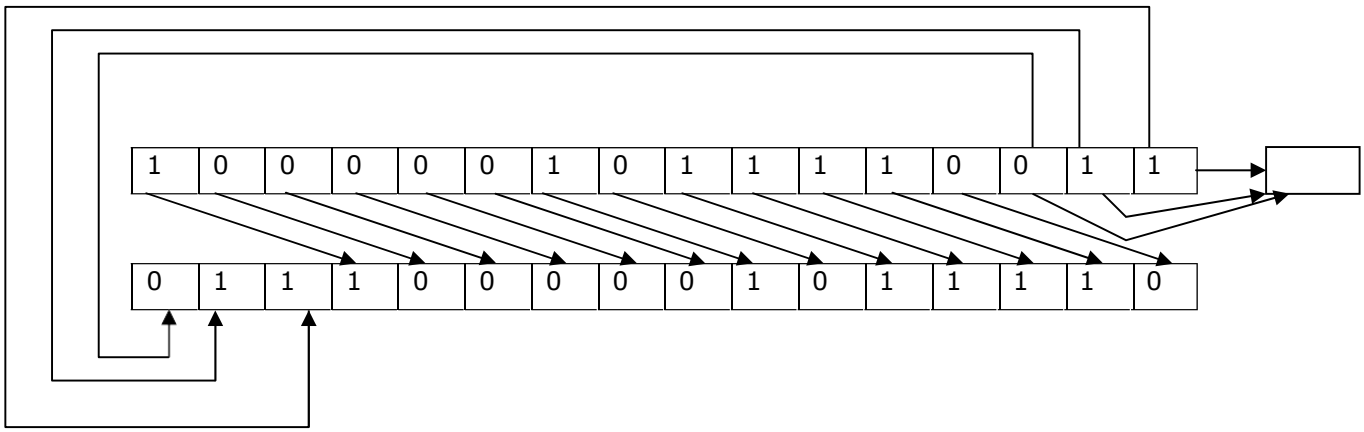
In this procedure, SHR commands inserts 0's from right side. Each time a 0 is inserted left most bit is vanished from register content.

```
MOV CL,03H          ;
MOV AX,82F3H        ; In binary 1000 0010 1111 0011
SAR AX,CL           ; In binary 1111 0000 0101 1110
```

In this procedure, SHR commands inserts MSB content from right side. Each time it is inserted left most bit is vanished from register content.

```
MOV CL,03H          ;
MOV AX,82F3H        ; In binary 1000 0010 1111 0011
ROR AX,CL           ; In binary 0111 0000 0101 1110
```

The whole procedure can be visualized as follows.



Here rotate by 3 operation is shown. It is clearly seen that every bit is assigned to a new position that is 3 places away from previous one. Unlike the shift command no right bit is destroyed. It is placed in the leftmost position.

Exercise part 1:

(a) Program 1:

```
CODE SEGMENT
        ASSUME CS:CODE

        MOV CL,02H
        MOV AX,105AH
        SHL  AX,CL
        HLT

CODE ENDS
        END
```

Obtain AX register value in write the previous value and present value in binary form. What type of operation is this?_____

_____

(b) Program 2:

```
CODE SEGMENT
        ASSUME CS:CODE

        MOV CL,04H
        MOV AX,564AH
        SAL AX,CL
        HLT

CODE ENDS
        END
```

Obtain AX register value in write the previous value and present value in binary form. What type of operation is this?_____

_____

(c) Perform for similar values of AX and CL with ROL, ROR. RCL, RCR command.

LOOP in assembly language:

Loop commands are used to perform same operation again and again. This is like for, while type instructions in 'C' or 'MATLAB'. A common example can be shown as,

```
        MOV CX,0100D
        MOV AX,564AH
  Lev: DEC  AX
        Loop LEV
        HLT
```

Here CX acts as a count register. Loop Lev instruction leads instruction to go back to Lev level until CX is zero. Each time Lev level is executed CX is decreased by 1. Loop command can be used for waiting purposes. Such as,

```
        MOV CX,0100D
   Wt:  NOP
        Loop Wt
        HLT
```

Here the loop is executed until CX is zero. If 1 loop takes 1ms, the program will wait for 100ms.

Exercise part 2:

(a) Program 1:

```
CODE SEGMENT
        ASSUME CS:CODE

        MOV AX,1025H
        MOV BX,475AH
        MOV CX,50H
  Lev: INC AX
        DEC BX
        LOOP Lev
        HLT

CODE ENDS
        END
```

Observe the operation of this code. What happens when the loop is executed again and again.

(b) Program 2: This code is to find GCD of two numbers.

```
CODE SEGMENT
        ASSUME CS:CODE

        MOV AX,5H
        MOV  BX,3H
  Lev: XOR DX,DX
        DIV BX
        MOV AX,BX
        MOV BX,DX
        TEST DX,0H
        JNZ Lev
        HLT
CODE ENDS
        END
```

Here GCD of 5 and 3 are found. You can change the values of AX and BX and obtain the result for any other values. Find GCD of 08D4H and 235H.
Result:_____

(c) Find Least Common Multiplier of 12H and 25H.

Report:

1. Suppose x = 20 and y = 28. Add y with x for 30 times.
2. Multiply 12 by 6 until result is below 3000H. If result is greater than this, divide the result by 2 for 3 times.
3. You can get input into microprocessor via following code.

   ```
   MOV AH, 1H ; keyboard input subprogram
   INT 21H
   HLT
   ```

   Take input from the keyboard until b is pressed.