### 3.4 Compare immediate data with a Register/ Memory location

| | | | Before | After |
|---|---|---|---|---|
| CMP BH, 0FH | | BH | 56H | 56H |
| 56H=0101 0110B | AND | | | |
| | | Temp | 45H | 47H |

CMP basically performs Subtract operation. Result of CMP is not stored in destination. It is stored in Temp register. Temp is not accessible to programmer. Only Flags are affected based result of subtraction.

### 3.4.1 Operand Instructions involving SR and R16/M16

MOV SR, R16/M16

| | | Before | After |
|---|---|---|---|
| MOV DS, CX | DS | 1122H | 2233H |
| | CX | 2233H | |

Note that there is no instruction to load an immediate data to a Segment register.

No. of opcodes = 2 x 4 x (8+24) = 256

| | | Before | After |
|---|---|---|---|
| MOV DS, [BX] | DS | 1122H | 2233H |
| | BX | 2000H | |
| | DS:2000H | 2233H | |

### 3.4.2 Operand Instructions to perform Input operation

IN AL/AX, a8/DX  4 opcodes

| | | Before | After |
|---|---|---|---|
| IN AL, DX | AL | 50H | 45H |
| | DX | 2111H | |
| | Input port no. 2111H | 45H | |

| | | Before | After |
|---|---|---|---|
| IN AL, 30H | AL | 50H | 45H |
| | Input port no. 30H | 45H | |

| | | Before | After |
|---|---|---|---|
| IN AX, DX | AX | 3050H | 4045H |
| | DX | 1177H | |
| | Input port no. 60H | 45H | |
| | Input port no. 61H | 40H | |

**3.4.3 Operand Instructions to perform Output operation**

OUT a8/DX, AL/AX 4 opcodes

| | | Before | After |
|---|---|---|---|
| OUT 30H, AL | AL | 50H | |
| | Out port no. 30H | 40H | 50H |

| | | Before | After |
|---|---|---|---|
| OUT DX, AX | AX | 3050H | |
| | DX | 2177H | |
| | Out port no. 2177H | 45H | 50H |
| | Out port no. 2178H | 40H | 30H |

| | | Before | After |
|---|---|---|---|
| OUT 60H, AX | AX | 3050H | |

| | | |
|---|---|---|
| Out port no. 60H | 45H | 50H |
| Out port no. 61H | 40H | 30H |

**3.4.4 Operand Instructions to perform Shift/Rotate operation**

ROR /ROL /RCR /RCL /SHR /SHL /SAR R/M, 1/CL

7 instructions x (16+48) x 2 = 896 opcodes

SHR and SHL: for shifting left / right unsigned numbers

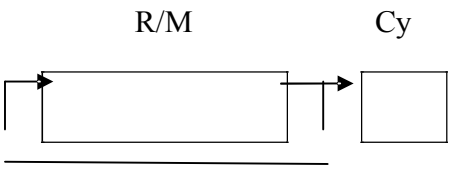
SAR used Shifting right a signed number

SHL is also called as SAL, as method for shift left of signed or unsigned number is the same

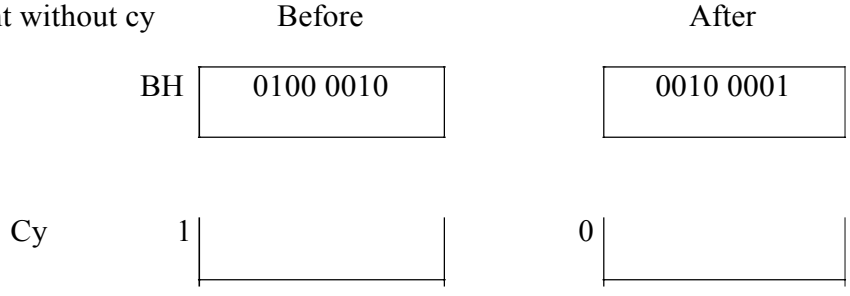
ROR R/M, 1/CL Used for division by power of 2

CL has no. of times rotation is to be done

ROR BH, 1



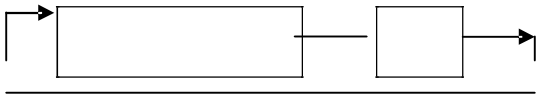

Rotate right without cy




RCR R/M, 1/CL

CL has no. of times rotation is to be done

RCR BH, 1 R/M Cy

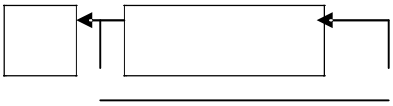


Rotate right with cy

| | Before | After |
|---|---|---|
| BH | 0100 0010 | 1010 0001 |
| Cy | 1 | 0 |

ROL R/M, 1/CL Used for multiplication by $2^n$

ROL BH, CL Cy R/M

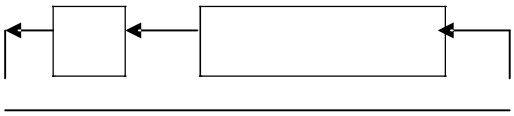


Rotate left without cy

| | ***Before*** | ***After*** |
|---|---|---|
| BH | 0010 0010 | 1000 1000 |
| CL | 02H | |
| Cy | 1 | 0 |

RCL R/M, 1/CL

RCL BH, CL  Cy  R/M



Rotate left with cy

| | ***Before*** | ***After*** |
|---|---|---|
| BH | 0010 0010 | 1000 0010 |
| CL | 02H | |
| Cy | 1 | 0 |

SHL R/M, 1/CL  Used for multiplication by $2^n$

SHL BH, CL  Cy  R/M


Shift left without cy

| | ***Before*** | ***After*** |
|---|---|---|
| BH | 0010 0010 | 1000 1000 |
| CL | 02H | |
| Cy | 1 | 0 |

SHR R/M, 1/CL  Used for division by $2^n$ of unsigned nos

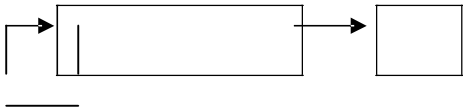
SHR BH, CL  R/M  Cy

Shift right

| | *Before* | *After* |
|---|---|---|
| BH | 0100 0100 | 0001 0001 |
| CL | 02H | |
| Cy | 1 | 0 |

SAR R/M, 1/CL  Used for division by $2^n$ of signed nos

SAR BH, CL  R/M  Cy



Shift right

| | | *Before* | *After* |
|---|---|---|---|
| 1100 0000 = -40H | BH | 1100 0000 | 1111 0000 |
| 1111 0000 = -10H | CL | 02H | |
| | Cy | 1 | 0 |

**3.4.5 Operand instruction to load an Effective address into an Address Register**

LEA AR, a16  4 x 24 = 96 opcodes

| | | Before | After |
|---|---|---|---|
| LEA BX, [SI] | BX | 1000H | 2000H |

LEA BX, [SI] functionally same as

MOV BX,SI

| | | |
|---|---|---|
| SI | 2000H | |
| DS:2000H | 3000H | |

### 3.4.6 Operand instruction to load DS and an Address Register from memory

LDS AR, M32 4 x 24 = 96 opcodes

LDS SI, 3000H

Loads DS and SI using single instruction

| | Before | After |
|---|---|---|
| DS | 2000H | 7000H |
| SI | 1000H | 6000H |

| | |
|---|---|
| DS:3000H | 6000H |
| DS:3002H | 7000H |

### 3.4.7 Operand instruction to load ES and an Address Register from memory

LES AR, M32 4 x 24 = 96 opcodes

| | | Before | After |
|---|---|---|---|
| LES DI, 3000H | ES | 2000H | 7000H |
| Loads ES and DI using single | DI | 1000H | 6000H |
| instruction | 2000:3000H | 6000H | |
| | 2000:3002H | 7000H | |