National University of Computer and Emerging Sciences

Laboratory Manual

for

Computer Organization and Assembly Language

Course Instructors

Lab Instructor(s)

Section

Semester

Department of Computer Science

COAL Lab 11 Manual

Objectives:

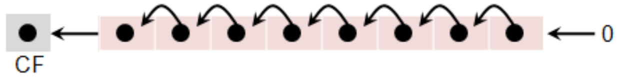
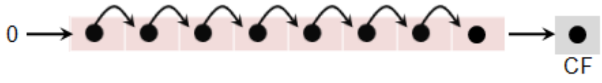
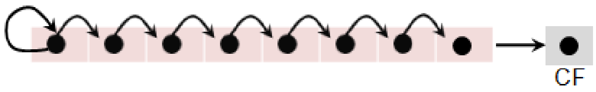
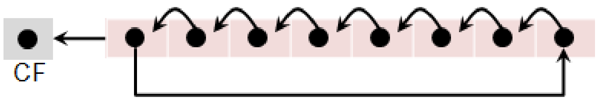
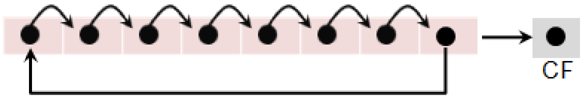
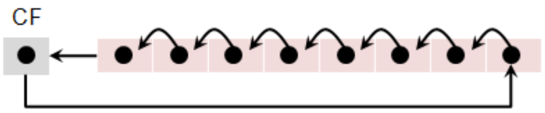
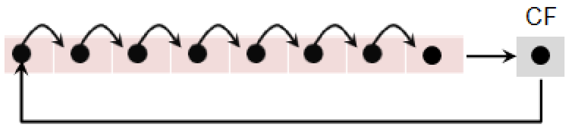
- Bit Manipulation
- Shift Rotate instructions
- MUL DIV instructions
- Problems & Assignments

11.1 Shift and Rotate Instructions:

For a shift instructions, the bits shifted out are lost, for a rotate instruction, bit shifted out from one end of the operand are put back into the other end. For a single shift or rotate of N-positions:

```
Instruction   Destination, count
```

Note: In both cases, destination can be a register or memory location, count can be CL register or 8-bit immediate value.

Instruction	Syntax	Explanation	Examples
SHL/SAL	SHL Dest, CL SAL Dest, CL		**EX 11.1: Multiply EAX by 8** SAL EAX,3
SHR	SHR Dest, CL		**EX 11.2: Divide EAX by 8** MOV CL,3 SHR EAX,CL
SAR	SAR Dest, CL		**EX 11.3: Divide AX by 8** MOV CL,3 SAR AX,CL
ROL	ROL Dest, CL		**EX 11.4: Count 1's in BX** XOR AX, AX MOV CX,16 ONE: ROL BX,1 JNC NEXT INC AX NEXT:LOOP ONE
ROR	ROR Dest, CL		SAME AS EX 11.4
RCL	RCL Dest, CL		
RCR	RCL Dest, CL		

11.2 SHLD/SHRD Instructions

Syntax

```
SHLD dest, source, count
```

The following instruction formats apply to both SHLD and SHRD. The destination operand can be a register or memory operand, and the source operand must be a register. The count operand can be the CL register or an 8-bit immediate operand:

```
SHLD reg16,reg16,CL/imm8
SHLD mem16,reg16,CL/imm8
SHLD reg32,reg32,CL/imm8
SHLD mem32,reg32,CL/imm8
```

11.3 MUL Instruction

The syntax of these instructions is;

```
MUL source
```

Note: The source may be 8/16/32 bit register or memory but not a constant.

MULTIPLICATION		Syntax	Source (1st operand or Multiplier)	Destination (2nd operand or Multiplicand)	Product		Examples
					Higher Byte/word	Lower Byte/word	
Byte Form	**MUL**	MUL source	Reg8 or mem8	AL	AH	AL	MOV AL,5 MOV BL,2 MUL BL ;AX = 000A ;CF = 0
Word Form			Reg16 or mem16	AX	DX	AX	MOV AX,50 MOV BX,20 MUL BX ; DX = 0000h ; AX = 03E8h ; CF = 0
Double Word Form			Reg32 or mem32	EAX	EDX	EAX	MOV EAX,5050 MOV EBX,20 MUL EBX ;EDX= 00 00 00 00h ;EAX= 00 01 8A88h ;CF = 0

11.4 DIV instruction

The syntax of these instructions is;

```
DIV divisor
```

Note: The source may be 8/16/32 bit register or memory but not a constant.

DIVISION		Syntax	Divisor	Dividend		Answer		Examples
				Higher Byte/word	Lower Byte/word	Remainder	Quotient	
Byte Form	**DIV**	`DIV divisor`	Reg8 or mem8	AH	AL	AH	AL	MOV AX,5 MOV BL,2 DIV BL ; AH = 1 ; AL = 2
Word Form			Reg16 or mem16	DX	AX	DX	AX	MOV DX,0000 MOV AX,2004 MOV BX,100 DIV BX ; AX = 14h ; DX = 04h
Double Word Form			Reg32 or mem32	EDX	EAX	EDX	EAX	

Divide Overflow:

It is possible that the quotient will be too big to fit in the specified destination (AL or AX). This can happen if the divisor is much smaller that the dividend. When this happens, the program terminates and the system displays the message “Divide Overflow”.

```
MOV DX,FFFFh
MOV AX,FFFBh
MOV BX,0002h
DIV EBX
```

Problem(s) / Assignment(s)

Discussion & Practice **Estimated completion time: 1 hr, 30 mins**

PROBLEM 11.1: NUMBER SYSTEM CONVERSION **Estimated completion time:30mins**

Write a program that converts 32-bit hex input into equivalent binary output using procedure CONVERT_BINARY and display the result.

Note: Don't use any built-in procedure for binary number conversion.

PROBLEM 11.2: NUMBER SYSTEM CONVERSION **Estimated completion time:30mins**

Write a program that takes a Binary input (0000 0000-1111 1111) from user using procedure IN_PROC1. Convert the input into hexadecimal using procedure CONVERT_HEX. Display the output using procedure OUT_PROC1 .

PROBLEM 11.3: NUMBER SYSTEM CONVERSION **Estimated completion time:30mins**

Write a program that takes a digit input (0-F) from user (use ReadChar) using procedure IN_PROC, store it in BL. Convert the input into decimal (make a logic using MUL/DIV) using procedure CONVERT_DECIMAL. Display the output in decimal using procedure OUT_PROC.

BONUS TASK: Write a program that take input of Byte size from the user, store it in BL reverse that input and display it in Hexadecimal. **Estimated completion time: 30mins**

Sample:

```
Entered value:    4B (0100 1011)

Reverse Output is: D2 (1101 0010)
```