DEPARTMENT OF COMPUTER & SOFTWARE ENGINEERING

COLLEGE OF E&ME, NUST, RAWALPINDI

Microprocessor and Microcontroller Based Design

Assignment 1

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Assignment 1

1. Explain/Elaborate the difference with example for the following instruction sets:

a. Shift Instructions

(SHL, SRL, SAL, SAR)

b. Rotate Instructions

(ROL, ROR, RCL ,RCR)

2. Write a code/program in EMU-8086 that should be able to perform the above instructions.

3. Notice the Data and segment register values (binary window) for each instruction and write them down.

4. Notice the FLAG register value and write them down.

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Q1

Shr [shift logical right] - UNSIGNED NUMBERS
Shl [shift logical left]
Sal [shift arithmetic left]
Sar [shift arithmetic right] - SIGNED NUMBERS

LSB = right most bit
MSB = left most bit

① Shr : LSB goes to CF (Carry Flag)
② Most s-bit MSB goes to ZF.

example 1

10100011
01010001 → [1] CF

[01010001]

example 2

10011100
01001110 → [1] CF

[01001110] [0]

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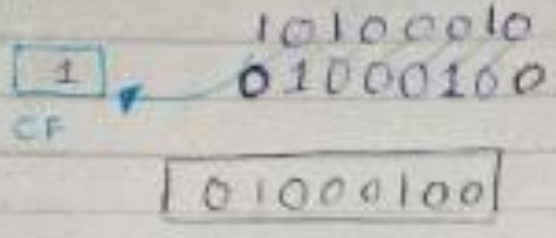
Shl [shift logical left]

① MSB goes to CF
② LSB becomes zero

example 1

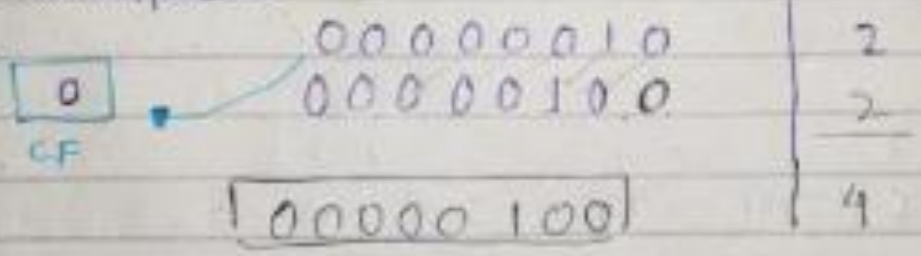


01000100

Sal [shift arithemtic left]

* Shifting left is process of multiplying a given number by 2

example 2-



Sar [shift arithemetic right]

* If MSB is 1 # is Negative [signed]
* If MSB is 0 # is Positive [unsigned]
* Sar is used for signed Numbers only. In signed numbers, MSB is important as it indicates the number itself is positive (0) or negative(1)

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example 1 : insert 1 in MSB is number is negative.

1 0 1 1 1 1 0 0
1 1 0 1 1 1 1 0 → [0] CF

[1 1 0 1 1 1 1 0]

* Shifting Right [Shr, sar] means dividing the number BY 2

example 2 :

0 0 0 0 0 1 1 0 → [0] CF | 6 ÷ 2 = 3

• insert 0 to MSB if number is +ve

0 0 0 0 0 0 1 1 | 3

ROR [Rotate right without carry]
ROL [Rotate left without carry]
RCR [Rotate right through carry]
RCL [Rotate left through carry]

ROR dest, count

ROR AL, CL

example: ASH → AL
02H → CL

1 1 0 1 0 0 1 0 1 → [3]

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ASH → first rotation → D2

1 1 0 1 0 0 1 0

D C

0 → CF

0 1 1 0 1 0 0 1

D2 → 2nd Rotation 69

ROL dest, count

ROL AL, CL

AL → 9CH

01H

1 0 0 1 1 1 0 0

9 C

1 → CF

00111001

RCR [rotate right through carry]

syntax: RCR dest, count

dest CD

count 01

CF = 1

RCR AL, CL

1 1 0 0 1 1 0 1

C D

1 → CF

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[1] → 1 1 D0 1 1 0 1
CF 1 1 1 0 0 1 1 0 1
E 6

CF = 1

RCL (Rotate left through carry)
syntax: RCL dest, count.

RCL AL, CL

CF
[0] ← 1 0 0 1 1 1 1 0
0 0 1 1 1 1 0 0

AL → 9E
CL → 02
CF → 0

[1]
CF

1- MSB moves to CF
2- CF = 0 moves to LSB
3- CF get 1.

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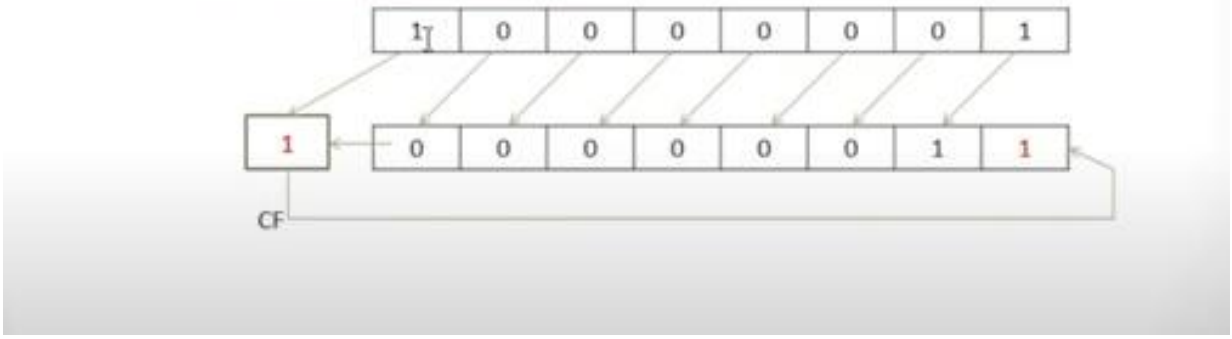
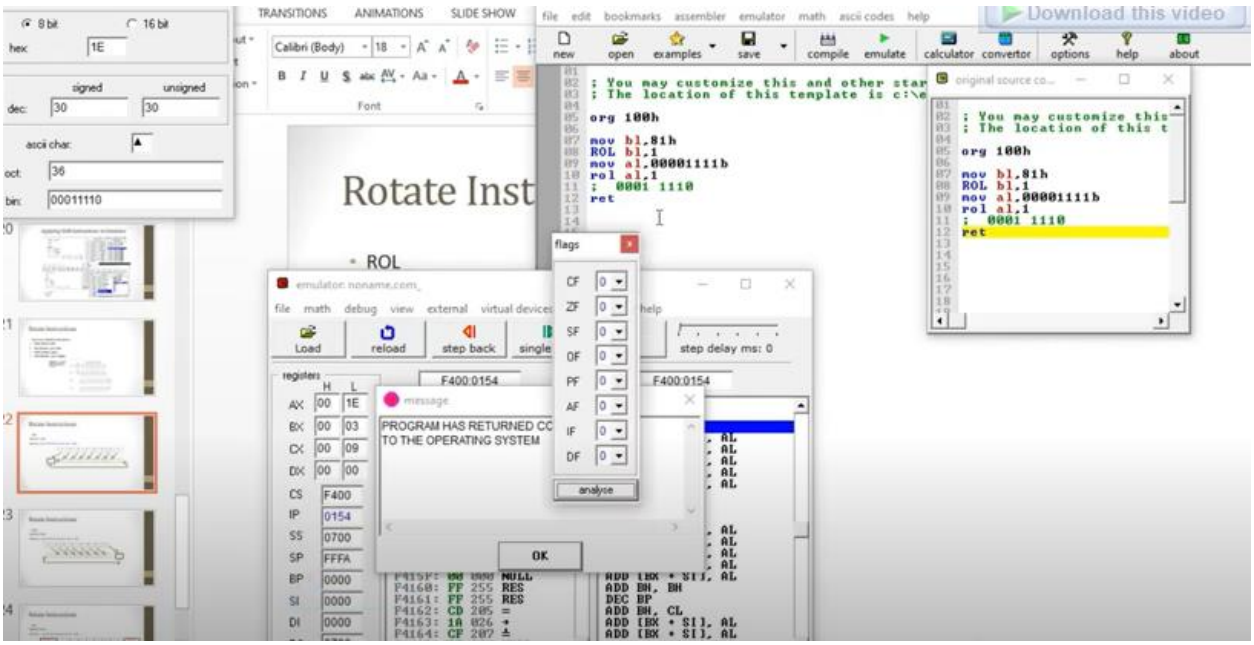
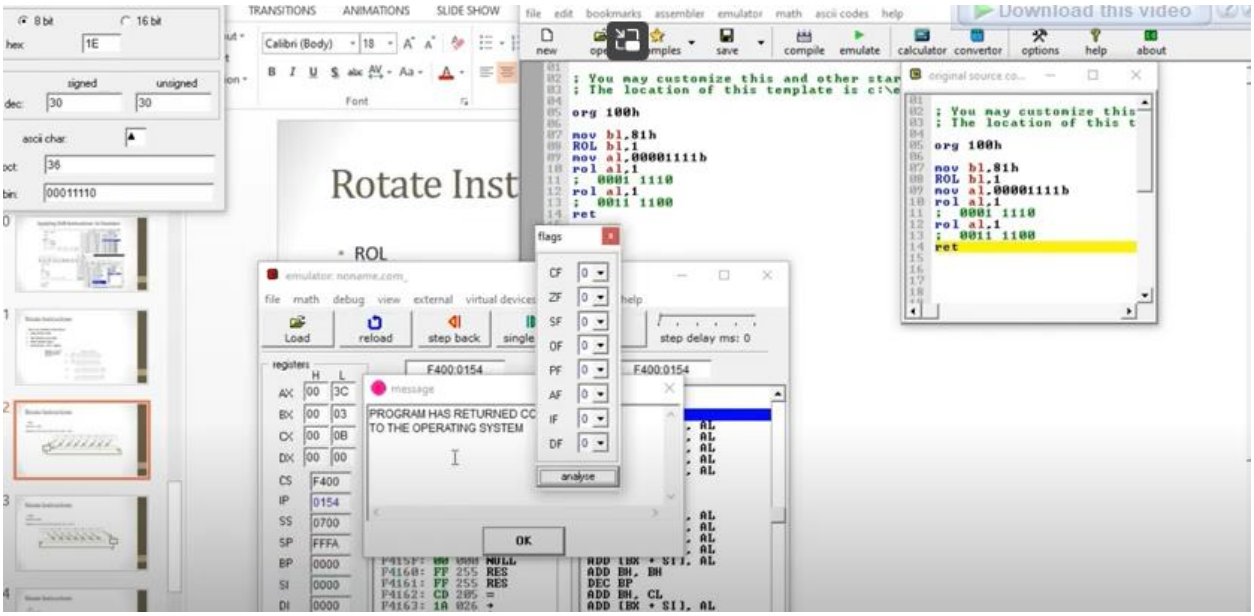
- ROL

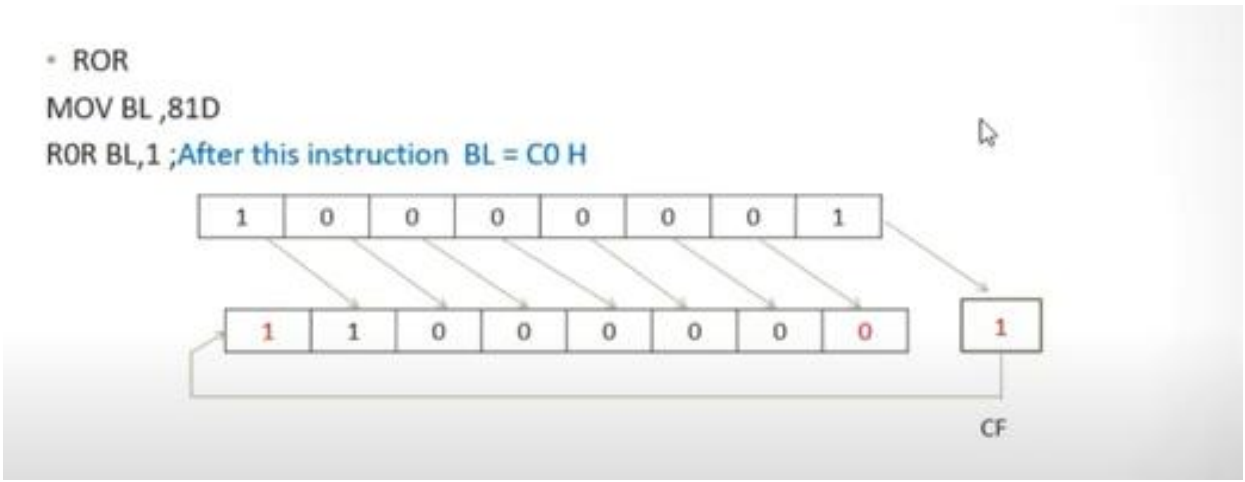
MOV BL ,81H

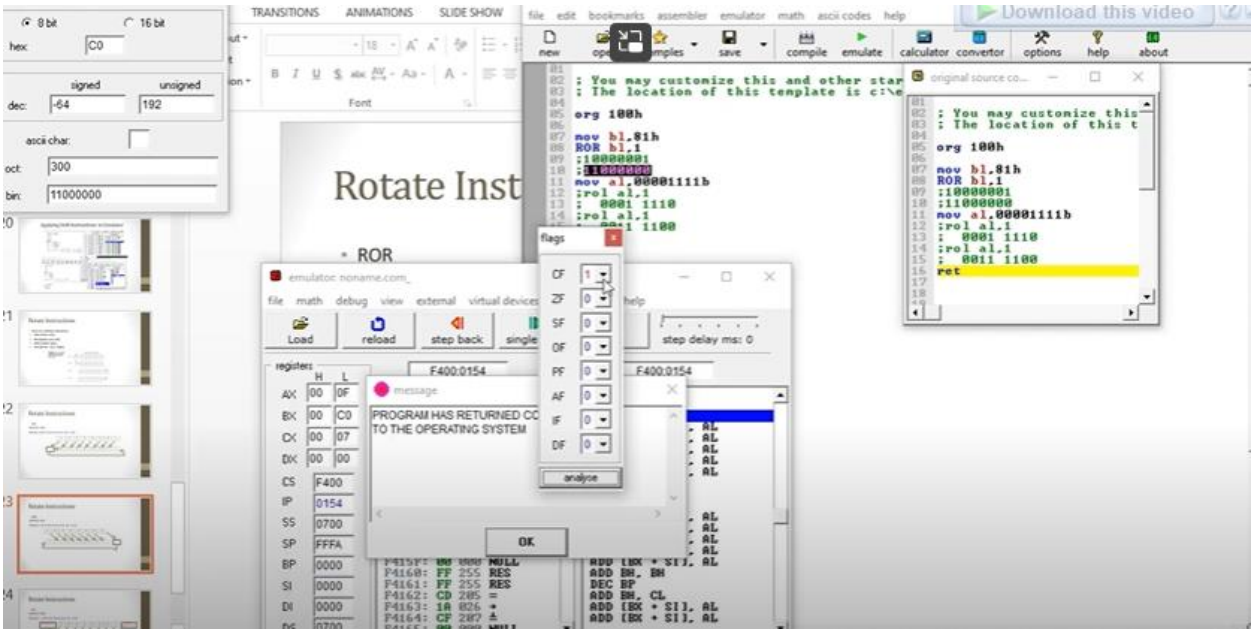
ROL BL,1;After this instruction BL = 03H

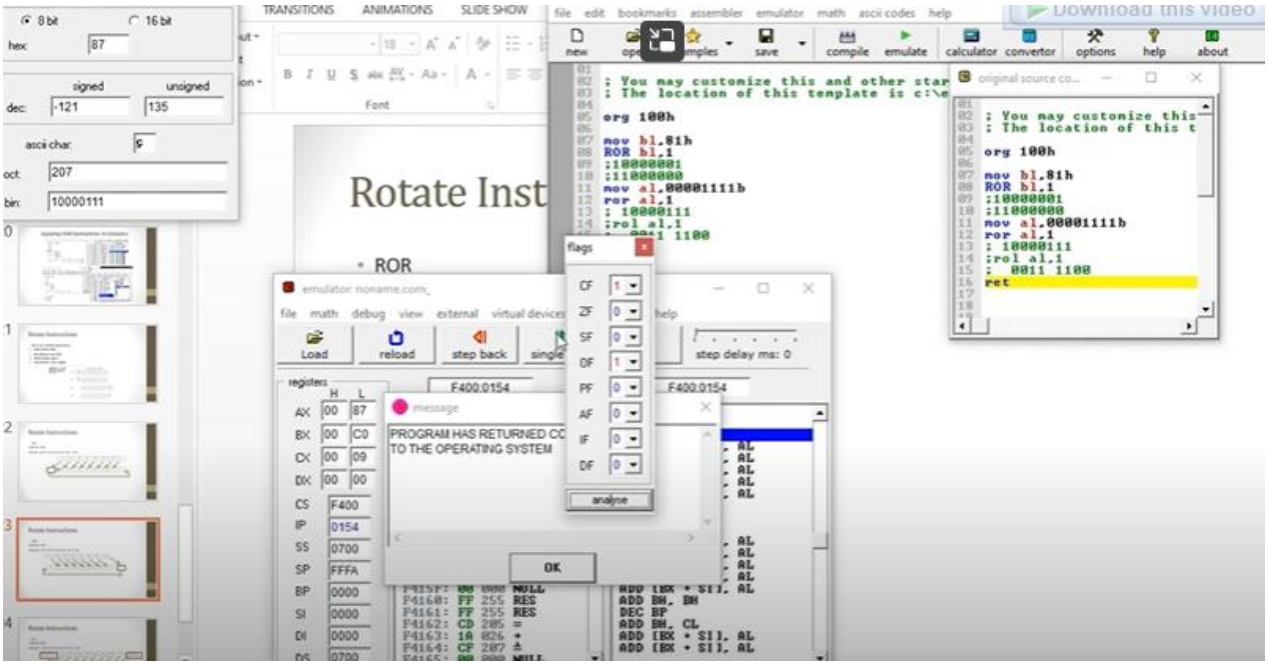


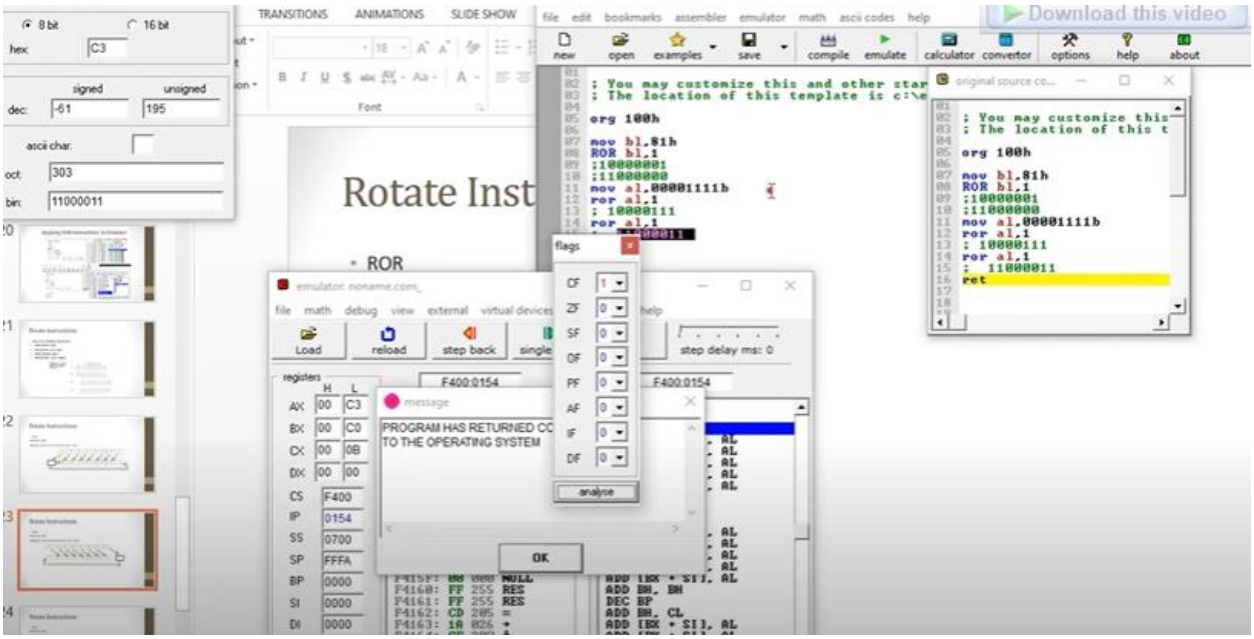



Rotate Inst
• ROL
PROGRAM HAS RETURNED CC
TO THE OPERATING SYSTEM
OK


• ROR
MOV BL ,81D
ROR BL,1 ;After this instruction BL = C0 H
1 0 0 0 0 0 0 1
1 1 0 0 0 0 0 0
1
CF


Rotate Inst
• ROR
PROGRAM HAS RETURNED CC
TO THE OPERATING SYSTEM
OK

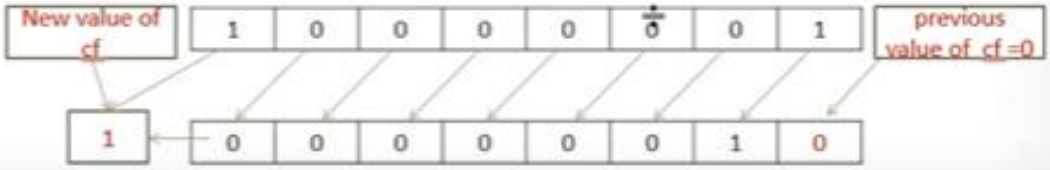

8 bit
16 bit
hex: 87
signed
unsigned
dec: -121
135
ascii char:
oct: 207
bin: 10000111
Rotate Inst
• ROR
; You may customize this and other star
; The location of this template is c:\e
org 100h
mov bl,81h
ROR bl,1
;10000001
;11000000
mov al,00001111b
ror al,1
; 10000111
;rol al,1
; 0011 1100
ret
original source co...
flags
CF
ZF
SF
OF
PF
AF
IF
DF
analyse
emulator: noname.com_
Load
reload
step back
step delay ms: 0
registers
AX 00 87
BX 00 C0
CX 00 09
DX 00 00
CS F400
IP 0154
SS 0700
SP FFFA
BP 0000
SI 0000
DI 0000
message
PROGRAM HAS RETURNED CO
TO THE OPERATING SYSTEM
OK


8 bit
16 bit
hex: C3
signed
unsigned
dec: -61
195
ascii char:
oct: 303
bin: 11000011
Rotate Inst
• ROR
; You may customize this and other star
; The location of this template is c:\e
org 100h
mov bl,81h
ROR bl,1
;10000001
;11000000
mov al,00001111b
ror al,1
; 10000111
ror al,1
; 11000011
ret
original source co...
flags
CF
ZF
SF
OF
PF
AF
IF
DF
analyse
emulator: noname.com_
Load
reload
step back
step delay ms: 0
registers
AX 00 C3
BX 00 C0
CX 00 0B
DX 00 00
CS F400
IP 0154
SS 0700
SP FFFA
BP 0000
SI 0000
DI 0000
message
PROGRAM HAS RETURNED CO
TO THE OPERATING SYSTEM
OK

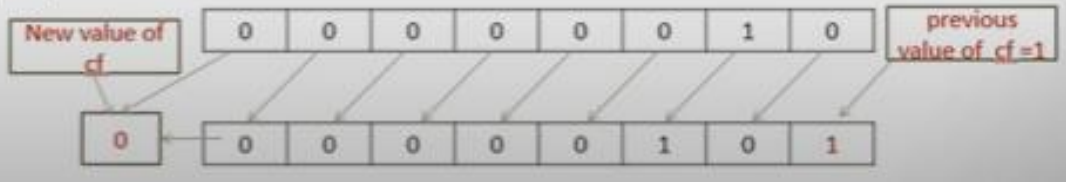
- RCL

MOV BL ,81H ;

RCL BL,1 ;After this instruction BL = 02H



RCL BL,1 ; After RCL bl=05h



- RCR (Followed instruction are complete one program)

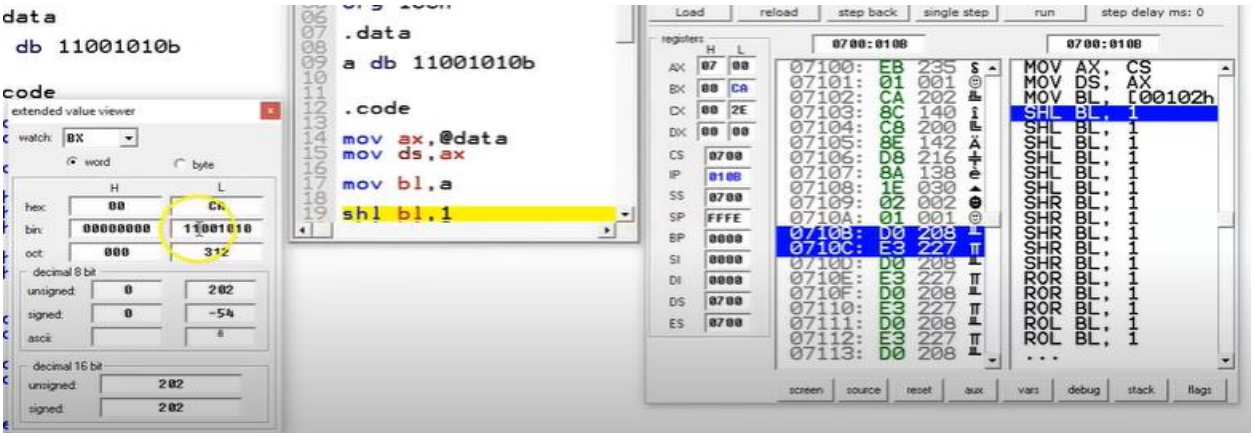
MOV BL ,81H ;

RCR BL,1 ;After this instruction BL = 40H

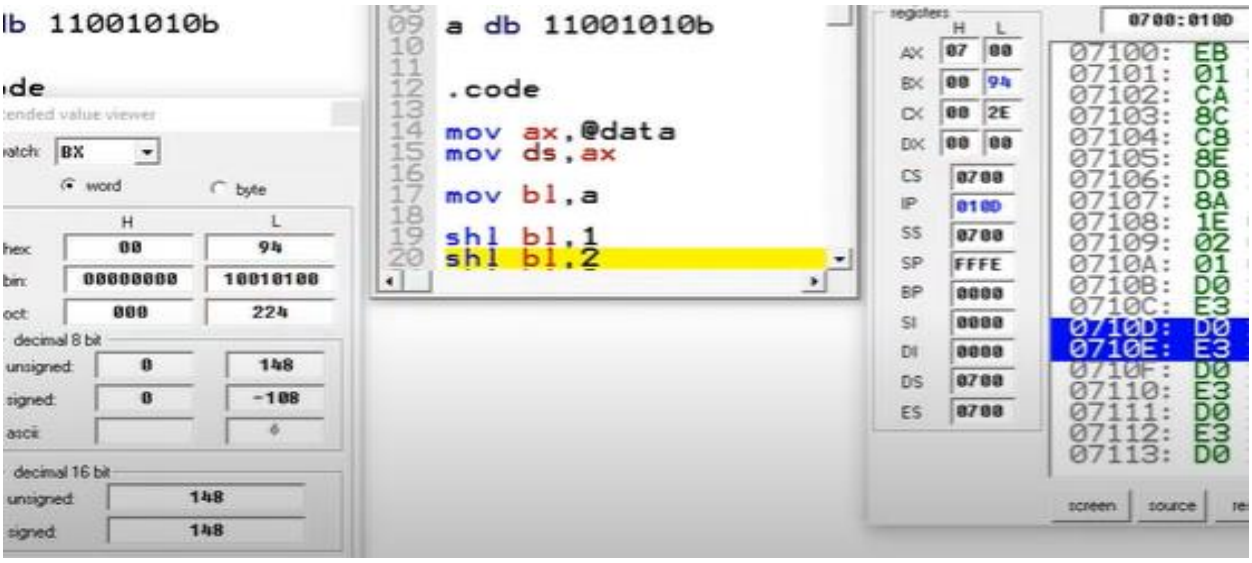
RCR BL,1 ; After RCR bl=A0h

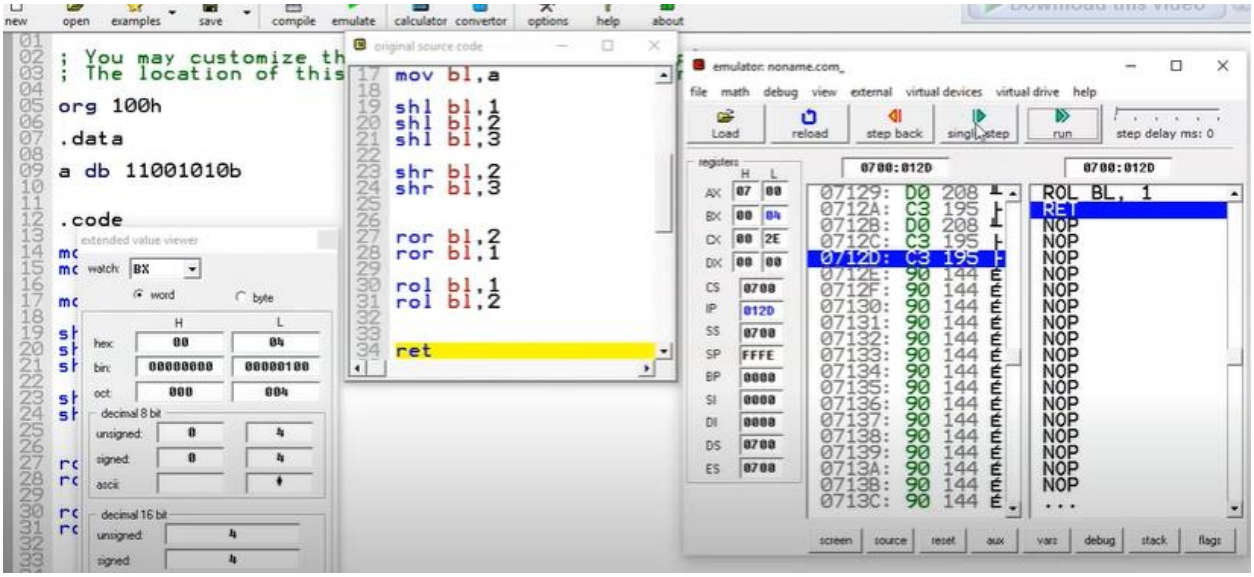
```
; You may customize this and other start-up templates;
; The location of this template is c:\emu8086\inc\0_com_template.txt

org 100h

.data

a db 11001010b


.code

mov ax,@data
mov ds,ax

mov bl,a

shl bl,1
shl bl,2
shl bl,3

shr bl,2
shr bl,3


ror bl,2
ror bl,1

rol bl,1
rol bl,2


ret
```

Shift 1

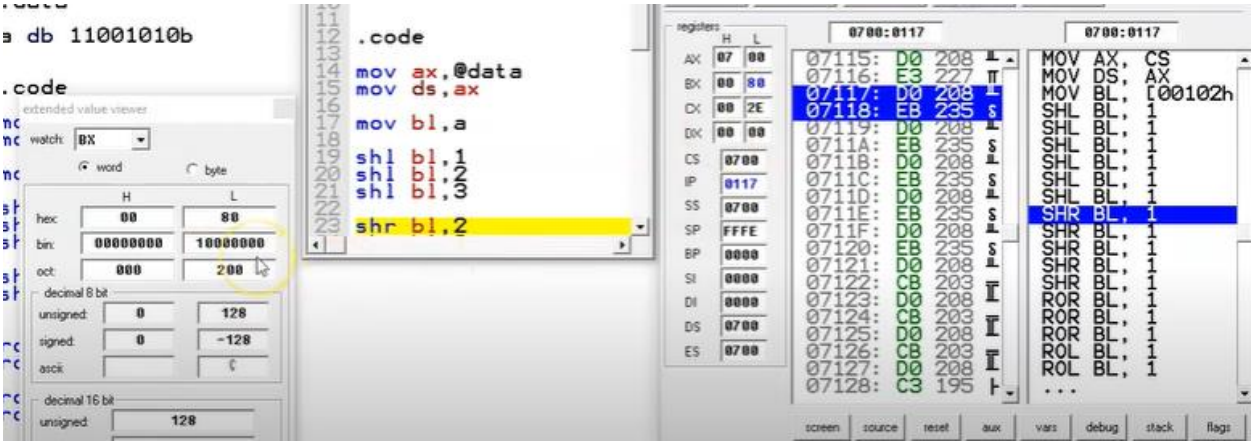


Shift 2

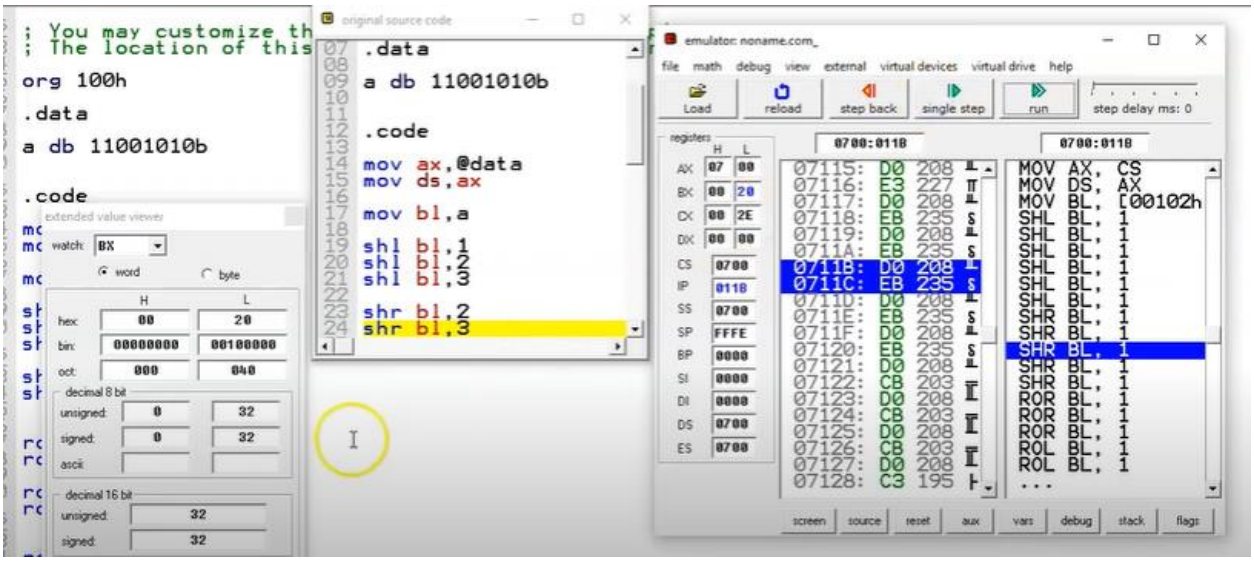




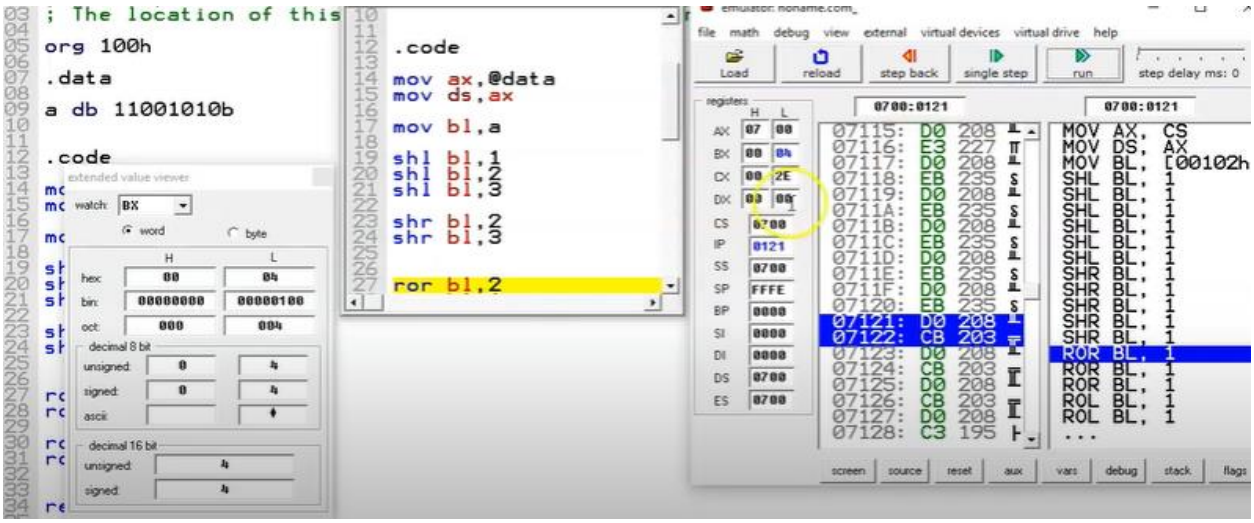
Shift 3



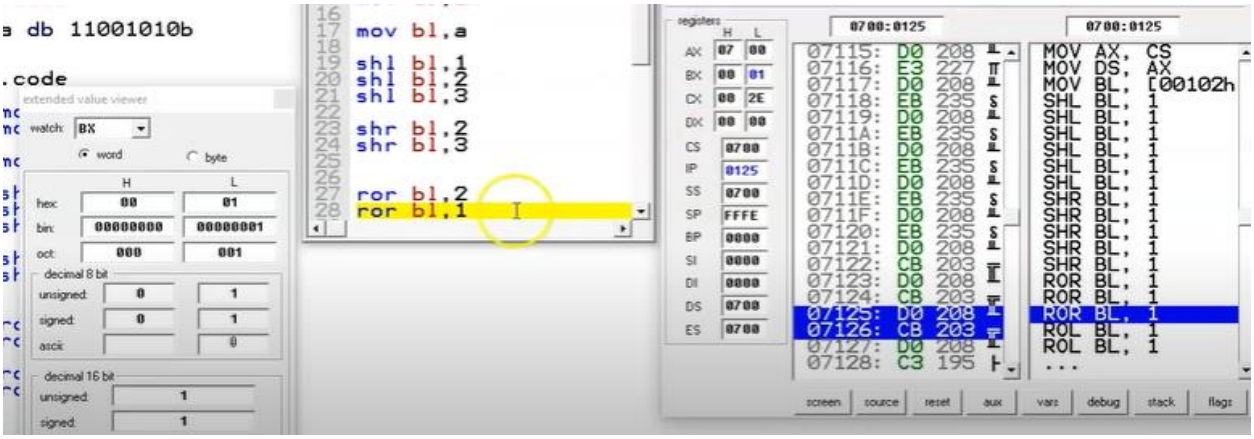
Shr bl 2



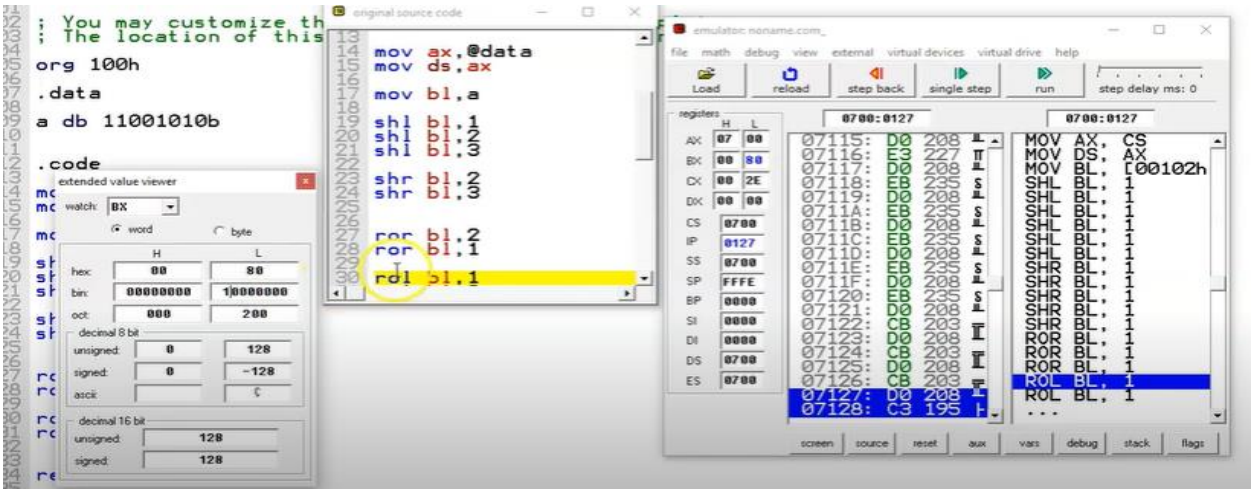
Shr bl 3



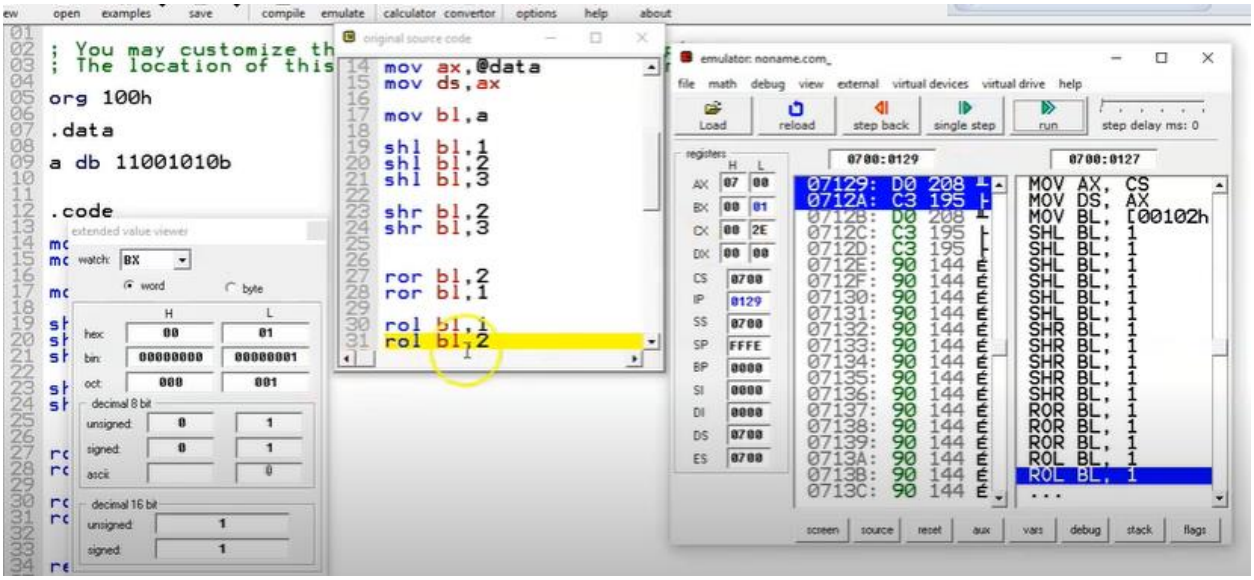
Ror bl 2



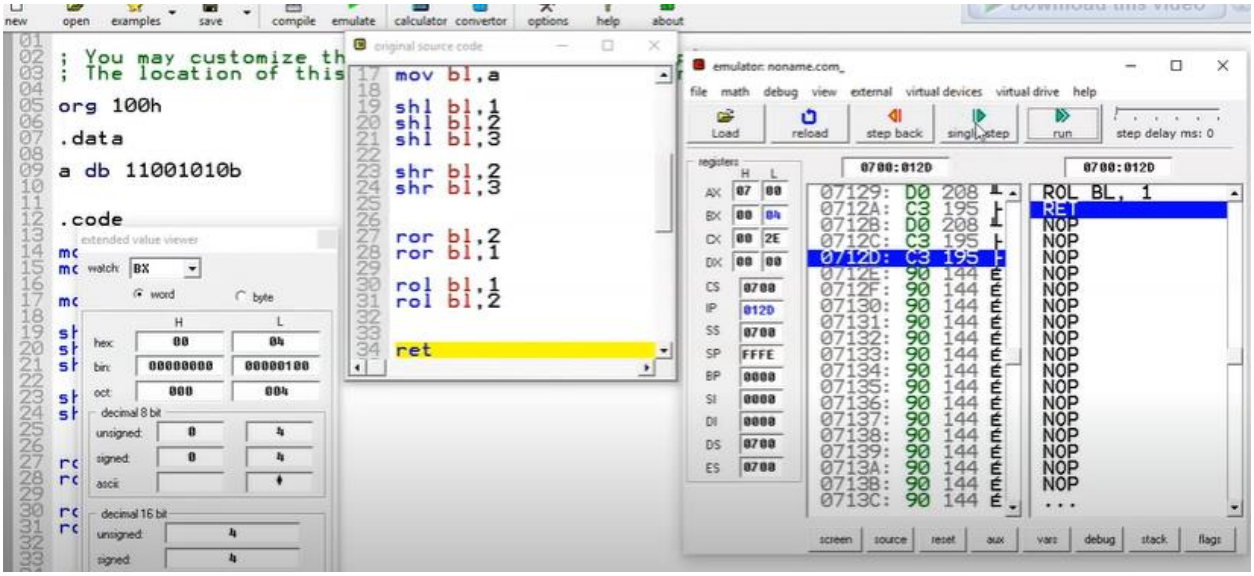
Ror bl 1



Rol bl 1



Rol bl 2


; You may customize th
; The location of this
org 100h
.data
a db 11001010b
.code
mov bl,a
shl bl,1
shl bl,2
shl bl,3
shr bl,2
shr bl,3
ror bl,2
ror bl,1
rol bl,1
rol bl,2
ret
emulator: noname.com
file math debug view external virtual devices virtual drive help
Load reload step back single step run step delay ms: 0
0700:012D
ROL BL, 1
RET
NOP

THE END