Microprocessor and Assembly Language Lab

Lab Material 4 for CSE 312 (M&AL Lab)

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Arithmetic and Logic Operations

Arithmetic Operations

Introduction to Arithmetic Instructions (INC, DEC, ADD, SUB and NEG)

Arithmetic Operations

<u>INC and DEC Instructions</u>

The INC (increment) and DEC (decrement) instructions, respectively, add 1 and subtract 1 from a single operand . The syntax is:

INC *reg/mem*

DEC *reg/mem*

<u>Example:</u>

Following are some examples :

MOV AX, 1000H

INC AX

INC AL

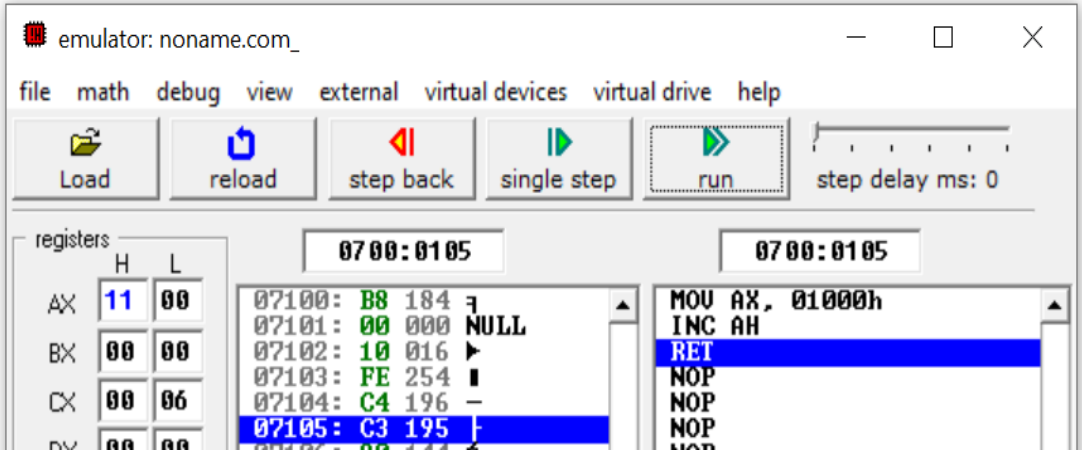
INC AH

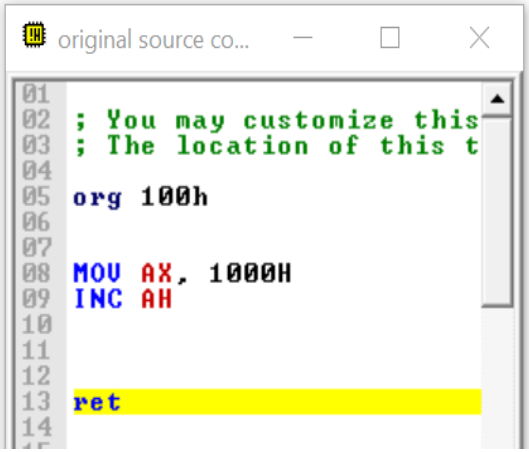
DEC AX

```
org 100h

MOV AX, 1000H
INC AH


ret
```





ADD Instruction

The ADD instruction adds a source operand to a destination operand of the same size. The syntax is:

ADD *dest,source*

Source is unchanged by the operation, and the sum is stored in the destination operand . The set of possible operands is the same as for the MOV instruction .

Example:

Here is a short code example that adds two 16-bit integers:

```
ORG 100h
MOV AX, var1
MOV BX, var2
ADD AX,BX
RET    ; stops the program.
VAR1 DW 7
var2 DW 1234h
```

org 100h? **ORG** (abbr. for ORiGin) is an **assembly** directive (not an instruction). It defines where the
machine **code** (translated **assembly** program) is to place in memory.

ADD Instruction

emu8086 - assembler and microprocessor emulator 4.08

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```
01 ORG 100h
02
03 MOV AX, var1
04 MOV BX, var2
05 ADD AX,BX
06
07 RET     ; stops the program.
08
09 VAR1 DW 7
10 var2 DW 1234h
```

emulator: noname.com_

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Load reload step back single step run step delay ms: 0

registers

	H	L
AX	12	3B
BX	12	34
CX	00	0E
DX	00	00
CS	0700	
IP	0109	
SS	0700	
SP	FFFE	
BP	0000	
SI	0000	
DI	0000	
DS	0700	

0700:0109

```
07100: A1 161 í
07101: 0A 010 NEWL
07102: 01 001 ☺
07103: 8B 139 ï
07104: 1E 030 ▲
07105: 0C 012 ♀
07106: 01 001 ☺
07107: 03 003 ♥
07108: C3 195 ├
07109: C3 195 ├
0710A: 07 007 BEEP
0710B: 00 000 NULL
0710C: 34 052 4
0710D: 12 018 ↕
0710E: 90 144 É
0710F: 90 144 É
07110: 90 144 É
07111: 90 144 É
07112: 90 144 É
07113: 90 144 É
07114: 90 144 É
07115: 90 144 É
```

0700:0109

```
MOV AX, [0010Ah]
MOV BX, [0010Ch]
ADD AX, BX
RET
POP ES
ADD [SI], DH
ADC DL, [BX + SI] + 09096
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
...
```

original source co...

```
01 ORG 100h
02
03 MOV AX, var1
04 MOV BX, var2
05 ADD AX,BX
06
07 RET     ; stops the progr
08
09 VAR1 DW 7
10 var2 DW 1234h
11
12
```

line: 9 col: 8

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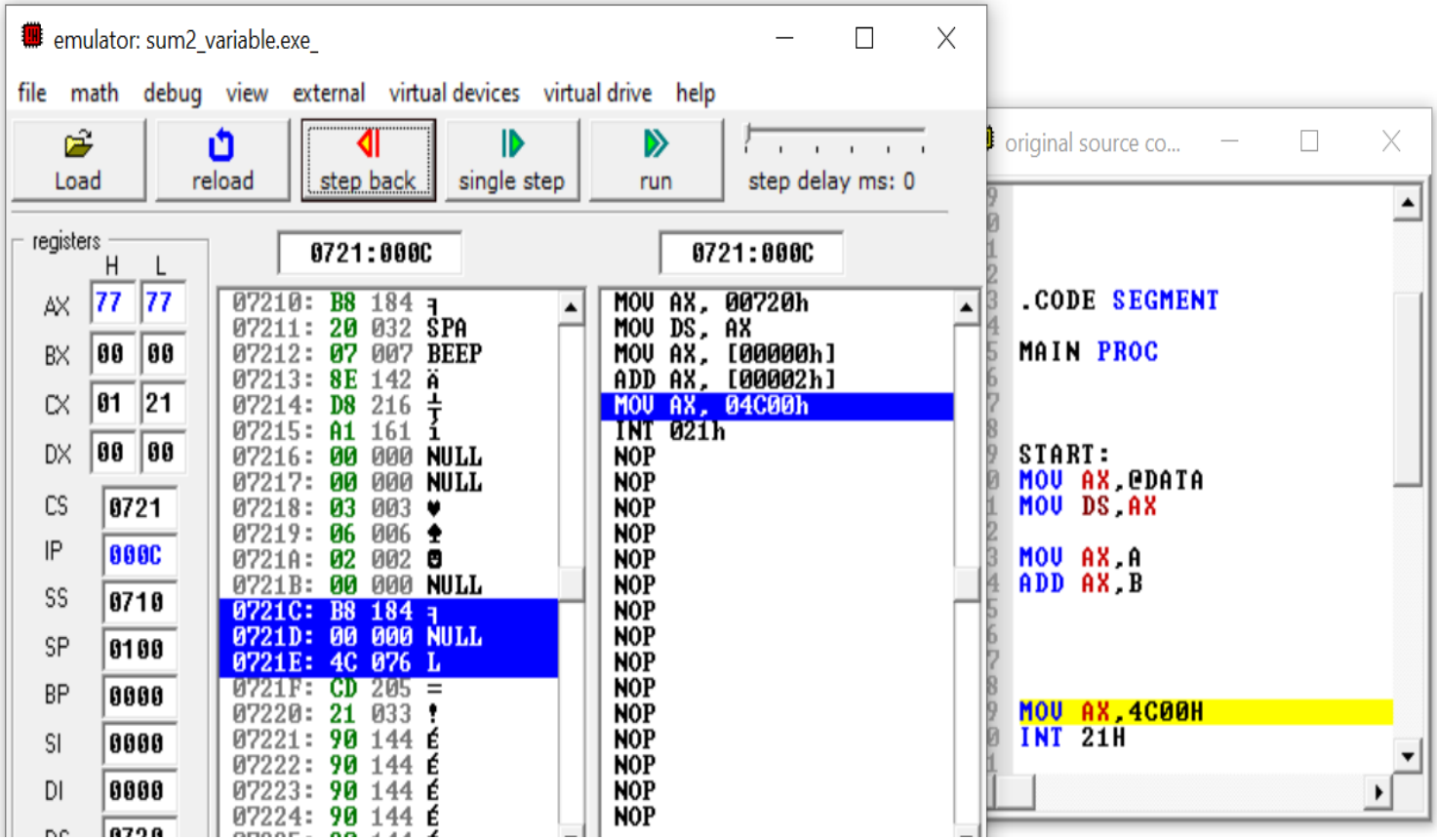
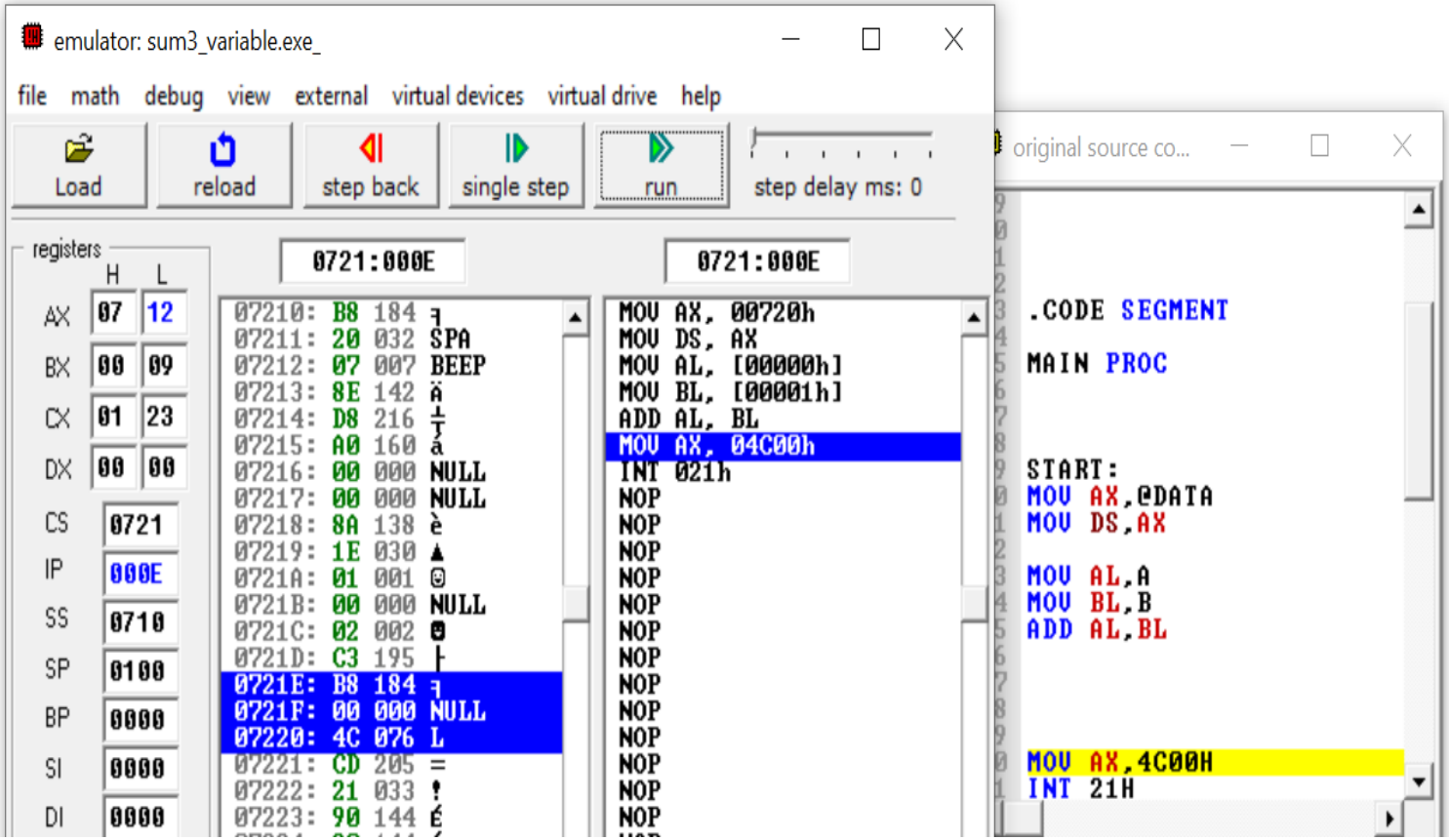
ADD Instruction

```
.MODEL SMALL

.STACK 100H

.DATA SEGMENT
        A DW 2222H
        B DW 5555H



.CODE SEGMENT

MAIN PROC


START:
        MOV AX,@DATA
        MOV DS,AX

        MOV AX,A
        ADD AX,B



        MOV AX,4C00H
        INT 21H


      MAIN ENDP
END MAIN
```



ADD Instruction

```
.MODEL SMALL

.STACK 100H

.DATA SEGMENT
        A DB 09H
        B DB 09H



.CODE SEGMENT

MAIN PROC


START:
        MOV AX,@DATA
        MOV DS,AX

        MOV AL,A
        MOV BL,B
        ADD AL,BL



        MOV AX,4C00H
        INT 21H


      MAIN ENDP
END MAIN
```



ADD Instruction

```
.MODEL SMALL

.STACK 100H

.DATA SEGMENT
        A DW 1111H
        B DW 9999H



.CODE SEGMENT

MAIN PROC


START:
        MOV AX,@DATA
        MOV DS,AX

        MOV AX,A
        MOV BX,B
        ADD AX,BX



        MOV AX,4C00H
        INT 21H


      MAIN ENDP
END MAIN
```

emulator: sum4_variable.exe_

file math debug view external virtual devices virtual drive help

Load | reload | step back | single step | run | step delay ms: 0

registers

	H	L
AX	AA	AA
BX	99	99
CX	01	23
DX	00	00
CS	0721	
IP	000E	
SS	0710	
SP	0100	
BP	0000	
SI	0000	
DI	0000	

0721:000E

```
07210: B8 184 ╕
07211: 20 032 SPA
07212: 07 007 BEEP
07213: 8E 142 Ä
07214: D8 216 ╪
07215: A1 161 í
07216: 00 000 NULL
07217: 00 000 NULL
07218: 8B 139 ï
07219: 1E 030 ▲
0721A: 02 002 ☻
0721B: 00 000 NULL
0721C: 03 003 ♥
0721D: C3 195 ├
0721E: B8 184 ╕
0721F: 00 000 NULL
07220: 4C 076 L
07221: CD 205 ═
07222: 21 033 !
07223: 90 144 É
07224: 90 144 É
```

0721:000E

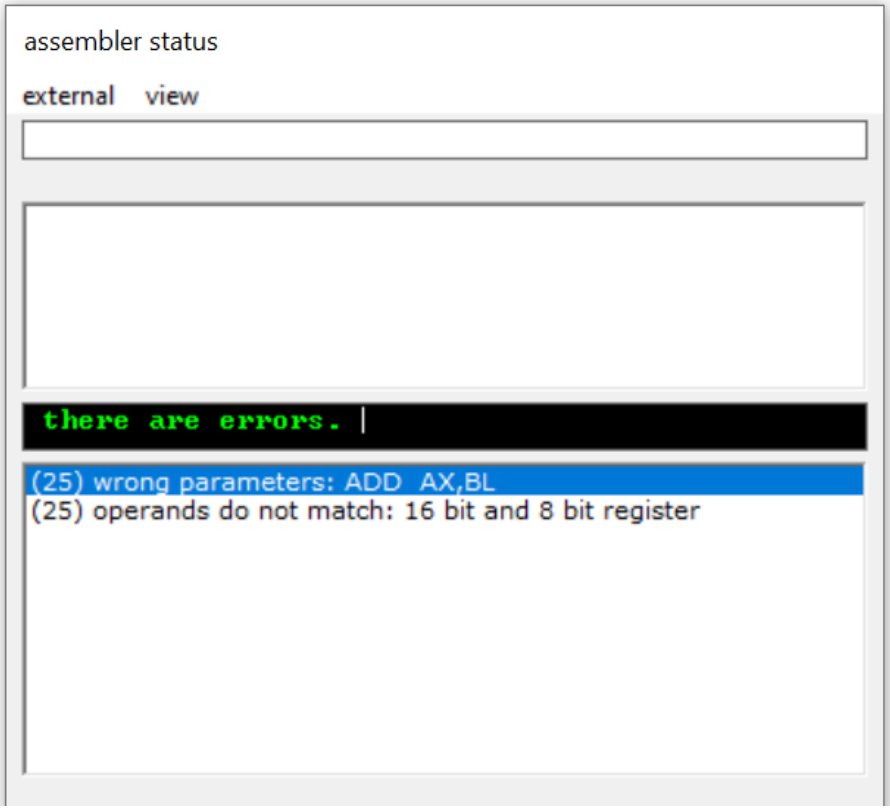
```
MOV AX, 00720h
MOV DS, AX
MOV AX, [00000h]
MOV BX, [00002h]
ADD AX, BX
MOV AX, 04C00h
INT 021h
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
NOP
```

original source co...

```
.CODE SEGMENT

MAIN PROC


START:
MOV AX,@DATA
MOV DS,AX

MOV AX,A
MOV BX,B
ADD AX,BX



MOV AX,4C00H
INT 21H
```

ADD Instruction

```
.MODEL SMALL
.STACK 100H
.DATA SEGMENT
        A DW 1111H
        B DB 99H


.CODE SEGMENT
MAIN PROC


START:
        MOV AX,@DATA
        MOV DS,AX

        MOV AX,A
        MOV BL,B
        ADD AX,BL



        MOV AX,4C00H
        INT 21H


       MAIN ENDP
END MAIN
```



SUB Instruction

The SUB instruction subtracts a source operand from a destination operand. The set of possible operands is the same as for the ADD and MOV instructions. The syntax is:

SUB *dest,source*

Example:

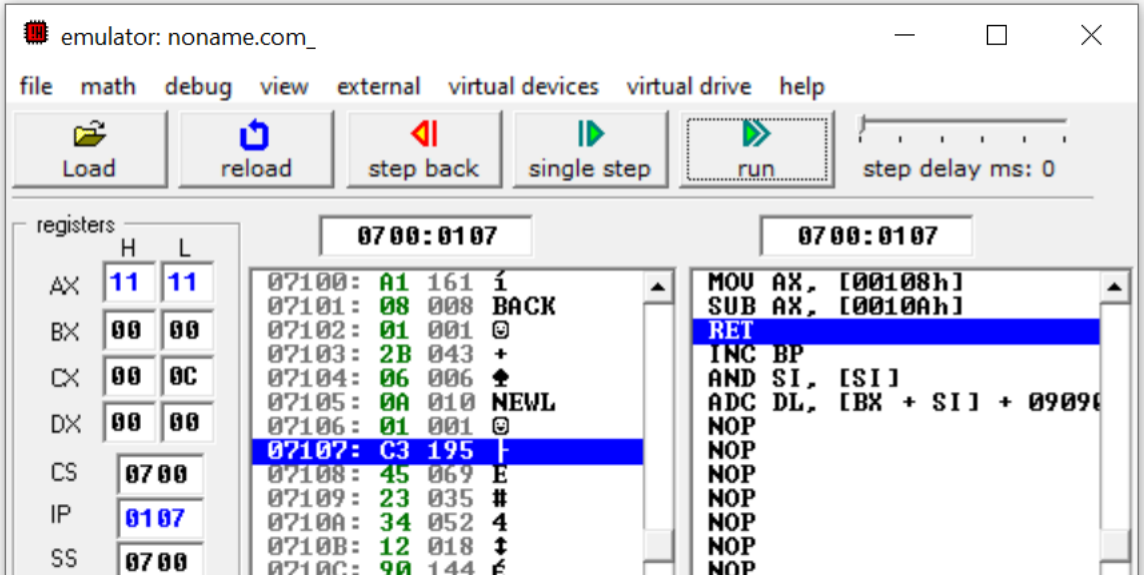
Example:

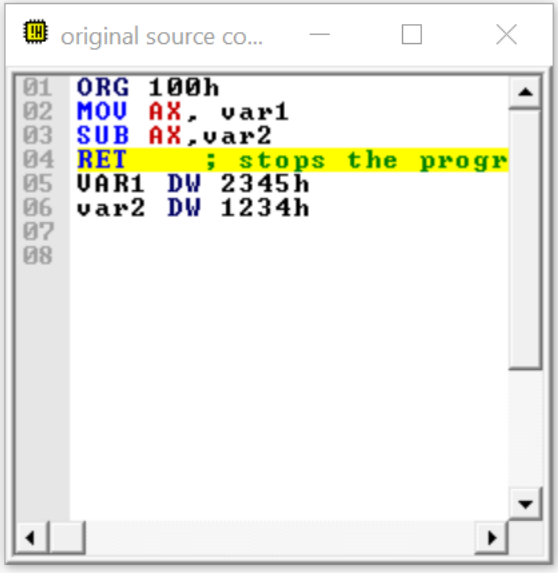
Here is a short code example that adds two 16-bit integers:

```
ORG 100h
MOV AX, var1
SUB AX,var2
RET    ; stops the program.
VAR1 DW 2345H
var2 DW 1234h
```

SUB Instruction

```
ORG 100h
MOV AX, var1
SUB AX,var2
RET     ; stops the program.
VAR1 DW 2345h
var2 DW 1234h
```





NEG Instruction

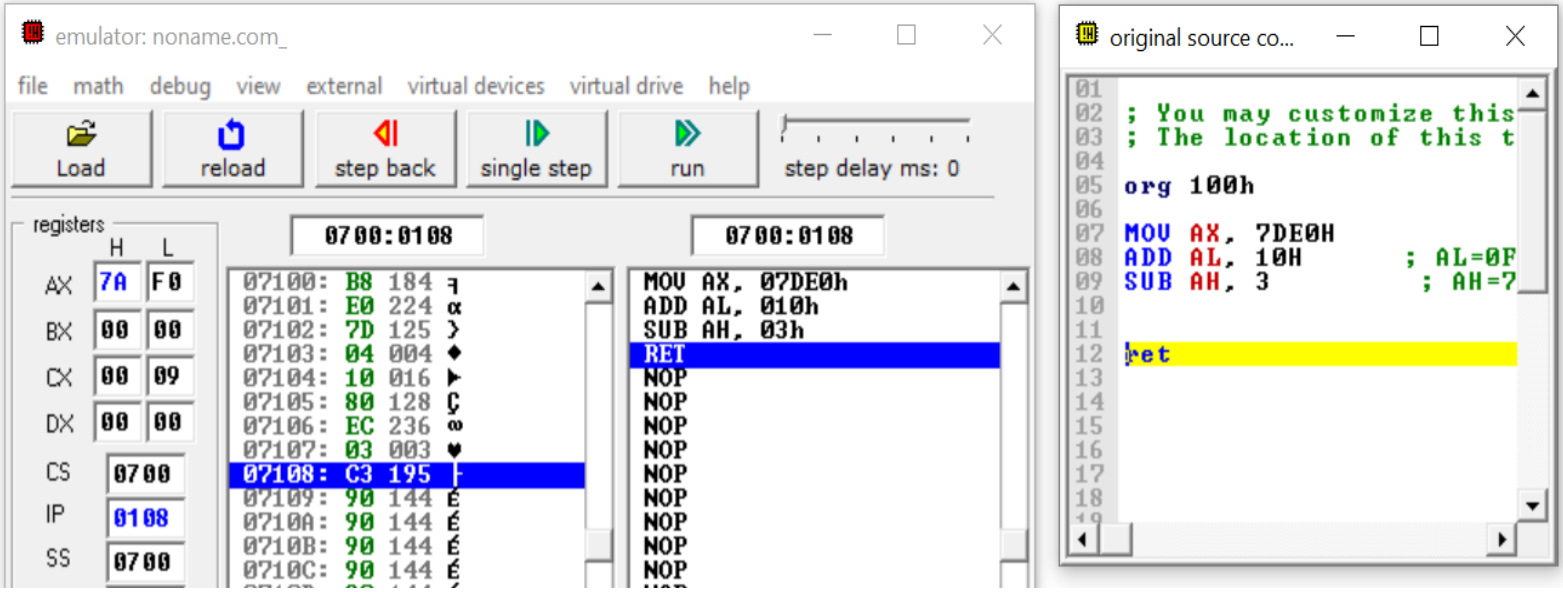
The NEG (negate) instruction reverse s the sign of a number by converting the number to its two's complement. The following operands are permitted:

NEG *reg*

NEG *mem*

Recall that the two's complement of a number can be found by reversing all the bits in the destination operand and adding 1.

```
org 100h

MOV AX, 7DE0H
    ADD AL, 10H       ; AL=0F0H, CF=0, SF=1,   ZF=0,   OF=0
    SUB AH, 3         ; AH=7AH,  CF=1, SF=0,   ZF=0,   OF=0       4

ret
```



Experiment 01:

Addition of two Hexadecimal numbers in 8086 Microprocessor.

Assembly code :

```
MOV AX,1234H
MOV BX,5678H
ADD AX,BX
```

Experiment 02:

Logical operations (AND, OR,NOT,XOR,TEST) in 8086 Microprocessor.

Assembly code :

```
MOV AX,2053H ;----0010000001010011B
MOV BX,3167H ;----0011000101100111B
AND AX,BX ;
OR AX,BX ;
NOT AX ;
NOT BX ;
XOR AX,BX ;
TEST AX,BX
```

Experiment 03 :

Perform the logical operation of the following function: $(A+(B \oplus C)).D$

Also find the 2's complement of the result.

Where, A=21H; B=11H;C=35H; D=57H

Assembly code:

```
MOV AX,21H
MOV BX,11H
MOV CX,35H
MOV DX,57H
XOR BX,CX
OR AX,BX
AND AX,DX
NEG AX
```

Experiment 03 :

Perform the logical operation of the following function: $(A+(B \oplus C)).D$

Also find the 2's complement of the result.

Where, A=21H; B=11H;C=35H; D=57H

Assembly code:

```
MOV AX,21H
MOV BX,11H
MOV CX,35H
MOV DX,57H
XOR BX,CX
OR AX,BX
AND AX,DX
NEG AX
```