Microprocessors and Interfaces: 2021-22
Lab 2
8086 Arithmetic Operations

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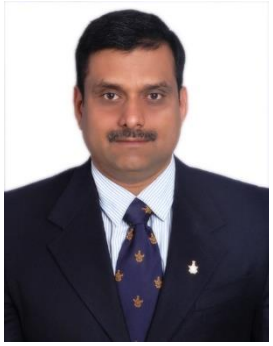


• 2.1 Addition of two numbers

- Instruction to be used: **ADD**

Instruction	Operands	Usage Description

ADD	REG, memory	Operand 1 = Operand 1 + Operand 2
		
		Example:
		ADD AL,BL
		ADD AL,-5
		
		Operates on both 8-bit or 16-bit numbers.

	memory, REG	
	REG, REG	
	memory, immediate	
	REG, immediate	

C	Z	S	O	P	A
r	r	r	r	r	r

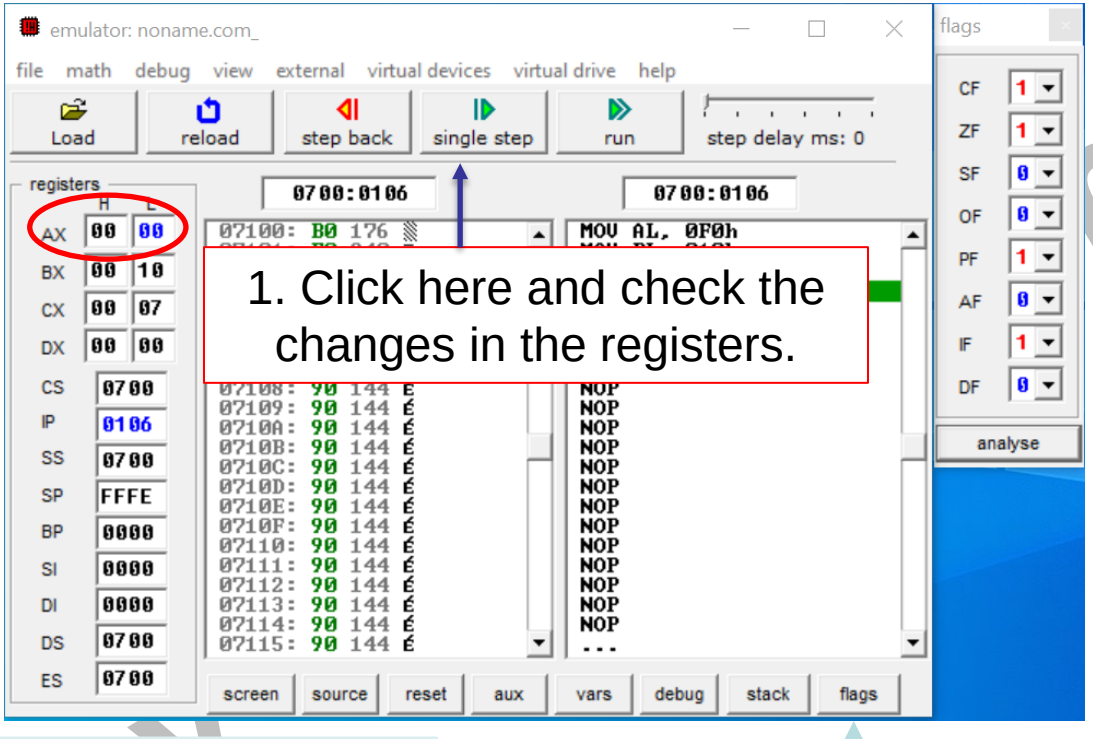
r: flag value depends on result of the instruction

- Effect on Flags

• 2.1 Addition of two 8-bit numbers

- **Example Code**

```
org 100h

MOV AL,0F0H
MOV BL,010H
ADD AL,BL

ret
```



1. Click here and check the changes in the registers.

2. Click here to check the conditions of flags of the µp.

3. Interpret the results of the flags of the µp.

CF: Carry is generated when performing n bit operations and the result is more than n bits, then it is 1, otherwise 0.

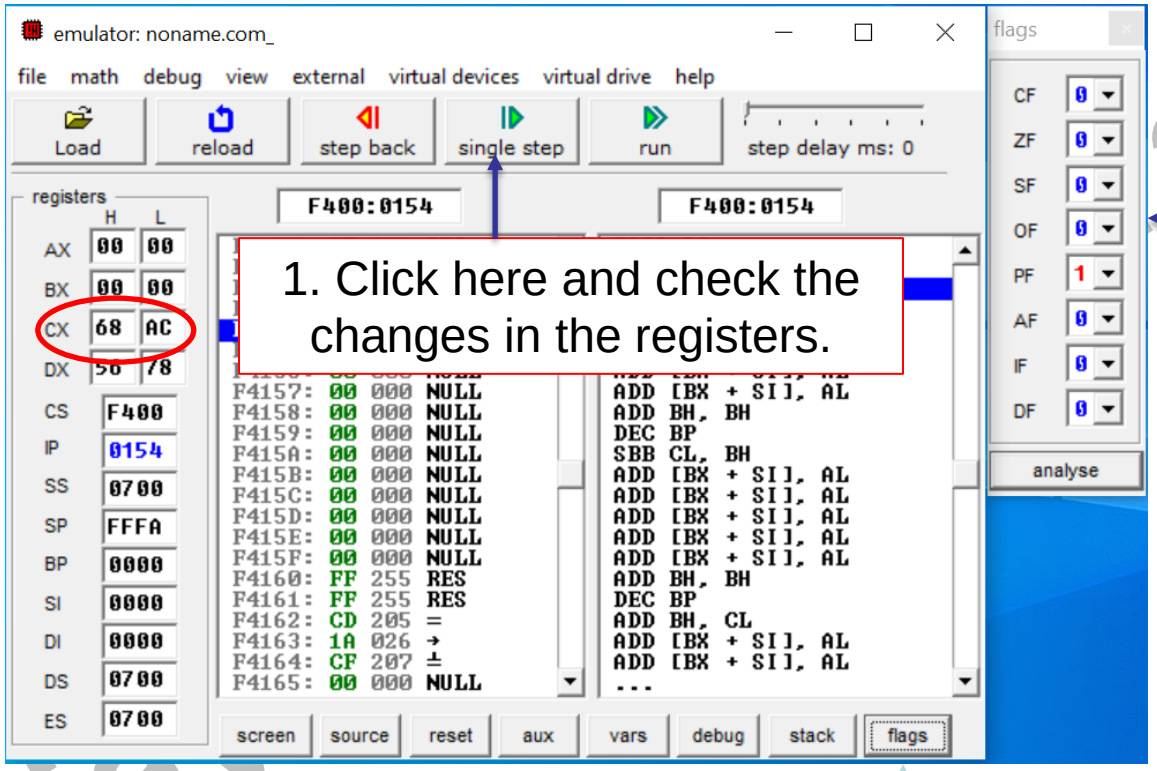
ZF: After any arithmetical or logical operation results 0 (00)H, the zero flag is 1, otherwise 0.

PF: 1 accumulator has even number of 1 bits
0 accumulator has odd parity

• 2.2 Addition of two 16-bit numbers

- **Example Code**

```
org 100h
MOV CX,1234H
MOV DX,5678H
ADD CX,DX
ret
```



1. Click here and check the changes in the registers.

2. Click here to check the conditions of flags of the µp.

3. Interpret the results of the flags of the µp.

2.3 Subtraction of two numbers

- Instruction to be used: **SUB**

Instruction	Operands	Usage Description

SUB	REG, memory	Operand 1 = Operand 1 - Operand 2
		
		Example:
		SUB AL,BL
		SUB AL,1
		
		Operates on both 8-bit or 16-bit numbers.

	memory, REG	
	REG, REG	
	memory, immediate	
	REG, immediate	

C	Z	S	O	P	A
r	r	r	r	r	r

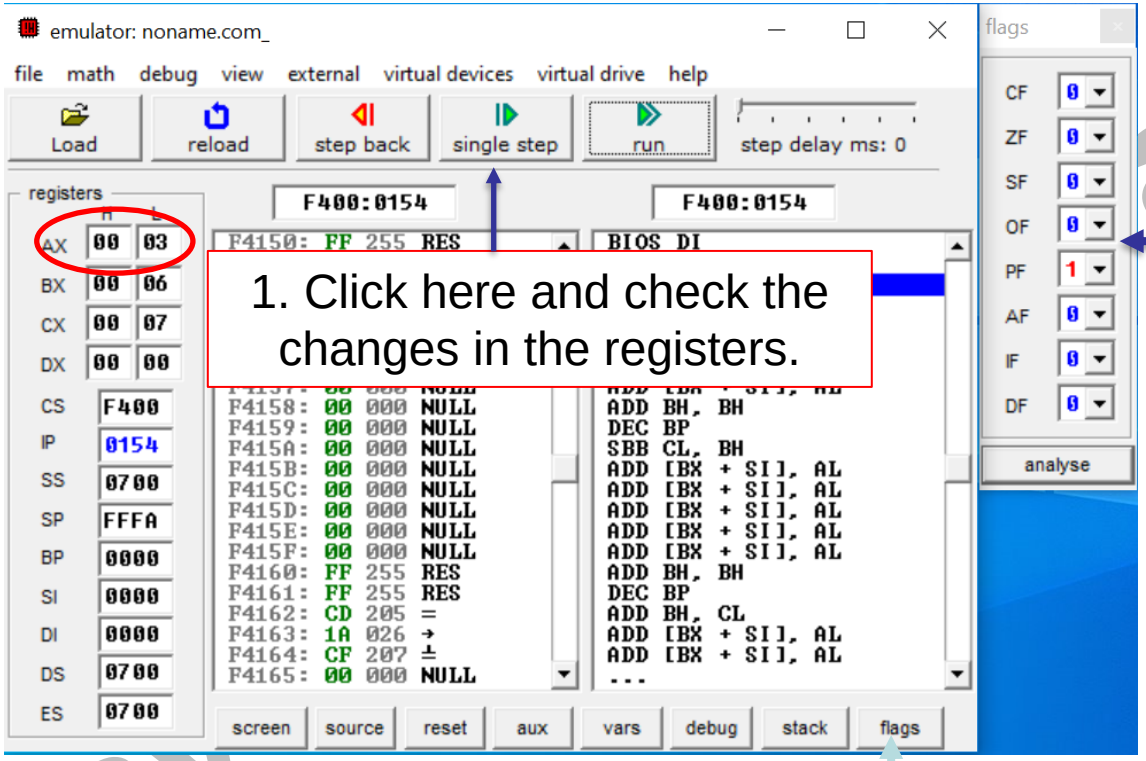
r: flag value depends on result of the instruction

- Effect on Flags

• 2.3 Subtraction of two 8-bit numbers

- **Example Code**

```
org 100h

MOV AL,009H
MOV BL,006H
SUB AL,BL

ret
```



1. Click here and check the changes in the registers.

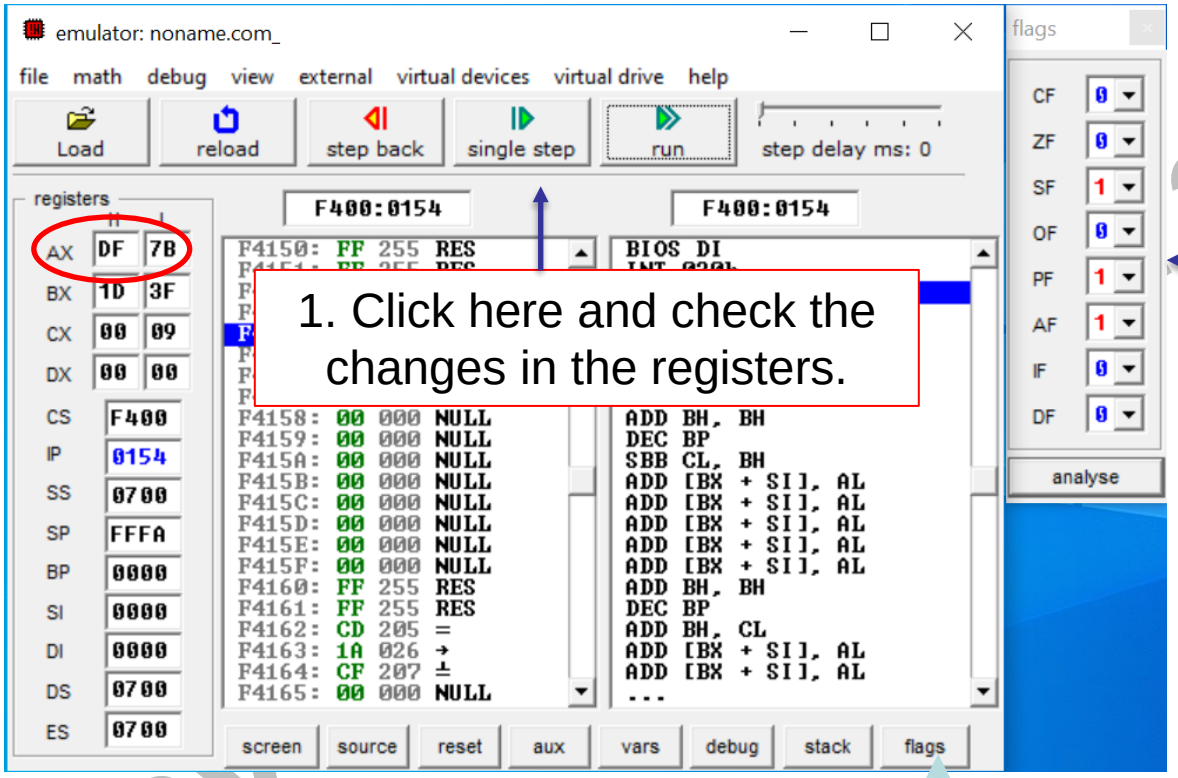
2. Click here to check the conditions of flags of the µp.

3. Interpret the results of the flags of the µp.

• 2.4 Subtraction of two 16-bit numbers

- **Example Code**

```
org 100h
MOV AX,0FCBAH
MOV BX,01D3FH
SUB AX,BX
ret
```



1. Click here and check the changes in the registers.

2. Click here to check the conditions of flags of the µp.

3. Interpret the results of the flags of the µp.

SF: 1- MSB is 1 (negative)
0- MSB is 0 (positive)

AF: 1-carry out from bit 3 on addition or borrow into bit 3 on subtraction
0-otherwise

• 2.5 Multiplication of two numbers

- Instruction to be used: **MUL**

Instruction	Operands	Usage Description
MUL	REG	When operand is a **byte**: AX = AL × operand. When operand is a **word**: (DX AX) = AX × operand.
	memory	

- Effect on Flags

C	Z	S	O	P	A
r	r	r	r	r	r

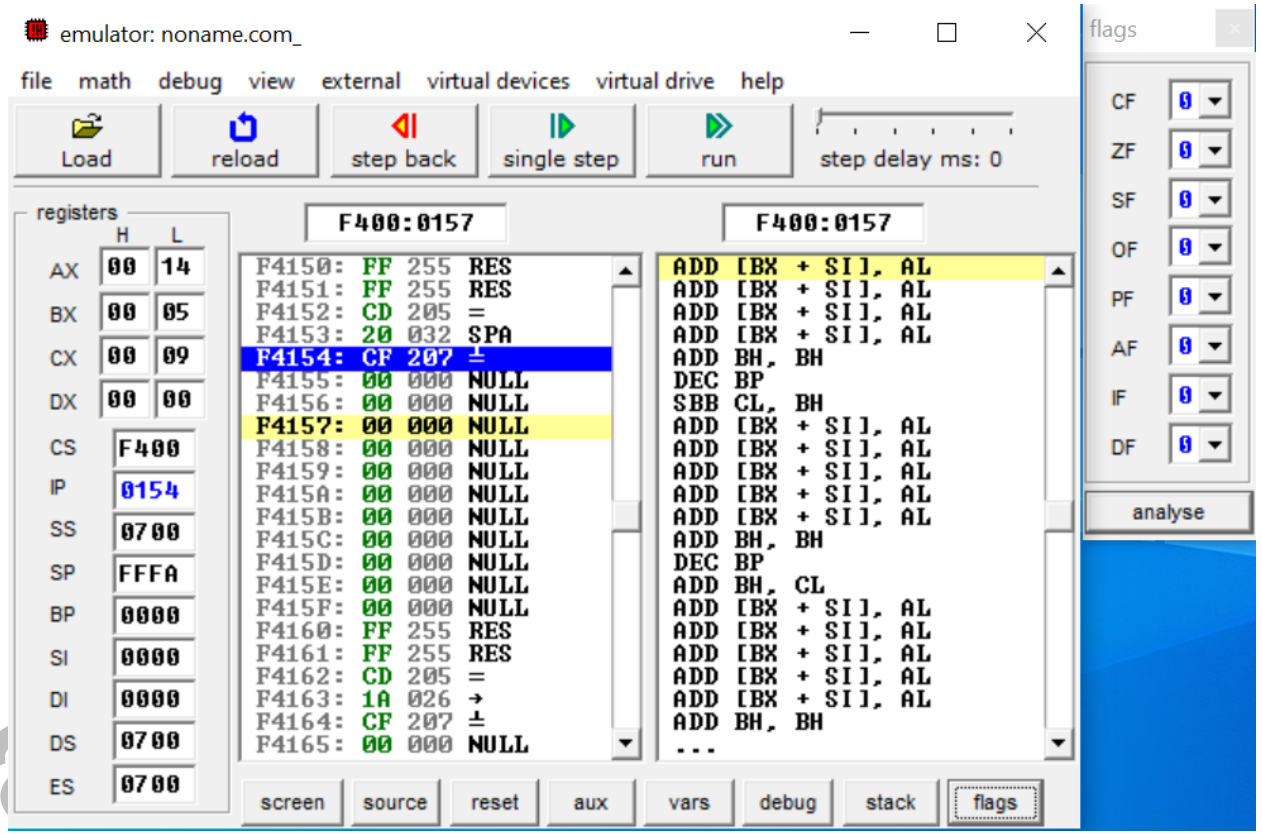
r: flag value depends on result of the instruction.

- CF = OF = 0 when high section of the result is zero.

• 2.5 Multiplication of two 8-bit numbers

- **Example Code**

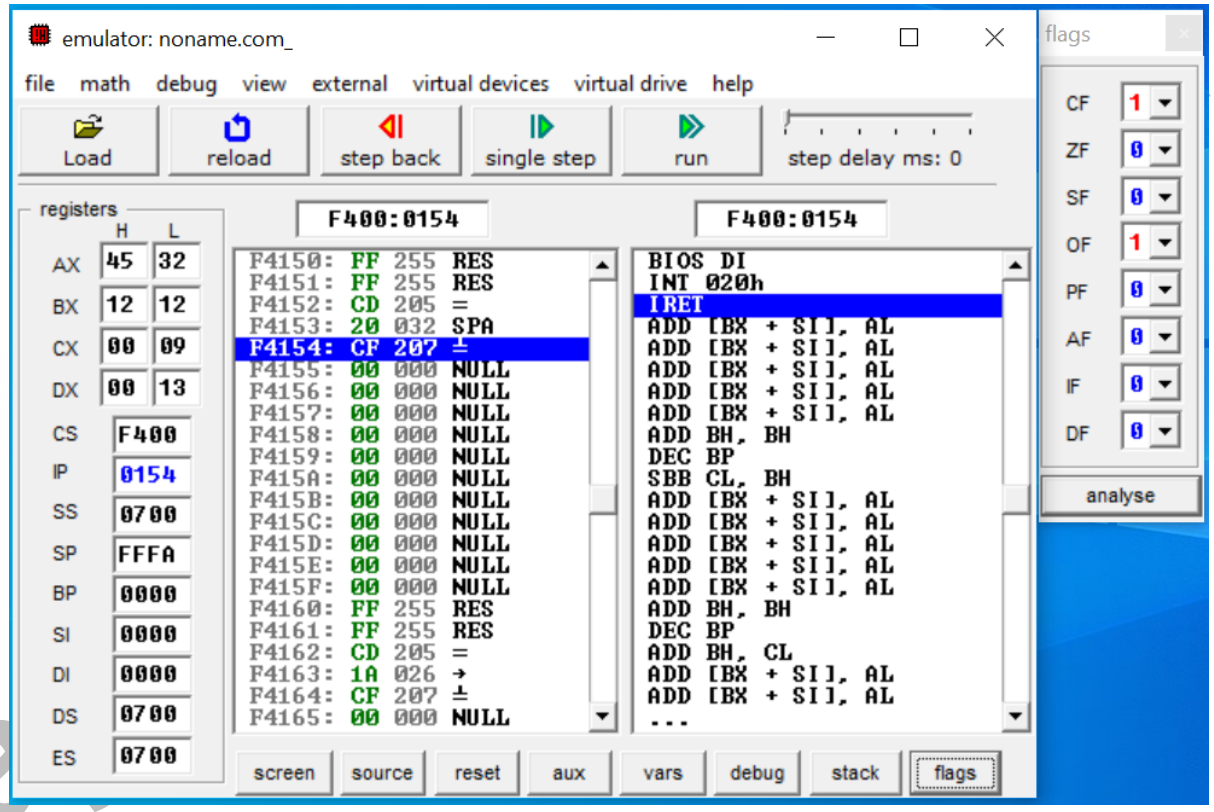
```
org 100h

MOV AX,04H
MOV BX,05H
MUL BX

ret
```



• 2.6 Multiplication of two 16-bit numbers

- **Example Code**

```
org 100h
MOV AX, 0111H
MOV BX, 1212H
MUL BX
ret
```



Check the content of both AX and DX registers.

• 2.7 Division of two numbers

- Instruction to be used: **DIV**

Instruction	Operands	Usage Description
DIV	REG	When operand is a **byte**: AL = AX / operand AH = remainder (modulus) When operand is a **word**: AX = (DX AX) / operand DX = remainder (modulus)
	memory	

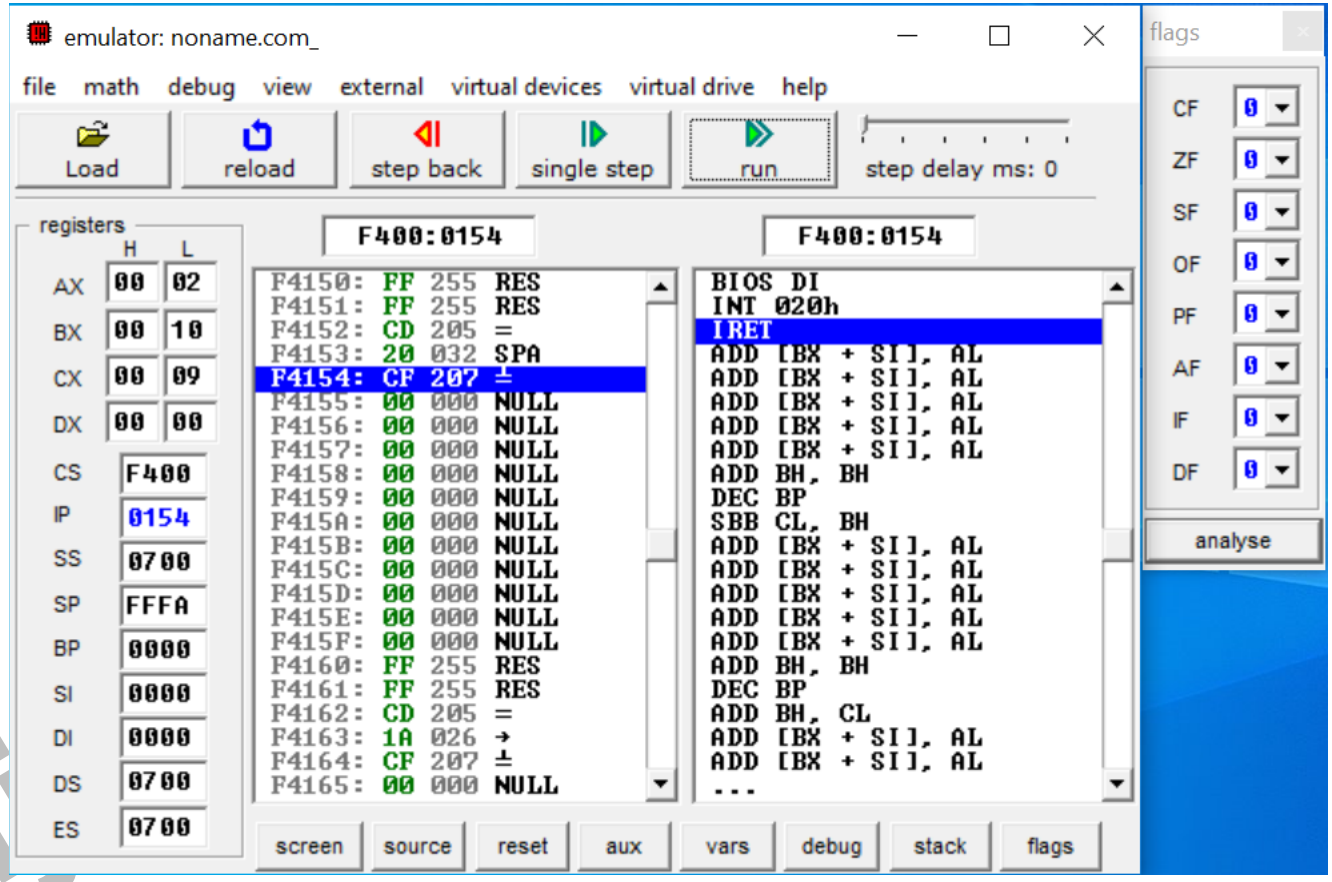
- Effect on Flags

C	Z	S	O	P	A
r	r	r	r	r	r

• 2.7 Division of two 8-bit numbers

- **Example Code**

```
org 100h

MOV AX,20H
MOV BX,10H
DIV BX

ret
```

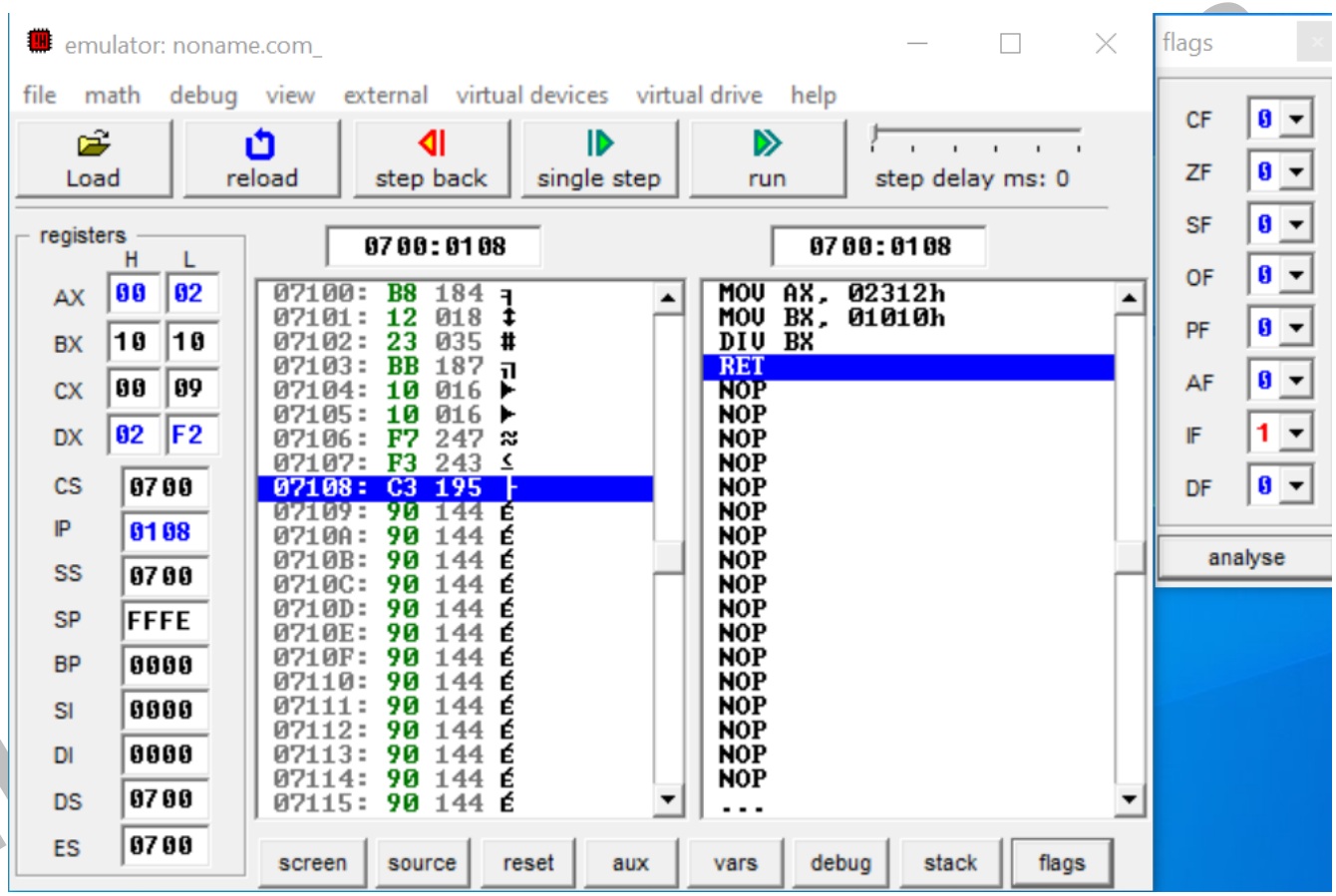


Check the content of both AL and DL registers.

• 2.8 Division of two 16-bit numbers

- **Example Code**

```
org 100h
MOV AX,2312H
MOV BX,1010H
DIV BX
ret
```



Check the content of both AX and DX registers.

• Exercise

- Write ALP codes for the following arithmetic operations:

Problem No.	Arithmetic Instructions	Which registers are to be used?
1	12H + CAH	CL, DL
2	1A4CH + B1DEH	AX, BX
3	7AH – 4CH	CL, DL
4	3B7AH – C142H	BX, CX
5	1DH × 77H	AL, BL
6	EF1AH × CD50H	AX, BX
7	19H ÷ 03H	AL, BL
8	1927H ÷ 1201H	AX, BX

-
- In each case interpret the results of different flags. Crosscheck your results by converting them into decimal numbers.

- Thankyou