EXPERIMENT NO- 1

AIM: WAP to perform 8bit/16 bit arithmetic operations and display the contents of flag register.

Resource Required: P-IV and above RAM 128MB, Dot Matrix Printer, Emu 8086, MASM 611/ TASM, Turbo C/C++, Printer, Printout Stationary.

THEORY:

Assemble language has two types of statements:

1. **Executable**: Instruction that are translated into machine code by the assembler
2. **Assembler Directives**:
    - Statements that direct the assembler to do some special task.
    - No machine language code is produced for these statements.
    - Their main task is to inform the assembler about the start/ end of a segment, procedure or program, procedure or program, to reserve appropriate space from data storage etc.
    - Some of the assembler directives are listed below:

.DB (define byte): used to define a byte variable. Ex SUM DB 0. Assembler reserves 1 byte of memory for the variable SUM and initializes it to 0.

.DW (Define word, 16 bit): used to define a word type variable.

.DD (Define double word, 32 bit): used to define a double word type variable.

.DQ (Quad Word): used to define a quad word type variable.

Instructions:

MOV Destination Source

Move a byte/word from the source to the destination specified in the instruction.

Source: Register, Memory location, immediate number

Destination: Register, Memory location

Both source & destination cannot be memory locations.

MOVE Register, Register

MOV Memory location, Register

MOV Register, Memory location

MOV Register data.

ADD Destination, Source

Adds the source to the destination & stores the result back in the destination.

Source: Register, Memory Location, Immediate number

Destination: Register

Both source & destination have to be of the same size.

ADD Register, Register

ADD Memory location, Register

ADD Register, Memory location

ADD Register, data.

ADC Destination, Source

Adds the source to the destination & stores the result the with carry back in the destination.

Source: Register, Memory location, immediate number.

Destination: Register

Both source & destination have to be of the same size

ADD Register, Register

ADD Memory location, Register

ADD Register, Memory location

ADD Register, data.

SUB/SBB Destination, source

It is similar to ADD/ADC expect that it does subtraction.

DAA (Decimal adjust for addition)

It makes the result in BCD from after BCD addition is performed.

It works only on AL register.

If D3-DO (Lower 4-bit) > 9 then AF is set, Add 06h to AL.

If D7-D4 (Upper 4-bit) > 9 then CF is set, Add 60h to AL.

DAS (Decimal adjust for subtraction)

It makes the result in packed BCD from after BCD subtraction is performed

It works only on AL register.

If D3-DO (Lower 4-bit) > 9 then AF is set, Add 06h to AL.

If D7-D4 (Upper 4-bit) > 9 then CF is set, Add 60h to AL.

MUL source (Unsigned 8/16-bit registers)

Source: Register, Memory Location

If the source is 8-bit it is multiplied with AL & result is stored in AX

(AH- higher byte, AX- lower byte)

If the source is 16-bit, it is multiplied with AX & result is stored in

DX –AX register (DX-higher byte, AX-lower byte)

MUL affects AF, PF, SF, & ZF.

DIV source (Unsigned 8/16-bit register-divisior)

This instruction is used for unsigned division.

Divides a word by a byte or a double word by word.

If divisior is 8-bit then the dividend is in AX register.

After division the quotient is in AL & reminder is in DX

If divisior is 16-bit then the dividend is in DX-AX

Algorithm :

1. **An algorithm for addition of two 16-bit numbers.**

   Step 1: Start

   Step 2: Initialize data segment

Step 3: Declare two variables that hold the actual data.

Step 4: Initialize code segment

Step 5: Initialize DS register to program

Step 6: move first no. in register (bx)

Step 7: move second no. in register (cx)

Step 8: Perform the addition

Step 9: Stop

2. **An algorithm for subtraction of two 16-bit numbers**.

Step 1: Start

Step 2: Initialize data segment

Step 3: Declare two variables that hold the actual data.

Step 4: Initialize code segment

Step 5: Initialize DS register to program

Step 6: move first no. in register (bx)

Step 7: move second no. in register (cx)

Step 8: Perform the subtraction

Step 9: Stop

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1. **Executable**: Instruction that are translated into machine code by the assembler
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Instructions:

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Move a byte/word from the source to the destination specified in the instruction.

Source: Register, Memory location, immediate number

Destination: Register, Memory location

Both source & destination cannot be memory locations.

MOV Register, Register

MOV Memory location, Register

MOV Register, Memory location

MOV Register data.

ADD Destination, Source

Adds the source to the destination & stores the result back in the destination.

Source: Register, Memory Location, Immediate number

Destination: Register

Both source & destination have to be of the same size.

ADD Register, Register

ADD Memory location, Register

ADD Register, Memory location

ADD Register, data.

ADC Destination, Source

Adds the source to the destination & stores the result the with carry back in the destination.

Source: Register, Memory location, immediate number.

Destination: Register

Both source & destination have to be of the same size

ADD Register, Register

ADD Memory location, Register

ADD Register, Memory location

ADD Register, data.

SUB/SBB Destination, source

It is similar to ADD/ADC expect that it does subtraction.

DAA (Decimal adjust for addition)

It makes the result in BCD from after BCD addition is performed.

It works only on AL register.

If D3-DO (Lower 4-bit) > 9 then AF is set, Add 06h to AL.

If D7-D4 (Upper 4-bit) > 9 then CF is set, Add 60h to AL.

DAS (Decimal adjust for subtraction)

It makes the result in packed BCD from after BCD subtraction is performed

It works only on AL register.

If D3-DO (Lower 4-bit) > 9 then AF is set, Add 06h to AL.

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MUL source (Unsigned 8/16-bit registers)

Source: Register, Memory Location

If the source is 8-bit it is multiplied with AL & result is stored in AX

(AH- higher byte, AX- lower byte)

If the source is 16-bit, it is multiplied with AX & result is stored in

DX –AX register (DX-higher byte, AX-lower byte)

MUL affects AF, PF, SF, & ZF.

IMUL source (Signed 8/16-bit registers)

Sam as MUL expect that the source is a signed number.

DIV source (Unsigned 8/16-bit register-divisior)

This instruction is used for unsigned division.

Divides a word by a byte or a double word by word.

If divisior is 8-bit then the dividend is in AX register.

After division the quotient is in AL & reminder is in DX

If divisior is 16-bit then the dividend is in DX-AX

Register.

IDIV source (Signed 8/16-bit register-divisior)

Same as DIV except that the source is a signed number.

Algorithm :

1. **An algorithm for addition of two 16-bit numbers.**

Step 1: Start

Step 2: Initialize data segment

Step 3: Declare two variables that hold the actual data.

Step 4: Initialize code segment

Step 5: Initialize DS register to program

Step 6: move first no. in register (bx)

Step 7: move second no. in register (cx)

Step 8: Perform the addition

Step 9: Stop

2. **An algorithm for addition of two 16-bit numbers**.

Step 1: Start

Step 2: Initialize data segment

Step 3: Declare two variables that hold the actual data.

Step 4: Initialize code segment

Step 5: Initialize DS register to program

Step 6: move first no. in register (bx)

Step 7: move second no. in register (cx)

Step 8: Perform the subtraction

Step 9: Stop

3. **An algorithm for multiplication of two 16-bit numbers.**

Step 1 : Start

Step 2: Initialize data segment

Step 3 : Declare two variables that hold the actual data.

Step 4 : Initialize code segment

Step 5 : Initialize DS register to program

Step 6 : move first no. in register (ax)

Step 7 : move second no. in register (cx)

Step 8 : multiply both the numbers by using word pointer & transfer the result in particular variable.

Step 9 : Stop

4. **An algorithm for division of 16-bit number by 8-bit number.**

Step 1 : Start

Step 2: Initialize data segment

Step 3 : Declare two variables that hold the actual data.

Step 4 : Initialize code segment

Step 5 : Initialize DS register to program

Step 6 : move 16-bit no.in register (al)

Step 7 : move 8-bit no.in register (bl)

Step 8 : perform division operation & store the result in particular variable

Step 9 : Stop

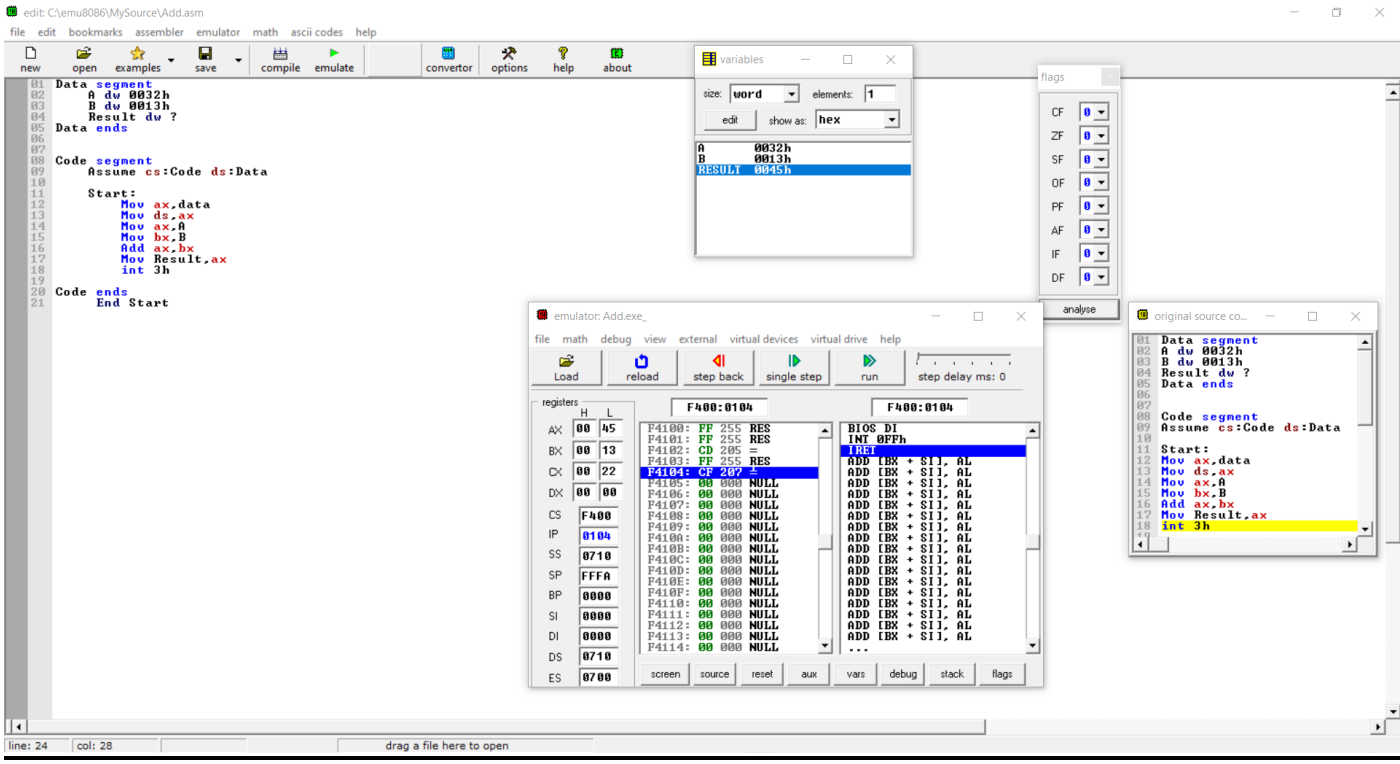
5.

CONCLUSION: **Hence we have done arithmetic operation on 2 8/16 bits number in emu8086 using assembly and display the output and flag contents**

1.Addition of two 16bits:

```
Data segment
   A dw 0032h
   B dw 0013h
   Result dw ?
Data ends
Code segment
   Assume cs:Code ds:Data
   Start:
      Mov ax,data
      Mov ds,ax
      Mov ax,A
      Mov bx,B
      Add ax,bx
      Mov Result,ax
      int 3h
Code ends
    End Start
```

Output:



2. Subtraction of two 16bits number:

Data segment

A dw 0032h

B dw 0013h

Result dw ?

Data ends

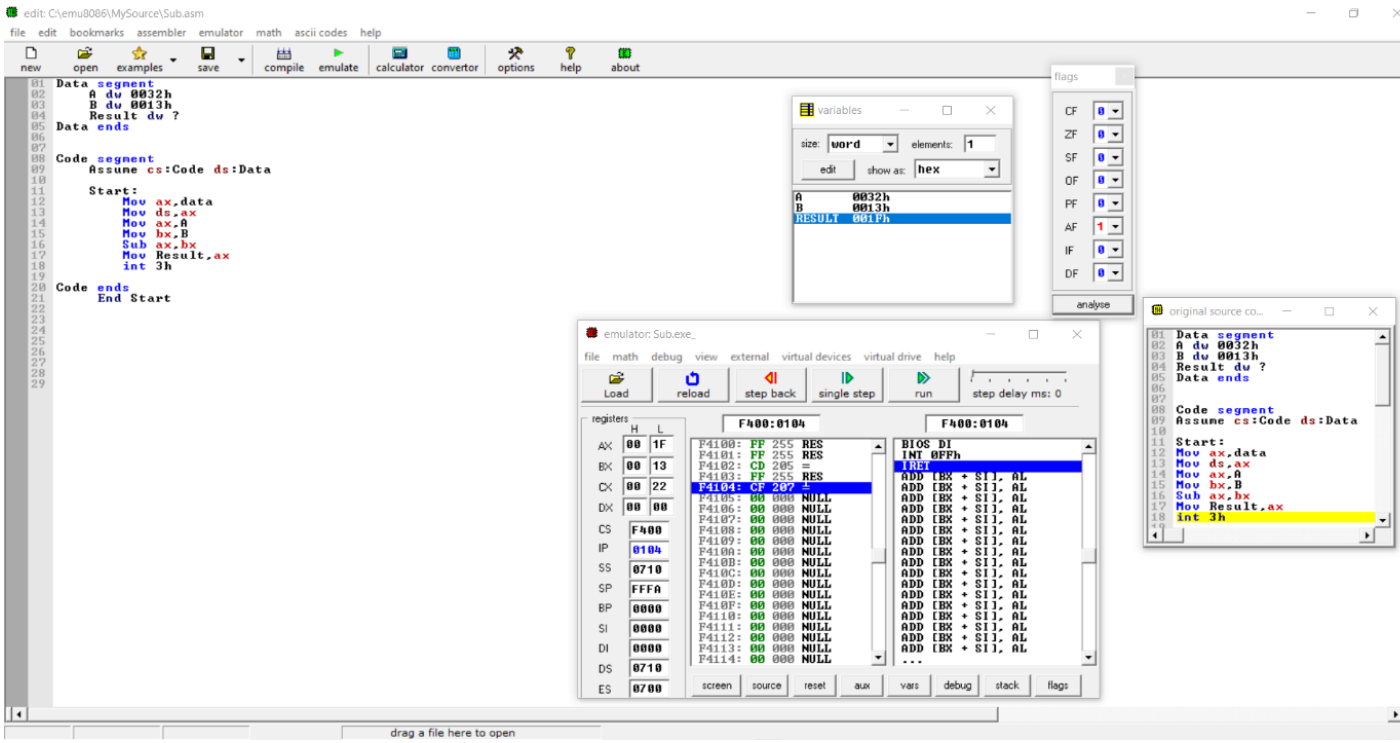
Code segment

Assume cs:Code ds:Data

Start:

```
    Mov ax,data
    Mov ds,ax
    Mov ax,A
    Mov bx,B
    Sub ax,bx
    Mov Result,ax
    int 3h
Code ends
  End Start
```

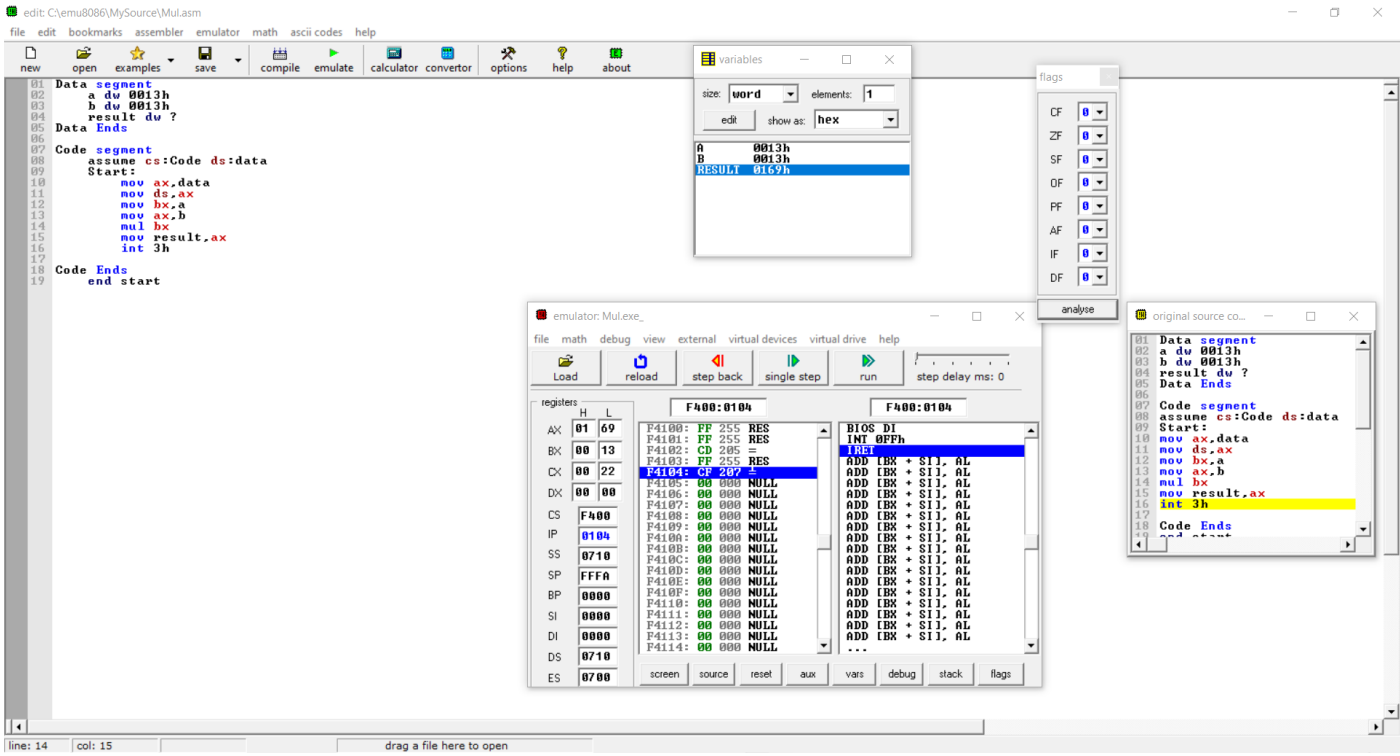
Output :



3. **Multiplication of two 16bits**:

```
Data segment
    a dw 0013h
    b dw 0013h
    result dw ?
Data Ends
Code segment
    assume cs:Code ds:data
    Start:
        mov ax,data
        mov ds,ax
        mov bx,a
        mov ax,b
        mul bx
        mov result,ax
        int 3h
Code Ends
    end start
```

Output:



4. **Division of 16bits/8bits**:

```
Data segment
    a dw 0011h
    b db 05h
    quotient db ?
    remainder db ?
Data Ends
Code segment
    Assume cs:code ds:data
    start:
        mov ax,data
        mov ds,ax
```

```
    mov ax,a
    mov bl,b
    div bl
    mov quotient,al
    mov remainder,ah
    int 3h
Code ends
  end start
```

Output: