AET's
Atharva College of Engineering, Malad(W)
Approved by AICTE, New Delhi, DTE, Mumbai
Affiliated to University of Mumbai, ISO certified 9001:2015
Department of Information Technology
Academic Year: 2021-22

Experiment No-1

AIM: Program for arithmetic operations (8-bits/16-bits)

THEORY:

TASM - This is the assembler. It is used to convert your assembly language file to an object file that contains the machine code that the processor will execute. Register examine or modify the content of internal register of the CPU.The 8086 contains 14 registers. Each register is 16 bits long. The general purpose registers can be "split". AH contains the high byte of AX and AL contains the low byte. "Mov" It is to be shorthand for the word "Move".

Code Segment − It contains all the instructions to be executed. A 16-bit Code Segment register or CS register stores the starting address of the code segment.

Data Segment − It contains data, constants and work areas. A 16-bit Data Segment register or DS register stores the starting address of the data segment.

Stack Segment − It contains data and return addresses of procedures or subroutines. It is implemented as a 'stack' data structure. The Stack Segment register or SS register stores the starting address of the stack.

Sub : It is used for substraction of two numbers

Add : It is used for addition of two numbers

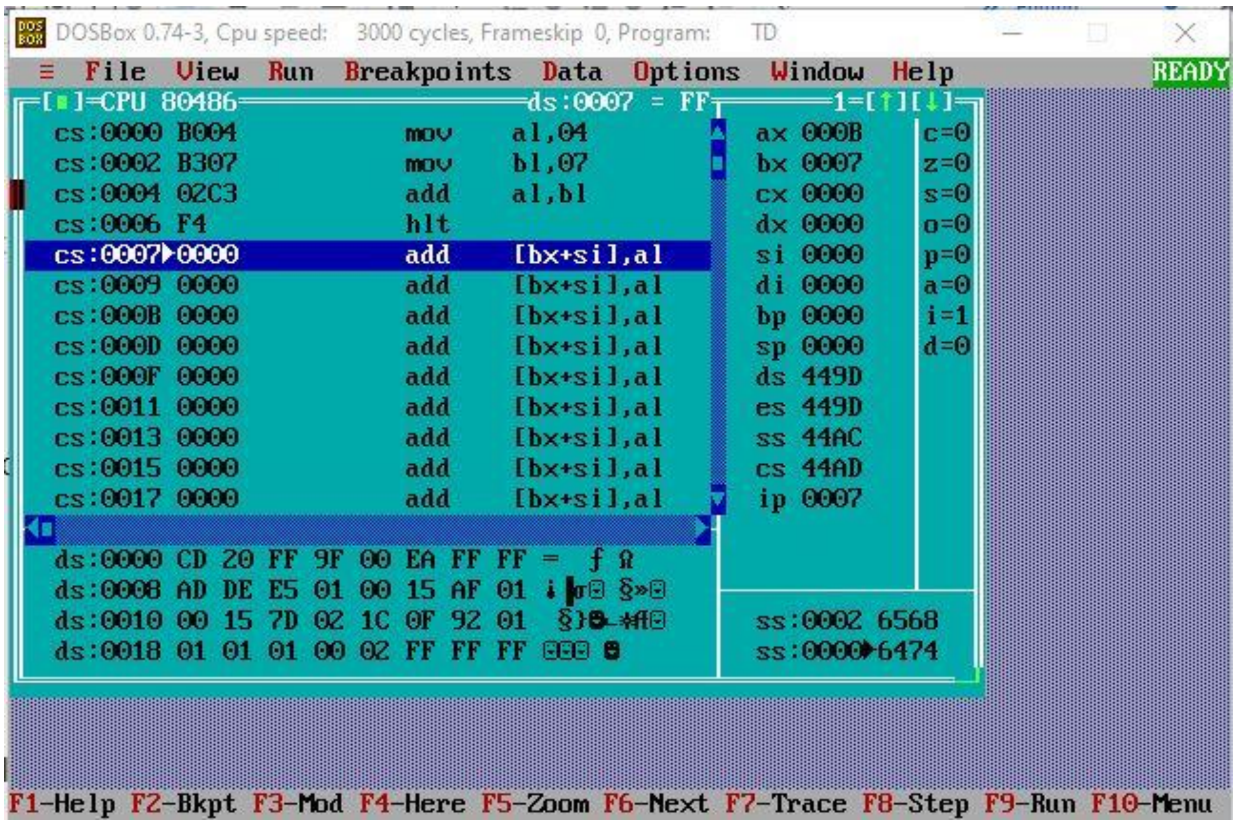
Mul : It is used for multiplication of two numbers

Div : It is used for division of two numbers

HLT : HLT (halt) is an assembly language instruction which halts the central processing unit (CPU) until the next external interrupt is fired

# Addition 0f 8-bit numbers

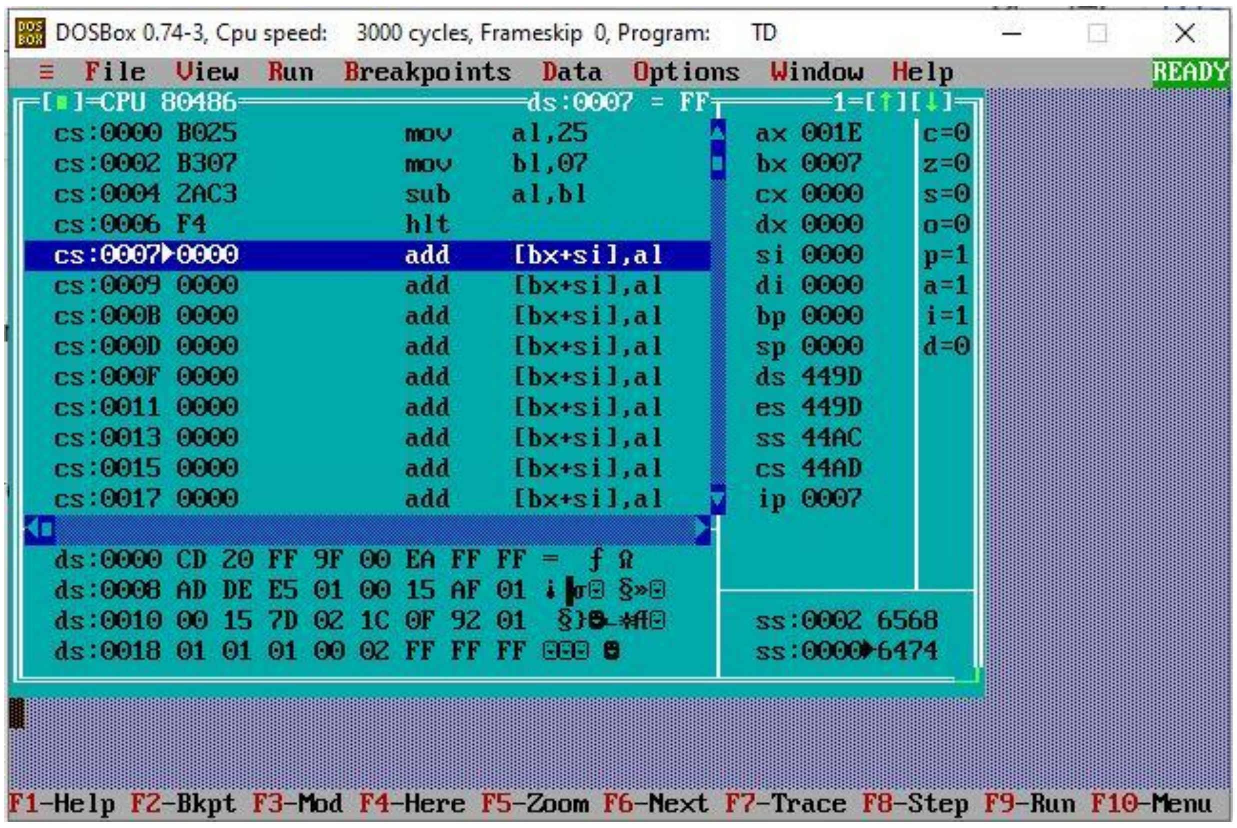
```
assume cs:code, ds:data
data segment
data ends

code segment
start:
        mov al,04h
        mov bl,07h
        add al,bl
        HLT
        code ends
        end start
```



```
DOSBox 0.74-3, Cpu speed:   3000 cycles, Frameskip  0, Program:    TD
 ≡  File  View  Run  Breakpoints  Data  Options  Window  Help            READY
[■]=CPU 80486=================ds:0007 = FF==========1=[↑][↓]=
  cs:0000 B004           mov    al,04           ax 000B    c=0
  cs:0002 B307           mov    bl,07           bx 0007    z=0
  cs:0004 02C3           add    al,bl           cx 0000    s=0
  cs:0006 F4             hlt                    dx 0000    o=0
  cs:0007▶0000           add    [bx+si],al      si 0000    p=0
  cs:0009 0000           add    [bx+si],al      di 0000    a=0
  cs:000B 0000           add    [bx+si],al      bp 0000    i=1
  cs:000D 0000           add    [bx+si],al      sp 0000    d=0
  cs:000F 0000           add    [bx+si],al      ds 449D
  cs:0011 0000           add    [bx+si],al      es 449D
  cs:0013 0000           add    [bx+si],al      ss 44AC
  cs:0015 0000           add    [bx+si],al      cs 44AD
  cs:0017 0000           add    [bx+si],al      ip 0007

  ds:0000 CD 20 FF 9F 00 EA FF FF  =  ƒ Ω
  ds:0008 AD DE E5 01 00 15 AF 01  ¡ σ☺ §»☺
  ds:0010 00 15 7D 02 1C 0F 92 01   §}☻∟☼Æ☺       ss:0002 6568
  ds:0018 01 01 01 00 02 FF FF FF  ☺☺☺ ☻          ss:0000▶6474

F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu
```

Subtraction of 8-bit numbers

```
assume cs:code, ds:data
data segment
data ends

code segment
start:
        mov al, 25h
        mov bl, 07h
        sub al,bl
        HLT
        code ends
        end start
```

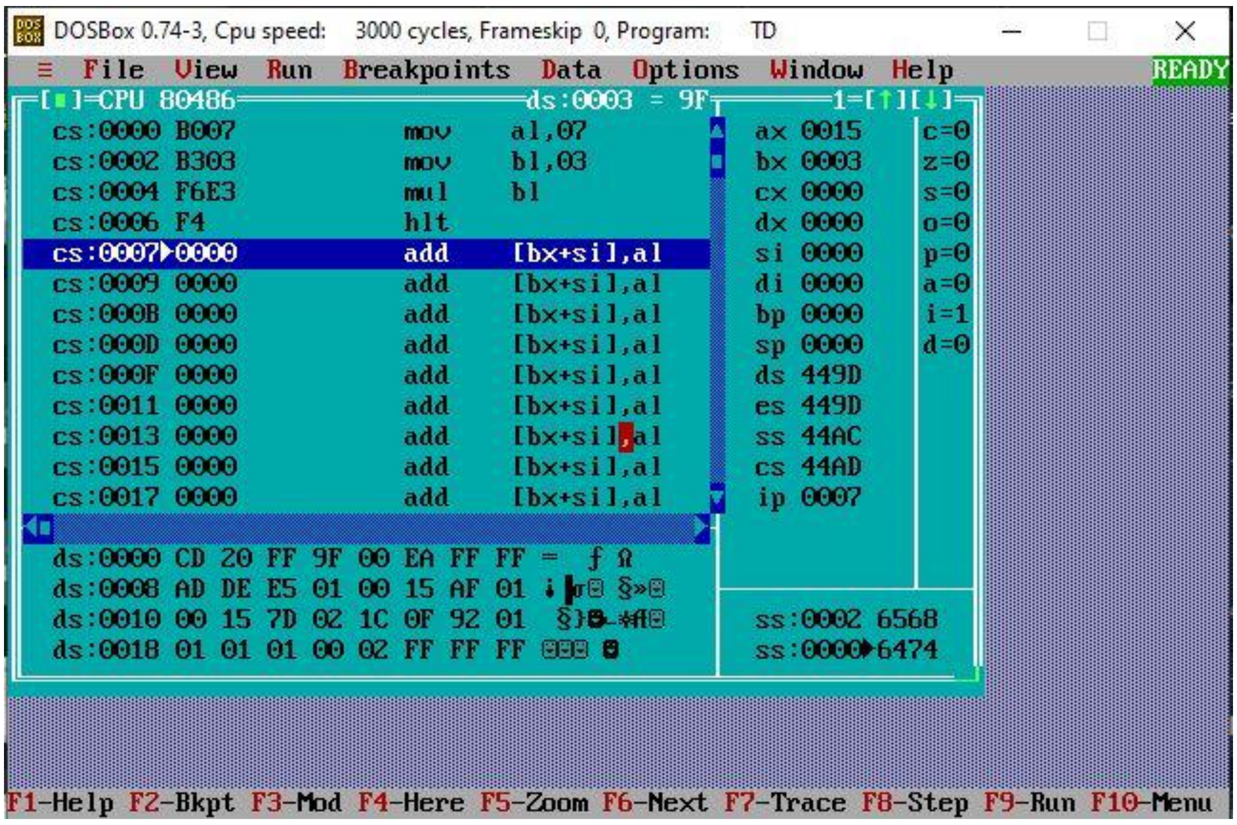


```
DOSBox 0.74-3, Cpu speed:   3000 cycles, Frameskip  0, Program:   TD
 ≡  File  View  Run  Breakpoints  Data  Options  Window  Help              READY
[■]=CPU 80486==================ds:0007 = FF=========1=[↑][↓]=
  cs:0000 B025          mov    al,25              ax 001E    c=0
  cs:0002 B307          mov    bl,07              bx 0007    z=0
  cs:0004 2AC3          sub    al,bl              cx 0000    s=0
  cs:0006 F4            hlt                       dx 0000    o=0
  cs:0007►0000          add    [bx+si],al         si 0000    p=1
  cs:0009 0000          add    [bx+si],al         di 0000    a=1
  cs:000B 0000          add    [bx+si],al         bp 0000    i=1
  cs:000D 0000          add    [bx+si],al         sp 0000    d=0
  cs:000F 0000          add    [bx+si],al         ds 449D
  cs:0011 0000          add    [bx+si],al         es 449D
  cs:0013 0000          add    [bx+si],al         ss 44AC
  cs:0015 0000          add    [bx+si],al         cs 44AD
  cs:0017 0000          add    [bx+si],al         ip 0007

  ds:0000 CD 20 FF 9F 00 EA FF FF
  ds:0008 AD DE E5 01 00 15 AF 01
  ds:0010 00 15 7D 02 1C 0F 92 01                 ss:0002 6568
  ds:0018 01 01 01 00 02 FF FF FF                 ss:0000►6474

F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu
```

Multiplication of 8-bit numbers

```
assume cs:code, ds:data
```

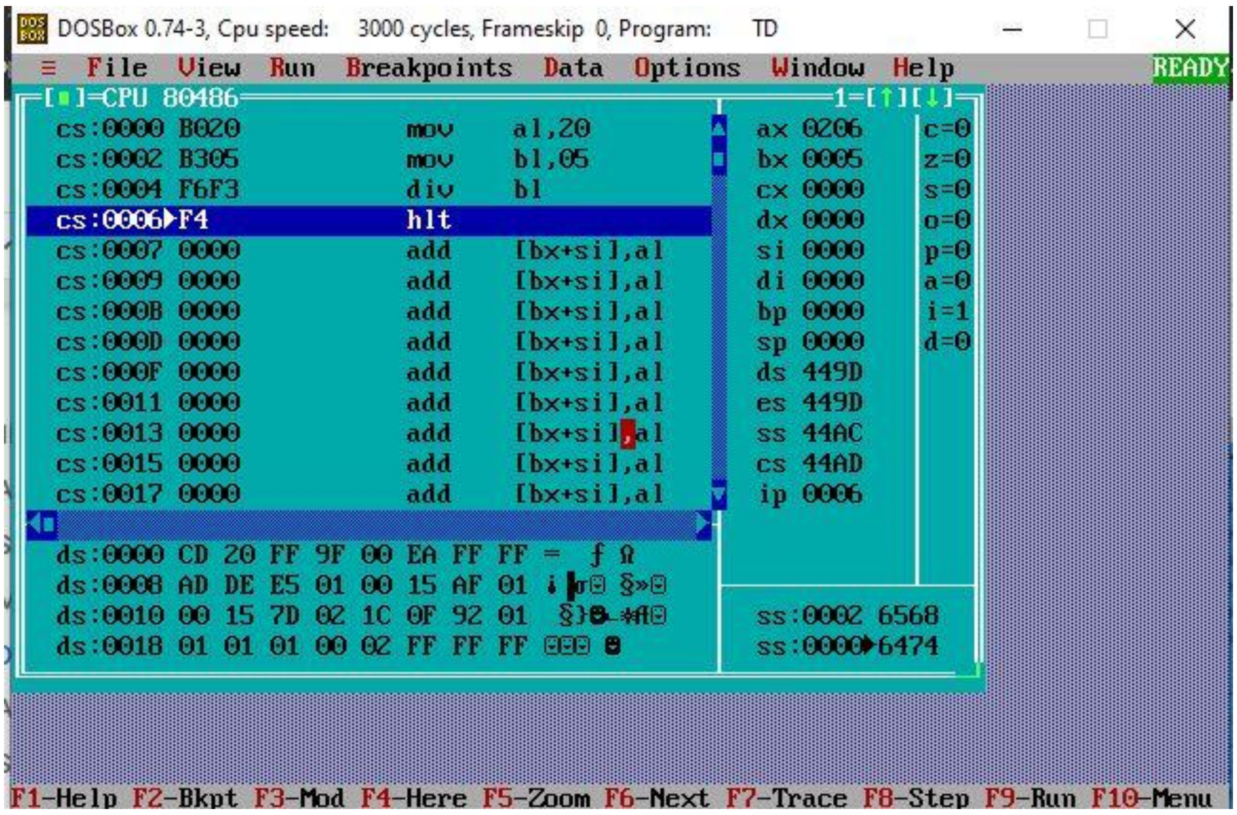
```
data segment
data ends
code segment
start:
        mov al,07h
        mov bl,03h
        mul bl
        HLT
        code ends
        end start
```



```
DOSBox 0.74-3, Cpu speed:   3000 cycles, Frameskip  0, Program:   TD
≡  File  View  Run  Breakpoints  Data  Options  Window  Help                READY
[■]=CPU 80486==================ds:0003 = 9F========1=[↑][↓]=
 cs:0000 B007            mov    al,07          ax 0015    c=0
 cs:0002 B303            mov    bl,03          bx 0003    z=0
 cs:0004 F6E3            mul    bl             cx 0000    s=0
 cs:0006 F4              hlt                   dx 0000    o=0
 cs:0007►0000            add    [bx+si],al     si 0000    p=0
 cs:0009 0000            add    [bx+si],al     di 0000    a=0
 cs:000B 0000            add    [bx+si],al     bp 0000    i=1
 cs:000D 0000            add    [bx+si],al     sp 0000    d=0
 cs:000F 0000            add    [bx+si],al     ds 449D
 cs:0011 0000            add    [bx+si],al     es 449D
 cs:0013 0000            add    [bx+si],al     ss 44AC
 cs:0015 0000            add    [bx+si],al     cs 44AD
 cs:0017 0000            add    [bx+si],al     ip 0007

 ds:0000 CD 20 FF 9F 00 EA FF FF  = ƒ Ω
 ds:0008 AD DE E5 01 00 15 AF 01  ¡ σ §»
 ds:0010 00 15 7D 02 1C 0F 92 01   §}   Æ      ss:0002 6568
 ds:0018 01 01 01 00 02 FF FF FF              ss:0000►6474

F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu
```

Division of 8-bit numbers

```
assume cs:code, ds:data
data segment

data ends

code segment
start:
        mov al,20 h
        mov bl,05h
        div bl
        HLT
        code ends
        end start
```

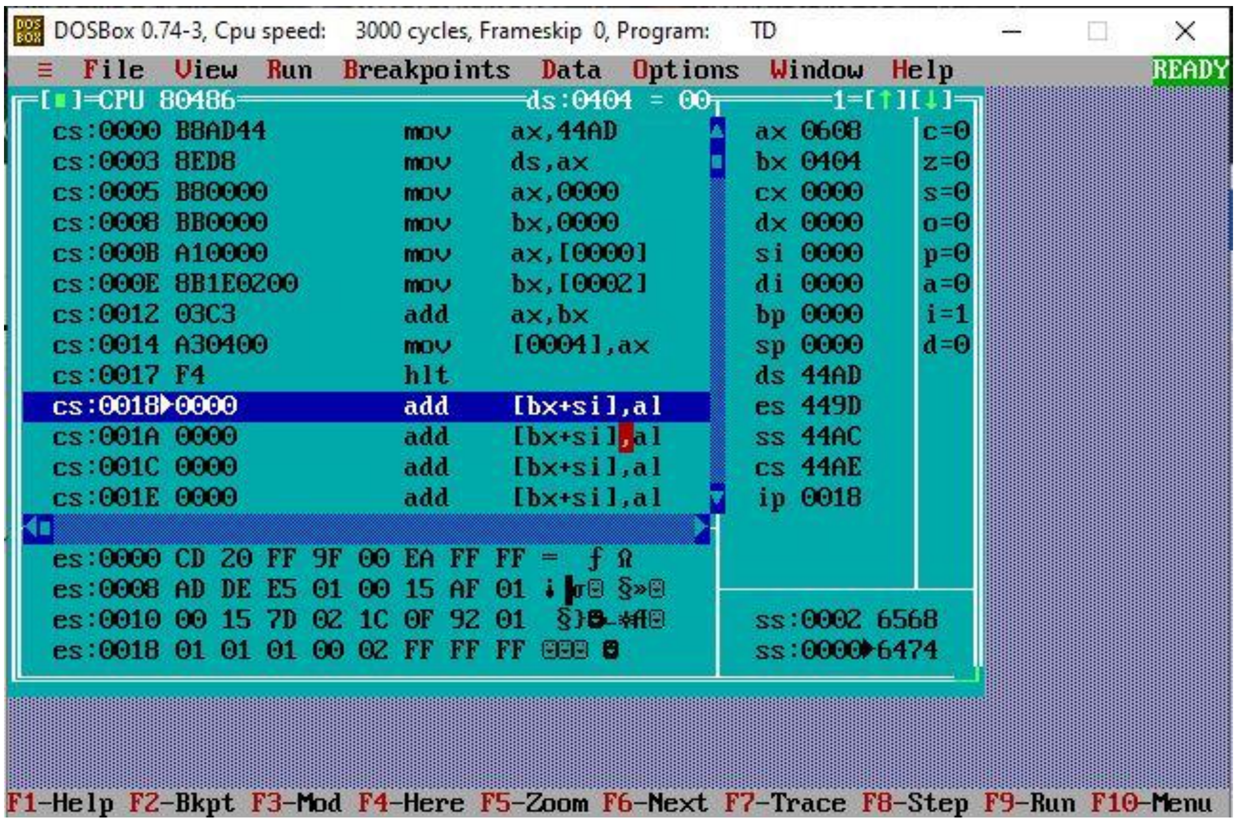


```
DOSBox 0.74-3, Cpu speed:   3000 cycles, Frameskip  0, Program:    TD
 ≡  File  View  Run  Breakpoints  Data  Options  Window  Help          READY
[■]=CPU 80486=================================1=[↑][↓]=
  cs:0000 B020         mov    al,20          ax 0206   c=0
  cs:0002 B305         mov    bl,05          bx 0005   z=0
  cs:0004 F6F3         div    bl             cx 0000   s=0
  cs:0006►F4           hlt                   dx 0000   o=0
  cs:0007 0000         add    [bx+si],al     si 0000   p=0
  cs:0009 0000         add    [bx+si],al     di 0000   a=0
  cs:000B 0000         add    [bx+si],al     bp 0000   i=1
  cs:000D 0000         add    [bx+si],al     sp 0000   d=0
  cs:000F 0000         add    [bx+si],al     ds 449D
  cs:0011 0000         add    [bx+si],al     es 449D
  cs:0013 0000         add    [bx+si],al     ss 44AC
  cs:0015 0000         add    [bx+si],al     cs 44AD
  cs:0017 0000         add    [bx+si],al     ip 0006

  ds:0000 CD 20 FF 9F 00 EA FF FF =  ƒ Ω
  ds:0008 AD DE E5 01 00 15 AF 01 ¡ σ☺ §»☺
  ds:0010 00 15 7D 02 1C 0F 92 01  §}☻∟☼Æ☺     ss:0002 6568
  ds:0018 01 01 01 00 02 FF FF FF ☺☺☺ ☻        ss:0000►6474

F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu
```

# Addition of 16-bit numbers

```
assume cs:code, ds:data
```

```
data segment
a dw 0204h
b dw 0404h
c dw 00h
data ends
code segment
start:
        mov ax,data
        mov ds,ax
        mov ax,0000h
        mov bx,0000h
        mov ax,a
        mov bx,b
        add ax,bx
        mov c,ax
        HLT
        code ends
        end start
```

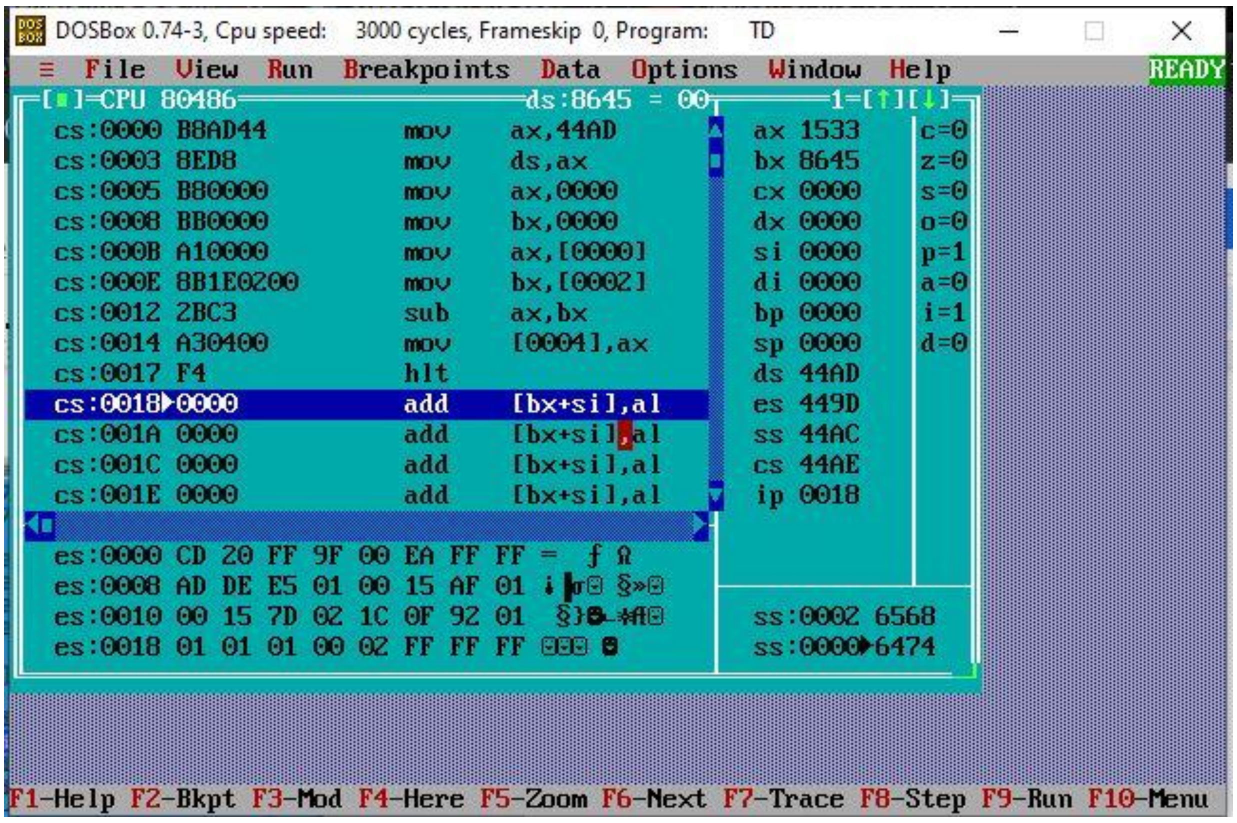


```
DOSBox 0.74-3, Cpu speed:   3000 cycles, Frameskip  0, Program:   TD
≡  File  View  Run  Breakpoints  Data  Options  Window  Help        READY
[■]=CPU 80486================ds:0404 = 00=====1=[↑][↓]=
  cs:0000 B8AD44        mov    ax,44AD          ax 0608    c=0
  cs:0003 8ED8          mov    ds,ax            bx 0404    z=0
  cs:0005 B80000        mov    ax,0000          cx 0000    s=0
  cs:0008 BB0000        mov    bx,0000          dx 0000    o=0
  cs:000B A10000        mov    ax,[0000]        si 0000    p=0
  cs:000E 8B1E0200      mov    bx,[0002]        di 0000    a=0
  cs:0012 03C3          add    ax,bx            bp 0000    i=1
  cs:0014 A30400        mov    [0004],ax        sp 0000    d=0
  cs:0017 F4            hlt                     ds 44AD
  cs:0018►0000          add    [bx+si],al       es 449D
  cs:001A 0000          add    [bx+si],al       ss 44AC
  cs:001C 0000          add    [bx+si],al       cs 44AE
  cs:001E 0000          add    [bx+si],al       ip 0018

  es:0000 CD 20 FF 9F 00 EA FF FF = ƒ ⌂
  es:0008 AD DE E5 01 00 15 AF 01 ¡ §»
  es:0010 00 15 7D 02 1C 0F 92 01  §}       ss:0002 6568
  es:0018 01 01 01 00 02 FF FF FF           ss:0000►6474

F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu
```

# Subtraction of 16-bit numbers

```
assume cs:code, ds:data
data segment
a dw 9B78h
```

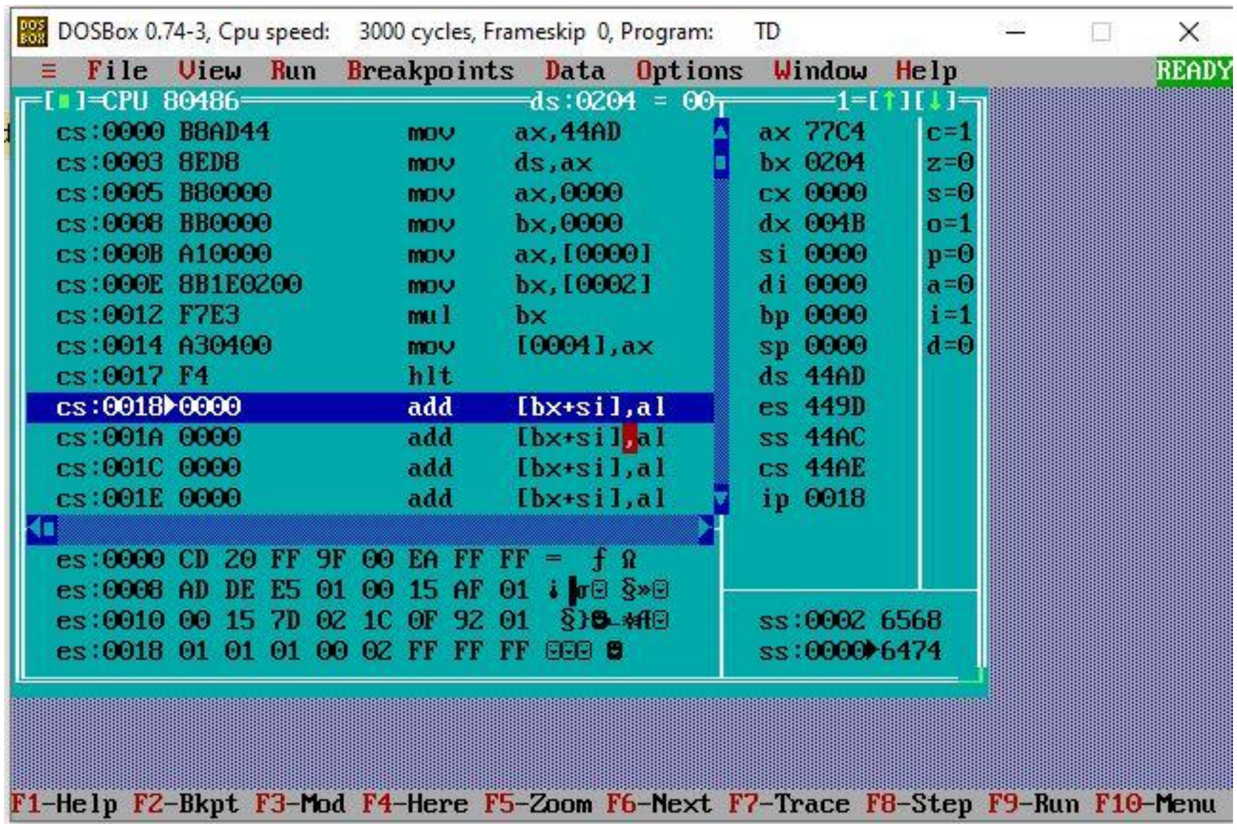
```
b dw 8645h
c dw 00h
data ends
code segment
start:
        mov ax,data
        mov ds,ax
        mov ax,00h
        mov bx,00h
        mov ax,a
        mov bx,b
        sub ax,bx
        mov c,ax
        HLT
        code ends
        end start
```



```
DOSBox 0.74-3, Cpu speed:   3000 cycles, Frameskip  0, Program:   TD
 ≡  File  View  Run  Breakpoints  Data  Options  Window  Help            READY
[■]=CPU 80486===================ds:8645 = 00========1=[↑][↓]=
  cs:0000 B8AD44         mov    ax,44AD         ax 1533   c=0
  cs:0003 8ED8           mov    ds,ax           bx 8645   z=0
  cs:0005 B80000         mov    ax,0000         cx 0000   s=0
  cs:0008 BB0000         mov    bx,0000         dx 0000   o=0
  cs:000B A10000         mov    ax,[0000]       si 0000   p=1
  cs:000E 8B1E0200       mov    bx,[0002]       di 0000   a=0
  cs:0012 2BC3           sub    ax,bx           bp 0000   i=1
  cs:0014 A30400         mov    [0004],ax       sp 0000   d=0
  cs:0017 F4             hlt                    ds 44AD
  cs:0018►0000           add    [bx+si],al      es 449D
  cs:001A 0000           add    [bx+si],al      ss 44AC
  cs:001C 0000           add    [bx+si],al      cs 44AE
  cs:001E 0000           add    [bx+si],al      ip 0018

  es:0000 CD 20 FF 9F 00 EA FF FF = ƒ Ω
  es:0008 AD DE E5 01 00 15 AF 01
  es:0010 00 15 7D 02 1C 0F 92 01               ss:0002 6568
  es:0018 01 01 01 00 02 FF FF FF               ss:0000►6474

F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu
```

# Multiplication of 16-bit numbers

```
assume cs:code, ds:data
data segment
a dw 2571h
b dw 0204h
c dw 00h
data ends
code segment
start:
        mov ax,data
        mov ds,ax
        mov ax,0000h
        mov bx,0000h
        mov ax,a
        mov bx,b
        mul bx
        mov c,ax
        HLT
        code ends
        end start
```

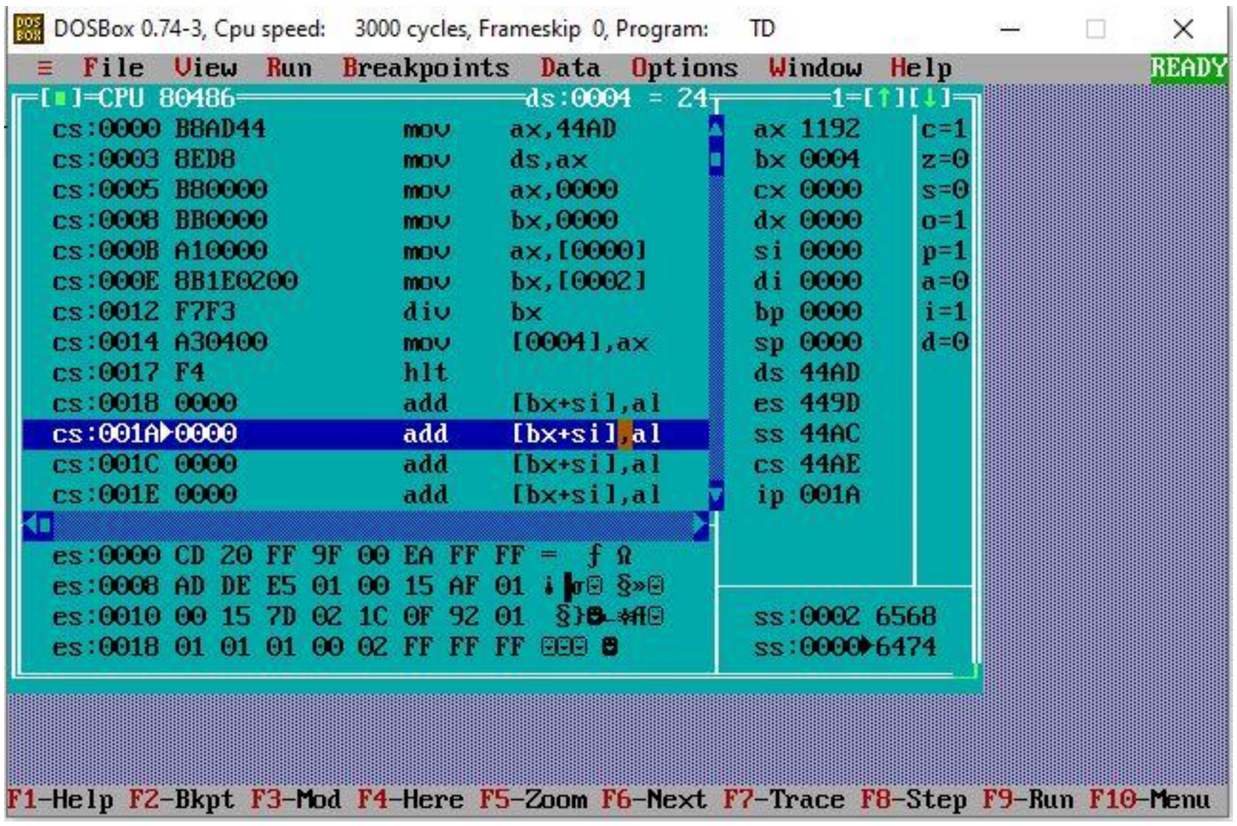


```
DOSBox 0.74-3, Cpu speed:    3000 cycles, Frameskip  0, Program:    TD
 ≡  File  View  Run  Breakpoints  Data  Options  Window  Help              READY
[■]=CPU 80486=====================ds:0204 = 00=========1=[↑][↓]=
 cs:0000 B8AD44         mov    ax,44AD           ax 77C4   c=1
 cs:0003 8ED8           mov    ds,ax             bx 0204   z=0
 cs:0005 B80000         mov    ax,0000           cx 0000   s=0
 cs:0008 BB0000         mov    bx,0000           dx 004B   o=1
 cs:000B A10000         mov    ax,[0000]         si 0000   p=0
 cs:000E 8B1E0200       mov    bx,[0002]         di 0000   a=0
 cs:0012 F7E3           mul    bx                bp 0000   i=1
 cs:0014 A30400         mov    [0004],ax         sp 0000   d=0
 cs:0017 F4             hlt                      ds 44AD
 cs:0018▶0000           add    [bx+si],al        es 449D
 cs:001A 0000           add    [bx+si],al        ss 44AC
 cs:001C 0000           add    [bx+si],al        cs 44AE
 cs:001E 0000           add    [bx+si],al        ip 0018

 es:0000 CD 20 FF 9F 00 EA FF FF  =  ƒ Ω
 es:0008 AD DE E5 01 00 15 AF 01  ¡ σ  §»
 es:0010 00 15 7D 02 1C 0F 92 01   §}   Æ        ss:0002 6568
 es:0018 01 01 01 00 02 FF FF FF                 ss:0000▶6474

F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu
```

# Division of 16-bit numbers

```
assume cs:code, ds:data
data segment
a dw 4648h
```

```
b dw 0004h
c dw 00h
data ends
code segment
start:
        mov ax,data
        mov ds,ax
        mov ax,0000h
        mov bx,0000h
        mov ax,a
        mov bx,b
        div bx
        mov c,ax
        HLT
        code ends
        end start
```



```
DOSBox 0.74-3, Cpu speed:   3000 cycles, Frameskip  0, Program:   TD
 ≡  File  View  Run  Breakpoints  Data  Options  Window  Help          READY
[■]=CPU 80486=====================ds:0004 = 24========1=[↑][↓]=
  cs:0000 B8AD44         mov    ax,44AD        ax 1192    c=1
  cs:0003 8ED8           mov    ds,ax          bx 0004    z=0
  cs:0005 B80000         mov    ax,0000        cx 0000    s=0
  cs:0008 BB0000         mov    bx,0000        dx 0000    o=1
  cs:000B A10000         mov    ax,[0000]      si 0000    p=1
  cs:000E 8B1E0200       mov    bx,[0002]      di 0000    a=0
  cs:0012 F7F3           div    bx             bp 0000    i=1
  cs:0014 A30400         mov    [0004],ax      sp 0000    d=0
  cs:0017 F4             hlt                   ds 44AD
  cs:0018 0000           add    [bx+si],al     es 449D
  cs:001A►0000           add    [bx+si],al     ss 44AC
  cs:001C 0000           add    [bx+si],al     cs 44AE
  cs:001E 0000           add    [bx+si],al     ip 001A

  es:0000 CD 20 FF 9F 00 EA FF FF =  ƒ Ω
  es:0008 AD DE E5 01 00 15 AF 01 ¡ σ☺ §»☺
  es:0010 00 15 7D 02 1C 0F 92 01  §}☻∟☼Æ☺    ss:0002 6568
  es:0018 01 01 01 00 02 FF FF FF ☺☺☺ ☻      ss:0000►6474

F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu
```

CONCLUSION: Thus using Doc and GUI we have successfully implemented the different mathematical concept i.e Learnt about the mov instruction and assembler directives such db, segment, assume, register, etc and implemented it using TASM and DoosBox