St. Francis Institute of Technology

Class: SE-ITA/ITB Semester: IV; A.Y. 2023-2024

Subject: Microprocessor Lab

Experiment – 8: Transfer block of data using string instructions

1. **Aim**:
   Write an ALP to transfer a block of data from data segment to extra segment using string instructions and display the block of data on the output screen.

2. **Requirements**
   DOSBox (an x86 emulator with DOS), Turbo Assembler, Turbo Debugger

3. **Pre-Experiment Exercise**
   Data transfer using string instruction: A string is a series of bytes stored sequentially in the memory. String instructions operate on such "String". The source element is taken from the Data Segment using the SI register. The destination element is in the Extra Segment pointed by the DI register. SI and/or DI are incremented/ decremented after each operation depending upon the direction flag "DF" in the Flag register. String instruction used in this program is MOVSB which is used to transfer a byte from Data Segment to Extra Segment. The instruction is used with a prefix REP which stands for repeat. The instruction is repeated CX number of times, the SI and DI registers are incremented and decremented based on the Direction Flag and CX is decremented.
   Display data on dos-prompt: INT 21h is a Dos interrupt that allows a programmer to interact with the input and output devices. To write a character to standard output, load the character to DL register and use the following command.

```
MOV AH,02H
INT 21
```

   Please note that output devices work with ASCII numbers so appropriate care must be taken to convert the character to equivalent ASCII number.

   Algorithm:
   A. Initialize a block of data in array1 in the data segment and empty block in array 2 in the extra segment.
   B. Load the respective effective address in SI and DI register.
   C. Initialize the CX register as counter to the size of the block.
   D. Use string instruction to transfer the block of data from data segment to extra segment.
   E. Reload the effective address in SI register and initialize the CX register as a counter.
   F. Use INT 21h and associated options to display the block on dos-prompt.

4. **Laboratory Exercise:**
   Procedure:
   A. Open DOSbox and go to TASM.
   B. Open a new document using the command - edit <filename>.asm
   C. Write the Program and save the changes to the same file.
   D. Assemble the program using the command - tasm <filename.asm>

E. If any errors are displayed, then change the code in <filename>

F. If no errors are displayed, execute the command - tlink <filename>.obj to create the executable file.

G. Next execute the command - td <filename>

H. Try to RUN the program step by step. Check both data segment and extra segment to observe the transfer of data.

I. Execute again using the command - <filename> to observe the block displayed on the dos-prompt.

5. Post Experiment Exercise:

A. Results/Calculations/Observations:

Along with ALP, attach two screenshots.

i. One after MOVSB instruction has been executed.

ii. Second after the data has been displayed on the output screen.

B. Questions:

i. Write in detail about the following String Instructions.
(a) LODS (b) STOS (c) CMPS (d) SCAS

ii. List the different REP prefixes used with string instructions.

C. Conclusion:

Write the conclusion/comments based on the experiment performed and the output obtained.

D. References:

Mention two book references and two web references.

```
Name:Vishal Rajesh Mahajan                     Roll No: 63
Class: SE INFT A                               EXP No.: 8
```

Write an ALP to transfer a block of data from data segment to extra segment using string instructions and display the block of data on the output screen.

Code:

```
model small
stack 10h
data segment
        ar1 dB 1,2,3,4,5,6,7,8,9
data ends
extra segment
        ar2 dB 09 dup('?')
extra ends
code segment
        assume cs:code,ds:data,es:extra
start:
        mov ax, data
        mov ds, ax
        mov ax, extra
        mov es, ax
        lea si, ar1
        lea di, ar2
        mov cx, 0009h
      rep movsb
        lea si, ar1
        mov cx, 0009h
      l2: mov dl, [si]
        add dl, 48
        mov ah, 02h
        int 21h
        mov dl, 32
        mov ah, 02h
        int 21h
        inc si
        loop l2
        mov ah, 4ch
        int 21h
code ends
end start
```

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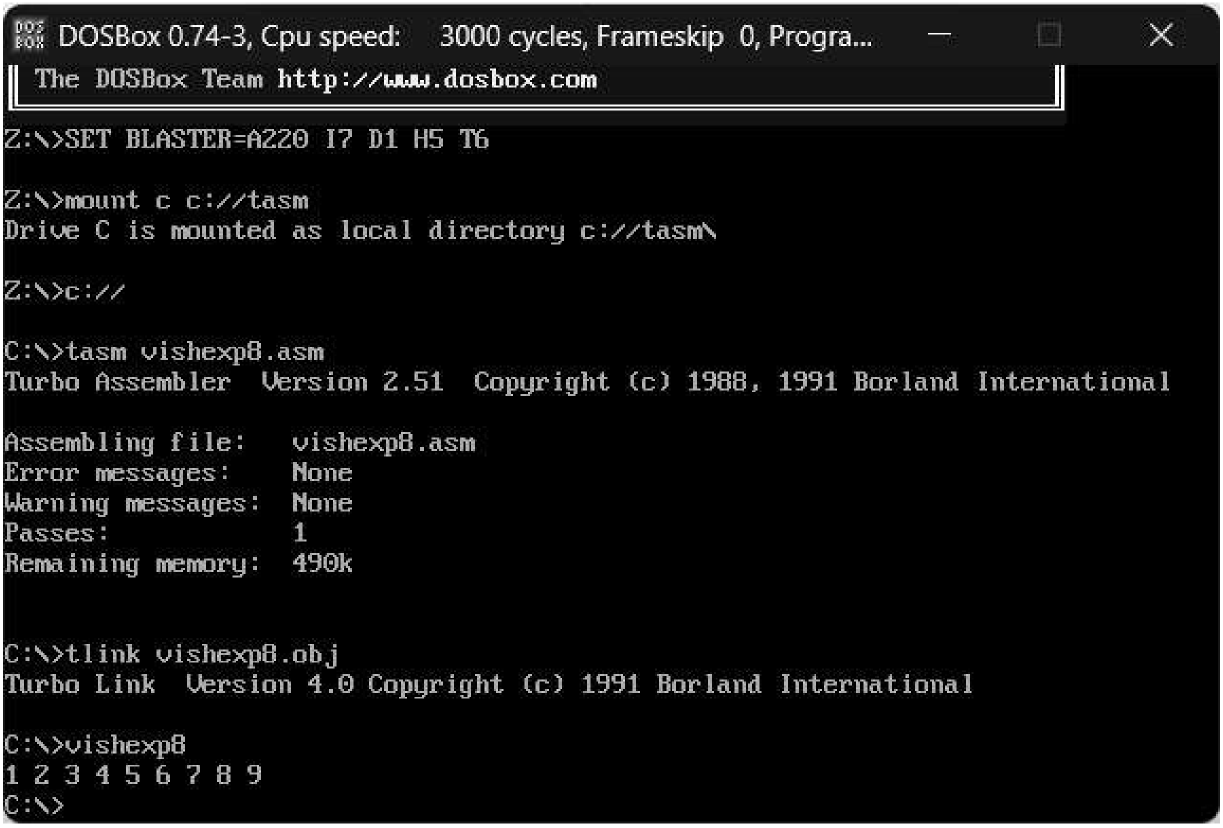
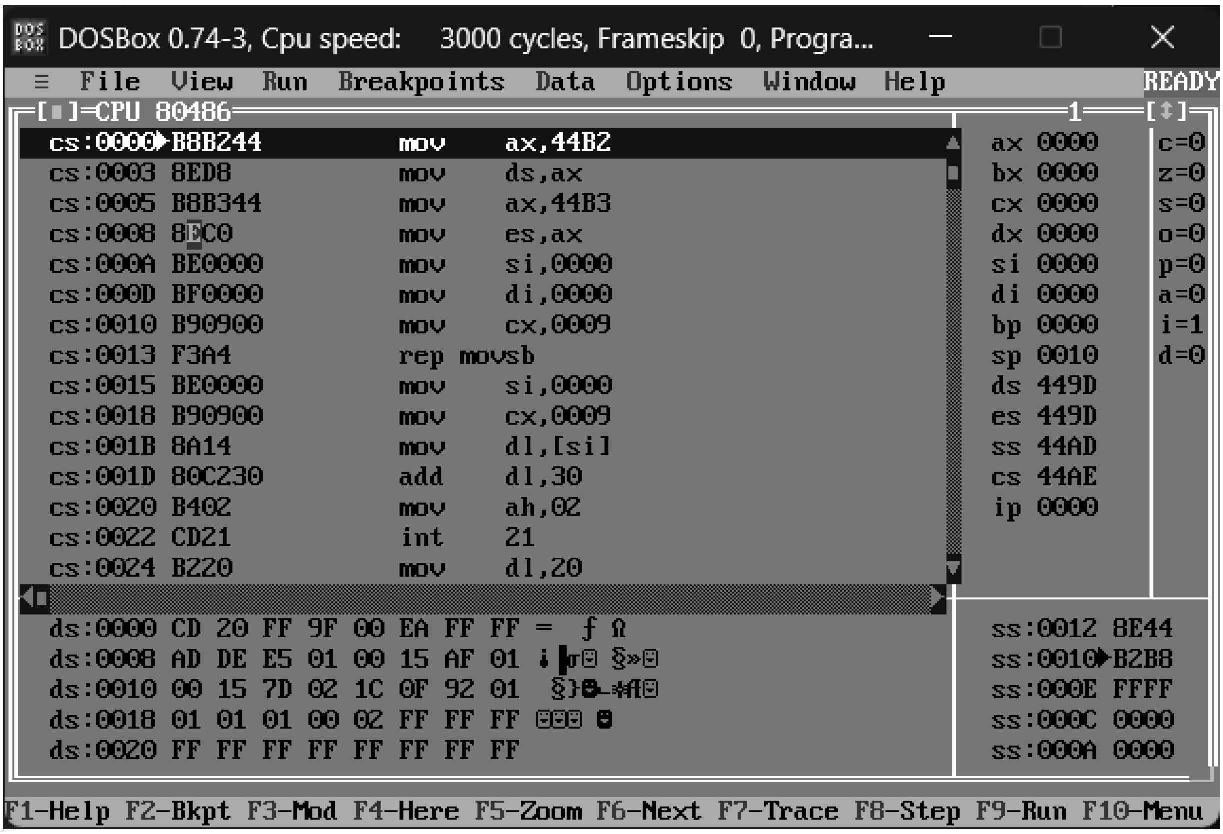
Class: SE INFT A   EXP No.: 8



DOSBox 0.74-3, Cpu speed: 3000 cycles, Frameskip 0, Progra...

```
 The DOSBox Team http://www.dosbox.com

Z:\>SET BLASTER=A220 I7 D1 H5 T6

Z:\>mount c c://tasm
Drive C is mounted as local directory c://tasm\

Z:\>c://

C:\>tasm vishexp8.asm
Turbo Assembler  Version 2.51  Copyright (c) 1988, 1991 Borland International

Assembling file:   vishexp8.asm
Error messages:    None
Warning messages:  None
Passes:            1
Remaining memory:  490k


C:\>tlink vishexp8.obj
Turbo Link  Version 4.0 Copyright (c) 1991 Borland International

C:\>vishexp8
1 2 3 4 5 6 7 8 9
C:\>
```

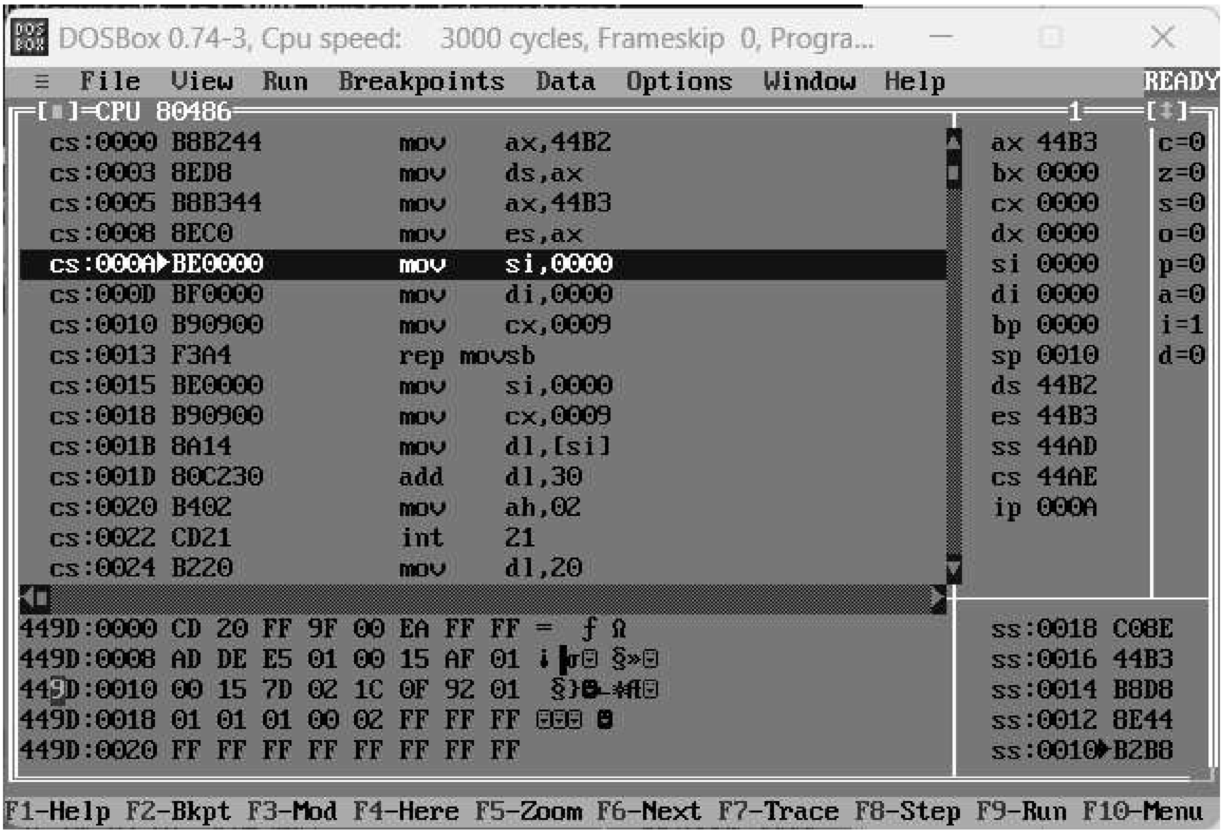


DOSBox 0.74-3, Cpu speed: 3000 cycles, Frameskip 0, Progra...
≡ File View Run Breakpoints Data Options Window Help   READY
[■]=CPU 80486
1
F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu

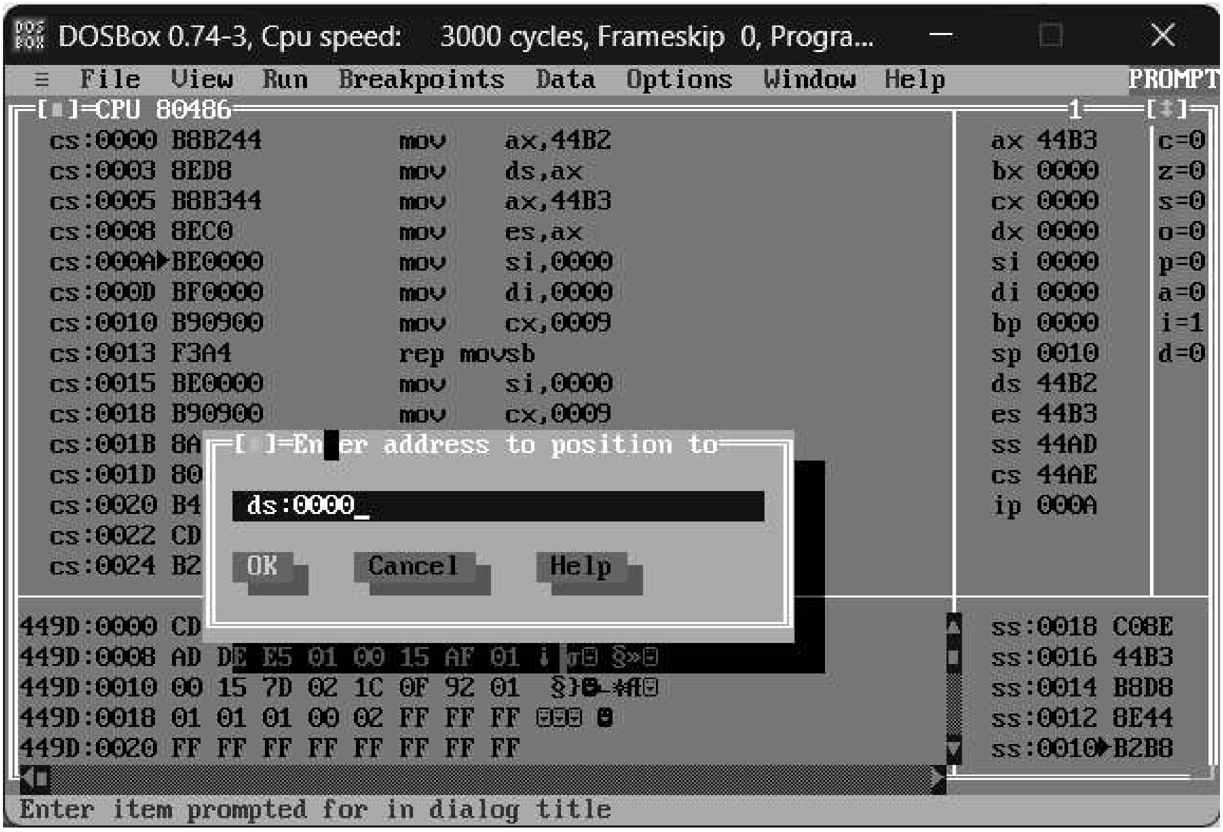
```
  cs:0000►B8B244        mov    ax,44B2        ax 0000   c=0
  cs:0003 8ED8          mov    ds,ax          bx 0000   z=0
  cs:0005 B8B344        mov    ax,44B3        cx 0000   s=0
  cs:0008 8EC0          mov    es,ax          dx 0000   o=0
  cs:000A BE0000        mov    si,0000        si 0000   p=0
  cs:000D BF0000        mov    di,0000        di 0000   a=0
  cs:0010 B90900        mov    cx,0009        bp 0000   i=1
  cs:0013 F3A4          rep movsb             sp 0010   d=0
  cs:0015 BE0000        mov    si,0000        ds 449D
  cs:0018 B90900        mov    cx,0009        es 449D
  cs:001B 8A14          mov    dl,[si]        ss 44AD
  cs:001D 80C230        add    dl,30          cs 44AE
  cs:0020 B402          mov    ah,02          ip 0000
  cs:0022 CD21          int    21
  cs:0024 B220          mov    dl,20

  ds:0000 CD 20 FF 9F 00 EA FF FF =  ƒ Ω          ss:0012 8E44
  ds:0008 AD DE E5 01 00 15 AF 01 ↓ σ☺ §»☺        ss:0010►B2B8
  ds:0010 00 15 7D 02 1C 0F 92 01  §}☻∟☼Æ☺        ss:000E FFFF
  ds:0018 01 01 01 00 02 FF FF FF ☺☺☺ ☻           ss:000C 0000
  ds:0020 FF FF FF FF FF FF FF FF                 ss:000A 0000
```

Name:Vishal Rajesh Mahajan Roll No: 63

Class: SE INFT A EXP No.: 8


DOSBox 0.74-3, Cpu speed: 3000 cycles, Frameskip 0, Progra...
≡ File View Run Breakpoints Data Options Window Help READY

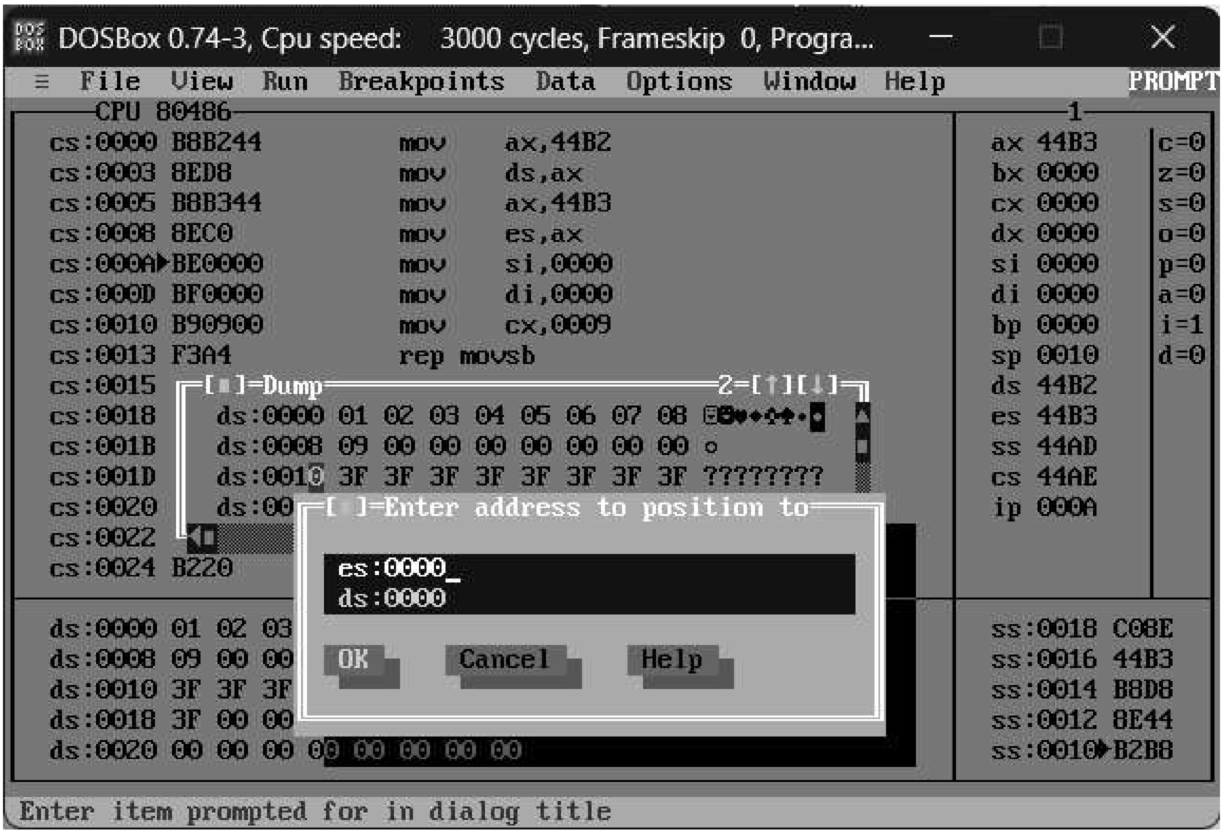
```
[■]=CPU 80486=========================================1====[↕]=
  cs:0000 B8B244        mov    ax,44B2          ax 44B3   c=0
  cs:0003 8ED8          mov    ds,ax            bx 0000   z=0
  cs:0005 B8B344        mov    ax,44B3          cx 0000   s=0
  cs:0008 8EC0          mov    es,ax            dx 0000   o=0
  cs:000A►BE0000        mov    si,0000          si 0000   p=0
  cs:000D BF0000        mov    di,0000          di 0000   a=0
  cs:0010 B90900        mov    cx,0009          bp 0000   i=1
  cs:0013 F3A4          rep movsb               sp 0010   d=0
  cs:0015 BE0000        mov    si,0000          ds 44B2
  cs:0018 B90900        mov    cx,0009          es 44B3
  cs:001B 8A14          mov    dl,[si]          ss 44AD
  cs:001D 80C230        add    dl,30            cs 44AE
  cs:0020 B402          mov    ah,02            ip 000A
  cs:0022 CD21          int    21
  cs:0024 B220          mov    dl,20
449D:0000 CD 20 FF 9F 00 EA FF FF =  ƒ Ω        ss:0018 C0BE
449D:0008 AD DE E5 01 00 15 AF 01 ¡ σ☺ §»☺      ss:0016 44B3
449D:0010 00 15 7D 02 1C 0F 92 01  §}☻∟☼Æ☺      ss:0014 B8D8
449D:0018 01 01 01 00 02 FF FF FF ☺☺☺ ☻         ss:0012 8E44
449D:0020 FF FF FF FF FF FF FF FF               ss:0010►B2B8
F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu
```


DOSBox 0.74-3, Cpu speed: 3000 cycles, Frameskip 0, Progra...
≡ File View Run Breakpoints Data Options Window Help PROMPT

```
[■]=CPU 80486=========================================1====[↕]=
  cs:0000 B8B244        mov    ax,44B2          ax 44B3   c=0
  cs:0003 8ED8          mov    ds,ax            bx 0000   z=0
  cs:0005 B8B344        mov    ax,44B3          cx 0000   s=0
  cs:0008 8EC0          mov    es,ax            dx 0000   o=0
  cs:000A►BE0000        mov    si,0000          si 0000   p=0
  cs:000D BF0000        mov    di,0000          di 0000   a=0
  cs:0010 B90900        mov    cx,0009          bp 0000   i=1
  cs:0013 F3A4          rep movsb               sp 0010   d=0
  cs:0015 BE0000        mov    si,0000          ds 44B2
  cs:0018 B90900        mov    cx,0009          es 44B3
  cs:001B 8A[ ]=Enter address to position to=   ss 44AD
  cs:001D 80                                    cs 44AE
  cs:0020 B4  ds:0000_                          ip 000A
  cs:0022 CD
  cs:0024 B2  OK      Cancel      Help
449D:0000 CD                                    ss:0018 C0BE
449D:0008 AD DE E5 01 00 15 AF 01 ¡ σ☺ §»☺      ss:0016 44B3
449D:0010 00 15 7D 02 1C 0F 92 01  §}☻∟☼Æ☺      ss:0014 B8D8
449D:0018 01 01 01 00 02 FF FF FF ☺☺☺ ☻         ss:0012 8E44
449D:0020 FF FF FF FF FF FF FF FF               ss:0010►B2B8
Enter item prompted for in dialog title
```

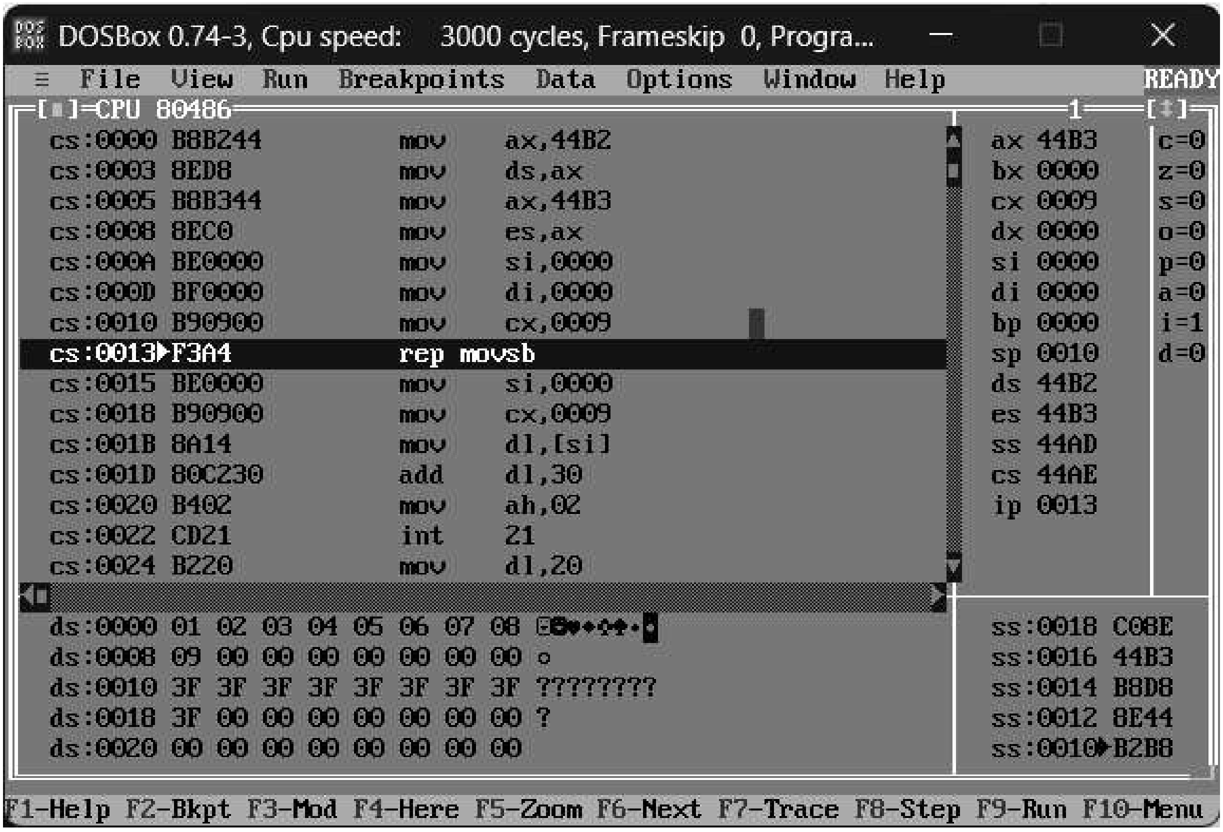
Name:Vishal Rajesh Mahajan Roll No: 63

Class: SE INFT A EXP No.: 8



DOSBox 0.74-3, Cpu speed: 3000 cycles, Frameskip 0, Progra...
≡ File View Run Breakpoints Data Options Window Help PROMPT

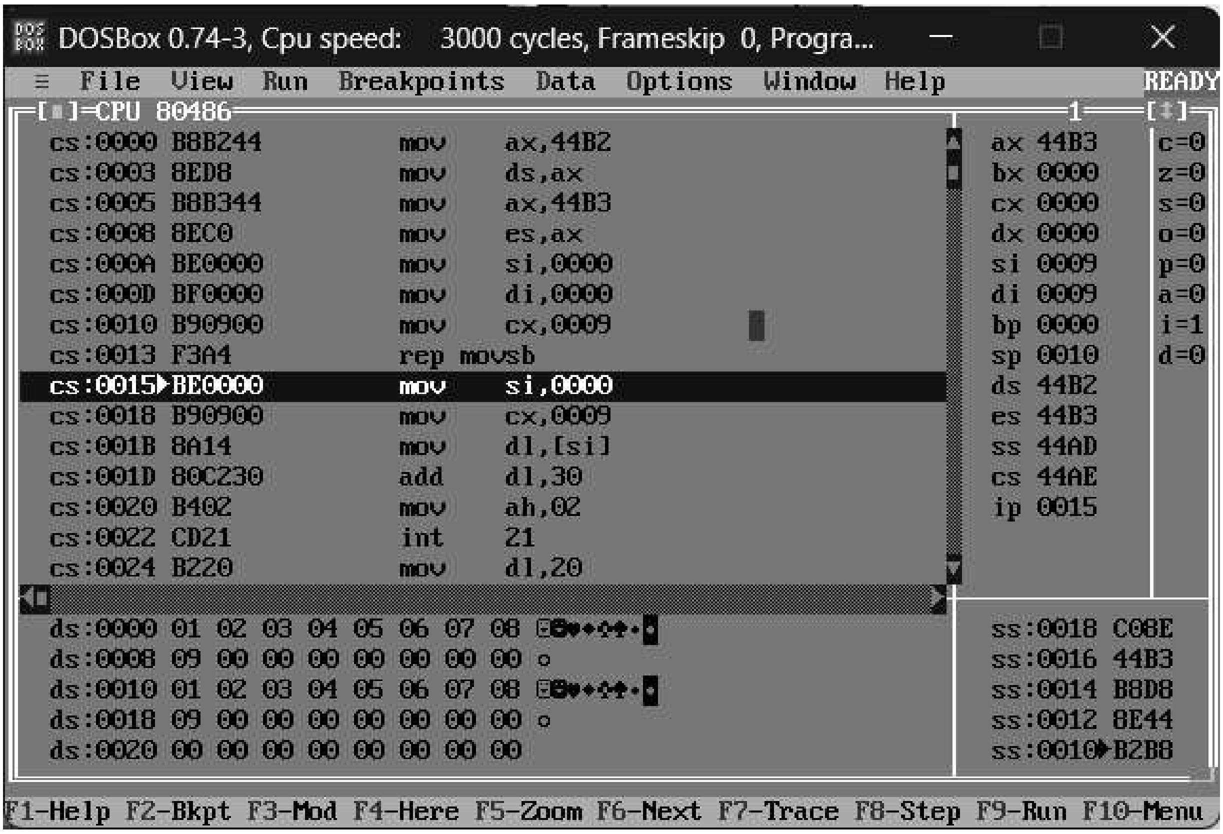
```
CPU 80486                                                      1
 cs:0000 B8B244       mov   ax,44B2                    ax 44B3  c=0
 cs:0003 8ED8         mov   ds,ax                      bx 0000  z=0
 cs:0005 B8B344       mov   ax,44B3                    cx 0000  s=0
 cs:0008 8EC0         mov   es,ax                      dx 0000  o=0
 cs:000A►BE0000       mov   si,0000                    si 0000  p=0
 cs:000D BF0000       mov   di,0000                    di 0000  a=0
 cs:0010 B90900       mov   cx,0009                    bp 0000  i=1
 cs:0013 F3A4         rep movsb                        sp 0010  d=0
 cs:0015  [■]=Dump                     2=[↑][↓]        ds 44B2
 cs:0018    ds:0000 01 02 03 04 05 06 07 08 ☐☻♥♦♣♠•◘   es 44B3
 cs:001B    ds:0008 09 00 00 00 00 00 00 00 ○          ss 44AD
 cs:001D    ds:0010 3F 3F 3F 3F 3F 3F 3F 3F ????????   cs 44AE
 cs:0020    ds:00 [■]=Enter address to position to     ip 000A
 cs:0022
 cs:0024 B220          es:0000_
                       ds:0000

 ds:0000 01 02 03      OK     Cancel     Help          ss:0018 C08E
 ds:0008 09 00 00                                      ss:0016 44B3
 ds:0010 3F 3F 3F                                      ss:0014 B8D8
 ds:0018 3F 00 00                                      ss:0012 8E44
 ds:0020 00 00 00 00 00 00 00 00                       ss:0010►B2B8
Enter item prompted for in dialog title
```



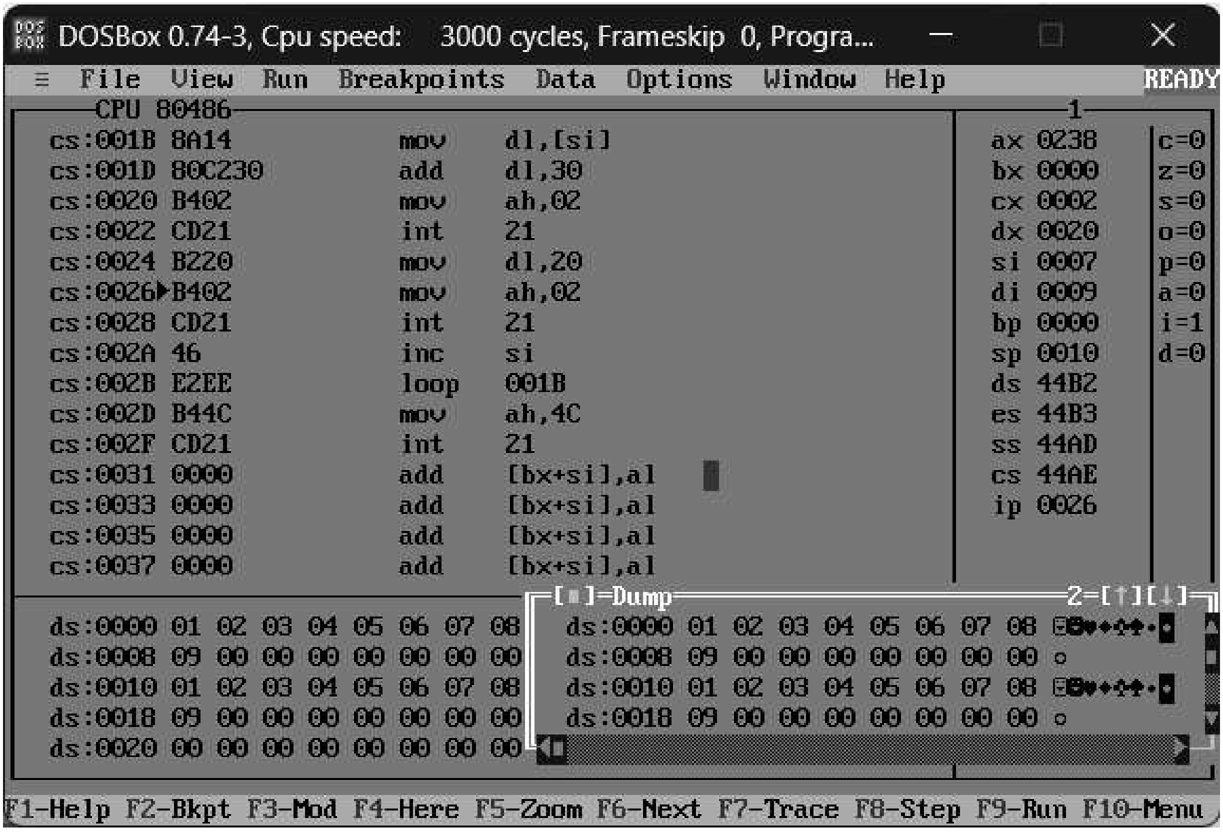
DOSBox 0.74-3, Cpu speed: 3000 cycles, Frameskip 0, Progra...
≡ File View Run Breakpoints Data Options Window Help READY

```
[■]=CPU 80486                                          1   [↕]
 cs:0000 B8B244       mov   ax,44B2                    ax 44B3  c=0
 cs:0003 8ED8         mov   ds,ax                      bx 0000  z=0
 cs:0005 B8B344       mov   ax,44B3                    cx 0009  s=0
 cs:0008 8EC0         mov   es,ax                      dx 0000  o=0
 cs:000A BE0000       mov   si,0000                    si 0000  p=0
 cs:000D BF0000       mov   di,0000                    di 0000  a=0
 cs:0010 B90900       mov   cx,0009                    bp 0000  i=1
 cs:0013►F3A4         rep movsb                        sp 0010  d=0
 cs:0015 BE0000       mov   si,0000                    ds 44B2
 cs:0018 B90900       mov   cx,0009                    es 44B3
 cs:001B 8A14         mov   dl,[si]                    ss 44AD
 cs:001D 80C230       add   dl,30                      cs 44AE
 cs:0020 B402         mov   ah,02                      ip 0013
 cs:0022 CD21         int   21
 cs:0024 B220         mov   dl,20

 ds:0000 01 02 03 04 05 06 07 08 ☐☻♥♦♣♠•◘              ss:0018 C08E
 ds:0008 09 00 00 00 00 00 00 00 ○                     ss:0016 44B3
 ds:0010 3F 3F 3F 3F 3F 3F 3F 3F ????????              ss:0014 B8D8
 ds:0018 3F 00 00 00 00 00 00 00 ?                     ss:0012 8E44
 ds:0020 00 00 00 00 00 00 00 00                       ss:0010►B2B8
F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu
```

```
Name:Vishal Rajesh Mahajan                        Roll No: 63
Class: SE INFT A                                  EXP No.: 8
```


DOSBox 0.74-3, Cpu speed: 3000 cycles, Frameskip 0, Progra...
≡ File View Run Breakpoints Data Options Window Help   READY
F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu

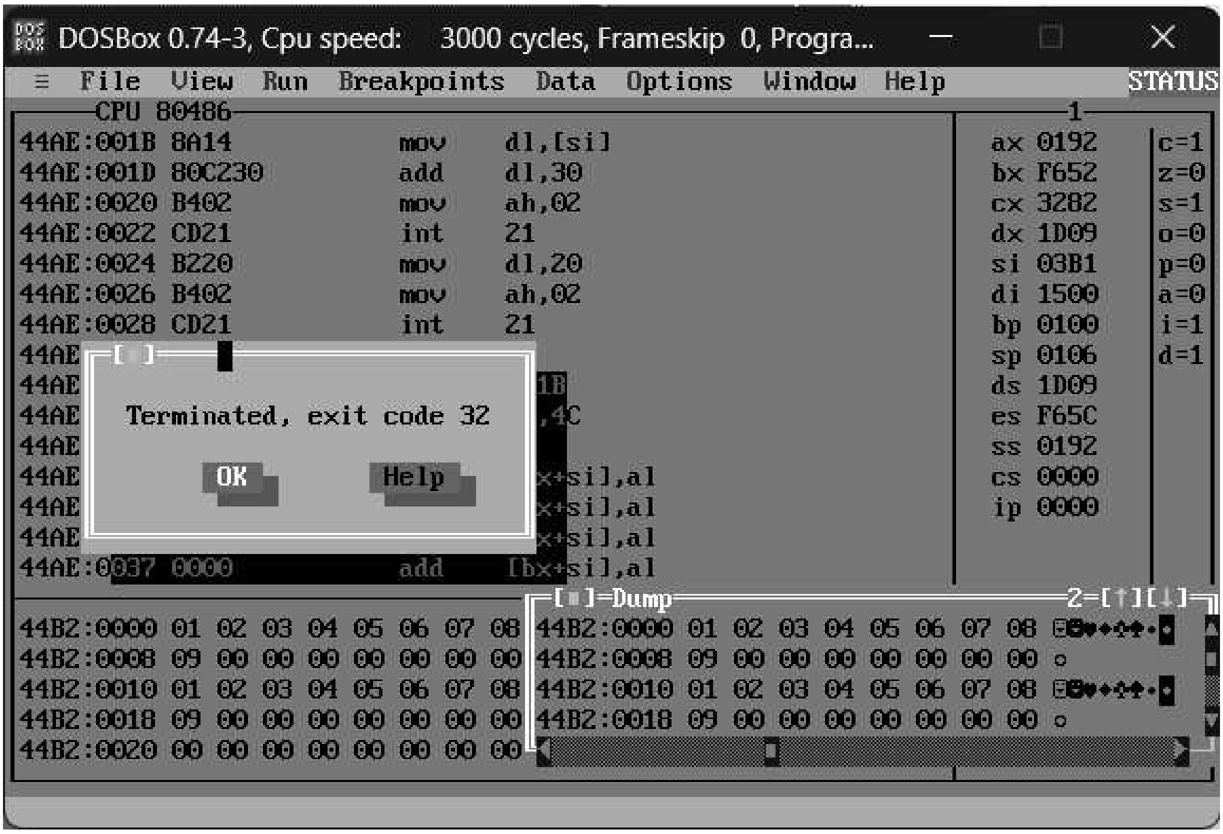
```
[■]=CPU 80486=========================================1===[↕]=
  cs:0000 B8B244        mov   ax,44B2             ax 4483   c=0
  cs:0003 8ED8          mov   ds,ax               bx 0000   z=0
  cs:0005 B8B344        mov   ax,44B3             cx 0000   s=0
  cs:0008 8EC0          mov   es,ax               dx 0000   o=0
  cs:000A BE0000        mov   si,0000             si 0009   p=0
  cs:000D BF0000        mov   di,0000             di 0009   a=0
  cs:0010 B90900        mov   cx,0009             bp 0000   i=1
  cs:0013 F3A4          rep movsb                 sp 0010   d=0
  cs:0015▶BE0000        mov   si,0000             ds 44B2
  cs:0018 B90900        mov   cx,0009             es 44B3
  cs:001B 8A14          mov   dl,[si]             ss 44AD
  cs:001D 80C230        add   dl,30               cs 44AE
  cs:0020 B402          mov   ah,02               ip 0015
  cs:0022 CD21          int   21
  cs:0024 B220          mov   dl,20

  ds:0000 01 02 03 04 05 06 07 08 ☺☻♥♦♣♠•◘    ss:0018 C08E
  ds:0008 09 00 00 00 00 00 00 00 ○           ss:0016 44B3
  ds:0010 01 02 03 04 05 06 07 08 ☺☻♥♦♣♠•◘    ss:0014 B8D8
  ds:0018 09 00 00 00 00 00 00 00 ○           ss:0012 8E44
  ds:0020 00 00 00 00 00 00 00 00             ss:0010▶B2B8
```


DOSBox 0.74-3, Cpu speed: 3000 cycles, Frameskip 0, Progra...
≡ File View Run Breakpoints Data Options Window Help   READY
F1-Help F2-Bkpt F3-Mod F4-Here F5-Zoom F6-Next F7-Trace F8-Step F9-Run F10-Menu

```
   CPU 80486                                          1
  cs:001B 8A14          mov   dl,[si]             ax 0238   c=0
  cs:001D 80C230        add   dl,30               bx 0000   z=0
  cs:0020 B402          mov   ah,02               cx 0002   s=0
  cs:0022 CD21          int   21                  dx 0020   o=0
  cs:0024 B220          mov   dl,20               si 0007   p=0
  cs:0026▶B402          mov   ah,02               di 0009   a=0
  cs:0028 CD21          int   21                  bp 0000   i=1
  cs:002A 46            inc   si                  sp 0010   d=0
  cs:002B E2EE          loop  001B                ds 44B2
  cs:002D B44C          mov   ah,4C               es 44B3
  cs:002F CD21          int   21                  ss 44AD
  cs:0031 0000          add   [bx+si],al          cs 44AE
  cs:0033 0000          add   [bx+si],al          ip 0026
  cs:0035 0000          add   [bx+si],al
  cs:0037 0000          add   [bx+si],al
                                  [■]=Dump==========================2=[↑][↓]=
  ds:0000 01 02 03 04 05 06 07 08  ds:0000 01 02 03 04 05 06 07 08 ☺☻♥♦♣♠•◘
  ds:0008 09 00 00 00 00 00 00 00  ds:0008 09 00 00 00 00 00 00 00 ○
  ds:0010 01 02 03 04 05 06 07 08  ds:0010 01 02 03 04 05 06 07 08 ☺☻♥♦♣♠•◘
  ds:0018 09 00 00 00 00 00 00 00  ds:0018 09 00 00 00 00 00 00 00 ○
  ds:0020 00 00 00 00 00 00 00 00
```

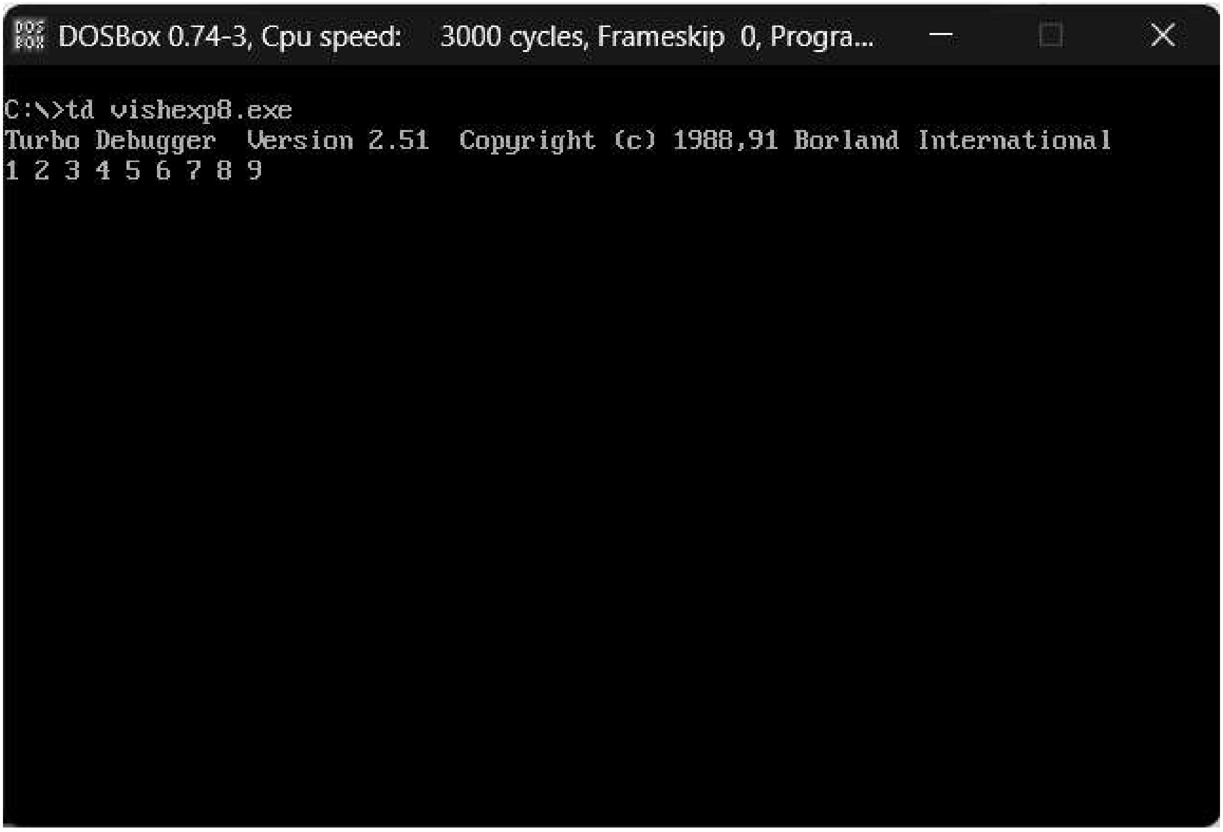
Name:Vishal Rajesh Mahajan   Roll No: 63

Class: SE INFT A   EXP No.: 8


DOSBox 0.74-3, Cpu speed: 3000 cycles, Frameskip 0, Progra...
≡ File View Run Breakpoints Data Options Window Help
STATUS
CPU 80486
1
[■]=Dump
2=[↑][↓]
OK
Help

```
44AE:001B 8A14          mov    dl,[si]                ax 0192   c=1
44AE:001D 80C230        add    dl,30                  bx F652   z=0
44AE:0020 B402          mov    ah,02                  cx 3282   s=1
44AE:0022 CD21          int    21                     dx 1D09   o=0
44AE:0024 B220          mov    dl,20                  si 03B1   p=0
44AE:0026 B402          mov    ah,02                  di 1500   a=0
44AE:0028 CD21          int    21                     bp 0100   i=1
44AE                                                  sp 0106   d=1
44AE                           1B                     ds 1D09
44AE                           ,4C                    es F65C
44AE                                                  ss 0192
44AE                           x+si],al               cs 0000
44AE                           x+si],al               ip 0000
44AE                           x+si],al
44AE:0037 0000          add    [bx+si],al

44B2:0000 01 02 03 04 05 06 07 08  44B2:0000 01 02 03 04 05 06 07 08 ☺☻♥♦♣♠•◘
44B2:0008 09 00 00 00 00 00 00 00  44B2:0008 09 00 00 00 00 00 00 00 ○
44B2:0010 01 02 03 04 05 06 07 08  44B2:0010 01 02 03 04 05 06 07 08 ☺☻♥♦♣♠•◘
44B2:0018 09 00 00 00 00 00 00 00  44B2:0018 09 00 00 00 00 00 00 00 ○
44B2:0020 00 00 00 00 00 00 00 00
```

Terminated, exit code 32


DOSBox 0.74-3, Cpu speed: 3000 cycles, Frameskip 0, Progra...

```
C:\>td vishexp8.exe
Turbo Debugger  Version 2.51  Copyright (c) 1988,91 Borland International
1 2 3 4 5 6 7 8 9
```