MICROPROCESSOR AND INTERFACING TECHNIQUES

CODE: CSI2006   **SLOT: L53 + L54**

LAB ASSIGNMENT – 4

AIM:

To write an assembly language program for

- ➢ Arranging numbers in ascending and descending order using bubble sort.
- ➢ Displaying the system time.

ALGORITHM:

For Bubble sort:

Input: -> enter the count value

        -> List of elements

Process: -> compare two numbers via iterations.

Conclusion: Numbers ordered in ascending and descending.

For displaying time:

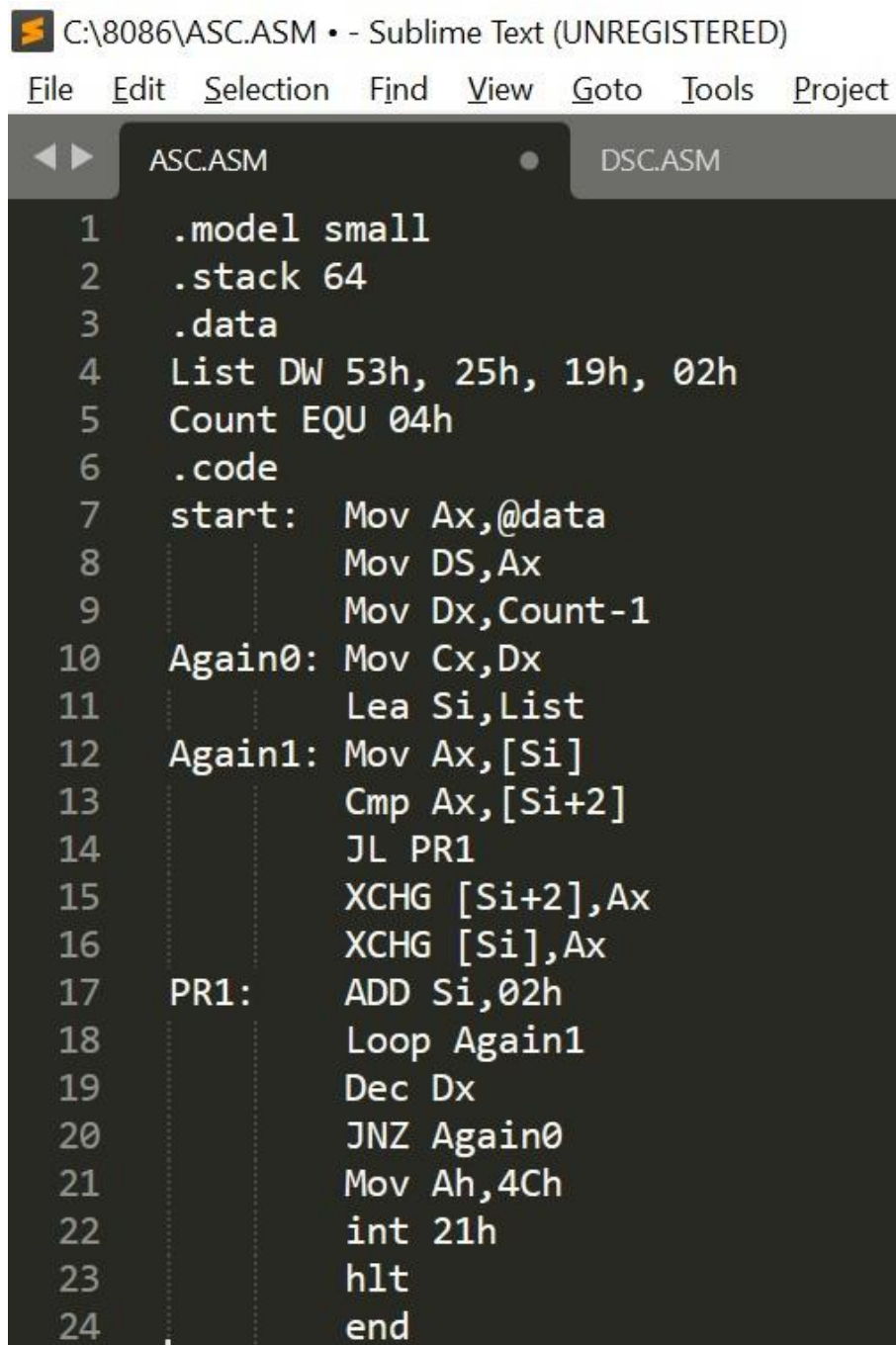**Conclusion:** System time displayed in HH:MM:SS format.

TEAM MEMBERS:

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1)

a) ALP for sorting elements in ascending order using bubble sort.

CODE:

C:\8086\ASC.ASM • - Sublime Text (UNREGISTERED)

File   Edit   Selection   Find   View   Goto   Tools   Project

ASC.ASM ● DSC.ASM

```asm
 1      .model small
 2      .stack 64
 3      .data
 4      List DW 53h, 25h, 19h, 02h
 5      Count EQU 04h
 6      .code
 7      start:   Mov Ax,@data
 8               Mov DS,Ax
 9               Mov Dx,Count-1
10      Again0: Mov Cx,Dx
11               Lea Si,List
12      Again1: Mov Ax,[Si]
13               Cmp Ax,[Si+2]
14               JL PR1
15               XCHG [Si+2],Ax
16               XCHG [Si],Ax
17      PR1:     ADD Si,02h
18               Loop Again1
19               Dec Dx
20               JNZ Again0
21               Mov Ah,4Ch
22               int 21h
23               hlt
24               end
```

OUTPUT:

```
C:\>masm asc.asm
Microsoft (R) Macro Assembler Version 5.00
Copyright (C) Microsoft Corp 1981-1985, 1987.  All rights reserved.

Object filename [asc.OBJ]:
Source listing  [NUL.LST]:
Cross-reference [NUL.CRF]:

  51606 + 464938 Bytes symbol space free

      0 Warning Errors
      0 Severe  Errors

C:\>link asc.obj

Microsoft (R) Overlay Linker  Version 3.60
Copyright (C) Microsoft Corp 1983-1987.  All rights reserved.

Run File [ASC.EXE]:
List File [NUL.MAP]:
Libraries [.LIB]:

C:\>debug asc.exe
_
```

```
AX=076C  BX=0000  CX=0030  DX=0000  SP=0040  BP=0000  SI=0000  DI=0000
DS=075A  ES=075A  SS=076D  CS=076A  IP=0003   NV UP EI PL NZ NA PO NC
076A:0003 8ED8          MOV    DS,AX
-t

AX=076C  BX=0000  CX=0030  DX=0000  SP=0040  BP=0000  SI=0000  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0005   NV UP EI PL NZ NA PO NC
076A:0005 BA0300        MOV    DX,0003
-t

AX=076C  BX=0000  CX=0030  DX=0003  SP=0040  BP=0000  SI=0000  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0008   NV UP EI PL NZ NA PO NC
076A:0008 8BCA          MOV    CX,DX
-t

AX=076C  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0000  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000A   NV UP EI PL NZ NA PO NC
076A:000A 8D360800      LEA    SI,[0008]                      DS:0008=0053
-t

AX=076C  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000E   NV UP EI PL NZ NA PO NC
076A:000E 8B04          MOV    AX,[SI]                        DS:0008=0053
_
```

```
AX=076C  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000E    NV UP EI PL NZ NA PO NC
076A:000E 8B04          MOV     AX,[SI]                              DS:0008=0053
-t

AX=0053  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0010    NV UP EI PL NZ NA PO NC
076A:0010 3B4402        CMP     AX,[SI+02]                           DS:000A=0025
-t

AX=0053  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0013    NV UP EI PL NZ AC PE NC
076A:0013 7C05          JL      001A
-t

AX=0053  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015    NV UP EI PL NZ AC PE NC
076A:0015 874402        XCHG    AX,[SI+02]                           DS:000A=0025
-t

AX=0025  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0018    NV UP EI PL NZ AC PE NC
076A:0018 8704          XCHG    AX,[SI]                              DS:0008=0053
-_
```

```
AX=0025  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0018    NV UP EI PL NZ AC PE NC
076A:0018 8704          XCHG    AX,[SI]                              DS:0008=0053
-t

AX=0053  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001A    NV UP EI PL NZ AC PE NC
076A:001A 83C602        ADD     SI,+02
-t

AX=0053  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001D    NV UP EI PL NZ NA PE NC
076A:001D E2EF          LOOP    000E
-t

AX=0053  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000E    NV UP EI PL NZ NA PE NC
076A:000E 8B04          MOV     AX,[SI]                              DS:000A=0053
-t

AX=0053  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0010    NV UP EI PL NZ NA PE NC
076A:0010 3B4402        CMP     AX,[SI+02]                           DS:000C=0019
-
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip  0, Program:   DEBUG                    —    □    ×

AX=0053  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0013   NV UP EI PL NZ AC PE NC
076A:0013 7C05          JL      001A
-t

AX=0053  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015   NV UP EI PL NZ AC PE NC
076A:0015 874402        XCHG    AX,[SI+02]                            DS:000C=0019
-t

AX=0019  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0018   NV UP EI PL NZ AC PE NC
076A:0018 8704         XCHG    AX,[SI]                               DS:000A=0053
-t

AX=0053  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001A   NV UP EI PL NZ AC PE NC
076A:001A 83C602       ADD     SI,+02
-t

AX=0053  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001D   NV UP EI PL NZ NA PE NC
076A:001D E2EF         LOOP    000E
-
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip  0, Program:   DEBUG                    —    □    ×

AX=0053  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001D   NV UP EI PL NZ NA PE NC
076A:001D E2EF         LOOP    000E
-t

AX=0053  BX=0000  CX=0001  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000E   NV UP EI PL NZ NA PE NC
076A:000E 8B04         MOV     AX,[SI]                               DS:000C=0053
-t

AX=0053  BX=0000  CX=0001  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0010   NV UP EI PL NZ NA PE NC
076A:0010 3B4402       CMP     AX,[SI+02]                            DS:000E=0002
-t

AX=0053  BX=0000  CX=0001  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0013   NV UP EI PL NZ NA PO NC
076A:0013 7C05         JL      001A
-t

AX=0053  BX=0000  CX=0001  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015   NV UP EI PL NZ NA PO NC
076A:0015 874402       XCHG    AX,[SI+02]                            DS:000E=0002
-
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip 0, Program:  DEBUG          —    □    ×

AX=0053  BX=0000  CX=0001  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015   NV UP EI PL NZ NA PO NC
076A:0015 874402          XCHG     AX,[SI+02]                        DS:000E=0002
-t

AX=0002  BX=0000  CX=0001  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0018   NV UP EI PL NZ NA PO NC
076A:0018 8704            XCHG     AX,[SI]                           DS:000C=0053
-t

AX=0053  BX=0000  CX=0001  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001A   NV UP EI PL NZ NA PO NC
076A:001A 83C602          ADD      SI,+02
-t

AX=0053  BX=0000  CX=0001  DX=0003  SP=0040  BP=0000  SI=000E  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001D   NV UP EI PL NZ NA PO NC
076A:001D E2EF            LOOP     000E
-t

AX=0053  BX=0000  CX=0000  DX=0003  SP=0040  BP=0000  SI=000E  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001F   NV UP EI PL NZ NA PO NC
076A:001F 4A              DEC      DX
-
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip 0, Program:  DEBUG          —    □    ×

AX=0053  BX=0000  CX=0000  DX=0002  SP=0040  BP=0000  SI=000E  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0020   NV UP EI PL NZ NA PO NC
076A:0020 75E6            JNZ      0008
-t

AX=0053  BX=0000  CX=0000  DX=0002  SP=0040  BP=0000  SI=000E  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0008   NV UP EI PL NZ NA PO NC
076A:0008 8BCA            MOV      CX,DX
-t

AX=0053  BX=0000  CX=0002  DX=0002  SP=0040  BP=0000  SI=000E  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000A   NV UP EI PL NZ NA PO NC
076A:000A 8D360800        LEA      SI,[0008]                         DS:0008=0025
-t

AX=0053  BX=0000  CX=0002  DX=0002  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000E   NV UP EI PL NZ NA PO NC
076A:000E 8B04            MOV      AX,[SI]                           DS:0008=0025
-t

AX=0025  BX=0000  CX=0002  DX=0002  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0010   NV UP EI PL NZ NA PO NC
076A:0010 3B4402          CMP      AX,[SI+02]                        DS:000A=0019
-
```

```
DOSBox 0.74, Cpu speed:   3000 cycles, Frameskip  0, Program:   DEBUG                    —    □    ×

AX=0025   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0010      NV UP EI PL NZ NA PO NC
076A:0010 3B4402           CMP      AX,[SI+02]                               DS:000A=0019
-t

AX=0025   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0013      NV UP EI PL NZ AC PE NC
076A:0013 7C05             JL       001A
-t

AX=0025   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0015      NV UP EI PL NZ AC PE NC
076A:0015 874402           XCHG     AX,[SI+02]                               DS:000A=0019
-t

AX=0019   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0018      NV UP EI PL NZ AC PE NC
076A:0018 8704             XCHG     AX,[SI]                                  DS:0008=0025
-t

AX=0025   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001A      NV UP EI PL NZ AC PE NC
076A:001A 83C602           ADD      SI,+02
-_
```

```
DOSBox 0.74, Cpu speed:   3000 cycles, Frameskip  0, Program:   DEBUG                    —    □    ×

AX=0025   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001A      NV UP EI PL NZ AC PE NC
076A:001A 83C602           ADD      SI,+02
-t

AX=0025   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001D      NV UP EI PL NZ NA PE NC
076A:001D E2EF             LOOP     000E
-t

AX=0025   BX=0000   CX=0001   DX=0002   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=000E      NV UP EI PL NZ NA PE NC
076A:000E 8B04             MOV      AX,[SI]                                  DS:000A=0025
-t

AX=0025   BX=0000   CX=0001   DX=0002   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0010      NV UP EI PL NZ NA PE NC
076A:0010 3B4402           CMP      AX,[SI+02]                               DS:000C=0002
-t

AX=0025   BX=0000   CX=0001   DX=0002   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0013      NV UP EI PL NZ NA PO NC
076A:0013 7C05             JL       001A
-_
```

```
DOSBox 0.74, Cpu speed:   3000 cycles, Frameskip 0, Program:   DEBUG                    —    □    ×

AX=0025  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0013   NV UP EI PL NZ NA PO NC
076A:0013 7C05           JL      001A
-t

AX=0025  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015   NV UP EI PL NZ NA PO NC
076A:0015 874402         XCHG    AX,[SI+02]                        DS:000C=0002
-t

AX=0002  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0018   NV UP EI PL NZ NA PO NC
076A:0018 8704           XCHG    AX,[SI]                           DS:000A=0025
-t

AX=0025  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001A   NV UP EI PL NZ NA PO NC
076A:001A 83C602         ADD     SI,+02
-t

AX=0025  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001D   NV UP EI PL NZ NA PE NC
076A:001D E2EF           LOOP    000E
-
```

```
DOSBox 0.74, Cpu speed:   3000 cycles, Frameskip 0, Program:   DEBUG                    —    □    ×

AX=0025  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001D   NV UP EI PL NZ NA PE NC
076A:001D E2EF           LOOP    000E
-       t

AX=0025  BX=0000  CX=0000  DX=0002  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001F   NV UP EI PL NZ NA PE NC
076A:001F 4A             DEC     DX
-t

AX=0025  BX=0000  CX=0000  DX=0001  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0020   NV UP EI PL NZ NA PO NC
076A:0020 75E6           JNZ     0008
-t

AX=0025  BX=0000  CX=0000  DX=0001  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0008   NV UP EI PL NZ NA PO NC
076A:0008 8BCA           MOV     CX,DX
-t

AX=0025  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000A   NV UP EI PL NZ NA PO NC
076A:000A 8D360800       LEA     SI,[0008]                         DS:0008=0019
-
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip 0, Program:  DEBUG          —   □   ×

AX=0025  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000A   NV UP EI PL NZ NA PO NC
076A:000A 8D360800       LEA     SI,[0008]                          DS:0008=0019
-t

AX=0025  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000E   NV UP EI PL NZ NA PO NC
076A:000E 8B04          MOV     AX,[SI]                            DS:0008=0019
-t

AX=0019  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0010   NV UP EI PL NZ NA PO NC
076A:0010 3B4402        CMP     AX,[SI+02]                         DS:000A=0002
-t

AX=0019  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0013   NV UP EI PL NZ NA PE NC
076A:0013 7C05          JL      001A
-t

AX=0019  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015   NV UP EI PL NZ NA PE NC
076A:0015 874402        XCHG    AX,[SI+02]                         DS:000A=0002
-_
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip 0, Program:  DEBUG          —   □   ×

AX=0019  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015   NV UP EI PL NZ NA PE NC
076A:0015 874402        XCHG    AX,[SI+02]                         DS:000A=0002
-t

AX=0002  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0018   NV UP EI PL NZ NA PE NC
076A:0018 8704          XCHG    AX,[SI]                            DS:0008=0019
-t

AX=0019  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001A   NV UP EI PL NZ NA PE NC
076A:001A 83C602        ADD     SI,+02
-t

AX=0019  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001D   NV UP EI PL NZ NA PE NC
076A:001D E2EF          LOOP    000E
-t

AX=0019  BX=0000  CX=0000  DX=0001  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001F   NV UP EI PL NZ NA PE NC
076A:001F 4A            DEC     DX
-_
```

b) ALP for sorting elements in descending order using bubble sort.

CODE:


```
1    .model small
2    .stack 64
3    .data
4    List DW 02h, 19h, 25h, 53h
5    Count EQU 04h
6    .code
7    start:  Mov Ax,@data
8            Mov DS,Ax
9            Mov Dx,Count-1
10   Again0: Mov Cx,Dx
11           Lea Si,List
12   Again1: Mov Ax,[Si]
13           Cmp Ax,[Si+2]
14           JG PR1
15           XCHG [Si+2],Ax
16           XCHG [Si],Ax
17   PR1:    ADD Si,02h
18           Loop Again1
19           Dec Dx
20           JNZ Again0
21           Mov Ah,4Ch
22           int 21h
23           hlt
24           end
25
```

OUTPUT:


```
C:\>masm dsc.asm
Microsoft (R) Macro Assembler Version 5.00
Copyright (C) Microsoft Corp 1981-1985, 1987.  All rights reserved.

Object filename [dsc.OBJ]:
Source listing  [NUL.LST]:
Cross-reference [NUL.CRF]:

  51606 + 464938 Bytes symbol space free

      0 Warning Errors
      0 Severe  Errors

C:\>link DSC.OBJ

Microsoft (R) Overlay Linker  Version 3.60
Copyright (C) Microsoft Corp 1983-1987.  All rights reserved.

Run File [DSC.EXE]:
List File [NUL.MAP]:
Libraries [.LIB]:

C:\>debug dcs.exe_
```



```
-q

C:\>debug dsc.exe
-t

AX=076C  BX=0000  CX=0030  DX=0000  SP=0040  BP=0000  SI=0000  DI=0000
DS=075A  ES=075A  SS=076D  CS=076A  IP=0003   NV UP EI PL NZ NA PO NC
076A:0003 8ED8          MOV     DS,AX
-t

AX=076C  BX=0000  CX=0030  DX=0000  SP=0040  BP=0000  SI=0000  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0005   NV UP EI PL NZ NA PO NC
076A:0005 BA0300        MOV     DX,0003
-t

AX=076C  BX=0000  CX=0030  DX=0003  SP=0040  BP=0000  SI=0000  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0008   NV UP EI PL NZ NA PO NC
076A:0008 8BCA          MOV     CX,DX
-t

AX=076C  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0000  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000A   NV UP EI PL NZ NA PO NC
076A:000A 8D360800      LEA     SI,[0008]                  DS:0008=0002
-_
```

```
AX=076C  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0000  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000A    NV UP EI PL NZ NA PO NC
076A:000A 8D360800      LEA     SI,[0008]                        DS:0008=0002
-t

AX=076C  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000E    NV UP EI PL NZ NA PO NC
076A:000E 8B04          MOV     AX,[SI]                          DS:0008=0002
-t

AX=0002  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0010    NV UP EI PL NZ NA PO NC
076A:0010 3B4402        CMP     AX,[SI+02]                       DS:000A=0019
-t

AX=0002  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0013    NV UP EI NG NZ AC PO CY
076A:0013 7F05          JG      001A
-t

AX=0002  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015    NV UP EI NG NZ AC PO CY
076A:0015 874402        XCHG    AX,[SI+02]                       DS:000A=0019
```

```
AX=0002  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015    NV UP EI NG NZ AC PO CY
076A:0015 874402        XCHG    AX,[SI+02]                       DS:000A=0019
-t

AX=0019  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0018    NV UP EI NG NZ AC PO CY
076A:0018 8704          XCHG    AX,[SI]                          DS:0008=0002
-t

AX=0002  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=0008  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001A    NV UP EI NG NZ AC PO CY
076A:001A 83C602        ADD     SI,+02
-t

AX=0002  BX=0000  CX=0003  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001D    NV UP EI PL NZ NA PE NC
076A:001D E2EF          LOOP    000E
-t

AX=0002  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000E    NV UP EI PL NZ NA PE NC
076A:000E 8B04          MOV     AX,[SI]                          DS:000A=0002
-_
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip  0, Program:  DEBUG          —  □  ×

AX=0002  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000E   NV UP EI PL NZ NA PE NC
076A:000E 8B04           MOV     AX,[SI]                        DS:000A=0002
-t

AX=0002  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0010   NV UP EI PL NZ NA PE NC
076A:0010 3B4402          CMP     AX,[SI+02]                    DS:000C=0025
-t

AX=0002  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0013   NV UP EI NG NZ AC PE CY
076A:0013 7F05           JG      001A
-t

AX=0002  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015   NV UP EI NG NZ AC PE CY
076A:0015 874402          XCHG    AX,[SI+02]                    DS:000C=0025
-t

AX=0025  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0018   NV UP EI NG NZ AC PE CY
076A:0018 8704           XCHG    AX,[SI]                        DS:000A=0002
-_
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip  0, Program:  DEBUG          —  □  ×

AX=0025  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0018   NV UP EI NG NZ AC PE CY
076A:0018 8704           XCHG    AX,[SI]                        DS:000A=0002
-t

AX=0002  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001A   NV UP EI NG NZ AC PE CY
076A:001A 83C602          ADD     SI,+02
-t

AX=0002  BX=0000  CX=0002  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001D   NV UP EI PL NZ NA PE NC
076A:001D E2EF           LOOP    000E
-t

AX=0002  BX=0000  CX=0001  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000E   NV UP EI PL NZ NA PE NC
076A:000E 8B04           MOV     AX,[SI]                        DS:000C=0002
-t

AX=0002  BX=0000  CX=0001  DX=0003  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0010   NV UP EI PL NZ NA PE NC
076A:0010 3B4402          CMP     AX,[SI+02]                    DS:000E=0053
-_
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip  0, Program:   DEBUG         —    □    ×

AX=0002   BX=0000   CX=0001   DX=0003   SP=0040   BP=0000   SI=000C   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0013    NV UP EI NG NZ AC PE CY
076A:0013 7F05            JG        001A
-t

AX=0002   BX=0000   CX=0001   DX=0003   SP=0040   BP=0000   SI=000C   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0015    NV UP EI NG NZ AC PE CY
076A:0015 874402           XCHG      AX,[SI+02]                       DS:000E=0053
-t

AX=0053   BX=0000   CX=0001   DX=0003   SP=0040   BP=0000   SI=000C   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0018    NV UP EI NG NZ AC PE CY
076A:0018 8704            XCHG      AX,[SI]                           DS:000C=0002
-t

AX=0002   BX=0000   CX=0001   DX=0003   SP=0040   BP=0000   SI=000C   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001A    NV UP EI NG NZ AC PE CY
076A:001A 83C602           ADD       SI,+02
-t

AX=0002   BX=0000   CX=0001   DX=0003   SP=0040   BP=0000   SI=000E   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001D    NV UP EI PL NZ NA PO NC
076A:001D E2EF            LOOP      000E
-_
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip  0, Program:   DEBUG         —    □    ×

AX=0002   BX=0000   CX=0001   DX=0003   SP=0040   BP=0000   SI=000E   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001D    NV UP EI PL NZ NA PO NC
076A:001D E2EF            LOOP      000E
-       t

AX=0002   BX=0000   CX=0000   DX=0003   SP=0040   BP=0000   SI=000E   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001F    NV UP EI PL NZ NA PO NC
076A:001F 4A              DEC       DX
-t

AX=0002   BX=0000   CX=0000   DX=0002   SP=0040   BP=0000   SI=000E   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0020    NV UP EI PL NZ NA PO NC
076A:0020 75E6            JNZ       0008
-t

AX=0002   BX=0000   CX=0000   DX=0002   SP=0040   BP=0000   SI=000E   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0008    NV UP EI PL NZ NA PO NC
076A:0008 8BCA            MOV       CX,DX
-t

AX=0002   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=000E   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=000A    NV UP EI PL NZ NA PO NC
076A:000A 8D360800         LEA       SI,[0008]                        DS:0008=0019
-
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip 0, Program:  DEBUG          —   □   ✕

AX=0002   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=000E   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=000A       NU UP EI PL NZ NA PO NC
076A:000A 8D360800        LEA     SI,[0008]                            DS:0008=0019
_
                                  t

AX=0002   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=000E       NU UP EI PL NZ NA PO NC
076A:000E 8B04          MOV     AX,[SI]                                DS:0008=0019
-t

AX=0019   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0010       NU UP EI PL NZ NA PO NC
076A:0010 3B4402        CMP     AX,[SI+02]                             DS:000A=0025
-t

AX=0019   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0013       NU UP EI NG NZ NA PO CY
076A:0013 7F05          JG      001A
-t

AX=0019   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0015       NU UP EI NG NZ NA PO CY
076A:0015 874402        XCHG    AX,[SI+02]                             DS:000A=0025
_
```

```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip 0, Program:  DEBUG          —   □   ✕

AX=0019   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0015       NU UP EI NG NZ NA PO CY
076A:0015 874402        XCHG    AX,[SI+02]                             DS:000A=0025
-t

AX=0025   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0018       NU UP EI NG NZ NA PO CY
076A:0018 8704          XCHG    AX,[SI]                                DS:0008=0019
-t

AX=0019   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001A       NU UP EI NG NZ NA PO CY
076A:001A 83C602        ADD     SI,+02
-t

AX=0019   BX=0000   CX=0002   DX=0002   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001D       NU UP EI PL NZ NA PE NC
076A:001D E2EF          LOOP    000E
-t

AX=0019   BX=0000   CX=0001   DX=0002   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=000E       NU UP EI PL NZ NA PE NC
076A:000E 8B04          MOV     AX,[SI]                                DS:000A=0019
-t
```

```
AX=0019  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0010    NV UP EI PL NZ NA PE NC
076A:0010 3B4402          CMP     AX,[SI+02]                       DS:000C=0053
-t

AX=0019  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0013    NV UP EI NG NZ NA PE CY
076A:0013 7F05            JG      001A
-t

AX=0019  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0015    NV UP EI NG NZ NA PE CY
076A:0015 874402          XCHG    AX,[SI+02]                       DS:000C=0053
-t

AX=0053  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0018    NV UP EI NG NZ NA PE CY
076A:0018 8704            XCHG    AX,[SI]                          DS:000A=0019
-t

AX=0019  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000A  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001A    NV UP EI NG NZ NA PE CY
076A:001A 83C602          ADD     SI,+02
```

```
AX=0019  BX=0000  CX=0001  DX=0002  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001D    NV UP EI PL NZ NA PE NC
076A:001D E2EF            LOOP    000E
-t

AX=0019  BX=0000  CX=0000  DX=0002  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=001F    NV UP EI PL NZ NA PE NC
076A:001F 4A              DEC     DX
-t

AX=0019  BX=0000  CX=0000  DX=0001  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0020    NV UP EI PL NZ NA PO NC
076A:0020 75E6            JNZ     0008
-t

AX=0019  BX=0000  CX=0000  DX=0001  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=0008    NV UP EI PL NZ NA PO NC
076A:0008 8BCA            MOV     CX,DX
-t

AX=0019  BX=0000  CX=0001  DX=0001  SP=0040  BP=0000  SI=000C  DI=0000
DS=076C  ES=075A  SS=076D  CS=076A  IP=000A    NV UP EI PL NZ NA PO NC
076A:000A 8D360800        LEA     SI,[0008]                        DS:0008=0025
-_
```

```
AX=0019   BX=0000   CX=0001   DX=0001   SP=0040   BP=0000   SI=000C   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=000A    NV UP EI PL NZ NA PO NC
076A:000A 8D360800        LEA     SI,[0008]                              DS:0008=0025
-       t

AX=0019   BX=0000   CX=0001   DX=0001   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=000E    NV UP EI PL NZ NA PO NC
076A:000E 8B04          MOV     AX,[SI]                                  DS:0008=0025
-t

AX=0025   BX=0000   CX=0001   DX=0001   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0010    NV UP EI PL NZ NA PO NC
076A:0010 3B4402          CMP     AX,[SI+02]                             DS:000A=0053
-t

AX=0025   BX=0000   CX=0001   DX=0001   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0013    NV UP EI NG NZ NA PE CY
076A:0013 7F05            JG      001A
-t

AX=0025   BX=0000   CX=0001   DX=0001   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0015    NV UP EI NG NZ NA PE CY
076A:0015 874402          XCHG    AX,[SI+02]                             DS:000A=0053
-
```

```
AX=0053   BX=0000   CX=0001   DX=0001   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0018    NV UP EI NG NZ NA PE CY
076A:0018 8704            XCHG    AX,[SI]                                DS:0008=0025
-t

AX=0025   BX=0000   CX=0001   DX=0001   SP=0040   BP=0000   SI=0008   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001A    NV UP EI NG NZ NA PE CY
076A:001A 83C602          ADD     SI,+02
-t

AX=0025   BX=0000   CX=0001   DX=0001   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001D    NV UP EI PL NZ NA PE NC
076A:001D E2EF            LOOP    000E
-t

AX=0025   BX=0000   CX=0000   DX=0001   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001F    NV UP EI PL NZ NA PE NC
076A:001F 4A              DEC     DX
-t

AX=0025   BX=0000   CX=0000   DX=0000   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0020    NV UP EI PL ZR NA PE NC
076A:0020 75E6            JNZ     0008
-
```
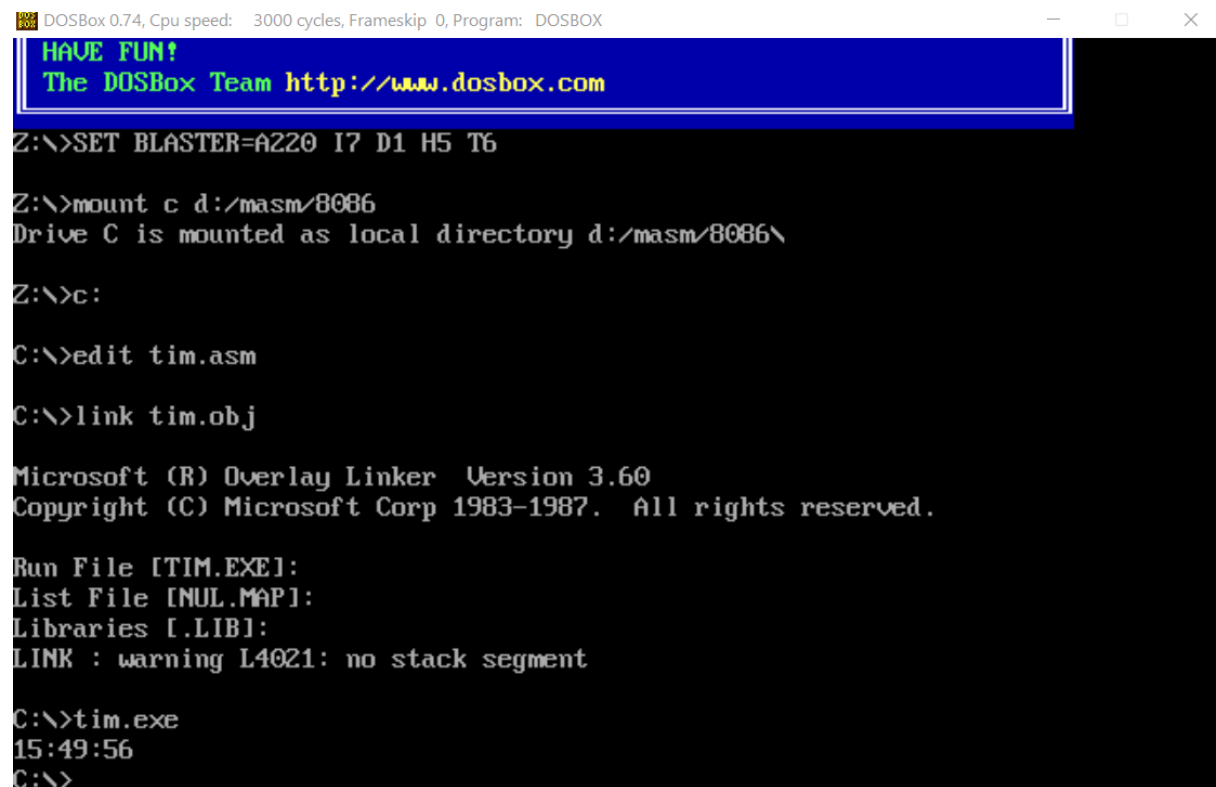
```
DOSBox 0.74, Cpu speed:    3000 cycles, Frameskip  0, Program:   DEBUG                    —    □    ×

AX=0025   BX=0000   CX=0000   DX=0001   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=001F    NV UP EI PL NZ NA PE NC
076A:001F 4A              DEC     DX
-t

AX=0025   BX=0000   CX=0000   DX=0000   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0020    NV UP EI PL ZR NA PE NC
076A:0020 75E6            JNZ     0008
-t

AX=0025   BX=0000   CX=0000   DX=0000   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0022    NV UP EI PL ZR NA PE NC
076A:0022 B44C            MOV     AH,4C
-t

AX=4C25   BX=0000   CX=0000   DX=0000   SP=0040   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=076A   IP=0024    NV UP EI PL ZR NA PE NC
076A:0024 CD21            INT     21
-t

AX=4C25   BX=0000   CX=0000   DX=0000   SP=003A   BP=0000   SI=000A   DI=0000
DS=076C   ES=075A   SS=076D   CS=F000   IP=14A0    NV UP DI PL ZR NA PE NC
F000:14A0 FB              STI
-_
```

2.) ALP to display system timing.

CODE:

```
.model small
.code
mov ah,2ch
int 21h
mov al,ch
call disp
mov dl, ':'
mov ah,2
int 21h
mov al,cl
call disp
mov dl, ':'
mov ah,2
int 21h
mov al,dh
call disp
mov ah,4ch
int 21h
disp proc near
aam
add ax,3030h
mov bx,ax
mov dl,ah
mov ah,02h
int 21h
mov dl,bl
int 21h
ret
disp endp
end
```

OUTPUT:

System time is 3:49 PM, and the program returns value 15:49:46 (24hr format).

VIDEO LINK:

https://www.youtube.com/watch?v=nnaAdciLgGA

-X-X-X-X-X-X-X-X-