SSN College of Engineering Department of Computer Science and Engineering

III year - UCS1512 – Microprocessors Lab

Sorting

Exp No: 06

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Date: 04/10/2020

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a) Sorting in ascending order:

Aim:

Design 8086 program for sorting in ascending order.

Procedure for executing MASM:

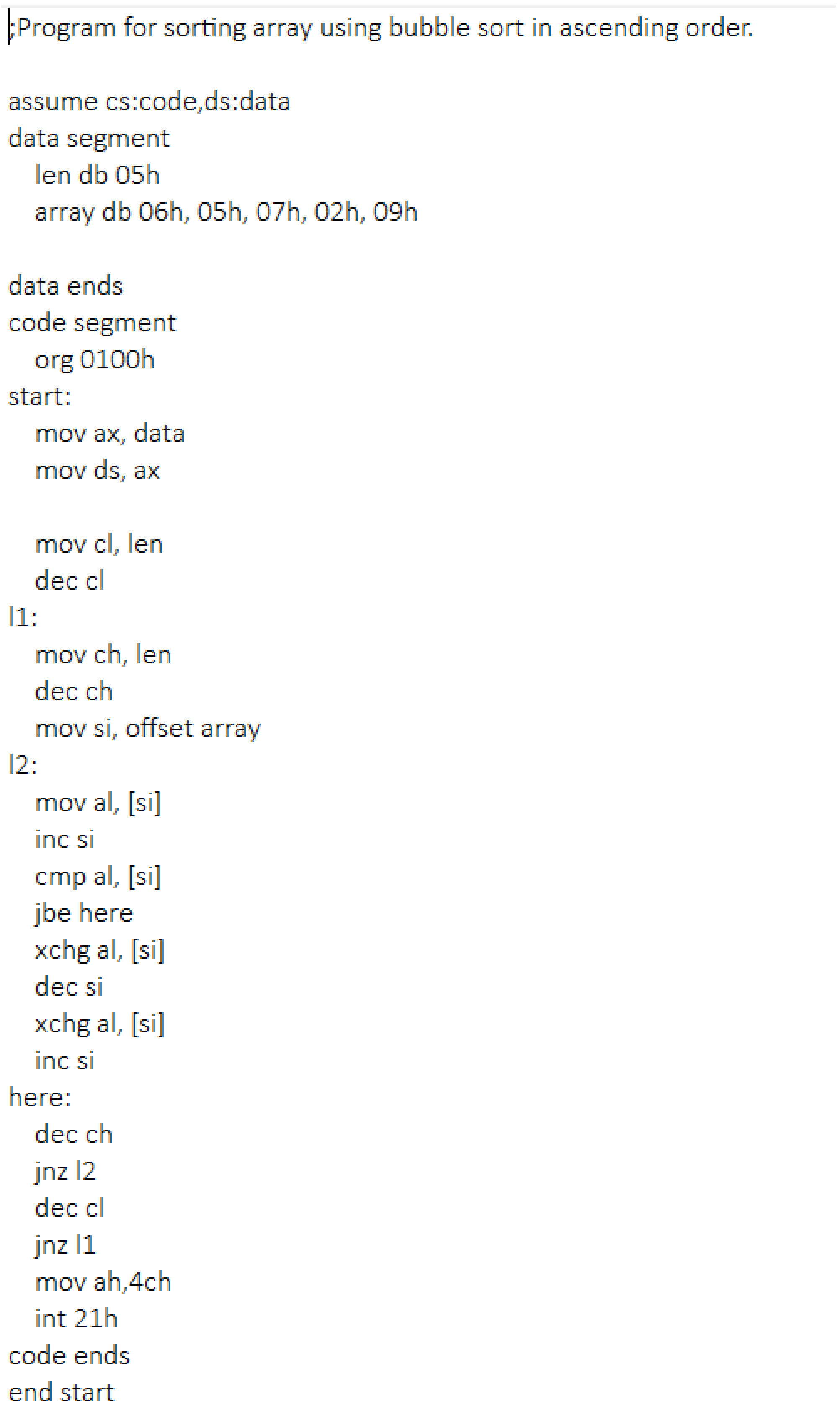
1. Run Dosbox and mount your masm folder to a drive in dosbox.
2. Goto the mounted drive.
3. Save the 8086 program with extension .asm in the same folder using command "edit"
4. After creating the file, assemble it using the command "masm filename.asm"
5. Link the file using the command "link filename.obj;"
6. Use debug command with filename.exe to execute and analyse the memory contents, "debug filename.exe".
7. In debug, command "u" will display the unassembled code.
8. Use command "d segment:offset" to see the content of memory locations starting from segment:offset address.
9. To change the value in memory, use the command "e segment:offset"
10. Verify the memory contents to ensure the updates (using command "d").
11. . Execute using the command "g" and check the outputs.
12. "q" to exit from debug and "exit" to exit from command prompt and to close the Dosbox.

Algorithm:

1. Move the starting address of data segment to AX register and move the data from AX register to DS register.
2. Move LEN to CH register and decrement, it.
3. L1: Move LEN to CL register and decrement, it.
4. Move the starting address of the array to SI register.
5. L2: Move the value stored in SI's register to AL register and increment SI register.
6. Compare the contents at AL register and at SI register's location using CMP.

7. Jump to HERE if the first value is less than or equal to second value.
8. Exchange the value at AL and SI register and decrement SI.
9. Now exchange values at AL and new SI's location and increment SI.
10. HERE: Decrement CH. If CH's value is not equal to zero, then jump to L2.
11. Decrement CL. If CL's value is not equal to zero, then jump to L1.
12. INT 21H means invoke the interrupt identified by the hexadecimal number 21. In MS-DOS, invoking interrupt 21h while AH = 4Ch causes the current process to terminate and uses the value of register AL as the exit code of the process.

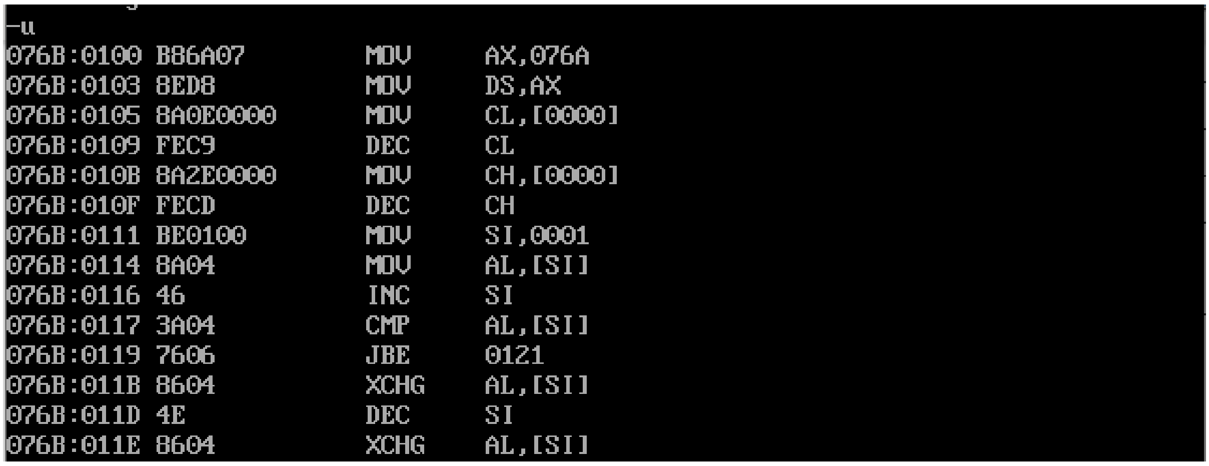
Program:



```
;Program for sorting array using bubble sort in ascending order.

assume cs:code,ds:data
data segment
   len db 05h
   array db 06h, 05h, 07h, 02h, 09h

data ends
code segment
   org 0100h
start:
   mov ax, data
   mov ds, ax

   mov cl, len
   dec cl
l1:
   mov ch, len
   dec ch
   mov si, offset array
l2:
   mov al, [si]
   inc si
   cmp al, [si]
   jbe here
   xchg al, [si]
   dec si
   xchg al, [si]
   inc si
here:
   dec ch
   jnz l2
   dec cl
   jnz l1
   mov ah,4ch
   int 21h
code ends
end start
```

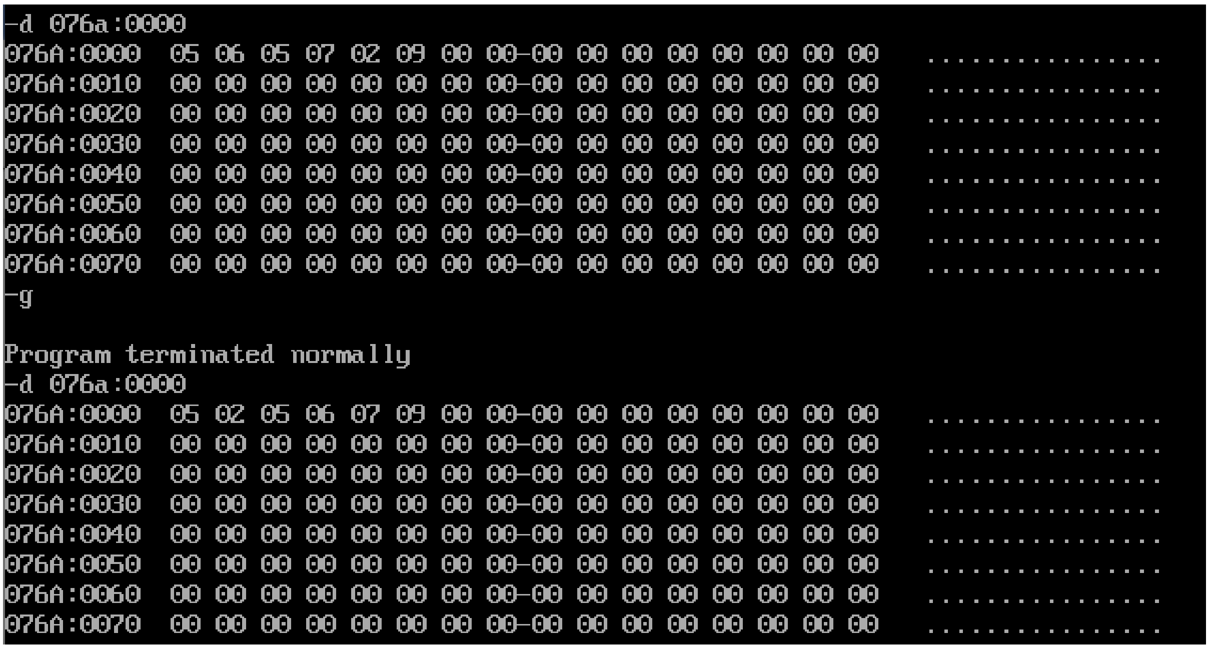
	Program	Comments
START:	ORG 0100H	Memory instruction starts from 0100H.
	MOV AX, DATA MOV DS, AX	Transferring the data from DATA to AX register and from AX register to DS register.
	MOV CL, LEN	CL <- LEN
	DEC CL	CL <- CL - 1
L1:	MOV CH, LEN	CH <- LEN
	DEC CH	CH <- CH -1
	MOV SI, OFFSET ARRAY	SI <- OFFSET ARRAY
L2:	MOV AL, [SI]	AL <- [SI]
	INC SI	SI <- SI + 1
	CMP AL, [SI]	Compare AL and {SI]
	JBE HERE	Jump to HERE, if AL is below/equal to [SI]
	XCHG AL, [SI]	Exchange contents at AL and [SI]
	DEC SI	SI <- SI - 1
	XCHG AL, [SI]	Exchange contents at AL and [SI]
	INC SI	SI <- SI + 1
HERE:	DEC CH	CH <- CH - 1
	JNZ L2	Jump to L2 if CH is zero.
	DEC CL	CL <- CL - 1
	JNZ L1	Jump to L2 if CL is zero.
	MOV AH, 4CH INT 21H	Terminates the program.

Snapshot of sample input and output:



```
-u
076B:0100 B86A07        MOV     AX,076A
076B:0103 8ED8          MOV     DS,AX
076B:0105 8A0E0000      MOV     CL,[0000]
076B:0109 FEC9          DEC     CL
076B:010B 8A2E0000      MOV     CH,[0000]
076B:010F FECD          DEC     CH
076B:0111 BE0100        MOV     SI,0001
076B:0114 8A04          MOV     AL,[SI]
076B:0116 46            INC     SI
076B:0117 3A04          CMP     AL,[SI]
076B:0119 7606          JBE     0121
076B:011B 8604          XCHG    AL,[SI]
076B:011D 4E            DEC     SI
076B:011E 8604          XCHG    AL,[SI]
```

Sorting the array in ascending order (06h, 05h, 07h, 02h, 09h):



```
-d 076a:0000
076A:0000  05 06 05 07 02 09 00 00-00 00 00 00 00 00 00 00   ................
076A:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
-g

Program terminated normally
-d 076a:0000
076A:0000  05 02 05 06 07 09 00 00-00 00 00 00 00 00 00 00   ................
076A:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
```

Result:

Thus the 8086 program for sorting in ascending order is executed successfully in DOS-BOX.

b) Sorting in descending order:

Aim:

Design 8086 program for Sorting in descending order.

Algorithm:

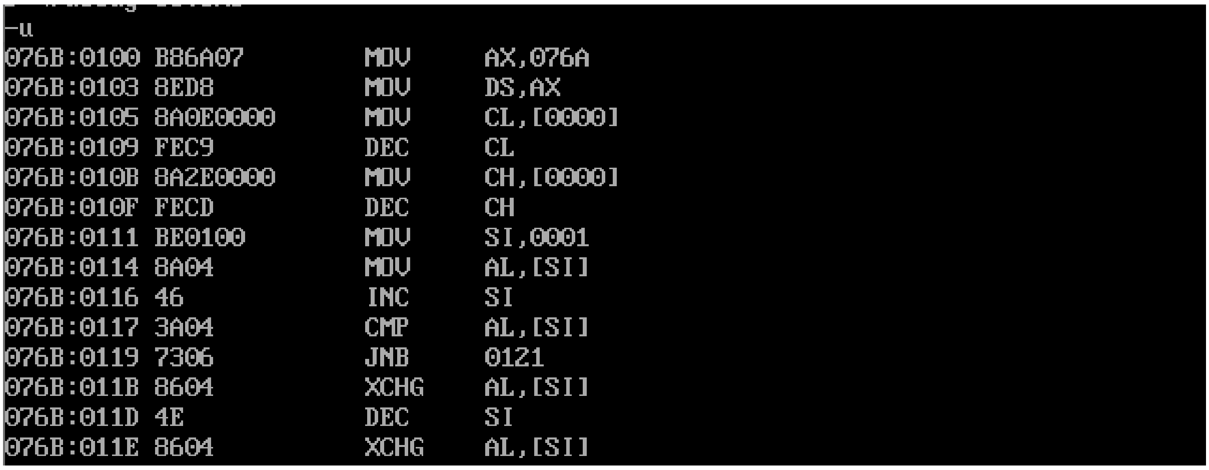
1. Move the starting address of data segment to AX register and move the data from AX register to DS register.
2. Move LEN to CH register and decrement, it.
3. L1: Move LEN to CL register and decrement, it.
4. Move the starting address of the array to SI register.
5. L2: Move the value stored in SI's register to AL register and increment SI register.
6. Compare the contents at AL register and at SI register's location using CMP.
7. Jump to HERE if the first value is greater than or equal to second value.
8. Exchange the value at AL and SI register and decrement SI.
9. Now exchange values at AL and new SI's location and increment SI.
10. HERE: Decrement CH. If CH's value is not equal to zero, then jump to L2.
11. Decrement CL. If CL's value is not equal to zero, then jump to L1.
12. INT 21H means invoke the interrupt identified by the hexadecimal number 21. In MS-DOS, invoking interrupt 21h while AH = 4Ch causes the current process to terminate and uses the value of register AL as the exit code of the process.

Program:

```
;Program for sorting array using bubble sort in descending order.

assume cs:code,ds:data
data segment
   len db 05h
   array db 06h, 05h, 07h, 02h, 09h

data ends
code segment
   org 0100h
start:
   mov ax, data
   mov ds, ax

   mov cl, len
   dec cl
l1:
   mov ch, len
   dec ch
   mov si, offset array
l2:
   mov al, [si]
   inc si
   cmp al, [si]
   jae here
   xchg al, [si]
   dec si
   xchg al, [si]
   inc si
here:
   dec ch
   jnz l2
   dec cl
   jnz l1
   mov ah,4ch
   int 21h
code ends
end start
```

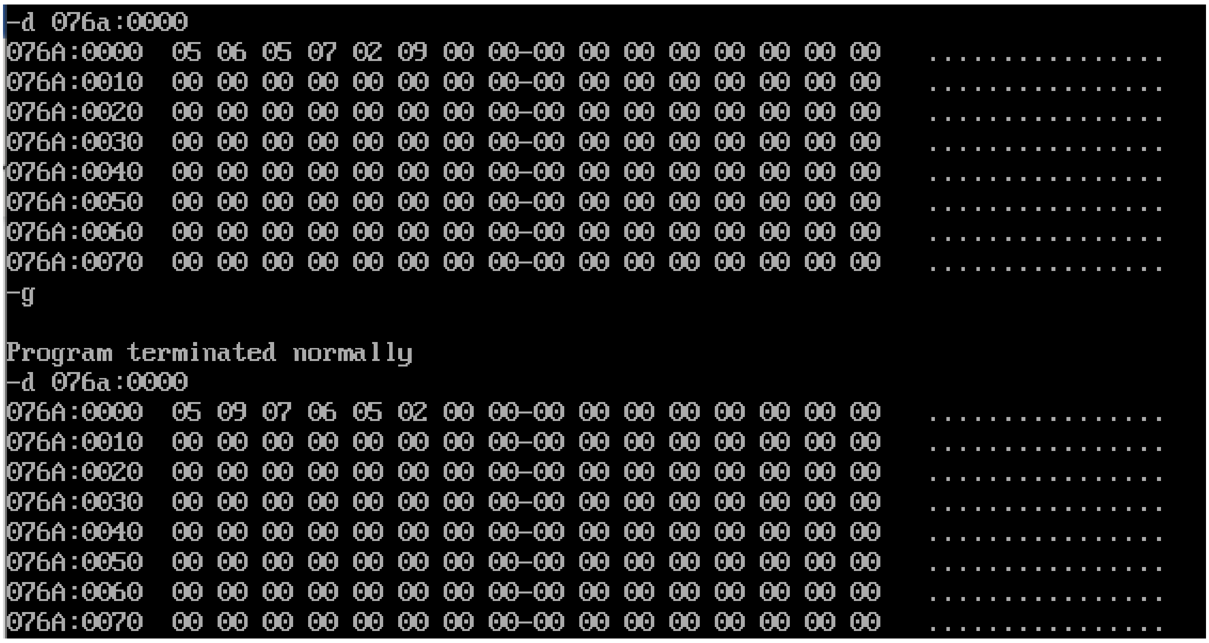
	Program	Comments
START:	ORG 0100H	Memory instruction starts from 0100H.
	MOV AX, DATA MOV DS, AX	Transferring the data from DATA to AX register and from AX register to DS register.
	MOV CL, LEN	CL <- LEN
	DEC CL	CL <- CL - 1
L1:	MOV CH, LEN	CH <- LEN
	DEC CH	CH <- CH -1
	MOV SI, OFFSET ARRAY	SI <- OFFSET ARRAY
L2:	MOV AL, [SI]	AL <- [SI]
	INC SI	SI <- SI + 1
	CMP AL, [SI]	Compare AL and {SI]
	JAE HERE	Jump to HERE, if AL is above/equal to [SI]
	XCHG AL, [SI]	Exchange contents at AL and [SI]
	DEC SI	SI <- SI - 1
	XCHG AL, [SI]	Exchange contents at AL and [SI]
	INC SI	SI <- SI + 1
HERE:	DEC CH	CH <- CH - 1
	JNZ L2	Jump to L2 if CH is zero.
	DEC CL	CL <- CL - 1
	JNZ L1	Jump to L2 if CL is zero.
	MOV AH, 4CH INT 21H	Terminates the program.

Snapshot of sample input and output:



```
-u
076B:0100 B86A07        MOV     AX,076A
076B:0103 8ED8          MOV     DS,AX
076B:0105 8A0E0000      MOV     CL,[0000]
076B:0109 FEC9          DEC     CL
076B:010B 8A2E0000      MOV     CH,[0000]
076B:010F FECD          DEC     CH
076B:0111 BE0100        MOV     SI,0001
076B:0114 8A04          MOV     AL,[SI]
076B:0116 46             INC    SI
076B:0117 3A04          CMP     AL,[SI]
076B:0119 7306          JNB     0121
076B:011B 8604          XCHG    AL,[SI]
076B:011D 4E            DEC     SI
076B:011E 8604          XCHG    AL,[SI]
```

Sorting the array in descending order (06h, 05h, 07h, 02h, 09h):



```
-d 076a:0000
076A:0000  05 06 05 07 02 09 00 00-00 00 00 00 00 00 00 00   ................
076A:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
-g

Program terminated normally
-d 076a:0000
076A:0000  05 09 07 06 05 02 00 00-00 00 00 00 00 00 00 00   ................
076A:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
```

Result:

Thus the 8086 program for sorting in descending order is executed successfully in DOS-BOX.