STRING MANIPULATIONS

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AIM:

To write assembly language programs to perform the following basic string operations.

1. To move a string of bytes.
2. To compare two strings of bytes.
3. To search a byte in a string of bytes.
4. To move a string without using string instructions.

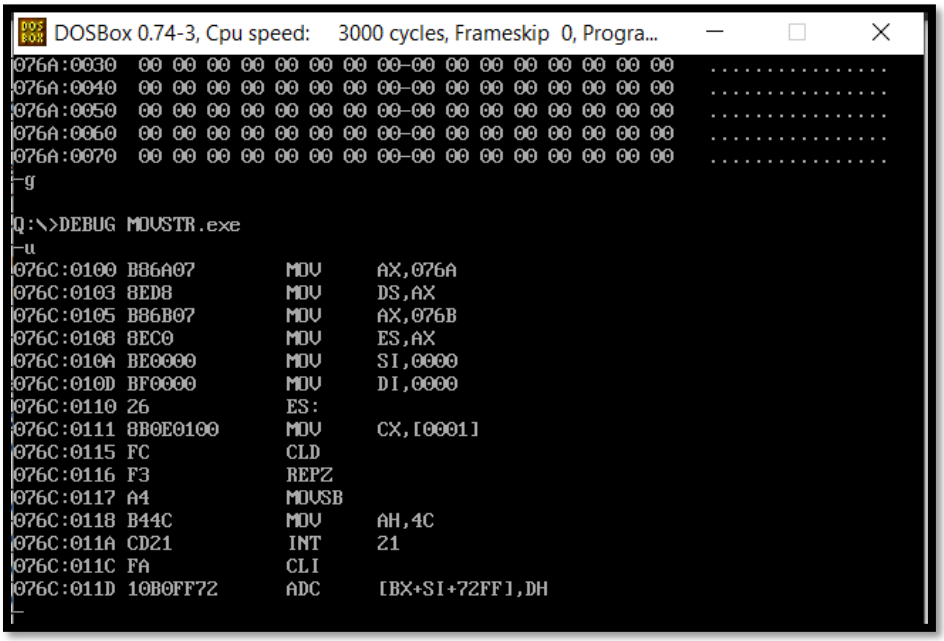
PROGRAM 1: MOVING A STRING OF BYTES

ALGORITHM:

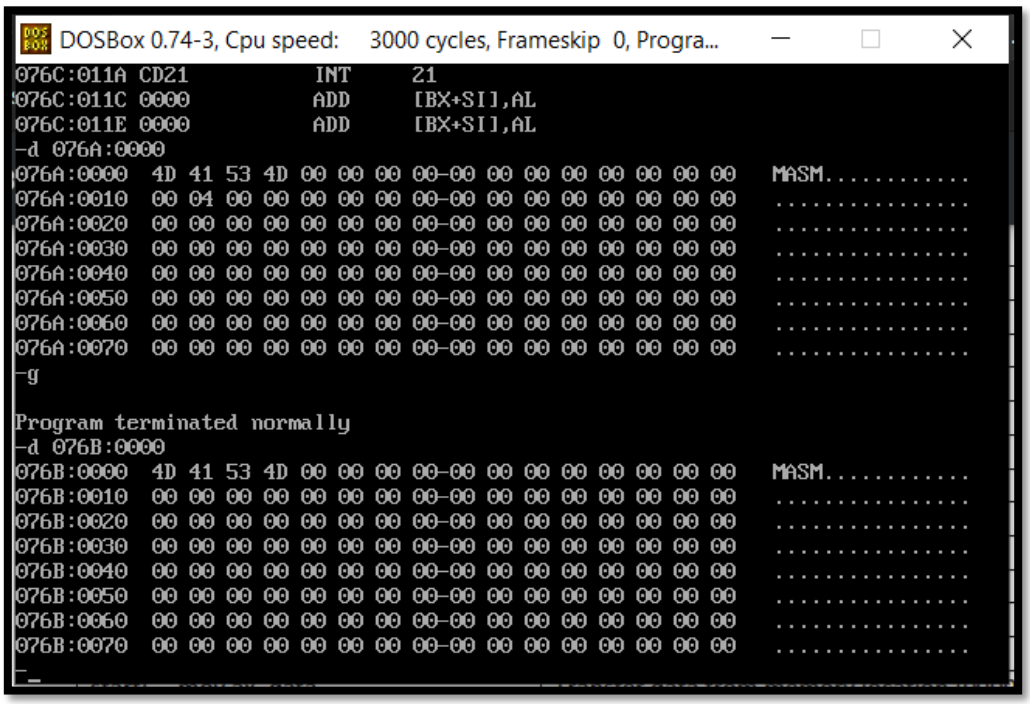
1. Begin
2. Declare data segment.
3. Initialize data segment with variables for storing the source string and its length.
4. Close the data segment.
5. Declare extra segment.
6. Initialize extra segment with a variable to store the destination string.
7. Close the extra segment.
8. Declare code segment.
9. Set a preferred offset (preferably 100h)
10. Load the data segment content into AX register.
11. Transfer the contents of AX register to DS register.
12. Load the extra segment content into AX register.
13. Transfer the contents of AX register to ES register.
14. Transfer to CX the length of source string.
15. Have SI point to source string and DI to destination string.
16. Clear the direction flag.
17. Repeat until CX is zero:
    (I) Transfer data from SI to DI using MOVSB.
18. Safely exit the program using an interrupt signal.
19. Close the code segment.
20. End

PROGRAM	COMMENTS
assume cs:code, ds:data, es:extra	Declare code and data segment.
data segment	Initialize data segment with values.
str1 db "MASM"	Stores a string STR1.
data ends	
extra segment	Initialize extra segment with values.
str2 db ?	Declaring a string with no preset value.
strlen dw 0004h	Declaring the length of the string STR1.
extra ends	
code segment	Start the code segment.
org 0100h	Initialize an offset address.
start: mov ax, data	Transfer data from “data” to AX.
mov ds, ax	Transfer data from memory location AX to DS.
mov ax, extra	Transfer the data from “extra” to AX.
mov es, ax	Transfer the data AX to ES.
mov si, offset str1	Store the starting offset address of STR1 in SI.
mov di, offset str2	Store the starting offset address of STR2 in DI.
mov cx, strlen	Store the length of STR1 in CX.
cld	Clear directional flag value.
rep movsb	Repeat MOVSB instruction till CX ≠ 0. MOVSB copies bytes from DS to ES.
mov ah, 4ch	
int 21h	Interrupt the process with return code and exit.
code ends	
end start	

UNASSEMBLED CODE:



SAMPLE I/O SNAPSHOT:



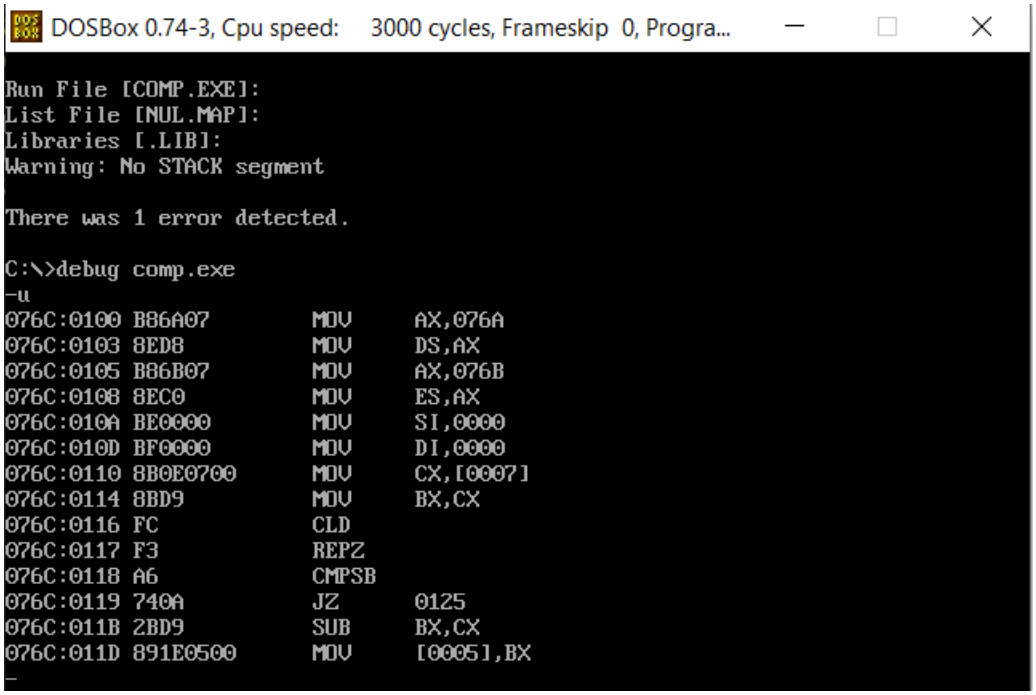
PROGRAM – 2: COMPARING 2 STRINGS OF BYTES:

ALGORITHM:

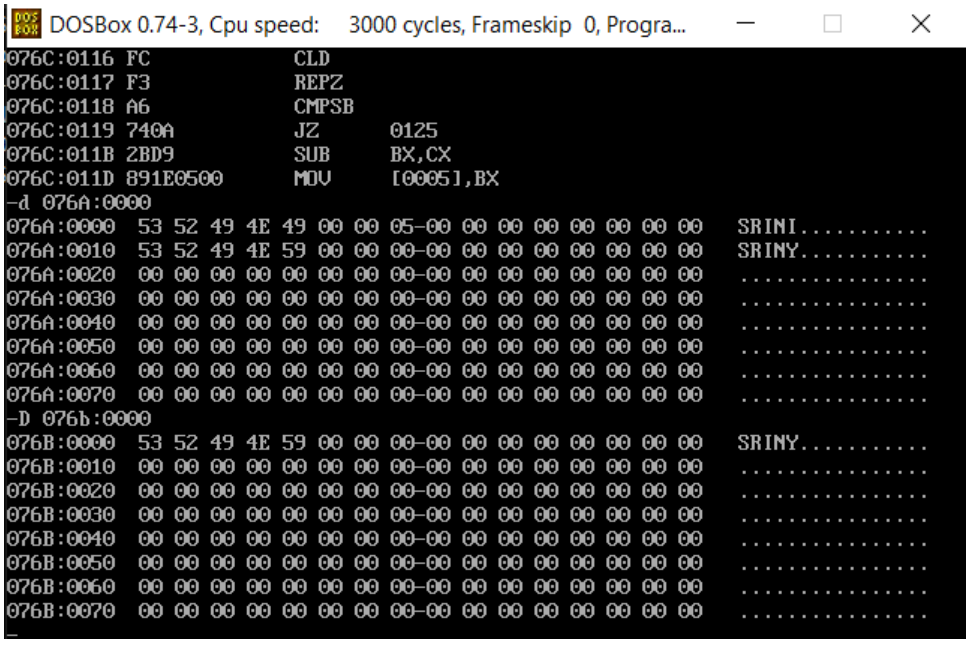
1. Begin.
2. Declare data segment.
3. Initialize data segment with variables for storing the source string and its length.
4. Close the data segment.
5. Declare extra segment.
6. Initialize extra segment with variables for storing the destination and its string.
7. Close the extra segment.
8. Declare code segment.
9. Set a preferred offset (preferably 100h)
10. Load the data segment content into AX register.
11. Transfer the contents of AX register to DS register.
12. Load the extra segment content into AX register.
13. Transfer the contents of AX register to ES register.
14. Transfer to CX the length of source string.
15. Have SI point to source string and DI to destination string.
16. Clear the direction flag.
17. Repeat until CX is zero or a mismatch is found:
    (I) Compare data in SI and DI using CMPSB, and increment the pointers.
18. If a mismatch is found, find the index of it by subtracting it with the source string's length.
19. Else, store zero as result. (String equality)
20. Safely exit the program using an interrupt signal.
21. Close the code segment.
22. End

PROGRAM	COMMENTS
assume cs:code, ds:data, es:extra	Declare code and data segment.
data segment	Initialize data segment with values.
str1 db "SRINI"	Stores a string STR1.
streq dw 0000h	Variable to store the result of the comparison.
strlen dw 0005h	Variable to hold the length of STR1.
data ends	
extra segment	Initialize extra segment with values.
str2 db "SRINY"	Declaring a string STR2.
extra ends	
code segment	Start the code segment.
org 0100h	Initialize an offset address.
start: mov ax, data	Transfer data from "data" to AX.
mov ds, ax	Transfer data from memory location AX to DS.
mov ax, extra	Transfer the data from "extra" to AX.
mov es, ax	Transfer the data AX to ES.
mov si, offset str1	Store the starting offset address of STR1 in SI.
mov di, offset str2	Store the starting offset address of STR2 in DI.
mov cx, strlen	Store the length of STR1 in CX.
mov bx, cx	Copy the value of CX to BX.
cld	Clear directional flag value.
repe cmpsb	Repeat CMPSB instruction till ZF = 1. CMPSB compares bytes of ES to corresponding bytes of DS.
jz equstr	Jump to "EQUSTR" if ZF = 0.
sub bx, cx	Subtract value of CX from value of BX.
mov streq, bx	Transfer the value of BX to variable STREQ.
mov ah, 4ch	
int 21h	Interrupt the process with return code and exit.
equstr: mov streq, 0000h	Transfer 0 to STREQ indicating STR1 and STR2 are equal.
mov ah, 4ch	
int 21h	Interrupt the process with return code and exit.
code ends	
end start	

UNASSEMBLED CODE:



SAMPLE I/O SNAPSHOT:



PROGRAM 3: SEARCHING A BYTE IN A STRING

ALGORITHM:

1. Begin.
2. Declare data segment.
3. Initialize data segment with a variable for the byte to be searched and variables to store the location and source string's length.
4. Close the data segment.

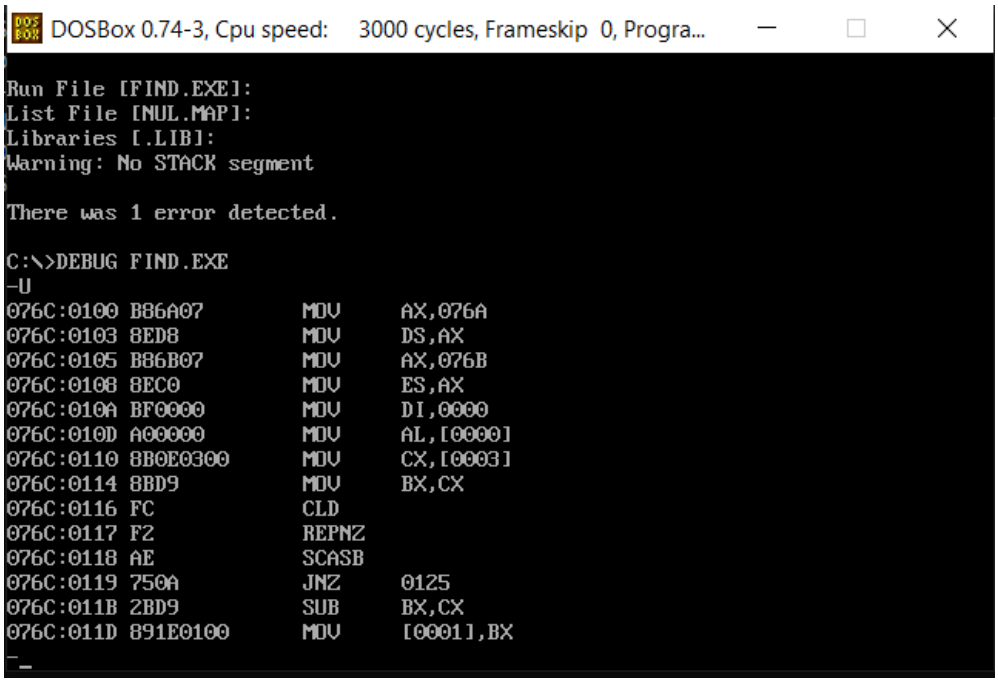
5. Declare extra segment.
6. Initialize extra segment with a variable to store the source string.
7. Close the extra segment.

8. Declare code segment.
9. Set a preferred offset (preferably 100h)
10. Load the data segment content into AX register.
11. Transfer the contents of AX register to DS register.
12. Load the extra segment content into AX register.
13. Transfer the contents of AX register to ES register.
14. Transfer to CX the length of source string.
15. Store in AL the byte to be searched for and in DI the source string.
16. Clear the direction flag.
17. Repeat until CX is zero or until a match is found:
    (I) Compare data in AL and DI using SCASB, and increment the pointers.
18. If a match is found, find its position by subtracting it with the source string's length.
19. Else, store zero as result. (Byte not found)
20. Close the code segment.

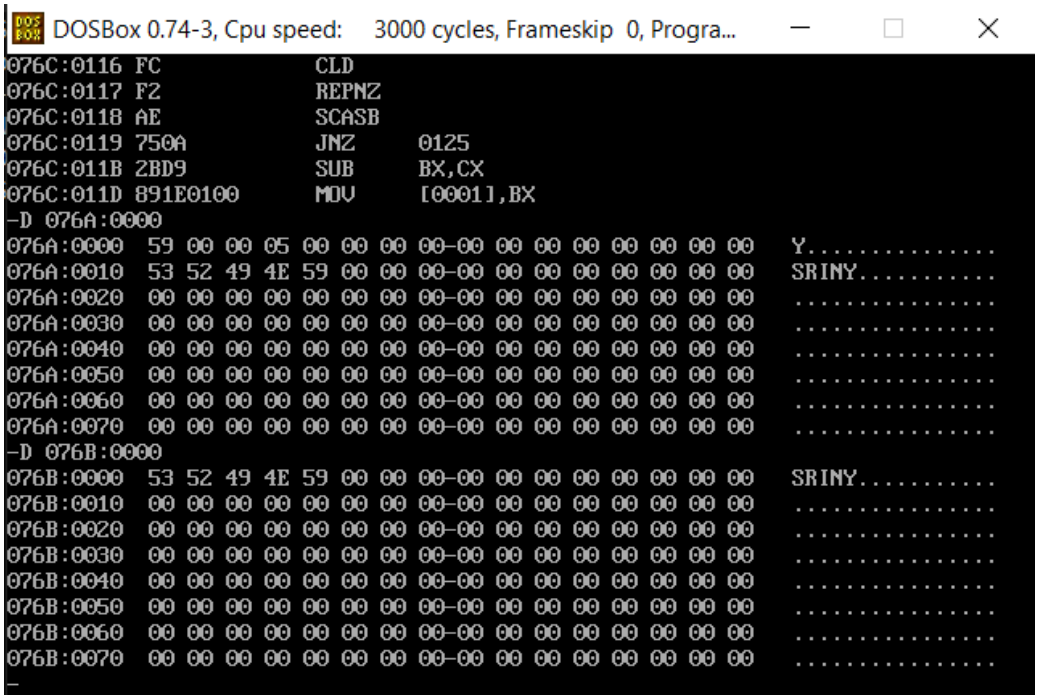
21. End

PROGRAM	COMMENTS
assume cs:code, ds:data, es:extra	Declare code and data segment.
data segment	Initialize data segment with values.
str2 db "Y"	Stores a string STR1.
strloc dw 0000h	Variable to store the index location.
strlen dw 0005h	Variable to hold the length of STR1.
data ends	
extra segment	Initialize extra segment with values.
str1 db "VENKY"	Declaring a string STR2.
extra ends	
code segment	Start the code segment.
org 0100h	Initialize an offset address.
start: mov ax, data	Transfer data from “data” to AX.
mov ds, ax	Transfer data from memory location AX to DS.
mov ax, extra	Transfer the data from “extra” to AX.
mov es, ax	Transfer the data AX to ES.
mov di, offset str1	Store the starting offset address of STR1 in DI.
mov al, str2	Store STR2 in AL.
mov cx, strlen	Store the length of STR1 in CX.
mov bx, cx	Copy the value of CX to BX.
cld	Clear directional flag value.
repne scasb	Repeat SCASB instruction till ZF = 0. SCASB scans for the occurrence of the byte in AL in ES.
jnz notfnd	Jump to “NOTFND” if ZF = 1.
sub bx, cx	Subtract value of CX from value of BX.
mov strloc, bx	Transfer the value of BX to variable STRLOC.
mov ah, 4ch	
int 21h	Interrupt the process with return code and exit.
notfnd: mov strloc, 0000h	Transfer 0 to STRLOC indicating STR2 was not found in STR1.
mov ah, 4ch	
int 21h	Interrupt the process with return code and exit.
code ends	
end start	

UNASSEMBLED CODE:



SAMPLE I/O SNAPSHOT:



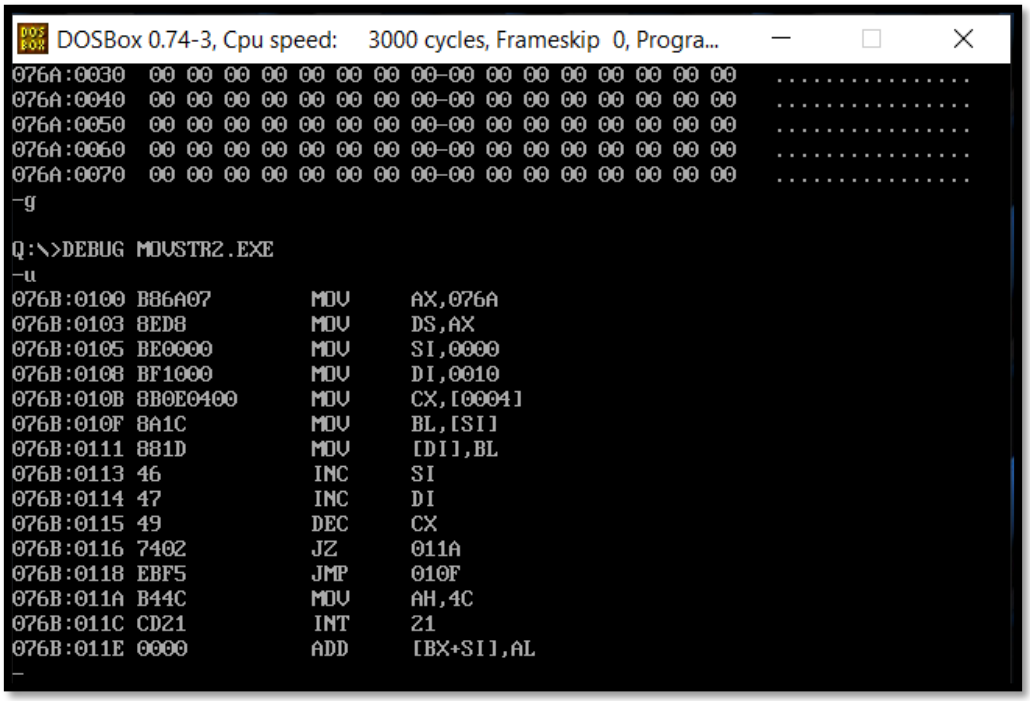
PROGRAM 4: MOVING WITHOUT USING STRING INSTRUCTIONS

ALGORITHM:

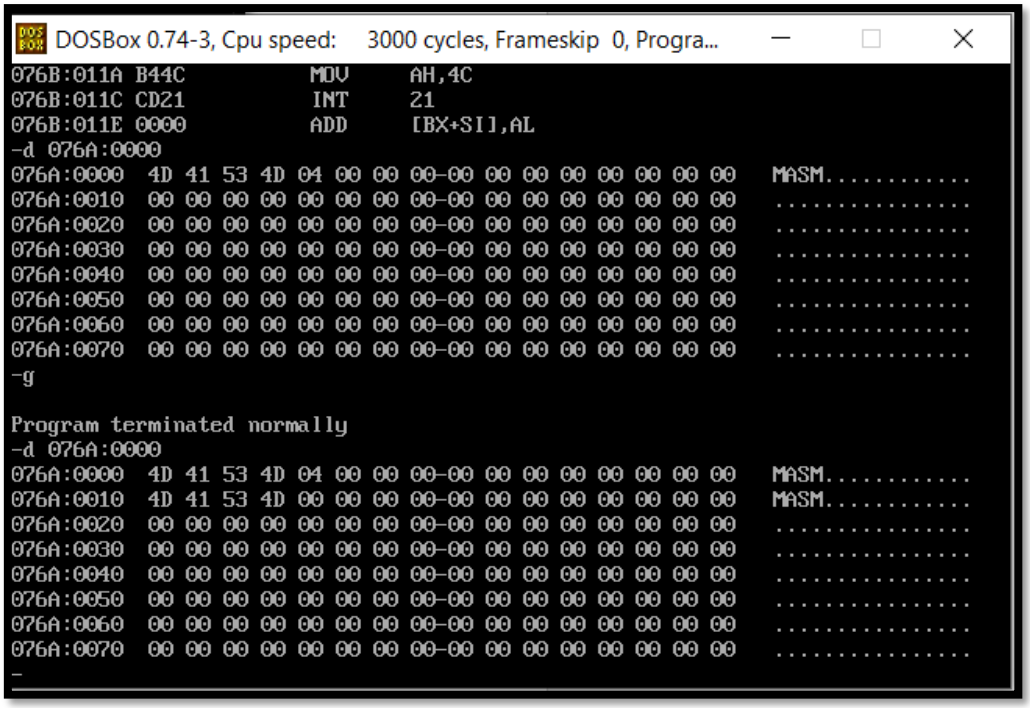
1. Begin
2. Declare data segment.
3. Initialize data segment with variables for storing the source string and its length.
4. Close the data segment.
5. Declare extra segment.
6. Initialize extra segment with a variable to store the destination string.
7. Close the extra segment.
8. Declare code segment.
9. Set a preferred offset (preferably 100h)
10. Load the data segment content into AX register.
11. Transfer the contents of AX register to DS register.
12. Load the extra segment content into AX register.
13. Transfer the contents of AX register to ES register.
14. Store in CX the length of the source string.
15. Have SI point to the source string and DI to the destination string.
16. Clear the direction flag.
17. Repeat until CX is zero:
    - (I) Transfer data from SI to DI
    - (II) Increment SI and DI
    - (III) Decrement CX
18. Safely exit the program using an interrupt signal.
19. Close the code segment.
20. End

PROGRAM	COMMENTS
assume cs:code, ds:data, es:extra	Declare code and data segment.
data segment	Initialize data segment with values.
str1 db "MASM"	Stores a string STR1.
strlen dw 0004h	Variable to hold the length of STR1.
str2 db ?	Declaring a string with no preset value.
data ends	
code segment	Start the code segment.
org 0100h	Initialize an offset address.
start: mov ax, data	Transfer data from "data" to AX.
mov ds, ax	Transfer data from memory location AX to DS.
mov si, offset str1	Store the starting offset address of STR1 in SI.
mov di, offset str2 + 000Ah	Store the starting offset address of STR2 + 000Ah in DI.
mov cx, strlen	Store the length of STR1 in CX.
looper: mov bl, [si]	Copy the value at SI's address location to BL.
mov [di], bl	Copy the value in BL to DI's address location.
inc si	Increment SI.
inc di	Increment DI.
dec cx	Decrement CX.
jz break	Jump to "BREAK" if CX = 0.
jmp looper	Unconditionally jump back to "LOOPER".
break: mov ah, 4ch	
int 21h	Interrupt the process with return code and exit.
code ends	
end start	

UNASSEMBLED CODE:



SAMPLE I/O SNAPSHOT:



RESULT:

The assembly level programs were written to perform the above specified basic string operations and the output was verified.