Microprocessor and Assembly Language CSC-321

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String Instructions

OUTLINE

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  - STOSB Instruction with examples
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- **References**
  - **Chapter 11,** Ytha Yu and Charles Marut, "Assembly Language Programming and Organization of IBM PC

String Instructions

Here are examples of operations that can be performed with the string instructions:

- Copy a string into another string
- Search a string for a particular byte or word
- Store characters in a string
- Compare strings of characters alphabetically

Benefits

- Automatic updating of pointer registers
- Memory-Memory operations are allowed

The Direction Flag

- The control flags are used to control the processor operations
- Direction Flag (DF)
- Its purpose is to determine the direction(Left-Right or Right-Left) in which string operations will proceed.
- These operations are implemented by the two index registers SI and DI

Example

- STRING1 DB ‘ABCDE’

String is stored in memory storing at offset 0200h

Offset Address	Content	ASCII Character
0200h	041h	A
0201h	042h	B
0202h	043h	C
0203h	044h	D
0204h	045h	E

- If DF = 0, SI and DI proceed in direction of increasing memory addressed, from left to right across the string.
- If DF = 1, SI and DI proceed in direction of decreasing memory addressed

CLD and STD

- To clear DF = 0, use CLD instruction

  Syntax: CLD
- To set DF = 1, use STD instruction

  Syntax: STD

CLD and STD have no effect on the other flags

Value of the Direction Flag	Effect on SI and DI	Address Sequence
0	Incremented	Low-high
1	Decremented	High-low

Moving a String

- MOVSB
  - Copies the contents of the byte addressed by DS:SI, to the byte addressed by ES:DI.
  - The contents of the source byte are unchanged.
  - Example:

STRING1 DB 'HELLO' (Source String)

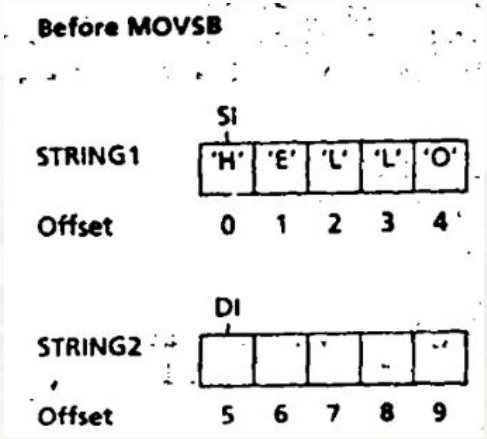
STRING2 DB 5 DUP (?) (Destination String)

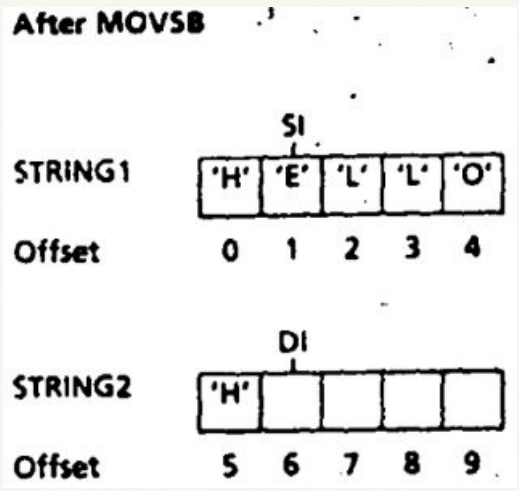
  - Both SI and DI is incremented if DF =0 or decremented if DF = 1

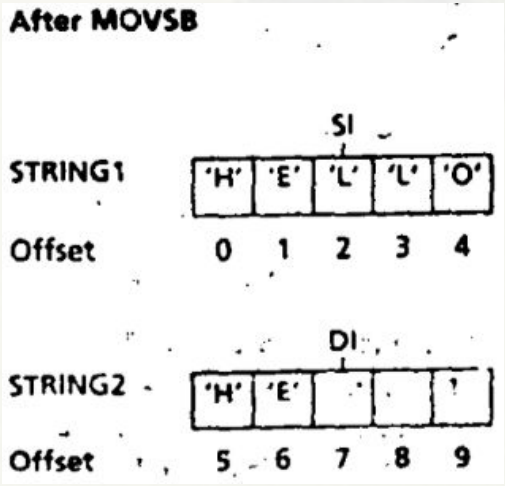
Cont.

- **Example:** Move first two bytes of String1 to String2.

```
.DATA
STRING1 DB 'HELLO'
STRING2 DB 5 DUP (?)
.CODE
MOV AX,@DATA
MOV DS,AX
MOV ES,AX
LEA SI,STRING1
LEA DI,STRING2
CLD
MOVSB
MOVSB
RET
```







CONT.

- MOVSW
  - Copies the contents of the word addressed by DS:SI, to the word addressed by ES:DI.
  - The contents of the source word are unchanged.
  - Both SI and DI is increased by 2 if DF =0 or decreased by 2 if DF = 1
- MOVSB and MOVSW have no effect on the flags

The REP prefix

- The REP prefix causes MOVSB to be executed N times.
- Syntax: REP MOVSB
- Example:

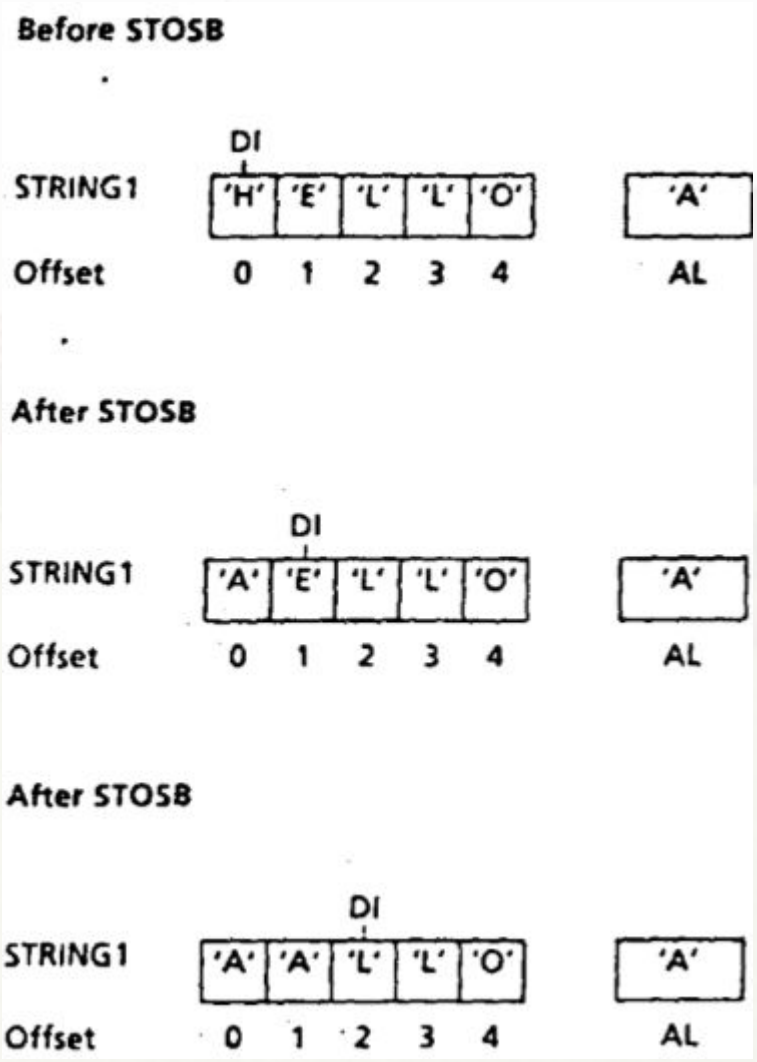
```
.CODE
MOV AX , @DATA
MOV DS ,  AX
MOV ES ,  AX
LEA SI , STRING1
LEA DI , STRING2
CLD
MOV CX , 5
REP MOVSB
RET
```

Store String

- STOSB
  - Move the contents of AL register to the byte addressed by ES:DI, DI is incremented if DF =0 or decremented if DF = 1
- STOSW
  - Move the contents of AX register to the word addressed by ES:DI, DI is increased by 2 if DF =0 or decremented by 2 if DF = 1
- STOSB and STOSW have no effect on the flags

Example (STOSB)


```
.DATA
STRING1 DB 'HELLO'
.CODE
MOV AX,@DATA
MOV ES,AX
LEA DI,STRING1
CLD
MOV AL,'A‘ ;AL has character to store
STOSB      ;store an ‘A’ in STRING1
STOSB      ;store another ‘A’ in STRING1
RET
```

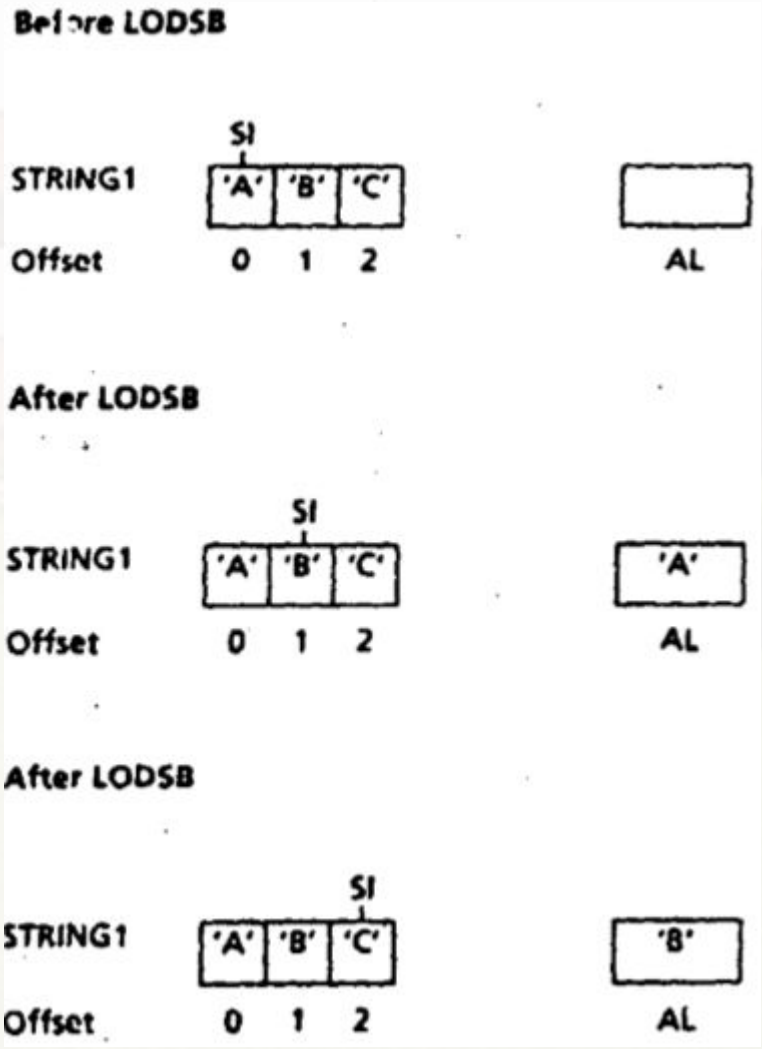


Load String

- LODSB
  - Move the byte addressed by DS:SI into AL, SI is incremented if DF =0 or decremented if DF = 1
- LODSW
  - Move the word addressed by DS:SI into AX, SI is increased by 2 if DF =0 or decreased by 2 if DF = 1
- LODSB and LODSW have no effect on the flags

Example


```
.DATA
STRING1 DB 'ABC'
.CODE
MOV AX,@DATA
MOV DS,AX
LEA SI,STRING1
CLD
LODSB   ;load first byte into AL
LODSB   ;load second byte into AL
RET
```

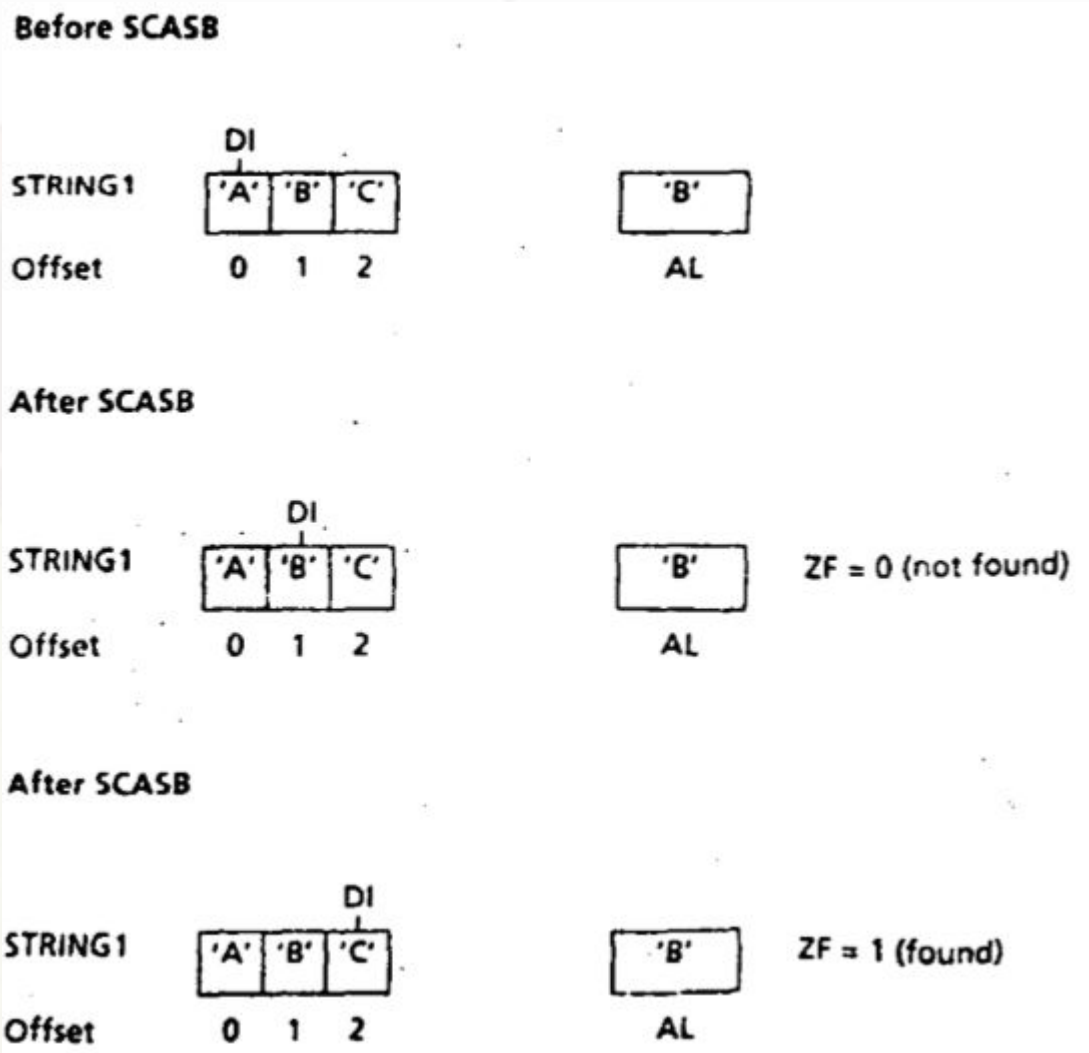


Scan String

- Use to examine a string for a target byte/word
- SCASB
  - Target byte is contained in AL
  - Subtract the string byte pointed to by ES:DI from the contents of AL and uses the result to set the flags
  - DI is incremented if DF =0 or decremented if DF = 1
- SCASW
  - Target word is contained in AX
  - Subtract the string word addressed by ES:DI from AX and set the flags.
  - DI is increased by 2 if DF =0 or decreased by 2 if DF = 1
- All status flags are affected by SCASB and SCASW

Example


```
.DATA
STRING1 DB 'ABC'
.CODE
MOV AX,@DATA
MOV ES,AX
LEA DI,STRING1
CLD
MOV AL,'B‘ ;target character
SCASB      ;scan first byte
SCASB      ;scan second byte
RET
```

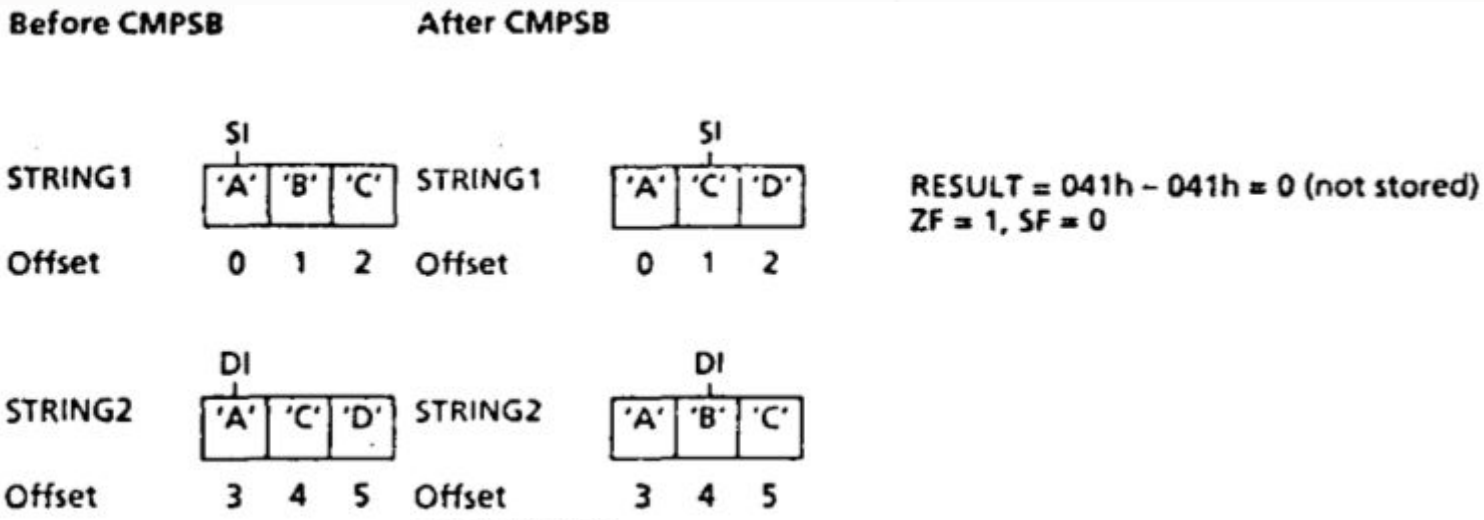


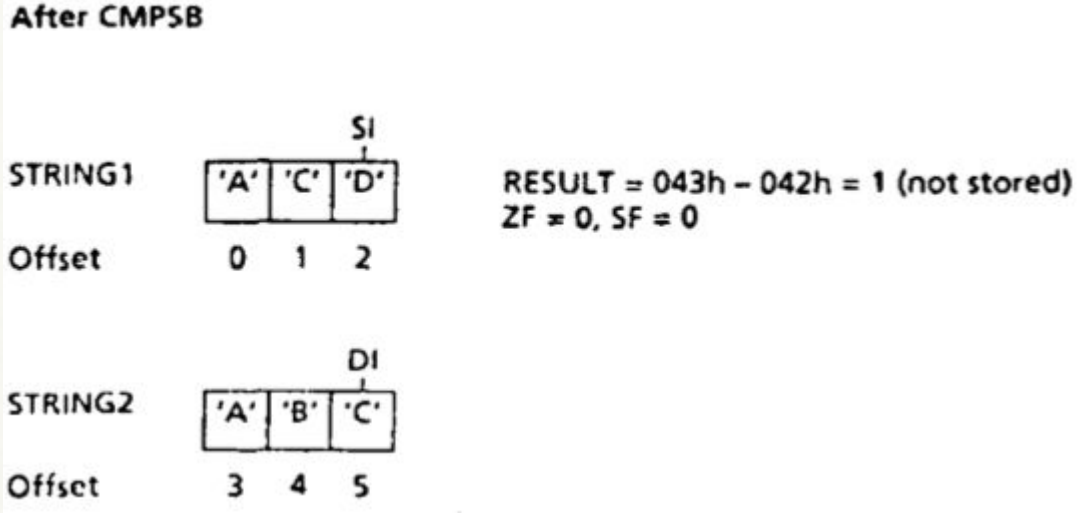
Compare String

- CMPSB
  - Subtracts the byte with address ES:DI, from the byte addressed by DS:SI.
  - The result is not stored
  - Both SI and DI is incremented if DF =0 or decremented if DF = 1
- CMPSW
  - Subtracts the word with address ES:DI, from the word addressed by DS:SI
  - Both SI and DI is increased by 2 if DF =0 or decreased by 2 if DF = 1
- All status flags are affected by CMPSB and CMPSW

Example


```
.DATA
STRING1 DB 'ACD'
STRING2 DB 'ABC'
.CODE
MOV AX,@DATA
MOV DS,AX
MOV ES,AX
CLD
LEA SI,STRING1
LEA DI,STRING2
CMPSB    ;compares first byte
CMPSB    ;compares second byte
RET
```





Cont.

- CMPSB may be used to compare two character strings to see which comes first alphabetically, or if they are identical, or if one string is a substring of the other (this means that one string is contained within the other as a sequence of consecutive characters).

Chapter # 11, Question # 1

- Suppose

SI contains 100h Byte 100h contains 10h

DI contains 200h Byte 101h contains 15h

AX contains 4142h Byte 200h contains 20h

DF = 0 Byte 201h contains 25h

- Give the source, destination, and the value moved for each of the following instructions. Also give the new contents of SI and DI.

1. MOVSB
2. MOVSW
3. STOSB
4. STOSW
5. LODSB
6. LODSW

Solution

No.	Instructions	Values (Contents in hex, of the source or destination which modified)	Values of SI or DI which modified
1.	MOVSB	[0200]=10h	SI=101h, DI=201h
2.	MOVSW	[0200]=1015h	SI=102h, DI=202h
3.	STOSB	[0200]= 42h	DI=201h
4.	STOSW	[0200]=4142h	DI=202h
5.	LODSB	AL=10h	SI=101h
6.	LODSW	AX=1510h	SI=102h