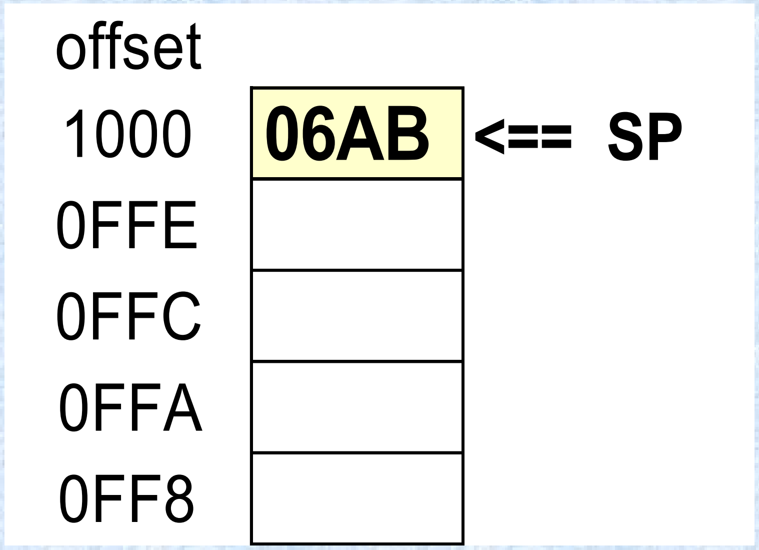
Stack Operations

- LIFO structure (last-in,first-out)
  - The last value put into the stack is the first value taken out
- Runtime stack
  - A memory array that is managed directly by HARDWARE in the CPU, using two registers: SS and SP.
  - Modified by instructions CALL, RET, PUSH, and POP

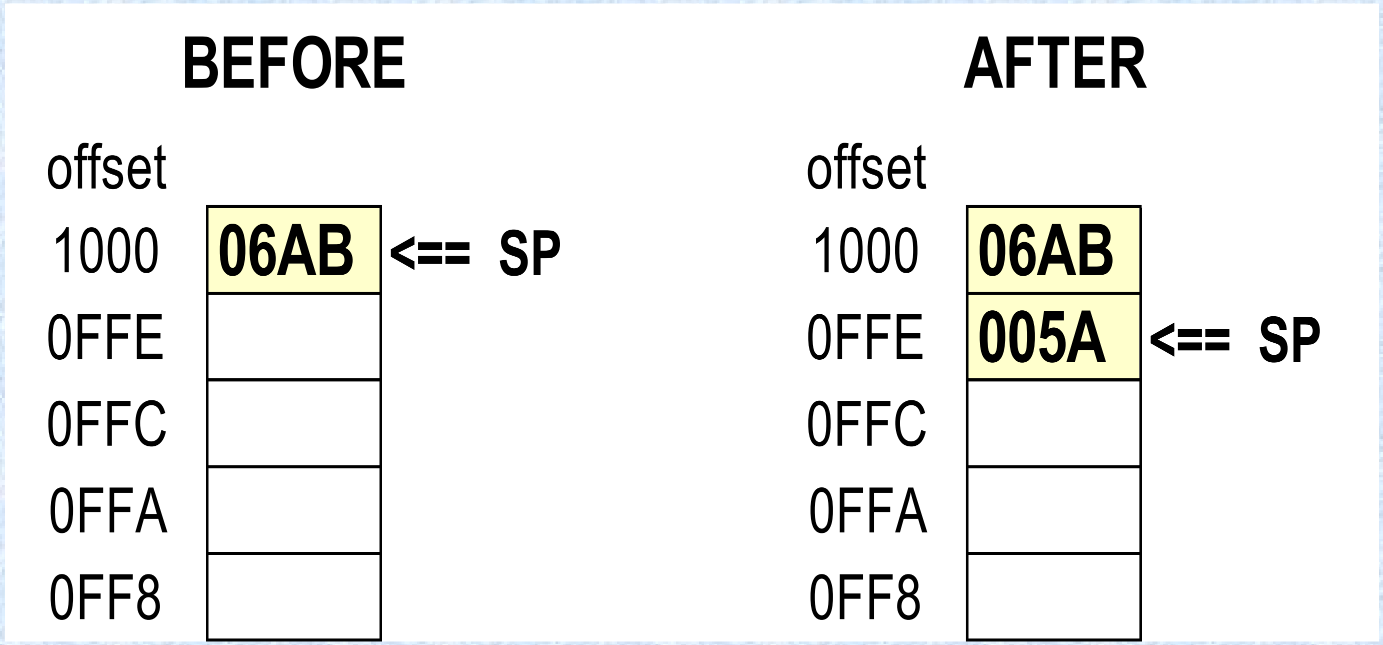
Stack Pointer Register (SP)

- Points to LAST integer to be added to (pushed onto) stack.



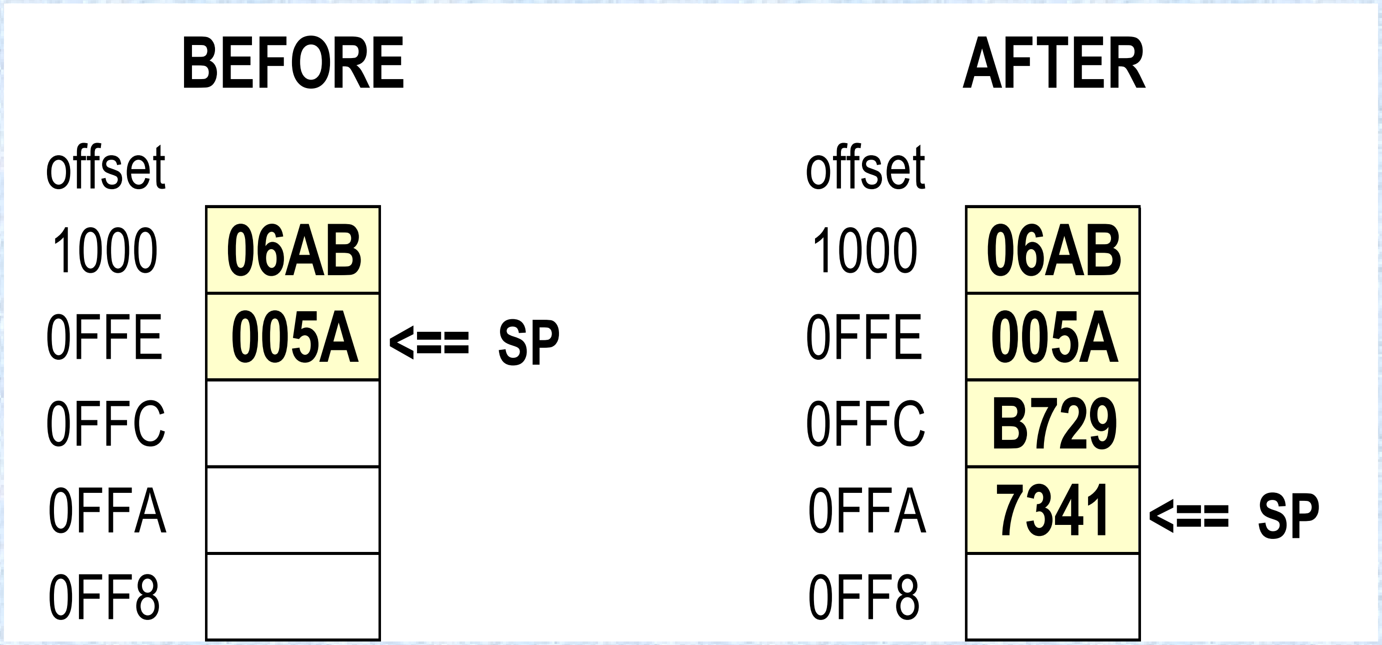
Push Operation

- PUSH 00A5



Push Operation(cont)

- PUSH 0B729h
- PUSH 7341h



BEFORE

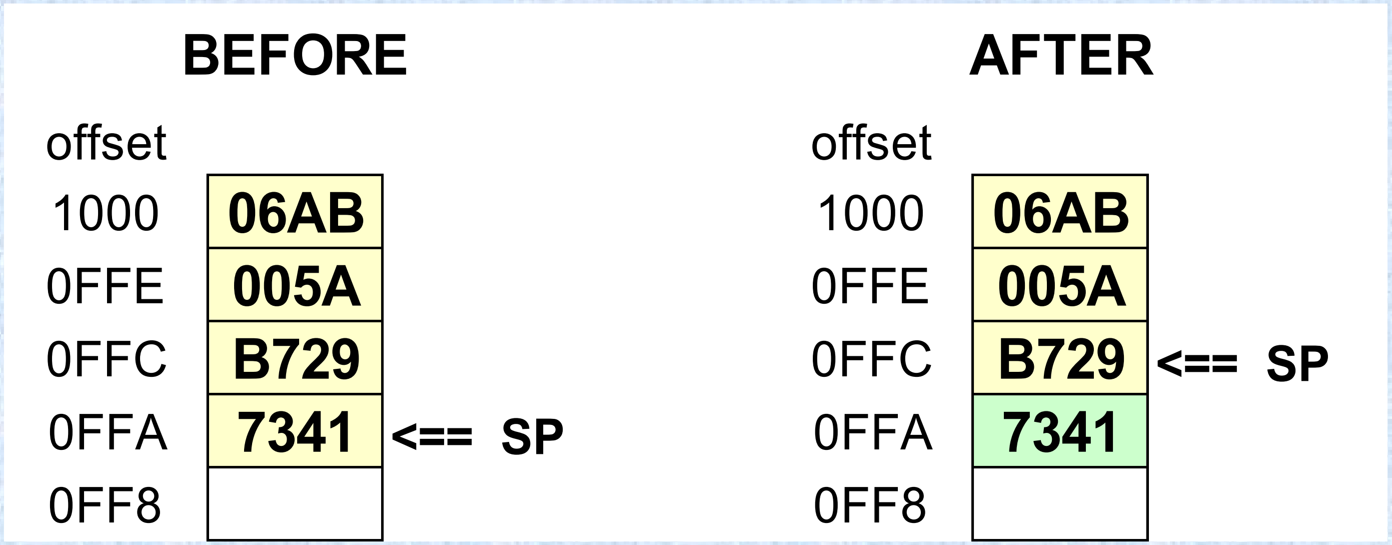
offset		
1000	06AB	
0FFE	005A	<== SP
0FFC		
0FFA		
0FF8		

AFTER

offset		
1000	06AB	
0FFE	005A	
0FFC	B729	
0FFA	7341	<== SP
0FF8		

Pop Operation

- POP DX
- After the operation, DX = 7431h



BEFORE

offset		
1000	**06AB**	
0FFE	**005A**	
0FFC	**B729**	
0FFA	**7341**	**<== SP**
0FF8		

AFTER

offset		
1000	**06AB**	
0FFE	**005A**	
0FFC	**B729**	**<== SP**
0FFA	**7341**	
0FF8		

Stack Information

- PUSH and POP must be 16- or 32-bit values
  - No 8-bit register, memory operands
- After a POP, the data still resides in the stack but is overwritten on the next push instruction.
- The stack grows downward in memory.

Stack Applications

- A temporary save area for registers when they are used for more than one purpose.
- For CALL instructions, the returning CS:IP address is saved on the stack.
- Passing arguments to procedures are passed on the stack.
- Local variables inside a procedure are created on the stack.

Other PUSH/POP Instructions

- PUSHF
  - Pushes the values of the 16-bit flags register
- PUSHA
  - Pushes all 16-bit registers on the stack in the following order (AX,CX,DX,BX,SP,BP,SI,DI)
- POPF
- POPA
- PUSHFD/POPFD
- PUSHAD/POPAD

Write a program to reverse a string using the stack

- Use the $ operator to determine the length of the string
- Use loops to move through the string
- Use Writestring to initially write the string correctly and again to write it backward. DX must point to the OFFSET of the string.
- Save the reversed string in the original string location.

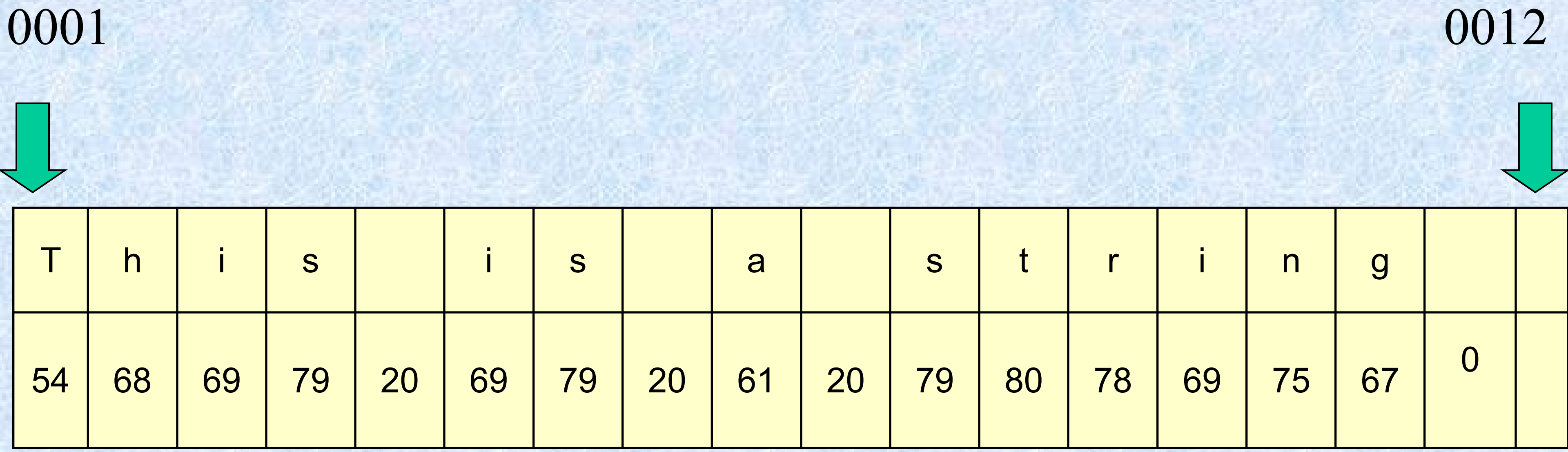
RevString.asm (data declaration)

```
Include Irvine16.inc
.data
   String1 BYTE “This is a string”,0
   String_size = ($ - String1) - 1
```

Contents of Memory

- The $ operator is the current location pointer. It points to the next available location in the data segment . If the first character is at location 0000, $=0012h

String_size = 0012 – 0001 – 1 = 0010h



T	h	i	s		i	s		a		s	t	r	i	n	g		
54	68	69	79	20	69	79	20	61	20	79	80	78	69	75	67	0	

RevString.asm (Data Segment Initialization)

```
.code
Main PROC
        Mov ax, @data
        Mov  ds,ax

        Mov dx, OFFSET String1
        Call Writestring
```

RevString.asm (code to push string on stack)

```
      Mov cx, String_size
      Mov si,0
Lp1:  Mov al, String1[si]
      Push ax
      inc si
      Loop Lp1
```

Contents of Stack Memory

- Push must be 16-bits (or 32-bits)
- Only wrote to AL – Don’t know what is in AH.
- After all pushes, SP =00DE (assuming original SP=0100)

00DE 00E7 00EF

?	g	?	s	?	n	?	i	?	r	?	t	?	s	?		?	a
?	67	?	79	?	75	?	69	?	78	?	80	?	79	?	20	?	61

?		?	s	?	i	?		?	s	?	i	?	h	?	T
?	20	?	79	?	69	?	20	?	79	?	69	?	68	?	54

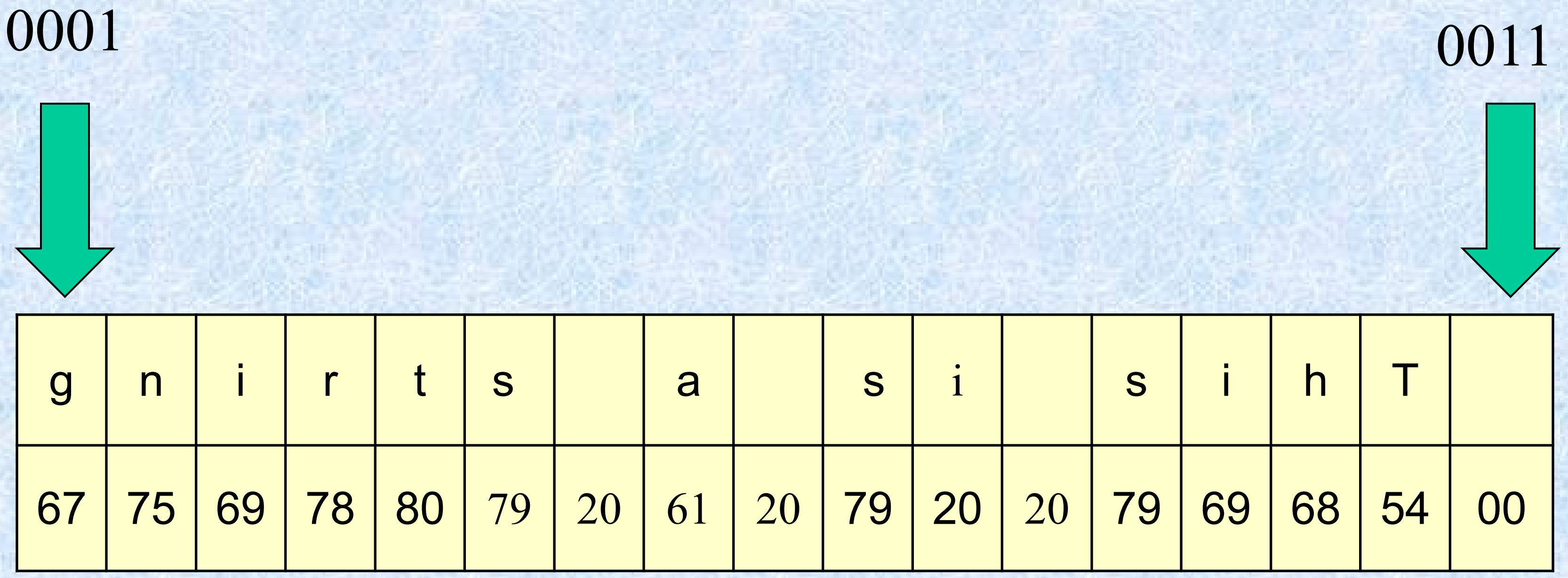
00F1 00F3 00F5 00F7 00F9 00FB 00FD 00FF

RevString.asm (code to pop string off stack)

```
        Mov cx, String_size
        Mov si,0
Lp2:    Pop ax
        Mov String1[si], al
        inc si
        Loop Lp2

        Call Writestring
```

Contents of Memory



g	n	i	r	t	s		a		s	i		s	i	h	T	
67	75	69	78	80	79	20	61	20	79	20	20	79	69	68	54	00

RevString.asm (Program Termination)

```
        Mov  ah,4Ch
        Int 21h
Main endp
END Main
```