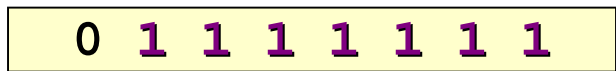


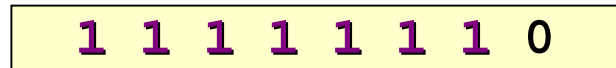
# Shifting Registers

- The CPU provides the facility to SHIFT registers in any direction. This can be useful for multiplication or division.
- Multiplication by 2 can be achieved by simply shifting the contents of a register 1 position to the left filling the vacant place with a “zero”.

Before



After



<u>Signed</u>	<u>Unsigned</u>
127	127
<b>OF=1</b>	254

Signed Error

```
INSTRUCTION: SHL AH, 1
```

SHifts the AH Register Left, 1 position by pushing in a '0'

# Shifting Registers

- This instruction also works on signed numbers :

Before

1 1 1 1 1 1 1 1

After

1 1 1 1 1 1 1 0

0

<u>Signed</u>	<u>Unsigned</u>
-1	255
-2	<b>CF=1</b>

Unsigned Error

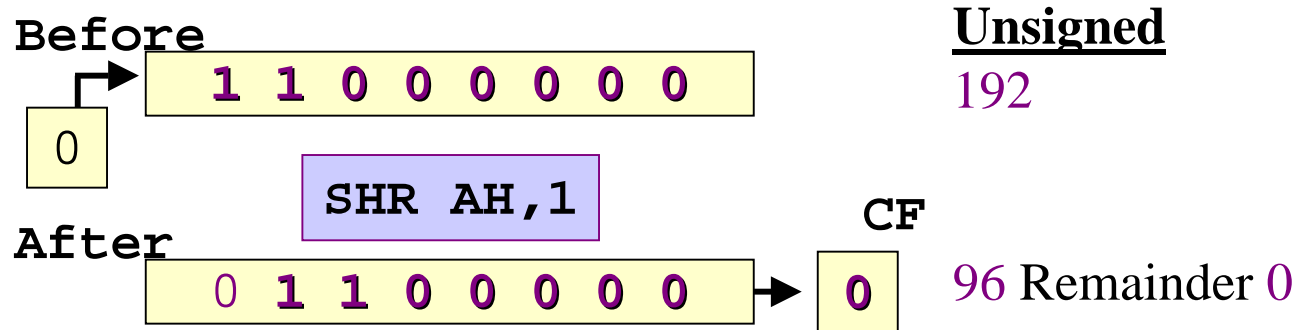
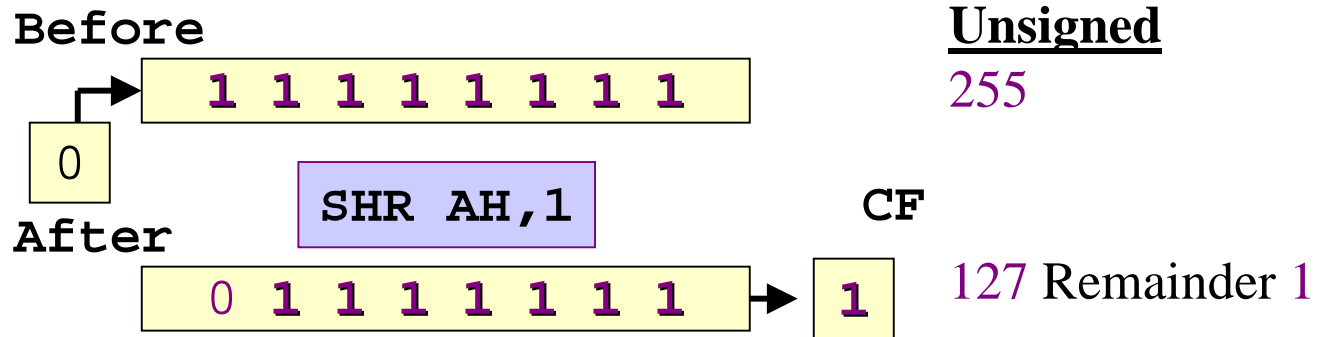
**INSTRUCTION: SHL AH,1**

**SHifts the AH Register Left, 1 position by pushing in a '0'**

# Shifting Registers

- Division by 2 can be achieved by Shifting Right by 1 position, however it is done differently for signed and unsigned numbers. The “remainder” is held in the Carry Flag.

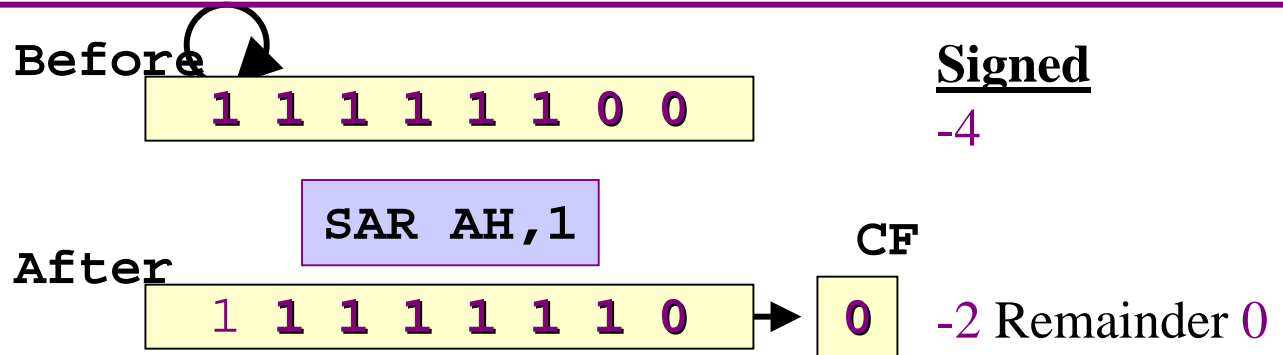
Shift Right for Unsigned numbers. Shifts in a '0'



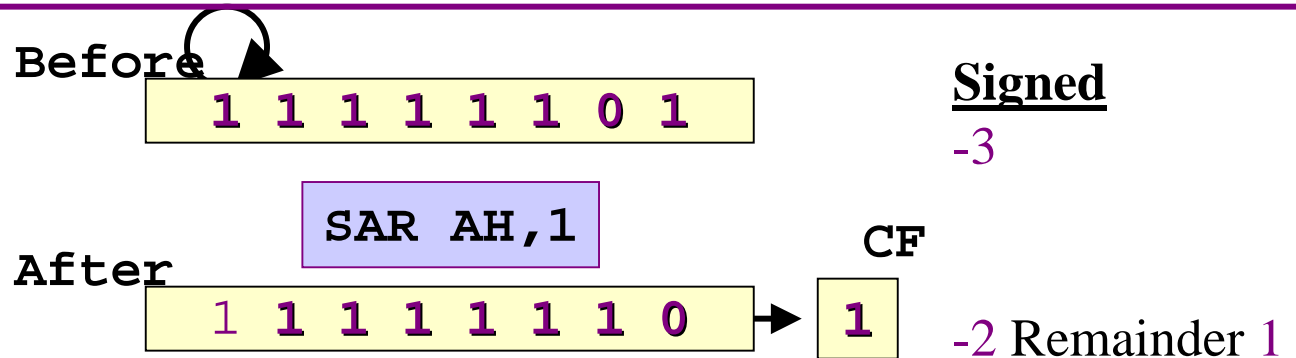
# Shifting Registers

- To preserve the sign-bit (Bit 7) on a signed number, a separate instruction SAR is used.

Shift Arithmetic Right for signed numbers. Replicates the MSB to preserve sign bit.



Remember: The remainder in the CF is always POSITIVE.





# Exercises

- Assume an 8-bit register contains the value 3, how can this value be manipulated by shift instructions only to become 12?
- Assume an 8-bit register contains the value 48, how can this value be manipulated by shift instructions only to become 3?