8086 Flag Register

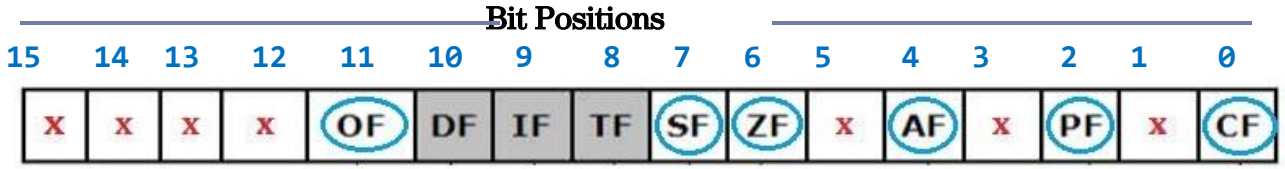
Dept. of Computer Science and Engineering
BRAC University
CSE 341 Team

Lecture References:

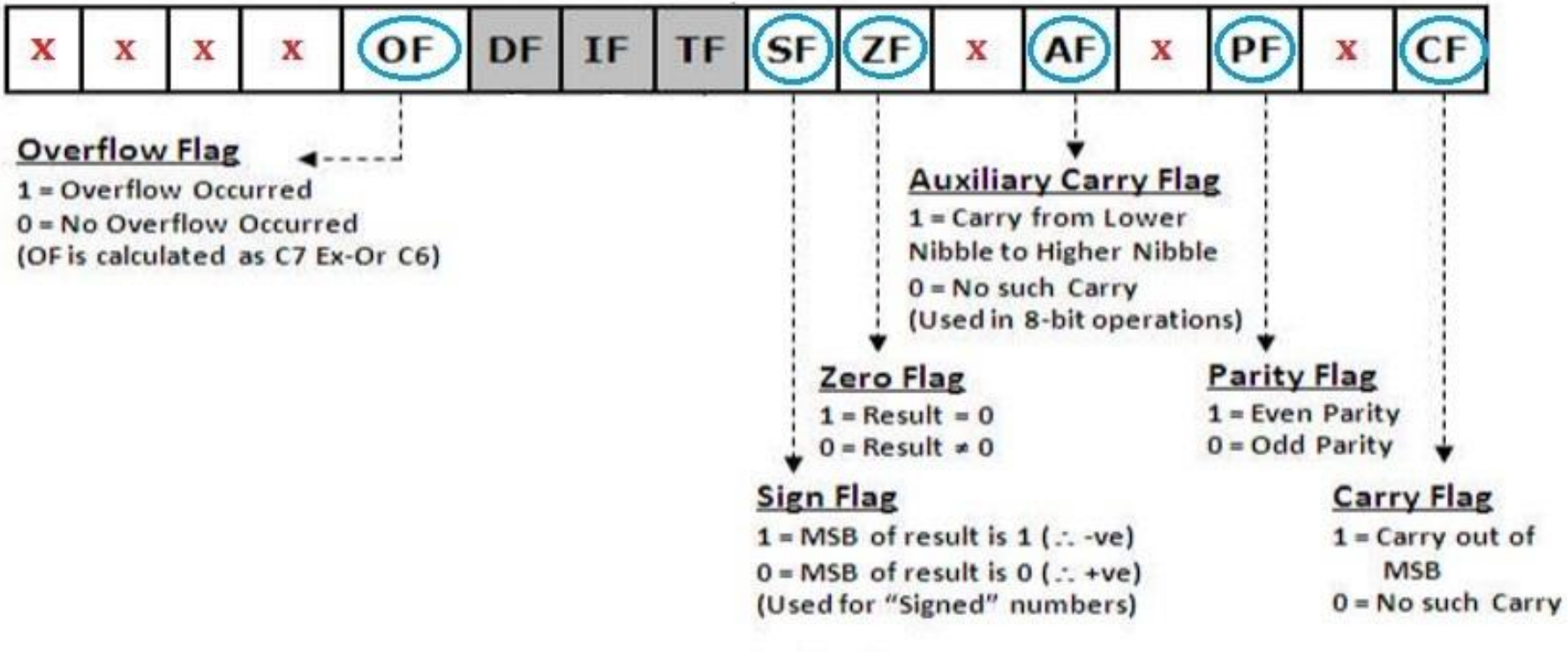
- **Book:**
  - *Microprocessors and Interfacing: Programming and Hardware, Chapter # 2,* **Author:** Douglas V. Hall

8086 Flag Register

- 16-**Bit register**
  - **7 bits are undefined/unused (marked by red x in the figure below)**
  - **6 status/condition flags (marked by blue circles)**
  - **3 control flags (those in grey boxes)**
- The condition flags are set (1) or reset (0) depending on the result of an arithmetic/logical operation.
- Control flags control the operations of the CPU



Status Flags



Flags are useful in programming e.g. when writing conditions such as:

- If answer is zero, do ... else .... // zero flag comes in hand here
- If answer is less than zero, do ... else .... // sign flag can be used here

Status Flags

- **Carry Flag (CF) -** is set to '1' when there is an unsigned overflow. E.g. when you add bytes 255 + 1 (result is not in range 0...255). When there is no overflow this flag is reset to 0.
- **Parity Flag (PF) -** set to '1' when there is even number of one bits in result, and reset to '0' when there is odd number of one bits.
- **Auxiliary Flag (AF) -** set to '1' when there is an unsigned overflow for low nibble (4 bits).

Status Flags

- **Zero Flag (ZF) -** set to '1' when result is zero. For non-zero result this flag is reset to '0'.
- **Sign Flag (SF) -** set to '1' when result is negative. When result is positive it is reset to '0'. (This flag takes the value of the most significant bit).
- **Overflow Flag (OF) -** set to '1' when there is a signed overflow. For example, when you add bytes 100 + 50.

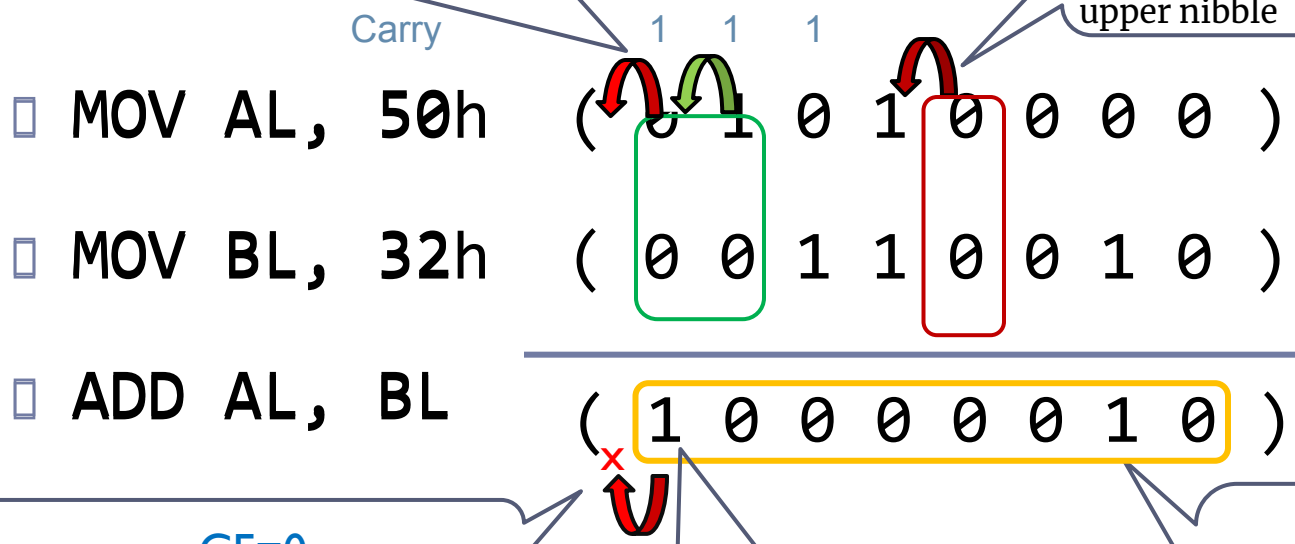
Status Flags

NB:
OF is **set to 1** if there is a carry from:
- **the 7th bit to the 8th bit ONLY or**
- **from the 8th bit to the 9th bit ONLY**

If there is a carry from the **7th bit to the 8th bit and** from the **8th bit to the 9th bit** at **THE SAME TIME** then **OF = 0**

OF=1
Set because there is a carry from the 7th bit to the 8th bit ONLY

AF=0
Reset because there is NO carry from the lower nibble to the upper nibble



CF=0
Reset because the answer has NO carry

SF=1
Set because the MSB is 1 indicating a negative answer

ZF=0
Reset because the answer is NOT zero

PF=1
Set because the answer has an EVEN number of 1s

Status Flags

NB:
OF is **reset to 0** if:
- there is a **carry** from **the** the **7th bit to the 8th** bit **and** from the **8th bit to the 9th bit** at **THE SAME TIME** or
- there is **NO carry** from **the** the **7th bit to the 8th** bit **and** from the **8th bit to the 9th bit** at **THE SAME TIME**

OF=0
Reset because there is a carry from the **7th bit to the 8th** bit **and** from the **8th bit to the 9th bit** at **THE SAME TIME**

AF=1
Set because there IS a carry from the lower nibble to the upper nibble

- `MOV AL, FFh` `1 1 1 1 1 1 1 1`
- `MOV BL, 01h` `0 0 0 0 0 0 0 1`
- `ADD AL, BL`

Carry 1 1 1 1 1 1 1 1

`1 0 0 0 0 0 0 0 0`

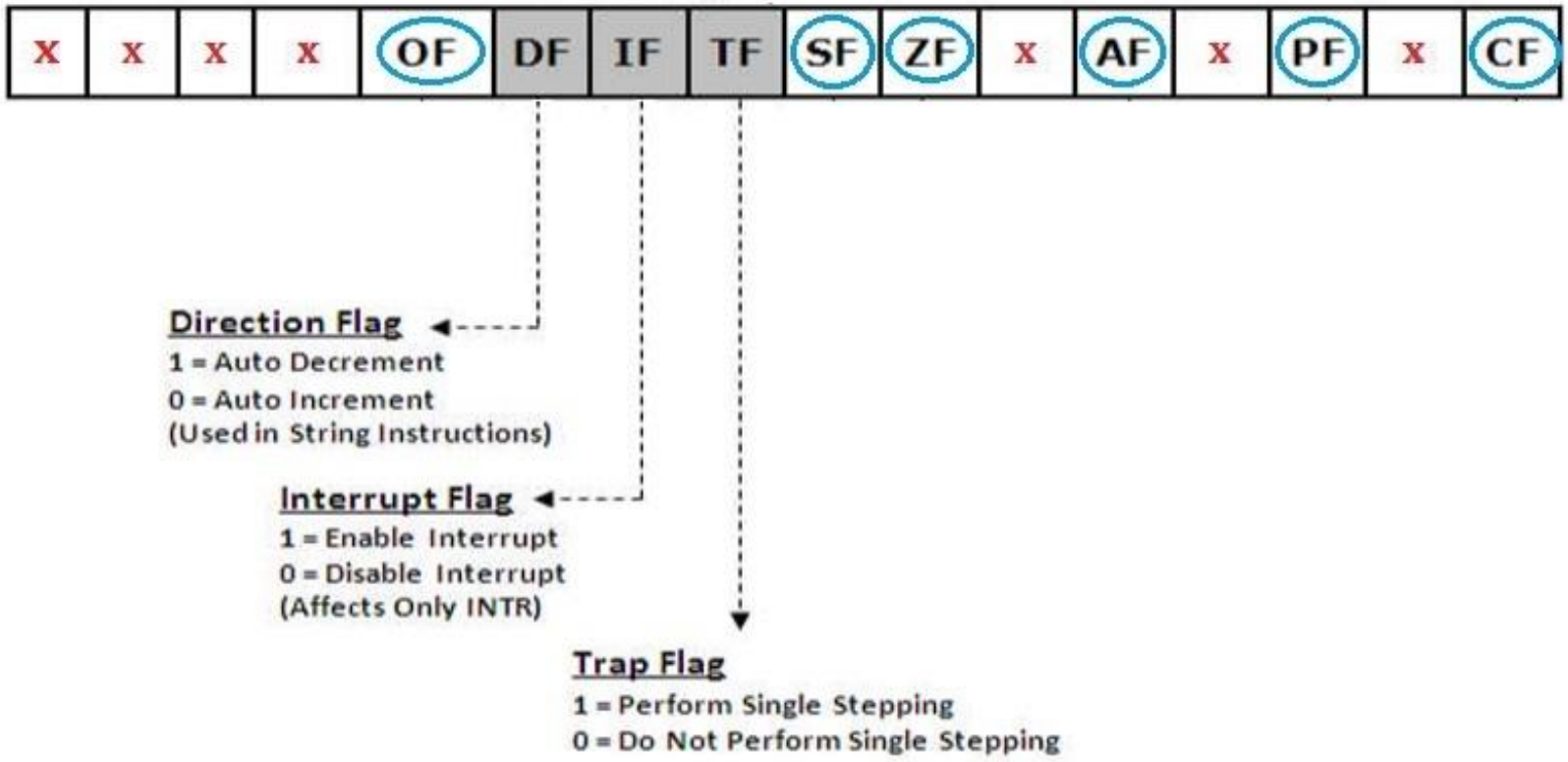
CF=1
Set because the answer has a carry

SF=0
Reset because the MSB is 0 indicating a positive answer

ZF=1
Set because the answer IS zero

PF=1
Set because the answer has an EVEN number of 1s

Control Flags:



Control Flags:

- **Trap Flag (TF)** - Used for on-chip single-step debugging.
- **Interrupt enable Flag (IF)** - when this flag is set to '1' CPU reacts to interrupts from external devices.
- **Direction Flag (DF)** - this flag is used by some instructions to process data chains, when this flag is set to '0' - the processing is done forward, when this flag is set to '1' the processing is done backward.

Quiz: Status Flag Values?

- `MOV AX, ABCDh`
- `MOV BX, 9876h`
- `ADD AX, BX`

Thank You !!