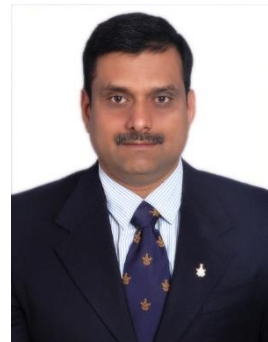




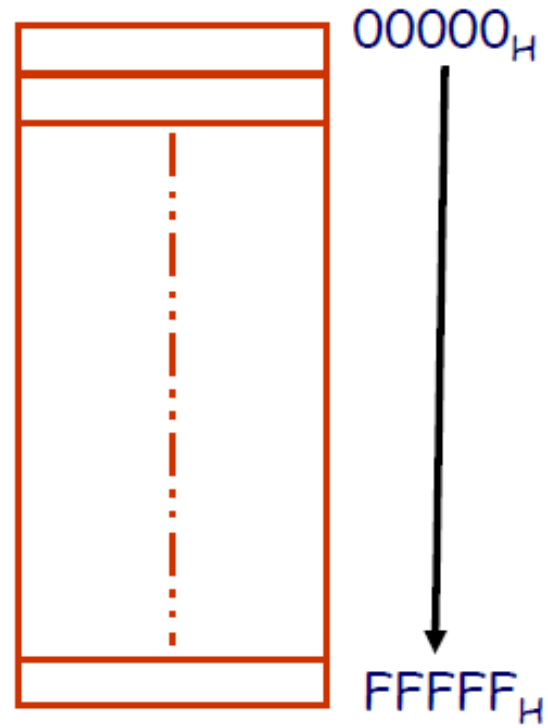
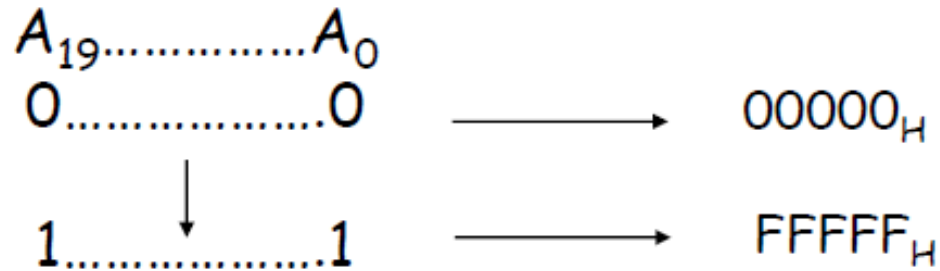
# **MPI Tutorial-3**

## **8086 Memory Physical Address**

**By Dr. Sanjay Vidhyadharan**



# 8086 Memory Organization



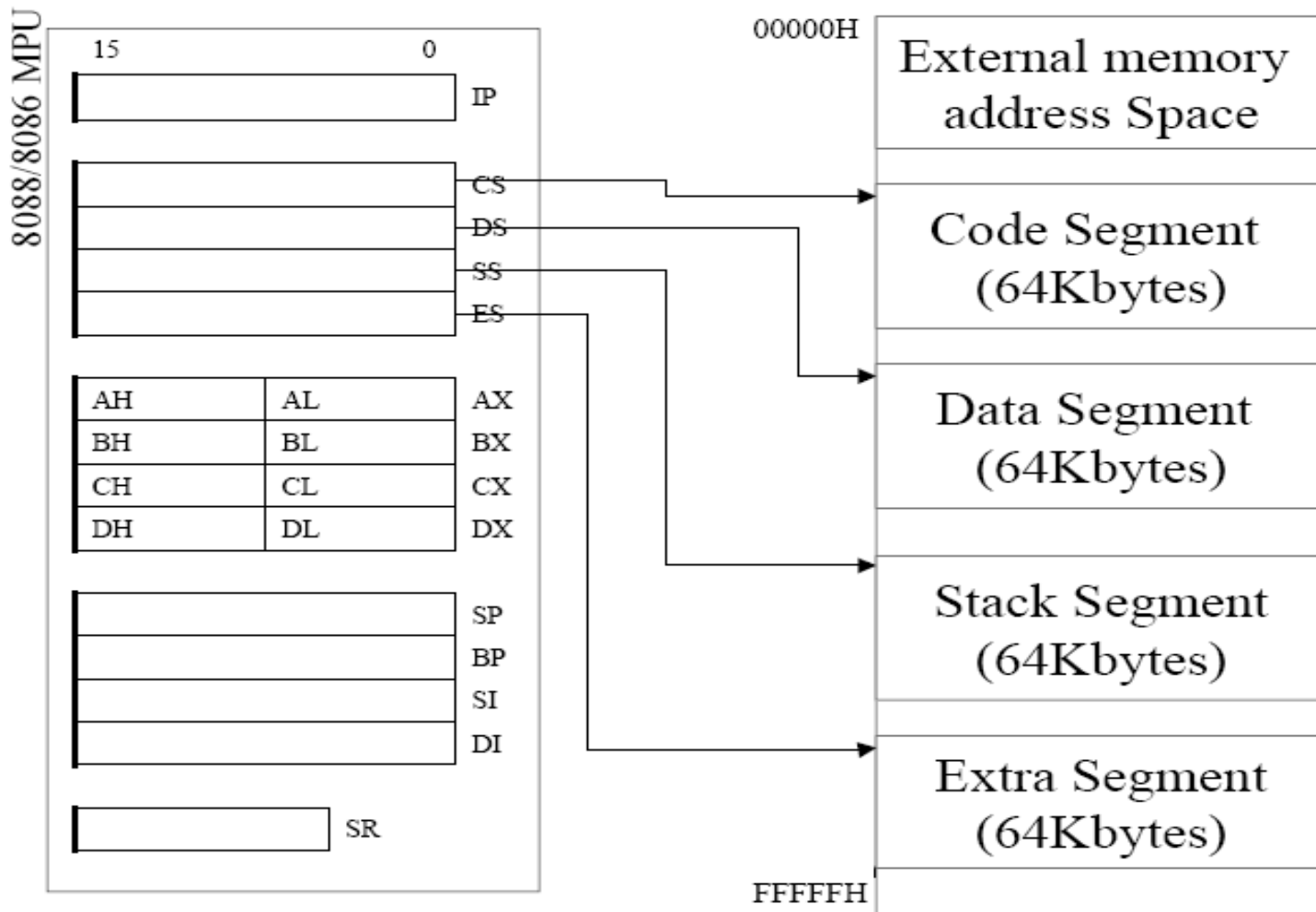
Memory Address Space

Sanja

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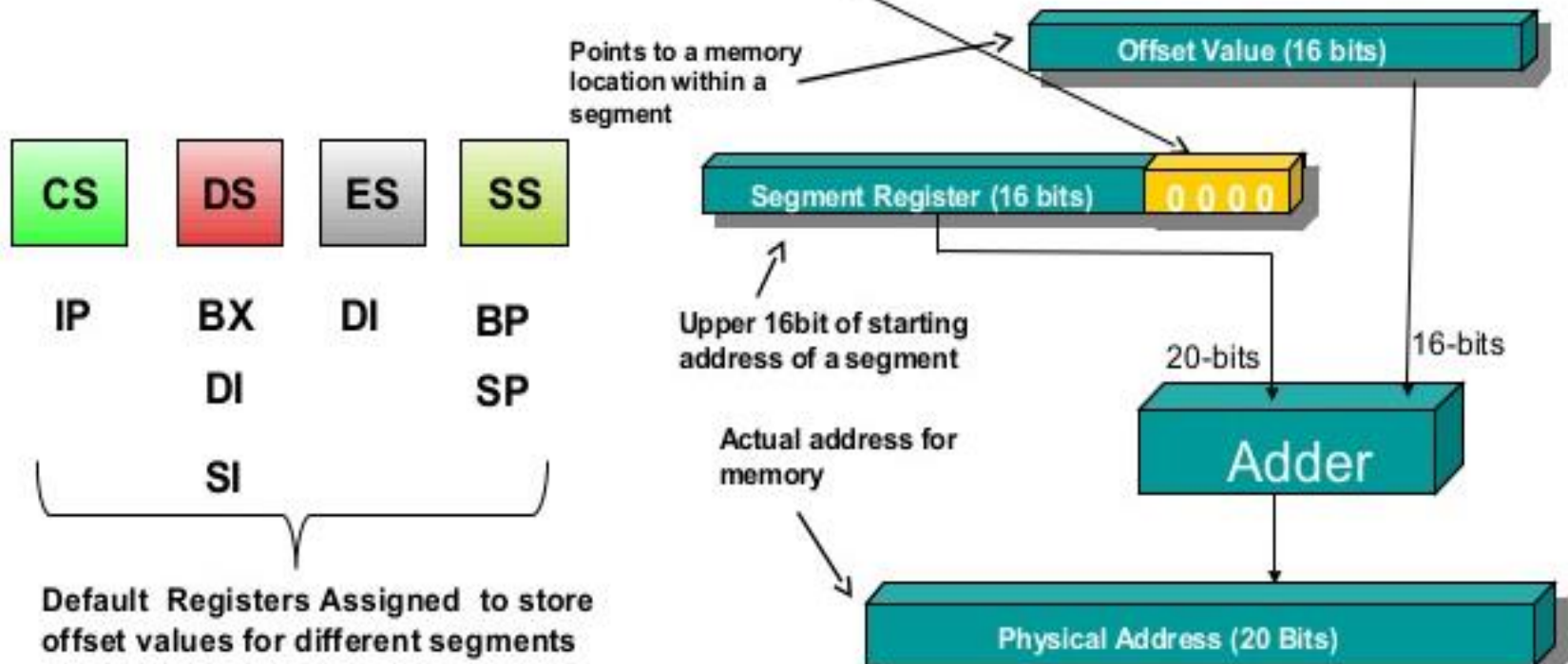
# 8086 Memory Organization

## Software Model of the 8088/8086 Microprocessor

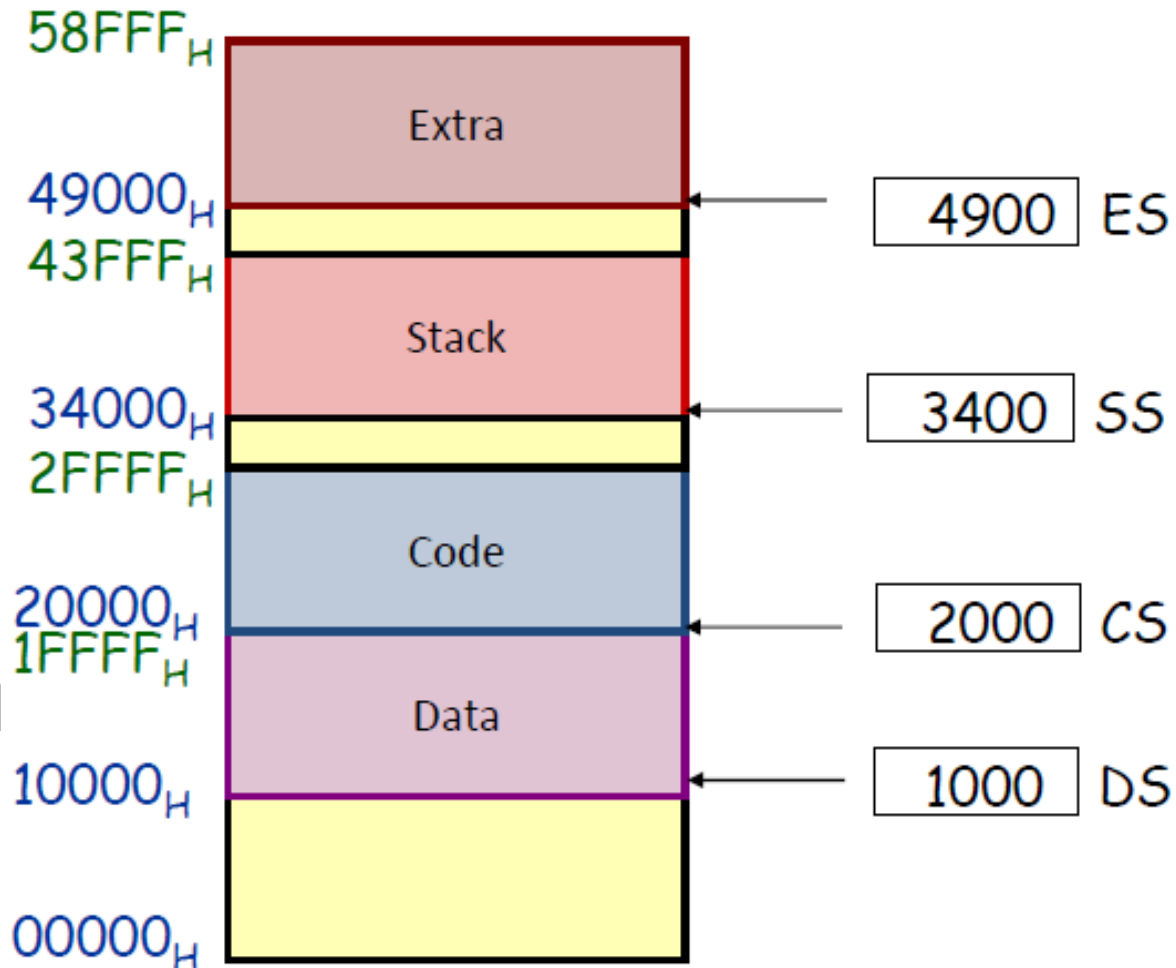


# Physical Address Generation in 8086

- The 20-bit physical address is generated by adding 16-bit contents of a **segment register** with an 16-bit **offset value** (also called **Effective Address**) which is stored in a corresponding **default register** (either in IP, BX, SI, DI, BP or SP. Different segments have different default register for offset, for example IP is default offset register for Code Segment)
- BIU always appends **4 zeros** automatically to the 16-bit address of a segment register (to make it 20-bit) because it knows the starting address of a segment always ends with 4 zeros

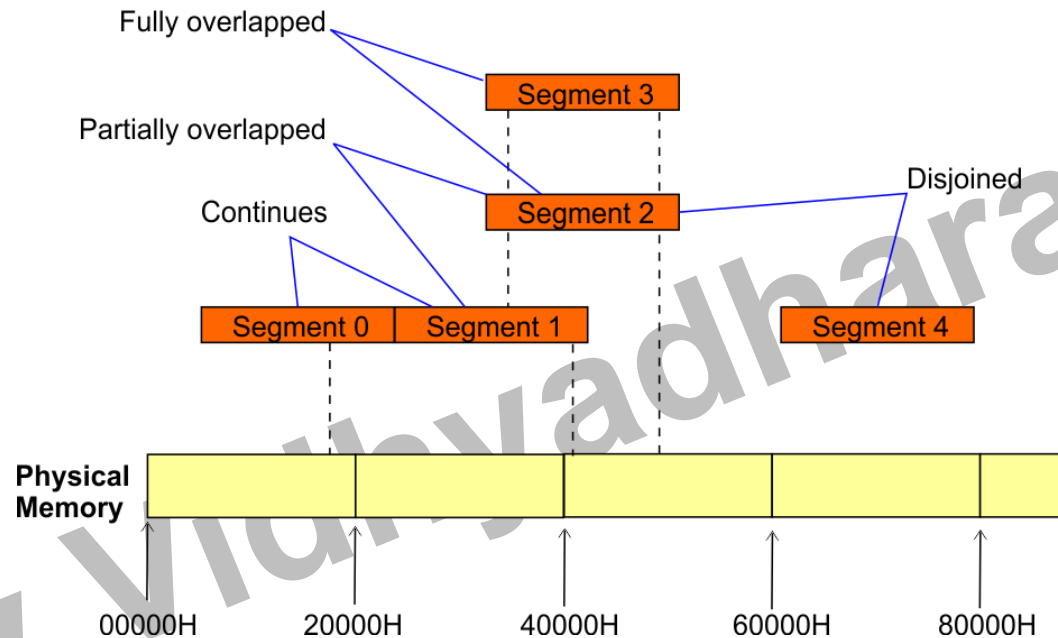
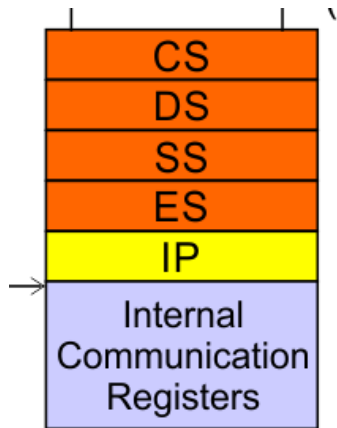


# 8086 Memory Organization



# 8086 Architecture

## Segment Registers



- 8086's 1-megabyte memory is divided into segments of up to 64K bytes each.

- The 8086 can directly address four segments (256 K bytes within the 1 M byte of memory) at a particular time.

- Programs obtain access to code and data in the segments by changing the segment register content to point to the desired segments.

# Physical Address Calculation

**Physical address is calculated as below:**

Ex: Segment address -----→ 1005H

Offset address -----→ 5555H

Segment address -----→ 1005H ----- 0001 0000 0000 0101

Shifted left by 4 Positions----- 0001 0000 0000 0101 0000

+

Offset address --- 5555H -----

0101 0101 0101 0101

Physical address -----155A5H

0001 0101 0101 1010 0101

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Physical address -----155A5H

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# Problem-1

Q1) The value of Code Segment (CS) Register is 4042H and the value of different offsets is as follows:

BX: 2025H , IP: 0580H , DI: 4247H

Calculate the effective address of the memory location pointed by the CS register.

# Problem-1

Q1) The value of Code Segment (CS) Register is 4042H and the value of different offsets is as follows:

BX: 2025H , IP: 0580H , DI: 4247H

Calculate the effective address of the memory location pointed by the CS register.

## Solution:

The offset of the CS Register is the IP register.

Therefore, the effective address of the memory location pointed by the CS register is calculated as follows:

Effective address = Base address of CS register  $\times 10_H$  + Address of IP

$$= 4042_H \times 10_H + 0580_H$$

$$= (40420 + 0580)_H$$

$$= 409A0_H$$

# Problem-2

Q2) Calculate the effective address for the following register:  
**SS: 3864H, SP: 1735H, BP: 4826H**

Sanjay Vidhyadharan

# Problem-2

Q2) Calculate the effective address for the following register:  
**SS: 3640H, SP: 1735H, BP: 4826H**

**Solution:**

Both SP and BP are the offsets for Stack Register (SS). The address calculated when BP is taken as the offset gives the starting address of the stack. The address when SP is taken as the offset denotes the memory location where the top of the stack lies.

Therefore, the effective address for both these cases is:

$$\begin{aligned}(\text{SS} \times 10\text{H}) + \text{SP} &= 3640\text{H} \times 10\text{H} + 1735\text{H} \\ &= 36400\text{H} + 1735\text{H} \\ &= 37\text{B}35\text{H}\end{aligned}$$

$$\begin{aligned}(\text{SS} \times 10\text{H}) + \text{BP} &= 3640\text{H} \times 10\text{H} + 4826\text{H} \\ &= 36400\text{H} + 4826\text{H} = 3\text{A}\text{C}26\text{H}\end{aligned}$$

# Problem-3

**Q3)** The value of the DS register is 3032H. And the BX register contains a 16 bit value which is equal to 3032H. 0008H is added to BX.

**ADD BX, 0008H**

The register AX contains some value which needs to be stored at a location as follows:

**MOV [BX], AX**

Calculate the address at which the value of the AX will be stored.

# Problem-3

**Q3)** The value of the DS register is 3032H. And the BX register contains a 16 bit value which is equal to 3032H. 0008H is added to BX.

**ADD BX, 0008H** , The register AX contains some value which needs to be stored at a location as follows:

**MOV [BX], AX** , Calculate the address at which the value of the AX will be stored.

## Solution:

After executing the first instruction, the value of BX Register is as follows:

$$\mathbf{BX = 303AH}$$

The BX register is an offset of the Data Segment (DS) register. So, the location at which the value of the AX register will be stored is calculated as follows:

$$\begin{aligned}(\text{DS} \times 10\text{H}) + \text{BX} &= 3032\text{H} \times 10\text{H} + 303\text{AH} \\ &= 30320\text{H} + 303\text{AH} \\ &= 3335\text{AH}\end{aligned}$$

# Problem-4

Q4) You are provided the following values:

**DS: 3056H, IP: 1023H, BP: 2322H and SP: 3029H**

Can you calculate the effective address of the memory location as per the DS register?

# Problem-4

Q4) You are provided the following values:

**DS: 3056H, IP: 1023H, BP: 2322H and SP: 3029H**

Can you calculate the effective address of the memory location as per the DS register?

## **Solution:**

No, the effective address of the DS register cannot be calculated from the given values because none of the given offset is an offset of the DS Register.



# Problem-5

- Three 16 bit numbers are stored in memory location 'a', 'b' and 'c'. Write ALP programs for adding the 3 numbers for CISC and a RISC processor.
- Assume that CISC processor has two temporary storage registers and RISC processor has 8 registers.
- The result is to be stored in memory location 'd'. The instructions involving ALU follow 3 operand format.

# Problem-5

## Solution

- **CISC:**
  - ADD R1, A, B
  - ADD D, R1, C
- **RISC:**
  - LD R1, A
  - LD R2, B
  - LD R3, C
  - ADD R1, R1, R2
  - ADD R1, R1, R3
  - ST R1, D

# Problem-6

- The starting address of various segments of 8086 processor is given as
- CS:F0000,
- DS:30000,
- ES:00000,
- SS:AB000.

Find the corresponding Ending address

# Problem-6

- The starting address of various segments of 8086 processor is given as
- CS:F0000, DS:30000, ES:00000, SS:AB000.

**Find the corresponding Ending address**

## **Solution**

- F0000-FFFFF
- 30000-3FFFF
- 00000-0FFFF
- AB000-BAFFF