# MEMORY SEGMENTATION OF INTEL 8086

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# Memory Segmentation

- The total memory size is divided into segments of various sizes.
- A segment is just an area in memory.
- The process of dividing memory this way is called **Segmentation**.

# Memory Segmentation

- In memory, data is stored as bytes.
- Each byte has a specific address.
- Intel 8086 has 20 lines address bus.
- With 20 address lines, the memory that can be addressed is $2^{20}$ bytes.
- $2^{20}$ = 1,048,576 bytes (1 MB).
- 8086 can access memory with address ranging from 00000 H to FFFFF H.

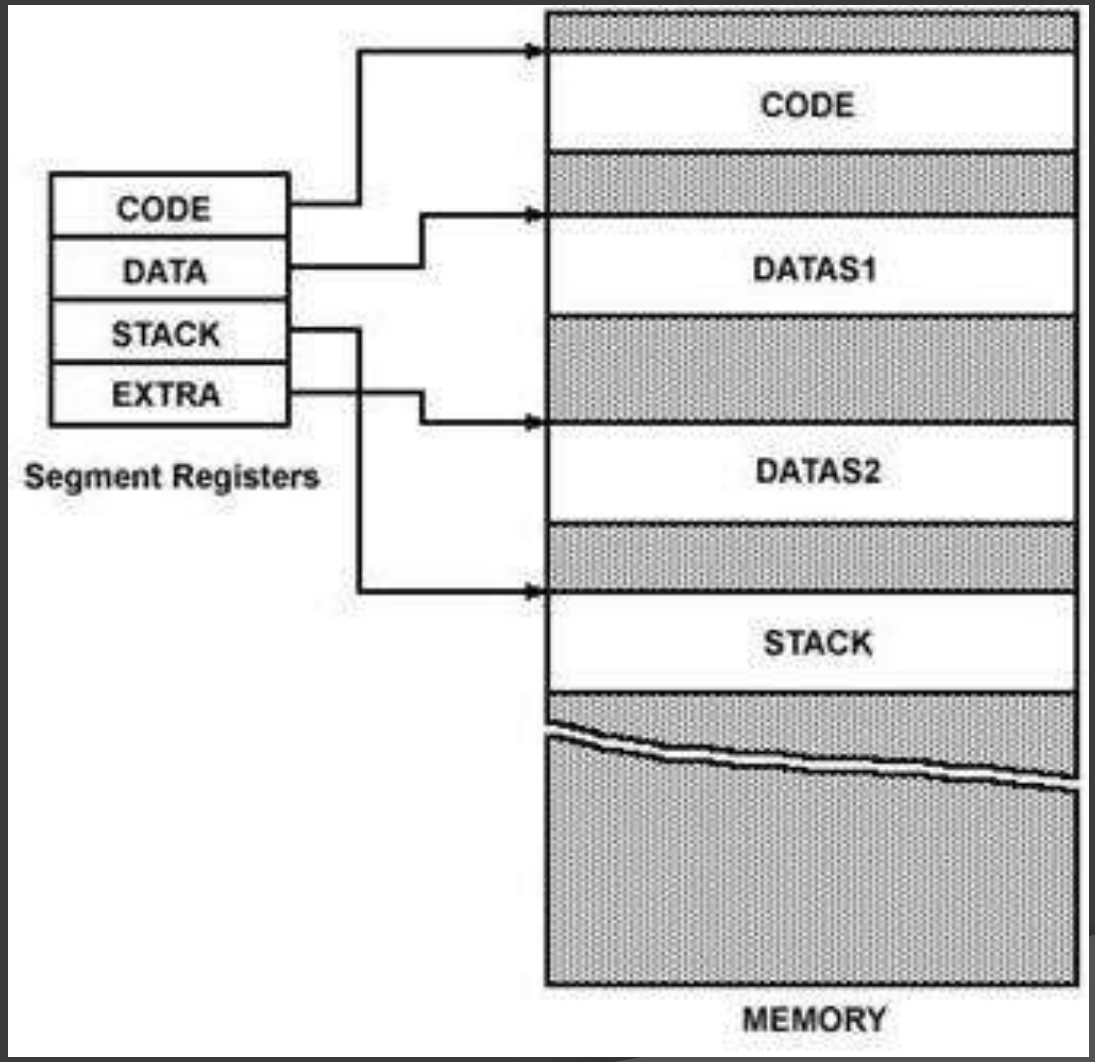
# Memory Segmentation

- In 8086, memory has four different types of segments.
- These are:
  - Code Segment
  - Data Segment
  - Stack Segment
  - Extra Segment

# Segment Registers

- Each of these segments are addressed by an address stored in corresponding segment register.
- These registers are 16-bit in size.
- Each register stores the base address (starting address) of the corresponding segment.
- Because the segment registers cannot store 20 bits, they only store the upper 16 bits.

# Segment Registers



# Segment Registers

- How is a 20-bit address obtained if there are only 16-bit registers?
- The answer lies in the next few slides.
- The 20-bit address of a byte is called its **Physical Address**.
- But, it is specified as a **Logical Address**.
- Logical address is in the form of:

**Base Address : Offset**

- Offset is the displacement of the memory location from the starting location of the segment.

# Example

- The value of Data Segment Register (DS) is 2222 H.
- To convert this 16-bit address into 20-bit, the BIU appends 0H to the LSBs of the address.
- After appending, the starting address of the Data Segment becomes 22220H.

# Example (Contd.)

- If the data at any location has a logical address specified as:

  2222 H : 0016 H

- Then, the number 0016 H is the offset.
- 2222 H is the value of DS.

# Example (Contd.)

- To calculate the effective address of the memory, BIU uses the following formula:
  - Effective Address = Starting Address of Segment + Offset
- To find the starting address of the segment, BIU appends the contents of Segment Register with 0H.
- Then, it adds offset to it.

# Example (Contd.)

- Therefore:
- EA = 22220 H

  + 0016 H

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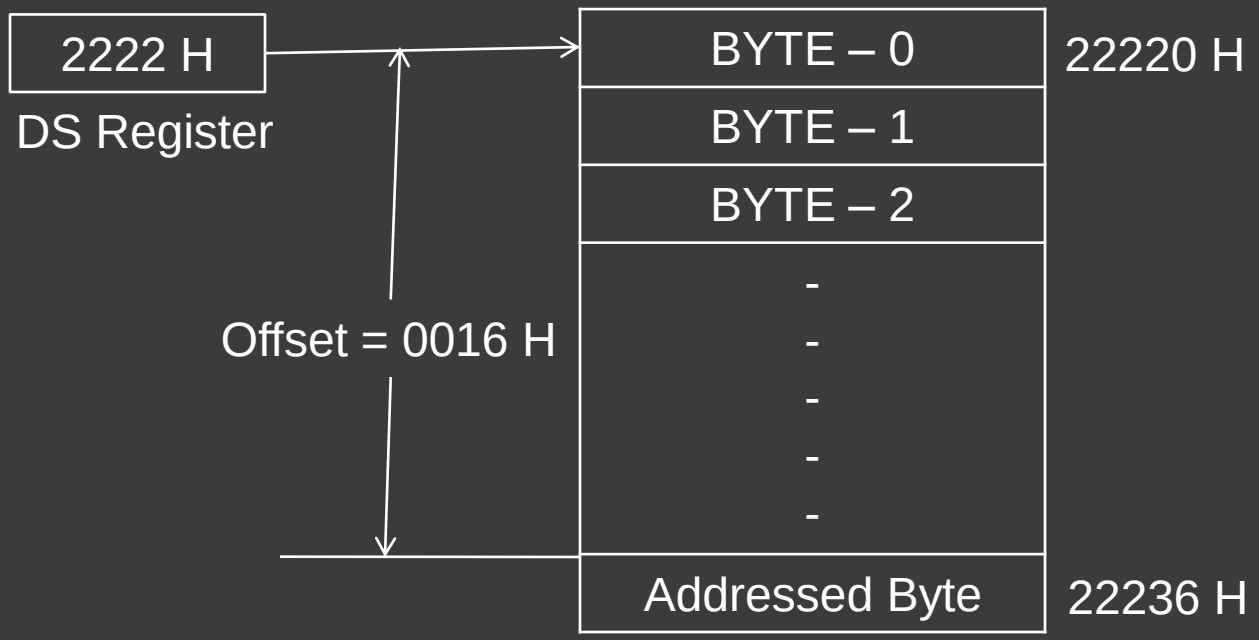
  22236 H

# Example (Contd.)



# Max. Size of Segment

- All offsets are limited to 16-bits.
- It means that the maximum size possible for segment is $2^{16}$ = 65,535 bytes (64 KB).
- The offset of the first location within the segment is 0000 H.
- The offset of the last location in the segment is FFFF H.

# Where to Look for the Offset

| Segment | Offset Registers | Function |
|---|---|---|
| CS | IP | Address of the next instruction |
| DS | BX, DI, SI | Address of data |
| SS | SP, BP | Address in the stack |
| ES | BX, DI, SI | Address of destination data (for string operations) |

# Question

- The contents of the following registers are:
  - CS = 1111 H
  - DS = 3333 H
  - SS = 2526 H
  - IP = 1232 H
  - SP = 1100 H
  - DI = 0020 H
- Calculate the corresponding physical addresses for the address bytes in CS, DS and SS.

# Solution

**1. CS = 1111 H**

- The base address of the code segment is 11110 H.
- Effective address of memory is given by 11110H + 1232H = 12342H.

**2. DS = 3333 H**

- The base address of the data segment is 33330 H.
- Effective address of memory is given by 33330H + 0020H = 33350H.

**3. SS = 2526 H**

- The base address of the stack segment is 25260 H.
- Effective address of memory is given by 25260H + 1100H = 26350H.

# Thank You

# Have a Nice Day