Memory Segmentation of Intel 8086

1

Segmentation

* It is the process in which the main memory of computer is divided into different segments and each segment has its own base address.

* Segmentation is used to increase the execution speed of computer system so that processor can able to fetch and execute the data from memory easily and fastly.

2
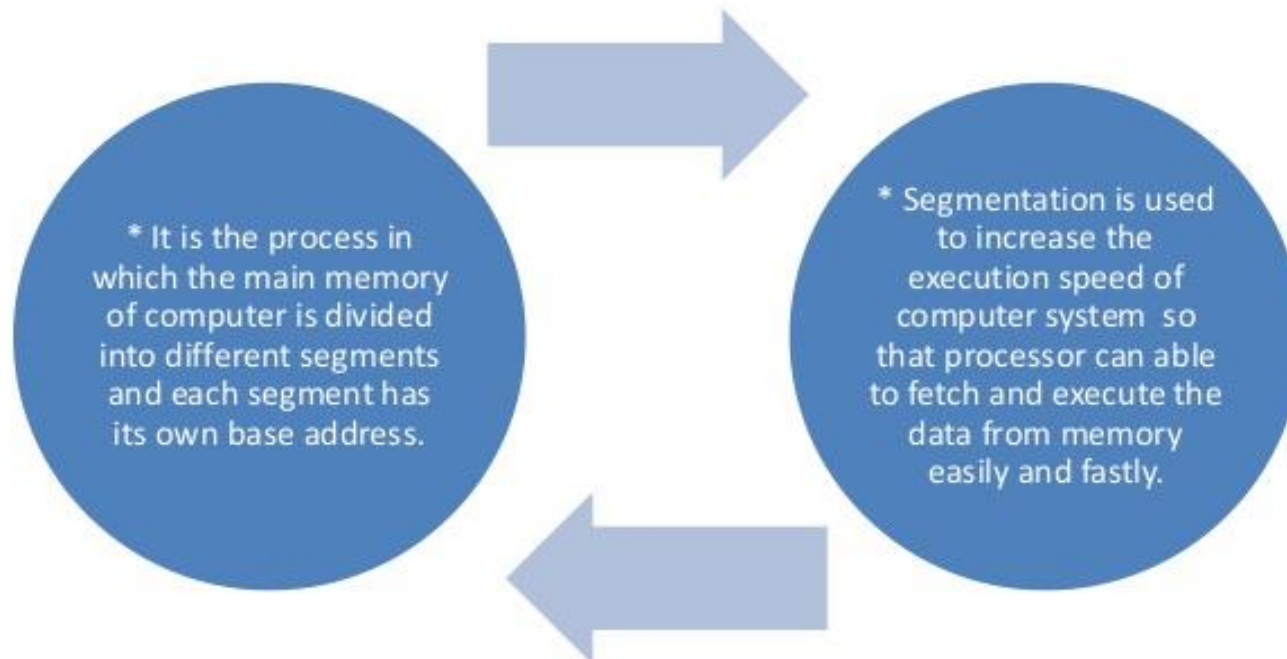
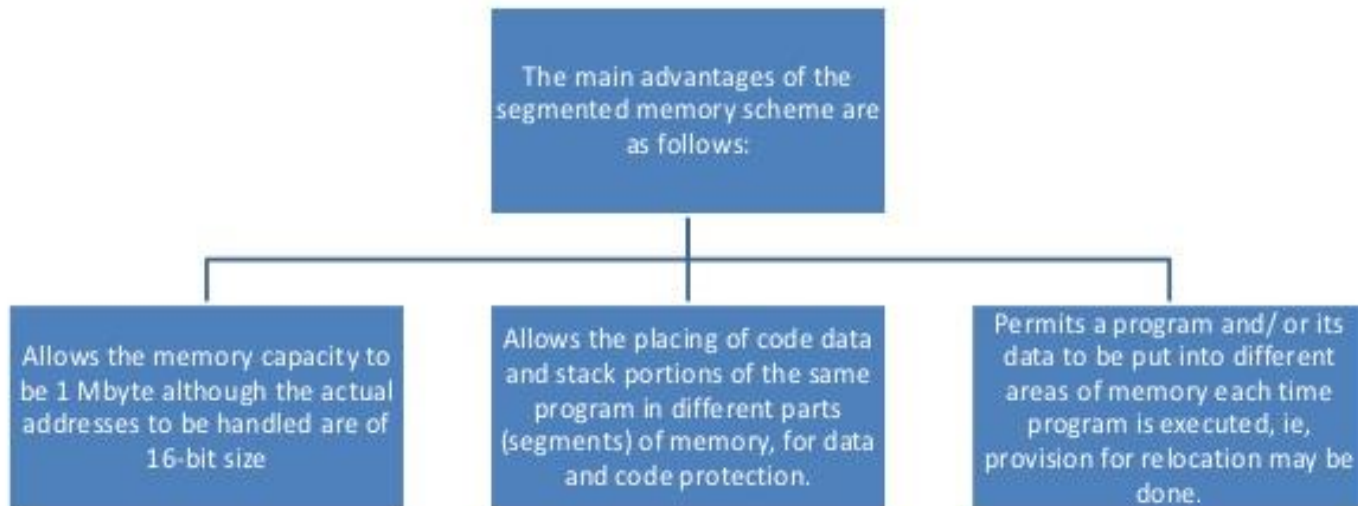# Segmentation
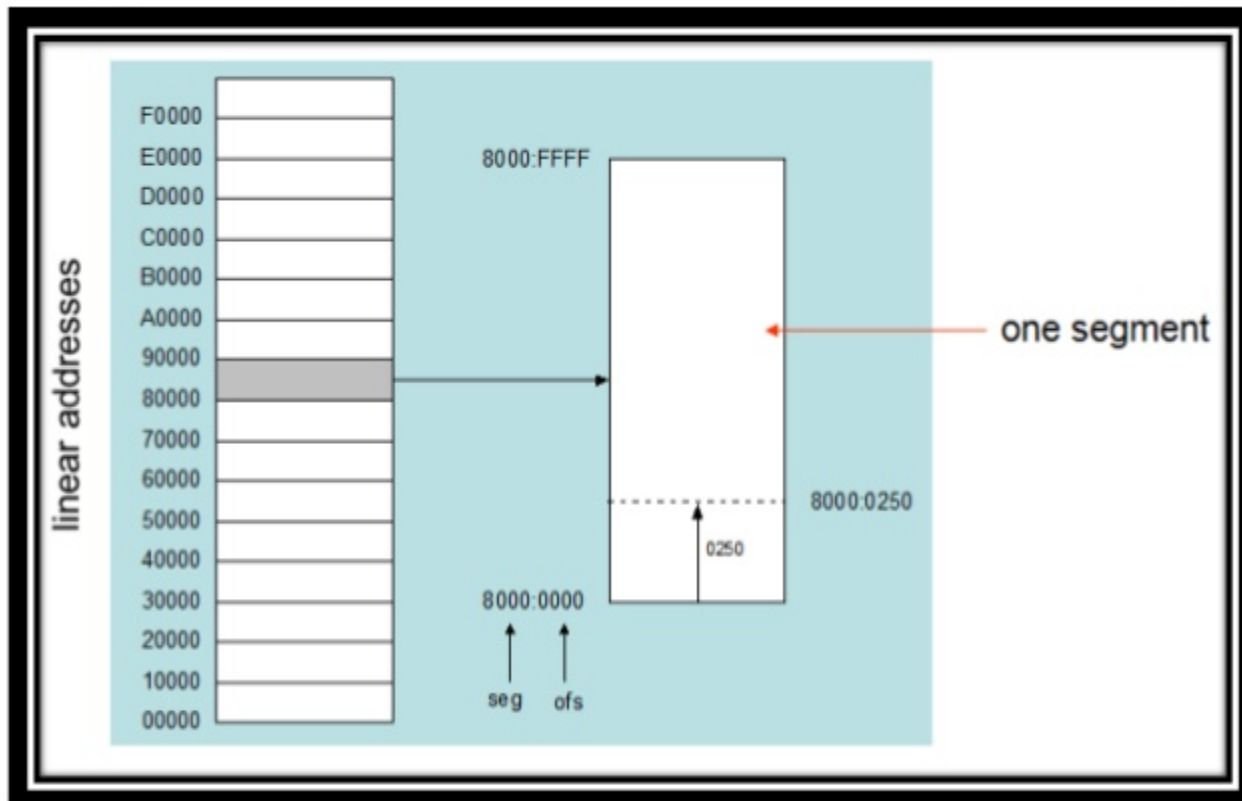
Segmentation in 8086

The size of address bus of 8086 is 20 and is able to address 1 Mbytes ( ) of physical memory.

The compete 1 Mbytes memory can be divided into 16 segments, each of 64 Kbytes size.

The addresses of the segment may be assigned as 0000H to F000H respectively.

The offset values are from 0000H to FFFFFH.

4

Advantages of segmentation

The main advantages of the segmented memory scheme are as follows:

Allows the memory capacity to be 1 Mbyte although the actual addresses to be handled are of 16-bit size

Allows the placing of code data and stack portions of the same program in different parts (segments) of memory, for data and code protection.

Permits a program and/ or its data to be put into different areas of memory each time program is executed, ie, provision for relocation may be done.

5

Memory Address Generation

- The BIU has a dedicated adder for determining physical memory addresses.

Offset Value (16 bits)

Segment Register (16 bits)   0 0 0 0

Adder

Physical Address (20 Bits)
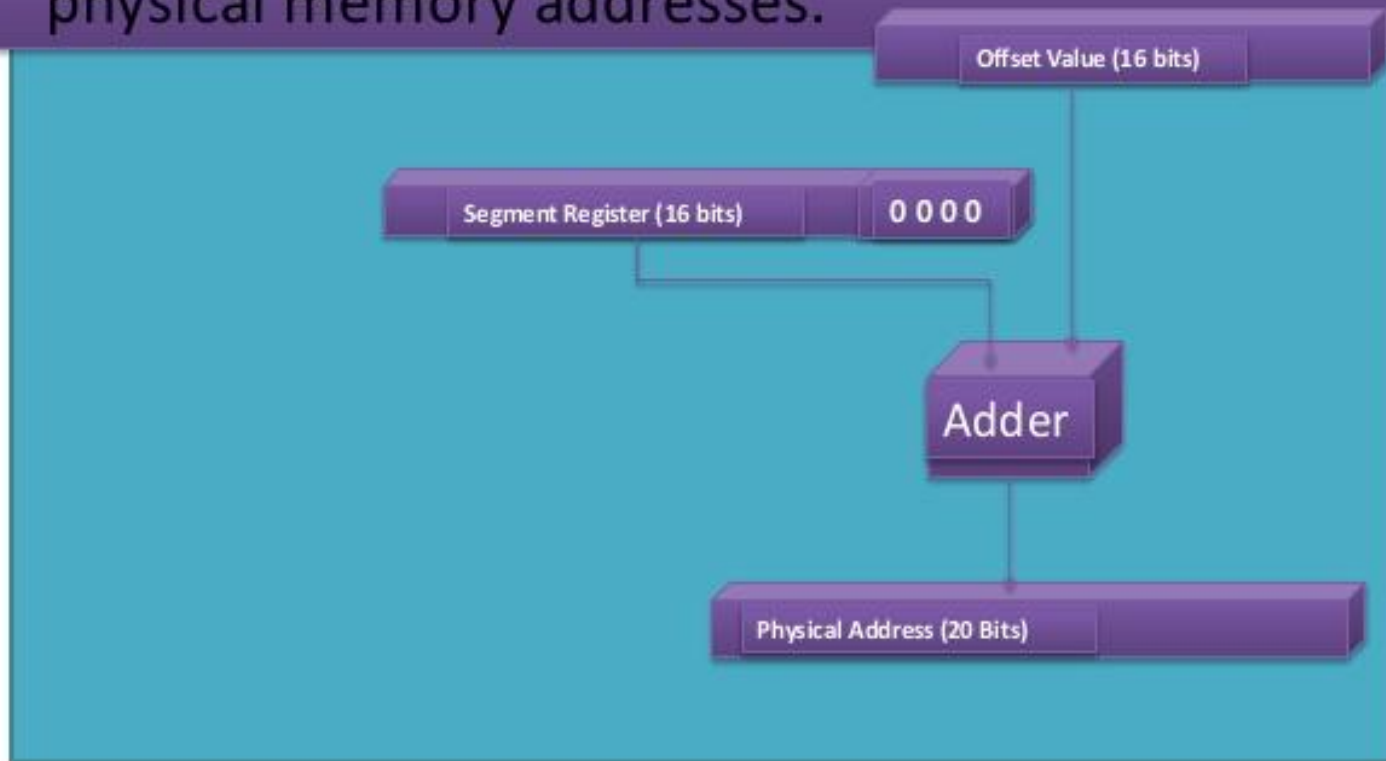
Segments, Segment Registers & Offset Registers

Segment Size = 64KB

Maximum number of segments possible = 14

Logical Address – 16 bits

Physical Address – 20 bits

2 Logical Addresses for each Segments.

- Base Address (16 bits)
- Offset Address (16 bits)

Segment registers are used to store the Base address of the segment.

7

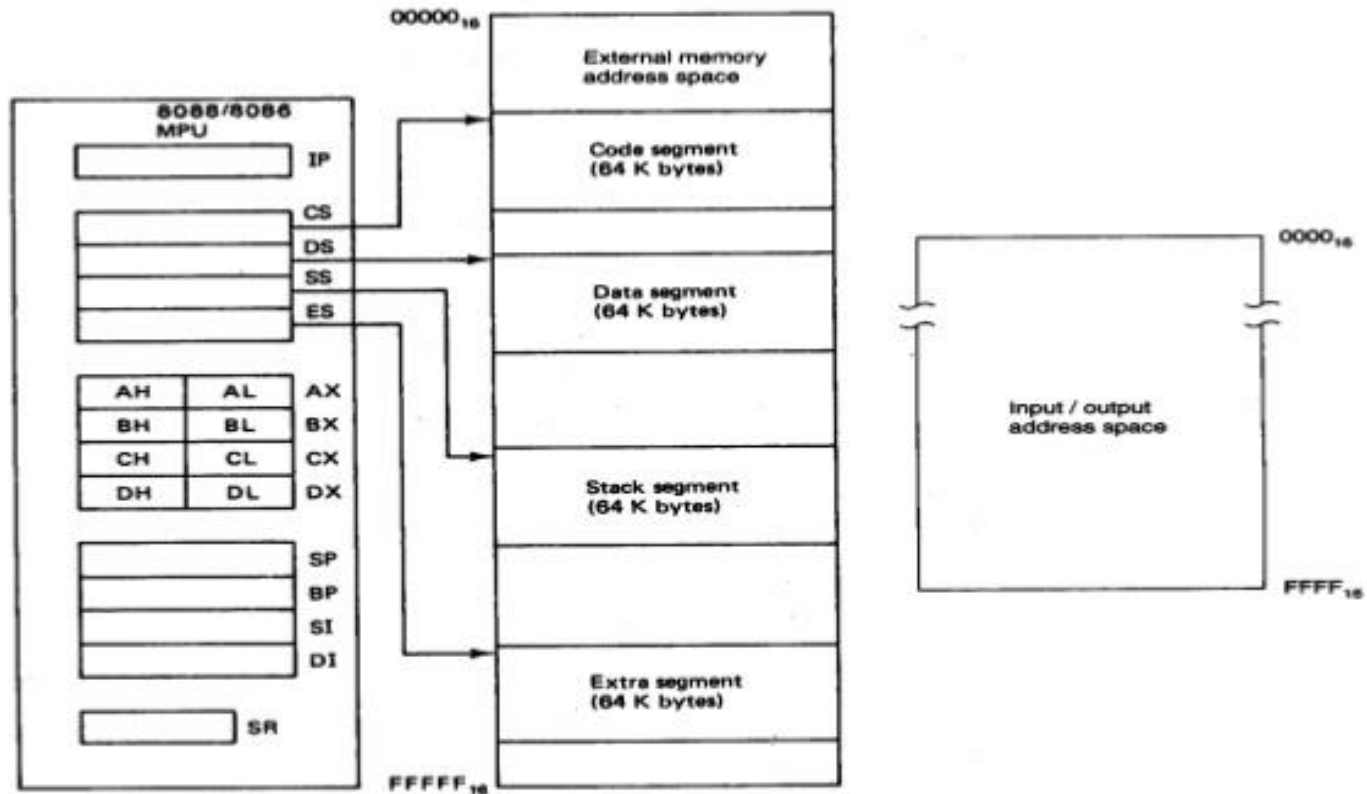# Segments, Segment Registers & Offset Registers

4 Segments in 8086

- Code Segment (CS)
- Data Segment (DS)
- Stack Segment (SS)
- Extra Segment (ES)

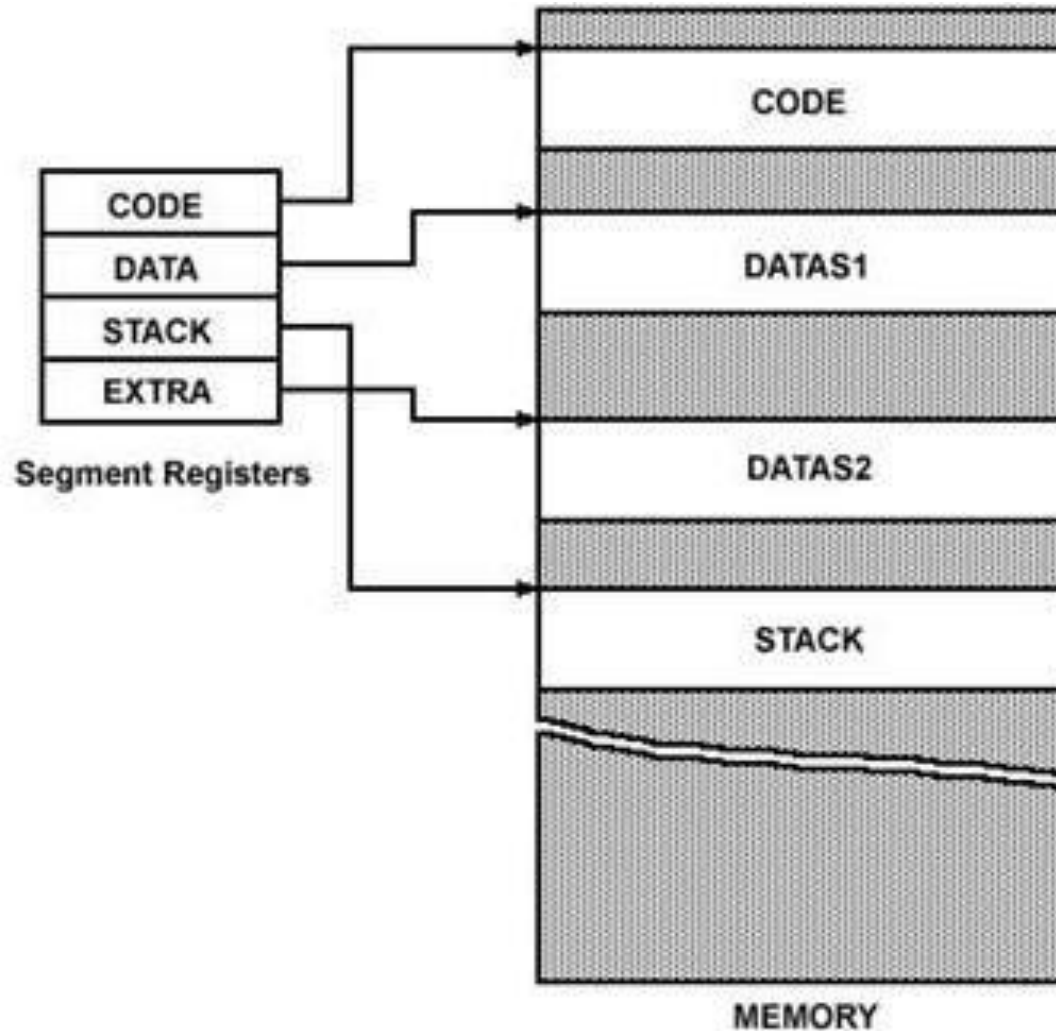| SEGMENT	SEGMENT REGISTER	OFFSET REGISTER
Code Segment	CSR	Instruction Pointer (IP)
Data Segment	DSR	Source Index (SI)
Extra Segment	ESR	Destination Index (DI)
Stack Segment	SSR	Stack Pointer (SP) / Base Pointer (BP)

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 of the corresponding segment.

- Because the segment registers cannot store 20 bits, they only store the upper 16 bits.

Segmented Memory Representation

SEGMENT REGISTERS

Segment Registers

MEMORY

SEGMENT REGISTERS

- How is a 20-bit address obtained if there are only 16-bit registers?

- 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.

12

EXAMPLE

o The value of Data Segment Register (DS) is 2222H.

o To convert this 16-bit address into 20-bit, the BIU appends 0H to the LSBs of the address.

o 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:

$$2222 \text{ H} : 0016 \text{ H}$$

- Then, the number 0016 H is the offset.

- 2222 H is the value of DS.

14

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.
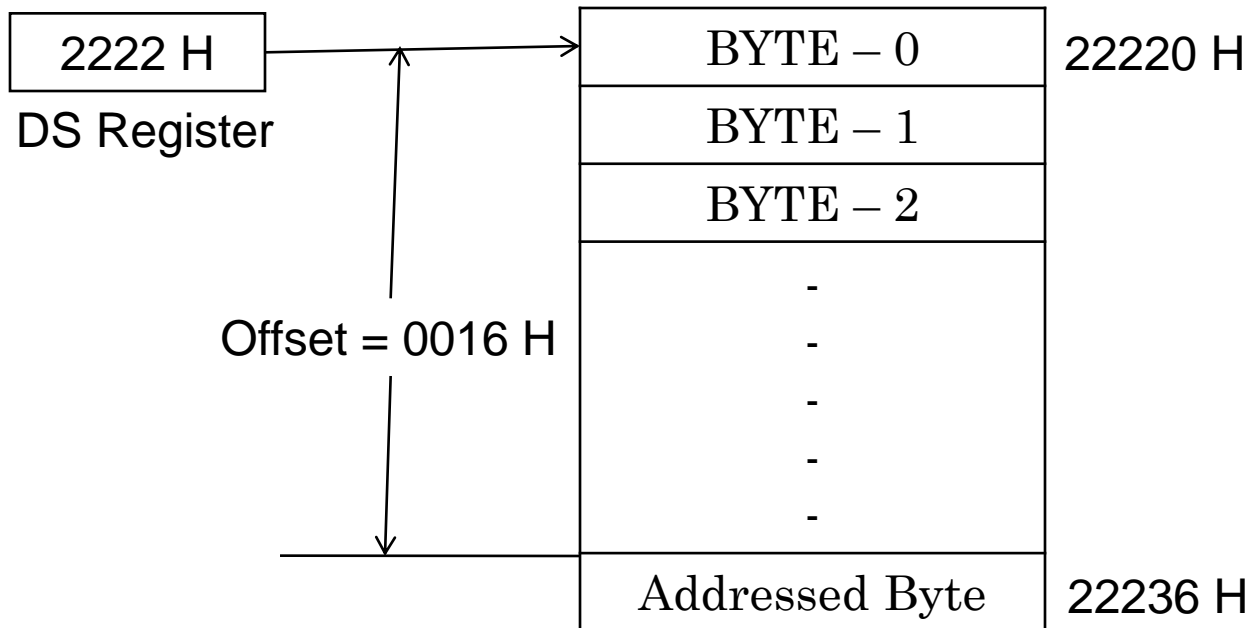
- Then, it adds offset to it.

15

EXAMPLE (CONTD.)

- Therefore:

- EA =   22220 H

              + 0016 H

              22236 H

16

EXAMPLE (CONTD.)

2222 H	

DS Register

BYTE – 0	22220 H
BYTE – 1	
BYTE – 2	
-	
-	
-	
-	
-	
Addressed Byte	22236 H

Offset = 0016 H

17

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)

19

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.

20

SOLUTION

1. CS = 1111 H
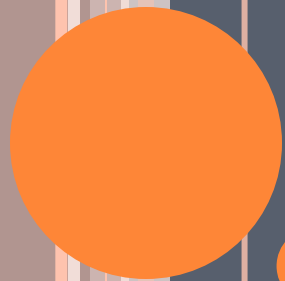
- The base address of the code segment is 11110 H.

- 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 = 26360H.

21

SEAT WORK

1. The contents of the following registers are:

- CS = 21A1 H

- DS = 43B2 H

- SS = 1735 H

- IP = 1452 H

- SP = 1240 H

- DI = 0040 H

- Calculate the corresponding physical addresses for the address bytes in CS, DS and SS.

2. The contents of the following registers are:

- CS = 1FA1 H
- DS = 4CB2 H
- SS = 1735 H
- IP = 1453 H
- BP = 1447 H
- SI = 0060 H

- Calculate the corresponding physical addresses for the address bytes in CS, DS and SS.

3.   DS – 8AB9

          BX – EA12

          SI – 45AC