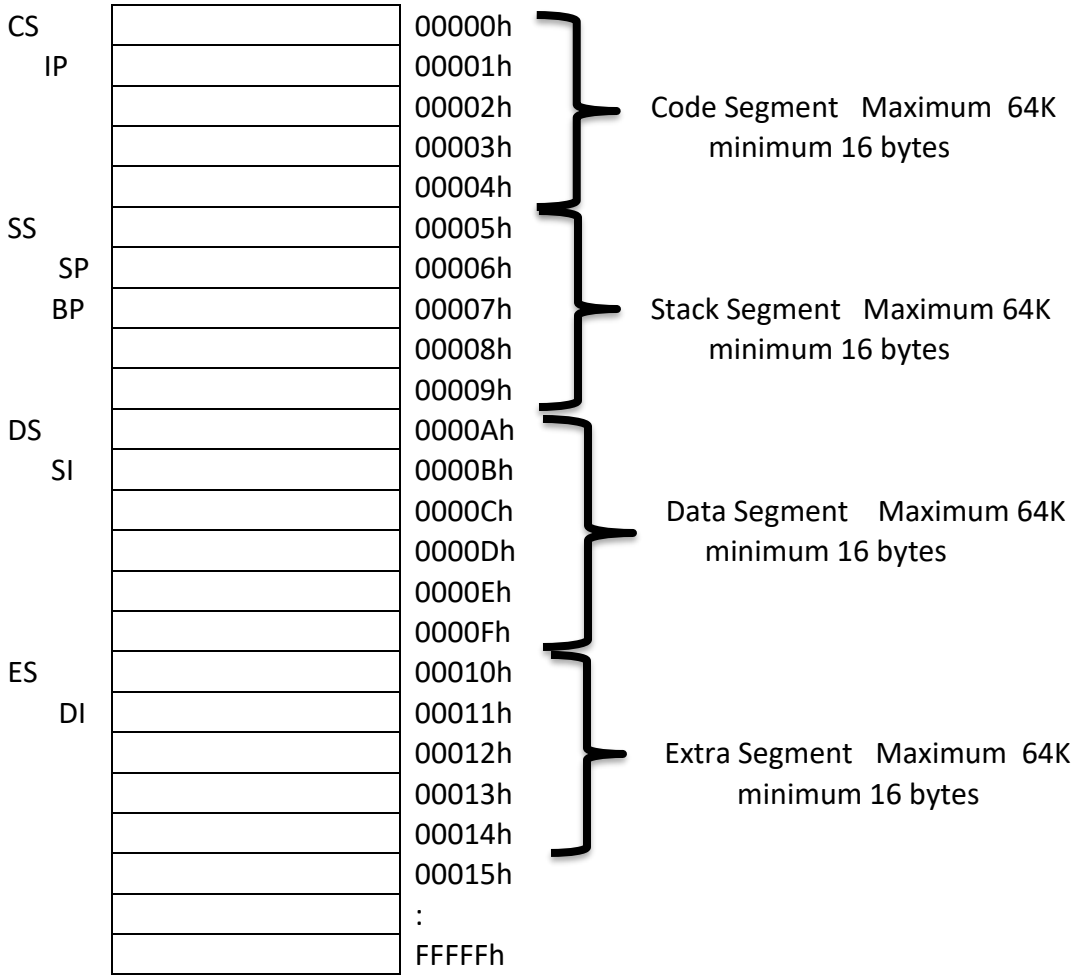
Memory Segmentation /management of 8086 Microprocessor Architecture

Segmentation was introduced on the Intel 8086 in 1978 as a way to allow programs to address more than 64 KB (65,536 bytes) of memory. The Intel 80286 introduced a second version of segmentation in 1982 that added support for virtual memory and memory protection.

Block diagram of Computer Memory



- 8086 has 20 bits of physical address
- Here, 20 bits of Physical Address is not byte compatible physical address.
- To avoid the issue of byte compatibility, Microprocessor 8086 uses memory segmentation. In which we uses concept of virtual address.
- Here, Memory is bisected into Four Segments.

1) Code Segment (CS)
2) Stack Segment (SS)
3) Data Segement (DS)
4) Extra Segment (EX)

- To calculate physical address from virtual address we should know segment and OFFSET address.
- Segment Address is held by segment register (16 bits). [CS,SS,DS & ES]
- OFFSET address is held by OFFSET Pointer (16 bits). [IP, (SP & BP), SI & DI]
- So , Physical Address is calculate by PA = SR x 10h + OP
- As Offset Pointer is having size of 16bits, Maximum size of any segment is 216 = 26 x210 = 64k
- Minimum size of any segment is 10h = 16 bytes.

Example-1 Of Physical Calculation

If code segment register is 1245h and instruction, Pointer is 1561h. Then finds the physical address of given instruction.

PA = SR x 10h +OP

There for **PA = 1245 x 10h + 1561h**
PA = 12450h + 1561h
PA = 139B1h

Example-2 of Physical Calcualtion

If Data segment register is 78EFh. Then finds the maximum and minimum range of physical address.

Here you remember (memory address range minimum to maximum from is 0000h to FFFFh)

★ for Maximum range

PA = SR x 10h + OP
PA = 78EFh x 10h + (0000h to FFFFh)
so PA = 78EF0h to 88EEFh

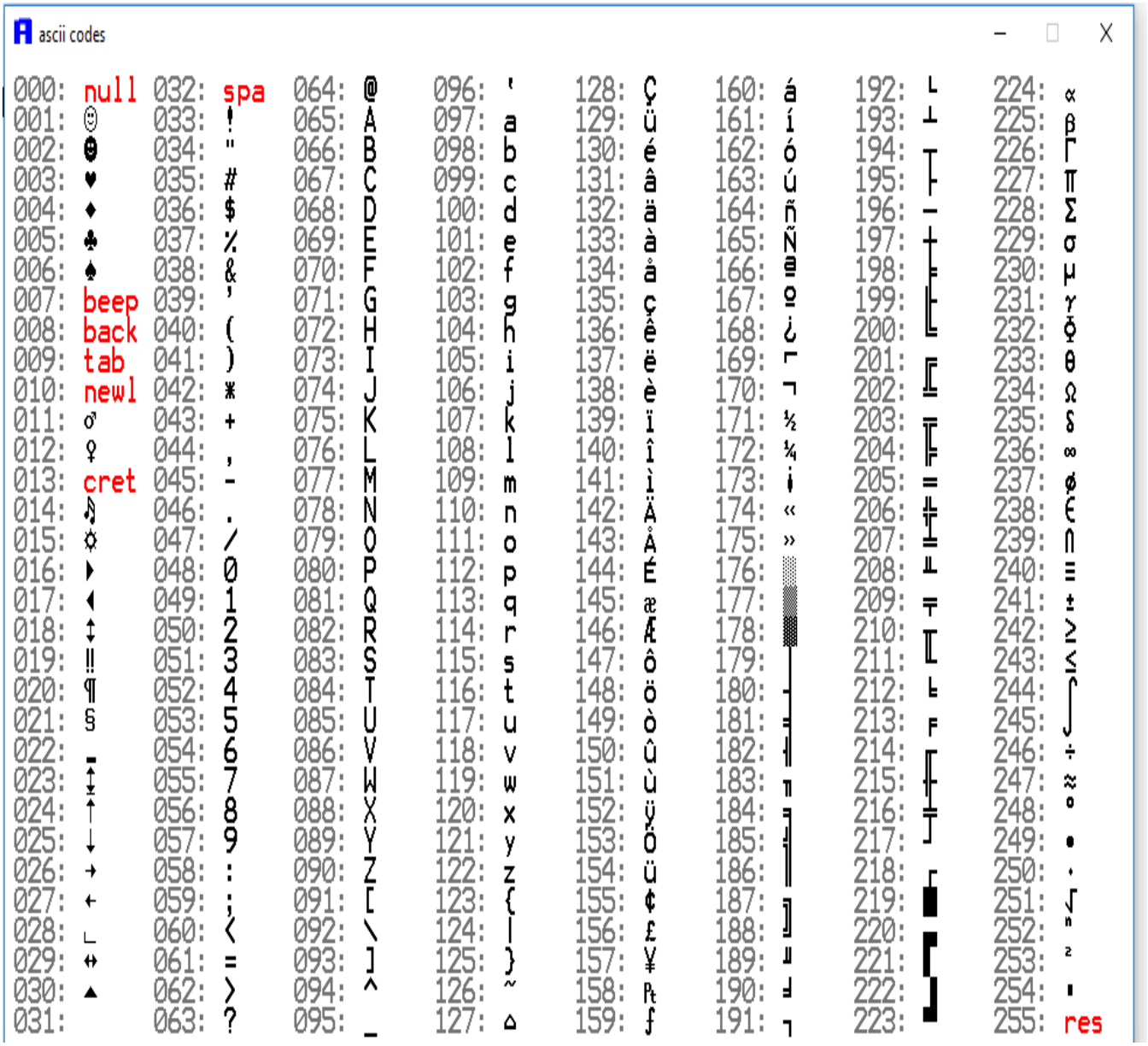
★ for minum range

PA = SR x10h + OP
PA = 78EFh x 10h + 0000h to 000Fh
so PA = 78EF0h to 78EFFh

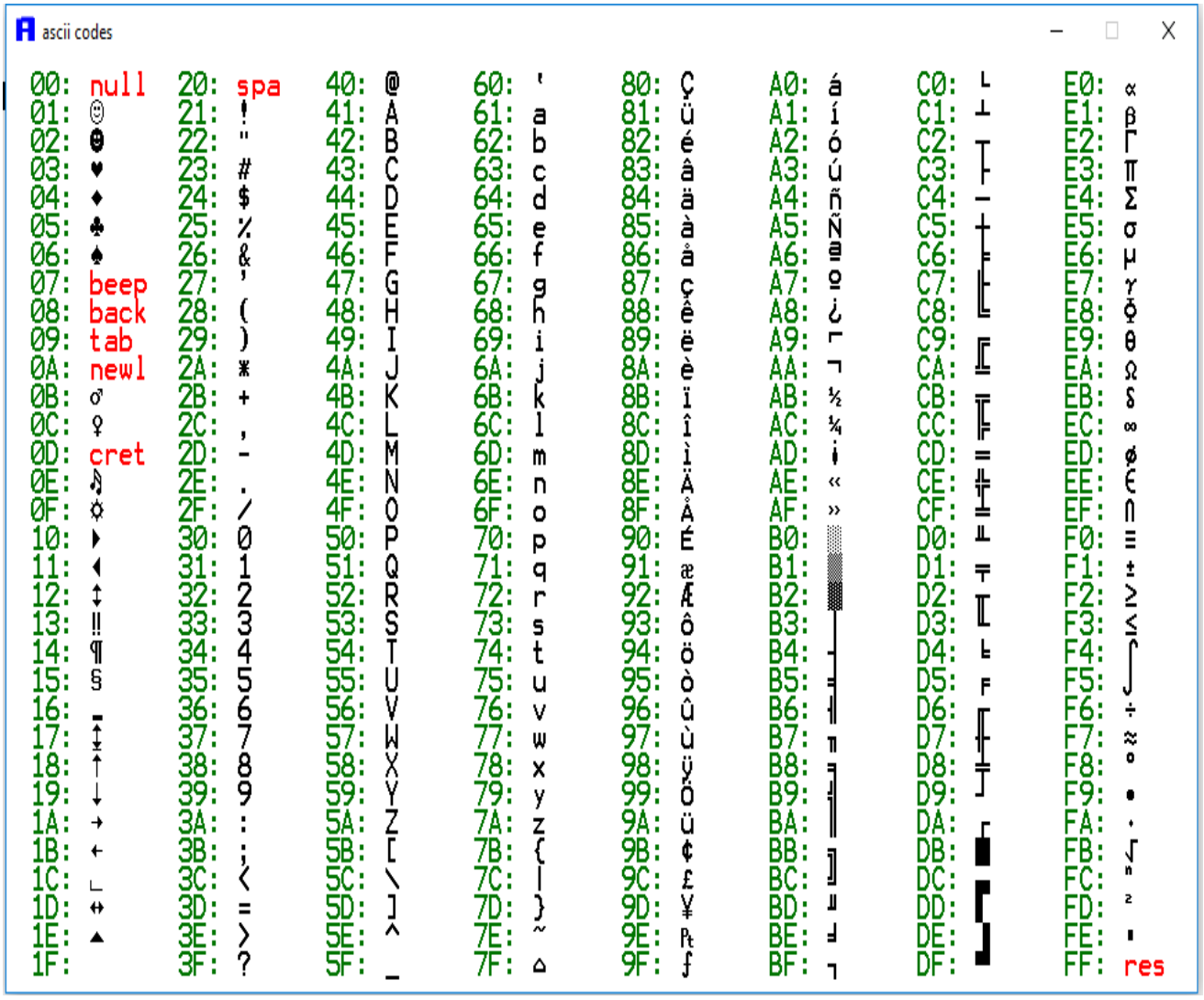
Advantages of memory segmentation of 8086

- We can program 8086 with 16 bits addressing.
- Due to memory segmentation, 8086 becomes backward compatible with 8085.
- Change in One segment does not affect the other segment.
- Memory management gets easier.
- Debugging gets easier.
- It avoids memory overlap with different segments.

ASCII CHART in Decimal Number



ASCII CHART in Hexa-Decimal Number



Assembly language

Uses of MOV, ADD, SUB command of assembly language. This program example of addition, subtraction of two-integer number and display string data on the screen.

```
org 100h
    MOV  BL,04h
    MOV  CL,03h
    ADD  BL, CL
    MOV  AH,02h
    MOV  DL,BL
    ADD  DL,30h
    INT 21H
ret
```

```
org 100h
    MOV  BL,04h
    MOV  CL,03h
    SUB  BL, CL
    MOV  AH,02h
    MOV  DL,BL
    ADD  DL,30h
    INT 21H
ret
```

```
org 100h

  MOV AH,09H
  MOV DX,MSG1
  INT 21H
ret

MSG1:  db  "Hello World$"
```

Exercise

Theory Questions.

1. Define memory segmentation of 8086 Microprocessor.
2. Advantages of memory segmentation of 8086.
3. Write block diagram of Computer Memory of 8086 Microprocessor.
4. If code segment register is 2B8Ah and instruction, Pointer is A131h. Then finds the physical address of given instruction.
5. What are ASCII code of decimal and Hexa-Decimal following?
   i) A ii) N iii) j iv) 0 v) 8 vi) space bar vii) Enter key
   vii) ♣ viii) ♥

Practical Questions.

1. Write assembly code to display your name and roll number using by string variable.

Objective and MCQs:

1. Total memory of 8086 Microprocessor computer.
   a) 1Mb
   b) 512Kb.
   c) 64Kb.
   d) 1Gb

2. Total segmentation of computer memory of 8086 microprocessor computer.
   a) 6
   b) 4
   c) 8
   d) 3

3. Each segmentation of computer memory of 8086 to hold _____.
   a) 128Kb
   b) 512Kb
   c) 1GB.
   d) 64Kb

4. 8086 has ____ bits of physical address
   a) 16.
   b) 20.
   c) 8.
   d) 32.

5. Which offset register of Data Segment (DS).
   a) SI
   b) DI
   c) BP
   d) SP

6. Which offset register of Extra Segment (ES). _____.
   a) SI
   b) DI
   c) BP
   d) SP

7. Which offset register of Stack Segment (SS). _____.
   a) SP
   b) DI
   c) BP
   d) Both a and c

8. This is _____ it is serves as a loop counter._____
   a) CS
   b) DS.
   c) CX.
   d) ES.

9. Total 1 Mb computer memory of 8086 divide into _____ segments.
   a) 4.
   b) 8.
   c) 16.
   d) 32.

10. The ASCII code of new line.
   a) 0Fh.
   b) 0Dh.
   c) 0Ah.
   d) 0Chl.