Tutorial 3: Addressing Data in Mem & Seg

January 12, 2020

1. Explain each of the following terms:
   (a) Segment
      i. Place to store stack information.
   (b) Offset
      i. The relative distance from one point. Usually refers to the number of bytes away.
   (c) Register
      i. High-speed, temporary memory.
2. Explain the purpose of the following items:
   (a) Code segment
      i. Stores machine instruction
   (b) Code segment (CS) register
      i. Stores the address to the code segment of the memory
   (c) Instruction pointer (IP) register
      i. Points to the next instruction to be executed
   (d) Accumulator (AX)
      i. Used in input/output, and most arithmetic operations
   (e) Count register (CX)
      i. Used for arithmetic operations, and looping
   (f) Parity flag (PF)
      i. Used for checksum and error-checking.
3. Questions
   (a) List and explain FOUR (4) main segment in a CPU.
      i. **Code segment**: Stores machine code
      ii. **Data segments**: Stores defined variables and constants

iii. **Stack segment**: Stores local function variables & function parameters

iv. **Extra segment**: Spare segment, used to specify location in memory

(b) Explain a similarity and THREE (3) differences between a register and a Random Access Memory (RAM).

i.

RAM		**Register**
Similarities		
Hold the data that can be directly accessed by the processor.		
Differences		
Using address of register.	**Access Method**	Using name to refer.
On Motherboard.	**Location**	Inside CPU.
In Sequence	**Content Order**	No particular order.

(c) Differentiate between a segment:offset address and an absolute address.

i. Absolute address directly refers to a particular location.

ii. Segment:offset address needs to be calculated to arrive at the intended location.

4. Perform the following calculations and show your answers in hexadecimal format. Draw a diagram for each of them to indicate how the respective answer would store in the AX register. You are required to show your working steps clearly.

(a) $73_8 + 25_8$

i. $120_8 = 50_{16}$

ii. AX register layout:

A.

AX	
AH	AL
00	50

(b) $1111_2 * 111_2 * 11_2$

i. $13B_{16}$

ii. AX register layout:

A.

AX	
AH	AL
01	3B

5. Given the information in the table below.

Register	Value
CS	02B3H
DS	26D2H
SS	09AFH
BP	2062H
SP	0094H
IP	0025H

(a) Calculate the absolute address for the next instruction to be executed by the CPU.

i. $02B30 + 0025 = 02B55_{16}$

(b) Calculate the corresponding 20-bit absolute memory address using the SS:SP.

i. $09AF0 + 0094 = 09B84H$

6. Given a 16-bit CS register consists of the hexadecimal value 12AB and the 16-bit IP register consists of the hexadecimal value 0020. Find the absolute address of the instruction and show the answer in 20-bit binary format.

(a) $12AB0_{16} + 0020_{16} = 12AD0H$

(b) $12AD0H = 01\,0010\,1010\,1101\,0000_2$

7. Complete the following table.

Register	Definition	High speed storage location in CPU
	Characteristics	Small capacity, faste
Types of register	General purpose	Address
Aim	Arithmetic, data movement	Indicate address
Size	8/16 bits	16 bits
Examples	16-bit: AX, BX, CX, DX. 8-bit: AL, AH.	Code segment register

8. Determine which register is/are used for the following purposes:-

(a) When the result of an arithmetic or logical operation generates a result of zero.

i. Zero Flag (ZF)

(b) Used for error checking when there is a possibility that data might be altered or corrupted.

i. Parity Flag (PF)

(c) When the result of an unsigned arithmetic operation is too large to fit into the destination.

i. Carry Flag (CF)

ii. EXTRA NOTE: OF only checks if result sign is opposite of both operands sign. It is ONLY for signed arithmetic.

(d) Used for arithmetic and data movement.

i. AX, BX, CX, DX

(e) Used for counting loops.

i. CX

9. Write down the values of the Carry, Sign, Zero and Overflow flags after each instruction has executed. Show your working steps clearly.

```
MOV AX,  6120H
ADD AL,  AAH
ADD AH,  FFH
ADD AX,  2
```

(a) $AX = 6120H$

i. $6120H = 0110\,0001\,0010\,0000_2$

ii. NC, PL, NZ, NV

(b) $AL = 20H + AAH = CAH$

i. $CAH = 0010\,0000_2 + 1010\,1010_2 = 1100\,1010_2$

ii. NC, PL, NZ, NV

(c) $AH = 61H + FFH = 0110\,0001 + 1111\,1111 = 1\,0110\,0000_2$

i. CY, PL, NZ, NV

(d) $0110\,0000 + 0000\,0010 = 0110\,0010_2$

i. NC, PL, NZ, NV

10. Fill in the flag mnemonics in the following table.

Set	Flag Mnemonics	Clear	Flag Mnemonics
Overflow	OV	No overflow	NV
Direction down	DN	Direction up	UP
Interrupt enabled	EI	Interrupt disabled	DI
Sign flag negative	NG	Sign flag positive	PL
Zero	ZR	Non zero	NZ
Auxiliary carry	AC	No auxiliary carry	NA
Odd parity	PO	Even parity	PE
carry	CY	No carry	NC