Construction of 8086 Machine Code

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Lecture References:

- **Book:**
  - *Microprocessors and Interfacing: Programming and Hardware, Chapter # 3,* **Author:** Douglas V. Hall

- **Lecture Materials:**

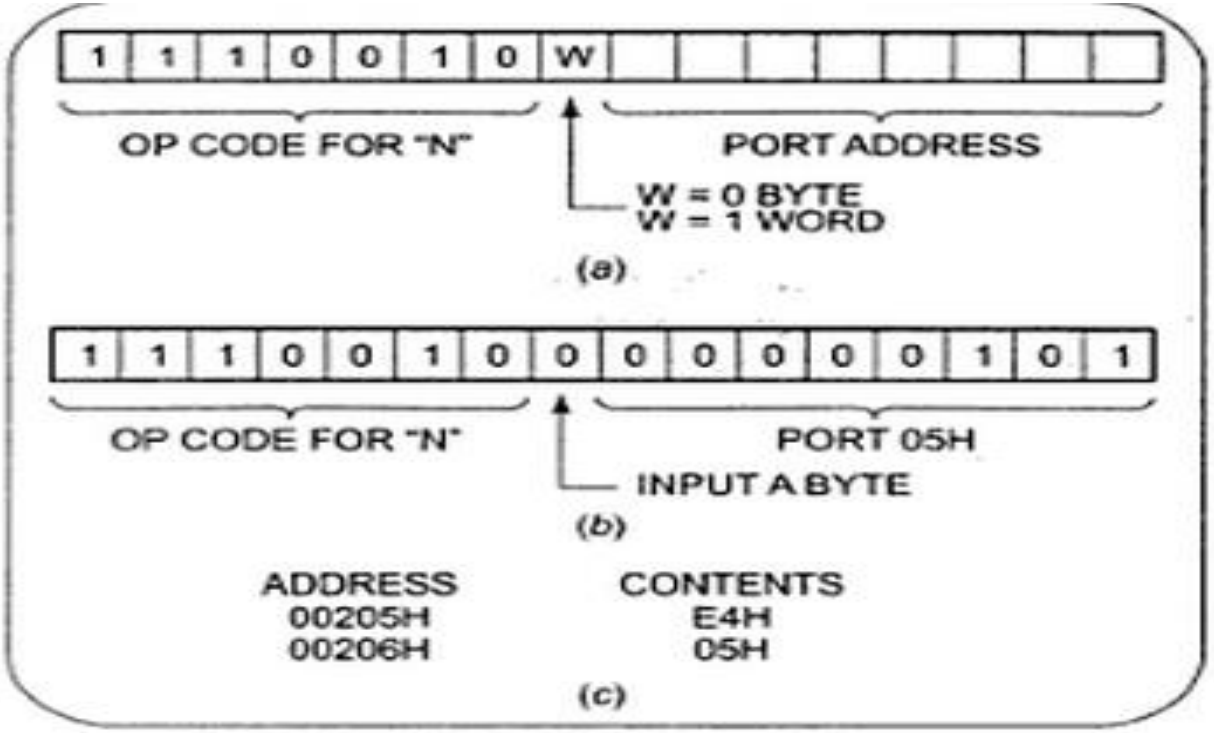
Construction of 8086 Machine Codes

- 8086 has 117 instructions in its instruction set.
- Each instruction in 8086 is associated with a **binary code**.
- Most of the time this work will be done by assembler.
- The things needed to keep in mind is:
  - ***Instruction templates*** and ***coding formats***
  - **MOD** and **R/M** Bit patterns for particular instruction

Instruction Template

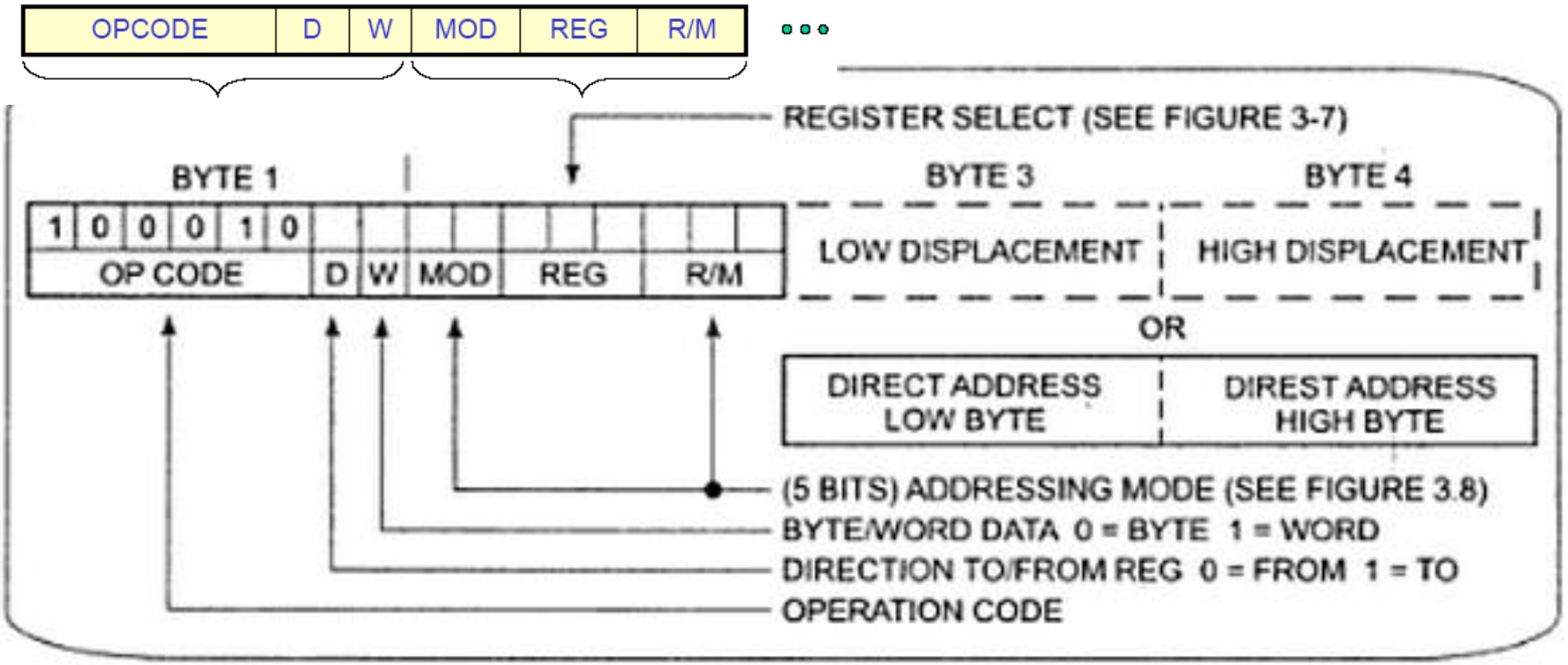
- The Intel literature shows two different formats for coding 8086 instructions.
- Instruction templates helps you to code the instruction properly.
- **Example:**

  IN AL, 05H



MOV Instruction Coding Format

- MOV data from a register to a register or from a register to a memory location or from a memory location to a register. (**Operation Code of MOV: 100010**)



MOV Instruction Coding: **REG Field**

- REG field is used to identify the register of the one operand

REG	W = 0	W = 1
000	AL	AX
001	CL	CX
010	DL	DX
011	BL	BX
100	AH	SP
101	CH	BP
110	DH	SI
111	BH	DI

MOV Instruction Coding: MOD and R/M Field

- 2-bit Mode (MOD) and 3-bit Register/Memory (R/M) fields specify the other operand.
- Also specify the addressing mode.

MOD / RM	00	01	10	11	
				W = 0	W = 1
000	[BX] + [SI]	[BX] + [SI] + d8	[BX] + [SI] + d16	AL	AX
001	[BXI + [DI]	[BX] + [DI] + d8	[BX] + [DI] + d16	CL	CX
010	[BP] + [SI]	[BP] + [SI] + d8	[BP] + [SI] + d16	DL	DX
011	[BP] + [DI]	[BP] + [DI] + d8	[BP] + [DI] + d16	BL	BX
100	[SI]	[SI] + d8	[SI] +d16	AH	SP
101	[DI]	[DI] + d8	[DI] +d16	CH	BP
110	d16 (direct address)	[BP] + d8	[BP] +d16	DH	SI
111	[BX]	[BX] + d8	[BX] + d16	BH	DI

MOV Instruction Coding: MOD and R/M Field

- If the other operand in the instruction is also one of the eight register then put in 11 for MOD bits in the instruction code.
- If the other operand is memory location, there are 24 ways of specifying how the execution unit should compute the effective address of the operand in the main memory.
- If the effective address specified in the instruction contains displacement less than 256 along with the reference to the contents of the register then put in 01 as the MOD bits.
- If the expression for the effective address contains a displacement which is too large to fit in 8 bits then out in 10 in MOD bits.

Example 1

- MOV BL,AL
- Opcode for MOV = 100010
- We'll encode AL so
  - D = 0 (AL source operand)
- W bit = 0 (8-bits)
- MOD = 11 (register mode)
- REG = 000 (code for AL)
- R/M = 011

OPCODE	D	W	MOD	REG	R/M
100010	0	0	11	000	011

Example 2

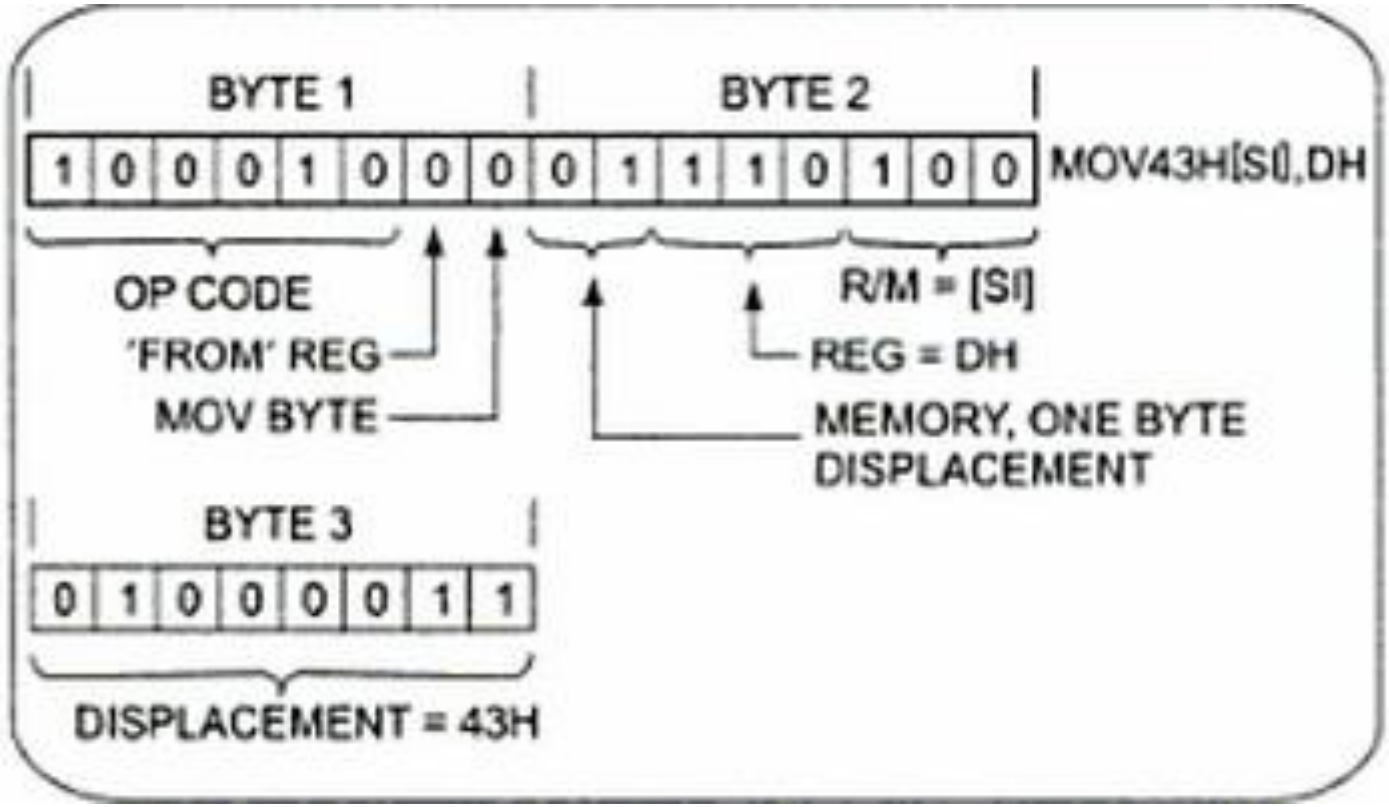
- MOV CL, [BX]

- 100010 – opcode for MOV
- D bit 1 – 'To' register (considering CL)
- W bit 0 – Moving 1 byte
- Memory, no displacement – 00
- REG CL – 001
- R/M – 111 for [BX]

- So, 1000101000001111 = 8A0Fh

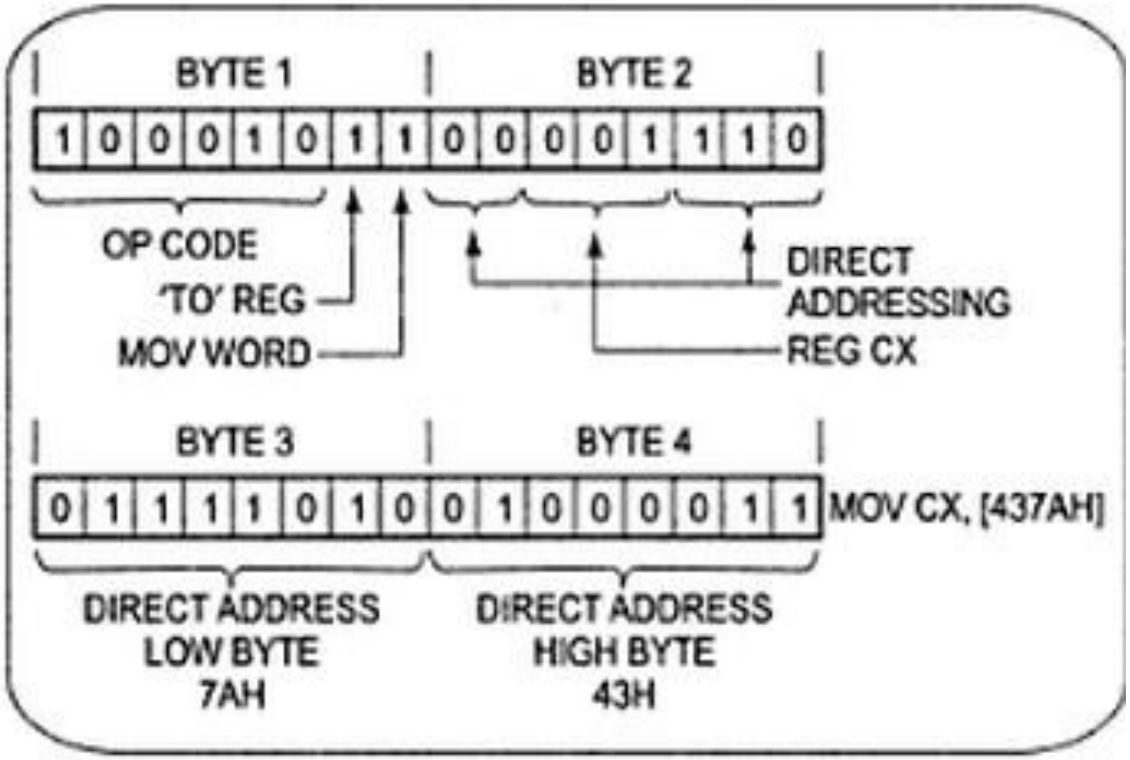
Example 3

- **MOV 43H [SI], DH:** Copy a byte from DH register to memory location.



Example 4

- **MOV CX, [437AH]:** Copy the contents of the two memory locations to the register CX.



Example 5

- MOV AX, 0010H
- Template: 1011 W REG ; DATA ; DATA (if W=1)
- 1011 1000 ; 0001 0000 ; 0000 0000

Example 6

- **MOV CS:[BX], DL:** Copy the contents of the DL register to a memory location indicated by BX register. Normally offset at BX will be added to the data segment to produce the physical address. Bu, in case of transfer of some content from code segment requires CS to use override prefix.

- **Segment Override Prefix:** 001xx110
- **Here, xx = 00 (ES), 01 (CS), 10 (SS), 11 (DS),**

Thank You !!