Lecture -6

Computer Science Dept. / 2nd year 1st Course (2024-2025)
Microprocessor
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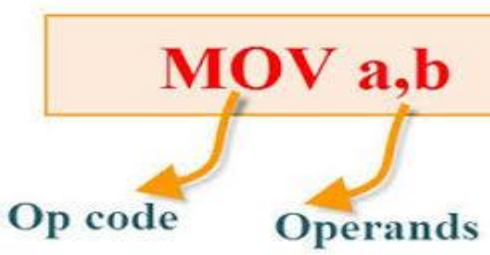
❖ *Instruction Formats*

Operands specify the value an instruction is to operate on, and where the result is to be stored. Instruction sets are classified by the number of operands used. An instruction may have no, one, two, or three operands.



Based on the number of operands in the instruction, we get four instruction formats:

1- Standard format (one operand):

Opcode	Operand(address)

Example: load r (Ac← r)

2- Two operands:

	Destination	Source
Opcode	Operand1	Operand2

Example: Sub R2, d (R2← R2-d)

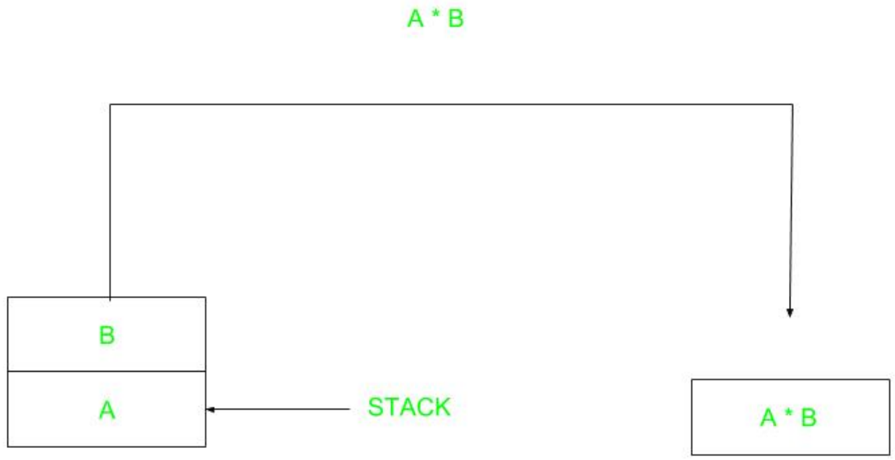
3- Three operands:

	Destination	Source	Source
Opcode	Operand1	Operand2	Operand3

Example: mul R1, c, b (R1← c*b)

4- Zero operand: these instructions have the operation field only. These instructions use a ***stack.***

Example: mul (TOP = A*B)



❖ ADDRESSING MODES

The microprocessor has different ways of ***specifying the data for the instruction***. These are called addressing modes. Many instructions require two operands for execution (for example transfer of data between two registers). The method of identifying the operands position by the instruction format is known as the addressing mode. ***When two operands are involved in an instruction, the first operand is assumed to be in a register Mp itself.***

✓ *Types of Addressing Modes*

- Immediate Addressing Mode
- Implied/ Implicit Addressing Mode
- Register Addressing Mode
- Direct Addressing Mode
- Indirect Base Addressing Mode
- Indirect Index Addressing Mode
- Indirect Base-Index Addressing Mode
- Relative Base Addressing Mode
- Relative Index Addressing Mode

- Relative Base-Index Addressing Mode
- Stack Addressing Mode
- String Addressing Mode
- I/O Addressing Mode

1- Immediate Addressing Mode

The destination field in the first operand defines the length of the data and may be a register or a memory location (the first operand is never an immediate value), and the second operand is the data itself (appears in the form of successive byte or bytes).

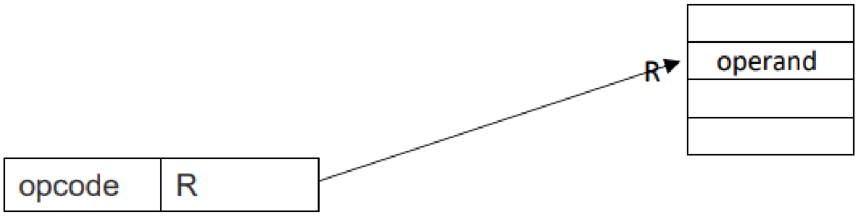
Example: MOV AX, 0005H

2- Implied/Implicit Addressing Mode

This mode ***doesn't require any operand***. The data is specified by the opcode itself. All the instructions that ***use an accumulator*** are implied mode instructions.
Example: RAL.

3- Register Addressing Mode

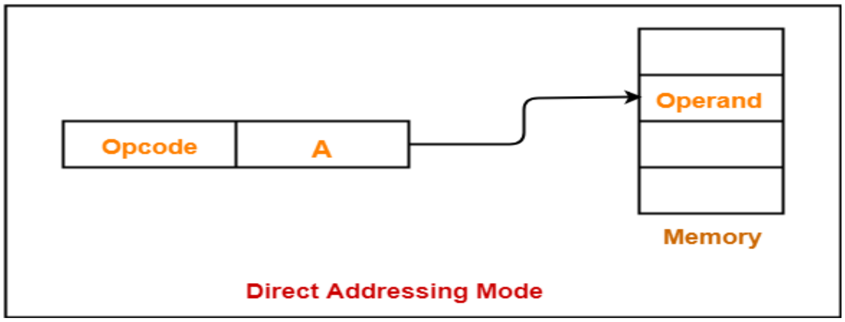
Transfers a copy of a byte or word from the source register to the destination register or memory location.
Note: All the registers, except IP, may be used in this mode.
Example: MOV AX, BX



4- Direct Addressing Mode

Data is ***directly copied*** from the given ***address*** to the register.

Example: MOV AX, [5000H]



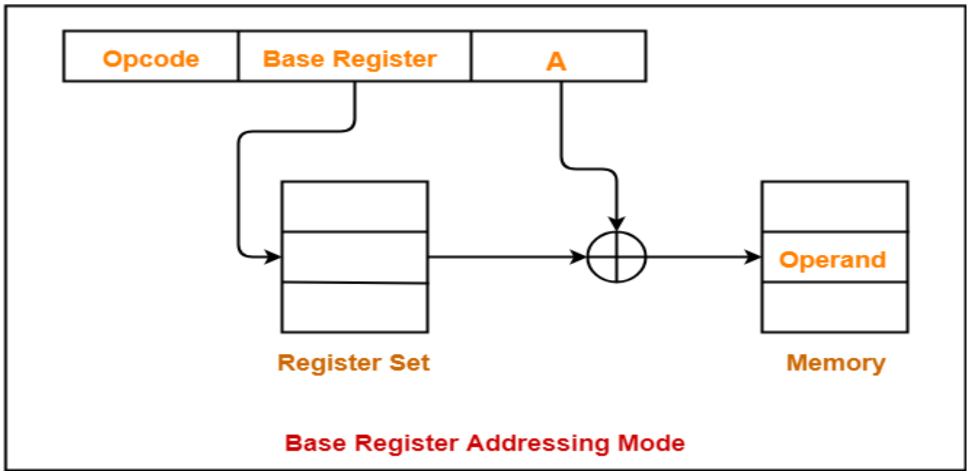
Direct Addressing Mode

5- Indirect Base Addressing Mode

Transfers a byte or word between a register and a memory location addressed by a ***base register***. The base registers are BP, and BX.

Example: MOV AX, [BX]

Effective Address = Content of Base Register + Address part of the instruction



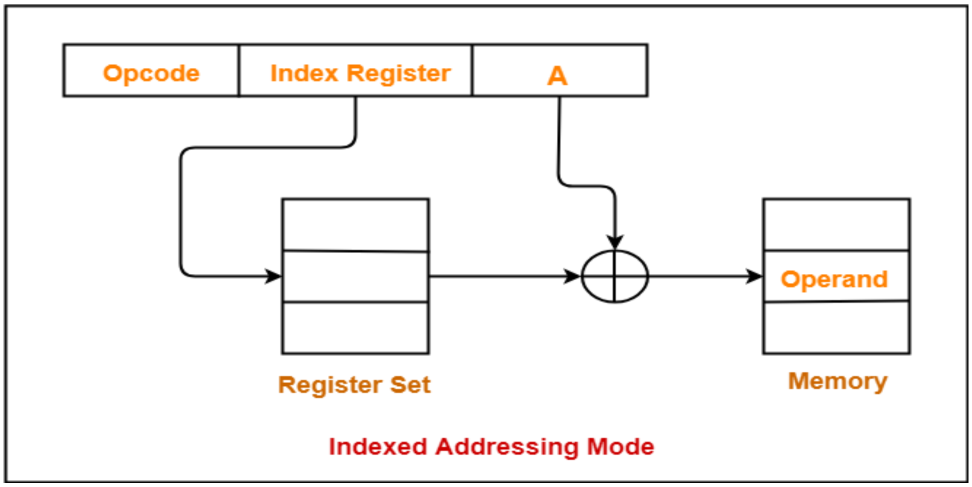
Base Register Addressing Mode

6- Indirect Index Addressing Mode

Transfers a byte or word between a register and a memory location addressed by an ***index register***. The index and base registers are DI, and SI.

Example: MOV AX, [SI]

Effective Address = Content of Index Register + Address part of the instruction



Indexed Addressing Mode

7- Indirect Base-Index Addressing Mode

Transfers a byte or word between a register and a memory location addressed by ***a base and index registers***.
Example: MOV AX, [BX+SI]

Effective Address= Content of Base Register + Content of Index Register + Address part of the instruction

8- Relative Base Addressing Mode

Moves a byte or word between a register and the memory location addressed by a ***base register plus a displacement***.
Example: MOV AX, [BX+50H]

9- Relative Index Addressing Mode

Moves a byte or word between a register and the memory location addressed by an ***index register plus a displacement***.
Example: MOV AX, [SI+50H]

10- Relative Base-Index Addressing Mode

Moves a byte or word between a register and the memory location addressed by a ***base and index registers plus a displacement***.
Example: MOV AX, [BX+SI+50H]

11- Stack Addressing Mode

In this addressing mode, the operand is contained at the ***top of the stack***.

Example: Push, Pop.

12- String Addressing Mode

Used to manipulate string data when performing ***string operations***.

Example: LODS, STOS, MOVS, CMPS.

13- Input / Output Addressing Mode

Accessing data from commonly used ***I/O mapped devices or ports*** is done using these addressing modes.

Example: IN, OUT.