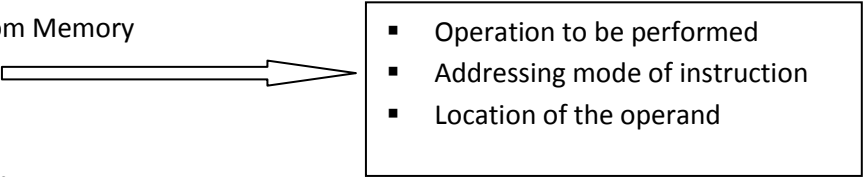## Addressing Modes

Addressing modes specifies a rule for interpreting or modifying the address field of the instruction (before the operand is actually referenced).

Variety of addressing modes used

- To give programming flexibility to the user
- To use the bits in the address field of the instruction efficiently

Instruction Cycle

- Fetch Instruction from Memory
- Decode Instruction
- Execute Instruction

- Operation to be performed
- Addressing mode of instruction
- Location of the operand

Addressing Mode Specification

- Distinct Binary Code
- Single Binary code for both mode and operation

Types of Addressing Modes

Implied Mode

- Address of the operands are specified implicitly in the definition of the instruction
- No need to specify address in the instruction
- Examples: CMA, RAL

Immediate Mode

- Instead of specifying the address of the operand, operand itself is specified
- No need to specify address in the instruction
- However, operand itself needs to be specified
- Sometimes, require more bits than the address
- Fast to acquire an operand
- Useful for initializing registers
- Examples: MVIA 05

Register Mode

- Address specified in the instruction is the register address
- Designated operand need to be in a register
- Shorter address than the memory address
- Faster to acquire an operand than the memory addressing
- Examples: MOV A, B

Register Indirect Mode

- Instruction specifies a register which contains the memory address of the operand
- Saving instruction bits since register address is shorter
- Examples: MOV A, M; where M is a pointer

Autoincrement or Autodecrement Mode

- When the address in the register is used to access memory
- The value in the register is incremented or decremented by 1 automatically
- Used to access tables of data in memory
- Examples: AC ← (R1)+

Direct Address Mode

- Instruction specifies the memory address which can be used directly to access the memory
- Operand resides in memory and its address is given in instruction
- Lengthy address for a large physical memory space
- Examples: LDA 2500H

Relative Addressing Modes

- The Address fields of an instruction specifies the part of the address (abbreviated address) which can be used along with a designated register to calculate the address of the operand
- Address field of the instruction is short
- Large physical memory can be accessed with a small number of address bits
- Three different Relative Addressing Modes depending on R
    - PC Relative Addressing Mode (R = PC)
        - Effective Address (EA) = PC + IR(address)
    - Indexed Addressing Mode (R = IX, where IX: Index Register)
        - Effective Address (EA) = IX + IR(address)
    - Base Register Addressing Mode (R = BAR, where BAR: Base Address Register)
        - Effective Address (EA) = BAR + IR(address)

Indirect Addressing Mode

- The address field of an instruction specifies the address of a memory location that contains the address of the operand
- When the abbreviated address is used large physical memory can be addressed with a relatively small number of bits
- Slow to acquire an operand because of an additional memory access
- Effective Address (EA) = M[IR(address)]