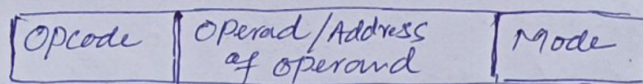


Instruction

An instruction is a command given to the computer to perform a specified operation on given data.

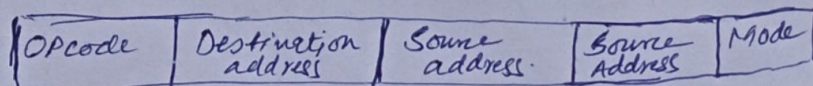
Instruction Format :- It describes the lay-out or internal structure of the instruction. Generally, there are three fields in an instruction.



- (i) Opcode Field :- In this field, code of operation is stored that tells CPU, to what type of operation is to perform like addition, subtraction, data transfer etc.
- (ii) Operand/Address of operand (data) :- It contains the operand (data) or address of operand on which operation is to be performed by CPU.
- (iii) Mode :- Mode defines the way of calculating address of operand whether, it is memory address or register address.

Types of Instruction

- (1) Three Address Instructions :- Instruction having three address field is called three address instruction. Program created using this type of instructions are much short in size but no. of bits per instruction increases.



Example, Program to evaluate $X = (A+B) * (C+D)$ using three address instruction.

Program	Comment
ADD R ₁ , A, B	$R_1 \leftarrow M[A] + M[B]$
ADD R ₂ , C, D	$R_2 \leftarrow M[C] + M[D]$
MUL X, R ₁ , R ₂	$M[X] \leftarrow R_1 * R_2$

(2)

Two Address Instructions:- Instruction having two address field is called two address instruction. Here two address can be specified in the instruction.

Opcode	Destination address	Source address	Mode
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For example, Program to evaluate $X = (A+B) * (C+D)$ using two address instruction.

Program	Comment
MOV R ₁ , A	$R_1 \leftarrow M[A]$
ADD R ₁ , B	$R_1 \leftarrow R_1 + M[B]$
MOV R ₂ , C	$R_2 \leftarrow M[C]$
ADD R ₂ , D	$R_2 \leftarrow R_2 + M[D]$
MUL R ₁ , R ₂	$R_1 \leftarrow R_1 * R_2$
MOV X, R ₁	$M[X] \leftarrow R_1$

(3)

One Address Instruction:- Instruction having one address field is called one address instruction. In this type of instruction, one operand is in accumulator and other is in register or memory location.

Opcode	Operand/Address of operand	Mode
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For example, Program to evaluate $X = (A+B) * (C+D)$ using one address instruction,

Program	Comment,
LOAD A	$ACC \leftarrow M[A]$
ADD B	$ACC \leftarrow ACC + M[B]$
STORE T	$M[T] \leftarrow ACC$
LOAD C	$ACC \leftarrow M[C]$
ADD D	$ACC \leftarrow ACC + M[D]$
MUL T	$ACC \leftarrow ACC * M[T]$
STORE X	$M[X] \leftarrow ACC$

(4) Zero Address Instruction :- Instruction having no address field is called Zero address instruction. Instruction specify data itself.

For example, Program to evaluate $X = (A+B) * (C+D)$ using Zero address instruction,

Program	Comment
PUSH A	$TOS \leftarrow A$
PUSH B	$TOS \leftarrow B$
ADD	$TOS \leftarrow (A+B)$
PUSH C	$TOS \leftarrow C$
PUSH D	$TOS \leftarrow D$
ADD	$TOS \leftarrow (C+D)$
MUL	$TOS \leftarrow (C+D) * (A+B)$
POP X	$M[X] \leftarrow TOS$