

# Instruction Format

- An instruction format defines the layout of the bits of an instruction.



# Zero Address / Zero Word Instruction

Zero Address / Zero Word Instruction:

- A stack based computer do not use address field in instruction.
- Stack is used,
- Arithmetic operation pops two operands from the stack and pushes the result.
- Also called stack organization.

# Zero Address / Zero Word Instruction

- Example:  $X = (A + B) - (C + D)$

PUSH A      ( $\text{tos} \leftarrow A$ )

PUSH B      ( $\text{tos} \leftarrow B$ )

ADD          ( $\text{tos} \leftarrow A + B$ )

PUSH C      ( $\text{tos} \leftarrow C$ )

PUSH D      ( $\text{tos} \leftarrow D$ )

ADD          ( $\text{tos} \leftarrow C + D$ )

SUB          ( $\text{tos} \leftarrow (A + B) - (C + D)$ )

POP X         $M[X] \leftarrow \text{TOS}$

# One Address / One Word Instruction

One Address / one Word Instruction:

- One address can be a register name or memory address.
- Single accumulator organization.
- It uses AC register for all data manipulation.
- Instruction: ADD X
- Microoperation:  $AC \leftarrow AC + M[X]$

# One Address / One Word Instruction

Example:  $X = (A + B) - (C + D)$

LOAD A	$(AC \leftarrow M[A])$
ADD B	$(AC \leftarrow AC + M[B])$
STORE T	$(M[T] \leftarrow AC)$
LOAD C	$(AC \leftarrow M[C])$
ADD D	$(AC \leftarrow AC + M[D])$
SUB T	$(AC \leftarrow AC - M[T])$
STORE X	$(M[X] \leftarrow AC)$

# Two Address / Two Word Instruction

Two Address / two Word Instruction:

- Two address registers or two memory locations are specified.
- Assume that the destination address is same as that of the first operand
- Instruction: ADD R1, R2
- Micro operation:  $R1 \leftarrow R1 + R2$

# Two Address / Two Word Instruction

Example:  $X = (A + B) - (C + D)$

MOV R1, A ( $R1 \leftarrow M[A]$ )

ADD R1, B ( $R1 \leftarrow R1 + M[B]$ )

MOV R2, C ( $R2 \leftarrow M[C]$ )

ADD R2, D ( $R2 \leftarrow R2 + M[D]$ )

SUB R1, R2 ( $R1 \leftarrow R1 - R2$ )

MOV X, R1 ( $M[X] \leftarrow R1$ )

# Three Address / Three Word Instruction

Three Address / three Word Instruction:

- memory addresses for the two operands and one destination needs to be specified.
- It is also called as a general register organization.
- Instruction: ADD R1, R2, R3
- Micro operation:  $R1 \leftarrow R2 + R3$



# Three Address / Three Word Instruction

Example:  $X = (A + B) - (C + D)$

ADD R1, A, B    ( $R1 \leftarrow M[A] + M[B]$ )

ADD R2, C, D    ( $R2 \leftarrow M[C] + M[D]$ )

SUB X, R1, R2    ( $M[X] \leftarrow R1 - R2$ )