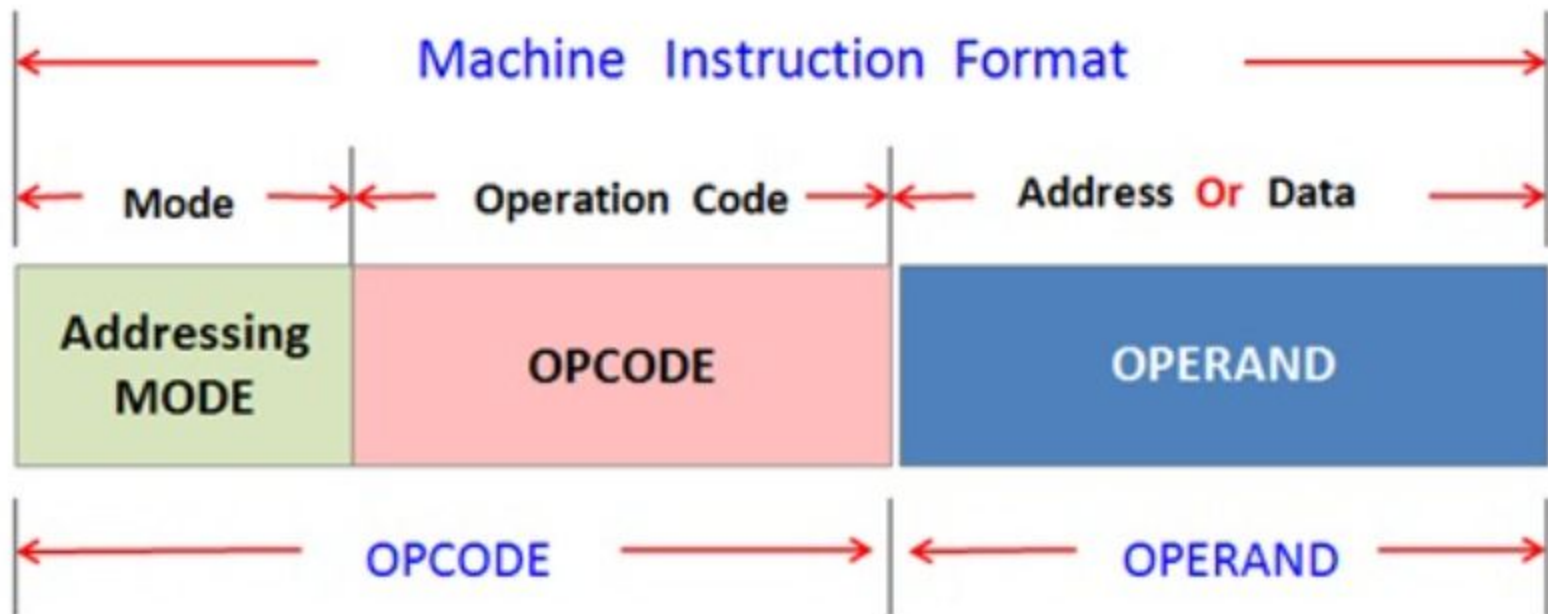


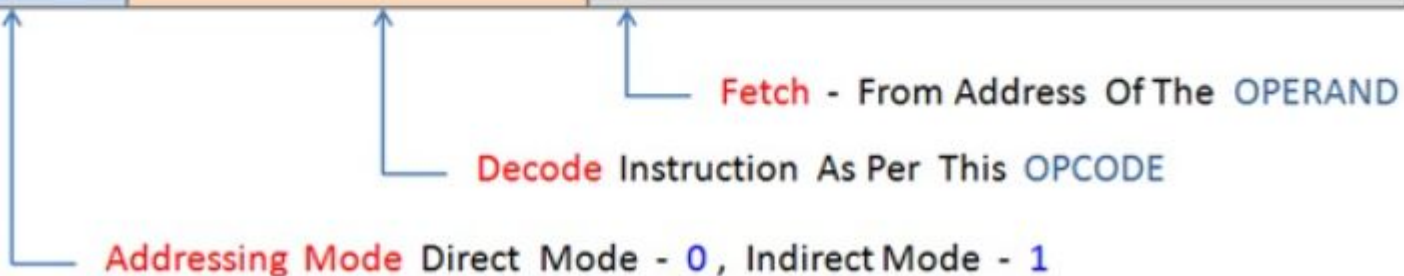
Basic Computer Organization and Design



Instruction Register - 16 Bits Format



Instruction Format



Types of addressing formats

Zero-Address Instructions



$$X = (A + B) * (C + D)$$

ASSEMBLY LANGUAGE

PUSH A

PUSH B

ADD

PUSH C

PUSH D

ADD

MUL

POP X

REGISTER OPERATION

[TOS \leftarrow A]

[TOS \leftarrow B]

[TOS \leftarrow (A + B)]

[TOS \leftarrow C]

[TOS \leftarrow D]

[TOS \leftarrow (C + D)]

[TOS \leftarrow (C + D) * (A + B)]

[M [X] \leftarrow TOS]

One-Address Instructions : accumulator (AC) register for data manipulation.



$$X = (A + B) * (C + D)$$

ASSEMBLY LANGUAGE INSTRUCTION	REGISTER OPERATION INSTRUCTION
-------------------------------	--------------------------------

LOAD A	
--------	--

	$[AC \leftarrow M[A]]$
--	------------------------

ADD B	
-------	--

	$[AC \leftarrow A[C] + M[B]]$
--	-------------------------------

STORE T	
---------	--

	$[M[T] \leftarrow AC]$
--	------------------------

LOAD C	
--------	--

	$[AC \leftarrow M[C]]$
--	------------------------

ADD D	
-------	--

	$[AC \leftarrow AC + M[D]]$
--	-----------------------------

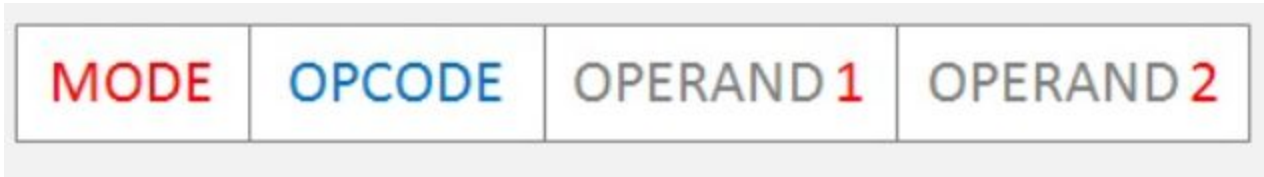
MUL T	
-------	--

	$[AC \leftarrow AC * M[T]]$
--	-----------------------------

STORE X	
---------	--

	$[M[X] \leftarrow AC]$
--	------------------------

Two-Address Instructions



$$X = (A + B) * (C + D)$$

ASSEMBLY LANGUAGE INSTRUCTION	REGISTER OPERATION INSTRUCTION
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	$[R2 \leftarrow R2 + M[D]]$
MUL R1, R2	$[R1 \leftarrow R1 * R2]$
MOV X, R1	$[M[X] \leftarrow R1]$

Three-Address Instructions



$$X = (A + B) * (C + D)$$

ASSEMBLY LANGUAGE

ADD R1, A, B

ADD R2, C, D

MUL X, R1, R2

REGISTER OPERATION

$[R1 \leftarrow M[A] + M[B]]$

$[R2 \leftarrow M[C] + M[D]]$

$[M[X] \leftarrow R1 * R2]$

Instruction Codes

- A set of instructions that specify the operations, operands, and the sequence by which processing has to occur.
- An instruction code is a group of bits that tells the computer to perform a specific operation part.

Addressing Modes

1. Implied Mode
2. Immediate Mode
3. Register Mode
4. Register Indirect Mode
5. Auto increment or Auto decrement Mode
6. Direct Address Mode
7. Indirect Address Mode
8. Relative Address Mode
9. Indexed Addressing Mode
10. Base Register Addressing Mode

Con

Register symbol	Number_ of bits	Register name	Register Function-----
DR	16	Data register	Holds memory operands
AR	12	Address register	Holds address for memory
AC	16	Accumulator	Processor register
IR	16	Instruction register	Holds instruction code
PC	12	Program counter	Holds address of instruction
TR	16	Temporary register	Holds temporary data
INPR	8	Input register	Holds input character
OUTR	8	Output register	Holds output character