TOPIC 8 – INSTRUCTIONS

LEARNING OUTCOMES

By the end of this topics, you will be able to:

1. explain the characteristics of instructions.
2. write format, type and number of address.

INTRODUCTION

This topic explains the characteristics of instructions, format, type and number of address.

8.1 CHARACTERISTICS

The machine instructions or computer instructions is a processor operation which determined by the execution of the instructions. The collection of different instructions that the processor can execute is referred to as the processor's instruction set.

The processor required the information provided by each instruction for execution. There are four elements of instructions; operation code, source operand reference, result operand reference and next instruction reference. Operation code or opcode specifies the operation to be performed (e.g., ADD, I/O). The operation is specified by a binary code. The source operand reference in the operation may involve one or more source operands that are inputs for the operation. Result operand reference becomes the reference for operation after produce a result. Lastly, next instruction reference that tells the processor the location to fetch the next instruction after the execution of current instruction complete.

The source and result operands consist of main or virtual memory, processor register, immediate and input/output device.

SELF CHECK 8.1

1. What is machine instruction?
2. Explain FOUR (4) elements of instructions.

8.2 FORMAT, TYPE, NUMBER OF ADDRESS

The instruction in computer is represented by a sequence of bits. It is divided into fields, corresponding to the constituent elements of the instruction. For example, in Figure 8.44

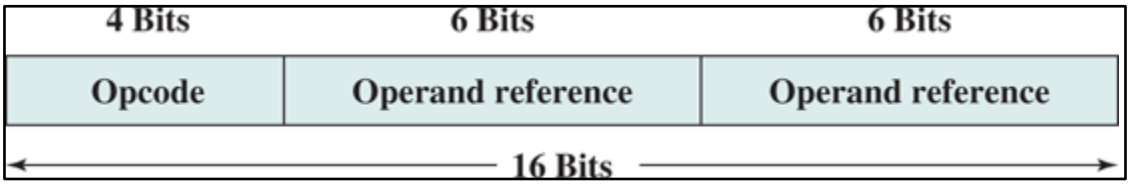

Figure 8.44

The most common fields found in instruction format are an operation code field that specified the operation to be performed, an address field that designates a memory address or a processor registers and a mode field that specifies the way the operand or the effective address is determined.

The operand can be addresses, numbers, characters or logical data while the opcodes are represented by mnemonics which indicate the operation. For example:

Table 8.12

Opcode	Description
ADD	Add
SUB	Subtract
MUL	Multiply
DIV	Divide
LOAD	Load data from memory
STOR	Store data to memory

The computers may have instructions of several different lengths containing varying number of addresses. The number of address field in the instruction format of a computer depends on the internal organization of its registers.

Most computers fall into one of the following types of CPU organization:

i. Single Accumulator organization: ADD X AC ® AC + M [×]
ii. General Register Organization: ADD R1, R2, R3 R ® R2 + R3
iii. Stack Organization: PUSH X

Following are the address instructions in computer:

i. Three address instruction

Computer with three addresses instruction format can use each address field to specify either processor register is memory operand.

For example:

ADD R1, A, B	R1 ® M [A] + M [B]	
ADD R2, C, D	R2 ® M [C] + M [D]	X = (A + B) * (C + D)
MUL X, R1, R2	M [X] R1 * R2	

ii. Two address instruction

Most common in commercial computers. Each address field can specify either a process register on a memory word.

For example:

MOV	R1, A	R1 ® M [A]	
ADD	R1, B	R1 ® R1 + M [B]	
MOV	R2, C	R2 ® M [C]	X = (A + B) * (C + D)
ADD	R2, D	R2 ® R2 + M [D]	
MUL	R1, R2	R1 ® R1 * R2	
MOV	X, R1	M [X] ® R1	

iii. One address instruction

It used an implied accumulator (AC) register for all data manipulation. For multiplication/division, there is a need for a second register.

LOAD	A	AC ® M [A]	
ADD	B	AC ® AC + M [B]	
STORE	T	M [T] ® AC	X = (A +B) × (C + A)
LOAD	C	AC ® M [C]	
ADD	A	AC ® AC + M [A]	
MUL	T	AC ® AC + M [T]	
STORE	X	M[X] = AC	

SELF CHECK 8.2

1. Write the following statements in three address instruction, two address instruction and one address instruction:
   a) x = y + z.
   b) a = (c + d) - (c + b + d - e).

SUMMARY

In this topic you have learnt that:

The characteristics of instructions, format, type and number of address.

KEY TERMS

Instructions Segment of code containing steps that need to be executed by the processor.

REFERENCES

Stallings, W., (2019). *Computer Organization and Architecture Designing for Performance.* 11th ed. New York: Pearson.