ADDRESSING MODES OF COMPUTER - II

INDEXING AND ARRAYS:-

A different kind of flexibility for accessing operands is useful in dealing with lists and arrays.

Index mode – the effective address of the operand is generated by adding a constant value to the contents of a register.

The register use may be either a special register provided for this purpose, or, more commonly, it may be any one of a set of general-purpose registers in the processor. In either case, it is referred to as index register. We indicate the Index mode symbolically as

X (Ri)

Where X denotes the constant value contained in the instruction and Ri is the name of the register involved. The effective address of the operand is given by

EA = X + [Rj]

The contents of the index register are not changed in the process of generating the effective address. In an assembly language program, the constant X may be given either as an explicit number or as a symbolic name representing a numerical value.

Fig a illustrates two ways of using the Index mode. In fig a, the index register, R1, contains the address of a memory location, and the value X defines an offset (also called a displacement) from this address to the location where the operand is found. An alternative use is illustrated in fig b. Here, the constant X corresponds to a memory address, and the contents of the index register define the offset to the operand. In either case, the effective address is the sum of two values; one is given explicitly in the instruction, and the other is stored in a register.

Fig (a) Offset is given as a constant

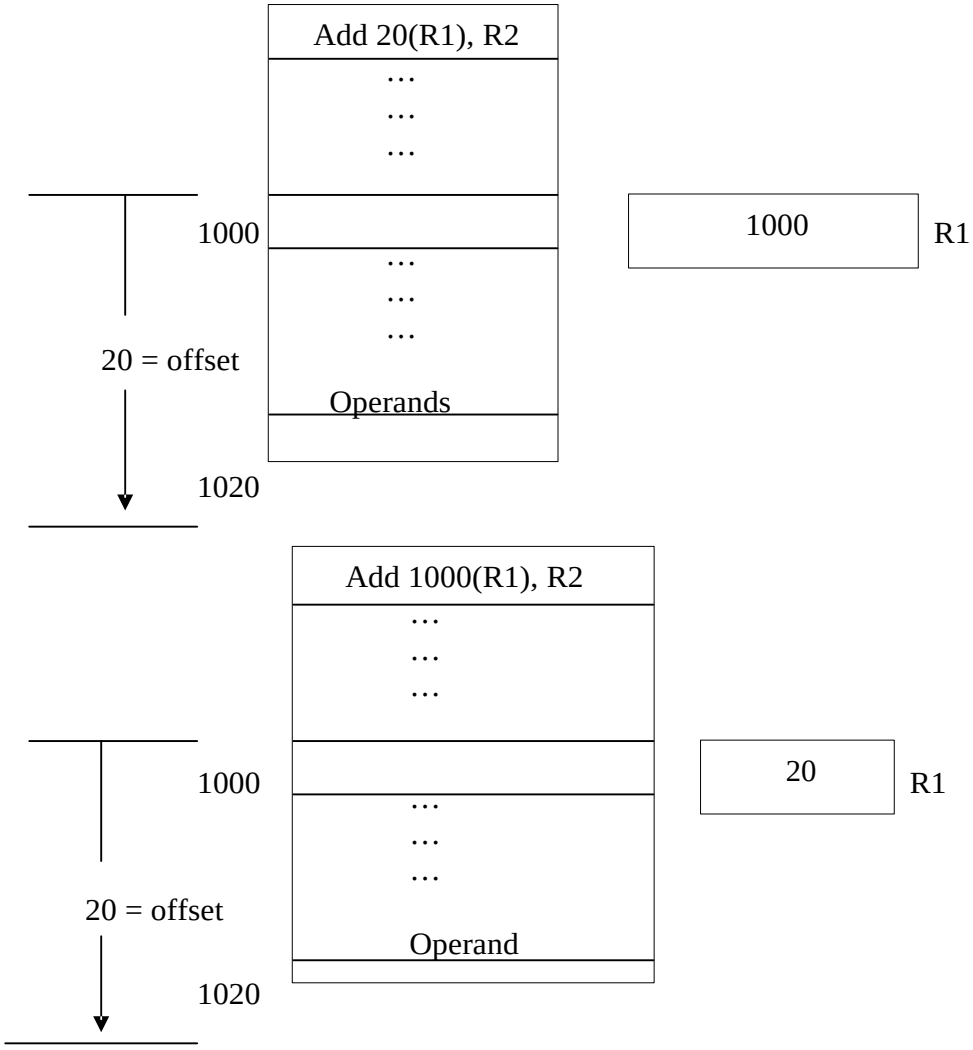
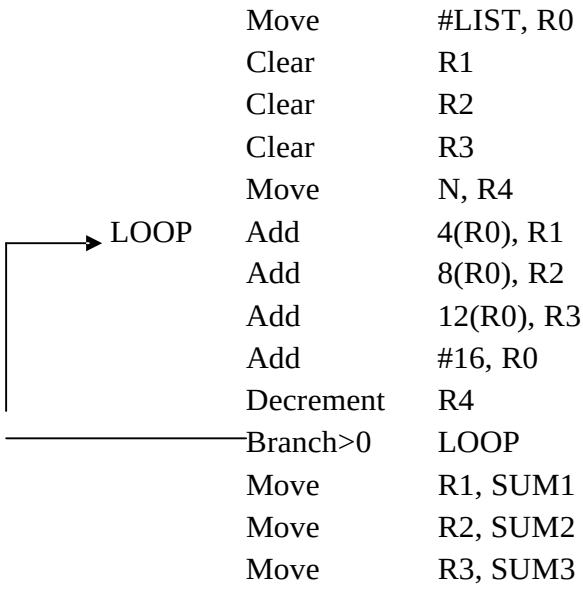


Fig (b) Offset is in the index register



In the most basic form of indexed addressing several variations of this basic form provide a very efficient access to memory operands in practical programming situations. For example, a second register may be used to contain the offset X, in which case we can write the Index mode as

(Ri, Rj)

The effective address is the sum of the contents of registers Ri and Rj. The second register is usually called the base register. This form of indexed addressing provides more flexibility in accessing operands, because both components of the effective address can be changed.

Another version of the Index mode uses two registers plus a constant, which can be denoted as

X(Ri, Rj)

In this case, the effective address is the sum of the constant X and the contents of registers Ri and Rj. This added flexibility is useful in accessing multiple components inside each item in a record, where the beginning of an item is specified by the (Ri, Rj) part of the addressing mode. In other words, this mode implements a three-dimensional array.

RELATIVE ADDRESSING:-

We have defined the Index mode using general-purpose processor registers. A useful version of this mode is obtained if the program counter, PC, is used instead of a general purpose register. Then, X(PC) can be used to address a memory location that is X bytes away from the location presently pointed to by the program counter.

Relative mode – The effective address is determined by the Index mode using the program counter in place of the general-purpose register Ri.

This mode can be used to access data operands. But, its most common use is to specify the target address in branch instructions. An instruction such as

Branch > 0 LOOP

Causes program execution to go to the branch target location identified by the name LOOP if the branch condition is satisfied. This location can be computed by specifying it as an offset from the current value of the program counter. Since the branch target may be either before or after the branch instruction, the offset is given as a signed number.

Autoincrement mode – the effective address of the operand is the contents of a register specified in the instruction. After accessing the operand, the contents of this register are automatically to point to the next item in a list.

(Ri)+

Autodecrement mode – the contents of a register specified in the instruction are first automatically decremented and are then used as the effective address of the operand.

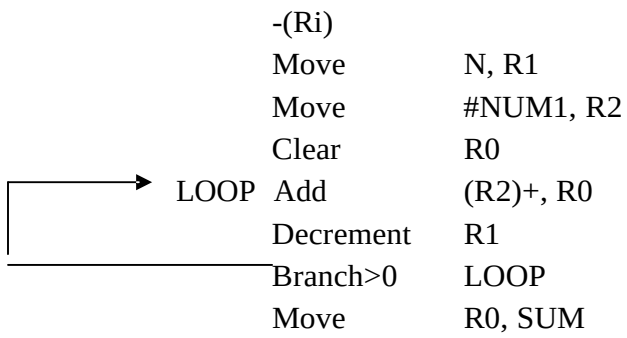


Fig c The Autoincrement addressing mode used in the program of fig 2.12

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