WEEK-11

3.6 MARIE Architecture.

MARIE, a Machine Architecture that is Really Intuitive and Easy, is a simple architecture consisting of memory (to store programs and data) and a CPU (consisting of an ALU and several registers). It has all the functional components necessary to be a real working computer. We describe MARIE's architecture in the following sections.

3.6.1 The Architecture.

MARIE has the following characteristics:

- Binary, two's complement.
- Stored program, fixed word length.
- Word (but not byte) addressable.
- 4K words of main memory (this implies 12 bits per address).
- 16-bit data (words have 16 bits).
- 16-bit instructions, 4 for the opcode and 12 for the address.
- A16-bit accumulator (AC).
- A16-bit instruction registers (IR).
- A16-bit memory buffer register (MBR).
- A12-bit program counter (PC).
- A12-bit memory address register (MAR).
- An 8-bit input register.

• An 8-bit output register.



Figure 3.3 shows the architecture for MARIE.

We emphasize again that each location in memory has a unique address (represented in binary) and each location can hold a value. These notions of the address versus what is actually stored at that address tend to be confusing. To help avoid confusion, just visualize a post office. There are post office boxes with various "addresses" or numbers. Inside the post office box, there is mail. To get the mail, the number of the post office box must be known. The same is true for data or instructions that need to be fetched from memory. The contents of any memory address are manipulated by specifying the address of that memory location. We shall see that there are many different ways to specify this address.

3.6.2 Registers and Buses.

Registers are storage locations within the CPU (as illustrated in Figure 4.4). The ALU (arithmetic logic unit) portion of the CPU performs all of the processing (arithmetic operations, logic decisions, and so on). The registers are used for very specific purposes when programs are executing: They hold values for temporary storage, data that is being manipulated in some way, or results of simple calculations.

Many times, registers are referenced implicitly in an instruction.

In MARIE, there are seven registers, as follows:

- **AC:** The accumulator, which holds data values. This is a general purpose register and holds data that the CPU needs to process. Most computers today have multiple general purpose registers.
- **MAR:** The memory address register, which holds the memory address of the data being referenced.
- **MBR:** The memory buffer register, which holds either the data just read from memory or the data ready to be written to memory.

- **PC:** The program counter, which holds the address of the next instruction to be executed in the program.
- **IR:** The instruction register, which holds the next instruction to be executed.

InREG: The input register, which holds data from the input device.

OutREG: The output register, which holds data for the output device.