

BASIC COMPUTER ORGANIZATION AND DESIGN

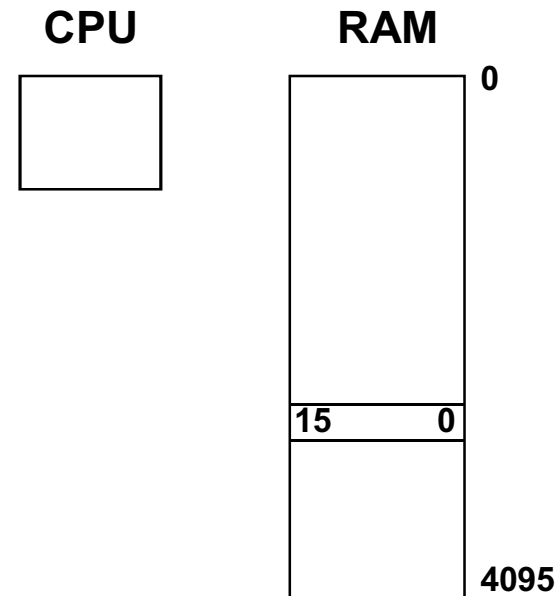
- **Instruction Codes**
- **Computer Registers**
- **Computer Instructions**
- **Timing and Control**
- **Instruction Cycle**
- **Memory Reference Instructions**
- **Input-Output and Interrupt**
- **Complete Computer Description**
- **Design of Basic Computer**
- **Design of Accumulator Logic**

INTRODUCTION

- Every different processor type has its own design (different registers, buses, microoperations, machine instructions, etc)
- Modern processor is a very complex device
- It contains
 - Many registers
 - Multiple arithmetic units, for both integer and floating point calculations
 - The ability to pipeline several consecutive instructions to speed execution
 - Etc.
- However, to understand how processors work, we will start with a simplified processor model
- This is similar to what real processors were like ~25 years ago
- M. Morris Mano introduces a simple processor model he calls the *Basic Computer*
- We will use this to introduce processor organization and the relationship of the RTL model to the higher level computer processor

THE BASIC COMPUTER

- The Basic Computer has two components, a processor and memory
- The memory has 4096 words in it
 - $4096 = 2^{12}$, so it takes 12 bits to select a word in memory
- Each word is 16 bits long

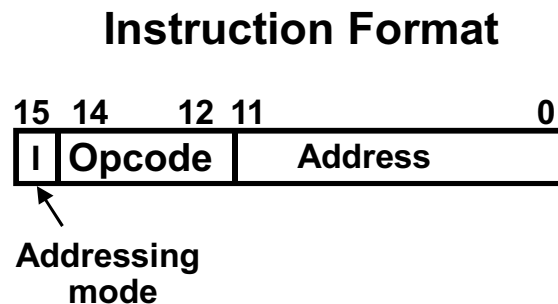


INSTRUCTIONS

- **Program**
 - A sequence of (machine) instructions
- **(Machine) Instruction**
 - A group of bits that tell the computer to *perform a specific operation* (a sequence of micro-operation)
- The instructions of a program, along with any needed data are stored in memory
- The CPU reads the next instruction from memory
- It is placed in an *Instruction Register (IR)*
- Control circuitry in control unit then translates the instruction into the sequence of microoperations necessary to implement it

INSTRUCTION FORMAT

- A computer instruction is often divided into two parts
 - An *opcode* (Operation Code) that specifies the operation for that instruction
 - An *address* that specifies the registers and/or locations in memory to use for that operation
- In the Basic Computer, since the memory contains 4096 (= 2^{12}) words, we need 12 bits to specify which memory address this instruction will use
- In the Basic Computer, bit 15 of the instruction specifies the *addressing mode* (0: direct addressing, 1: indirect addressing)
- Since the memory words, and hence the instructions, are 16 bits long, that leaves 3 bits for the instruction's opcode



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