Microprocessors

TE 258

8085 Microprocessors

Justice Owusu Agyemang, Department of Telecommunications Engineering, KNUST

8085 MICROPROCESSORS

Basic Concepts of Microprocessors

Differences between:

- **Microcomputer**: a computer with a microprocessor as its CPU. Includes memory, I/O etc.

- **Microprocessor**: silicon chip which includes ALU, register circuits & control circuits.

- **Microcontroller**: silicon chip which includes microprocessor, memory & I/O in a single package.

Basic Concepts of Microprocessors

Characteristics of a Microprocessor

- Programmable device.

- Takes in numbers, performs on them arithmetic or logical operations; instructions.

- Recognizes and processes a group of bits (word) together.

- Produces other numbers as a result.

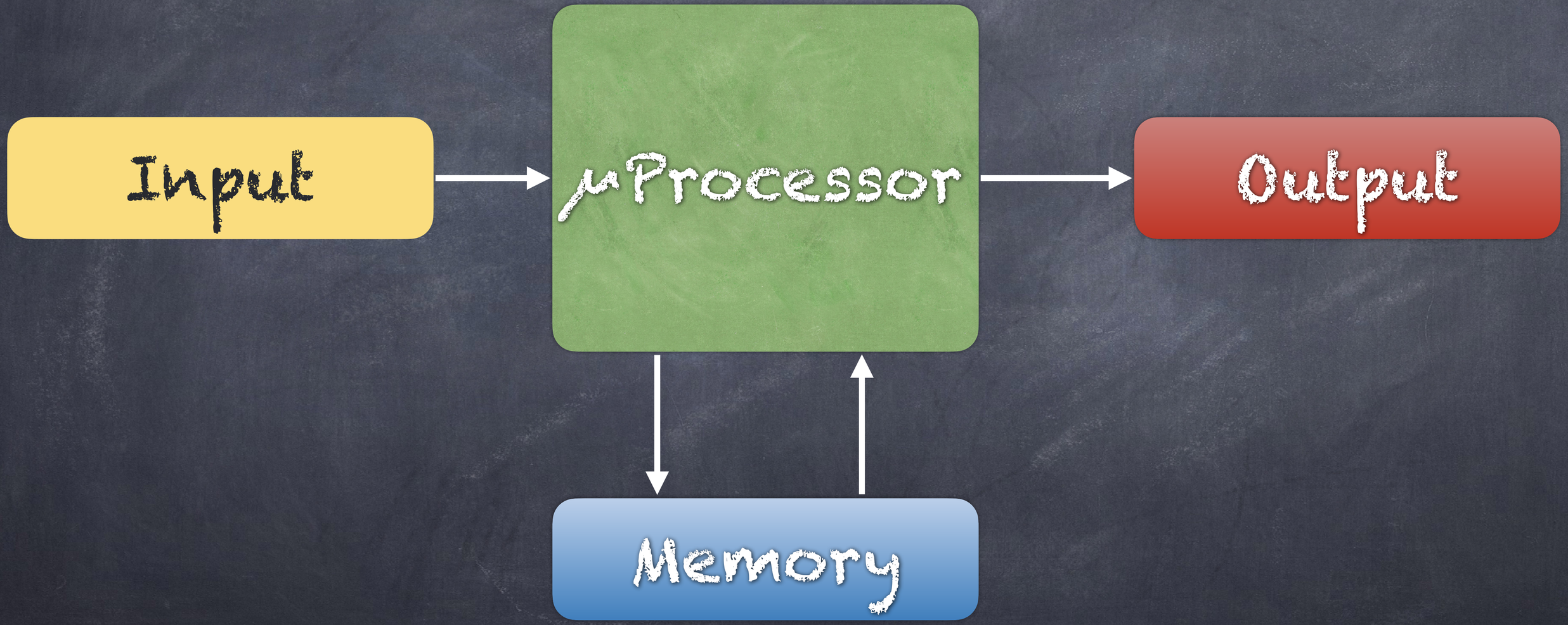
A Microprocessor-Based System

Words, Bytes, etc

- The earliest microprocessor (Intel 8088, Motorola 6800) recognized 8-bit words.

- Later microprocessors (8086 and 68000) were designed with 16-bit words.
  - A group of 8-bits were referred to as a "half-word" or "byte".
  - A group of 4 bits is called a "nibble".
  - 32-bit groups were given the name "long word".

A Microprocessor-based System

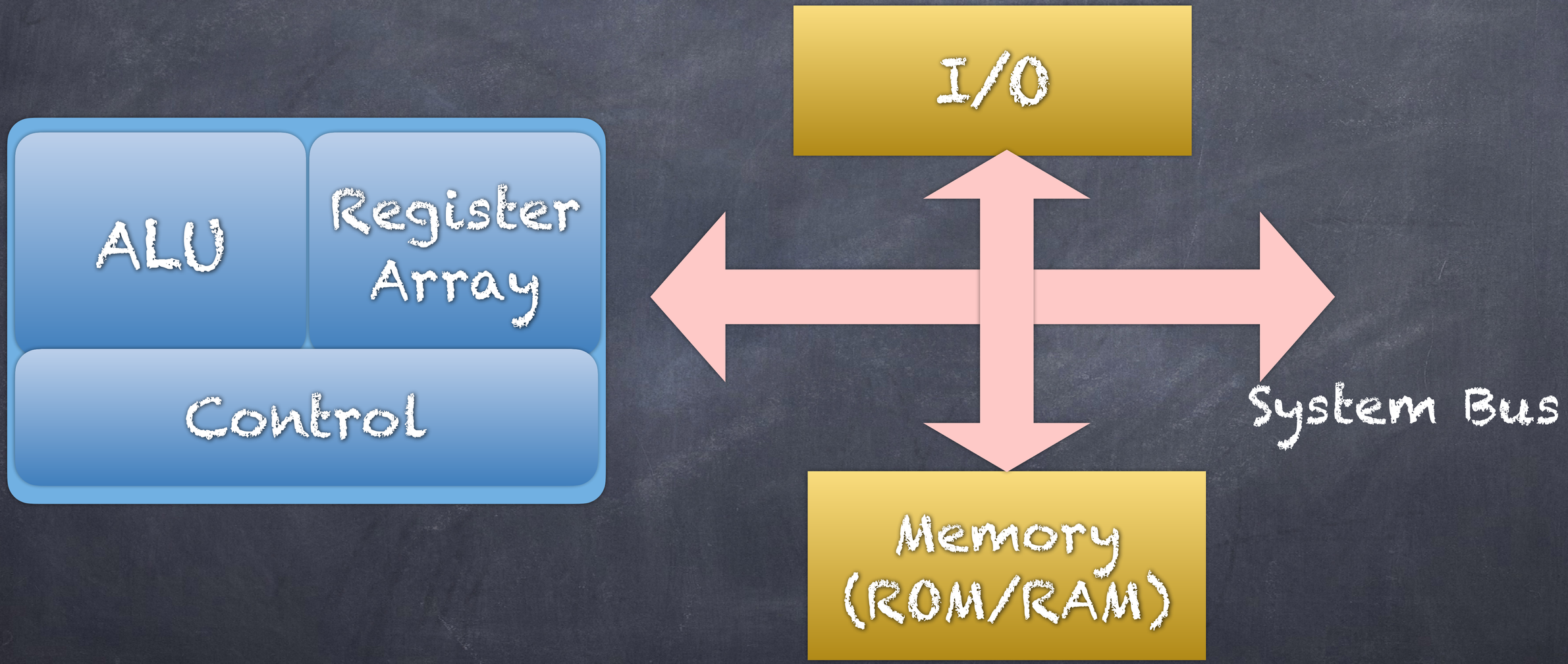


A Microprocessor-Based System

Inside the μprocessor:

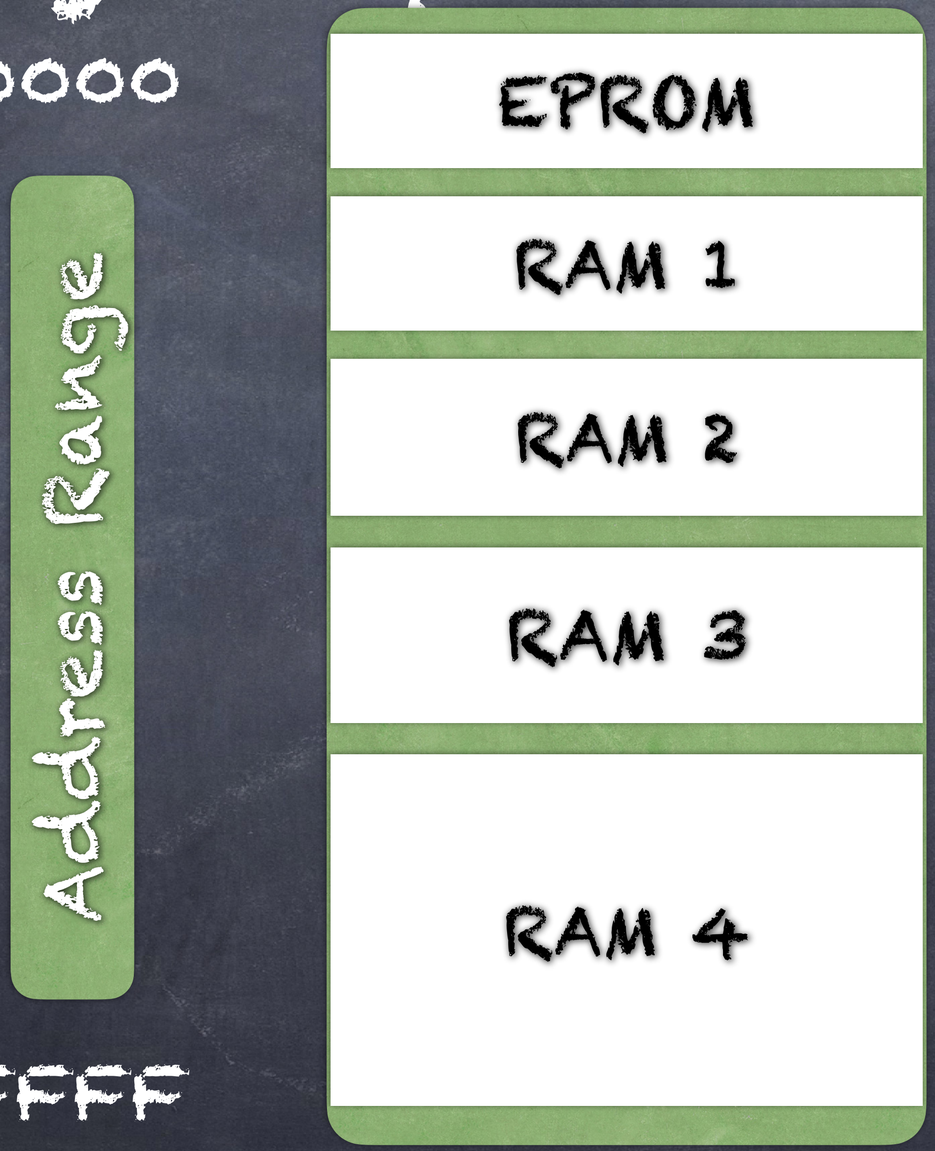
- ALU.
- The Control Unit.
- An array of registers for holding data while it is being manipulated.

Organization of a microprocessor-based System

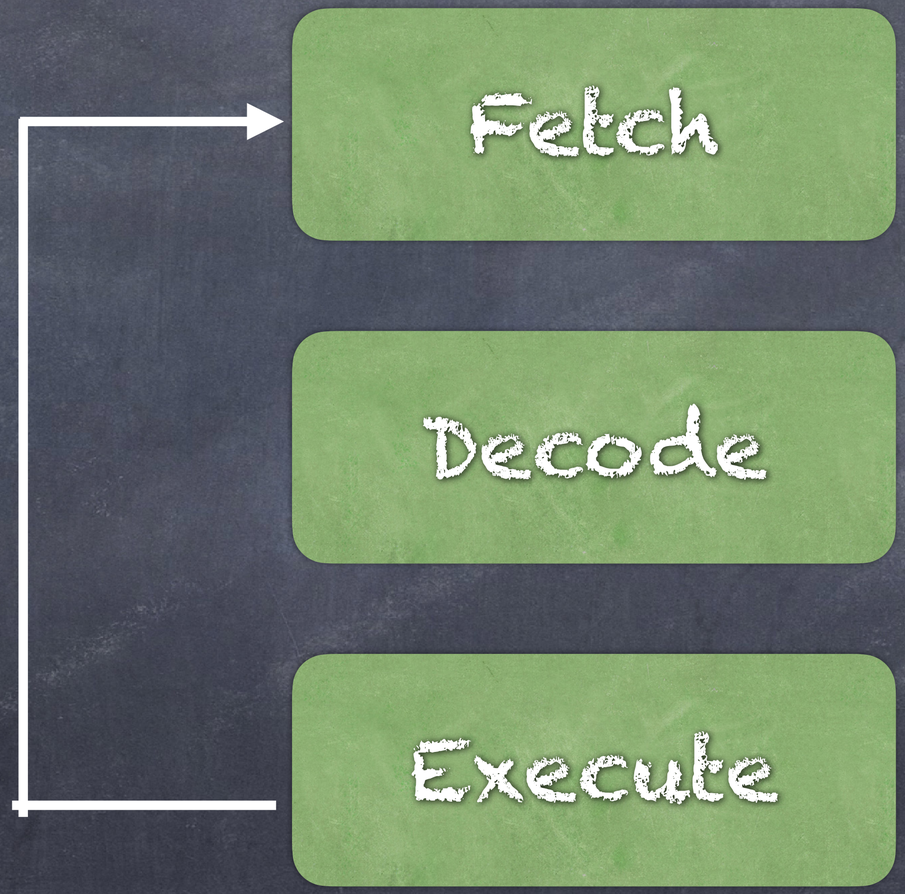


Memory Map and Addresses

Example:



CPU Execution Cycle



Machine Language

- The number of bits that form the "word" of a microprocessor is fixed for that particular processor.
  - These bits define the maximum number of combinations.

- However, in most microprocessors, not all of these combinations are used.
  - Certain patterns are chosen and assign specific meanings.
  - Each of these patterns forms an instruction for the microprocessor.
  - The complete set of these patterns makes up the microprocessor's machine language.

The 8085 Machine Language

- The 8085 Intel microprocessor is an 8-bit microprocessor.
  - It uses a total of 246 bit patterns to form its instruction set.
  - These 246 patterns represent only 74 instructions.
  - Bit patterns are usually entered in hexadecimal instead of binary.

Assembly Language

- Entering instruction using hexadecimal is quite easier than entering the binary combinations.
  - However, it is still difficult to understand what a program written in hexadecimal does.
  - A symbolic code is used for each instruction. These codes are called "mnemonics".
  - The mnemonic for each instruction is usually a group of letters that suggest the operation performed.

Assembly Language

Example:

- 00111100 translates to 3C in hexadecimal (OPCODE).
- Its mnemonic is "INR A".
- INR stands for "increment register" and "A" stands for accumulator.

Assembly Language

Example:

- 10000000 translates to 80 in hexadecimal (OPCODE).

- Its mnemonic is "ADD B".

- It adds register B to the accumulator and stores the result in the accumulator.

Assembly Language

NB:

- The machine language and its associated assembly language are completely machine dependent.

Assembly Language

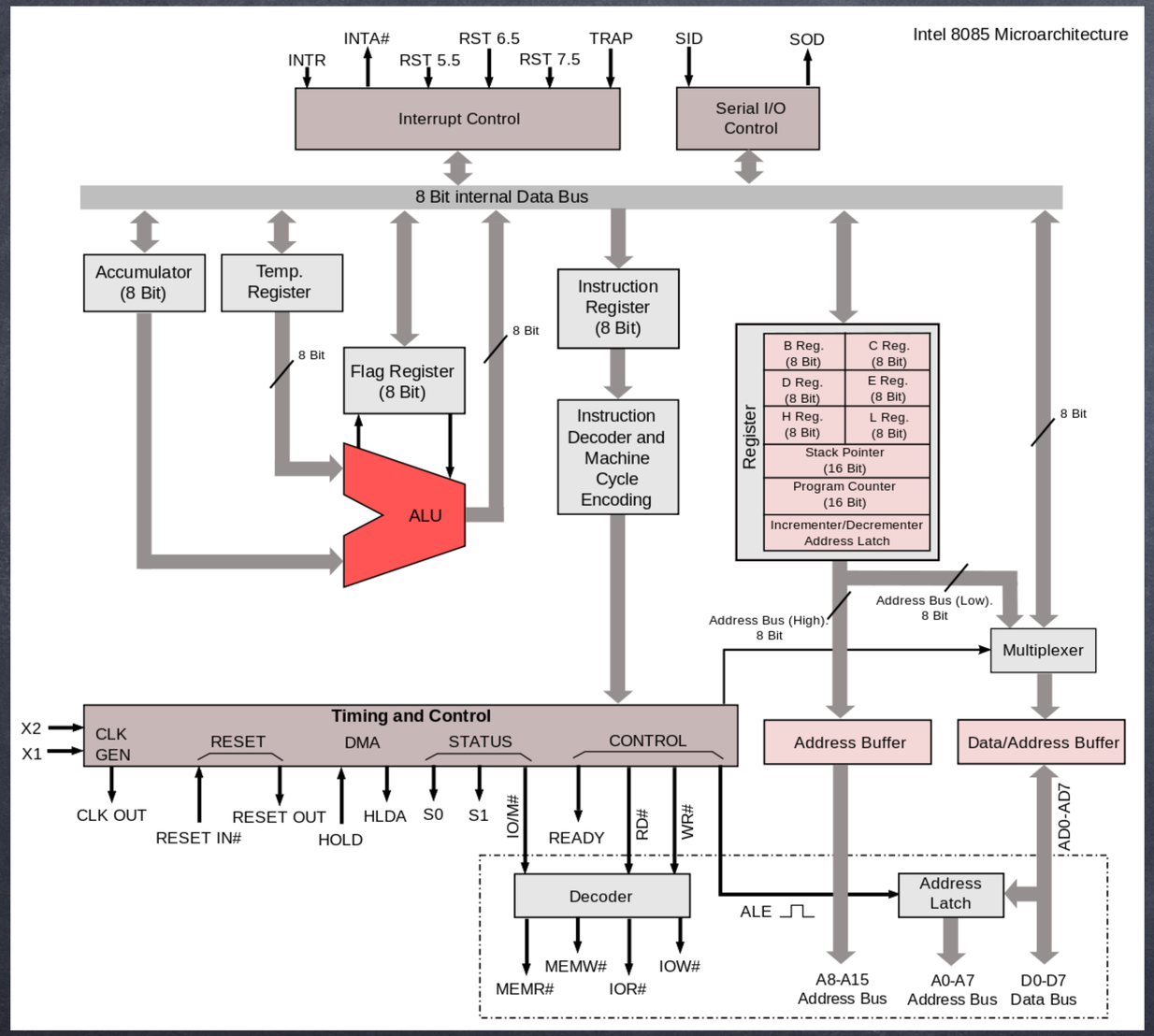
How does assembly language
gets translated into machine language?

1. "Hand Assembly"
2. The use of an "Assembler".

8085 Microprocessor Architecture

- 8-bit general purpose microprocessor.
- Capable of addressing 64k of memory.
- Has 40 pins.
- Requires +5v power supply.
- Can operate with 3MHz clock.

8085 Microprocessor Architecture



- Compatible with 8085 upwards.

Intel 8085 Microprocessor

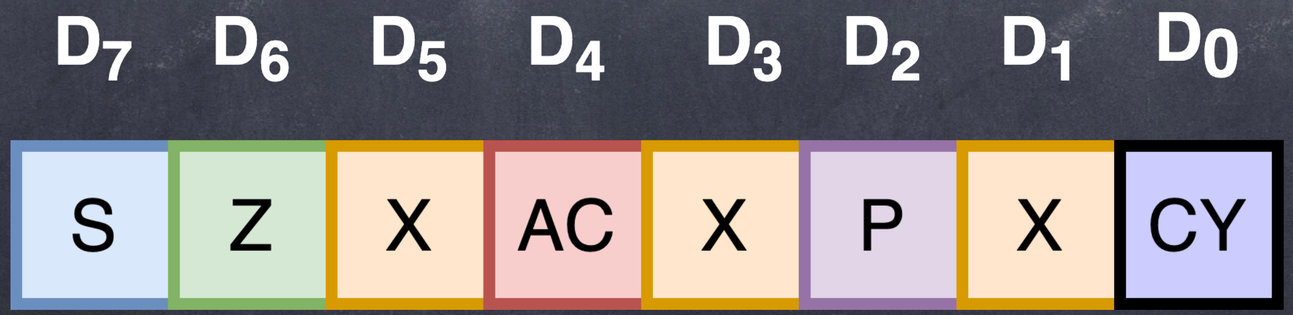
- The Microprocessor consists of:
  - Control Unit: controls microprocessor operations.
  - ALU: performs data processing functions.
  - Registers: provide storage internal to CPU.
  - Interrupts.
  - Internal data bus.

Registers

- General Purpose Registers:
  - B, C, D, E, H & L (8 bit registers).
  - Can be used as 16 bit register pairs; BC, DE, HL.
  - H & L can be used as a data pointer.
- Special Purpose Registers
  - Accumulator (8 bit register)
    - Stores 8 bit data.
    - Stores the result of an operation.

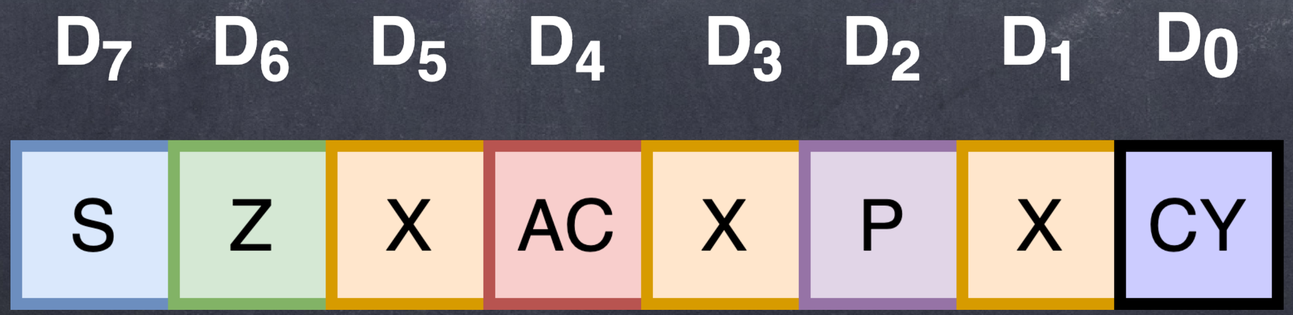
Flag Register

- 8 bit register
  - Shows the status of the microprocessor before/after an operation.
  - S (sign flag), Z (zero flag), AC (auxiliary carry flag), P (parity flag) & CY (carry flag).



Sign Flag

- Used to indicate the sign of the data in the accumulator.
- The sign flag is set if negative (1 - negative).
- The sign flag is reset if positive (0 - positive).

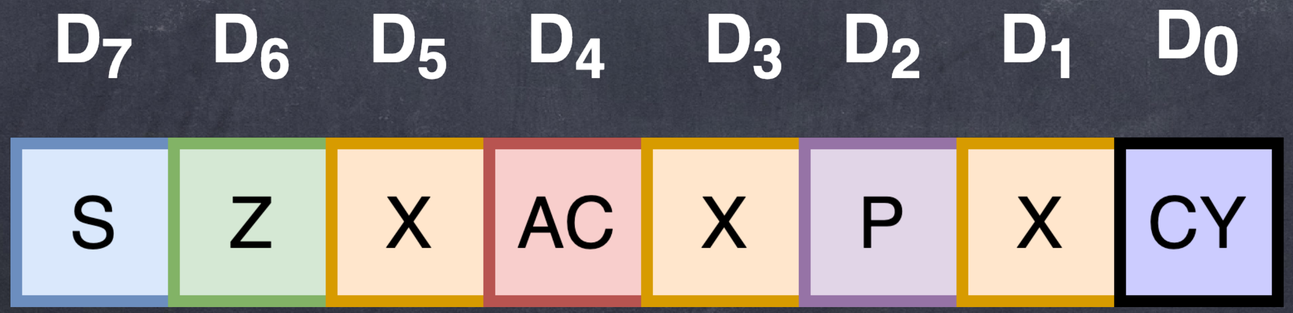


Zero Flag

- It's set if the results obtained after an operation is 0.
- It's set following an increment or decrement operator of a register.

Carry Flag

- It's set if there is a carry or borrow from an arithmetic operation.

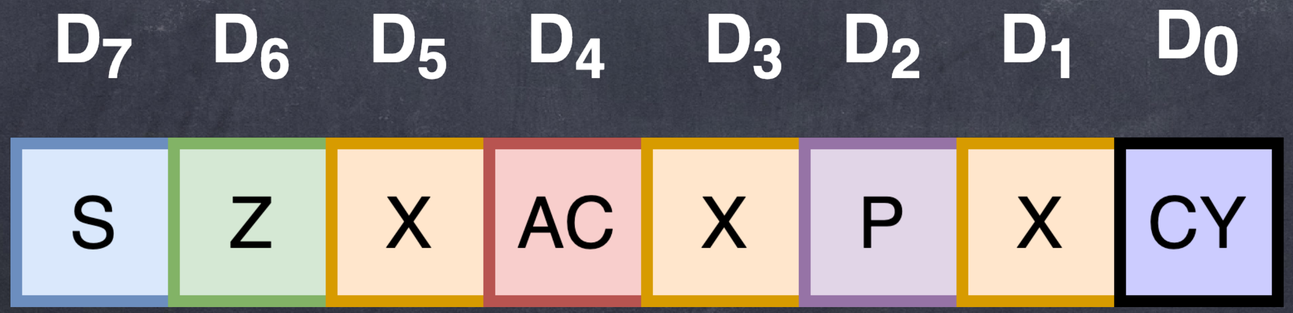


Auxillary Carry Flag

- It's set if there is a carry out of 3 bits.

Parity Flag

- It's set if parity is even and cleared if parity is odd.



Internal Architecture

- The Stack Pointer
  - Used to point to a memory location.
  - The memory it points is a special area called the Stack.
  - The stack is an area of memory used to hold the data that will be retrieved soon.
  - The stack is always accessed in a Last-In-First-Out (LIFO) fashion.

Non-Programmable Registers

- Instruction Register & Decoder
  - Instruction is stored in IR after fetched by the processor.
  - Decoder decodes instruction in IR.
- Internal Clock Generator
  - 3.125 MHz internally.
  - 6.25 Mhz externally.

The Address and Data Busses

- The address bus has 8 signal lines A8 - A15 which are unidirectional.
- The other 8 address bits are multiplexed (time shared) with the 8 data bits.
  - The bits AD0-AD7 are bi-directional and serve as A0 - A7 and D0 - D7 at the same time.
  - In order to separate the address from the data, a latch can be used to save the value before the bits change.

8085 Instructions

- Each instruction has two parts the Opcode and the Operand.
- The instructions can be grouped into five different groups.
  - Data Transfer Operations.
  - Arithmetic Operations.
  - Logic Operations.
  - Branch Operations.
  - Machine Control Operations.

8085 Instructions

- Data Transfer Operations.

Copies data from a source to a destination.

- MOV (Move)
- MVI (Move Immediate)
- LDA (Load Accumulator)
- STA (Store Accumulator)
- LXI (Load Extended Immediate)