Microprocessor based digital Systems

Architecture of a Microprocessor Based Digital System (MbDS)

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Types of Digital Systems

Two distinct types of digital systems

Combinational . . . or memoryless

Perform operations (AND, OR, NOT, ….) over bits

Sequential . . . or with memory (limited amount of states)

Go through states depending on:

- Previous state
- Inputs

THIS COURSE:

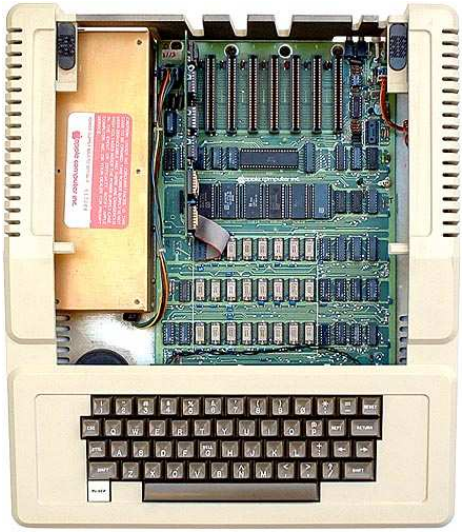
Programmable . . . or with infinite number of states

Also known as Microprocessor based digital systems (MbDS)

Types of Digital Systems

Types of Microprocessor based digital systems (MbDS)

Microcomputer . . . or general purpose



Large amount of resources: Memory, Data Exchange,

Always governed by an OS.

Embedded . . . or oriented purpose

Limited memory & processing power.

Usually run Real-time software

Functional Blocks of a Digital System

Academic view

Processor Based Digital System

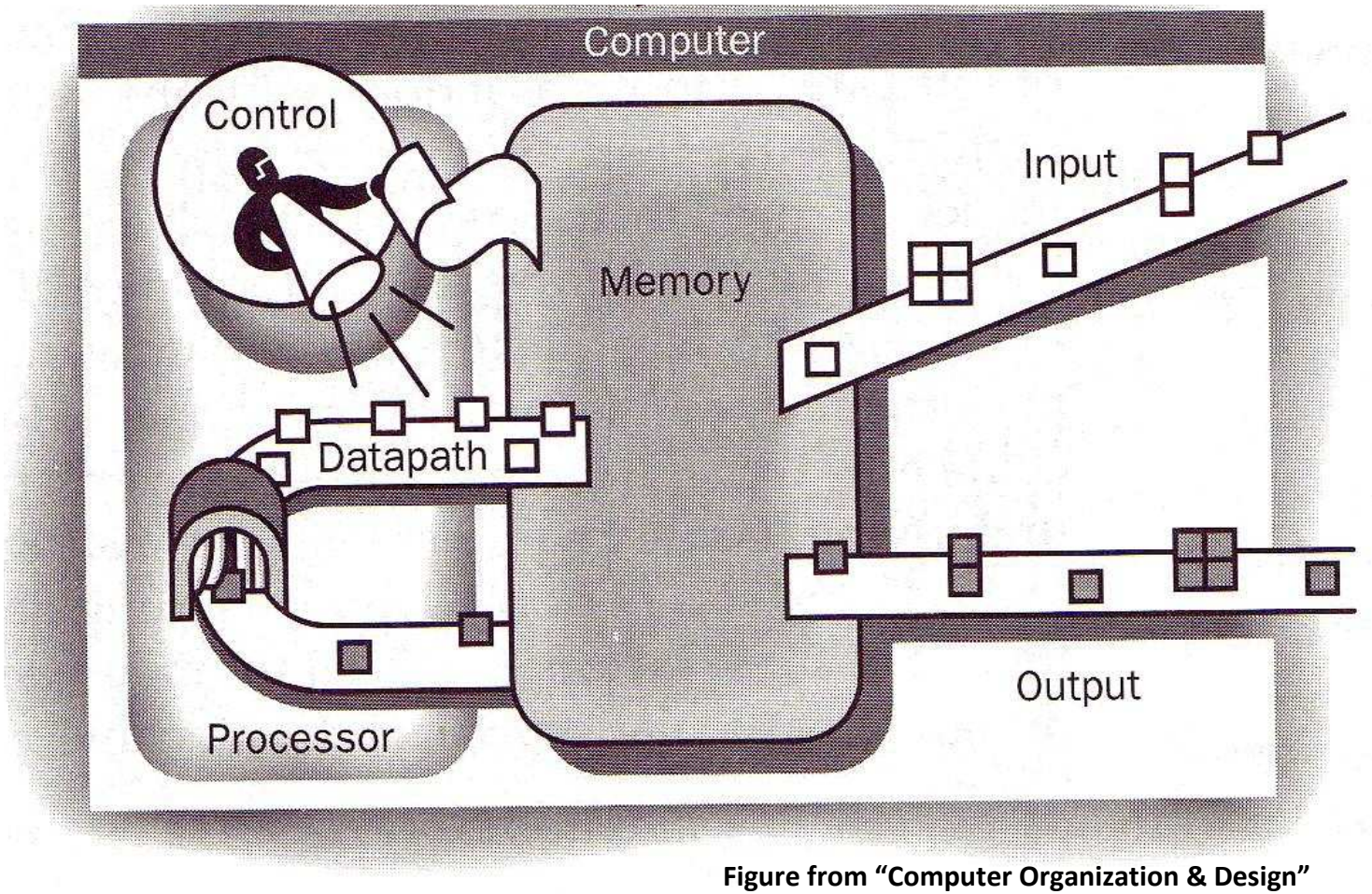


Figure from "Computer Organization & Design"
D.A.Patterson and J.L.Hennessy
Morgan Kaufmann Publ. 1998

Functional Blocks of a Digital System

Processor (Processes Information):

Is the functional block that executes the instruction

It is subsequently divided into two blocks: **Data path**
Control

Memory (Stores Information):

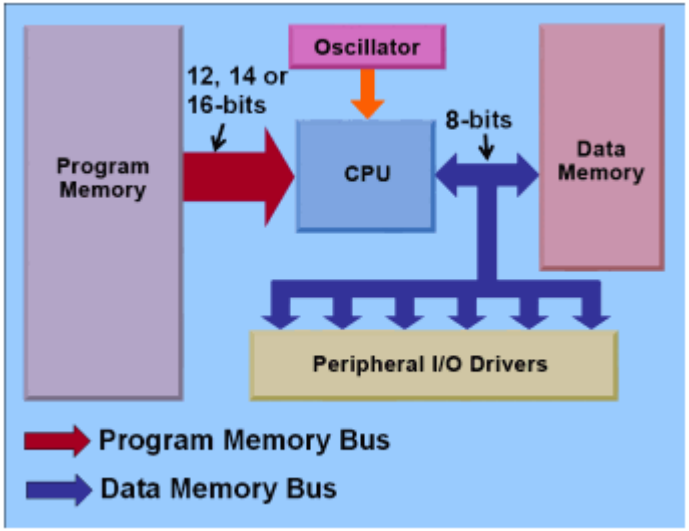
Actually, two types of information: **Programs**, and **Data**

Input / Output (Exchanges Information):

Window to the outside world

Functional Blocks of a Digital System

Vendor view



8-bit PIC® Microcontroller Architecture

The PIC microcontroller architecture is based on a modified **Harvard RISC** instruction set

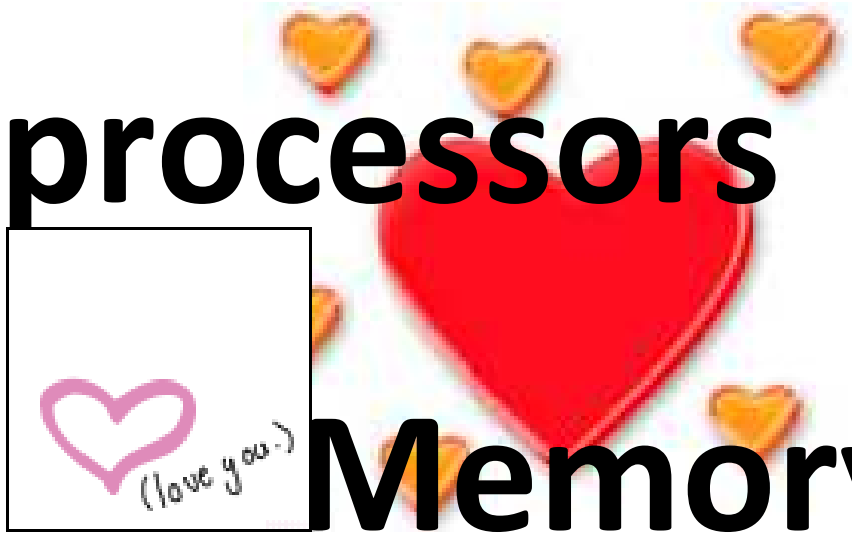
■ 12-bit (Baseline), 14-bit (Mid-range and enhanced mid-range) and 16-bit (PIC18) wide instructions are upward compatible and tailored to maximize processing efficiency and boost performance

■ Instructions and data are transferred on separate buses, avoiding **processing bottlenecks**. This increases speed and overall system performance

■ Two-stage **pipelining** enables one instruction to be executed while the other instruction is being fetched

■ Single wide-word instruction increases software **code efficiency** and reduces required program memory

Microprocessors

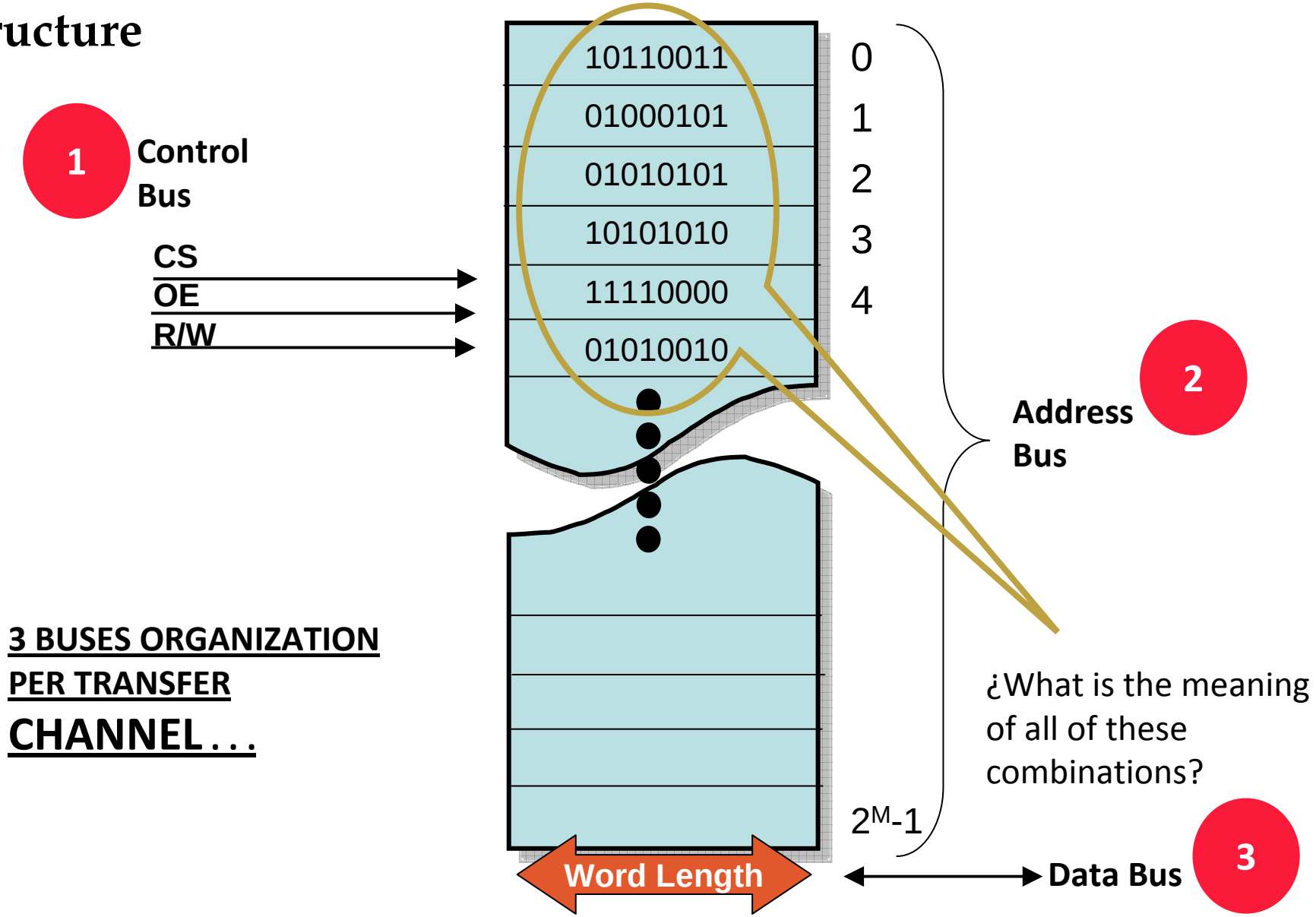


Memory

. . . OR, all Microprocessors CARE ABOUT IS REGISTERS

Memory

Structure



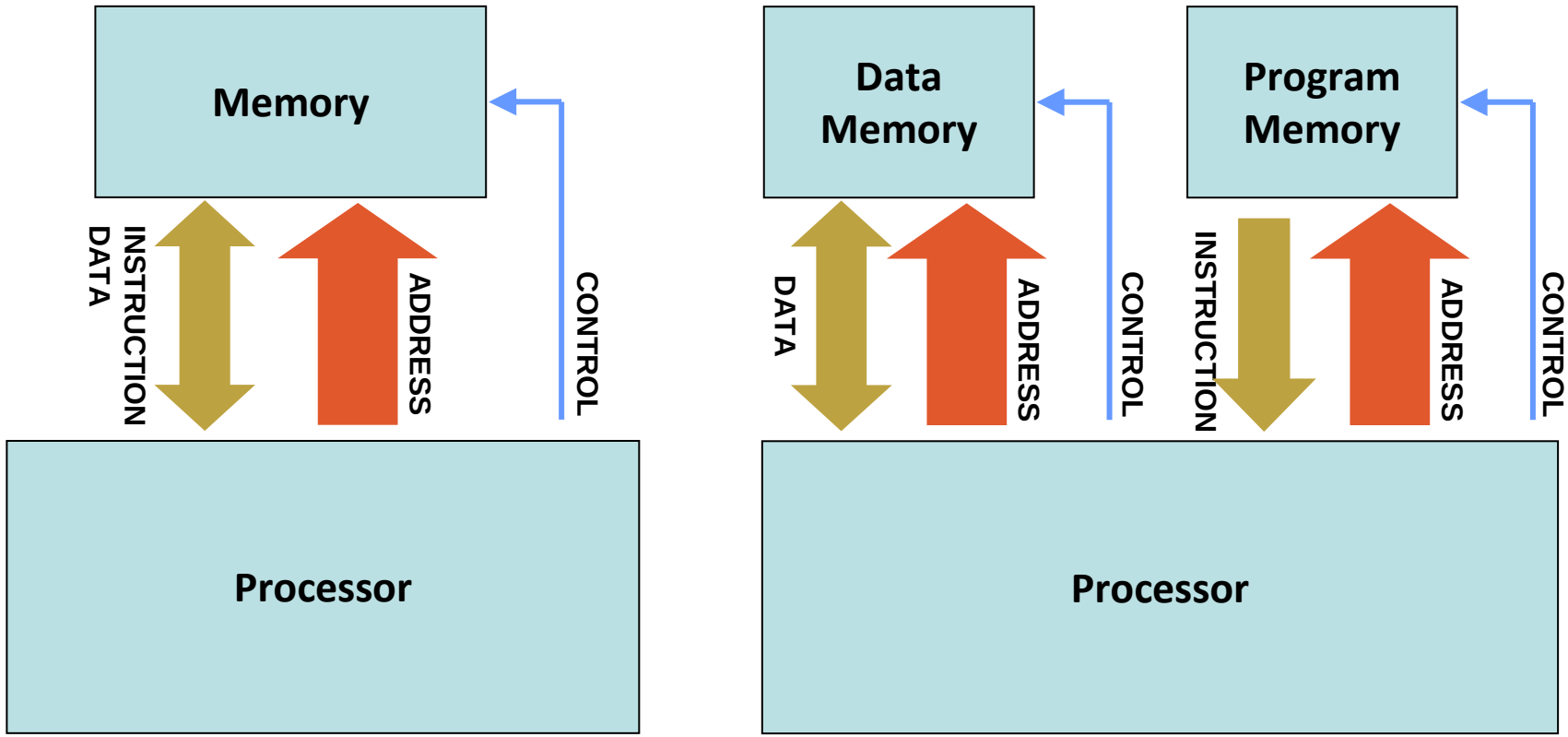
3 BUSES ORGANIZATION PER TRANSFER

CHANNEL . . .

Memory

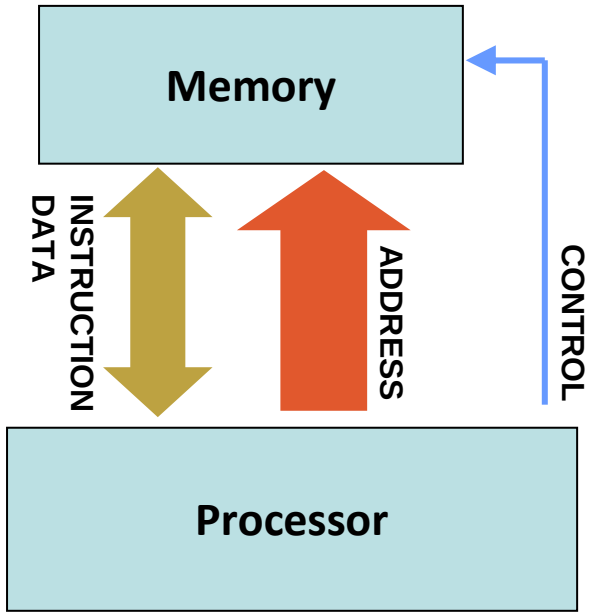
That Microprocessors love memory . . .

. . . does not mean that they love just one !!!!!

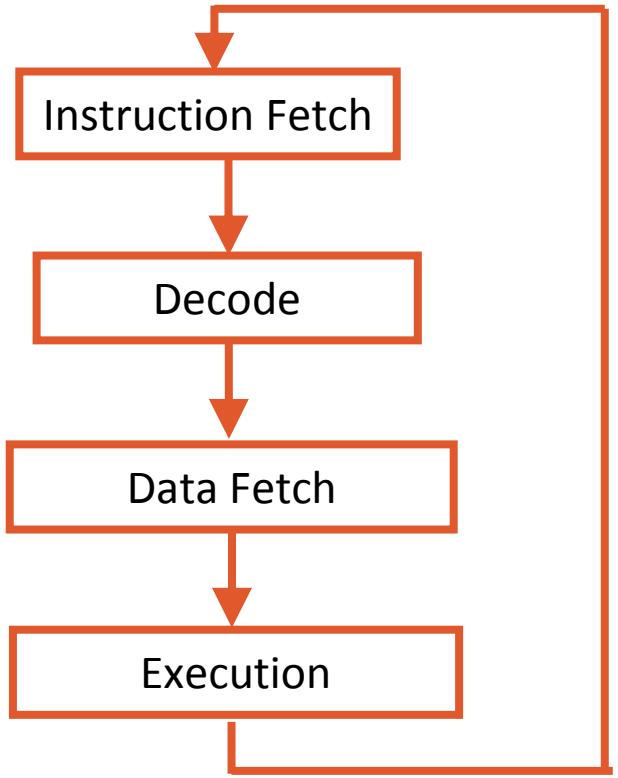


The Basic Function of a Processor

OK, Microprocessors love memory.
What for?



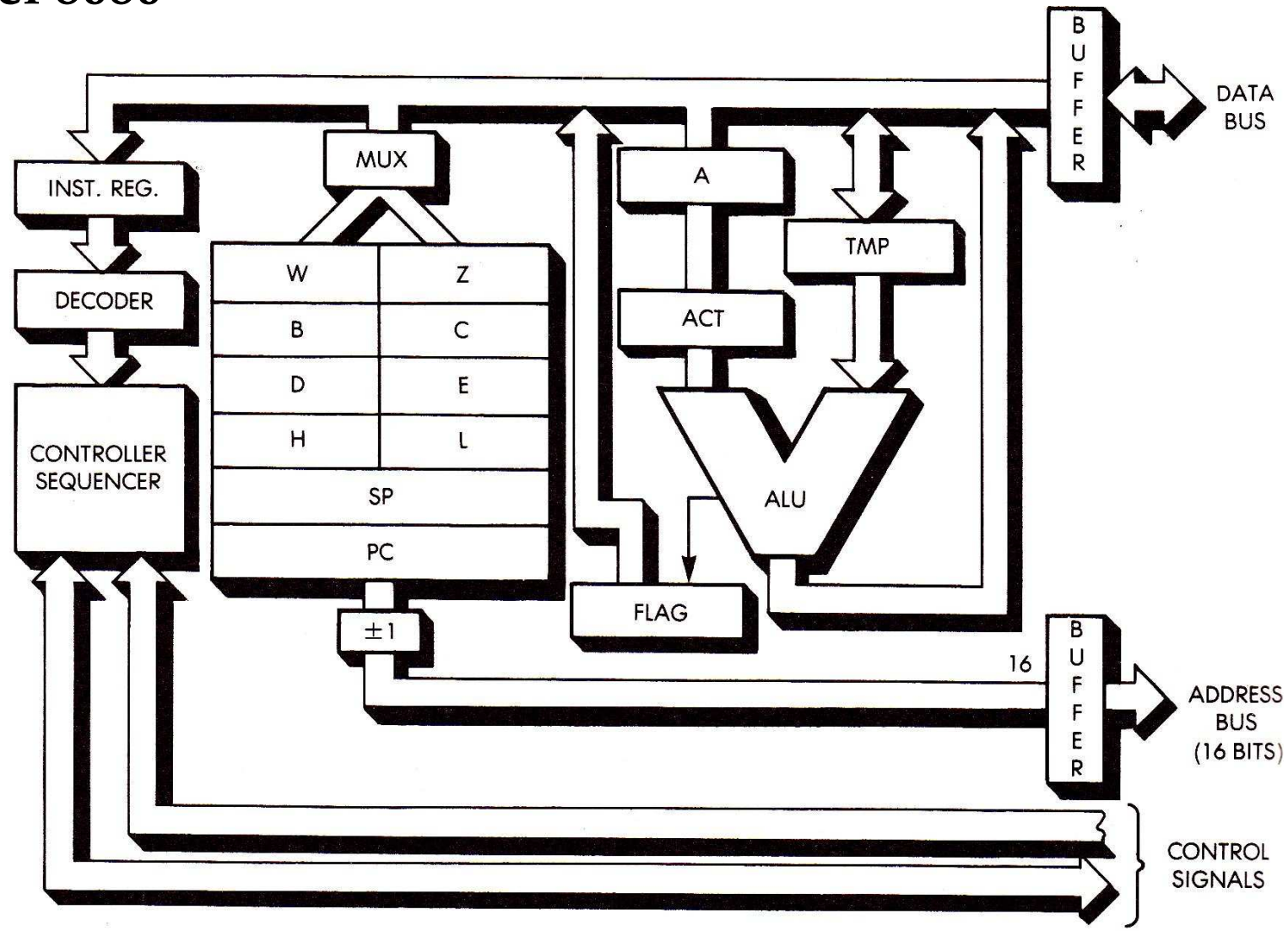
Steps that involve Memory access



Sequential Execution Principle

Processor Data Path

Intel 8080



An example: Intel 8080

Production April, 1974

Designers

Lead Federico Faggin

Masatoshi Shima

Stan Mazor

Type	NMOS,CPU
Data Word	8-bit
Address Space	64KB
Clock	2Mhz
Instructions	**48**
Registers	7 (A, BC, DE, HL)
IO Ports	512
Stack	Stack Pointer
Interrupts	**Vectored**
Transistors	6,000

"The 8080 really created the microprocessor market. The 4004 and 8008 suggested it, but the 8080 made it real."

Federico Faggin.

Processor Data Path

INTERNAL REGISTERS

Data Registers

Acumulator (ACC, A):

Register to hold ALU operators

Internal Registers:

Working registers of the CPU to hold temporal data

Status Register:

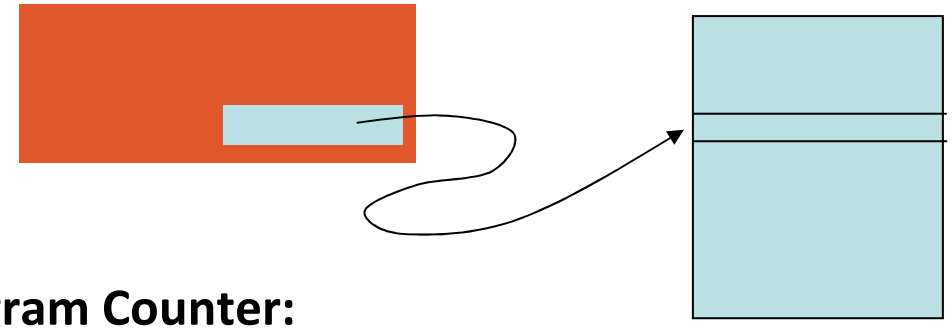
- Holds summary information of the last operation
- Usings **FLAGS:**

C - Carry
V - Overflow
N - Negative
Z - Zero

Processor Data Path

Address Registers

Registers for holding a memory address (Register actually points one memory location: POINTER).



PC – Program Counter:
Holds address to the next instruction to execute.

SP – Stack Pointer
Register to manage a LIFO memory structure.

IX - Index Registers:
User pointers.

Processor Data Path

RESET

On turn on, the device starts with all registers with random values.

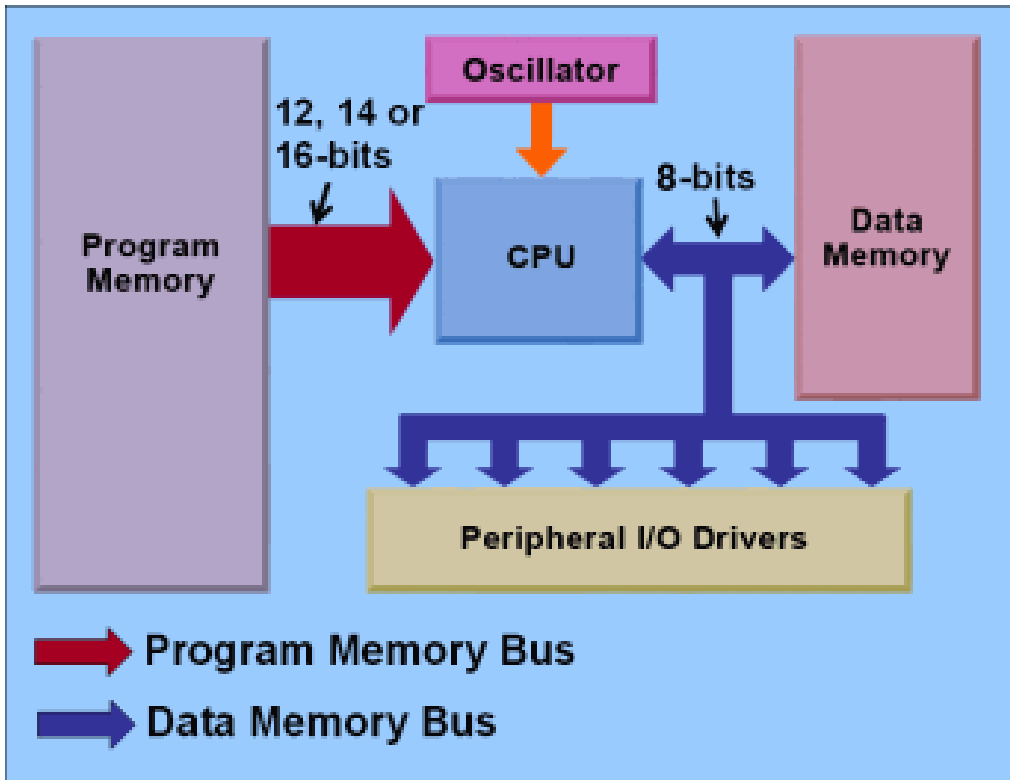
This situation is not desirable for PC & STATUS registers.

¿Why these two? ¿Any other as well?

RESET is a procedure to give important registes an initial value after power has been swiched on.

Microcontroller

"Computer on a chip"



Microcontroller

"Computer on a chip"

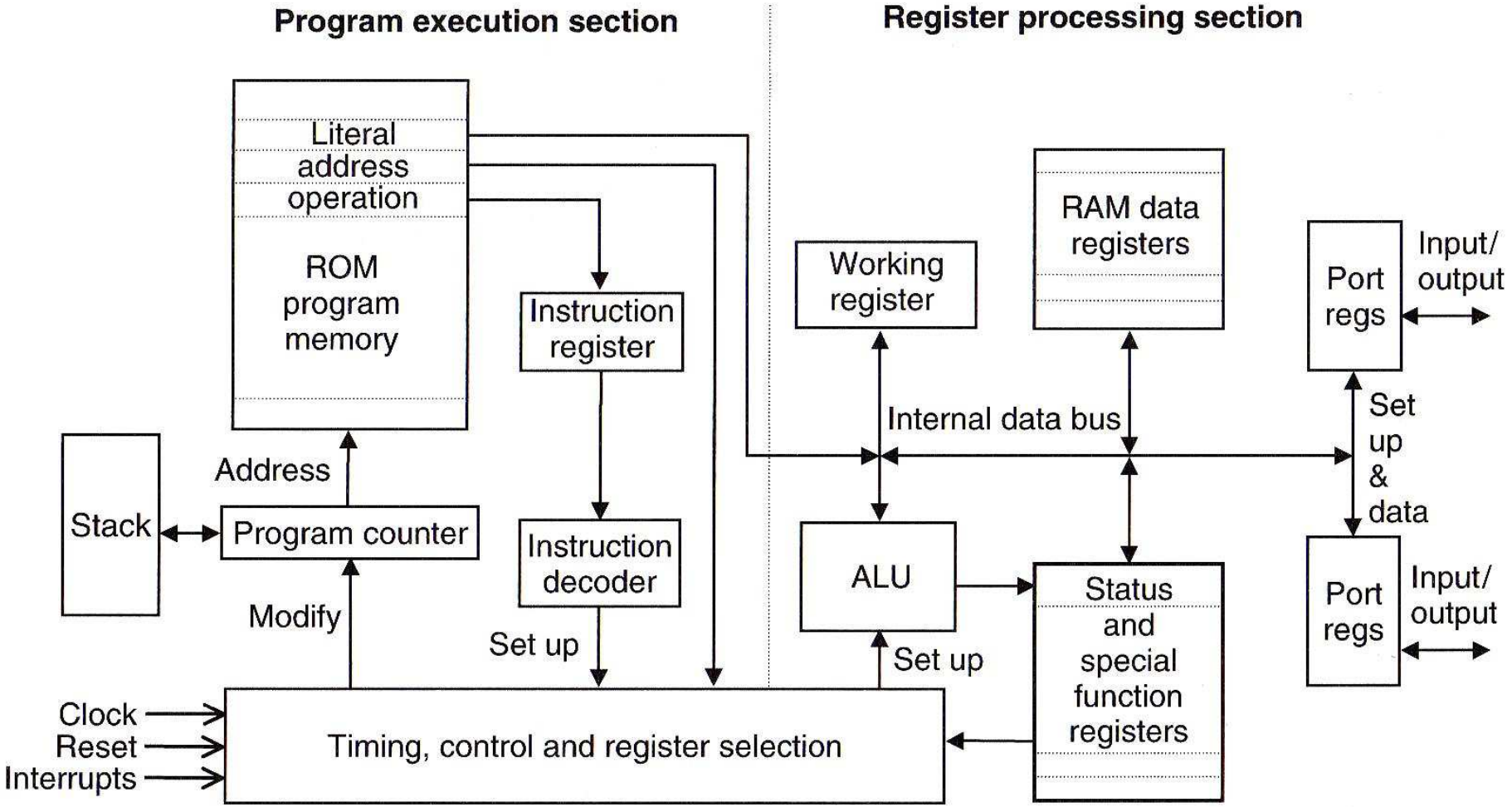


Figura de "PIC microcontrollers: An introduction to Microelectronics"
M. Bates
Elsevier/Newnes 2004