

Overview of Microcomputer Structure and Operation

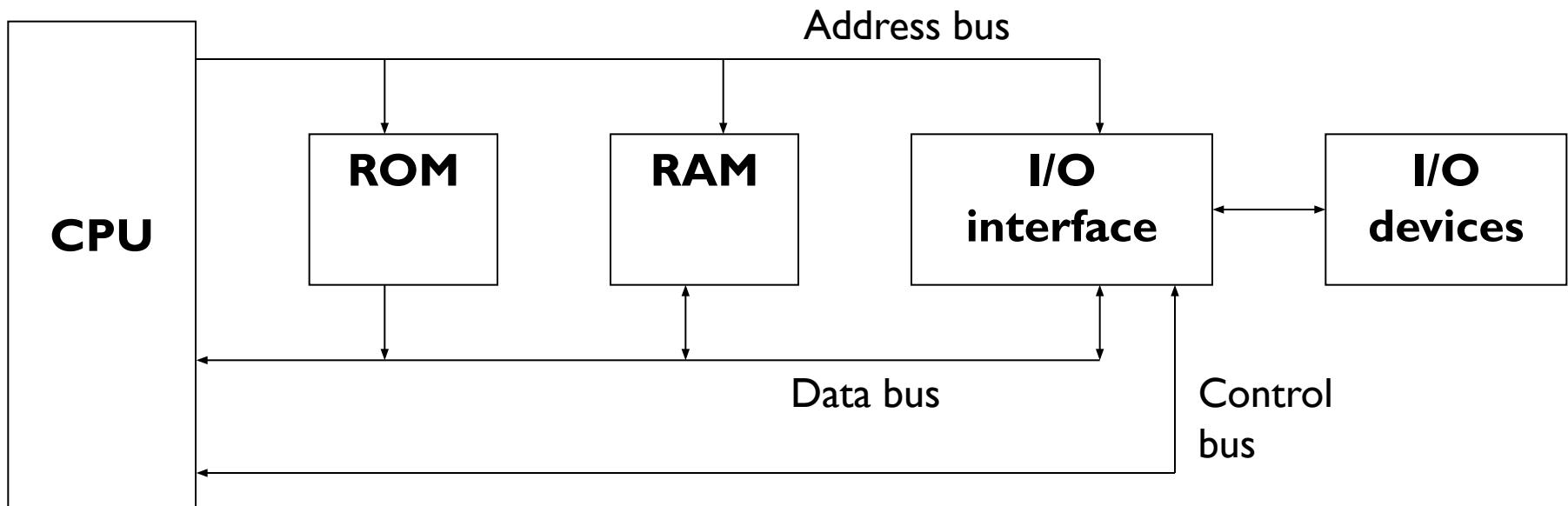
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Course ID: CSE - 341
Course Title: Microprocessors

Block Diagram of a Microcomputer

Components of Microcomputer:

- ? CPU (Microprocessor)
- ? Memory (RAM, ROM etc.)
- ? I/O
- ? System Buses:
 - Address bus
 - Data bus
 - Control bus



CPU - Central Processing Unit

FETCH : Take in binary-coded instructions from memory

DECODE : Analyze or make sense of the instructions

EXECUTE : Carry out the instructions, Controls overall operation of the computer

Important components: Registers , ALU , Control Unit



Pentium D dual core processors

Memory

- ? This is where all the binary coded instructions and data are stored.
Example: ROM, RAM etc.

RAM (Random Access Memory) :

- Can be read and written to anytime by the CPU.
- It is volatile memory. That means contents of RAM are erased when the power to the computer is turned off.

ROM (Read Only Memory) :

- Can only be read by the CPU.
- It is pre-loaded with data and software that never changes like computer's initial start-up instructions.
- It is non volatile memory. That means contents of ROM are **NOT** erased when the power to the computer is turned off.

I/O Unit

- ? **Input/output (I/O) units serve as a medium of communication between the user and the computer.**
- ? **Inputs** are the signals or data received by the system, and **outputs** are the signals or data sent from it.
- ? Devices that provide input or output to the computer are called **peripherals**.
- ? For example:
 - keyboard, mouse** (input)
 - display, printer**(output)

System Bus

- ? System bus is made up of three types of bus :
 - Address Bus
 - Data Bus
 - Control Bus
- ? **WRITE operation** : When data is written onto memory location or an I/O port by the processor
- ? **READ operation** : When data is read from a selected memory location or an I/O port by the processor

Address Bus

- ? Carries memory address of the instructions which are to be executed
- ? Information transfer takes place from the processor to the memory or I/O elements.
- ? That is why address bus is ***Unidirectional***.
- ? The number of locations that the CPU can address is determined by the size of address bus

For example : microprocessor with 32 bit address bus can address 2^{32} memory locations

Data Bus

- ? It is used to carry data.
- ? It is a bidirectional. That means data can flow in both to or from the microprocessor.
- ? The size of the data bus varies from one microprocessor to another.
- ? Usually matches the *word length* of the microprocessor

Control Bus

- ? It carries timing and control signals generated by the CPU that are used to synchronize operation of the individual microcomputer elements.

- ? It can carry many different signals. For e.g.
 - ? I/O Read
 - ? I/O Write
 - ? Interrupt
 - ? Memory read
 - ? Memory write

Fetch & Execute Cycles

The Fetch & Execute Cycle of the CPU is composed of three basic operations :

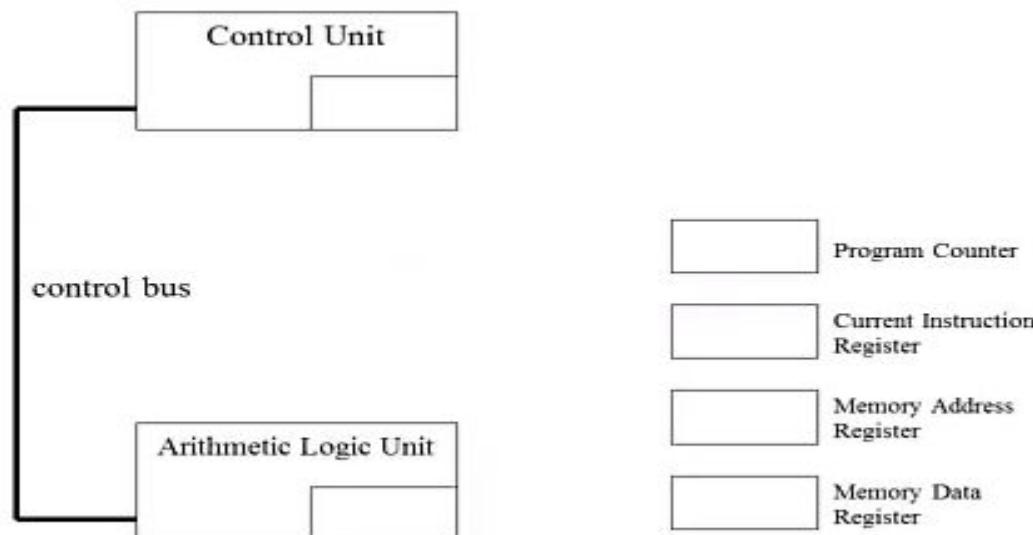
- Fetch**
- Decode**
- Execute**

? **Fetch :**

- ? The instruction required from memory is stored or copied in the instruction register.
- ? Increments the program counter so that it points to the next instruction.

The CPU's Special Purpose Registers

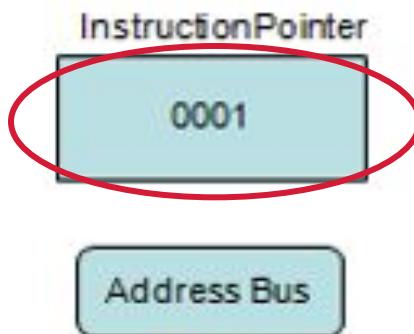
- ? **Program Counter** : Holds address of next instruction
- ? **Instruction Register** : Holds the instruction currently being executed or decoded
- ? **Memory Address Register** : Holds memory address from where data will be fetched
- ? **Memory Data Register** : Holds the data being transferred to the memory or from the memory by the CPU



Fetching an Instruction

? Step I

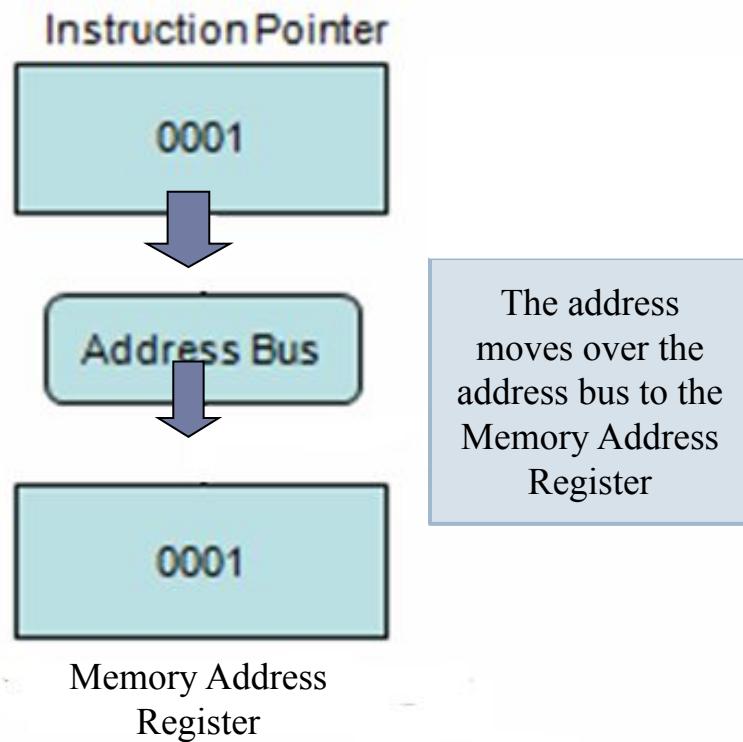
Program Counter or instruction pointer (IP) is a register that holds the address of the next instruction to be fetch.



| Memory location | contents |
|-----------------|----------|
| 0001 | 0FFF |
| 0002 | 0FA0 |
| 0003 | 010D |
| 0004 | 00C1 |
| 0005 | 0010 |

Fetching an Instruction

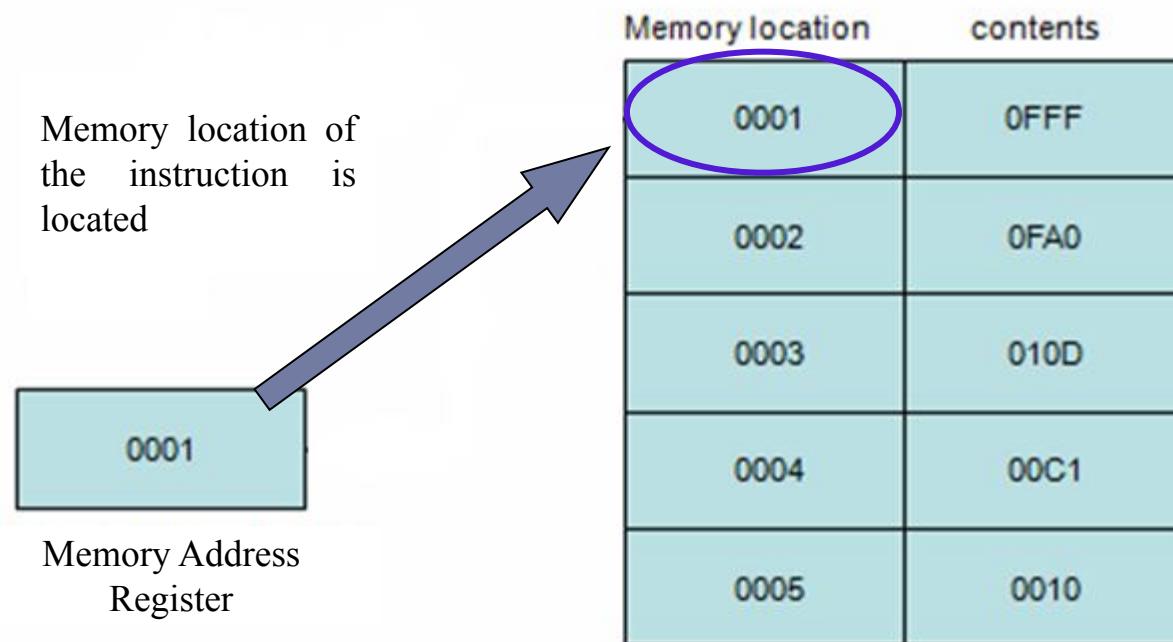
? Step 2



| Memory location | contents |
|-----------------|----------|
| 0001 | 0FFF |
| 0002 | 0FA0 |
| 0003 | 010D |
| 0004 | 00C1 |
| 0005 | 0010 |

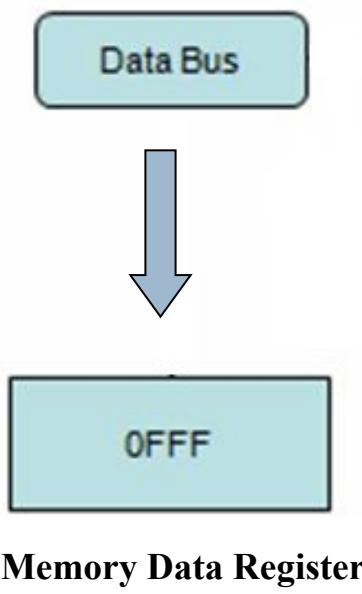
Fetching an Instruction

? Step 3



Fetching an Instruction

? Step 4

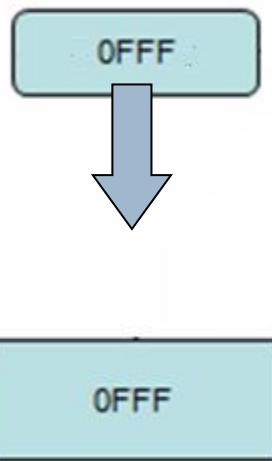


| Memory location | contents |
|-----------------|----------|
| 0001 | 0FFF |
| 0002 | 0FA0 |
| 0003 | 010D |
| 0004 | 00C1 |
| 0005 | 0010 |

Fetching an Instruction

? Step 5

Memory Data Register



Into the instruction
register (IR)

Memory location contents

| Memory location | contents |
|-----------------|----------|
| 0001 | 0FFF |
| 0002 | 0FA0 |
| 0003 | 010D |
| 0004 | 00C1 |
| 0005 | 0010 |

Food for thought

- ? What do you mean by a 32 bit Data Bus ?
- ? BIOS is a special program that orchestrates loading the computer's operating system. Should it be stored in ROM or RAM ?