Overview of Microcomputer Structure and Operation

Department of Computer Science & Engineering
BRAC University.

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

Address bus

CPU	ROM	RAM	I/O interface	I/O devices

Data bus

Control bus

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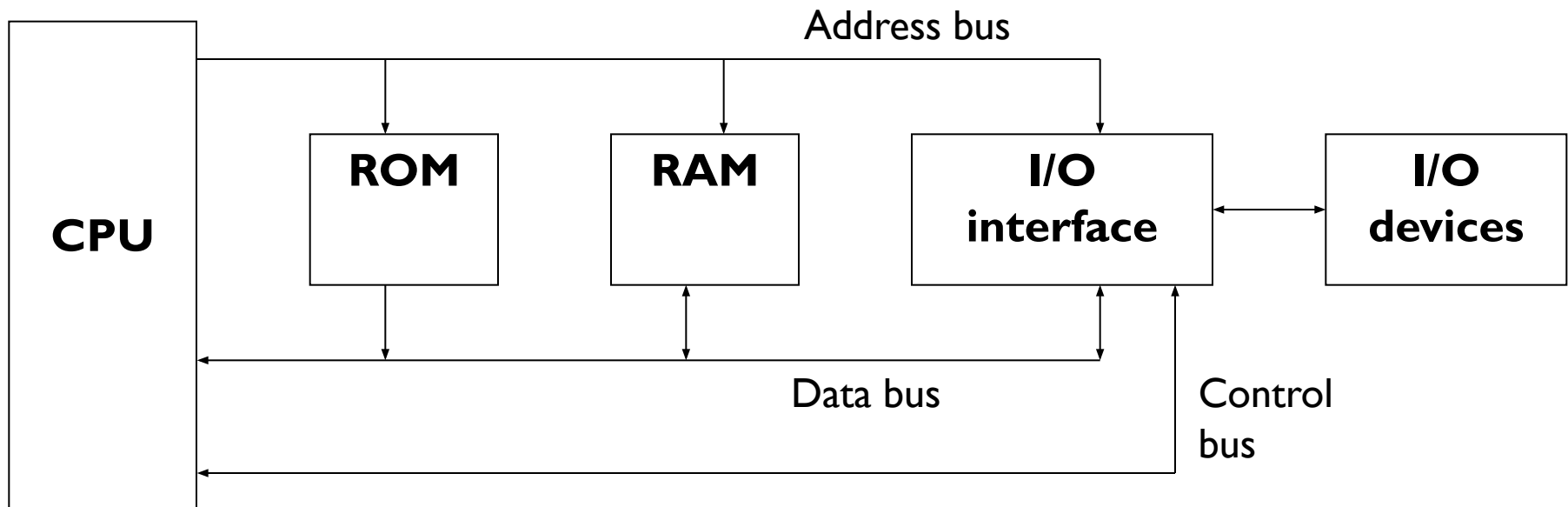
CPU - Central Processing Unit

- **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
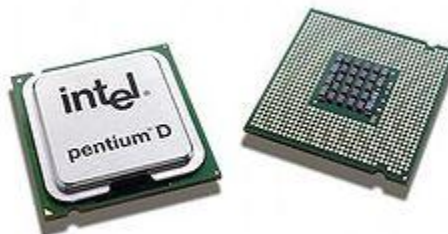
Pentium D dual core processors

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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.

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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**)**

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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

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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

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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

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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

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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.

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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

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Fetching an Instruction

 Step 1
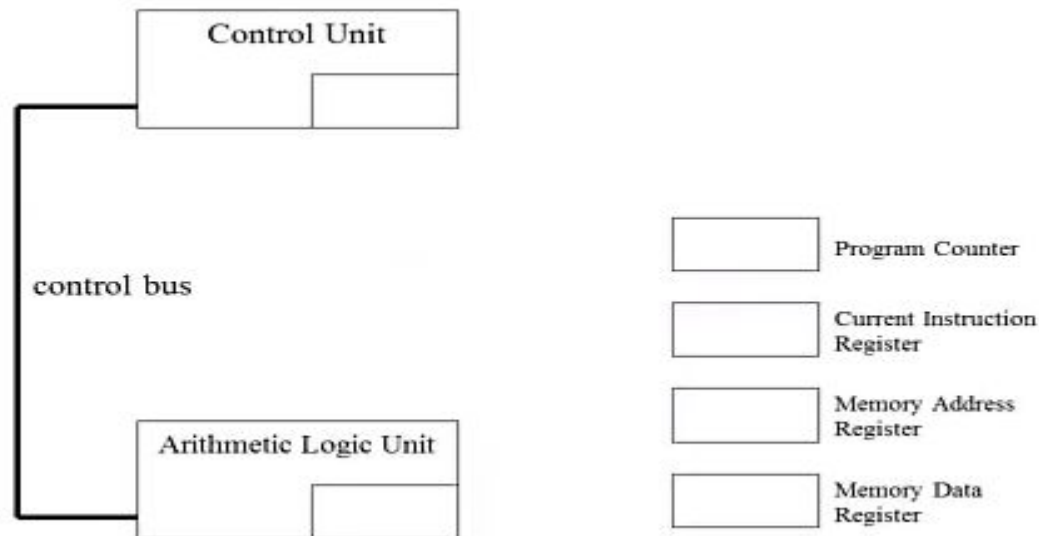
Program Counter or instruction pointer (IP) is a register that holds the address of the next instruction to be fetch.
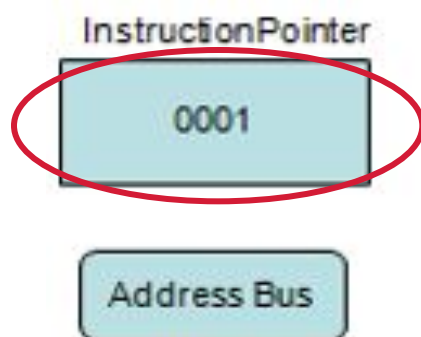
InstructionPointer
0001

Address Bus

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

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Fetching an Instruction

☐ **Step 2**

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Fetching an Instruction

☐ **Step 3**

Memory location of the instruction is located

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

0001

Memory Address Register

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Fetching an Instruction

☐ Step 4

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

Data Bus

0FFF

Memory Data Register

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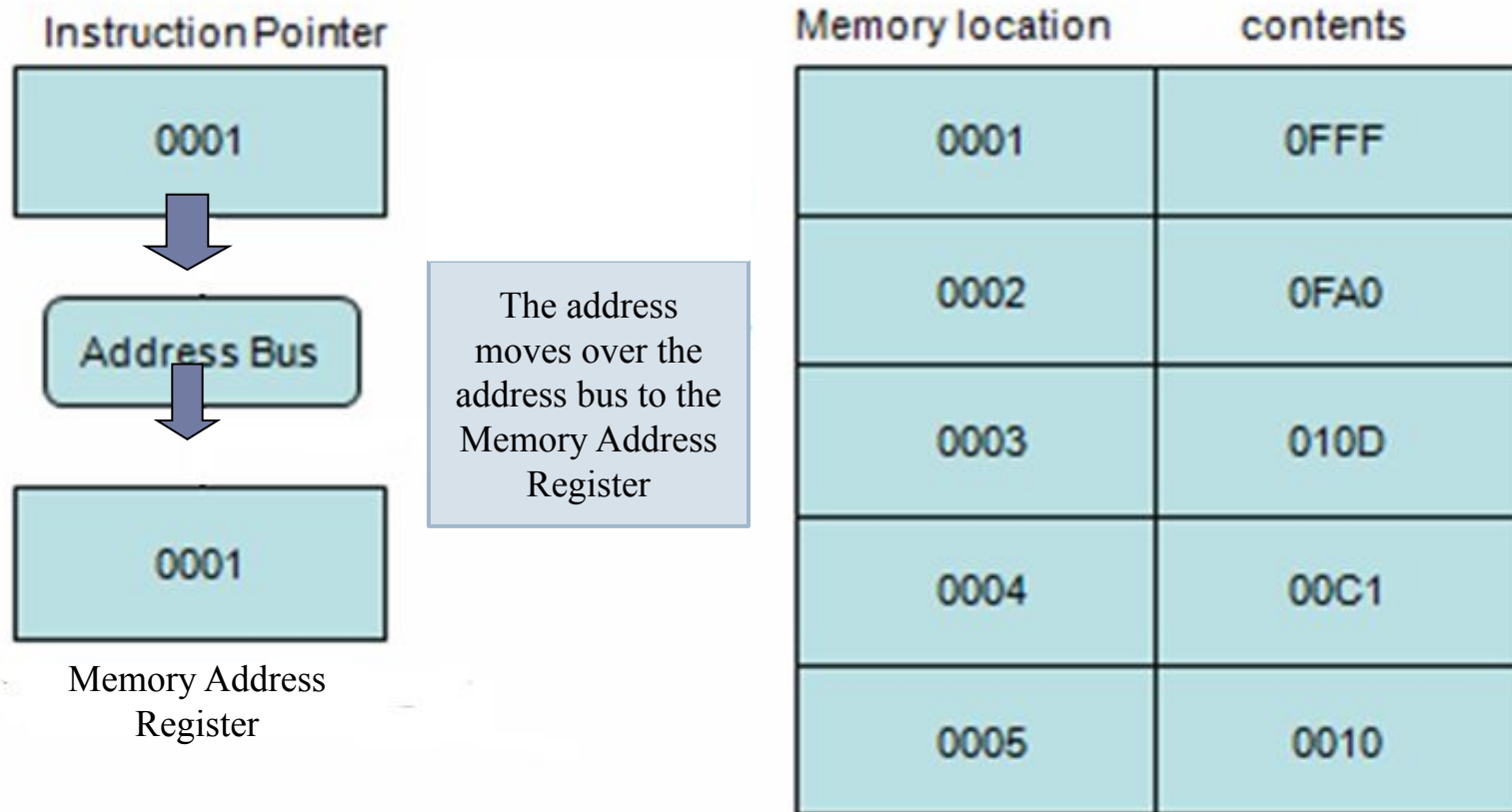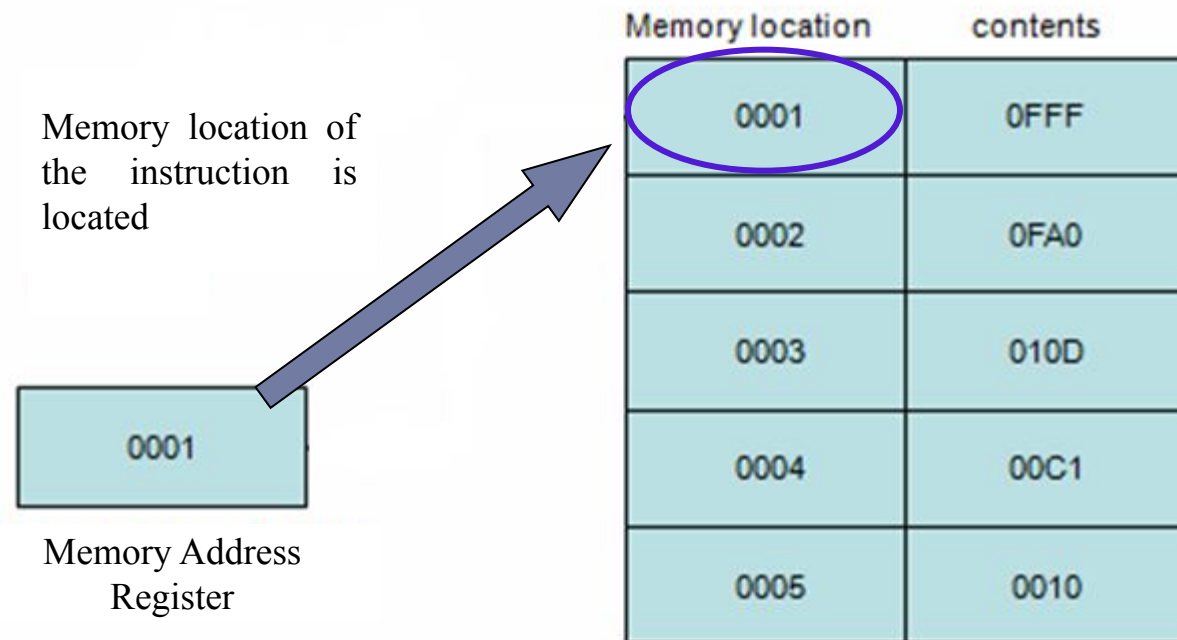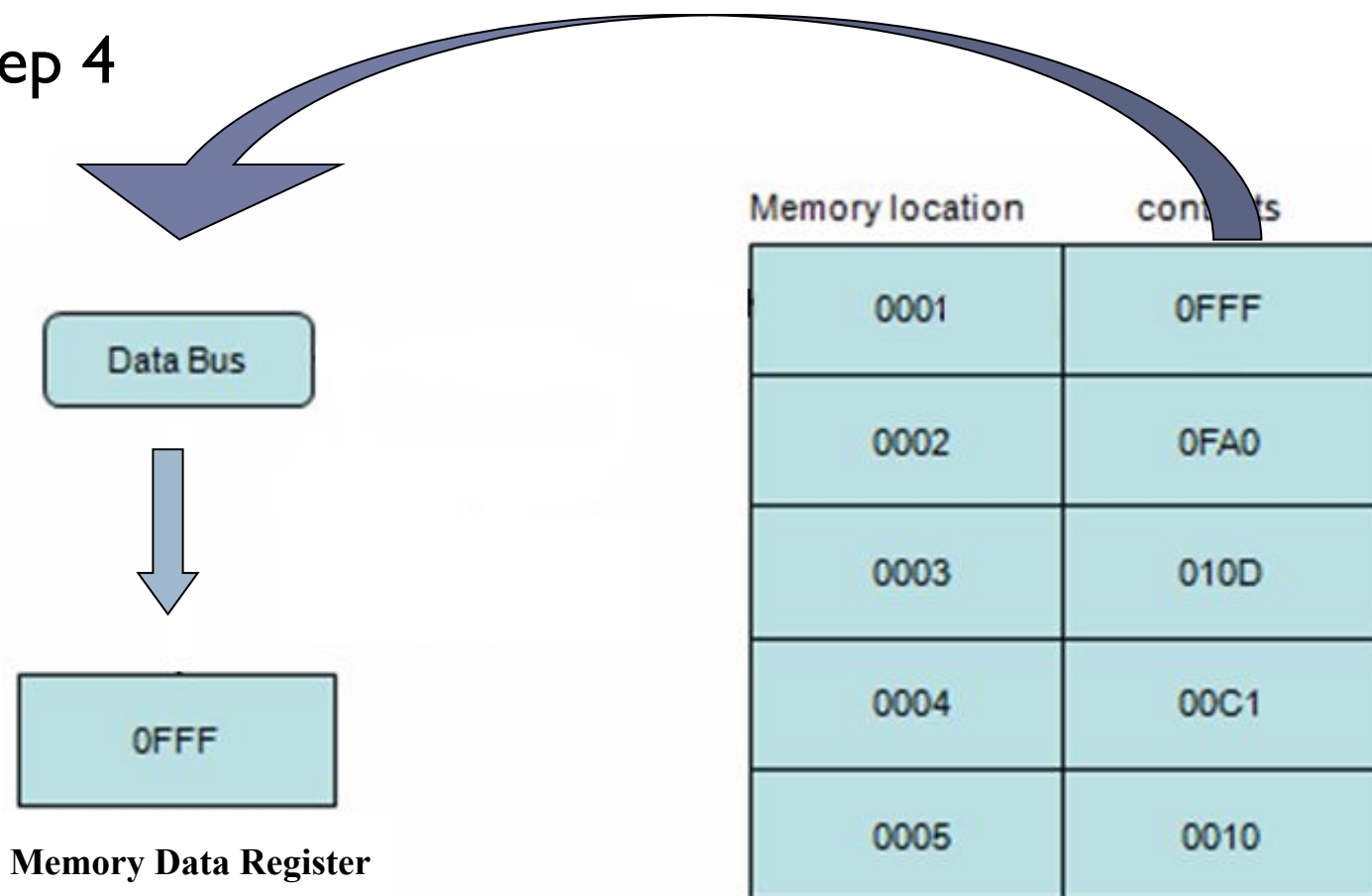
Fetching an Instruction

⬜ Step 5

Memory Data Register

OFFF
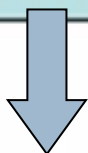
Into the instruction
register (IR)

0FFF

Instruction Register

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

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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 ?

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