CSE 333

Computer Peripherals & Interfacing

Lecture 3

Peripheral/Computer Connections

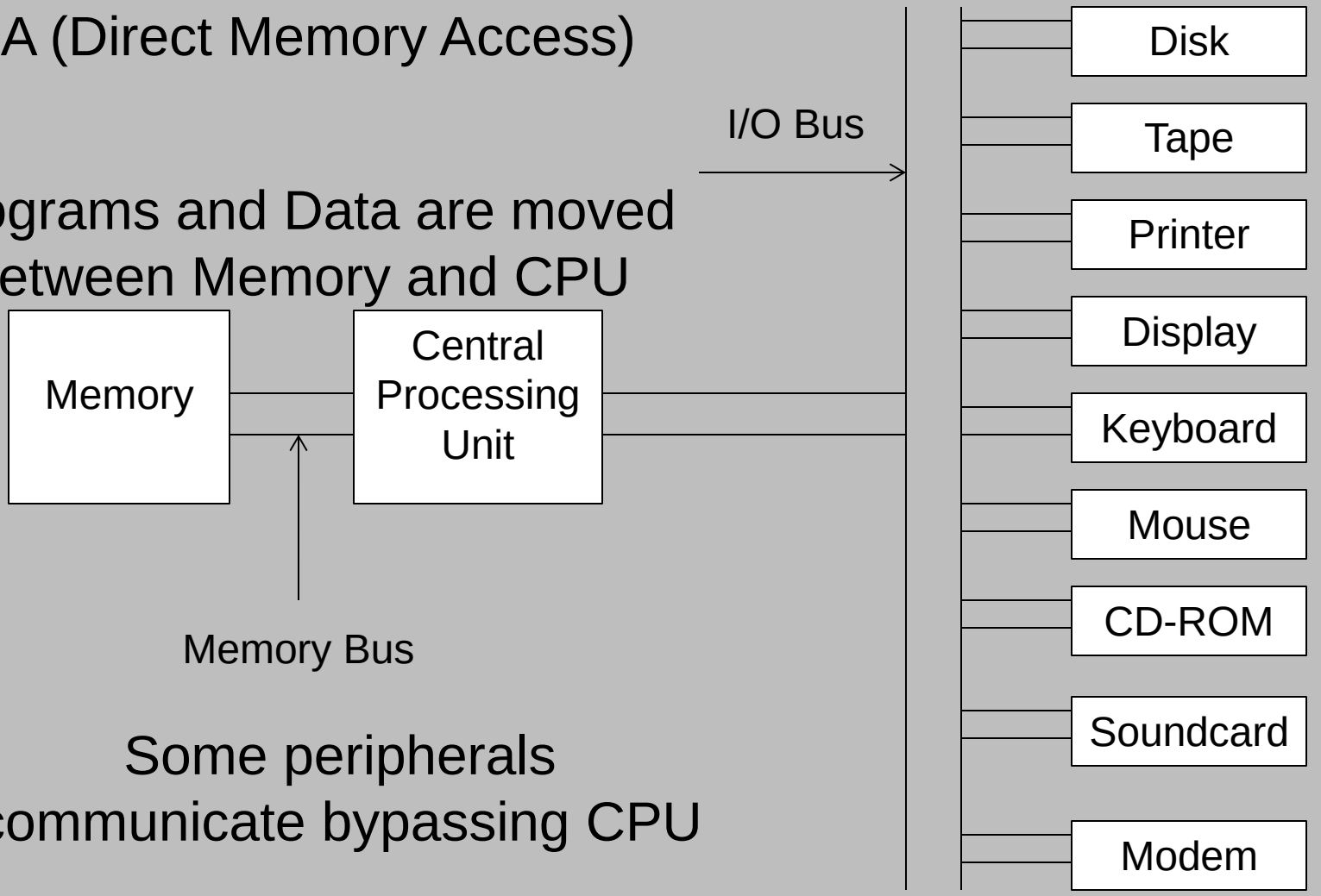
Outline

- Typical Computer System
- Reasons for I/O Module or Peripheral Adaptor
- Model for Basic Computer System
- Data Highways or Bus
- Removable Storage
- Non-Removable Storage

Typical Computer System

DMA (Direct Memory Access)

Programs and Data are moved between Memory and CPU

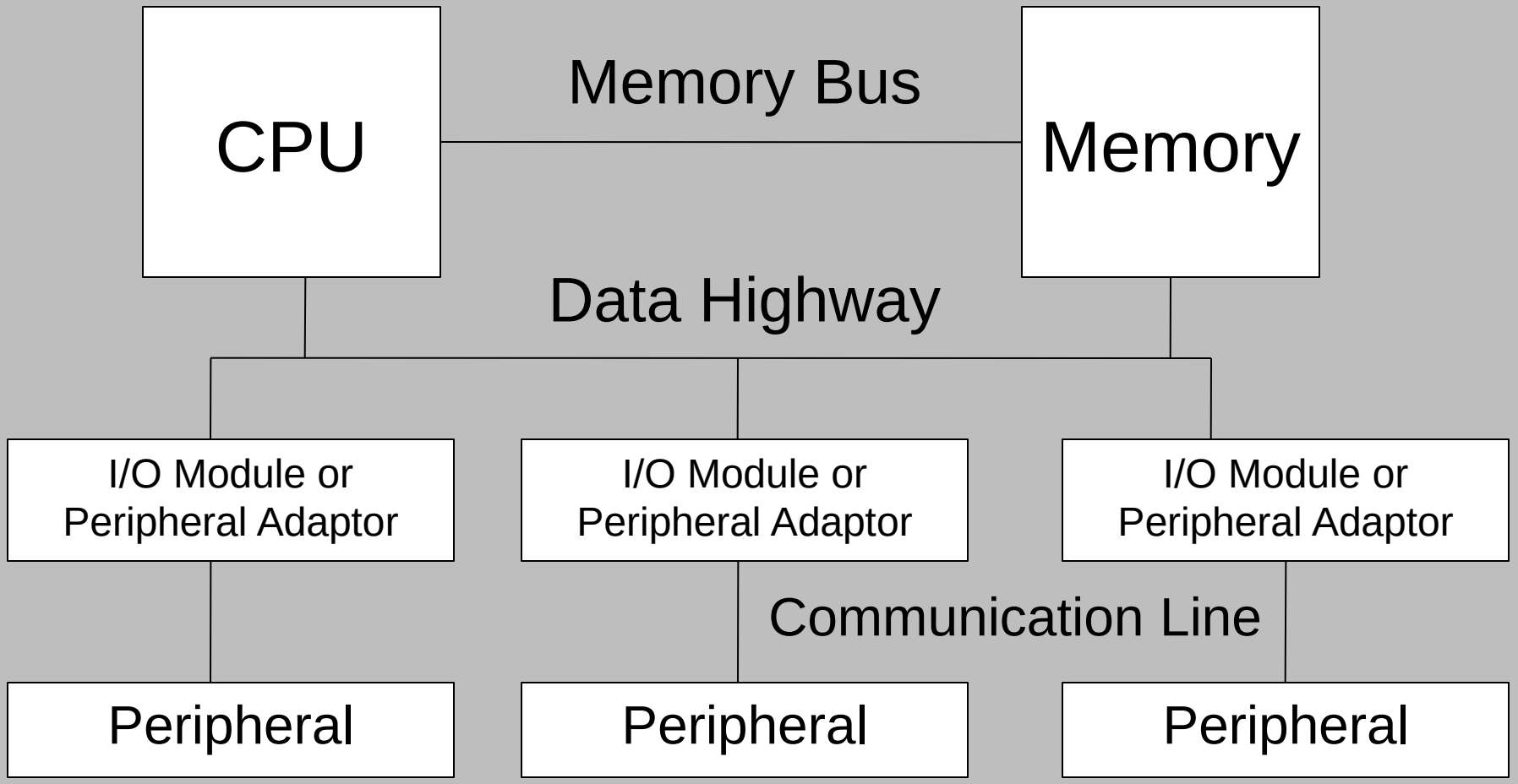


Some peripherals communicate bypassing CPU

Reasons to use I/O Module or Peripheral Adapter

- There are a wide variety of peripherals with various functions.
- The data transfer rate of peripherals is often much slower than that of the memory or processor.
- The data transfer rate of some peripherals is faster than that of the memory or CPU
- The data formats and word lengths of Peripherals are different from the CPU

A Model for the Basic Computer



Data Highways or BUS

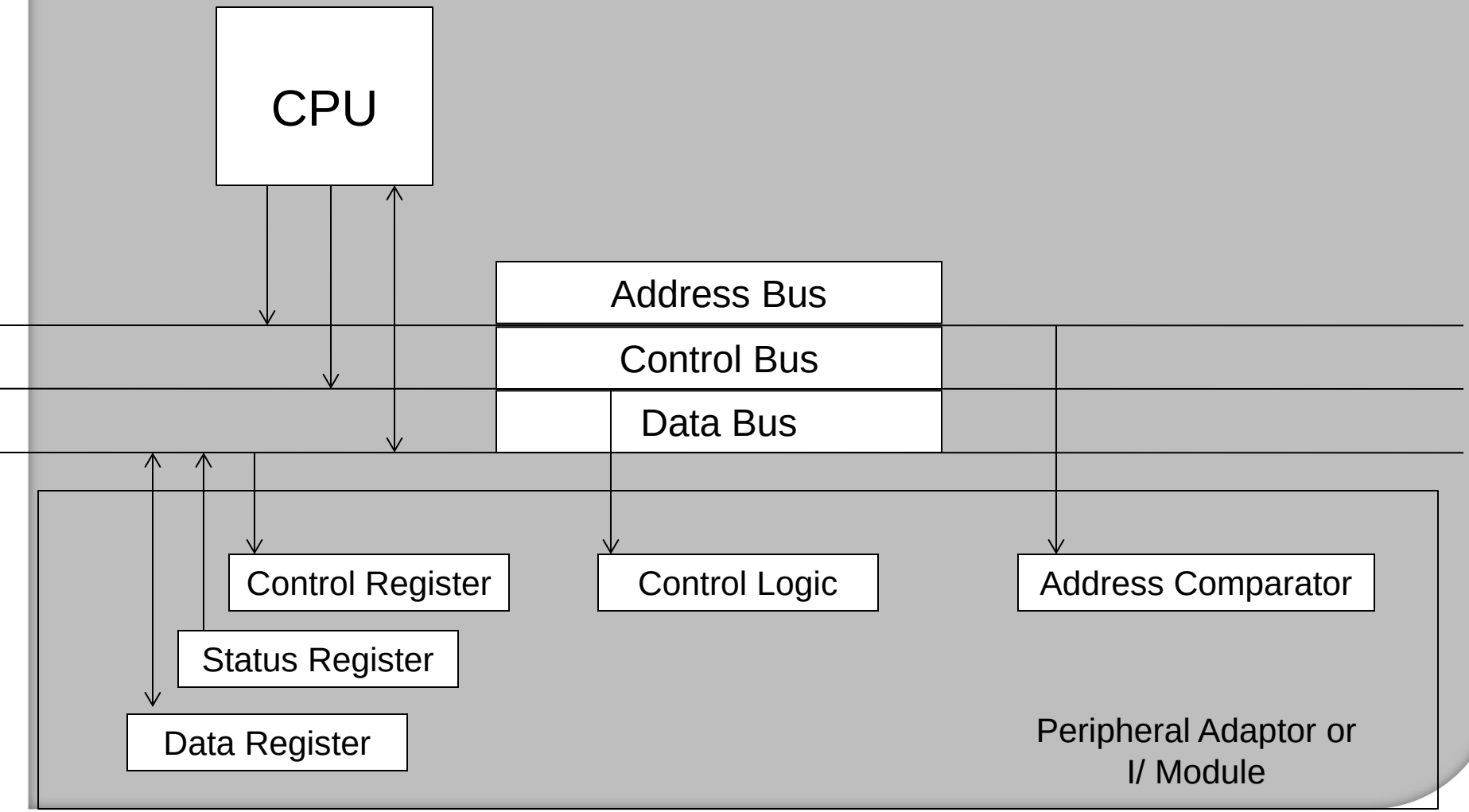
- It Data Highways or bus are divided into three distinct groups
  - Data Bus
    - contain the information or programs
    - 8086 has 16-bit data bus
    - 80386 has 32-bit data bus
    - CAD workstation has 64-bit data bus
  - Address Bus
    - It contains address information
    - It refers to the size of memory

Data Highways or BUS

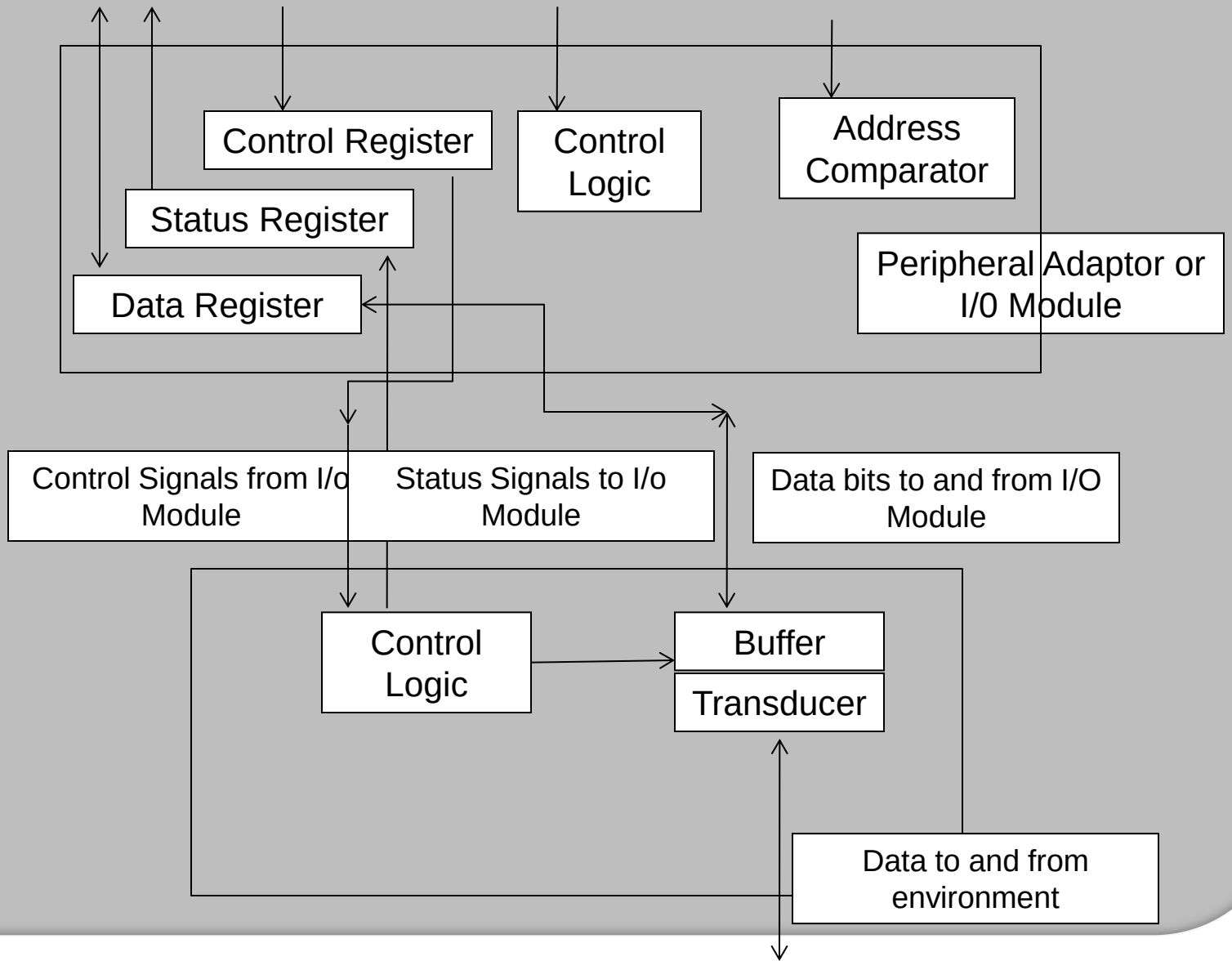
- If it has n address line, the memory capacity of that system is 2^n
- IBM personal computer used an 8086 processor having 20 address lines

- Control Bus
  - It contains control information
  - It indicates whether to read or write data
  - How much data to transfer
  - Timing signals
  - Status lines

Data Highways or BUS



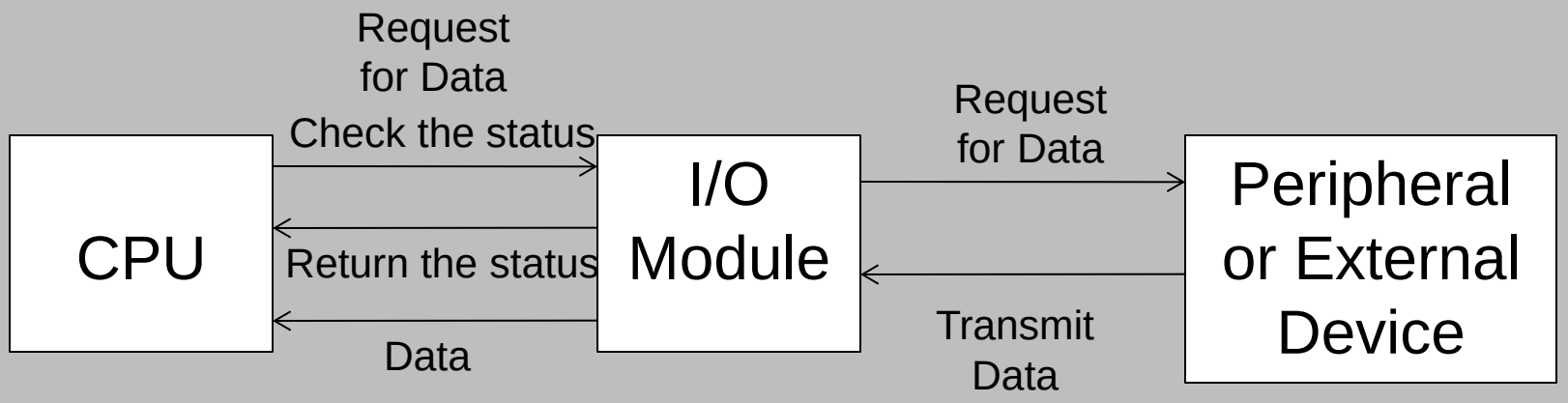
Block Diagram of a Peripheral



Sequences to transfer data

- The steps to transfer data from external device to the processor
  - The Processor interrogates the I/O module to check the status of the attached device
  - The I/O returns the device status
  - If the device is operational and ready to transmit, the processor requests the transfer of data, by means of a command to the I/O module
  - The I/O module obtains a unit of data from the external device
  - The data are transferred from the I/O Module to Processor

Sequences to transfer data



Interrogates the I/O Module to check the status of the attached device

The processor requests the transfer of data, by means of a command to the I/O Module

If the device is operational and ready to transmit

IN Port Number

Functions of I/O Module

- The major functions for an I/O module are as follows
  - Control and Timing : To coordinate flow of traffic between internal resources and external resources
  - Processor Communication : Command Decoding, Data, Status Reporting, Address Recognition
  - Device Communication : it involves commands, Status information and Data
  - Data Buffering : Data are buffered in I/O module to balance the transfer rate
  - Error Detection : Paper Jam and bad disk track

I/O Operation

- Transferring data between a computer system and external devices or peripherals
  - Input Operation : Receiving data from external resources
  - Output Operation : Sending data to external resources
- Three Techniques for I/O operations
  - Programmed I/O
  - Interrupt-Driven I/O
  - Direct Memory Access (DMA)

Programmed I/O Technique

- Data are exchanged between processor and I/O module, which is completely controlled by a program
- The program includes
  - Sensing device status
  - Sending a read or write command
  - Transferring the data

Programmed I/O Technique

- Procedure of Programmed I/O
  - Issuing a command to appropriate I/O module
  - I/O module will perform that action
  - Set the appropriate bits in the I/O register
    - Note: I/O module takes no action to alert the processor
  - Processor check periodically the status of I/O module if the operation is complete
- I/O related instruction execution
  - Processor issues
    - An address- Specifying the particular I/O Module
    - I/O command

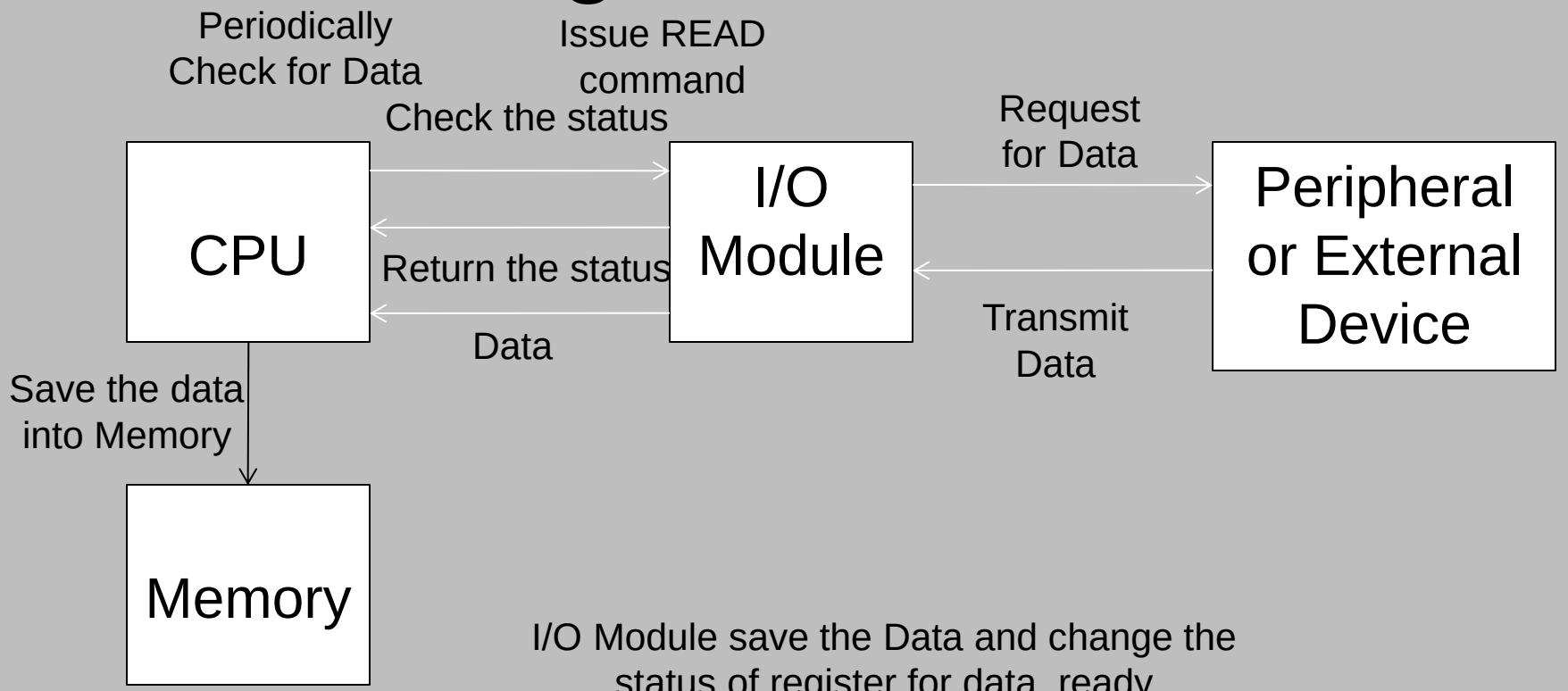
Programmed I/O Technique

- Four types of I/O commands
  - Control:
    - To active a peripheral
    - To tell what to do
    - Magnetic Tape: to rewind or move forward one record
  - Test:
    - To test various status conditions associated with an I/O module and its peripherals
      - If Interested peripheral is powered on and available for use
      - the most recent operation is completed and if any errors occurred

Programmed I/O Technique

- Read
  - To get the data from peripheral
  - Place it in an internal buffer
  - Request to I/O module to place data on the data bus
- Write
  - Request to I/O module to take data from the data bus
  - Transmit that data to the peripheral

Programmed I/O



I/O Module save the Data and change the status of register for data ready

I/O module Show Business and Data is not ready

If the device is free

Check if the I/O Device is engaged

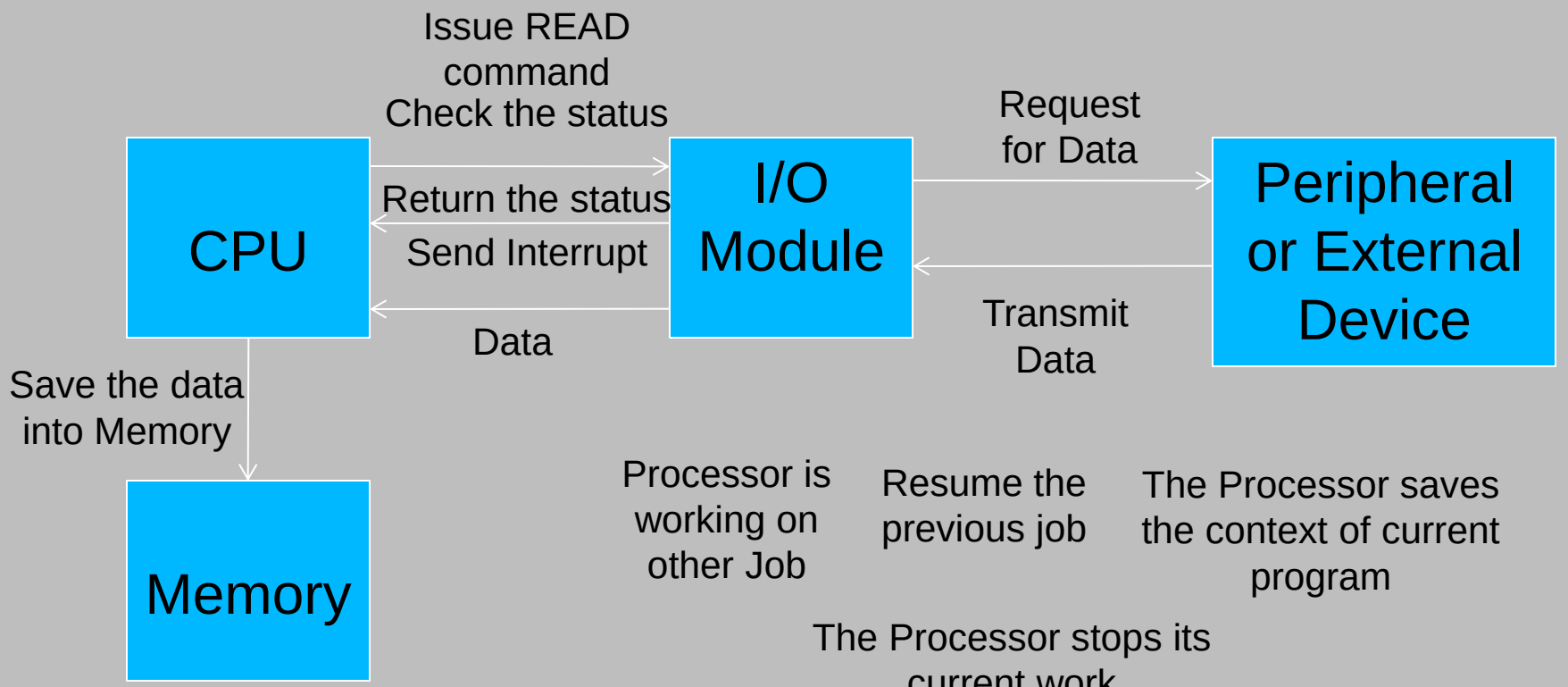
Disadvantage of Programmed I/O

- Processor has to wait a long time for the I/O module of concern of ready for transferring data
- While waiting, the processor must interrogate the status of the I/O module repeatedly
- So the performance is severely degraded

Interrupt-Driven I/O

- Processor issue an I/O command to a I/O module
- Go on to do other useful work
- When I/O module is ready for transferring data, it sends an interrupt to the processor
- The processor then stop the current task by saving the values of different register
- And then executes the data transfer
- Finally processor resumes its former processing

Interrupt-Driven I/O



The processor moves to other useful task

Check if the I/O Device is engaged

If the device is free

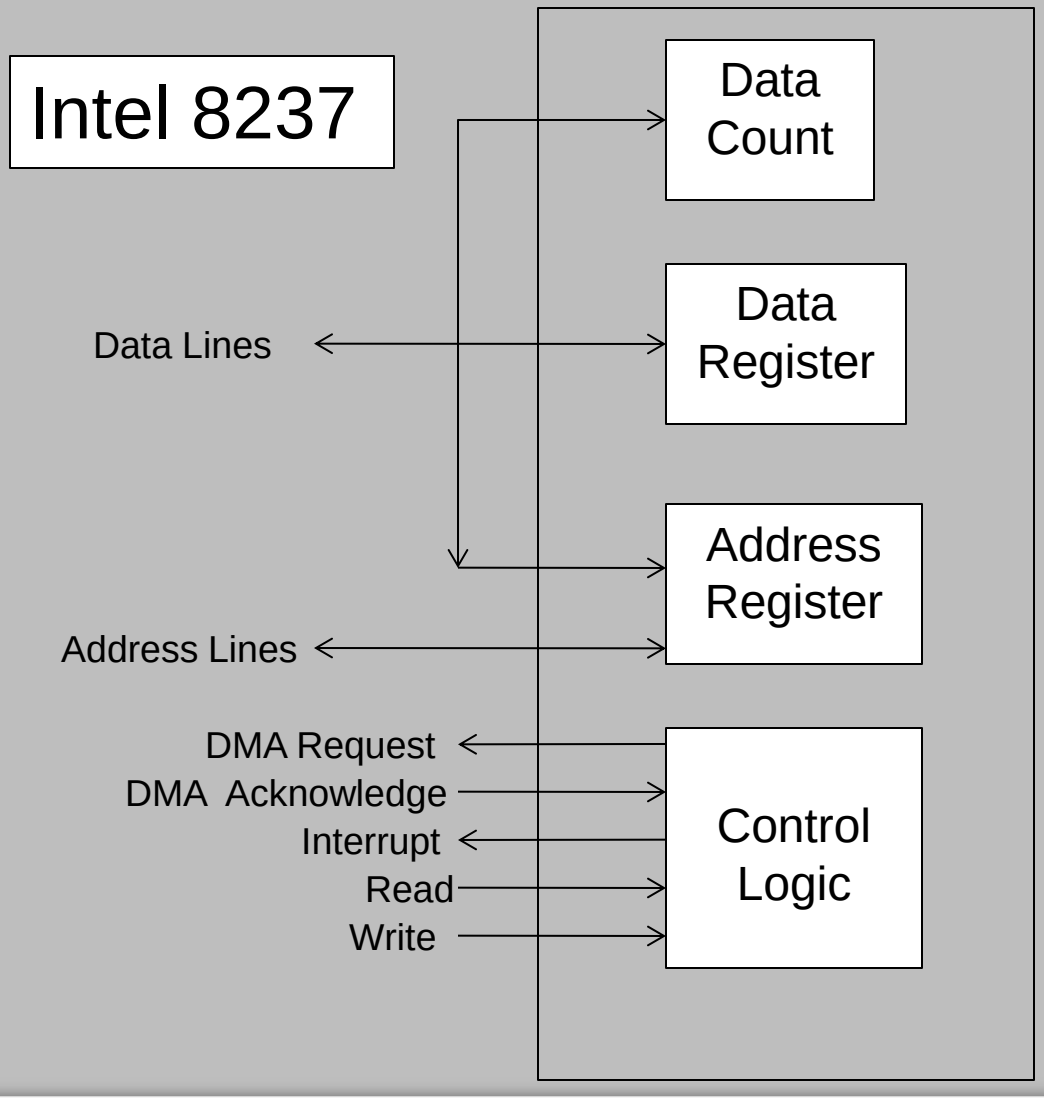
Disadvantage of two Techniques

- Both requires the active intervention of the processor to transfer Data

Direct Memory Access (DMA) I/O

- It involves an additional module on system bus
- DMA module is capable of mimicking the processor and
- DMA module can take the control of system bus from the processor, when the processor does not need it
- It must force the processor the processor to suspend operation temporarily

DMA



During I/O operation, Processor Issues a command to the I/O module with the following information

1. read or write operation
2. Address of the I/O device
3. The starting location in memory to be read or written
4. The number of words

1. DMA has been delegated for I/O operation
2. DMA Module transfer the entire block data into memory directly through system bus
3. After finishing the transfer DMA sends an interrupt to the processor
4. The processor take the control of system bus

Evolution of I/O function

- The CPU directly controls a peripheral device
- A controller or I/O module is added, CPU uses programmed I/O for data transfer
- A controller or I/O module is added, CPU uses interrupt for data transfer
- I/O module is given direct access to memory via DMA
- I/O channel: I/O module is enhanced to become a processor in its own right with specialized instruction set tailored for I/O
- I/O Processor: it has a local memory, in fact it is a computer to execute I/O instruction