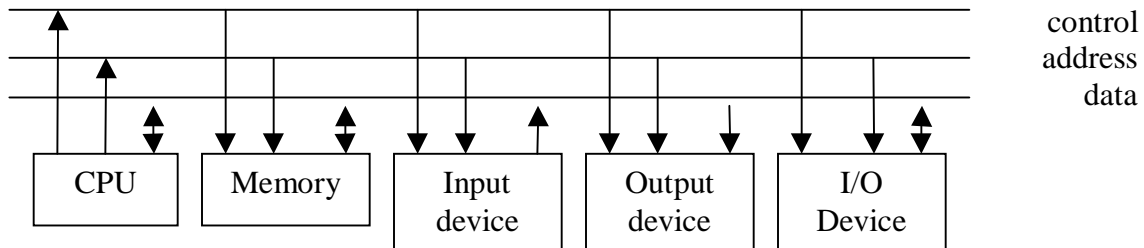
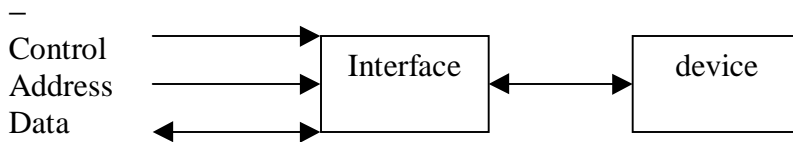


Input/Output

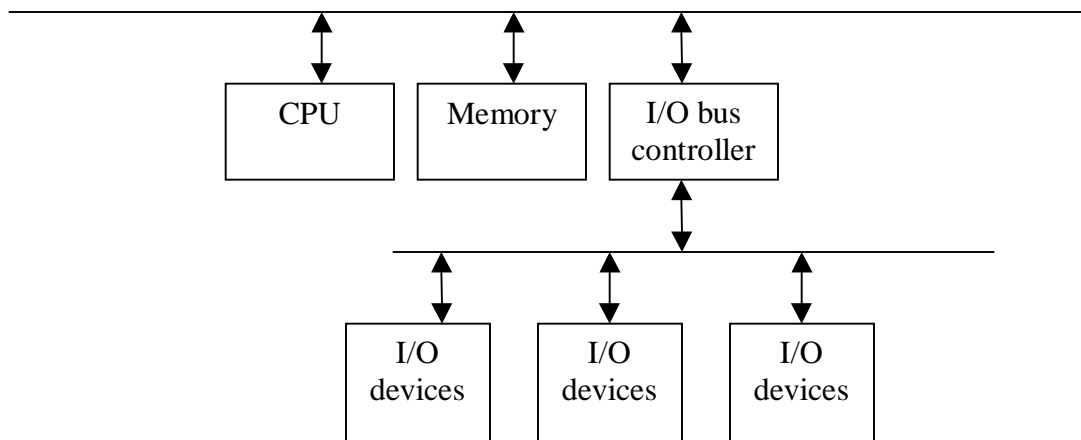
- The CPU typically communicates with the memory & I/O chains over the I/O bus:



- The I/O device are typically made up of an interface & physical devices:



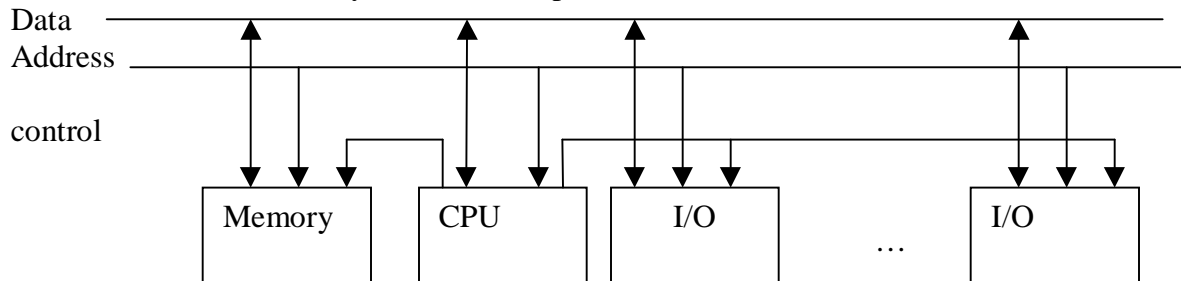
- the lines of the typical bus are”
 - data: carry information between the CPU & other units
 - address: the address in memory or from the “I/O address space”
 - Some of the “memory” address will actually refer to I/O devices.
 - Control: carrying information about the transactions.
 - E.g. read/write clock
- In this bus configuration, the CPU, memory & I/O share a single bus
 - The CPU must handle all I/O itself
 - Can take a lot of work for devices with a lot of data to move
 - E.g. display, memory, hard disk, video in...
 - Most I/O device are much slower than the CPU, so there’s a lot of waiting
 - We can deal with this by creating a separate I/O bus



- The bus controller handles low-level I/O stuff, so the CPU doesn’t have to

I/O addressing

- There are several ways to allow the CPU to communicate with the I/O devices
- These often go together with a particular bus layout
- Memory-mapped I/O
 - Some “memory” addresses refers to I/O ports
 - These addresses activate particular I/O interfaces
 - The devices on the I/O bus must know the address they use
- Isolated I/O configuration
 - The data & address busses are shared between memory & I/O
 - The memory & I/O have separate control lines



this allows the memory & I/O devices to have different address space