

# Computer Science CSCI 251

## Systems and Networks

*Dr. Peter Walsh*

*Department of Computer Science*

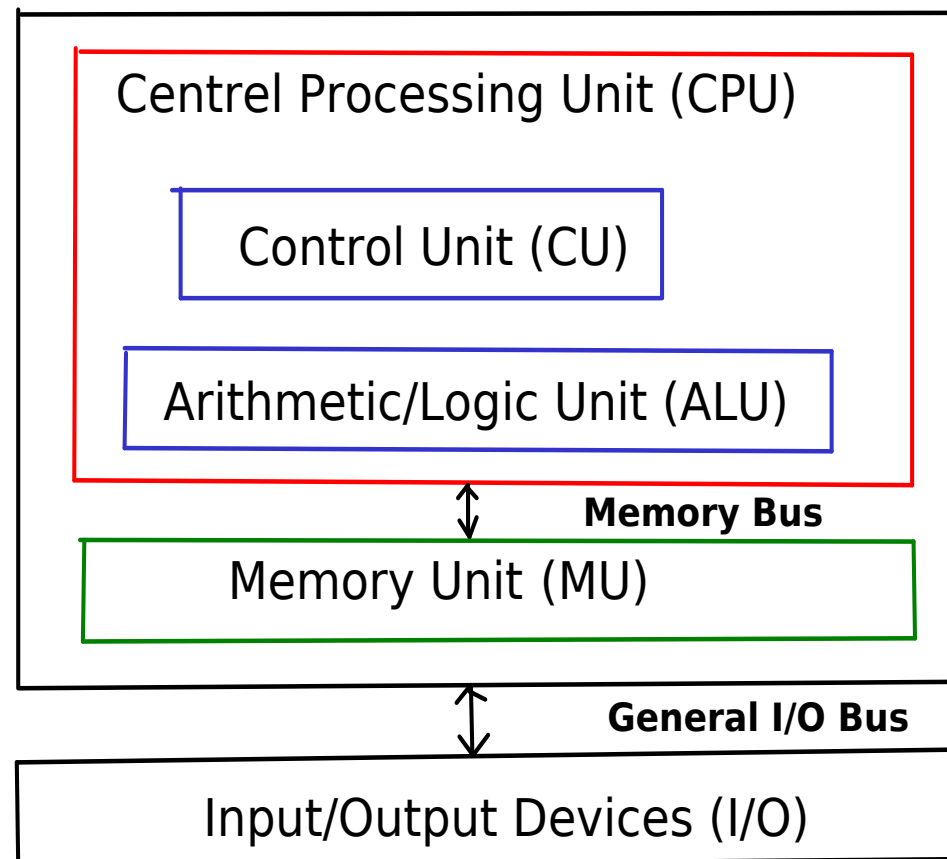
*Vancouver Island University*

*[peter.walsh@viu.ca](mailto:peter.walsh@viu.ca)*

## Recap

- Virtualization (Process)
  - OS: Three Easy Pieces: chapters 1-6
- Persistence
  - OS: Three Easy Pieces: chapters 36-?
- Historical Perspective
  - The UNIX System: Making Computers More Productive (1982)  
<https://www.youtube.com/watch?v=tc4R0CJYbm0>
  - Brian Kernighan: UNIX, C, AWK, AMPL, and Go Programming ...  
<https://www.youtube.com/watch?v=09upVbGSBFo>

# von Neumann Architecture



# Personal Computer Hardware

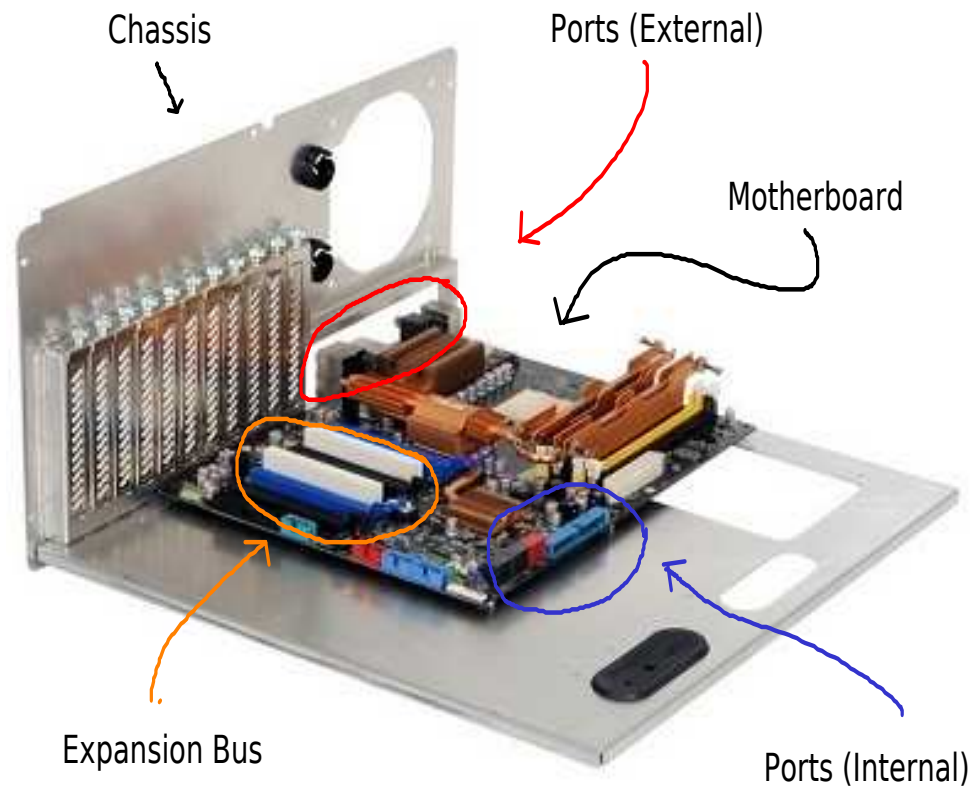


Photo from PC Magazine

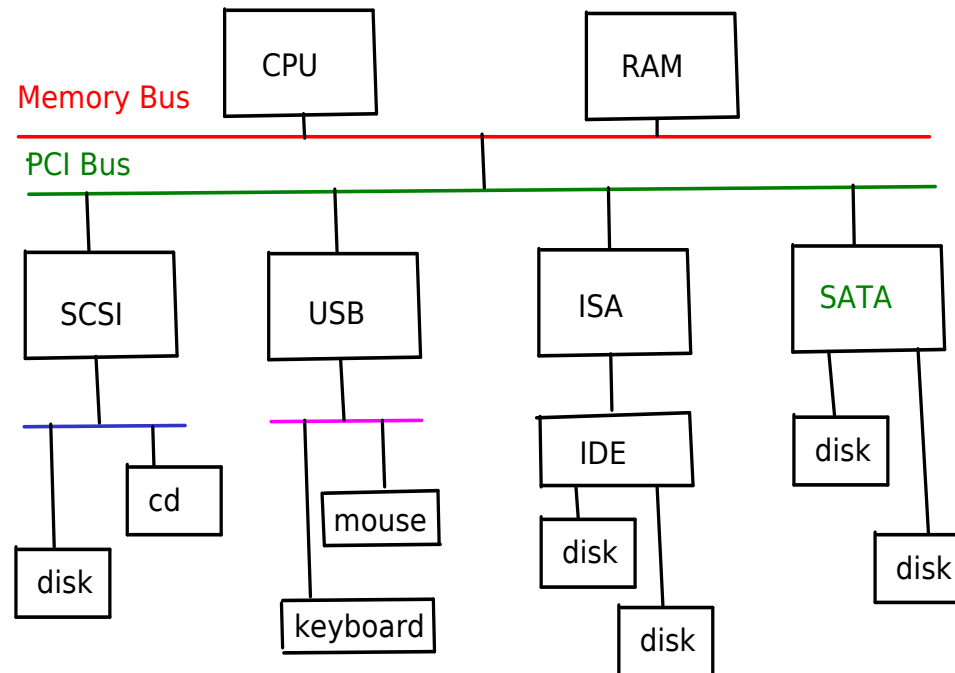
# Busses

- Memory Bus
  - connects the CPU with main memory
  - proprietary
  
- General I/O Bus (Expansion Bus)
  - connects high speed I/O devices to the memory bus
  - standardized, e.g., PCI and ISA
  
- Peripheral Bus
  - connects low speed I/O devices to the memory bus
  - standardized, e.g., SCSI, SATA, USB, IDE

## Busses cont.

- PCI (Peripheral Component Interconnect)
- ISA (Industry Standard Architecture)
- SCSI (Small Computer System Interface)
- SATA (Serial AT Attachment)
- USB (Universal Serial Bus)
- IDE (Integrated Drive Electronics or PATA)

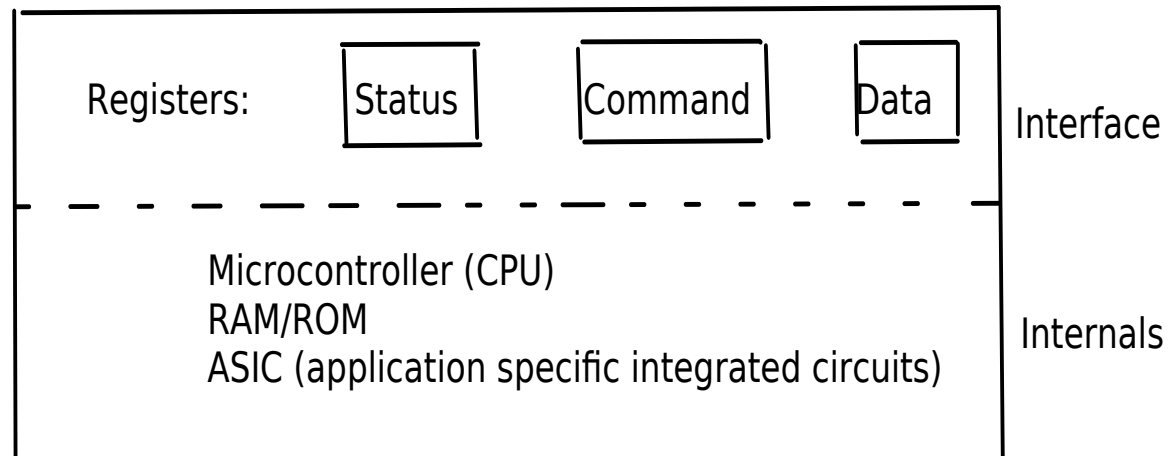
# Model Architecture



- PC Motherboard Evolution

<https://www.youtube.com/watch?v=sewt2pqc3us>

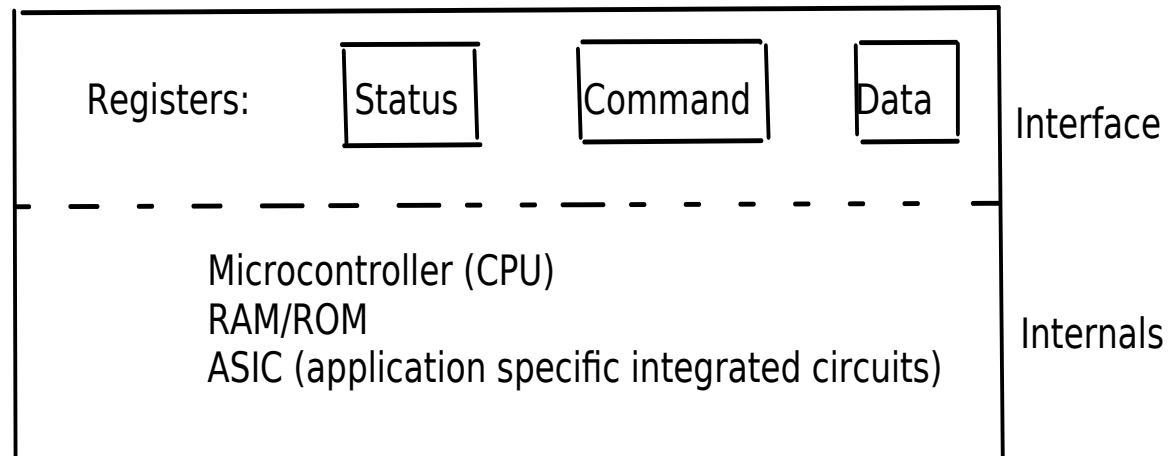
# Generic I/O Device and Protocol



```
// disk write operation using polling
While (STATUS == BUSY);
DATA = "data" ;
COMMAND = "write";
While (STATUS == BUSY);
```



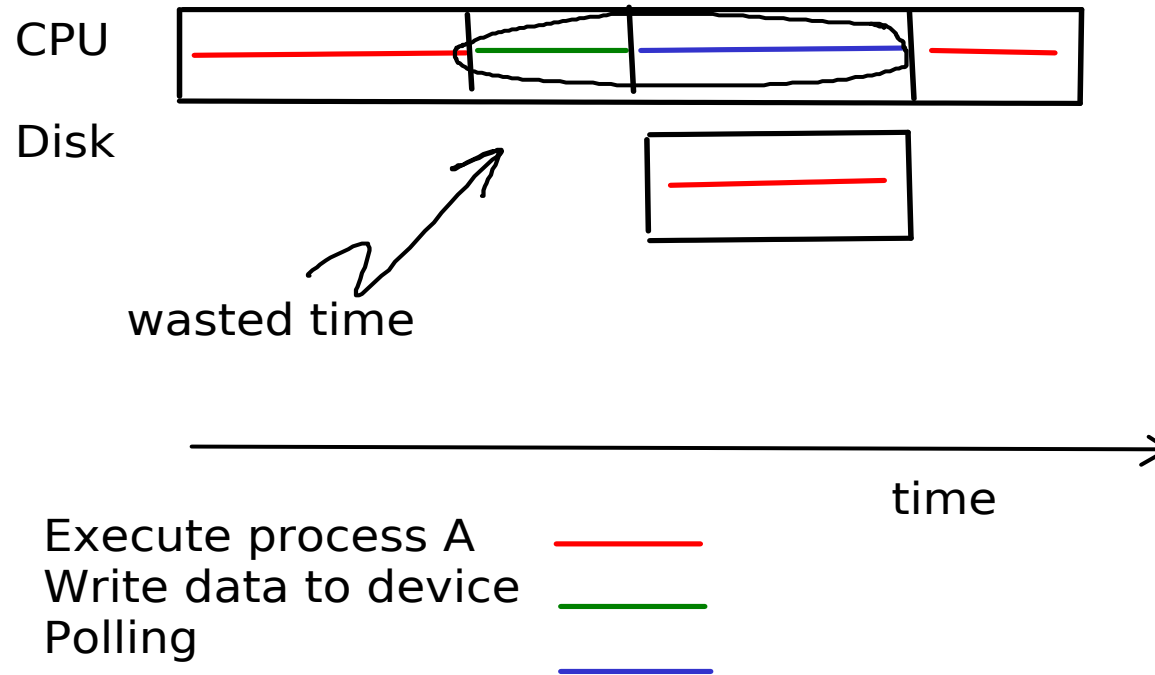
## Generic I/O Device and Protocol cont.



```
// disk read operation using polling
While (STATUS == BUSY);
COMMAND = "read";
While (STATUS == BUSY);
"data" = DATA;
```

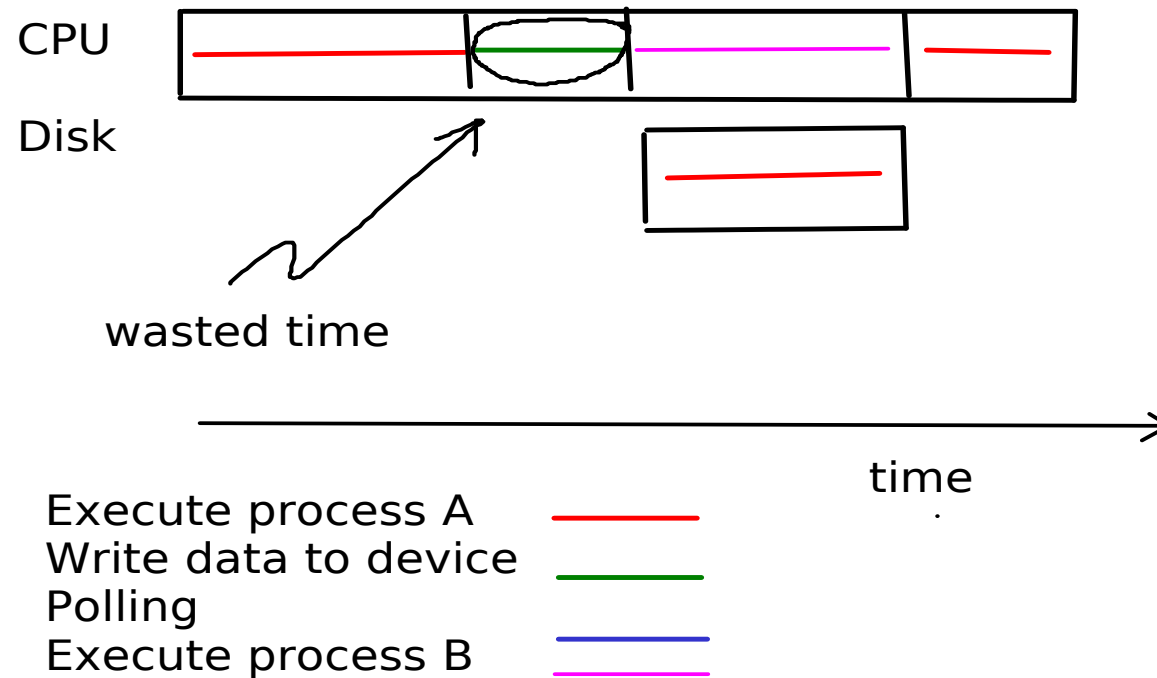
# Write CPU Utilization

○ Polling



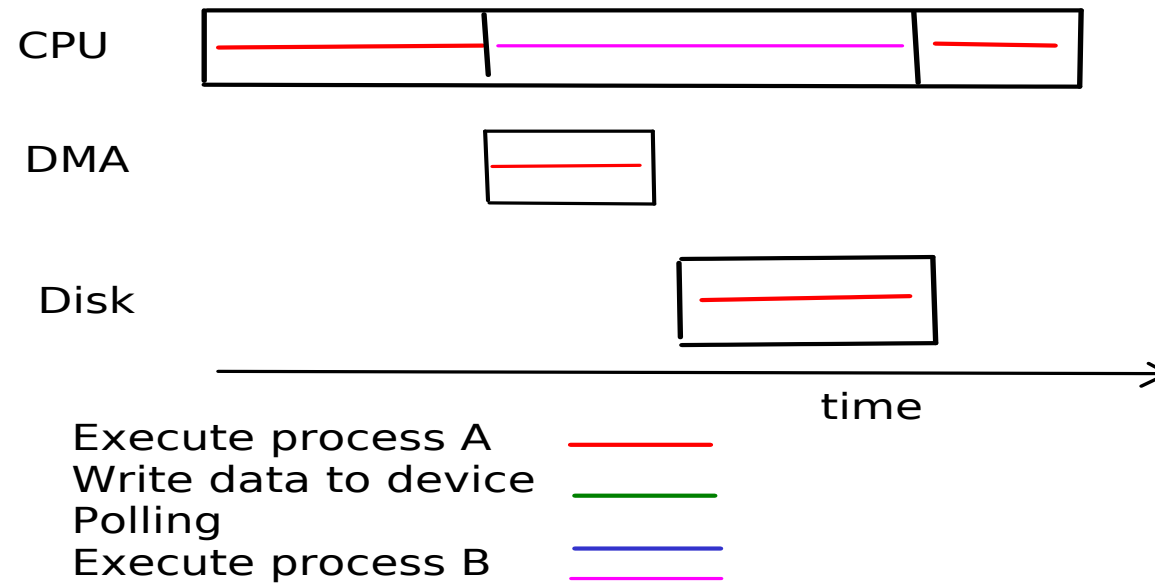
# Write CPU Utilization cont.

## ○ Interrupts



## Write CPU Utilization cont.

- Direct Memory Access (DMA)
  - arranges data transfers between a device and main memory

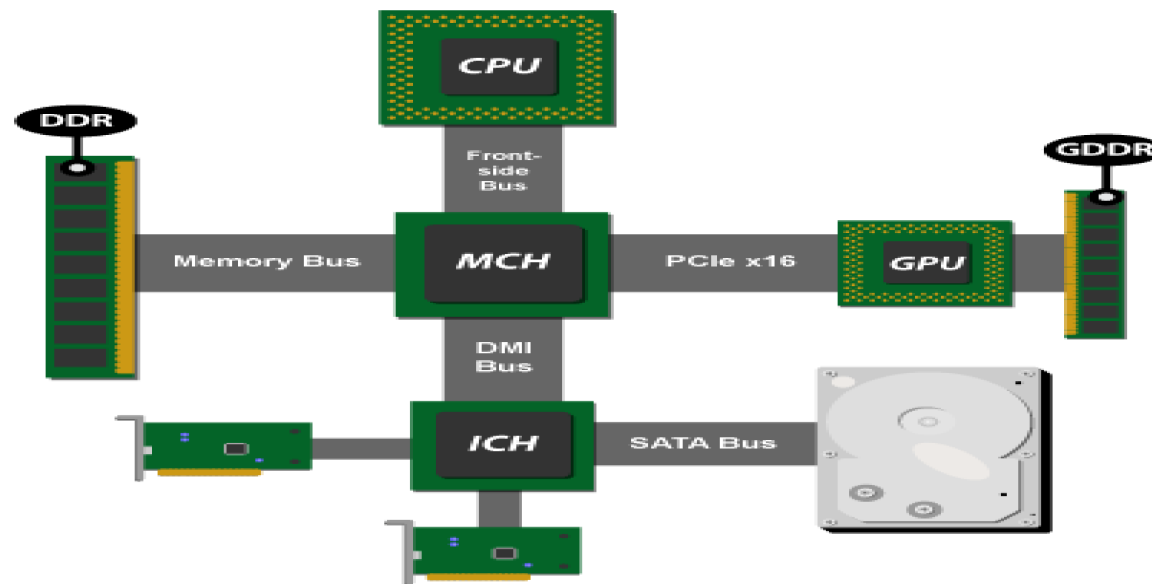


## Data Transmission

- Programmed I/O (PIO)
  - CPU is directly involved with data movement
  
- Direct memory Access (DMA)
  - method that allows an input/output (I/O) device to send or receive data directly to or from the main memory, bypassing the CPU
  - process is managed by a DMA controller (DMAC)

# Modern PC Architecture

- Intel launches all-new PC architecture with Core i5/i7 CPUs
- <https://arstechnica.com/gadgets/2009/09/intel-launches-all-new-pc-architecture-with-core-i5i7-cpus/>



## CPU I/O Instructions

- Explicit I/O
  - e.g., x86 `in` and `out` instructions
- Memory Mapped I/O
  - device registers are available as if they were memory locations
  - e.g., `store(0x2015, 43)`

## I/O Device Types

### ○ Block

- composed of fixed-sized blocks
- buffering is required
- seeking is possible
- e.g. devices: disk drives

### ○ Character

- composed of a stream of sequential bytes
- no buffering is required
- no seeking is possible
- e.g. devices: keyboard, serial port



# OS-I/O Integration

- e.g., File System Stack

