Review of Computer Organization

(Chapters 1.1, 1.2, 1.3)

Agenda

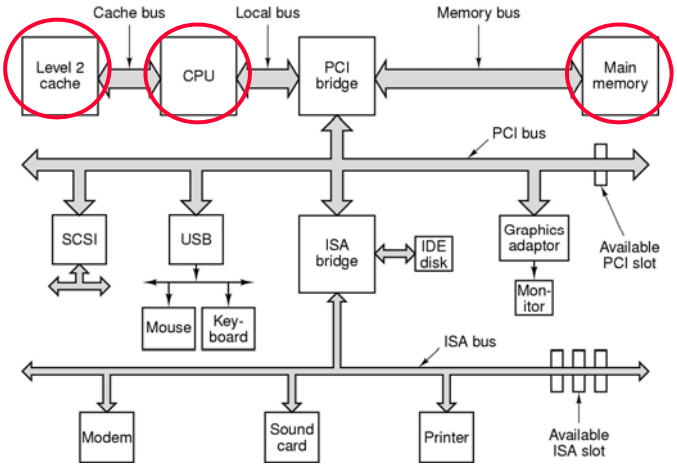
1. Computer Organization
2. CPU
3. Memory
4. I/O
5. Architecture

1. Computer Organization

CPU

Memory

I/O



2. CPU (1)

Access

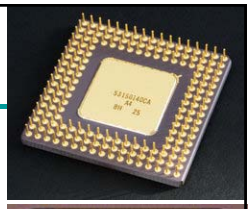
- pins: address, data, control, status

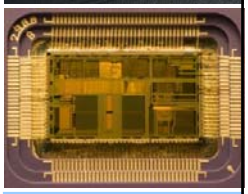
Internals

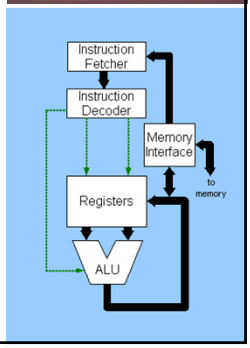
- program counter (PC)
- registers: address, data, control, flags
- arithmetic logic unit (ALU), FPU, etc

Benchmarks

- clock (GHz), instruction/cycle, MIPS







2. CPU (2) operations

Fetch
- retrieve instructions from memory (cache)

Decode
- instruction: operator, operands; microcode

Execute
- arithmetic/logic operation
- move data between register, memory, I/O
- change execution flow

3. Memory (1)

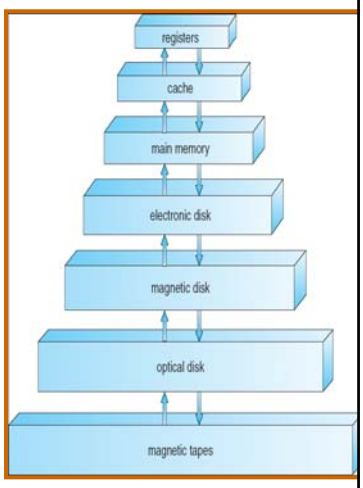
Access
- linear address
- segmented address: segment, index
- physical address: cylinder, header, sector (disk)

Benchmarks
- clock (MHz)
- width (bits)
- throughput (Mbps)

3. Memory (2): hierarchies

Speed vs. size
- registers: inside CPU
- cache: transparent to programs
- memory: main storage
  - DRAM, SDRAM, SRAM, etc
- disks: secondary storage
  - electronic, magnetic, optical, etc
- tapes: backup storage
- networked storage

Caching

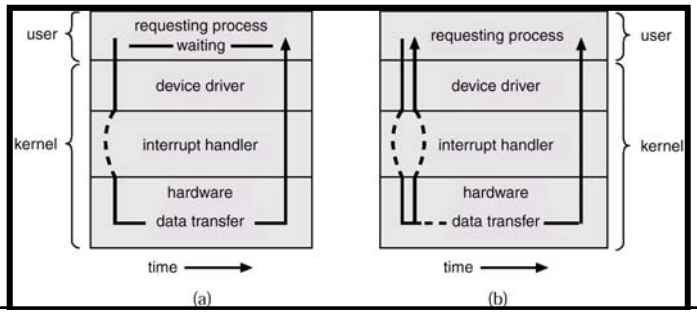


4. I/O (1)

A large variety of input/output devices
- keyboard/mouse, video, audio, network, etc

Access
- Address
  - port numbers
  - I/O vs. memory space
- Interrupt
- Direct memory access (DMA)

Synchronous vs asynchronous



4. I/O (2): DMA

High-speed I/O, bulk data transfer

DMA controller

- source/destination address
- counter: the amount of data to be moved

DMA handling

- program DMA controller
- execute DMA *concurrently*
- issue an interrupt on DMA completion

Q: compare interrupt vs DMA

5. Computer architectures

Single-processor systems

Multi-processor systems

- symmetric multiprocessing (SMP)

Cluster systems

- interconnected systems