CS 492: Operating Systems

Introduction

Instructor: Iraklis Tsekourakis

Email: itsekour@stevens.edu

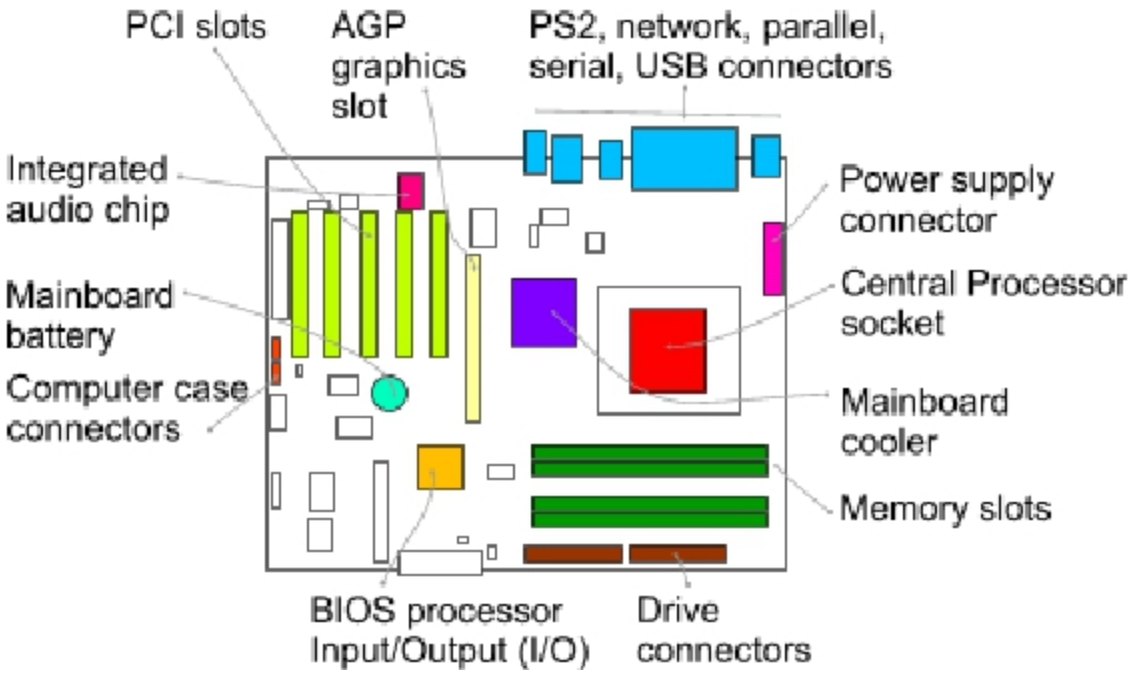
Logistics

- CAs Office hours: (NB 101)
  - Monday 2-4pm
  - Thursday 1-3pm

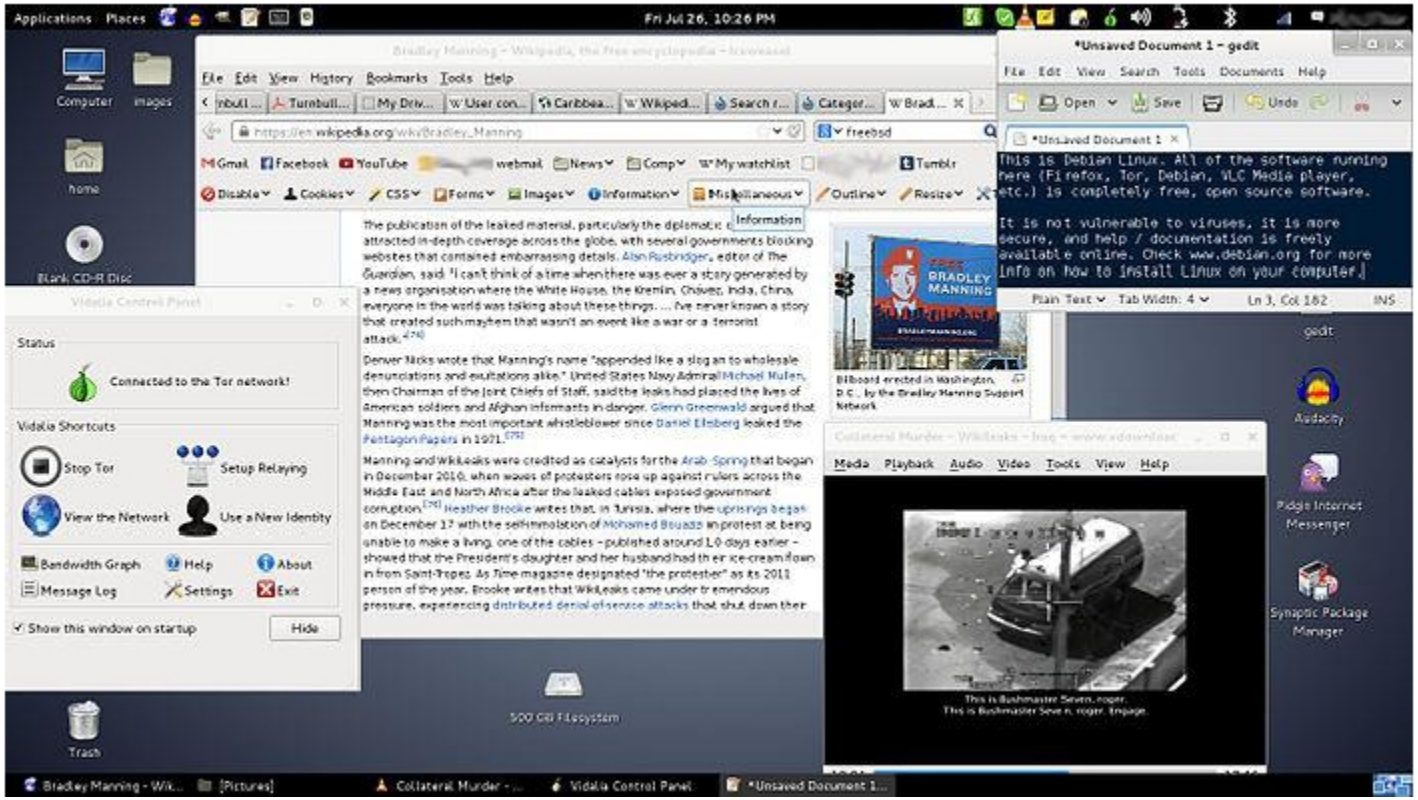
General Concept

- A computer system used to have many types of devices

Inside Box


PCI slots
AGP graphics slot
PS2, network, parallel, serial, USB connectors
Integrated audio chip
Power supply connector
Mainboard battery
Central Processor socket
Computer case connectors
Mainboard cooler
Memory slots
BIOS processor Input/Output (I/O)
Drive connectors

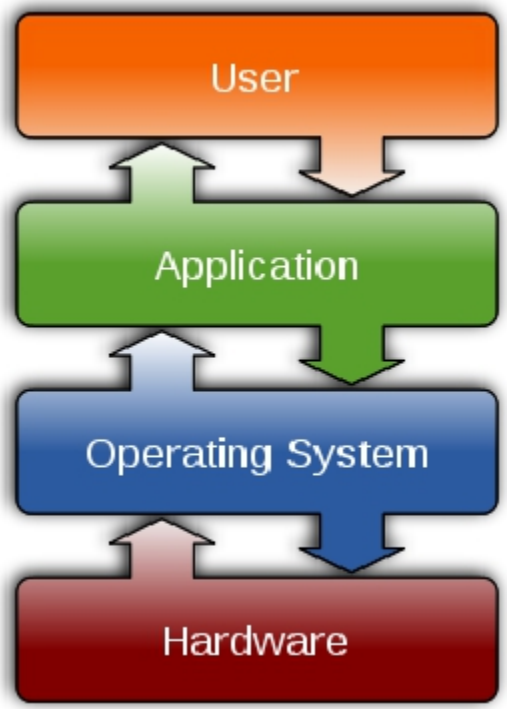
Users' Views



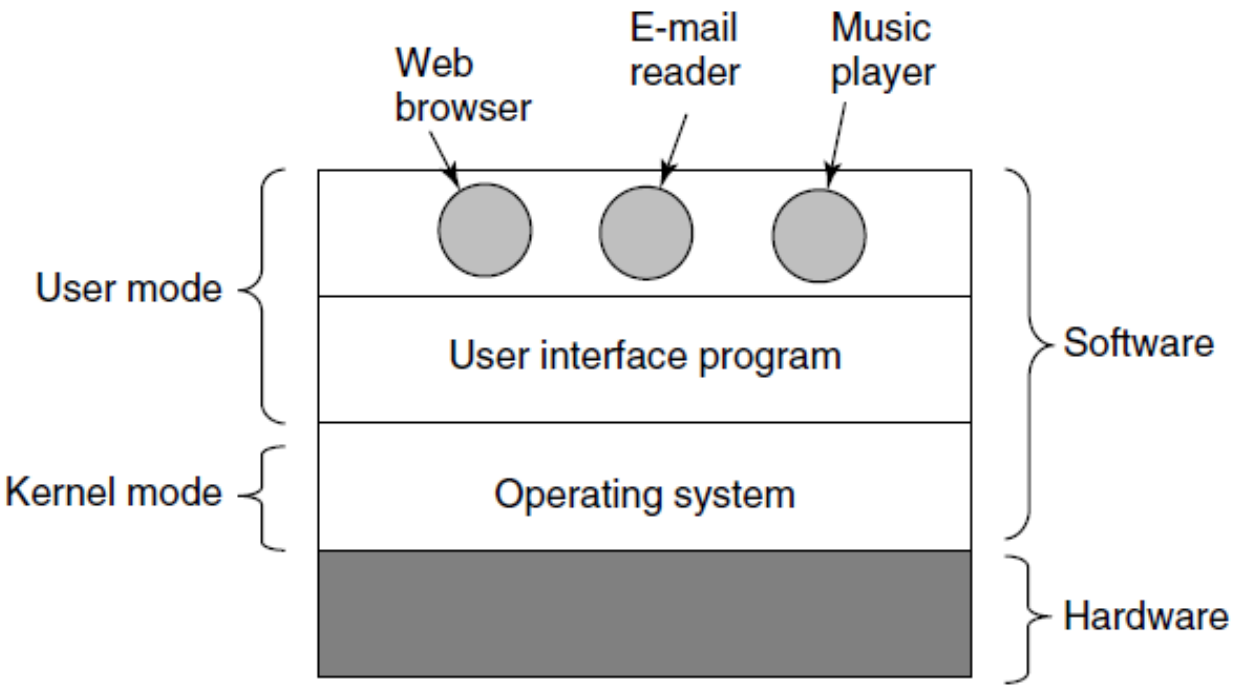
- OS Features
  - Multitasking, scheduling, memory allocation, file system interface, I/O interface, multimedia, security…

Functionality of OS

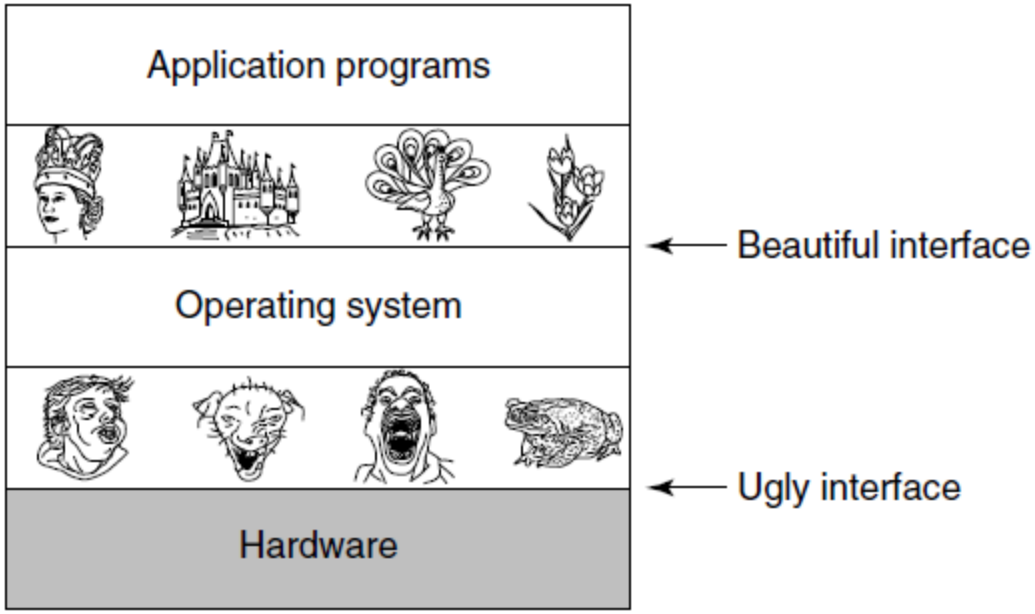
- OS manages and allocates the resources (including hardware and software)
- An OS provides service for
  - Processor management
  - Memory management
  - File management
  - Device management
  - Concurrency control



Where the OS fits in..



The Operating System as an Extended Machine



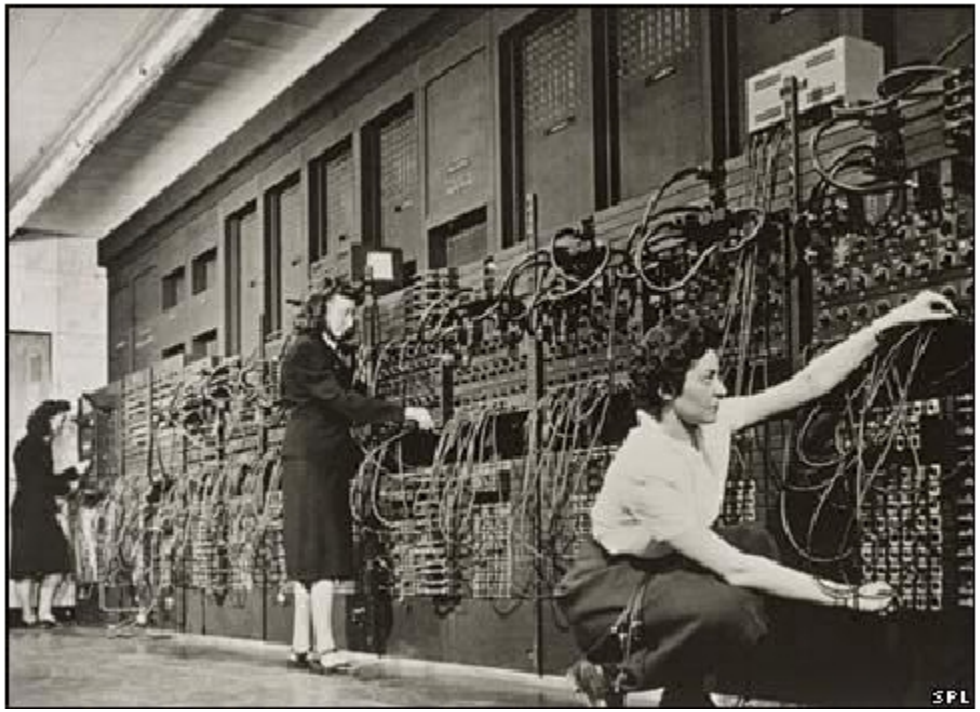
OS perform 2 main unrelated functions

- Top down view
  - Provide abstractions to application programs
- Bottom up view
  - Manage pieces of complex system
- Alternative view
  - Provide orderly, controlled allocation of resources
  - Resource management: space & time multiplexing

CS492 will Cover…

- Features
  - Multitasking
  - Scheduling
  - Memory Allocation
  - File System
  - I/O Interface
  - Disks

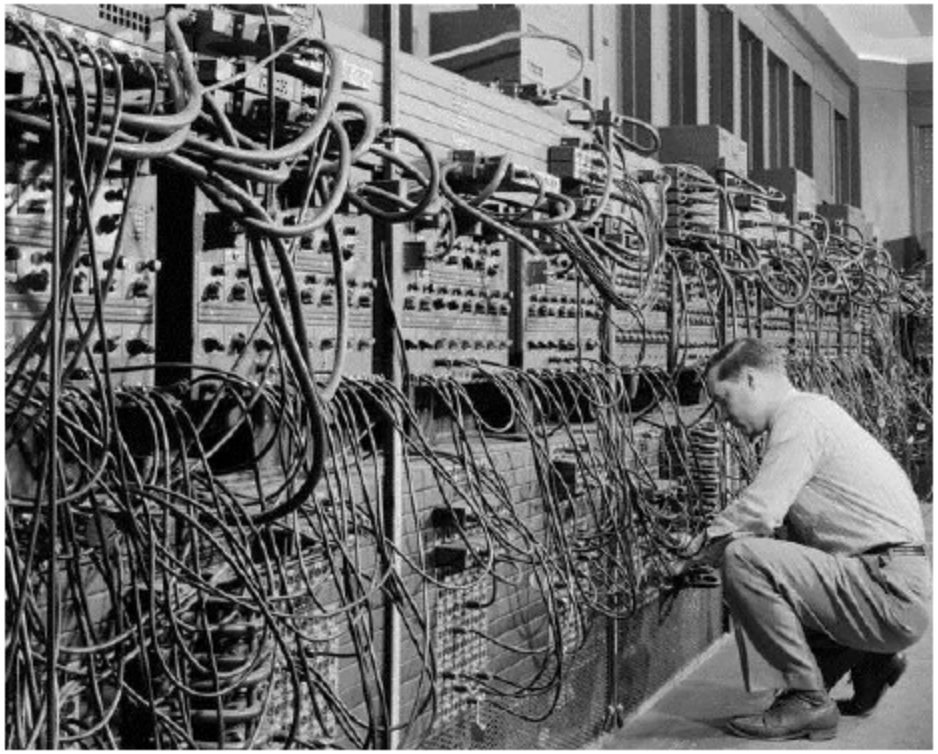
OS History: Before OS



ENIAC, 1943

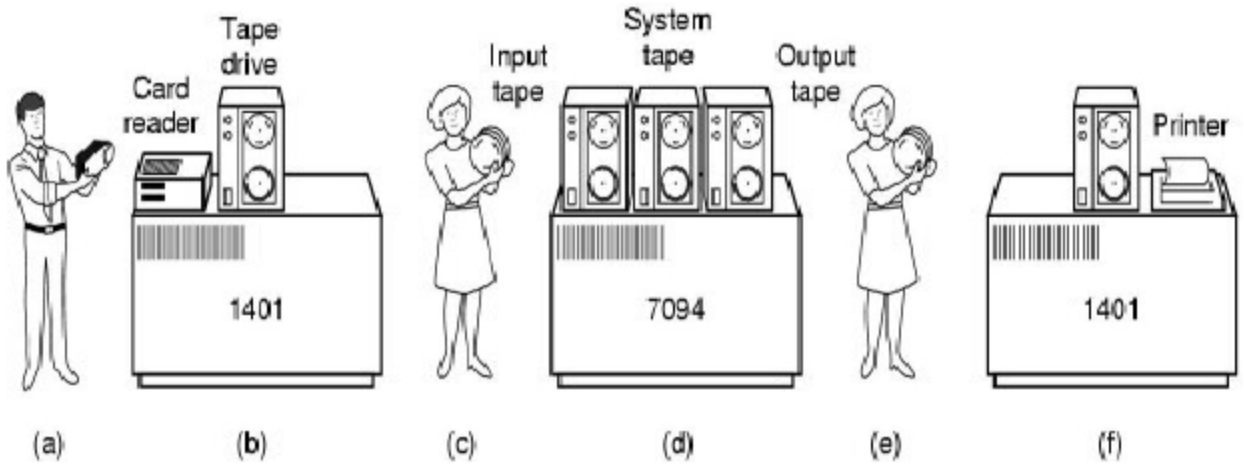
ENIAC (More)

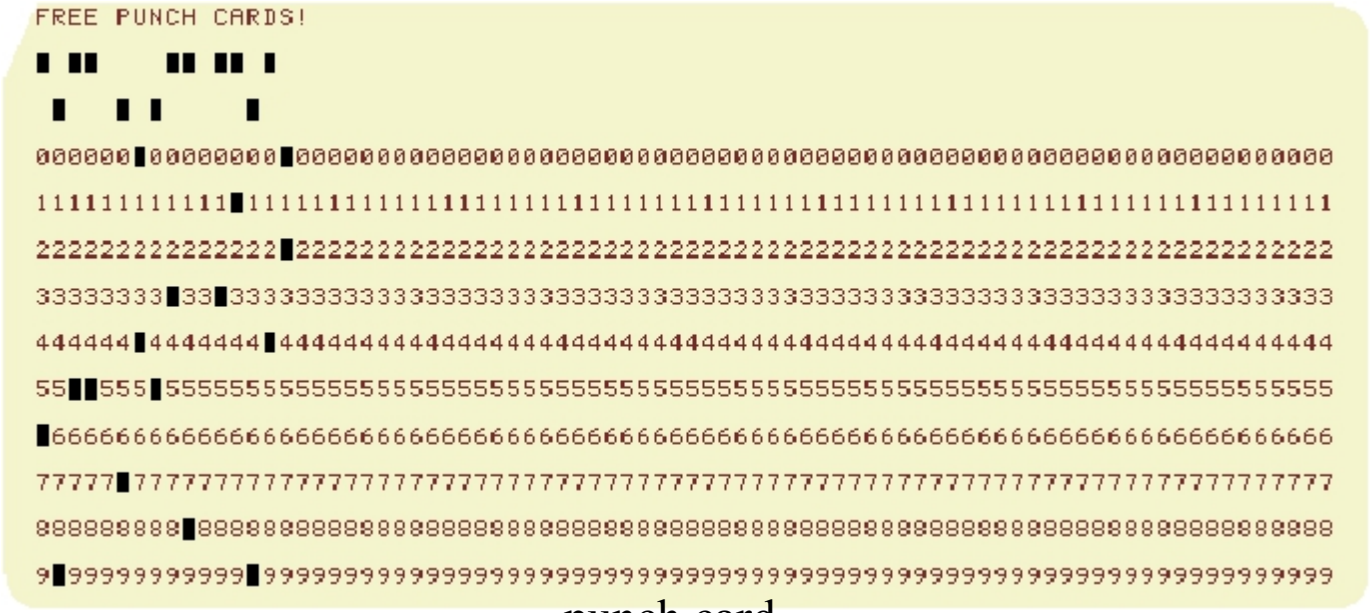
Programs were loaded into memory manually using switches, punched cards, or paper tapes.



ENIAC : coding by cable connections

How Did it Work without OS?





punch card

The 1st Operating System (OS)

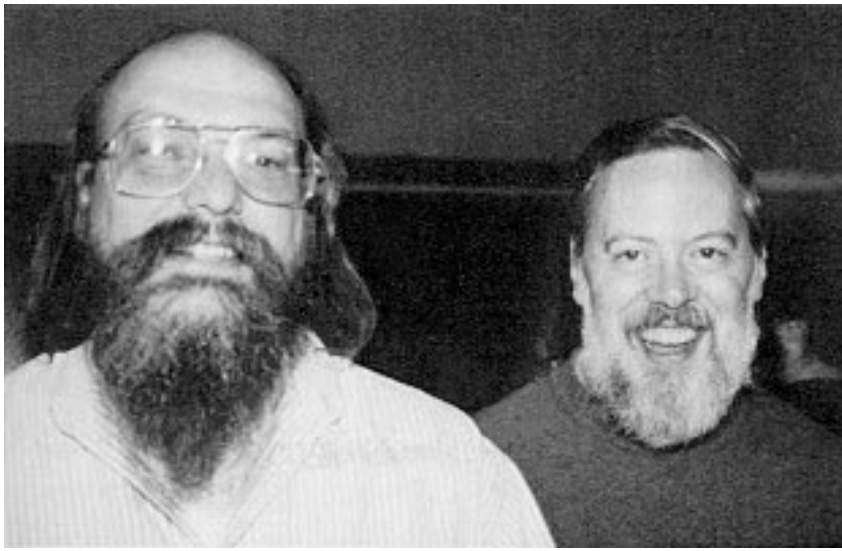
- 1956: The GM-NAA I/O system of General Motors and North American Aviation
  - For the IBM 704 mainframe.
  - Shared routines to the programs
  - Common access to the I/O devices

OS on Mainframes

- IBM OS/360 for mid-range and large systems
- **Multics** (***Mult****iplexed* ***I****nformation and* ***C****omputing* ***S****ervice*)
  - MIT, GE, and Bell labs, 1964
  - First OS provides security and hierarchical file systems

The rise of Unix

- AT&T Bell Laboratories, the late 1960s
- Authors: Ken Thompson, Dennis Ritchie
- UNIX based on Multics, but vastly simplified



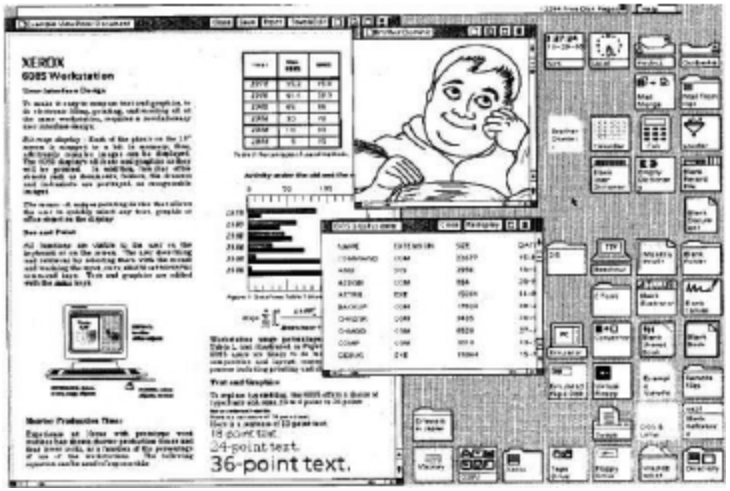
- Variants: Linux, BSD descendants (FreeBSD, NetBSD, OpenBSD, etc)

Minicomputers (1980-)

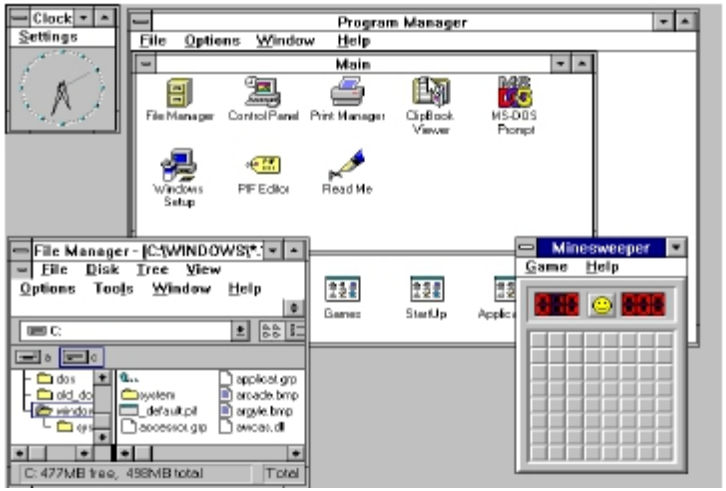
- Personal computing:
  - Computers cheap, so everyone has a PC
- Limited hardware resources initially:
  - OS becomes a subroutine library
  - One application at a time (MSDOS, CP/M, …)
- Eventually PCs become powerful:
  - OS regains all the complexity of a “big” OS

The Personal Computer Era

- CP/M-80 OS for the 8080 / 8085 / Z-80
- MSDOS: Microsoft's first OS.
- New OS feature: graphical user interface



xerox star



windows 3.1

OS Now

- Rising star: mobile Operating System (MobiOS)
  - Laptops, PDAs, phones
    - Small, portable, and inexpensive
  - Examples of MobiOS
    - Android OS
    - iOS

- Design of MobiOS is very different from an OS on desktop machines
  - Why?

A List of Popular Operating Systems

- Microsoft Windows
- Apple MacOS
- Unix OS (FreeBSD, etc.)
- Linux OS

Operating Systems VS. Airlines

- What if airlines ran things the way operating systems do?
  - **UNIX Airways**
    - Everyone brings one piece of the plane along when they come to the airport.
    - They all go out on the runway and put the plane together piece by piece, arguing non-stop about what kind of plane they are supposed to be building.

http://www.tensionnot.com/jokes/operating_systems_and_airlines

Operating Systems VS. Airlines (Cont.)

- **Mac Airlines**
  - All the stewards, captains, baggage handlers, and ticket agents look and act exactly the same.
  - Every time you ask questions about details, you are gently but firmly told that you don't need to know, don't want to know, and everything will be done for you without your ever having to know, so just shut up.

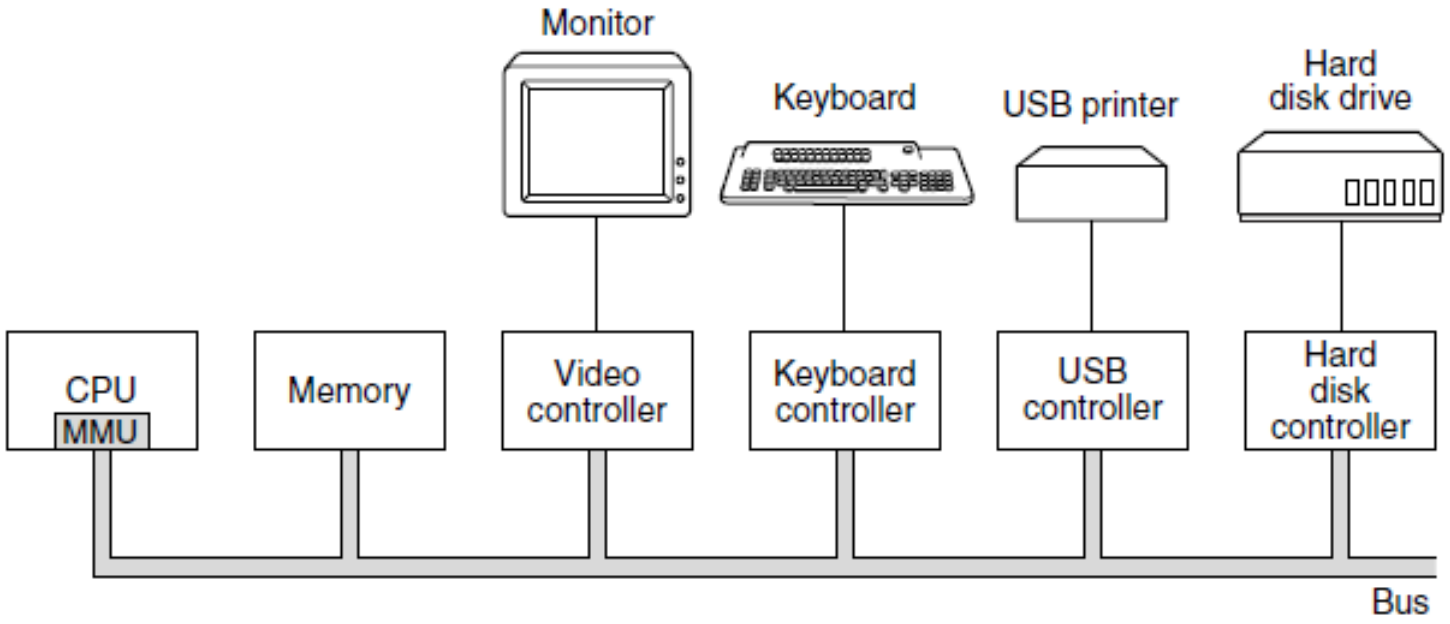
Operating Systems VS. Airlines (Cont.)

- **Windows Air**
  - You show up at the airport, which is under contract to only allow Windows Air planes.
  - All the aircraft are identical, brightly colored and three times as big as they need to be.
  - Whichever way you go, someone pops up dressed in a cloak and pointed hat insisting you follow him.
  - No matter what destination you booked you will always end up crash landing at Whistler in Canada.
  - …..

Operating Systems VS. Airlines (Not the End!)

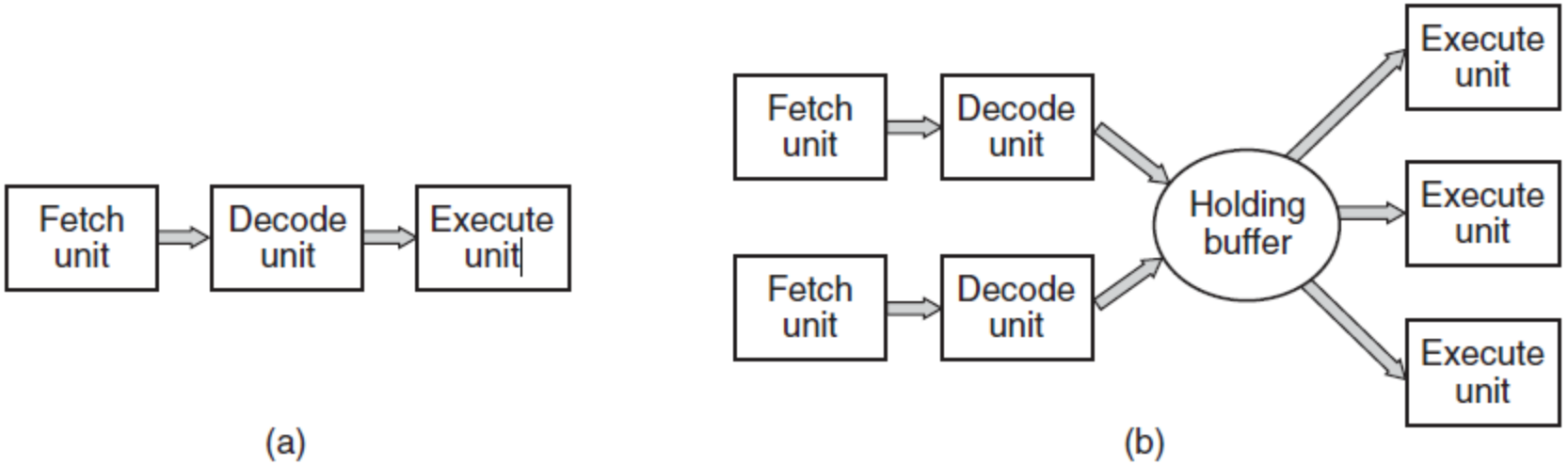
- **Linux Air**
  - Disgruntled employees of all the other OS airlines decide to start their own airline.
  - They build the planes, ticket counters, and pave the runways themselves.
  - They charge a small fee to cover the cost of printing the ticket, but you can also download and print the ticket yourself.
  - When you board the plane, you are given a seat, four bolts, a wrench and a copy of the seat-HOWTO.html.
  - You try to tell customers of the other airlines about the great trip, but all they can say is, "You had to do what with the seat?

Hardware



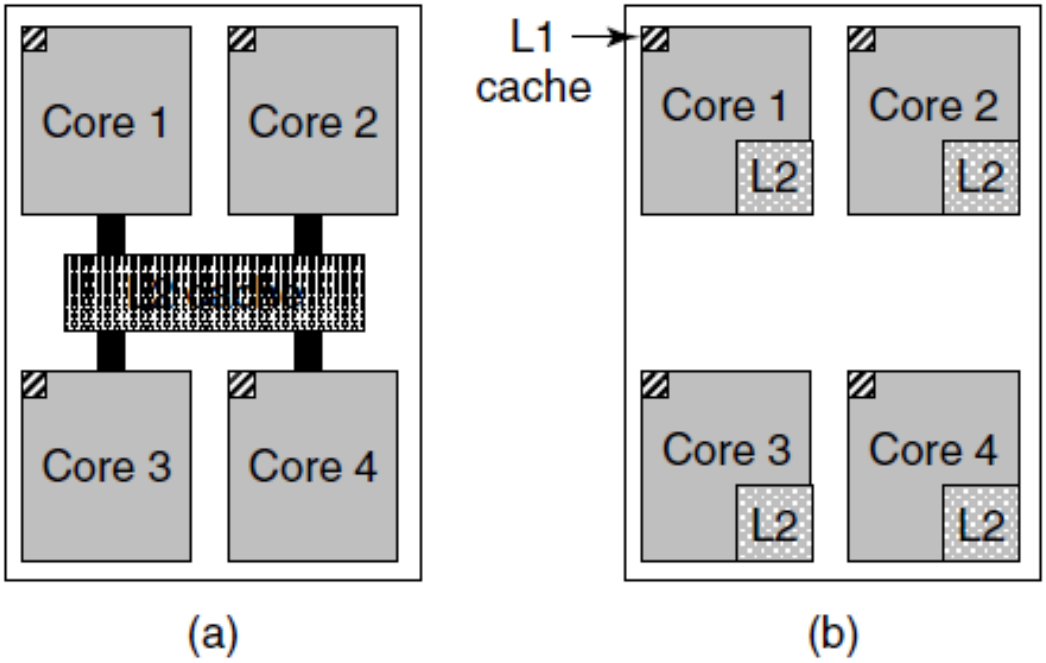
Some of the components of a simple personal computer

Processors



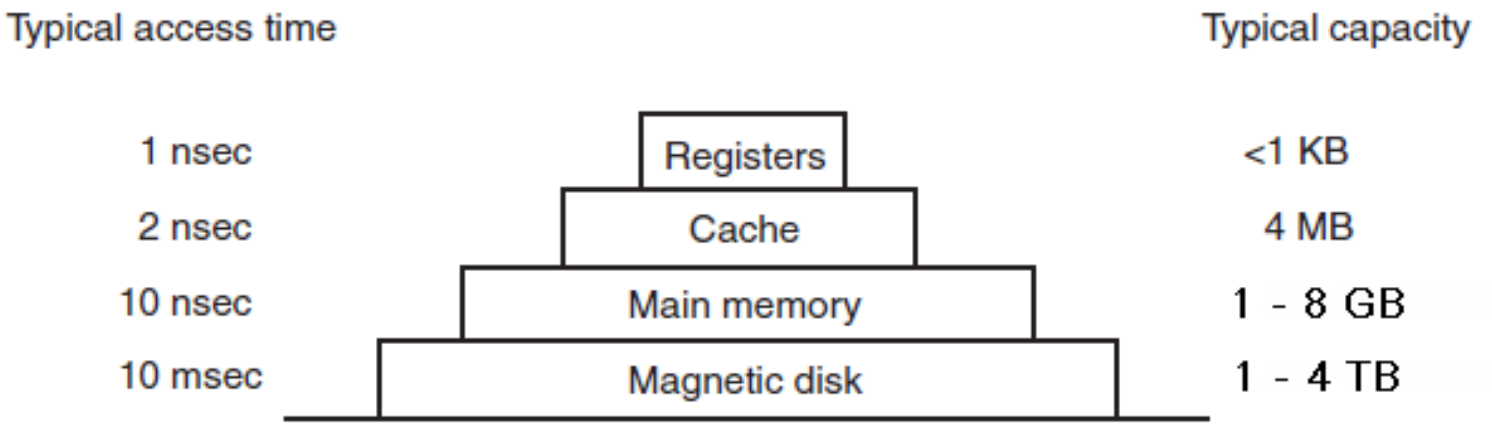
(a) A three-stage pipeline. (b) A superscalar CPU.

Memory



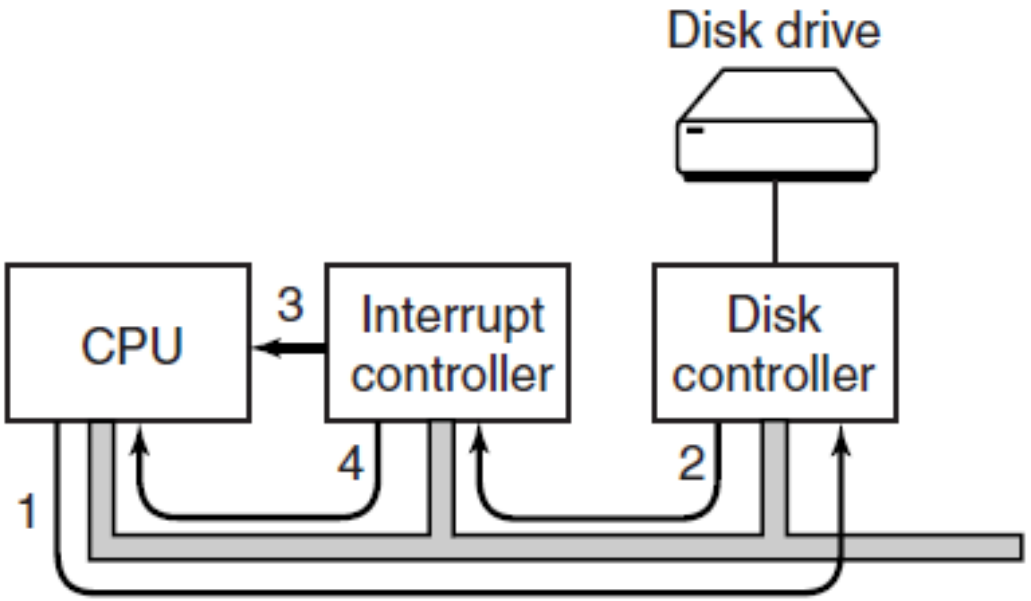
(a) A quad-core chip with a shared L2 cache.
(b) A quad-core chip with separate L2 caches.

Memory (2)



A typical memory hierarchy. The numbers are very rough approximations.

I/O Devices

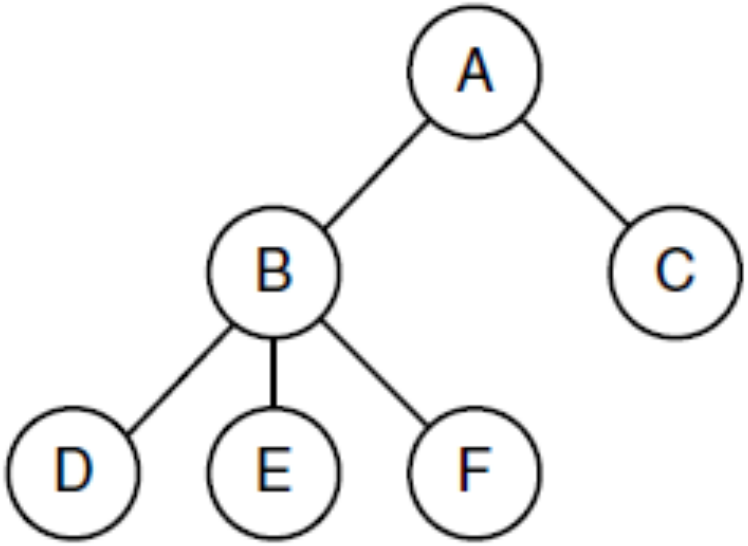


(a) The steps in starting an I/O device and getting an interrupt.

Processes

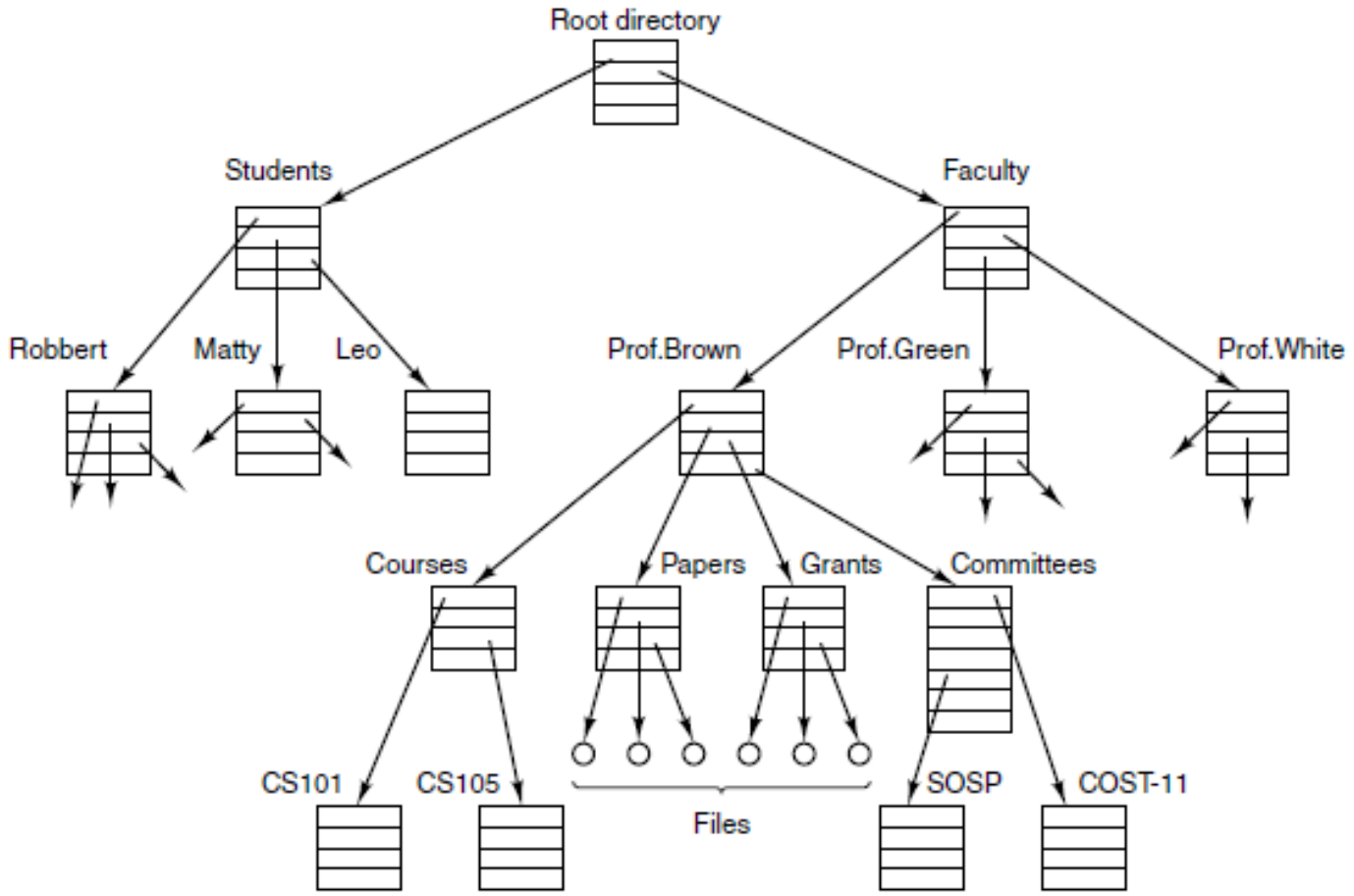
- Key concept in all operating systems
- Definition: a program in execution
- Process is associated with an address space
- Also associated with set of resources
- Process can be thought of as a container
  - Holds all information needed to run a program

Processes (2)



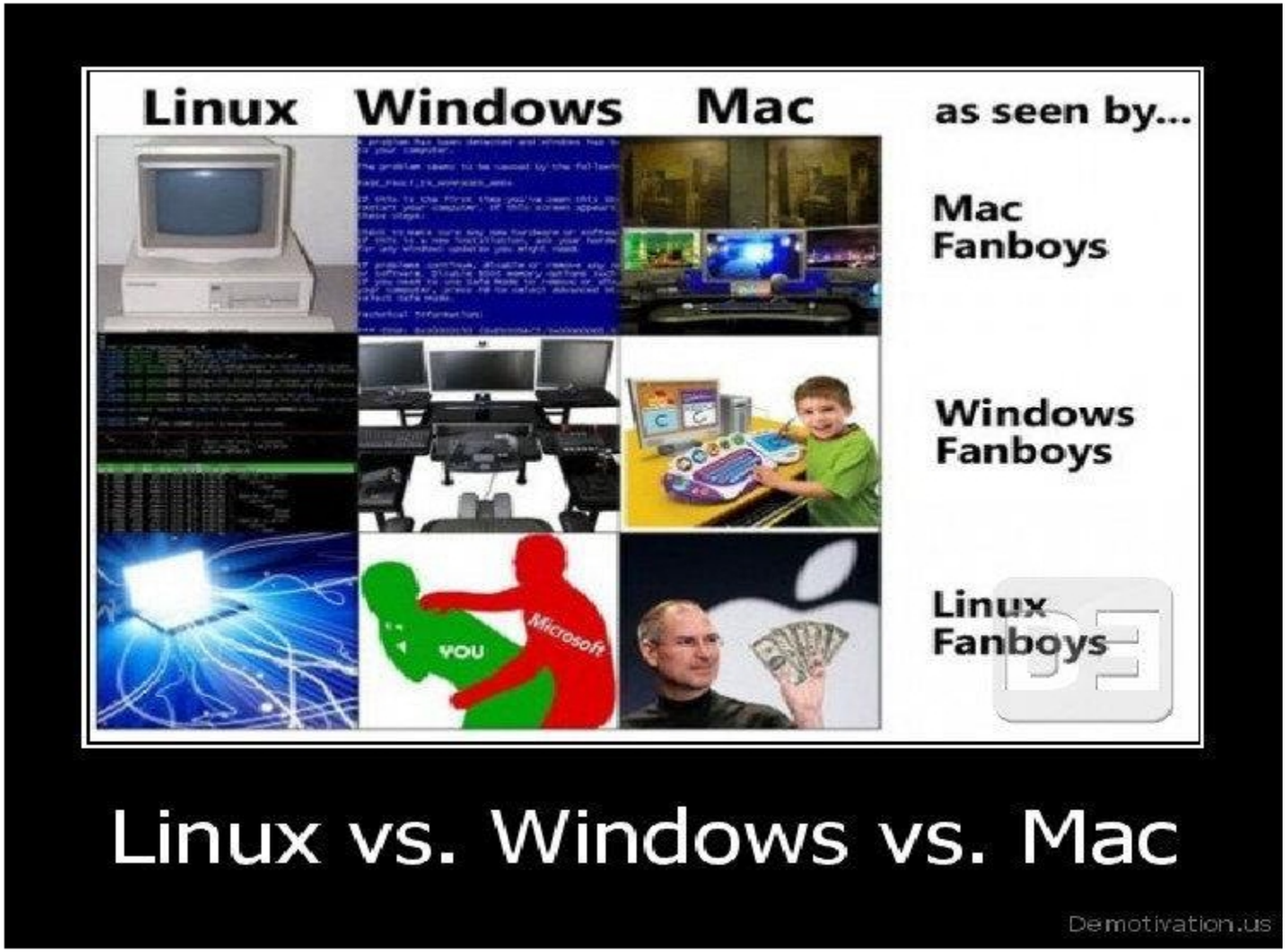
A process tree. Process A created two child processes, B and C. Process B created three child processes, D, E, and F.

File Systems



A file system for a university department.

Which OS is the Best?



And A Few Comments…

Linus Torvalds

- *Microsoft isn't evil, they just make really crappy operating systems.*
- *When you say, 'I wrote a program that crashed Windows,' people just stare at you blankly and say, 'Hey, I got those with the system, for free!'*

And a Few Photos

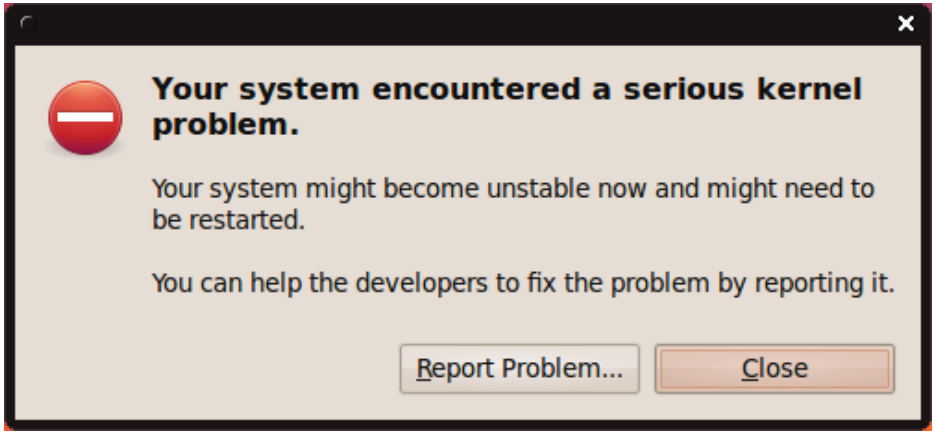
[The Windows system crashed when Bill Gates gave a demo…]

And a Few Photos (Cont.)

If you crash, crash big!

And a Few Photos (Cont.)

Crash does not happen only to Windows!



Conclusion

- Making the operating system work correctly is challenging!
- Before we try to make it work normally, at least we should know how it works.
- So welcome to CS 492!