# CS 149D, slide set 2

M. Overstreet
Old Dominion University
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## Current Topic

- Many people think information should be as free as possible
  - The internet helps
- One example: wikipedia
  - On on-line free encyclopedia
  - According to wikipedia, "wiki" comes from the side of buses in Honolulu airport (from "wiki-wiki", Hawaiian for "fast", "quick")
  - Entries written by volunteers
  - **Anyone** can edit. **Anyone!**
    - If you see a mistake, you should fix it!
    - Modeled on "open-source" software
      - Anyone can read the code
      - Best way of finding defects in the code
  - It works well—mostly
    - As accurate as Encyclopedia Britannica in most areas
    - As of this week, no-one from the U.S. House of Representatives is allowed to edit entries. They've be naughty!



# Chapter 3

Operating Systems

## Assignment

- Read chapter 3
  - Note that we have skipped chapter 2
    - You should thank me.



## Chapter 3 Operating Systems

- 3.1 The Evolution of Operating Systems
- 3.2 Operating System Architecture
- 3.3 Coordinating the Machine's Activities
- 3.4 Handling Competition Among Processes
- 3.5 Security



## Some functions of an operating system

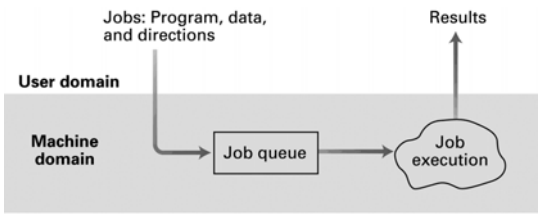
- Oversee operation of computer
- Store and retrieve files
- Manage access to networks
- Manage execution of several programs
- Protect things on the computer
  - From both intentional and unintentional actions

## Evolution of shared computing

- Batch processing
- Job queue
- Time-sharing
  - Multi-tasking: multiple tasks for a single user
  - Interactive processing
  - Real-time processing
- Scheduling multiprocessor machines

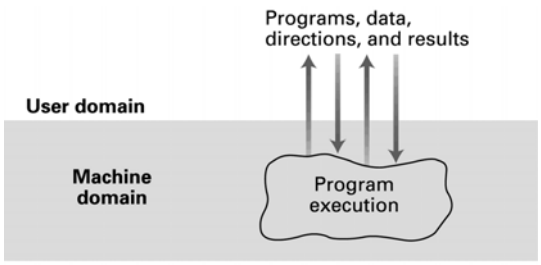


## **Figure 3.1** Batch processing (from many years ago)






## **Figure 3.2** Interactive processing

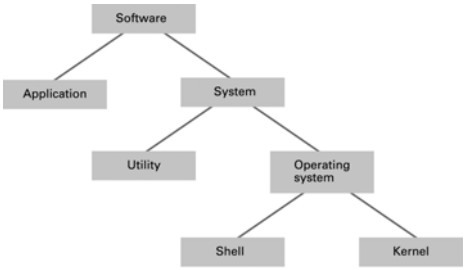


## Types of software

- Application software
  - perform specific tasks for users; usually buy separately
  - examples:
    - games, Microsoft word
- System software
  - perform tasks needed by all computer systems
  - operating system
  - utility software
- Sometimes not a clear distinction between them
  - e.g. Microsoft asserts that its media player is part of the operating system
  - to continue to sell Windows in Europe, they must provide an "unbundled" version



## **Figure 3.3** Software classification

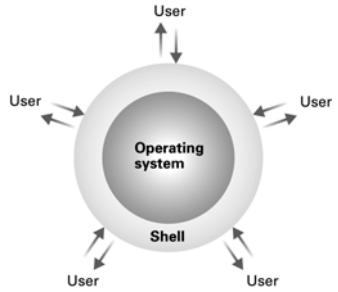





## Components of an operating system

- Shell: portion that communicates with users
  - Graphical user interface (GUI)
    - Window manager
  - Command line interface (CLI)
- Kernel: contains components performing basic required functions
  - File manager
  - Device drivers
  - Memory manager
  - Scheduler and dispatcher

**Figure 3.4** The shell as an interface between users and the operating system






## File Manager

- Directory or folder: user-created group or bundle of files
- Path: position of a file in directory hierarchy
- File descriptor: information needed to access an open file



## Memory manager

- Page: unit of memory managed (a few kilobytes)
- Virtual memory: illusionary memory space
  - Created by shuffling units of data, called pages, between actual main memory space and mass storage

## Major computer hardware components - 1

- Physical memory
  - Volatile (required, practically)
    - Contents lost if no electricity
    - Typical: 512 megabytes to 4 gigabytes
  - Nonvolatile (required, practically)
    - Contents remain even with no electricity
    - Much smaller; used primarily for booting
    - Usually Read Only (& called ROM)
  - Cache memory (required, practically)
    - Very small, very fast
    - Can really speed up computer
- Disk drives (required, practically)
  - Hard drives
  - Floppy drives
  - CD or DVD drives
- Computers used in “embedded” systems may omit everything but memory and CPU



## Computer Hardware - 2

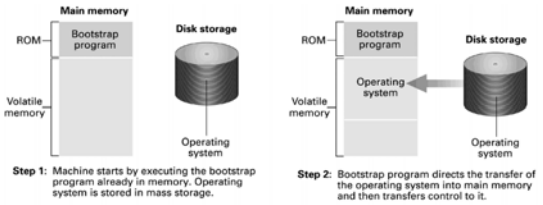
- Central Processing Unit (CPU) (required)
  - Where all “computation” occurs
    - Does arithmetic, compares values, etc.
  - CPU can’t do anything with data on disk or in memory (except copy to cache or CPU)
- Bus (required)
  - Used to transfer contents of memory to cache and CPU
  - Anything on disk must be copied to memory before it can be accessed
  - Anything in memory must be moved to cache and CPU before it can be processed
- Network card or modem (optional)
  - But almost necessary
  - Transfer data (music, pictures, documents) to/from machine
    - Often using the web



## Getting it started (bootstrapping)

- Bootstrap: program in read-only memory (ROM)
  - Run by the CPU when power is turned on
  - Transfers operating system from mass storage to main memory
  - Executes jump to operating system

## **Figure 3.5** The booting process






## Processes

- Program: a static set of instructions
  - an instruction is an atomic action that the computer hardware (CPU) can perform
- Process: the activity of executing a program
- Process state: current status of the activity
  - Snapshot of relevant parts of the machine state:
    - What instruction the program will run next
    - Partially completed actions that are not yet in memory
      - They're in **registers**
      - Example: before two numbers can be added by a computer, each must be move from computer memory to registers



## Process administration

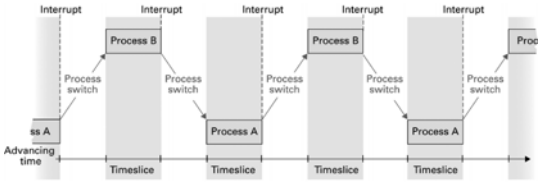
- Scheduler
  - Keeps state of all processes in an process table
    - Ready or waiting
    - Priority
    - Non-scheduling information: memory pages, files in use, etc.

## Process administration (continued)

- Dispatcher
  - Gives one time slice or quantum to a process that is ready
  - Executes a process switch (or context switch) when the running process's time slice is over
    - Interrupt indicates that time slice is over
    - Interrupt handler: part of dispatcher



## **Figure 3.6** Time-sharing between process A and process B






## Handling competition for a resource

- Semaphore = a software concept, thought of as a control flag telling if resource is in use
  - Test and set must be done together for proper function
- Critical region = sequence of instructions that should be executed by only one process at a time
  - Usually protected by a semaphore
- Mutual exclusion = requirement for proper implementation of a critical region

## Security: A major OS concern

- Dates from time when many people shared one computer:
  - Keep one person's process from causing another's to fail
  - Protect files
    - You can only read/change files you "own"
  - Only authorized people could use this very expensive device



## Common security approaches

- Only authorized people **have an object** that provides them access
  - Key, id-card, retina (for a retina scan)
- Only authorized people **know something** that gives them access
  - Password, special code
  - Very old example: Who won the last world series (used in WWII)
- Also used, but regarded as poor choice:
  - Security through obscurity
    - Assume no one will figure out the puzzle
- Quiz:
  1. what's a **shibboleth**? (Judges 14:4)
  2. what's the **enigma** machine?



## Security from outside mistakes or attacks

- Most common protection for computers: require user name and password
  - Problem: password stealing
    - Too many passwords!
  - Problem: automated password guessers
  - Countermeasures:
    - Always tell user when he/she last logged in
    - Report repeated bad guesses
    - Log the guesser into a captive account to spy on the guesser

## Security from mistakes or attacks from within

- Operating system prevents illegal access to resources
  - Different memory for different processes
  - Privileged instructions only allowed in kernel (thus the OS can do things others can't)
  - All file access passes through the kernel
  - Other devices can only be accessed through the kernel



## Homework, for Wed.

- Pg. 129: 14, 15
- Will discuss before exam