CSCI 330: Operating Systems

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What is an Operating System?

- Why do we need them?
- Why is defining them difficult?
- From whose perspective should we answer this question?

OS Goals

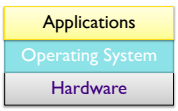
- Make computers easier to use
  - Abstraction!
  - Bridge gap between hardware and user experience
- Use computer hardware efficiently

Why are these two separate goals?

What is a "computer"?

What is an Operating System?

- A program that acts as an intermediary between a user of a computer and the computer hardware
  - Resource allocator
  - Control program



- Tasks:
  - Execute user programs and make solving user problems easier
  - Make the computer system convenient to use
  - Use the computer hardware in an efficient manner

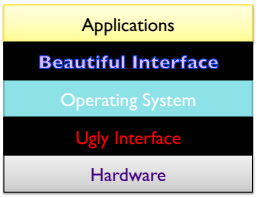
What is an Operating System?

- "Everything a vendor ships when you order an operating system"
- Types of Programs:
  - **Kernel**: the one program running at all times on the computer
  - **System program:** ships with the OS
  - **Application program**

Why is this program classification imprecise?

What is an Operating System?

- An interface:



Abstraction

- Separate:
  - Interface from internals
  - Specification from implementation
- Abstraction is a double-edged swor
  - "Don't hide power."
- More than an interface:

A **contract** for how an object is to be used and how it is to behave, across many variations of its specific use and implementation.

We want abstractions that are simple, powerful, efficient to implement, and long-lasting.

User's Perspective

- OS makes it easier to
  - Launch programs
  - Use multiple programs concurrently
  - Keep track of files
  - Add additional hardware devices
  - Run large programs
- OS goal: Improve the user experience.

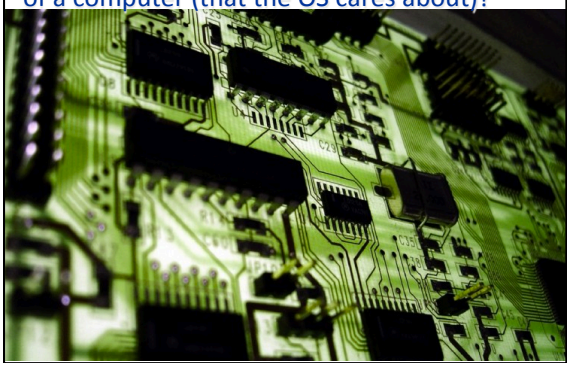
Programmer's Perspective

- The OS makes it easier for programs (and programmers) to use the computer by providing support for common tasks:
  - Accessing hardware devices
  - Sharing system resources with other programs
  - Exchanging information and coordinating with other programs

What is an Operating System?

- **Formally**: A program that acts as an intermediary between the computer user and the computer hardware
- **Goals**:
  - Make the computer system easy to use.
  - Use the computer hardware efficiently.
- It is an extended machine
  - Hides the messy details which must be performed
  - Presents user with a virtual machine, easier to use
- It is a resource manager
  - Each program gets time with the resource
  - Each program gets space on the resource

What are the hardware components of a computer (that the OS cares about)?



What are the hardware components of a computer?

- One or more processors (CPUs)
- Main memory
- Disks and other IO devices
- …

OS Components

- Essential managers of an operating system:
  - Memory Manager
  - Processor Manager
  - Device Manager
  - File Manager
- Each manager both works closely with the other managers and performs its unique role
- User Command Interface is unique to each operating system

Efficient Use of Hardware

- OS advances that allow more efficient use of computer hardware than running a single program at a time:
  - Task Switching
  - Multiprogramming
  - Timesharing
- The use of these advances necessitate that the OS also manage:
  - Resource allocation
  - Resource sharing
  - Protection and Security

OS Roles

- Referee:
  - Resource allocation among users, applications
  - Isolation of different users, applications from each other
  - Communication between users, applications
- Illusionist
  - Each application appears to have the entire machine to itself
  - Infinite number of processors, (near) infinite amount of memory, reliable storage, reliable network transport
- Glue
  - Libraries, user interface widgets, …

Why Should We Study OS?

One (bad) Answer

- To better understand the movie *The Social Network*

http://matt-welsh.blogspot.com/2010/10/in-defense-of-mark-zuckerberg.html
http://matt-welsh.blogspot.com/2009/02/how-i-almost-killed-facebook.html

Why Study OS?

- Understanding the OS helps you write better code
- Understand a wide range of system designs and tradeoffs of those designs

Design Considerations

- What should be in the hardware? In the OS? In the user applications?
  - What are the tradeoffs of these decisions?
- Ease of use vs. efficiency?

Design Decisions

- Depends on computer system's goals

Provide an example of
a) a system that prefers ease of use to efficiency
b) a system that prefers efficiency to ease of use

Course Objectives

- to demystify the interactions between the software you have written in other courses and hardware,
- to familiarize you with the issues involved in the design and implementation of modern operating systems,
- and to explain the more general systems principles that are used in the design of **all** computer systems

Learning Objectives

- Explain how operating systems manage concurrent processes including the complete life-cycle of user processes, threads, process synchronization, and deadlock avoidance.
- Evaluate algorithms used for process scheduling, memory allocation, and disk access.
- Understand how operating systems manage physical and virtual memory including segmentation and paging.
- Develop programs that emulate or interact with operating system code.

Class Details

- Course Web Site `http://www.cs.wlu.edu/~sprenkle/cs330`
  - Lecture slides, readings, assignments, resources
- Textbook
  - *Operating System Concepts Essentials*, Siberschatz, Galvin, and Gagne.
- Participation
  - Class discussions

Class Details

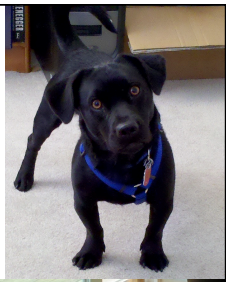
- Programming and Written Assignments
  - Various sizes
- OS Programming Projects
- 2 Exams
  - Midterm
  - Final

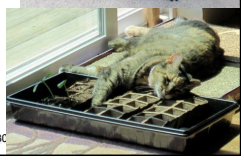
Course Dynamics

- Professor's Responsibilities:
  - Be prepared for class
  - Provide constructive feedback to students
  - Treat students with respect
  - Challenge and encourage students
  - Make material as clear as possible
- Student's Responsibilities
  - Be prepared for class (do readings and homework)
  - Give attention and effort in class to learning
  - Ask questions (**during class** and via email)
  - Use professor's office hours
  - Let professor know if something is going wrong
  - Treat other students and professor with respect

My Bio

- From Dallastown, PA
- B.S., Gettysburg College
- M.S., Duke University
- Ph.D., University of Delaware
- For fun: pop culture, gardening
- Volunteer at Rockbridge Animal Alliance





Where We Go From Here

- Read Chapter 1 in the text book