CSE 120
Principles of Operating Systems

Winter 2007

Lecture 1: Course Introduction

Keith Marzullo and Geoffrey M. Voelker

Lecture 1 Overview

- Class overview
- What is an operating system?

Personnel

- Instructors
  - Keith Marzullo: Section A00, T/Th 6:30pm
    - » Office hours: Tue 11am-12n, Fri 10-11am.
  - Geoff Voelker: Section B00, T/Th 8am
    - » Office hours: Mon 3-4pm, Wed 4-5pm
  - Sections equivalent, coursework shared
- TAs
  - Michael Vrable: Discussion A01, Wed @ 10a
  - Jeremy Lau: Discussion B01, Wed @ 3pm
  - Office hours TBD
  - Lead sections, support and grade homework, projects

CSE 120 Class Overview

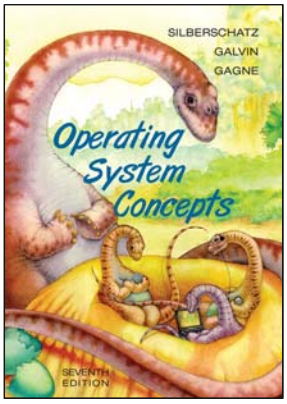
- Course material taught through class lectures, textbook readings, and handouts
- Course assignments are
  - Homework questions (mostly from the book)
  - Three large programming projects in groups
- Discussion sections are a forum for asking questions
  - Lecture material and homework
  - Additional OS topics (e.g., how does an OS boot?)
- Other forums
  - Mailing list (cse120@cs.ucsd.edu)
  - Discussion board (http://webboard.ucsd.edu)

Homeworks

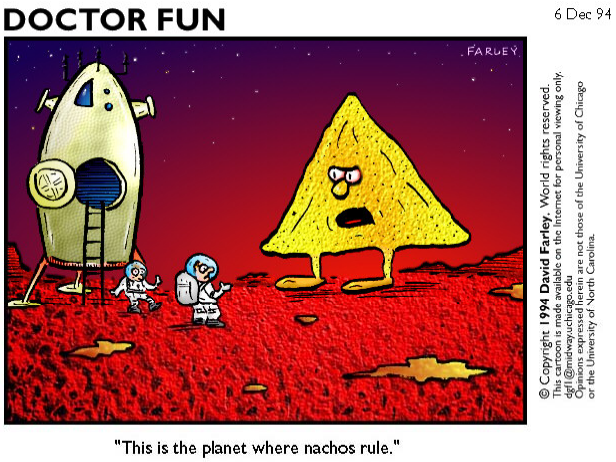
- There will be 4-5 homeworks throughout the quarter
  - Reinforce lecture material…no better practice
- Collaboration vs. cheating
  - I encourage you to discuss homework problems with others
    - » You can learn a lot from each other
  - But there is a distinction between collaboration and cheating
  - Rule of thumb: Discuss together in library, walk home, and write up answers independently
  - Cheating is copying from other student's homeworks or solution sets, searching for answers on the Web, etc.
  - Suspicious homeworks will be flagged for review

Textbook

- Silberschatz, Galvin, and Gagne, *Operating System Concepts*, John Wiley and Sons, 7th Edition, ISBN 0-471-69466-6



Nachos Project



Nachos

- Nachos is an instructional operating system
  - It is a user-level operating system and a machine simulator
    - » Not unlike the Java runtime environment
    - » Will become abundantly clear (or not so clear) very soon
  - Programming environment will be C++ on Unix (Linux/Solaris)
  - The projects will require serious time commitments
    - » Waiting until the last minute is not an option
- You will do three projects using Nachos
  - Concurrency and synchronization
  - Multiprogramming
  - Virtual memory
- You will work in groups of 1-4 on the projects
  - Start identifying partners now

Labs

- We will use the uAPE (B230) lab in the EBU3B basement
  - Linux running on Dell x86 machines
- You can also use your home machine
  - The same project source will work on Linux (but not Windows)
  - Note: We will test and grade on uAPE machines
  - Be sure to test your projects there as well

Exams

- Midterm
  - Thursday, Febuary 8
  - Covers first half of class
- Final
  - (A) Tue 3/20, 7-10pm
  - (B) Thu 3/22, 8-11am
  - Covers second half of class + selected material from first part
    - » I will be explicit about the material covered
- No makeup exams
  - Unless dire circumstances
- Crib sheet
  - You can bring one double-sided 8.5x11" page of notes to each exam to assist you in answering the questions
  - Not a substitute for thinking

Grading

- Homeworks: 15%
  - Think of these collectively as a take-home midterm
- Midterm: 25%
- Final: 30%
- Projects: 30%
  - Each project is 10% of your grade

How *Not* To Pass CSE 120

- Do not come to lecture
  - It's nice out, the slides are online, and the material is in the book anyway
  - Lecture material is the basis for exams and directly relates to the projects
- Do not do the homework
  - It's only 15% of the grade
  - Excellent practice for the exams, and some homework problems are exercises for helping with the project
  - 15% is actually a significant fraction of your grade (difference between an A and a C)

How *Not* To Pass (2)

- Do not ask questions in lecture, office hours, or email
  - It's scary, I don't want to embarrass myself
  - Asking questions is the best way to clarify lecture material at the time it is being presented
  - Office hours and email will help with homeworks, projects
- Wait until the last couple of days to start a project
  - We'll have to do the crunch anyways, why do it early?
  - The projects cannot be done in the last few days
  - Repeat: **The projects cannot be done in the last few days**
  - Some groups last time learned that starting early meant finishing all of the projects on time…and some didn't

Class Web Page

`http://www.cse.ucsd.edu/classes/wi07/cse120-b/`

- Serves many roles…
  - Course syllabus and schedule (updated over quarter)
    - » Lecture slides
  - Homework handouts
  - Project handouts (tons of info on Nachos, start now)
- Supplemental readings on Unix, monitors, and threads
  - e.g., seminal research paper describing the early Unix system
  - FYI only, but you might find it interesting
  - Concepts in paper might seem obvious and familiar, but they were new at one time

Questions

- Before we start the material, any questions about the class structure, contents, etc.?

Why Operating Systems?

- Why are we making you sit here today, having to suffer through a core course in operating systems?
  - It's not like everyone will become OS developers, after all
- Understand what you use
  - Understanding how an OS works helps you develop apps
  - System functionality, performance, efficiency, etc.
- Pervasive abstractions
  - Concurrency: Threads and synchronization are common modern programming abstractions (Java, .NET, etc.)
- Complex software systems
  - Many of you will go on to work on large software projects
  - OSes serve as examples of an evolution of complex systems

CSE 120 Course Material

- This course addresses classic OS concepts
  - Services provided by the OS
  - OS implementation on modern hardware
  - Co-evolution of hardware and software
  - Techniques for implementing software systems that are
    - » Large and complex
    - » Long-lived and evolving
    - » Concurrent
    - » Performance-critical
- System software tends to be mysterious
  - Virtual memory? Wazzat?
- Our goal is to reveal all mysteries

Fundamental OS Issues

- The fundamental issues/questions in this course are:
  - Structure: how is an operating system organized?
  - Sharing: how are resources shared among users?
  - Naming: how are resources named (by users and programs)?
  - Protection: how are users/programs protected from each other?
  - Security: how can information access/flow be restricted?
  - Communication: how to exchange data?
  - Reliability and fault tolerance: how to mask failures?
  - Extensibility: how to add new features?

Fundamental OS Issues (2)

- Concurrency: how to control parallel activities?
- Performance: how to make efficient use of resources, reduce OS overhead?
- Scale and growth: how to handle increased demand?
- Compatibility: can we ever do anything new?
- Distribution: how to coordinate remote operations?
- Accountability: how to charge for/restrict use of resources?

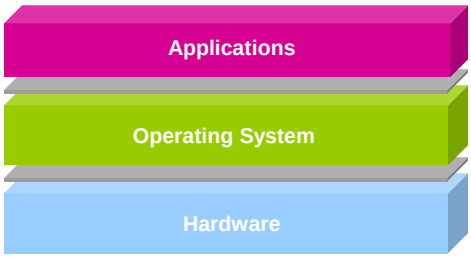
- And the principles in this course are the design methods, approaches, and solutions to these issues

What is an Operating System?

- How would you answer?
- (Yes, I know that's why you're taking the course…)
- (Note: There is no one good answer)

What is an operating system?

- The operating system is the software layer between user applications and the hardware



- The OS is “all the code that you didn’t have to write” to implement your application

The OS and Hardware

- The OS abstracts/controls/mediates access to hardware resources
  - Computation (CPUs)
  - Volatile storage (memory) and persistent storage (disk, etc.)
  - Communication (network, modem, etc.)
  - Input/output devices (keyboard, display, printer, camera, etc.)
- The OS defines a set of logical resources (objects) and a set of well-defined operations on those objects (interfaces)
  - Physical resources (CPU and memory)
  - Logical resources (files, programs, names)

The OS and Hardware (2)

- Benefits to applications
  - Simpler (no tweaking device registers)
  - Device independent (all network cards look the same)
  - Portable (across Windows95/98/ME/NT/2000/XP/Vista/…)
  - Transportable (same program across different OSes (Java))

The OS and Applications

- The OS defines a logical, well-defined environment…
  - Virtual machine (each program thinks it owns the computer)
- For users and programs to safely coexist, cooperate, share resources
  - Concurrent execution of multiple programs (timeslicing)
  - Communication among multiple programs (pipes, cut & paste)
  - Shared implementations of common facilities
    - » No need to implement the file system more than once
  - Mechanisms and policies to manage/share/protect resources
    - » File permissions (mechanism) and groups (policies)

Other Questions to Ponder

- What is part of an OS? What is not?
  - Is the windowing system part of an OS? Java?
- Popular OSes today are Windows, Linux, and OS X
  - How different/similar do you think these OSes are?
  - How would you go about answering that question?
- Somewhat surprisingly, OSes change all of the time
  - Consider the series of releases of NT, Linux, OS X…
  - What are the drivers of OS change?
  - What are the most compelling issues facing OSes today?

Pondering Cont'd

- How many lines of code in an OS?
  - Vista (2006): 50M (XP + 10M)
    - » What is largest kernel component?
  - OS X (2006): 86M
  - Debian 3.1 (2006): 213M
- What does this mean (for you)?
  - OSes are useful for learning about software complexity
  - OS kernel is only one component, however
    - » Linux 2.6.0: 6M
    - » KDE (X11): 4M
    - » Browser : 2M+
  - OS is just one example of many complex software systems
    - » If you become a developer, you will face complexity

For next class...

- Browse the course web
  - http://www.cse.ucsd.edu/classes/wi07/cse120-b/
- Read Chapters 1, 2, and 3
  - Start reading Nachos Chapter, Appendix C (online)
- Start thinking about partners for project groups
- No discussion this Wednesday (nothing to discuss)
- If you did not get email on cse120@cs.ucsd.edu list
  - Send Geoff (voelker@cs.ucsd.edu) your email address
- See me up front if you have any questions
- Let the fun begin!