Department of Physics,
Computer Science & Engineering

CPSC 410 – Operating Systems I

Chapter 0: Introduction

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Topics

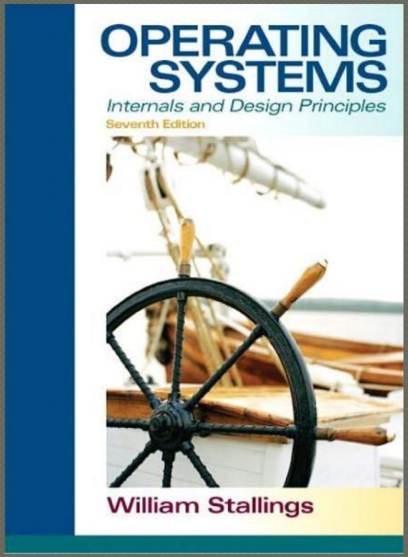
- Admin
  - prereqs, text, eval, etc…
- What is an Operating System (OS)?
- Where are OS coming from?
  - History by functionality
- Closing remarks
  - OS & Software Engineering

Admin: Your Background

- Some high level programming language
- CPSC 270 AND CPEN 214, CPSC 327 (C++)
- Pre or coreq CPSC 330 or CPEN 315

Admin: Text

- Operating Systems Internals and Design Principles, William Stallings, 7th or later Edition, Pearson, 2011.



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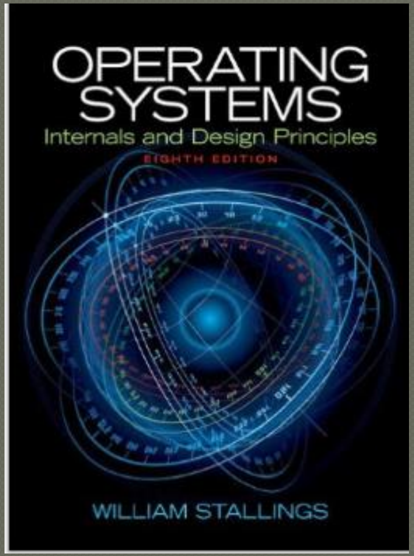


Admin: Evaluation

- Multiple projects — Probably 3 but may be as many as 8
- 1 midterm — Lateish in the semester
- 1 final

Admin: What you get from this class

- Some C++ experience
- How an OS works (multitasking)
- Scheduling
- Memory Management
- I/O management and File Management ← Wish
- Threads and concurrency ← Most Useful

Admin: Language

- C++
  - A brief review
  - One C++ starter project
  - The rest will be OS specific
- Why C++

Admin: Compiling and debugging

- C and C++ both compile to an executable
- Can use many compilers (clang, gcc, G++ …)
- Show you how to use gcc and g++
- Show you IDEs for C++
  - And I hope to demonstrate the advantage of an IDE

Admin: Development Environment

- Could use vim, g++, gdb, valgrind, tmux for a command line only dev environment
- Or an Integrated Development Environment (IDE)
- Lots to choose from, Codeblocks, Netbeans,Ms Visual Studio, Eclipse CDT…Clion
- We will use Eclipse CDT

Admin - Git

- You will use version control professionally, best to learn it now
- See ‘Git-The simple guide’ on course website
- In class demo

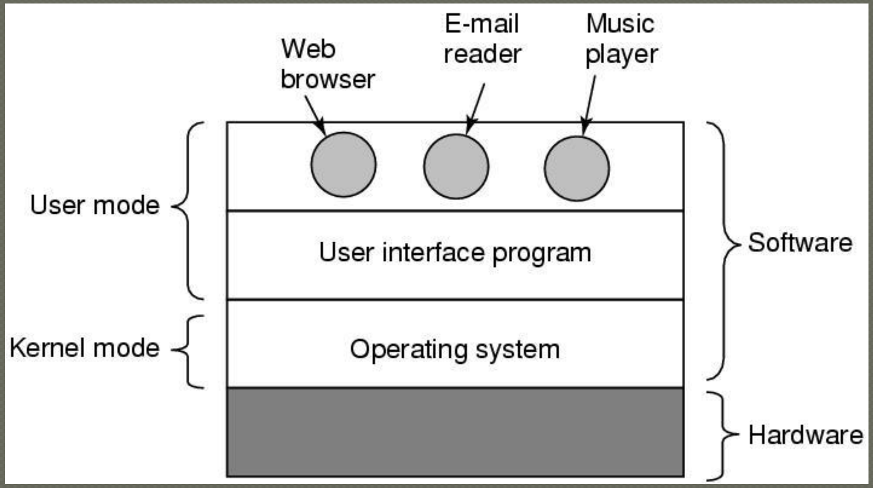
Admin - Linux

- Most of the worlds OSs are based on unix like kernels (Mac, Android, Linux)
- Lots of high performance remotely hosted (cloud) machines are linux (AWS, paperspace, etc)
- See tutorials on course website
- In class demo

- A bit on OS History

What is an OS?

- An Operating System is software that acts as:
  - 1) an Extended Machine
    - To provide consistent, simpler, high-level interfaces (abstractions) between user programs and hardware
  - 2) a Resource Manager
    - To provide an orderly and controlled access to hardware.



imagine CPSC150

If OS didn’t exist…
user programs would access hardware directly…
who wants to create programs dealing with details in { memory | disks | printers | network } ?

- An Operating Syst
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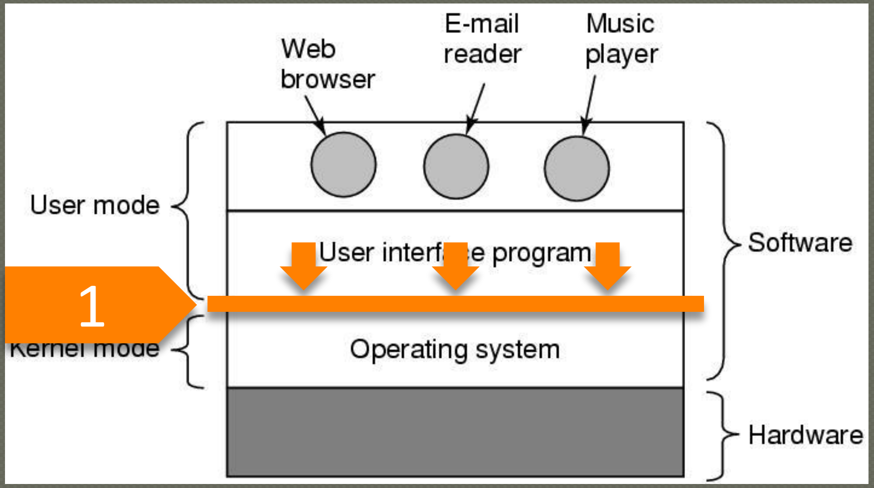


simple abstractions

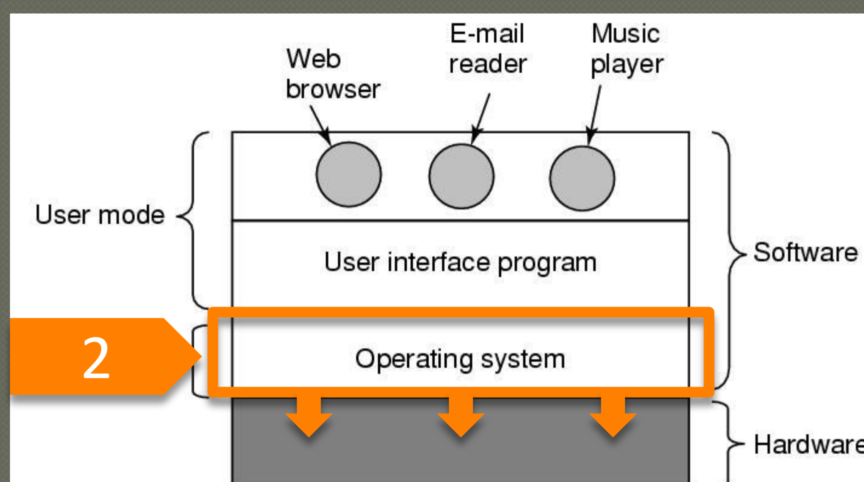
What is an OS?

- An Operating System is softwar… s:
  - 1) an Extended M…
    - To provide consist… (<u>abstractions</u>) betw…
  - 2) a Resource Manager
    - To provide an orderly and <u>controlled access</u> to hardware.

imagine CPSC150

If OS didn't exist…
user programs would access hardware directly…
what if 2+ programs <u>concurrently access</u> the same
{ memory | disks | printers | network } ?

controls <u>hardware</u>



History of OS

- 1. Using I/O devices
  - Problem
    - Programs should not handle I/O devices directly
      - e.g., spinning disk, moving disk arm, find tracks to read/write
  - Solution
    - Build modules (device drivers) to:
      - manage the interaction with I/O devices.
      - provide a high-level & consistent abstraction across device types
        - e.g. the concept of a “file” accessed through read/write operations.
  - Result
    - Programs dealt with a well-defined & simple interface for a range of device types (e.g., disks/tapes, printers)

History of OS

- 2. Idle CPU Time (between job runs)
  - Problem
    - Because of how early computers were used (programmers booked time slots), the CPU was idle most of the time waiting for input (from one programmer to the next) and output (e.g., printer, disk).
  - Solution
    - Queue incoming programs, so that they can be executed one immediately after another (batch processing), and queue outgoing results for processing (spooling).
  - Result
    - CPU is freed sooner to take next job

History of OS

- 3. Idle CPU Time (waiting for I/O)
  - Problem
    - Since the CPU is faster than I/O devices (e.g., printer, disk), the CPU must sit idle waiting for I/O operations to finish.
  - Solution
    - Allow another job to take over the CPU while an I/O operation in the current job finishes (multiprogramming).
    - Use memory buffers (to hold I/O data) and interrupts (to signal the CPU when an I/O operation is over).
  - Result
    - CPU performs cooperative multitasking (non-preemptive)

History of OS

- 4. Concurrent interactive programs
  - Problem
    - Several users provide real-time input and expect real-time output from programs, but dedicated computer time is expensive.
  - Solution
    - Allow several programs to alternate execution (multiprogramming) using time interrupts (preemptively)
  - Result
    - Users access a computer through multiple terminals, while given the illusion that their programs execute concurrently (at the same time).

OS Lessons & Challenges

- Lessons for Software Engineering
  - OS are some of the larger software projects ever attempted.
    - Hundreds of programmers
    - Millions of lines of code
  - How to tackle such an effort while…
    - creating few bugs?
    - being adaptable to change?

Next Time

- C++ outline
- Compiling, linking, running, debugging
  - The hard way
  - The easy way
- If you would like to follow along then please follow the instructions outlined in 'Install Eclipse CDT on Linux' on the course website