EECS 482: Introduction to operating systems

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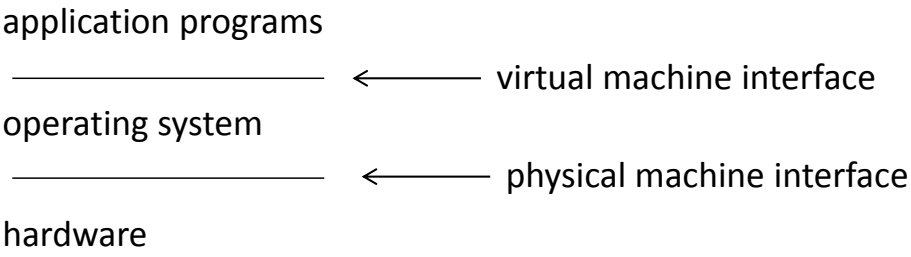
A complete picture of programs execute?

- EECS 280, EECS 281
  - Ideas into high-level programming language
- EECS 370
  - High-level program into machine instructions
  - How processor executes machine instructions
- Missing pieces?

What's an operating system?

- A software layer between the hardware and application programs



- Creates abstractions to make hardware easier to use
- Manages shared hardware resources
- For any area of OS (e.g., threads, address spaces, file systems, networking, security), ask
  - What interface does hardware present to OS (physical reality)?
  - What interface does OS present to applications?

Relationship between applications and the OS

- Perspective 1: application is main program; it gets services by calling kernel (OS)
- Perspective 2: OS is main program; calls applications as subroutines

Why study operating systems?

- You may write part of one

- The purposes and techniques of an OS appear in many domains
  - Abstraction, management
  - Concurrency, caching, indirection, naming, atomicity, authentication, protection
  - Cloud computing, web servers, concurrent programs, virtual machine monitors, …
  - OS principles are pervasive to all fields of computing

- Fun to "open the hood" and understand how things work

History of operating systems

- Hardware started out very expensive
- Operating systems started out very simple, then became more advanced to use expensive hardware more efficiently

- Single operator at console
  - Goal: basic functionality
  - Interactive
  - Very simple
    - One thing happening at a time
    - OS is library of standard services
  - Poor utilization of hardware resources

History of operating systems

- Batch processing
  - Goal: improve CPU and I/O utilization by removing user interaction
  - Submit job and wait for answer; no human interaction during execution
  - One job at a time
  - OS is batch monitor + library of standard services
  - Protection starts to become an issue: batch monitor must be able to run next program on queue
    - Why wasn't this an issue for single operator at console?

History of operating systems

- Multi-programmed batch
  - Goal: improve CPU and I/O utilization by overlapping CPU and I/O
  - Allows multiple I/Os to take place simultaneously
  - Allows CPU and I/O to take place simultaneously
  - OS getting more complex
    - OS switches between multiple processes
    - OS manages multiple I/O devices
    - OS must protect processes from each other
  - Still not interactive

History of operating systems

- Time sharing
  - Goal: allow people to interact with programs as they run
  - Insight: people can be modeled as a (very slow) I/O devices
  - Switch between processes while waiting for user
  - OS is now quite complicated
    - Lots of simultaneous jobs
    - Multiple sources of new jobs

History of operating systems

- Personal computers
  - Is the driving assumption (hardware is expensive) still true?
  - How does this affect OS design?
  - Agree/disagree: personal computers don't need to time share between multiple jobs?
  - Agree/disagree: personal computers don't need protection between multiple jobs?
  - Personal computing operating systems have gradually added back all features from time-sharing systems

History of operating systems

- What's next?
  - Operating systems for smartphones and wearable computing
  - Operating systems for cloud computing