CS331
Advanced Operating Systems

2:40—4:00 Tu/Th

Instructor: Shan Lu (JCL 343, shanlu@...)

Outline

- An overview of 331
  - Who am I
  - What this class will be about
- Introduce yourself
- A brief history of OS
- Administrative stuff

Who am I

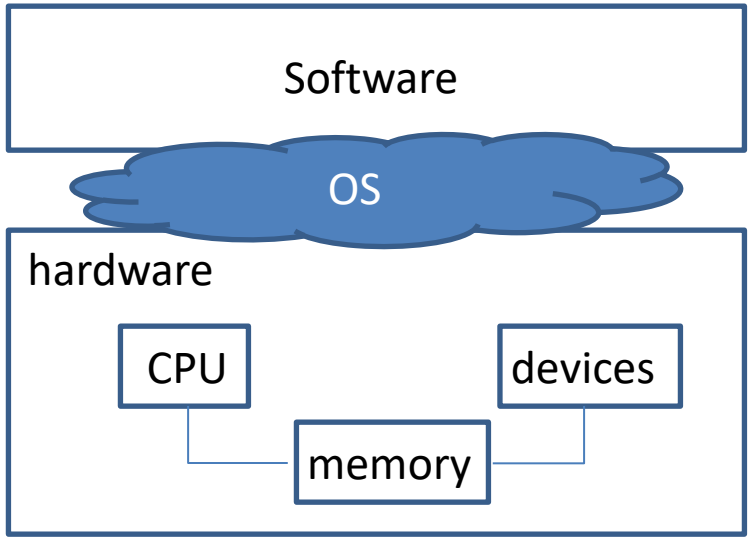
- Shan
  - Research
    - Software reliability & efficiency
    - Distributed systems, web applications, ML systems, end-user programming ...
  - Teaching
    - I enjoy discussion
    - We will use chalk board a lot
    - Thanks in advance for your feedback

What this class is about?

- What does operating system do?
  - Resource management
    - Schedule (CPU)
  - Security & protection
    - Files
    - Memory

What this class is about?

- What does operating system do?



Management
Protection
Communication
Interface
A software of software

What this class is about?

- What does operating system do?
  - Management, protection, communication, …
- What is the scope of software systems?

This class is about …

- Knowledge about OS and software systems
- System research approaches
- Recent system research topics

No textbook; paper reading

OS Knowledge

- Similar w/ CS230, except that …

- More emphasis on `research'
  - How did things come out and evolve?
    - What was the driving force
    - Why was this an important problem at that time
    - How was the problem addressed
    - The significance and impact
  - What are/were the alternative solutions?

Hopefully you are interested in history

OS research ideas/approaches

- Common themes
  - What are the criteria for a “good” system?
- Common tricks
- …

OS research ideas/approaches

- Common themes
  - Performance
  - Complexity
  - Usability
  - Protection and security
- Common tricks
  - Caching
  - Indirection
  - Modularity/abstraction
  - Mechanism vs. policy
  - Hardware support
  - Balance/trade-off
- …

Am I qualified to take the class?

https://pages.cs.wisc.edu/~remzi/OSTEP/

What do you need to do?

- Paper reading
  - Get knowledge; writing tips; **taste**
  - Answer questions before class, ask questions in class
- Come to class
- Do a project
  - Proposal
  - Implementation
  - Write-up and presentation

Introduce yourself!

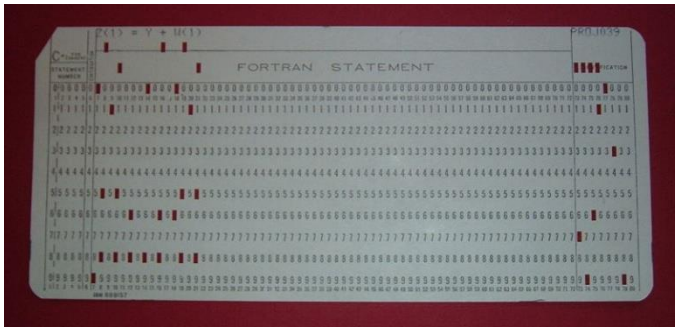
- Name
- Which year are you in?
- Something interesting about yourself

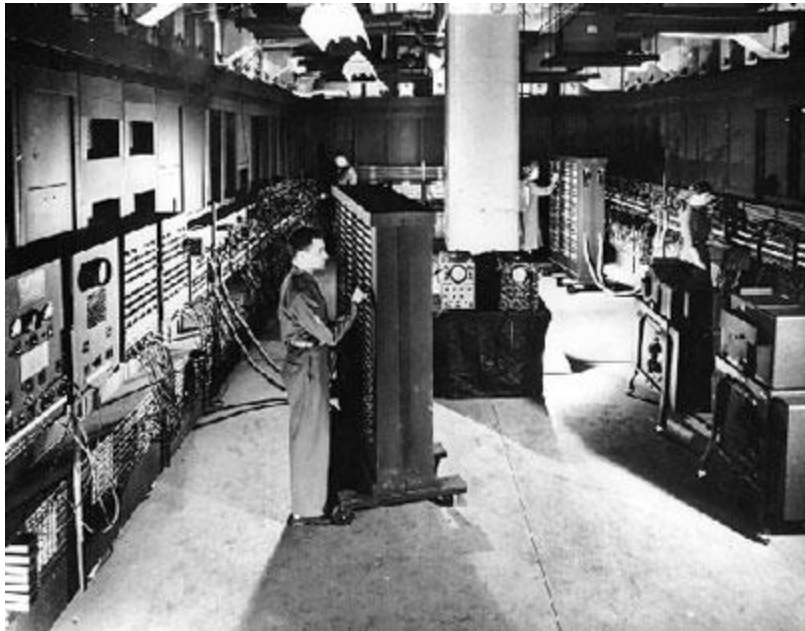
- What do you want to learn from this class?

- What research topic (inside and outside OS) are you interested in?

A brief history of OS (i)

- 1st period (1940's—1950's)
  - Machine is very expensive
    - Most things are manual
  - Software
    - No high-level language

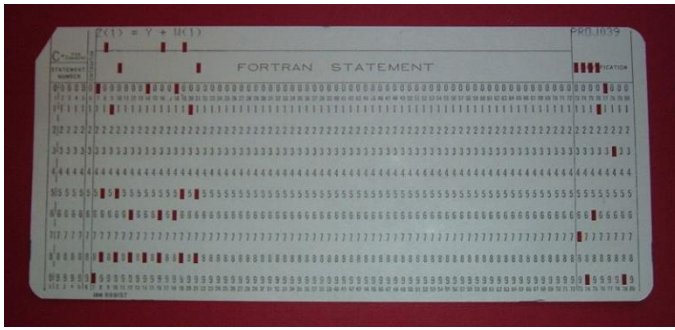


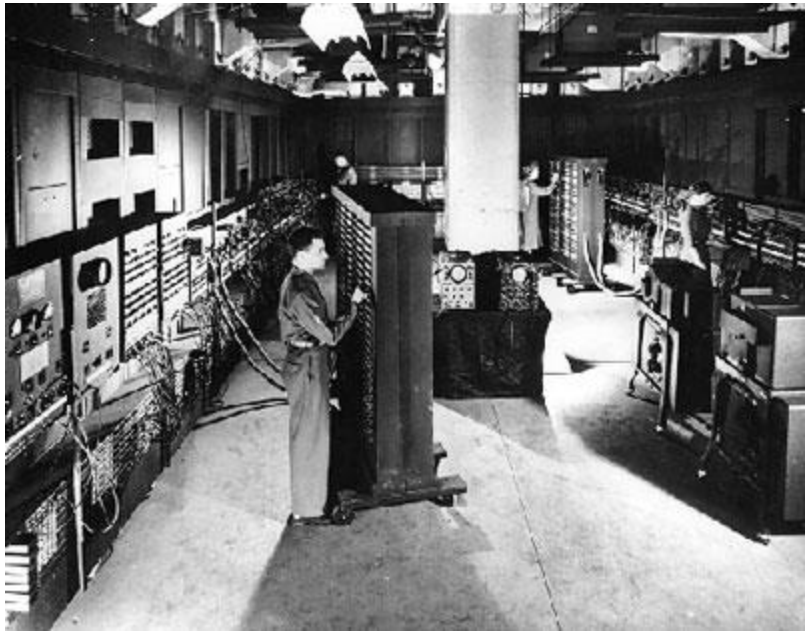


Q: was there OS? Why …?

A brief history of OS (i)

- 1st period (1940's—1950's)
  - Machine is very expensive
    - Most things are manual
  - Software
    - Library, I/O device, compiler
    - No OS
    - Long software setup time





A brief history of OS (ii)

- 2nd period (1950's)
  - Batching system
    - A deck of card/paper-tape at a time

    Q: what does OS do?
    - OS is a loader
      - Handles interrupt, no scheduling
  - Magnetic tape (replaces paper tape)
    - Use separate machine to turn paper-tape to magnetic tape
  - Disk replaces magnetic tape
    - Reading to disk can go together with calculation (spooling)

UNIVAC

A brief history of OS (iii)

- 1960---1970’s
  - `advanced batch OS’
    - Virtual memory
      - Ease programming
      - Atlas [1961] a batch OS with spooling
    - Multi-programming
      - Improve CPU utility
      - THE [1968] 5-job at a time, s/w VM
      - DOS/360 [1966 IBM] 3-job at a time, no VM
  - Time-sharing OS
    - Human interaction becomes more important
      - CTSS [1962], Multics [1965~], Unix [1969]

A brief history of OS (iv)

- 1980's
  - PC OS
    - Back to single-user and single address-space
    - Pilot [1980 Xerox]
    - PC-DOS, MS-DOS (single task)
- 1990's--
  - PC OS goes back to old mainframe style
    - Multi-user, multi-task, protection, virtualization

Current OS research

- Complexity
- Reliability & Security
- Scalability
  - Multicore, cloud computing, edge computing
- Opportunities/challenges from new hardware/workload
  - SSD
  - Persistent memory
  - Sensors
  - Heterogeneity
  - Machine learning

Administration

A brief overview of our schedule

- 3 lec — OS (kernel) organization
- 3 lec — Concurrency; Resource management
- (project proposal due)
- 1 lec — Virtualization
- Midterm
- 3.5 lec — File systems (local & distributed)
- 1.5 lec — Distributed systems
- 1 lec — Reliability
- 2 lec — Project Presentation

Things you will do (i)

- Paper reading
  - Form a reading group (2~4 people)
    - Let me know if you cannot find partners
  - Read the paper(s) BEFORE every class
  - Submit Question-Answer BEFORE every class

    Send to me (shanlu@) with 331 in the email subject

Things you will do (ii)

- Come to class (if your time zone allows)
  - Ask questions
  - Answer questions
- If you cannot make the lectures
  - Watch zoom recording
- Class website

  https://www.classes.cs.uchicago.edu/archive/2021/spring/33100-1/index.html

Things you will do (iii)

- A course project
  - Who 3~4 people group
  - When now
  - What
    - Decide topic & write project proposal (4/20)
    - Do the work
    - Final report (6/1) & group presentation (5/25, 5/27)

Things you will do (iv)

- Mid-term
  - April 29th
- Final
  - June ??

Grading

- 20% paper-reading question answers
- 20% mid-term
- 20% Final
- 40% course project

Summary

- Things to do
  - Form a reading group
  - Write a review for THE/Nucleus
  - Start thinking about project proposal
- Things to remember
  - This class is research oriented
  - System research is fun
  - Interact with your instructor ☺!