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?
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
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)

- 1\textsuperscript{st} 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)

• 2\textsuperscript{nd} 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)
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 😊!