Graduate Operating Systems

Fall 2018

Course Overview

• Instructor:
  – Christian Poellabauer (cpoellab@nd.edu)
• Course Meetings
  – TR 9:30 – 10:45
  – DeBartolo 141
• TA:
  – John Templeton (office hours & locations will be announced on website)
• Office Hours
  – Tuesday 1-2 & Thursday 11-12 or send email
  – Course web site, announcements
Course Overview

• Three primary components:
  – Read and discuss papers (quizzes, exams)
  – Work on a research project (reports, papers, presentations, software, review)
  – “Grad Student 101”

Goals of Course

• Learn about advanced systems issues
• Pass the qualifying exam
• Learn about systems research
• Learn about “life as a grad student & researcher”
OS Research Literature

- How has the role of the OS evolved?
- What are key principles for OS?
- How did past influence present?
- What are current trends and what will the future bring?

Reading/Critiquing Papers

- Read many, many papers
- Discuss papers, methodology, problems they address, solutions they propose, etc.
- Determine what makes a good research paper
- Typically discuss 2 papers per lecture
Why?

• Establish a common language and history
• Know/critique what is known
• Explore what is unknown
• Become experts

Papers and Discussions

• Classical/important/recent papers
• Papers that demonstrate excellence in research
• Papers that demonstrate how the field is changing
• Be willing to question the paper
• Be willing to take a position
• Be willing to be wrong
• Understand that there is likely to be no right or wrong answer
Engineering vs Research

• “I want to build a mouse trap”
  – “Is my new mouse trap better at trapping mice than a conventional mouse trap?”
  – “Are there common traits among the mice that are being captured (and the ones not being captured)?”
  – “Does habituation occur and how?”

Engineering vs Research

• Research requires a question!
  – Is my mousetrap better?
  – Why?
  – Are there characteristics (materials) that make better traps?
  – If my mousetrap were invisible, would it be better?
  – How can we build an invisible mousetrap?
Engineering vs Research

• Engineering helps you ask the question
  – Create a prototype mousetrap
  – Build a framework in which to evaluate the efficacy of mousetraps
  – Designing experiments combines engineering and research
  – Conducting experiments is often engineering
  – Analyzing and interpreting the results is research

Reproducible/Diligent Research

• Write down everything
• Understand the numbers
• Question yourself constantly
• Remind yourself of the question you are asking
OS Research

• Applications are changing and demands change
• CPU vs memory vs I/O vs ...
• New technologies (multi-core, hyperthreading, SSD, ...)
• Distributed, networked, mobile, ...

Evaluate a Hypothesis

• Measure
• Measure
• Measure again
• Use real systems
• Gather trace data
• Instrument existing system
• Simulate
• Analytical investigation
• Isolate small components
Draw Conclusions

- Use results to suggest new hypotheses
- Compare results against others’ results

Research

- There are not necessarily any right answers
- No one can tell you with certainty that you are right
- You are never done
- Understanding large systems is difficult
# Research Papers

- Big idea papers, unifying themes, small ideas with evaluation, measurements, comparisons, retrospective or experience papers, ...
- Keep track of important/relevant/good papers in your field (bibliography, bib file, etc.)

## Research Papers

- Is the problem well described/motivated?
- Does the idea make sense?
- Does the paper make a difference?
- What is being measured/proven/demonstrated?
- Are the measurements (experimental setup) meaningful?
- Are the results meaningful?
Critiquing

- Summarize paper in 1-3 sentences
- Put papers in categories (e.g., classic, important, useless, ...)
- Is the paper well-written?
- What did you learn from the paper?
- How would you have conducted the research?
- Does the paper suggest any future work?

Writing a Paper

- Abstract: introduce area, state problem, explain approach, summarize conclusions
- Introduction: describe problem, importance, approach and contributions, road map
- Background: anything reader needs to know
- Approach/Solution: what you did
- Results: experimental setup, explain expected results, surprising results
- Related Work: relate your work to prior efforts
- Conclusions (and future work)
Writing a Paper

• SPELL CHECK!!!!!!!!!!!!!!!
• Learn grammar, style, etc., adapt to your field/advisor/community/…
• Read and critique your own work!!! Are you satisfied? If you know there is a problem, a reviewer will find it too
• Write while you do the work; keep track of all you do; safely store data!

Next Up: Entrance Exam & Reading List

• “Exam” on Thursday; results by Tuesday
  – Nobody will be kicked out, but you may realize that you:
    • May want to wait a year and take ugrad OS first
    • Need to learn (some) basic OS concepts in parallel
• Course website; “resources” link
• 1-2 papers per lecture
• Typical course structure:
  – Quiz (5 minutes; not each lecture)
  – Introduction into subject (not each lecture)
  – Discussion of paper(s)
  – Discussion of “grad student life” topics (time permitting)
• First papers: next week Tuesday
• Start thinking about annotated bibliography & project proposal