Graduate Operating Systems
CSE 60641

Fall 2019

Course Overview

• Instructor:
  – Christian Poellabauer (cpoellab@nd.edu)

• Course Meetings
  – TR 9:30 – 10:45
  – Hayes-Healy 127

• TA:
  – Yuan Gong (office hours & locations will be announced in class and on website)

• Office Hours
  – Monday 9-10 & Thursday 11-12 or stop by/send email
  – Course web site, announcements
Course Overview

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

Goals of Course

• Operating systems research
• Reading, reviewing, critiquing research literature
• Conduct operating systems research (including paper writing process)
• Pass the qualifying exam
• 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 papers
• Discuss papers, methodology, problems they address, solutions they propose, etc.
• Determine what makes a good research paper
• Discuss 1-2 papers per lecture
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 not always a “right” or “wrong” answer

Engineering vs Research

- “I want to build a mouse trap”
  - This is not research
Engineering vs Research

• “I want to build a mouse trap”
  – “Is my new mouse trap better at trapping mice than a conventional mouse trap?” (Why?)
  – “Are there common traits among the mice that are being captured (and the ones not being captured)?”
  – Are there characteristics (materials) that make better traps?
  – “Does habituation occur and how?”
  – If my mousetrap were invisible, would it be better?
  – How can we build an invisible mousetrap?

  – Research requires a question!
  – Research often requires engineering!

Engineering vs Research

• Engineering helps you answer 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 data
- Question yourself constantly
- Remind yourself of the question you are asking
- Keep (publish) the data
- Avoid bias
- Be careful (ethical) using & interpreting data

Research

- There are not necessarily any right answers
- No one can tell you with certainty that you are right
- You are never really done
- Understanding (and working with) large systems is difficult
Examples of Research Approaches

• Form a hypothesis
• Measure a real system (trace data)
• Instrument existing systems (and measure again)
• Run simulations
• Analytical investigation of collected data
• Micro vs macro investigations
• Draw conclusions
• Compare results against others’ results
• Use results to form new hypotheses

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!

Writing a Paper

• LaTeX
  — Recommendation: Overleaf/Sharelatex
• Microsoft Word
  — Recommendation: Google Docs
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 undergrad 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