Graduate Operating Systems

Fall 2017

Course Overview

• Instructor:
  – Christian Poellabauer (cpoellab@nd.edu)
• Course Meetings
  – TR 9:30 – 10:45
  – DeBartolo 125
• TA:
  – Suraj Mishra (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

• Two primary components:
  – Read and discuss papers (quizzes, exams)
  – Work on a research project (reports, papers, presentations, software, review)

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
• Understand the numbers
• Remind yourself of the question you are asking
• Understand the numbers
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!

OS Research

• How to produce quality research
• Identify a research problem
• Design an experimental setup
• Build, measure, analyze, question, etc.
• Report, present, write, etc.
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 or Thursday
- Start thinking about annotated bibliography & project proposal