Scaling Learning Experiences when Teaching Large Courses
Today's Goals

1. Discuss:
   How do you make the most effective use of student's time?

2. Explore:
   What can a large lecture course achieve that a smaller course cannot?
My Background

• I teach large courses.
  • COMP110 - Introduction to Programming
  • COMP211 - Systems Fundamentals
  • COMP423 (Future) - Foundations Soft. Eng
  • COMP426 - Modern Web Development

• > 10,000 students in 8 years
Time is your student's and your course's scarce resource.

• How does the design of your course allocate student's time?
  
  • Knowledge Acquisition
    • Reading
    • Watching
    • Listening
  
  • Knowledge Application
    • Working problems
    • Programming
    • Completing assessments
  
  • How is time spent synchronously vs. asynchronously?
    • How is time spent in the classroom vs. outside of it?
Think, Pair, Share

1. In a large CS course, what is more impactful for learning outcomes: time spent on knowledge acquisition or on knowledge application?

2. Class meetings are an expensive synchronization checkpoint and the scarcest slices of student's time you have. How do you allocate time in-class to knowledge acquisition vs knowledge application?

• Think on these points for a minute.
• Share with your neighbor(s) for a minute.
• Then we'll discuss.
What is active learning?

“What active learning engages students in the process of learning through activities and/or discussion in class, as opposed to passively listening to an expert.

It also emphasizes higher-order thinking and often involves group work.”
The Case for Active Learning vs. Lecturing

• Key findings in most comprehensive meta-analysis to date
• “Active learning increases student performance in science, engineering, and mathematics” – 2014 Proceedings of the National Academy of Sciences – Scott Freeman, Sarah L. Eddy, et. al.
• 225 studies with data from 29,300 students
• Criteria for admission were studies that compared traditional lecture vs. “active” classified as 10% to 100% of class time on active learning activities including
  • Cooperative group activities in class
  • In-class worksheets
  • Clickers / Digital Response Systems
  • Problem-based Learning
  • Digital Studios
The meta-analysis focused on two questions:

- Does active learning *raise* examination scores?
- Does active learning *lower* failure rates?
Does active learning *raise* examination scores?

- Yes, on average, by just under ½ standard deviation.

- In “letter grade” terms by about a third of a letter, i.e. B to B+, B+ to A-, and so on.

- Fail-safe numbers on publication bias: 114 studies with effect size 0 would be necessary to negate findings.
Does active learning **lower** failure rates?

- Yes. “On average, students in traditional lecture courses are 1.5 times more likely to fail than students in courses with active learning.”

- “If the experiments here had been conducted as randomized controlled trials of medical interventions, they may have been **stopped for benefit** – meaning that enrolling patients in the **control condition** might be discontinued because the treatment being tested was **clearly more beneficial**.”

- Fail-safe numbers on publication bias: 438 studies with effect size 0 would be necessary to negate findings.
Are these effects only relevant to large courses?

- No!

- The strongest effects were observed in courses with < 50 students.

- The findings were durable across all sizes.
Who benefits from active learning and high structure?

• Results from UNC’s Kelly Hogan (BIOL) in her 2014 paper “Getting Under the Hood: How and for Whom Does Increasing Course Structure Work?”

• “We found that a "moderate-structure" intervention increased course performance for all student populations, but worked disproportionately well for black students-halving the black-white achievement gap-and first-generation students-closing the achievement gap with continuing-generation students.”

• Everyone benefits. Underrepresented groups benefited most.
Flipped Classrooms and Frequent Assessment

• Deliver canned lessons outside of class through
  • Videos
  • Readings
  • "Check for understanding" questions

• Use policy and small incentives to ensure students prepare
  • "You can use one page of notes to take the next low stakes quiz"

• Lecture focuses on common misconceptions, practice, and engagement.

• Evidence-based research supports the efficacy of flipped classrooms.
What can a large lecture course achieve that a smaller course cannot?

In the Trailing Week

One-on-one meetings: 352
Students: 196
Wait Time: 2.4min +/- 3.6min
Duration: 15.0min +/- 18.5min
High-availability and Fault-tolerance

• Managing a large course is an exercise in distributed systems design

• More students means larger staffs
  • More availability outside of the classroom for help!

• Laws of large numbers means lots of issues
  • If 2% of students have a computer hardware failure…
    1 student in a 50 student class, 16 in COMP110
  • Deaths in family, injuries, depression. You see it all.
  • The only way to address this is to build-in fault tolerance policies.
    • Automatically drop or replace a few low grades
    • Late policies not to penalize, but to prevent students from falling behind
The Importance of UTAs

• Provide high quality 1:1 help
  • Staffing around the clock!

• Distribute the e-mail load, grading load, review sessions

• Have recently been in the student's seats

• A great source of feedback and ideas for improving the course
Data Points – COMP110 Fall 2016

• Performance
  • Poll Everywhere
  • Assignment (12,582 final submissions)
  • Exams (57,200 data points)

• Effort
  • Office Hours Visits
    • 664 students visited at least once
    • 8,018 interactions
  • Poll Everywhere (91,950 responses)
  • Assignment Attempts (38,918 submissions)
  • Review Sessions (566 check-ins*)

• Suggestive
  • Mid-semester Feedback (855 responses)
  • Suggestion Box Form (100 suggestions)
  • Teaching Evaluations (484 evals)

• Out-of-Band
  • LA Applications (N=105)

Data helps you steer the course and spend more time effectively.