Undergraduate Curriculum Discussion

October 7, 2015

Andrew Tolmach, Mark Jones, and others with original impetus and much of the ground work from Tom Shrimpton
Context

• Paperwork for curriculum changes in 2016-17 needs to be completed by mid November

• Today: Share some ideas from conversations in three areas
  • Math core (stats, 250/251, ...)
  • Programming languages
  • Theory track

• Finalize/vote on proposals during 11/4 meeting
What do we hope to gain?

- Opportunity to align with newer models for curriculum (e.g., CS 2013), texts, etc.
- Reduced size of required core, greater opportunity for new and diverse electives
- Shorter critical path to capstone, increased completion rates
- Remove uninterested students from courses that are no longer required
Rethinking the Math Core
Origins

• Tom Shrimpton represented the department in conversations about suitability of STAT 451 for students in MCECS

• Where does statistics fit in our curriculum?
  • Internal needs
  • ABET expectations
  • Disciplinary standards
ABET Criteria for Computing Programs

Students must have the following amounts of course work or equivalent educational experience:

1. Mathematics: At least one half year that must include discrete mathematics. The additional mathematics might consist of courses in areas such as calculus, linear algebra, numerical methods, probability, statistics, number theory, geometry, or symbolic logic.

method and provides students with an opportunity to experience this mode of inquiry in courses for science or engineering majors that provide some exposure to laboratory work.
Summary from CS2013

• Recommends basic topics in probability as part of core curriculum:
  • Finite probability spaces; Probability measures; Conditional probability; Independence; Integer random variables; Expectation
  • (We don't currently cover these in our core)

• Suggests a role for statistics in electives such as cryptography, machine learning, computer vision, and HCI (experimental design)
Rethinking Our Math Core

• Proposal for this year:
  • Drop requirement for STAT 451

• Topics for conversation this year:
  • Identify material in CS 250/251 that should be moved or dropped to make room for probability and statistics
  • General review (e.g., transition 251 to an UD elective?)
  • Consider community college articulations
Programming Languages
PoPL Principles of Programming Languages

• New required class (CS3xx?), replacing 321 and 322, which transition to electives

• Collects and reinforces core material on PL and logic from current 251, 311, 321, and 322

• Requires 250 (but not 251 or 311)

• Informed by CS2013

• Key topics: context free grammars; syntax vs semantics; interpreters and compilers; basic logic; programs as data; basic type systems; intro to program correctness
What Do We Lose?

• Reduced opportunities for motivating and illustrating for practical impacts of theory in CS (e.g., automata, parser generators)

• Reduced understanding of low-level performance issues

• Reduced student exposure to substantial individual programming projects
Programming Intensive (PI) Courses

• Certain upper division CS classes will be designated as “Programming Intensive” (PI)

• Students will be required to complete a certain number of PI courses for graduation (number set to match required courses in current curriculum)

• Any combination of required or elective courses may be used to meet this requirement
(Proposed) Requirements for PI Designation

• Provide students with experience of navigating and working with codebases that have many moving parts

• Require one or more significant, individual programming projects with:
  • an aggregate span of at least five weeks
  • an expectation that students will be creating or extending one or more codebases that involve, by default, at least 1000 lines of code and 10 distinct compilation units.

• PI components must be documented explicitly in the course learning objectives
Additional Details

• The FT Faculty are responsible for ensuring that the PI designation is used appropriately and consistently

• Likely candidates include: CS300, CS321, CS322, CS333, CS415, CS447, ... (+ likely several 410s)

• Requires an administrative process to track and share PI designations with students

• In 2016-17, we would offer PoPL twice, with one CS 321/322 sequence
  • No net change in number of class sections
  • Better distribution of students to electives
Theory Track
Theory Track

• Goal: Ensure a place for theory in the curriculum while providing more flexibility for students and an opportunity for faculty to develop new electives

• Add a "Theory" designation for courses that rely on formal definitions and mathematically rigorous proof

• Students are required to complete a certain number of courses with the Theory designation

• Initial inventory likely includes CS 311 and CS 350 (both of which transition to electives), potentially STAT 451, and additional CS electives

• FT Faculty are again responsible for appropriate and consistent use of the Theory designation
Summary
Over the coming year

• Let's have a conversation about math foundations in our curriculum
  • Finding a place for probability & statistics
  • Rethinking role of CS 250/251
  • Rethinking math requirements outside CS

• And perhaps ponder the possible role for other course tracks or designations in our UG program ...
Immediate Action Items

• Decide whether to proceed with:
  • Introduction of PoPL course, transitioning 321/322 to electives
  • Identification of "Programming Intensive" courses; with modifications to catalog descriptions and learning objectives where necessary
  • Transitioning STAT 451 to elective
  • Introducing "Theory Track", transitioning 311/350 to electives

• Requires a mixture of individual course change proposals and a unifying program change proposal