CS 153 Current Topics in Theoretical Computer Science **Spring 2012**

Course Summary and Syllabus

Lecturer: Chris Umans *Date: April 3*

Course summary:

This year's focus will be Fast Matrix Multiplication, by a vote of the participants.

We'll spend the term studying matrix multiplication, the most prominent open "upper bounds" problem in the Algebraic Complexity. We'll cover the key results since Strassen's algorithm, and develop the so-called "group-theoretic" approach. Along the way we'll study several conjectures that would imply "exponent 2" algorithms for matrix multiplication.

Course Information:

- Instructor: Chris Umans (`umans@cs.caltech.edu`)
- Lectures: Tuesdays and Thursdays 1:00 – 2:25 in Annenberg 314
- Office hours: TBD
- Text: None. Significant portions of the material in the course is covered/surveyed in these documents, available online:
  - Notes from the course "Complexity of Bilinear Problems." Markus Bläser. 2009. Available at `http://www-cc.cs.uni-saarland.de/teaching/SS09/ComplexityofBilinearProblems/script.pdf`
  - H. Cohn and C. Umans. "A Group-theoretic Approach to Fast Matrix Multiplication." 2003. Available at `http://front.math.ucdavis.edu/math.GR/0307321`
  - H. Cohn, R. Kleinberg, B. Szegedy, and C. Umans. "Group-theoretic Algorithms for Matrix Multiplication." 2005. Available at `http://users.cms.caltech.edu/~umans/papers/CKSU05.pdf`
  - H. Cohn and C. Umans. "Fast Matrix Multiplication using Coherent Configurations." 2013. Available at `http://www.cs.caltech.edu/~umans/papers/CU12.pdf`

  The webpage will be updated regularly with links to relevant papers.
- Webpage: `http://www.cs.caltech.edu/~umans/cs153/`

Prerequisite: This course is pitched at a beginning graduate level, but both undergrads and grad students are encouraged to attend. Prerequisites are mathematical maturity and curiosity. The course is intended to be largely self-contained, but exposure to elementary probability and algebra, as well as material covered in CS21, CS38 and CS151, is helpful.

Course requirements:

Course participants should attend/participate in lectures (20%), complete 2 short problem sets (30%), and read and present a relevant research paper at the end of the term (50%).

Possible topics/papers for presentation will be listed on the webpage.