CS 59000 CTT Current Topics in Theoretical CS Aug 21, 2012

Syllabus

Lecturer: Elena Grigorescu

1 Schedule

Beering Hall of Liberal Arts & Education B232, Tu/Th 3:00 - 4:15 pm

2 Instructor

Elena Grigorescu, elena-g@purdue.edu, office hours by appointment.

3 Description

This is a graduate level/advanced undergraduate course intended to introduce students to some exciting research directions in theoretical CS. We will cover a broad selection of areas, tentatively including topics on interconnections between: sublinear models of computation, error-correcting codes, expander graphs, additive combinatorics. We will introduce proof techniques such as discrete Fourier analysis, the probabilistic method, Yao's principle, and more.

Prerequisites: There are no specific course requirements other than some mathematical maturity. Some familiarity with discrete math and algorithms would be useful.

4 A partial list of topics

Introduction to sublinear models of computation. Probability basics. Szemeredi's regularity lemma. Testing triangle freeness in dense graphs. Application to additive combinatorics. Proof of the "triangle removal lemma". Testing connectivity. Estimating the number of connected components and minimum spanning tree. Testing monotonicity of functions. Spanner graphs. Intro to codes. Finite fields. Hadamard, Reed-Solomon, Reed Muller codes. Locally testable codes. Testing membership in the Hadamard code (testing linearity). The Fourier analytic method. Locally decodable codes. Expander graphs. Codes from graphs. Other applications of expanders. Communication complexity. Application to Property testing lower bounds.

5 Assignments

The grade is based on scribing notes for 1-2 lectures and a project consisting of a presentation of a paper from a theoretical CS conference and writing scribe notes for this presentation.

6 Grading

10% for class participation. 25% for scribing notes 65% for the project