The University of Chicago

Departments of Computer Science,
Mathematics, and Statistics

Scientific and Statistical Computing Seminar

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Departments of Mathematics and EECS
University of Michigan

Sublinear Time, Measurement-Optimal, Sparse Recovery For All

(Note special time: 4:00–5:00pm; *preceded by Anna Gilbert's related talk at 3:00–4:00pm in Ryerson 251*)

FRIDAY, May 25, 2012, at 4:00 PM

133 Eckhart Hall, 5734 S. University Avenue.

ABSTRACT

In the Sparse Recovery problem, the goal is to recover, approximately, the large-magnitude components of a vector from a collection of linear measurements of that vector. Many variations of this problem have been studied.

We present the first "sublinear-time, forall" result. That is, we present a single matrix that works simultaneously for all sufficiently-sparse vectors (as opposed to working, with high probability, on each vector). Our algorithm requires time $\sqrt{(kN)}$ to recover approximately the largest k components of a vector of length N.

This work appeared in SODA, 2012. It is joint with Ely Porat of Bar Ilan University.

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University of Chicago
Undergraduate Lecture Series in Mathematics
Presented by
Professor Anna Gilbert
University of Michigan

Lecture I (Cohen Prize Lecture):
Group Testing: Magic Tricks and Fun Experiments

Abstract: Group testing was originally designed to screen Selective Service inductees in World War II for syphilis. The idea was to collect blood samples from individuals and test the blood in aggregated groups or pools for the presence of syphilis antibodies, rather than testing each individual's sample separately. When there are a few people in the population with syphilis, one can determine which people are infected with a very small number of these Wasserman tests.

In this talk, we will analyze a magic trick that uses group testing, discuss several models for group testing design problems, and do some demonstrations of these different models (ranging from finding an anomalous box of candies with a pan balance, to guessing secret number).

THURSDAY, MAY 24
Pizza at 6:30 in the Barn (Ryerson 352)
Lecture at 7:30 p.m. (E 206)
Seniors are especially invited!

Lecture II:
What's the frequency Kenneth?: A survey of Fourier sampling algorithms

Abstract: In the last decade, scientists, mathematicians, and engineers have recognized that our ability to generate data far exceeds our ability to record it, to analyze it, and to extract meaningful information from it. In recognition of this limitation, computer scientists have developed streaming algorithms that can efficiently process streams of data in sketches and then analyze those sketches very efficiently, mathematicians have developed mathematical models of highly efficient data acquisition and processing, and engineers have built systems for efficiently collecting signal or image information. One of the problems that all three disciplines have contributed to is that of Fourier sampling—designing an efficient sampling set (or collecting a small number of samples of a signal) so that, from those samples, one can determine very efficiently which frequencies are dominant in the signal (equivalently one can construct an algorithm to find these frequencies). For this problem computer scientists have developed algorithms that are faster than the FFT, electrical engineers have built analog-to-digital converters that sample at sub-Nyquist rates, and mathematicians have contributed solid theoretical underpinnings to these results.

In this talk we will cover the basic problem, the highly efficient recovery algorithms, and some of the analog-to-digital converter designs. In honor of some of my favorite subjects as a U of C undergraduate, the main mathematical ingredient of this talk will be Fourier analysis and, Fourier analysis on finite groups in particular, in addition to a little material from Thursday's fun talk on group testing.
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FRIDAY, MAY 25
3:00 p.m. RY 251

- The Paul R. Cohen Prize is awarded annually to the graduating senior who has achieved the best record in mathematics. We will also recognize those graduating seniors who have achieved honors in mathematics.

- The endowment for this lecture series has been supported by Neil Chriss, Margaret M. Holen, Judith Sally, the 2007 Putnam Team, and others.