Course: Math 7018 (Probabilistic Methods in Combinatorics) Fall '09

- **Instructor:** Asaf Shapira
- **Time/Location:** Skiles 246, Tuesday/Thursday 15:00-16:30
- **Office hour and location:** Skiles 262, Tuesday/Thursday 13:30-14:30
- **Contact info:** asafico-at-math.gatech.edu
- **Prerequisites:** Math 4022 and Math 6221 or consent of School

Suggested Textbooks:

- *The Probabilistic Method*, by N. Alon and J. Spencer, Wiley (Third Edition, 2008).
- *Concentration of Measure for the Analysis of Randomized Algorithms*, by D. P. Dubhashi and A. Panconesi (Cambridge 2009).
- *Extremal Combinatorics with Applications in Computer Science*, by S. Jukna (Springer 2001).

Course Objective: To develop an appreciation for the strength and beauty of the probabilistic techniques in combinatorics.

Tentative List of Topics:

- The basic (first moment) method: Examples from graph theory, combinatorics, and number theory, of the use of the probabilistic method, the use of linearity of expectation
- The second moment method: Number-theoretic and Random graph applications.
- The Lovasz local lemma: Basic lemma, its variations and applications
- Alterations: Ramsey numbers, Property B, Packing and Recoloring
- Combinatorial discrepancy theory: Balancing lights, Spencer's six standard deviations result, Beck-Fiala theorem and the Komlos conjecture
- Correlation inequalities: The four functions theorem, FKG and XYZ inequalities
- Random graphs: Chromatic number, Clique number, Sharp threshold phenomenon
- The Poisson paradigm: Janson's inequalities
- Martingale Inequalities: Azuma-Hoefding inequality, Talagrand's inequality
- Entropy techniques: Shearer's lemma and combinatorial enumeration applications
- Pseudorandomness and Derandomization. Eigenvalues and Expanders.

General grading policy : Homeworks 100%

Homeworks will be assigned, collected and graded on a regular basis. You are strongly advised to (attempt to) solve all the homework problems. You are allowed to discuss your homework assignments with other students, but you are required to write the solutions on your own. In other words, you are **not** allowed to copy another student's solution.

Late submission of HWs is discouraged with a penalty of 20%.

Suggestions:

- Please feel free to ask questions at any time: before, after or during the class.
- Please make use of my office hours.
- Class participation and discussion is highly encouraged.

Academic Dishonesty: All students are expected to comply with the Georgia Tech Honor Code. Any evidence of cheating or other violations of the Georgia Tech Honor Code will be submitted directly to the Dean of Students. The institute honor code is available at http://www.deanofstudents.gatech.edu/Honor/honorcode.txt