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פרס נסיהו במתמטיקה תשס"ט

פרס נסיהו במתמטיקה לשנת תשס"ט (2009) מוענק במשותף לדר' **מיכאל הוכמן** מהאוניברסיטה העברית ולדר' **דנה מושקוביץ** ממכון ויצמן למדע. ציטוט נימוקי ועדת הפרס מופיע להלן.

2009 Nessyahu Prize in Mathematics

The 2009 Nessyahu Prize in Mathematics is awarded jointly to Dr. **Michael Hochman** from the Hebrew University and to Dr. **Dana Moshkovitz** from the Weizmann Institute of Science. The Prize Committee's citation follows.

We have reached the decision to award the Nessyahu prize for this year jointly to Dr. Michael Hochman and Dr. Dana Moshkovitz. Eight excellent PhD theses were submitted this year, all of which would merit the prize in the absence of competition, and we had a very difficult time choosing among them. After discussing the strengths and contributions of each of the theses, we have reached the conclusion that the theses of Drs. Hochman and Moshkovitz are truly exceptional, and they should jointly receive the award this year.

Dr. Hochman's thesis. Dr. Hochman's thesis, Combinatorial Methods in Dynamical Systems, written under the supervision of Professor Benjamin Weiss at the Hebrew University, Jerusalem, January 2008, consists of three contributions to the theory of dynamical systems, related by their underlying combinatorial nature.

In the first part of his thesis, Hochman introduces a new approach to the study of the genericity of topological dynamical systems, i.e. the question "what does a typical topological dynamical system look like". Hochman's pioneering work develops the right framework and methods to attack this problem. Surprising differences emerge between the setting Hochman studies and more classical settings, for example with regard to whether strong mixing is a generic property.

It is well known that amenable groups may be characterized via sequences of almost invariant sets, known as Følner sequences. Combinatorial properties of these sequences are studied in the second part of Hochman's thesis. It is surprisingly shown that Z^{∞} has no good averaging sequence. A precise characterization of commutative groups with Tempel'man sequences is given.

The fundamental theorem of Shannon-MacMillan-Breimann (SMB) in information theory generalizes classical convergence theorems for martingales and ergodic averages. Finding a quantitive version of SMB theorem was a long standing open problem, till it was solved in the third part of Hochman's thesis. The solution applies a brilliant reduction to the combinatorics of collections of segments, a method which may be extended to general measure preserving group actions. Various applications are given, including applications to computational complexity. We believe that many more applications of this theorem will be found in the future.

The entire thesis is very clearly written and combines original ideas with extraordinary technical ability. The problems studied are of natural and general interest and the results contain solutions of classical open problems. It is a work of the highest standard imaginable.

Dr. Moshkovitz's thesis. Dr. Moshkovitz's thesis, Two Query Probabilistic Checking of Proofs with Subconstant Error, written under the supervision of Professor Ran Raz, at the Weizmann Institute of Science, Rehovot, August 2008, deals with probabilistically checkable proofs (PCPs).

The celebrated PCP theorem shows that mathematical proof (equivalently, any witness of membership for an NP statement) can be transformed into a PCP { a proof that can be probabilistically verified by reading only a constant number of symbols of the proof. The PCP Theorem has had wide-ranging consequences, most notably being the key to showing that it is hard to find even approximate solutions to many NP optimization problems.

In her thesis, Dr. Moshkovitz gives the first construction of very efficient PCPs with almost-linear size and simultaneously with two queries and small error probability. Such PCPs imply strong inapproximability results; specifically it follows that 3SAT and 3LIN cannot be efficiently approximated within factors of 7/8+o(1) and 1/2+o(1) respectively unless P=NP. The conceptual and technical contributions of Dr. Moshkovitz thesis are truly impressive. Her proofs combine elegant algorithmic techniques with novel combinatorial methods. The latter set of techniques achieve a surprising result: it is possible to "compose" PCPs without increasing the number of queries or the error probability.

In summary, Dr. Moshkovitz's thesis consists of ground-breaking work that resolves central questions in the study of PCPs and inapproximability. It is difficult to imagine a thesis making a greater contribution.

Conclusion. By introducing original and powerful ideas, Hochman's and Moshkovitz's dissertations solve important open problems in two very different areas of mathematics. Both dissertations contain pioneering and surprising results and develop methods which will deeply influence future mathematical research in their fields.

In general, it is difficult to compare works in very different mathematical disciplines, such as pure and applied mathematics. In our case, both works are unique and exceptional. We thus recommend awarding the prize jointly to Dr. Michael Hochman and Dr. Dana Moshkovitz.

Prize Committee Chairman
Professor Yuval Roichman
Bar-Ilan University