2022 Knuth Prize Awarded to Noga Alon

The 2022 Donald E. Knuth Prize is awarded to Noga Alon, Professor of Mathematics at Princeton University and Emeritus Professor of Mathematics and Computer Science at Tel Aviv University, for foundational contributions in combinatorics and graph theory and applications to fundamental topics in computer science.

For over three decades, Alon has made significant contributions at the interface between discrete mathematics and computer science, creating and fortifying lasting bridges between the two communities. His works include many seminal results that influenced a wide variety of important research directions in computer science.

Expanders and Spectral Theory: With coauthors, Alon developed the deep connection between the expanding properties of a graph and the eigenvalues of its adjacency or Laplacian matrices. This discovery was crucial in the study of expanders, which became one of the most important and applicable concepts in graph theory and theoretical computer science, and in bringing in advanced mathematical tools, including many of algebraic nature, to the subject. He also demonstrated several remarkable applications of expanders to the study of algorithmic problems and the design and analysis of communication networks. In addition to enabling finding hidden structures in random graphs (with Krivelevich and Sudakov) and solving graph coloring problems (with Kahale), Noga showed that spectral analysis can be used to amplify the minimum distance of an error correcting code (with Bruck, Naor, Naor and Roth).

Property Testing: Alon played a significant role in applying property testing to dense graphs, settling several open questions. An outcome of this work was the first algorithmic version of Szemerédi's Regularity Lemma that resulted in deep connections to graph property testing and which was central in the recent developments on graph limits. Alon's STOC'06 paper with Fischer, Newman, and Shapira gave a complete characterization of which problems can be tested using only a constant number of samples, resolving another open question.

Streaming: Alon's STOC'96 paper with Matias and Szegedy approximating frequency moments under sublinear space constraints is one of the foundational results in the study of streaming algorithms. Streaming algorithms are of theoretical and practical importance as they are now routinely used in the industry in a host of data analysis tasks. The Alon-Matias-Szegedy result gives insightful algorithms that have influenced practice while also pointing to limits of streaming algorithms. Based on these contributions, they were the recipients of the 2005 Gödel Prize and, along with Gibbons, the 2019 ACM Paris Kanellakis Theory and Practice Award.

Noga Alon's contributions to the field also include his influential book with Spencer, "The Probabilistic Method," serving as the canonical reference on its applications to combinatorics as well as theoretical computer science.

Prize committee: Harold Gabow (U. Colorado), Monika Henzinger (U. Vienna), Kurt Mehlhorn (Max Planck Institute), Dana Randall (Chair, Georgia Tech), Madhu Sudan (Harvard U.), and Andy Yao (Tsinghua U.).