2015 Knuth Prize Citation for László Babai

The 2015 Donald E. Knuth Prize is awarded to László Babai of the University of Chicago for his fundamental contributions to theoretical computer science, including algorithm design and complexity theory. The impact of Babai's conceptual innovations and pioneering work, especially in the use of group theory and randomness, is felt across the discipline well beyond areas in which he has worked. His multiple visionary contributions have transformed the landscape of the theory of computing.

Babai pioneered a new understanding of the notion of mathematical proof. This notion helped usher in a new era in combinatorial optimization in which the ability to prove hardness of approximation became the norm. This notion of proof combined interaction and randomness, and was formalized by both Babai's Arthur-Merlin games and an independent paper by Goldwasser, Micali, and Rackoff. This shift in our view of the millennia-old concept of mathematical proof has been one of the most fruitful developments in computer science. For his work introducing interactive proofs, Babai shared the inaugural Gödel Prize in 1993, but this was only the start of his contributions to the area. It was Babai's seminal work with Fortnow and Lund on the power of interactive proofs with multiple provers that led to the discovery of the fundamental implications that probabilistic proofs have for the hardness of approximation in optimization. In further development, together with Fortnow, Levin, and Szegedy, he introduced transparent (or "holographic") proofs. The two papers offered the entirely unanticipated phenomenon that every formal proof can (efficiently) be replaced by one verifiable by spot-checks. The celebrated PCP theorem followed in the pioneering conceptual trail set by Babai and his collaborators, and tightened the connection between approximation and proof. The chief technical ingredient in Babai's work, a low-degree test, was a foundation for development of locally testable codes, and the study of property testing more generally.

Babai has been a key leader in the development of algorithmic group theory, and in the study of the graph isomorphism problem, one of the most important problems whose complexity remains unresolved. In groundbreaking early work, Babai introduced a fundamentally new, group-theoretic, approach to the graph isomorphism problem (coining the term "Las Vegas algorithm" along the way) which motivated the development of the best algorithms known for the problem.

Babai's much cited "nearest plane algorithm" for finding an approximate closest lattice point (often referred to as the "Babai point" in the signal processing literature) has become a tool in several areas including lattice-based cryptography.

Babai's work on communication complexity has also been highly influential. With Frankl and Simon he introduced communication complexity analogues of computational complexity classes and the importance of the set disjointness problem. His work with Nisan and Szegedy on multiparty communication complexity has been the touchstone of work in the field for more than twenty-five years, yielding many complexity-theoretic applications.

In addition to his extensive research contributions, Babai is well known for his commitment to the free flow of knowledge without geographical or economic barriers. He has spearheaded and continues to lead many efforts to make cutting-edge research accessible to all.

Born in Budapest, Prof. Babai received his Ph.D. from the Hungarian Academy of Sciences in 1975. After holding faculty positions at Eötvös University in Budapest, he joined the University of Chicago in 1984. His honors include the Erdős Prize, the aforementioned Gödel Prize, and election as a Fellow of the American Academy of Arts and Sciences. He is a founder of *Budapest Semesters in Mathematics* and of the journal *Combinatorica*, and the open-access journal *Theory of Computing*.

Prize Committee: Russell Impagliazzo, Chair (University of California, San Diego), Uriel Feige, (The Weizmann Institute of Science), Michel Goemans (Massachussets Institute of Technology), Johan Håstad (KTH Royal Institute of Technology), Anna Karlin (University of Washington), Satish B Rao (University of California, Berkeley)