2022 JOHN VON NEUMANN THEORY PRIZE

IS AWARDED TO

Vijay V. Vazirani

The 2022 INFORMS John von Neumann Theory Prize is awarded to Vijay Virkumar Vazirani for his fundamental and sustained contributions to the design of algorithms, including approximation algorithms, computational complexity theory, and algorithmic game theory, central to operations research and the management sciences.

While a first year Ph.D. student, Vazirani developed what is still the most efficient algorithm for the classical maximum matching problem, with fellow student Silvio Micali. His co-authored seminal 1990 paper proposed an optimal algorithm for the online bipartite matching problem, in which the underlying graph is revealed one vertex at a time and needs to be instantaneously matched without knowledge of future arrivals. Numerous matching markets, including Google's AdWords, Uber, and Airbnb, share this online decision-making feature, and this algorithm has become a paradigm in this area. More recent joint work introduced a tradeoff-revealing family of linear programs and the notion of bid-scaling – ideas that have had enormous influence within digital advertising markets.

In addition, Vazirani is known for his role in developing approximation algorithms for NP-hard optimization problems, including set covering, survivable network design, multicommodity flow and multicut, k-cuts, facility location, and k-medians, culminating in his now classic book, *Approximation Algorithms*. He has been a major contributor to the primal-dual approach that is now recognized as the most powerful algorithmic design technique within this area.

Vazirani is one of the founders of algorithmic game theory, focusing on the computability of market equilibria. In a 2012 paper, he introduced the notion of a rational convex program, established that they "behave like" linear programs, and showed that certain market equilibria programs have this property. He and his co-authors also provided complementary pivot algorithms for markets under additively-separable, piecewise-linear concave utilities and markets with production, thereby yielding practical tractability for this class of problems. In other joint work, he gave the first polynomial-time algorithm for a market model, namely the Fisher market with linear utility functions.

Peter Glynn
Prize Committee Chair

October 2022

Radhika Kulkarni
2022 INFORMS President