

Intelligent Heuristics Are the Future of Computing

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Abstract

Back in 1988, game trees for chess were among the largest search structures in real-world computing. Because such trees are too large to evaluate exhaustively, chess programs must rely on heuristic strategic decisions based on partial information—making them a powerful case study for teaching AI search. In one of his lectures that year on AI search for games and puzzles, Professor Hans Berliner — a pioneer in computer chess — stated: “Intelligent heuristics are the future of computing.”

As a student of computing theory, I was naturally perplexed but fascinated by this perspective. I had been trained to believe that “algorithms and computational complexity theory are the foundation of computer science.” And yet, my own journey to understand heuristics in computing has played a defining role in my career as a theoretical computer scientist. Over time, I’ve come to appreciate Berliner’s statement as a far-reaching worldview—one that resonates even more in our current era of rich, complex, and multifaceted data and models, where computing interacts deeply with science, engineering, the humanities, and society.

In this talk, I will reflect on my experiences with heuristics in computing, highlighting examples of theoretical work aimed at understanding the behavior of heuristics on real data, as well as efforts to design practical heuristics with meaningful theoretical foundations. My hope is that these insights—drawn from techniques such as spectral partitioning, multilevel methods, the simplex method, and regularization for optimization and machine learning—can shed light on, and perhaps inspire, a deeper understanding of the current and future techniques in AI and data mining.

Biography

Shang-Hua Teng is a USC University Professor of Computer Science and Mathematics. He is a fellow of SIAM, ACM, and Alfred P. Sloan Foundation, and has twice won the Gödel Prize, first in 2008, for developing smoothed analysis, and then in 2015, for designing the breakthrough scalable Laplacian solver. Citing him as, “one of the most original theoretical computer scientists in the world”, the Simons Foundation named him a 2014 Simons Investigator to pursue long-term curiosity-driven fundamental research. He also received the 2009 Fulkerson Prize, 2023 Science & Technology Award for Overseas Chinese from the China Computer Federation, 2025 ACM STOC Test of Time Award & 2011 ACM STOC Best Paper Award (for improving maximum-flow minimum-cut algorithms), 2022 ACM SIGecom Test of Time Award (for settling the complexity of computing a Nash equilibrium), 2021 ACM STOC Test of Time Award (for smoothed analysis), 2020 Phi Kappa Phi Faculty Recognition Award (2020) for his book *Scalable Algorithms for Data and Network Analysis*. In addition, he and collaborators developed the first optimal well-shaped Delaunay mesh generation algorithms for arbitrary three-dimensional domains, settled the Rousseeuw-Hubert regression-depth conjecture in robust statistics, and resolved two long-standing complexity-theoretical questions regarding the Sprague-Grundy theorem in combinatorial game theory. For his industry work with Xerox, NASA, Intel, IBM, Akamai, and Microsoft, he received fifteen patents in areas including compiler optimization, Internet technology, and social networks.

