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An Axiomatic Theory of Fairness

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Abstract

The tradeoff between fairness and throughput has been widely observed in network analysis and protocol design. Despite many existing fairness metrics (from simple ones like Jain's index to more complex ones like α-fair utility), the meaning of fairness is largely based on problem-oriented interpretations and judgments, with no well-established framework. To tackle this challenging problem, we presented a set of five axioms for fairness, and showed that a wide range of fairness measures satisfying the axioms can be constructed in a unifying framework. The construction incorporates as special cases many existing metrics, such as Jain's index, entropy, and α-fair utility, and also reveals a new family of fairness measures. Our axiomatic theory illuminates many issues in network resource allocation research, among which is a novel tradeoff between efficiency and fairness. The parallelism of our framework and well-known theories in other fields, e.g., Renyi Entropy, Lorenz Curve, Nash Bargaining Solutions, and Rawls' Theory of Justice, greatly sharpens our understanding of the notion of fairness.

Biography

Tian Lan is an Assistant Professor at the Department of Electrical and Computer Engineering of George Washington University. He received his B.S. degree in 2003 from Tsinghua University, Beijing, China, M.S. degree in 2005 from the University of Toronto, Ontario, Canada, and Ph.D. degree from Princeton University in 2010. His research interests lie in the area of network security and communications. He received the IEEE Signal Processing Society 2008 Best Paper Award and the GLOBECOM 2009 Best Paper Award.