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Guest Editorial for Information Complexity and Applications

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This special issue grew out of a workshop at the Symposium on Theory of Computing (STOC) conference in 2013 where the basics of information theory and information complexity were presented, followed by applications of this framework. Information complexity is a finer notion than communication and attempts to quantify how much information about the inputs to players in a communication protocol must be revealed. There are a number of applications such as data stream and data structure lower bounds, lower bounds in compressed sensing, sketching, and distributed computation, as well as establishing tradeoffs between privacy, efficiency, and accuracy in various settings. The study of interactive information complexity is connected to the study of coding for interactive communication— where the goal is to understand the limits of communication in the settings where block length does not tend to infinity.

The aim of this special issue is to highlight the recent advances in the theory of information complexity as well as to showcase several representative applications of this theory.

The issue consists of 9 papers that are briefly discussed as follows:

In "Common Information and Unique Disjointness" the authors introduce the notion of common information for lower bounding non-negative rank of unique disjointness, and apply them to give new lower bounds for extended formulations.

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In “Deterministic Compression with Uncertain Priors” the authors study the problem of communicating between parties that do not share a common prior, but rather only priors which are close to each other; unlike previous work there is no common randomness assumption.

In “Superlinear Lower Bounds for Multipass Graph Processing” the authors prove the first superlinear (in the number of vertices) lower bounds for multi-pass streaming algorithms for the perfect matching problem and certain distance and connectivity queries in a graph.

In “Zero-Information Protocols and Unambiguity in Arthur–Merlin Computation” the authors study information complexity in the context of Arthur–Merlin communication complexity and prove results for zero-information Arthur–Merlin protocols and unambiguous Arthur–Merlin protocols.

In “A Direct Product Theorem for Two-Party Bounded-Round Public-Coin Communication Complexity” the authors prove the first strong direct product theorem for any relation for two-party bounded round public-coin randomized communication complexity.

In “Towards a Reverse Newman’s Theorem in Interactive Information Complexity” the authors prove that any bounded round protocol with private randomness can be converted into one using only public randomness while preserving the information revealed to each player.

In “Direct Sum Fails for Zero Error Average Communication” the authors show that for zero-error communication complexity, a direct sum theorem fails for average communication complexity and external information complexity, and highlights the issue of promise versus non-promise problems.

In “Certifying Equality with Limited Interaction” the authors study the equality problem with applications to small set disjointness and obtain optimal round versus information cost tradeoffs, as well as optimal tradeoffs in the case of zero error protocols.

In “A Discrepancy Lower Bound for Information Complexity” the authors show that the discrepancy of a function lower bounds not only its two-party communication complexity (a classical result), but also its information complexity. Follow up works established that other lower bound measures on communication are also lower bounds on information.