International
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The IMU Abacus Medal 2022

Short citation:

Mark Braverman is awarded the IMU Abacus Medal 2022 for his path-breaking research developing the theory of information complexity, a framework for using information theory to reason about communication protocols. His work has led to direct-sum theorems giving lower bounds on amortized communication, ingenious protocol compression methods, and new interactive communication protocols resilient to noise.

Long citation:

Mark Braverman led the development of the theory of information complexity, the interactive analog of Shannon's information theory. This theory has been successfully used to obtain tight lower bounds on the communication cost of interactive communication protocols for the joint computation of some function when the input is distributed across two or more parties.

Braverman's early work (with Rao) shows that in any interactive communication protocol between two players, the information revealed by the protocol to the players about the inputs hidden from them exactly equals the amortized communication complexity of computing independent copies of the same function. This extended his earlier work (with Barak, Chen, Rao), that bounded amortized communication cost from below in terms of communication cost and internal information cost. These works led to a more nuanced understanding of different information cost measures, and along with later independent advances, establish that for randomized protocols, amortized communication costs can be significantly less than the non-amortized costs. It also spurred the design of new protocols achieving better compression, and new coding schemes that exhibit improved resilience to transmission errors.

Braverman's work has led to the use of information complexity in other interactive communication regimes as well, including distributed statistical estimation, memory requirements in streaming algorithms, and distributed error-correction. It has also found beautiful application in a notable non-communication setting: direct-product theorems for parallel repetition.

In addition to his work on information complexity, Braverman has made contributions to diverse areas at the interface of theoretical computer science and mathematical sciences. These contributions include the settling of the long-standing conjecture concerning pseudorandomness and constant depth Boolean circuits – polylog-wise independence fools AC^0, understanding the decidability frontier for geometric objects such as quadratic Julia sets (joint with Yampolsky), and developing tools for algorithm mechanism design.