Mathematical Physics

Nondeterministic multiparty quantum communication

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We study nondeterministic multiparty quantum communication with GHZ-type broadcasts, or, equivalently, with preshared GHZ-entanglement and communication by message passing. We show that, with number-in-hand classical inputs, the communication complexity of a Boolean function in this communication model equals the logarithm of the support rank of the corresponding tensor, whereas the 'approximation' complexity in this model is characterized by the border support rank. As a first application, we prove a log-rank conjecture posed by Villagra et al. for nondeterministic multiparty quantum communication without preshared entangle- ment. Second, we study the communication complexity of the graphwise equality problem. For a cycle graph, the complexity of this communication problem is closely related to the complexity of the computational problem of multiplying matrices, or more precisely, to the tensor rank of the iterated matrix multiplication tensor. We exhibit a nontrivial protocol for the three-player and five-player cyclic equality problem, and we show how Young flattenings yield nontrivial lower bounds on the border support rank of the iterated matrix multiplication tensor.