Abstract

Quantum Information

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The Quantum Information Bottleneck: Properties and Applications

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In classical information theory, the information bottleneck method (IBM) can be regarded as a method of lossy data compression which focuses on preserving meaningful (or relevant) information. As such it has of late gained a lot of attention, primarily for its applications in machine learning and neural networks. A quantum analogue of the IBM has recently been defined, and an attempt at providing an operational interpretation of the so-called quantum IB function as an optimal rate of an information-theoretic task, has recently been made by Salek et al. The interpretation given by these authors is however incomplete, as its proof is based on the conjecture that the quantum IB function is convex. Our first contribution is the proof of this conjecture. Secondly, the expression for the rate function involves certain entropic quantities which occur explicitly in the very definition of the underlying information-theoretic task, thus making the latter somewhat contrived. We overcome this drawback by pointing out an alternative operational interpretation of it as the optimal rate of a bona fide information-theoretic task, namely that of quantum source coding with quantum side information at the decoder, which has recently been solved by Hsieh and Watanabe. We show that the quantum IB function characterizes the rate region of this task, Finally, we discuss some further properties, applications and the related privacy funnel function.