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Title of the Project: Assessing the power of variational quantum classifiers and quantum extreme learning machines

One of the main classes of problems that are usually tackled through machine learning techniques is represented by data classification [1]. In the search for quantum advantages in machine learning, classification tasks have been mainly studied recurring to quantum artificial neural networks (QANNs) [2]. Recently, the alternative route of variational quantum classifiers was also followed [3], showing similar performances with respect to QANNs. Within the field of artificial neural networks, reservoir computing and extreme learning machines offer the advantage of easy and fast trainability, as only the output layer of the network needs to be updated during the training phase [4].

Moving to the quantum realm, both techniques have already been shown to conjugate sufficiently high performances with the advantage of an exponentially large Hilbert space [5,6]. While quantum reservoir computing is especially suited to solve time-dependent tasks, quantum extreme learning machines can be useful in problems as diverse as state preparation, state reconstruction, and also data classification. The main scope of this project is to build a comprehensive framework to benchmark the performance of variational quantum classifiers and quantum extreme learning machines, considering both the standard paradigm of classification of classical data and the classification of purely quantum information, such as entanglement, coherence, etc. We will also study the possibility of implementing both methods in physical systems, exploring different theoretical models and experimental platforms.

References

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