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Higgs analysis with quantum classifiers

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We have developed two quantum classifier models for the $t\bar{t}H$ classification problem, both of which fall into the category of hybrid quantum-classical algorithms for Noisy Intermediate Scale Quantum devices (NISQ). Our results, along with other studies, serve as a proof of concept that Quantum Machine Learning (QML) methods can have similar or better performance, in specific cases of low number of training samples, with respect to conventional ML methods even with a limited number of qubits available in current hardware. To utilise algorithms with a low number of qubits -to accommodate for limitations in both simulation hardware and real quantum hardware- we investigated different feature reduction methods. Their impact on the performance of both the classical and quantum models was assessed. We addressed different implementations of two QML models, representative of the two main approaches to supervised quantum machine learning today: a Quantum Support Vector Machine (QSVM), a kernel-based method, and a Variational Quantum Circuit (VQC), a variational approach.

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