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Modeling and Performance Evaluation of Hybrid Classical–Quantum Serverless Computing Platforms

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Abstract: *While quantum computing technologies are evolving toward achieving full maturity, hybrid algorithms, such as variational quantum computing, are already emerging as valid candidates to solve practical problems in fields, such as chemistry and operations research. This situation calls for a tighter and better integration of classical and quantum computing infrastructures to improve efficiency and users' quality of service. Inspired by recent developments in cloud technologies, serverless computing has recently been considered a promising solution for this purpose by both industry and research. In this work, we define a system model for a hybrid classical–quantum serverless system, with an associated open-source numerical simulator that can be driven by production traces and stochastic workload models. We therefore describe how we produced a public dataset using IBM Qiskit in a local and remote infrastructure, with a sample application on optimization. The simulation results show initial insights on some distinguishing features of the platform simulated, measured in terms of user and system metrics, for jobs with heterogeneous problem sizes and priorities. We also report a few lessons we learned from developing the application with IBM Qiskit serverless and running it on IBM Quantum backends*

Keywords*:* High-performance computing (HPC), hybrid computing, quantum approximate optimization algorithm (QAOA), quantum computing, quantum optimization, serverless computing, variational quantum computing, variational quantum eigensolver (VQE)

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