Quantum Machine Learning Model for predicting CVA value

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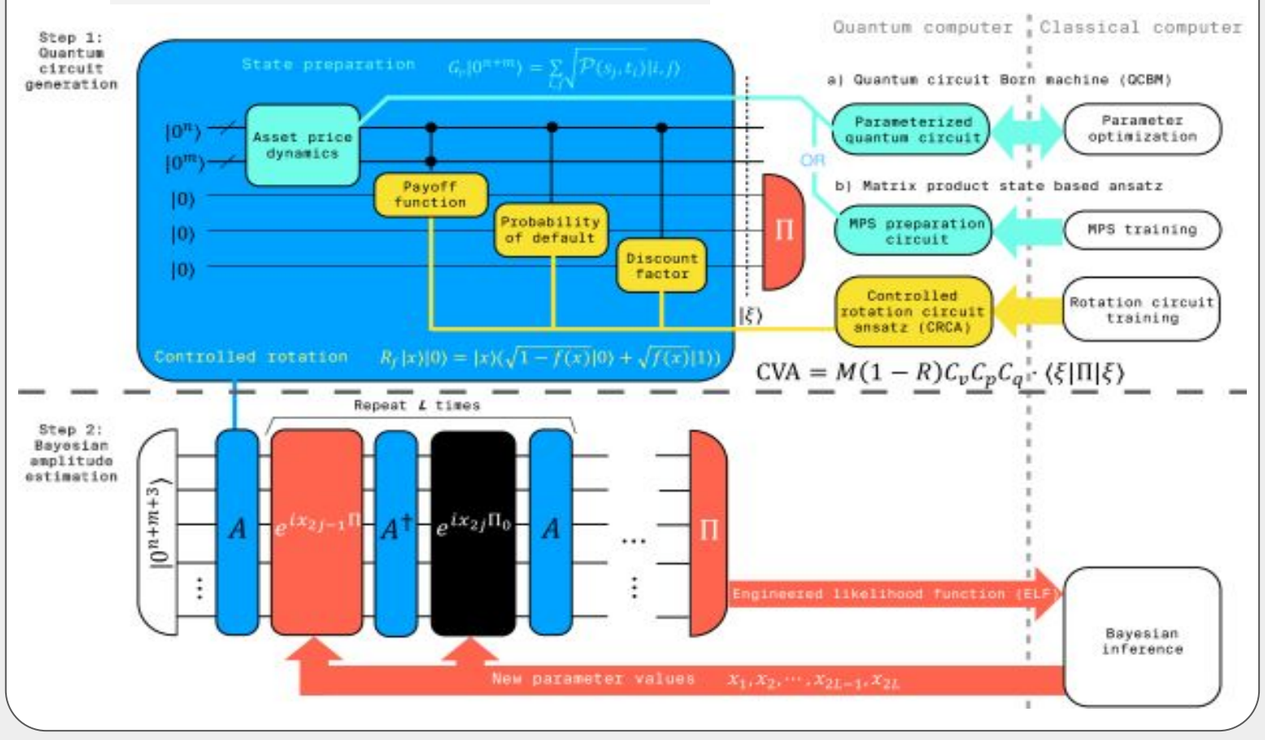
Abstract Introduction

- ***Credit valuation adjustment is the difference between the risk-free portfolio value and the true portfolio value that takes into account the possibility of a counter-party's default. In other words, CVA is the market value of counterparty credit risk.***

- ***We developed a quantum machine learning model to obtain a practical benefit for a specific use case in finance that is one step beyond pricing complex derivatives; Credit Valuation Adjustments (CVA).***

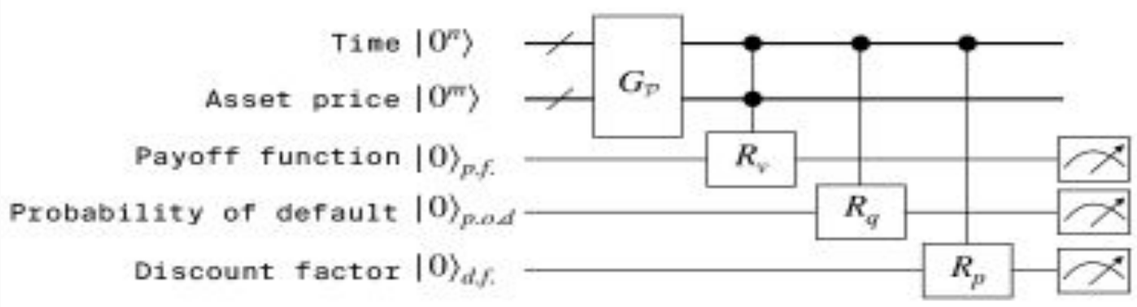
- ***We present a quantum machine learning model and detailed resource estimation.***

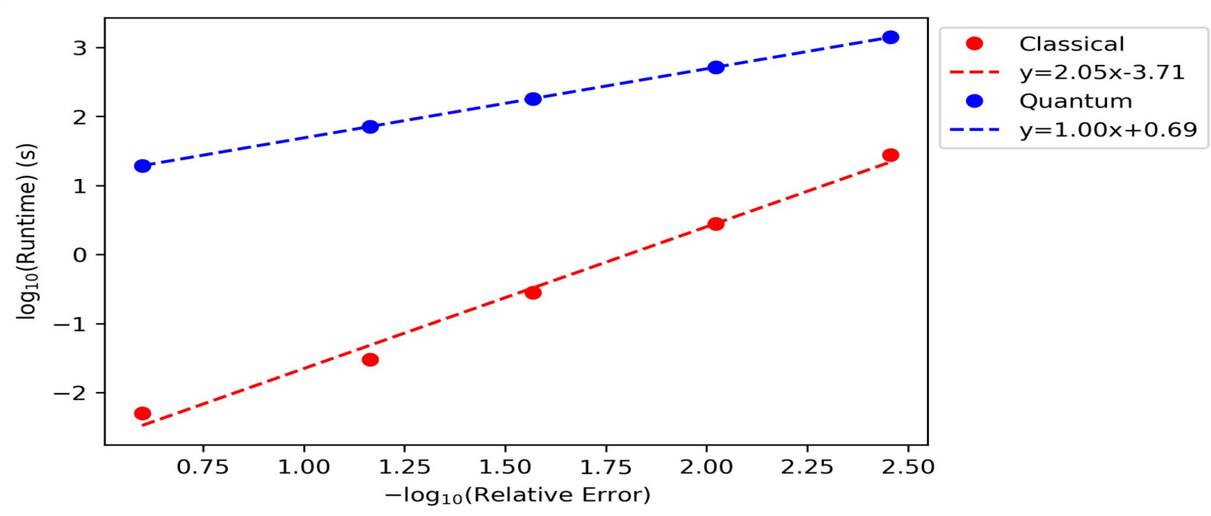


$$\mathrm{CVA} = M(1-R)C_v C_p C_q \cdot \langle \xi | \Pi | \xi \rangle$$

Results

- ***Our algorithm will run faster than the classical one for estimating CVA within relative error ≤0.0067%. We emphasize that this threshold heavily depends on the hardware specifications, and could be dramatically shifted once we have better technology for realizing high-fidelity quantum gates.***





Methodology

- ***We used PennyLane and Qiskit for developing our Quantum ML model for predicting the CVA value.***

- ***To improve the depths of quantum circuits for solving such problems, we draw on various heuristics that indicate the potential for significant improvement over well-known techniques such as reversible logical circuit synthesis.***

- ***In minimizing the resource requirements for amplitude amplification while maximizing the speedup gained from the quantum coherence of a noisy device, we adopt a recently developed Bayesian variant of quantum amplitude estimation using engineered likelihood functions (ELF).***

- ***We perform numerical analyses to characterize the prospect of quantum speedup in concrete CVA instances over classical Monte Carlo simulations.***

Conclusion

- ***The quantum machine learning model can significantly reduce the resource needed for solving the CVA problem. The CVA use case is both ubiquitously significant and computationally challenging but we are simplifying the estimating procedure with our model which increases the efficiency of financial firms.***

- ***It helps in minimizing the systemic risk of the overall financial ecosystem.***

Reference

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