Hasso Plattner Institut

IT Systems Engineering | Universität Potsdam

Summer Term 2021

Quantum Programming: Introduction, Engineering, and Applications

Projects Descriptions

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Quantum PCA (Selina)

- Do the integration for a 2x2 matrix [He et al. 2020]
- Extend the implementation for 4x4 matrix
- Generate and execute tests
- Apply the algorithm to two different datasets
- Compare the quantum implementation with a pure traditional one

Papers:

He, C., Li, J., Liu, W., & Wang, Z. J. (2020). A Low Complexity Quantum Principal Component Analysis Algorithm. *arXiv preprint arXiv:2010.00831*.

Bellante, A., Luongo, A., & Zanero, S. (2021). Quantum Algorithms for Data Representation and Analysis. *arXiv preprint arXiv:2104.08987*.

Quantum Neural Network (Leo)

- Extend the algorithm by adding more inputs in the first layer and more internal layers
- Generate and execute tests
- Apply the algorithm to two different datasets
- Compare the quantum implementation with a pure traditional one

Tutorials:

https://www.tensorflow.org/quantum/tutorials/qcnn?hl=en

Papers:

Farhi, et al., (2018), Classification with Quantum Neural Networks on Near Term Processors

Jeswal, S. K., & Chakraverty, S. (2019). Recent developments and applications in quantum neural network: a review. Archives of Computational Methods in Engineering, 26(4), 793-807.

Quantum SVM (Phillip)

- Extend the existing implementation on tutorials (for instance, paper [1])
- Generate and execute tests
- Apply the algorithm to two different datasets
- Compare the quantum implementation with a pure traditional one

Tutorials

https://qiskit.org/documentation/tutorials/machine_learning/01_qsvm_classification.html

https://quantumcomputinguk.org/tutorials/how-to-implement-qsvm-algorithm-on-ibms-quantum-computers-with-qiskit

Papers:

Allcock, J., & Hsieh, C. Y. (2020). A quantum extension of SVM-perf for training nonlinear SVMs in almost linear time. *Quantum*, *4*, 342.

Arodz, T., & Saeedi, S. (2019). Quantum sparse support vector machines. *arXiv preprint arXiv:1902.01879*.