

NITheCS Colloquium
Monday, 11 July 2022, 16h00 – 17h00 SAST
Dr Carsten Blank (Dr @data cybernetics ssc GmbH)

‘A compact quantum distance-based binary classifier - how entanglement is a resource’

ABSTRACT



Quantum computing opens exciting opportunities for kernel-based machine learning methods, which have broad applications in data analysis. Recent works show that quantum computers can efficiently construct a model of a classifier by engineering the quantum interference effect to carry out the kernel evaluation in parallel. For practical applications of these quantum machine learning methods, an important issue is to minimise the size of quantum circuits.

We present the simplest quantum circuit for constructing a kernel-based binary classifier. This is achieved by generalising the interference circuit to encode data labels in the relative phases of the quantum state and by introducing compact amplitude encoding. This encodes two training data vectors into one quantum register.

When compared to the simplest known quantum binary classifier, the number of qubits is reduced by two, and the number of steps is reduced linearly with respect to the number of training data. The two-qubit measurement with post-selection required in the previous method is simplified to single-qubit measurement. Furthermore, the final quantum state has a smaller amount of entanglement than that of the previous method, which advocates the cost-effectiveness of our method.

Our design also provides a straightforward way to handle an imbalanced data set, which is often encountered in many machine learning problems.

BIOGRAPHY

Dr Carsten Blank studied at Karlsruher Institut für Technologie and graduated in 2010 with a PhD (Dr. rer. nat.) from the faculty of mathematics. His area of expertise was applied mathematics, in particular the analysis of non-linear partial differential equations.

He is co-founder and co-managing director of data cybernetics ssc GmbH. His focus areas are consulting in software-engineering, data science and strategic consulting projects predominantly in the renewable electrical energy industry.

In particular, he is an expert in renewable energy-systems and digital energy-products.

Since 2021 he has led his company in data cybernetics for a government funded project to develop software for quantum computers – Rymax-One. The project is funded by the BMBF (Ministry of Education & Science) with the goal to build a quantum computer demonstrator.

Since 2020 Dr Blank has been module director and tutor at the Internationalen Universität (IU) for Quantum Computing.

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