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Senior Professor

Quantum Computing and Quantum Information

Quantum computers are now produced by several companies located essentially in the United States. The news of the recent publication in *Nature* of the results of the Google Team, demonstrating what John Preskill coined as *Quantum Supremacy*, has traveled fast on the social media. It put the topics on the frontline of the news worldwide.

This news triggered some of my colleagues to organize an educational course in Münster. They asked me to deliver such a course knowing that I created and taught it at the Georgia Institute of Technology for 13 years between 2003 and 2016. As the Georgia Tech course, I intend to present the topic to a large audience, including, mathematicians, physicists, computer science people and engineers, from senior students to Faculty, with the minimum amount of prerequisite, except for some familiarity with matrix calculus and linear algebra in finite dimension. A possible content is proposed below.

This course will be delivered during the Summer semester 2020, each Wednesday morning from 9h to 12h. A weekly calendar will be proposed before the beginning of the semester.

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Proposed Content

- Basic Framework

    - What is a *qubit*? Description, 1-qubit states, 1-qubit gates.
    - N-qbits, entanglement, Bell's inequalities.
    - Basic on Quantum Mechanics. Quantum Circuits.

- The Schor Algorithm

    - The Quantum Fourier Transform.
    - Phase estimate, order finding.
    - Schor's algorithm for factorization of integers into primes.
    - Quantum search algorithm.

- Measurement and Information Retrieval.

    - The Copenhagen interpretation of measurement
    - Measurement operators. Measurement theory.

- Elements of Quantum Information

    - Trace distance and Fidelity.
    - Introduction to quantum error corrections

Proposed Textbook

Many textbooks on the topics have been published since the end of the last centuries. But the one I used at Gatech is still the most complete

- Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press; 10th Anniversary edition (January 31, 2011).

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