Support Programm at IMPA   June 05, 2022

Research and Study Intentions

I am eager to continue my scientific activity in the field of quantum computing.

Quantum computing is a very intriguing field. Ideally, I want to push our knowledge to bring quantum computing to the industrial sector. I see an abundance of opportunities to utilize quantum computations in chemistry simulations. If we had a perfect quantum computer with a large number of qubits, we could simulate any chemical experiment with great accuracy. To understand to what extent this statement is true, I want to expand my skills with a closer study of complexity theory and Quantum finite automata. It may not have applications in NISQ era, but it surely will guide humanity towards the right path.

However, to understand how we can push the boundaries of quantum computing, we need to understand our current limitations. Today's quantum processors are small and noisy. I want to study and understand how we can overcome the low number of qubits and the high exposure to noise. In particular, I am very interested in the topic of the impact of noise on the efficiency of quantum algorithms.

Currently, I am working on this project with Sergei Borisovich. The big goal, as I see it, is to find a mathematical apparatus that conveniently describes the amount of noise that accumulates during the execution of different algorithms. There is a lot of material and mathematical models on this topic that one needs to be able to handle, such as density matrices, Schmidt decomposition, purifications, so my work involves a lot of studying and searching for existing methods.

Chemistry simulations have an essentially quantum nature, so my idea is to find an overlap between the potential of quantum computers and the quantum nature of chemical simulations. Though it seems easy, there is a lot of work to do. I already have experience with optimization algorithms, such as VQE and QAOA, which can be used in chemistry simulations, and I can't wait to deepen my knowledge on this topic. This summer I will be participating in 2022 Qiskit Global Summer School: Quantum Simulations and hope to gain as much experience as I can.

I am also interested in the field of quantum cryptography. So far, I have only theoretical knowledge in this area, but I would really like to study it in detail and see what it can bring to our world.

Currently, I have one last year left before receiving a bachelor's degree from St. Petersburg State University. But I have no supervisor to help me write my dissertation. Ideally, I would like to apply to the Master's degree at IMPA and get my Bachelor's online, if such an option is possible. As I plan to advance my career in the academical field, after a Master's degree I will be aiming for a Ph.D.

Yours truly,

Ivan Ogloblin

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