

# SQUANDER: Variational Quantum Eigensolver

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Dear Reviewer,

My name is Balázs Menkó, and I am working on a project called Variational Quantum Eigensolver (VQE) as a part of the course *Scientific Modeling Computer Lab* at Eötvös Loránd University. In this project I am using the Sequential Quantum Gate Decomposer (SQUANDER) package<sup>1</sup> to simulate the VQE algorithm.

As the main part of the project I am using the *XXX Heisenberg* model and some classical optimization methods (including ADAM, gradient descend etc.) to find the eigenvalue of the unitary matrix which describes a quantum circuit.

Despite various challenges, I have successfully modified an existing Python script to use gradient-free optimization methods and added some feature to run this script and save the data easier. Furthermore, I generated figures from the simulations and tried to analyze the results.

However, further improvements are necessary. In the second half of the semester, my goal is to analyze the *gradient descend* method and its behavior since it has peaks in the minimization method. I will try to explore the reasons of this behavior and investigate possible ways to mitigate these fluctuations to improve convergence stability.

For my source code and execution scripts please refer to my GitHub repository: [github.com/menkobalazs/SMC-Lab-SQUANDER](https://github.com/menkobalazs/SMC-Lab-SQUANDER). These codes are also available on Moodle.

Sincerely,  
**Balázs Menkó**

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<sup>1</sup>See on GitHub: <https://github.com/rakytap/sequential-quantum-gate-decomposer>