Quantum algorithms are considered a promising method for solving certain types of problems, particularly those related to combinatorial optimization. In such cases, classical algorithms often struggle because the number of possible solutions grows rapidly as the problem size increases. To make use of quantum computing, these problems are often reformulated as QUBO models — Quadratic Unconstrained Binary Optimization. This form of the problem aligns with the requirements of modern quantum algorithms and enables their application on currently available hardware platforms.

Although QUBO is a highly flexible and versatile approach, its effectiveness depends on several key factors. One of them is the so-called ”energy gap” between the best and the second-best solution — the larger the gap, the easier it is for the algorithm to identify the optimal result. The distribution of numerical values within the model is also important. A wide range of coefficient values can reduce the performance of optimization algorithms, both classical and quantum. Additionally, many problems involve specific constraints that must be properly incorporated into the model to ensure that the solution meets the required conditions.

The aim of this project is to propose a new machine learning-based approach to improve the properties of problems formulated in the QUBO format. The proposed solution employs a neural network architecture capable of symbolically representing and modifying the mathematical structure of such problems. By combining the latest advances in machine learning and quantum computing, we seek to enhance the efficiency of solving optimization problems. In the longer term, the outcomes of this project may support broader adoption of quantum technologies in real-world applications and contribute to the development of modern tools for addressing complex problems.