QCentroid

QCentroid Challenge: Quantum Portfolio Optimization

🧠 Challenge Overview

Welcome to the **QCentroid Portfolio Optimization Challenge**, part of the ETH Quantum Hackathon 2025! In this challenge, participants will tackle a classic financial problem: **optimizing a portfolio of assets** with a quantum twist.

Portfolio optimization lies at the heart of financial decision-making, where investors aim to find the most efficient allocation of capital among different assets. While traditional algorithms have provided strong solutions, quantum computing opens new doors to solving these problems more efficiently, particularly as the size and complexity of datasets grow.

Your mission is to design and implement a quantum, quantum-inspired or hybrid algorithm that performs optimal portfolio selection using the provided financial datasets.

This is your chance to apply quantum technologies to a real-world use case with measurable business impact—and to show how far your innovation can go when paired with the power of quantum computing.

🎯 Objective

Your task is to develop a **portfolio optimization algorithm** for a given set of historical financial data.

- **You may use any of the classic approaches**
- **You can create your own approach to select the assets**
- **You can choose the metric you want to optimize**

The goal is to select the better performing portfolio out of the given assets.

Participants are encouraged to explore a wide range of strategies: purely quantum, hybrid quantum-classical, or quantum-inspired classical approaches

At least ***one of the routines must be a quantum solution***, for example:

- The predictive model
- The assets selection
- The portfolio weighting
- Any other

Creativity, performance, and clarity of approach will all play a role in the final evaluation.

🧰 Tools & Environment

Participants will use their **own computers or laptops** to develop and test their solutions during the hackathon. All quantum and classical computations should be executed using **Qiskit**, the open-source SDK for working with quantum computers developed by IBM.

To simulate and test quantum algorithms, participants are expected to use the **free simulators provided by Qiskit**, such as the `Aer` simulator. No access to real quantum hardware is required for this challenge, ensuring accessibility for all teams regardless of hardware availability.

We encourage participants to use **Python** as the primary programming language and leverage the powerful features of Qiskit's optimization modules, including `qiskit.algorithms`, `qiskit_optimization`, and relevant community-contributed libraries.

If you're new to Qiskit or need a refresher, check out the Qiskit documentation and Qiskit tutorials.

📊 Datasets Provided

We will provide participants with **one historical financial datasets**, designed to simulate real-world portfolio selection challenges:

1. **Equities Dataset** – Contains daily returns for more than 800 publicly traded stocks over a 3-year period. Includes metadata such as sector, market cap, and sustainability metrics.

Each dataset will include:

- **Historical stock prices**
- Company financial data, such as market cap, sector, country, number of employees…
- Sustainability information

🧪 Evaluation Criteria

Submissions will be evaluated based on a combination of **technical merit**, **originality**, and **practical performance**. Judges will use the following criteria:

- **Optimization Performance**
  How effective is your algorithm at maximizing return and minimizing risk under the given constraints? Metrics such as Sharpe ratio, risk-adjusted return, and constraint satisfaction will be considered.

- **Quantum Advantage / Use of Quantum Methods**
  To what extent does your solution explore or demonstrate the value of quantum computing, hybrid approaches, or quantum-inspired techniques? Effective use of quantum resources will be rewarded.

- **Scalability & Robustness**
  Can your approach scale to larger portfolios or adapt to new datasets and constraints with minimal changes?

- **Technical Innovation & Creativity**
  Did your team employ novel ideas or clever problem-solving techniques, whether in algorithm design, formulation, or implementation?

📎 Submission Requirements

To ensure a fair and thorough evaluation, each team must submit the following items via the DoraHacks platform before the deadline:

1. **Code Repository (GitHub)**
   A well-structured and commented implementation of your solution, including:
   - Source code (quantum/classical/hybrid)
   - Instructions to run the code
   - Any required dependencies or environment setup
2. **README**
   A concise explanation of:
   - Your approach and design choices
   - How quantum techniques were used
   - Challenges encountered and how you addressed them

Only submissions that include all required components and are submitted on time will be eligible for judging and prizes.