

# Quantum Machine Learning in Quantitative Finance

## A Review of Applications of Quantum Machine Learning for Quantitative Finance

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# Introduction

"By leveraging the unique properties of quantum systems, such as superposition and entanglement, QML techniques have the potential to improve traditional methodologies in finance. These techniques promise to enhance predictive capabilities in areas such as portfolio optimization, market prediction, trading, pricing, and risk management"

# Introduction

## Challenges

- Classical Bottle Neck: scalability struggling when the dimension of the data increases.
- Monte Carlo Simulation: a method used to estimate the value of an option by simulating the underlying asset's price path. However, it can be computationally expensive and time-consuming, especially for high-dimensional problems.

## Quantum Advantage

- Handling High Complexity: Quantum algorithms can offer exponential speedups.
- Solving Combinatorial Optimization Problems.
- Speeding up Monte Carlo Simulations: Quantum algorithms can potentially speed up the process of generating random samples, which is a key component of Monte Carlo simulations.

# Portfolio Optimization

## Objective

Build an investment portfolio that maximizes returns while minimizing risk. To achieve this, we need to choose carefully the option of assets such as stocks, bonds, and other financial instruments. The key is diversification, which means spreading investments across different assets that has **little to no correlation** to minimize risk and domino effect.

# Portfolio Optimization - Classical Approach