Quantum Applications for Financial Institutions
Why is Quantum relevant for FIs’s?

Small improvement in Return on Assets (ROA) can make a massive $$$ impact

Quantum could help solve intractable problems and deliver performance improvements
The Framework

**STAKEHOLDERS**
- Financial Institution
- Quantum Hardware Co.
- Quantum Application Co.

**DEPENDENCIES**
- Data
- Business Process/Rules
- Resources
- Proof of Concept
- Testing

**OWNERSHIP**
- Intellectual Property
- Process Improvement

**OUTCOME**
- Demonstrate Improved Return on Assets (ROA)
Collaboration Requirements

IDENTIFY
Intractable Problem

FORMALIZE
Structure
Process
Benchmark

RESOURCE
People
Partnerships

R&D
Formulate
Test

CognitoFrame®
The Hybrid Machine Learning Company
What to Quantum-ize?

- Types of Problems
- Scalability
- Hardware Capabilities
- Impact Value
Approaches

- Classical vs Quantum vs Hybrid
- Simulated vs Quantum
- Evaluation of Results
The Use Case: Non-Convex Optimization

- Our quantum computing software allows financial institutions to find better Optimal Solution(s).

- This leads to increased returns, reduced risk, and greatly outperforms the optimal solution found using convex optimization.

- CogniFrame’s solution can be customized for a financial institution’s objectives such as risk, returns or other constraints.
Sources of Non-Convex Problems

- **Nature of Problem**
  Problems that contain a number of local optimality across the energy space (e.g. combinatorial optimization, discrete optimization).

- **Choice of Models**
  The choice of utility function, risk metrics, objectives functions (e.g. VaR, trading trajectory).

- **Market Friction and Irrationality**
  The market cost and irrationality embedded in data resulting in negative eigenvalues, usually noticeable when the scale of the problem grows.

- **Optimization Constraints**
  Non-linear/inequality constraints in the optimization problem.

Non-convexity usually emerges with relaxing of certain “handcuffs” in the optimization problem.
Non-Convex Problems
Multiple Use Cases

- ALM - Active Portfolio Optimization and cash flow matching for banking book.
- Pension Funds - Optimize allocations of member contributions and benefit payouts.
- Collateral Optimization
- Insurance - Solvency II, Portfolio Optimization.
- Asset Managers - Portfolio Optimization.
- Fixed Income - Portfolio Optimization.
Workflow

How does our model work?

Current FI approach
- Linear Risk Modeling
- Convex Optimization

The CogniFrame approach
- Linear and Non-Linear Risk Modeling with ML
- Convex and Non-Convex optimization
- Retaining all existing models and procedures
- Optimizing use of funds with reduced market and liquidity risks
Early Results using Non-Convex Return Matrices

Hybrid Solution = Classical Methods + D Wave Quantum

- Problem: 12 constraints, 20 variables (investments) per constraint
- Objective: Lower is better; small decimals represent hours of run time or even intractability
- Specialized Classical optimization tools accelerated on Graphics processor (GPU):
  - Brute force use of compute power with a robust optimization method
  - 2.5 hours of runtime
- Industry-standard package (CPLEX 12.8):
  - 2.5 hours of runtime
  - Out-of-memory condition on a 64GB machine
  - Optimal not proven
- Hybrid solution
  - 30 minutes of runtime

-7.46
-8.62
-8.714
Proof Of Concept - Objectives

- Demonstrate “performance improvement” vs Classical
- Demonstrate Financial Value
- Demonstrate Commercial Scalability
- Costs vs Benefits Analysis

- PERFORMANCE
- SCALABILITY
Key Challenges

- Choosing the right problem (setting up for success)
- Data aggregation/acquisition – dispersed among many legacy systems
- Commercial Scalability
- Multiple Low Energy Solutions – evaluating ROA
Commercialization

- Business Models (In-house vs SaaS, Pricing structure, IP)
- Implementation Challenges
- Repeatability

Going beyond the Technology
THANK YOU