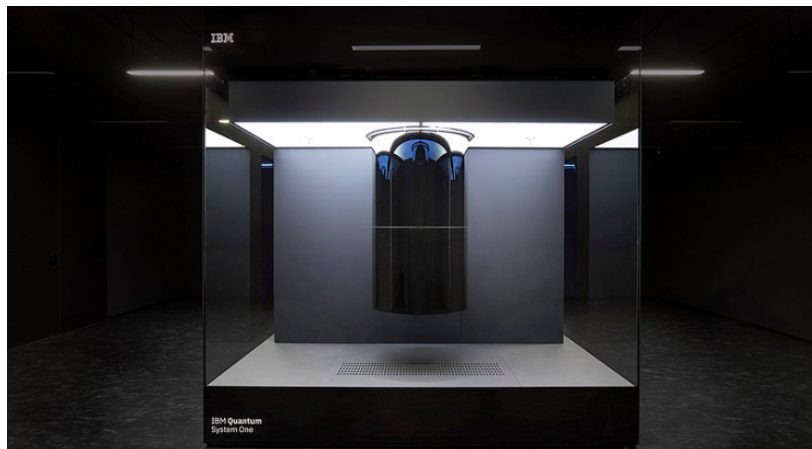


# Quantum Machine Learning Technologies

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PennState



Quantum computing

## Technology Summary

A family of inventions covers various quantum computing & machine learning related topics. Quantum Machine Learning (QML) combines the benefits of quantum computing & machine learning. Two inventions propose solutions to improve performance of QML models, one by optimizing the shot allocation for training on real hardware, and another via a new embedding scheme using QRAM Memory. As the accessibility of quantum computing hardware grows, there is a concern for security, which are addressed in two of the inventions. One proposes a solution to model & simulate adversarial tampering on quantum circuits, another supports user distribution of their quantum computing tasks among trusted & untrusted quantum providers. Another proposes a method to prevent IP theft when using hybrid quantum classical algorithms. These inventions represent significant contributions to the field of quantum computing and its intersection with machine learning and cybersecurity.

## Application & Market Utility

1. A novel method to speed up the convergence of QML models. This reduces the number epochs, providing speedup & reducing cost
2. A method for obfuscating quantum circuits to enhance security during compilation
3. An optimization method for QML models to reduce training time & cost
4. An embedding scheme using QRAM for machine learning applications
5. A solution to quantum computing insecurity by modeling adversarial tampering
6. A method to address QML security by de-risking untrusted or unreliable third-party tools and hardware

## Next Steps

Prototype quantum circuits and emulations are available to share with prospective licensees.

TECHNOLOGY READINESS LEVEL

4-7

### Seeking

Licensing | Research

### Keywords

- Quantum Computing
- Quantum Machine Learning (QML)
- Cybersecurity
- Machine Learning

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