**“Quantum Enhanced Machine Learning: Algorithmic Approach and Implementation”**

Abstract for MSc Data Science Final Semester Project

**Project Guide: Prof. K. Vedavathi, HoD Computer Science**

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Machine Learning aims at designing models that learn from previous experience, without being explicitly formulated. Applications of machine learning are inexhaustible, including recognizing patterns, predicting future trends and making decisions, and they are capable of handling sizable quantities of multi-dimensional data in the form of large vectors and tensors. To perform these operations on classical computers, however, requires vast time and computational resources. Unlike the classical computers that rely on computations using binary bits, Quantum Computers (QC) benefit from qubits which can hold combinations of 0 and 1 at the same time via superposition and entanglement. This makes QCs powerful at handling and post processing large tensors, making them a prime target for implementing ML algorithms. While several models used for ML on QCs are based on concepts from their classical computing counterparts, utilization of the QC’s potential has made them the superior of the two.

One of the biggest problems facing machine learning is the so-called curse of dimensionality - in general the number of training data sets required for the machine to learn the desired information is exponential in the dimension. If a data set lies in a high-dimensional space, then it quickly becomes computationally unmanageable. That complexity is similar to quantum mechanics, for which an exponential amount of information is generally also required to fully describe a quantum many-body state. Despite its intricacies, quantum theory is arguably the most successful quantitative theory of nature. It not only provides the basis for understanding physics on all length scales, from elementary particles like electrons and quarks to gigantic objects like stars and galaxies, but also lays the foundation for modern technologies ranging from lasers and transistors to nuclear magnetic resonators and even quantum computers.

The idea of quantum information processing has revolutionized theories and implementations of computation. New quantum algorithms may offer tantalizing prospects to enhance machine learning itself. The interaction between machine learning and quantum physics will undoubtedly benefit both fields.

This project gives an overview of the current state of knowledge in application of Machine Learning on Quantum Computing, and evaluating the speed up, and complexity advantages of using quantum machines. Quantum Support Vector Machine for Classification will be stressed and also the procedures implemented will explain the enhancement of classification techniques and learning algorithms on Quantum Machine learning.