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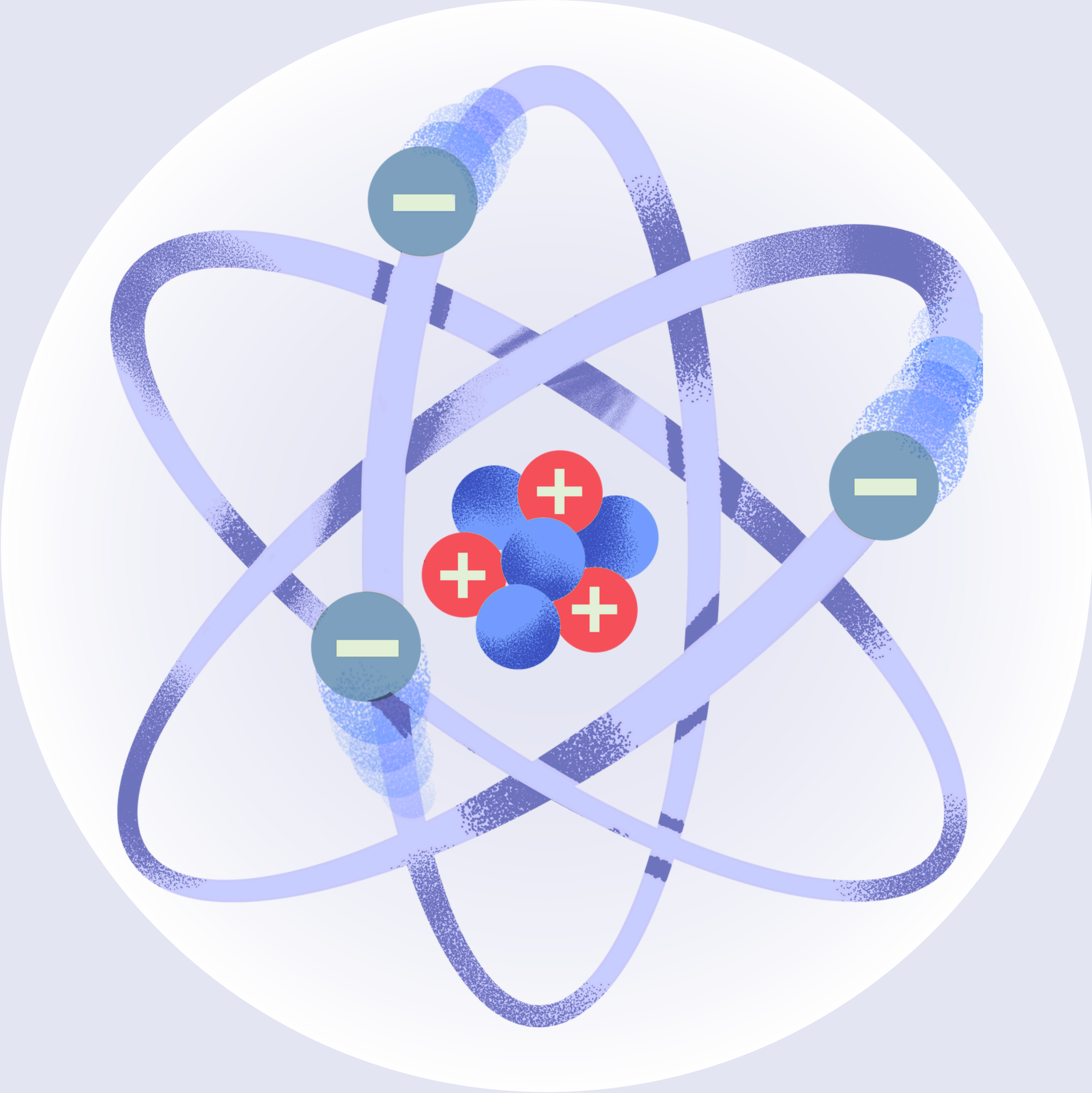
QUANTUM+AI PROJECT

QML for Conspicuity Detection

Harsh Sanjay Roniyar



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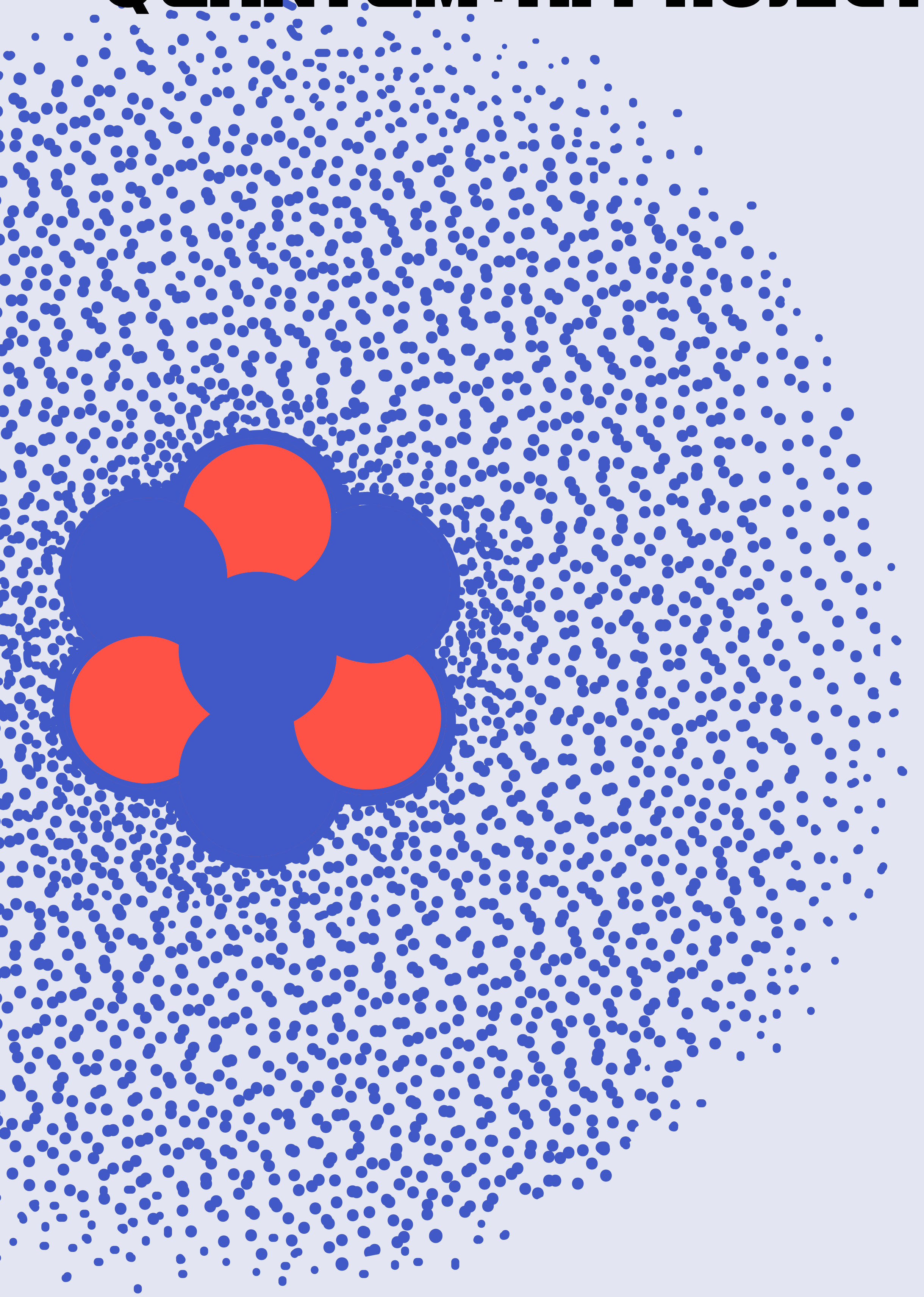

TABLE OF CONTENTS:

WOMANIUM | QUANTUM

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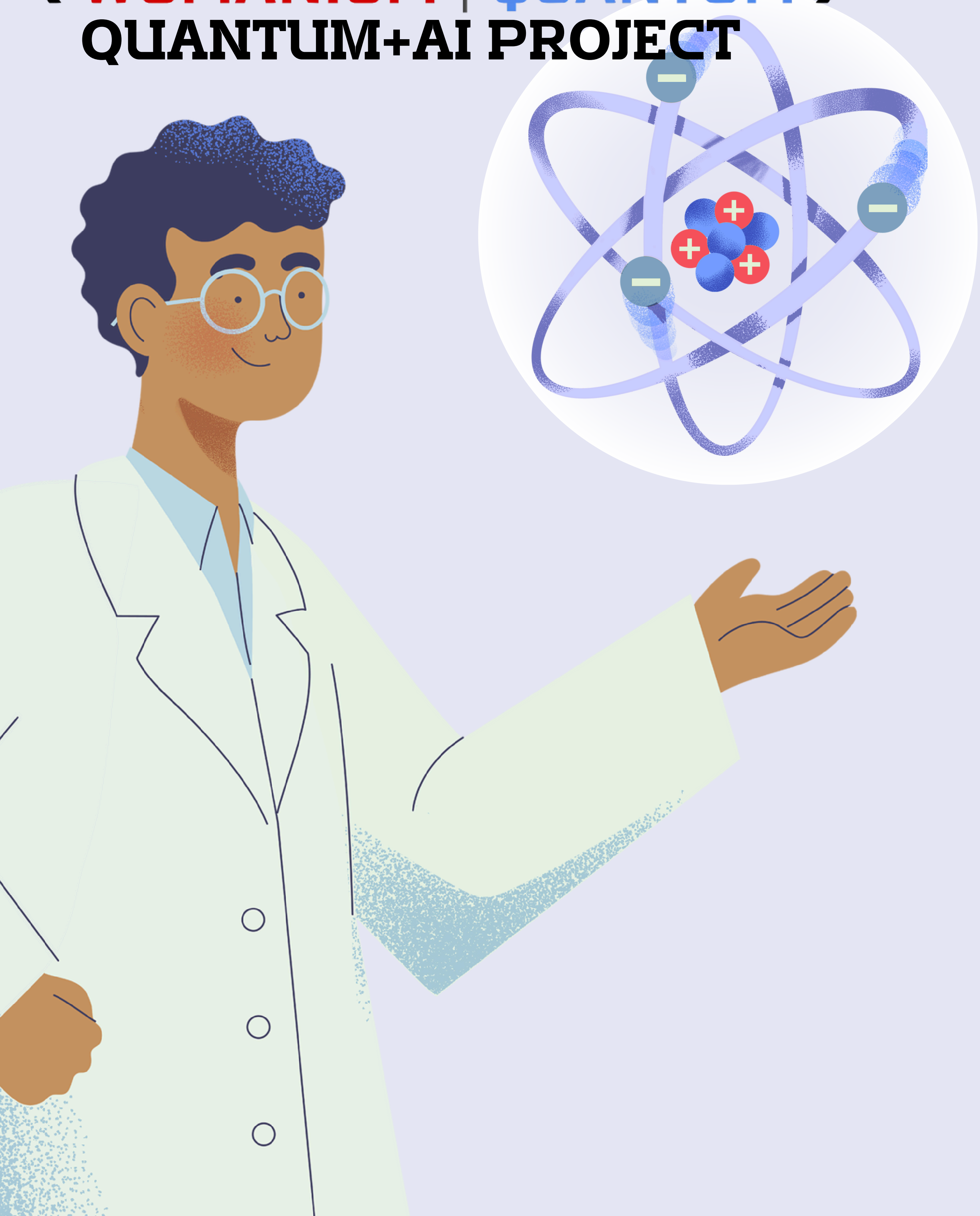

INTRODUCTION

The advent of quantum machine learning and algorithms has revolutionized our approach towards solving problems.

With quantum tools at our disposal, we are now able to employ hybrid quantum-classical methods employing the best from both domains, helping us to get better results on current research problems.

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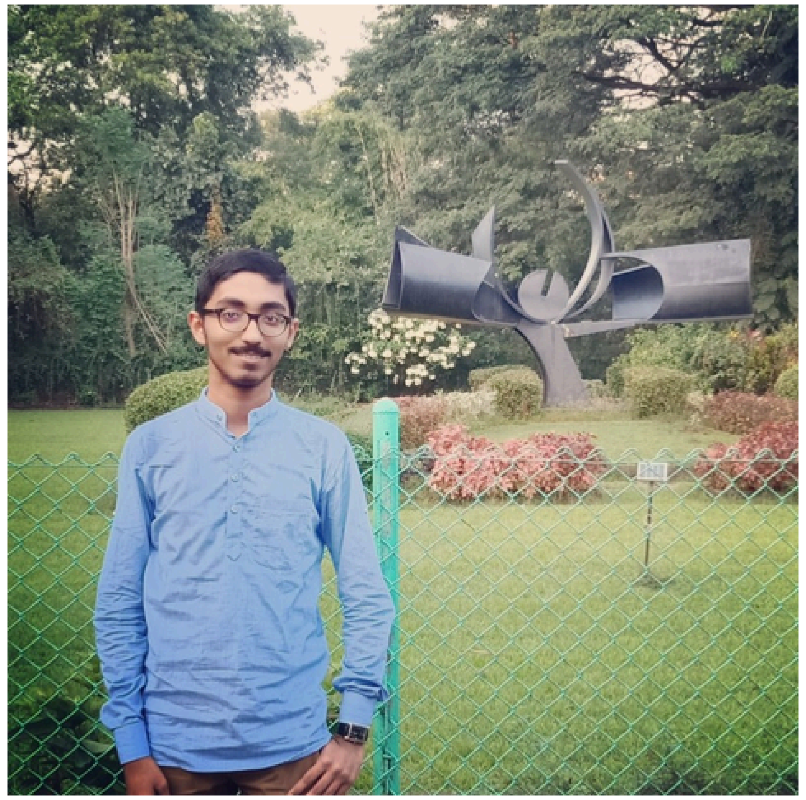
TEAM – PRODIGIUM



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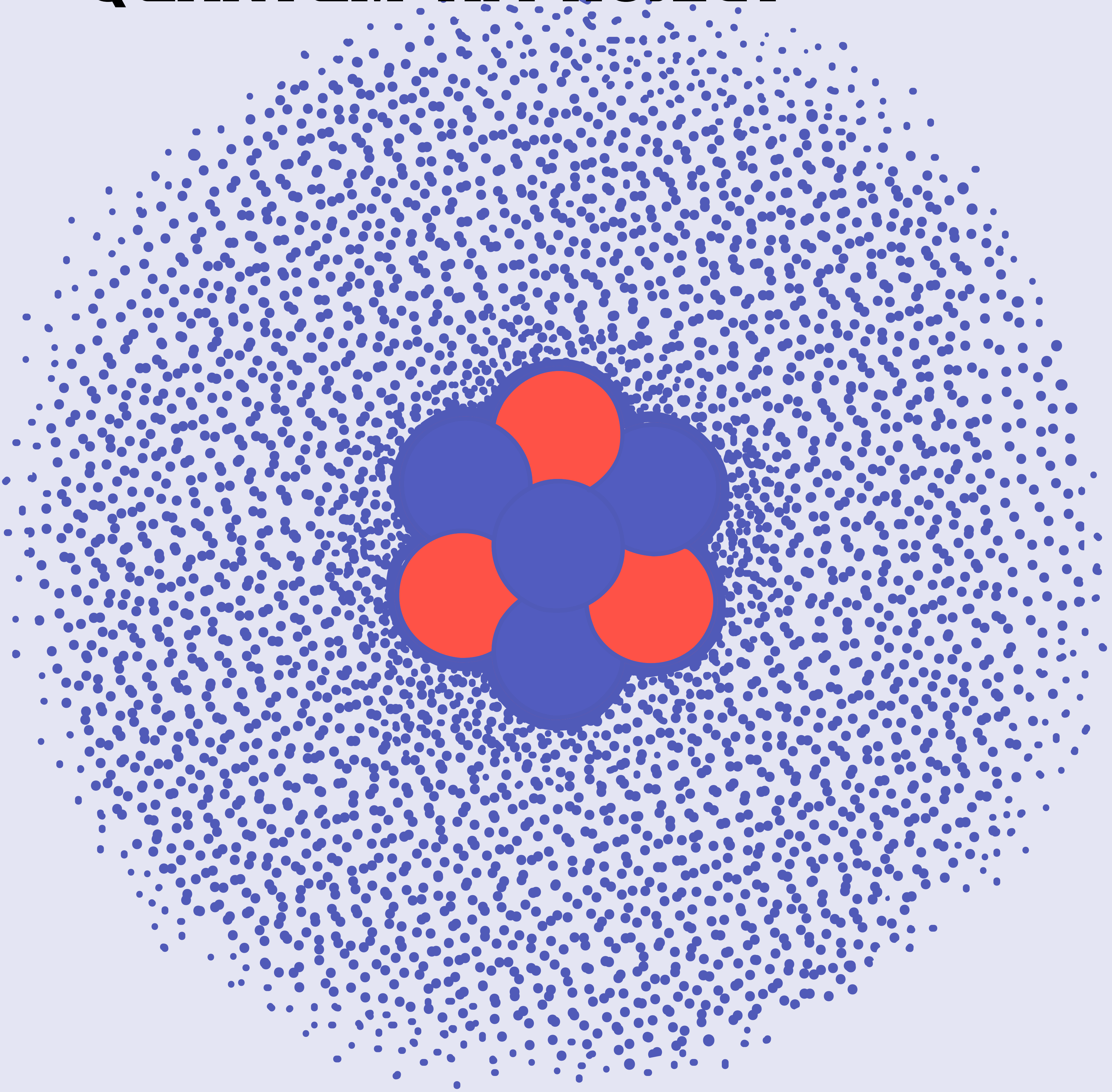

THE CODEBOOK

On starting using pennylane for this project, I had to initially learn the basics and functionality of their modules.

For this, I started to begin with the Pennylane codebook and managed to learn the basics of pennylane.

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VARIATIONAL QUANTUM CLASSIFIER

BASIS ENCODING

Encode binary inputs from the computational basis state into the initial state of the circuit

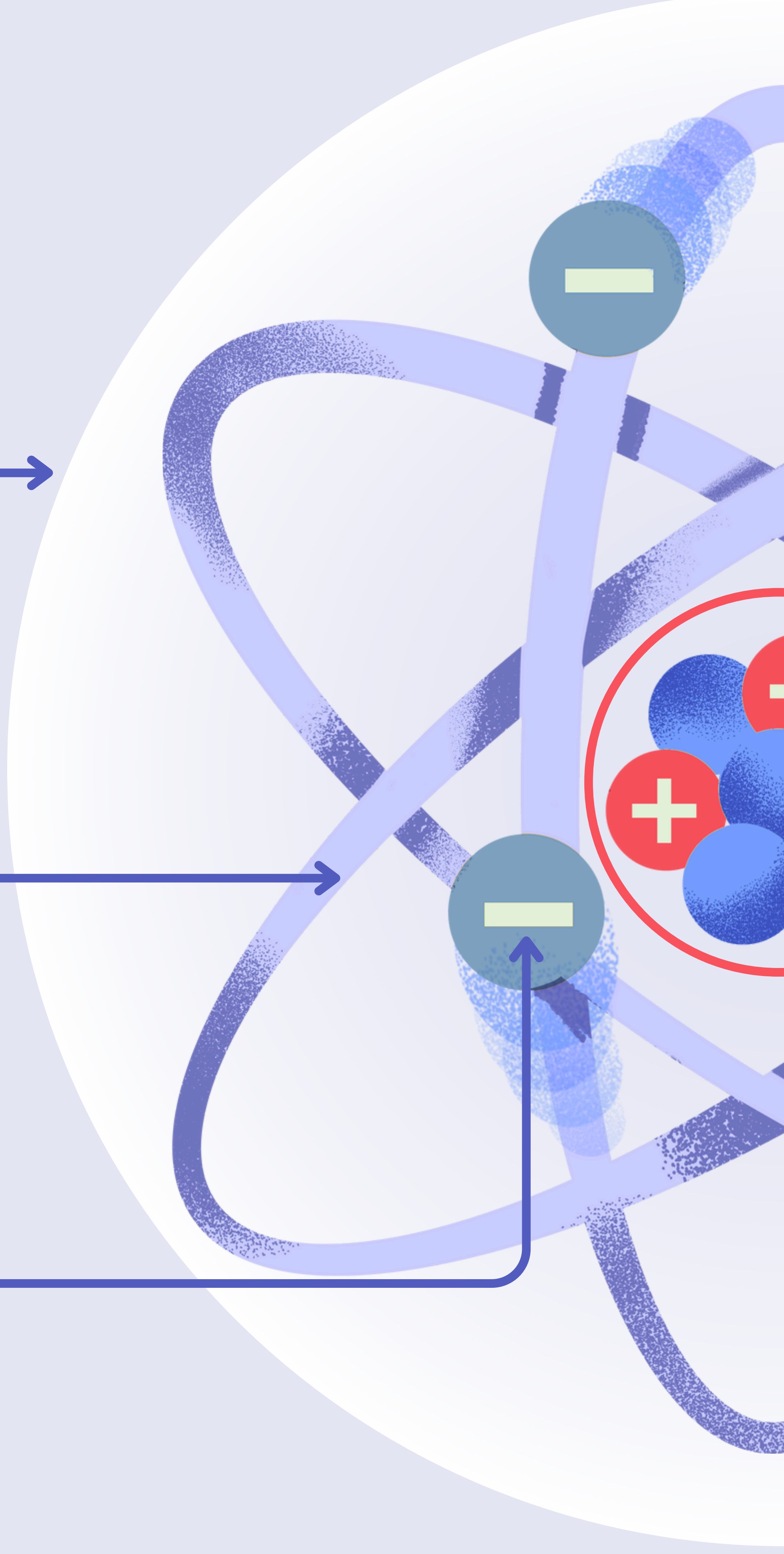
AMPLITUDE ENCODING

Encode real vectors as amplitude vectors into quantum states

OPTIMIZATION

Used the Nesterov Momentum Optimizer

$a(t+1)=ma(t)+\eta\, \nabla f(x(t)-ma(t))$.



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QUANVOLUTIONAL NEURAL NETS

QUANTUM CONVOLUTION

Convolves the input image with many applications of the same quantum circuit.

HYBRID MODEL

Take the output of the quanvolutional layer and feed it to a classical NN and train it.

TRAINING

Trained the model on MNIST dataset and compared results with baseline model.

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QML – SINE FUNCTION

1. DISCRETIZATION:

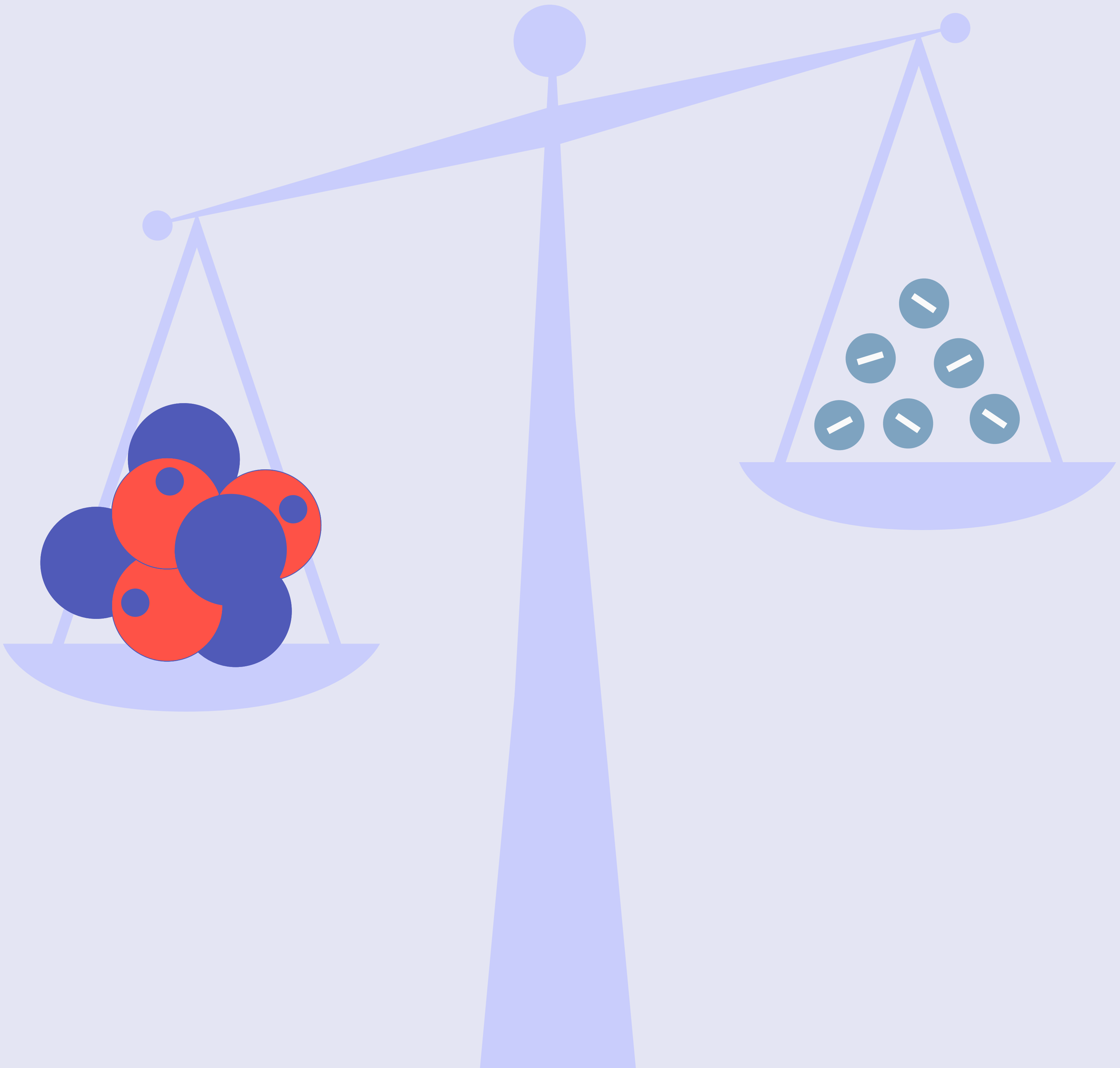
Discretizing the primary interval and using these data-points as labels for the sine function.

2. VARIATIONAL QUANTUM CIRCUIT:

Created a 1-qubit, 3-layered VQC model which learns and reproduces the values of the sine function.

3. GRADIENT DESCENT OPTIMIZER:

Used Gradient Descent Optimizer for iterative cost minimization for epochs.



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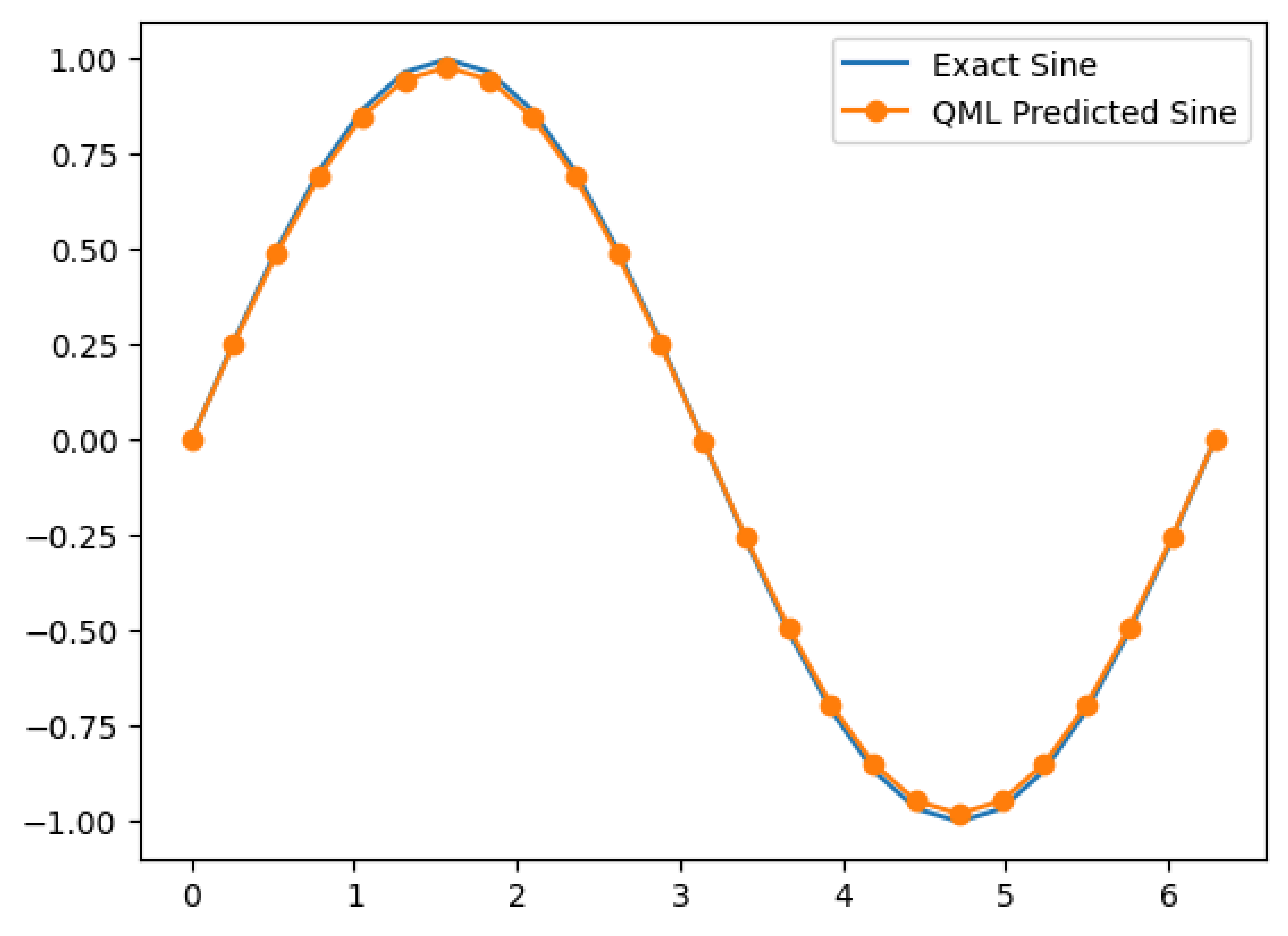
SINE RESULTS



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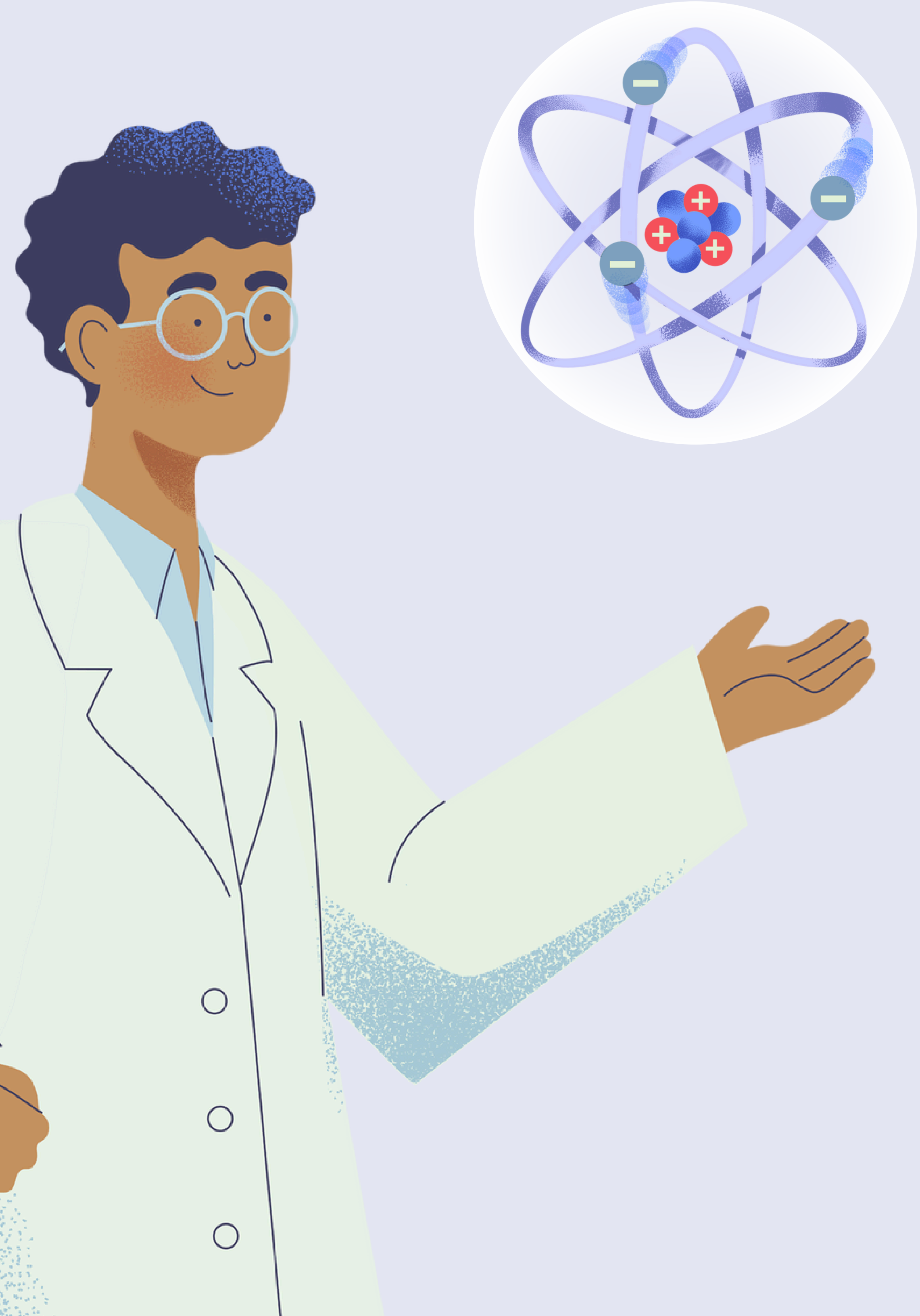

CONCLUSION

We managed to develop our own QML model which reproduces/approximates the sine function with great accuracy even with a limited number of epochs.

I enabled myself to develop and implement good Quantum ML models on real-life datasets and benchmark them with classical models.