

QML for Conspicuity Detection in Production

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Project Statement and Tasks

Base Tasks:

- Learn PennyLane QML framework
- Implement a Variational Classifier with PennyLane
- Implement a Quanyvolutional Neural Network with PennyLane

Extra Tasks:

- Implement a QML model to learn the sine function
- Implement a QML model to detect a defective production part (Aluminum welds)

◀ **WOMANIUM** | **QUANTUM** ▶

The background features decorative curved lines in the corners. In the top-right corner, there is a thick, multi-layered arc transitioning from light blue to light green. In the bottom-left corner, there is a similar thick, multi-layered arc transitioning from light green to light blue. The text is centered between these two decorative elements.

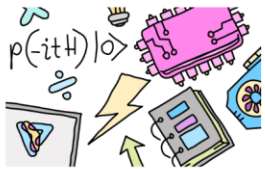
Project Solution

PennyLane QML Framework

- Solved exercises on sections “Introduction to Quantum Computing”, “Single-Qubit Gates” and “Circuits with Many Qubits” from PennyLane’s Codebook

Introduction to Quantum Computing

Single-Qubit Gates



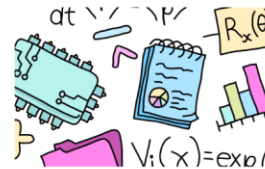
All About Qubits

Learn the fundamental concepts in quantum computing.



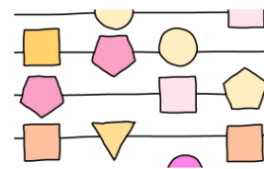
Quantum Circuits

Get some hands-on experience in building quantum circuits.



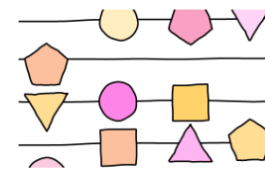
Unitary Matrices

Learn how to represent quantum operations using unitary matrices.



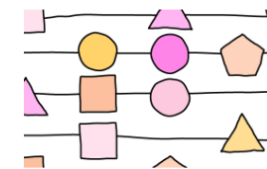
X and H

Become familiar with the Pauli X and Hadamard gates.



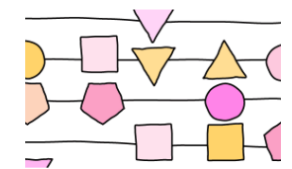
It's Just a Phase

Learn about qubit rotations and global phases.



From a Different Angle

Study the effects of qubit rotation about the X and Y axes.



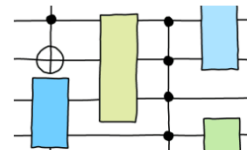
Universal Gate Sets

Build all possible single-qubit gates from a subset of them.

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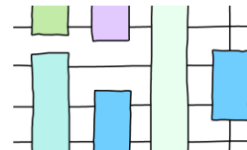
Circuits with Many Qubits

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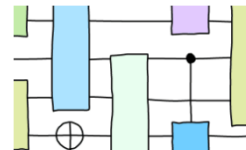
Multi-Qubit Systems

Learn how to build quantum circuits with many qubits.



All Tied Up

Explore the mysteries of quantum entanglement.



We've Got It Under Control

Expand your gate repertoire by using controlled gates.



Multi-Qubit Gate Challenge

Hone your skills with these extra challenging exercises.

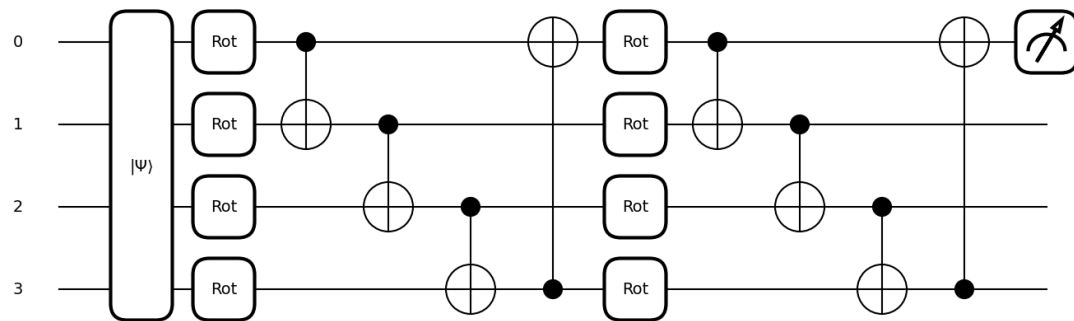
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Womanium Quantum+AI Project

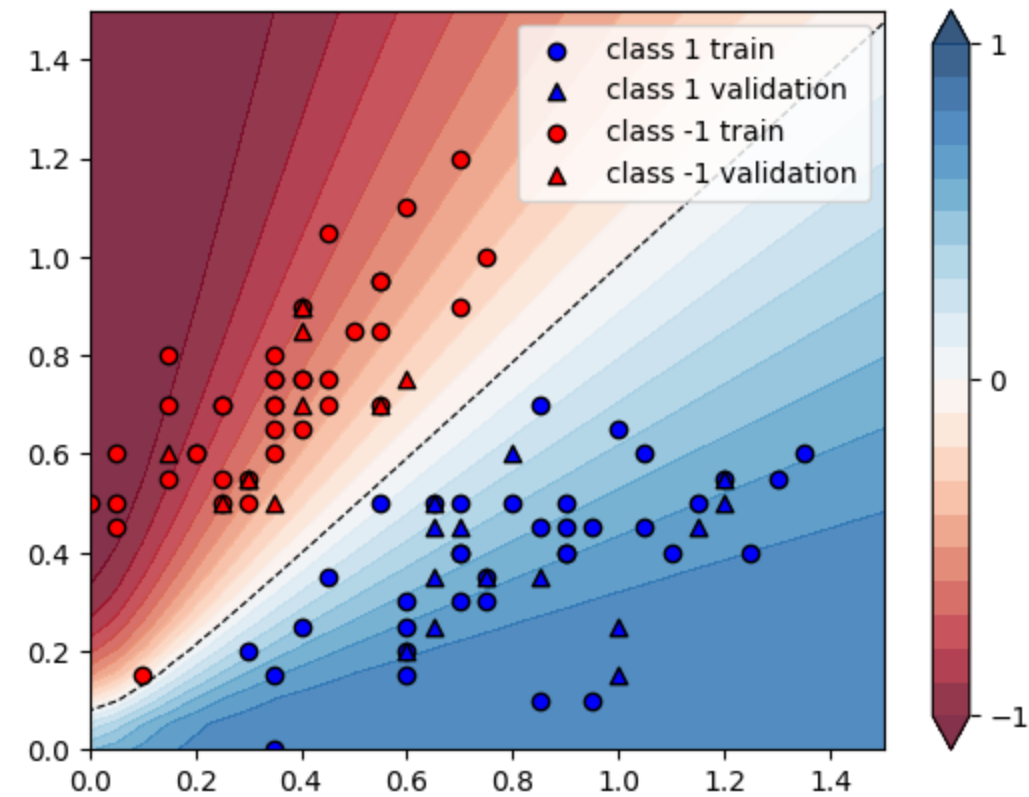
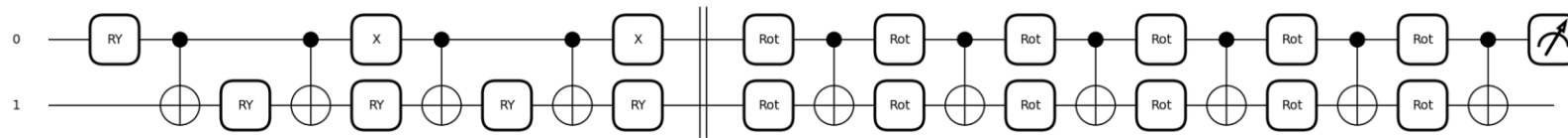
Variational Classifier

- Implemented the [Variational Classifier](#) PennyLane Demo

Parity function variational circuit



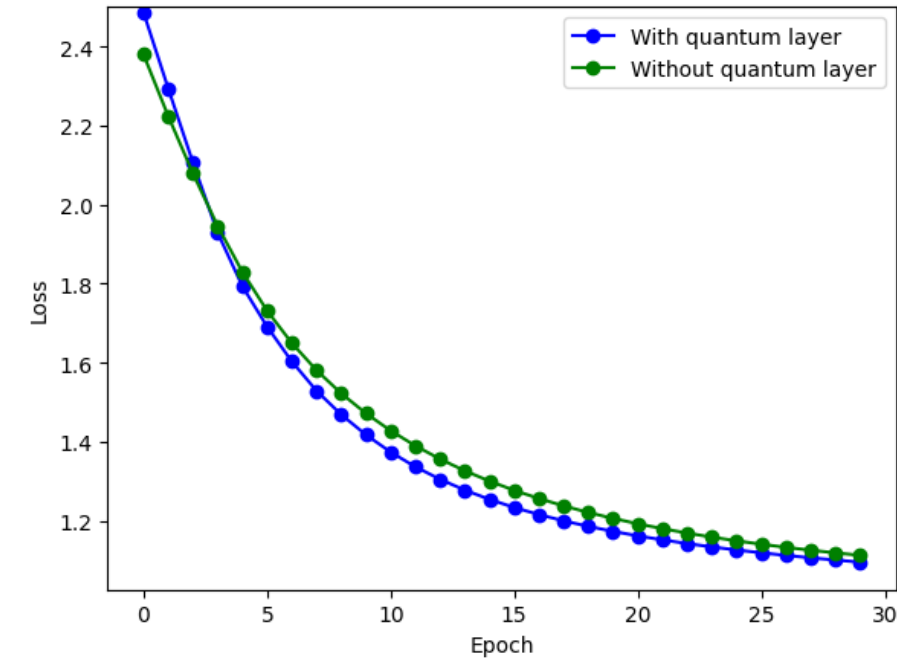
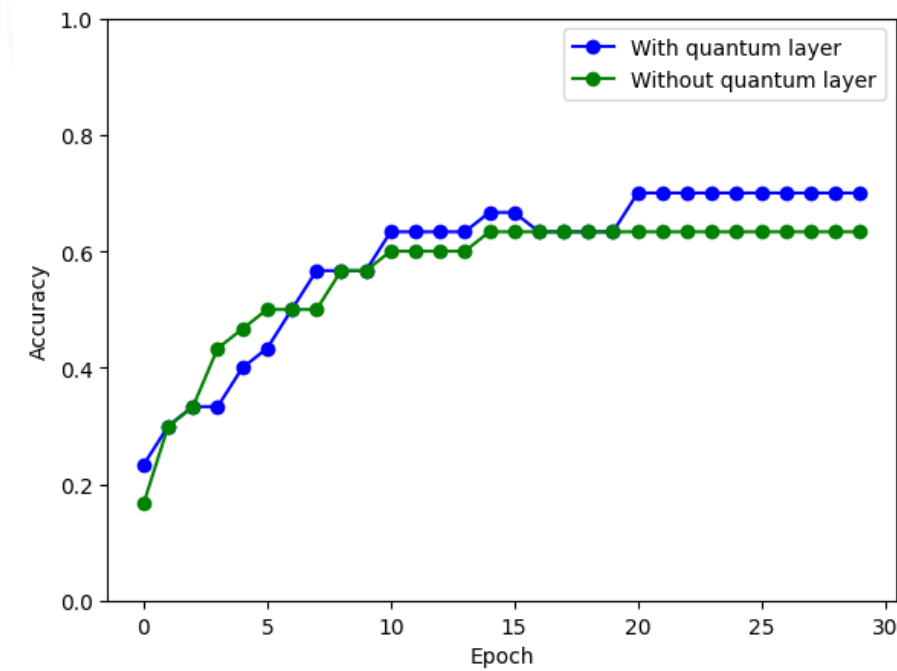
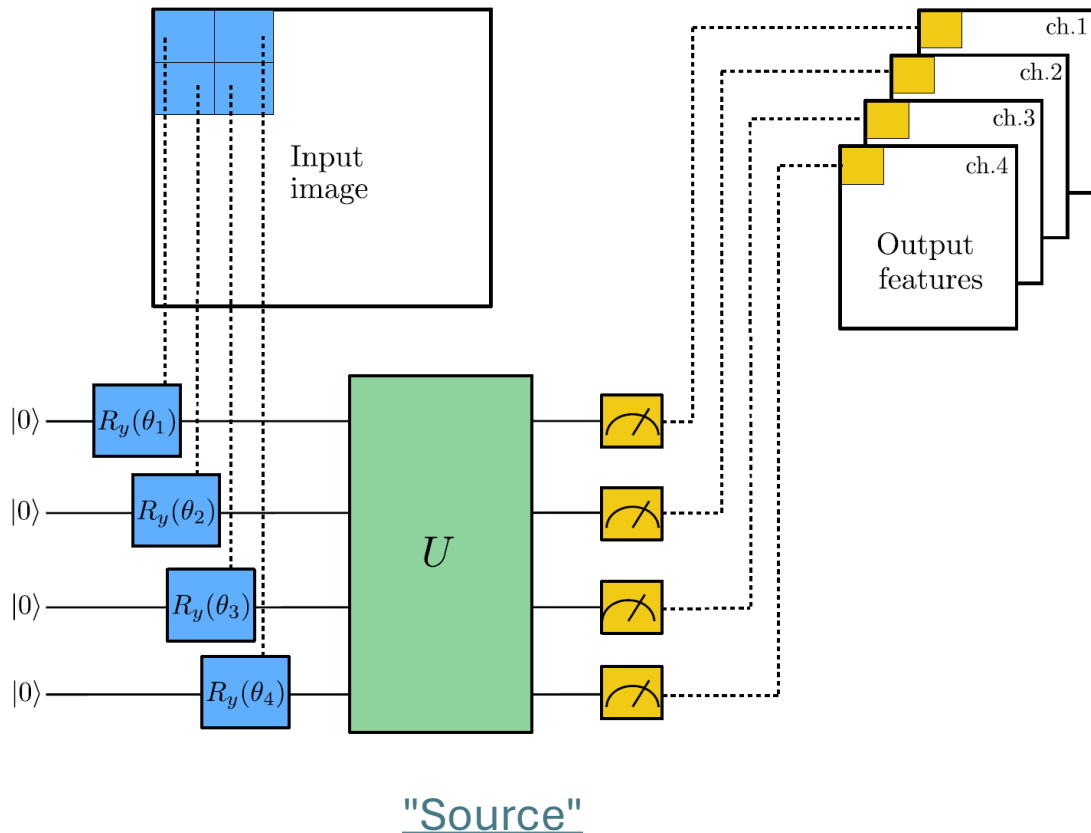
Iris flower dataset classification variational circuit



Source: Task-2 in GitHub Repo

Quantvolutional Neural Network

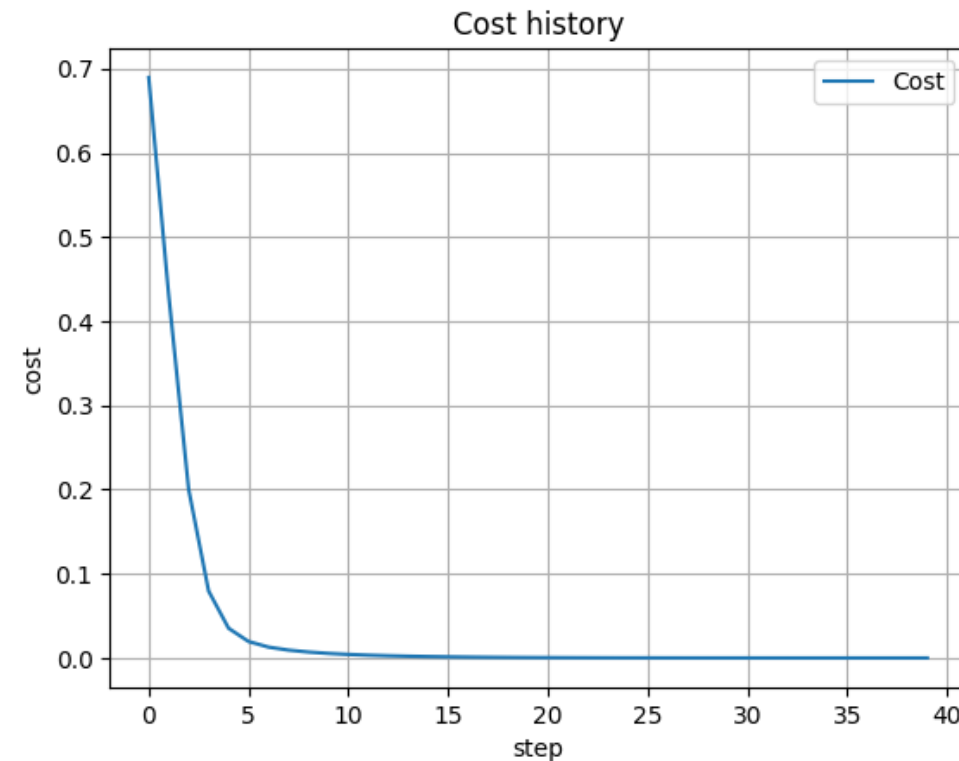
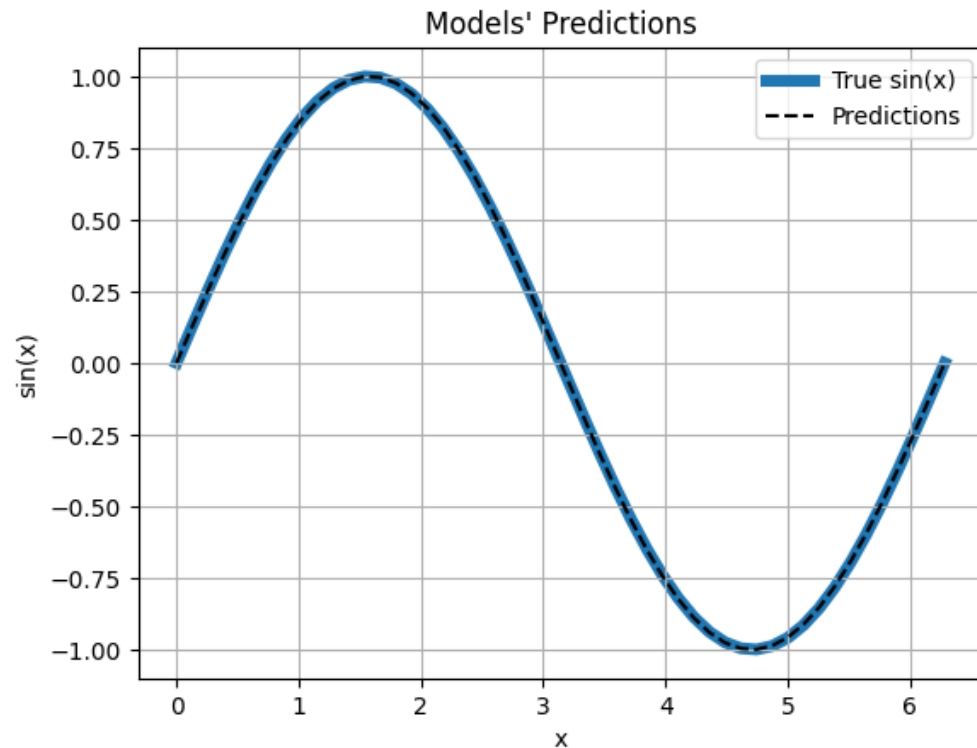
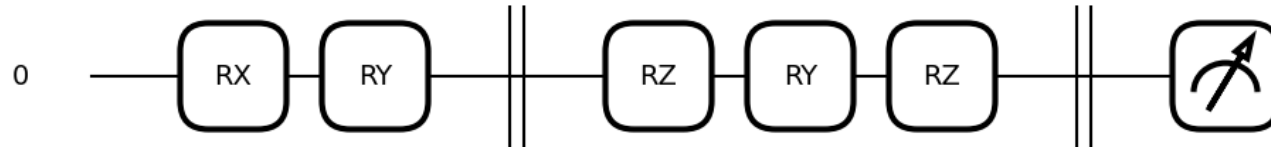
- Implemented the [Quantvolutional NN](#) PennyLane Demo



Learning the Sine Function

- Implemented a Simple Quantum Neural Network (Variational Circuit) that learns the sine function on the interval $x \in [0, 2\pi]$

State Preparation and Ansatz:



QML model to Detect Defective Aluminum Welds

- Our Idea was to use the Quanvolutional Layer from Task 3 and convert it into a Keras Layer such that it becomes optimizable just like a classical filter
- Due to time Constraints and technical difficulties in the PennyLane-Keras interface, we could not finish our implementation

