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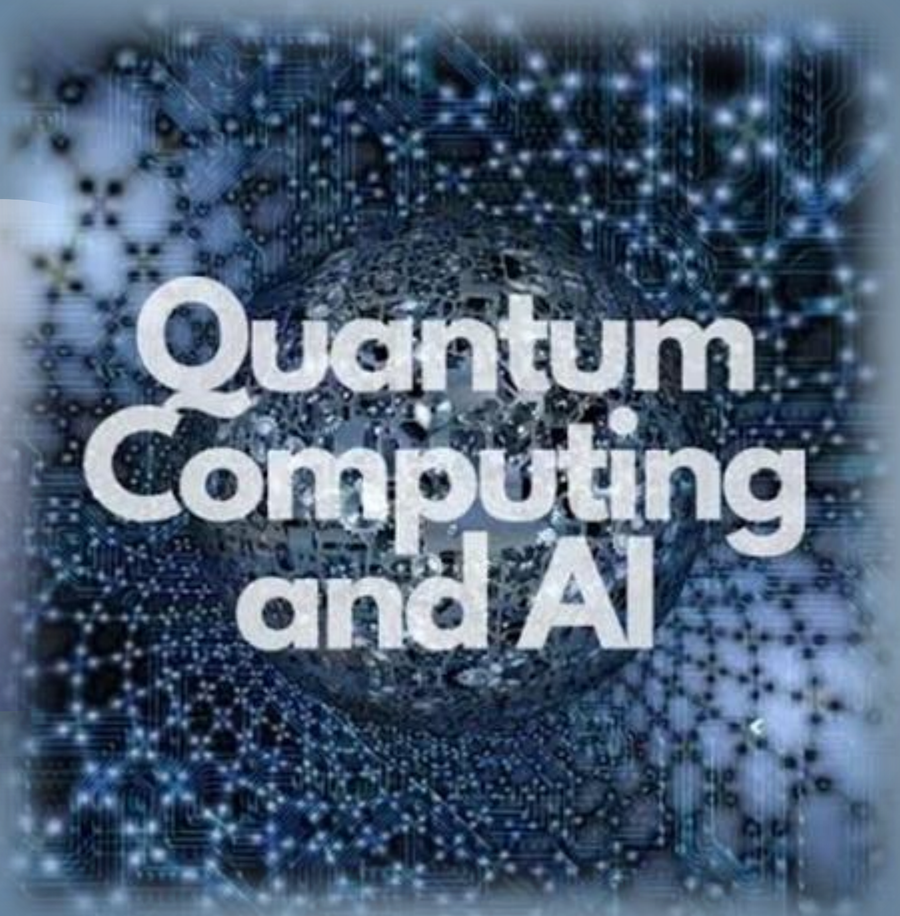
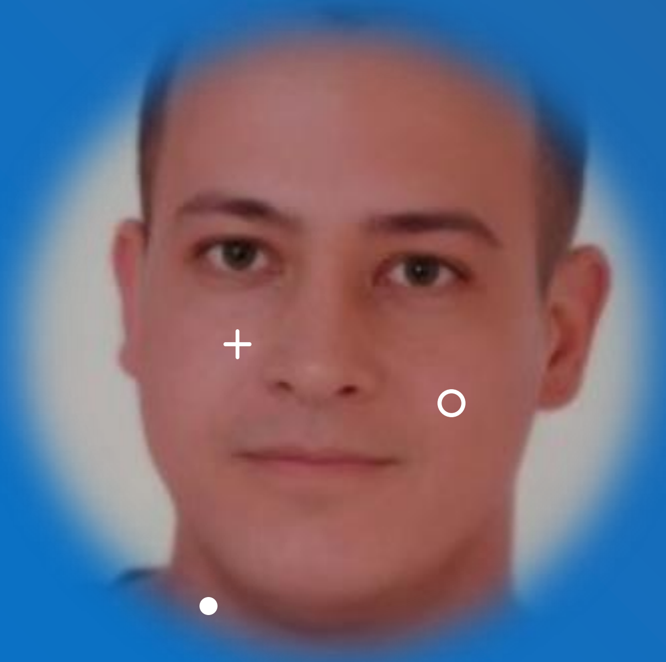


QML FOR CONSPICUITY DETECTION

THE DETECTION DUO TEAM

- ML Engineer intern
- Graduated from physics major
- Currently Computer science undergraduate



- Full stack developer
- Currently pursuing phd in computer science
- Teaches university courses on optimization fundamentals, algorithmic techniques, and quantum algorithms

Outline

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1

Problem

2

Solution 4 and 5

3

Challenges and future steps

Problem

1

Predict sine function

- sin(x)

Predict more complicated sine function

- 2*sin(x) + 0.7*sin(3*x)

2

Image classification

- Defective/non-defective

Find best accuracy

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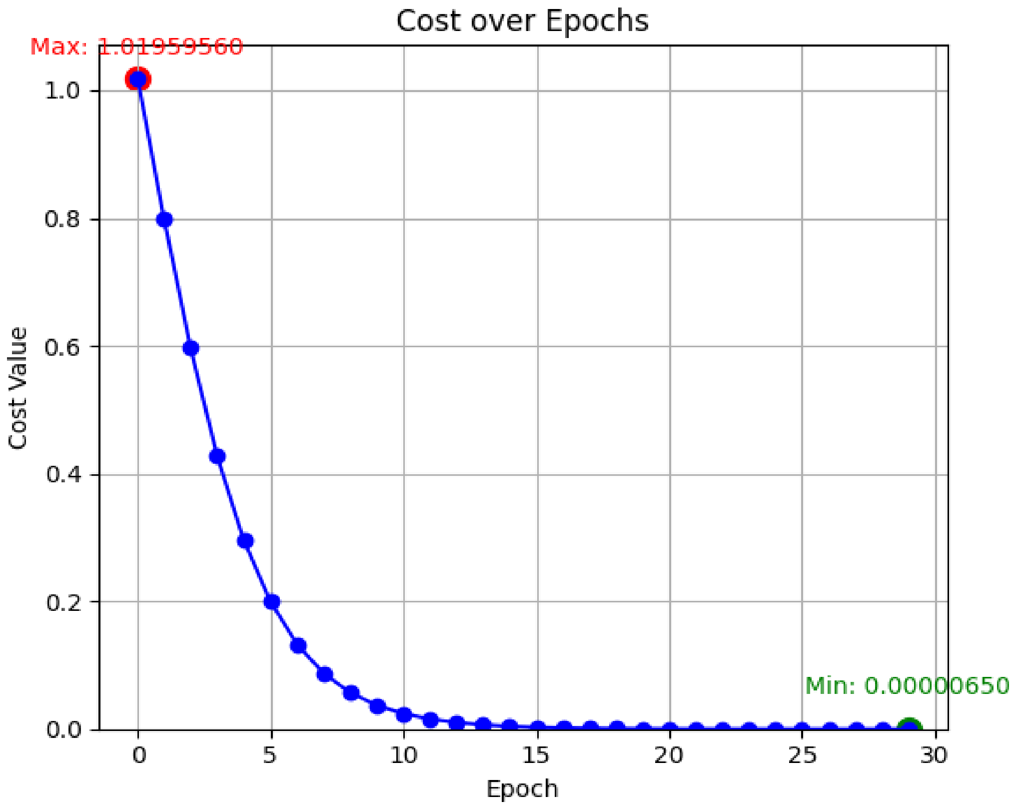
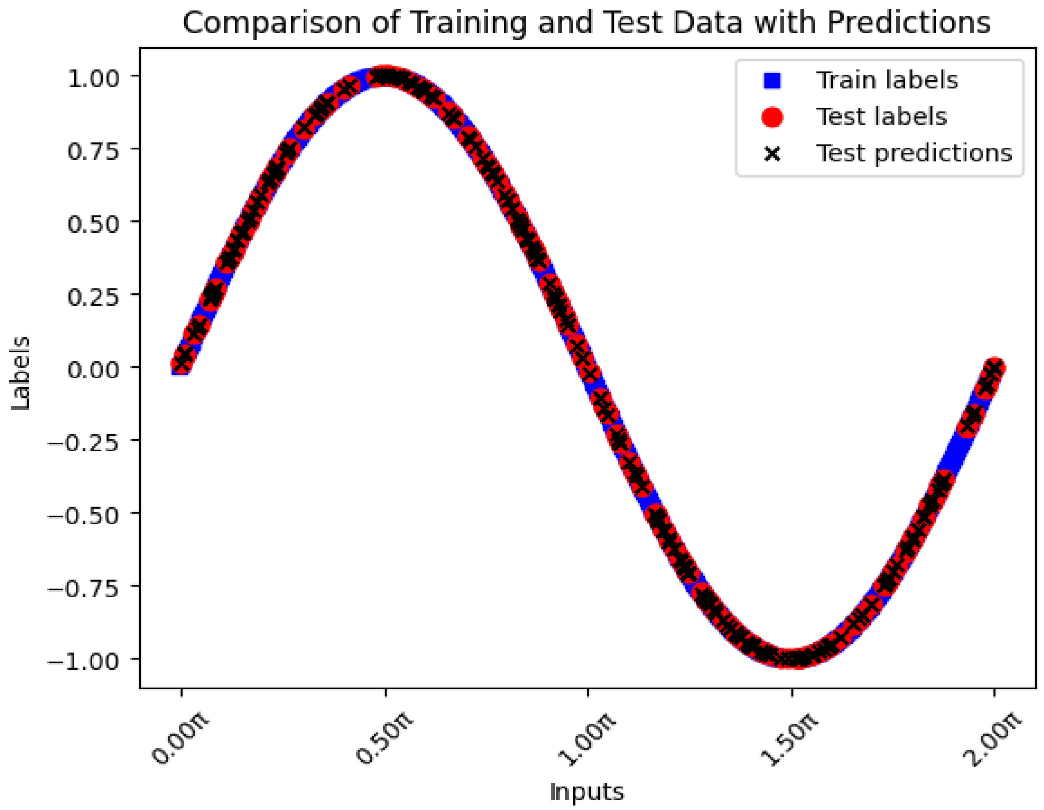
Task 4 Solution part-1

Good Results for simple sine function but not for the complex one





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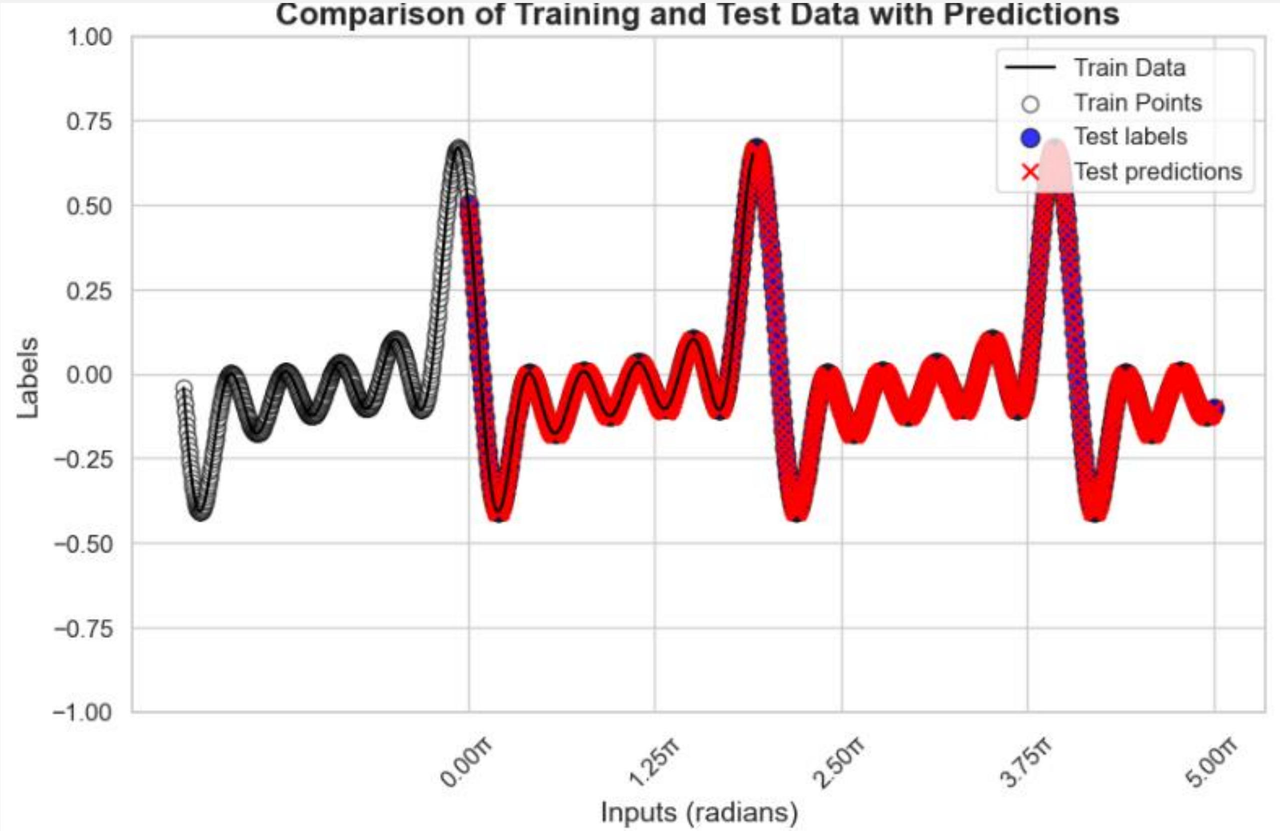
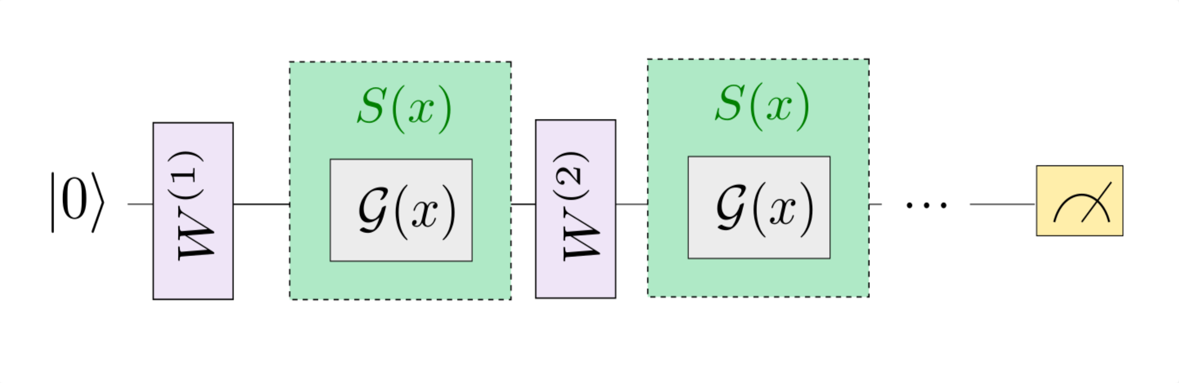
Task4 Solution part-2

We used a different approach to account for low test accuracy in the complicated sine function:

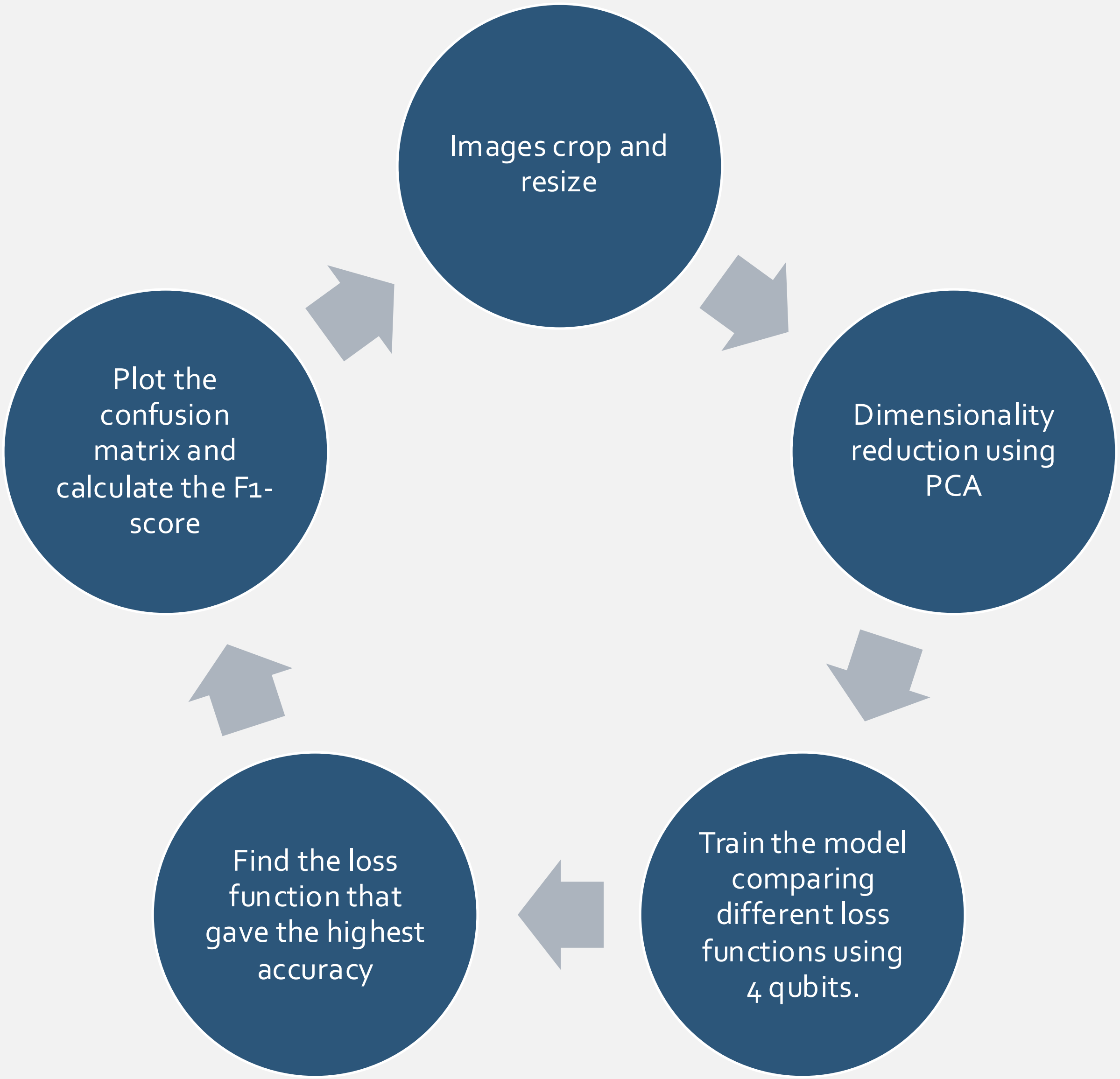




W
- Training layer

S(x)
- Encoding layer

Task 5 Approach 1



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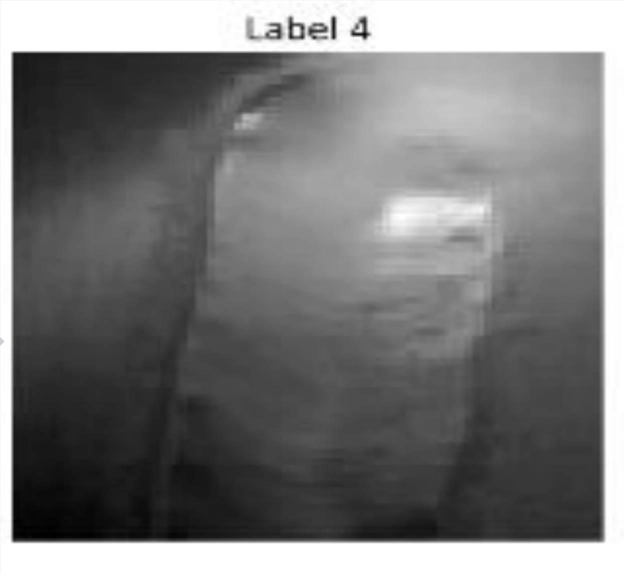
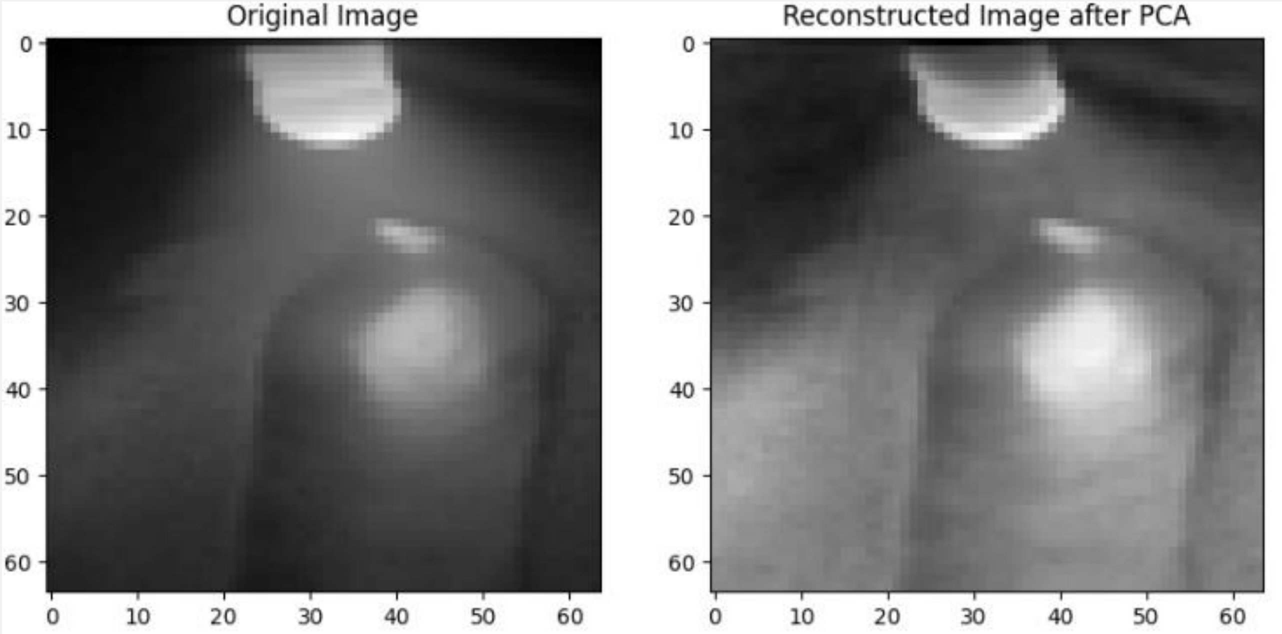
Task 5 Approach 1

Crop and resize

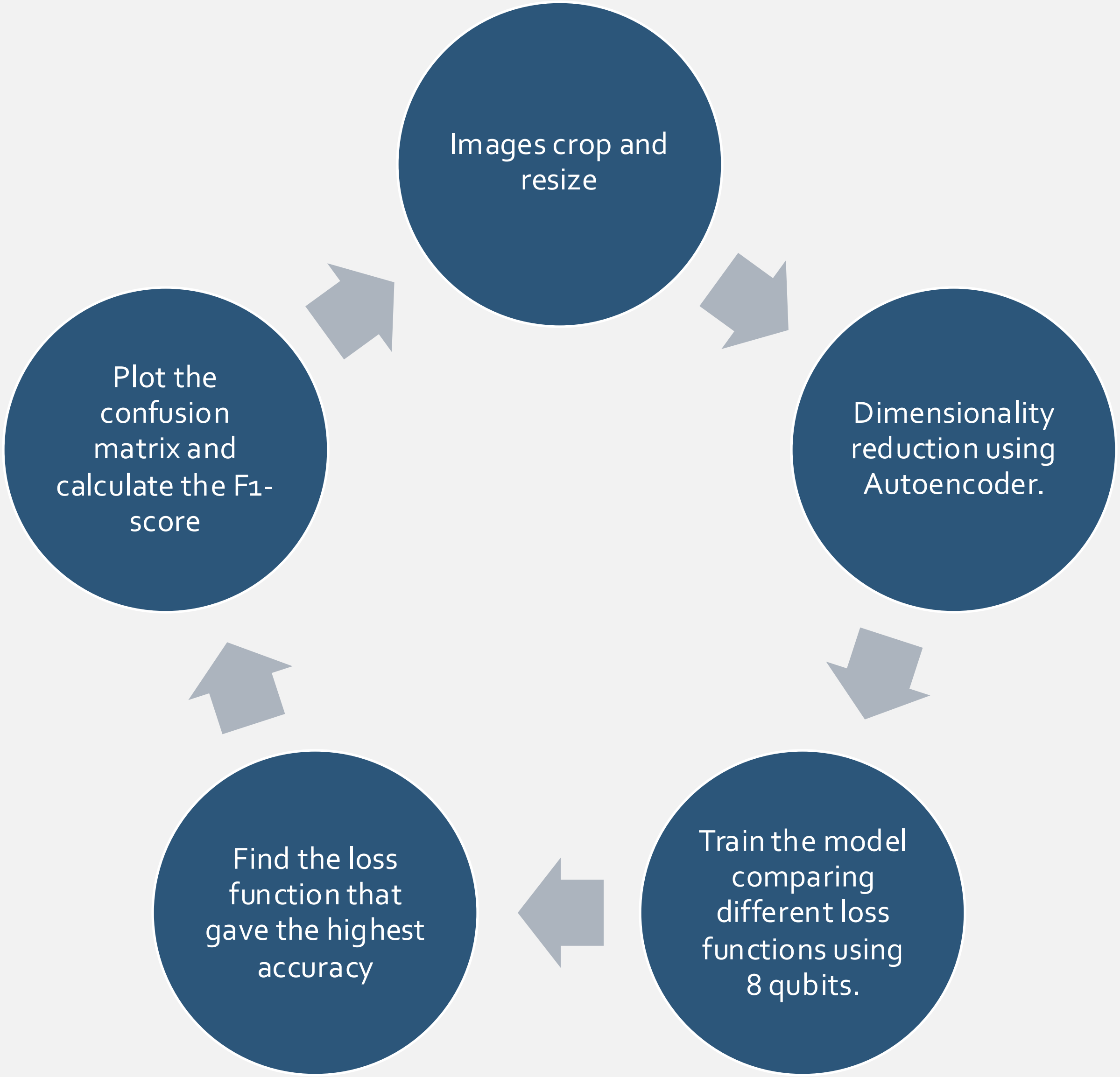


PCA:

- Is a technique that can compress the image. So that we have fewer values to encode in our quantum circuit.
- The image can be decompressed after encoding or compressing, with minimal loss possible.



Task 5 Approach 2



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Results for task 5

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Best results achieved:

92.67%	**Validation Accuracy**
89.83%	**Test Accuracy**

8 Qubits
+
Exponential loss
+
Autoencoder

FL: Focal Loss

$$FL(p_t) = -(1 - p_t)^{\gamma} \log(p_t)$$

BCE: Binary Cross Entropy

$$Loss = -\sum_{i=1}^{\text{output size}} y_i \cdot \log \hat{y}_i$$

Exponential Loss

$$loss = \sum_i (1 + 10e^{7p_i})^{-1}$$

Challenges and future scope

Challenges
- Computational resources
- Big images dimensions
- Trying to implement a novel approach

Future scope
- Comparing with other models
- Extending for multiclassification
- Find potential speedup

References:

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[2] Frank Kster Hans-Martin Rieser and Arne Peter Raulf. Tensor networks for quantum machine learning. Royal Society, pages 1–23, 7 2023.

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[4] Enrico Prati Marco Lazzarin, Davide Emilio Galli. Multi-class quantum classifiers with tensor network circuits for quantum phase recognition. Arxiv, pages 1–7, 7 2021.

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THANKYOU

https://github.com/Martyna94/The_Detection_Duo

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