

INFORMATICS INSTITUTE OF TECHNOLOGY

In Collaboration with

UNIVERSITY OF WESTMINSTER



LuCa-QuanPred

Diagnosing Non-Small Cell Lung Cancer Using CT Images with Quantum-Classical Hybrid Machine Learning

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April 2025

Submitted in partial fulfilment of the requirements for the BEng (Hons) in Software Engineering degree at the University of Westminster

ABSTRACT

Globally, Non-Small Cell Lung Cancer (NSCLC) ranks amongst the cancer types with the highest mortality rates. Even with progress in medical imaging and treatment, establishing diagnosis as an objective remains a challenge due to the intricate and multifaceted characteristics associated with the data. There is a well-established existing approach based on the classic machine-learning models, however, it is not always optimal for loading big data sets. This work attempts to respond to these challenges by using Quantum Machine Learning (QML) to enhance the precision and time efficiency of diagnosis.

A hybrid model was developed using an 8-qubit quantum neural network for feature extraction and a classical neural net for classification tasks. The QNN used the parameterized quantum circuits framework, extracting quantum encoded features. The classical model, trained on CT scan images, used a linear layer, ReLU, Dropout, and Sigmoid for binary classification. The optimal early stopping criterion was set at epoch 14.

The final hybrid model showed promising results on the testing set with a 91.31% test accuracy, 0.9665 ROC AUC score, and weighted F1 score of 0.91, demonstrating a closer metric balance between precision and recall. The Dice coefficient of 0.9173 showed region overlap for effective cancer diagnosis. Moreover, the model in question had an average precision score of 0.9656, showcasing its ability to tackle class imbalance. This model enables the hybrid model to be relied upon for real-life use in NSCLC diagnosis due to its scalability and dependability in medical image analysis.

Keywords: Quantum Machine Learning, NSCLC Diagnosis, Quantum Computing, Medical Imaging, Hybrid Systems

Subject Descriptors:

Computing methodologies -> Machine learning -> Machine learning approaches -> Quantum computing

Applied computing -> Life and medical sciences -> Health care information systems -> Medical information systems