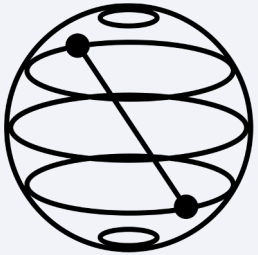

Project #6 - Quantum fMRI analysis

Mentor: Robert Loredo

Mentees: Adnani Hinde, Hamza Ahmed, Iulia Zidaru, Jody Burks, José Victor, Khadija Challaouy, Louis Chen and Tai Yue Li

Our team

Qiskit

Mentor:

Robert Loredo — North America

Miami, United States

@Robert Loredo

Mentees:

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Nancy, France

@Adnani Hinde

Hamza Kamel Ahmed — Africa

New Cairo, Egypt

@Hamza Ahmed

Iulia Zidaru — Asia

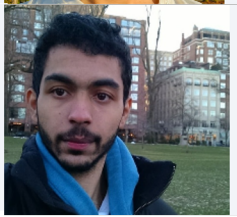
Bucharest, Romania

@iulia

Jody Burks — North America

Houston, United States

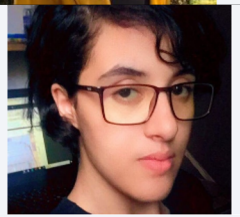
@



José Victor Soares Scursulim — South America

Vila Velha, Brazil

@José Victor Soares Scursulim



Khadija Ech-challaouy — Africa

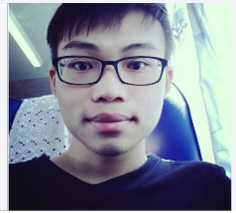
Rabat, Morocco

@khadija ech-challaouy

Kuan-Cheng (Louis) Chen — Europe

London, United Kingdom

@Louis_the_Quantum



Tai Yue Li — Asia

Hualien, Taiwan

@Tai Yue Li

Qiskit

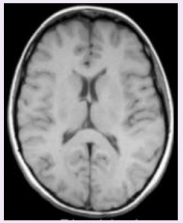
Preparing the Data

Qiskit

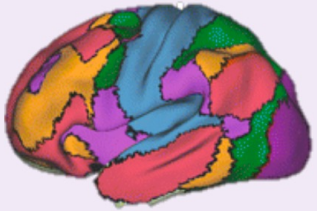
Autism fMRI images using ABID Dataset

ABIDE is a collaboration of 16 international imaging sites that have aggregated and are openly sharing neuroimaging data from **539 individuals** suffering from ASD and **573 typical controls**.

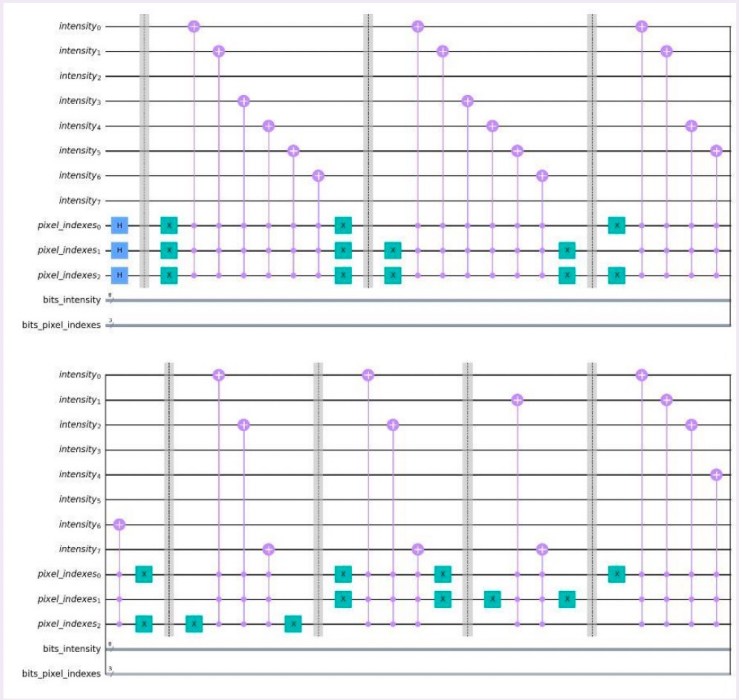
Quantum Image Representation：NEQR、FRQI and QPIE

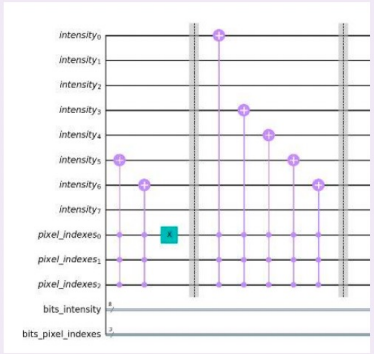


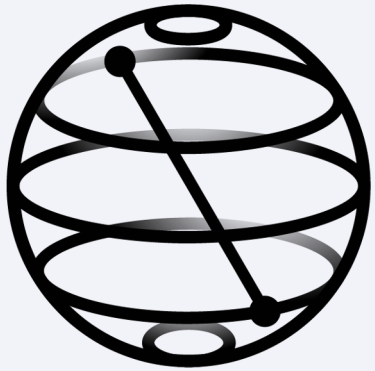
or



2D or 3D images



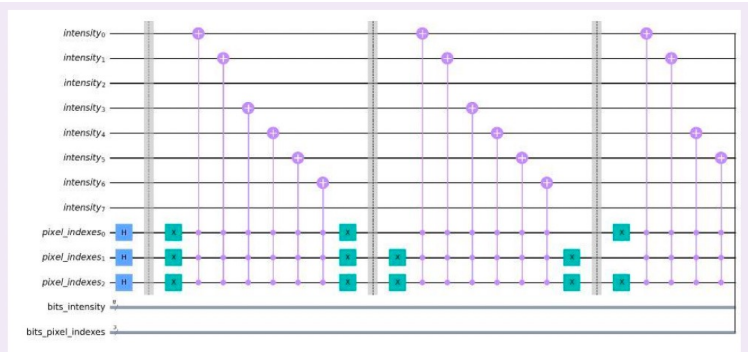


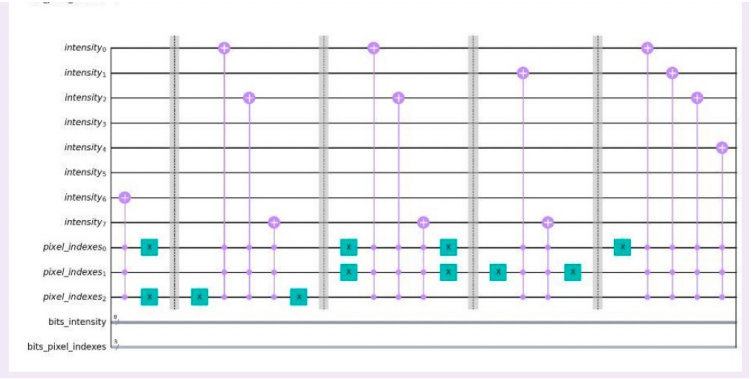


FRQI & NEQR

The goal of the Flexible Representation of Quantum Images (FRQI) allows **an efficient encoding of the classical data into a quantum state and the subsequent use of operators for image processing operations**

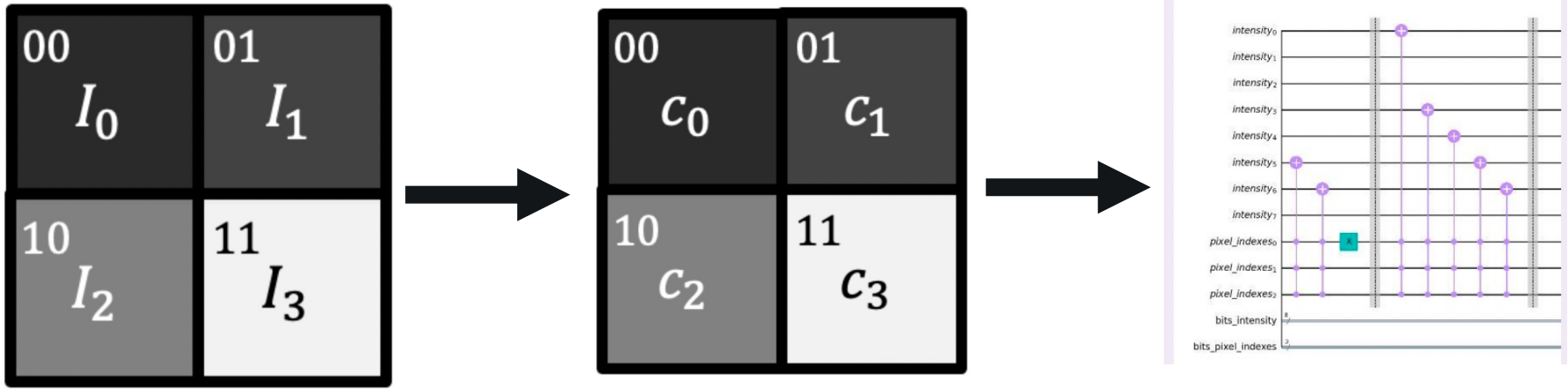
The **Novel Enhanced Quantum Representation** NEQR was created to improve over FRQI by leveraging the basis state of a qubit sequence to store the image's grayscale value



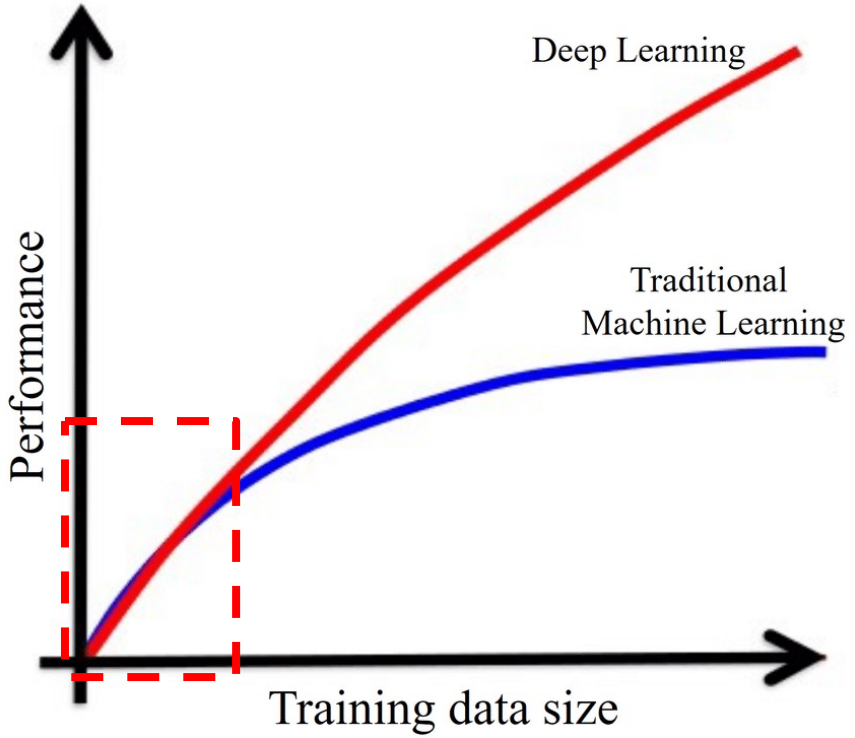


QPIE

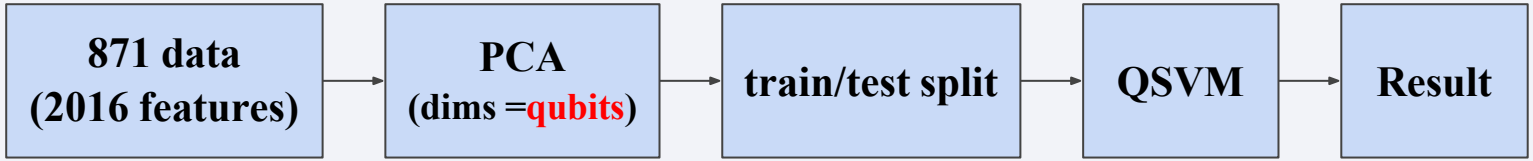
The QPIE representation uses the probability amplitudes of a quantum state to store the pixel values of a classical image.

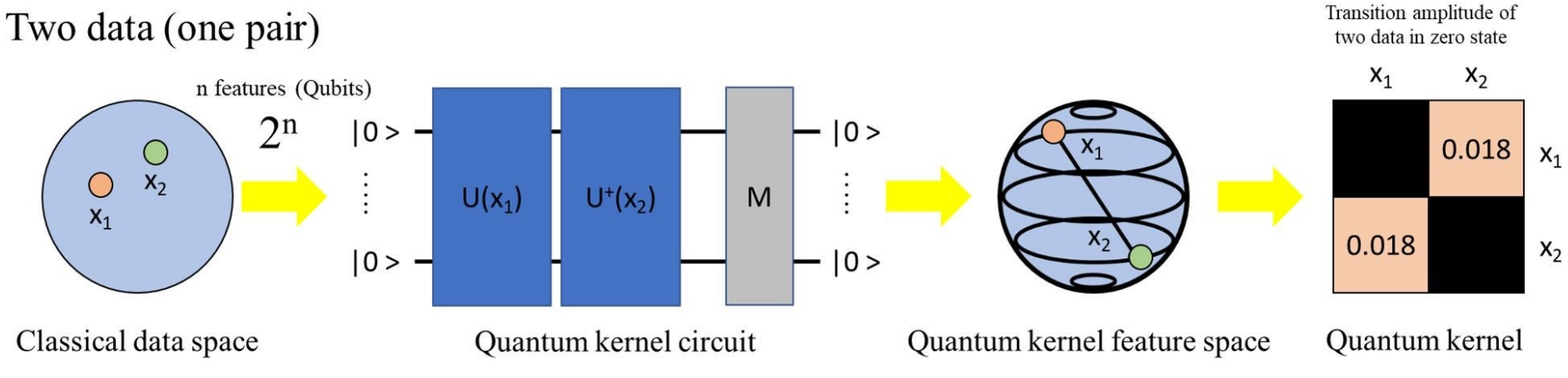


Challenge

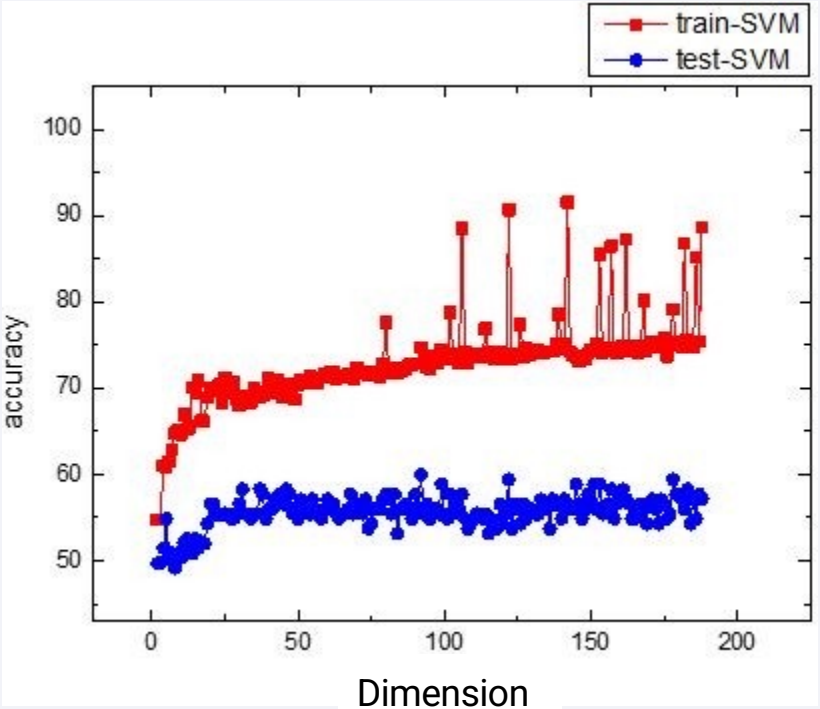

Deep Learning
Traditional
Machine Learning
Performance
Training data size

Mathod 1 ： SVM and QSVM

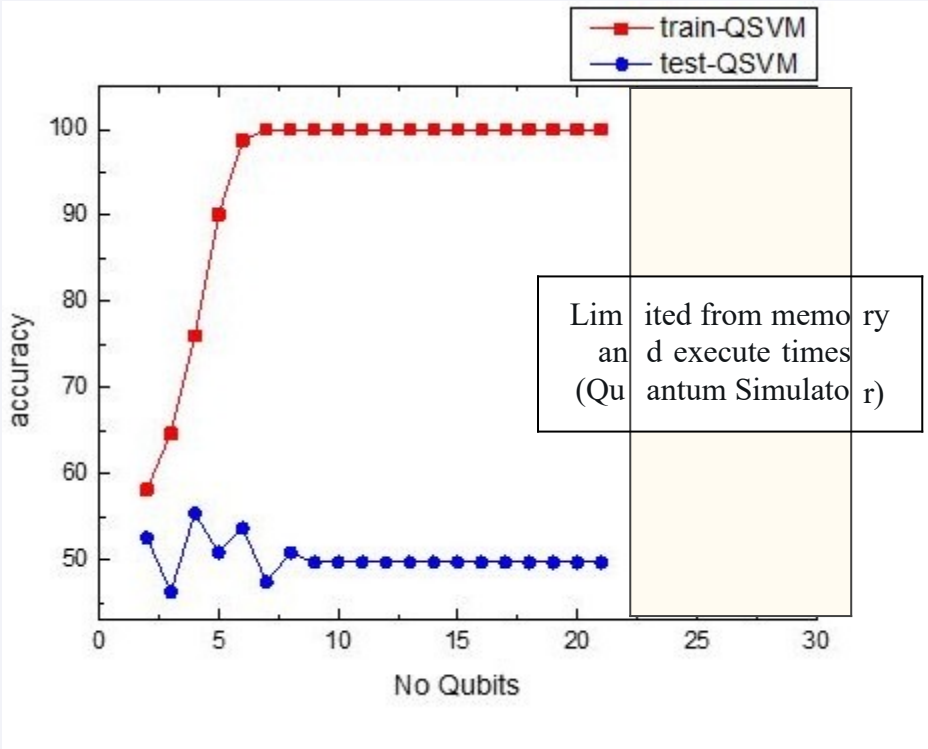




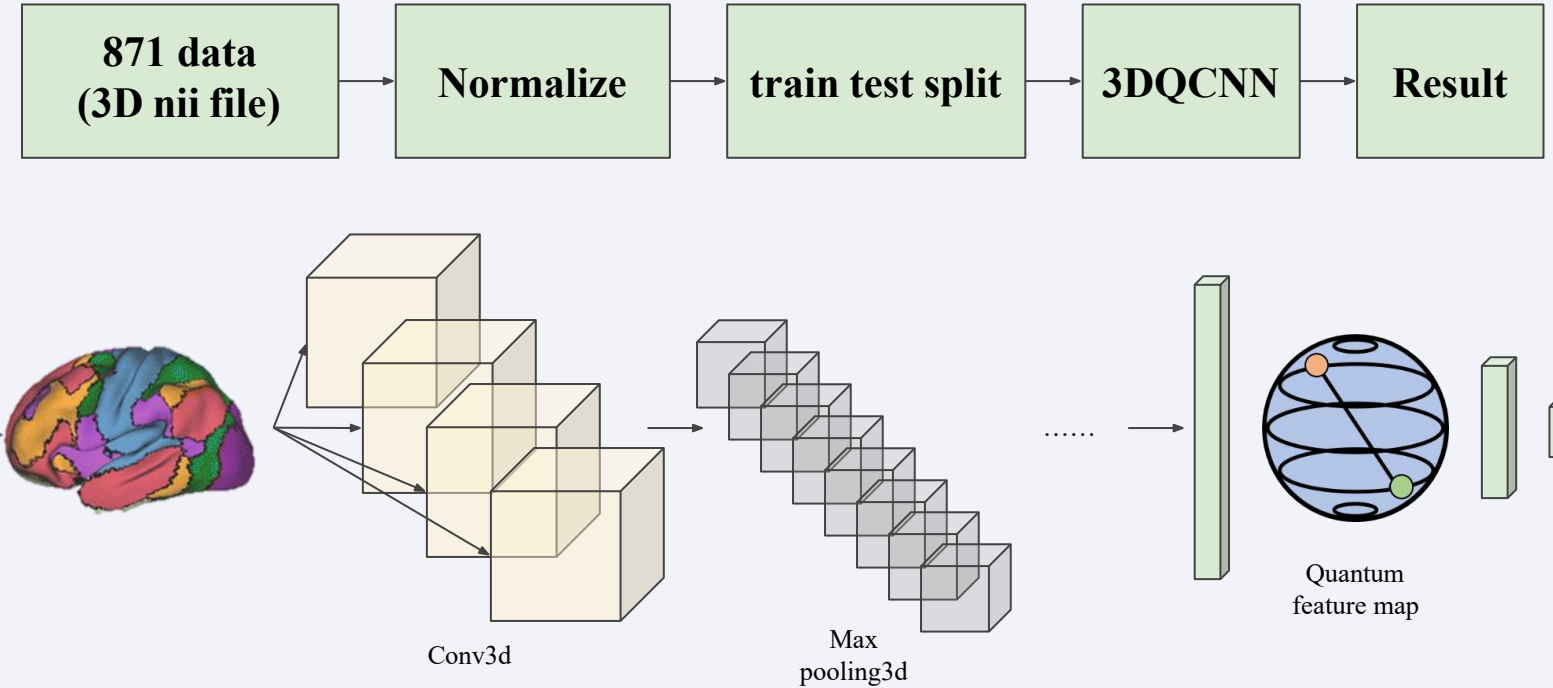
SVM


train-SVM
test-SVM
accuracy
100
90
80
70
60
50
0
50
100
150
200
Dimension

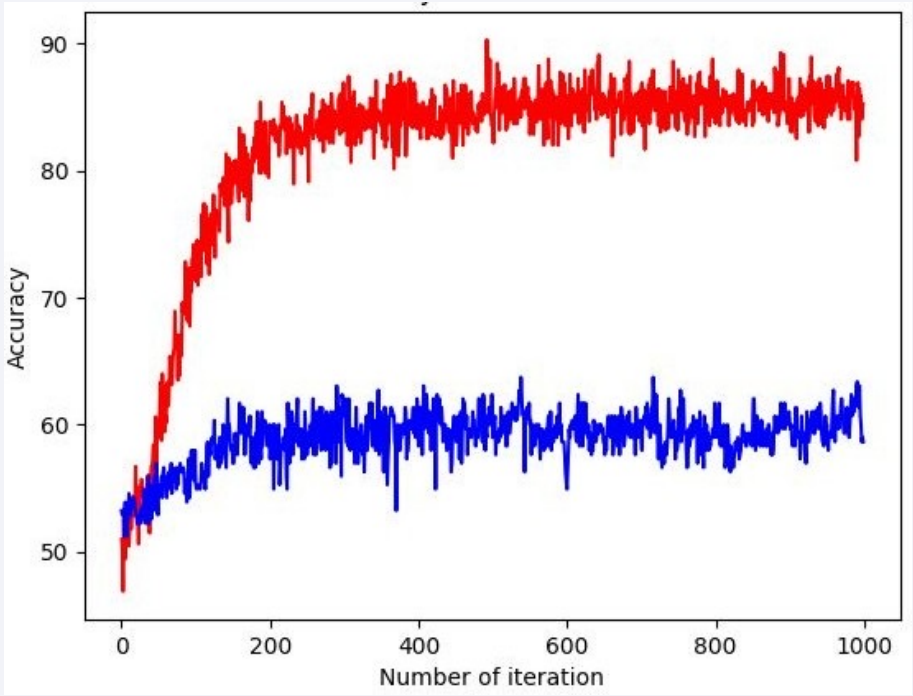
QSVM


train-QSVM
test-QSVM
accuracy
100
90
80
70
60
50
0
5
10
15
20
25
30
No Qubits
Lim ited from memo ry
an d execute times
(Qu antum Simulato r)

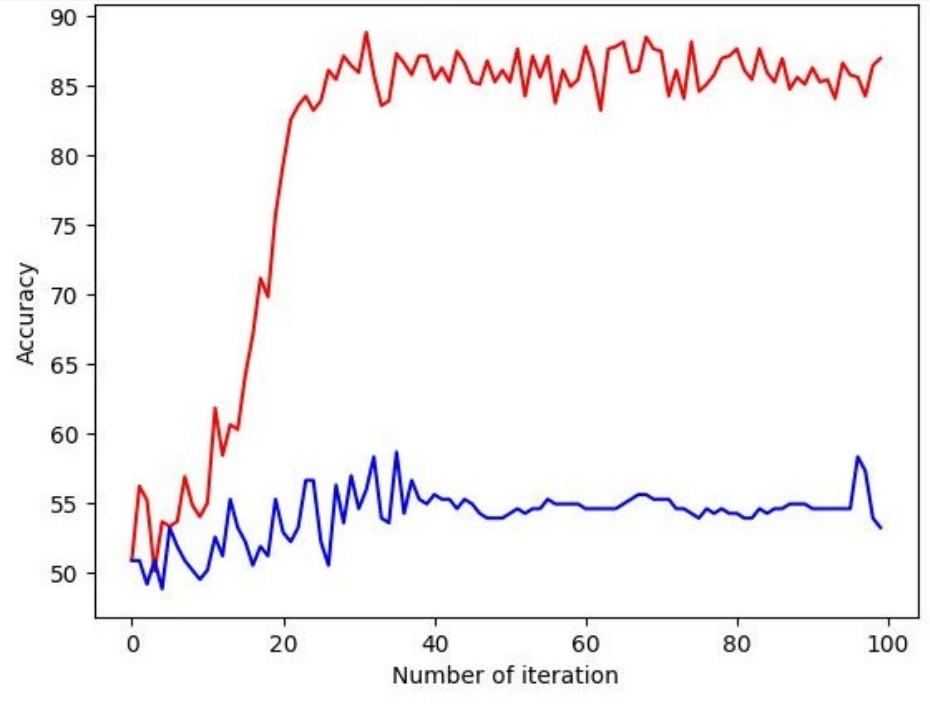
Mathod 2 ： 3DCNN and 3DQCNN



3DCNN



3DQCNN

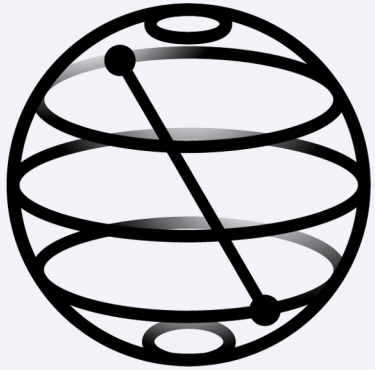


Conclusion and future work

- QSVM have an huge advantage on features' learning process compared to classical SVM. The training dataset reacehed 90% accuracy with stable performance. (SVM only reached 75% and unstable.) However, there is a image pre-processing issue need to be done in our future work.

- 3DQNN can speed up the learning process (less iteration) than classical 3DCNN in our current stage. However, there is a over-fitting need to be solved in our futurework. (training dataset reached 90%, test dataset only reached 50%)

- Two promising QML framework have already developed. The next step will collaborate with experts in the field of fMRI to deal with issue in data pre-processing.

- When everything is well-settled, we can run those on a real QC

Thank you for your attention!!!