Quantum ML Classifier

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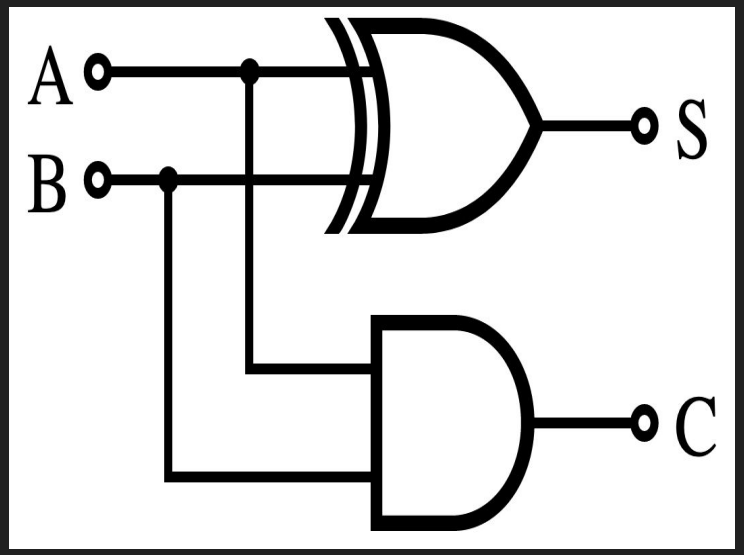
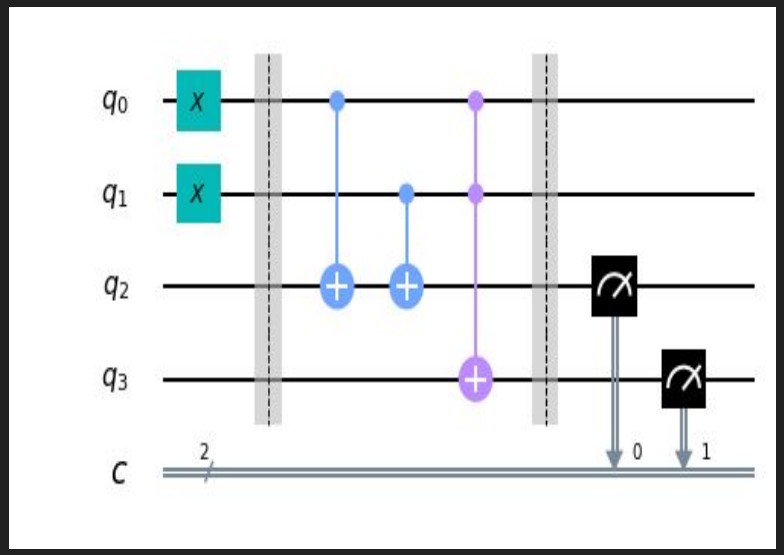
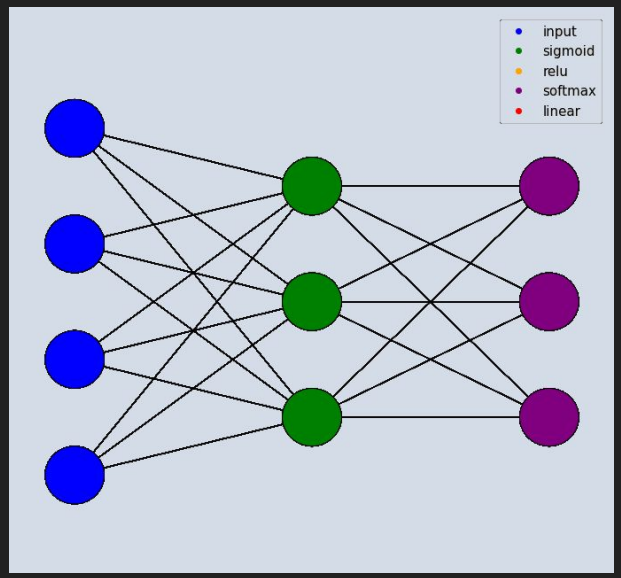
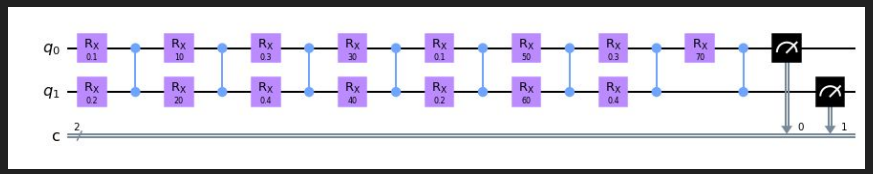
Quantum Machine Learning: General Description









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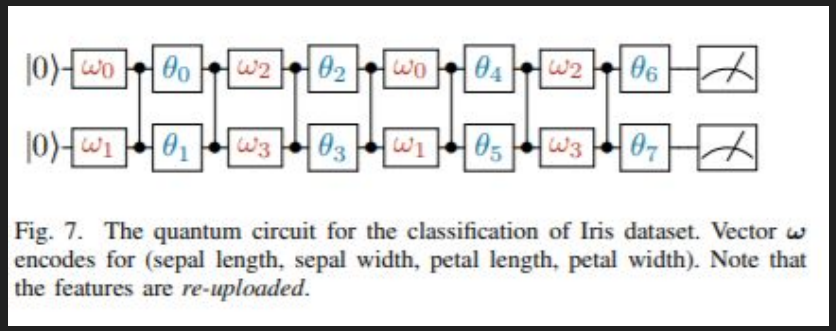

Fig. 7. The quantum circuit for the classification of Iris dataset. Vector $\boldsymbol{\omega}$ encodes for (sepal length, sepal width, petal length, petal width). Note that the features are *re-uploaded*.

Polyadic Quantum Classifier

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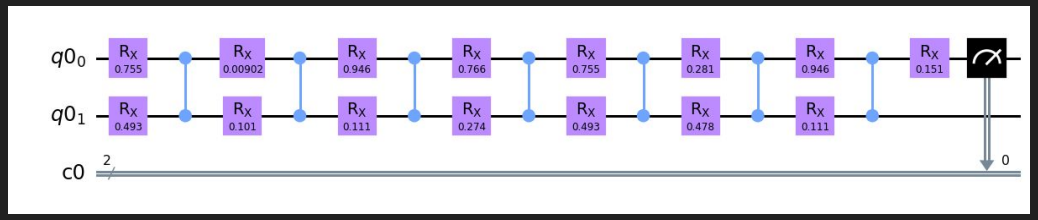
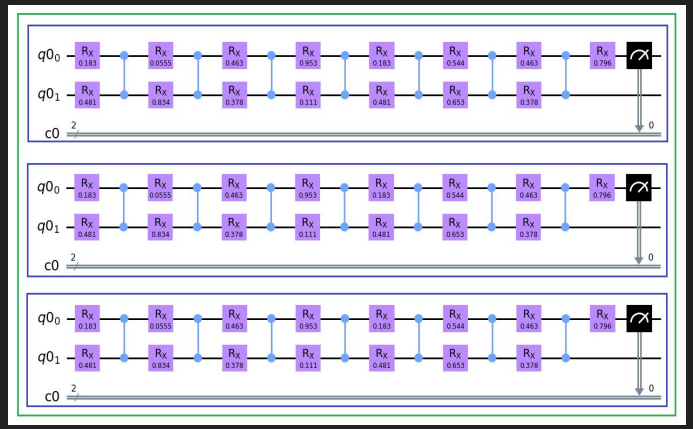


$$\nabla_{\theta_i}\langle\hat{B}\rangle(\boldsymbol{\theta}) = \frac{1}{2}\left[\langle\hat{B}\rangle\left(\boldsymbol{\theta}+\frac{\pi}{2}\hat{\mathbf{e}}_i\right) - \langle\hat{B}\rangle\left(\boldsymbol{\theta}-\frac{\pi}{2}\hat{\mathbf{e}}_i\right)\right]$$

Row of Data:
$X_0\ X_1\ X_2\ X_3$
$target_4 = 0$

Train



Positive gradient

Negative gradient

Negative gradient

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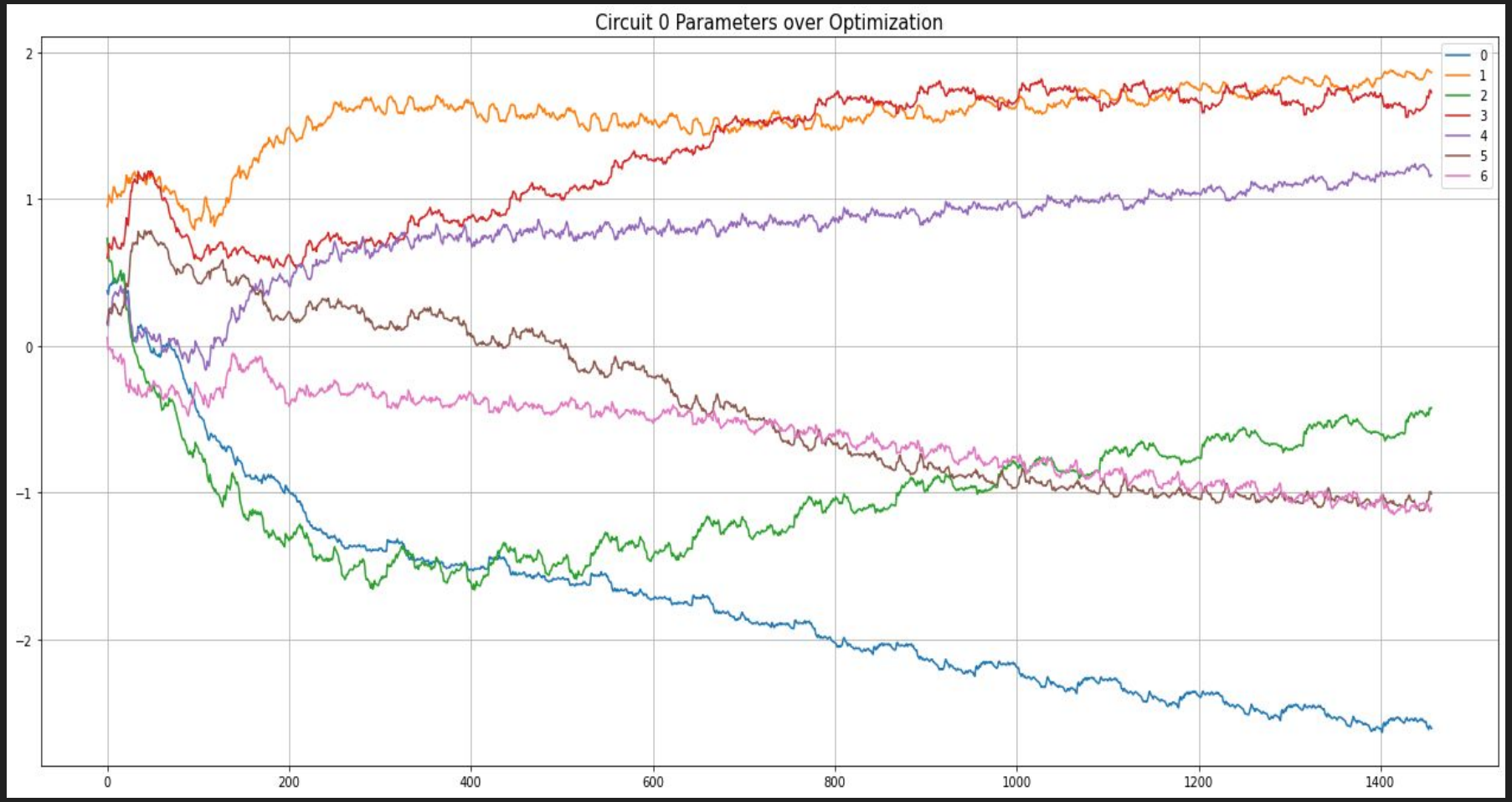

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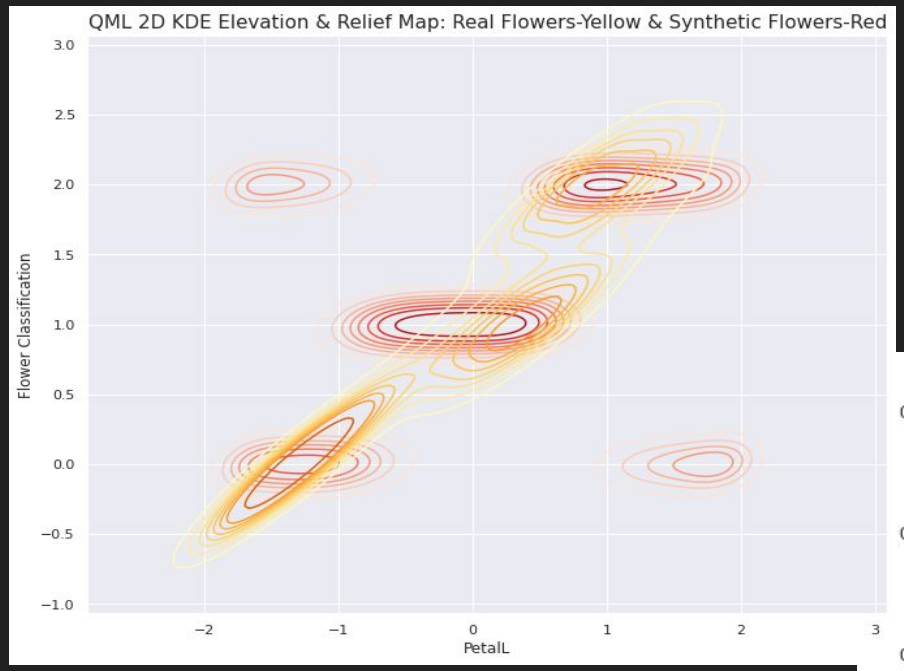

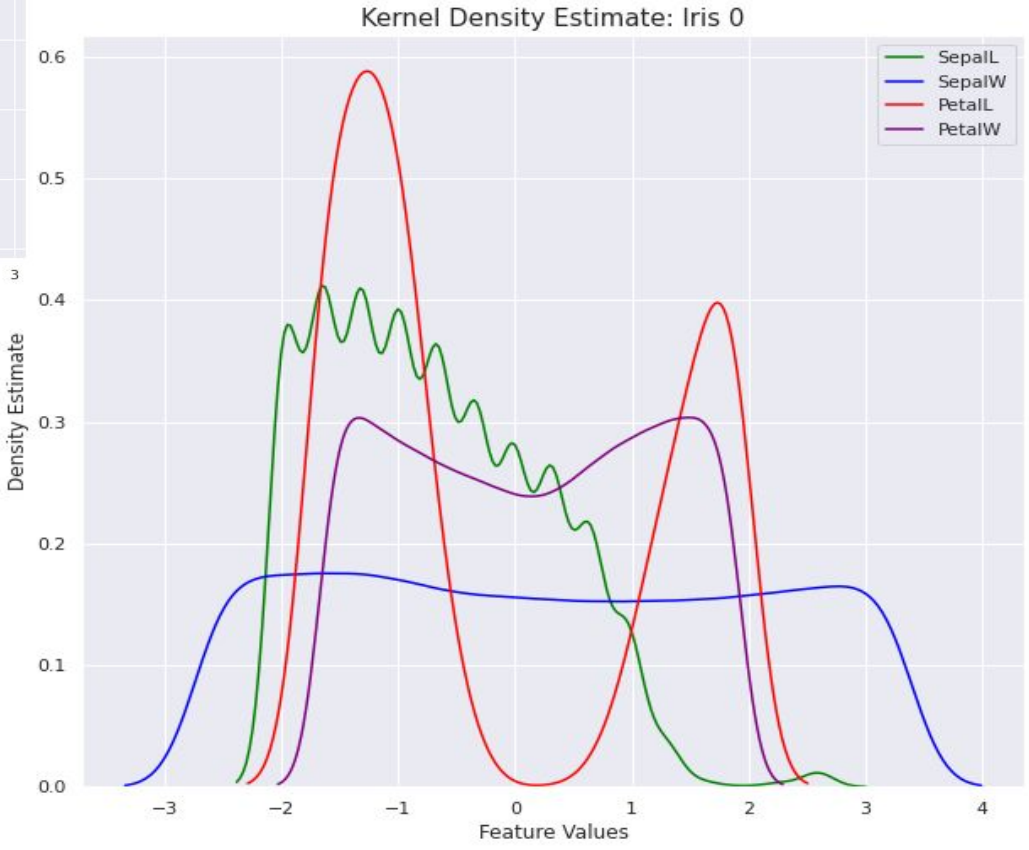

	SepalL	SepalW	PetalL	PetalW	SynthPrediction
0	-1.970024	-2.533947	-1.667576	-1.547076	0.0
1	-1.970024	-2.533947	-1.667576	-1.307136	0.0
2	-1.970024	-2.533947	-1.667576	-1.067195	0.0
3	-1.970024	-2.533947	-1.667576	-0.827254	0.0
4	-1.970024	-2.533947	-1.667576	-0.587313	0.0
...	...	...	...	...	...
50620	2.592019	3.190775	1.885832	0.852332	2.0
50621	2.592019	3.190775	1.885832	1.092273	2.0
50622	2.592019	3.190775	1.885832	1.332214	2.0
50623	2.592019	3.190775	1.885832	1.572155	2.0
50624	2.592019	3.190775	1.885832	1.812096	2.0

[50625 rows x 5 columns]

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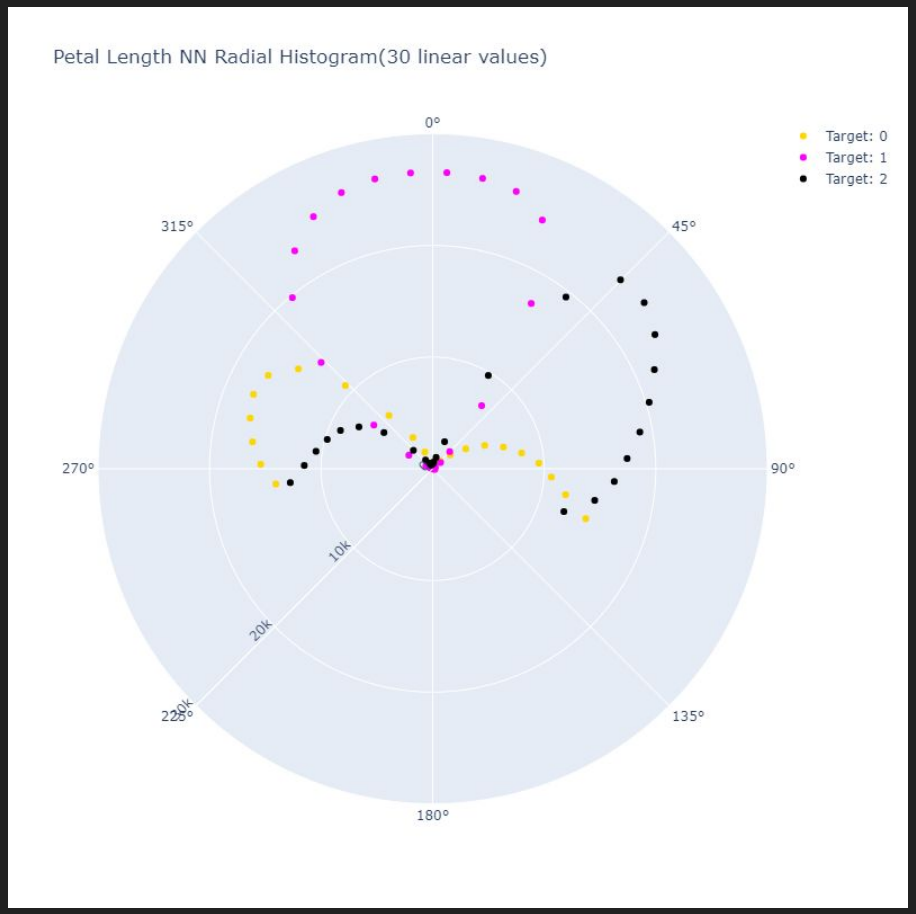
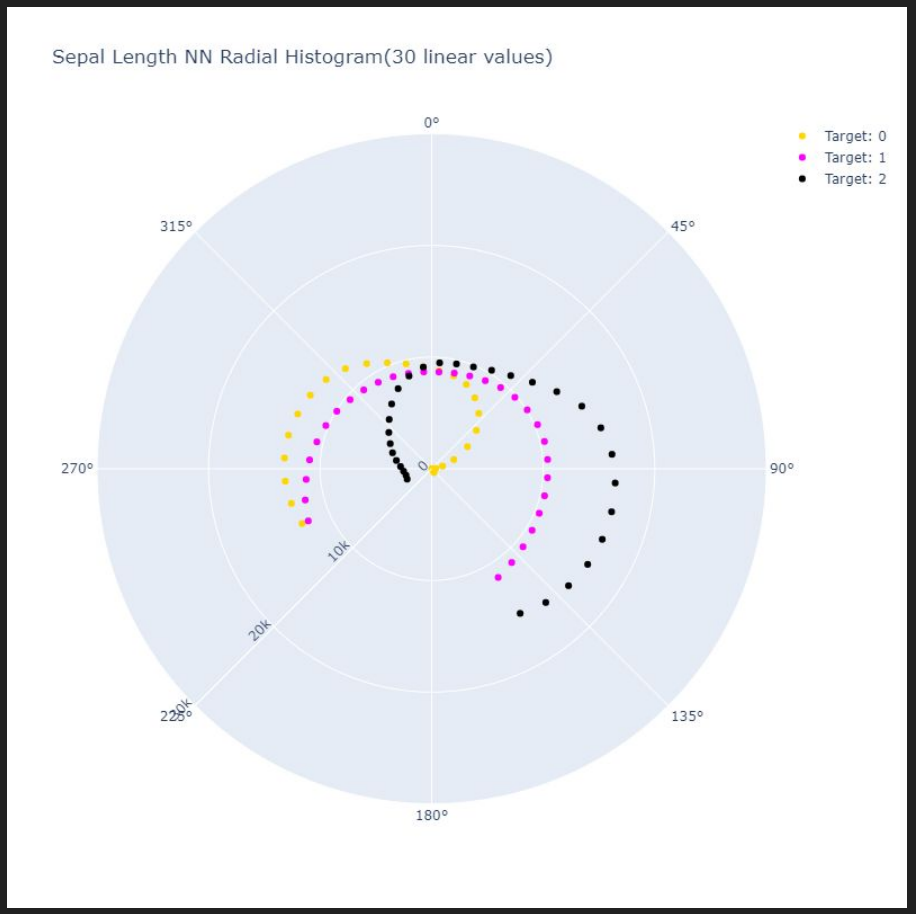


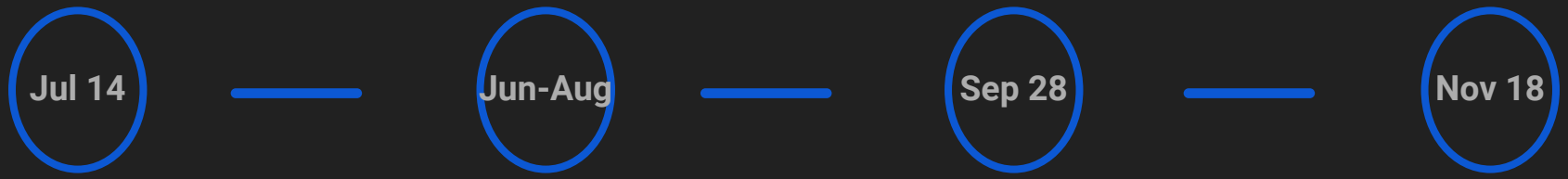


Quantum Machine Learning: Goals

1. Original
    a. Noisy quantum circuit simulation
    b. Natural language processing using quantum computing

2. Final
    a. Replicate neural network calculus using quantum computing
    b. Develop a reproducible classification model
    c. Analyze the classification decision boundaries

Quantum Machine Learning: Timeframe



Launch

The goals, scope and expectations of the research are presented

Circuit Research

Circuit research and model classification proves successful

FICC

Letter of acceptance is received from FICC publication

SC21 BoF

Research is presented at SC21 BoF

Quantum Machine Learning: Accomplishments

- Accepted for publication

- Established pipeline with institutions
  - CAREERS → Pace University Career Services

- Research continuation at new Pace University lab

Quantum Machine Learning: Good, Bad & Quantum

- Good
  - Rensselaer Polytechnic Institute (AiMOS)
  - Publishing and presenting
  - Slack
  - Circuit development and testing

- Bad
  - Stipends
  - Volume of research

Quantum Machine Learning: Publications

Future of Information and Communications Conference (FICC) 2022:

"Quantum Machine Learning Classifier"

https://saiconference.com/FICC

Quantum Machine Learning: Contributions

Github: https://github.com/Gio-AbouJaoude/QML-CLassifier

CI AiMOS Doc: https://docs.google.com/document/d/1XVTtWfKOCxxq-yBZ3ZBT9Zcna04OSZHo5cGS1AS2o8Q/edit?usp=sharing