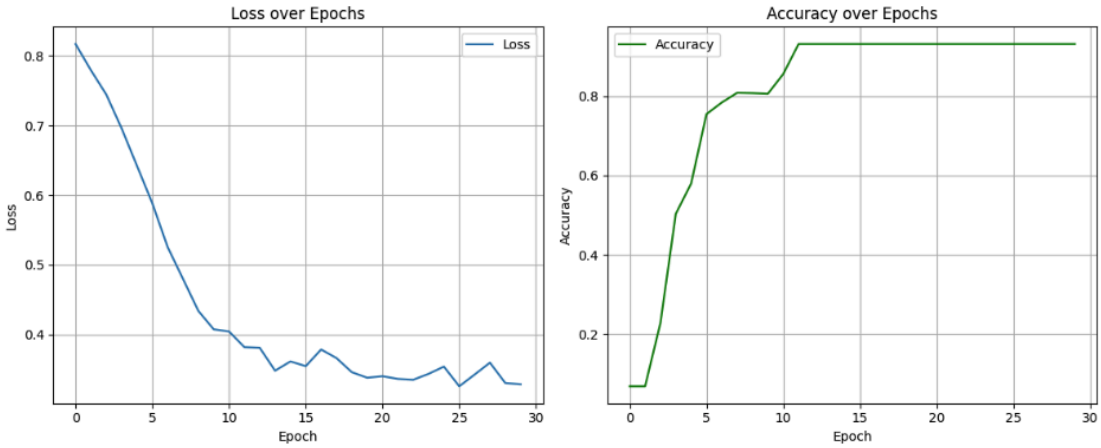
QNN

SECOM:

q_depth = 3

Unoptimized: {'depth': 12, 'num_qubits': 8, 'ops': {'ry': 32, 'cx': 21, 'h': 8, 'measure': 8, 'barrier': 1}, 'num_multi_qubit_ops': 21}

Training:

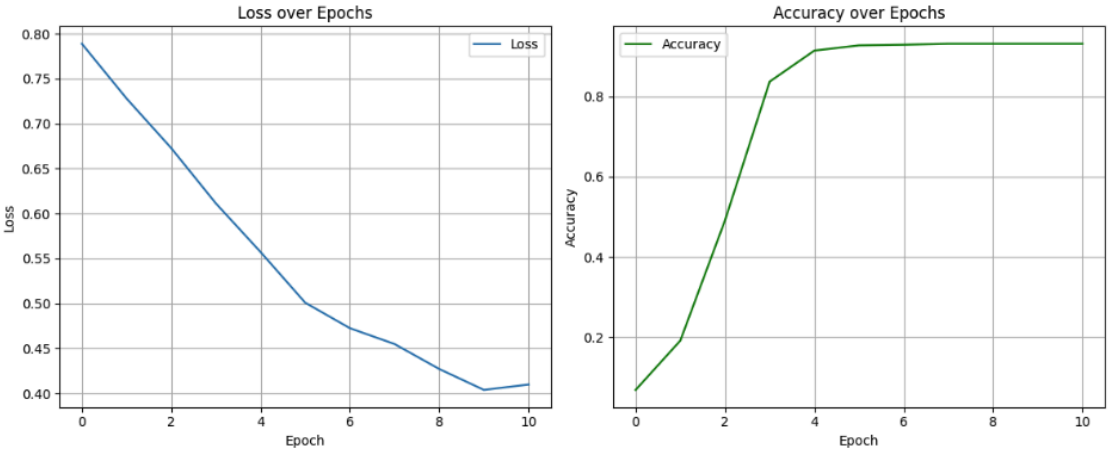


Testing: Acc: 0.9351, Loss: 0.2489

Optimized: {'depth': 27, 'num_qubits': 8, 'ops': {'rz': 65, 'sx': 65, 'cx': 21, 'measure': 8, 'x': 1, 'barrier': 1}, 'num_multi_qubit_ops': 21}

Optimizing the QNN circuit affects the model accuracy severely while training. Optimization is done during each iteration using a Coupling Map from line and optimizing it at level 3.

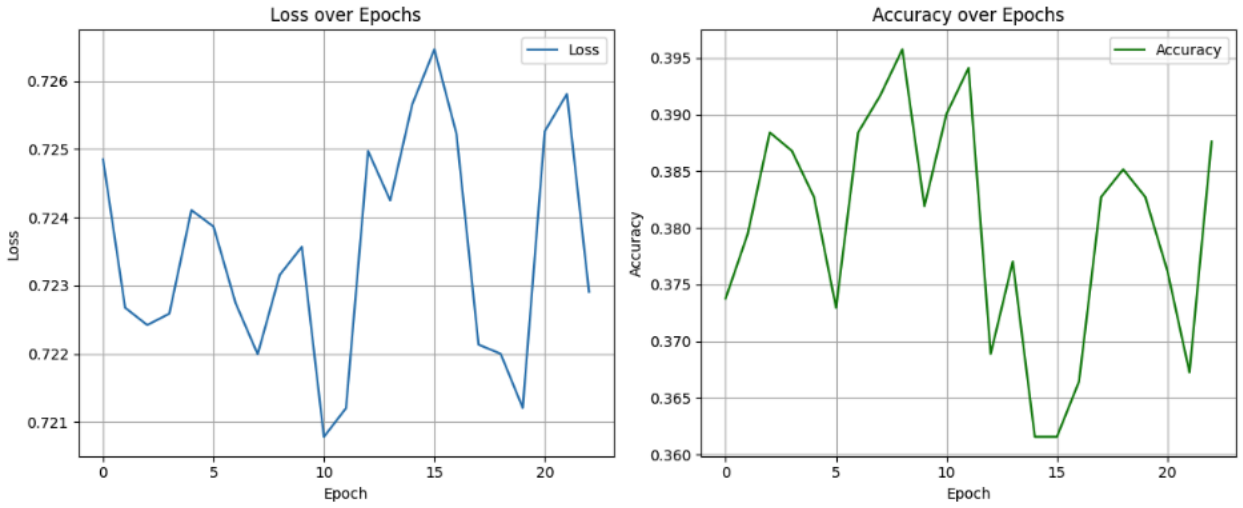
Optimized circuit + QNGD…



q_depth = 1

Unoptimized: {'depth': 6, 'num_qubits': 8, 'ops': {'ry': 16, 'h': 8, 'measure': 8, 'cx': 7, 'barrier': 1}, 'num_multi_qubit_ops': 7}

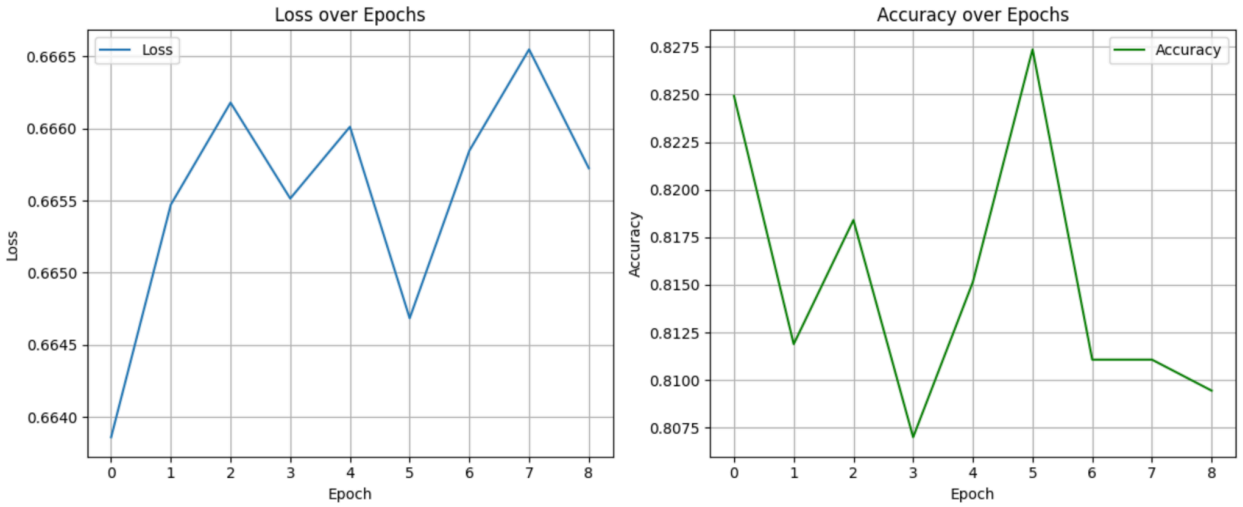
Training:



Testing: Acc: 0.0649, Loss: 0.7189

Optimized: {'depth': 15, 'num_qubits': 8, 'ops': {'rz': 34, 'sx': 33, 'measure': 8, 'cx': 7, 'x': 1, 'barrier': 1}, 'num_multi_qubit_ops': 7}

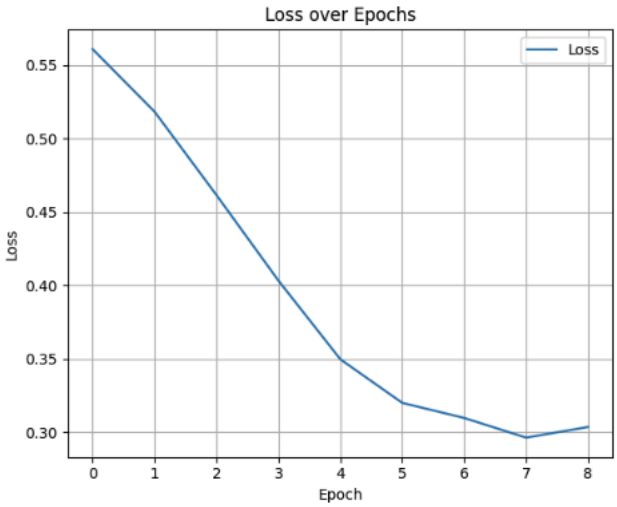
Training:

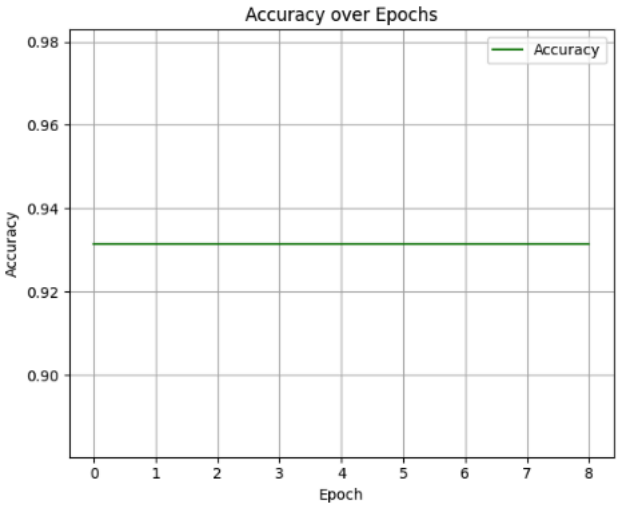


Testing: Acc: 0.9351, Loss: 0.6651

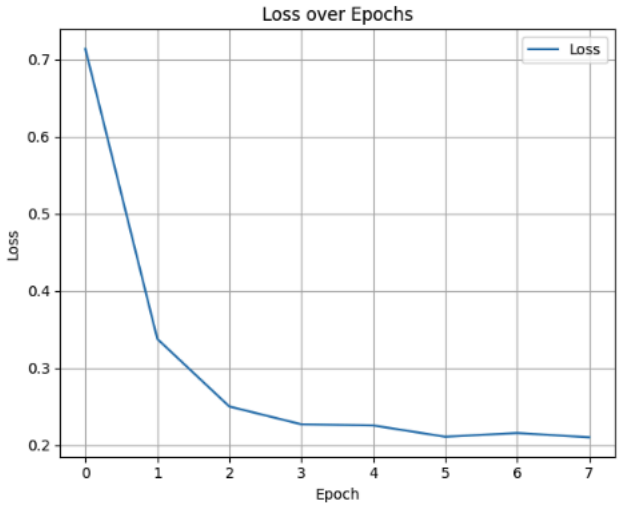
Optimized circuit shows better results in terms of model training. However, optimization increases the number of gates.

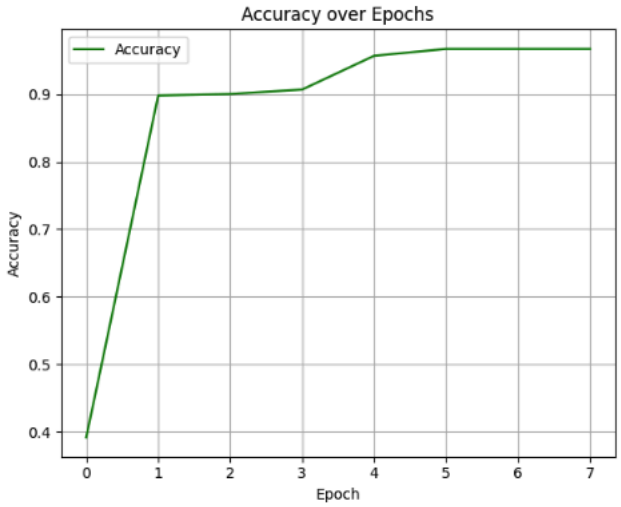
Optimized circuit + (two separate optimizers for the classical and quantum params)





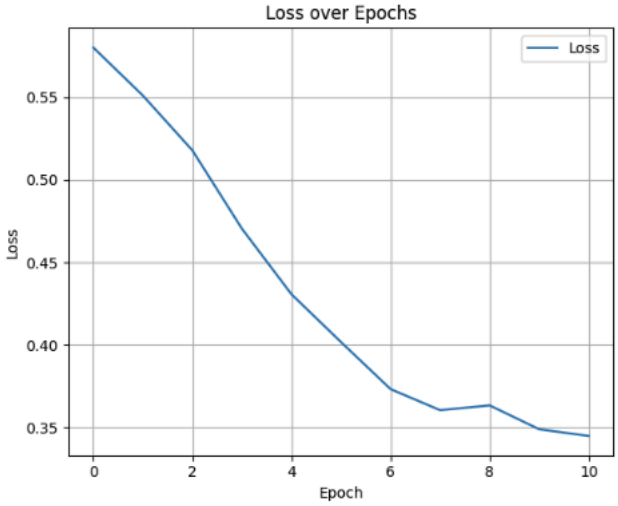
q_depth = 2 (full classical optimizer)

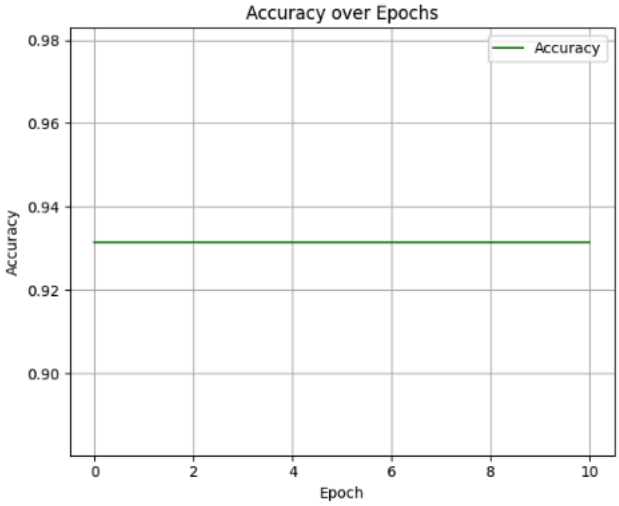




	precision	recall	f1-score	support
0.0	0.97	1.00	0.98	4836
1.0	0.00	0.00	0.00	164
accuracy			0.97	5000
macro avg	0.48	0.50	0.49	5000
weighted avg	0.94	0.97	0.95	5000

depth=2, SECOM, (full classical optimizer)





	precision	recall	f1-score	support
0.0	0.94	1.00	0.97	288
1.0	0.00	0.00	0.00	20
accuracy			0.94	308
macro avg	0.47	0.50	0.48	308
weighted avg	0.87	0.94	0.90	308

QAE

depth=1