For the exercise, it's recommended to use the Python notebook and then upload the ipynb file to github(or use python notebook and then convert the ipynb file to pdf).

Machine Learning Part

You will explore how best to apply machine learning algorithms, for example, Neural Network, Boosted Decision Tree (BDT), Support Vector Machine(SVM) to solve a High Energy Data analysis issue, more specifically, separating the signal events from the background events.

A set of input samples (simulated with Delphes) is provided in NumPy NPZ format [Download Input]. In the input file, there are only 100 samples for training and 100 samples for testing so it won't take much computing resources to accomplish this task. The signal events are labeled with 1 while the background sample are labeled with 0.

You can apply one machine learning algorithm to this input but be sure to show that you understand how to fine tune your machine learning model to improve the performance. The performance can be evaluated with classification accuracy or Area Under ROC Curve (AUC).

Quantum Computing Part

1) implement a simple quantum operation with Cirq
   a) With 5 qubits
   b) Apply Hadamard operation on every qubit
   c) Apply CNOT operation on (0, 1), (1,2), (2,3), (3,4)
   d) SWAP (0, 4)
   e) Rotate X with pi/2
   f) Plot the circuit

2) Create a circuit that is a series of small `cirq.Rx` rotations and plot the probability of measuring the state in the $|0\rangle$ state. For example, for a qubit, at first, you can rotate 0.1 degree, you get one probability of measuring the state in the $|0\rangle$ state; then you rotate another 0.1 degree in addition, you get another probability; then you another 0.1 degree and so on.