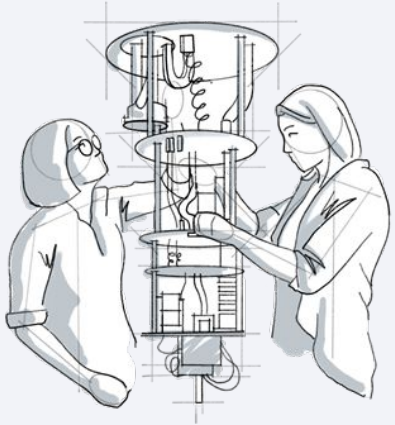
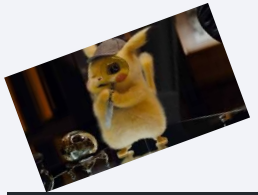
# QAMP Spring 2022

Qiskit

Mentee: Leonardo Placidi (Qiskit Advocate)

Mentor:  Atsushi Matsuo (IBM Research Tokyo)





Add performance benchmarks for Qiskit Machine Learning #4

# The Task

1) Analyze the QuantumKernel code/features for potential benchmarks.
2) Re-use the existing code and implement new benchmarks.
3) Analyze the obtained results and suggest further improvement if any.

## QuantumKernel

CLASS QuantumKernel(*feature_map=None, enforce_psd=True, batch_size=900, quantum_instance=None, user_parameters=None*) [SOURCE]

Bases: `object`

Quantum Kernel.

The general task of machine learning is to find and study patterns in data. For many algorithms, the datapoints are better understood in a higher dimensional feature space, through the use of a kernel function:

$$K(x, y) = \langle f(x), f(y) \rangle.$$

Here K is the kernel function, x, y are n dimensional inputs. f is a map from n-dimension to m-dimension space. $\langle x, y \rangle$ denotes the dot product. Usually m is much larger than n.

The quantum kernel algorithm calculates a kernel matrix, given datapoints x and y and feature map f, all of n dimension. This kernel matrix can then be used in classical machine learning algorithms such as support vector classification, spectral clustering or ridge regression.

## Qiskit Application Benchmarks

license Apache-2.0 Application Benchmarks Tests passing

# The work in progress

1) We wrote 3 codes to benchmark QuantumKernel and QuantumKernelTrainer. We benchmark with regard to classification tasks. We made a draft pull request.
2) These first benchmarks check the most common statistics, such as time to fit the model and the quality of the prediction performance.
3) We are currently working on the visualization with the tool airspeed velocity.

# Next steps

Visualize soon the successful benchmarks results.

Experiment and test the performances with different feature maps that we propose. Possibly adding some new datasets to the benchmark!

# That’s all, for now!


Leonardo Placidi and Atsushi Matsuo