Team Name: Quantum HQ
Team Participants:
- Anusha Agarwal | anushaagarwal.us@gmail.com | Student at Thomas Jefferson High School QLab
- Neha Chandran | neha.zchandran@gmail.com | Student at Thomas Jefferson High School QLab
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Team Roles:
Anusha will construct the *ansatz* and apply the variational quantum algorithm, Neha will build the parameterized feature map circuit, Sophia will mathematically encode the calcium signal data as quantum information, and Surbhi will integrate our model into a simple patient-driven health app.

Team Qualifications for the NeuroQuantum Nexus Challenge:
Together, our team members have taken an assortment of courses in physics, computer science, and mathematics. The skills learned in the previously mentioned courses include quantum computing, modeling and simulation, materials science, etc. Our team members have applied these concepts in various hackathons, internships, and research projects for quantum computing enhanced applications. These versatile experiences allow for extensive application to quantum machine learning, as required in the NeuroQuantum Nexus challenge, which our team looks forward to tackling!

High Level Overview of Proposal:
Our solution aims to develop a streamlined quantum machine learning (QML) model to predict phenotypes from the calcium signals dataset. By applying a post-variational optimization approach to the input state vectors, we can generate an enhanced set of feature vectors. These optimized features will then be used to train a classical dense neural network (DNN), achieving accurate predictions with fewer training epochs.

Technical Approach:
Calcium imaging data is typically structured such that each row represents a sample collected over a short window, with entries corresponding to the calcium trace ($\Delta F/F$) values for every neuron. These are represented as normalized as floating-point numbers between 0 and 1. To construct our quantum feature map circuit, we will encode these calcium trace values as parameterized θ angles, which determine the rotations applied through a sequence of alternating RZ and RX gates. Next, we will define the *ansatz* for the variational algorithm, composed of RY rotations and cylically connected controlled-NOT gates applied to each qubit. The full quantum circuit will then be fed to an optimization loop, which will iteratively invoke a classifier, loss function, and cost function to generate enhanced feature vectors. These optimized vectors will ultimately serve as inputs to a classical dense neural network (DNN) with an $N - 2N - 1$ architecture, where N corresponds to the dimensionality of each input vector.

Projected Industry Impact:
Our proposed solution can be seamlessly integrated into the backend of health-focused web and mobile applications. Patients can upload their calcium signal data in .csv format–collected by medical providers–or sync data through live-tracking platforms such as Apple Health. Additionally, by leveraging OpenAI's API, the system can deliver personalized health and nutrition recommendations informed by phenotype predictions from our quantum machine learning model, setting a new industry standard for precision wellness and preventative care.