Research Experience for Teachers (RET) Summer 2021

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**LESSON PLAN OBJECTIVES FOR MAT-227**

**RESEARCH OBJECTIVES/PLAN**

- Prepare the Data: data in Quantum computers are stored in Qubits which can be in State 0 or 1 or in their superposition.

- Create a Circuit: currently, to run a quantum algorithm we need to create a circuit that implements the steps in the algorithm as gates.

- Analyze and Interpret the results: since they are provided as final 0/1 qubits states and are susceptible to random errors due to decoherence.

**RESEARCH RESULTS/REMARKS**

- The graph below shows QFT simulations on IBM Simulator and Real Quantum Machine (ibmq_quito).
- The error grows as the number of Qubits is added.
- Real QCs are not as reliable as the simulators predict.

- The graph below compares QFT simulators for IBM and Amazon. There seem to be an Amazon advantage when implementing the QFT but not when inverting.

**LEARNING IMPLEMENTATION/OUTCOMES**

- The learners work in groups to find the complexity of two algorithms a min/max algorithm and a mean finding algorithm. We discuss the findings.
- Introduce Machine Learning ideas and present the difficulty to establish the complexity of algorithms that do not have a set number of steps due to their nondeterministic nature.
- Student work in groups to study a non-linear regression algorithm that will be the foundation for an individual take-home assessment.

**TEACHING REFERENCES**