**My Understanding Towards Quantum Computing and Quantum Machine Learning : by UJJWAL KUMAR**

Quantum Computing is an extremely amazing research field which uses the bizzare concepts of Quantum Mechanics to sort out the classical computational problems such as searching, optimization, cryptography and many more…

Like in searching, Grover’s algorithm had proved the edge over classical search algorithms by using the black box function to increase the probability of the target element and reduce the probabilities of others in each iteration. This is how in very few iterations we have the target element with highest probability.

I’m more interested towards the field of Quantum Machine Learning and Quantum Cryptography, may be due to my experience in QML & AI. QML is an emerging field which has shown the quantum advantages in many cases even on the constrained and limited hardware systems. It will definitely overcome the classical machine learning as the developments in hardware get accessible. For example, the hybrid quantum models has shown the decent comparable advantages in different fields either it is finance, or data generation.

In QML, the quantum optimization of classical models grab my attention when I was working on such project last summer, that was based on Hybrid Quantum Fuzzy based Neural Network (HQFNN) in which we have to optimize the neural network using Fuzzy C-means Clustering and to find the fuzzy parameters we used Hamiltonian concept, in place of backpropagation. That was the one thing I got inspired by, to work on such hybrid models that can prove the supremacy over the normal classical models.  
  
And in Quantum Cryptography, I recently got connected with Quantum Safe Cryptography concepts, which shows that the data encryption models that we’re using nowadays are in threat as the encryption keys (random numbers) generated by the classical computers can be regenerated or guessed by using powerful ML models. And also, QGAN models are also used to understand and generate the trend of these random numbers. So, for the higher security the Quantum Mechanically generated random numbers or the Quantum Random Numbers are considered to be more safe due to their unpredictabilty as most of the random numbers are generated using the concept of state collapse from superposition state i.e. truly random.  
  
I would be more glad to work on these fields in future. And about the Quantum Softwares, I had experienced Qiskit, Pennylane, and bit of Cirq. I prefer Pennylane and Qiskit for now as I think they are more developed and have much more support either thorough communities or libraries to perform the Quantum Computing tasks in more simpler languages than any other. Qiskit has a good support of simulators, and libraries that make the things understandable either it is for transpilation of circuits, or using some kind of data encoding techniques. Pennylane is also really good and easy to work on and get embedded with PyTorch and helpful for using GPUs and TPUs for Quantum Simulations.

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