Quantum Computing for Machine Learning and Deep Learning

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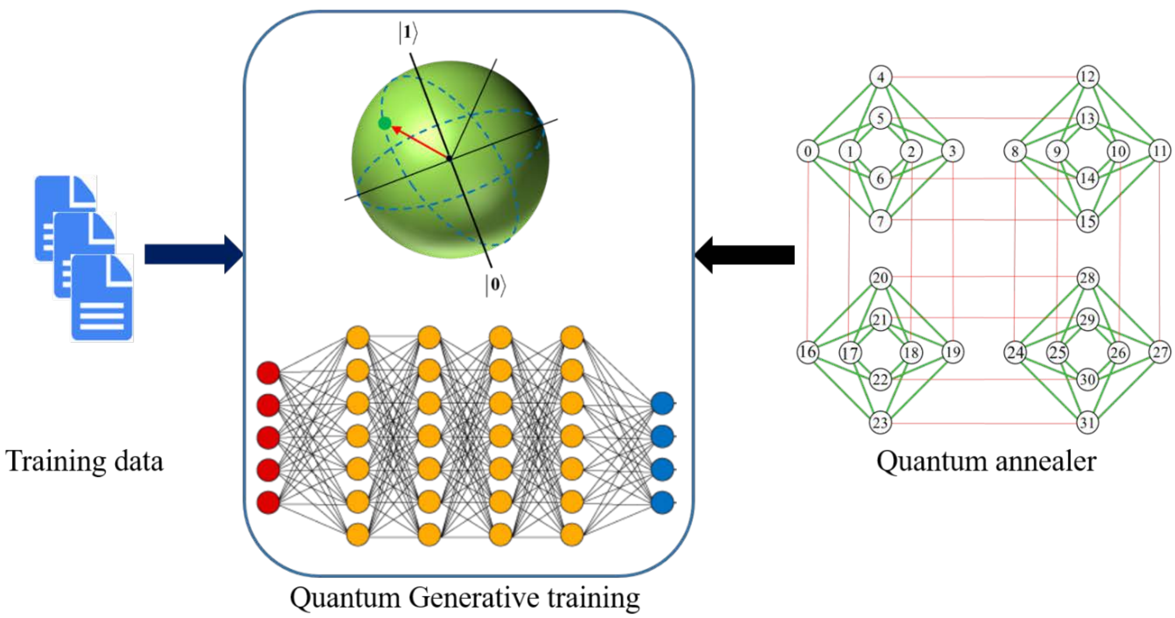
Quantum computing is the new frontier of technology and has the potential to change the world of computation. The properties of quantum computers facilitate massively parallel computing schemes that delivers huge leaps in computing power, with the potential of outperforming any transistor-based computers. The applications of quantum computing have revolutionized the areas of chemistry, pharmaceuticals, materials science, network security, and machine learning as well. With the growing popularity of machine learning and quantum computers, machine learning will soon be a “killer app” for quantum computers. Nowadays, it is very popular to use the deep architectures in machine learning. A class of deep neural networks called the deep belief network has been used for generating and recognizing images, video sequences, motion-capture data, and speech processing. Considering the wide applicability of deep learning and quantum computers, it is important to study the scope and extent of implementing deep architectures using quantum systems.



In this project, we will develop deep neural network models that can be trained efficiently with quantum annealing based computers. A quantum advantage must be perceived for these deep architectures when compared with traditionally trained networks. We will also explore the applications for which the developed quantum generative models can be effectively used. Some of the interesting application examples include image classification, data forecasting, sequence prediction for natural language processing, and speech and music synthesis. Currently only binary models can be trained through quantum computers. To address this challenge, we will also develop new methods of generative training performed through quantum sampling, which can be well approximated for continuous variants of deep belief networks. Effectively, the scope of this project is to study deep neural net models trained on quantum annealing systems by generalizing the quantum training methodologies and model performances.