Quantum Deep Neural Networks: A Survey

Amita Kapoor, Associate Professor, University of Delhi, India.
Narotam Singh, Meteorologist, Ministry of Earth Sciences, India.

Abstract (300 word limit)

Today there is not a single field remains where artificial intelligence and machine learning has left its mark, whether it is understanding the data generated from the CERN collider, identifying exoplanets, detecting Alzheimer or predicting financial markets, its presence can be seen everywhere. At the heart of this overwhelming success are deep neural networks, multi-layered neural network models. This success can be attributed to two major technological advancements, one the specialized processing units which could perform matrix operations (multiplication and addition) in parallel (Graphical processing units GPU and Tensor Processing Units TPU). Second, the internet and the multitude of devices connected to the internet and as a result availability of large amount of data.

Despite this tremendous success, there are challenges and areas, the problem of reproducibility in AI, the unsolved problem of artificial general intelligence and excessively long training time for recurrent neural networks and reinforcement learning agents. Quantum deep neural networks with the possibility of achieving computational supremacy promises to offer another technological leap. In this talk we will, provide a comprehensive survey of the available quantum computing infrastructure. The main emphasis of the talk will be quantum models implementing deep neural networks. The existing deep learning models need to be redesigned to work on quantum processors. We will demonstrate how to implement a quantum associative memory and perform an image classification task using quantum neural networks.

Finally, the talk will summarize the challenges ahead in this exciting merger of two young fields.

Recent Publications (minimum 5)

1. Soni, N., Sharma, E. K., Singh, N., & Kapoor, A. (2018, October). Assistance System (AS) for Vehicles on Indian Roads: A Case Study. In International Conference on Human Systems Engineering and Design: Future Trends and Applications (pp. 512-517). Springer, Cham.
2. Soni, N., Singh, N., Kapoor, A., & Sharma, E. K. (2018). Low-Resolution Image Recognition Using Cloud Hopfield Neural Network. In Progress in Advanced Computing and Intelligent Engineering (pp. 39-46). Springer, Singapore.
3. Fandango, A., & Kapoor, A. (2018, April). Investigation of Iterative and Direct Strategies with Recurrent Neural Networks for Short-Term Traffic Flow Forecasting. In International Conference on Advances in Computing and Data Sciences (pp. 433-441). Springer, Singapore.
4. Gulli, A., & Kapoor, A. (2017). TensorFlow 1. x Deep Learning Cookbook: Over 90 unique recipes to solve artificial-intelligence driven problems with Python. Packt Publishers, UK.
5. Chawla, S., Kapoor, A., Sharma, S., Shukla, B., Gupta, M., Kaushik, P., & Pushkar, S. (2016). App based Garden Bot for Regulation of Water Level in plants. International Research Journal of Engineering and Technology (IRJET)-2016.
6. Soni, N., Singh, N., Kapoor, A., & Sharma, E. K. (2016, March). Face recognition using cloud Hopfield neural network. In Wireless Communications, Signal Processing and Networking (WiSPNET), International Conference on (pp. 416-419). IEEE.
7. Singh, N., & Kapoor, A. (2015, August). Cloud Hopfield neural network: Analysis and simulation. In Advances in Computing, Communications and Informatics (ICACCI), 2015 International Conference on (pp. 203-209)
8. Kapoor, A., & Sharma, E. K. (2013, December). Neural network modelling of EDFA. In Recent Advances in Photonics (WRAP), 2013 Workshop on (pp. 1-3). IEEE.
9. Kapoor, A., & Sharma, E. K. (2009). Long period grating refractive-index sensor: optimal design for single wavelength interrogation. Applied optics, 48(31), G88-G94.



Biography (150 word limit)

Amita Kapoor is an Associate Professor in the Department of Electronics, SRCASW, University of Delhi. She has been actively teaching neural networks for the last twenty years. She did her Masters in Electronics in the year 1996, and her Ph.D. in the year 2011. During her Ph.D., she was awarded prestigious DAAD fellowship to pursue a part of her research work in Karlsruhe Institute of Technology, Karlsruhe, Germany. She had been awarded best Presentation Award at International Conference Photonics 2008 for her paper. She is a member of professional bodies like ACM, AAAI, INNS, and IEEE. She is co-author of two books in the field of Deep Learning using TensorFlow. She has more than 40 research publications in the international journals and conferences. Her present research areas include Machine Learning, Artificial Intelligence, Neural Networks, Robotics, Buddhism (Philosophy and Psychology) and Ethics in AI.

Email: dr.amita.kapoor@ieee.org



Biography

Narotam Singh is Assistant Meteorologist-II at India Metrological Department, Ministry of Earth Sciences. His job profile involves teaching and research at Information Communication and Instrumentation Training Center. He did his Masters in the field of Electronics from Jamia Milia Islamia in the year 1996, and graduation in Physics (Hons.) from University of Delhi in the year 1993. He also holds diploma and postgraduate diploma in the field Computer Applications. His present research interests involve neural networks, Internet of things, Robotics and Buddhism

Notes/Comments:

The talk will be presented by Dr Amita Kapoor