


Chapter 1

Navigating the Landscape of Distributed Computing Frameworks for Machine and Deep Learning: Overcoming Challenges and Finding Solutions

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ABSTRACT

For a number of reasons, distributed computing is crucial to machine learning and deep learning models. In the beginning, it makes it possible to train big models that won't fit in a single machine's memory. Second, by distributing the burden over several machines, it expedites the training process. Thirdly, it enables the management of vast amounts of data that may be dispersed across multiple devices or kept remotely. The system can continue processing data even if one machine fails because of distributed computing, which further improves fault tolerance. This chapter summarizes major frameworks Tensorflow, Pytorch, Apache spark Hadoop, and Horovod that are enabling developers to design and implement distributed computing models using

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large datasets. Some of the challenges faced by the distributed computing models are communication overhead, fault tolerance, load balancing, scalability and security, and the solutions are proposed to overcome the abovementioned challenges.

1. INTRODUCTION

In order to get quick and precise results, significant computation must be applied to speech recognition and object recognition applications. By combining the pertinent qualities, multiscale CNNs effectively serve this type of work with less compute, fewer errors, and low memory needs. Parallel distributed training algorithms offer parallel computing for communication synchronisation, compression approaches, and system topologies, replacing the need for high processing environments like GPUs and TPUs for effective communication.

The main distributed computing frameworks in usage, issues affecting the results of distributed computing, and appropriate solutions are all covered in this chapter. The Local SGD (DaSGD with Delayed Averaging) technique is a synchronous execution model that necessitates workers to pause forward and back propagations, wait for gradients aggregated from all workers, and get weight updates prior to the next batch of jobs and offers trustworthy results.

The fundamental ideas of algorithms for deep learning and machine learning are examined one at a time before moving on to distributed computing.

Machine Learning: A subfield of artificial intelligence, machine learning enables computers to learn through data and gradually improve performance without explicit programming. It entails developing algorithms capable of seeing patterns and producing predictions or choices based on what input data they are given. These algorithms gain the ability to identify complex links and trends by being exposed to enormous datasets, which enables them to offer meaningful information and automate processes. Machine learning improves decision-making and enables computers perform jobs that used to be believed to be exclusively the domain of human intelligence in a number of industries, including banking, healthcare, marketing, and more.

Deep Learning is a specialised area of machine learning that was motivated by the neural networks in the human brain. To enable computers to learn on their own representations of data, complex simulated neural networks with multiple levels are constructed. By tackling challenging issues including image and language translation, speech recognition, and even engaging strategic games, deep learning has produced remarkable results in a variety of fields. These networks tend to be most efficient for jobs involving huge datasets because of their depth and complexity, which enable them to identify complex trends and hierarchies in data. Deep learning's capacity

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