

Chapter 1

A Review of Infrastructures to Process Big Multimedia Data

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ABSTRACT

In the last years, the volume of information is growing faster than ever before, moving from small to huge, structured to unstructured datasets like text, image, audio and video. The purpose of processing the data is aimed to extract relevant information on trends, challenges and opportunities; all these studies with large volumes of data. The increase in the power of parallel computing enabled the use of Machine Learning (ML) techniques to take advantage of the processing capabilities offered by new architectures on large volumes of data. For this reason, it is necessary to find mechanisms that allow classify and organize them to facilitate to the users the extraction of the required information. The processing of these data requires the use of classification techniques that will be reviewed. This work analyzes different studies carried out on the use of ML for processing large volumes of data (Big Multimedia Data) and proposes a classification, using as criteria, the hardware infrastructures used in works of machine learning parallel approaches applied to large volumes of data.

1. INTRODUCTION

Machine Learning tries to imitate human being intelligence using machines. Machine learning algorithms use data of any kind to train the model. Depending on the problem, the data may be of the order of gigas. For this reason an optimized storage system for large volumes of data (Big Data) is indispensable.

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In recent years there has been an accelerated growth in the volume of information available on the network. Likewise, several alternatives have appeared for processing these large volumes of data (Big Data) and their storage. These alternatives are related to both: structured (numerical and alphanumerical data) and unstructured (text, images and videos) data. In the first case, some sort of *Database System* is needed, and in the second a sophisticated *File System* has to be used. As an example of the first case we can mention Apache HBase¹, and in the second Hadoop Distributed File System (HDFS)². The complexity of the data demands the creation of new architectures that optimize the computation time and the necessary resources to extract valuable knowledge from the data (Singh & Kaur, 2016).

The accelerated growth of information of various types available on the network, has generated the need to extract information and process it in an efficient way. Traditional techniques are oriented to process information in clusters. With the evolution of the graphic processor unit (GPU) it appeared alternatives to take full advantage of the multiprocessing capacity of this type of architectures. The most common programming frameworks are NVidia and OpenCL (Demidov, Ahnert, Rupp, & Gottschiling, 2013). In 2008, Khronos Group introduced the OpenCL (Open Computing Language) standard, which was a model for parallel programming. Subsequently appeared its main competitor, NVidia CUDA (Computer Unified Device Architecture). CUDA devices increase the performance of a system due to the high degree of parallelism they are able to manage (Kirk & Hwu, 2010).

This document reviews platforms, languages, and many other features of the most popular machine learning frameworks and offers a classification for someone who wants to begin in this field. In addition, an exhaustive review of works using machine learning techniques to deal with Big Data is done, including its most relevant features.

The remainder of this document is organized as follows. Section 2 introduces the Big Data concept summarizing its characteristics; Section 3 describes the techniques of machine learning and the most popular platforms. Next, an overview about Big Multimedia Data Processing is presented. Section 4 presents a summary table with several classification criteria. Finally, in section 5 some conclusions and opportunities for future work are presented.

2. BIG DATA

Big Data is present in all areas and sectors worldwide. However, its complexity exceeds the processing power of traditional tools, requiring high-performance computing platforms to exploit the full power of Big Data (Shim, 2013). These requirements have undoubtedly become a real challenge. Many studies focus on the search of methodologies that allow lowering computational costs with an increase in the relevance of extracted information. The need to extract useful knowledge has required researchers to apply different machine learning techniques, to compare the results obtained and to analyze them according to the characteristics of the large data volumes (volume, velocity, veracity and variety, the 4V's) (Mujeeb & Naidu, 2015).

The techniques used by Machine Learning (ML) are focused on minimizing the effects of noise from digital images, videos, hyperspectral data, among others, extracting useful information in various areas of knowledge, such as civil engineering (Rashidi, 2016), medicine (Athinarayanan, 2016), remote Sensing (Torralba, 2008).

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