International Journal of Advanced Computer Technology (IJACT)

ISSN:2319-7900

BIG DATA: DEVELOPMENTS IN THE WORLD OF INFORMATION

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Abstract :

After the emergence of social media, internet and mass media, continuous increase and the details of the registered data by organizations have led to changing the flow and types of data, both in the structured and also non-structured frames. The data, hereinafter called “big data” are created with extraordinary speed, and this has made the processing and analyzing of them as one of the most important possible problems. Method of processing, storing and analyzing the extensive mass of the data are only considered as a small part of the existing problems in that regard. Thus, to identify the other problems in this domain, both from researching point of view and from the engineering dimensions, it was primarily required to evaluate the specifications, properties and needs, within a framework of a researching work, and then, analyze the problems that have the most indications in this domain, comprehensively. Thus, it has been tried in this study to cover the aims to their most possible extent, which has facilitated the way for future studies to its possible extent, since more complete and optimized methods can be given by proper identification of the needs and problems in this domain. The concepts, classification, importance and analysis of the big data will be evaluated, and the existing problems and opportunities in this domain will be described in this article.

Introduction

Big Data have attracted public attention, including universities, government and industry. Big Data with three main characteristics are distinct from normal data: (A) Data are countless. (B) The data cannot be categorized in regular relational databases. (C) Data can be quickly created, recorded and processed. (D) Big Data are reshaping to health care, science, engineering, finance, business and the community. Now the rate of data creation is confusing. The main challenge of researchers and practitioners in the field is that, this growth rates over lapped its ability to design appropriate platforms for cloud computing to analyze data and to update the intensive workload [4].

Definition and characteristics of Big Data

Big Data, a term that refers to the increasing volume of data that storage, processing and analysis of by using traditional database technologies is hard. Big Data have none unique name. The term "Big Data," is relatively new term in the business and IT. But researchers and workers in this area used this term in their studies before. For example we can refer to Big Data as large amount of scientific data to make them more visible. There are various definitions of Big Data. For example Big Data were defined as: “The amount of data that is more than storage, management and efficient processing technology capacity. The definition of Big Data is subject to three features at the same time (That all of them start with letter V and they call it V3): Volume, variety and velocity. The term volume, variety and velocity were first introduced by Gartner. He used this term to describe the challenges of Big Data elements. IDC research firm defined Big Data technologies as this: "A new generation of technologies and architectures that are designed that by enabling high-speed registration, discovery and analysis to extract the amounts to more affordable way of large volumes of a wide range of data”. Big Data features not only are not limited to V3 but also can be expanded to V4 that their name is: Volume, variety, velocity and value. This V4definition is known globally because shows meaning and importance of Big Data very well. The following definition was suggested based on the definitions listed above, and our observation and analysis of Big Data. Big Data is a collection of techniques and technologies that require new forms of integration to extract hidden large amount from several Big Datasets, complex and large-scale. [5][7][8].

Volume

Volume relates to the production of all kinds of data from different sources that are still widespread. The advantage to collect massive amounts of data includes creation of information and hidden patterns by analyzing the data. Laurila et al presented a unique collection of longitudinal data from smart mobile devices and made it available for research community use [3].

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Variety

Variety is related to different types of data collected by sensors, smart phones and social networking sites. This kind of data, including video, image, text, audio, and other data types are found whether in the form of structured or non-structured form. The majority of data created by applications of mobile phones, the majority of data created by applications of mobile phones, are in structured format. For example, text messages, online games, blogs, and social media, create various types of non-structured data, through devices and sensors. Internet users also produce highly diverse set of structured and unstructured data [10] [9].

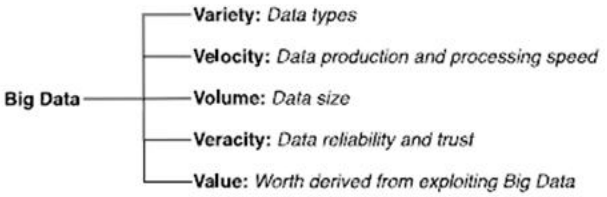

Figure 1 Some of the Vs of Big Data

Velocity

Velocity refers to the speed of data transmission. Content of data have already been archived due to attraction of additional data collection. Rule sets and data that arrive from various sources [6].

Amount is the most important aspect of Big Data that is related to process of massive amounts of secret discovery of massive datasets with different types and fast generation [7]. Also 3 other V was also presented as three other dimensions of Big Data. These dimensions include the following:

Validity

IBM made validity as 4th V that says Uncertainty in some sources of information is inseparable. For example, naturally, customer sentiment on social media is unreliable. However it has valuable information. Hence the need to address the misinformation and other Big Data is unreliable procedure that considered the use of analysis tools developed to manage and extract unreliable data. The variability and complexity of Big Data is defined as two extra dimensions. Variability refers to Variety in the flow of information. Speed of Big Data is not stable and often has periodic up and down. Complexity refers to the fact that Big Data have been created through countless resources [3] [2].

Value

Oracle enterprise defined value as defining characteristic of Big Data. According to the Oracle, Big Data has often been described as a low-density value and that's how, information is received in original form and usually depends on the size of its low value. However, high-value can be achieved by analyzing large volumes of such information. Therefore, there are no international standard for value, velocity and variety. Defining definitions depends on the limits to the size, sector and location on the economic unit and these limitations evolve over time. Also important is the fact that these dimensions are not independent of each other. So that if a later change increases the likelihood that change will result in another dimension. Therefore, the value of the expected future economic unit should be in front of Big Data technology implementation costs weigh [11] [1].

In this article, in the second part classification of Big Data a will be described, the third part importance of Big Data reviewed. The fourth section analyzes of Big Data have been investigated and in the fifth episode of the challenges in Big Data will also be discussed.

Classification of Big Data

Big data is classified in various categories, for the specifications to be understood more clearly. Fig. 2 shows the classification of big data, done according to five different statutes:

a) Data resources
b) Content format
c) Data storage
d) Deleting the data
e) Data processing

According to fig. 2, each of the above classifications has its own specifications and complexities. Data resources involve internet data, sensing and all the conventional information resources, consisting various structured formats to various non-structured formats (table 1). Moreover, different types of data in the big data structure are also classified in table 2. On the other hand, different methods exist for storing the extensive mass of the produced data in the structure of big data, the most popular of which is the relational database with extensive diversity. Table 3 shows the storing methods of data. Besides, due to extensive range of data resources, the registered data indicates difference with regards to their size, redundancy, compatibility, sound, etc. [18].

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Table 1 Diversity of Data Sources, having the role of originating the content in the structure of Big Data

Storage of data	Description
Document-oriented databank	The data is stored in rows in a document-oriented database (similar to relational database), but the difference is its more flexibility. For instance, the type of data here is not limited to the context, and the data can be stored with formats, such as JSON, XML, PDF or even Docx (such as MongoDB, Simple DB, Couch DB)
Column-oriented databank	This type os database stores its contents in columns, and it is different to the common relational database that stores the data in rows (such as Big Table)
Graphical databank	This type of database stores the data which is in graphical models, including nodes, corners, specifications, and relations, in itself (such as Neo4)
Key-value databank	In a key-value database, the data is stored as a pair of keys (index) and values (contents). Due to this storing model, the accessing process to the stored data is faster as compared to other databanks (such as Cassandra, HBase, Amazon Dynamo)

Importance of Big Data

Due to their importance, big data mainly change and transform our lifestyle, working and our thoughts. The importance of big data is described as follows with regards to various viewpoints [14].

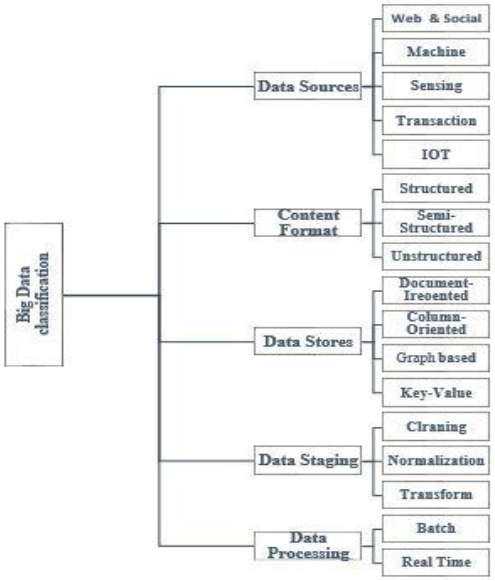

Figure 2 Classification of Big Data

Table 2 Different Types of Data Generated in the Big Data Structure

Types	Description
Structured	Structured data mainly includes managed SQLs; a programming language created for managing and querying of the data in RDBMS. The structured data can easily be inputted, queried, stored and analyzed. The examples of such data include numbers, words and dates
Semi-structured	Semi-structured data includes the ones that do not observe conventional database systems. Semi-structured data can be in the form of structured data, not arranged in the relational database models (such as tablets). Registering the semi-structured data for analysis is different with registering files with fixed format. Thus, registering the semi-structured data require using complicated regulations, deciding about the process after registering the data
Non-structured	Non-structured data, like texts, GPS data, videos and social media data are not the data that follow special formats. Since the size of these data is continually increasing (using smart phones), requiring such analyses has been transformed into a great problem

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Importance of big data in the growth of the citizens

Big data are at present considered as complicated problems that many industries confront with, bringing numerous problems in front of the industries dependent on numbers and based on information. Research on the common problems of big data, especially on eliminating the obstacles ahead of nuclear technologies will enable the industries to restrain the complexities. This leads to interconnection of information, dominating the uncertainties that are the results of redundancies or information deficiencies.

It is expected that strong bonds of big data and cloud processing to change the ecosystem, and even, effect the general pattern of information industry.

Importance of big data for scientific studies

Macro data has followed a scientific communion for reviewing scientific researches, being the pioneer of a revolution in scientific thoughts and methods [16].

Importance of big data for emergence of inter-disciplinary studies

Macro data technologies and dependent fundamental studies have been turned into the central point of studies in the academic domain. An inter-disciplinary emerging field called information knowledge gradually found its ways into the studies. This field considered big data as its researching subject, intending generalize the extraction and use of knowledge from the required data and information. This field of studies has involved many other fields of studies such as information knowledge, mathematics, social science, network knowledge, system knowledge, psychology and economics. This field of studies has used various techniques and theories from many principles, such as signal processing, probability theory, machine learning, statistical knowledge, computer programing, information engineering, pattern recognition, visualization, uncertainty modeling, databank and calculations with high efficiency [15]]16][17].

Importance of big data for helping the understanding of the present conditions

Big data, especially big data under network contains the power of social information. Thus, it can be used in network form for social surveying. Analyzing the big data and finding the keys, documents and regulations that implicitly include that can help us to clearly understand the present conditions.

Precise and proper extraction of the existing information in big data can help people in making decisions. For instance, in the U.S. presidential elections in 2012, Barak Obama's team helped him by analyzing the big data to defeat Romney and be re-selected. Obama's analyzing team made a great data processing system during 18 months before the elections. By collecting and analyzing the data about the real time, the team could not only tell him that how the election team find the voters and attract their attention, but it also could analyzed the inclination of the voters for the election. The analyzing team used to do a simulation of the elections, every night, and the results were submitted the next day, on order to help the probable realization about Obama's victory in some regions, since that team could allocate the resources in a more precise way. The realities showed later that the information analysis team had a vital role in re-election of Obama. This was beyond the people's imagine.

Table 3 Different Methods of Storing the Existing Data in Big Data Sets

Data Resources	Description
Social Media	Social media are the resources of generating information via URL. Exchanging information in virtual networks such as (weblogs, Face Book, Tweeter, etc.)
Machine made Data	Machine data are the information created automatically from hardware or software (such as computers or medical devices or other machines), without human interference
Sensors	There are various sensors for measuring physical quantity and their changing to signals
Related Data to Businesses	Contains an event that involves the dimension of time for describing the data
Internet of Things	Internet of things provides a set of objects that are exclusively identifiable as a part of internet. These objects include smart phones, digital cameras, and tablets. When they connect with each other via internet, they can have more smart processes and services supporting the health, environmental, financial and basic requirements. A large no. of connected devices to internet provide different services, and create a great deal of information

Importance of big data for helping the people's predictions about future

Better predictions about future events can be achieved by effective integration and proper analysis of large inhomoge-

neous data with multiple resources.it is possible for the big data to even promote the sustainable development of the community and economy, providing a rebirth to the new industries related to the data services.

Big Data Analysis

Big data are not valuable. Their potential value is indicated only when effective processes are done on a great mass of fast and varied data, with purposive instincts. The general process of extracting instincts from the big data could be classified in 5 stages, as shown in fig. 3. These five stages establish two main sub-processes:

- ✓ Data management
- ✓ Data analysis

Data management includes processes for acquiring, storing the data and recycling it for the required analysis. On the other hand, evaluations indicate using of the methods for analyzing and gaining knowledge and information from the big data. Hence, the science of analyzing the big data can be considered as a sub-process in the general process of "extraction of instinct" in the big data.
We shall consider briefly the methods of analyzing the big data in table 4, for structural and non-structural information [1].

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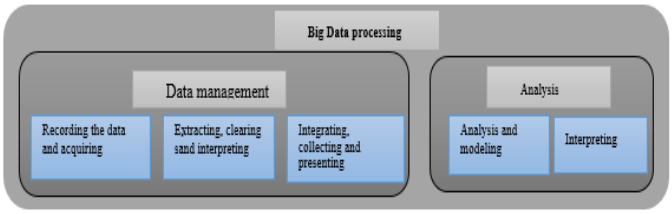

Figure 3 General Process of Extracting Instincts from the Big Data

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Table 4 Methods of Analyzing Big Data for Structural and Non-Structural Information

Types of analysis	Performance	Data examples	Types of systems or methods
Text	Extracting information from texts changes the extensive texts created by human to meaningful abstracts, supporting the decisions based on documents	Social networks, emails, weblogs, online societies, company documents, news and records of telephone centers are among the context data kept by organizations	Statistical analyses, computer linguistics and machine learning
Sound	Extracting the information from non-structured sound data	Contact centers of customers, health care are the basic uses of sound analyses	In health care, LVXSR systems Systems based on phonetics
Video	Various techniques for supervising, analysis, and compacting meaningful information	Extracting the created information by closed circuit cameras in shops, and studying the behavior of purchasing groups	Regarding system architecture, there are two systems for video analysis, i.e. based on servers, etc.
Social Media Traffic	Social media (types of online operating systems providing the users the possibility to create and exchange the contents	Social networks, weblogs, microweblogs (Tweeter), communal media (Instagram, U-tube), query sites (Yahoo, Ask.com)	Analysis based on contents Analysis based on structure
Predicted Traffic	It includes various techniques predicting	Predicting failures of jet engines according to	Predicting analyzing techniques are mainly

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	future results according to the historical and current data	data flow from some thousand sensors, up to predicting the next move by the customers according to what they buy	based on statistical methods

Research Difficulties Regarding Big Data

There are various challenges today in controlling the abilities resulted from the big data, changing from designing for processing systems in lower levels to analyzing tools in higher levels, along with various other problems in scientific researches. Some of the problems are resulted from the special specifications of the big data, some are related to the methods and models of analysis, and some are related to the limitations of data processing systems. In this section, we briefly state the most important difficulties in the above aspects [4][12][13].

Data Complexity

Emergence of big data during facing with calculating problems equipped us with extraordinary large scaled examples. However, we should confront with rather more complex data. As stated before, special specifications of big data are classified into different examples and patterns, complex mutual relations and data quality that is diverse to a great extent. Inherent complexity of big data (including complex types, complex structures and complex patterns) provide the understanding, reviewing and calculations to be transformed into even more difficult problems, and the problematic results calculating complexities will be increased during comparisons with traditional calculating models based on the total data. Analyzing and extracting the data will be transformed into great problems in cases such as detection, subjective discovery, conceptual analysis (semantic) and sentimental analysis, in using the big data. For instance, we lack the knowledge in distribution rules and mutual relations of big data. We do not have a deep understanding about inherent relations between the data complexity and calculating complexities of the big data, having no knowledge about processing domain-oriented methods of the big data. All these matters shall limit our potentials for designing calculating models with very high efficiencies and solving problems in using the macro data.

One main problem in the formulation with quantitative description of main specifications for the complexities of the big data. Studying the theory of complexities of big data will help us in understanding main specifications and formation of complex pattern in the big data, simplifying its presentation, receiving better abstraction of the knowledge and develop the design of the models and calculating algorithms about the big data. For that, we require the establishment of this theory and data distribution models under the mutual relations of multiple models. We also need the classification of inherent relations between data complexities and time-space calculating complexities. In addition, by framing and analyzing the inherent mechanisms of data complexities, we shall be able to interpret the principles and mechanisms for processing the big data in a strong infrastructure for calculating and processing the big data. Three features of the big data include having multiple resources, massive rate of data and rapid changes, for traditional calculating methods (such as machine learning, detecting the information and extracting the data) will make the effective support of the processing, analyzing and calculating the big data to be difficult. Such calculations cannot simply rely on the previous data, repetitive tools of analysis and patterns, used for a little rate of the data in the traditional approaches. New approaches require breaking away from the hypotheses created in traditional calculations based on independent and exclusive distribution of the data and adequate sampling for generating trusted records. We shall need the reconsideration and detection of calculating complexities and the potentials of calculations and the algorithms, in solving the existing problems in the big data.

New approaches about calculating the big data require regulation of calculating paradigms with high efficiency, new and big data-orientation, providing new methods for processing and analyzing the big data, and support of the relevant software in determined ranges. New features in processing the big data, such as inadequate samples, undefined inter-relational and open data, and distribution with no valued compaction balancing, not only provide great opportunities, but also considers intensive problems for studying the calculating potentials of the big data and developing new calculating paradigms.

We shall need to concentrate on the whole life cycle of the software packages for big data for studying the traditional data-oriented calculating paradigms based on the big data features to organize the calculating complexities of the software and big data applications. We need to break away from traditional calculation-oriented paradigms and create data-oriented calculating paradigms as well as search for weak systemic model of using of network data and the theory of its algebraic calculations. We shall need to develop algorithms for distributing and calculating and forming a calculating frame based on big data that are properly inte-

ISSN:2319-7900

grated and optimized for relations, storing and calculations. We should study the appropriate uncertainty algorithm theory for big data, and leave the hypothesis for independent distribution created in the traditional statistical studies. We also require searching in calculating methods based on the existing simplifications of big data to a suitable extent. Finally, we will need to develop the self-working and sampling on the basis of local calculations and approximation methods, and suggest for new theoretical principles for large data algorithms, which are scalable and comparative in analyzing a massive rate of information [18].

System Complexity

Big data processing systems for analyzing diverse samples of the data and software are the key alternatives for supporting scientific researches regarding the big data. Data processing of big data with a complex structure and dispersive values faces with great calculating complexities, long cycle and real time requirements. Not only the requirements provide new problems for designing the systematic architectures, calculating frameworks and processing systems, but they also impose intensive limitations in operational productivity and energy consumptions.

The design of system architectures, calculating frames, processing states and evaluations for processing systems of big data with high efficiency of energy is a key for organizing the system complexity. Solving the problems can consider required principles for designing, implementing, testing and optimizing big data processing systems.

Evaluating and optimizing energy productivity of big data processing systems indicate great research problems that not only requires us to solve the relation between the complexity and calculating potentials of the applications of big data and the relation between productivity and energy consumption of processing systems, but we also require comprehensive measurements for different energy productivity factors, including the operating potential of the system, parallel processing potentials, verification of occupational calculations and energy consumption in each unit. We should consider the real conditions of the capacity of work, and consider repetitive and dispersed resources. We shall need conduction of fundamental researches on evaluation of performance, distributive system architecture, calculation framework, and online processing of the data, while considering dispersion features of the value and position of access weakness as well as the life cycle of applied software for the big data. We shall need the tools for measuring the credits, including measures and prediction methods of the system performance. Due to a repetitive process of designing, implementing and credibility, we shall be able to develop processing systems of big data, with a potential to acquire the data, low energy consumption and a very efficient calculation.

Problems in Managing the Big Data

We shall discuss about big data management, in this section. There are still various problems about this matter. However, the following list is not complete and there are various other problems in this regard to be considered [2].

Diversity of Data

By diversity of data, it means how the increasing volume of data is undertaken, especially when the data sets are non-structured; how the significance extraction of the concepts is done; and how the collection and relation between some resources are fulfilled.

Data Storage

Storing the data indicates how the storage and identifying of information from the non-structured data are fulfilled; how a large volume of information is stored during detection; and whether the file systems are optimized by the analytical/applied programs for the volume and diversity of the demands.

Data Collection

Collecting the data indicates new protocols and relations for managing different non-structured and semi-structured data and resources.

Data Processing

New programming models are optimized for multiple data. Motors can combine applied software packages of programming models. For instance, MapReduce and business duties indicates this aspect. Optimization of using resources and consuming power is possible when the execution of analytical/applied programs is occurred.

Creation of the data

Storing the data and the data as a service (DAAS) produced by clouds are considered important. However, for analyzing this affair, using the data for making the model is considered as much that can be used for predictions. Moreover, as the models are made according to the available data, they also require to analyze their own abilities for predicting the future predictions.

ISSN:2319-7900

Conclusion

"Big data" is a term used for the extensive volume of the data, where the data is produced from different resources, such as computers, cellphones, sensors, and even home appliances, involving different domains, for the business organizations, including industry, commerce, health, etc. the trend of generation of the data is growing dynamically and with an extensive volume. The points considered ad problems include the state of managing and analyzing the massive rate of data, which in case of lack of proper using of it, it will be transformed into a useless object, only having maintenance and storing expenses. Thus, if a trade can search for information existing in the data, it can absorb more customers and have better business. We tried in this article to express the importance of big data as a new transformation in the world of information, by analyzing the concepts and classifications. Furthermore, the specifications and existing needs in the domain of big data is analyzed in this article. It was also tried finally to help the other researchers, who intend to have studies in this domain, by expressing the most important existing research problems and opportunities in this regard.

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