

Integration of Cloud Computing, Big Data, Artificial Intelligence, and Internet of Things: Review and Open Research Issues

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ABSTRACT

Cloud computing, internet of things (IoT), artificial intelligence, and big data are four very different technologies that are already discussed separately. The use of the four technologies is required to be more and more necessary in the present day in order to make them important components in today's world technology. In this paper, the authors center their attention on the integration of cloud, IoT, big data, and artificial intelligence. Several kinds of research papers have surveyed artificial intelligence, cloud, IoT, and big data separately and, more precisely, their main properties, characteristics, underlying technologies, and open issues. However, to the greatest of the authors' knowledge, these works require a detailed analysis of the new paradigm that combines the four technologies, which suggests completely new challenges and research issues. To bridge this gap, this paper presents a survey on the integration of cloud, IoT, artificial intelligence, and big data.

KEYWORDS

Artificial Intelligence, Big Data, Cloud Computing, Internet of Things

INTRODUCTION

Internet of Things (IoT) is a network of Smart devices which collect and transfer the data between them. The number of connected devices will be more than thirteen billion devices in 2020 and seventeen billion in 2025. It will create Trillions of Data every hour. For several years now, the internet has not been limited to computers and other smartphones. Now almost all objects are connectable to the internet. The Internet of Things has no limits. For this, businesses operate various communication networks. In order to control such enormous data, there is a need for Big Data.

Big Data is a term for data sets that are so large and huge. So, using Big Data can manage those huge data which the authors achieved from IoT devices and other sources.

The concept of big data is a concept generalized since 2012 to reflect the fact that companies are confronted with data capacities (data) to be processed more and more considerable and presenting great commercial and marketing issues. In order to cope up with scaling and rapidly increasing the volume, centralization, and infrastructure, here comes Cloud Computing.

Cloud Computing: Cloud Computing gives the centralized platform to access the data from anywhere in the world with the shared infrastructure. Now, everything works ideally. To treat all these data, there is a need for Artificial Intelligence.

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Artificial Intelligence: can use those data and learn from those data. It will predict or take decisions from those trillions of data. So, the usual information can get and predict our future from our past. There are a lot of AI offers. So, the real power comes with the use of all the technologies for our better future.

In this paper, the authors will discuss how these four technologies Internet of things, artificial intelligence, big data and cloud computing are related to each other.

FUNDAMENTAL CONCEPTS

In the modern world, the use of new technology is important for several IT operations and numerous industries such as big data, cloud computing, artificial intelligence and IoT (Internet of things) for many of their applications for efficient management of the company. Various concepts and definitions are discussed below.

Characteristics of Big Data

Big data is data whose scale, distribution, variety, and/or timeliness need the use of new technical architectures, analytics, and tools in order to allow insights that open new sources of business value. Three main features characterize big data: volume, variety, and velocity. The volume of the data is its size, and how enormous it is. Velocity concerns to the rate with which data is changing, or how often it is created. Finally, variety includes the different formats and representations of data, as well as the different kinds of methods and techniques of analyzing the data (EMC, 2012).

Characteristics of Cloud

Cloud computing is the realization of utility computing where resources are implemented by the service provider and the cloud customer will pay as they use the resources. The user can access the cloud via a thin client. Cloud also provides memory for a large number of data to store and allows computation. Hence a lot of users can rely on a cloud as it reduces the infrastructure charge that the user needs to invest (Drissi et al., 2015), (Drissi et al., 2019).

Characteristics of IoT

Internet of Things: Future internet will be mainly based on IOT. As the title indicates the Internet of Things is nothing but an interconnected network of things which are embedded with sensors and actuators. The thing may be any real-world object. These objects have the ability to collect data from the environment with the help of sensors and therefore they are termed as smart objects. A large amount of data will be managed by such smart objects, which will be helpful in future analysis.

Characteristics of INTELLIGENCE Artificial

Artificial intelligence relates to science and technology that can simulate human sensing, thinking, reasoning and action, and demonstrates the capacity to solve problems with human intelligence. Artificial intelligence uses human input data to get knowledge and enhances problem-solving through machine learning mode (Maurício et al., 2018). Literature Review

In (Soldatos et al., 2012), the authors describe design principles for IOT cloud environment and also introduce a framework for converging computing models with developing IOT infrastructure. The paper has explained that future internet is mainly focused on IOT and therefore integrated easily with the services such as the Internet of Services (IOS) and their standards. Management of IOT based cloud environment is not simple and consequently, this paper introduces the main building block of a middle wear framework. With this framework service providers can efficiently handle end user requests by deploying cloud utility-based infrastructure. The paper also explains the design principles for the framework.

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