# CCT College Dublin

Assessment Cover Page

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| Module Title: | Advanced Data Analytics, Big Data Processing and Storage |
| Assessment Title: | Integrated CA 1 SEM 2 MSc Data Analytics |
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| Assessment Due Date: | 5 April 2024 |
| Date of Submission: |  |

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Innovative Applications of Deep Learning and Big Data in Healthcare

***Abstract-* With advancement in technology and medicine, the healthcare facilities have improved a lot. The key player in the domain is data, which not only provide insights but also forecast the upcoming trends. The enormous amount of data which is generated each day in healthcare and other fields is so massive that it is impossible for traditional technology to evaluate and study. These type of data that falls in the category of Big Data is processed differently by the data scientists which create advanced algorithms to study it. These specialized algorithms are too complex that they behave like human brain, the scientists have created deep learning models which are known as neural networks which behave like neurons and make decisions appropriately. The intersection of both these fields provide a path for future developments that will not only revolutionize the healthcare but will change the core in all other domains. This paper provides an overview, applications, challenges and future aspects of Deep Learning and Big Data in Healthcare. The data storage management system, the architecture of distributed file system, big data stack and limitations of legacy approaches to big data are evaluated. The various different types of neural networks and set of requirements to determine the type of neural network are also discussed.**

***Keywords- Machine Learning, Deep Learning, Neural Networks, Big Data, Data Analytics, Medicine, Healthcare***

I. INTRODUCTION

In this decade, the healthcare industry has witnessed a drastic change driven by the advancements in technology especially in the areas of Artificial Intelligence and Machine Learning. Deep learning which is subset of Machine Learning and Artificial Intelligence has emerged as a powerful tool for extracting meaningful insights from large and complex databases. Similarly, Big Data, characterized by the massive volume, velocity and variety of healthcare data, presents both challenges and opportunities for transforming healthcare in a great way.

The collaboration of Deep Learning along with Big Data and healthcare with change the various aspects of healthcare including diagnosis of the disease,

treatment therapy, preventive measures, medicine and surgical intervention through bots and AI. The management sector will also be positively impacted by the data driven decisions. The medical sector generates many different categories of data ranging from structured, semi-structured and unstructured. The diagnosis facilities in the healthcare include studying images, graphs and visualizations. The mobile devices and wearable gadgets help keep record of vitals and generate daily logs incorporating huge amount of data which lays the foundation for studying the trends, recognizing patterns and make predictions via modelling which is the core of advanced data analytics.

II. BIG DATA

*A. Understanding the term*

The term Big Data is coined to demonstrate the enormous data which cannot be studied by the traditional data studying tools. To understand the complexity and magnitude of big data, the five core fundamentals volume, velocity, variety, veracity and variability plays an important role. The **Volume** represents the huge amount of data which is generated every single day. The media, sensors and devices creates terabytes of data which needs robust infrastructure to study. The **Velocity** at which the data flows also plays a crucial role in decision making. The transactions, streaming devices, online interactions generate a huge flow which needs to be studied for the insights.

The images, audio files, videos, spreadsheets and text files contribute to the **variety** of data that needs to be processed. This create a challenge for the data analysts to understand, manage and modify the data. The **Variability** refers to the fluctuations in the data generated over the time. The inconsistent nature of the data poses a problem for accurate predictions which needs to be addressed. In the vast sea of data, it is mandatory to check the quality of data being created which constitutes the **veracity** factor. It pertains to accuracy and reliability of data.

*B. Limitations of Legacy approaches to Big Data*

The traditional relational databases and on premises data warehouses have several limitations which include scalability, cost, performance, variety, security, processing speed and flexibility. The exponential growth of data needs horizontal scaling, but as the volume of the data increases, the capacity constraint becomes an issue. The upfront investment in hardware, maintenance cost of scaling the infrastructure to handle big data is expensive as compared to the cloud based services which have pay as you use price models. The traditional systems were optimized for structured data which pose a problem for different variety of data like images, texts and other semi structured or unstructured data. These data types are not supported by the relational databases. Processing these type of data require complex modeling and transformation. Another issue with legacy systems is it could not handle the velocity at which the big data is generated and processed. These systems were not able to handle real time analytics and decision making. The storage and modification of existing data also cause the lack in processing due to the time consuming, inflexible and rigid traditional systems. The system also lack the robust security features. Data stored in on premise centers may be susceptible to breaching and data loss.

*C. Big Data Storage and Management*

There are various processes and technologies involved in analyzing big data. The storage system has to handle enormous amount of data which traditional systems struggle to organize. Distributed storage systems like Hadoop, Apache Cassandra, Apache HBase, Google Cloud Storage and Azure Blob are designed to scale data across multiple servers and reduce fault tolerance. Technologies like Apache Spark, Flink and Kafka provide parallel processing capabilities to handle big data and process it. Machine learning and real time stream processing are some of the core functionalities. Cloud computing and containerization provides scalability by ensuring elasticity and dynamic resource allocation. Data management also includes managing the lifecycle of data by creating guidelines for data retention, deletion and archival. The utilization of storage resources is core of data lifecycle management. The metadata includes information about the structure, lineage and source. For better understanding, search, discovery and performance effective metadata management is necessary. The reason for data storage and management is to study the data to develop useful insights. Various dashboards like Tableau and Power BI are used to visualize, compare, analyze the data and generate reports. Data management and storage is a complex aspect of dealing with big data. Data Warehouses like Amazon Redshift, snowflake and Google Big Query are specialized systems designed to assist big data storage and management.

*D. Architecture*

Distributed file system (DFS) architecture is designed to store large amount of data across multiple nodes. This DFS is stored in a distributed computing environment. The typical architecture of a distributed file system includes Name node, Data node and Client node. The name node is responsible for storing the metadata about the file. It keeps track of which blocks constitute each file and their locations in the cluster. The actual data is stored in the data nodes which are known as the worker nodes. Each data node is responsible for serving read and write requests on its disk. The applications which interact with the distributed file system to read, write and manipulate data is referred as the client node. Client node send operational commands to the name node, which then coordinate with data node to perform the task. The client head may also store data in cache to improve performance and reduce traffic. The data is stored in blocks of fixed size typically 128 MB and there are multiple replicas of each block across the system to ensure there is no data loss and this feature is called replication. It is fundamentally important to make system redundant and fault tolerance.