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Investigation the role of Data Science in Advancements for Mechanical Engineering

Raghuvamshi Bathini, Ganji Lokesh, Avula Nivish
Department of Mechanical Engineering
CVR College of Engineering, Hyderabad, India.

Abstract: Although both data science and mechanical engineering are quite different fields, they overlap each other in some areas. Individuals with expertise in data science & mechanical engineering are going to be in high demand in the upcoming years. Nowadays different components of a machine or device are made using intelligent systems and techniques to enhance performance and for optimization. It is important to have suitable predictions for making better decisions in engineering studies, medical studies, and businesses. Currently, mechanical engineers have only a limited set of tools. These tools are benchmarks of standard tools for processes like hardware design, machine control, etc. Although there is some exceptionally good software like ANSYS, CATIA, MATLAB, Abaqus, etc, they are largely complex. And if something goes wrong in a project it would be really difficult for engineers and managers to identify it. Then it will become a huge disaster resulting in a big financial loss along with loss of time, energy, and manpower.That's where Data Science comes in with a solution. It provides a way to make online updates for relevant predictions, visualizations, and analysis for the performance of thousands of factors including equipment, parts, environmental conditions, etc. In this regard the present work will examine the facets of data science and its influence in mechanical engineering.

Keywords: Investigation, Data science, Advancements, Mechanical Engineering

I. INTRODUCTION

Introduction: Data science can be defined as a blend of mathematics, business acumen, tools, algorithms and machine learning techniques, all of which help us in finding out the hidden insights or patterns from raw data which can be of major use in the formation of big business decisions [1]. In data science, one deals with both structured and unstructured data. The algorithms also involve predictive analytics in them. Thus, data science is all about the present and future. That is, finding out the trends based on historical data which can be useful for present decisions and finding patterns which can be modelled and can be used for predictions to see what things may look like in the future [2].

Data Science is an amalgamation of Statistics, Tools and Business knowledge. So, it becomes imperative for a Data Scientist to have good knowledge and understanding of these. With the amount of data that is being generated and the evolution in the field of Analytics, Data Science has turned out to be a necessity for companies. To make most out of their data, companies from all domains, be it Finance, Marketing, Retail, IT or Bank. All are looking for Data Scientists. This has led to a huge demand for Data Scientists all over the globe. With the kind of salary that a company has to offer and IBM is declaring it as trending job of 21st century, it is a lucrative job for many. This field is such that anyone from any background can make a career as a Data Scientist. Data Science consists of 3 parts namely: [3]

Machine Learning: Machine Learning involves algorithms and mathematical models, chiefly employed to make machines learn and prepare them to adapt to everyday advancements [4]. For example, these days, time series forecasting is very much in use in trading and financial systems. In this, based on historical data patterns, the machine can predict the outcomes for the future months or years [5]. This is an application of machine learning.

Big Data: Everyday, humans are producing so much of data in the form of clicks, orders, videos, images, comments, articles, RSS Feeds etc. These data are generally unstructured and is often called as Big Data. Big Data tools and techniques mainly help in converting this unstructured data into a structured form [6]. For example, suppose someone wants to track the prices of different products on e-commerce sites. He/she can access the data of the same products from different websites using Web APIs and RSS Feeds. Then convert them into structured form [7].

Business Intelligence: Each business has and produces too much data every day. This data when analysed carefully and then presented in visual reports involving graphs, can bring good decision making to life. This can help the management in taking the best decision after

carefully delving into patterns and details the reports bring to life [8].

Tools in Data Science:
n-depth knowledge in R: R is used for data analysis, as a programming language, as an environment for statistical analysis, data visualization.
Python coding: Python is majorly preferred to implement mathematical models and concepts because python has rich libraries/packages to build and deploy models [9].
MS Excel: Microsoft Excel is considered a basic requirement for all data entry jobs. It is of great use in data analysis, applying formulae, equations, diagrams out of a messy lot of data.
Hadoop Platform: It is an open-source distributed processing framework. It is used for managing the processing and storage of big data applications [10].
SQL database/coding: It is mainly used for the preparation and extraction of datasets. It can also be used for problems like Graph and Network Analysis, Search behaviour, fraud detection etc.
Technology: Since there is so much unstructured data out there, one also should know how to access that data. This can be done in a variety of ways, via APIs, or via web servers.
Data Science in Mechanical Engineering
Mechanical Engineering is a branch of engineering that amalgamates mathematics and engineering physics concepts for the purpose of designing, analysing, manufacturing, and maintaining mechanical systems [11]. It is one of the earliest and widest of the engineering disciplines. Mechanical engineering requires the core understanding of subjects such as:

- Mechanics
- Dynamics
- Thermodynamics
- Material Science
- Structural Analysis
- Electricity

In addition to these fundamental principles, mechanical engineers also use several tools like Computer-Aided Manufacturing (CAM), Computer-Aided Design (CAD), Product Lifecycle Management to design and analyse: [12, 13, 14]

- Manufacturing plants
- Industrial Equipment and Machinery
- Heating and Cooling Systems
- Transport Systems
- Medical Devices
- Weapons
- Aircraft
- Watercraft
- Robotics

Although both data science and mechanical engineering are quite different fields they overlap each other in some areas. Individuals with expertise in data science & mechanical engineering are going to be in high demand in the upcoming years [15,16,17]. Nowadays different components of a machine or device are made using intelligent systems and, techniques to enhance performance and for optimization. It is important to have suitable predictions for making better decisions in engineering studies, medical studies, and businesses.
Currently, mechanical engineers have only a limited set of tools.

These tools are benchmarks of standard tools for processes like hardware design, machine control, etc. Although there is some exceptionally good software like ANSYS, CATIA, MATLAB, Abaqus, etc, they are largely complex. And If something goes wrong in a project it would be really difficult for engineers and managers to identify it. Then it will become a huge disaster resulting in a big financial loss along with loss of time, energy, and manpower. That's where Data Science comes in with a solution. It provides a way to make online updates for relevant predictions, visualizations, and analysis for the performance of thousands of factors including equipment, parts, environmental conditions, etc.
As we discussed earlier, data science in mechanical engineering employs techniques from various disciplines like computer science, mathematics, and statistics. Mechanical engineers are very familiar with these topics so it would be pretty easy for them to understand advanced concepts of data science in mechanical engineering.
The applications of data science in mechanical engineering are as follows: -

- Biomechanical Applications
- Robotic Applications
- Control Engineering Applications
- Solid Mechanics Applications

Mechanical engineers may quickly increase their value by mastering data science. This indicates they can ask for a raise or switch to a better-paying job. Every organization's numerous decision-making processes are built on data. Advantages of data science for mechanical engineers are as follows:

- To gain knowledge and value so that they can demand higher salaries or move to bigger organizations.
- To enhance decision-making skills based on data science results and effectively manage massive datasets.
- To get the knowledge of various programming languages so as to develop scalable and effective solutions.

Data science applications in mechanical engineering

- Mechanical engineers generally have a very strong mathematical background.
- Statistics is the backbone of data science and it forms the basic foundation for machine learning algorithms.
- Domain Knowledge is an essential skill for a data scientist. There are three main aspects of domain knowledge:
- Identifying source of the problem
- Understanding of domain data collection mechanisms
- In-depth understanding of business operations

- As data science & mechanical engineering experts need to have hardcore programming skills.
- There are various programming tools like Python, R, Java, SQL, Scala, etc.
- You can learn these programming languages through online courses in a short period of time if you are really motivated and interested.

III.CONCLUSIONS

Learning data science for mechanical engineers is both challenging and rewarding. In this article, we briefly discussed how data science in mechanical engineering can be useful to mechanical engineers and the applications of data science in the mechanical engineering field. In the upcoming times, individuals with knowledge of mechanical engineering disciplines and the skillsets of a data scientist would be very important. They would be required to fulfil various industry needs.

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