SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF MECHANICAL ENGINEERING

19MEE403 - Industrial Digitalization

IV YEAR / VII SEM

UNIT – 1 INTRODUCTION TO DIGITAL MANUFACTURING

Introduction to Machine Learning

Machine Learning (ML) is a branch of artificial intelligence (AI) that enables computers to learn from data and make decisions or predictions without being explicitly programmed for specific tasks. Unlike traditional software, where a programmer writes a sequence of instructions to solve a problem, machine learning algorithms use statistical methods to identify patterns in data, allowing the system to improve its performance over time.

Definition

A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks T, as measured by P, improves with experience E. Examples i) Handwriting recognition learning problem • Task T: Recognising and classifying handwritten words within images • Performance P: Percent of words correctly classified • Training experience E: A dataset of handwritten words with given classifications

ii) A robot driving learning problem • Task T: Driving on highways using vision sensors • Performance measure P: Average distance traveled before an error • training experience: A sequence of images and steering commands recorded while observing a human driver

iii) A chess learning problem • Task T: Playing chess • Performance measure P: Percent of games won against opponents • Training experience E: Playing practice games against itself

INTRODUCTION TO MACHINE LEARNING

Basic components of learning process The learning process, whether by a human or a machine, can be divided into four components, namely, data storage, abstraction, generalization and evaluation. Figure 1.1 illustrates the variouscomponents and the steps involved in the learning process.

1. Data storage Facilities for storing and retrieving huge amounts of data are an important component of the learning process. Humans and computers alike utilize data storage as a foundation for advanced reasoning. • In a human being, the data is stored in the brain and data is retrieved using electrochemical signals. • Computers use hard disk drives, flash memory, random access memory and similar devices to store data and use cables and other technology to retrieve data.

2. 2. Abstraction The second component of the learning process is known as abstraction. Abstraction is the process of extracting knowledge about stored data. This involves creating general concepts about the data as a whole. The creation of knowledge involves application of known models and creation of new models. The process of fitting a model to a dataset is known as training. When the model has been trained, the data is transformed into an abstract form that summarizes the original information.

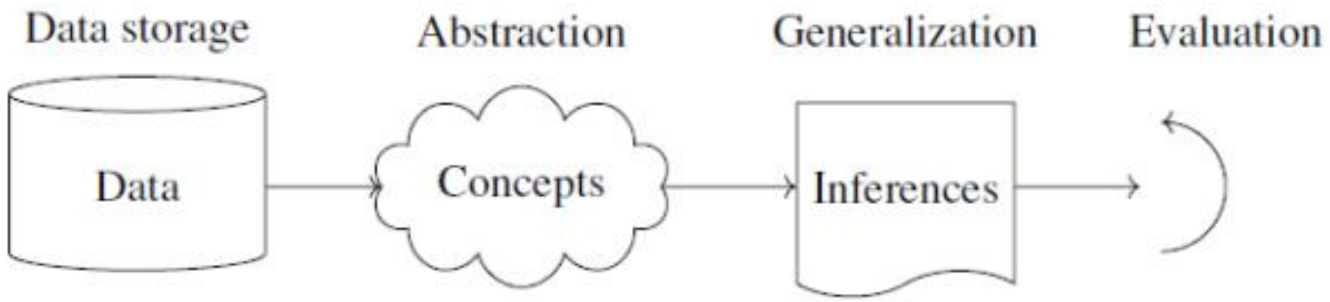

Figure 1.1: Components of learning process

3. Generalization

The third component of the learning process is known as generalisation. The term generalization describes the process of turning the knowledge about stored data into a form that can be utilized for future action. These actions are to be carried out on tasks that are similar, but not identical, to those what have been seen before. In generalization, the goal is to discover those properties of the data that will be most relevant to future tasks.

4. Evaluation

Evaluation is the last component of the learning process. It is the process of giving feedback to the user to measure the utility of the learned knowledge. This feedback is then utilised to effect improvements in the whole learning process

AI USED IN COMPUTER-AIDED DESIGN

•**Predictive Modeling and Simulation**:
•AI enhances simulation processes by predicting outcomes more accurately and quickly than traditional methods. Machine learning models can be trained on historical simulation data to predict the performance of new designs without the need for time-consuming simulations.
•Example: AI-driven simulations can predict how a product will behave under different conditions, allowing for real-time adjustments during the design process.

•**Intelligent Feature Recognition**:
•AI algorithms can automatically recognize and categorize features in CAD models, such as holes, slots, or fillets. This capability speeds up the design process by automating routine tasks and ensuring consistency across designs.
•Example: AI-powered feature recognition can automatically identify manufacturable features in a part, aiding in the preparation of CNC machining or 3D printing processes.

•**Design Error Detection and Correction**:
•AI can detect potential design errors or inconsistencies in real-time, alerting designers to issues that might lead to manufacturing defects or product failures. This reduces the need for costly revisions and improves the overall quality of the final product.
•Example: AI-driven tools can analyze a CAD model and identify areas where tolerances might be too tight or where stress concentrations might cause failure.

•**Collaborative Design**:
•AI facilitates collaborative design by integrating input from multiple stakeholders, automatically balancing conflicting requirements, and suggesting compromises. This is particularly useful in large, complex projects where multiple disciplines are involved.
•Example: AI can manage design data and feedback from different teams, ensuring that all aspects of a project are aligned and optimized.

Thank You