

Unit No. 1

Machine Learning Basics

Lecture No. 02

Outlines

- **Introduction**
- **What is ML**
- **Need for Machine Learning**
- **Why & When to Make Machines Learn**
- **Machine Learning Model**
- **Challenges in Machines Learning**
- **Applications of Machines Learning**
- **References**

Student Effective Learning Outcomes(SELO)

01: Ability to understand subject related concepts clearly along with contemporary issues.

02: Ability to use updated tools, techniques and skills for effective domain specific practices.

03: Understanding available tools and products and ability to use it effectively.

Introduction

- We are living in the 'age of data' that is enriched with better computational power and more storage resources,.
- This data or information is increasing day by day, but the real challenge is to make sense of all the data.
- Businesses & organizations are trying to deal with it by building intelligent systems using the concepts and methodologies from Data science, Data Mining and Machine learning.
- Among them, machine learning is the most exciting field of computer science. It would not be wrong if we call machine learning the application and science of algorithms that provides sense to the data.

What is Machine Learning?

- Machine Learning (ML) is that field of computer science with the help of which computer systems can provide sense to data in much the same way as human beings do.
- In simple words, ML is a type of artificial intelligence that extract patterns out of raw data by using an algorithm or method.
- The main focus of ML is to allow computer systems learn from experience without being explicitly programmed or human intervention.

Need for Machine Learning

- Human beings, at this moment, are the most intelligent and advanced species on earth because they can think, evaluate and solve complex problems. On the other side, AI is still in its initial stage and haven't surpassed human intelligence in many aspects.
- Then the question is that what is the need to make machine learn? The most suitable reason for doing this is, "to make decisions, based on data, with efficiency and scale".
- Lately, organizations are investing heavily in newer technologies like Artificial Intelligence, Machine Learning and Deep Learning to get the key information from data to perform several real-world tasks and solve problems.
- We can call it data-driven decisions taken by machines, particularly to automate the process. These data-driven decisions can be used, instead of using programming logic, in the problems that cannot be programmed inherently.

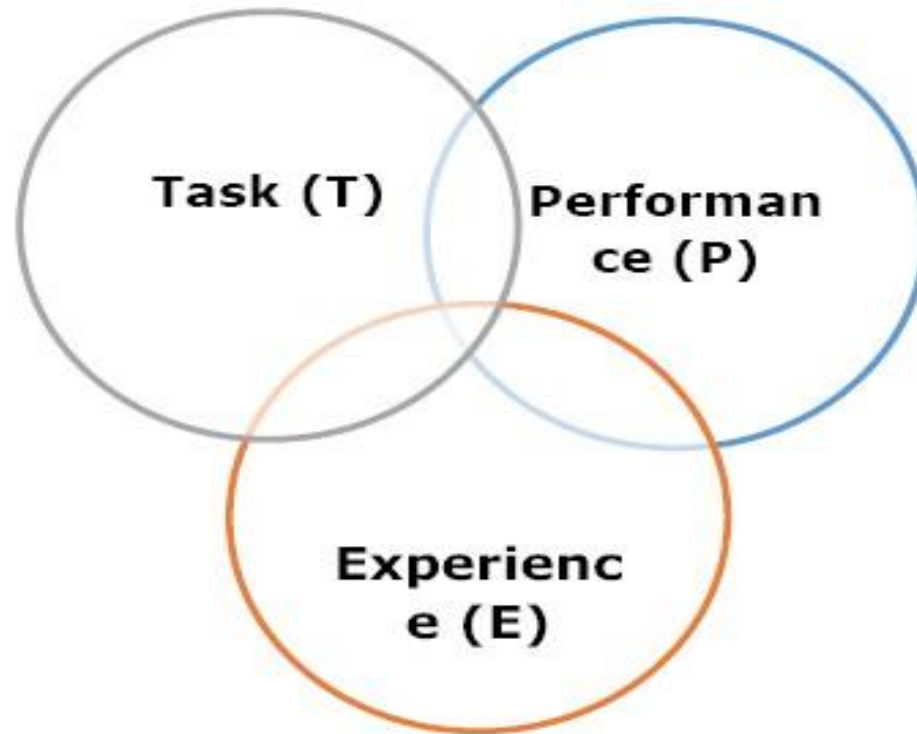
Why & When to Make Machines Learn?

- There can be several circumstances where we need machines to take data-driven decisions with efficiency and at a huge scale.
- **Lack of human expertise:** The very first scenario in which we want a machine to learn and take data-driven decisions, can be the domain where there is a lack of human expertise. The examples can be navigations in unknown territories or spatial planets.
- **Dynamic scenarios:** There are some scenarios which are dynamic in nature i.e. they keep changing over time. In case of these scenarios and behaviors, we want a machine to learn and take data-driven decisions. Some of the examples can be network connectivity and availability of infrastructure in an organization.
- **Difficulty in translating expertise into computational tasks:** There can be various domains in which humans have their expertise,; however, they are unable to translate this expertise into computational tasks. In such circumstances we want machine learning. The examples can be the domains of speech recognition, cognitive tasks etc.

Machine Learning Model

- **“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 in T, as measured by P, improves with experience E.”**
- **The above definition is basically focusing on three parameters, also the main components of any learning algorithm, namely Task(T), Performance(P) and experience (E).**
- **In this context, we can simplify this definition as: ML is a field of AI consisting of learning algorithms that:**
 - **Improve their performance (P)**
 - **At executing some task (T)**
 - **Over time with experience (E)**

Machine Learning Model



Machine Learning Model

- **Task(T)**

From the perspective of problem, we may define the task T as the real-world problem to be solved. The problem can be anything like finding best house price in a specific location or to find best marketing strategy etc. On the other hand, if we talk about machine learning, the definition of task is different because it is difficult to solve ML based tasks by conventional programming approach.

A task T is said to be a ML based task when it is based on the process and the system must follow for operating on data points. The examples of ML based tasks are Classification, Regression, Structured annotation, Clustering, Transcription etc.

Machine Learning Model

- **Experience (E)**

As name suggests, it is the knowledge gained from data points provided to the algorithm or model. Once provided with the dataset, the model will run iteratively and will learn some inherent pattern. The learning thus acquired is called experience(E). Making an analogy with human learning, we can think of this situation as in which a human being is learning or gaining some experience from various attributes like situation, relationships etc. Supervised, unsupervised and reinforcement learning are some ways to learn or gain experience. The experience gained by our ML model or algorithm will be used to solve the task T.

Machine Learning Model

- **Performance (P)**

An ML algorithm is supposed to perform task and gain experience with the passage of time. The measure which tells whether ML algorithm is performing as per expectation or not is its performance (P). P is basically a quantitative metric that tells how a model is performing the task, T, using its experience, E. There are many metrics that help to understand the ML performance, such as accuracy score, F1 score, confusion matrix, precision, recall, sensitivity etc.

Challenges in Machines Learning

- While Machine Learning is rapidly evolving, making significant strides with cyber security and autonomous cars, this segment of AI as whole still has a long way to go. The reason behind is that ML has not been able to overcome number of challenges. The challenges that ML is facing currently are:
- **Quality of data:** Having good-quality data for ML algorithms is one of the biggest challenges. Use of low-quality data leads to the problems related to data preprocessing and feature extraction.
- **Time-Consuming task:** Another challenge faced by ML models is the consumption of time especially for data acquisition, feature extraction and retrieval.
- **Lack of specialist persons:** As ML technology is still in its infancy stage, availability of expert resources is a tough job.

Challenges in Machines Learning

- **No clear objective for formulating business problems:** Having no clear objective and well-defined goal for business problems is another key challenge for ML because this
- technology is not that mature yet.
 - **Issue of overfitting & underfitting:** If the model is overfitting
 - or underfitting, it cannot be represented well for the problem.
- **Curse of dimensionality:** Another challenge ML model faces is too many features of data points. This can be a real hindrance.
- **Difficulty in deployment:** Complexity of the ML model makes it quite difficult to be deployed in real life.

Applications of Machines Learning

- Machine Learning is the most rapidly growing technology and according to researchers we are in the golden year of AI and ML. It is used to solve many real-world complex problems which cannot be solved with traditional approach. Following are some real-world applications of ML:
 - Emotion analysis
 - Sentiment analysis
 - Error detection and prevention
 - Weather forecasting and prediction
 - Stock market analysis and forecasting
 - Customer segmentation
 - Fraud detection
 - Recommendation of products to customer in online shopping

Learning Outcomes

The students have learn and understand the followings

- **What is ML**
- **Need for Machine Learning**
- **Why & When to Make Machines Learn**
- **Machine Learning Model**
- **Challenges in Machines Learning**
- **Applications of Machines Learning**

References

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Thank you