Study of Machine Learning Survey

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Abstract- *This paper describes a survey of Machine Learning. Machine learning is wherever a computing system is fed massive amounts of information, that it then uses to find out a way to perform a particular task, like understanding speech or captioning a photograph. Machine learning could be a set of AI and is usually split into 2 main categories: supervised and unsupervised learning. This survey paper mainly looks into the methods, techniques and application which helps for researches to refer Machine learning.*

Keywords- Machine learning, Supervised and Unsupervised learning, Reinforcement learning.

I. INTRODUCTION

Machine learning is associate application of computer science (AI) that has systems the flexibility to mechanically learn and improve from expertise while not being expressly programmed. Machine learning focuses on the event of laptop programs that may access information and use it learn for themselves.

The process of learning begins with observations or information, like examples, direct expertise, or instruction, so as to seem for patterns in information and create higher choices within the future based on the examples that we provide. The primary aim is to permit the computers learn automatically while not human intervention or help and alter actions consequently.

II. THE EVOLUTION OF MACHINE LEARNING

The name machine learning was coined in 1959 by Tom M. Mitchell provided a widely quoted, more formal definition of the algorithms studied in the machine learning field: "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. This definition of the tasks in which machine learning is concerned offers a fundamentally operational definition rather than defining the field in cognitive terms.

It is the field of computer gaming and artificial intelligence, coined the term "Machine Learning" in 1959. As a scientific endeavor, machine learning grew out of the quest for artificial intelligence. Already in the early days of AI as an academic discipline, some researchers were interested in having machines learn from data. They attempted to approach the problem with various symbolic methods, as well as what were then termed "neural networks"; these were mostly perceptions and other models that were later found to be reinventions of the generalized linear models of statistics.

Probabilistic reasoning was also employed, especially in automated medical diagnosis.

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However, an increasing emphasis on the logical, knowledge-based approach caused a rift between AI and machine learning. Probabilistic systems were plagued by theoretical and practical problems of data acquisition and representation. By 1980, expert systems had come to dominate AI, and statistics was out of favour. Work on symbolic/knowledge-based learning did continue within AI, leading to inductive logic programming, but the more statistical line of research was now outside the field of AI proper, in pattern recognition and information retrieval. Neural networks research had been abandoned by AI and computer science around the same time. This line, too, was continued outside the AI/CS field, as "connectionism", by researchers from other disciplines including Hopfield, Rumelhart and Hinton. Their main success came in the mid-1980s with the reinvention of back propagation.

Machine learning, reorganized as a separate field, started to flourish in the 1990s. The field changed its goal from achieving artificial intelligence to tackling solvable problems of a practical nature. It shifted focus away from the symbolic approaches it had inherited from AI, and toward methods and models borrowed from statistics and probability theory. It also benefited from the increasing availability of digitized information, and the ability to distribute it via the Internet

III. .MACHINE LEARNING TECHNIQUES

Various Machine Learning techniques are:

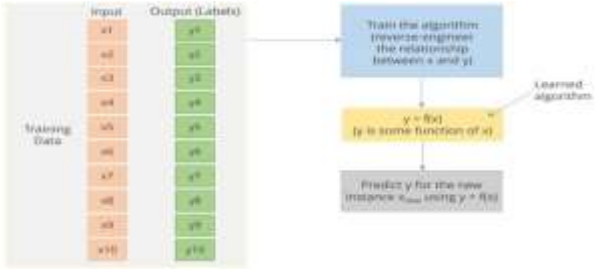
- Supervised Learning,
- Unsupervised Learning,
- Reinforcement Learning.

A. Supervised Learning: Case Study

Amazon uses supervised learning algorithms to predict what items the user may like based on the purchase history of similar classes of users. New Input Predicted Output Algorithm Trained on Historical Data.

Supervised Learning

Supervised Learning is a type of Machine Learning used to learn models from labeled training data. It allows us to predict the output for future or unseen data.
Understanding the Algorithm of Supervised Learning
The image below explains the relationship between input and output data of Supervised Learning.



Supervised Learning Flow

Let's look at the steps of Supervised Learning flow:

- Data Preparation
- Training Step
- Evaluation or Test Step
- Production Deployment

Testing the Algorithm

Given below are the steps for testing the algorithm of Supervised Learning.

1. Once the algorithm is trained, test it with test data (a set of data instances that do not appear in the training set).
2. A well-trained algorithm can predict well for new test data.
3. If the learning is poor, we have an under fit situation. The algorithm will not work well on test data. Retraining may be needed to find a better fit.
4. If learning on training data is too intensive, it may lead to over fitting – a situation where the algorithm is not able to handle new testing data that it has not seen before. The technique to keep data generic is called regularization.

Examples of Supervised Learning

Take a quick look at some examples of Supervised Learning that are given below.

Example 1: Voice Assistants like Apple Siri, Amazon Alexa, Microsoft Cortana, and Google Assistant are trained to understand human speech and intent. Based on human interactions, these chatbots take appropriate action.

Example 2: Gmail filters a new email into Inbox (normal) or Junk folder (Spam) based on past information about what you consider spam.

Example 3: The predictions made by weather apps at a given time are based on some prior knowledge and analysis of how the weather has been over a period of time for a particular place.

Types of Supervised Learning

Given below are 2 types of Supervised Learning.

- Classification
- Regression

Classification Supervised Learning

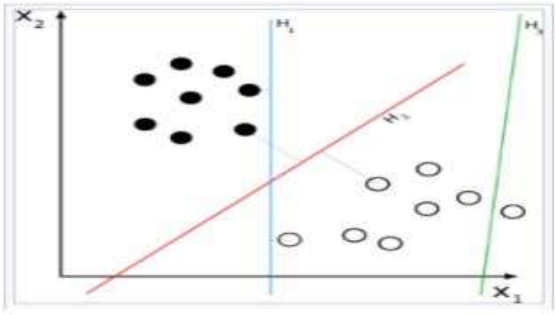
Let us look at the classifications of Supervised learning.

- Answers "What class?"
- Applied when the output has finite and discrete values

Example: Social media sentiment analysis has three potential outcomes, positive, negative, or neutral.

Example: Given the age and salary of consumers, predict whether they will be interested in purchasing a house. You can perform this in your lab environment with the dataset available in the LMS.

Regression Supervised Learning



Given below are some elements of Regression Supervised learning.

Supervised learning.

- Answers "How much?"
- Applied when the output is a continuous number
- A simple regression algorithm: y = wx + b. Example: the relationship between environmental temperature (y) and humidity levels (x)

Example

Given the details of the area a house is located, predict the prices. You can perform this in your lab environment with the dataset available in the LMS.

B. Unsupervised Learning: Case Study

Ever wondered how NASA discovers a new heavenly body and identifies that it is different from a previously known astronomical object? It has no knowledge of these new bodies but classifies them into proper categories.

NASA uses unsupervised learning to create clusters of heavenly bodies, with each cluster containing objects of a similar nature. Unsupervised Learning is a subset of Machine Learning used to extract inferences from datasets that consist of input data without labeled responses.

Types of Unsupervised Learning

The 3 types of Unsupervised Learning are:

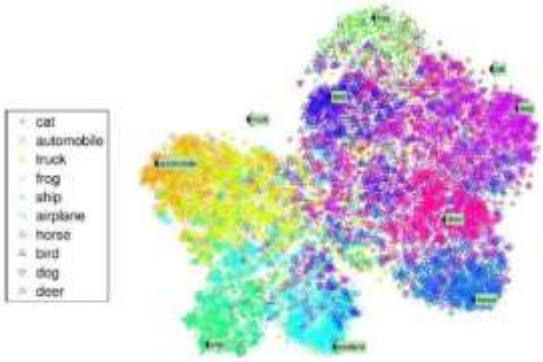
1. Clustering
2. Visualization Algorithms
3. Anomaly Detection

The most common unsupervised learning method is cluster analysis. It is used to find data clusters so that each cluster has the most closely matched data.

Clustering:

Example: An online news portal segments articles into various categories like Business, Technology, Sports, etc. Visualization algorithms are unsupervised learning algorithms that accept unlabeled data and display this data in an intuitive 2D or 3D format. The data is separated into somewhat clear clusters to aid understanding.

In the figure, the animals are rather well separated from vehicles. Horses are close to deer but far from birds, and so on.



Anomaly Detection

This algorithm detects anomalies in data without any prior training. It can detect suspicious credit card transactions and differentiate a criminal from a set of people.

C. Semi-Supervised Learning:

It is a hybrid approach (combination of Supervised and Unsupervised Learning) with some labeled and some non-labeled data.

Example of Semi-Supervised Learning

Google Photos automatically detects the same person in multiple photos from a vacation trip (clustering – unsupervised). One has to just name the person once (supervised), and the name tag gets attached to that person in all the photos.

D. Reinforcement Learning

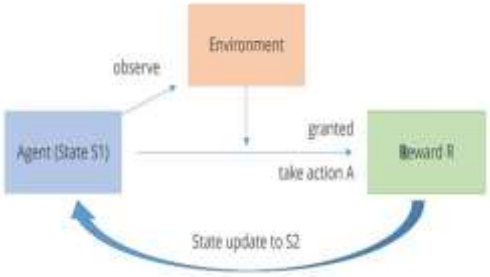
einforcement Learning is a type of Machine Learning that allows the learning system to observe the environment and learn the ideal behaviour based on trying to maximize some notion of cumulative reward.

Features of Reinforcement Learning

Some of the features of Reinforcement Learning are mentioned below.

The learning system (agent) observes the environment, selects and takes certain actions, and gets rewards in return (or penalties in certain cases).

The agent learns the strategy or policy (choice of actions) that maximizes its rewards over time.



Example of Reinforcement Learning

In a manufacturing unit, a robot uses deep reinforcement learning to identify a device from one box and put it in a container. The robot learns this by means of a rewards-based learning system, which incentivizes it for the right action.

IV. IMPORTANT CONSIDERATIONS IN MACHINE LEARNING

Lets us have a quick look at some important considerations in Machine learning below

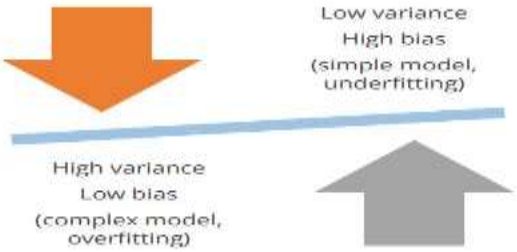
Bias and Variance Tradeoff

Bias refers to the error in the machine learning model due to wrong assumptions. A high-bias model will underfit the training data.

Variance refers to problems caused due to overfitting. This is a result of the over-sensitivity of the model to small variations in the training data. A model with many degrees of freedom (such as a high-degree polynomial model) is likely to have high variance and thus overfit the training data.

Bias and Variance Dependencies

Increasing a model's complexity will reduce its bias and increase its variance.



Images of the cars are given as input for processing. For storing the input images, UFPR-ALPR Dataset is used. The sample image of the input car is shown as follows:

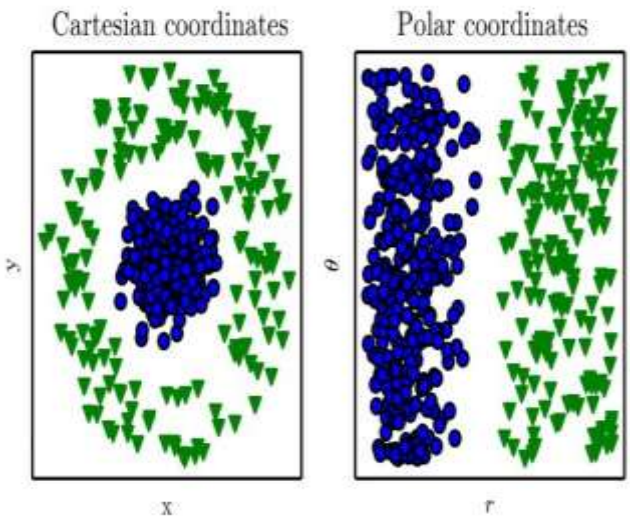
Conversely, reducing a model's complexity will increase its bias and reduce its variance. This is why it is called a tradeoff.

Representation Learning

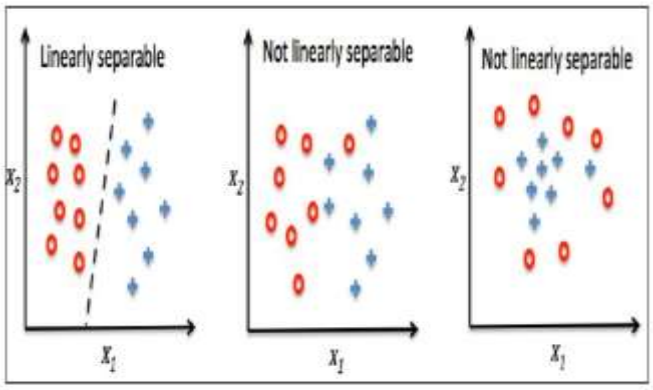
In Machine Learning, Representation refers to the way the data is presented. This often makes a huge difference in understanding.

Example of Representation Learning

The figure shows sample data in Cartesian coordinates and polar coordinates. In this particular case, categorization becomes easier when data is presented in a different coordinate system. Hence, representation matters.



Linearly Separable or Not



If the two classes can't be separated by a linear decision boundary, you can set a maximum number of passes over the training dataset (epochs) and/or a threshold for the number of tolerated misclassifications.

V. OTHER MACHINE LEARNING TECHNIQUES

Let us look at some of the other Machine Learning Techniques below.

Techniques and Working

Probabilistic Models:

Model the probability distribution of a data set and use it to predict future outcomes

Decision Trees:

Arrive at a hierarchical decision tree structure

Clustering:

Classify data based on closest data points appearing in the same cluster

Associated Rules:

A method to discover what items tend to occur together in a sample space

Deep Learning:

Based on Artificial Neural Network models

VI. APPLICATIONS OF MACHINE LEARNING

- Biomedical informatics
- Computer vision
- Customer relationship management
- Data mining
- Email filtering
- Inverted pendulum – balance and equilibrium system.
- Natural language processing (NLP)
- Automatic summarization
- Automatic taxonomy construction
- Pattern recognition
- Recommendation system
- Collaborative filtering
- Content-based filtering
- Hybrid recommender systems (Collaborative and content-based filtering).

VI. MACHINE LEARNING FRAMEWORK AND ALGORITHMS

Proprietary machine learning frameworks

- Amazon Machine Learning
- Microsoft Azure Machine Learning Studio
- DistBelief – replaced by TensorFlow

Open source machine learning frameworks

- Apache Singa
- Caffe
- H2O
- PyTorch
- mlpack
- TensorFlow
- Torch
- CNTK
- Accord.Net

Machine learning libraries

- Deeplearning4j
- Theano
- Scikit-learn

Machine learning algorithms

Types of machine learning algorithms are:
Bootstrap aggregating, CN2 algorithm, Constructing skill trees, Diffusion map, Dominance-based rough set approach, Dynamic time warping, Error-driven learning, Evolutionary multimodal optimization, Expectation–maximization algorithm, Forward–backward algorithm, K-nearest neighbours algorithm, Kernel methods for vector output, Minimum redundancy feature selection, Online machine learning, PVLV, Reinforcement learning, Rule-based machine learning, Structured kNN, Weighted majority algorithm (machine learning) and etc..

VII. CONCLUTION

Due to the advances in technology, a great amount of data has been available and has been widely used in different applications. Thus, machine learning has become a valuable application and used to integrate with all technologies. Indeed, the above techniques, method and applications are used for researchers, to refer the machine learning. In this paper to cover the machine learning techniques, methods, features, applications and algorithms.

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