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Introduction To Machine Learning
Assignment 1

Q1 Compare machine learning vs artificial intelligence

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	Artificial Intelligence		Machine Learning
(i)	Artificial intelligence is a technology which enables a machine to simulate human behaviour.	(i)	Machine learning is a subset of AI which allows a machine to automatically learn from past data without programming explicitly.
(ii)	The goal of AI is to make ~~ture~~ a smart computer system like humans to solve complex problems.	(ii)	The goal of ML is to allow machines to learn from data so that they can give accurate output.
(iii)	In AI, we make intelligent systems perform tasks humanely.	(iii)	In ML, we teach machines with data to perform a particular task and give an accurate result.
(iv)	Machine learning and deep learning are the two main subsets of AI.	(iv)	Deep learning is the main subset of machine learning
(v)	AI has a wide range of scope.	(v)	ML has a limited scope
(vi)	AI is working to create an intelligent system which can perform various complex tasks.	(vi)	ML is working to create machines that can perform only the tasks it has been trained for.
(vii)	AI is concerned with maximizing the chances of success.	(vii)	ML is mainly concerned with accuracy and precision

	Artificial Intelligence		Machine Learning
(viii)	AI can be categorized into 3 types which are Weak AI, General AI, and Strong AI.	(viii)	ML can be categorized into 3 types which are supervised learning, unsupervised learning, reinforcement learning
(ix)	It includes learning, reasoning, and self-correction.	(ix)	It includes learning and self-correction when introduced with new data.
(x)	AI completely deals with structured, semi-structured, and unstructured data.	(x)	ML deals with structured and semi structured data.
(xi)	The main applications of AI are SIRI, customer support, expert system, online games, robotics, etc.	(xi)	The main applications of ML are Online recommender system, Google search algorithms, Facebook auto friend tagging suggestions, etc

Q2. Explain the parametric and non-parametric machine learning models.

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Parametric Machine Learning Model.

(I) A learning model that summarizes data with a set of parameters of fixed size (independent of the number of training examples) is called a parametric model.

(II) No matter how much data you throw at a parametric model, it won't change its mind about how many parameters it needs.

(III) The algorithm involves 2 steps:

(1) Select a form for the function

(2) Learn the coefficients for the function from the training data.

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(IV) We estimate the parameters of the distribution from the given sample, plug in these estimates to the assumed model and get an estimated distribution, which we then use to make a decision. The method we use to estimate the parameters of a distribution is maximum likelihood estimation.

(V) Benefits

(I) Simpler : These methods are easy to understand and interpret results.

(II) Speed : Parametric models are very fast when it comes to learning

(III) Less Data : They do not require as much training data and can work well even if the data is not perfect.

(VI) Limitations

(I) Constrained : By choosing a functional form, these methods are highly constrained to the specific form.

(II) Limited Complexity : These methods are more suited to simpler problems.

(III) Poor Fit : In practice, the methods are unlikely to match the underlying mapping functions.

(VII) Examples

(VIII) (1) Logistic Regression (2) Linear Discriminant Analysis

(3) Perceptron (4) Naïve Bayes.

Non Parametric Machine Learning Algorithms.

(I) Algorithms that do not make strong assumptions about the form of the mapping function are called non-parametric machine learning algorithms.

(II) Non-parametric methods are good when you have a lot of data and no prior knowledge and when you don't want to worry too much about choosing just the right features.

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(III) Non-parametric methods lean towards additional precision because they try to find the best fit for the data points. This happens at the cost of needing a very huge amount of observations.

(IV) Benefits
(i) Flexibility : Capable of fitting a large number of functional forms
(ii) Power : No assumptions (or weak assumptions) about the underlying functions
(iii) Performance : Can result in higher performance models for prediction

(V) Limitations
(i) More data : Requires a lot more training data to estimate the mapping function
(ii) Slower : A lot slower as they often have far more parameters to train
(iii) Overfitting : More of a risk to overfit the data and it is harder to explain why specific predictions are made

(VI) Examples :
(i) k Nearest Neighbours (ii) Support Vector Machines
(iii) Decision Trees like CART and C4.5

Q3 Explain various data formats that confirm the ML elements.

A Types of Data Formats :
(i) NHWC (ii) NCHW (iii) NCDHW (iv) NDHWC

(I) N : Batch size : it is the number of images passed together as a group for inference
(II) C : Channel : it is the number of data components that make a data

point for the input data. It is 3 for opaque images and 4 for transparent.

(III) H : Height : it is the height / measurement in y axis of the input data.

(IV) W : Width : it is the width / measurement in x axis of the input data.

(V) D : Depth : it is the depth of the input data.

(I) NHWC

NHWC denotes (Batch size, Height, Width, Channel). This means there is a 4D array where the first dimension represents batch size accordingly.

Commonly used data : images

Software : Tensorflow

(II) NCHW

NCHW denotes (Batch size, Channel, Height, Width). This means there is a 4D array where the first dimension represents Batch size.

Commonly used data : images

Software : MKLDNN

(III) NCDHW

NCDHW denotes (Batch size, channel, depth, height, width). This means there is a 5D array where the first dimension represents batch size.

Commonly used data : videos

Software : MKLDNN

(IV) NDHWC

NDHWC denotes (Batch size, Depth, Height, Width, Channel). This means there is a 5D array where the first dimension represents batch size.

Commonly used data : Videos

Software : TensorFlow

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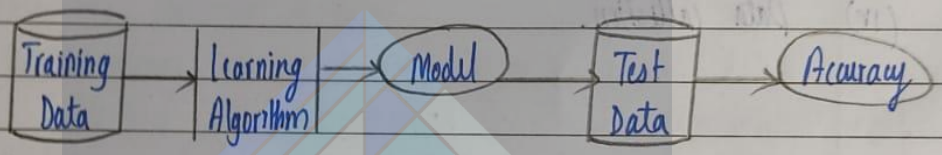
Q4 What is supervised, unsupervised, and semi-supervised learning?

A (I) Supervised Learning

(i) Supervised learning is the machine learning task of inferring a function from supervised training data. The training data consists of a set of training examples.

(ii) The task of the supervised learner is to predict the output behaviour of a system for any set of input values after an initial training phase

(iii) Diagram:



(iv) Training data includes both the input and desired results. For some examples, the correct results are known and given in inputs to the model during the learning process.

(v) The construction of a proper training, validation and test set is crucial. These methods are usually fast and accurate.

Advantages

(i) It performs classification and regression tasks.

(ii) It allows estimation and mapping the result to a new sample

(iii) We have complete control over choosing the number of classes we want in the training data.

Disadvantages

(i) Supervised learning cannot handle all the complex tasks in ML

(ii) Computation time is high

(iii) It requires a labelled dataset.

(iv) It requires a training process.

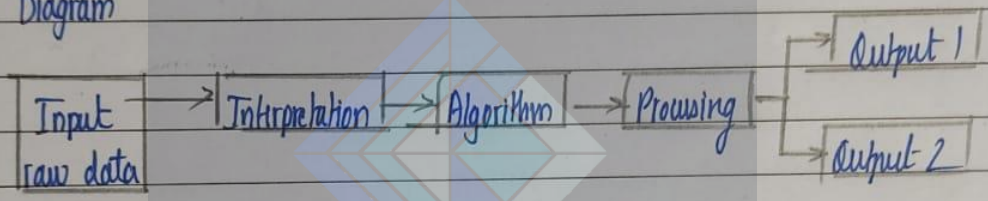
(II) Unsupervised Learning

(i) Unsupervised learning is a type of machine learning where the models are trained using unlabelled dataset and allowed to act on that data without any supervision.

(ii) A dataset is provided without labels and a model learns useful properties of the structure of the dataset. The main goal of unsupervised learning is to discover hidden and intresting patterns in unlabelled data.

(iii) The tasks typically involve grouping similar examples together, dimensionality reduction and density estimation.

(iv) Diagram



Advantages

(i) It does not require a training dataset to be labelled
(ii) Dimensionality reduction is easily accomplished using unsupervised learning
(iii) Capable of finding previously unknown patterns in data.

Disadvantages

(i) Difficult to measure accuracy of or effectiveness due to lack of predefined answers during training
(ii) The results often have less accuracy
(iii) The user needs to spend some time interpreting and labelling the dasses which follow.

(III) Semi-supervised learning

(i) Semi-supervised learning uses both labelled and unlabelled data to improve supervised learning. The goal is to learn a predictor that predicts future test data better.

(ii) Semi-supervised learning is motivated by its practical value in learning faster, better

and cheaper.

(iii) Semi-supervised learning makes use of both labelled and unlabelled data for training, typically a small amount of labelled data with a large amount of unlabelled data.

(iv) When unlabelled data is used in conjuchtion with a small amount of labelled data, it can produce considerable improvement in learning accuracy.

Q5 Explain various Statistical Learning Approaches in Machine Learning

(I) Descriptive Statistical Analysis

(i) It summarizes or Describes the characteristics of a data set.

(ii) It consists of 3 basic categories of measures: measures of central tendency, variability, and frequency distribution

(iii) Descriptive Statistics often depict data using scatterplots, histograms, line graphs, or stem and leaf displays

(II) Inferential Statistical Analysis.

(i) It involves drawing conclusions about populations by examining samples.

(ii) It allows us to make inferences about the entire set, including specific examples within it, based on information obtained from a subset of examples.

(iii) These inferences rely on the principles of evidence and utilize sample statistics as a basis for drawing broader conclusions

(III) Predictive Analysis

(i) It uses statistics and modern techniques to determine future performance

(ii) Predictive models help make weather forecasts, develop video games, translate voice-to-text messages, customer service decisions, etc

(iii) Types of predictive models include decision trees, regression, and neural networks.

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(IV) Prescriptive Analysis

(i) It is a form of data analysis that tries to answer "Why do we need to achieve this ?"

(ii) Prescriptive analysis works with predictive analytics which use data to determine near-term outcomes.

Other types

(i) Associative statistical analysis

(ii) Exploratory data analysis

(iii) Causal analysis

(iv) Data collection