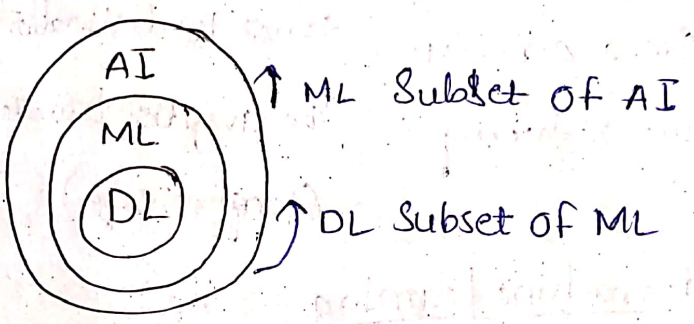
Mid-1 Assignment Questions

(1) a) Define Machine Learning. Explain in detail about Machine Learning types

→ A field of study that gives computers a capability to learn without being explicitly programmed.

→ Machine adapts to the user based on data

Eg :- amazon Shopping



→ Well Posed learning Problems : (learning through experience)

→ An agent Solves a problem or Task (T) performance (P) and gain some experience (E)

→ If P is measured at T, it can improve 'E'

(learning by experience)

→ Eg :- 1) playing checkers Problem

2) Hand written recognition Problem

3) Role driving learning Problem

Problem	Task(T)	Performance(P)	experience(E)
1	Playing against opponents to win	makes Perfect moves to win game	It Plays itself to improve.
2	Handwriting recognition learning classifying the unique of text	Better classification	A data base of homework text
3	Drive a car in 4 lane highway	Source to destination the avg dist travelled (long & safe)	Images, vehicles on road.

* Types of machine learning

Several different types of machine learning power the many different digital goods and services we use every day. To help you get a better idea of how these types differ from one another, here's an overview of the four different types of machine learning Primarily in used today

1) Supervised machine learning

In Supervised machine learning, algorithms are trained on labeled data sets that include tags describing each piece of data. In other words,

the algorithms are fed data that includes an "answer key" describing how the data should be interpreted.

for example, an algorithm may be fed images of flowers that include tags for each flower type so that it will be able to identify the flower better again when fed a new photograph

→ Supervised machine learning is often used to create machine learning models used for prediction and classification Purposes

2) Unsupervised machine learning

Unsupervised ML uses unlabeled data sets to train algorithms. In this process, the algorithm is fed data that doesn't include tags, which requires it to uncover patterns on its own without any outside guidance. for instance, an algorithm may be fed a large amount of unlabeled user data culled from a social media site in order to identify behavioral trends on the platform.

→ Unsupervised ML is often used by researchers and data scientists to identify Patterns within large, unlabeled data sets quickly and efficiently.

3) Reinforcement learning

Reinforcement learning uses trail and error to train algorithms and create models. During the training process, algorithms operate in specific environments and then are provided with feedback following each outcomes.

→ Reinforcement learning is often used to create algorithms that must effectively make sequences or decisions or actions to achieve their aims, such as playing a game or summarizing an entire text.

(b) Explain briefly about the benefits of Machine learning

Machine learning is already transforming much of our world for the better. Today, the method is used to construct models capable of identifying cancer growths in medical scans, detecting fraudulent transactions, and even helping people learn languages. But, as with any new society-transforming technology, there are also potential dangers to know about

Benefits

→ Decreased operational costs: AI and machine learning may help businesses to automate some of its jobs, causing overall operational costs to decrease.

→ Improved operational efficiency and accuracy: Machine learning models are able to perform certain narrow tasks with extreme efficiency and accuracy, ensuring that some tasks are completed to a high degree in a timely manner

→ improved insights :- Machine learning has the potential to quickly identify trends and patterns in large amounts of data that would be time consuming for humans. These insights can equip businesses, researches and society as a whole with new knowledge that has the potential to help them achieve their overall goals.

(2) Describe issues in Machine Learning

Machine learning has undoubtedly transformed industries by enabling data driven decision-making. However, it's crucial to acknowledge the practical challenges that professionals face while honing ML skills and developing applications from scratch.

1. Inadequate Training data

The backbone of any ML algorithm is the data it is trained on. The challenge arises when there is a shortage of both quality and quantity in the training dataset.

Noisy, incorrect, or unclean data can significantly impact the effectiveness of ML algorithms.

2) Poor quality of Data

Data quality is a recurring issue, with noisy, incomplete and inaccurate data undermining the accuracy of classification and overall results. Achieving high-quality data is essential for the success of ML models, necessitating a meticulous approach to data Preparation

3) Non-representative Training data

The representativeness of training data directly influences the generalization capability of ML models. Using representative data in training mitigates biases and enhances prediction accuracy.

4) Overfitting and Underfitting

Overfitting occurs when a model captures noise and inaccuracies from a large dataset, adversely affecting its performance. This can be mitigated by employing linear and parametric algorithms, increasing training data or reducing model complexity.

→ Underfitting arises from a model being too simple for the data, resulting in incomplete and

inaccurate Predictions

5) Monitoring and Maintenance

Regular monitoring and maintenance are essential to ensure the continued effectiveness of ML models. changes in data or user expectations may necessitate code adjustments and resource updates, emphasizing the need for ongoing vigilance.

⑥ Getting Bad Recommendations

ML models operating in a specific content may Provide outdated or irrelevant recommendations, known as data drift. Regularly updating and monitoring data helps mitigate this issue, ensuring recommendations align with current user expectation

⑦ Lack of Skilled Resources

The shortage of skilled Professionals with in-depth knowledge of mathematics, Science, and technology Poses a challenge in the ML industry.

⑧ Customer Segmentation

Accurate Customer Segmentation is Crucial for effective ML algorithms. Developing algorithms that recognize customer behavior and trigger relevant recommendations based on Past experiences is

essential for personalized User interactions

9) Process Complexity of Machine learning

The complexity of the ML Process, marked by Experimental phases and continuous changes, Presents a challenges for engineers and data Scientists

10) Data Bias

Data bias introduces errors when certain elements in the dataset are given disproportionate weight. Detecting and mitigating bias requires careful examination of the dataset, regular analysis, and implementing strategies to ensure data diversity.

(3) Explain about well-posed learning problems with Examples

⇒ Well posed Learning Problem :- (Learning through experience)

→ An agent Solves a problem or Task(T) performance(P) and gain Some experience(E)

→ If P is measured at T, it can improve (E) (learning by experience)

→ Eg :- 1) Playing Chekers Problem

2) Hand written recognition Problem

3) Robot driving learning

Problem	Task (T)	Perf (P)	expl (E)
1.	Playing against opponents to units	makes Perfect moves to win game	It plays itself to improve

2) Handwriting recognition learning

Task :- classifying the images & text

Performance (P) :- Better classification

Experience (E) :- A data base of homework text

3) Robot driving learning Problem

Task (T) :- Drive a car in 21 lane highway

Performance (P) :- Source to distination the average distance travelled (long & Safe)

Experience (E) :- Image, vehicles on road.

④ Define hypothesis. Explain different types of hypothesi with examples in Machine Learning.

⇒ Hypothesis

A hypothesis is a conjecture or Proposed explanation that is based on insufficient facts or assumptions. It is only a conjecture based on certain known facts that have yet to be confirmed.

→ Defining hypothesis in Machine Learning

In machine learning, a hypothesis is a mathematical

function or model that converts input data into output Predictions. The model's first belief or explanation is based on the facts supplied. the hypothesis is typically expressed as a collection of Parameters characterizing the behavior of the model.

Types of Hypotheses in Machine learning

The next step is to build a hypothesis after identifying the problem and obtaining evidence. A hypothesis is an explanation or Solution to a problem based on insufficient data. It acts as a Springboard for further investigation and experimentation.

1) Null Hypothesis

A Null hypothesis is a basic hypothesis that States that no link Exists between the independent and dependent variables. In other words, it assumes the independent variable has no influence on the dependent variable. If the null hypothesis is correct, the coefficient of determination is the probability of rejecting it. A null hypothesis is involved in test findings Such as t-tests and ANOVA

2) Alternative Hypothesis

An alternative hypothesis is a hypothesis that contradicts the null hypothesis. It assumes

that there is a relationship between the independent and dependent variables. In other words, it assumes that there is an effect of the independent variable on the dependent variable. An alternative hypothesis is generally accepted if the p-value is less than the significance level (α). An alternative hypothesis is also known as a research hypothesis.

3) One-tailed Hypothesis

A One-tailed test is a type of significance test in which the region of rejection is located at one end of the sample distribution. It denotes that the estimated test parameter is more or less than the critical value, implying that the alternative hypothesis rather than the null hypothesis should be accepted.

4) Two-tailed Hypothesis

The two-tailed test is a hypothesis test in which the region of rejection or critical area is on both ends of the normal distribution. It determines whether the sample tested falls within or outside a certain range of values, and an alternative hypothesis is accepted if the calculated value falls in either of the two tails of the probability distribution.

(5) a) Illustrate the find-S algorithm with an example.

→ What is the find-S algorithm in machine learning

The S algorithm, also known as the find-S algorithm is a machine learning algorithm that seeks to find a maximally specific hypothesis based on labeled training data. It starts with the most specific hypothesis and generalizes it by incorporating positive examples.

→ Symbols used in find-S algorithm

- ϕ (Empty Set) - This symbol represents the absence of any specific value or attribute.
- ? (Don't Care) :- The question mark symbol represents a "don't care" or "unknown" value for an attribute.
- Positive Examples (+) - The plus symbol represents positive examples, which are instances labeled as the target class or concept being learned.
- Negative Examples (-)

The minus symbol represents negative examples, which are instances labeled as non-target classes or concepts that should not be covered by the hypothesis.

- Hypothesis (h)

The variable h represents the hypothesis, which is the learned concept or generalization based on the training data.

examples

Origin	Manufacturer	color	year	type	Class
japan	Honda	blue	1980	eco	Yes
japan	Toyato	green	1970	sport	No
japan	Toyato	blue	1990	eco	Yes
USA	Audi	red	1980	eco	NO
japan	Honda	white	1980	eco	Yes
japan	Toyato	green	1980	eco	Yes
japan	Honda	red	1980	eco	NO

initialize 'h'

→ $h_0 = \langle \phi, \phi, \phi, \phi, \phi \rangle$

→ $h_1 = \langle$ JP, HO, blue, 1980, eco $\rangle$

→ $h_2 = h_1$

→ $h_3 = \langle$ JP, ?, blue, ?, eco $\rangle$

→ $h_4 = h_3$

→ $h_5 = \langle$ JP, ?, ?, ?, eco $\rangle$

→ $h_6 = \langle$ JP, ?, ?, ?, eco $\rangle$

5) b) write a program to implement the find-S algorithm

Example

Animal	Has fur	Makes Sound	Label
Dog	Yes	Yes	Dog
Cat	Yes	NO	Cat
Dog	NO	Yes	Dog
Cat	NO	NO	Cat
Dog		Yes	Dog

Program

```
training_data = [
    (['Yes','Yes'],'Dog'),
    (['Yes','No'],'Cat'),
    (['No','Yes'],'Dog'),
    (['No','No'],'Cat'),
    (['Yes','Yes'],'Dog')
]

for example, label in training_data:
    if label == 'Dog':
        for i in range(len(example)):
            if h[i] == 'ϕ':
                h[i] = example[i]
            elif h[i] != example[i]:
                h[i] = '?'

Print("final hypothesis:", h)
```

Output :- final hypothesis : ['?','Yes']

(6) a) What do you understand by Concept learning?

Concept learning, as a broader term, includes both case-based and instance-based learning.

At its core, concept learning involves the extraction of general rules or patterns from specific instances to make predictions on new, unseen data.

The ultimate goal is for the machine to grasp abstract concepts and apply them in diverse contexts

Concept learning in machine learning is not confined to a single pattern; it spans various approaches, including rule-based learning, neural networks, decision trees, and more. The choice of approach depends on the nature of the problem and the characteristics of the data

→ The process of concept learning in machine learning involves iteractive refinement. The model learns from examples, refines its understanding of the underlying concepts, and continually updates its knowledge as it encounters new instances.

→ learning may be characterized as "the problem of exploring through a preset space of candidate hypotheses for the theory that best matches the training instances" in terms of machine learning, according to TOM Michell.

6(b) Define Reinforcement Learning

Reinforcement Learning (RL) is the science of decision making. It is about learning the optimal behavior in an environment to obtain ~~behavior~~ ~~in~~ maximum reward In RL, the data is accumulated ~~from~~ machine

learning systems that use a trial-and-error method. Data is not part of the input that we would feed in supervised or unsupervised machine learning.

Reinforcement learning

→ Reinforcement learning is all about making decisions sequentially. In simple words, we can say that the output depends on the state of the current input and the next input depends on the output of the previous input

→ In reinforcement learning decision is dependent, so we give labels to sequences of dependent decisions.

Ex :- chess game, text Summarization

Types

There are two types of Reinforcement

1 :- Positive :- Positive Reinforcement is defined as when an event, occurs, due to a particular behavior, increases the strength and the frequency of the behavior.

2 :- Negative :- Negative Reinforcement is defined as strengthening of behavior because a negative condition is stopped or avoided.

Advantages of reinforcement learning :-

→ Increases Behavior

→ Provide defiance to a minimum Standard of Performance

→ If only provides enough to meet up the minimum behavior

(7) Which disciplines have their influence on machine learning? Explain with examples.

Due to its generality, the field is studied in many other disciplines, such as game theory, control theory, operations research, information theory, simulation-based optimization, multi-agent systems, swarm intelligence, statistics and genetic algorithms

(8) a) Demonstrate the Designing of a Learning System in ML.

In simple words, when we feed the training data to machine learning Algorithm, this algorithm will produce a mathematical model and with the help of the mathematical model, the machine will make a Prediction and take a decision without being Explicitly Programmed.

Training Data → Machine learning Algorithm → Building Logical mathematical model → Output

Example :- In Driverless Car, the training data is fed to Algorithm like how to Drive Car in highway, Busy and Narrow Street with factors like Speed limit, parking, stop at Signal etc.

Steps for Designing Learning System are

Choosing Training Experience

↓

Choosing Target function

↓

Choosing Representation of Target function

↓

choosing function approximation

↓

final Design

Step 1) choosing the Training

The very important and first task is to choose the training data or training Experience which will be fed to the machine Learning Algorithm. It is important to note that the data or experience that we fed to the algorithm must have a Significant impact on the Success or failure of the Model.

Step 2 :- choosing target function :

The next important Step is choosing the target function it means according to the knowledge fed to the algorithm the machine learning will choose NextMove function which will describe what type of legal moves should be taken. for example : While playing chess with the opponent, when opponent will play then the machine learning algorithm will decide what be the number of possible legal moves taken in order to get Success

Step 3 :- Choosing Representation for target function

When the machine algorithm will know all the possible legal moves the next step is to choose the optimized move using any representation i.e using linear Equations, Hierarchical Graph Representation, Tabular form etc. The NextMove function will move the target move like out of these move which will provide more Success rate.

Step 4) :- choosing function Approximation Algorithm

An optimized move cannot be chosen just with the training data. The training data had to go through with set of Example and through these Examples the training data will approximates

which steps are chosen and after that machine will Provide feedback on it.

→ for example: when a training data of playing chess is fed to algorithm so at that time it is not machine algorithm will fail or get success and again from that failure or success it will measure while next move what step should be chosen and what is its success rate.

Step 5 :- final Design

The final design is created at last when system goes from number of examples, failures and success, correct and incorrect decision and what will be the next step etc.

(8) b) Explain the version space with examples

Hypothesis space can be partially ordered using the specialization relation:

h_2 is more specific than h_1 if $h_1(a) \rightarrow h_2(a)$ for all individuals A.

→ The version space is the subspace of the hypothesis space which is consistent with the training examples

→ The general boundary G of a version space is the set of maximally general members of the version space

→ The specific boundary S of a version space is the set of maximally specific members of the version space.

General and specific boundary completely determine the version space

Example

0 $G_0 = \{T\}$

$S_0 = \{F\}$

1 $G_1 = \{T\}$

$S_1 = \{\text{crime} \wedge \text{academic} \wedge \text{local} \wedge \text{music}\}$

2 $G_2 = \{T\}$

$S_2 = \{\text{crime} \wedge \text{academic} \wedge \text{local}\}$

3 $G_3 = \{\text{crime}, \neg \text{academic}\}$

$S_3 = \{\text{crime} \wedge \text{academic} \wedge \text{local}\}$

4 $G_4 = \{\text{crime}, \text{academic} \wedge \text{local}\}$

$S_4 = \{\text{crime} \wedge \text{academic} \wedge \text{local}\}$

5 $G_5 = \{\text{crime}\}$

$S_5 = \{\text{crime} \wedge \text{local}\}$

9) Illustrate the Candidate Elimination Algorithm.

Let $G = \{T\}$ and $S = \{F\}$

for Each Example e:

- If e is a positive Example:

- Remove the elements of G from G which classify e as negative
- Remove each element of S that classifies e as negative and replace it by the minimal generalizations of S that classify e positive and are less general or equal to some member of G
- Nonmaximal hypotheses are removed from S

• if e is a negative example:

- Remove the elements of S from S which classify e as positive
- Remove each element g of G that classify e as positive and replace it by the minimal specializations of g that classify e as negative and are more general or equal to some member of S
- Nonminimal hypotheses are removed from G

(10) a) what are various issues of Machine learning? Explain

↳ 2 question also same

(10)(b) Explain remarks on version space and candidate elimination algorithm.

The version space learned by the candidate elimination algorithm will converge toward the hypothesis that

correctly describes the target concept, provided

1) there are no errors in the training examples

2) there is some hypothesis in H that correctly describes the target concept.

In fact, as new training examples are observed, the version space can be monitored to determine the remaining ambiguity regarding the true concept and to determine when sufficient training examples have been observed to unambiguously identify the target concept

The target concept is exactly learned when the S and G boundary sets converge to a single identical, hypothesis

11) a) Define Inductive Bias

Inductive bias is the set of assumptions that a machine learning algorithm makes about the relationship between input variables and output variables based on the training data. In other words, It is the prior knowledge or beliefs that the algorithm uses to generalize from the training data to new, unseen data.

Inductive bias is necessary in machine learning because it allows the algorithm to make predictions on

new data based on what it learned from the training data. without any prior knowledge, the algorithm would have to start from scratch every time it encountered new data, making it much less efficient and accurate

Types of Inductive Bias

There are two main types of inductive bias in machine learning : restrictive bias and Prefercutial bias.

⇒ Restrictive Bias

Restrictive bias refers to the assumptions that limit the set of functions that the algorithm can learn. for Example, a linear regression model assumes that the relationship between the input variables and the output variable is linear. This means that the model can only learn linear functions, and any non-linear relationships between the variables will not be Captured

⇒ Preferential Bias

Preferential bias refers to the assumptions that make some functions more likely to be learned than others. for Examples, a neural network with a large number of hidden layers and parameters has a preferential bias towards complex,

non-linear functions. This means that the algorithm is more likely to learn Complex functions than Simple ones.

Importance of Inductive Bias

Inductive bias is important because it affects the generalization Performance of the machine learning algorithm. A machine learning algorithm with a good inductive bias will be able to generalize well to new, unseen data, while an algorithm with a bad inductive bias may overfit to the training data and Perform Poorly on new data.

11) b) List the advantages of converting decision trees to rules before pruning.

A decision tree is a decision support hierarchical model that uses a tree-like model of decisions and their Possible consequences, including chance event outcomes, resource costs, and utility.

Decision rules

The decision tree can be linearized into decision rules, where the outcome is the contents of the leaf node, and the conditions along the Path form a conjunction in the if clause. In general, the rules

have the form;

"if condition1 and condition2 and condition3 then outcome.

Decision rules can be generated by constructing association rules with the target variable on the right. They can also denote temporal or causual relations

Advantages

Among decision support tools, decision trees have several advantages

→ decision trees are simple to understand and interpret. people are able to understand decision tree models after a brief explanation.

→ Have value even with little hard data. Important insights can be generated based on experts describing a situation

→ Help determine worst, best and expected values for different scenarios

→ use a white box model. If a given result is provided by a model

→ Can be combined with other decision techniques

→ The actions of more than one decision-maker can be considered.

(12) How is the Candidate Elimination algorithm different from find-S algorithm? Discuss

* find-S algorithm

→ find-S algorithm starts from the most specific hypothesis and generalize it by considering only Positive examples.

→ find-S algorithm ignores negative examples

→ As long as the hypothesis Space contains a hypothesis that describes the true target concept, and the training data contains no errors, ignoring negative Example does not cause to any problem

→ find-S algorithm finds the most specific hypothesis with H that is consistent with the positive training Examples

→ The final hypothesis will also be consistent with negative examples if the correct target concept is in H, and the training examples are correct

* Candidate - Elimination Algorithm

→ find-S outputs a hypothesis from H, that is consistent with the training examples,

→ This is just one of many hypotheses from H that might fit the training data Equally well.

→ The key idea in the Candidate-elimination algorithm is to output a description of the set of all hypotheses consistent with the training examples.

→ Candidate-elimination algorithm computes the description of this set without explicitly enumerating all of its members.

→ This is accomplished by using the more-general than Partial Ordering and maintaining a compact representation of the set of consistent hypotheses.

13) a) Explain the two uses of features in machine learning

In machine learning and pattern recognition, a feature is an individual measurable property or characteristic of a phenomenon. Choosing informative, discriminating and independent features is a crucial element of effective algorithms in pattern recognition, classification and regression.

<u>feature types</u>

In feature Engineering, two types of features are commonly used

i) numerical
ii) categorical

i) <u>numerical</u>

Numerical features are continuous values that

can be measured on a scale. Examples of numerical features include age, height, weight, and income. Numerical features can be used in machine learning algorithm directly

ii) Categorical features

These are discrete values that can be grouped into categories. examples of Categorical features include gender, color and zip code. Categorical features typically need to be converted to numerical features before they can be used in machine learning algorithms.

13)b) Discuss about decision tree representation, in detail.

Decision trees is one of the most widely used Classification Algorithm

features of decision Tree Learning

Method for approximating discrete-valued functions (including boolean)

Learned functions are represented as decision trees (or if-then-else rules)

Expressive hypotheses Space, including disjunction

The decision tree is robust to noisy data

→ Representation of decision tree

→ Decision trees classify instances by sorting them down the tree from the root to some leaf node, which provides the classification of the instance.

Each node in the tree specifies a test of some attribute of the instance, and each branch descending from that node corresponds to one of the possible values for this attribute.

→ An instance is classified by starting at the root node of the tree, testing the attribute specified by this node, then moving down the tree branch corresponding to the value of the attribute in the given example. This process is then repeated for the subtree rooted at the new node.

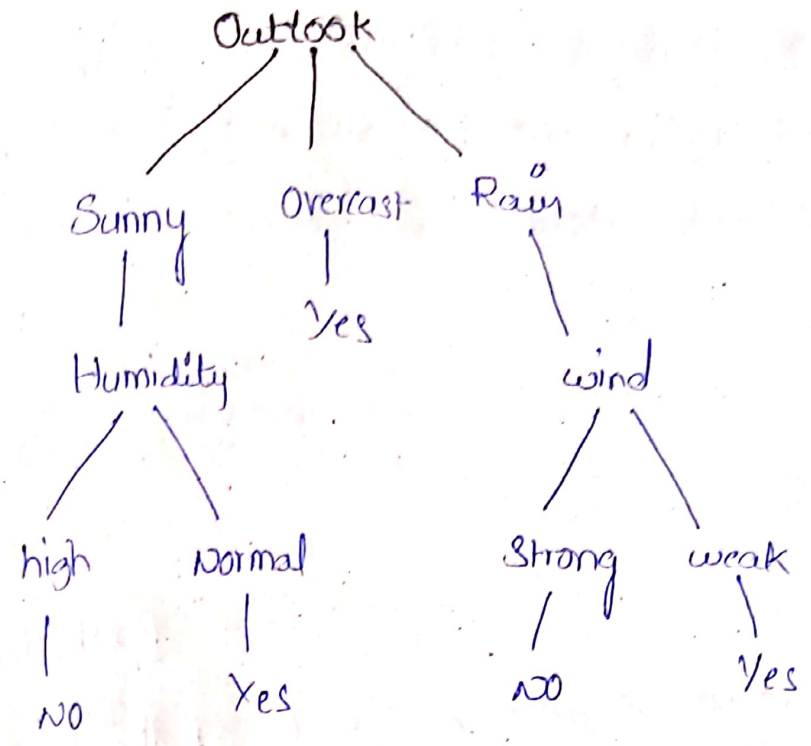
In general, decision trees represent a disjunction of conjunctions of constraints on the attribute values of instances

Each path from the tree to a leaf corresponds to a conjunction of attribute tests, and the tree itself to a disjunction of these conjunctions

Ex

Day	Outlook	Temp	Humidity	wind	playTennis
1	Sunny	hot	high	weak	NO
2	Sunny	hot	high	Strong	NO
3	Overcast	hot	high	weak	Yes
4	Rain	mild	high	weak	Yes
5	Rain	Cool	Normal	weak	Yes

decision tree for the above data set-



(14) What is a decision tree? explain how it works for classification Problems?

A decision tree is a simple representating for classifying examples. It's a form of Supervised machine learning where we continuously split the data according to a certain Parameter.

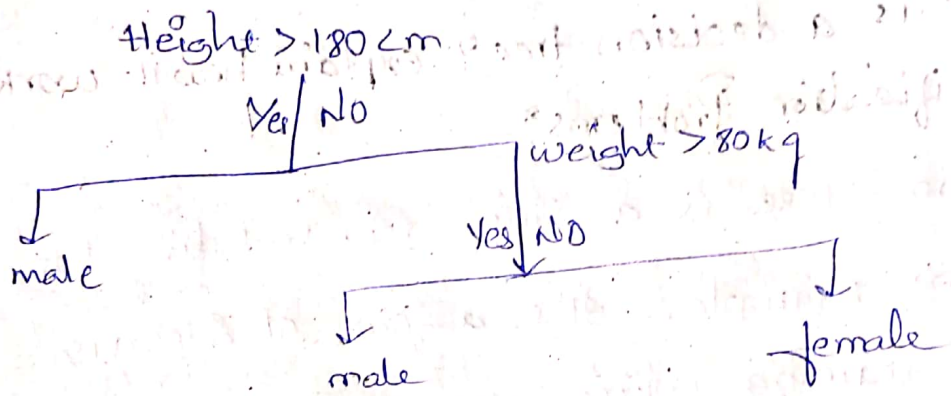
Components OF Decision tree Classification

- Nodes : test for the values of a certain attribute
- Edges/Branch: correspond to the Outcome of a test and connect to the next node or leaf.
- leaf nodes : terminal nodes that Predict the Outcome and represent class labels or class distribution.

1.) Classification trees

What we've seen above is an example of a classification tree where the outcome was a variable like "fit" or "unfit". Here the decision variable is categorical / discrete

We build this kind of tree through a process known as binary recursive Partitioning. This iterative process means we split the data into partitions and then split it up further on each of the branches.



Advantages of Classification with Decision trees

→ Inexpensive to construct
→ extremely fast at classifying unknown records
→ Easy to interpret for small sized trees
→ Their accuracy is comparable to other classification techniques for many simple data sets
→ Exclude unimportant features

(15) Describe briefly about the K-Nearest Neighbor Algorithm.

→ K-Nearest Neighbour is one of the simplest Machine learning algorithms based on Supervised learning technique

→ K-NN algorithm assumes the similarity between the new case/data and available cases and put the new case into the category that is most similar to the available Categories.

→ K-NN is a non-parametric algorithm, which means it does not make any assumption on underlying data.

Eg :- Suppose we have an image of a creature that looks similar to cat and dog, but we want to know either it is a cat or dog. So for this identification, we can use the KNN algorithm, as it works on a similarity measure. Our KNN model will find the similar features of the new data set to the cats and dogs' images and based on the most similar features it will put it in either cat or dog category

The K-NN working can be explained on the basis of the below algorithm:

Step 1 :- Select the number K of the neighbors

Step 2 :- Calculate the Euclidean distance of

k number of neighbors

Step 3 :- Take the k nearest neighbors as per the calculated euclidean distance

Step 4 :- Among these k neighbors, count the number of the data points in each category

Step 5 :- Assign the new data points to that category for which the number of the neighbor is maximum

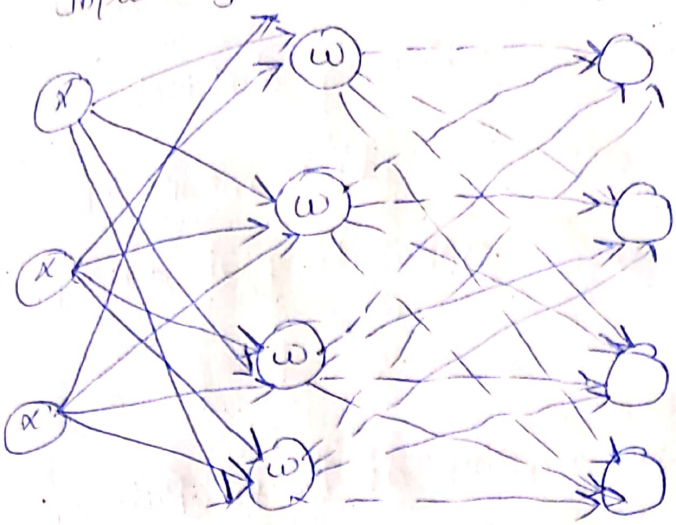
Step 6 :- Our model is ready

(16) Illustrate the working of Back-propagation algorithm in multilayered Neural Network.

Backpropagation is the essence of neural network training. It is the method of fine-tuning the weights of a neural network based on the error rate obtained in the previous epoch. proper tuning of the weights allows you to reduce error rates and make the model reliable by increasing its generalization

How Backpropagation Algorithm works

The Back propagation algorithm in neural network computes the gradient of the loss function for a single weight by the chain rule. It efficiently computes one layer at a time, unlike a native direct computation. It computes the gradient, but it does not define how the gradient is used.



1) Inputs X, arrive through the preconnected path
2) Input is modeled using real weights W. The weights are usually randomly selected
3) Calculate the output for every neuron from the input layer, to the hidden layers, to the output layer
4) Calculate the error in the Outputs
5) Travel back from the outputs layer to the hidden layer, to adjust the weights such that the error is decreased.

(17) Illustrate Naive Bayes classifier of Bayesian learning

→ Naive Bayes algorithm is a supervised learning algorithm, which is based on Bayes theorem and used for solving classification problems.

→ It is mainly used in text classification that includes a high-dimensional training dataset

→ It is a probabilistic classifier, which means it Predicti on the basis of the probability of an objec

Bayes' Theorem

→ Bayes theorem is also known as Bayes Rule or Bayes law which is used to determine the probability of a hypothesis with prior knowledge, It depends on the conditional Probability

→ The formula for Bayes theorem is given as

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

- P(A|B) is posterior probability ; probability of hypothesis A on the observed event B
- P(B|A) is likelihood probability ; probability of the evidence given that the probability of a hypothesis is true.
- P(A) is prior probability ; probability of hypothesis before observing the evidence
- P(B) is marginal Probability ; Probability of evidence

working

1) Convert the given dataset into frequency tables
2) Generati likelihood table by finding the Probabilities of given features
3) Now, use Bayes theorem to Calculate the posterior Probability

(18) Describe Artificial Neural Networks (ANN) and its applications

Artificial Neural Networks contain artificial neurons which are called units. These units are arranged in a series of layers that together constitute the whole Artificial Neural Network in a System.

→ A layer can have only a dozen units or millions of units as this depends on how the complex neural networks will be required to learn the hidden pattern in the dataset.

→ Commonly, Artificial Neural Network has an input layer, an Output layer as well as hidden layers. The input layer receives data from the outside world which the neural network needs to analyze or learn about.

Types of Artificial Neural Networks

→ feedforward Neural Network
→ Convolutional Neural Network
→ modular Neural Network
→ Radial basis function Neural Network
→ Recurrent Neural Network

Applications

1) Social media :-

Artificial Neural Networks are used heavily in Social media. for example facebook that suggests People that you might know in real life. So that you can Send them friend requests.

2) Marketing and Sales

When you log onto E-commerce sites like Amazon and flipkart, they will recommend your products to buy based on your previous browsing history. Similarly zomato, swiggy etc

3) Healthcare

Artificial Neural Networks are used in Oncology to train algorithms that can identify Cancerous tissue at the microscopic level at the same accuracy as trained physicians.

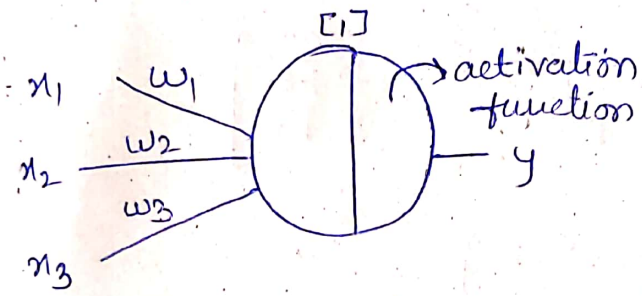
4) Personal Assistants..

I am sure you all have heard of Siri, Alexa, Cortana etc and also these are personal assistants and an example of speech recognition that uses Natural Language Processing to interact with the users and formulate a response accordingly.

(19) Explain about Neural Network Representation

Neural networks mimic the basic functioning of the human brain and are inspired by how the human brain interprets information.

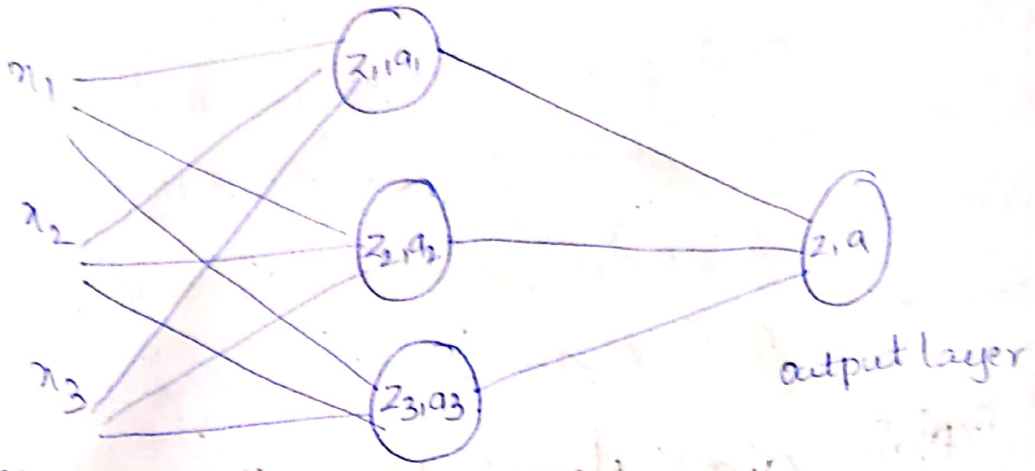
One-layer Neural Network architecture



Here $[x_1, x_2, x_3]$ are the input features to the neural networks represented as x. whereas the Superscripti is used to denote by $[w_1, w_2, w_3]$ associated with each connection to the neuron from the input of that particular layer

$$z = \begin{bmatrix} w_1 \\ w_2 \\ w_3 \end{bmatrix}^T \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + b$$

Two layer Neural Network Architecture



This architecture has three input features namely $[x_1, x_2, x_3]$. These features are sent to a hidden layer

vectorization of two layer Neural Network Architecture

$$\begin{bmatrix} z_1 \\ z_2 \\ z_3 \end{bmatrix} = z = \begin{bmatrix} -w_1^{[1]} \\ -w_2 \\ -w_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix}$$

$$\begin{bmatrix} w_{11} & w_{12} & w_{13} \\ w_{21} & w_{22} & w_{23} \\ w_{31} & w_{32} & w_{33} \end{bmatrix}$$

(20) what are remarks on the back-propagation algorithm in ANN

Backpropagation is the essence of neural net training. It is the practice of fine-tuning the weights of a neural net based on the error rate obtained in the

Previous epoch · proper tuning of the weights ensures lower error rates, making the model reliable by increasing its generalization.

remarks or limitations

→ Training data can impact the performance of the model. So high quality data is essential

→ Noisy data can also affect backpropagation, Potentially tainting its results

→ It can take a while to train backpropagation models and get them up to speed

→ Backpropagation requires a matrix-based approach which can lead to other issues.