

**COMPUTER ENGINEERING DEPARTMENT**

**ASSIGNMENT NO-01**

**SUB: Machine Learning**

**COURSE: T.E.**

**Year: 2020-2021**

**Semester: VI**

**DEPT: Computer Engineering**

**SUBJECT CODE: CSDLO6021**

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**Roll No.: 50**

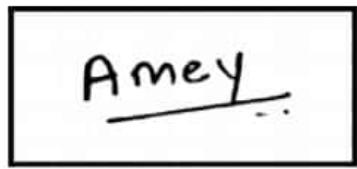
**Class: TE Comps B-50**

**ID: TU3F1819127**

**Assignment No 1**

<b>Sr. No.</b>	<b>Question</b>	<b>CO mapping</b>
<b>1</b>	What are the issues in machine learning?	C01
<b>2</b>	What are the applications of machine learning?	C01
<b>3</b>	What is machine learning? Explain types of machine learning.	C01
<b>4</b>	What is ANN? Explain the architecture of ANN.	C02
<b>5</b>	Implement NOR gate using McCulloch-Pitts Model.	C02

6	<p>Use the method of least squares regression to predict the final exam grade of a student who received 84 of the midterm exams.</p> <table border="1" data-bbox="425 406 953 929"> <thead> <tr> <th data-bbox="425 406 710 485">Midterm Exam (X)</th><th data-bbox="710 406 953 485">Final Exam (Y)</th></tr> </thead> <tbody> <tr><td data-bbox="425 485 710 518">72</td><td data-bbox="710 485 953 518">84</td></tr> <tr><td data-bbox="425 518 710 552">50</td><td data-bbox="710 518 953 552">63</td></tr> <tr><td data-bbox="425 552 710 586">81</td><td data-bbox="710 552 953 586">77</td></tr> <tr><td data-bbox="425 586 710 619">74</td><td data-bbox="710 586 953 619">78</td></tr> <tr><td data-bbox="425 619 710 653">94</td><td data-bbox="710 619 953 653">90</td></tr> <tr><td data-bbox="425 653 710 687">86</td><td data-bbox="710 653 953 687">75</td></tr> <tr><td data-bbox="425 687 710 720">59</td><td data-bbox="710 687 953 720">49</td></tr> <tr><td data-bbox="425 720 710 754">83</td><td data-bbox="710 720 953 754">79</td></tr> <tr><td data-bbox="425 754 710 788">65</td><td data-bbox="710 754 953 788">77</td></tr> <tr><td data-bbox="425 788 710 822">33</td><td data-bbox="710 788 953 822">52</td></tr> <tr><td data-bbox="425 822 710 855">88</td><td data-bbox="710 822 953 855">74</td></tr> <tr><td data-bbox="425 855 710 911">81</td><td data-bbox="710 855 953 911">90</td></tr> </tbody> </table>	Midterm Exam (X)	Final Exam (Y)	72	84	50	63	81	77	74	78	94	90	86	75	59	49	83	79	65	77	33	52	88	74	81	90	CO4																																							
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Q1. What are the issues in Machine Learning?

Ans:

Machine learning provides business with the knowledge to make more informed, data - driven decisions that are faster than traditional approaches. But machine learning has its own set of challenges.

- ① In what settings will particular algorithms converge to the desired function, given sufficient training data.
- ② What algorithms exist for learning general target functions from specific training examples.
- ③ Which algorithms perform best for which types of problems and representations.
- ④ How much training data is sufficient.
- ⑤ What is the best way to reduce the learning task to one or more functions approximation problems.
- ⑥ Can prior knowledge be helpful even when it is only approximately correct.
- ⑦ What is the best strategy for choosing a helpful training experience and how does the choice of this strategy alter the complexity of the learning problem.
- ⑧ How can the learner automatically alter its representation to improve its ability to represent and learn the target function.

Q2. What are the applications of Machine Learning?

Ans:

### Applications of Machine Learning

- Machine Learning is a buzzword for today's technology, and it is growing very rapidly day by day.
- We are using machine learning in our daily life even without knowing it such as Google Maps, Google Assistant, Alexa, etc.
- Below are some most trending real-world applications of Machine Learning:

#### ① Image Recognition:

- Image recognition is one of the most common applications of machine learning. It is used to identify objects, persons, places, digital images, etc. The popular use case of image recognition and face detection is, Automatic Friend Tagging Suggestions.
- Facebook provides us a feature of auto friend tagging suggestion. Whenever we upload a photo with our Facebook friends, then we automatically get a tagging suggestion with name, and the technology behind this is machine learning's face detection and recognition algorithm.
- It is based on the Facebook project named "Deep Face", which is responsible for face recognition and person identification in the picture.

## ② Speech Recognition.

- While using Google, we get an option of "Search by voice", it comes under speech recognition, and it's a popular application of machine learning.
- Speech recognition is a process of converting voice instructions into text, and it is also known as "Speech to text", or "Computer Speech recognition". At present, machine learning algorithms are widely used by various applications of speech recognition. Google Assistant, Siri, Cortana, and Alexa are using speech recognition technology to follow the voice instructions.

## ③ Traffic Prediction

- If we want to visit a new place, we take help of Google Maps, which shows us the correct path with the shortest route and predicts the traffic conditions.
- It predicts the traffic conditions such as whether traffic is cleared, slow-moving, or heavily congested with the help of two ways:
  - Real Time Location of the vehicle from Google Map App and Sensors.
  - Average Time has Taken on past days at the same time.
- Everyone who is using Google map is helping this app to make it better. It takes information from the user and sends back to its database to improve the performance.

#### ④ Product Recommendations

- Machine learning is widely used by various e-commerce and entertainment companies such as Amazon, Netflix, etc., for product recommendation to the user. Whenever we search for some product on Amazon, then we started getting an advertisement for the same product while internet surfing on the same browser and this is because of machine learning.
- Google understands the user interest using various machine learning algorithms and suggests the product as per customer interest.
- As similar, when we use Netflix, we find some recommendations for entertainment series, movies, etc., and this is also done with the help of machine learning.

#### ⑤ Self Driving Cars

- One of the most exciting applications of machine learning is self-driving cars. Machine Learning plays a significant role in self-driving cars. Tesla, the most popular car manufacturing company is working on self-driving cars. It is using unsupervised learning method to train the car models to detect people and objects while driving.

## (6) Email Spam and Malware Filtering

- Whenever we receive a new email, it is filtered automatically as important, normal and Spam. We always receive an important mail in our inbox with the important symbol and spam emails in our spam box, and the technology behind this is Machine Learning.
- Below are some spam filters used by Gmail.
  - Content Filter
  - Header Filter
  - General Blacklists Filter
  - Rules - based Filters
  - Permission Filters
- Some machine learning algorithms such as Multi-Layer Perception, Decision Tree, and Naive Bayes Classifier are used for email spam filtering and malware detection.

## (7) Virtual Personal Assistant

- We have various personal assistants such as Google Assistant, Alexa, Cortana, Siri. As the name suggests, they help us in finding the information using our voice instructions. These assistants can help us in various ways just by our voice instructions such as Play music, Call someone, Open an email, Scheduling an appointment, etc.
- These virtual assistants use machine learning algorithms as an important part.
- These assistants record our voice instructions, send it over the server on a cloud, and decode it using ML algorithms and act accordingly.

### ⑧ Online Fraud detection

- Machine learning is making our online transaction safe and secure by detecting fraud transactions. Whenever we perform some online transaction, there may be various ways that a fraudulent transaction can take place such as fake accounts, fake ids, and steal money in the middle of a transaction. So to detect this, Feed Forward Neural Network helps us by checking whether it is a genuine transaction or a fraud transaction.
- For each genuine transaction, the output is converted into some hash values, and these values become the input for the next round. For each genuine transaction, there is a specific pattern which gets change for the fraud transaction. Hence, it detects it and makes our online transactions more secure.

### ⑨ Stock Market Trading

- Machine Learning is widely used in stock market trading. In the stock market, there is always a risk of up and down in shares, so for this machine learning's long short term memory neural network is used for the prediction of stock market trends.

### ⑩ Medical Diagnosis

- In medical science, machine learning is used for disease diagnoses. With this, medical technology is growing very fast and able to build 3D models that can predict the exact position of lesions in the brain.
- It helps in finding brain tumors and other brain-related diseases easily.

Q.3. What is machine learning? Explain types of machine learning.

Ans:

### Machine Learning

- Machine learning is the science of getting computers to learn and act like humans do, and improve their learning overtime in autonomous fashion, by feeding them data and information in the form of observations and real world interactions.
- Machine learning focuses on applications that learn from experience and improve their decision-making or predictive accuracy over time.
- Machine learning is a branch of Artificial Intelligence (AI) focused on building applications that learn from data and improve their accuracy over time without being programmed to do so.

### Types of Machine Learning

#### ① Supervised Learning

- Supervised learning as the name indicates a presence of supervisor as teacher.
- Basically supervised learning is a learning in which we teach or train the machine using data which is well labelled.
- After that, machine is provided with new set of examples (data) so that supervised learning algorithm analyses the training data.
- Machine then produces a correct outcome from labelled data.
- Supervised learning classified into two categories of algorithms
  - i. Classification
  - ii. Regression.

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## (2) Unsupervised Learning

- Unlike supervised learning, no teacher is provided that means no training will be given to the machine.
- Unsupervised learning is the training of machine using information that is neither classified nor labelled.
- It allows the algorithm to act on that information without guidance.
- Unsupervised learning classified into two categories of algorithm

i. Clustering

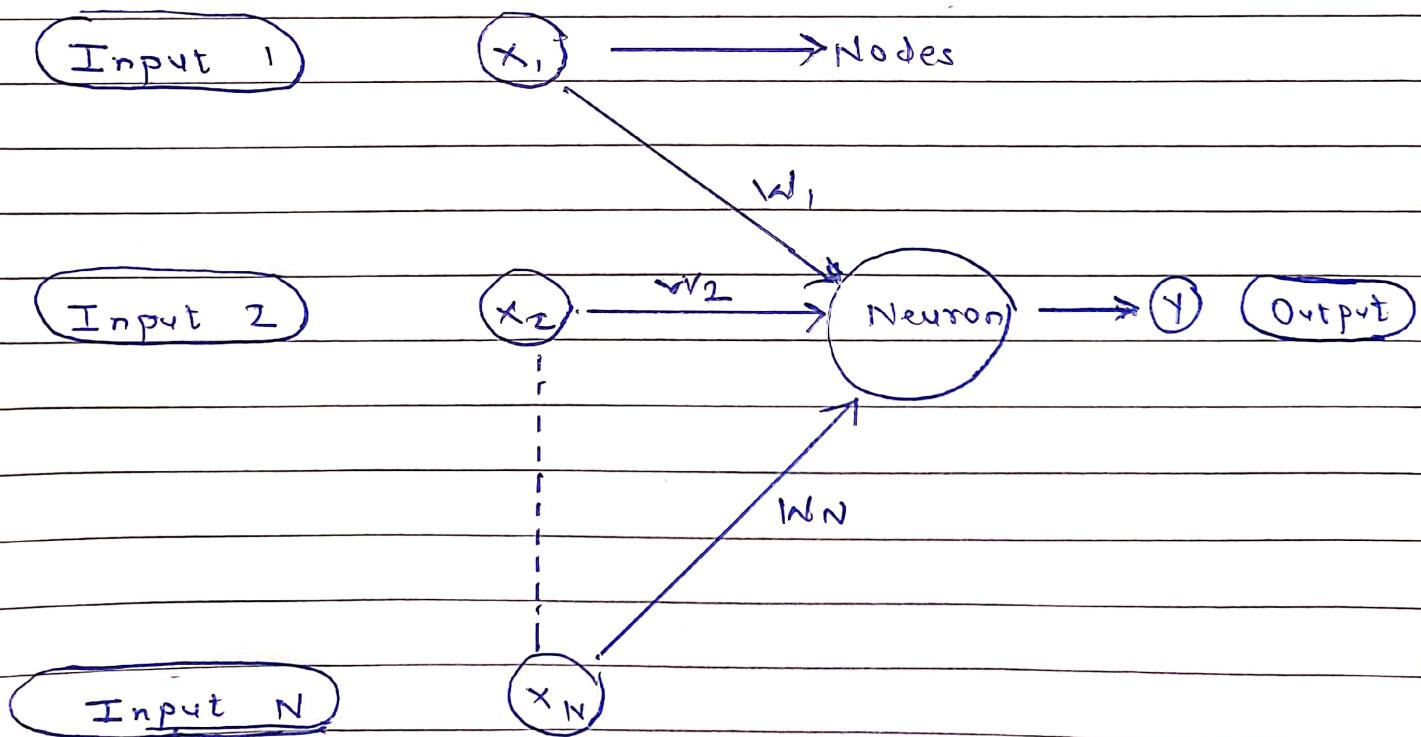
ii. Association.

Q.4. What is ANN? Explain the architecture of ANN.

Ans:

### Artificial Neural Network

- An Artificial Neural Network (ANN) is the piece of a computing system - designed to simulate the way the human brain analyses and processes information.
- It is the foundation of Artificial Information (AI) and solves problem that would prove impossible or difficult by human or statistical standards.
- ANN's have self learning capabilities that enables them to produce better results as more data becomes available.
- Typical Artificial Neural Network Looks like :-

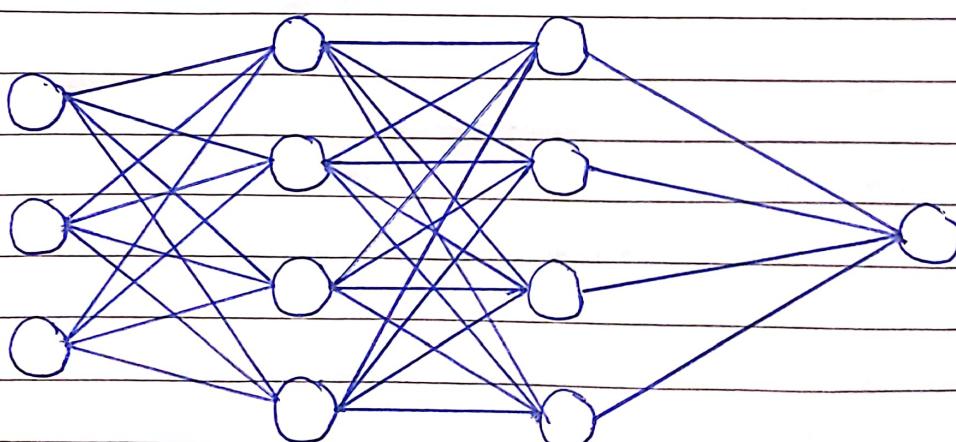


## Architecture of an Artificial Neural Network

- In a Neural Network, all neurons influence each other, and hence, they are all connected. The network can acknowledge and observe every aspect of the dataset at hand and how the different parts of data may or may not relate to each other.
- In Neural Network, flow of information occurs in two ways.
  - ① Feed forward Networks
  - Signal only travels in one direction, towards the output layer. Feed forward networks have an input layer and a single output layer with zero or multiple hidden layers. widely used in pattern recognition.

### ② Feedback Networks

- In this model, the recurrent or interactive networks use their internal state to process the sequence of inputs. Signals can travel in both directions through loops in the network.



Input  
Layer

Hidden  
Layer  
1

Hidden  
Layer  
2

Output  
Layer

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### Input Layer

- It accept inputs in several different formats provided by the programmer.

### Hidden Layer

- The hidden layer presents in-between input and output layers. It performs all the calculations to find hidden features and patterns.

### Output Layer

- The input goes through a series of transformations using the hidden layer, which finally results in output that is conveyed using this layer.

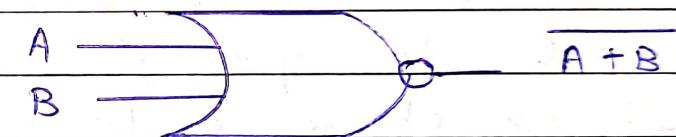
Q5. Implement NOR gate using McCulloch Model.

Ans:

- The McCulloch - Pitts model was an extremely simple artificial neuron. The inputs could either be a zero or a one. And a output was either zero or one. And each input could be either excitatory or inhibitory.

Implementation of NOR Gate using McCulloch - Pitts Neuron - Model

A	B	Output
0	0	1
0	1	0
1	0	0
1	1	0



NOR Gate

Perception algorithm states that :

$$\text{Prediction } (y') = \begin{cases} 1 & \text{if } w_1x_1 + b > 0 \\ 0 & \text{if } w_1x_1 + b \leq 0 \end{cases}$$

Now, from the diagram, the NOR gate is 1 only if both inputs are zero.

## Row 1

From  $w_1x_1 + w_2x_2 + b$ , initializing  $w_1$  &  $w_2$  as 1 and  $b$  as -1, we get  
 $x_1(1) + x_2(1) - 1$

Passing first row of NOR gate logic table  
 $(x_1 = 0, x_2 = 0)$ , we get

$$0 + 0 - 1 = -1$$

From Perceptron rule, if  $wx + b \leq 0$ ; then  $y' = 0$   
This row is incorrect, as output is 1 for NOR gate

So we want values that will make input  $x_1 = 0$   
 $x_2 = 0$  to give  $y'$  a value of 1.

If we change  $b$  to 1, we get

$$0 + 0 + 1 = 1$$

From Perceptron rule, this works.

## Row 2

Passing  $(x_1 = 0, x_2 = 1)$ , we get

$$0 + 1 + 1 = 2$$

From perception rule, if  $wx + b > 0$ , then  $y' = 1$   
This row is incorrect, as output is 0 for NOR gate

So we want values that will make  $x_1 = 0, x_2 = 1$   
to give  $y'$  a value of 0.

If we change  $w_2$  to -1, we get

$$0 - 1 + 1 = 0$$

From the perceptron rule, this is valid for both  
row 1 and row 2.

Row 3

Passing  $(x_1 = 1, x_2 = 0)$ , we get  
 $1 + 0 + 1 = 2$

From perception rule, if  $w_x + b > 1$  then  $y' = 1$

This row is incorrect, as output is zero for NOR gate

So we want values that makes input  $x_1 = 0$  and  $x_2 = 1$  to give  $y'$  a value of 0.

If we change  $w$ , to -1, we get

$$-1 + 0 + 1 = 0$$

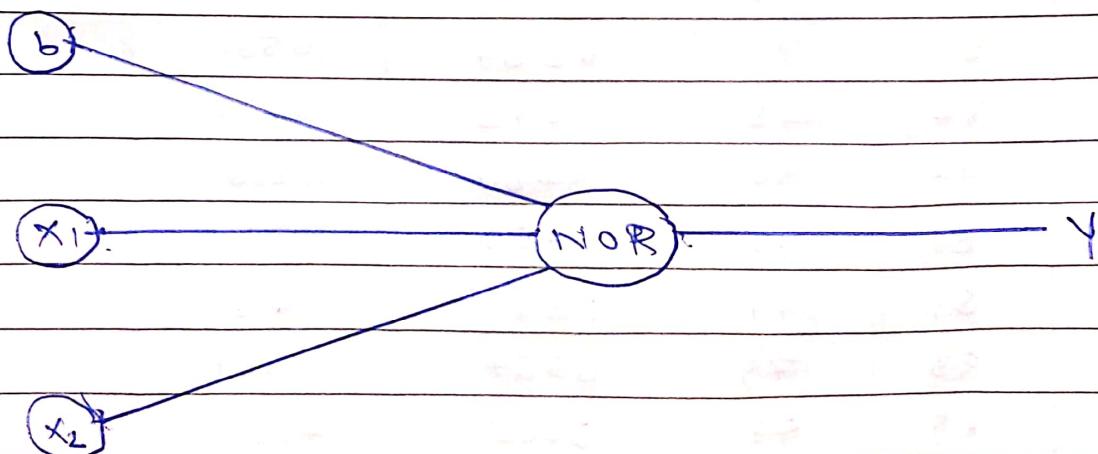
From perception rule, this is valid for row 1, 2  $\neq$  3.

Row 4

Passing  $(x_1 = 1, x_2 = 1)$  we get,  
 $-1 - 1 + 1 = -1$

From perception rule, this still works

Therefore, we can conclude the model to achieve NOR gate, using perception algorithm is  $-x_1 - x_2 + 1$



Q.6 Use the method of least squares regression to predict the final exam grade of a student who received 84 of the midterm exams.

	Midterm Exam (x)	Final Exam (y)
	72	84
	50	63
	81	77
	74	78
	94	90
	86	75
	59	49
	83	79
	65	77
	33	52
	88	74
	81	90

Ans:

Finding  $\bar{x} \cdot \bar{y}$  and  $\bar{x}^2$  using given data

x	y	$\bar{x} \cdot \bar{y}$	$\bar{x}^2$
72	84	6048	5184
50	63	3150	2500
81	77	6237	6561
74	78	5772	5476
94	90	8460	8836
86	75	6450	7396
59	49	2891	3481
83	79	6557	6889
65	77	5005	4225
33	52	1716	1089
88	74	6512	7744
81	90	7290	6561

Here  $n = 12$  (total number of values in either  $x$  or  $y$ )

Now we have to find  $\sum x$ ,  $\sum y$ ,  $\sum(x \cdot y)$  and  $\sum x^2$   
where,

$\sum x$  = sum of all  $x$  values

$\sum y$  = sum of all  $y$  values

$\sum(x \cdot y)$  = sum of all  $x \cdot y$  values

$\sum x^2$  = sum of all  $x^2$  values.

$$\sum x = 866$$

$$\sum y = 888$$

$$\sum(x \cdot y) = 66088$$

$$\sum x^2 = 65942$$

Now we have to find  $a$  and  $b$

$$a = \frac{n * \sum xy - \sum x \sum y}{n * \sum x^2 - (\sum x)^2}$$

$$b = \frac{\sum y - a * \sum x}{n}$$

$$a = \frac{(12 * 66088) - (866 * 888)}{(12 * 65942) - (866)^2}$$

$$b = \frac{888 - (0.59 * 866)}{12}$$

$$a = 0.59$$

$$b = 31.42$$

Estimating final exam grade of a student who received  
84 marks =  $y = a + x + b$

Here,

$$a = 0.59$$

$$b = 31.42$$

$$x = 84$$

Putting these values in equation of  $y$ .

$$y = (0.59 * 84) + 31.42$$

$$= 80.98 \text{ Marks.}$$

Q7. Create a decision tree for the attribute using Gini Index.

Eye color	Married	Sex	Height	Class
Brown	Yes	Male	Long	Football
Blue	Yes	Male	Short	Football
Brown	Yes	Male	Long	Football
Brown	No	Female	Long	Netball
Brown	No	Female	Long	Netball
Blue	No	Male	Long	Football
Brown	No	Female	Long	Netball
Brown	No	Male	Short	Football
Brown	Yes	Female	Short	Netball
Brown	No	Female	Long	Netball
Blue	No	Male	Long	Football
Blue	No	Male	Short	Football

Anc:

Gini Index for Eye color

Eye color	Football	Netball	Total
Brown	3	5	8
Blue	4	0	4

$$\text{Gini (Brown)} = 1 - \left(\frac{3}{8}\right)^2 - \left(\frac{5}{8}\right)^2 = 0.4687$$

$$\text{Gini (Blue)} = 1 - \left(\frac{4}{4}\right)^2 - \left(\frac{0}{4}\right)^2 = 0$$

$$\text{Gini (Eye color)} = \left(\frac{8}{12}\right) \times (0.4687) + \left(\frac{4}{12}\right) \times 0$$

$$= 0.312$$

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## Gini Index for Married

Married	Football	Netball	Total
Yes	3	1	4
No	4	4	8

$$\text{Gini (Yes)} = 1 - \left(\frac{3}{4}\right)^2 - \left(\frac{1}{4}\right)^2 = 0.375$$

$$\text{Gini (No)} = 1 - \left(\frac{4}{8}\right)^2 - \left(\frac{4}{8}\right)^2 = 0.5$$

$$\text{Gini (Married)} = \left(\frac{4}{12}\right) \times (0.375) + \left(\frac{8}{12}\right) \times (0.5)$$

$$= \underline{\underline{0.458}}$$

## Gini Index for Sex

Sex	Football	Netball	Total
Male	7	0	7
Female	0	5	5

$$\text{Gini (Male)} = 1 - \left(\frac{7}{7}\right)^2 - \left(\frac{0}{7}\right)^2 = 0$$

$$\text{Gini (Female)} = 1 - \left(\frac{0}{5}\right)^2 - \left(\frac{5}{5}\right)^2 = 0$$

$$\text{Gini (Sex)} = \left(\frac{7}{12}\right) \times (0) + \left(\frac{5}{12}\right) \times (0) \\ = \underline{\underline{0}}$$

## Gini Index for Height

Height	Football	Netball	Total
Long	4	4	8
Short	3	1	4

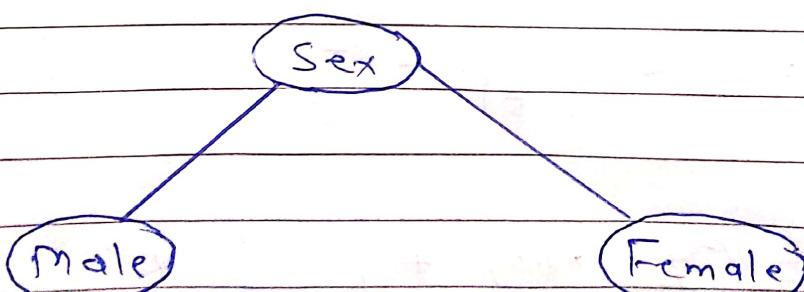
$$\text{Gini (Long)} = 1 - \left(\frac{4}{8}\right)^2 - \left(\frac{4}{8}\right)^2 = 0.5$$

$$\text{Gini (Short)} = 1 - \left(\frac{3}{4}\right)^2 - \left(\frac{1}{4}\right)^2 = 0.375$$

$$\begin{aligned} \text{Gini (Height)} &= \left(\frac{8}{12}\right) \times (0.5) + \left(\frac{4}{12}\right) \times (0.375) \\ &= \underline{\underline{0.458}} \end{aligned}$$

Attributes	Gini Index
Eyecolor	0.312
Married	0.458
Sex	0
Height	0.458

$\therefore$  Sex has minimum Gini Index  
 $\therefore$  It will be the root node



First, for male value to get its child node

We have to repeat the entire process for Sex = Male

Eyecolor	Married	Sex	Height	Class
Brown	Yes	Male	Long	Football
Blue	Yes	Male	Short	Football
Brown	Yes	Male	Long	Football
Blue	No	Male	Long	Football
Brown	No	Male	Short	Football
Blue	No	Male	Long	Football
Blue	No	Male	Short	Football

Here, we can observe Football is the only value associated with Male value of Sex class

Now, for Female value to get its child node

We have to repeat the entire process for Sex = Female

Eyecolor	Married	Sex	Height	Class
Brown	No	Female	Long	Netball
Brown	No	Female	Long	Netball
Brown	No	Female	Long	Netball
Brown	Yes	Female	Short	Netball
Brown	No	Female	Long	Netball

Here, we can observe Netball is the only value associated with Female value of Sex class.

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∴ Final Decision Tree

