ARTIFICIAL INTELIGENCE AND MACHINE LEARNING

Course Code- 23AD2001O

Topic:

CONFUSION MATRIX

CO-3 Session - 3

AIM OF THE SESSION

To familiarize students with the basic concept of Confusion matrix, Accuracy, F-score, Precession and Recall.

INSTRUCTIONAL OBJECTIVES

This Session is designed to:

1. Demonstrate the significance of Performance Metrics.
2. Describe the Concept of Confusion Matrix, Accuracy, F-score etc.
3. Explanation of numerical formula to calculate the confusion matrix

LEARNING OUTCOMES

At the end of this session, you should be able to:

1. Understand the concept of confusion matrix.
2. How to solve the numerical problem based on the confusion matrix.

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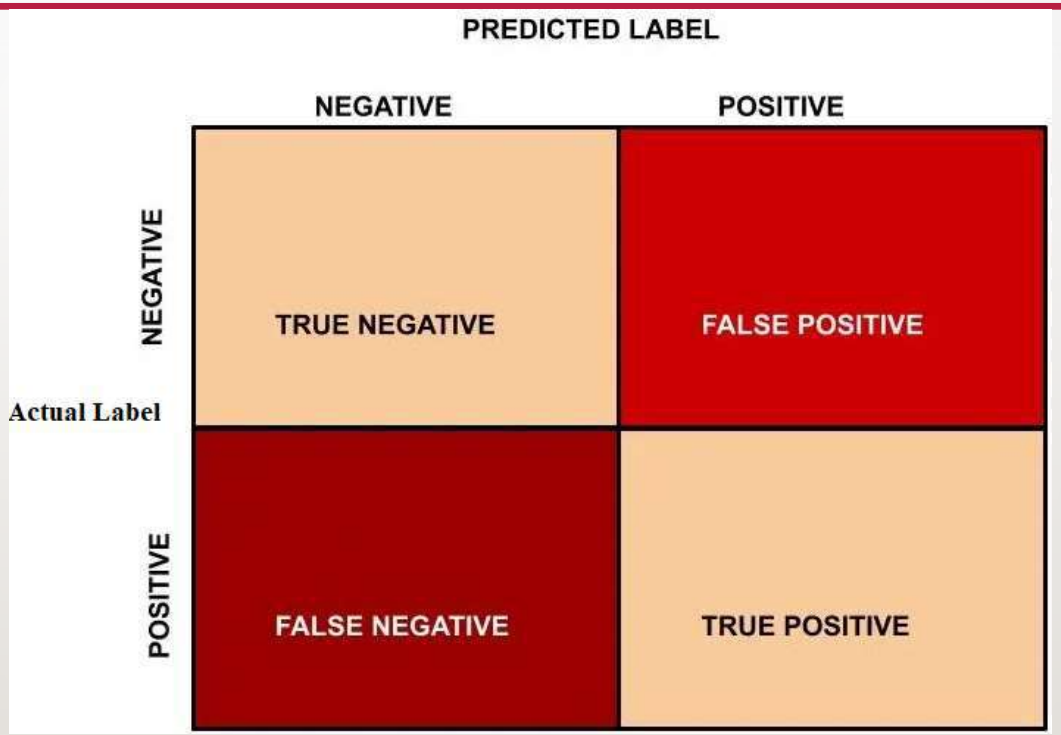
SESSION INTRODUCTION

1. In this session we are going to learn about basic concept of **Performance metrics:** Confusion matrix, Accuracy, F-score, Precession and Recall.
2. Discussion about Numerical Formula based on above topic.

SESSION DESCRIPTION

- A confusion matrix is **a table that is used to define the performance of a classification algorithm**.
- A confusion matrix visualizes and summarizes the performance of a classification algorithm.
- Confusion matrix is a very popular measure used while solving classification problems.
- It can be applied to binary classification as well as for multiclass classification problems.
- The confusion matrix was utilized for the performance evaluations of the methods used after the classification. For binary classification.
- It is NxN Matrix used for evaluating the performance of a given model .

Confusion Matrix



Example-

n=200	Predicted: No	Predicted: Yes	
Actual: No	TN=100	FP=15	115
Actual: Yes	FN=5	TP=80	85
	105	95	

True Negatives (TN): The patients actually don't have disease and our model also says that these patients don't have disease

True Positives (TP): These are cases in which, The patients actually have disease and our model also says that these patients do have disease

False Positives (FP): These are cases in which, The patients actually don't have disease but our model says that these patients do have disease

False Negatives (FN): These are cases in which, The patients actually have disease but our model says that these patients don't have disease

Accuracy

- It is one of the important parameters to determine the accuracy of the classification problems. It defines how often the model predicts the correct output. It can be calculated as the ratio of the number of correct predictions made by the classifier to all number of predictions made by the classifiers. The formula is given below.

$$Accuracy = \frac{TP+TN}{TP+FP+FN+TN}$$

n=200	Predicted: No	Predicted: Yes	
Actual: No	TN=100	FP=15	115
Actual: Yes	FN=5	TP=80	85
	105	95	

- Accuracy=(80+100)/(80+15+5+100)
- Accuracy=0.9

Precision

- **Precision:** It can be defined as the number of correct outputs provided by the model or out of all positive classes that have predicted correctly by the model, how many of them were actually true. It can be calculated using the below formula:

$$\text{Precision} = \frac{TP}{TP+FP}$$

n=200	Predicted: No	Predicted: Yes	
Actual: No	TN=100	FP=15	115
Actual: Yes	FN=5	TP=80	85
	105	95	

- Precision=80/(80+15)
- Precision=0.84

Recall

- **Recall:** It is defined as the out of total positive classes, how our model predicted correctly. The recall must be as high as possible.

$$Recall = \frac{TP}{TP+FN}$$

n=200	Predicted: No	Predicted: Yes	
Actual: No	TN=100	FP=15	115
Actual: Yes	FN=5	TP=80	85
	105	95	

- Recall=80/(80+5)
- Recall=0.94

F-Score

- If two models have low precision and high recall or vice versa, it is difficult to compare these models. So, for this purpose, we can use F-score. This score helps us to evaluate the recall and precision at the same time. The F-score is maximum if the recall is equal to the precision. It can be calculated using the below formula:

$$\text{F-measure} = \frac{2*Recall*Precision}{Recall+Precision}$$

n=200	Predicted: No	Predicted: Yes	
Actual: No	TN=100	FP=15	115
Actual: Yes	FN=5	TP=80	85
	105	95	

- F-Score=(2*0.94*0.84)/(0.94+0.84)
- F-Score=0.8871

Summary

It offers a thorough analysis of true positive, true negative, false positive, and false negative predictions, facilitating a more profound comprehension of a model's **recall, accuracy, precision,** and overall effectiveness in class distinction. When there is an uneven class distribution in a dataset, this matrix is especially helpful in evaluating a model's performance beyond basic accuracy metrics.

SELF ASSESSMENT QUESTIONS

1. What is the accuracy of the classification model?

	Predicted Positive	Predicted Negative
Actual Positive	50	10
Actual Negative	5	35

(a) 0.80

(b) 0.85

(c) 0.90

(d) 0.95

2. What is the recall of the classification model?

	Predicted Positive	Predicted Negative
Actual Positive	40	20
Actual Negative	10	30

(a) 0.50

(b) 0.67

(c) 0.80

(d) 0.90

SELF ASSESSMENT QUESTIONS

1. What is the precision of the classification model??

	Predicted Positive	Predicted Negative
Actual Positive	70	30
Actual Negative	20	80

(a) 0.70

(b) 0.74

(c) 0.90

(d) 0.92

2. What is the F1-Score of the classification model?

	Predicted Positive	Predicted Negative
Actual Positive	50	25
Actual Negative	15	60

(a) 0.67

(b) 0.71

(c) 0.80

(d) 0.90

TERMINAL QUESTIONS

1. Describe in detail about performance matrix regarding Machine learning.
2. Discuss the advantages of precision.
3. Write Short note- Confusion matrix, Accuracy, F-score, Precession and Recall.

REFERENCES

- **Reference Books:**

- 1. Russel and Norvig, 'Artificial Intelligence', third edition, Pearson Education, PHI, (2015)
- 2. Elaine Rich & Kevin Knight, 'Artificial Intelligence', 3nd Edition, Tata Mc Graw Hill Edition, Reprint(2008)

- **Sites and Web links:**

1. https://www.virtusa.com/digital-themes/heuristic-search-techniques
2. https://towardsdatascience.com/a-star-a-search-algorithm-eb495fb156bb

THANK YOU