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Q1. Write a short note on

i) model Assesment
ii) cross validation
iii) Error measures

i) model Assesment or model evaluation

model evaluation is the process of using different evaluation metrics to understand a machine learning model's performance. as well as its strength & weakness. model evaluation is an integral part of the model development process. It helps to find the best model that represents our data & how well the chosen model will work in the future. there are diffrent techniques for model Evaluation, which depend on the specific task we want to solve. model evaluation can be divided into two sections:

a) Classification
b) Regression

a) classification

The most common evaluation metrics for classification are:

- Precision :- Among all the positive predictions, count how many of them are really positive.
- Recall :- Among all the real positive cases, count how many of them are predicted positive.
- Accuracy :- Among all the cases, count how many of them have been predicted correctly.

b) Regression

To evaluate regression model, the most popular metrics are :-

- mean absolute error :- The average of the difference between the actual value & the predicted one.
- Root mean squared error :- The square root of mean squared error.
- R2 score :- The proportion of variance in y that can be explained by x.

ii) Cross validation

when only a limited amount of data is available to achieve an unbiased estimate of the model performance we use k-fold cross validation.
In k-fold cross validation, we divide the data into k-subsets of equal size. we build model k-times, each time leaving out one of the subsets from training and use it as the test set.
The three steps involved in cross-validation are as follows:-

① Reserve some portion of sample data-set.
② Using the rest data-set train the model.
③ Test the model using the reserve portion of the data-set.

methods of cross validation

a) Validation

In this method, we perform training on the 50% of the given data-set & rest 50% is used for the testing purpose. The drawback of this method is we perform training on 50% dataset, it may possible that the remaining 50% of the data contains some important information which we are leaving while training our model.

b) LOOCUC Leave one out cross validation)

In this method, we perform training on the whole dataset but leaves only one data-point of the available dataset & then iterates ~~over~~ for each data point.

c) k-fold ~~so~~ cross validation

In this method, we split the data-set into k number of subsets (known as folds) then we perform training on all the subsets but leave one (k-1) subset for the evaluation of trained model.

iii) Error measures or performance metrics

There are various metrics which we can use to evaluate the performance of ML algorithms, classification as well as regression algorithm.

a) Confusion matrix

It is easiest way to measure the performance of a classification problem where the output can be of two or more type of classes. A confusion matrix is nothing but a table with two dimensions viz. Actual & predicted & furthermore, both dimensions have True positives (TP), True negatives (TN), False positives (FP) & False negatives (FN)

- True positives (TP) :- It is the case when both actual class & predicted class of data point is 1.

- True Negative (TN):- It is the case when both actual class & predicted class of data point is 0

- False positive (FP):- It is case when actual class of data point is 0 & predicted class of data point is 1.

- False Negative (FN) :- It is the case when actual class of data point is 1 & predicted class of data point is 0.

b) Accuracy :- It is most common performance metric for classification algorithms. It may be defined as the number of correct mode as ratio of all predictions made.

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

c) Precision

Precision used in document retrievals, may be defined as the number of correct documents ~~returned~~ returned by our ML model.

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

f) Recall

Recall may be defined as the number of positives returned by our ML model.

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

g) F1 score

This score will give us the harmonic mean of precision and recall.

$$F1 = 2 * (\text{precision} * \text{recall}) / (\text{precision} + \text{recall})$$