Deep Learning with Perception

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1 Evaluating Machine Learning Models

In the first week, we studied fundamentals of Machine Learning. Let's study how we will evaluate a machine learning model.

1.1 Evaluation Metrics

A machine learning model can be evaluated using different parameters.

1.2 Confusion Matrix

A Confusion Matrix provides an overview of the performance of a classification model. It has NXN entries, where N denotes the no. of classes.

1. **True Positive**: Both the actual and the predicted values are positive (TP).
2. **True Negative**: Both the actual and the predicted values are negative (TN).
3. **False Positive**: The actual value is negative and the predicted value is positive (FP).
4. **False Negative**: The actual value is positive and the predicted value is negative (FN).

1.3 Accuracy Precision and Recall

We can also measure Accuracy, Precision, Recall using the above mentioned components of the confusion matrix

1. Accuracy: Number of correct predictions over total predictions.
   $Accuracy = (TP + TN)/(TP + TN + FP + FN)$

2. Precision: It determines that how many positive predictions are correct. Or What proportion of positive identifications was actually correct?

   $Precision = TP/(TotalPositivePredictions)$

   $Precision = TP/(TP + FP)$

   A model with no false positives has a precision of 1.0

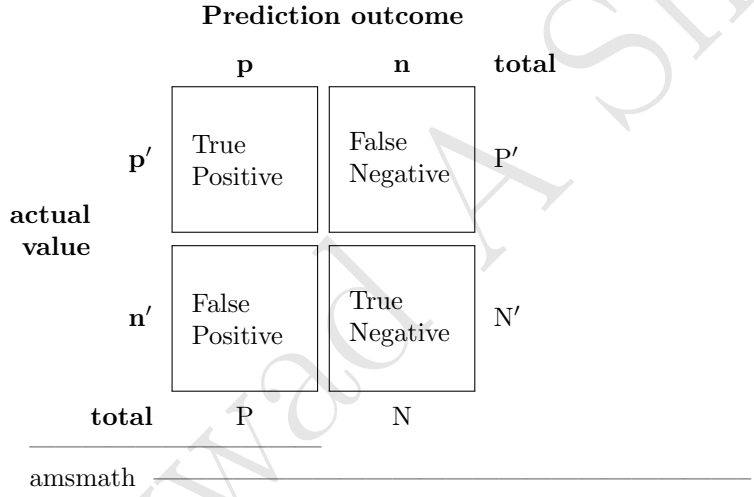
3. Recall: It measures that how many positive instances are predicted correctly over all the positive cases in the data.

   $Recall = CorrectlyPredictedPositiveCases/(TotalPositiveInstances)$

   $Reall = TP/(TP + FN)$

1.3.1 Precision vs. Recall

A trade-off exist between precision and recall. That is, improving precision typically reduces recall and vice versa. Consider figure **??** citeGoogle-MLbasics



1.4 Class Imbalance

A class imbalance problem occurs if we have imbalance of occurrence of classes. For instance, in case of a cancer detection dataset we have fewer instances of cancer. Class imbalance occurs when the distribution between the two classes is highly skewed. Normally, we have more negative instances as compared to the positive instances.

1.4.1 Choosing the right set of parameters

Accuracy can be misleading on imbalanced data. For instance, consider if we have a highly skewed data such as only one positive per hundred negatives. If we develop a model, which always predicts a negative value, such a model will give us 99% accuracy. However, the model will not be acceptable.

The failure of accuracy as a metric on imbalanced data is well-known. Consider the case of a dataset with the ratio of 1 positive per 100 negatives. On this task, a model that predicts all cases to be negative yields an accuracy of 99

Problem 1. Computing Confusion Matrix
Suppose you would like to develop a classifier which can distinguish if a student will proceed to MS, immediately after completing his/her studies. Feature variables include CGPA and monthly income of parents.