Name: CHAN King Yeung

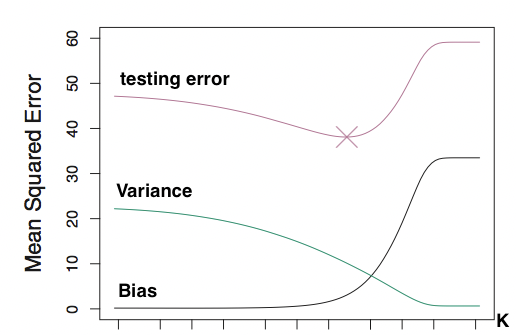
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CSCI3230 Assignment 3

1. Assume is the target predicate and hypothesis predicts the predicate, say . We get true positive (TP) when says is positive and is positive in fact. Likewise, we get true negative (TN) when says is negative whereas is negative actually. In contrast, we commit false positive (FP) if claims is positive but is negative. With the same idea, we commit false negative (FN) for claims is negative but is positive in fact. We can summarise the idea in the following table.

|  |  |  |
| --- | --- | --- |
|  | is positive | is negative |
| says positive | True Positive | False Positive |
| says negative | False Negative | True Negative |

1. Generalisation and specialisation are methods to handle with false positive and false negative in logical formulation of learning. Let and for every . We say is a generalisation of . When commits false negative, we can drop some conditions in and it becomes . Similarly, we say is a specialisation of . When commits false positive, we can add some conditions in and it becomes . Both generalisation and specialisation help to develop a consistent hypothesis in training data.
2. Overfitting is a kind of error that a model over learns the structure of train data. The overfitted model only explain the idiosyncrasies in the data under study. It memorises the data pattern but not a general behaviour. In other words, it forms a lookup table instead of learning the pattern. Ockham’s Razor principle is a concept which describes the simple thing is better than the complex one. When we apply the idea in inductive learning, we can interpret as simpler models usually perform better than the complicate models. We can explain the reason behind using the formula of test error which defined as . When we develop models, the variance decreases as the degree of learning increases.



source: Lecture note from STAT4001

Simpler models usually consist more noice in learning the train data. If we apply the concept of Ockham’s Razor principle, such as pruning a decision tree, we accept the model to learn more noise. From the test error formula or the above graph, we can see that increasing the variance can reduce the amount of bias which also known as bias-variance trade-off. Although simpler models have larger variance, we can reduce the test error for the model. We can utilise the principle to handle with the issue of overfitting. Just like what we have said in a second before, we can apply some technique to reduce the complexity of model, such that the variance of model will increase, and the bias will decrease. At the point where variance equals bias, the test error is minimised. If the model is underfitting, then it is another story, and we will not discuss in here.

1. Entropy is a measure of impurity, which is defined as . Entropy describes how much information were provided from the average information content of events weighted by the probability of the corresponding event . The greater the entropy, the little information were given from the attribute, and will lead to difficulties in prediction for unseen data. To compute the information gain for attribute , we subtract the entropy of parent node by weight average for the entropy of child node. More formally, information gain is defined as where is an attribute.

Since 'price' has the largest gain, we use it to construct the root node of the decision tree.

Diagram

Description automatically generated

1. We convert the sentences from Horn Clause Form to Conjunctive Normal Form here.

Therefore, we want to show that Kate is happy i.e., . To prove entails , we prove by contradiction i.e., showing is unsatisfiable.

Consider and with complementary literals and , we have

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We, then, put resolvent into .

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We, then, put resolvent into .

Consider and with complementary literals and , we have

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Since the resolvent contains an empty clause, is unsatisfiable which implies cannot be negated. Thus, entails and Kate is happy.

HAIYAA!!!!!