# Abstract

Predicting medical data is becoming more and more vital towards helping reduce death rates, or reducing risks in medical procedures. With the use of tools such as WEKA \cite{weka}, the ability to build machine learning classifiers has become easier, and has helped produced more reliable results. This paper looks at death rate prediction following thoracic surgery, and compares different means of prediction and configurations on a given test set of data.

# Introduction

Thoracic surgery is a means of lung resection, and is performed in order to remove part or all of a lung from a patient who is suffering or has suffered from lung cancer \cite{thoracic}. The data provided for training a machine learning approach to predicting the death rate one year after surgery contains 300 patients, each of which hold several attributes, including age and ‘Risk1Yr’. The most latter of these states is the example patient survived (indicated by a 0) or did not (indicate by a 1). The aim of the classifier trained at the end of this report is to be able to predict the survival rate in conjunction with an identical test set of data. \par

For easier statistical reading, and the ability to easily try a range of classifiers on the training data, Weka was chosen to perform experiments and training. Weka allows pre-processing of data, classifiers and filters to be applied, and also provides good visualisation of training results, such as ROC curves. Throughout this paper, both graphs generated within Weka, and ones created from comparing different classifiers will help to reinforce result conclusions. \par

To visualise data quickly during the fine tuning and selection of classifiers during the start of this project, the Weka Explorer application will be used, and then will be moved onto the experimenter during latter parts of the project in order to quickly run multiple experiments at once. Finally, the Weka Knowledge flow application will allow comparisons of the ROC curve of multiple solutions in order to choose the most suitable set up for predicting the test data results. \par

As stated in the assignment, more than one classifier will be selected and compared to see which one best suits predicting this type of data. Following that, more comparisons will be made looking at changing a range of hyper-parameters for chosen classifiers.

## Data pre-processing

In Weka, and in any machine learning approach, some data pre-processing should be performed. Because the data set is real-life based, data is not always complete, or follow a linear pattern. Due to this, an issue known as class imbalance can hinder the performance of learning systems, and means that one instance of an attribute (in this example, surviving patients) is the majority sample causing a bias when training the machine learning algorithm. On first inspection of the data in the training set, it can be seen in Figure 1 that the ‘Risk1Yr’ attribute holds far more surviving patients that ones who did not.

[IMAGE FOR DATA HERE]

There are two means of settling imbalances in data however \cite{imbalance}:

\begin{enumerate}

\item Under-sampling – where the size of the samples are reduced proportionally

\item Over-sampling – where the size of samples are increased proportionally

\end{enumerate}

In the case of Weka, there are filters available within the pre-processing stage of experiments allowing the addition of under or over-sampling. In this case, the SMOTE (Synthetic Minority Over-sampling Technique) \cite{smote} plugin for Weka offered an easy means of resampling data based on a given set of parameters. In an accompanying paper \cite{over-sampling}, SMOTE is described as creating ‘synthetic examples’ rather than replacements

# Classifying data

## Classifier selection

## Investigation and

# Conclusions

## Algorithm findings

## Scenario findings

Cancer could have spread before, therefore data may not be completely true, though should be fairly accurate.

Thoracic

<http://www.bmc.org/thoraciconcology/treatments/lung-resection.htm>

imbalance

<https://hydra.hull.ac.uk/resources/hull:10103>

smote

<https://msdn.microsoft.com/en-us/library/azure/dn913076.aspx>

over-sampling

<https://www.jair.org/media/953/live-953-2037-jair.pdf>