Chapter 7.26
Data Mining Medical Information:
Should Artificial Neural Networks be Used to Analyse Trauma Audit Data?

Thomas Chesney
Nottingham University Business School, UK

David Chesney
Freeman Hospital, UK

Kay Penny
Napier University, UK

Nicola Maffulli
Keele University School of Medicine, UK

Peter Oakley
University Hospital of North Staffordshire, UK

John Templeton
Keele University School of Medicine, UK

Simon Davies
University of Birmingham Research Park, UK

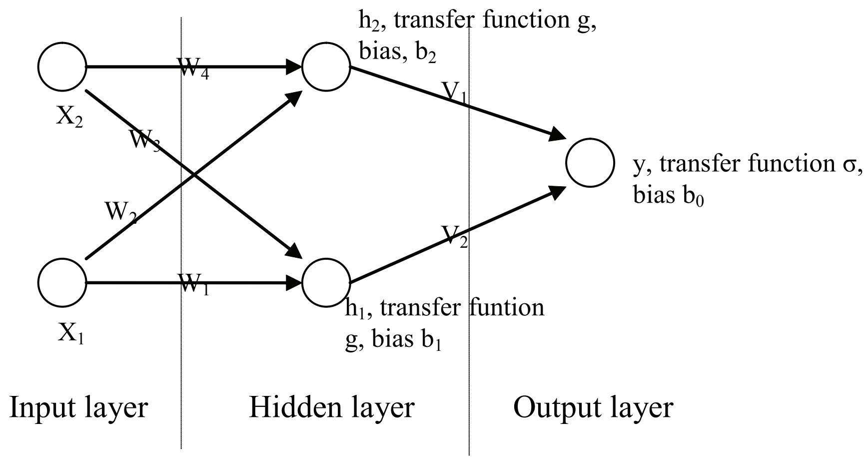
ABSTRACT

Trauma audit is intended to develop effective care for injured patients through process and outcome analysis, and dissemination of results. The system records injury details such as the patient's sex and age, the mechanism of the injury, various measures of the severity of the injury, initial management and subsequent management interventions, and the outcome of the treatment including whether the patient lived or died. Ten years' worth of trauma audit data from one hospital are modelled as an Artificial Neural Network (ANN) in order to compare the results with a more traditional logistic regression analysis. The output was set to be the probability that a patient will die. The ANN models and the logistic regression model achieve roughly the same predictive accuracy, although the ANNs are more difficult to interpret than the logistic regression model, and neither logistic regression nor the ANNs are particularly good at predicting death. For these reasons, ANNs are not seen as an appropriate tool to analyse trauma audit data. Results do suggest, however, the usefulness of using both traditional and non-traditional analysis techniques together and of including as many factors in the analysis as possible.

INTRODUCTION

An Artificial Neural Network (ANN) attempts to model human intelligence using the neurons in a human brain as an analogy. ANNs have been described numerous times (Lee & Park, 2001; Bose & Mahapatra, 2001; Setiono, Thong, & Yap, 1998; Lee, Hung Cheng, & Balakrishnan, 1998), but a brief description is that the network accepts a series of factors as input, which it processes to output a probability that the input belongs to a certain class. For example, in the case of the trauma data analysed in this study, the characteristics of the trauma are the input to the ANN, which then outputs the probability that the patient will die. The processing is done by layers of neurons (called hidden layers) which apply a weight to each input factor according to how important that factor is in calculating the classification probability. The weight is learned by the network during its training. In training, a series of input factors to which the correct classification is known is fed into the ANN. The ANN then adjusts its weights to minimise the error between its predicted classification and the known correct class. A pictorial representation of an ANN is shown in Figure 1.

An ANN has the potential to discriminate accurately between patients who will live and those who will die, and can capture complex relationships between factors that traditional analysis methods may miss. However, there are two potential problems with using ANNs to analyse trauma data. First, they are affected by imbalances in the data (Fu, Wang, Chua, & Chu, 2002). A common characteristic of medical data is its imbalance (Cios & Moore, 2002). What this means is that the attribute of interest to data miners is likely to be present only in a minority of records in the dataset. In the case of the trauma data discussed here, a much higher percentage of patients lived than died. The second disadvantage with neural networks is that it is very difficult to explain and to justify the model. In other words, after train-



Output of h_1, $h_{1out} = g(w_1x_1 + w_3x_2 + b_1)$
Output of h_2, $h_{2out} = g(w_2x_1 + w_4x_2 + b_2)$
Output of node y, the output layer which uses the sigmoid function and is the probability of a certain class, for instance DEATH = 1, given the input vector $\overline{x}$,
$p(DEATH = 1 \mid \overline{x}) = s(v_1(h_{1out}) + v_2(h_{2out}) + b_0)$

Related Content

Study of Fetal Anatomy using Ultrasound Images: A Systematic Conceptual Review
Sandeep Kumar E.and N. Sriraam (2014). *International Journal of Biomedical and Clinical Engineering (pp. 1-13).*
www.irma-international.org/article/study-of-fetal-anatomy-using-ultrasound-images/127395

Gait Event Detection System for the Control of Lower Limb Exoskeleton: Review and Future Requirements
Mohanavelu Kalathe, Sakshi Agarwal, Vinutha Sampaathand Jayanth Daniel (2021). *International Journal of Biomedical and Clinical Engineering (pp. 14-28).*
www.irma-international.org/article/gait-event-detection-system-for-the-control-of-lower-limb-exoskeleton/282492

Semantic Integration for Research Environments
Tomasz Gubala, Marian Bubakand Peter Sloot (2009). *Handbook of Research on Computational Grid Technologies for Life Sciences, Biomedicine, and Healthcare (pp. 514-530).*
www.irma-international.org/chapter/semantic-integration-research-environments/35710

Role of Acoustic Properties in Biomedical Active Noise Control
Sajil C. K.and Achuthsankar S. Nair (2020). *International Journal of Biomedical and Clinical Engineering (pp. 48-60).*
www.irma-international.org/article/role-of-acoustic-properties-in-biomedical-active-noise-control/240746

Bioengineering/Biomedical Engineering Education
Ziad O. Abu-Faraj (2012). *Handbook of Research on Biomedical Engineering Education and Advanced Bioengineering Learning: Interdisciplinary Concepts (pp. 1-59).*
www.irma-international.org/chapter/bioengineering-biomedical-engineering-education/63389