

Novel Algorithms for Cost-Sensitive Decision Tree Learning

Decision tree learning is one of the major success stories of AI, with many data mining tools utilizing decision tree learning algorithms. Recent research in this field has been influenced by realizing that human decision making is not focused solely on accuracy, but also takes account of the potential implications of a decision. For example, a chemical engineer considers the risks of explosion when assessing the safety of a process plant, a bank manager carefully considers the implications of a customer defaulting on a loan and a medical consultant does not ignore the potential consequences of misdiagnosing a patient.

This realisation has led to significant interest in developing cost-sensitive decision tree learning algorithms. This key note presents a tour of the rich variety of cost-sensitive decision tree algorithms, aimed at illuminating the characteristics of the algorithms that will help researchers position their own work and identify gaps for future research. The presentation will begin with early algorithms that make minor changes to the entropy based selection measure used in C4.5, present use of genetic algorithms to evolve cost-sensitive trees, describe the use of bagging and boosting, and conclude with some ideas such as use of multi-arm bandits, and optimisation to develop novel tree induction algorithms . The presentation will be based on the authors work with colleagues and PhD students over the last decade, some of which is reported in the following publications:

- Sunil Vadera (2010), CSNL: A Cost-Sensitive Non-Linear Decision Tree Algorithm, ACM Transactions on Knowledge Discovery from Data, Vol 4, No 2, pp1-25.
- Lomax, S. and Vadera, S. (2011). An empirical comparison of cost-sensitive decision tree induction algorithms. Expert Systems, 28: 227–268
- Lomax, S. and Vadera, S. (2013). A survey of cost-sensitive decision tree induction algorithms, ACM Computing Surveys, Vol 45, No 2, pp1-35.
- Lomax, S. and Vadera, S. (2017), A Cost-Sensitive Decision Tree Learning Algorithm Based on a Multi-Armed Bandit Framework, The Computer Journal, Volume 60, Issue 7, July 2017, Pages 941–956.

Papers available from <http://usir.salford.ac.uk/view/authors/13105.html>