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Automatic Design of Decision-Tree Induction Algorithms

 Springer

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*This book is dedicated to my family:
Alessandra, my wife;
Marta and Luís Fernando, my parents;
Roberta, my sister; Gael, my godson;
Lygia, my grandmother.*

Rodrigo C. Barros

*To Valeria, my wife, and to Beatriz,
Gabriela and Mariana, my daughters.*

André C.P.L.F. de Carvalho

To Jie, my wife.

Alex A. Freitas

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Notations

T	A decision tree
\mathbf{X}	A set of instances
N_x	The number of instances in \mathbf{X} , i.e., $ \mathbf{X} $
\mathbf{x}^j	An instance— n -dimensional attribute vector $[x_1^j, x_2^j, \dots, x_n^j]$ —from \mathbf{X} , $j = 1, 2, \dots, N_x$
\mathbf{X}_t	A set of instances that reach node t
A	The set of n predictive (independent) attributes $\{a_1, a_2, \dots, a_n\}$
y	The target (class) attribute
Y	The set of k class labels $\{y_1, \dots, y_k\}$ (or k distinct values if y is continuous)
$y(x)$	Returns the class label (or target value) of instance $\mathbf{x} \in \mathbf{X}$
$a_i(x)$	Returns the value of attribute a_i from instance $\mathbf{x} \in \mathbf{X}$
$dom(a_i)$	The set of values attribute a_i can take
$ a_i $	The number of partitions resulting from splitting attribute a_i
$\mathbf{X}_{a_i=v_j}$	The set of instances in which attribute a_i takes a value contemplated by partition v_j . Edge v_j can refer to a nominal value, to a set of nominal values, or even to a numeric interval
$N_{v_j, \bullet}$	The number of instances in which attribute a_i takes a value contemplated by partition v_j , i.e., $ \mathbf{X}_{a_i=v_j} $
$\mathbf{X}_{y=y_l}$	The set of instances in which the class attribute takes the label (value) y_l
N_{\bullet, y_l}	The number of instances in which the class attribute takes the label (value) y_l , i.e., $ \mathbf{X}_{y=y_l} $
$N_{v_j \cap y_l}$	The number of instances in which attribute a_i takes a value contemplated by partition v_j and in which the target attribute takes the label (value) y_l
v_X	The target (class) vector $[N_{\bullet, y_1}, \dots, N_{\bullet, y_k}]$ associated to \mathbf{X}
p_y	The target (class) probability vector $[p_{\bullet, y_1}, \dots, p_{\bullet, y_k}]$
p_{\bullet, y_l}	The estimated probability of a given instance belonging to class y_l , i.e., $\frac{N_{\bullet, y_l}}{N_x}$

$p_{v_j, \bullet}$	The estimated probability of a given instance being contemplated by partition v_j , i.e., $\frac{N_{v_j, \bullet}}{N_x}$
$p_{v_j \cap y_l}$	The estimated joint probability of a given instance being contemplated by partition v_j and also belonging to class y_l , i.e., $\frac{N_{v_j \cap y_l}}{N_x}$
$p_{y_l v_j}$	The conditional probability of a given instance belonging to class y_l given that it is contemplated by partition v_j , i.e., $\frac{N_{v_j \cap y_l}}{N_{v_j, \bullet}}$
$p_{v_j y_l}$	The conditional probability of a given instance being contemplated by partition v_j given that it belongs to class y_l , i.e., $\frac{N_{v_j \cap y_l}}{N_{\bullet, y_l}}$
ζ_T	The set of nonterminal nodes in decision tree T
λ_T	The set of terminal nodes in decision tree T
\aleph_T	The set of nodes in decision tree T , i.e., $\aleph_T = \zeta_T \cup \lambda_T$
$T^{(t)}$	A (sub)tree rooted in node t
$E^{(t)}$	The number of instances in t that do not belong to the majority class of that node