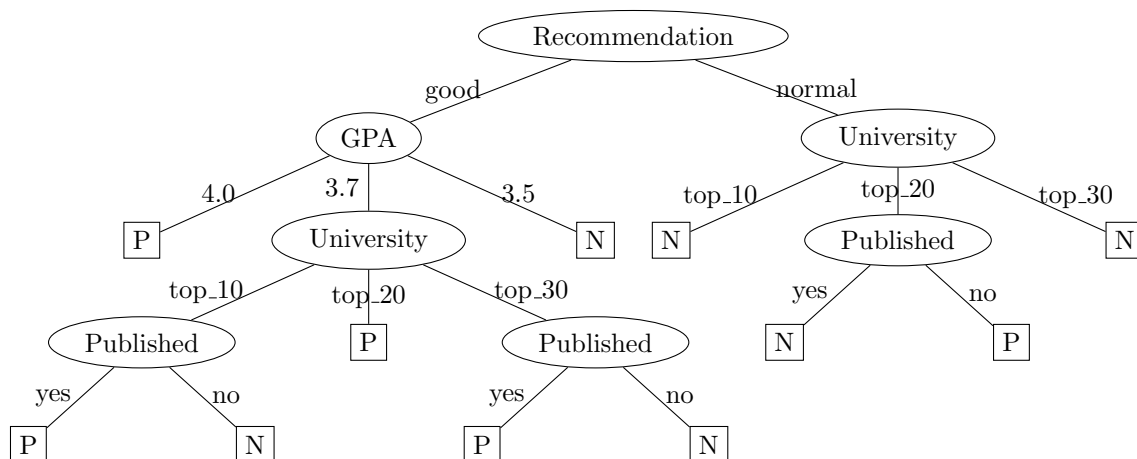


Exercises for the Lecture Techniques in Artificial Intelligence

Decision Tree Learning

- 1) Consider the criteria for accepting candidates to the Ph.D. program at the mythical University of St. Nordaf. Each candidate is evaluated according to four attributes: The grade point average (GPA), the quality of the undergraduate university attended, the publication record, and the strength of the recommendation letters. To simplify our example, let us discretize and limit the possible values of each attribute: Possible GPA scores are 4.0, 3.7, and 3.5; universities are categorized as top_10, top_20, and top_30 (by top_20 we mean ranks 11–20, and by top_30 we mean 21–30); publication record is a binary attribute — either the applicant has published previously or not; and recommendation letters are similarly binary, they are either good or normal. Finally, the candidates are classified into two classes: accepted, or P (for ‘positive’), and rejected, or N (for ‘negative’).

The decision tree for determining acceptance officially used by St. Nordaf looks like the following.



Alice Applicant does not know this tree, but she has the following data available about applicants of the last year:

No.	Attributes				Class
	GPA	University	Published	Recommendation	
1	4.0	top_10	yes	good	P
2	4.0	top_10	no	good	P
3	4.0	top_20	no	normal	P
4	3.7	top_10	yes	good	P
5	3.7	top_20	no	good	P
6	3.7	top_30	yes	good	P
7	3.7	top_30	no	good	N
8	3.7	top_10	no	good	N
9	3.5	top_20	yes	normal	N
10	3.5	top_10	no	normal	N
11	3.5	top_30	yes	normal	N
12	3.5	top_30	no	good	N

- (a) Make sure that the data available to Alice could have been generated by this official decision tree.
- (b) Alice now applies the algorithm for decision tree learning introduced in the lecture to the data in order to (hopefully) induce the decision tree used by St. Nordaf. Follow Alice and provide all calculations necessary.
- (c) Is the tree you constructed in the last question equivalent to the official tree (i.e. are all applications evaluated equally)? If your answer is yes, explain if this is coincidence, or find a contrary example if your answer is no.
- (d) In the considered decision trees, there is no attribute, which is used twice along one single path. Why not?