

## Foundations of Artificial Intelligence

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### Exercise Sheet 8

Due: Friday, June 27, 2008

#### Exercise 8.1 (Decision Tree Learning)

Two candidates O and M who appeal to different parts of the population run for a political office. The following table shows the preferences of seven voters of different age, income and educational background.

| No. | Age       | Income | Education  | Candidate |
|-----|-----------|--------|------------|-----------|
| 1   | $\geq 35$ | High   | Highschool | O         |
| 2   | $< 35$    | Low    | University | O         |
| 3   | $\geq 35$ | High   | College    | M         |
| 4   | $\geq 35$ | Low    | Highschool | M         |
| 5   | $\geq 35$ | High   | University | O         |
| 6   | $< 35$    | High   | College    | O         |
| 7   | $< 35$    | Low    | Highschool | M         |

- (a) Use the learning algorithm from the lecture to compute a minimum-size decision tree correctly classifying all examples wrt the preferred candidate based on the attributes *age*, *income*, and *education*. For the root node, give the information gains associated with all candidate attributes.
- (b) Deduce from the decision tree a logical formula which is satisfied iff candidate O is preferred.

#### Exercise 8.2 (Information Content)

Show that the information content of a more uniform distribution is greater than that of a less uniform one, i.e., for all  $p_1, \dots, p_n \geq 0$  with  $\sum_{i=1}^n p_i = 1$

$$I(p_1, \dots, p_i, \dots, p_j, \dots, p_n) \leq I(p_1, \dots, \frac{p_i + p_j}{2}, \dots, \frac{p_i + p_j}{2}, \dots, p_n)$$

#### Exercise 8.3 (Situation Calculus)

Within situation calculus, write an axiom to associate time 0 with the situation  $S_0$  and another axiom to associate the time  $t$  with any situation that is derived from  $S_0$  by a sequence of  $t$  actions.

#### Exercise 8.4 (Allen's Interval Calculus)

Consider the non-empty intervals *match*, *goalShot*, *cheering* und *finalWhistle* together with the constraints

- (i) *finalWhistle finishes match*
- (ii) *goalShot meets cheering*
- (iii) *goalShot (during, finishes) match*
- (iv) *goalShot (before, meets) finalWhistle*

Which of the following relations are entailed?

- (a) *goalShot during match*

(b) *cheering during match*

The exercise sheets may and should be worked on in groups of three (3) students.  
Please fill the cover sheet<sup>1</sup> and attach it to your solution.

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<sup>1</sup><http://www.informatik.uni-freiburg.de/~ki/teaching/ss08/gki/coverSheet-english.pdf>