



Artificial Intelligence

– Sheet 3: Advanced Search and Learning –

Exercise 1 (4 Points, Optimality of Uniform-cost - and Breadth-first-search)

Show a state space with constant step costs in which *Graph-search* using Iterative-deepening-search finds a **suboptimal** solution.

Exercise 2 (4 Points, Optimality of A* using Graph-search)

Prove Theorem 2.12 formally: A* is optimal using *Graph-search*, if the heuristic function h is consistent.

Exercise 3 (8 Points, Decision list)

Consider the following two definitions:

(Canonic DL) A decision list is called *canonic* if, and only if, each test consists of a *disjunction* of attributes (or a single attribute, or \perp) and the answers of the tests are *alternating* (where the first answer is *no*).

(Monotonic DL) A decision list is called *monotone* if, and only if, each test consists of a single attribute.

(a) Consider the following decision list:

$$(y_1 \vee y_4; no) \rightarrow (y_2 \vee y_9; yes) \rightarrow (y_5 \vee y_{10} \vee y_{11}; no) \rightarrow (y_8; yes) \rightarrow no$$

1. (1 points) Is this list canonic? Why or why not?
2. (1 points) Transform the list into an equivalent monotone list!

(b) Assume that n attributes are available and prove the following:

1. (3 points) Every *canonic* decision list can be transformed into a *monotone* decision list **with at most n tests**.
2. (3 points) Every *monotone* decision list can be transformed into a *canonic* decision list **with at most $n + 1$ tests**.

Date: 08. May 2012

Points:

_____ of 25

Group / Tutor:

Name(s) & Matr. no.:

To be submitted:

22. May 2012
before class



Exercise 4 (9 Points, Decision-tree-learning)

Consider the following examples:

Number	Burger	French fries	Coke	Sick
1	No	Yes	No	Yes
2	No	Yes	Yes	Yes
3	No	Yes	No	Yes
4	Yes	Yes	Yes	Yes
5	Yes	Yes	No	No
6	No	No	Yes	No
7	Yes	No	No	No
8	No	No	Yes	No

- (a) (3 points) Which attribute is **the best** to start with and why? Use information theory!
- (b) (2 points) Build the decision tree starting with the best attribute! Assign all the examples to their respective leaf nodes and classify them.
- (c) (2 points) Build a decision tree starting with a *first* attribute **that is different** from the one chosen in (b). (That is, *french fries* if the tree in (b) starts with *burger* and *burger* if the tree starts with *french fries* or *coke*.)
Assign all the examples to their respective leaf nodes and classify them.
- (d) (1 points) Consider the following menus: Menu 1 (Burger and Coke) and Menu 2 (the “empty” menu).
Which of these menus would you recommend according to the tree constructed in (a) (respectively, in (b))? Explain why!
- (e) (1 points) Assume that a decision tree is constructed only from these examples which cause illness. Is the resulting tree useful? Why or why not?