



Artificial Intelligence

– Sheet 3: Advanced Search and Learning –

Date: 29. April 2014

Exercise 1 (8 Points, Optimality of Uniform-cost - and Breadth-first-search)

Prove that *Uniform-cost-search* and *Breadth-first-search with constant step costs* are optimal when used with the *Graph-search* algorithm. Show a state space with constant step costs in which *Graph-search* using *Iterative-deepening-search* finds a suboptimal solution.

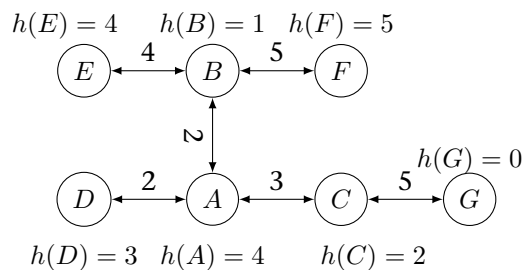
Points:

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Exercise 2 (7 Points, LRTA*)

Perform LRTA*-search on the state space shown below. Start with state *A* and proceed until goal node *G* is reached. For each cycle write down the updated table (function) *H*.

Important: If a node out of a set of nodes with the same costs has to be chosen, do choose in alphabetical order (wrt. to the node name).



Group / Tutor:

Name(s) & Matr. no.:

Exercise 3 (6 Points, Decision trees)

In the recursive construction of decision trees, it sometimes happens that a mixed set of positive and negative examples remain at a leaf node, even after all attributes have been used. Suppose that we have p positive examples and n negative examples.

- (a) Show that using the **majority classification** **minimizes the absolute error** over the set of examples at the leaf.
- (b) Show that using the **class probability** $\frac{p}{p+n}$ **minimizes the sum of squared errors**. (The sum of squared errors is given by $E(x) = p(1 - x)^2 + nx^2$).

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

To be submitted:

14. May 2014
in class



- (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 (b) (respectively, in (c))? 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?