

Course

1595 - Artificial Intelligence

Lecturer:

Jan VORACEK

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Notes:

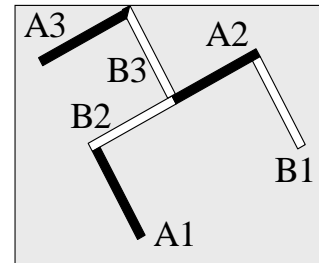
a) calculators, dictionaries and mathematical handbooks are allowed
b) type, please, your answers in English

Problem 1: Hackenbush game

(4+2+2 pts)

A simplified version of the Hackenbush game (*The Book of Numbers*, John H. Conway and Richard K. Guy, Springer-Verlag, New York, 1996) has following rules (see figure):

- Each player (A or B in our case) can play during the whole session only with own type of stick (white or black).
- At each turn, a player can remove one (arbitrary) stick.
- If, after that one stick is removed a part of the picture has become disconnected from the frame, that 'free' section of the picture must be completely removed in the same step, too.
- The player who removes the last bit of the interconnected stick structure leaving only the frame is the winner.



Example: 1. A starts with A3; 2. B removes B3 and released (A1,B1,A2,B2) are removed automatically \Rightarrow B is the winner.

[a] Draw the complete tree for the depicted situation expanding the single in increasing order (i.e. $A1 < A2 < A3$ etc.) from left to right. If player A will win the game, then the value of the final node is +1, otherwise -1. Pass these values upwards the tree.

[b] How can Alpha-Beta pruning affect the final topology of the tree? Mark clearly omitted nodes to your existing diagram assuming that lower ordered nodes are evaluated at first.

[c] Suggest possible general solution for Hackenbush game, i.e. how to process optimally very large game situations, for which computer cannot build the whole tree in memory at once.

Problem 2: Propositional logic

(2+2 pts)

[a] Convert the following expression to CNF:

$$(A \wedge D \wedge \neg C) \vee (\neg A \wedge \neg B \wedge \neg C) \vee (A \wedge \neg C \wedge \neg D)$$

[b] Express the result as a conjunction of Horn Clauses or explain why it is impossible.

Problem 3: PROLOG

(4 pts)

Comment each line of the following program:

```
misty(0,0,_) :- !,fail.  
misty(0,_,0) :- !.  
misty(_,0,1) :- !.  
misty(X,1,X) :- !.  
misty(X,Y,Z) :- K is Y-1,misty(X,K,L),Z is X*L,!.
```

Problem 4: Genetic algorithms

(3+3 pts)

[a] Assume that you are applying a standard genetic algorithm (GA) to a small population and don't use mutation at all. What might happen?

[b] And what is an expected GA behavior if you omit only crossover function on a complete population?

Tip: use an analogy with searching algorithms and express your conclusions by means of visited search space.

Problem 5: Expert systems

(3+3 pts)

[a] Define the general concept of Expert System (ES) and formulate its main features, application requirements and employment areas. Accompany this part with a block diagram(s).

[b] Give a concrete example of an intelligent agent (approach) you have met in AI course (or in literature, in practice etc.) applicable as an ES.