Foundations of Artificial Intelligence

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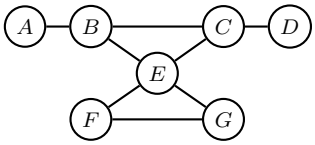
Exercise Sheet 4

Due: Friday, May 30, 2008

Exercise 4.1 (Tree decompositions for CSPs)

You want to 3-color the following graph (say with the colors r, g, b).



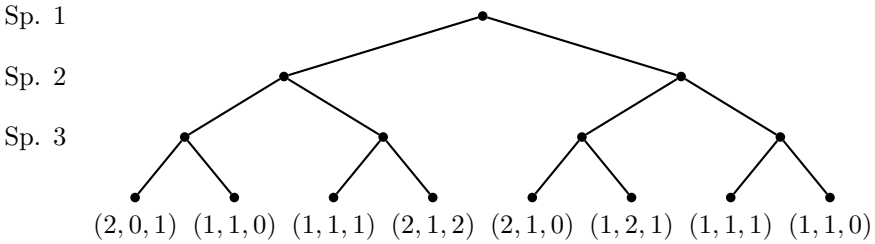
Show a minimal tree decomposition of the graph and give the sets of all solutions for each of the subproblems. Merge the solutions of the subproblems into an overall solution in the way presented in the lecture. Write down such an overall solution.

Exercise 4.2 (Generalization of the Minimax algorithm)

Consider the problem of search in a three-player game (you may assume that no alliances are allowed) without the zero-sum condition. The players are called 1, 2, and 3. Unlike in the case of two-player zero-sum games, the evaluation function now returns a triple (x_1, x_2, x_3) such that x_i is the value the node has for player i.

(a) Complete the game tree given below by annotating all interior nodes and the root node with the backed-up value triples.

(b) Assume that the value triple $(1, 1, 1)$ at the third leaf nodes from the left is replaced by $(0, 1, 2)$. Which problem arises now when you try to back up value triples? Suggest how to modify the back-up procedure to obtain a "robust" result at the root node.



Exercise 4.3 (Rationality assumption in the Minimax algorithm)

The Minimax algorithm for two-player zero-sum games returns the best move for a player under the assumption that the opponent plays optimally as well. Does this also hold if the opponent does not play optimally?

Exercise 4.4 (Propositional logic)

A very special island is inhabited only by knights and knaves. Knights always tell the truth, and knaves always lie. You meet three inhabitants: Andreas, Benjamin, and Christoph.
Andreas claims that Benjamin is a knave and Christoph is a knight. Benjamin says: "Andreas is a knave." Christoph asserts that neither Benjamin nor Andreas is a knave.
Formalize the problem using propositional logic and provide a model. Is the model unique? Who is a knight and who is a knave?
Hint: Use three atomic propositions A, B, and C with the intended semantics "Andreas (or Benjamin or Christoph, respectively) is a knight/tells the truth" and provide a propositional formula over those atomic propositions exactly capturing the situation described above.

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

[1] `http://www.informatik.uni-freiburg.de/~ki/teaching/ss08/gki/coverSheet-english.pdf`