T-79.4201 **Autumn 2007**
Search Problems and Algorithms
Tutorial 11, 13 December
Problems

This is the last set of tutorial problems. The course exam is scheduled for Thu 20 Dec, 9–12, in Lecture Hall T1. Please verify the time and place from the DCSE department exam schedule, and remember to register for the exam via TOPI. Also, remember to provide feedback on the course via the department's course feedback system. The electronic questionnaires at
`http://www.cs.hut.fi/Opinnot/Palaute/kurssipalaute.html`
open Mon 10 Dec and close Mon 7 Jan.

1. Outline an Ant Colony Optimisation scheme for the 3-SAT problem. (Thus, the input is a propositional 3-cnf formula, and the goal is to find a truth assignment to the formula's variables that satisfies as many of its clauses as possible.)

2. Consider the Belief Propagation Algorithm applied to the 2-SAT formula

$$(x_1 \vee \bar{x_2}) \wedge (x_2 \vee x_3) \wedge (x_2 \vee \bar{x_4})$$

   (a) Draw the factor graph representation of the formula.

   (b) List all the satisfying truth assignments explicitly, and based on this list compute the biases $\beta_i(\xi) = \Pr_{x \in \mathcal{S}}(x_i = \xi)$ for each of the variables x_i and values $\xi \in \{0, 1\}$.

   (c) Apply the Belief Propagation Algorithm to estimate the biases. (Note that in a tree-like factor graph such as here, the algorithm should converge in a single two-way pass from the leaves of the tree to a chosen root and back.)

3. Outline a belief propagation method for the Graph 3-Colourability problem discussed earlier in the lectures (i.e. Graph Colouring with the number of colours fixed to $k = 3$).