T-79.4201 **Autumn 2006**
Search Problems and Algorithms
Tutorial 11, 7 December
Problems

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 $\beta_i(\xi) = \mathrm{Pr}_{x \in \mathrm{SAT}}(x_i = \xi)$ 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 $k = 3$).