T-79.4201 **Spring 2006**
Search Problems and Algorithms
Tutorial 4, 17 February
Problems

1. Consider the simulated annealing approach to solving the MAX CUT problem as discussed in problem 3 of last week's tutorial. What kind of cooling schedules would the simulated annealing convergence theorem presented at this week's lecture suggest in the case of a 3-regular input graph with n nodes? (3-regular $\equiv$ every node has exactly 3 neighbours.)

2. Consider the relationship between branch-and-bound optimisation and the A* algorithm. Reformulate the branch-and-bound approach to solving the TSP problem discussed at last week's lecture as an A* graph search. What are the nodes, edges and edge costs of the search graph? What are the functions f, g and h used in the A* algorithm in this case?

3. Prove that if the search graph (X, N) is finite, then an A* search using an admissible heuristic h always terminates with an optimal (i.e. minimum length) path from the start node x_0 to some goal node $x^* \in X^*$. (*Hint:* Show that until the algorithm terminates, there is always some node $x \in X$ in OPEN with the property that x lies on some optimal start-to-goal path and $f(x) \leq f^*$, where f^* is the cost of an optimal path.)

4. Draw the search space corresponding to the 3-SAT formula

$$(x_1 \vee x_2 \vee x_3) \wedge (\bar{x}_1 \vee x_2 \vee x_3) \wedge (x_1 \vee \bar{x}_2 \vee x_3) \wedge (x_1 \vee x_2 \vee \bar{x}_3) \wedge (\bar{x}_1 \vee \bar{x}_2 \vee x_3)$$

as a cube, and mark down at the corners of this cube the values of the objective function indicating the number of unsatisfied clauses at each point (= truth assignment). Trace the progress of a WalkSAT search with $p = 0$ along the corners of the cube, starting at initial point $(x_1, x_2, x_3) = (0, 0, 0)$.