T-79.4201 **Spring 2006**
Search Problems and Algorithms
Tutorial 10, 22 April
Problems

Note that because of the Easter break, there is no lecture on Thu 13 April, and no tutorial session on 14 April. Classes resume the following week.

1. Suppose you were designing a Genetic Algorithm for solving (a) the MAX CUT problem, (b) the MIN VERTEX COVER problem. (Cf. Tutorial 2.) What would you choose as the individuals ("chromosomes") in the algorithm, and what would be the objective fuction? How would you perform recombination ("crossover") of the individuals?

2. Suppose you were designing a Genetic Algorithm for solving the MIN TSP problem. What would you choose as the individuals ("chromosomes") in the algorithm, and what would be the objective fuction? How would you perform recombination ("crossover") of the individuals?

3. Verify the claim that if $m(H, p)$ denotes the number of individuals sampling schema H in population p, and $f(H, p)$ denotes the average fitness of schema H in population p, then the expected number of individuals sampling schema H after a proportional selection operation $\sigma(p)$ (say, roulette-wheel selection) satisfies:

$$E[m(H, \sigma(p))] = m(H, p) \cdot f(H, p).$$

4. (a) Observe that binary n-bit Gray codes correspond exactly to Hamiltonian tours (cycles) of the n-dimensional binary hypercube, whose corners are labeled by the respective coordinate strings $x \in \{0, 1\}^n$.

   (b) Validate the formulas for converting between the standard binary representation of integers and (one particular) Gray code representation given in the lectures. I.e., if $a_1 a_2 \ldots a_n$ is the standard representation and $b_1 b_2 \ldots b_n$ is the Gray code representation, then:

   - standard $\rightarrow$ Gray conversion: $b_i = \begin{cases} a_i, & i = 1, \\ a_{i-1} \oplus a_i, & i > 1. \end{cases}$
   - Gray $\rightarrow$ standard conversion: $a_i = \bigoplus_{j=1}^{i} b_j$.