CSCI/ENGR 8940 Computational Intelligence

Assignment Number 2: Due Thursday 2/27/2003 **(in class)**

1. **[10 points]**

   Consider a genetic algorithm using permutation representation with length 5. Consider the following two parents:

   ```
   Parent1: 1 2 3 4 5
   Parent2: 5 2 1 3 4
   ```

   (a) Give two examples of individuals that could result from doing the **swap** mutation (discussed in class) to Parent1.

   (b) Give an example of an individual that could result from doing the **order** crossover (OX) of Parent1 and Parent2. Briefly explain how you got this individual.

2. **[20 points]** Prove that that every individual has the same selection probability under each of the following selection methods:

   (a) Linear rank based selection (discussed in class) in which the population is sorted, each individual i gets a score of M-rank(i) where M is the population size, and proportional selection is done based on scores.

   (b) Deterministic binary tournament selection in which two distinct individuals selected randomly with uniform probability compete at each tournament.

   You may assume that no two individuals in the population have the same fitness value.

3. **[10 points]** Consider three strings S1=11101111, S2=00010100, and S3=01000011 and four schemata H1=0*******, H2=******11, H3=***0*00*, and H4=1110**1*.

   (a) Which schemata are matched by which strings?

   (b) What are the order and defining length of each of the schemata?

   (c) Estimate the probability of survival of each schema under mutation if the probability of a single mutation is Pm=0.001

4. **[10 points]** Define the fitness F of bit string x with length l=4 to be the integer represented by the binary number x (e.g., F(0011)=3, F(1111)=15).

   (a) What is the average fitness of schema 1*** under F?

   (b) What is the average fitness of schema 0*** under F?

   (c) What is the average fitness of schema ***1 under F?

   (d) What is the average fitness of schema ***0 under F?