Problem Set No. 2
BMI 226 / CS 426
Fall 2003

NAME_____

(1) Speculative Completion of Goldberg's 5-bit example run: Refer to the "new population" column of Table 1.2 on page 17 of Goldberg GASOML. Carry out the next generation of this run of the genetic algorithm.

(a) What is likely to happen to individual 1 on the next generation of the process?

(b) What is the likely new population?

(c) Looking at the middle bit (of the 5 bits), what possible value(s) can this bit attain in the future with the operations of fitness proportionate reproduction and crossover?

(d) What additional genetic operation can change the set of possible values that the middle bit can attain?

(2) Speculative New run of the "Hamburger" Problem: When the "Hamburger" problem is a second time, generation 0 for this new run consists of the 4 random individuals shown below. These 4 individuals are different from the 4 in the example in the book Genetic Programming.

GENERATION 0		MATING POOL		GENERATION 1	
Indiv	Fitness	Indiv	Fitness	Indiv	Fitness
010	2	010	2	001	1
101	5	101	5	110	6
100	4	101	5	101	5
001	1	100	4	100	4
Aver	3		4		4
Best	5		5		6
Worst	1		2		2

(a) The first and 2nd columns of the following table show the 27 schemata for binary strings of length 3. Fill in the 3rd column with the number of occurrences, m(H,0), of each of the 27 schema H at generation 0.

(b) How many of the 27 schemata are represented (i.e., have non-zero number of occurrences) in generation 0?

(c) What is the sum (i.e. crossfoot) of the m(H,0) over the 27 schemata at generation 0?

(d) Fill in the 4th column with the values of the scheme average fitness, f(H,0), for each of the 27 schema H for the initial random generation (i.e., generation 0).

(e) Assume the mating pool is created according to the expected values as shown above. Fill in the 5th column with the number of occurrences, m(H,MP), of each 27 schema H in the mating pool (MP).

(f) How many of the 27 schemata are represented in the mating pool (MP)?

(g) What is the sum of the m(H,MP) over the 27 schemata in the mating pool (MP)?

(h) Fill in the 6th column with the schema average fitness, f(H,MP), of each 27 schema H in the mating pool (MP).

(i) Assume that the crossover is performed between the first and second bits of the first and second individuals in the mating pool on this particular run, as shown above. The result is generation 1. Note that the global optimum 111 = 7 does not appear in generation 1 (but probably appears by generation 2, which is not shown). Fill in the 7th column with the number of occurrences, m(H,1), of each 27 schema H in generation 1.

(j) How many of the 27 schemata are represented in generation 1?

(k) What is the sum of the m(H,MP) over the 27 schemata in generation 1?

(L) Fill in the 8th column with the schema average fitness, f(H,MP), of each 27 schema H in generation 1.

(m) Fill in 9th column with the number m(H,t+1) predicted by the Fundamental Theorem of Genetic Algorithms (Holland "Schema" Theorem) for the active schema shown in column 7 generation no. 1.

		Gen 0		Mating Pool		Gen 1		
#	H	m(H,0)	f(H,0)	m(H,MP)	f(H,MP)	m(H,1)	f(H,1)	
1	000							
2	001							
3	00*							
4	010							
5	011							
6	01*							
7	0*0							
8	0*1							
9	0**							
10	100							
11	101							
12	10*							
13	110							
14	111							
15	11*							
16	1*0							
17	1*1							
18	1**							
19	*00							
20	*01							
21	*0*							
22	*10							
23	*11							
24	*1*							
25	**0							
26	**1							
27	***							