Topics Covered: This assignment covers: Evolutionary Computation (specifically, Genetic Algorithms, crossover, mutation, selection, Holland's Schema Theorem)

Must be done independently.

Complete the following problems/answer the following questions.

The Simple GA

Show the children that result from each of the GA operations described below:

(1) Single point crossover (random cross-point between elements 7 and 8---assume 0-based indexing) for the following pair of parents:

Parent 1: 0000001110010100

Parent 2: 1011011111111111

(2) Single point crossover (random cross-point between elements 4 and 5---assume 0-based indexing) for the following pair of parents:

Parent 1: 0000000000000000

Parent 2: 1111111111111111

(3) Two point crossover (random cross-points between elements 2 and 3, and between elements 6 and 7--assume 0-based indexing) for the following pairs of parents:

Parent 1: 0000001110010100

Parent 2: 1011011111111111

(4) Two point crossover (random cross-points between elements 2 and 3, and between elements 6 and 7--assume 0-based indexing) for the following pairs of parents:

Parent 1: 0000000000000000

Parent 2: 1111111111111111

For the following 2 questions (numbers 5 and 6), use the following stream of random floating-point numbers from the interval [0.0, 1.0). There are more than enough random values here. Use them in order and don't skip any: 0.2, 0.45, 0.1, 0.48, 0.6, 0.13, 0.75, 0.68, 0.9, 0.01, 0.51, 0.82, 0.1, 0.23, 0.32, 0.66, 0.71, 0.09, 0.99, 0.11, 0.68, 0.21, 0.34, 0.55, 0.52, 0.56, 0.48, 0.99, 0.43, 0.88, 0.47, 0.31, 0.36, 0.45, 0.1, 0.48, 0.6, 0.13, 0.75, 0.68, 0.9, 0.01, 0.09, 0.99, 0.11, 0.68, 0.2, 0.45, 0.1, 0.48, 0.21, 0.34, 0.55, 0.52, 0.56, 0.48, 0.99, 0.43, 0.88, 0.47

(5) Perform Uniform Crossover (using a value of 0.5 as uniform crossover's parameter value):

Parent 1: 0000001110010100

Parent 2: 1011011111111111

(6) Perform Uniform Crossover (using a value of 0.5 as uniform crossover's parameter value):

Parent 1: 0000000000000000

Parent 2: 1111111111111111

(7) Assuming we are using Fitness Proportionate Selection (weighted roulette wheel selection), assume we have a population of 10 bit-strings with the following fitness values, and indicate the probability of selecting each member of the population for transition to the next generation:

Population Member ID	1	2	3	4	5	6	7	8	9	10
Fitness	5	5	5	12	10	8	7	20	10	6
Selection Probability										

(8) Assuming we are using Stochastic Universal Sampling Selection (weighted wheel where you spin a wheel with N "arrows" once instead of spinning a single "arrow" N times), assume we have a population of 10 bit-strings with the following fitness values, and indicate the probability of selecting each member of the population for transition to the next generation:

Population Member ID	1	2	3	4	5	6	7	8	9	10
Fitness	5	5	5	12	10	8	7	20	10	6
Selection Probability										

Holland's Schema Theorem

(9) For each of the following schema, indicate its defining length, and its order.

Schema	Defining Length	Order
1010***01		
111001		
1*1******		

(10) We are using a GA for Boolean satisfiability, with a fitness function equal to the number of satisfied clauses. The instance has 8 variables, A, B, C, D, E, F, G, and H. The bit strings in our population are thus of length 8, one bit per variable, with 1 indicating true, and 0 indicating false. The order of the bits correspond to alphabetical order of the variables. That is, the first bit is the value for A, the second bit the value for B, etc. The Boolean function we are trying to satisfy is:
(A or B or C) and (~A or ~B or ~C) and (C or D or E) and (~C or ~D or ~E) and (E or F or G) and (~E or G or H) and (G or H or A) and (F or H or B).

What is the fitness of the schema: 000*1*00 ? [Show your work.]