

CS5401 FS2018 Exam 1

This is a closed-book, closed-notes exam. The only items you are allowed to use are writing implements. Mark each sheet of paper you use with your name and the string “cs5401fs2018 exam1”. If you are caught cheating, you will receive a zero grade for this exam. The max number of points per question is indicated in square brackets after each question. The sum of the max points for all the questions is 53, but note that the max exam score will be capped at 50 (i.e., there are 3 bonus points but you can’t score more than 100%). You have exactly 75 minutes to complete this exam. Keep your answers clear and concise while complete. Good luck!

Multiple Choice Questions - write the letter of your choice on your answer paper

1. Mutation has the potential to modify an individual’s: [2]
 - (a) genotype
 - (b) phenotype
 - (c) alleles
 - (d) fitness
 - (e) all of the above
 - (f) a, b, and c, but not d
2. Mutation has the potential to increase population diversity by: [2]
 - (a) increasing the number of unique fitness values without increasing the number of unique alleles
 - (b) increasing the number of unique alleles without increasing the number of unique phenotypes
 - (c) increasing the number of unique phenotypes without increasing the number of unique genotypes
 - (d) a, b, and c
 - (e) a and b, but not c
3. Which is the odd one out: [2]
 - (a) Random resetting mutation
 - (b) Uniform mutation
 - (c) Creep mutation
 - (d) Bit-flipping mutation
4. To increase selective pressure for an EA employing tournament parent selection one can: [2]
 - (a) switch from truncation survivor selection (i.e., deterministically replacing the worst individuals) to an elitist stochastic survivor selection
 - (b) decrease the tournament size used in parent selection
 - (c) both of the above
 - (d) none of the above

5. In an EA which utilizes truncation survival selection: [2]
- (a) the chance of premature convergence is lower than other elitist EAs
 - (b) the parent selection may not be elitist because that would cause premature convergence
 - (c) the parent selection should be stochastic to decrease the chance of premature convergence
 - (d) all of the above
 - (e) none of the above

Open Questions - write your answer on your answer paper

6. (a) What is the binary gray code for the standard binary number 0100111011? [2]
(b) What is the standard binary number encoded by the binary gray code 11100001? [2]
7. Given the following two parents with permutation representation:
 $p1 = (147628539)$
 $p2 = (193465872)$
- (a) Compute the first offspring with Cycle Crossover. [4]
 - (b) Compute the first offspring with PMX, using crossover points between the 3rd and 4th loci and between the 6th and 7th loci. [4]
 - (c) Compute the first offspring with Edge Crossover, except that for each random choice you instead select the lowest element. [8]
 - (d) Compute the first offspring with Order Crossover, using crossover points between the 2nd and 3rd loci and between the 7th and 8th loci. [3]

The last four questions are about the Light Up Puzzle assignment assuming that the genotype representation is any set of coordinate pairs (coordinates merely need to map to the dimensions of the grid) for bulb placements and the decoder function maps these sets to bulb placements in white cells on Light Up puzzle grids where no two bulbs shine on each other, black cell adjacency constraints are met, and fitness is determined by the number of cells lit up.

8. Explain whether this problem is unimodal or multimodal. [4]
9. Explain whether this encoding is pleiotropic and/or polygenetic. [2]
10. Explain whether this decoding function is surjective and/or injective. [4]
11. Say that constraint satisfaction techniques are to be employed in regard bulbs shining on each other.
- (a) Explain whether it would be better to (I) ignore the constraints, (II) upon generating an infeasible solution immediately kill it and generate a new solution, or (III) employ a penalty function. [4]
 - (b) Describe a possible instance of the decoder function given its description. [3]
 - (c) Propose a high-quality repair function. [3]