

## COMP 5660/6660/6666 Fall 2020 Exam 1 - Canvas Quiz

This is a closed-book, closed-notes exam. The sum of the max points for all the questions is 84, but note that the max exam score will be capped at 80 (i.e., there are 4 bonus points, but you can't score more than 100%). You have exactly 50 minutes to complete this exam. Keep your answers clear and concise while complete. Good luck!

1. Mutation has the potential to modify an individual's: [4 pts]

- (a) genotype
- (b) phenotype
- (c) alleles
- (d) fitness

Select one of:

- a
- b
- c
- d
- a, b, c, and d
- a, b, and c, but not d
- none of a, b, c, nor d

2. Mutation has the potential to increase population diversity by: [4 pts]

- (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

Select one of:

- a
- b
- c
- a and b, but not c
- a, b, and c
- none of a, b, nor c

3. To increase selective pressure for an EA employing tournament parent selection one can: [4 pts]
- switch from truncation survivor selection (i.e., deterministically replacing the worst individuals) to an elitist stochastic survivor selection
  - decrease the tournament size used in parent selection
  - increase the mutation rate
- a
  - b
  - c
  - a and b
  - b and c
  - a and c
  - a, b, and c
  - none of a, b, nor c
4. In an EA which utilizes truncation survival selection: [4 pts]
- the chance of premature convergence is lower than other elitist EAs
  - the parent selection must not be elitist because that would cause premature convergence
  - the parent selection should be stochastic to decrease the chance of premature convergence
- a
  - b
  - c
  - a and b
  - b and c
  - a and c
  - a, b, and c
  - none of a, b, nor c
5. What is the binary gray code for the standard binary number 010011011? [4 pts]
6. What is the standard binary number encoded by the binary gray code 1110001? [4 pts]
7. Given the following two parents with permutation representation:  
 $p1 = (435792168)$   
 $p2 = (623571489)$  compute the first offspring with Order Crossover, using crossover points between the 2nd and 3rd loci and between the 6th and 7th loci. Show your offspring construction steps. [6 pts]
8. Given the following two parents with permutation representation:  
 $p1 = (542176839)$   $p2 = (295463871)$  compute the first offspring with Cycle Crossover. Show first the cycles you've identified and then the construction of the offspring. [8 pts]
9. Given the following two parents with permutation representation:  $p1 = (542176839)$   $p2 = (425913876)$  compute the first offspring with PMX, using crossover points between the 2nd and 3rd loci and between the 6th and 7th loci. Show your offspring construction steps. [12 pts]

10. Given the following parents with permutation representation:  $p1 = (435792168)$   
 $p2 = (623571489)$  compute the first offspring with Edge Crossover, except that for each random choice you instead select the lowest element. Show how you arrived at your answer by filling the following templates: [16 pts]

Edge Table: 

Element	Edges
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Construction Table: 

Element Selected	Reason Selected	Partial Result
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The last three 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.

11. Given a mutation operator which is restricted to moving bulbs to adjacent cells, is this problem: [4 pts]

- (a) unimodal
- (b) multimodal
- (c) either unimodal or multimodal depending on the neighborhood structure
- (d) either unimodal or multimodal depending on the recombination operator

- a
- b
- c
- d

12. Explain whether this encoding is pleiotropic and/or polygenetic. [6 pts]

13. Explain whether this decoding function is surjective and/or injective. [8 pts]