COMP 5660/6660 Fall 2024 Exam 2

This is a closed-book, closed-notes exam. The sum of the max points for all the questions is 56, but note that the max exam score will be capped at 52 (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. When dealing with an extraordinarily large phenotype search space where only small distantly disconnected regions constitute valid solutions (i.e., small islands of validity in a gigantic sea of invalidity) and the fitness function does not account for constraint violations, which one of the following constraint satisfaction methods would be the most effective assuming that all are applicable? [4 pts]

   (a) Ignore Constraints
   (b) Kill Infeasible Solutions
   (c) Assign Arbitrarily Low Fitness
   (d) Penalty Function
   (e) Repair Function
   (f) Closed Feasible Solution Space
   (g) Feasible Decoder

   Select one of:

   - a
   - b
   - c
   - d
   - e
   - f
   - g

2. Which of the following would happen if a constraint-satisfaction EA using a penalty function had a self-adaptive penalty coefficient? [4 pts]

   (a) The mean penalty coefficient converges to a value effective for evolving good solutions.
   (b) The mean penalty coefficient varies over time to encourage evolving good solutions.
   (c) The mean penalty coefficient varies randomly, and does not improve the evolved solutions.
   (d) The mean penalty coefficient will decrease, leading to invalid solutions.

   Select one of:

   - a
   - b
   - c
   - d
   - none of a, b, c, nor d

3. How do fitness landscapes and utility landscapes differ? [4 pts]

   (a) Fitness values are stochastic while utility values are deterministic.
   (b) The notion of fitness is usually strongly related to the objective function of the problem in the application layer, while the notion of utility depends on the performance metrics used.
   (c) Tuning is the process of the algorithm designer optimizing utility at the algorithm layer.
   (d) Tuning is the process of the algorithm designer optimizing fitness at the application layer.

   Select one of:

   - a
   - b
   - c
   - d
   - a and b
   - a and c
   - a and d
   - b and c
   - b and d
   - c and d
   - a, b, and c
   - a, b, and d
   - a, c, and d
   - b, c, and d
   - a, b, c, and d
   - none of a, b, c, nor d

4. "Blind Parameter Control" is a better name for the class of parameter control mechanisms named "Deterministic Parameter Control" in the textbook because that class: [4 pts]

   (a) includes stochastic mechanisms
   (b) does not use any feedback from the evolutionary process
   (c) avoids biasing against dissimilar individuals in the population

   Select one of:

   - a
   - b
   - c
   - a and b
   - a and c
   - b and c
   - a, b, and c
   - none of a, b, nor c

5. Parameter Control is important in EAs because: [4 pts]

   (a) it somewhat relieves users from parameter tuning as parameter control tends to make EAs less sensitive to its initial parameter values
   (b) left uncontrolled, parameters may experience drift
   (c) optimal EA strategy parameter values may change during evolution
   (d) it significantly reduces the EA parameter space

   Select one of:

   - a
   - b
   - c
   - d
   - a and b
   - a and c
   - a and d
   - b and c
   - b and d
   - c and d
   - a, b, and c
   - a, b, and d
   - a, c, and d
   - b, c, and d
   - a, b, c, and d
   - none of a, b, c, nor d

6. For evolution strategies employing self-adaptation of mutation step sizes, when individual $(\bar{x}, \bar{\sigma})$ creates offspring $(\bar{x}', \bar{\sigma}')$ it is recommended to update the mutation step sizes $(\bar{\sigma})$ before updating the object variables $(\bar{x})$, because this allows: [4 pts]

   (a) the offspring to be evaluated directly for its viability during survivor selection

   (b) the offspring to be evaluated indirectly for its ability to create good offspring

   (c) the mutation step sizes to reflect the stage of the evolutionary process

   (d) the mutation step sizes to reflect the shape of the fitness landscape in its neighborhood

   Select one of:

   - a
   - b
   - c
   - d
   - a and b
   - a and c
   - a and d
   - b and c
   - b and d
   - c and d
   - a, b, and c
   - a, b, and d
   - a, c, and d
   - b, c, and d
   - a, b, c, and d
   - none of a, b, c, nor d

7. Which of the following are recommended for evolution strategies employing self-adaptation of mutation step sizes? [4 pts]

   (a) (μ, λ) strategy

   (b) $\lambda/\mu \approx 5$–7

   (c) discrete global recombination of object variables

   (d) intermediate global recombination of strategy parameters

   Select one of:

   - a
   - b
   - c
   - d
   - a and b
   - a and c
   - a and d
   - b and c
   - b and d
   - c and d
   - a, b, and c
   - a, b, and d
   - a, c, and d
   - b, c, and d
   - a, b, c, and d
   - none of a, b, c, nor d

8. Which of the following are important conclusions from Braden's research into the automated design of novel graph-based evolutionary cycles? [4 pts]

   (a) Automatically designing evolutionary cycles is quicker & easier than parameter tuning.

   (b) Automatically-designed evolutionary cycles can outperform even the best traditional EA configuration on certain problems.

   (c) An automatically-designed evolutionary cycle is more general (i.e., works effectively on a wider range of problems) than a well-tuned traditional EA.

   (d) The complexity of high-performing evolutionary cycles is *not* related to the complexity of the problem they were designed for.

   Select one of:

   - a
   - b
   - c
   - d
   - a and b
   - a and c
   - a and d
   - b and c
   - b and d
   - c and d
   - a, b, and c
   - a, b, and d
   - a, c, and d
   - b, c, and d
   - a, b, c, and d
   - none of a, b, c, nor d

9. In Multi-Objective EAs employing levels of non-domination, a decrease in the number of levels, generally will: [4 pts]

   (a) not impact the amount of selective pressure

   (b) increase the amount of selective pressure

   (c) decrease the amount of selective pressure

   (d) either increase or decrease the amount of selective pressure, depending on the number of conflicting objectives

   Select one of:

   - a
   - b
   - c
   - d
   - none of a, b, c, nor d

10. In Multi-Objective EAs employing levels of non-domination, if one kept increasing the number of conflicting objectives, then eventually the number of levels will converge on: [4 pts]

   (a) the number of conflicting objectives
   (b) the size of the population
   (c) the ratio of conflicting objectives to the population size
   (d) the optimal number specific to the multi-objective problem being optimized
   (e) one single level

   Select one of:

   - a
   - b
   - c
   - d
   - e
   - none of a, b, c, d, nor e

11. Say you want to purchase a GPU with the highest clock speed and the largest amount of memory, but you have a limited budget so you have to make a trade-off between these two objectives. You execute a multi-objective EA and the final population contains the solutions listed in the following table, where you're maximizing both objectives:

ID	Clock Speed	Memory
1	4	6
2	4	4
3	6	4
4	3	7
5	9	1
6	3	2
7	2	1
8	2	10
9	10	6
10	10	8

   (a) List for each element which elements it dominates; indicate elements with their IDs. [4 pts]

(b) Show the population distributed over non-dominated levels like some multi-objective EAs employ, after each addition of an element, starting with element 1 and ending with element 10, increasing the element number one at a time; indicate elements with their IDs. So you need to show ten different population distributions, the first one consisting of a single element, and the last one consisting of ten elements. [12 pts]