COMP 5660/6660 Fall 2023 Exam 3 Key

This is a closed-book, closed-notes exam. The sum of the max points for all the questions is 58, but note that the max exam score will be capped at 54 (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. The Pitt and Michigan approaches in Learning Classifier Systems differ in that: [4 pts]

   (a) in the Pitt approach each individual has the option of either representing a single rule or a rule set, while in the Michigan approach each individual represents a single rule and the entire population represents the complete rule set

   (b) in the Pitt approach each individual represents a single rule and the entire population represents the complete rule set, while in the Michigan approach each individual has the option of either representing a single rule or a rule set

   (c) in the Pitt approach each individual represents a complete rule set, while in the Michigan approach each individual represents a single rule and the entire population represents the complete rule set

   (d) in the Pitt approach each individual represents a single rule and the entire population represents the complete rule set, while in the Michigan approach each individual represents a complete rule set

   (e) in the Pitt approach each individual represents a complete rule set, while in the Michigan approach each individual has the option of either representing a single rule or a rule set

   Select one of:

   - a [2]
   - b [1]
   - **c**
   - d [2]
   - e [2]
   - none of a, b, c, d, nor e [0]

2. Differential evolution is characterized by the following: [4]

   (a) Representation: real-valued vectors

   (b) Mutation: differential mutation which guarantees that at least one element of the target individual's vector is replaced by an element based on three distinct randomly chosen individuals

   (c) Survival selection: deterministic elitist replacement

   Select one of:

   - a [1]
   - b [1]
   - c [1]
   - a and b [3]
   - a and c [3]
   - b and c [3]
   - **a, b, and c**
   - none of a, b, nor c [0]

3. The Baldwin Effect is: [4 pts]

   (a) improved EA performance obtained by applying local search prior to fitness calculation

   (b) improved EA performance obtained by applying local search after fitness calculation

   (c) improved EA performance obtained by combining local search with Lamarckian evolution

   Select one of:

   - **a**
   - b [2]
   - c [1]
   - none of a, b, nor c [0]

4. The Iterated Prisoner's Dilemma is a game where in successive rounds, two individuals without means of communication must decide whether to defect or cooperate; this game: [4 pts]

   (a) is technically not a competitive coevolution problem because it is a single population problem

   (b) is technically not a competitive coevolution problem because it is a single species problem

   (c) is technically not a cooperative coevolution problem because it is a single population problem

   (d) is technically not a cooperative coevolution problem because it is a single species problem

   Select one of:

   - a [0]
   - b [0]
   - c [0]
   - d [0]
   - a and b [0]
   - a and c [0]
   - a and d [0]
   - b and c [0]
   - b and d [0]
   - c and d [0]
   - a, b, and c [0]
   - a, b, and d [0]
   - a, c, and d [0]
   - b, c, and d [0]
   - all of a, b, c, and d [0]
   - **none of a, b, c, nor d**

5. Countermeasures to bloat in GP include: [4 pts]

   (a) increasing mutation rate to maintain genetic diversity

   (b) increasing parsimony pressure to penalize the fitness of large chromosomes

   (c) reducing the number of alleles to prevent disproportional tree growth

   Select one of:

   - a [0]
   - **b**
   - c [0]
   - a and b [2]
   - a and c [0]
   - b and c [2]
   - a, b, and c [1]
   - none of a, b, nor c [0]

6. Some of the issues Interactive EAs face are: [4 pts]

   (a) human fitness bottleneck (i.e., humans are relatively slow in evaluating trial solutions)

   (b) humans are prone to fatigue and loss of attention

   (c) humans can be inconsistent

   (d) due to the visual and memory limitations of humans, the number of solutions being ranked at any given moment, needs to be kept relatively small

   Select one of:

   - a [1]
   - b [1]
   - c [1]
   - d [1]
   - a and b [2]
   - a and c [2]
   - a and d [2]
   - b and c [2]
   - b and d [2]
   - c and d [2]
   - a, b, and c [3]
   - a, b, and d [3]
   - a, c, and d [3]
   - b, c, and d [3]
   - **all of a, b, c, and d**
   - none of a, b, c, nor d [0]

7. The exacerbation of premature convergence in memetic algorithms is due to: [4 pts]

   (a) limited seeding
   (b) diversity preserving recombination operators
   (c) non-duplicating selection operators
   (d) Boltzmann selection

   Select one of:

   - a [1]
   - b [0]
   - c [0]
   - d [0]
   - a and b [0]
   - a and c [0]
   - a and d [0]
   - b and c [0]
   - b and d [0]
   - c and d [0]
   - a, b, and c [0]
   - a, b, and d [0]
   - a, c, and d [0]
   - b, c, and d [0]
   - a, b, c, and d [0]
   - **none of a, b, c, nor d**

8. Which of the following is an example of intransitivity in competitive coevolution? [4]

   (a) Conflating historical progress with global progress in competitive coevolution
   (b) When agent A outperforms agent B against opponent X, but agent B outperforms agent A against opponent Y
   (c) Inaccurate fitness approximations caused by playing against too few opponents or non-performant opponents

   Select one of:

   - a [0]
   - **b**
   - c [0]
   - a and b [2]
   - a and c [0]
   - b and c [2]
   - a, b, and c [1]
   - none of a, b, nor c [0]

9. Which of the following are true about parallel EAs? [4]

   (a) They allow for distribution of evolution across multiple machines or CPUs

   (b) They can inhibit premature convergence if properly tuned

   (c) They can improve search efficiency if properly tuned

   (d) They must use subpopulations with identical parameters

   Select one of:

   - a [1]
   - b [1]
   - c [1]
   - d [0]
   - a and b [3]
   - a and c [3]
   - a and d [1]
   - b and c [3]
   - b and d [1]
   - c and d [1]
   - **a, b, and c**
   - a, b, and d [1]
   - a, c, and d [1]
   - b, c, and d [1]
   - all of a, b, c, and d [3]
   - none of a, b, c, nor d [0]

10. Which of the following are true about the Covariance Matrix Adaptation Evolution Strategy (CMA-ES) algorithm? [4]

    (a) Maintains a population consisting of children from the current generation and parents from previous generations

    (b) Maintains a probability distribution that is sampled to generate solutions

    (c) Uses a cycle of parent selection, child generation, and survival selection

    (d) Uses a cycle of ask, eval, and tell – to sample solutions, evaluate fitness, and update a multivariate distribution, respectively

    Select one of:

    - a [0]
    - b [2]
    - c [0]
    - d [2]
    - a and b [1]
    - a and c [0]
    - a and d [1]
    - b and c [1]
    - **b and d**
    - c and d [1]
    - a, b, and c [1]
    - a, b, and d [3]
    - a, c, and d [1]
    - b, c, and d [3]
    - all of a, b, c, and d [2]
    - none of a, b, c, nor d [0]

11. Which of the following are motivations for searching through algorithmic space to find new EA strategies (such as Braden's presentation on designing novel evolutionary cycles), rather than simply tuning parameters on a traditional EA? [4]

    (a) It consistently finds performant EA configurations more quickly than parameter tuning

    (b) It can potentially achieve better performance than any amount of parameter tuning could

    (c) The No Free Lunch Theorem tells us that parameter tuning alone cannot improve an EA's average performance across all problems, while algorithmic changes can

    (d) It may be able to come up with strategies which exploit problem-specific characteristics in ways that traditional EAs can't

    Select one of:

    - a [0]
    - b [2]
    - c [0]
    - d [2]
    - a and b [1]
    - a and c [0]
    - a and d [1]
    - b and c [1]
    - **b and d**
    - c and d [1]
    - a, b, and c [1]
    - a, b, and d [3]
    - a, c, and d [1]
    - b, c, and d [3]
    - all of a, b, c, and d [2]
    - none of a, b, c, nor d [0]

12. Which of the following genetic programming variants use a linear representation for their genotype? [4]

    (a) Tree genetic programming

    (b) Cartesian genetic programming

    (c) Stack-based genetic programming

    (d) Grammatical evolution

    Select one of:

    - a [0]
    - b [0]
    - c [2]
    - d [2]
    - a and b [0]
    - a and c [1]
    - a and d [1]
    - b and c [1]
    - b and d [1]
    - **c and d**
    - a, b, and c [1]
    - a, b, and d [1]
    - a, c, and d [3]
    - b, c, and d [3]
    - all of a, b, c, and d [2]
    - none of a, b, c, nor d [0]

13. Given the following bit strings v_1 through v_5 and schema S
    $v_1 = (11101110111101)$ $fitness(v_1) = 0.3$
    $v_2 = (10110010001101)$ $fitness(v_2) = 0.1$
    $v_3 = (00001010011010)$ $fitness(v_3) = 1.0$
    $v_4 = (01001110111001)$ $fitness(v_4) = 1.9$
    $v_5 = (11001011110101)$ $fitness(v_5) = 1.7$
    $S = (00000001111111)$

    (a) Compute the *order* of S. [2 pts]

    14

    (b) Compute the *defining length* of S and show your computation. [2 pts]

    14-1=13

    (c) Compute the fitness of S and justify your answer. [2 pts]

    Undefined because S doesn't match any of the given strings.

    (d) Do you expect the number of strings matching S to increase or decrease in subsequent generations? Explain your answer! [4 pts]

    Because S currently doesn't match any strings and eventually may match strings after sufficient recombination and mutation has taken place, the number of strings matching S is expected to eventually increase.