COMP 5660/6660 Fall 2022 Exam 3 Key

This is a closed-book, closed-notes exam. The sum of the max points for all the questions is 54, but note that the max exam score will be capped at 52 (i.e., there are 2 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. A Coevolutionary Algorithm (CoEA) is an EA: [4 pts]

   (a) where the fitness of each individual depends on one or more individuals from a different species

   (b) with exactly two populations

   (c) with two or more populations

   (d) where the fitness of each individual depends on one or more other individuals

   Select one of:

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

2. One countermeasure to cycling in competitive coevolution is maintaining a hall of fame which: [4 pts]

   (a) stores the most famous warriors of previous generations in order to intimidate current individuals in the opposing population

   (b) stores the best solutions found in previous generations to guarantee that the global best solution is preserved and not forgotten over and over again

   (c) consists of the best individuals of previous generations against who current individuals are competed to prevent later populations from "forgetting" about the winning traits of earlier generations

   Select one of:

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

3. Is it necessary in competitive coevolution to recompute each individual's fitness every generation? [4 pts]

   (a) Yes, because in competitive coevolution, fitness is dependent on other individuals, so it can change every generation.

   (b) Yes, because in competitive coevolution, the fitness of an individual in one population is dependent on the fitness of all the individuals in the competing population, so it can change every generation.

   (c) No, because in competitive coevolutionn, the fitness of an individual only needs to be recomputed when one or more of the opponents it was previously sampled against are eliminated.

   (d) No, because in all evolutionary algorithms, including coevolution, fitness is an absolute measure of the quality of the solution encoded in an individual.

   Select one of:

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

4. In competitive coevolution opponent selection methods: [4 pts]

   (a) individuals under random opponent sampling only need one opponent, because it selects an unbiased and uniform random representative

   (b) comparing against only the highest-fitness opponents is effective because the highest-fitness genotypes generally also have the most diversity

   (c) shared sampling generally results in robust coevolution, because it constructs a phenotypically diverse set of opponents

   (d) comparing against similar-strength opponents needs a surrogate fitness function, because strong individuals will receive mediocre fitness against other strong opponents

   Select one of:

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

5. A CIAO plot which at some point becomes uniformly dark is indicative of: [4 pts]

   (a) mediocre stability
   (b) cycling
   (c) disengagement

   Select one of:

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

6. A hyper-heuristic is: [4 pts]

   (a) a metaheuristic which searches algorithm space employing algorithmic primitives
   (b) a type of Genetic Programming to automate the design of algorithms employing a Turing complete set of primitives *(it can be a different type of metaheuristic than GP and typically should use higher order primitives than a Turing complete set to avoid an infeasibly large search space)*
   (c) a type of EA which employs algorithmic primitives extracted typically from existing algorithms to automate the design of algorithms *(it can be a different type of metaheuristic than an EA)*

   Select one of:

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

7. Hyper-heuristics are particularly well suited for: [4]

   (a) Sequential EAs

   (b) Synchronous Parallel EAs

   (c) Asynchronous Parallel EAs **(because hyper-heuristics are computationally expensive (so are particularly well suited for parallel computing) and tend to exhibit hetereogeneous execution times (so synchrony may be expected to cause excessive idling))**

   Select one of:

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

8. On a computer system with 200 computing cores and given a population size of 100 and an offspring size of 500, employing an Asynchronous Parallel EA (APEA) for evolving GP controllers for Pac-Man: [4 pts]

   (a) may be expected to reduce run-time versus a Synchronous Parallel EA (SPEA) because a SPEA cannot utilize more cores than the offspring size while an APEA can *(while the reason given is true, it doesn't apply here because* $\lambda = 500 \geq 200 =$ *# computing cores)*

   (b) may be expected to increase run-time versus a SPEA because an APEA cannot utilize more cores than the population size while a SPEA can

   (c) may be expected to reduce run-time versus a SPEA because a SPEA has to wait for the longest evaluation to complete while an APEA can exploit the heterogeneous evaluation times common to GP

   Select one of:

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

9. In the context of John Holland's Schema Theorem, which of the following statements are true: [4 pts]

   (a) The Building Block Hypothesis is that a genetic algorithm seeks near-optimal performance through the juxtaposition of short, low-order, high-performance schemata, called the building blocks.

   (b) Short, low-order, above-average schemata receive exponentially decreasing trials in subsequent generations of a genetic algorithm.

   (c) The result that a population of size μ will usefully process $O(\mu^3)$ schemata is known as Implicit Parallelism.

   Select one of:

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

10. Some of the advantages of Interactive EAs are: [4 pts]

    (a) handling situations with no clear fitness function

    (b) handing situations with changeable objectives and preferences

    (c) improved search ability through the user changing their guiding principle

    (d) increased exploration and diversity through direct user manipulation of the system

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

11. To battle the "human bottleneck" in interactive evolution, one can employ: [4 pts]

    (a) surrogate fitness functions

    (b) small population sizes

    (c) multi-objective EAs for problems that exhibit a mixture of quantitative and qualitative aspects

    (d) crowdsourcing

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

12. Given the following bit strings v_1 through v_5 and schema S
    $v_1 = (01101110101001)$ $fitness(v_1) = 0.8$
    $v_2 = (10110010011001)$ $fitness(v_2) = 0.1$
    $v_3 = (00001010011010)$ $fitness(v_3) = 1.0$
    $v_4 = (01001110111001)$ $fitness(v_4) = 1.2$
    $v_5 = (01001011100011)$ $fitness(v_5) = 1.9$
    $S = (01 * *11101 * 100*)$

    (a) Compute the *order* of S. [2 pts] 10

    (b) Compute the *defining length* of S. [2 pts] 13-1=12

    (c) Compute the fitness of S. [2 pts] $\frac{0.8+1.2}{2} = 1.0$

    (d) Do you expect the number of strings matching S to increase or decrease in subsequent generations? Explain your answer! [4 pts] *Average population fitness:* $\frac{0.8+0.1+1.0+1.2+1.9}{5} = 1.0$
    Decrease, because the fitness of S is equal to the average population fitness and S has a high-order and defining length so large destruction chance.