CS5401 FS2016 Exam 3 Key

This is a closed-book, closed-notes exam. The only items you are allowed to use are writing implements. Write your name in the designated spot on the top left of each of the exam pages. 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 32. Note that this exam consists of 12 multiple-choice questions followed by a multi-part open question. You have exactly 75 minutes to complete this exam. Good luck!

Multiple Choice Questions - circle the letter of your choice on the exam pages

1. The Limiting Cases in the Greedy Population Sizing EA (GPS-EA) are those instances when: [2]
   (a) both populations are stuck in a local minimum and the average fitness of the larger population is higher than the average fitness of the smaller population [1]
   (b) the larger population is stuck in a local minimum but the average fitness of the smaller population is larger than the average fitness of the larger population [$1\frac{1}{2}$]
   (c) **both populations are stuck in a local minimum and the average fitness of the larger population is lower than the average fitness of the smaller population**
   (d) none of the above [0]

2. In the hybridization of the GPS-EA and ELOOMS, the Limiting Cases are detected by: [2]
   (a) **none of the individuals desiring to mate with an individual who reciprocates that desire**
   (b) the average fitness of the mating pool being higher than the average population fitness [0]
   (c) the average fitness of the mating pool being lower than the average population fitness [0]
   (d) none of the individuals desiring to mate with any other individual [1]
   (e) none of the above [0]

3. A shortcoming of the GPS-EA + ELOOMS hybrid in terms of population size control is: [2]
   (a) the lack of support for dynamic population size control [1]
   (b) that it can overshoot the optimal population size because of the stochastic nature of the doubling criterion [$\frac{1}{2}$]
   (c) its inability to reuse the high-quality individuals identified in preceding populations [$\frac{1}{2}$]
   (d) **all of the above**
   (e) none of the above [0]

4. The challenge when employing parameter control in order to reduce the number of EA strategy parameters which the practitioner has to configure is: [2]
   (a) the introduction of "stealth" parameters, namely new parameters to control the parameter control, which may be as hard or harder to tune than the parameter(s) eliminated by the employment of the parameter control [1]
   (b) the introduction of "stealth" parameters, namely new parameters to control the parameter control, which cause a dynamic derived variable associated with the eliminated EA strategy parameter to converge to a fixed value deterministically specified by the stealth parameters [1]
   (c) the interaction between the parameter control of different operators, such as population sizing and offspring sizing, may be complex and hard to tune [$\frac{1}{2}$]
   (d) **all of the above**
   (e) none of the above [0]

5. In Supportive Coevolution, the fitness of an individual in a support population (the support individual) is determined by: [2]
   (a) the fitness of the associated individual in the primary population (the primary individual) [$\frac{1}{2}$]
   (b) the fitness of the individual in the primary population employing the strategy parameter/operator encoded in the support individual [1]
   (c) **the average fitness of the individuals in the primary population employing the strategy parameter/operator encoded in the support individual**
   (d) none of the above [0]

6. A hyper-heuristic is: [2]
   (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 [1] *(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 [$1\frac{1}{2}$] *(it can be a different type of metaheuristic than an EA)*
   (d) all of the above [1]
   (e) none of the above [0]

7. In order for a hyper-heuristics to target not only a specific class of problems (e.g., SAT) but also a specific computational architecture (e.g., Intel Xeon processor with lots of cache): [2]
   (a) this is not possible because hyper-heuristics work independent from the computational architecture [0]
   (b) they need to reflect the efficiency of the evolved algorithm in the fitness function [1]
   (c) they need to be supplied with algorithmic primitives which not only are suited to the specific class of problems being targeted, but also allow the differences between computational architectures to be exploited [1]
   (d) **answers b and c**
   (e) none of the above [0]

8. A CIAO plot: [2]
   (a) **visualizes the progress of two populations in competitive coevolution where the luminance of each pixel (x, y) indicates the relative performance of the y-axis population's fittest individual in generation y versus the x-axis populations fittest individual in generation x**
   (b) visualizes the relative performance of two populations in competitive coevolution where the luminance of each pixel (x, y) indicates the average performance of individual y from the y-axis population versus all its ancestors fittest opponents [1]
   (c) isn't a plot, "ciao" is Italian for "hello" [0]
   (d) none of the above [0]

9. A CIAO plot which at some point becomes uniformly dark is indicative of: [2]
   (a) mediocre stability [1]
   (b) cycling [0]
   (c) **disengagement**
   (d) answers a and b [$\frac{1}{2}$]
   (e) answers a and c [$1\frac{1}{2}$]
   (f) answers b and c [1]
   (g) answers a, b, and c [1]
   (h) none of the above [0]
10. On a computer system with 400 computing cores and given a population size of 200 and an offspring size of 300, employing an Asynchronous Parallel EA (APEA) for evolving GP controllers for Pac-Man: [2]
    (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 [1]
    (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 [0]
    (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 [1]
    (d) answers a and b [$\frac{1}{2}$]
    (e) answers b and c [$\frac{1}{2}$]
    (f) **answers a and c**
    (g) answers a, b, and c [1]
    (h) none of the above [0]
11. "Intelligent" initialization in a memetic algorithm can be performed by: [2]
    (a) Seeding [$\frac{1}{2}$]
    (b) Selective Initialization [$\frac{1}{2}$]
    (c) Locally Optimized Random Initialization [$\frac{1}{2}$]
    (d) Mass Mutation [$\frac{1}{2}$]
    (e) **all of the above**
    (f) none of the above [0]
12. If we employ self-adaptation to control the value of penalty coefficients for an EA with an evaluation function which includes a penalty function, then: [2]
    (a) the penalty coefficients will be self-adapted to cause fitness improvement just like, for instance, mutation step sizes [1]
    (b) this cannot be done because it is inherently impossible to self-adapt any part of the evaluation function [$\frac{1}{2}$]
    (c) **the penalty coefficients will be self-adapted, but the increase in fitness achieved may not be correlated with better performance on the objective function**
    (d) none of the above [0]

Regular Questions - write your answer under the question on the exam page

13. Given the following bit strings v_1 through v_5 and schema S
$v_1 = (11101110111101)$ $fitness(v_1) = 0.3$
$v_2 = (10110010001101)$ $fitness(v_2) = 0.1$
$v_3 = (00001010011010)$ $fitness(v_3) = 1.0$
$v_4 = (01001110111001)$ $fitness(v_4) = 1.9$
$v_5 = (11001011110101)$ $fitness(v_5) = 1.7$
$S = (1********1*101)$

(a) Compute the *order* of S. [1]
5

(b) Compute the *defining length* of S and show your computation. [1]
14-1=13

(c) Compute the fitness of S and show your computation. [2]
$\frac{0.3+1.7}{2} = 1.0$

(d) Do you expect the number of strings matching S to increase or decrease in subsequent generations? Explain your answer! [4]
Average population fitness: $\frac{0.3+0.1+1.0+1.9+1.7}{5} = 1.0$

Decrease, because the fitness of S is equal to the average population fitness and S has a moderate order and high defining length so above average destruction chance.