COMP 5660/6660 Fall 2021 Exam 2 - Canvas Quiz Key

This is a closed-book, closed-notes exam. The sum of the max points for all the questions is 70, but note that the max exam score will be capped at 66 (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. Fitness sharing differs from crowding in that fitness sharing: [4]

   (a) results in panmictic mating
   (b) results in niches sized proportional to fitness
   (c) implicitly requires fitness proportionate selection
   (d) implicitly requires fitness ranked selection

   Select one of:

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

2. Panmictic mate selection in EAs has the following properties: [4]

   (a) strategy parameters are fixed during an EA run
   (b) no genotypic restrictions on mating
   (c) more fit individuals mate more often
   (d) process of tuning mate selection parameters for each problem is time-consuming

   Select one of:

   - a [0]
   - **b**
   - c [0]
   - d [0]
   - a and b [1]
   - a and c [0]
   - a and d [0]
   - b and c [2]
   - b and d [2]
   - c and d [0]
   - a, b, and c [1]
   - a, b, and d [1]

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

3. Meta Evolutionary Programming (Meta-EP) is characterized by: [4]

   (a) borrowing the self-adaptation of mutation step sizes from Evolutionary Strategies
   (b) self-adapting covariance matrices
   (c) combining Gaussian & Cauchy distributions to generate random mutations
   (d) evolving the parameters of an EP which in turns is solving a problem

   Select one of:

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

4. The phenomenon of bloat in GP occurs most likely because: [4]

   (a) individuals with bigger genomes have a larger chance of survival (also known as "survival of the fattest")
   (b) the variable length aspect of GP causes a natural tendency for the population to reflect the different possible sizes
   (c) the ratio of alleles to genes in bloated individuals is higher than non-bloated individuals which gives them an evolutionary advantage

   Select one of:

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

5. The ramped half-and-half method is the most common technique in GP for: [4]

   (a) initialization
   (b) parent selection
   (c) survival selection
   (d) termination

   Select one of:

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

6. Over-selection is employed in GP because: [4]

   (a) GP typically uses large trees which suffer from bloat

   (b) GP typically uses fitness proportionate selection which suffers from premature convergence

   (c) GP typically uses large populations which cause excessively high selective pressure

   Select one of:

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

7. 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: [4]

   (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

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

8. 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 hetereogenerous 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]

9. In an EA employing Lamarckian evolution: [4]

(a) improved EA performance is obtained through the Baldwin effect

(b) improved EA performance is obtained through local search

(c) acquired traits are passed on genetically

Select one of:

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

10. Dawkin's concept of a "meme" is: [4]

(a) the addition of a learning phase to the evolutionary cycle

(b) a unit of biological transmission

(c) a unit of cultural transmission

(d) a process of imitation

Select one of:

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

11. Learning Classifier Systems are technically speaking: [4]

(a) a type of Condition-Action Rule-Based System

(b) a type of Reinforcement Learning System

(c) a type of Evolutionary Algorithm

Select one of:

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

12. Pittsburgh-style LCS: [4]

    (a) predates but is similar to GP in that each individual represents a complete model mapping input to output spaces

    (b) each gene typically represents a rule

    (c) tends to outperform Michigan-style LCS given sufficient computing resources and effective parsimony methods

    (d) suffers from bloat similar to GP

    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]

13. The n-bit multiplexer function consist of k address bits a_i followed by 2^k data bits d_j where $n = k + 2^k$ and the function is defined as $a_{k-1}, \ldots, a_1, a_0, d_{2^k-1}, \ldots, d_1, d_0$. Assume a Michigan-style Learning Classifier System (LCS) to solve a 6-bit multiplexer problem with the following rule set:
    Rule 1: 1#1### : 0 $\rightarrow$ 35
    Rule 2: 11###0 : 0 $\rightarrow$ 15
    Rule 3: 1#1100 : 1 $\rightarrow$ 20
    Rule 4: #11##0 : 1 $\rightarrow$ 40
    Rule 5: #00100 : 0 $\rightarrow$ 50
    Rule 6: #1##0# : 1 $\rightarrow$ 10

    If the input string 111100 is presented to this LCS:

(a) which rules will the match set consist of? [2]

Rules 1, 2, 3, 4, 6

(b) which rules will the action set consist of and what action will the LCS execute? Show how you computed this. [6]

Group them by advocated action and compute predicted action payoff:
Action 0: Rules 1 & 2: Mean predicted action payoff: (35+15)/2=25
Action 1: Rules 3, 4 & 6: Mean predicted action payoff: $(20 + 40 + 10)/3 = 23\frac{1}{3}$
Highest predicted payoff action: Action 0
Action set: Rules 1 & 2
LCS executes Action 0

14. Say you need to purchase a GPU on a budget for executing machine learning experiments, so want to maximize both VRAM and affordability. You execute a multi-objective EA and the final population contains the solutions listed in the following table, where higher VRAM and higher affordability are desired (i.e., maximize both objectives):

ID	VRAM	Affordability
1	8	3
2	4	4
3	2	5
4	1	6
5	8	4
6	4	3
7	2	2
8	1	9
9	8	1
10	4	7

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

ID	Dominates
1	6,7,9
2	6,7
3	7
4	None
5	1,2,6,7,9
6	7
7	None
8	4
9	None
10	2,3,4,6,7

(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. [10]

After adding element 1:

- **Level 1:** 1

After adding element 2:

- **Level 1:** 1,2

After adding element 3:

- **Level 1:** 1,2,3

After adding element 4:

- **Level 1:** 1,2,3,4

After adding element 5:

- **Level 1:** 3,4,5
- **Level 2:** 1,2

After adding element 6:

- **Level 1:** 3,4,5
- **Level 2:** 1,2
- **Level 3:** 6

After adding element 7:

- **Level 1:** 3,4,5
- **Level 2:** 1,2
- **Level 3:** 6
- **Level 4:** 7

After adding element 8:

- **Level 1:** 3,5,8
- **Level 2:** 1,2,4
- **Level 3:** 6
- **Level 4:** 7

After adding element 9:

- **Level 1:** 3,5,8
- **Level 2:** 1,2,4
- **Level 3:** 6,9
- **Level 4:** 7

After adding element 10:

- **Level 1:** 5,8,10
- **Level 2:** 1,2,3,4
- **Level 3:** 6,9
- **Level 4:** 7