COMP 5660/6660 Fall 2025 Exam 2 Key

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. Good luck!

Multiple Choice Questions

1. A (1+1) EA is equivalent to: [4 pts]

   (a) random search
   (b) hill climber
   (c) simulated annealing
   (d) stochastic universal sampling

   Select one of:

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

2. Which of the following EA constraint satisfaction methods inherently reduce the effective search space: [4 pts]

   (a) Penalty Function
   (b) Repair Function
   (c) Closed Feasible Solution Space
   (d) Feasible Decoder

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

3. The process of parameter tuning in evolutionary computation requires: [4 pts]

   (a) Utility Function
   (b) EA (not an EA instance)
   (c) Test Problem(s)
   (d) Tuner

   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]

4. Which of the following are methods of parameter control in evolutionary computation: [4 pts]

   (a) Blind parameter control
   (b) Adaptive parameter control
   (c) Self-adaptive parameter control

   Select one of:

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

5. In Multi-Objective problems a solution x is said to be dominated by a solution y when: [4 pts]

   (a) solution x is no better than y in all objectives

   (b) solution x is strictly worse than y in no more than one objective

   Select one of:

   - a [2]
   - b [0]
   - a and b [2]
   - **none of the above**

6. In Evolution Strategies (ES), the purpose of uncorrelated mutation with n $\sigma's$ rather than just one σ is: [4 pts]

   (a) to ensure proportionality between the different coordinates while allowing for an overall change of the mutability

   (b) the sum of n normally distributed variables is also normally distributed thus guaranteeing Gaussian mutation

   (c) coordinate specific step sizes provide the flexibility to use different mutation strategies in different directions

   Select one of:

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

7. The selection scheme generally used in Evolution Strategies (ES) is (μ, λ), because: [4 pts]

   (a) (μ, λ) discards all parents and so can easier escape local optima than $(\mu + \lambda)$.

   (b) In nonstationary environments (i.e., fitness changes over time), $(\mu + \lambda)$ preserves outdated solutions, so is less able to follow the moving optimum.

   (c) $(\mu + \lambda)$ hinders self-adaptation, because misadapted strategy parameters may survive for a relatively large number of generations.

   Select one of:

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

8. Modern Evolutionary Programming (EP) is practically merging with modern Evolution Strategies (ES) in the aspects of: [4 pts]

   (a) parent selection

   (b) self-adaptation of mutation step sizes

   (c) the order in which mutation variables and strategy parameters are updated

   Select one of:

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

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

   (a) The best graphs found in Braden's research are very similar to traditional EAs

   (b) Braden's graph representation is equivalent to traditional parameter tuning, but the graph representation is easier to modify

   (c) The best graph EAs can outperform the best traditional EAs on certain problems

   (d) More difficult problems benefit from more complex algorithms, while easy problems might not require complex algorithms

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

10. There is no recombination in "standard" Evolutionary Programming (EP) because: [4 pts]

    (a) extensive research has shown that the use of recombination is counterproductive in EP

    (b) EP was conceived before the invention of recombination

    (c) each individual in "standard" EP is viewed as the abstraction of a species

    Select one of:

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

11. Say you want to purchase a new house and care most about maximizing square footage and minimizing price. You collect square footage data and pricing on ten different houses and then you normalize both the square footage data and the pricing which results in the following table, where higher square footage numbers indicate greater square footage and higher affordability numbers indicate lower price:

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

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

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

(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]

After adding element 1:
Level 1: 1

After adding element 2:
Level 1: 2
Level 2: 1

After adding element 3:
Level 1: 2,3
Level 2: 1

After adding element 4:
Level 1: 2,3,4
Level 2: 1

After adding element 5:
Level 1: 2,3,4
Level 2: 1,5

After adding element 6:
Level 1: 2,3,4,6
Level 2: 1,5

After adding element 7:
Level 1: 2,3,4,6
Level 2: 1,7
Level 3: 5

After adding element 8:
Level 1: 2,3,4,6
Level 2: 1,7
Level 3: 5,8

After adding element 9:
Level 1: 2,3,4,6
Level 2: 7,9
Level 3: 1,5
Level 4: 8

After adding element 10:
Level 1: 2,3,4,6
Level 2: 7,9,10
Level 3: 1,5
Level 4: 8