Evolutionary Computation

Example exam

This is a 'closed book' exam: you can only make use of a single sheet of paper with your own notes (A4, double-sided). Write your name, student number and study program on the first page, and your name on any extra pages. DO NOT BE TOO BRIEF: ALWAYS CLARIFY YOUR ANSWER. If you prefer, you can write down your answers in Dutch.

1. In the lectures notes on population sizing it is stated that $P[SelErr] = \Phi(\frac{-1}{\sqrt{2(\ell-1)p(1-p)}})$. What does this mean ? Explain all symbols used. What are the assumptions made to derive this equation ? How is this equation derived ?

2. Assume we have a population of 1000 cows whose milk production is normally distributed with mean value 10 litres and standard deviation 2 litres. Calculate the expected mean value of the milk production of the 500 cows that are selected from the original group according to their milk production using the following selection algorithms (note: higher milk production is better):

   (a) standard proportionate selection

   (b) tournament selection with tournament size 2

   (c) truncation selection with threshold 50%

3. The paper on map labeling discusses guiding rules to design efficient selecto-recombinative genetic algorithms. These rules are based on the models for convergence behavior and population sizing. Explain what these guiding rules are recommending.

4. Explain how the Greedy Partitioning Crossover (GPX) is applied to graph coloring problems. Why is this crossover beter suited for graph coloring than an assignment based crossover ?

5. Consider the adaptive pursuit algorithm and the probability matching algorithm for allocating an operator to the current state of our search process. Assume we have 4 possible operators $\{a_1, a_2, a_3, a_4\}$ to choose from. The current probability vector is $P(t) = [0.1; 0.2; 0.3; 0.4]$ and the current reward estimate is $Q(t) = [5; 10; 15; 20]$. After applying the currently most likely operator we receive a reward of 40. Calculate for both algorithms the updated values $P(t+1)$ and $Q(t+1)$ when $\alpha = 0.5$, $\beta = 0.75$, and $P_{max} = 0.85$.

6. Explain how selection can be performed in multi-objective optimization with evolutionary algorithms using the concept of domination ranks.