Student Number (Required) ______________________

Name (Optional)________________________________

This is a closed book test. You may not refer to any resources.

This is a 50 minute test.

Please write your answers in ink. Pencil answers will be marked, but will not be reconsidered after the test papers have been returned.

The test will be marked out of 50.

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Question 1 (8 Marks)

Branch and Bound Algorithms and Genetic Algorithms are both designed to find a solution to an optimization problem by searching the set of possible solutions. B&B proceeds by constructing good solutions step by step, while GA takes a set of possible solutions and modifies them to try to create better solutions.

(a) Under what conditions would it be preferable to use a Branch and Bound Algorithm rather than a Genetic Algorithm?

(b) Under what conditions would it be preferable to use a Genetic Algorithm rather than a Branch and Bound Algorithm?
Question 2 (5 Marks)

What is the purpose of mutation in a Genetic Algorithm?
Question 3 (5 marks)

In a Genetic Algorithm we choose members of the current population to be the parents of new offspring, with preference given to the stronger members.

Why don’t we simply use every possible pairing of members of the current generation to produce new offspring, and then keep only the best ones?

(Hint: what if the current population has 1000 members – which is an entirely plausible number for real-world applications?)
Question 4: (30 marks)

The League of Rational People has successfully landed on Titan, thanks to your excellent work on assigning people to space ships. Now comes the task of assigning people to living space. Nobody got left behind so there are still exactly n people.

It turns out that the surface of Titan holds a number of caves, all conveniently warm, well lit and filled with breathable air.

Each person is to be granted some number of square meters of floor space for their personal use. The number can be any value in the range [50 .. 100]. The more space a person has, the happier they will be – in fact there is a happiness function \( f(p, s) \) that tells you how happy person \( p \) is if they are given \( s \) square meters. Unfortunately you can’t just give everyone 100 square meters because the total allocation of space must be \( \leq k \), where \( k \) is the total amount of available floor space (we know \( 50n \leq k < 100n \)).

Design a genetic algorithm to search for a good solution to this problem. Your goal is to maximize the sum of the happiness of the population.

For most parts of this question there is more than one reasonable answer. Whatever answer you give, explain your reason for choosing it.

There are six parts to this question. Each part is worth 5 marks.
(a) Describe how you will represent each solution as a vector. Specify clearly what the individual elements of the vector represent.

(b) Describe how you will compute the value of any given solution.
(c) Describe how you will ensure that each vector of values in your population represents a feasible solution.

(d) Describe how you will generate the initial population of feasible solutions.
(e) Describe the cross-over operation you will use.

(f) Describe the mutation operation you will use.
Question 5: (2 marks)

True or False: The Hamming Cliffs are located in the Rocky Mountains near Banff.

FALSE