ST ANDREW'S CATHEDRAL SCHOOL
FOUNDED 1885

Computer Science
Higher Level
Paper 3

August, 2021

Duration: 60 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- A clean copy of the **computer science case study** is required for this examination paper.
- Answer all questions.
- The maximum mark for this examination paper is **[30 marks**].
- Make sure all your responses are clearly labelled with their question number.

Question 1

(a) Outline one ***decision***, AND as its associated ***condition***, that is made by an ***evaluation*** sub-program in a genetic algorithm.

[2 marks]

(b) Fenna is wanting to implement one of the crossover algorithms discussed in the cases study. Evaluate the use of arrays, collections, linked lists and binary trees as possible data structures for her implementation.

[4 marks]

Question 2

(a) Identify the ***inputs*** that a fitness function takes, and the ***outputs*** it gives.

[2 marks]

(b) The fitness function in the genetic algorithm that addresses the travelling salesman problem is relatively straightforward to execute. Explain reasons why fitness functions in genetic algorithms that address other scenarios may be much more computationally expensive.

[3 marks]

Question 3

(a) Explain what the ***mutate*** sub-program does in a genetic algorithm.

[2 marks]

(b) Evaluate the use of ***brute force*** algorithms, ***hill climbing*** algorithms and ***genetic algorithms*** in computationally intractable problems.

[5 marks]

Question 4

Fenna has been given the job of packing ***items*** into ***containers*** for a large company. The items to pack have ***varying weights*** and all weigh less than 9 kg. Each container has a ***maximum capacity*** of 9kg. There is a significant cost for each ***container*** and so Fenna is asked to use the ***fewest number of containers*** *she can*.

Fenna recognises this problem as computationally intractable and decides to use a genetic algorithm to help figure out optimal item arrangements. Discuss how Fenna could incorporate elitism, mutation rate, cross-over operators, fitness functions and selection strategies into her algorithm.

[12 marks]

End of Examination