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|  | **Entrance Examination**  **March 2022** |
| **COMPUTER SCIENCE**  Time allowed: 1.5 hours (90 minutes)  The questions in this paper are divided into two sections: A and B.  Answer **TWO** questions in total,  i.e. the only question in section A and your choice of question from section B.  Each question answered will be worth 50 marks. | |

### **SECTION A**

1. a) In a ‘typed’ programming language of your choice (not in a database), what data structures or primitive data types would be most appropriate for storing each of the following? Please specify the programming language used. You should provide reasons for your answers:

* The number of students in a room
* The distance between two points in a school, in kilometres
* A person’s gender
* A UK car registration number e.g. AB12CDE
* The result of a mathematical expression such as (x+2)2 >3y
* The humidity reading in each room in a house
* A collection of information about a car – e.g. make, manufacturer, engine size, colour etc.
* The same information about a number of cars in a street
* A pile of cards to be used in a game of solitaire
* The state of the board in a game of noughts and crosses (tic-tac-toe)

[15 marks]

b) Write an algorithm in clear pseudo code, i.e. write down the detailed steps using ideas like:

while (some condition is true)

do some action

repeatedly

if (something is true) then

do action 1

else

do action 2

**or**

if (something is true)

then

do action 1

else

that describes how you can find all of the factors of each of the numbers from 120 to 500. For example, the factors of 16 are 2, 4 and 8 because:

2x8=16

4x4=16

8x2=16

Your answer should specify the data structures that you use, list any optimisations that you have made, and may describe other optimisations that you could make, specifically addressing the trade off between memory use and execution speed. You may wish to add additional comments to explain your algorithm.

[19 marks]

c) A software engineer is writing software to process a large text file. The file contains DNA data (i.e. 4 values G, A, T and C as characters).

(i) Describe the data structures and/or variable types that she might reasonably use to perform a count of the number of times each character appears in the file and propose an algorithm to perform the task.

[8 marks]

(ii) Describe how your algorithm would change, and the computational burden that might be created, if instead of counting individual characters she wanted to count the number of times each possible n-character long DNA sequence appeared.

[8 marks]

### **SECTION B**

2. Giving examples from your own experience where necessary:

a) Explain what an **operating system** is and what it does.   
 [20 marks]

b) How would an operating system present its services to the following?

i)The end user.

ii) An application program.  
 [12 marks]

c) Discuss the possibility of a computer system which does not have an operating system, and how that would affect any programs that run on that computer.  
 [18 marks]

3. a) The term “Cloud Computing” has become well used in the mainstream media and in more technical situations. Provide a reasoned explanation of what **The Cloud** is, and describe the various different meanings of the term **Cloud Computing.** Your answer should consider the positive and negative consequences of using Cloud technologies for an individual.

[30 marks]

b) Many devices are now marketed as “Internet-enabled”, from smartphones to home automation devices to environmental monitoring sensors. Discuss the privacy and security issues that these devices can cause, and whether these are significant compared with the benefits that internet enabling provides.

[20 marks]