Text

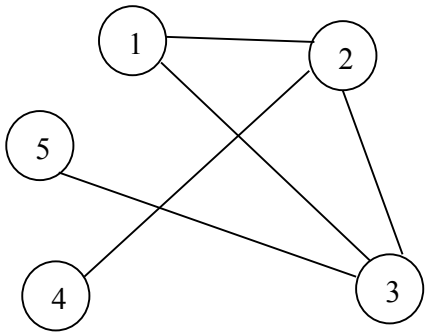
0 3 The Cat transportation company (CTC) is a business that specialises in preparing cats for cat shows.

They need to take five cats to the AQA cat show. They will transport the cats in their van. CTC owns only one van.

They cannot put all the cats in their van at the same time because some of the cats get stressed when in the company of some of the other cats. The cats would not therefore arrive in top condition for the cat show if they were all in the van at the same time.

The graph in **Figure 3** shows the relationships between the five cats (labelled 1 to 5). If there is an edge between two cats in the graph then they **cannot** travel in the van together at the same time.

Figure 3



0 3 . 1 Explain why the graph in **Figure 3** is **not** a tree.

[1 mark]

0 3 . 2 Represent the graph shown in **Figure 3** as an adjacency list by completing **Table 3**.

Complete **Table 3** and copy the table into the Electronic Answer Document.

[2 marks]

Table 3

Vertex (in Figure 3)	Adjacent vertices
1	
2	
3	
4	
5	

Table 4 shows how the graph in **Figure 3** can be represented as an adjacency matrix.

Table 4

Vertex (in Figure 3)	1	2	3	4	5
1	0	1	1	0	0
2	1	0	1	1	0
3	1	1	0	0	1
4	0	1	0	0	0
5	0	0	1	0	0

0 3 . 3 Explain the circumstances in which it is more appropriate to represent a graph using an adjacency list instead of an adjacency matrix.

[2 marks]

Question 3 continues on the next page

Figure 4 shows an algorithm, written in pseudo-code, that CTC use.

Figure 4

```
NoOfCats ← 5
Cat[1] ← 1
FOR A ← 2 TO NoOfCats
  B ← 1
  C ← 1
  WHILE B < A DO
    IF M[A, B] = 1
      THEN
        IF Cat[B] = C
          THEN
            B ← 1
            C ← C + 1
          ELSE B ← B + 1
        ENDIF
      ELSE B ← B + 1
    ENDIF
  ENDWHILE
  Cat[A] ← C
ENDFOR
```

The two-dimensional array, `M`, is used to store the adjacency matrix shown in **Table 4**.

0 3 . 4 Complete **Table 5** to show the result of tracing the algorithm in **Figure 4**.

[6 marks]

Copy your answer in **Table 5** into the Electronic Answer Document.

Table 5

				Cat				
NoOfCats	**A**	**B**	**C**	**1**	**2**	**3**	**4**	**5**

0 3 . 5 Explain the purpose of the algorithm in **Figure 4**.

[1 mark]

After a cat show, CTC needs to return the cats to their owners. They can have all the cats in the van at the same time because the show is now finished.

CTC likes to plan the return journey so that the shortest possible distance is travelled by the van. This is an example of an intractable problem.

0 3 . 6 What is meant by an intractable problem?

[2 marks]

0 3 . 7 What approach might a programmer take if asked to solve an intractable problem?

[2 marks]

Answer **all** questions.

1 A software company decides to release a duplicate file finder which it has named "De-Duplicator". Duplicate files are files that are exactly the same (bit for bit identical). Space is often wasted on computers by having multiple versions of the same file. Duplicate file finders are programs that find and identify duplicate files on a hard drive so that they can be removed.

(a) A duplicate file finder is an example of a utility. Describe what is meant by a utility.

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[2]

(b) De-Duplicator creates a tree to represent directories and files on the system. It then traverses each directory and file represented in the tree. It does this using a depth-first traversal. State what order it will visit each of the **files** as shown in Fig.1 below.

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[3]

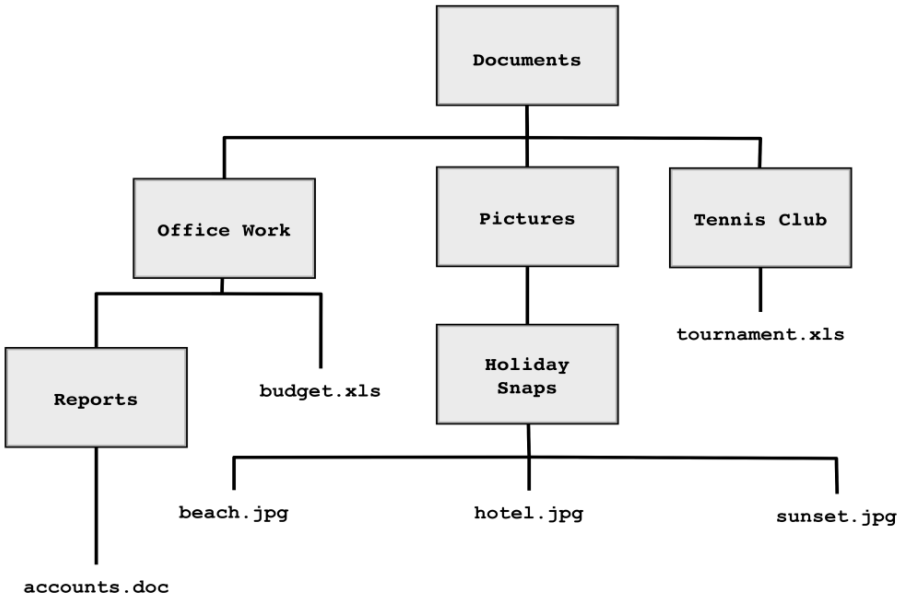

Fig.1

(c) Every time the program encounters a file it takes a hash of the file and checks it against a list. If the hash exists in the list, the file is marked to be deleted. If the hash does not exist it is added to the list.

(i) Explain **two** characteristics you would look for in a hashing algorithm for this purpose.

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[4]

(ii) After running the program a user finds that they still have apparent duplicates of some of their images. Explain why these apparent duplicates might still be present.

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[3]

(d) The software team that produces De-Duplicator decides to make a new version that can detect duplicated images the previous version could not. The software team must decide which methodology they will use for the project. Some members of the team suggest extreme programming whilst others would prefer to use the waterfall lifecycle.

Compare the **two** methodologies **and** justify which you would recommend.

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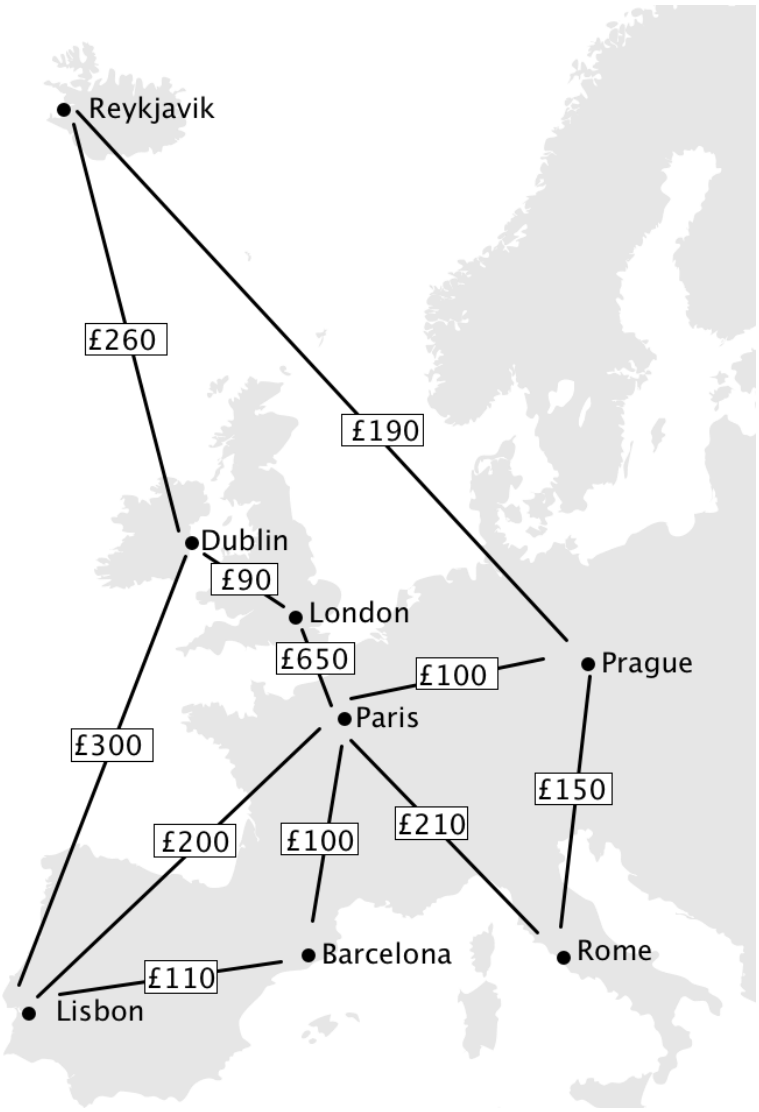
2 Atlas Airlines runs flights across cities in Europe. It stores the prices of different flights in its computer system.



(a) State a data structure that would be suited to representing the data above.

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[1]

(b) A function `tripCost` has been written that takes in two cities and returns the price of a direct flight between them.

e.g. `tripCost("Dublin", "London")` returns 90.

A journey is represented by an array called cities. An example of a trip from Dublin to Rome is shown below:

Dublin
London
Paris
Rome

(i) Write a program in the language or pseudocode of your choice that uses the cities array to calculate and output the cost of a given journey as a monetary value. In the case above this would be £950.

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(ii) Rather than storing cities in an array you could use a linked list.

Describe a difference between an array and a linked list.

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[2]

(c) Each airport has a three letter code. The airline's system stores the airports and corresponding airport codes:

Code	Name
BCN	Barcelona International
DUB	Dublin
LIS	Lisbon
LHR	London Heathrow
CDG	Paris, Charles De Gaulle
PRG	Prague
RKV	Reykjavik
FCO	Rome, Fiumicino

In a programming language or pseudocode of your choice write a program that takes in an airport code and finds and displays the airport name. You can assume a 2D array called airports has already been declared and populated with the data above. There is no need to validate the input and you can assume that the user will only enter a code that exists in the array.

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