Computer Science (H046, H446)

Exchanging Data

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Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

47/51

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **51**.
- The total number of marks may take into account some 'either/or' question choices.

1(a) A survey is carried out to look at the types of vehicle that travel down a stretch of motorway.

For each vehicle that passes by, a letter is entered into the system.

For a car 'C' is entered.

For a motorbike 'M' is entered.

For a lorry 'L' is entered.

For any other vehicle 'O' is entered.

It is decided to compress the data that has been generated.

State what is meant by the term 'compression'.

The reducing of the filesize or amount of space a file takes up in storage. [1]

(b) It is decided that Run Length Encoding will be used.

The following sequence has been compressed using Run Length Encoding.

3C3M4C

Show the result of decompressing the sequence.

CCCMMMMCCCC [2]

2 Traditionally films have been distributed on optical media such as DVDs.

Being able to stream high resolution films is only possible due to improvements in compression.

Explain why compression is important for the streaming of high resolution films.

High resolution films ~~to~~ have very large file sizes, meaning files take up a lot of space in storage since they are composed of many pixels. This makes sending films across the internet if you wanted to share them very slow since larger file sizes mean more data needs to be transmitted. This also takes up a lot of bandwidth which you have a limited amount of. Compression reduces the file size, making data transmission faster therefore saving time. It also often takes up less storage so you can store download and store more files. [3]

3 All videos that are streamed are compressed. Customers have the option to choose from watching the videos with lossy compression or lossless compression.

Explain how this choice will impact the customer.

Lossy compression compresses files (the videos) by picking out unnecessary bits of data in the video and permanently deleting them. This results in minor pixels and colours in the video being removed so the video quality decreases and the resolution, but the video is still watchable. This was by reduces the video's file size so it is fast to transmit if you wanted to share the video on the internet and takes up less bandwidth to do so, also saves more storage. Lossless compression however does not permanently remove data. Instead it stores frequently repeated data as one. This is a video like usually does not find much frequently repeated data, therefore it does not compress the file size as so if you needed to send the video to someone else, it takes more bandwidth and storage to do so. However, the video quality will be unchanged when compressed. If the customer wants the highest possible quality of video, lossless should be used. If they favour file size, then lossy. [5]

4(a) The XOR operator can be used to encrypt data.

Show the effect of applying XOR on Text and Key, by completing the last row of the table below.

Text	O								C								R							
Value	0	1	0	0	1	1	1	1	0	1	0	0	0	0	1	1	0	1	0	1	0	0	1	0
Key	A								B								C							
Value	0	1	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1
XOR	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1

[2]

(b) Show the effect of applying XOR on your answer to part (a) and Key, by completing the first and last rows of the table below.

(a)	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1
Key	A								B								C						
Value	0	1	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1
XOR	0	1	0	0	1	1	1	1	0	1	0	0	0	0	1	1	0	1	0	1	0	0	1	0

[2]

(c) Explain whether the type of encryption described above is symmetric or asymmetric.

Symmetric because the same key is used to decrypt and encrypt the data

[2]

(d) Explain why asymmetric encryption is more suited to transactions over the internet than symmetric encryption.

Asymmetric encryption uses 2 separate keys. One key is publicly distributed so users can encrypt data then send it. The other key is purely for decrypting data so it can be deployed and used. Symmetric encryption sends the key with the data across the internet meaning if someone were to intercept the data, they would have the key to decrypt it as well, therefore not being very secure. The key for decryption in asymmetric encryption however, is transfered in person, so physically from one person to another. This is more secure as if the data is intercepted the interceptor can't do anything with the data anyway so it is safe. [4]

5 A programmer spends her spare time contributing to an open source application that converts video files from a range of formats to one which uses lossy compression.

Describe what is meant by the term 'lossy compression'.

Where unnecessary parts of a file are permanently deleted to reduce the size, it is a compression technique and has a larger reduction of size than lossless. [2]

6 Customers' details are stored in the flat file database table `Customer`. An extract of the table is shown below.

CustomerID	Surname	Title	Phone	CarReg
JJ178	James	Mr	(0121) 343223	DY51 KKY
HG876	Habbick	Miss	(01782) 659234	PG62 CRG
EV343	Elise	Mrs	(07834) 123998	HN59 GFR
PG127	Pleston	Mr	(07432) 234543	JB67 DSF

(i) State what is meant by the term 'primary key', identifying the primary key in the table above.

A unique identifier for each record in the table. A primary here is CustomerID, since it is completely unique.

[2]

(ii) Write the SQL statement that would show only the `CustomerID` and `Surname` fields for customers with the `Title` "Miss" or "Mrs".

```
SELECT CustomerID, Surname
FROM Custare
WHERE Title = "Miss" or "Mrs"
```

[4]

(iii) Describe **one** problem that would arise with the flat file database structure if a customer wanted to insure more than one car at the same time.

They would have to put in redundant data since multiple cars will belong to the same person who's name will be repeated multiple times in the table's records. Possibly opening up to data and referential integrity issues.

[2]

[2]

(iv) Describe how the flat file database structure could be altered to efficiently allow each customer to insure multiple cars at the same time. (You may assume each car is insured to only one customer.)

Turn it into a relational database. You could remove the "CarReg" column from the "Customer" table so that the "Customer" table only includes the details of each customer. Create a separate table with the primary key as "CarReg" and put all the registered cars in that table. It could be named "Cars". Then add a foreign key in "Cars". The foreign key will be the primary key, "CustomerID" from "Customer". This way if you want to have multiple cars, you just have to put in your CustomerID with the car that is registered and that table will now have access to the customer's details without having to put in all the details manually each time which may result in a larger chance of a mistake being made since humans are fallible. Doing this also puts the database in 3rd normal form. [5]

7 Details of all users that have accessed a robot are stored in a database table called `TblAccessLog`. This table stores the username and user type of each user. When a user accesses the robot, the current date is added to the `DateAccessed` field for that user.

A selection of the data from this table is shown here. Username is the key field.

Username	UserType	DateAccessed
Mrphy003	User	08/05/21, 07/06/21, 08/06/21
Lwis076	Admin	17/04/21, 19/07/21
Bbby412	NotNeeded	01/06/21, 02/07/21, 14/07/21

TblAccessLog

(i) Write an SQL statement to delete all records from the table `TblAccessLog` for users who have a UserType of "`NotNeeded`".

DELETE FROM TblAccessLog

WHERE UserType = "Not Needed"

[2]

(ii) State **two** requirements for a database to be in First Normal Form (1NF).

1 Data is atomic (cannot be broken down any further)

2 A primary key is present (uniquely identifies for each record)

[2]

(iii) Explain why the structure of `TblAccessLog` means that this database is **not** in First Normal Form (1NF).

The data is not atomic first of all, because there are multiple dates in the DateAccessed column for each record.

[2]

8(a) Every bank account has an account number and sort code. The sort code identifies the bank branch (location of the bank) with which the account is held and the account number uniquely identifies the bank account. An extract from a bank's database table is shown in Fig. 5.1.

CustomerID	Forename	Surname	Acc No	Sort Code	Branch Name
145204	Elaine	Murray	14725200	67-34-56	Hull
657875	Jordan	Rogers	62703441	67-45-67	Truro
735951	Monim	Khan	96385547	67-00-11	Cambridge
744078	Tom	Banner	45623929	67-00-11	Cambridge

Fig. 5.1

State why the table in Fig. 5.1 is not in Third Normal Form.

There is still transitive dependencies (Sort Code, Branch Name)

[1]

(b) Explain how the database could be put into Third Normal Form.

Create a separate table with the colums "Sort Code" and "Branch Name". Remove from the table in fig 5.1 the column "Branch Name". In the newly created table "Sort Code" is the primary key. In fig 5.1, "Sort Code" is now a foreign key, this links the tables together.

[3]

9 A video streaming service uses a relational database. An extract of the data from two tables from this database is shown in **Fig. 2**.

`Membership` contains data about current memberships that customers hold and `package` contains data about different streaming packages available.

Username	FirstName	StartDate	PackageType
User001	Amaya	08/05/2016	Premium
User002	Amit	06/06/2019	Basic
User003	Tom	17/08/2019	Free
User004	Kareem	08/08/2017	Basic
User005	Sarah	25/03/2020	Premium

Membership

PackageType	CostPerMonth(£)	Adverts
Premium	12.99	false
Basic	7.99	true
Free	0.00	true

Package

Fig. 2

The `Adverts` field indicates if customers will be shown adverts. `true` indicates that customers will be shown adverts, and `false` indicates that adverts are not shown.

Write Structured Query Language (SQL) to return the `Username` and `FirstName` fields for all customers who see adverts.

SELECT Username, FirstName ✓

FROM Membership, Package

WHERE PackageType = "Basic" or "Free" X

2

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[5]

END OF QUESTION PAPER