HERIOT WATT UNIVERSITY

F21DF

Database and Information Systems

Semester 1 2019/20

Duration: Two Hours

ANSWER THREE QUESTIONS

Q1

(a) Explain the terms ‘Database’, ‘Database Management System’, and ‘Database Application’, including an example of each.

(3 marks)

(b) Consider the following database instance *(primary keys have been underlined)*.

Account:

number	sortCode	balance
86036247	002500	4721.81
36771186	369183	921.51
87491718	002500	-821.12
36771186	718291	9281.27
77718727	718291	28.01

Customer:

cid	lastName	firstName
48	Gray	Alasdair
149	Bartie	Phil
199	Ivanov	Nedi

CustomerAccount:

cid	number	sortCode
48	86036247	002500
199	86036247	002500
48	87491718	002500
149	77718727	718291

Write SQL queries to answer the following questions.

(i) Return the names of customers with a negative bank balance.

(5 marks)

(ii) Return the total amount at each branch (identified by the sort-code). Only return branches with a total less than £1,000.

(4 marks)

(c)

(i) What does it mean for a transaction workload to be serialisable?

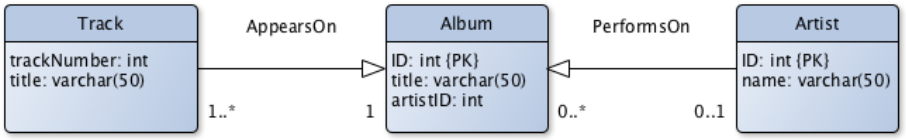
(2 marks)

(ii) Explain with the aid of a diagram the states of a transaction and how it transitions between these states.

(6 marks)

Q2

(a) Consider the following ER diagram capturing music albums, the tracks that appear on them, and the performers



(i) Why is it incorrect to have artistID on the Album entity? How else is the artist of an album captured in the diagram?

(2 marks)

(ii) What is a weak entity and why is Track one?

(2 marks)

(iii) Convert the Track entity to a relational schema.
(Remember to include types, primary keys, and foreign keys where appropriate.)

(4 marks)

(b) Explain the difference between the SQL types CHAR(10) and VARCHAR(10). Which would you use for storing someone's surname and why?

(4 marks)

(c)

(i) Draw the query plan tree for the following query:

```
SELECT S.lastName, S.firstName, P.title
FROM   Staff as S, Project as P,
WHERE  S.sid = P.sid
AND    S.lastName LIKE 'Smith';
```

(6 marks)

(ii) What is an index and why would an index on the lastName column help with query answering.

(2 marks)

Q3

(a) Define the terms: Data, Information, Knowledge.

(3 marks)

(b) What is a Geographic Information System (GIS)?
What features does a desktop GIS include?

(2 marks)

(c) Explain the meaning of the following terms:

- Polyline
- Minimum Bounding Rectangle
- Multi-part geometry
- OpenStreetMap
- Geocoding

(5 marks)

(d) What is the name given to this representation of a polygon geometry? Explain what the output would look like if visualised.

```
POLYGON ((35 10, 45 45, 15 40, 10 20, 35 10),
(20 30, 35 35, 30 20, 20 30))
```

(2 marks)

(e) What is a least-cost path? Name 3 variables that could be used for the cost attribute, and explain the resulting route that would be calculated.

(4 marks)

(f) List 8 of Jacques Bertin's graphic primitives (also known as visual variables).

(4 marks)

Q4

Consider the following table of data:

Library

Title	Authors	Published	Format	List Price GBP
Ice Fishing	S Hamilton	2015	Hardback	24.99
PostgreSQL	K Douglas S Douglas	2003	Softback	50.00
Music Theory	J Chriss	2003	Softback Hardback	24.95

(a) Write the data on books from the table above in XML format.

(5 marks)

(b) Write the XPATH needed to answer the following questions:

(i) Return the titles of all of the books

(2 marks)

(ii) Return the details for the last book on the list

(2 marks)

(iii) The number of authors listed in the collection

(2 marks)

(iv) The titles of the books available in hardback

(2 marks)

(v) Return all the details for books costing less than £30.00

(2 marks)

(vi) Return titles for books with more than 1 author

(2 marks)

(c) Write the data on books (from the table above) in JSON format

(3 marks)

END OF PAPER