HERIOT WATT UNIVERSITY

**SCHOOL OF MATHEMATICAL AND COMPUTER SCIENCES**

**Department of Computer Science**

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**F28DM**

**DATABASE MANAGEMENT SYSTEMS**

Semester 2 2018/19

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Duration: Two Hours

ANSWER THREE QUESTIONS

Q1

(a)

(i) Name 4 types of integrity constraint supported in an RDBMS, and give an example of each.

(4 marks)

(ii) Explain what CRUD stands for and give the appropriate related SQL operation in each case.

(2 marks)

(b) What is SQL injection and which steps should be taken to prevent it from happening?

(4 marks)

(c) Give the results (including column names) from each of the following SQL statements based on the tables T1 and T2.

| T1 | |
|---|---|
| **id** | **value** |
| 1 | a |
| 2 | b |
| 3 | c |

| T2 | |
|---|---|
| **id** | **value** |
| 2 | x |
| 3 | y |
| 4 | z |

(i)
```
SELECT t1.value AS v1,t2.value AS v2
FROM T1 JOIN T2 ON t1.id=t2.id;
```

(2 marks)

(ii)
```
SELECT t1.value as v1, t2.value as v2
FROM T2 LEFT JOIN T1 ON t2.id=t1.id;
```

(2 marks)

(iii)
```
SELECT t1.id as id1 ,t2.id as id2
FROM T1, T2;
```

(2 marks)

(iv)
```
SELECT t1.value as v1, t2.value as v2
FROM T1 LEFT JOIN T2 on t1.id=t2.id
UNION
SELECT t1.value as v1, t2.value as v2
FROM T2 LEFT JOIN T1 on t2.id=t1.id;
```

(2 marks)

(v)
```
SELECT * FROM T1
WHERE t1.id NOT IN (SELECT id from T2);
```

(2 marks)

Q2

(a) What is a database index?

(2 marks)

(b) What is an ERD and what does it show?

(2 marks)

(c) What is a weak entity? Include examples.

(3 marks)

(d) Which two data models are used to represent geospatial data in a spatial database? Explain each data model and give examples of what they are suited to modelling.

(6 marks)

(e) Take a look at the following database relation. What are the issues with it?

| **id** | **name** | **dob** | **deptNo** | **deptName** |
|---|---|---|---|---|
| 100 | Jon Pi | 01/04/1978 | 2 | Marketing |
| 101 | Sarah Toms | 14/12/1985 | 2 | Marketing |
| 102 | Tim Law | 30/07/1982 | 5 | HR |
| 103 | Mary White | 22/09/1975 | 5 | HR |

(4 marks)

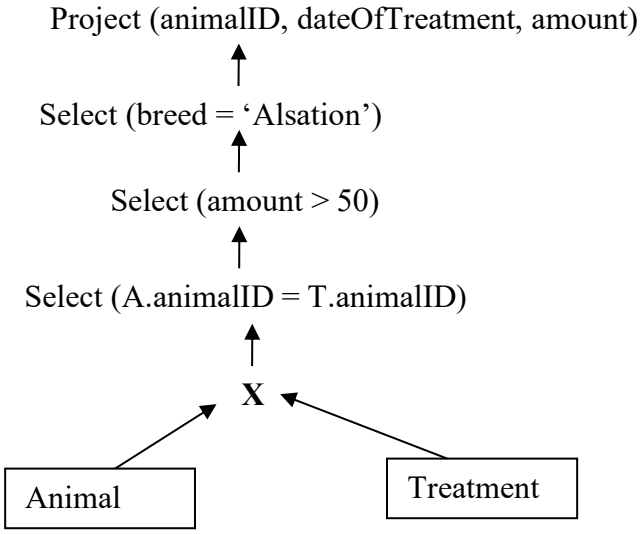
(f) What is a database VIEW and how can it provide security?

(3 marks)

Q3

(a)

(i) The following query tree has been generated for a query. How could you alter the tree at a logical level to make it more efficient?




(4 marks)

(ii) An index is available for the breed column of the Animal table. Explain how this information is used by the optimizer.

(2 marks)

(b) Describe two advantages and two limitations of the relational model.
*(The limitations should be distinct from the advantages, e.g. online transaction processing can be seen as both an advantage and a limitation. No marks will be given for online transaction processing.)*

(4 marks)

***Question 3 continues on next page***

(c) Below is an XML Schema for a bank

```
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="bank_accounts">
    <xs:complexType>
      <xs:sequence>
        <xs:element  name="account" type="accountType"
                     maxOccurs="unbounded" minOccurs="1"/>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
  <xs:complexType name="accountType">
    <xs:sequence>
      <xs:element name="account_number"
                  type="accountNumberType"
                  maxOccurs="1" minOccurs="1"/>
      <xs:element name="branch" type="branchType"
                  maxOccurs="1" minOccurs="1"/>
      <xs:element name="given_name" type="xs:string"
                  maxOccurs="1" minOccurs="1"/>
      <xs:element name="middle_names" type="xs:string"
                  maxOccurs="1" minOccurs="0"/>
      <xs:element name="family_name" type="xs:string"
                  maxOccurs="1" minOccurs="1"/>
      <xs:element name="balance" type="xs:decimal"/>
    </xs:sequence>
  </xs:complexType>
  <xs:simpleType name="accountNumberType">
    <xs:restriction base=" xs:nonNegativeInteger">
      <xs:pattern value="[0-9]{8}"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="branchType">
    <xs:sequence>
      <xs:element name="sort_code" type="sortCodeType"
                  maxOccurs="1" minOccurs="1"/>
      <xs:element name="branch_name" type="xs:string"
                  maxOccurs="1" minOccurs="1"/>
    </xs:sequence>
  </xs:complexType>
  <xs:simpleType name="sortCodeType">
    <xs:restriction base=" xs:nonNegativeInteger">
      <xs:pattern value="[0-9]{6}"/>
    </xs:restriction>
  </xs:simpleType>
</xs:schema>
```

(i) Write a valid XML document containing one account that conforms with the above schema.

(7 marks)

(ii) Write an XPath expression to find the sort code for the Heriot-Watt branch.

(3 marks)

Q4

(a) What is a serialisable schedule?

(2 marks)

(b) Consider the following sequence of operations of transactions T1 and T2.

1) T1 reads value V
2) T2 reads value W
3) T1 deducts 1 from V
4) T2 reads value V
5) T1 writes V
6) T2 adds the value of W to V
7) T2 writes V

(i) Draw a serialisability graph to show why the sequence of operations is not serialisable? State the reason for each edge in the graph and the property of the graph that makes it not serialisable

(4 marks)

(ii) Explain the acquisition of locks using classical 2 phase locking and the resulting problem (refer to the step numbers to state when locks are acquired).

(7 marks)

(c)

(i) What is online analytic processing (OLAP) and what is it used for?

(2 marks)

(ii) Explain why a separate data warehouse is needed from the operational databases of a company.

(2 marks)

(iii) Explain the steps involved in creating a data warehouse.

(3 marks)

**END OF PAPER**