THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATIONS
BCS Level 6 Professional Graduate Diploma in IT

ADVANCED DATABASE MANAGEMENT SYSTEMS

18th October 2007, 10.00 a.m.-1.00 p.m.
Answer THREE questions out of FIVE. All questions carry equal marks.
Time: THREE hours

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

Calculators are **NOT** allowed in this examination.

1. Relational database management systems are based on the relational model of data. It is often argued that there is no similar model underpinning object-oriented database management systems. Explain what is meant by the term *data model* and discuss whether the lack of an underpinning data model is a hindrance to the acceptance of object-oriented database systems. **(25 marks)**

2. Almost all database management systems permit users to store and retrieve information about the date and times at which events occur. Given this, discuss the additional features that are expected of temporal database management systems. **(25 marks)**

3. (This question uses Appendix A : EA database application)

a) Refer to Table A1 in Appendix A and the two Program batches below.

----- PROGRAM batch 1----------

```
CREATE VIEW View1
(when_taken, precipitation, rating)
AS
SELECT when_taken, precipitation,
      (SELECT COUNT(DISTINCT when_taken)
       FROM measurements2005 AS T1
       WHERE T1.when_taken <= T0.when_taken) AS rating
FROM measurements2005 AS T0
```

----- PROGRAM batch 2----------

```
SELECT P1_WHEN=V1.when_taken, P2_WHEN=V2.when_taken,
P1=V1.precipitation, P2=V2.precipitation,
DIFF=(V2.precipitation - V1.precipitation)
FROM View1 AS V1 LEFT OUTER JOIN View1 AS V2
ON (V2.rating=V1.rating + 1)
ORDER BY V1.Rating
```

i) Work out the output produced from PROGRAM batch 2: **(6 marks)**

ii) Explain why the above code is inefficient given the context in which it runs. **(5 marks)**

iii) Rewrite the above Program Batches so that they run more efficiently. **(8 marks)**

b) Explain how you would satisfy the following requirement:

SQL code is required that will *efficiently* compare data selected from 2 different measurement tables, one that contains data from 5 years ago, the other that contains data from 9 years ago. The selection criteria might include a range of dates or a set of observatory data for a particular date and river. **(6 marks)**

4. (All parts of this question refers to Appendix A)

a) Explain with the aid of examples how you would differentiate a Data Warehouse from a Database System. Use examples from the scenario given in Appendix A in your answer. **(6 marks)**

b) With reference to Appendix A give an example of an application that would require the support of a Data Warehouse and associated analysis tools. Include in your answer the type and nature of the data represented in the Data Warehouse and the software tools you would use. State any assumptions you have made. **(10 marks)**

c) With reference to Appendix A explain the stages required to update a Data Warehouse with the raw data that has been recently collected from observatories and weather feeds. **(9 marks)**

5. a) Explain the function of the following components of *Web Services* technology -
WSDL; UDDI ; SOAP
Use a diagram to assist your answer. **(6 marks)**

b) Compare *Web Services* with CORBA and explain why Web Services/SOA has become more widely used than CORBA. **(9 marks)**

c) Explain, with reference to stated software tools you are familiar and supported by example programs, how a Web Service would be deployed to enable access to data running on a distant server. **(10 marks)**

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Appendix A : Environment Agency Database for use in Q3,Q4

The Environment Agency (EA) is an organisation that is responsible for monitoring the level and flow rate of rivers. They collect information so that they can predict flooding events and act on these appropriately.
The EA is organised into 5 regions covering distinct geographical areas. Each region has a HQ that is responsible for the maintenance of rivers within its region.

The EA monitors about 500 rivers that have been identified as having a high risk of flooding. Observatories are positioned upstream on these rivers with about 5 observatories per river. The data collected from these observatories is sent to the EA Head Quarters where the data is processed and stored in an SQL database called the 'HQ database'.

Observatories contain equipment used to take measurements of the following :-

- *Precipitation (rainfall measured in cm)*
- *River levels (the maximum depth of water in a river measured in cm)*
- *Maximum Flow rate (measured in cubic cm per second)*

The above measurements are recorded at discrete intervals on a 24x7 basis. When precipitation is above a certain threshold then measurements are taken approximately every minute otherwise they are taken approximately every hour.
Measurements for the last 20 years have been kept and these are stored in the HQ database.

There have been about 750 serious flooding events in the last 20 years and these are also stored in the HQ database. Each event lasts on average for 3 days before flood levels subside.

Another organisation called the Meteorological Agency (MA) send data transmissions known as 'weather feeds' to the EA every 2 hours. A weather feed contains the following information:

- *The date and time of the feed.*
- *The EA region that this data refers to*
- *Average recorded precipitation (in cm) since the last feed*
- *Predicted precipitation (in cm) for the next 24 hours*

The EA store this information the HQ database and use it to predict flood events.

Figure A1 shows a snapshot of a large measurements table (called Measurements2005) which contains measurements recorded by EA observatories during 2005.

Measurements2005 contains the following columns :-
- *Timestamp of data recording (when_taken).*
- *Precipitation (eg rainfall)*
- *River levels*
- *Observatory which recorded this data*

The primary key of this table is the timestamp field ('when_taken')

FIGURE A1: A snapshot of a Table called Measurements2005

when_taken	precipitation	river_level	ObservatoryID
2005-07-17 12:33:43.003	1.0	23.3	123
2005-07-17 13:32:21.266	0.0	23.4	123

Turn over]

2005-07-17 12:34:51.772	1.1	43.4	295
2005-07-17 13:33:49.283	1.1	43.4	295
2005-07-17 14:31:34.033	1.7	24.5	295
2005-07-17 15:31:59.783	2.8	25.9	295
2005-07-17 15:38:52.843	1.1	43.4	123
2005-07-17 16:40:34.973	1.2	26.9	123
2005-07-17 17:31:22.983	0.2	27.2	295
2005-07-17 17:32:10.443	1.1	43.4	123
2005-07-17 18:33:04.203	0.6	27.2	295
2005-07-17 19:31:12.267	1.6	26.9	295
2005-07-17 20:32:59.553	1.8	27.5	123
2005-07-17 22:36:42.783	3.1	28.8	295
2005-07-17 23:38:49.208	2.6	29.9	295
2005-07-18 20:38:42.242	1.1	43.4	295
2005-07-17 21:36:21.281	3.8	28.3	123
2005-07-17 22:39:01.287	4.0	33.5	123
2005-07-18 00:00:00.296	4.9	38.8	123
2005-07-18 00:01:00.007	3.4	43.5	123
2005-07-18 00:03:03.124	2.6	44.0	123
2005-07-17 23:38:43.894	2.3	34.0	295
2005-07-18 00:04:45.005	1.0	44.1	123
2005-07-18 00:05:49.255	1.2	44.5	123
2005-07-18 00:06:51.562	0.9	42.5	123