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UNIVERSITY OF PORTSMOUTH

BACHELOR OF SCIENCE (HONS) IN COMPUTING

TERM 1 – APRIL 2005 EXAMINATION

IT354: DATABASE DESIGN AND MANAGEMENT

OPEN BOOK EXAMINATION

***DURATION*: 3 HOURS**

Students are permitted to refer the following books and course material

1) "Fundamentals of Database systems ", Elmasri and Navathe, Addison Wesley
2) "Database Systems – A practical Approach to Design, implementation and management", Thomas Connolly and Carolyn Begg, Addison Wesley
3) Course Contents

NOTE: No handwritten notes and printed materials other than the above are permitted

INSTRUCTIONS

1. Choose any 3 questions out of 4 questions.
2. Do not answer more than 3 questions in total.
3. Each question is marked out of 33
4. One extra mark will be added to each script to make a percentage.
5. Please start every question on a new page.
6. Answers will not be marked if they are illegible.
7. Enter the question numbers (in the order you have attempted them) in the boxes provided in the answer script.
8. Write your INDEX NUMBER and MODULE NUMBER on the cover page of the answer booklet(s).

IT354: DATABASE DESIGN AND MANAGEMENT

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EXAMINATION

QUESTION 1

Consider the following relations:

Sailor (Sailor_id, Sailor_name , date_of_birth)

Boat(Boat|_id, Boat_name, colour,)

Reserves(Sailor_id, Boat_id , date)

a) Write relational algebra expressions that satisfy the following information requirements:

i) Give the colours of all boats for which the sailor named 'John' has reservations.

[4 marks]

ii) Give the name, and Sailor_id for all sailors that have reservations for at least one blue boat and for at least one red boat

[4 marks]

iii) Give two different relational algebra expressions that correctly implement the following query and show that one is optimum when compared with the other.

" Give the names (Sailor_name) of all sailors that reserved a green boat for 01/01/05"

[13 marks]

b) Sample records for the two relations are given below.

Sailor

Sailor_id	Sailor_name	Date_of_birth
S100	John	11-11-1958
S101	Williams	25-08-1975
S102	Chen	08-09-1972
S103	Martin	02-02-1965
S104	Armstrong	17-07-1970

(Continued)

Boat

Boat-id	Boat_name	Colour
B500	Voyage	Red
B501	Mirror	Green
B502	Sea Horse	Blue
B503	Flood	Purple
B504	Sea Bird	Red
B505	Blue Bird	Blue
B506	Sea Horse	Red

Reserves

Sailor_id	Boat_id	Date
S100	B503	01-01-05
S104	B500	05-02-05
S103	B501	18-03-05
S101	B502	19-04-05
S100	B506	20-04-05

Produce the results of the following Queries:

i) $Boat \div (Blue, \mathrm{Re}\,d)$

[4 marks]

ii) $Boat \rhd\lhd \mathrm{Re}\,serves$ (Note this is an equijoin)

[8 marks]

QUESTION 2

An investment firm database must include information about the firm's various offices, brokers employed by the firm, investors (i.e. firm's customers) and their investment portfolios.

The firm has a number of offices. An office is identified by its ID, and the address and phone number of each office must be recorded. For each broker, the database must record his/her name, years with the company and the office where he/she works.

Each broker is paid a fixed salary and commission at a fixed rate. The salary and the rate of commission depend on the broker's category (probationer, junior, senior, partner).

(Continued)

Each investor's interests are looked after by a broker who helps him/her buy and sell stock. Typically, an investor owns a quantity of each of several stocks. The current nominal value of the stock (per share), the market value (also per share) and the dividend (as % of the nominal value) should also be recorded.

The un-normalized relation is as given below

InvestmentFirm (<u>InvestorID, StockID</u>, Quantity, InvestorName, NominalValue, MarketValue, Dividend, BrokerID, BrokerName, Yrs_with_firm, Category, Salary, Rate_of_commission, OfficeID, OfficePhone, OfficeAddress)

a) Identify all the functional dependencies for the above scenario.

[16 marks]

b) Hence give the BCNF relations (do not go through 1NF, 2Nf and 3NF).

[6 marks]

c) Suppose that instead of recording the current dividend for a stock, we need to record the dividend history and also record the promotion history of brokers, that is not just their current category but also previous categories, but without storing any dates. Identify the multi-values dependencies that these new requirements cause and hence find a fourth normal form decomposition for InvestmentFirm.

[11 marks]

QUESTION 3

(a) Consider a database with objects X and Y. There are two transactions T1 and T2. Transactions T1 reads objects X and Y and then writes X. Transaction T2 reads objects X and Y and writes X and Y.

Consider the following three schedules:

S1 = T2R(X) T2R(Y) T2W(X) T1R(X) T1R(Y) T1W(X) T2W(Y),

S2 = T2R(X) T2R(Y) T1R(X) T R(Y) T1W(X) T2W(X) T2W(Y),

S3 = T1R(X) T1R(Y) T1W(X) T2R(X) T2R(Y) T2W(X) T2W(Y).

i) Identify the concurrency problems associated with each of the above schedules.

[6 marks]

ii) Either by drawing the serialization graph or otherwise, identify which of the schedules are serializable and which are not serializable.

[6 marks]

(Continued)

iii) Explain whether the strict 2PL schedule will resolve the problems that you found in each schedule.

[6 marks]

(b) Consider a database schema that represents customer orders at a company. Each order contains one or more line items. Orders are represented using two relations.

Orders (**ordernumber,** customerid, total)

Lineitems(**ordernumber, Item_id,** item_type**)**

The following predicates appear in the majority of queries:

Total <= 1000 Total <= 5000

Item_type = 0 Item_type = 1

i) Write down the fragments that result from performing primary horizontal fragmentation on the Orders and Line Items using the predicates above.

[7 marks]

ii) The above fragments in (Q3 b(i)) can be further fragmented using derived horizontal fragmentation. Write down the resulting fragments.

[8 marks]

QUESTION 4

a) In the following two relations, identify the highlighted feature shown and rectify the errors or anomalies that those features exhibit.

i) **Customer:**

Cust-no	Name	Sales_rep
C5	Jasmine	SR1
C2	**Smith**	SR1
C2	**Smith**	SR4

ii) **Customer:**

Cust-no	Name	Sales_rep
C5	Jasmine	SR1
C2	Smith	**SR1, SR4**

[10 marks]

(Continued)

b) Check the Integrity constraints on the relations Parent and Child given below and rectify any violations. (Note that both Pid and Cid should be built to a common format of one letter followed by two or three numbers)

Parent

Pid	Pname
P23	Smith
P11	Johnson
P68	Winston
P77	Blackstone
P101	Null
Null	Wilson

Child:

Cid	Cname	Pid
C666	Wong	P68
MMM	Patel	P23
C099	Brown	P68
C011	Hughes	P11
C553	Smith	P11
C001	Ng	P69
C453	James	Null

[6 marks]

c) Consider the following scenario:

A number of vendors use several warehouses from which they ship various items. Each vendor is identified by a VendorNumber, each warehouse by a WarehouseNumber and each item by an ItemNumber. For every shipment made a unique shipment number is assigned. A shipment can consist of several different items and also multiple occurrences of any of those items.

Construct an ER diagram model for this scenario utilizing an *associative entity*, that is a relationship which has its own primary key that is NOT part of the primary key of any of the entities that participate in that relationship. The diagram must show all primary keys.

[17 marks]