

**UNIVERSITY OF ESSEX**

Undergraduate Examinations 2013–14

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**INTRODUCTION TO DATABASES**

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Time Allowed: **TWO** hours

The paper consists of **FOUR** questions.

Candidates must answer **ALL** questions.

All questions are of equal weight.

The percentages shown in brackets provide an indication of the proportion of the total marks for the **PAPER** which will be allocated.

- Please do not leave your seat unless you are given permission by an invigilator.  
Do not communicate in any way with any other candidate in the examination room.  
Do not open the question paper until told to do so.  
All answers must be written in the answer book(s) provided.  
All rough work must be written in the answer book(s) provided. A line should be drawn through any rough work to indicate to the examiner that it is not part of the work to be marked.  
At the end of the examination, remain seated until your answer book(s) have been collected and you have been told you may leave.

*Candidates must answer ALL FOUR questions.*

**Question 1**

- (a) Explain briefly what is meant by each of the following terms/phrases. Give examples or use diagrams to illustrate your answers.
- (i) Sets are extensional [4%]
  - (ii) Cartesian products [4%]
  - (iii) Power sets [4%]
- (b) Given the sets  $A = \{a, d, e\}$  and  $B = \{c, d, a\}$ , compute
- (i)  $A \otimes B$  [5%]
  - (ii) The power set of  $B$  [4%]
  - (iii)  $A - B$  [4%]

## Question 2

(a) Explain briefly what is meant by each of the following terms. Give examples or use diagrams, to illustrate your answers.

- (i) Aggregate functions in SQL [4%]
- (ii) Null values in SQL [4%]
- (iii) SELECT DISTINCT [4%]

(b) Given the schema in Figure 1, write a SQL query for the following [13%]

The average account balance for accounts at each branch, but only for branches located in London.

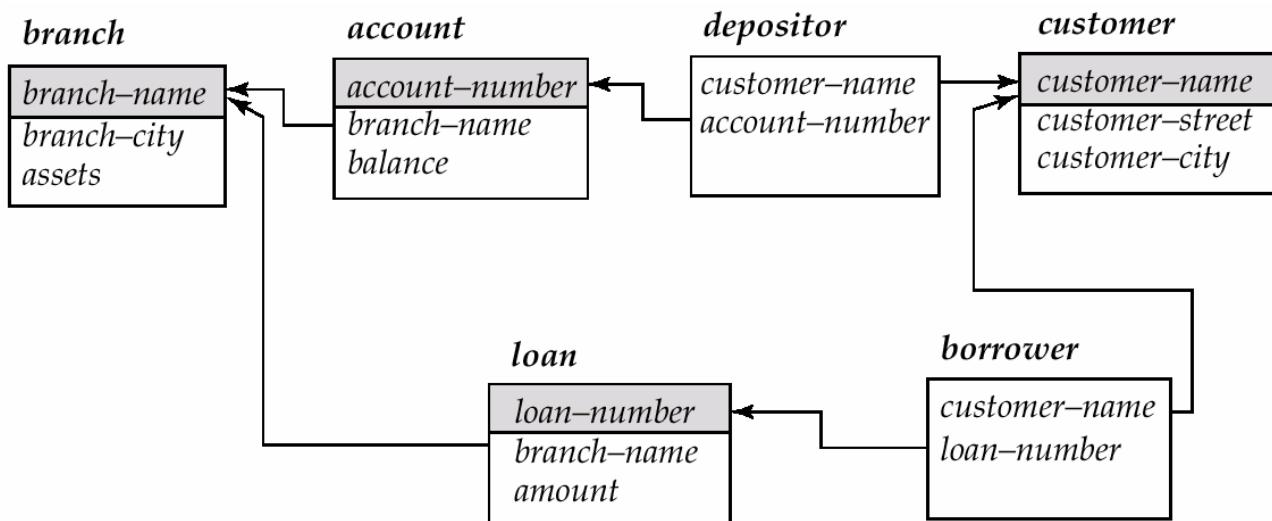


Figure 1: Simplified Schema for a Bank

**Question 3**

(a) Given the relations **Students** and **Marks**, below, compute

- (i) The Cartesian product of **Students** and **Marks**. [6%]
- (ii) The natural join of **Students** and **Marks**. [6%]

<b>Students:</b>		<b>Marks:</b>	
<i>StudentID</i>	<i>Name</i>	<i>StudentID</i>	<i>Mark</i>
012	Alice	012	75
023	Beatrix	023	30
034	Charles	034	40

(b) Given the schema in Figure 2, express the following query in the **relational algebra**. [13%]

Find the location (*branch-city*) of all banks with loans greater than 2,000.

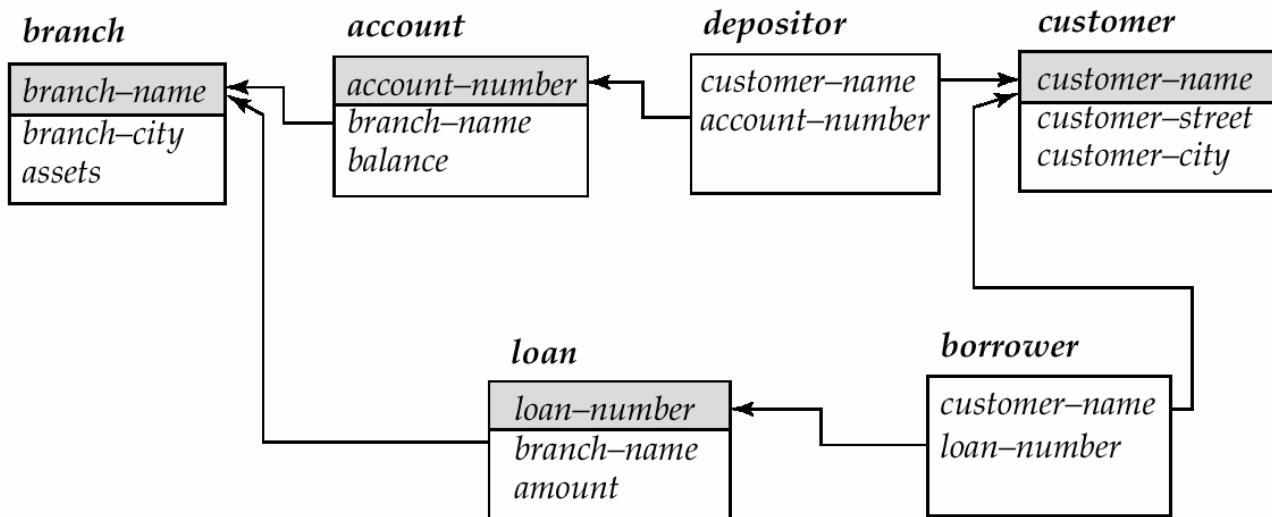


Figure 2: Simplified Schema for a Bank

**Question 4**

(a) Define *First Normal Form*, *Second Normal Form*, and *Third Normal Form*. [10%]

(b) Convert the following table to First Normal Form, explaining your reasoning. [15%]

<b>Branch</b>		
<i>branchNo</i>	<i>address</i>	<i>telephone</i>
B1	Abbey	1661, 1771
B2	Bath	2442, 2552
B3	Colchester	3113, 3223, 3333
B4	Derby	4004

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