

University of Cape Town
Department of Computer Science

Computer Science CSC303S

Class Test 1 – August 2004 – Open Book Test

Answer all questions

Marks: 45

• Approximate marks per question are shown in brackets

Time: 45 minutes

• The use of calculators is permitted

Question 1. [10 marks]

A company that repairs cars wants to computerise its business. Customers bring in their cars for servicing or repair, usually once or twice a year, sometimes more often. For each car, the registration number (e.g. CA 1234), model and make is required. A customer can own many cars but a car belongs to only one customer. The name, address and phone number of a customer is kept while s/he continues to bring us her car/s to repair, in case of problems. Each service or repair job is performed by exactly one mechanic. The mechanic has a name, wage and ID number. The system must record the date of each job and who did that job. In addition, the type of service must be stored (first, small or large service), while the cost and problem (short text) must be kept for every repair.

- a) **Draw an ER (Entity-Relationship) model for the application.** Show as many ER features as possible, so as to capture as much about the business as possible. [7]
- b) The next step is to convert an ER diagram into a relational schema. Just choose **any one relation containing a foreign key**, and show the schema of that relation (list all attribute names, underline the primary key attribute/s, and put a dotted line under the foreign key/s in that relation). A foreign key is an attribute that references a tuple in another relation of your database. [3]

Question 2. [9 marks]

With reference to the following relation schema of employees, jobs and work-records, give an SQL statement for each of the queries below. *If you cannot do any of these immediately, first complete the test before puzzling over it further!*

EMP (ENO, ENAME, WAGE, DEPT)
JOB (JNO, JNAME, COST, CLIENT)
WORK (ENO, JNO, WORKDATE, HOURS)

- a) Give the names of all jobs that employee “Li” worked on which cost less than R9000.
- b) Give employee numbers of employees who have worked on all the jobs that employee number 42 (eno = 42) has worked on.
- c) List all employees showing their ENO and the number of hours they have worked altogether.

Question 3. [6 marks]

- a) Formulate query (2a) above using the relational algebra.
- b) Formulate query (2a) above using the relational calculus.
- c) Choose any one other query from question 2 and formulate this in **either** the relational algebra **or** the relational calculus.

Question 4. [5 marks]

Consider relation R(ABCDEF) with the following four FDs:

$$CDE \rightarrow B \quad ACD \rightarrow F \quad BEF \rightarrow C \quad B \rightarrow D.$$

- a) Give any one FD that violates BCNF. Show that it violates BCNF and then show how you would decompose R into two relations (let us call them R1 and R2) in order to remove this problem. [2]
- b) Is your scheme comprising R1 and R2 a lossless join decomposition of R? Give a reason for your answer. [1]
- c) Suppose that the given set of 4 FDs above forms a canonical cover. What 3NF scheme would you then derive for R? [2]

Question 5. [10 marks]

Answer the following questions based on this piece of XML:

```
<?xml version="1.0"?>

<test xmlns="http://www.cs.uct.ac.za/csc/303/test">
  <section>
    <question number="6">
      <instruction>Answer 2 questions</instruction>
      <subquestion>Meaning of life?</subquestion>
      <subquestion>6 x 7</subquestion>
    </question>
  </section>
</test>
```

- a) Write code that uses the DOM API to access the contents of the **instruction** node and store it into the **instruct** (or **\$instruct**) *string* variable, given that the document has been parsed and assigned to the **top** (or **\$top**) variable. [2]
Note: The sequence of commands is important, not the programming language.
- b) Write an XPath expression that locates the **question** node corresponding only to question number 6, assuming the current context node is the root element **test**. [2]
- c) Write an XML Schema *complexType* type definition **questionType** for the **question** node and all its descendants. Assume all elements are infinitely repeatable and that the **instruction** node is also optional. [6]

Question 6. [5 marks]

- a) Ignoring interoperability, standards and availability of tools/skills, what advantage is there to using XML in the solution to problems? [1]
- b) Give 2 examples of how the XML Schema language is more expressive than the DTD language. [2]
- c) An XML database could adopt a “tree” representation. Explain why this is not efficient for the storing and retrieving of documents. [2]