University of Cape Town
Department of Computer Science

Computer Science CSC303S

Class Test 1 – August 2004 – RETEST – 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 sailing club wants a record of the results of its races. Each boat has a unique ID number. The names of boats are also recorded. Each boat has a crew of more than one person. Each crew member has an ID, name and home telephone number and only sails on one boat. A boat may take part in many races. The race number, date and wind speed are recorded. The finishing position of each participating boat is recorded.

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 suppliers, parts and deliveries, 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!*

SUPP (SNO, SNAME, TELNO, DISCOUNT)
PART (PNO, PNAME, WEIGHT)
DELIV (SNO, PNO, DATE, QUANTITY, COST)

a) Give the names of all parts that supplier "ABC" supplies which weigh more than 10kg.
b) Give supplier numbers of suppliers who have delivered all the parts that supplier number 42 (sno = 42) has delivered.
c) List all suppliers showing their SNO and the total quantity of part 8 (PNO = 8) they have delivered (over all deliveries), but only for suppliers that have delivered part 8 more than once.

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:

$$CDE \rightarrow BF \qquad BD \rightarrow FE \qquad E \rightarrow C \qquad B \rightarrow A.$$

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 dependency preserving 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"?>

<food xmlns="http://www.cs.uct.ac.za/csc/303/food">
   <fruit name="apples">
      <colour>green</colour>
      <colour>red</colour>
      <colour>yellow</colour>
   </fruit>
   <fruit name="bananas">
      <colour>green</colour>
      <colour>yellow</colour>
   </fruit>
</food>
```

a) Write code that uses the DOM API to access the contents of the first **colour** node of the first **fruit** node and store it into the **colour** (or **$colour**) *string* variable, given that the document has been parsed and assigned to the **top** (or **$top**) variable. [2]
Note: The sequence of commands is important, not the programming language.

b) Write an XPath expression that locates the **fruit** node corresponding only to the name "apples", assuming the current context node is the root element **food**. [2]

c) Write an XML Schema *complexType* type definition **fruitType** for the **fruit** node and all its descendants. Assume all child elements are infinitely repeatable and must occur at least once. [6]

Question 6. [5 marks]

a) Is it possible to write an XML document with multiple namespaces but without using namespace prefixes? Explain how or why not. [2]

b) What does an XSLT processor do if no template matches the root/context node? [1]

c) XQuery is considered to be a bridge between XML and Databases. What essential feature does XQuery contain and how does this map to database operations? [2]