Instructor: Davood Rafiei

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University of Alberta
Faculty of Science

Fall 2000

CMPUT 291 – A1
File Structures and Data Management

Duration: 2 Hours
No Aids Allowed

QUESTION	VALUE	SCORE
1	14	
2	27	
3	10	
4	17	
5	16	
6	16	
TOTAL	100	

Your examination booklet must have **8 pages** (including this one).

Question 1

[14 marks in total] TRUE or FALSE: 2 marks for each correct answer; -2 marks for each incorrect answer; 0 mark if no choice is selected.

   a) In an ER diagram, the relationship between an owner entity set and a weak entity set can only be one-to-many with the total participation of the weak entity set.

      ( ) TRUE   ( ) FALSE

   b) Integrity constraints can be inferred for a given relational schema by examining its instances.

      ( ) TRUE   ( ) FALSE

   c) The result of a SQL statement cannot have duplicates.

      ( ) TRUE   ( ) FALSE

   d) The SQL query "SELECT name FROM customers WHERE city <> 'Ottawa'" will not list any customer whose city field is NULL.

      ( ) TRUE   ( ) FALSE

   e) Armstrong axioms are complete meaning that for a given set F of FD's the axioms can only generate functional dependencies that are logically implied from F.

      ( ) TRUE   ( ) FALSE

   f) Every BCNF relation is in 3NF.

      ( ) TRUE   ( ) FALSE

   g) For equality queries, B+ trees are faster than hash-based indexes in the average case.

      ( ) TRUE   ( ) FALSE

Question 2

[**27 marks in total**] The following schema describes information about service histories of vehicles (for example in a garage). A tuple *(v, t, s, d, c)* in **services** means that the vehicle with VIN *v* of type *t* is serviced with service type *s* on day *d* and the service is charged *c* dollars and cents. The **vehicles** relation gives for each vehicle of type *t*, its make (e.g. Honda), model (e.g. Accord) and the year of the vehicle.

services (vin, vtype, srv-type, date, charge)
vehicles (vtype, make, model, year)

a) [6 marks] Give a SQL statement that creates view **Service-History**(*make, model, srv-freq, avg-charge*) which contains for every make and model the number of services and the average service charge.

b) [5 marks] Using view Service-History, give a SQL statement that lists the make and the model of vehicles with the fewest number of services.

c) [5 marks] Using view Service-History, give a SQL statement that lists the number of services for every make of vehicles.

d) [5 marks] Give a SQL statement that lists service types that have never been charged over $100.

e) [6 marks] Give a SQL statement that lists for every make and model of vehicles the most common service type.

Question 3

[10 marks in total] Using the schema given in Question 2, explain in plain English what the following relational algebra queries compute.

a) [5 marks] $\pi_{srv-type}(\sigma_{date\geq1/12/1999 \ \wedge \ date\leq31/12/1999}services)$

b) [5 marks] $\pi_{make,\bmod el,year}(vehicles \bowtie (\pi_{vtype}vehicles - \pi_{vtype}(\sigma_{date\geq1/1/2000}services)))$

Question 4

[17 marks in total] Consider relation R with attributes ABCDE and functional dependencies $\{AB \rightarrow D, BC \rightarrow E\}$.

a) [3 marks] Show that ABC is a key.

b) [3 marks] How many keys does the relation have? Justify.

c) [3 marks] Is the relation in BCNF? Explain.

d) [3 marks] Is the relation in 3NF? Explain.

e) [5 marks] Give a BCNF decomposition of the relation.

Question 5

[16 marks in total] Consider a B+ tree in which an internal node can hold up to 3 keys and a leaf can hold up to 2 records. Starting from an empty tree, perform the following operations in the given order (show the final tree in each part).

a) [3 marks] Insert 33*, 44*.

b) [3 marks] Insert 65*, 25*.

c) [3 marks] Insert 100*, 50*.

d) [3 marks] Insert 60*.

e) [4 marks] Delete 25*, 35*.

Question 6

[16 marks in total] Starting from an empty extendible hash file, perform the following operations in the given order. Show the result including all indicators after each part. Assume a page can hold up to 3 records.

a) [3 marks] Insert 10*, 18*, 25*.

b) [3 marks] Insert 36*, 9*.

c) [3 marks] Insert 8*, 7*.

d) [3 marks] Insert 26*, 3*.

e) [4 marks] Delete 8*, 36*.