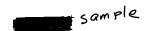
University of Alberta Faculty of Science



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	

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)	•		relationship between an owner entity set and a weak entity set my with the total participation of the weak entity set.		
	() TRUE	() FALSE		
b)	Integrity constraints instances.	can	be inferred for a given relational schema by examining its		
	() TRUE	() FALSE		
c)	c) The result of a SQL statement cannot have duplicates.				
	() TRUE	() FALSE		
d)	~		CT name FROM customers WHERE city \Leftrightarrow 'Ottawa''' will nose city field is NULL.		
	() TRUE	() FALSE		
e)	•		complete meaning that for a given set F of FD's the axioms can dependencies that are logically implied from F.		
	() TRUE	() FALSE		
f)	Every BCNF relation	on is	s in 3NF.		
	() TRUE	() FALSE		
g)	For equality queries	s, B	+ trees are faster than hash-based indexes in the average case.		
	() TRUE	() FALSE		

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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.

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sample

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.

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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] $\boldsymbol{p}_{srv-type}(\boldsymbol{s}_{date \ge 1/12/1999 \ \land \ date \le 31/12/1999} services)$

b) [5 marks] $\boldsymbol{p}_{make, \text{mod } el, \text{ year}}(vehicles \triangleright \triangleleft (\boldsymbol{p}_{vtype}vehicles - \boldsymbol{p}_{vtype}(\boldsymbol{s}_{date \ge 1/1/2000} services))$

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.

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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*.

sample

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*.