

Name:

Section (315/415):

MIDTERM EXAM - 600.315/415 - Database Systems

Date: Friday, November 2 2007, 2:30 PM

The total number of points in this exam is 76 for 600.315 students, and 86 for 600.415 students. If you work at approximately 1 minute per point, you should finish on time.

Some questions should only be done by 600.415 student, and are marked with a “*” **and** by the phrase (*600.415 only*). Other questions should only be done by 600.315 . These are marked with a # **and** (*600.315 only*).

Question 1 - Relational Algebra (15 points)

Express the following queries in Relational Algebra. The table schema that you need are given on a separate sheet.

- (a) (5 points) List the names of customers who have had the repair 'Oil Change' done in the states of MD or PA (or both).

- (b) (5 points) List the names of cities where **no** store has in stock more than 20 units of the part 'Spark Plug' manufactured by 'Acme Auto Parts'

Question 1 (continued) - Relational Algebra

- (c) List the ID's of the stores which stock **every** part manufactured by 'General Auto Parts Co.'

Question 2 - Tuple Relational Calculus (5 points)

Express the following query in Tuple Relational Calculus:

- (a1) (#5 points) List the names of all repairs that have been performed by a store in Florida. (*600.315 only*)
- (a2) (*5 points) List the names of all repairs that have **never** been performed by a store in Florida. (*600.415 only*)

Question 3 - SQL (25 points)

Express the following queries in SQL:

- (a) (5 points) List the manufacturer ID's and serial numbers of parts not stocked by store number 55 but which are stocked by stores in the same city.

- (b) (5 points) What is the name of the part which has the greatest absolute difference between wholesale and retail price (you can assume that retail price is always greater than wholesale).

Question 3 (continued) - SQL

(c) (5 points) List the total *labor* cost of repair jobs performed at store number 221 on 11/2/07.

(d1) (#5 points) What is the name of the most expensive (retail cost) part in the database.
(600.315 only)

(d2) (*5 points) List the ID of the store in Ohio which stocks the smallest total number of parts, among stores which perform an average of at least 500 repairs per month.
(600.415 only)

Question 3 (continued) - SQL

- (e1) (#5 points) Print the average retail cost of parts manufactured by 'Ace Manufacturing Company' and are also currently stocked at some store in Towson, MD. (*600.315 only*)
- (e2) (*5 points) List the ID's of all stores along with the *total* cost of all repairs performed at the store. Note that the total cost of a repair is the labor cost of the repair plus the sum of the retail costs of all required parts. (*600.415 only*)

Question 4 - QBE (10 points 315, 15 points 415)

Express the following queries in QBE:

- (a) (5 points) Print the dates on which customer 'Bill Brody' has had the repair 'Refill Washer Fluid' performed.

REPAIR	<u>Repair_Id</u>	Repair_Name	Labor_Cost

REPAIR_PARTS_REQUIRED	<u>Repair_Id</u>	<u>MID</u>	<u>Serial_Num</u>	Quantity_Required

JOB	<u>Job_Number</u>	Customer_Name	Date	Store_Id

JOB_REPAIRS	<u>Job_Number</u>	<u>Repair_Id</u>	<u>Quantity_Of_Repair</u>

- (b) (5 points) List the names of all repairs that *both* have a labor cost less than 'Oil Change' *and* requires the part 'spark plug'.

REPAIR	<u>Repair_Id</u>	Repair_Name	Labor_Cost

REPAIR_PARTS_REQUIRED	<u>Repair_Id</u>	<u>MID</u>	<u>Serial_Num</u>	Quantity_Required

PART	<u>MID</u>	<u>Serial_Num</u>	Name	Retail_Cost	Wholesale_Cost	Shipping_Days

MANUFACTURER	<u>MID</u>	Name	Street_Address	City	State	Zipcode

- (c) (*5 points) List the zipcodes of all stores that have more than 1 'spark plug' manufactured by 'Acme Auto Parts' in stock, *or* have performed a repair that requires 'Acme Auto Parts' 'spark plugs' (or both). (600.415 required, but 600.315 students can also do this problem for extra credit if they have extra time)

MANUFACTURER	<u>MID</u>	Name	Street_Address	City	State	Zipcode

PART	<u>MID</u>	<u>Serial_Num</u>	Name	Retail_Cost	Wholesale_Cost	Shipping_Days

STORE	<u>Store_Id</u>	Street_Address	City	State	Zipcode

STOCK	<u>MID</u>	<u>Serial_Num</u>	<u>Store_Id</u>	Number_In_Stock

REPAIR	<u>Repair_Id</u>	Repair_Name	Labor_Cost

REPAIR_PARTS_REQUIRED	<u>Repair_Id</u>	<u>MID</u>	<u>Serial_Num</u>	Quantity_Required

JOB	<u>Job_Number</u>	Customer_Name	Date	Store_Id

JOB_REPAIRS	<u>Job_Number</u>	<u>Repair_Id</u>	Quantity_Of_Repair

Question 5 - Functional Dependencies (11 points 315; 12 points 415)

Consider the following relation:

L	N	A	C	T
89	32	BWI	CKK	32.0
91	32	PHL	CNN	32.0
89	32	BWI	IBM	46.6
69	54	BKK	ATT	33.9

(a) State whether the following Functional Dependencies are satisfied by the relation r above (circle yes or no). Only students in 600.415 should do problems marked with a *. If a FD is not satisfied, explain why by giving a counterexample in the data.

FD	Satisfied?	Reason for <i>No</i> answer
$A \rightarrow T$	Yes / No	
$A \rightarrow N$	Yes / No	
$A \rightarrow LNACT$	Yes / No	
$C \rightarrow LNACT$	Yes / No	
$LN \rightarrow A$	Yes / No	
$LN \rightarrow C$	Yes / No	* (600.415 only)

List a possible Candidate Key for r as instantiated above: _____

(b) (5 points) Let $r(A, B, C)$ be a relational schema. Give a particular instance r_1 (i.e. a relation) of r such that r_1 satisfies $A \rightarrow B$ but $C \rightarrow A$ does not hold for r_1 . (This question is unrelated to 5A. You should invent and give your own relation satisfying the above).

Question 6 - Integrity Constraints (6 points)

- **Briefly** list 2-3 *very different* potential uses for foreign key integrity constraints (e.g. how would any relational database system benefit from knowing that EMPLOYEE.DNO is a foreign key pointing to DEPARTMENT.DNUMBER).

Only a few words are necessary for each potential use, but if you pick something obscure be sure to justify it.

Question 7 (5 points) - Database Normalization

Given an arbitrary relational schema with only 2 attributes, is it true that this schema is necessarily in BCNF? Explain why or why not.