

Computer Science 361 – Spring 2014

Assignment #4

(60 points)

Due: Tuesday, 4/29/13 in class by 11:30AM

Answer all questions, with your work clear and legible, and all sheets stapled together.

1. (8 points) Consider the relation:

`hard_disk (sno, manf, model, batch, capacity, retailer)`

Each tuple in the relation contains information about a hard disk drive with a unique serial number, made by a manufacturer with a particular model number, released in a certain batch, which has a certain storage capacity and is sold by a certain retailer. Write each of the following dependencies as an FD:

- i. The manufacturer and serial number uniquely identifies the drive.
- ii. A model number is registered by a manufacturer and therefore cannot be used by another manufacturer.
- iii. All disk drives in a particular batch are the same model.
- iv. All disk drives of a certain model of a particular manufacturer have exactly the same capacity.

2. (7 points) Consider the relation:

`accessories (carID, optType, listPrice, saleDate, discountPrice)`

Each tuple in the relation refers to options installed in cars that were sold at a dealership, and the list and discounted prices of the options. Given the following functional dependencies:

`carID → saleDate`

`optType → listPrice`

`carID, optType → discountPrice`

- i. What is the strongest normal form this relation is in?
 - ii. Normalize it to BCNF, if it is not already in BCNF.
3. (15 points) The table shown below lists sample dentist/patient appointment data. A patient is given an appointment at a specific time and date with a dentist located at a particular surgery. On each day of patient appointments, a dentist is allocated to a specific surgery for that day.
- i. Using the given information, and examining the data in the table, identify the functional dependencies represented by the attributes shown in the table. State any reasonable assumptions you make about the data and the attributes shown in the table.
 - ii. Identify all candidate keys.

- iii. For each functional dependency, state the highest normal form (1NF through BCNF, or None) that it violates.
- iv. Normalize the table into 2NF relations.
- v. Normalize the table into 3NF relations.
- vi. Normalize the table into BCNF relations.

staffNO	dentistName	patNo	patName	date	time	surgeryNo
S1011	Tony Smith	P100	Gillian White	12-Sep-08	10:00	S15
S1011	Tony Smith	P105	Jill Bell	12-Sep-08	12:00	S15
S1024	Helen Pearson	P108	Ian McKay	12-Sep-08	10:00	S10
S1024	Helen Pearson	P108	Ian McKay	14-Sep-08	14:00	S10
S1032	Robin Plevin	P105	Jill Bell	14-Sep-08	16:30	S15
S1032	Robin Plevin	P110	John Walker	15-Sep-08	18:00	S13

4. (9 points) Consider the three schedules below. Determine whether each schedule is *strict*, *cascadeless*, *recoverable* or *unrecoverable* and provide justification for your choice. (Determine the strictest recoverability condition that each schedule satisfies.)
 - a. S_3 : $r_1(X)$; $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $w_1(X)$; C_1 ; $w_3(Y)$; C_3 ; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$; C_2 ;
 - b. S_4 : $r_1(X)$; $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $w_1(X)$; $w_3(Y)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$; C_1 ; C_2 ; C_3 ;
 - c. S_5 : $r_1(X)$; $r_2(Z)$; $r_3(X)$; $r_1(Z)$; $r_2(Y)$; $r_3(Y)$; $w_1(X)$; C_1 ; $w_2(Z)$; $w_3(Y)$; $w_2(Y)$; C_3 ; C_2 ;
5. (16 points) Consider the following two transactions:

T_1 : $r_1(A)$; $r_1(B)$; $w_1(B)$;
 T_2 : $r_2(B)$; $r_2(A)$; $w_2(A)$;

 - i. Add lock and unlock instructions to T_1 and T_2 so they observe the *basic* two phase locking protocol ($s_i(Q)$, $x_i(Q)$ and $u_i(Q)$ instructions). Can the execution of these transactions result in a deadlock?
 - ii. Add lock and unlock instructions to T_1 and T_2 so they observe the *conservative* two phase locking protocol. Can the execution of these transactions result in a deadlock?
 - iii. Add lock and unlock instructions to T_1 and T_2 so they observe the *strict* two phase locking protocol (but not the rigorous 2 phase locking protocol). Can the execution of these transactions result in a deadlock?

- iv. Add lock and unlock instructions to T_1 and T_2 so they observe the *rigorous* two phase locking protocol. Can the execution of these transactions result in a deadlock?
6. (5 points) Trace the execution of the following time stamping schedule until either the first abort/rollback or completion of the schedule:
- S_6 : $TS(T_1)$; $r_1(A)$; $TS(T_2)$; $w_2(B)$; $r_2(A)$; $w_1(B)$; $TS(T_3)$; $r_3(A)$; C_1 ; C_2 ; C_3 ;