

CpSc 4620/6620 Quiz #6

Name: _____

Date: _____

Question #1 (20 points):

Are the following statements **true** or **false**?

1. A trivial functional dependency $Y \rightarrow X$ means X only depends on Y slightly. (F)
2. A multi-value dependency $X \twoheadrightarrow Y$ implies that values of attributes in Y depend on multiple attributes in X. (F)
3. A candidate key must be a superkey but a superkey may not be a candidate key. (T)
4. If a set contains all the attributes in a relational table, this set must be a superkey. (T)
5. It is possible to have multiple primary keys in a relational table. (F)
6. Entity integrity requires every foreign key value must match a primary key value in an associated table (F)
7. We should avoid use of nullify insert or delete rules. Because the parent entity in a parent-child relationship must exist, the nullify insert or delete rule violate this constraint. (T)
8. Use cascade insert rule for generalization hierarchies to ensure that all instances in the subtypes are also in the supertype. (F)
9. If $Z \rightarrow Y$ and $Y \rightarrow X$, X has a transitive dependency on Z. (T)
10. Given two attributes X and Y, $Y \rightarrow X$ is a full functional dependency. (T)

Question #2 (25 points): Please briefly describe the minimum criteria for a relational table to be 2NF, 3NF, BCNF, 4NF, 5NF respectively.

2NF: The table (relation) must be in 1NF. Functional dependencies of non-prime attributes on candidate keys are full functional dependencies. If a non-prime attribute of a table is functionally dependent on only a part (subset) of a candidate key, this table is not in 2NF.

3NF: The table must be in 2NF. No non-prime attribute is transitively dependent on a candidate key. If a non-prime attribute is only indirectly dependent (transitively dependent) on a candidate key, this table is not in 3NF.

BCNF: A table is in Boyce-Codd normal form (BCNF) if and only if, for every one of its non-trivial functional dependencies $X \rightarrow Y$, X is a superkey. i.e., X is either a candidate key or a superset thereof.

4NF: A table is in fourth normal form (4NF) if and only if, for every one of its non-trivial multivalued dependencies $X \twoheadrightarrow Y$, X is a superkey, i.e., X is either a candidate key or a superset thereof.

5NF: The table must be in 4NF. A 4NF table is said to be in the 5NF if and only if every join dependency in it is implied by the candidate keys.

Question #3 (15 points): Which three types of anomaly problems does the normalization process try to address? Please use an example to explain the problem associated with each anomaly type.

Update Anomaly: The same information may be expressed in multiple records; therefore updates to the table may result in logical inconsistencies.

Example: Each record in the "Employees' Skills" table in Question #4 might contain an Employee ID, Employee Address, and Skill; thus a change of address for a particular employee will potentially need to be applied to multiple records (one for each of his skills). If the update is not carried through successfully—if, that is, the employee's address is updated on some records but not others—then the table is left in an inconsistent state.

Insert Anomaly: There are circumstances in which certain facts cannot be recorded at all.

Example: In the previous example, if it is the case that Employee Address is held only in the "Employees' Skills" table, then we cannot record the address of an employee whose skills are not yet known.

Delete Anomaly: There are circumstances in which the deletion of data representing certain facts necessitates the deletion of data representing completely different facts.

Example: Suppose a table has the attributes Student ID, Course ID, and Lecturer ID (a given student is enrolled in a given course, which is taught by a given lecturer). If in the early stages of enrolment the number of students on the course temporarily drops to zero, then the last of the records referencing that course must be deleted—meaning, as a side-effect, that the table no longer tells us which lecturer has been assigned to teach the course.

Question #4 (25 points): What is the highest degree of normal form the following relational tables comply with respectively? If a table does not comply with any degree of normal form, state “none”. Please fill in the blanks with the appropriate degree of normal form.

1. Tournament Winners: _____ 2NF _____
2. Employees' Skills: _____ 1NF _____
3. CTX: _____ BCNF _____
4. Today's Court Bookings: _____ 3NF _____
5. Travelling Salesman Product Availability by Brand: _____ 4NF _____

Tournament Winners

Tournament	Year	Winner	Winner Date of Birth
Des Moines Masters	1998	Chip Masterson	14 March 1977
Indiana Invitational	1998	Al Fredrickson	21 July 1975
Cleveland Open	1999	Bob Albertson	28 September 1968
Des Moines Masters	1999	Al Fredrickson	21 July 1975
Indiana Invitational	1999	Chip Masterson	14 March 1977

Employees' Skills

Employee	Skill	Current Work Location
Brown	Light Cleaning	73 Industrial Way
Brown	Typing	73 Industrial Way
Harrison	Light Cleaning	73 Industrial Way
Jones	Shorthand	114 Main Street
Jones	Typing	114 Main Street
Jones	Whittling	114 Main Street

CTX

Course	Teacher	Text
Physics	Green	Basic Mechanics
Physics	Green	Principles of Optics
Physics	Brown	Basic Mechanics
Physics	Brown	Principles of Optics
Math	Green	Basic Mechanics
Math	Green	Vector Analysis

Today's Court Bookings

Court	Start Time	End Time	Rate Type
1	9:30	10:30	SAVER
1	11:00	12:00	SAVER
1	14:00	15:30	STANDARD
2	10:00	11:30	PREMIUM-B
2	11:30	13:30	PREMIUM-B
2	15:00	16:30	PREMIUM-A

- Each row in the table represents a court booking at a tennis club that has one hard court (Court 1) and one grass court (Court 2)
- A booking is defined by its Court and the period for which the Court is reserved
- Additionally, each booking has a Rate Type associated with it. There are four distinct rate types:
 - SAVER, for Court 1 bookings made by members
 - STANDARD, for Court 1 bookings made by non-members
 - PREMIUM-A, for Court 2 bookings made by members
 - PREMIUM-B, for Court 2 bookings made by non-members

Travelling Salesman Product Availability By Brand

Travelling Salesman	Brand	Product Type
Jack Schneider	Acme	Vacuum Cleaner
Jack Schneider	Acme	Breadbox
Willy Loman	Robusto	Pruning Shears
Willy Loman	Robusto	Vacuum Cleaner
Willy Loman	Robusto	Breadbox
Willy Loman	Robusto	Umbrella Stand
Louis Ferguson	Robusto	Vacuum Cleaner
Louis Ferguson	Robusto	Telescope
Louis Ferguson	Acme	Vacuum Cleaner
Louis Ferguson	Acme	Lava Lamp
Louis Ferguson	Nimbus	Tie Rack

The table's predicate is: Products of the type designated by *Product Type*, made by the brand designated by *Brand*, are available from the traveling salesman designated by *Traveling Salesman*.

Also the following rules apply: A Traveling Salesman has certain Brands and certain Product Types in their repertoire. If Brand B1 and Brand B2 are in their repertoire, and Product Type P is in their repertoire, then (assuming Brand B1 and Brand B2 both make Product Type P), the Traveling Salesman must offer products of Product Type P those made by Brand B1 and those made by Brand B2.

Question #5 (15 points): Please normalize the following tables to higher degree normal form tables to address their anomaly problems.

Tournament Winners

<u>Tournament</u>	<u>Year</u>	<u>Winner</u>	<u>Winner Date of Birth</u>
Des Moines Masters	1998	Chip Masterson	14 March 1977
Indiana Invitational	1998	Al Fredrickson	21 July 1975
Cleveland Open	1999	Bob Albertson	28 September 1968
Des Moines Masters	1999	Al Fredrickson	21 July 1975
Indiana Invitational	1999	Chip Masterson	14 March 1977

Tournament Winners

<u>Tournament</u>	<u>Year</u>	<u>Winner</u>
Indiana Invitational	1998	Al Fredrickson
Cleveland Open	1999	Bob Albertson
Des Moines Masters	1999	Al Fredrickson
Indiana Invitational	1999	Chip Masterson

Winners

<u>Winner</u>	<u>Winner Date of Birth</u>
Al Fredrickson	21 July 1975
Bob Albertson	28 September 1968
Chip Masterson	14 March 1977

Customer

<u>Customer ID</u>	<u>First Name</u>	<u>Surname</u>	<u>Telephone Number</u>
123	Robert	Ingram	555-861-2025
456	Jane	Wright	555-403-1659 555-776-4100
789	Maria	Fernandez	555-808-9633

Customer

<u>Customer ID</u>	<u>First Name</u>	<u>Surname</u>	<u>Telephone 1</u>	<u>Telephone 2</u>
123	Rachel	Ingram	555-861-2025	Null
456	James	Wright	555-403-1659	555-776-4100
789	Maria	Fernandez	555-808-9633	Null

Employees' Skills

Employee	Skill	Current Work Location
Brown	Light Cleaning	73 Industrial Way
Brown	Typing	73 Industrial Way
Harrison	Light Cleaning	73 Industrial Way
Jones	Shorthand	114 Main Street
Jones	Typing	114 Main Street
Jones	Whittling	114 Main Street

Employees's Skills

<u>Employee</u>	<u>Skill</u>
Brown	Light Cleaning
Brown	Typing
Harrison	Light Cleaning
Jones	Shorthand
Jones	Typing
Jones	Whittling

Work Location

<u>Employee</u>	Current Work Location
Brown	73 Industrial Way
Harrison	73 Industrial Way
Jones	114 Main Street