CSCI 455: Database Management System
Spring 2024

Exam 1

Thursday, Feb.29
Due date: March 3rd at 11:59 PM

Total Points: 106

Part 1: Multiple Choices (2 points)

1. Relations imply certain characteristics that make them different from files or tables. Which of the following statements applies to the relation?
    a. **A relation is defined as a set of tuples hence tuples in a relation do not have any particular order.**
    b. ~~An n-tuple is considered as an ordered list of n values, therefore the ordering of values in a tuple and hence attributes in a relation schema definition is significant.~~
    c. ~~Each value in a tuple is an atomic value.~~
    d. ~~The relation schema can be interpreted as a declaration or type of assertion.~~
    e. ~~All the above~~
2. Which one of the following constraints specifies that the value of each attribute A must be an atomic value?
    a. ~~Key constraint~~
    b. **Domain Constraint**
    c. ~~Primary Key~~
    d. ~~Constraint on Null~~
    e. ~~None of the above~~
3. Which one of the following constraints states that the primary key value cannot be NULL
    a. ~~Key constraint~~
    b. ~~Domain Constraint~~
    c. ~~Entity constraint~~
    d. **Constraint on Null**
    e. ~~None of the above~~
4. Which one of the following constraints states the relationship between two relations? This constraint is used to maintain the consistency among tuples of two relations.
    a. ~~Key constraint~~
    b. ~~Domain Constraint~~
    c. ~~Entity constraint~~
    d. ~~Constraint on Null~~
    e. **Referential Integrity**
5. Which one of the following constraints specifies a *uniqueness* constraint that no two distinct tuples in a state r(R) can have the same value for that key
    a. **Primary Key**
    b. Candidate key
    c. Super Key
    d. Foreign Key
    e. None of the above
6. This key must satisfy BOTH *uniqueness* and *minimality* constraints.
    a. Primary Key
    b. Super Key
    c. Foreign Key
    d. All the above

e. None of the above

7. The operations of the relational model can be categorized into
   ~~a. Retrievals and updates~~
   ~~b. Insert, Delete, Alter~~
   ~~c. Insert, Delete, Modify~~
   d. **Select, Project, Set-theoretic Operations**.
   ~~e. Set-theoretic Operations and Aggregate Functions~~
8. These operation(s) can ONLY violate referential integrity.
   ~~a. Delete~~
   ~~b. Insert~~
   ~~c. Update~~
   ~~d. All the above~~
   e. None of the above
9. A basic set of relational model operations constitutes the _____. These operations enable the user to specify basic retrieval requests.
   a. **Relational algebra, Select, Project, and Set-theoretic operations**.
   ~~b. Relational Calculus, Select, Project, set-theoretic operations.~~
   ~~c. All the above~~
   ~~d. None of the above~~
10. A complete set of relational algebra operations
   a. Selection, Projection, Union, Difference, Rename, and Cartesian Product
   ~~b. Selection, Projection, Union, Intersection, and Difference~~
   ~~c. Selection, Projection, Division, Union~~
   ~~d. Selection, Projection, Union, Difference, and Join~~
   ~~e. All the above~~
   ~~f. None of the above~~
11. The _____ operation is used to combine related tuples from two relations using equality comparisons.
   a. Join
   ~~b. Natural Join~~
   ~~c. Theta Join~~
   ~~d. EQIJOIN~~
   ~~e. None of the above~~
12. This join operation was created to get rid of the second (superfluous) attribute in equality comparisons.
   ~~a. Join~~
   ~~b. Natural Join~~
   c. Theta Join
   ~~d. EQIJOIN~~
   ~~e. None of the above~~
13. If there is no join condition, it means all combinations of tuples qualify and the JOIN becomes.
   ~~a. UNION~~
   ~~b. INTERSECTION~~

c. CARTESIAN PRODUCT
~~d. Difference~~
~~e. DIVISION~~

14. this operation produces a relation R(X) that includes all tuples t[X] in $R_1(Z)$ that appear in R1 in combination with every tuple from $R_2(Y)$, where $Z = X \cup Y$.
    ~~a. UNION~~
    ~~b. INTERSECTION~~
    c. CARTESIAN PRODUCT
    ~~d. MINUS (Difference)~~
    ~~e. DIVISION~~
15. The_____ operation was developed to take the union of tuples from two relations if the relations are not union compatible.
    ~~a. JOIN~~
    ~~b. OUTER JOIN~~
    ~~c. OUTER UNION~~
    d. None of the above
16. The _____ operation keeps every tuple in the first relation R in the JOIN operation.
    a. LEFT OUTER JOIN
    ~~b. RIGHT OUTER JOIN~~
    ~~c. LEFT OUTER UNION~~
    ~~d. RIGHT OUTER UNION~~
    ~~e. None of the above~~
17. In relational database systems, SQL is a comprehensive database language that supports.
    ~~a. DDL~~
    ~~b. DML~~
    ~~c. Views~~
    ~~d. Security and authorization~~
    ~~e. Integrity constraints, and transaction control~~
    f. All of the above
18. The basic form of the SELECT statement is formed by this particular order
    a. SELECT <attribute list> FROM < table list> WHERE <Condition>;
    ~~b. SELECT <table list> FROM < attribute list> WHERE <Condition>.~~
    ~~c. SELECT <Condition > FROM < table list> WHERE <attribute list>;~~
    ~~d. SELECT <attribute list> WHERE < Condition> FROM <table list>;~~
    ~~e. None of the above~~
19. What are the problems associated with redundancy in the database?
    ~~a. Update problem.~~
    ~~b. Insert problem.~~
    ~~c. Delete problem.~~
    ~~d. Waste of Storage~~
    e. All the above
    ~~f. None of the above~~

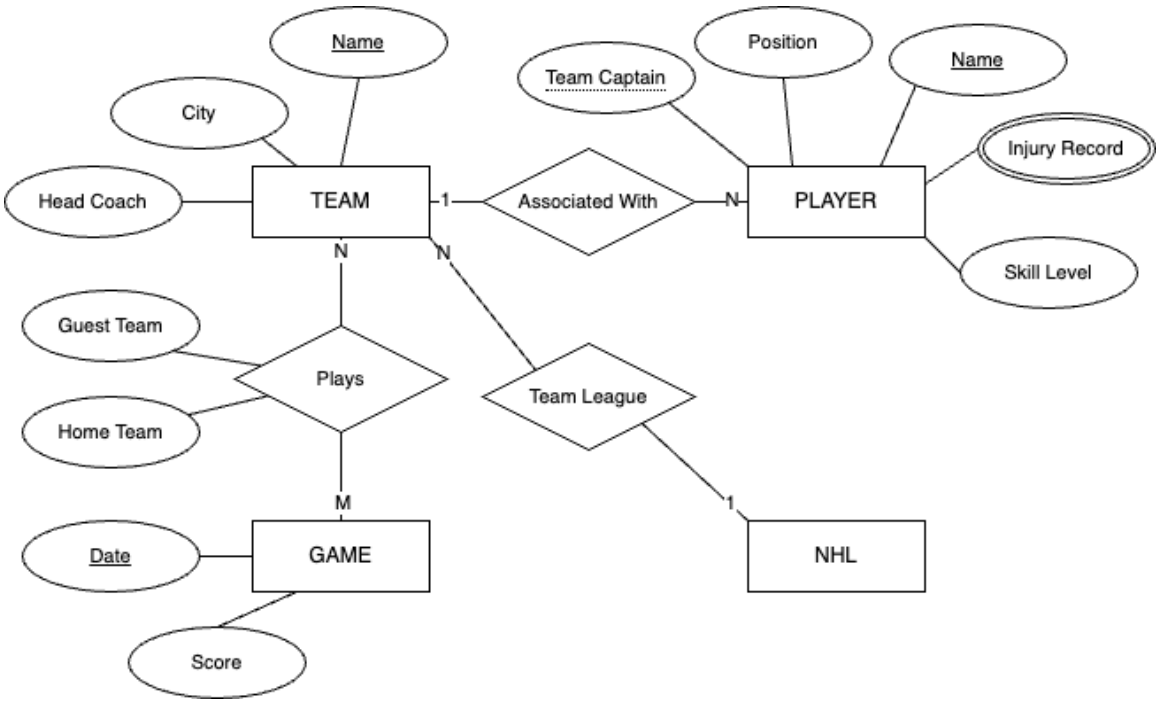
20. In Relational database systems, NULLS can have multiple interpretations. Which of the following can be applied to the interpretation of NULL values?
    a. ~~The attribute does not apply to this tuple.~~
    b. ~~The attribute value for this tuple is missing.~~
    c. ~~The value for this tuple is unknown.~~
    d. All the above

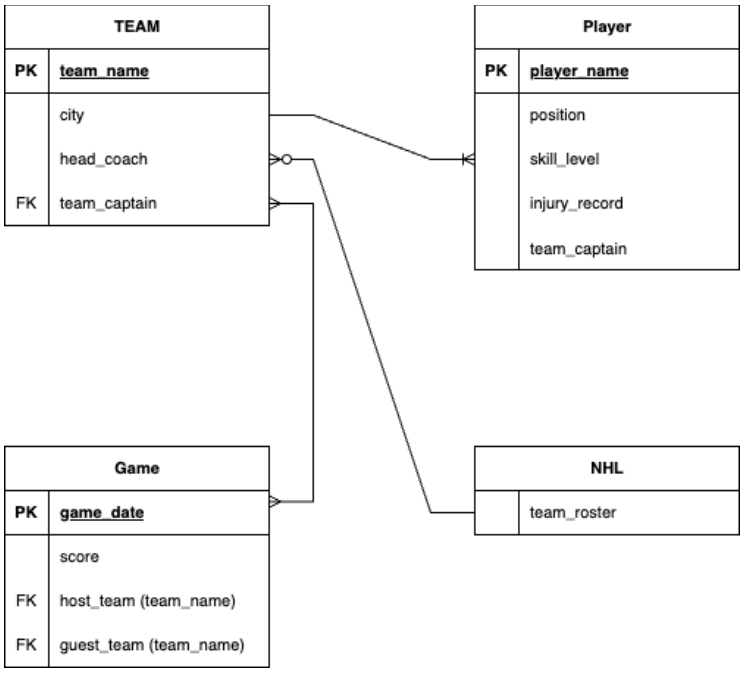
Part 2: Design:

(**24 points**) Suppose you are given the following requirements for a simple database for the National Hockey League (NHL):

1. the NHL has many teams,
2. each team has a name, a city, a head coach, a captain, and a set of players,
3. each player plays for only one team.
4. each player has a name, a position (such as left-wing or goalie), a skill level, and a set of injury records,
5. a team captain is also a player
6. a game is played between two teams (referred to as host_team and guest_team); a game has a date (such as March 9th, 2023) and a score (such as 4 to 2).

1. **Draw an ER diagram that captures the above requirements (10 points)**
2. **Identify the Keys (4 points)**
3. **Convert your ER diagram into relational tables schema (10 points)**





The primary keys of the diagram would include the Player Name, Team Name, and the Game Date. The foreign keys would be the Team Captain Key from Player in Team and the host and guest teams in Game.

Game			
Attribute	Data Type	PK	FK
date	DATE	Yes	
score	VARCHAR(10)		
host_team	VARCHAR(10)		Team.team_name
guest_team	VARCHAR(10)		Team.team_name
Player			
Attribute	Data Type	PK	FK
player_name	VARCHAR(50)	Yes	
position	VARCHAR(20)		
skill_level	VARCHAR(20)		
team_captain	BOOLEAN		Team.team_name
Team			
Attribute	Data Type	PK	FK
team_name	VARCHAR(50)	Yes	
city	VARCHAR(50)		
head_coach	VARCHAR(50)		
team_captain			Player.team_captain
NHL			
Attribute	Data Type	PK	FK
team_roster	VARCHAR(200)		

Part 3: Problem Solving

1. (**12 Points**) Consider the two tables T1 and T2 shown below. Show the result of the following operations:
   a. T1 JOIN $_{T1.P=T2.A}$ T2

T1.P	T1.Q	T1.R	T2.A	T2.B	T2.C
10	a	5	10	b	6
25	c	6	25	c	3

   b. T1 LEFT OUTER JOIN $_{T1.P=T2.A}$ T2

T1.P	T1.Q	T1.R	T2.A	T2.B	T2.C
10	a	5	10	b	6
15	b	8	NULL	NULL	NULL
25	c	6	25	c	3

   c. T1 RIGHT OUTER JOIN $_{T1.Q=T2.B}$ T2

T1.P	T1.Q	T1.R	T2.A	T2.B	T2.C
NULL	NULL	NULL	10	b	6
15	b	8	10	b	6
15	b	8	10	b	5
25	c	6	25	c	3

   d. T1 FULL OUTER JOIN $_{T1.P=T2.A}$ T2

T1.P	T1.Q	T1.R	T2.A	T2.B	T2.C
10	a	5	10	b	6
10	a	5	10	b	5
15	b	8	NULL	NULL	NULL
25	c	6	25	c	3

   e. T1 $\cup$ T2

T1.P	T1.Q	T1.R	T2.A	T2.B	T2.C
10	a	5	NULL	NULL	NULL
15	b	8	NULL	NULL	NULL
25	c	6	NULL	NULL	NULL
NULL	NULL	NULL	10	b	6
NULL	NULL	NULL	25	c	3
NULL	NULL	NULL	10	b	5

   f. T1 × T2 (I assume this is Cartesian product)

T1.P	T1.Q	T1.R	T2.A	T2.B	T2.C
10	a	5	10	b	6
10	a	5	25	c	3
10	a	5	10	b	5
15	b	8	10	b	6
15	b	8	25	c	3
15	b	8	10	b	5
25	c	6	10	b	6
25	c	6	25	c	3
25	c	6	10	b	5

T1

P	Q	R
10	a	5
15	b	8
25	c	6

T2

A	B	C
10	b	6
25	c	3
10	b	5

2. (**20 Points**) In general, given a populated relation (extension), we cannot determine which FDs hold and which do not unless we know the meaning of the relationships among the attributes. All we can say is that certain FDs *may* exist if they hold in that extension. We cannot guarantee its existence until we understand the meaning of the corresponding attributes. However, given the **current state** of the table below, list:

   a) The FDs that may exist among the *attributes of the **current state** of the table? If yes, then **list the FDs.***

      The only functional dependencies I see include
      C → B
      B → C

      Each value of B has a unique value of C and vice versa.

   b) The FDs that do NOT exist among the *attributes of the current state of the table. If yes, then **list the FDs** that violate this constraint.*

      FD's that violate this would include A→B, A→C, A→D, B→A, B→D, C→A, C→D, D→A, D→B, D→C

A	B	C	D
a1	b1	c1	d1
a1	b2	c2	d2
a2	b2	c2	d3
a3	b3	c4	d3

3. (**10 points**) What are the potential update anomalies in the EMP_PROJ and EMP_DEPT relations of Figure 14.4 (please see the figure in the textbook)?

There are a lot of redundancy in both tables since the same pieces of information are shared between both tables if the information needs to be updated changes can be missed or applied inconsistently meaning the two tables can have inconsistent data.