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In this project we have decided to make a database of a sports team, specifically for a basketball team. The model is mostly based on the features of an NBA team. The focus of a basketball team database is the team itself. A team is the most important entity of the E/R diagram. In the NBATeam entity, it includes the attribute conference and the key attribute teamName.

In a basketball team database, people usually would like to query the followings:

- a) *Games the NBA team has played through the season or the team history.*
- b) *The owner or people that own the teams, including the management team.*
- c) *The coaching staff on a team.*
- d) *Team statistics of the team history.*
- e) *Last of all, the NBA players that play on the team.*

We will discuss the entity in order in the following.

a) In the NBAGame entity set we included the attributes of homeTeam, date, awayTeam, and score. The first two attributes are the keys for the entity set. We chose date and homeTeam as key attribute due to the fact that most Home Teams keep the records of the games that was played on there court.

b) Owners and management team are always one of the most important aspect of a team. This is the reason that we included it into the database. In this entity, Owner, we have ownerName, companyName, and type as the attributes. The ownerName is the key attribute for this entity set. The type attribute is to distinguish the different role of the management team from general manager to scouts.

c) Coaching staff are another important aspect of the team. A good coaching staff can bring a team to their best status, while a mediocre coaching staff can ruin a team. We included coachName, type, previousPosition, and experience as the attributes in this entity set, while taking coachName and type together as the key attribute. The type attribute is the role that the particular coaching staff has on the team. This may include the head coach, assistant coach, trainers, or any other staffs that may be on the team. The previousPosition is the attribute that records the previous coaching role the person was. This attribute is important because people may want to know the work they have been doing before the became the staff here. The experience attribute shows the years that the staff has worked on this expertise.

d) The entity teamStatistics has the attributes of year and record. This is a weak entity, since we do not have attribute(s) that can differentiate the members of the entity set. So we need the key of NBATeam which is teamName and the year attribute of teamStatistics to form the key attribute.

e) Last but not least, the NBAPlayer entity set which is the most sophisticated schema. The NBAPlayer entity set includes the attributes playerName, jerseyNo, birthDate, Height, Weight, nationality and education. The keys of this entity set is composed by playerName, jerseyNo, and birthDate. The education attribute shows the University or the last level of school the player previously attended. If the player is an international player, then it will show the nationality of the player in the nationality attribute. The NBAPlayer entity set has two other relationship with two other entity set, one of them is the sportCompany that the player endorses and the other one is playerStatistics. In the sportCompany entity set, the attributes are phoneNo, headquarter, companyName, and companyNo that they have registered. The companyNo is the key attribute for the entity set. The playerStatistics has the basic attributes that people would want to query, this includes Points per game (PPG), Rebounds per game (RPG), Assists per game (APG), Blocks per game (BPG), Steals per game (SPG), and the year that the users wants to query. Since this is a weak entity, the NBAPlayer entity set's key and the Year attribute of playerStatistics forms the key attribute for playerStatistics.

Most of the basic information are included in this database and hopefully the informations are all in a precise hierarchy order.

Schemes for all Relations in Our Database

Finally, we conclude 9 schemas in our database system:

1. NBATeam (teamName, conference);
2. teamStatistics (teamName, year, record);
3. NBAPlayer (playerName, jerseyNo, birthDate, height, weight, education, salary, teamName, companyNo);
4. playerStatistics (playerName, jerseyNo, birthDate, year, APG, BPG, RPG, SPG, PPG);
5. sportCompany (companyNo, companyName, headquarter, phoneNo);
6. NBAGame (date, homeTeam, awayTeam, score);
7. teamCoach (coachName, teamName, salary, type, experience, previousPosition);
8. Owner (ownerName, teamName, company, type);

The reasoning steps are as follows:

- 1: For entity set “NBATeam”:

NBATeam (teamName, conference);

- 2: For entity set “teamStatistics” and relationship “Has”:

Since “teamStatistics” is a weak entity, and have a many-one supporting relationship “Has” to entity set “NBATeam”. Thus, the relation schema of “teamStatistics” should include the key of “NBATeam”, and the supporting relation “Has” itself is not necessary to convert into a schema. That is,

teamStatistics (teamName, year, record);

- 3: For entity set “NBAPlayer”:

NBAPlayer (playerName, jerseyNo, birthDate, height, weight, education);

- 4: For relation “Contract”

Contract (teamName, playerName, jerseyNo, birthDate, salary)

Because the relation “Contract” is a many-one relationship from “NBAPlayer” to “NBATeam”, it’s better to combine relation “NBAPlayer” and “Contract” into one relation. That is,

NBAPlayer (playerName, jerseyNo, birthDate, *height*, *weight*, *education*, *salary*, *teamName*);

5: For entity set “sportCompany”:

sportCompany (companyNo, *companyName*, *headquarter*, *phoneNo*);

6: For relation “Endorsement”

Endorsement (playerName, jerseyNo, birthdate, companyNo);

Because the relation “Endorsement” is a many-one relationship from “NBAPlayer” to “sportCompany”, it’s better to combine relation “NBAPlayer” and “Endorsement” into one relation. That is,

NBAPlayer (playerName, jerseyNo, birthDate, *height*, *weight*, *education*, *salary*, *teamName*, *companyNo*);

7: For entity set “playerStatistics” and relationship “Has”:

Since “playerStatistics” is a weak entity, and have a many-one supporting relationship “Has” to entity set “NBAPlayer”. Thus, the relation schema of “playerStatistics” should include the key of “NBAPlayer”, and the supporting relation “Has” itself is not necessary to convert into a schema. That is,

playerStatistics (playerName, jerseyNo, birthDate, year, *APG*, *BPG*, *RPG*, *SPG*, *PPG*);

8: For entity set “teamStatistics” and relationship “Has”:

Since “teamStatistics” is a weak entity, and have a many-to-one supporting relationship “Has” to entity set “NBATeam”. Thus, the relation schema of “teamStatistics” should include the key of “NBATeam”, and the supporting relationship “Has” itself is not necessary to convert into relational schema.

teamStatistics (teamName, year, *record*);

9: For entity set “NBAGame”:

NBAGame (date, homeTeam, awayTeam, *score*);

10: For entity set “Coach”:

Coach (coachName, *type*, *experience*, *previousPosition*);

11: For relation “Works-for”

Works-for (coachName, teamName, *salary*)

Because the relation “Works-for” is a many-one relationship from “Coach” to “NBATeam”, it’s better to combine relation “Coach” and “Works-for” into one relation. That is,

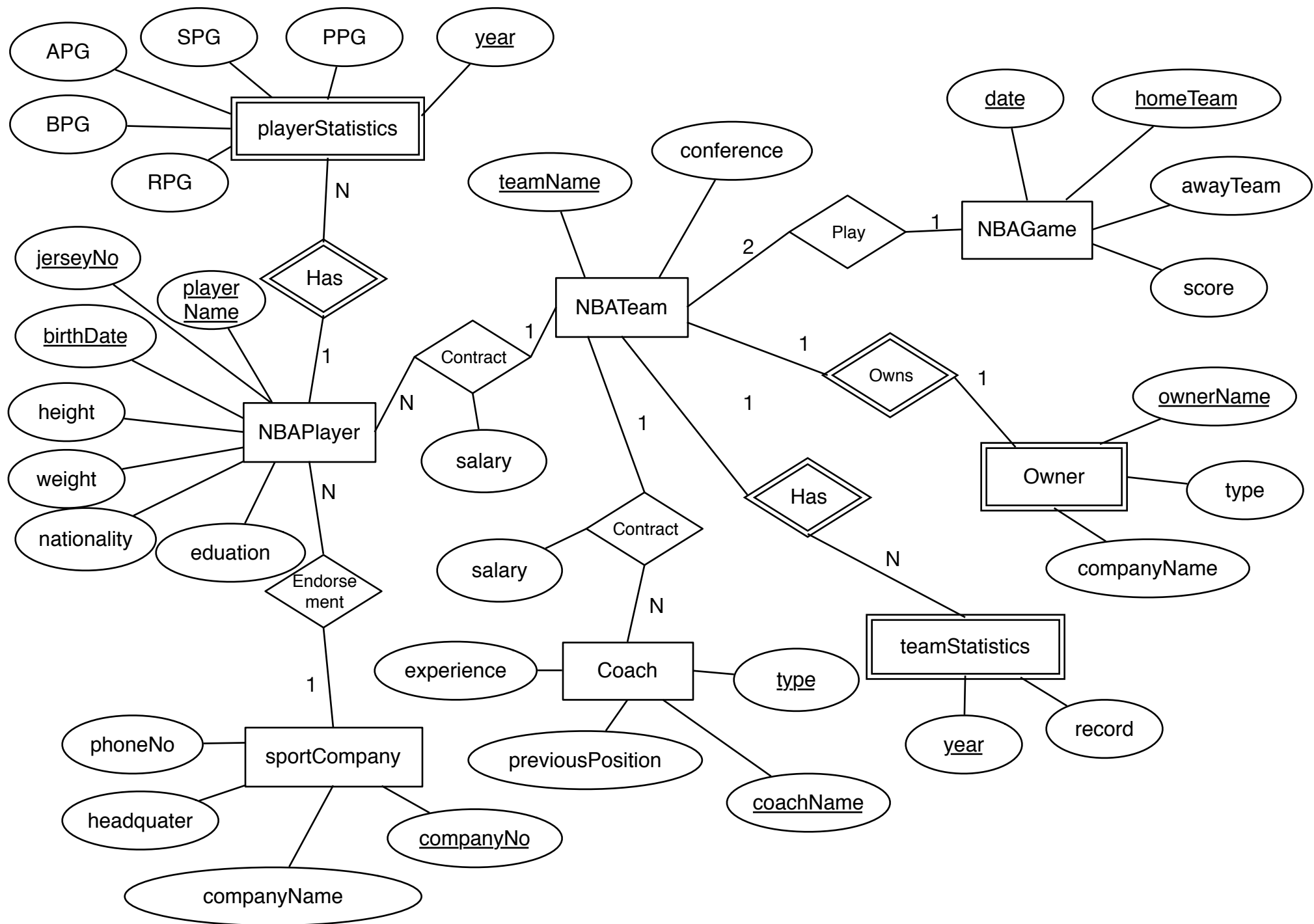
teamCoach (coachName, teamName, *salary*, *type*, *experience*, *previousPosition*);

12: For entity set “Owner”:

Owner (ownerName, *company*, *type*);

Since “Owner” is a weak entity, and have a many-one supporting relationship “Owns” to entity set “NBATeam”. Thus, the relation schema of “Owner” should include the key of “NBATeam”, and the supporting relation “Owns” itself is not necessary to convert into a schema. That is,

Owner (ownerName, teamName, *company*, *type*);



Nontrivial Functional Dependencies

1. NBAGame (*date*, *homeTeam*, *awayTeam*, *score*)

FD: { *date*, *homeTeam* \rightarrow *awayTeam*, *score* }

This schema is already in BCNF and 4NF

2. Owner (*ownerName*, *teamName*, *company*, *type*)

FD: { *ownerName*, *teamName* \rightarrow *company*, *type* }

This schema is already in BCNF and 4NF

3. teamCoach (*coachName*, *teamName*, *salary*, *type*, *experience*, *previousPosition*)

FD: { *coachName*, *teamName* \rightarrow *salary*, *type*, *experience*, *previousPosition* }

This schema is already in BCNF and 4NF

4. teamStatistics (*teamName*, *year*, *record*)

FD: { *teamName*, *year* \rightarrow *record* }

This schema is already in BCNF and 4NF

5. NBAPlayer (*jerseyNo*, *playerName*, *birthDate*, *height*, *weight*, *education*, *salary*, *teamName*, *companyNo*)

FD: { *jerseyNo*, *playerName*, *birthDate* \rightarrow *height*, *weight*, *education*, *salary*, *teamName*, *companyNo* }

This schema is already in BCNF and 4NF

6. NBA Team (teamName, conference)

FD: { *teamName* \rightarrow *conference* }

This schema is already in BCNF and 4NF

7. playerStatistics (playerName, jerseyNo, birthDate, year, APG, BPG, RPG, SPG, PPG)

FD: { *playerName*, *jerseyNo*, *birthdate*, *year* \rightarrow APG, BPG, RPG, PPG, SPG }

This schema is already in BCNF and 4NF

8. sportCompany (companyNo, phoneNo, headquarter, companyName)

FD: { *companyNo* \rightarrow *phoneNo*, *headquarter*, *companyName* }

This schema is already in BCNF and 4NF

Explanation for Java code and embedded SQL

This Java embedded SQL code includes several classes: 'connectJDBC', 'main', 'query', and 'update'. The official database (namely, 'cccheng-project') we used for demonstration is on Cheng's laptop (MacBook). The Java code can be opened by importing the project 'tamu.databaseproject' via the IDE eclipse. Open code 'main.java' and choose to run as Java application to begin our database system menu.

1. The startup codes

Class 'main' is the main structure of this code. It activates the database by executing the connector from Java to MySQL via JDBC. The username and password for MySQL is default as 'root' and 'project', respectively. Since we use Cheng's laptop (MacBook) for formal demonstration, the database is name as 'cccheng-project'. Therefore, the connector will assign to use database 'cccheng-project' for further actions. In windows system, the 'localhost' in url part should be '127.0.0.1:3306' instead. When program starts, the main menu will show up on the console (screen) and ask the user to choose the following modes: 1. Query; 2. Update; 0. Exit. A new object of class 'query' or 'update' will then be established when the user selects in the corresponding mode: 'Query' or 'Update'. The constructor on either class 'query' or 'update' is to print out a message on screen to show which section the user are currently in: general query or data modification?

2. The function codes

In 'query' class, the whole procedure will execute by a method call 'start'. We first run the query "SELECT TABLE_NAME FROM INFORMATION_SCHEMA.TABLES WHERE TABLE_TYPE = 'BASE TABLE' AND TABLE_SCHEMA = 'cccheng-project'" by using the class 'connectJDBC' to declare a statement in order to use the method 'executeQuery' to interpret the SQL script. This will show the table list of databases 'cccheng-project'. Then, we can follow the steps specified in pdf file 'captured-screen' to do the query action. User's input will be organized into a string, and we use 'nextLine' or 'nextInt' to capture the characters type or numerical type of corresponding input answers that valid to respond to the question. Some inputs will be used to combine with the query statement in order to retrieve the results with respect to the user's inputs. For instance, the query will ask the user to type in the attributes they want to see and the condition they want to select the attributes. Java.sql class Statement, ResultSet and ResultSetMetaData achieve the query function of the database. The 'update' class is similar to 'query' class but just the user's input organization, statement realization is different (i.e., use method 'executeUpdate' to trigger the query statement for data modification instead of using method 'executeQuery'). In addition, the 'update' class has defined an extra method 'insert' to deal with data insertion.

The organization of the whole database system is a WHILE loop on the outside to keep running the program when the user is not decided to leave the program (i.e., input 0 in the main menu to exit). In the inner part, we use IF-ELSE statement for mode selection, and in some levels of questions, the input will be using FOR loop to capture each separate string correctly. Notice that exception may occur in loading to SQL driver, connecting to MySQL server, BufferedWriter input, and execute SQL statement in MySQL database. Therefore, we use 'try' and 'catch' in these places to catch and handle the potential exceptions.

Database Systems Screen Shot

1. The main menu

We classify all the operations into two parts.

- Query
In this part, we can query the tables depend on what user want. For example, query the whole table or some attributes of a table.
- Data Modification (insert/update/delete)
In this part, we can do insert, update, and delete.

```
main [Java Application] /System/Library/Java/JavaVirtualMachines/1.6.0.jdk/Contents/Home/bin/java (2014/11/16 下午2:13:50)
Please select the NUMBER you want to perform 1.Query 2.Data Modification(insert/update/delete) 0.Exit...
```

2. Query a table from database

In this example, we query whole NBAPlayer table. First, we choose the table we want to look up. Second, we type 0 to see whole table.

```
Please select the NUMBER you want to perform 1.Query 2.Data Modification(insert/update/delete) 0.Exit...
1
This is a query session.
-----
NBAGame
NBAPlayer
NBATeam
Owner
playerStatistics
sportCompany
teamCoach
teamStatistics
-----
Which Table do you want to look up?
NBAPlayer
How many attributes do you want to lookup? If all type 0
0
-----
Amare Stoudemire      1      1982-11-16      6.1      245      Cypress Creek      21679893      New York Knicks      3648
Carmelo Anthony 7      1984-05-29      6.8      230      Oak Hill Academy      22458401      New York Knicks      3406
Dion Waiters      3      1991-12-10      6.4      210      Syracuse University      3894240      Cleveland Cavaliers      3648
Dwyane Wade      3      1982-01-17      6.4      220      Marquette University      15000000      Miami Heat      3406
James Harden      13      1989-08-26      6.5      220      Arizona State University      13701250      Houston Rockets      3406
Jeremy Lin      7      1988-08-23      6.3      200      Harvard University      5225000      Houston Rockets      3227
Kobe Bryant      24      1978-08-23      6.6      205      Lower Merion      23500000      Los Angeles Lakers      3227
Kyrie Irving      2      1992-03-23      6.2      191      Duke University      5607240      Cleveland Cavaliers      2099
LeBron James      6      1984-12-30      6.8      250      Saint Vincent-Saint Mary      20644400      Miami Heat      3227
Steve Nash      10      1974-02-07      6.3      178      Santa Clara University      9300500      Los Angeles Lakers      624
Tim Duncan      21      1976-04-25      6.11      255      Wake Forest University      10361446      San Antonio Spurs      624
Tony Parker      9      1982-05-17      6.2      185      France      12500000      San Antonio Spurs      2099
-----
Type 0 to go to main menu! Type 1 to continue!
```

3. Query three attributes of a table from database

In this example, we query three attributes of teamCoach table. First, we choose the table we want to look up. Second, we type 3 to see three attributes. Third, we type the attributes' name that we want to look up.

```
Please select the NUMBER you want to perform 1.Query 2.Data Modification(insert/update/delete) 0.Exit...
```

```
1
```

```
This is a query session.
```

```
-----  
NBAGame  
NBAPlayer  
NBATeam  
Owner  
playerStatistics  
sportCompany  
teamCoach  
teamStatistics  
-----
```

```
Which Table do you want to look up?
```

```
teamCoach
```

```
How many attributes do you want to lookup? If all type 0
```

```
3
```

```
-----  
coachName  
teamName  
salary  
types  
experience  
previousPosition  
-----
```

```
Which attribute(s) do you want to lookup?
```

```
coachName
```

```
teamName
```

```
salary
```

```
-----  
Byron Scott    Los Angeles Lakers    4250000  
David Blatt    Cleveland Cavaliers    3330000  
Derek Fisher   New York Knicks 5000000  
Erik Spoelstra Miami Heat      3000000  
Gregg Popovich San Antonio Spurs     6000000  
Kevin McHale    Houston Rockets 4000000  
-----
```

```
Type 0 to go to main menu! Type 1 to continue!
```

4. Insert a row into a table

In this example, we insert a row into an Owner table. First, we choose the table we want to insert. Second, we insert a row. Third, we go back to menu and query the table to see the result.

```
Please select the NUMBER you want to perform 1.Query 2.Data Modification(insert/update/delete) 0.Exit...
2
This is an data modification session.
1.Insert a new record 2. Delete a Table 3.Update NBAPlayer Stats
1
-----
NBAGame
NBAPlayer
NBATeam
Owner
playerStatistics
sportCompany
teamCoach
teamStatistics
-----
Which Table do you want to insert?
Owner
-----
Dan Gilbert      Cleveland Cavaliers    Quicken Loans    Chairman
James Dolan      New York Knicks The Madison Square Garden Comp Chairman
Jeanie Buss      Los Angeles Lakers     Los Angeles Lakers Chairman
Leslie Alexander Houston Rockets The Alexander Group Chairman
Micky Arison     Miami Heat      Carnival Corporation & plc Chairman
Peter Holt       San Antonio Spurs    Holt Cat         CEO
-----
ownerName      varchar(20)
teamName       varchar(25)
company varchar(30)
types         varchar(10)
-----
Enter the record according to the above one by one.
Eric_Hsu Chicago_Bulls Taiwan_Company CEO
Type 0 to go to main menu! Type 1 to continue!
0
Update Successfully!
```

the data we insert

```
Please select the NUMBER you want to perform 1.Query 2.Data Modification(insert/update/delete) 0.Exit...
1
This is a query session.
-----
NBAGame
NBAPlayer
NBATeam
Owner
playerStatistics
sportCompany
teamCoach
teamStatistics
-----
Which Table do you want to look up?
Owner
How many attributes do you want to lookup? If all type 0
0
-----
Dan Gilbert      Cleveland Cavaliers    Quicken Loans    Chairman
Eric_Hsu Chicago_Bulls Taiwan_Company CEO
James Dolan      New York Knicks The Madison Square Garden Comp Chairman
Jeanie Buss      Los Angeles Lakers     Los Angeles Lakers Chairman
Leslie Alexander Houston Rockets The Alexander Group Chairman
Micky Arison     Miami Heat      Carnival Corporation & plc Chairman
Peter Holt       San Antonio Spurs    Holt Cat         CEO
-----
Type 0 to go to main menu! Type 1 to continue!
```

insert successfully!

5. Update a row in a table

For the update, we restrict that users can only change players' jerseyNo and teamName. In this example, first, we choose the player that we want to update. Second, we update his jerseyNo and teamName. Third, we go back to menu and query the table to see the result.

```
Please select the NUMBER you want to perform 1.Query 2.Data Modification(insert/update/delete) 0.Exit...
2
This is an data modification session.
1.Insert a new record 2. Delete a Table 3.Update NBAPlayer Stats
3
```

NBAGame
NBAPlayer
NBATeam
Owner
playerStatistics
sportCompany
teamCoach
teamStatistics

Amare Stoudemire	1	1982-11-16	6.1	245	Cypress Creek	21679893	New York Knicks	3648
Carmelo Anthony	7	1984-05-29	6.8	230	Oak Hill Academy	22458401	New York Knicks	3406
Dion Waiters	3	1991-12-10	6.4	210	Syracuse University	3894240	Cleveland Cavaliers	3648
Dwyane Wade	3	1982-01-17	6.4	220	Marquette University	15000000	Miami Heat	3406
James Harden	13	1989-08-26	6.5	220	Arizona State University	13701250	Houston Rockets	3406
Jeremy Lin	7	1988-08-23	6.3	200	Harvard University	5225000	Houston Rockets	3227
Kobe Bryant	24	1978-08-23	6.6	205	Lower Merion	23500000	Los Angeles Lakers	3227
Kyrie Irving	2	1992-03-23	6.2	191	Duke University	5607240	Cleveland Cavaliers	2099
LeBron James	6	1984-12-30	6.8	250	Saint Vincent-Saint Mary	20644400	Miami Heat	3227
Steve Nash	10	1974-02-07	6.3	178	Santa Clara University	9300500	Los Angeles Lakers	624
Tim Duncan	21	1976-04-25	6.11	255	Wake Forest University	10361446	San Antonio Spurs	624
Tony Parker	9	1982-05-17	6.2	185	France	12500000	San Antonio Spurs	2099

Please enter the player name that you want to update.
Jeremy Lin
Jeremy Lin

change Jeremy's jerseyNo and teamName

Jeremy Lin	7	1988-08-23	6.3	200	Harvard University	5225000	Houston Rockets	3227
------------	---	------------	-----	-----	--------------------	---------	-----------------	------

Input jerseyNo to be modified.
17

Input teamName to be modified.
Los Angeles Lakers

```
Type 0 to go to main menu! Type 1 to continue!
0
Invalid input
Update Successfully!
Please select the NUMBER you want to perform 1.Query 2.Data Modification(insert/update/delete) 0.Exit...
1
This is a query session.
```

NBAGame
NBAPlayer
NBATeam
Owner
playerStatistics
sportCompany
teamCoach
teamStatistics

Which Table do you want to look up?
NBAPlayer

How many attributes do you want to lookup? If all type 0
0

update successfully!

Amare Stoudemire	1	1982-11-16	6.1	245	Cypress Creek	21679893	New York Knicks	3648
Carmelo Anthony	7	1984-05-29	6.8	230	Oak Hill Academy	22458401	New York Knicks	3406
Dion Waiters	3	1991-12-10	6.4	210	Syracuse University	3894240	Cleveland Cavaliers	3648
Dwyane Wade	3	1982-01-17	6.4	220	Marquette University	15000000	Miami Heat	3406
James Harden	13	1989-08-26	6.5	220	Arizona State University	13701250	Houston Rockets	3406
Jeremy Lin	17	1988-08-23	6.3	200	Harvard University	5225000	Los Angeles Lakers	3227
Kobe Bryant	24	1978-08-23	6.6	205	Lower Merion	23500000	Los Angeles Lakers	3227
Kyrie Irving	2	1992-03-23	6.2	191	Duke University	5607240	Cleveland Cavaliers	2099
LeBron James	6	1984-12-30	6.8	250	Saint Vincent-Saint Mary	20644400	Miami Heat	3227
Steve Nash	10	1974-02-07	6.3	178	Santa Clara University	9300500	Los Angeles Lakers	624
Tim Duncan	21	1976-04-25	6.11	255	Wake Forest University	10361446	San Antonio Spurs	624
Tony Parker	9	1982-05-17	6.2	185	France	12500000	San Antonio Spurs	2099

Type 0 to go to main menu! Type 1 to continue!

6. Drop a table

In this example, first, we choose teamCoach to drop. Second, we go back to menu and query the table to see the result.

```
Please select the NUMBER you want to perform 1.Query 2.Data Modification(insert/update/delete) 0.Exit...
2 main [Java Application] /System/Library/Java/
This JavaVirtualMachines/1.6.0.jdk/Contents/Home/
1.In: bin/java (2014/11/15 上午12:08:18) .Update NBAPlayer Stats
2
```

```
-----
NBAPlayer
NBATeam
Owner
playerStatistics
sportCompany
teamCoach
teamStatistics
-----
```

Which Table do you want to delete?

teamCoach

```
-----
Byron Scott    Los Angeles Lakers    4250000 Head coach    14    Assistant coach
David Blatt    Cleveland Cavaliers    3330000 Head coach    21    Assistant coach
Derek Fisher   New York Knicks 5000000 Head coach    1     Player
Erik Spoelstra Miami Heat    3000000 Head coach    17    Assistant coach
Gregg Popovich San Antonio Spurs    6000000 Head coach    40    Assistant coach
Kevin McHale   Houston Rockets 4000000 Head coach    9     Assistant coach
-----
```

Delete Table?(y/n)

y

Table Deleted

```
-----
This is a query session.
-----
```

```
NBAPlayer
NBATeam
Owner
playerStatistics
sportCompany
teamStatistics
-----
```

drop successfully!
There is no teamCoach table anymore

Which Table do you want to look up?