

DATABASE SYSTEM

FOR NBA
PAYROLL DATA
SERVICE



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INTRODUCTION

This report focuses on the integrated database system for NBA payroll data service, which provide concise and meaningful information about NBA.

The service is based on a responsive website for mobile, tablet, and desktop devices. The interested user can purchase a one-time single user or organization license, which is reasonably-priced, for a lifetime access to the database.

The NBA player payroll data system is divided into four parts, including salaries, the performance of individual players, taxes, and contracts. These figures with meaningful contexts reveal the overall value of the NBA players, so internal stakeholders could invest in the most suitable player. Team's transparency could also be increased to external stakeholders with processed raw data.

INTRODUCTION OF NBA

NBA, which means 'National Basketball Association', is made up of 30 teams in two leagues: the Eastern Conference and the Western Conference. Each conference is made up of 3 divisions: each division with 5 teams. As one of the major professional sports leagues in the United States and Canada, each team plays 82 games in the regular season from mid-October to April. After the regular season, the top eight teams will play for totally 7 matches in the playoffs season to determine the league's champion in that season.

The terms and conditions of the salary of NBA players and teams are set by The Collective Bargaining Agreement (CBA) between the The National Basketball Players Association (NBPA) and the NBA.

TERMINOLOGY FOR SALARY

- Salary cap: A limit on the amount of money that the team can spend on player contracts.
- Soft limit: The amount of money that the team can spend.
- Hard limit: The team's total salary must not exceed this amount.
- Salary Floor: The minimum threshold that the team's gross salary must meet.
- Luxury tax line: If the team exceeds this tax threshold, the team will be fined for the amount exceeded.
- Minimum: The minimum salary a player can receive.



- Trade Except: During trading, if a team's salary does not exceed the Luxury tax line, at most, 150% of the player's salary traded by the team can be exchanged.
- Mid-Level: It is an exception. When the team's salary exceeds the specified amount of money, the team can choose one of the mid-level to sign players. After using one of them, it is unable to use the other mid-level exceptions. There are three types of mid-level :
 - Non-Taxpayer Mid-Level: When the team's salary exceeds the salary cap but is not over the Luxury tax line, the team can use it to sign one player.
 - Taxpayer Mid-Level: When the team's salary exceeds the Luxury tax line, the team can use it to sign one player.
 - Room Mid-Level: When the team's salary is below the salary cap, the team can use it to sign one player.

PROSPECTIVE CLIENTS TYPE

- Sports journalists
 - e.g., Mike Breen (an NBA Play-by-Play commentator and broadcaster for the New York Knicks)
 - Malika Andrews (an NBA Reporter and Host from NBA Today)
- Sponsors and Advertisers
 - e.g., Adidas, YouTube TV, Coinbase (a cryptocurrency platform), Tencent (international digital partner)
- Fans // Audiences
 - Comes from different countries worldwide
 - Passionate and loyal to the NBA teams they supported
- Organizations that highly depend on NBA
 - e.g., NBAstuffer (a website provided NBA basketball analytics), The National Basketball Coaches Association (NBCA), The National Basketball Players Association (NBPA)
- Owners and employees of the NBA teams
- Coaches
- NBA players



DESCRIBE THE BUSINESSES RULE

OUR SERVICE

The data system service provides NBA player payroll data to the paid users, including player's salaries as well as their performance, and team's taxes and contracts. Users could access the database after purchasing at once. Users come from many countries worldwide. The Username, Phone number, Email address, Password, Country, User Type should be recorded.

NBA DATA

NBA holds several games annually. In every season, there are 16 teams selected. Each team could participate in 82 NBA games per season. Each game is competed by two teams consisting of at most 15 players per team.

The Name, Country, Birth Date, Weight(lb), Height(cm), First and Second Position, Jersey number, Team, Salary, Sign Season in League should be recorded as the player information. The performance of players, such as Points, Rebounds, Assists, Steals, Blocks Per Game, Field Goal Percentage and 3-Point Field Goal Percentage will be recorded.

Each player can only be signed by one team while only have one contract at the same time. Depending on the strength of players, their salary has been decided at different levels and varied from time by time. The salaries and his salary rate, such as increasing 5%, decreasing 5% or no change, of a player on different contracts will be recorded and updated in every season.

Each team has the same salary limit per season, but the salary limit is assigned to each team for each season. Soft limit, Hard limit, Salary floor, Luxury tax line, Non-Taxpayer Mid-Level, Taxpayer Mid-Level, Room Mid-Level, Minimum will be recorded and updated in each season.

Team Name, Conference, Team Salary, Number of Championships, Trade Exception is recorded as the information of each team. The state of winning or losing after a match should be recorded as well. The performance of the team will be calculated by using the queries.



CONCEPTUAL MODEL (ERD)

Considering the business rule, we created the ER diagram by using Lucidchart.

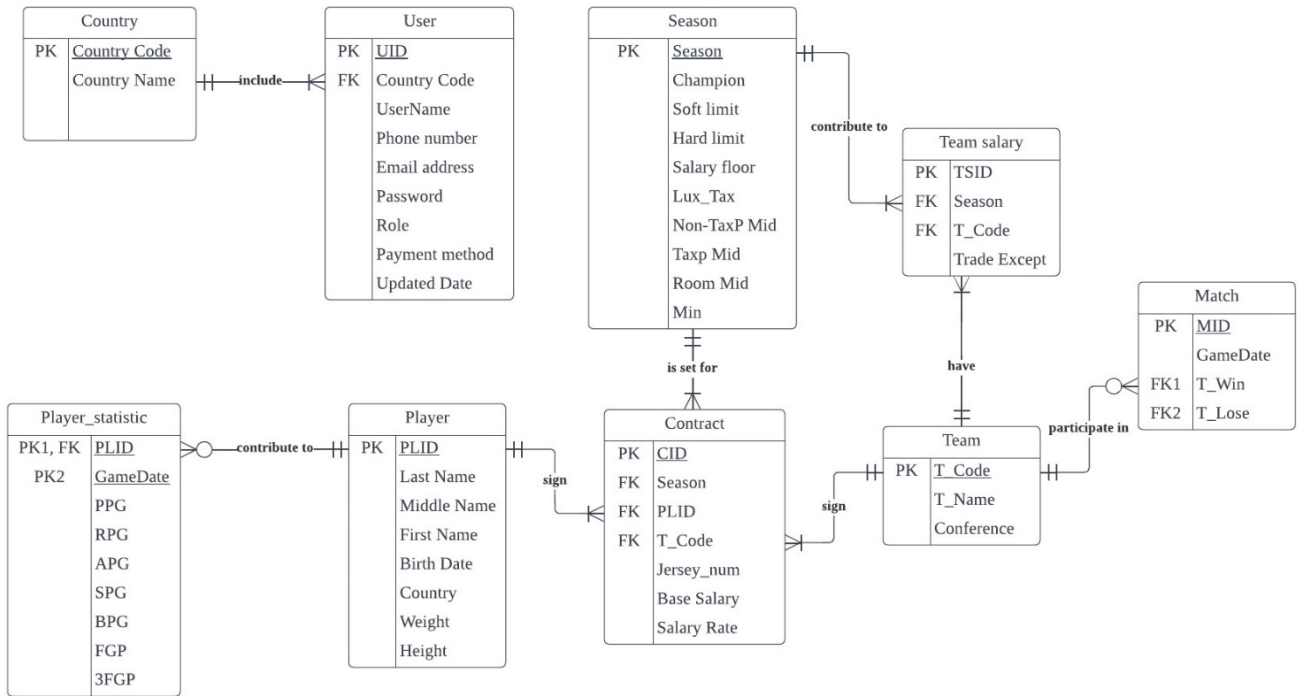


Figure 1 Entity relationship diagram (ERD) of the NBA payroll data service



LOGICAL DESIGN

TABLE STRUCTURE

CREATE TABLE

1. Create Contract table

```
1. CREATE TABLE Contract (  
2.     CID AUTOINCREMENT PRIMARY KEY,  
3.     Season CHAR (5) NOT NULL,  
4.     PLID INT NOT NULL,  
5.     T_Code VARCHAR (2) NOT NULL,  
6.     Jersey_num CHAR (3),  
7.     [Base Salary] CURRENCY,  
8.     [Salary Rate] NUMBER  
9. );
```

Figure 2 Create Contract Table SQL

2. Create Country table

```
1. CREATE TABLE Country (  
2.     [Country Code] VARCHAR (2) NOT NULL,  
3.     [Country Name] VARCHAR (2) NOT NULL,  
4.     PRIMARY KEY (Country Code)  
5. );
```

Figure 3 Create Country Table SQL

3. Create Player table

```
1. CREATE TABLE Player (  
2.     PLID AUTOINCREMENT PRIMARY KEY,  
3.     LastName CHAR (50) NOT NULL,  
4.     MiddleName CHAR (50),  
5.     FirstName CHAR (50) NOT NULL,  
6.     [Birth Date] DATE,  
7.     Country VARCHAR (50),  
8.     Weight_lb NUMBER,  
9.     Height_cm NUMBER  
10. );
```

Figure 4 Create Player Table SQL



4. Create Player statistics table

```
1. CREATE TABLE Player_statistic (  
2.     PLID INT NOT NULL,  
3.     GameDate DATE NOT NULL,  
4.     PPG NUMBER,  
5.     RPG NUMBER,  
6.     APG NUMBER,  
7.     SPG NUMBER,  
8.     BPG NUMBER,  
9.     FGP NUMBER,  
10.    3FGP NUMBER,  
11.    PRIMARY KEY (PLID, GameDate)  
12. );
```

Figure 5 Create Player Statistics Table SQL

5. Create Season table

```
1. CREATE TABLE Season (  
2.     Season CHAR (5) NOT NULL UNIQUE,  
3.     Champion VARCHAR (3) NOT NULL,  
4.     Soft_limit CURRENCY NOT NULL,  
5.     Hard_limit CURRENCY NOT NULL,  
6.     Salary_floor CURRENCY NOT NULL,  
7.     Lux_Tax CURRENCY NOT NULL,  
8.     Non_TaxP_Mid CURRENCY NOT NULL,  
9.     Taxp_Mid CURRENCY NOT NULL,  
10.    Room_Mid CURRENCY NOT NULL,  
11.    Min CURRENCY NOT NULL,  
12.    PRIMARY KEY(Season)  
13. );
```

Figure 6 Create Season Table SQL

6. Create Team table

```
1. CREATE TABLE Team (  
2.     T_Code VARCHAR (2) NOT NULL UNIQUE,  
3.     T_Name CHAR (50) NOT NULL,  
4.     Conference CHAR (1) NOT NULL,  
5.     PRIMARY KEY(T_Code)  
6. );
```

Figure 7 Create Team Table SQL



7. Create Team Salary table

```
1. CREATE TABLE [Team salary] (  
2.     TSID NUMBER NOT NULL,  
3.     Season CHAR (5) NOT NULL,  
4.     Salary CURRENCY NOT NULL,  
5.     [Trade Except] YESNO,  
6.     PRIMARY KEY(TSID)  
7. );
```

Figure 8 Create Team Salary Table SQL

8. Create Match table

```
1. CREATE TABLE [Match] (  
2.     MID AUTOINCREMENT PRIMARY KEY,  
3.     GameDate DATE,  
4.     T_Win VARCHAR (2) NOT NULL,  
5.     T_Lose VARCHAR (2) NOT NULL  
6. );
```

Figure 9 Create Match Table SQL

9. Create Users table

```
1. CREATE TABLE Users (  
2.     UID AUTOINCREMENT PRIMARY KEY,  
3.     UserName VARCHAR (50) NOT NULL Unique,  
4.     Phone_number VARCHAR (50) NOT NULL,  
5.     Email_Address VARCHAR (50) NOT NULL,  
6.     Password CHAR (8) NOT NULL Unique,  
7.     [Country Code] VARCHAR (2) NOT NULL,  
8.     Role VARCHAR (50) NOT NULL,  
9.     [Payment method] VARCHAR (50) NOT NULL,  
10.    [Updated Date] DATE NOT NULL  
11. );
```

Figure 10 Create Users Table SQL

RELATIONSHIP

1. Create a foreign key to Contract table

```
1. ALTER TABLE Contract  
2.     ADD FOREIGN KEY (PLID) REFERENCES Player (PLID);  
  
1. ALTER TABLE Contract  
2.     ADD FOREIGN KEY (T_Code) REFERENCES Team (T_Code);  
  
1. ALTER TABLE Contract
```



```
2. ADD FOREIGN KEY (Season) REFERENCES Season (Season);
```

2. Create a foreign key to Player_statistic table

```
1. ALTER TABLE Player_statistic
2. ADD FOREIGN KEY (PLID) REFERENCES Player (PLID);
```

3. Create a foreign key to Team salary table

```
1. ALTER TABLE [Team salary]
2. ADD FOREIGN KEY (T_Code) REFERENCES [Team] (T_Code);
```

4. Create a foreign key to Match table

```
1. ALTER TABLE [Match]
2. ADD FOREIGN KEY (T_Win) REFERENCES Team (T_Code);

1. ALTER TABLE [Match]
2. ADD FOREIGN KEY (T_Lose) REFERENCES Team(T_Code);
```

5. Create a foreign key to User table

```
1. ALTER TABLE Users
2. ADD FOREIGN KEY (Country Code) REFERENCES Country (Country Code);
```

QUERIES DESIGN

FOR NBA PLAYER

1. Show the statistics of a player

Purpose: To show the statistics of a player and decide whether he need to improve his skill after the game finish

```
1. SELECT LastName, MiddleName, FirstName, GameDate, PPG, RPG, APG, SPG, BPG,
   FGP, [3FGP]
2. FROM Player AS p, Player_statistic AS ps
3. WHERE p.PLID = ps.PLID
4.       AND p.PLID = [Enter the player ID]
5.       AND GameDate = [Enter the GameDate:];
```

Figure 11 Queries SQL - Show the statistics of a player

Show the statistics of a player											
LastName	MiddleName	FirstName	GameDate	PPG	RPG	APG	SPG	BPG	FGP	3FGP	
Adams	Funaki	Steven	28/3/2019	13	9	1	1	1	59.5	37.8	

Figure 12 Queries Result - Show the statistics of a player



2. Comparison between player and his teammates

Purpose: To compare the statistics of his own and his teammates after he has a game and find what he needs to improve comparing with his teammates

```

1. SELECT LastName, MiddleName, FirstName, GameDate, PPG, RPG, APG, SPG, BPG,
   FGP, [3FGP]
2. FROM Player AS p, Player_statistic AS ps, Contract AS c
3. WHERE p.PLID = ps.PLID
4.       AND ps.PLID = c.PLID
5.       AND T_Code = [Enter the team code:]
6.       AND GameDate =[Enter the GameDate:];

```

Figure 13 Queries SQL - Comparison between player and his teammates

LastName	MiddleName	FirstName	GameDate	PPG	RPG	APG	SPG	BPG	FGP	3FGP
Adams	Funaki	Steven	15/3/2018	13	9	1	1	0	62.9	38.1
Adams	Funaki	Steven	15/3/2018	13	9	1	1	0	62.9	38.1
Adams	Funaki	Steven	15/3/2018	13	9	1	1	0	62.9	38.1
Adams	Funaki	Steven	15/3/2018	13	9	1	1	0	62.9	38.1

Figure 14 Queries Result - Comparison between player and his teammates

3. Player status in average

Purpose: To check his own status on average

```

1. SELECT LastName, MiddleName, FirstName,
2.       Format(AVG(PS.PPG), "#.00") AS Avg_PPG,
3.       Format(AVG(PS.RPG), "#.00") AS Avg_RPG,
4.       Format(AVG(PS.APG), "#.00") AS Avg_APG,
5.       Format(AVG(PS.SPG), "#.00") AS Avg_SPG,
6.       Format(AVG(PS.BPG), "#.00") AS Avg_BPG,
7.       Format(AVG(PS.FGP), "#.00") AS Avg_FGP,
8.       Format(AVG(PS.[3FGP]), "#.00") AS Avg_3FGP
9. FROM Player AS p, Player_statistic AS ps
10. WHERE p.PLID = ps.PLID
11.       AND p.PLID = [Enter the player ID:]
12.       AND ps.GameDate Between [Enter the startdate:] And [Enter the enddate:]
13. GROUP BY p.LastName, p.MiddleName, p.FirstName;

```

Figure 15 Queries SQL - Player status in average

LastName	MiddleName	FirstName	Avg_PPG	Avg_RPG	Avg_APG	Avg_SPG	Avg_BPG	Avg_FGP	Avg_3FGP
Adams	Funaki	Steven	11.00	8.20	1.40	1.00	.80	59.24	33.08

Figure 16 Queries Result - Player status in average



FOR NBA TEAM

4. Show the performance of a team

Purpose: To check Team's performance after an NBA game and find where team should be improved

```

1. SELECT T_Name, ps.GameDate,
2.     SUM(PPG) AS T_PPG, SUM(RPG) AS T_RPG, SUM(APG) AS T_APG,
3.     SUM(SPG) AS T_SPG, SUM(BPG) AS T_BPG,
4.     Format(AVG(FGP), "#.00") AS T_FGP,
5.     Format(AVG([3FGP]), "#.00") AS T_3FGP
6. FROM Team AS t, [Match] AS m, Player AS p, Player_statistic AS ps, Contract AS c
7. WHERE c.T_Code = t.T_Code
8.     AND p.PLID = ps.PLID
9.     AND ps.PLID = c.PLID
10.    AND T_Name = [Enter the Team Name:]
11. GROUP BY T_Name, ps.GameDate
12. HAVING ps.GameDate = [Enter the GameDate:];

```

Figure 17 Queries SQL - Show the performance of a team

T_Name	GameDate	T_PPG	T_RPG	T_APG	T_SPG	T_BPG	T_FGP	T_3FGP
Oklahoma City Thunder	28/3/2019	780	540	60	60	60	59.50	37.80

Figure 18 Queries Result - Show the performance of a team

5. Team status in average

Purpose: To check the team status on average

```

1. SELECT t.T_Name,
2.     Format(AVG(PPG), "#.00") AS Avg_PPG,
3.     Format(AVG(RPG), "#.00") AS Avg_RPG,
4.     Format(AVG(APG), "#.00") AS Avg_APG,
5.     Format(AVG(SPG), "#.00") AS Avg_SPG,
6.     Format(AVG(BPG), "#.00") AS Avg_BPG,
7.     Format(AVG(FGP), "#.00") AS Avg_FGP,
8.     Format(AVG([3FGP]), "#.00") AS Avg_3FGP
9. FROM Team AS t, [Match] AS m, Player AS p, Player_statistic AS ps, Contract AS c
10. WHERE (((c.T_Code)=t.T_Code)
11.    And ((p.PLID)=ps.PLID) And ((ps.PLID)=c.PLID)
12.    And ((t.T_Name)=[Enter the Team Name:]))
13.    AND (((ps.GameDate) Between [Enter the startdate:] And [Enter the enddate:])))
14. GROUP BY t.T_Name;

```

Figure 19 Queries SQL - Team status in average



Team status in average								
T_Name	Avg_PPG	Avg_RPG	Avg_APG	Avg_SPG	Avg_BPG	Avg_FGP	Avg_3FGP	
Portland Trail Blazers	16.79	7.33	1.48	.97	.73	44.40	29.98	

Figure 20 Queries Result - Team status in average



FOR FANS

6. Show the favorite team of NBA team

Purpose: To find their favorite team and compare their statistics together with the statistics of opponent after NBA game

```
1. SELECT T_Name, M.T_Lose, PS.GameDate, SUM(PPG) AS T_PPG,
2. SUM(RPG) AS T_RPG, SUM(APG) AS T_APG, SUM(SPG) AS T_SPG, SUM(BPG) AS T_BPG,
3. Format(AVG(FGP), "#.00") AS T_FGP,
4. Format(AVG([3FGP]), "#.00") AS T_3FGP
5. FROM Team AS T, [Match] AS M, Player AS P, Player_statistic AS PS, Contract AS C
6. WHERE C.T_Code = T.T_Code
7. AND M.T_Win = T.T_Code
8. AND P.PLID = PS.PLID
9. AND PS.PLID = C.PLID
10. AND T_Name =[Enter the Team Name:]
11. AND PS.GameDate =[Enter the GameDate:]
12. GROUP BY T_Name, M.T_Lose, PS.GameDate;
```

Figure 21 Queries SQL - Show the favorite team of NBA team

Show the favorite team of NBA team									
T_Name	T_Lose	GameDate	T_PPG	T_RPG	T_APG	T_SPG	T_BPG	T_FGP	T_3FGP
Oklahoma City Thunder	PB	3/28/2019	52	36	4	4	4	59.50	37.80

Figure 22 Queries Result - Show the favorite team of NBA team



FOR ORGANISATION

7. Analyzation of the strength of players

Purpose: To analyze the strength of a player

```
1. SELECT T_Name, M.GameDate, SUM(PPG) AS T_PPG, SUM(RPG) AS T_RPG,
2.     SUM(APG) AS T_APG, SUM(SPG) AS T_SPG, SUM(BPG) AS T_BPG,
3.     Format(AVG(FGP), "#.00") AS T_FGP,
4.     Format(AVG([3FGP]), "#.00") AS T_3FGP
5. FROM Team AS T, [Match] AS M, Player AS P, Player_statistic AS PS,
   Contract AS C
6. WHERE C.T_Code = T.T_Code
7.     AND P.PLID = PS.PLID AND PS.PLID = C.PLID
8.     AND T_Name =[Enter the Team Name:]
9. OR T.T_code = M.T_Lose
10. GROUP BY T_Name, M.GameDate
11. HAVING M.GameDate =[Enter the GameDate:];
```

Figure 23 Queries SQL - Analyzation of the strength of players

T_Name	GameDate	T_PPG	T_RPG	T_APG	T_SPG	T_BPG	T_FGP	T_3FGP
LA Clippers	25/1/2021	104328	44712	13284	7128	3888	47.38	34.28

Figure 24 Queries Result - Analyzation of the strength of players



FOR SPORT JOURNALIST

8. The ability of players

Purpose: To investigate the overall strength of players and predict who will enter a new team after the end of season

```

1. SELECT LastName, MiddleName, FirstName,
2.     Format(AVG(PS.PPG), "#.00") AS Avg_PPG,
3.     Format(AVG(PS.RPG), "#.00") AS Avg_RPG,
4.     Format(AVG(PS.APG), "#.00") AS Avg_APG,
5.     Format(AVG(PS.SPG), "#.00") AS Avg_SPG,
6.     Format(AVG(PS.BPG), "#.00") AS Avg_BPG,
7.     Format(AVG(PS.FGP), "#.00") AS Avg_FGP,
8.     Format(AVG(PS.[3FGP]), "#.00") AS Avg_3FGP
9. FROM Player AS P, Player_statistic AS PS
10. WHERE P.PLID = PS.PLID
11.     AND P.PLID = [Enter the player ID:]
12. GROUP BY P.LastName, P.MiddleName, P.FirstName, PS.GameDate
13. HAVING PS.GameDate Between [Enter the startdate:] And [Enter the enddate:];

```

Figure 25 Queries SQL - The ability of players

LastName	MiddleName	FirstName	Avg_PPG	Avg_RPG	Avg_APG	Avg_SPG	Avg_BPG	Avg_FGP	Avg_3FGP
Adams	Funaki	Steven	13.00	9.00	1.00	1.00	.00	62.90	38.10

Figure 26 Queries Result - The ability of players

9. The basic information of players

Purpose: To provide a support for the report of sport journalist

```

1. SELECT P.LastName, P.MiddleName, P.FirstName, T.T_Name, C.Jersey_num
2. FROM Player AS P, Contract AS C, Team AS T
3. WHERE P.PLID = C.PLID
4.     AND T.T_Code = C.T_Code
5. GROUP BY P.LastName, P.MiddleName, P.FirstName, T.T_Name, C.Jersey_num;

```

Figure 27 Queries SQL - The basic information of players

LastName	MiddleName	FirstName	T_Name	Jersey_num
	Kelly	Matt	Memphis Grizzlies	0
Adams	Funaki	Steven	Oklahoma City Thunder	12
Afflalo	Augustin	Arron	Portland Trail Blazers	4
Aldridge	Nurae	LaMarcus	Portland Trail Blazers	12
Aminu		Al-Farouq	Portland Trail Blazers	8
Anthony	Kyam	Carmelo	Portland Trail Blazers	00
Bradley	Antonio	Avery	Oklahoma City Thunder	77
Clarke		Brandon	LA Clippers	5
Forbes	Jerrel	Bryn	San Antonio Spurs	11

Figure 28 Queries Result - The basic information of players



FOR SPONSOR AND ADVERTISER

10. Sponsoring the potential players

Purpose: To analyze the overall potential of players and hence, sponsoring suitable players

```

1. SELECT P.LastName, P.MiddleName, P.FirstName, T.T_Name,
2.     Format(AVG(PS.PPG), "#.00") AS Avg_PPG,
3.     Format(AVG(PS.RPG), "#.00") AS Avg_RPG,
4.     Format(AVG(PS.APG), "#.00") AS Avg_APG,
5.     Format(AVG(PS.SPG), "#.00") AS Avg_SPG,
6.     Format(AVG(PS.BPG), "#.00") AS Avg_BPG,
7.     Format(AVG(PS.FGP), "#.00") AS Avg_FGP,
8.     Format(AVG(PS.[3FGP]), "#.00") AS Avg_3FGP
9. FROM Team AS T, [Match] AS M, Player AS P, Player_statistic AS PS, Contract AS C
10. WHERE C.T_Code = T.T_Code
11.     AND P.PLID = PS.PLID AND PS.PLID = C.PLID
12. GROUP BY P.LastName, P.MiddleName, P.FirstName, T.T_Name;

```

Figure 29 Queries SQL - Sponsoring the potential players

LastName	MiddleName	FirstName	T_Name	Avg_PPG	Avg_RPG	Avg_APG	Avg_SPG	Avg_BPG	Avg_FGP	Avg_3FGP
Adams	Funaki	Steven	Oklahoma City Thunder	11.00	8.20	1.40	1.00	.80	59.24	33.08
Afflalo	Augustin	Arron	Portland Trail Blazers	10.67	2.00	1.00	1.00	.00	42.30	41.67
Aldridge	Nuræ	LaMarcus	Portland Trail Blazers	22.00	9.50	1.75	1.00	1.00	48.00	21.93

Figure 30 Queries Result - Sponsoring the potential players

11. Sponsoring the potential teams

Purpose: To analyze the overall potential of and hence, sponsoring suitable teams

```

1. SELECT T_Name,
2.     Format(AVG(PPG), "#.00") AS Avg_PPG,
3.     Format(AVG(RPG), "#.00") AS Avg_RPG,
4.     Format(AVG(APG), "#.00") AS Avg_APG,
5.     Format(AVG(SPG), "#.00") AS Avg_SPG,
6.     Format(AVG(BPG), "#.00") AS Avg_BPG,
7.     Format(AVG(FGP), "#.00") AS Avg_FGP,
8.     Format(AVG([3FGP]), "#.00") AS Avg_3FGP
9. FROM Team AS T, [Match] AS M, Player AS P, Player_statistic AS PS, Contract AS C
10. WHERE C.T_Code = T.T_Code
11.     AND P.PLID = PS.PLID AND PS.PLID = C.PLID
12. GROUP BY T_Name;

```

Figure 31 Queries SQL - Sponsoring the potential teams

T_Name	Avg_PPG	Avg_RPG	Avg_APG	Avg_SPG	Avg_BPG	Avg_FGP	Avg_3FGP
Oklahoma City Thunder	11.75	7.29	1.79	1.04	.67	57.26	33.96
Portland Trail Blazers	16.79	7.33	1.48	.97	.73	44.40	29.98

Figure 32 Queries Result - Sponsoring the potential teams



FOR OWNER AND GM

12. Perform the calculation of maximum of player salary

Purpose: To calculate the maximum salary of player after signing in by entering their ID

```

1. SELECT FirstName, MiddleName, LastName,
2.     [Base Salary] + [Base Salary] * [Salary Rate] + Soft_limit*0.2 AS
   [Maximum salary], c.Season
3. FROM Player AS a, Contract AS c, Season AS d
4. WHERE a.PLID = c.PLID
5.       AND c.Season = d.Season
6.       AND a.PLID = [Enter the player's ID];

```

Figure 33 Queries SQL - Perform the calculation of maximum of player salary

FirstName	MiddleName	LastName	Maximum salary	Season
Steven	Funaki	Adams	48962831.85	19-20
Steven	Funaki	Adams	45738969.2	18-19
Steven	Funaki	Adams	43414106.55	17-18
Steven	Funaki	Adams	22054732.51	16-17

Figure 34 Queries Result - Perform the calculation of maximum of player salary

13. Perform the calculation of Luxury Tax

Purpose: To check whether his/her team need to pay Luxury Tax or not

```

1. SELECT Salary-Lux_Tax AS [Luxury tax], T_Name
2. FROM [Team salary] AS a, Season AS b, Team AS c
3. WHERE a.Season = b.Season
4.       AND a.T_Code= c.T_Code
5.       AND Salary > Lux_Tax;

```

Figure 35 Queries SQL - Perform the calculation of Luxury Tax

Luxury tax	T_Name
HK\$2,821,164.00	Boston Celtics
HK\$4,383,779.00	Atlanta Hawks
HK\$17,523,620.00	Oklahoma City Thunder
HK\$1,618,326.00	LA Clippers
HK\$2,945,405.00	Oklahoma City Thunder
HK\$58,705,732.00	San Antonio Spurs
HK\$77,487,869.00	Portland Trail Blazers
HK\$46,395,055.00	Boston Celtics
HK\$41,588,200.00	San Antonio Spurs

Figure 36 Queries Result - Perform the calculation of Luxury Tax



14. Perform the behavior of team

Purpose: To check how team behaves after the game

```
1. SELECT t.T_Name, (SELECT COUNT(T_Win)
2. FROM Match
3. WHERE T_Win = [Enter the team code:]
4. ) AS [Total number of win],
5. COUNT (*) AS [Total number of lose],
6. [Total number of win] / ([Total number of win] + [Total number of lose])
   AS [Win rate]
7. FROM Team AS t, [Match] AS m
8. WHERE (((t.T_Code) = [m].[T_Lose]
9. And (t.T_Code) = [Enter the team code:])))
10. GROUP BY t.T_Name;
```

Figure 37 Queries SQL - Perform the behavior of team

T_Name	Total number of win	Total number of lose	Win rate
Oklahoma City Thunder	1	3	0.25

Figure 38 Queries Result - Perform the behavior of team



FOR CREATING REPORT

To improve the user's experience, the queries below were created for further usage in report. For further explanation about the report, please refer to the report in application part.

Queries for Our Service

15. Users' role count

Purpose: To sort the users in different category of role and realize the purpose of the user who has purchased our service

```
1. SELECT Users.Role, COUNT (*) AS Quantity
2. FROM Users
3. GROUP BY Users.Role;
```

Queries for Salary Cap

To be aware of the trend of salary cap, several queries is created. Take an illusion, NBA Organization would make good use of those report and decide the upcoming salary cap based on previous data within several years.

16. Soft limit trend for 10 years

```
1. SELECT Season, Soft_limit
2. FROM Season;
```

17. Hard limit trend for 10 years

```
1. SELECT Season.Season, Season.Hard_limit
2. FROM Season;
```

18. Salary Floor trend for 10 years

```
1. SELECT Season, Salary_floor
2. FROM Season;
```

19. Luxury Tax line trend for 10 years

```
1. SELECT Season, Lux_Tax
2. FROM Season;
```

20. Non-Taxpayer Mid-Level trend for 10 years

```
1. SELECT Season, Non_TaxP_Mid
2. FROM Season;
```



21. Taxpayer Mid-Level trend for 10 years

```
1. SELECT Season, Taxp_Mid
2. FROM Season;
```

22. Room Mid-Level trend for 10 years

```
1. SELECT Season, Room_Mid
2. FROM Season;
```

23. Minimum trend for 10 years

```
1. SELECT Season, Min
2. FROM Season;
```

Queries for NBA teams' information

24. Team Win count

Purpose: To count the win rate of team after a season

```
1. SELECT T_Name, COUNT(T_Win) AS [Win total]
2. FROM Team AS t, [Match] AS m
3. WHERE t.T_Code = m.T_Win
4. GROUP BY T_Name;
```

Queries for NBA players' information

25. Height

Purpose: To decide the position for player according to their height

```
1. SELECT FirstName, LastName, Player.Height_cm
2. FROM Player;
```

26. Height average

Purpose: To calculate the average height of player

```
1. SELECT Format(AVG(Player.Height_cm), "#.00") AS [Avg Height cm]
2. FROM Player;
```



27. Player stat 3FGP

Purpose: To show the 3FGP of a player in several year individually

```
1. SELECT FirstName, MiddleName, LastName, GameDate, [3FGP]
2. FROM Player_statistic AS ps, Player AS p
3. WHERE ps.PLID = p.PLID
4.     AND ps.PLID = [Enter the player ID:]
5. ORDER BY GameDate;
```

28. Player stat APG

Purpose: To show the APG of a player in several year individually

```
1. SELECT FirstName, MiddleName, LastName, GameDate, APG
2. FROM Player_statistic AS ps, Player AS p
3. WHERE ps.PLID = p.PLID
4.     AND ps.PLID = [Enter the player ID:]
5. ORDER BY GameDate;
```

29. Player stat BPG

Purpose: To show the BPG of a player in several year individually

```
1. SELECT FirstName, MiddleName, LastName, GameDate, BPG
2. FROM Player_statistic AS ps, Player AS p
3. WHERE ps.PLID = p.PLID
4.     AND ps.PLID = [Enter the player ID:]
5. ORDER BY GameDate;
```

30. Player stat FGP

Purpose: To show the FGP of a player in several year individually

```
1. SELECT FirstName, MiddleName, LastName, GameDate, FGP
2. FROM Player_statistic AS ps, Player AS p
3. WHERE ps.PLID = p.PLID
4.     AND ps.PLID = [Enter the player ID:]
5. ORDER BY GameDate;
```

31. Player stat PPG

Purpose: To show the PPG of a player in several year individually

```
6. SELECT FirstName, MiddleName, LastName, GameDate, PPG
7. FROM Player_statistic AS ps, Player AS p
8. WHERE ps.PLID = p.PLID
9.     AND ps.PLID = [Enter the player ID:]
10. ORDER BY GameDate;
```



32. Player stat RPG

Purpose: To show the RPG of a player in several year individually

```
11. SELECT FirstName, MiddleName, LastName, GameDate, RPG
12. FROM Player_statistic AS ps, Player AS p
13. WHERE ps.PLID = p.PLID
14.      AND ps.PLID = [Enter the player ID:]
15. ORDER BY GameDate;
```

33. Player stat SPG

Purpose: To show the SPG of a player in several year individually

```
16. SELECT FirstName, MiddleName, LastName, GameDate, SPG
17. FROM Player_statistic AS ps, Player AS p
18. WHERE ps.PLID = p.PLID
19.      AND ps.PLID = [Enter the player ID:]
20. ORDER BY GameDate;
```




APPLICATIONS

FORMS

Limitation:

All the forms, which will be used by users directly, should originally be created as a page of the website with additional pages like the payment page and report pages for users to view and filter the data. However, considering the website itself is just a hypothesis for the database system we made, the form for inputting user data and reports with NBA information are created using only Microsoft Access.

For Main Menu:

To improve user experience of our staff and user, a Main Menu, which separates the form and report in different criteria, was created.

1. For Forms

Depend on the current stage of season, NBA information should be entered by our staff using the form in the Access. The main menu was separated in three category such as the start of season, the middle of season and the end of season. Each form has organized in different category and user can press the button for initializing the form.

Here is the interface of main menu:

The screenshot shows a web application interface titled "NBA Payroll Data Entry". At the top left is a logo of a stylized globe. To the right of the logo is a red button labeled "User Register Website". Below the title bar, there are three tabs: "Start of Season", "Middle of Season" (which is selected and highlighted in blue), and "End of Season". The main content area displays the text "The Season has started! What data you want to enter?". Below this text are three red buttons: "Salary Cap and Enrolled Team", "Confirmed Existed Player", and "Confirmed New Player". At the bottom of the main content area is a wide red button labeled "Data Analysis". The footer of the interface shows the date "12/4/2022", the time "20:54", and the text "SEHH2240 203B Group316".

Figure 39 The main menu for Data Entry



The screenshot shows a web application titled "NBA Payroll Data Entry" with a blue header and a red button labeled "User Register Website". Below the header, there are three tabs: "Start of Season", "Middle of Season", and "End of Season". The main content area has a white background with the text "One NBA game has ended! What data you want to enter?". There are three red buttons: "Result", "Each Player's performance", and "Data Analysis". The footer shows the date "12/4/2022", the time "20:54", and the text "SEHH2240 203B Group316".

Figure 40 The main menu for Data Entry(2)

The screenshot shows the same web application as Figure 40, but with the text "All the NBA games has ended! What data you want to enter?". There are two red buttons: "Result" and "Data Analysis". The footer shows the date "12/4/2022", the time "20:54", and the text "SEHH2240 203B Group316".

Figure 41 The main menu for Data Entry(3)



2. For Reports

Many reports were formed to present the overall result within these 10 years. In this menu, the reports were sorted into three categories including player statistics, team statistics and NBA salaries standard. Users can depend on their preference and press the button for displaying the information within a period.

Here is the interface of main menu:

The screenshot shows the 'NBA Payroll Data Analysis' application interface. The top header is dark blue with the NBA logo on the left and a close button on the right. Below the header, there are two red buttons: 'User Information' and 'User Role Proportion'. The main content area has a light blue background. At the top of this area, there are three tabs: 'Player Statistic' (selected), 'NBA Salary Statistic', and 'Team Statistic'. Below the tabs, the text 'What player information are you interested in?' is displayed. Underneath, there are seven red buttons arranged in two rows: 'Height of all players' (top row), and '3FGP', 'FPG', 'APG', 'BPG' (second row), and 'RPG', 'SPG', 'PPG' (third row). At the bottom of the main content area, there is a wide red button labeled 'Data Entry'. The footer is dark blue and contains the date '12/4/2022', the time '20:55', and the text 'SEHH2240 203B Group316'.

Figure 42 The main menu for Data Analysis

The screenshot shows the 'NBA Payroll Data Analysis' application interface, similar to Figure 42 but with the 'NBA Salary Statistic' tab selected. The top header and buttons are the same. The main content area has the 'NBA Salary Statistic' tab selected. The text 'What NBA salary information are you interested in?' is displayed. Underneath, there are seven red buttons arranged in two rows: 'Luxury tax line', 'Minimum', 'Non-Tax Mid-Level', 'Room Mid-Level' (top row), and 'Salary_floor', 'Soft_limit', 'Taxpayer Mid-Level' (bottom row). At the bottom of the main content area, there is a wide red button labeled 'Data Entry'. The footer is dark blue and contains the date '12/4/2022', the time '20:55', and the text 'SEHH2240 203B Group316'.

Figure 43 The main menu for Data Analysis(2)



NBA Payroll Data Analysis

User Information User Role Proportion

Player Statistic NBA Salary Statistic Team Statistic

What team information are you interested in?

Team Winning Count

Team Average Performance During a Period

Data Entry

12/4/2022 20:55 SEHH2240 203B Group316

Figure 44 The main menu for Data Analysis (3)

For Our Services:

A user could access to the NBA payroll database by creating an account with the form below. After filling the forms, they will be redirected to the payment page. The record of user will be inserted into the user table after the purchase is done.

Welcome New User!

Login

Sign up

UserName Bloom Basketball

3758-9561

BloomBasket@gmail.com

Password* *****

Tell Us Something about You...

Where do you come from? Hong Kong

Who are you? Fans

How would you like to pay? Paypal

Joined Date* 2022/3/28 上午 04:33:36

Confirmed

2022/3/29 16:09 SEHH2240 203B Group316

Figure 45 "Add a New User" Form



For NBA database:

1. When the start of new season, our staff could insert some data about the salary of team by using the upper part of form, then enter the enrolled team which could take part in the upcoming season.

The Start of New Season
SEHH2240 203B Group316

Start Date of New Season

Soft limit

Hard limit

Salary floor

Luxury tax line

Non-Taxpayer Mid-Level

Taxpayer Mid-Level

Room Mid-Level

Minimum

Add a New Team

Save Record

Figure 46 Forms: The Start of New Season

2. Also, the staff could use this form to enter the information for the team which enrolled recently.

Add a New Team
SEHH2240 203B Group316

Team Code

Full Name

Conference

TSID

Season

Salary


Trade Except

Save Record

Figure 47 Forms: Add a New Team



- Some NBA players may sign a new contract before new season. For solving this situation, our staff could enter the information for the player who had signed a new contract.



Player signed a New Contract

SEHH2240 203B Group316

Season

Team Code

Player ID

Base Salary

Salary Rate

Jersey num of Player

Save Record

Figure 48 Forms: Player signed a New Contract

- Sometimes, some team could sign some new player to enhance the strength of team, our staff could confirm the accurately of information and enter the information of players by utilize this form.



A New Player is signed

SEHH2240 203B Group316

Season

Team Code

Player ID

(New)

Last Name

Middle Name

First Name

Birth Date

Country

Weight (lb)

Height (cm)

Position 1

Position 2

Base Salary


Salary Rate

Jersey num of Player

Figure 49 Forms: A New Player is signed



- After having a training, players may have an improvement which have performed in a new NBA game. To classify their strength and weakness, our staff could enter the updated statistic after the game.



Player's Statistic of a match

SEHH2240 203B Group316

GameDate

Player ID

Points

Rebounds

Assists

Steals

Blocks


Field Goal Percentage

3-Point Field Goal Percentage

Save Record

Figure 50 Forms: Player's Statistic of a match

- Each NBA game is competed by two teams. When the end of a NBA game, it is necessary to update the information which team win or lose the game.



Team's Statistic of a match

SEHH2240 203B Group316

GameDate

11/1/2021

T_Win

AH

T_Lose

PP

Save Record

Figure 51 Forms: Team's Statistic of a match




- At the end of season, update the champion of NBA game in that season.

Enter Parameter V... ? X

Enter the Season:

OK Cancel



End of a season

SEHH2240 203B Group316

Season

20-21

Champion

MB

Save Record

Figure 52 Forms: End of a season



REPORTS

For Our Service:

1. After entering the information, the data of the user could display in the report according to the alphabetical order.

Users info						2022年4月11日 17:24:01	
UserName	Phone_number	Email_Address	Country Code	Role	Payment method		
Adidas	3100-0496	bulksales@adidas.com	HK	Sponsors	Cash		
anonymous150	3982-0156	anonymous150150@gmail.com	US	Other	WeChat pay		
Bloom Basketball	3758-9561	BloomBasket@gmail.com	HK	Fans	Paypal		
Kyle Anderson	9894-0159	KyleAnderson@gmail.com	US	NBA players	Paypal		
Mike Breen	3895-2460	MikeBreenOfical@gmail.com	HK	Journalists	Paypal		
MVP Jason	5987-2093	JasonCheung@hotmail.com	UK	Owner or Employees of NBA team	Paypal		

Figure 53 Reports: Users info

2. After the report of users is formed, the quantity of user role is showed in the user role count report.

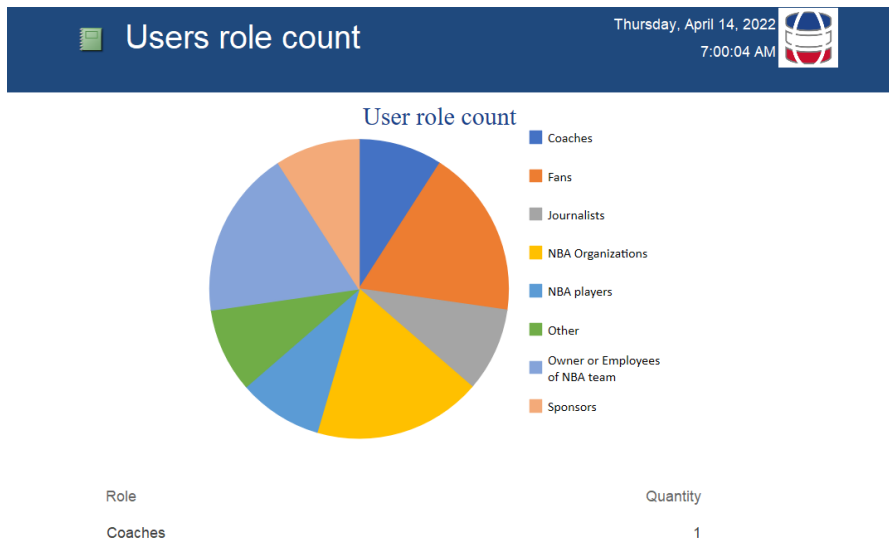


Figure 54 Reports: Users role count



For Player and Team:

- One of important factor that provide a benefit to the NBA player which is the height of player. It stored the height of player in a team and display the report according to the last name of player which in alphabetical order.

Height			2022年4月11日 17:21:09	
LastName	FirstName	Height_cm		
Adams	Steven	211		
Afflalo	Arron	196		
Aldrige	LaMarcus	211		
Aminu	Al-Farouq	203		
Anthony	Carmelo	201		
Barnes	Matt	201		
Billups	Chauncey	190		
Bradley	Avery	190		
Brewer	Corey	206		
Butler	James	201		

Figure 55 Reports: Users role count

- To customize the training of a player, the coaches and employee of team could adjust their menu by analyzing their own statistics in average, including 3FGP, APG, BPG, FGP, PPG, RPG, SPG.

Here is one example of the reports of those statistics we made:

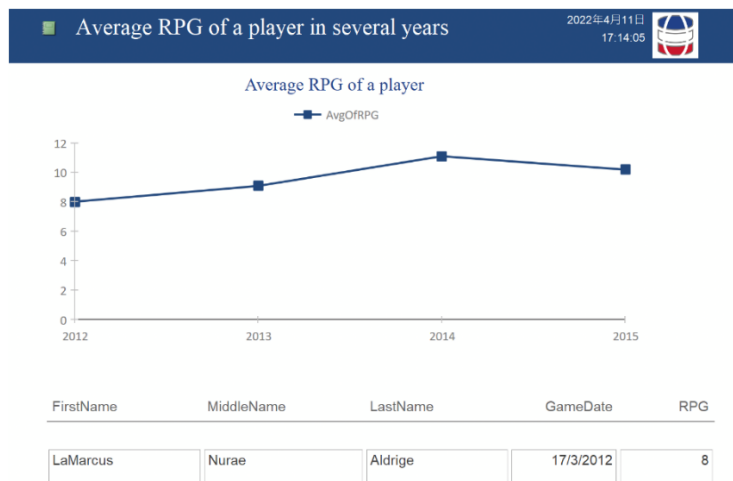


Figure 56 Reports: Average RPG of a player in several year



For NBA:

To limit the total amount of money that allows to pay players, the salary cap is set for controlling the cost and benefit parity which defined by the collective bargaining agreement (CBA).

If the total amount of team salary is exceeded with the salary cap, there are penalties to the teams who ignored the salary cap. That report has organized the information within 10 years, including Soft limit, Hard limit, Salary floor, Room Mid-Level, Non Taxpay Mid-Level, Taxpayer Mid-Level, Minimum, and Luxury tax line. Our users can analyze the data and check whether the team has violated the salary cap.

Here is one example of the reports of those salary cap we made:

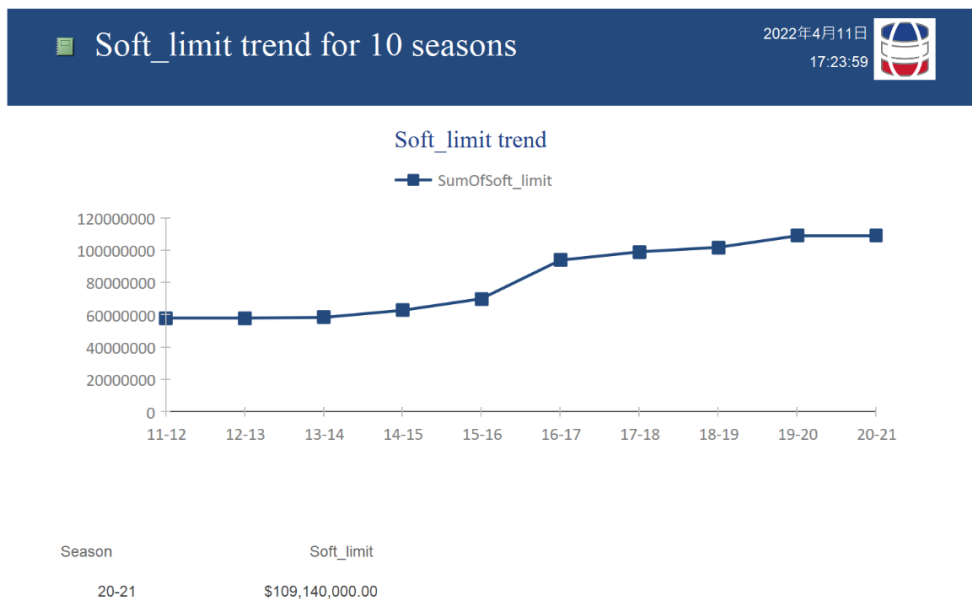


Figure 57 Reports: Soft_limit trend for 10 seasons

For Team, Fan, Organization:

5. To ensure the win rate of each team, this report is created for checking the times of team wins. According to the win rate, the coaches of the team will reschedule the training menu and focus the weakness of players.

Fan can access this report by knowing the win rate of their favorite team and give more support to the player though different platform.



Team Win count		2022年4月12日	
		15:10:19	
T_Name	Win total		
Atlanta Hawks	2		
Boston Celtics	1		
Indiana Pacers	1		
LA Clippers	2		
Memphis Grizzlies	1		
Miami Heat	2		


Figure 58 Reports: Team Win count

6. Besides, the average of team statistics is necessary for showing the strength of team. Before the start of NBA game, the coaches of team could analyze another team statistics and make good planning on training. Some Fan uses it for predicting which team has a higher potential to win the coming competition.

Team status in average

2022年4月12日

20:57:11



T_Name	GameDate	Avg_PPG	Avg_RPG	Avg_APG	Avg_SPG	Avg_BPG	Avg_FGP	Avg_3FGP
Oklahoma Cit	4/1/2021	11.74	8.46	2.00	1.02	.94	59.24	33.08
Oklahoma Cit	6/1/2021	11.74	8.46	2.00	1.02	.94	59.24	33.08
Oklahoma Cit	11/1/2021	11.74	8.46	2.00	1.02	.94	59.24	33.08
Oklahoma Cit	14/1/2021	11.74	8.46	2.00	1.02	.94	59.24	33.08
Oklahoma Cit	16/1/2021	11.74	8.46	2.00	1.02	.94	59.24	33.08
Oklahoma Cit	26/1/2021	11.74	8.46	2.00	1.02	.94	59.24	33.08
Oklahoma Cit	12/2/2021	11.74	8.46	2.00	1.02	.94	59.24	33.08
Oklahoma Cit	13/2/2021	11.74	8.46	2.00	1.02	.94	59.24	33.08
Oklahoma Cit	15/2/2021	11.74	8.46	2.00	1.02	.94	59.24	33.08
Oklahoma Cit	16/2/2021	11.74	8.46	2.00	1.02	.94	59.24	33.08

Figure 59 Reports: Team status in average



IMPLEMENTATION DETAILS

SOFTWARE USED

To create our database, we used Microsoft Access from Microsoft Office Professional Plus 2022 as the physical model.

To protect the private personal data of our users, such as password, phone numbers and email address, we set a relatively strong password of “2240_paNyrBolAl316” to the database.

APPLICATION DETAILS

ERD in Access

We set up 9 tables, which are contact, country, match, player, player_statistic, season, team, team salary, and users, and connect the table by running the SQL.

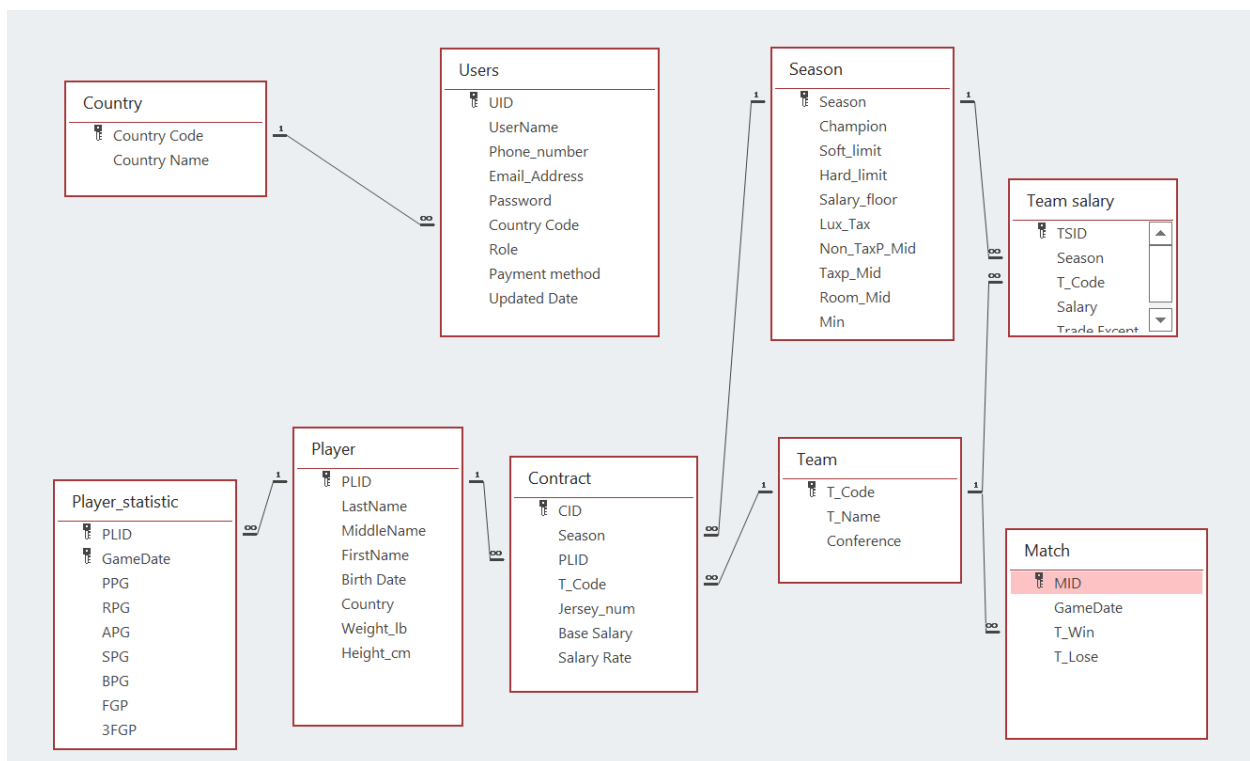
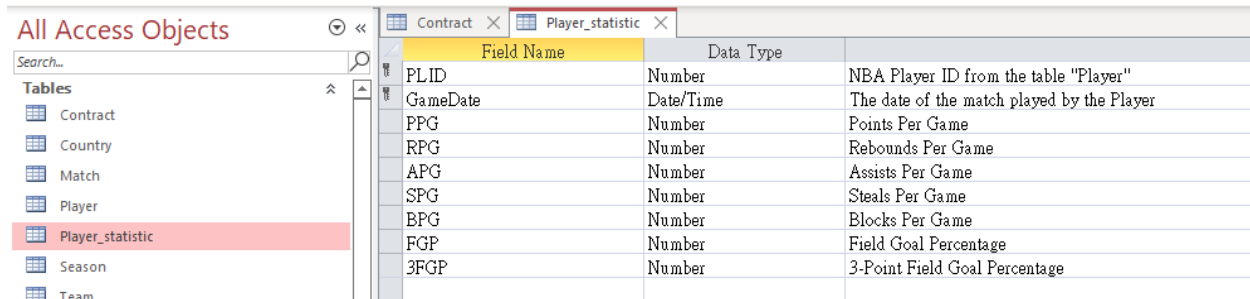


Figure 60 ERD in access



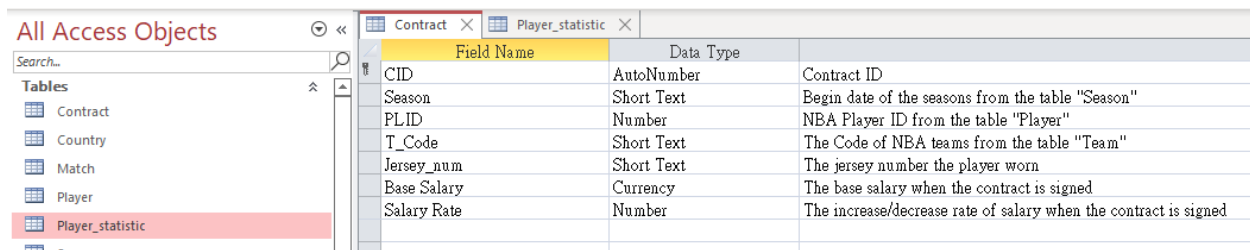
Field Description

To explain more on the abbreviation that used for field names, we described the meaning in detail in the description in the design view of the table. The example is below.



Field Name	Data Type	
PLID	Number	NBA Player ID from the table "Player"
GameDate	Date/Time	The date of the match played by the Player
PPG	Number	Points Per Game
RPG	Number	Rebounds Per Game
APG	Number	Assists Per Game
SPG	Number	Steals Per Game
BPG	Number	Blocks Per Game
FGP	Number	Field Goal Percentage
3FGP	Number	3-Point Field Goal Percentage

Figure 61 Field Description of table Player_statistic



Field Name	Data Type	
CID	AutoNumber	Contract ID
Season	Short Text	Begin date of the seasons from the table "Season"
PLID	Number	NBA Player ID from the table "Player"
T_Code	Short Text	The Code of NBA teams from the table "Team"
Jersey_num	Short Text	The jersey number the player worn
Base Salary	Currency	The base salary when the contract is signed
Salary Rate	Number	The increase/decrease rate of salary when the contract is signed

Figure 62 Field Description of table Contract

Field properties

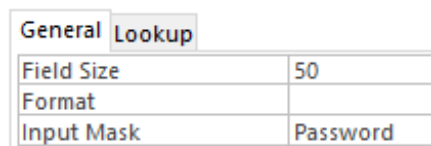
Field size

To reduce the extra storage space, the field size and “required” was set by SQL. An Example is showed below.

1. T_Code **VARCHAR** (2) NOT NULL,
2. Jersey_num **CHAR** (3),

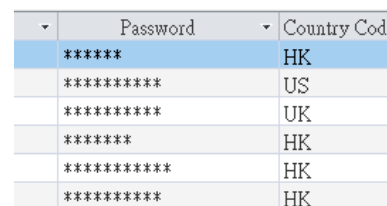
Input mask

To protect user’s privacy, we set the input mask of password in Access to prevent our staff or other users viewing it easily.



General	
Field Size	50
Format	
Input Mask	Password

Figure 64 Password as the Input mask



Input Mask	Country Cod
*****	HK
*****	US
*****	UK
*****	HK
*****	HK
*****	HK

Figure 63 Result of the Input mask



Format

Also, to unify the user's input consistency, we formatted the data to display consistently by format. Every currency type data was set in \$#, ##0.00 to express USD dollars. Also, season was set a #-# format to ensure input showing like "20-21". The outputs are shown below.

Figure 66 Format for currency

Season	Salary
20-21	\$135,448,164.00
20-21	\$137,010,779.00
20-21	\$104,570,165.00
20-21	\$150,150,620.00
20-21	\$134,245,326.00
20-21	\$135,572,405.00
20-21	\$130,767,745.00

Figure 65 Result of the Format

Figure 67 Format for season

Validation rule

We used validation rule to specify the criteria that all valid field values must meet. For example, it is only allowed to type in the role of user with the exact wording.

Figure 68 Result of validation rule of role

Caption	
Default Value	"Fans"
Validation Rule	In ("Journalists"; "Sponsors"; "Fans"; "NBA Organizations"; "Owner or Employees of NBA team"; "Coaches"; "NBA players"; "Other")
Validation Text	[Please specify your user type as "Journalists"; "Sponsors"; "Fans"; "NBA Organizations"; "Owner or Employees of NBA team"; "Coaches"; "NBA players" or "Other"]

Figure 69 validation rule of role

We also used validation rule for seasons.

Figure 71 Result of validation rule of season

Figure 70 validation rule of season



Form properties

Blank Form for Data Entry

1. To create a blank form without any previous record, we toggled the data entry to “Yes” for some forms.

Combining tables in a single form

2. We used the record source to join two tables for a form and enhance data entry.

Season

Team Code

Player ID

Base Salary

Salary Rate

Jersey num of Player

Save Record

Property Sheet

Selection type: Form

Form

Format Data Event Other All

Record Source

Figure 72 Joining tables using record source

Figure 73 Result of joining tables

Limiting the Input

3. To limit the choice, we made use of the value list in “row source” and the “Controls” elements like Combo box.

UserType

Format Data Event Other All

Control Source

Row Source

Row Source Type

Figure 74 Row source

Fans

Figure 75 Combo box



SOURCE OF DATA

User information

We used the search engine to find the user information depend on the user role. Though the data entry, there were six authentic information in the database. For instance, Adidas, Mike Breen, NBAstuffer, MVPJason, Nate McMilian, and Tillman Fertitta. However, other anonymous user was created for simulating a real database system. At the same time, the information of user was extracted such as phone number, email, role, country code. Password, which contains more than 8 characters as well as it should contain one numbers and the characters, was created for login the system.

NBA players and their performance

We used ESPN (n.d.) to find the NBA player's performance statistics on 26 March. We found 6 NBA players to be the example. Here are the players' names that we used: Avery Antonio Bradley, Steven Funaki Adams, Arron Auguatin Afflalo, LaMarcus Nurae Aldrige, Al-Farouq Aminu, and Carmelo Kyam Anthony. We also exploited Basketball-Reference (n.d.) to find information about the players on 28 March, for example, birth date, country, weight, height, and position.

NBA season and salaries

We found the salary cap and the luxury tax for NBA from 2011 to 2021 at Google on 20 March. According to CBS Sports (2012), it is shown that salary cap and luxury for 2012-13 are \$58.044 million and \$70.307 million. Sports Illustrated (2013) reported that the salary cap and luxury for 2013-14 are \$58.7 million and \$71.7 million. Sports Illustrated (2014) also reported that the salary cap and luxury for 2014-15 are \$63.1 million and \$76.8 million. And it said, "The NBA announced Wednesday that the 2015-16 salary cap will rise to \$70 million, the luxury tax line will increase to \$84.74 million" (Sports Illustrated, 2015). Moreover, Sports Illustrated (2016) showed that the salary cap and luxury for 2016-17 are \$94.1 million and \$113.3 million. In addition, Bleacher Report (2017) pointed out that the salary cap and luxury for 2017-18 are \$94.1 million and \$113.3 million. And SBNATION (2018) stated that the salary cap and luxury for 2018-19 are \$101.86 million and \$123.73 million. According to NBA News (2019), it reported that the salary cap and luxury for 2019-20 are \$109.14 million and \$132.627 million. And The Washington Post (2020) pointed out that the salary cap and luxury for 2020-21 are \$109.1 million and \$132.6 million.

NBA teams, their salaries

Moreover, we used Basketball-Reference (n.d.) to find some competitions for fewer teams on 29 March. In addition, we found the team salary and the trade experience for 3 seasons at Spotrac on 28 March. At least, we found some players' salaries at HoopsHYPE on 29 March.



DIFFICULTIES

DESIGN PHASE

In the beginning of the project, our group chose a relatively specific topic of “NBA payroll database service”, which lead to one of the most challenge we had – deciding the accurate attributes of every table. Take the salary regulation as an example, every team has the same salary regulation as hard limit, soft limit and luxury tax for each season. However, some of our teammates, who are not familiar with NBA rules, misunderstood that the salary regulation will vary for every teams. In fact, the reason of the team salaries’ difference is whether the team chose and allowed to exceed the salary cap in order to sign a player. Therefore, those attributes should be put under the “season” table but not the “team” table. The complex exception and rules are a double-edged sword which provides a persuasive reason for developing the service but also contribute to the difficulties for database designer with less knowledge about the NBA league.

Another challenge we had is dealing with redundant data. During the middle of implementation phase, we faced a dilemma between entering derived data and difficult queries development. For instance, the team statistics are derived from the performance of all team members. With a view to designing a good database, we decided to delete the unnecessary attributes, which might cause redundancy, and delayed the development process by returning to design stage.

IMPLEMENTATION PHASE

Data validation is the most challenging obstacle our group encountered during the implementation phase. To ensure the consistency of data entry, we made use of the Input mask and validation rule of Microsoft Access. As the syntax of different DBMS are different, we sometimes misused the wildcard character which contributed to a troublesome modification of correcting all SQL statements. There were countless bugs discovered in the data entry process, especially we had a change of direction from Oracle to Microsoft Access previously. Therefore, we spent a lot of times to correcting all the commands for data validation.

LESSONS LEARNT

Despite the satisfying teamwork and collaboration, our group faced some inefficiencies due to the wrong working process. After creating the ERD, we jumped to the development of queries and implementation without normalization. However, after acquiring sufficient knowledge of normalization in lectures, we discovered some problems of the original ERD such as the redundant data mentioned before. To increase our efficiency, we learnt to follow the process strictly.



WORK DISTRIBUTION LIST

Phrase 1: Proposal	Introduction	Kwan Wai Kiu
	What data to be stored?	Wan Hoi Nam, Lai Chun Ho
	Who will use the system?	Yeung Miu Wan
	How do they use the system?	Li Yin Cheung
Phrase 2: Implementation	Internal Model	Lai Chun Ho, Wan Hoi Nam, Li Yin Cheung
	Normalization	Yeung Miu Wan
	Form	Yeung Miu Wan
	Data Entry	Kwan Wai Kiu
	Queries	Lai Chun Ho, Wan Hoi Nam, Li Yin Cheung
	Report	Li Yin Cheung
	Proofreading	Li Yin Cheung, Kwan Wai Kiu
Phrase 2: Report	Introduction	Kwan Wai Kiu
	Business rules	Lai Chun Ho, Wan Hoi Nam
	Conceptual model (ERD)	Li Yin Cheung, Yeung Miu Wan
	Logical design	Wan Hoi Nam
	Implementation details	Kwan Wai Kiu
	Difficulties	Yeung Miu Wan
	Work distribution list	Yeung Miu Wan
	Conclusion	Wan Hoi Nam
	Reference	Kwan Wai Kiu
	Proofreading	Yeung Miu Wan, Lai Chun Ho
Phrase 3: Presentation	Power Point Design	Yeung Miu Wan
	Opening	Yeung Miu Wan
	Introduction	Kwan Wai Kiu
	Describe the business rules	Yeung Miu Wan
	Conceptual model (ERD)	Yeung Miu Wan
	Logical design	Wan Hoi Nam
	Demonstration	Lai Chun Ho, Li Yin Cheung
	Conclusion	Li Yin Cheung
	Q&A Session	Yeung Miu Wan, Lai Chun Ho



CONCLUSION

Due to the popularity of NBA game, people from all walks of life are fond of watching the NBA game in their free time. Therefore, our team is decided to illustrate an integrated database system for NBA payroll data service. Our NBA payroll data service provides lot of concise and meaningful information about NBA and supply a user-friendly platform for getting the information easily.

A various of people use the database system. For instance, Sport journalists, Sponsor, NBA fans, Organization, Owner, Employees, Coaches, NBA players. This act allows NBA fans to browse the information and statistics of their favorite team(s) and player(s) via queries while the organization uses the same queries to check which team and players has a potential to be an MVP. This system gives an enormous support that coaches of each team could use it to track the strength and ability of player and team, then design a proper training content.

Besides, this activity provides an approach that allows the owner and employee to understand the situation of their team. Though the uses of queries, the Sport journalists and the sponsor investigate the overall strength and potential of teams or players via queries, the sport journalist predict the players who is going to sign a new contract and report by giving a reason while the sponsor could decide a team for sponsoring.

Users must register as our members and has a one-time payment before they use the system. After the payment, they could get the recent update permanently. The database will regularly classify raw data and update information by using the form so the users would access the information of the recent NBA season.

To conclude, this integrated database system could reduce many human-made error and the time for managing a huge amount data. Also, it could improve the data inconsistency. Users do not need to back up data frequency because the backup and recovery function of DBMS's, the system could restore the database to the previous state if there are crash or failure of the system.



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