# Monopolee - Monopoly gameplay using SQL

**In this project, I developed an SQL based simplified version of the popular game "Monopoly".**

## Section 1: ER Diagram

Figure 1 shows the design entity relationship diagram for the game Monopolee.

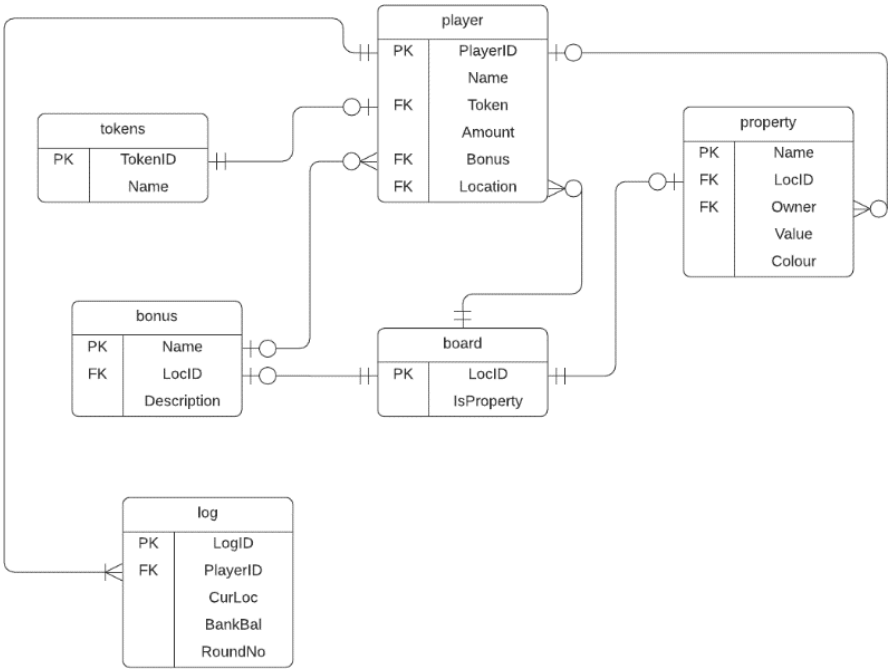


*Figure 1 Entity Relationship Diagram for Monopolee*

## Section 2: Design Summary

The design includes six tables, namely tokens, player, property, board, bonus and log. Each location in the Monopolee board has been assigned an index between 0 and 15. The indexing starts from GO and increases clockwise as shown in figure 2.

| | | | | |
|---|---|---|---|---|
| 8 | 9 | 10 | 11 | 12 |
| 7 | | | | 13 |
| 6 | | | | 14 |
| 5 | | | | 15 |
| 4 | 3 | 2 | 1 | 0<br>GO |

*Figure 2 Monopolee Board Indexing*

All the even numbered locations are bonuses while the odd numbered ones are properties. The IsProperty attribute of the board entity has been added to determine whether that location ID is a property or a bonus. This helps in choosing which table we need to go to, bonus or property, to get the required information to update the player table. A new bonus called “Visiting Jail” has been added at location 4 instead of considering it as Jail as a player landing on that location without getting a “Go To Jail” bonus should not be penalised. The name of the bonus has been used as the primary key for the bonus table as there is no need to add an extra column of unique identifiers. The location IDs present in the table are also unique. The handling of the “PASS GO” rule has been done along with the “GO” bonus. The game has been created in such a way that a player has at most two die rolls, meaning that there can be only one extra throw if the player has rolled a 6 in the first throw. A die roll of 6 in the second roll does not provide an extra throw of the dice. This holds even if the player is in Jail. In the initial state given, Norman is at Kilburn, which is not owned by anyone. He doesn’t buy it either, which is against Rule 1. This has however been disregarded and Kilburn remains unowned at the initial state of the gameplay.

**Locations:**

0. GO
1. Kilburn (Yellow)
2. Chance 1
3. Uni Place (Yellow)
4. Visiting Jail
5. Victoria (Green)
6. Community Chest 1
7. Piccadilly (Green)
8. Free Parking
9. Oak House (Orange)
10. Chance 2
11. Owens Park (Orange)
12. Go To Jail
13. AMBS (Blue)
14. Community Chest 2
15. Co-Op (Blue)

**Bonuses:**

0. Go – Collect £200
1. Chance 1 – Pay each of the other players £50
2. Visiting Jail – No Action
3. Community Chest 1 – For winning a beauty contest, you win £100
4. Free Parking – No Action
5. Chance 2 – Move forward 3 spaces
6. Go To Jail – Go to Jail, do not pass GO, do not collect £200
7. Community Chest 2 – Your library books are overdue. Pay a fine of £30

## Section 3: The Schema & Game Design

**Mapping ER to Schema:**

There are 6 entities that have been mapped to 6 relational tables, namely player, board, property, bonus, token and log. There are 7 relations between the tables. Foreign keys have been added to implement these relations. All the tables are in the 1$^{st}$ normal form. The tables created, details about their attributes and the relationships between them have been discussed in the section below.

**Relational Database Schema:**

1. **player (<u>PlayerID</u>, Name, Token, Amount, Bonus, Location)**

*Table 1 player Table*

| PlayerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| INT | VARCHAR | INT | INT | VARCHAR(30) | INT |
| Primary Key | | Foreign Key | | Foreign Key | Foreign Key |

Table 1 shows the schema for the player table. Player ID is the primary key. Attribute token references the TokenID of the tokens table. Attribute Bonus references name in the bonus table and the attribute location references LocID board table.

2. **tokens (<u>TokenID</u>, Name)**

*Table 2 tokens table*

| TokenID | Name |
|---|---|
| INT | VARCHAR(30) |
| Primary Key | |

The tokens table (table 2) has two attributes, tokenID which is the primary key and name which has the names of the tokens.

3. **property (<u>Name</u>, ID, Owner, Value, Colour)**

*Table 3 property table*

| Name | ID | Owner | Value | Colour |
|---|---|---|---|---|
| VARCHAR(30) | INT | INT | INT | VARCHAR(10) |
| Primary Key | Foreign Key | Foreign Key | | |

The property table, as seen in table 3, has Name as its primary key. The ID here references the location table. Owner references the player table.

4. **board (<u>LocID</u>, IsProperty)**

*Table 4 board table*

| LocID | IsProperty |
|---|---|
| INT | Boolean |
| Primary Key | |

This table (table 4), as the name suggests, maps each location on the table to a unique ID, locID. The IsProperty attribute is 1 if the location on the board is a property and 0 if it is a bonus.

**5. bonus (Name, ID, Description)**

*Table 5 bonus table*

| Name | ID | Description |
|---|---|---|
| VARCHAR(30) | INT | VARCHAR(50) |
| Primary Key | Foreign Key | |

This table stores information about the various bonuses as discussed in Section 2.

**6. log (LogID, PlayerID, CurLoc, CurBank,RoundNo)**

*Table 6 log table*

| LogID | PlayerID | CurLoc | CurBank | RoundNo |
|---|---|---|---|---|
| INT | INT | INT | INT | INT |
| Primary Key | Foreign Key | | | |

Table 6 is the schema for the log table that is used to log each move of the game. The PlayerID references the player ID in the player table. The CurLoc and CurBank attributes give the location of the player in the board and their bank balance after the turn is over.

I have created a procedure, insertTables, that when called will create all the required tables with the proper constraints. The procedure also inserts all the initial values for the tables. Please refer to the code document.

**Gameplay:**

The take turn procedure has 4 input parameters, the name of the player, the first die roll, the second die roll if necessary, and the round number. It then processes the input die roll and updates the tables accordingly. All update statements are present inside the takeTurn procedure. This procedure is called from the playGame procedure to simulate each turn. The player name, their die rolls and the round number are passed on to the takeTurn procedure to simulate each turn. The gameView view is created inside the playGame procedure. The view gets updated after every turn and is displayed. The first check that is done in each turn is whether the player is in jail.

## Section 4: Sample Gameplay

This sample gameplay is the continuation of a game being played by Mary, Bill, Jane and Norman. This simulation plays two rounds of the game with Jane rolling first followed by Norman, Mary and Bill. The section below illustrates the changes in the player table based on the moves. Figure 3 shows the initial state of the player table before the start of the simulation.

Figure 3 shows the initial state of the player table. The log and gameView are initially empty.

| playerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| 1 | Mary | 3 | 190 | FREE PARKING | 8 |
| 2 | Bill | 1 | 500 | *NULL* | 11 |
| 3 | Jane | 2 | 150 | *NULL* | 13 |
| 4 | Norman | 5 | 250 | *NULL* | 1 |

*Figure 3 Initial state of player table*

**Gameplay Round 1:**

Jane rolls a 3:

Figure 4 shows the status of Jane after the first turn. She moves from location 13 to location 0. She gains £200 as she landed on go.

**Player Table**

Updated Player Table

| playerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| 1 | Mary | 3 | 190 | FREE PARKING | 8 |
| 2 | Bill | 1 | 500 | *NULL* | 11 |
| 3 | Jane | 2 | 350 | *NULL* | 0 |
| 4 | Norman | 5 | 250 | *NULL* | 1 |

*Figure 4 tables affected after turn 1*

Norman rolls a 1:

Norman moves 1 spot to CHANCE 1 and therefore has to pay £50 to each player. He loses £150 while Mary, Bill and Jane each get £50 as seen in figure 5.

**Player Table**

Updated Player Table

| playerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| 1 | Mary | 3 | 240 | FREE PARKING | 8 |
| 2 | Bill | 1 | 550 | *NULL* | 11 |
| 3 | Jane | 2 | 400 | *NULL* | 0 |
| 4 | Norman | 5 | 100 | CHANCE 1 | 2 |

*Figure 5 tables affected after turn*

Mary rolls a 4:

Mary rolls a 4 and lands on GO TO JAIL. Therefore, she goes to location 4 (Jail) without passing jail. The result is shown in figure 6.

**Player Table**

Updated Player Table

| playerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| 1 | Mary | 3 | 240 | GO TO JAIL | 4 |
| 2 | Bill | 1 | 550 | *NULL* | 11 |
| 3 | Jane | 2 | 400 | *NULL* | 0 |
| 4 | Norman | 5 | 100 | CHANCE 1 | 2 |

*Figure 6 tables affected after turn 3*

Bill rolls a 2:

Bill moves two spots and buys AMBS. Figure 7 shows the updates to the property and player tables.

**Property Table**

Updated Property Table

| Name | Id | Owner | Value | Colour |
|---|---|---|---|---|
| AMBS | 13 | 2 | 400 | Blue |
| Co-Op | 15 | 3 | 30 | Blue |
| Kilburn | 1 | *NULL* | 120 | Yellow |
| Oak House | 9 | 4 | 100 | Orange |
| Owens Park | 11 | 4 | 30 | Orange |
| Piccadilly | 7 | *NULL* | 35 | Green |
| Uni Place | 3 | 1 | 100 | Yellow |
| Victoria | 5 | 2 | 75 | Green |

**Player Table**

Updated Player Table

| playerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| 1 | Mary | 3 | 240 | GO TO JAIL | 4 |
| 2 | Bill | 1 | 150 | *NULL* | 13 |
| 3 | Jane | 2 | 400 | *NULL* | 0 |
| 4 | Norman | 5 | 100 | CHANCE 1 | 2 |

*Figure 7 tables affected after turn 4*

Game View after Round 1:

Figure 8 shows the gameView after the end of the first round.

| Round | playerID | Name | Amount | Location | Properties | Bonus |
|---|---|---|---|---|---|---|
| 1 | 3 | Jane | 400 | 0 | Co-Op | *NULL* |
| 1 | 4 | Norman | 100 | 2 | Oak House,Owens Park | CHANCE 1 |
| 1 | 1 | Mary | 240 | 4 | Uni Place | GO TO JAIL |
| 1 | 2 | Bill | 150 | 13 | AMBS,Victoria | *NULL* |

*Figure 8 Game View after Round 1*

Gameplay Round 2:

Jane rolls a 5:

Jane rolls a 5 and moves to Victoria. She pays the owner Bill £75. The updated values can be viewed in figure 9.

**Player Table**

Updated Player Table

| playerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| 1 | Mary | 3 | 240 | GO TO JAIL | 4 |
| 2 | Bill | 1 | 225 | *NULL* | 13 |
| 3 | Jane | 2 | 325 | *NULL* | 5 |
| 4 | Norman | 5 | 100 | CHANCE 1 | 2 |

*Figure 9 tables affected after turn 5*

Norman rolls a 4:

Norman moves from CHANCE 1 to COMMUNITY CHEST 1 by rolling a 4. He gets a 100 pounds as can be seen in figure 10.

**Player Table**

Updated Player Table

| playerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| 1 | Mary | 3 | 240 | GO TO JAIL | 4 |
| 2 | Bill | 1 | 225 | *NULL* | 13 |
| 3 | Jane | 2 | 325 | *NULL* | 5 |
| 4 | Norman | 5 | 200 | COMMUNITY CHEST 1 | 6 |

*Figure 10 tables affected after turn 6*

Mary rolls a 6, and then a 5:

Mary, who is in jail, has rolled a 6, meaning she can leave jail and roll again. She then rolls a 5. She goes to oak house. She has to pay double the rent as Norman owns both places of the colour orange. She pays £200 to him. The updated bank balances can be seen in figure 11.

**Player Table**

Updated Player Table

| playerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| 1 | Mary | 3 | 40 | *NULL* | 9 |
| 2 | Bill | 1 | 225 | *NULL* | 13 |
| 3 | Jane | 2 | 325 | *NULL* | 5 |
| 4 | Norman | 5 | 400 | COMMUNITY CHEST 1 | 6 |

*Figure 11 tables affected after turn 7*

Bill rolls a 6, and then a 3:

Bill rolls a 6, moves 6 spaces and then rolls a 3 and moves 3 more spaces to COMMUNITY CHEST 1. He gets £100 pounds for winning a beauty contest. The updates are shown in the table in figure 12.

**Player Table**

Updated Player Table

| playerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| 1 | Mary | 3 | 40 | *NULL* | 9 |
| 2 | Bill | 1 | 525 | COMMUNITY CHEST 1 | 6 |
| 3 | Jane | 2 | 325 | *NULL* | 5 |
| 4 | Norman | 5 | 400 | COMMUNITY CHEST 1 | 6 |

*Figure 12 tables affected after turn 8*

Game View after round 2:

Figure 13 shows the gameView at the end of the second round.

| Round | playerID | Name | Amount | Location | Properties | Bonus |
|---|---|---|---|---|---|---|
| 2 | 3 | Jane | 325 | 5 | Co-Op | *NULL* |
| 2 | 4 | Norman | 400 | 6 | Oak House,Owens Park | COMMUNITY CHEST 1 |
| 2 | 1 | Mary | 40 | 9 | Uni Place | *NULL* |
| 2 | 2 | Bill | 525 | 6 | AMBS,Victoria | COMMUNITY CHEST 1 |

*Figure 13 Game View at the end of Round 2*

**Audit Trail and final player table:**

| LogID | PlayerID | CurLoc | CurBank | Round |
|---|---|---|---|---|
| 1 | 3 | 0 | 350 | 1 |
| 2 | 4 | 2 | 100 | 1 |
| 3 | 1 | 4 | 240 | 1 |
| 4 | 2 | 13 | 150 | 1 |
| 5 | 3 | 5 | 325 | 2 |
| 6 | 4 | 6 | 200 | 2 |
| 7 | 1 | 9 | 40 | 2 |
| 8 | 2 | 6 | 525 | 2 |

| playerID | Name | Token | Amount | Bonus | Location |
|---|---|---|---|---|---|
| 1 | Mary | 3 | 40 | *NULL* | 9 |
| 2 | Bill | 1 | 525 | COMMUNITY CHEST 1 | 6 |
| 3 | Jane | 2 | 325 | *NULL* | 5 |
| 4 | Norman | 5 | 400 | COMMUNITY CHEST 1 | 6 |

*Figure 14 Audit Trail showing details each turn  Figure 15 Final state of Player table*

The log table shows the details about each round. It displays the LogID, which is the turn number, the PlayerID of the person who rolled that turn, the location of the player at the end of their turn, their bank balance at the end of the turn and the round they played. Figure 14 shows the state of the log table at the end of the second round. Figure 15 displays the state of the player table at the end of Round 2.