

Databases and Cloud Computing

Final Project

Summary

During this final project, you will design a database that can store information about the matches that are played during the **FIFA World Cup**. You will design and implement the database in two phases:

- First by hosting it on a local server.
- Second by deploying the database in the Cloud, using Microsoft Azure.

First Phase: Host the Database on a local server.

1. Design the Database
 - 1.1. Design a database that meets the specifications of the use case (see Appendix 1).
 - 1.2. Draw an Entity Relationship Diagram (ERD) using Visio or Draw.IO. Use crow-foot notation.
 - 1.3. Normalize the database. Start with checking if the database, you derived from the specifications, complies with the 1NF, 2NF, 3NF, up to the Boyce-Codd Normal form. Clearly explain the steps on how you came from your original ERD design to the Boyce-Codd Normal form.
 - 1.4. Discuss the design with your teacher.
 - 1.5. Check if the database design is complete. You should be able to answer simple and advanced queries about the tournament. See some example queries in Appendix 1.
2. Implement the Database in SQL Server
 - 2.1. Create the table structure according to your design.
 - 2.2. Add the constraints (primary key, foreign keys, not null, and additional constraints).
 - 2.3. Populate data from the FIFA World Cup Qatar 2022, which will be provided by the teachers.
 - 2.4. Implement the triggers indicated in Appendix 3.
 - 2.5. Export the database by generating a script (SQL file).
3. Query the Database
 - 3.1. Propose five interesting (new) queries about the tournament. They should be advanced queries, i.e. involving several joins and several subqueries, and different from the ones in Appendix 1.
 - 3.2. Answer the list of queries in Appendix 1.
 - 3.3. Answer the list of your proposed queries.
 - 3.4. Export the results of all the queries (3.2 and 3.3) to an Excel file. Each query should be in a different sheet in the same Excel file.
 - 3.5. Prepare for additional queries that will be requested (on the spot) during the project demonstration.

4. Peer assessment

- 4.1. Assess and give feedback on the design of another team in your class. You should use the given rubrics to assign a score.
- 4.2. Assess and give feedback on the query answers of another team in your class. You should use the given rubrics to assign a score.

Submission First Phase

Your design should consider future tournaments. You may assume that the number of participants and rules will remain the same. The design and implementation will be checked using the data of the WC 2022.

You should deliver a SQL file with commands to realize the following:

- a. create the database;
- b. create the tables;
- c. add the constraints;
- d. populate the data into the database;
- e. answer the given queries (Appendix 2);
- f. answer your own proposed queries;
- g. answer another group's proposed queries;
- h. execute the triggers (Appendix 3).
- i. assess the design of another group.
- j. assess the query results from another group;

Second Phase: Deploy the Database in the cloud.

Instructions for phase 2 of the project will be provided after the lecture on cloud computing.

FIFA WORLD CUP

Use Case

The FIFA World Cup is a worldwide football competition between the senior men's national teams that happens every four years. Usually, 32 teams compete and try to win the competition over the course of a month. Each team belongs to one of the regions and six FIFA confederations, which oversee the game in the different continents, and regions of the world. A tournament includes data about the year, location, winner, and the start and end dates of the tournament. The host country is chosen several years before the competition starts. Multiple host countries are possible in a tournament.

The competition happens in several stadiums located in the host countries. Among other details, it is important to store the name of the stadium, the city, state, country, capacity (number of people it can host), and the location (GPS coordinates). Some stadiums have hosted several World Cup matches. Some cities have several stadiums.

The competition consists of two stages: it starts with the *group stage* and is followed by the *knockout phase*, therefore it is key to keep the dates when each stage happens. The host nation automatically qualifies for the group stage of the tournament.

In the *group stage*, teams will compete within eight groups of four teams each. Each group plays a tournament in which each team is organized for three matches against other teams in their group. So, in total six matches are played within a group. Points are used to rank the teams within a group. Three points are awarded for a *win*, one point for a *draw*, and no points for a *loss*. The best two teams of each group advance to the knockout stage. In the case of ties, there are some criteria to decide what teams pass to the following stage (see details in Appendix 2).

The *knockout stage* is a single-elimination tournament. Teams will compete with each other in one-off matches. In case of a draw, extra time and penalty shoot-outs are used to decide the winner. This stage begins with the round of sixteen teams, in which the winner of each group plays against the runner-up of another group. This is followed by the quarter-finals, the semi-finals, the third-place match (played by the losing semi-finalists), and the final.

For each match, it is important to keep (at least) the stage of the tournament, the venue (stadium) at which the game is played, the teams involved (home team and away team), the date, the result, and the start time of the game. It should be possible to see if the match is part of the group stage (and of which group) or part of the knockout stage (and what kind of game: final, third-place match, semi-final, quarter-final, or the round of 16).

Each team has several players. Each player is identified (at least) with an identification, first name, last name, shirt number, birth date, and position. The position can be attacker, defender, midfielder, goalkeeper, or forward.

Each team has a well-known manager. There are managers who had been appointed to other teams (in previous tournaments).

For each match of a tournament, FIFA appoints a set of officials. This includes the main referee, two assistant referees, the fourth official referee, and the reserve assistant referee. In recent tournaments, a team of Video Assistant Referees (VAR) are also appointed. The appointment of officials to matches also indicates the home country and confederation of each referee.

Many events might happen during a match. For instance, a player scores a goal; a player might get booked (yellow card, red card, second yellow card, sent off); or a player might be substituted; penalty kicks in penalty shootouts and their outcomes (penalty kicks) are also recorded events. Bear in mind that goals scored in penalty shoot-outs are not counted towards players' goal counts or to match goal counts.

The referee is the highest authority of the game. His job is to ensure the game is played according to the twelve laws of the game. When an incident has breached the laws, the referee decides what action (and/or punishment) should be taken as a result. Law 12 indicates the types of offenses and misconduct that might result in a caution.

A caution is also known as a "booking". For instance, a yellow card indicates a caution given to a player regarding their conduct. A second yellow card would result in a disqualification of the offending player for a certain number of subsequent matches. A red card indicates a serious offense and signifies that a player has been sent off, i.e. the player must take no further part of the game.

The database should also keep track of these in-match events. For instance, it should be possible to show a summary of all the events per match. For each event, it should be possible to know the minute in which the event happens, what match period (first half, second half, extra time first half, extra time second half, etc.), and which player(s) and team were involved. Moreover, the data stored in the database should be useful to calculate valuable statistics about teams, players, matches, managers, and referees, among others.

At the end of the tournament, several awards are given to the players and teams who performed the best in several aspects. It should be possible to generate these award winners, see Appendix 3 for details.

References

[https://en.wikipedia.org/wiki/Laws_of_the_Game_\(association_football\)](https://en.wikipedia.org/wiki/Laws_of_the_Game_(association_football))

https://en.wikipedia.org/wiki/2022_FIFA_World_Cup

https://en.wikipedia.org/wiki/FIFA_World_Cup

<https://www.fifa.com/fifaplus/en/articles/the-best-fifa-football-awards-2022-set-for-27-february>

Appendix 1

Examples of Queries for the FIFA world cup.

Create queries for the following results, based on your own database design.

Players

1. Show a list of player names, given a part of a player name.
2. Show a list of all player names in a given tournament, their team (country), nationality, and age.
3. Show a list of players who played in a given position, for instance as a defender or mild fielder.

Matches

4. Show a list of matches that haven't been played yet. Sort the result by the kick-off date and time of the match (the earliest first). The result should contain the names of the teams and the kickoff date and time.
5. Show a list of all the matches in a given group (e.g. group A).
6. Show the first and second places in a given group (e.g. group D).
7. Show a list of all the matches and scores in each phase from the knockout stage.

Top scorers

8. Show an ordered list of players who are the top scorers of the whole competition, together with the total of goals. Players that haven't scored will not be listed.
9. Show a list of top scores in the final match, together with the team, and the minute when the goal happened.
10. Show a list of top scores in the kick-out stage.
11. Show the players with the most goals scored during penalty minutes.
12. What is the average number of goals per match?
13. Show the name of all the players who scored the same number of goals scored in the competition, in descending order.

Matches played

14. Show a list of matches that have been played, sorted by kickoff date and time (the most recent first). The result should contain the names of the teams and the kickoff date and time.
15. Show the result of a match.
16. Show the matches that were won during extra time and the matches won on a penalty shoot-out.
17. Show a list of goals of a given match. The result should contain the name of the player and the minute he has scored. Show also if the goal was scored in regular time or extra time. Any goals scored during the penalty shoot-out are excluded.
18. Show the list of matches that required extra time, the teams involved, and the total time.
19. Show the list of matches in the knockout stage where penalties were required. Include the players, and if they scored or not.

Managers and referees

20. Show the list of teams and their managers that participate in the whole competition.
21. Show the list of referees and their nationalities.
22. Show the list of referees who have more bookings in the tournament.
23. Show the list of referees for each phase in the knockout stage.

Bookings

24. Show the list of players who went sent off in the quarter of the final.
25. Show the players who had more yellow cards in the tournament ordered descending.
26. Show the players who did not have any bookings in all the tournaments, including the matches where they participated.
27. Show a summary of all the bookings per match.
28. For each of the possible bookings, show the minute in which the booking happened, what match period (first half, second half, extra time first half, extra time second half, etc.), which player(s) and which team were involved

Substitutions

29. Show the list of players who never played in the tournament.
30. Show the players who played less than 10 minutes in any of the matches.
31. Show the players who had more substitutions.

Ranking

Wins, draws, losses

32. Show the number of matches that are played in the whole competition, given a team.
33. Show the matches that are a draw in the whole competition, given a team.
34. Show the matches that are a win in the group competition, given a team.
35. Show the matches that are lost in the group competition, given a team.

Goal difference

36. Compute the number of goals that are scored by a team in the whole competition (given a team ID)
37. Compute the number of goals that are scored by all opponents of a team in the whole competition (given a team ID).

Appendix 2

Group Stage: What teams move forward to the knockout stage?

Source: https://en.wikipedia.org/wiki/FIFA_World_Cup

Points are used to rank the teams within a group. Three points are awarded for a *win*, one point for a *draw*, and no points for a *loss*. The best two teams of each group advance to the knockout stage. In the case of ties between the second and third places, the ranking is determined by:

1. Greatest combined goal difference in all group matches
2. Greatest combined number of goals scored in all group matches
3. If more than one team remains level after applying the above criteria, their ranking will be determined as follows:
 - 3.1. Greatest number of points in head-to-head matches among those teams
 - 3.2. Greatest goal difference in head-to-head matches among those teams
 - 3.3. Greatest number of goals scored in head-to-head matches among those teams
 - 3.4. Fair play points, defined by the number of yellow and red cards received in the group stage:
 - 3.4.1. Yellow card: minus 1 point
 - 3.4.2. Indirect red card (as a result of a second yellow card): minus 3 points
 - 3.4.3. Direct red card: minus 4 points
 - 3.4.4. Yellow card and direct red card: minus 5 points
4. If any of the teams above remain level after applying the above criteria, their ranking will be determined by the drawing of lots.

Appendix 3

List of Triggers to implement

1) Trigger 1. Statistics

Add triggers to automatically create a table view that holds the most important summaries and statistics of the tournament. This view should be useful for determining who passes to the next stage, and for determining the award winners. For instance, the number of goals against, goals for, goal difference, penalties, etc.

2) Trigger 2. Classification group stage

Add triggers to determine the teams that pass from the group stage to the knock-out stage. Use the data from each match, the laws of the game (research on the internet), and the rules to break ties (see Appendix 2).

3) Trigger 3. Awards

Add triggers to determine the tournament's award winners. Including: the golden ball for best player; the golden boot for top goal scorer; the golden globe for best goal keeper; the best young player for the best player who is at most 21 years old; and the fair play trophy for the team that advanced to the second round with the best record of fair play. Other awards which are voted by public will not be considered.