FitZone - Gym - Database
Author: Francesco Di Stasio

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0. Domain:

FitZone gym is a facility that offers a wide range of fitness, wellness courses, and personalized workouts. To manage course enrollments, memberships, and workouts, the gym has decided to develop a computer system that simplifies operations for both users and staff. In the gym, there are various rooms for courses in addition to a weight room. At the same time, in the same room, there cannot be more than one course simultaneously. In the weight room, there can only be the weight room type of course. The users of the system are the members of the gym also called athletes, the instructors, and the administrators. Each user has a first name, last name, password, and email. For athletes, the city of residence is also of interest. For instructors, a list of telephone numbers to contact them is of interest. The instructors hold and manage the courses. The gym athletes must enroll in the courses they want to attend. Each course is characterized by a title, description, lesson duration, typology (crossfit, zumba, pilates, weight room, etc.), and a maximum number of participants which depends on the room where the course is held. Each course takes place every year. The course typologies have a detailed description. Each course is made of a set of lessons in which the gym athletes can participate. A lesson is characterized by a date and a time. A course is held by only one instructor. A member can participate only in the lessons of the courses for which they are enrolled depending on their membership. Athletes can leave numerical ratings from one to five for each lesson they participated in and can leave textual comments for the courses to which they are subscribed. An athlete can follow another athlete. Athletes can enter the gym using different types of memberships with respect to the activities performed (weight room only, set of selected courses, all-inclusive) and with respect to the membership duration (monthly, quarterly, semi-annual, or annual). The membership of a gym member is managed by an administrator. Track is kept of the administrator of the month and the instructor of the month with respect to the number of memberships made and the ratings of the individual lessons. An instructor or an administrator can be enrolled in the gym and participate in courses. Obviously, one cannot be enrolled in the course of which they are the instructor.

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1. Domain Description:

Description of the identified classes (excluding subclasses):

1. Users: List of people registered in the system. This includes first name, last name, email address, and password. Users include: Athletes (for whom the city of residence is of interest), Administrators, and Instructors (for whom a list of telephone numbers is of interest).

2. Courses: List of courses offered. This includes the title, description, and duration of the lessons.

3. Course Types: List of various course types (CrossFit, Zumba, Pilates, weight training, etc.). This includes name and description.

4. Lessons: List of lessons related to the courses taught. This includes date and time.

5. Rooms: List of rooms where classes are held. This includes the name, capacity, and whether or not they are a weight room.

6. Memberships: List of memberships purchased by athletes. This includes the start date.

7. Membership Types: List of membership types identified by activity type and duration. This includes the name and price.

8. Activity Types: List of membership types based on the activities offered (weight room only, selected classes, all-inclusive). This includes name and description.

9. Duration Types: List of membership types by duration (monthly, quarterly, semi-annual, or annual). This includes name and description.

10. Monthly Awards: List to track the month's administrator and instructor. This includes month, year, and role.

Description of the various associations between classes:
A room hosts zero or more courses, while a course is hosted in a room.
A lesson is offered by a course, while a course offers zero or more lessons.
A lesson is attended by zero or more athletes, while an athlete attends zero or more lessons.
A course belongs to a typology, while a typology refers to zero or more courses.
A course is taught by an instructor, while an instructor teaches zero or more courses.
A course receives enrollments from zero or more athletes, while an athlete enrolls in zero or more courses.
A course is included in zero or more memberships, while a membership includes one or more courses.
A membership belongs to a membership type, while a typology refers to zero or more memberships.
A membership is managed by an administrator, while an administrator manages zero or more memberships.
A membership is purchased by an athlete, while an athlete purchases one or more memberships.
A membership type includes one activity type, while an activity type is included in zero or more membership types.
A membership type includes a duration type, while a duration type is included in zero or more membership types.
A user gets zero or more monthly awards, while a monthly award is given to one user.
An athlete follows zero or more athletes, while an athlete is followed by zero or more athletes.

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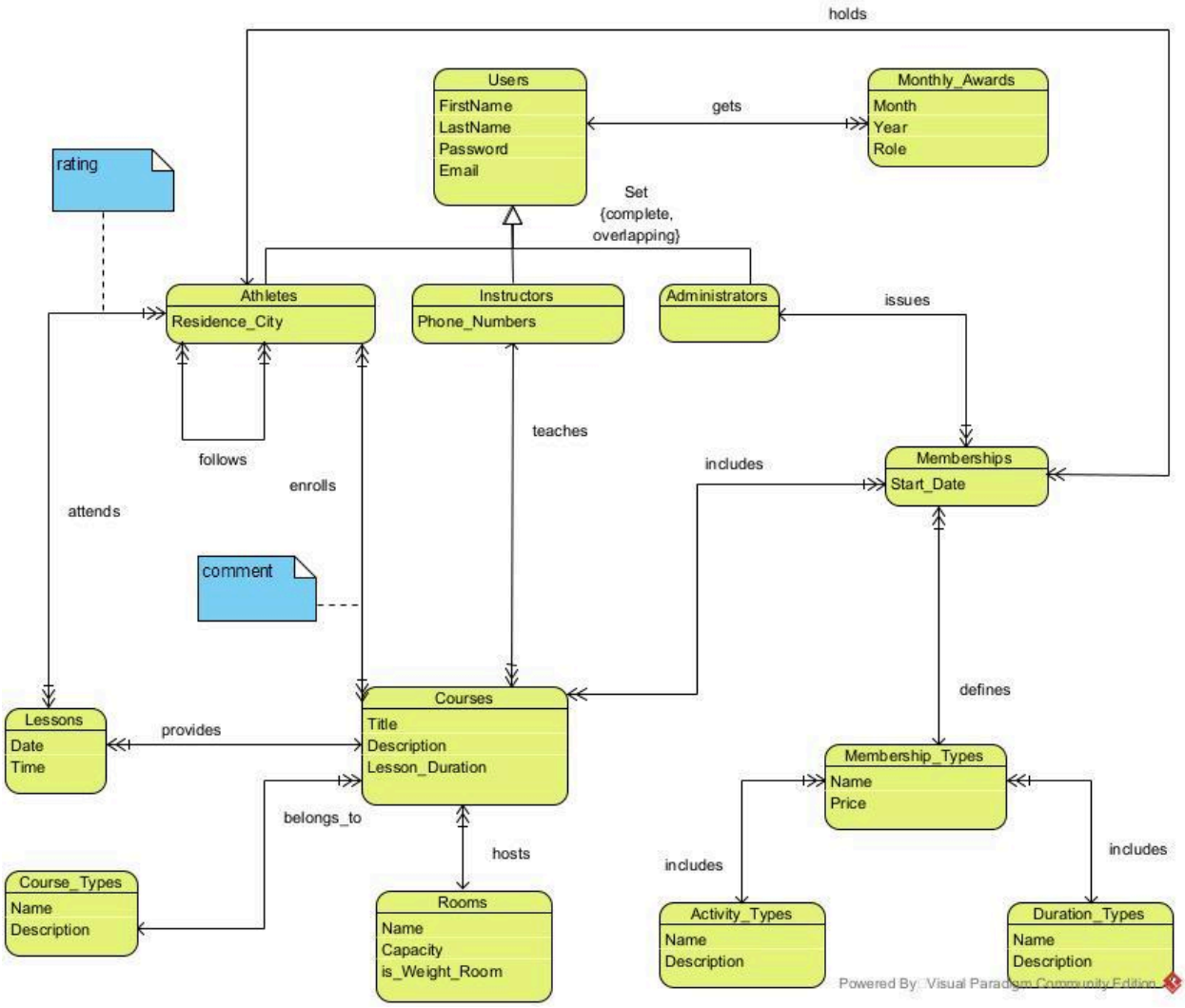
2. Conceptual scheme:

Conceptual diagram in graphic format:



Constraints not captured graphically:

1. If a lesson is recorded with a date and time that overlaps with another lesson, the room associated with the course associated with the first lesson must be different from the room associated with the course associated with the second lesson.

2. A course that is associated with a room with the attribute is_Weight_Room = true, must be associated with the weight room type.

3. An athlete can enroll in a course if and only if the number of enrollments for that course is less than the capacity of the room associated with the course.

4. An athlete can enroll in a course if and only if it is included in his membership and can participate in a lesson if and only if he is enrolled in the course for that lesson.

5. The numerical ratings left by athletes for the lessons range from 1 to 5.

6. The role attribute in Monthly Awards can only assume the values Instructor or Administrator.

7. A user can be associated with a specific monthly award if and only if the role indicated in the award corresponds to a subclass to which the user belongs.

8. An instructor can enroll in a course if and only if the instructor holding it is not him.

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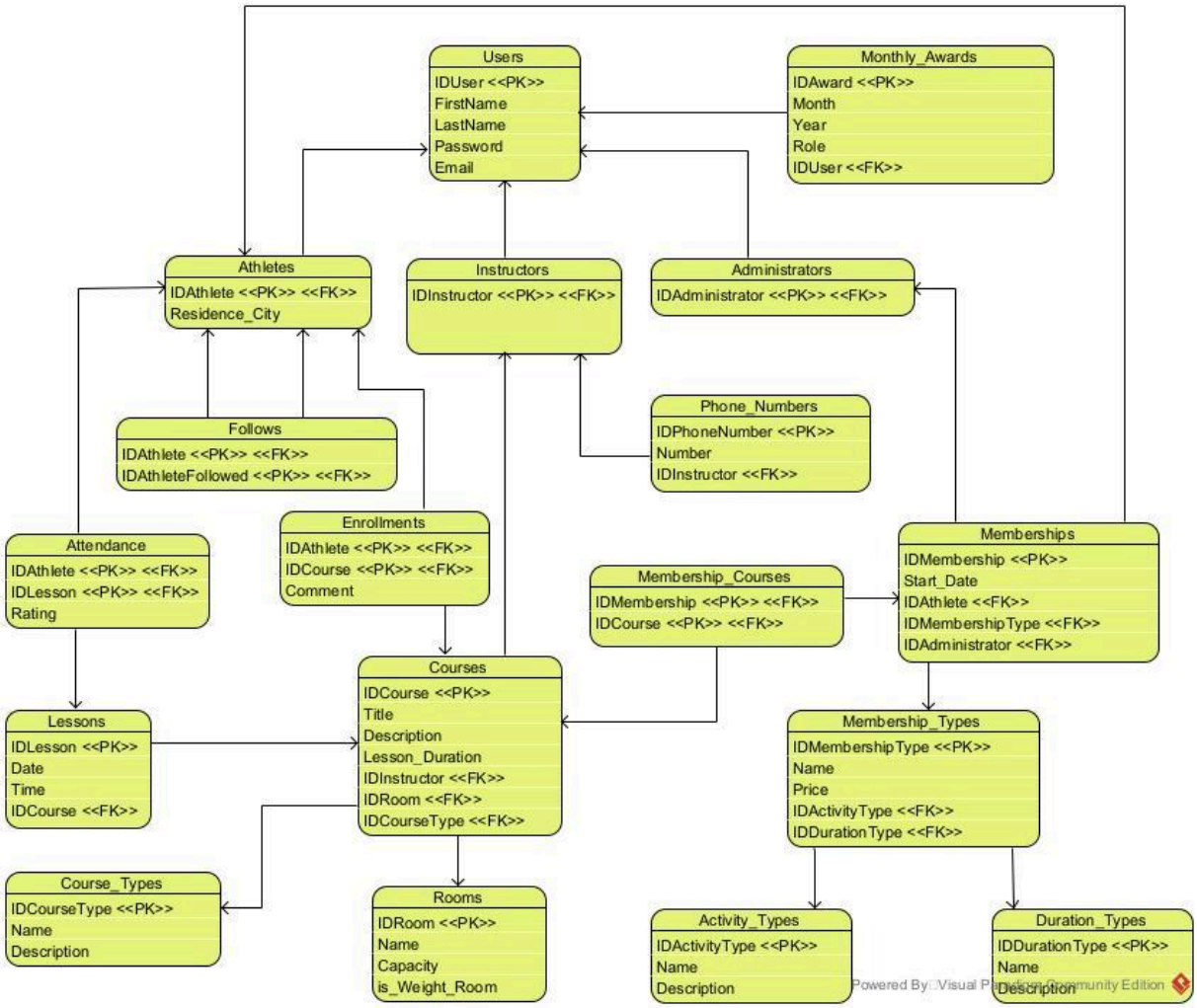
3. Relational logical scheme:

Relational logical diagram in graphical format:



Relational logical schema in text format with the related sets of functional dependencies:
Users(IDUser, FirstName, LastName, Password, Email)
DF_Users = {IDUser -> FirstName, LastName, Password, Email}

Athletes(IDAthlete*, Residence_City)
DF_Athletes = {IDAthlete -> Residence_City}

Instructors(IDInstructor*)
DF_Instructors = {}

Administrators(IDAdministrator*)
DF_Administrators = {}

Phone_Numbers(IDPhoneNumber, Number, IDInstructor*)
DF_Phone_Numbers = {IDPhoneNumber -> Number, IDInstructor}

Rooms(IDRoom, Name, Capacity, is_Weight_Room)
DF_Rooms = {IDRoom -> Name, Capacity, is_Weight_Room}

Course_Types(IDCourseType, Name, Description)
DF_Course_Types = {IDCourseType -> Name, Description}

Courses(IDCourse, Title, Description, LessonDuration, IDInstructor*, IDRoom*, IDCourseType*)
DF_Courses = {IDCourse -> Title, Description, LessonDuration, IDInstructor, IDRoom, IDCourseType}

Lessons(IDLesson, Date, Time, IDCourse*)
DF_Lessons = {IDLesson -> Date, Time, IDCourse}

Enrollments(IDAthlete*, IDCourse*, Comment)
DF_Enrollments = {IDAthlete, IDCourse -> Comment}

Attendance(IDAthlete*, IDLesson*, Rating)
DF_Attendance = {IDAthlete, IDLesson -> Rating}

Follows(IDAthlete, IDFollowedAthlete)
DF_Follows = {}

Memberships(IDMembership, StartDate, IDAthlete*, IDMembershipType*, IDAdministrator*)
DF_Memberships = {IDMembership -> StartDate, IDAthlete, IDMembershipType, IDAdministrator}

Membership_Courses(IDMembership*, IDCourse*)
DF_Membership_Courses = {}

Membership_Types(IDMembershipType, Name, Price, IDActivityType*, IDDurationType*)
DF_Membership_Types = {IDMembershipType -> Name, Price, IDActivityType, IDDurationType}

Activity_Types(IDActivityType, Name, Description)
DF_Activity_Types = {IDActivityType -> Name, Description}

Duration_Types(IDDurationType, Name, Description)
DF_Duration_Types = {IDDurationType -> Name, Description}

Monthly_Awards(IDAward, Month, Year, Role, IDUser*)
DF_Monthly_Awards = {(IDAward -> Month, Year, Role, IDUser), (Month, Year, Role -> IDAward)}

Normal Forms:
All defined tables obey Boyce Codd normal form since for each relation where functional dependencies exist, the determinant is a superkey for the table.

Representation of hierarchies:
The User hierarchy was represented using a vertical partitioning.
This choice is supported by the following reasons:

1. If a single relationship had been used, there would have been no redundancies in the data but multiple NULL values.

2. Horizontal partitioning is impractical since the table Monthly Awards has a foreign key to the Users superclass.

3. Even if horizontal partitioning had been practicable (without the Monthly Awards relationship), it would not have been optimal since the hierarchy involves overlaps and therefore there would have been possible data redundancies.

Choosing vertical partitioning therefore allows you to avoid data redundancies and possible NULL values.

Note: In the table Monthly Awards the functional dependency Month, Year, Role -> IDAward ensures that there is only one award in a given month of a given year for a given role.

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4. Limitations:

The main limitations of the proposed solution are reported below:

1. Monthly awards are tied to a specific user, so the system doesn't exclude athletes from receiving recognition. This choice was made to allow for a more flexible structure. In fact, since a month administrator is determined but not an instructor (or vice versa), it avoids possible NULL values. It also makes the system potentially extendable to include athlete recognition (by adding the athlete role to the possible role values in the recognitions).

2. Complicating the scheme regarding the types of memberships. It was also chosen to use the class Membership Types so as to form ready-made packages of offers that include a type of activity, a type of duration and a price. This may slightly complicate the scheme and any queries, but it allows for standardization of memberships and makes the system more flexible in recording any offers for certain combinations of activities and duration.

3. A course is associated with a single room with a capacity. This means that all lessons for that course will take place in the same room and there is no flexibility in this regard. The advantage is that it allows you to determine a maximum number of participants in the course (capacity of the room hosting it), which would otherwise not be possible to achieve by allowing the lessons of a course to be held in different rooms.
