

## **Part A – Topic Description**

LDN GYM Ltd. is a new chain of gyms across London focussing on supplying a friendly training environment with high quality equipment and low membership costs. The business has recently purchased multiple **land parcels** across the city and built a high-quality training **facility** within each.

LDN GYM Ltd. requires a system to keep track of the performance of each gym **facility**. Most importantly, the system will ensure efficient monitoring of staff (both **Managers** and **Instructors**), **Members**, the **Classes** they partake in and any **Equipment** they rent.

This system will ensure the performance of each gym and their staff by easily allowing revenue to be derived for each **Facility**. Furthermore, underperforming gyms with larger numbers of inactive **Memberships** could be identified, allowing appropriate strategies to be drafted to tackle the situation and ensure LDN GYM Ltd becomes increasingly profitable.

The following definitions should be noted:

- Land parcel – In the context of LDN GYM Ltd., a land parcel is an area of land purchased for the purpose of constructing a gym facility within it.
- Facility – A single occupant building situated within a land parcel. The sole purpose of the building is to house a gymnasium.
- Class – A one-to-one training session between gym instructor and gym member.
- Equipment – Portable equipment that will enhance a member's gym session by increasing safety, comfort or effectiveness of an exercise or workout.

LDN GYM Ltd. Offers three types of **Membership**:

- Premium – The full price, most expensive membership on offer at £20 PCM. Premium membership offers full gym access 24/7. This is reserved for any persons which do not qualify for the 'Child' or 'Elderly' memberships.
- Child – Same benefits as the Premium membership, but at the reduced rate of £10 PCM. Reserved for any persons below the age of 18 (*Valid proof must be provided*).
- Elderly - Same benefits as the Premium membership, but at the reduced rate of £10 PCM. Reserved for any persons 60+ (*Valid proof must be provided*).

Table 1 – A list of entities in the entity-relationship diagram (figure 1).

Entity #	Entity Name	Spatial	3D
1	Land Parcel	Yes	No
2	Facilty	Yes	Yes
3	Manager	No	No
4	Instructor	No	No
5	Member	No	No
6	Membership	No	No
7	Class	No	No
8	Equipment	No	No
<b>Totals</b>	<b>8</b>	<b>2</b>	<b>1</b>

Table 2 – A list of functional requirements that the system will meet.

Requirement #	Requirement	Entity or Entities Required	Spatial Query	Join
1	What is the total area of land owned by the business?	Land Parcel	Yes	No
2	Which two gyms are the furthest distance away from eachother?	Facility	Yes	No
3	How many gyms fall within an area of interest (for example, a London Borough)?	Facility	Yes	No
4	What is the proximity of each gym to a proposed gym location defined by gps coordinates?	Facility	Yes	No
5	What is the perimeter of a given land parcel owned by the business?	Land Parcel	Yes	No
6	Which member participates in the most classes during a given date range?	Member, Class	No	Yes
7	Which gym facility employs the most instructors?	Facility, Instructor	No	Yes
8	Which gym facility has the most child memberships?	Facility, Member, Membership	No	Yes
9	What is the total number of gym members across the whole business?	Member	No	No
10	What percentage of active memberships are classified as premium memberships?	Membership	No	No
<b>Totals</b>	<b>10</b>	<b>N/A</b>	<b>5</b>	<b>3</b>

## Part B – Conceptual Design

### a) Entity-Relationship Diagram

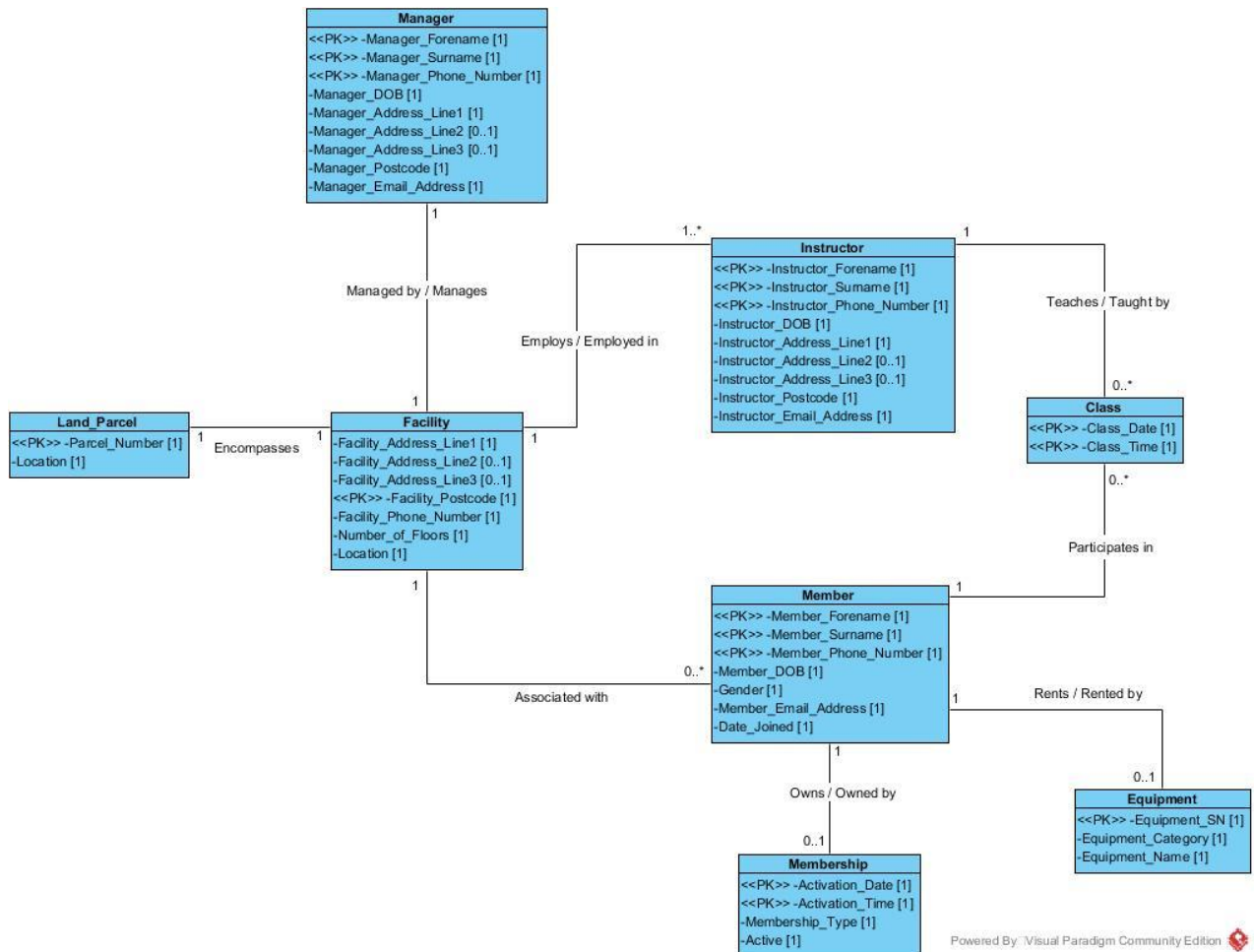


Figure 1 – Conceptual entity-relationship diagram for the database of the proposed system.

### b) Entity-Relationship Diagram Documentation

#### bi)

The following section will describe each entity, the relationships, including cardinality of each entity and their respective attributes. The unique identifier for each entity is also outlined. It should be noted that the above diagram is conceptual. Upon implementation of the proposed system, some entities may be subject to slight modification so the system works as intended. For example, ID's may be generated for Managers, Instructors, Members and Memberships. Furthermore, 'foreign keys' will be added to the entities which act as a link between data in two (or more) entities. For example, following ID generation for the relevant entities, the Class entity may have the 'Member ID' and 'Instructor ID' foreign keys added.

### **Land Parcel**

The Land Parcel entity represents the physical parcels of land purchased by LDN GYM Ltd. Each parcel of land is uniquely identified using the Parcel Number attribute (future primary key). The only other attribute in this table is Location, which holds the 2D coordinates delineating the boundary of the purchased land. Both attributes in this entity are mandatory [1]. The Land Parcel entity is related to the Facility entity in a one-to-one relationship. This relationship is determined by the business rule outlined in succeeding subsection (Bii), stating that a facility must be present within a land parcel, and each land parcel can have a maximum of one facility.

### **Facility**

This entity holds information relating to the LDN GYM Ltd. facilities. Information includes three lines of Address information, with the first being mandatory [1], whilst the second and third lines are optional [0..1]. Postcode is a mandatory attribute used to uniquely identify a facility. This is based on the assumption as stated in section B iv that no two gyms will have the same postcode. Further mandatory information includes Facility Phone Number, Number of Floors and the Location attribute, which holds the spatial 3D coordinate information of the gym facility.

The Facility entity is related to the following four entities:

1. Land Parcel - The aforementioned relationship in which a facility must be present within a single land parcel.
2. Manager - The facility can have one and only one manager.
3. Instructor - A single facility can have one or many instructors (but a minimum of one is required).
4. Member – A facility can have zero or many members.

### **Manager**

This entity provides information relating to the manager of each facility. It includes attributes relating to Manager Forename, Surname, Phone number, Date of Birth, Address, Postcode and Email Address. The unique identifier (future composite primary key) results from combining the Manager Forename, Surname and Phone Number attributes. All of the attributes of this entity are mandatory [1], with Address Line 2 and Address Line 3 being the exception (optional cardinality [0..1]).

The Manager entity is only related to the Facility entity. In accordance with the business rule and as previously mentioned, a gym must have a manager and each manager can work at one and only one facility.

### **Instructor**

The Instructor entity is reserved for staff members who are qualified gym instructors, otherwise known as personal trainers etc. The attributes and associated cardinality for this entity holds the same type of information as the aforementioned Manager entity. Similarly, the unique identifier is made up of the equivalent respective attributes (Instructor Forename, Surname, Phone Number).

The Instructor entity is related to two others. The relationship with the Facility entity is derived from the business rule that one or many instructors can work at any single gym. The second relationship is with the Class entity, in which an instructor can teach zero or many classes. This is due to the acknowledgment that an instructors demand will be highly

dependent on the number of active memberships at the facility they are employed in. It will also take time for an instructor to build up customer relations. Therefore, it is entirely possible for a new instructor to teach zero classes when they first begin working at a facility.

### **Member**

This entity holds the information relating to the gym members. All attributes in this entity are mandatory. Attributes cover general information such as Member Forename, Surname, Phone Number, Date of Birth, Gender, Email Address and Date Joined.

The unique identifier of this entity is provided by the combination of the Member Forename, Surname and Phone Number attributes.

The Member entity is related to following four entities:

1. Facility – Zero or many members can be members of a particular gym facility.
2. Class – One member can participate in zero or many classes per day.
3. Membership – One member can have either zero or one valid membership.
4. Equipment – One member can rent either zero or one piece of equipment at once.

### **Membership**

The Membership entity relates to the memberships held by the gym members. The entity consists of four mandatory attributes which detail the last Activation Date and Activation Time, Membership Type (Premium, Child or Elderly) and whether it is currently Active (each membership lasts one calendar month). Membership only relates to the Member entity as either zero or one memberships can be owned by any single member. Together, the Activation Date and Activation Time attributes provide the unique identifier for the entity. This is based on the assumption that two memberships will not be activated at exactly the same time.

The situation in which a person would be member but have zero memberships would arise if a person did not renew their membership etc. That person is still classed as a member of LDN GYM Ltd. but does not have a current active membership and therefore cannot access a facility. In this case, the stored contact information of the inactive member can be used to send incentives and promotional offers, encouraging the purchase of a new membership.

### **Class**

The class entity holds the information relating to the one-on-one training classes. The entity holds two mandatory attributes, which relate to the Class Date and Time respectively. These attributes also act as the unique identifiers for the entity. Class is related to two entities. Firstly, to the Instructor entity, in which zero or more classes may be taken by the instructor. However, as classes are one-to-one sessions, each class can only be taken by one single instructor (hence the one-to-many relationship). The second relationship the class entity holds is with the member entity, in which zero or many classes can be participated in by any single member.

### **Equipment**

The Equipment entity holds information about the equipment that has been rented by gym members. Each piece of equipment can be uniquely identified by the Equipment SN attribute (serial number). All attributes in this entity are mandatory. Further information about each item is held by the attributes Equipment Category and Equipment Name. The Equipment entity only relates to the Member entity. The relationship is defined by the business rule that states zero or one pieces of equipment can be rented by any one gym member.

### **bii)**

The following business rules are associated with the above ER diagram:

- A maximum of one 'Class' between a specific member and instructor per day. A member can have multiple classes in a single day, but they must be with different instructors.
- A 'Class' has only one default time length – one hour. There is no option to change this.
- A person can be a member at only one gym at a time. LDN GYM Ltd. does not offer multi-gym access memberships.
- All memberships are offered on a default monthly basis. There is no option for any other length of time, nor is there an option for a day-pass.
- Staff (both managers and instructors) can only be employed at a single gym. It is not possible to work at any other location.
- A member can rent a maximum of one piece of equipment at once.

The following integrity constraints are associated with the above ER diagram:

- To register for a 'Child' membership, the person must be below 18 years old.
- To register for an 'Elderly' membership, the person must be 60+ years old.
- To register for a 'Premium' membership, the person must not qualify for the 'Child' or 'Elderly' membership.
- Parcel number provides the unique identifier for the Land parcel entity.
- Postcode provides the unique identifier for the Facility entity.
- Manager Forename, Surname and Phone number provides the unique identifier for the Manager entity.
- Instructor Forename, Surname and Phone number provides the unique identifier for the Instructor entity.

- Member Forename, Surname and Phone number provides the unique identifier for the Member entity.
- Activation Date and Activation Time provides the unique identifier for the Membership entity.
- Class Date and Time provides the unique identifier for the Class entity.
- Equipment SN provides the unique identifier for the Equipment entity.

### **B iii)**

The following derivations detail arithmetic calculations that can be performed on the data:

- The total number of gym members can be calculated by adding the members of individual gyms together.
- The average number of gym members per gym can be calculated by dividing the total number of gym members by the number of gym facilities. `
- The age of a person (whether it be a gym manager, instructor or member) can be derived from their date of birth.
- The revenue a gym facility generates from memberships can be calculated by multiplying the number of each membership type by their respective cost and adding the total per membership type together.
- The total revenue LDN GYM Ltd. generates from memberships can be calculated by completing the above calculation for each gym and adding the totals together.
- The area or perimeter of each land parcel can be derived from the 2D coordinates.
- The volume of each facility can be derived from the 3D coordinates.

### **B iv)**

The following assumptions have been made:

- There is a maximum of one gym facility per postcode.
- Every person (gym manager, instructor and member) has a phone number.
- All land parcels are modelled in 2D.
- All gym facilities are modelled in 3D.
- Each land parcel must have a gym facility on it. There can only be one gym facility on each land parcel owned by LDN GYM Ltd.

- There will not be any gym managers which share the same forename, surname and phone number.
- There will not be any gym instructors which share the same forename, surname and phone number.
- There will not be any gym members which share the same forename, surname and phone number.
- Two gym members will not sign up at exactly the same time.
- A member can technically exist without a membership if, for example, they signed up but did not continue to pay their membership the following month.
- An instructor can only do one class (one-to-one session) with one member at any given time.