# DNA Project-Phase 3

## Group 14 - SQ(L)uad

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## 1 Mapping ER to Relational model

We have meticulously transformed our mini-world's Entity-Relationship (ER) model into a highly structured Relational model. Each entity type has been translated into a dedicated relation or table, incorporating essential constraints like data types, NOT NULL specifications, and Primary Keys which servers as Foreign Keys and Primary Keys of the lookup tables. Furthermore, for relationship types, we've introduced lookup tables, where the attributes consist of the Primary Keys of the associated entity types. To enhance efficiency and eliminate redundancy, we've strategically converted certain weak entity types into relationship types. This comprehensive approach ensures the integrity and optimization of our relational database design.

## 2 Conversion of Relational model to 1NF

We've undertaken a meticulous refinement of our relational schema by systematically addressing multi-valued attributes. Rather than allowing multi-valued attributes to persist within relations, we've opted for a more elegant solution. By creating new tables specifically dedicated to handling these multi-valued attributes, we've effectively decomposed relations and enhanced the overall database structure.

For instance, in the Army Composition table, we've disentangled the complexity by introducing separate tables for Spells and Troops, thereby streamlining data management. Additionally, in the League table, we've optimized the design by removing the 'players' attribute and, in its place, established a new table where 'player' serves as the Primary Key and 'league' as the Foreign Key. This meticulous decomposition not only ensures a cleaner and more modular database but also contributes to improved data integrity and query efficiency.

## 3 Conversion of 1NF to 2NF

We've seamlessly advanced from the first normal form (1NF) to the second normal form (2NF), and this transition necessitated minimal adjustments, given

that the majority of our tables feature single primary keys, each comprising a single attribute—eliminating the need for composite primary keys.

In cases where lookup tables involve multi-attribute primary keys, we've ensured a clear and functional dependence without any partial dependencies. This meticulous approach guarantees that every non-primary key attribute within our tables is functionally dependent on the respective table's primary key. This commitment to the principle of functional dependence not only streamlines our database design but also reinforces the integrity of our data model in adherence to the second normal form. In all of our relations the non primary key attributes are functionally dependent on the primary key.

# 4   Conversion of 2NF to 3NF

We want to highlight that our journey from the second normal form (2NF) to the third normal form (3NF) was characterized by minimal alterations. This is largely attributed to the pre-existing structure of our relations, which inherently eliminates any transitive functional dependencies on the respective primary keys. In other words, the assurance that no non-key attribute requires modification due to changes in another non-key attribute remained intact. This lack of extensive modifications underscores the efficiency and foresight in our initial database design, resulting in a smooth transition with minimal adjustments.

# 5   Conclusion

We meticulously crafted a relational data model for our miniworld, prioritizing the prevention of update anomalies, insert anomalies, and delete anomalies. Our approach involved a thoughtful application of normalization at every step, ensuring that our design meets the necessary criteria for a robust and normalized database structure. In certain instances, explicit normalization steps were unnecessary as the existing structure already fulfilled the prerequisites for normalization.

Furthermore, a pivotal focus of our design philosophy was to guarantee that each relation encapsulates information pertaining to only one distinct type. This meticulous consideration not only reinforces data integrity but also establishes a foundation that safeguards against potential pitfalls associated with anomalies. Our commitment to a well-structured and normalized database underscores our dedication to data reliability and effective management

The Relational model diagrams are attached below. The first diagram is the unnormalized form and the second one is the normalized one.(Since in this case there were no explicit changes for 2NF and 3NF).

**Achievements**

| PK | Name(VARCHAR(30),Single-Valued) |
|---|---|
| FK | PlayerID(CHAR(8),Single-Valued) |
| | Status(VARCHAR(3),Single-Valued) |

**Player's Achievements**

| PK,FK1 | PlayerID |
|---|---|
| PK,FK2 | Achievement |

**Leagues**

| PK | Name(VARCHAR(30),Single-valued) |
|---|---|
| | Players(VARCHAR(30),Multi-valued,NOT NULL) |
| | Upper Limit of trophy range(INT,Single-valued,NOT NULL) |
| | Lower Limit of trophy range(INT,Single-valued,NOT NULL) |

**Player "part of" league**

| PK,FK | Name |
|---|---|
| PK,FK | PlayerID |

**Player**

| PK | PlayerID(Char(8)-Single-valued) |
|---|---|
| | Clan Name(VARCHAR(20),Single-valued,NOT NULL) |
| | Username(VARCHAR(20),Single-valued,NOT NULL) |
| | Clan Role(VARCHAR(20),Single-valued,NOT NULL) |
| | Elixir(INT,Single-valued,NOT NULL) |
| | Gold(INT,Single-valued,NOT NULL) |
| | Dark Elixir(INT,Single-valued,NOT NULL) |
| | Gems(INT,Single-valued,NOT NULL) |
| | Trophies(INT,Single-valued,NOT NULL) |
| | XP Level(INT,Single-valued,NOT NULL) |
| | Town-hall Level(INT,Single-valued,NOT NULL) |

**Clan**

| PK | Clan_ID(CHAR(8),Single-valued) |
|---|---|
| | Name(VARCHAR(30),Single-valued,NOT NULL,UNIQUE) |
| | Trophies(INT,Single-valued,NOT NULL) |
| | No. of members(INT,Single-valued,NOT NULL) |
| | Player and their role(COMPOSITE(VARCHAR(30),VARCHAR(20)),Multi-valued,NOT NULL) |

**Player "part of" clan**

| PK,FK | Clan_ID |
|---|---|
| PK,FK | PlayerID |

**Clan Chat**

| PK,FK1 | Clan_ID |
|---|---|
| PK,FK2 | PlayerID |
| | Time(TIME,Single-valued,NOT NULL) |

**Clan War**

| PK,FK1 | Clan1_ID |
|---|---|
| PK,FK2 | Clan2_ID |
| | Result(VARCHAR(8)valued,NOT NULL) |

**"Players" Attack Log**

| PK,FK | Attacker_ID |
|---|---|
| PK,FK | Defender_ID |

**Defences**

| PK | Name |
|---|---|
| | Hitpoints(INT,Single-valued,NOT NULL) |
| | Damage per second(INT,Single-valued,NOT NULL) |
| | Currency(VARCHAR(20,Single-valued,NOT NULL) |
| | Targets(VARCHAR(20),Single-valued,NOT NULL) |
| | Damage Type(VARCHAR(30),Single-valued,NOT NULL) |
| | Range(INT,Single-valued,NOT NULL) |
| | Upgrade Cost(INT,Single-valued,NOT NULL) |
| | Upgrade Time(TIME,Single-valued) |
| | Build Cost(INT,Single-valued,NOT NULL) |

**Spells**

| PK | Name(VARCHAR(30),Single-valued) |
|---|---|
| | Damage Type(INT,Single-valued,NOT NULL) |
| | Total Damage(INT,Single-valued,NOT NULL) |
| | Targets(VARCHAR(20),Single-valued,NOT NULL) |
| | Housing Space(INT,Single-valued,NOT NULL) |
| | Upgrade Time(TIME,Single-valued,NOT NULL) |
| | Currency(VARCHAR(20),Single-valued,NOT NULL) |
| | Upgrade Cost(INT,Single-valued,NOT NULL) |
| | Brewing Time(Time,Single-valued,NOT NULL) |
| | Spell factory lvl unlock(INT,Single-valued,NOT NULL) |

**Troops**

| PK | Name(VARCHAR(30),Single-valued) |
|---|---|
| | Hitpoints(INT,Single-valued,NOT NULL) |
| | Damage per sec(INT,Single-valued,NOT NULL) |
| | Training Time(TIME,Single-valued,NOT NULL) |
| | Damage Type(VARCHAR(30),Single-valued,NOT NULL) |
| | Movement Speed(INT,Single-valued,NOT NULL) |
| | Barrack level unlock(INT,Single-valued,NOT NULL) |
| | Currency(VARCHAR(30),Single-valued,NOT NULL) |
| | Upgrade Time(TIME,Single-valued,NOT NULL) |
| | Upgrade Cost(INT,Single-valued,NOT NULL) |
| | Targets(VARCHAR(20),Single-valued,NOT NULL) |
| | Housing Space(INT,Single-valued,NOT NULL) |

**Buildings**

| PK | Name |
|---|---|
| | Hitpoints(INT,Single-valued,NOT NULL) |
| | Upgrade Time(TIME,Single-valued,NOT NULL) |
| | Build Cost(INT,Single-valued,NOT NULL) |
| | Currency(VARCHAR(20),Single-valued,NOT NULL) |
| | Upgrade Cost(INT,Single-valued,NOT NULL) |

**Troops,Spells and Heroes 'part' of Army composition**

| PK,FK1 | Troop.Name |
|---|---|
| PK,FK2 | Spell.Name |
| PK,FK3 | Hero.Name |
| PK,FK4 | Army.Name |

**Heroes**

| PK | Name(VARCHAR(20),Single-valued) |
|---|---|
| | Hitpoints(INT,Single-valued,NOT NULL) |
| | Damage per second(INT,SIngle-valued,NOT NULL) |
| | Currency(VARCHAR(20),Single-valued,NOT NULL) |
| | Targets(VARCHAR(20),Single-valued,NOT NULL) |
| | Damage Type(VARCHAR(20),Single-valued,NOT NULL) |
| | Regeneration Time(TIME,Single-valued,NOT NULL) |
| | Movement Speed(INT,Single-valued,NOT NULL) |
| | Upgrade Cost(INT,Single-valued,NOT NULL) |
| | Upgrade Time(TIME,Single-valued,NOT NULL) |
| | Unlock Cost(INT,Single-valued,NOT NULL) |
| | Housing Space(INT,Single-valued,NOT NULL) |

**Popular Army Composition**

| PK | Name(VARCHAR(30),Single-valued) |
|---|---|
| | Spells and Count(COMPOSITE(VARCHAR(30),INT),Multi-valued) |
| | Troops and Count(COMPOSITE(VARCHAR(30),INT),Multivalued,NOT NULL) |

## Leagues

| PK | Name(VARCHAR(30),Single-valued) |
|---|---|
| | Upper Limit of trophy range(INT,Single-valued,NOT NULL) |
| | Lower Limit of trophy range(INT,Single-valued,NOT NULL) |

## Player "part of" league

| PK,FK | Name |
|---|---|
| PK,FK | PlayerID |

## Players and their league

| PK,FK | PlayerID(Char(8),Single-valued) |
|---|---|
| FK | League(VARCHAR(30),Single-valued) |

## "Players" Attack Log

| PK,FK | Attacker_ID |
|---|---|
| PK,FK | Defender_ID |

## Player's Achievements

| PK,FK1 | PlayerID |
|---|---|
| PK,FK2 | Achievement |

## Achievements

| PK | Name(VARCHAR(30),Single-valued) |
|---|---|
| FK | PlayerID(CHAR(8),Single-valued) |
| | Status(VARCHAR(3),Single-valued) |

## Player

| PK | PlayerID(Char(8),Single-valued) |
|---|---|
| | Clan Name(VARCHAR(20),Single-valued,NOT NULL) |
| | Username(VARCHAR(20),Single-valued,NOT NULL) |
| | Clan Role(VARCHAR(20),Single-valued,NOT NULL) |
| | Elixir(INT,Single-valued,NOT NULL) |
| | Gold(INT,Single-valued,NOT NULL) |
| | Dark Elixir(INT,Single-valued,NOT NULL) |
| | Gems(INT,Single-valued,NOT NULL) |
| | Trophies(INT,Single-valued,NOT NULL) |
| | XP Level(INT,Single-valued,NOT NULL) |
| | Town-hall Level(INT,Single-valued,NOT NULL) |

## Player "part of" clan

| PK,FK | Clan_ID |
|---|---|
| PK,FK | PlayerID |

## Clan Chat

| PK,FK1 | Clan_ID |
|---|---|
| PK,FK2 | PlayerID |
| | Time(TIME,Single-valued,NOT NULL) |

## Clan

| PK | Clan_ID(CHAR(8),Single-valued) |
|---|---|
| | Name(VARCHAR(30),Single-valued,NOT NULL,UNIQUE) |
| | Trophies(INT,Single-valued,NOT NULL) |
| | No. of members(INT,Single-valued,NOT NULL) |

## Clan War

| PK,FK1 | Clan1_ID |
|---|---|
| PK,FK2 | Clan2_ID |
| | Result(VARCHAR(8),Single-valued,NOT NULL) |

## Defences

| PK | Name |
|---|---|
| | Hitpoints(INT,Single-valued,NOT NULL) |
| | Damage per second(INT,Single-valued,NOT NULL) |
| | Currency(VARCHAR(20,Single-valued,NOT NULL) |
| | Targets(VARCHAR(20),Single-valued,NOT NULL) |
| | Damage Type(VARCHAR(30),Single-valued,NOT NULL) |
| | Range(INT,Single-valued,NOT NULL) |
| | Upgrade Cost(INT,Single-valued,NOT NULL) |
| | Upgrade Time(TIME,Single-valued,NOT NULL) |
| | Build Cost(INT,Single-valued,NOT NULL) |

## Buildings

| PK | Name |
|---|---|
| | Hitpoints(INT,Single-valued,NOT NULL) |
| | Upgrade Time(TIME,Single-valued,NOT NULL) |
| | Build Cost(INT,Single-valued,NOT NULL) |
| | Currency(VARCHAR(20),Single-valued,NOT NULL) |
| | Upgrade Cost(INT,Single-valued,NOT NULL) |

## Spells

| PK | Name(VARCHAR(30),Single-valued) |
|---|---|
| | Damage Type(INT,Single-valued,NOT NULL) |
| | Total Damage(INT,Single-valued,NOT NULL) |
| | Targets(VARCHAR(20),Single-valued,NOT NULL) |
| | Housing Space(INT,Single-valued,NOT NULL) |
| | Upgrade Time(TIME,Single-valued,NOT NULL) |
| | Currency(VARCHAR(20),Single-valued,NOT NULL) |
| | Upgrade Cost(INT,Single-valued,NOT NULL) |
| | Brewing Time(Time,Single-valued,NOT NULL) |
| | Spell factory lvl unlock(INT,Single-valued,NOT NULL) |

## Troops,Spells and Heroes 'part' of Army composition

| PK,FK1 | Troop.Name |
|---|---|
| PK,FK2 | Spell.Name |
| PK,FK3 | Hero.Name |
| PK,FK4 | Army.Name |

## Troops

| PK | Name(VARCHAR(30),Single-valued) |
|---|---|
| | Hitpoints(INT,Single-valued,NOT NULL) |
| | Damage per sec(INT,Single-valued,NOT NULL) |
| | Training Time(TIME,Single-valued,NOT NULL) |
| | Damage Type(VARCHAR(30),Single-valued,NOT NULL) |
| | Movement Speed(INT,Single-valued,NOT NULL) |
| | Barrack level unlock(INT,Single-valued,NOT NULL) |
| | Currency(VARCHAR(30),Single-valued,NOT NULL) |
| | Upgrade Time(TIME,Single-valued,NOT NULL) |
| | Upgrade Cost(INT,Single-valued,NOT NULL) |
| | Targets(VARCHAR(20),Single-valued,NOT NULL) |
| | Housing Space(INT,Single-valued,NOT NULL) |

## Heroes

| PK | Name(VARCHAR(20),Single-valued) |
|---|---|
| | Hitpoints(INT,Single-valued,NOT NULL) |
| | Damage per second(INT,Single-valued,NOT NULL) |
| | Currency(VARCHAR(20),Single-valued,NOT NULL) |
| | Targets(VARCHAR(20),Single-valued,NOT NULL) |
| | Damage Type(VARCHAR(20),Single-valued,NOT NULL) |
| | Regeneration Time(TIME,Single-valued,NOT NULL) |
| | Movement Speed(INT,Single-valued,NOT NULL) |
| | Upgrade Cost(INT,Single-valued,NOT NULL) |
| | Upgrade Time(TIME,Single-valued,NOT NULL) |
| | Unlock Cost(INT,Single-valued,NOT NULL) |
| | Housing Space(INT,Single-valued,NOT NULL) |

## Popular Army Composition

| PK | Name(VARCHAR(30),Single-valued) |
|---|---|

## Spells in Army Compositions

| PK,FK | Spells(VARCHAR(30),Single-valued) |
|---|---|
| PK,FK | Army Composition(VARCHAR(30),Single-valued,NOT NULL) |
| | Count(INT,Single-valued,NOT NULL) |

## Troops in Army Composition

| PK,FK | Troop(VARCHAR(30),Single-valued) |
|---|---|
| PK,FK | Army Composition(VARCHAR(30),Single-valued,NOT NULL) |
| | Count(INT,Single-valued,NOT NULL) |