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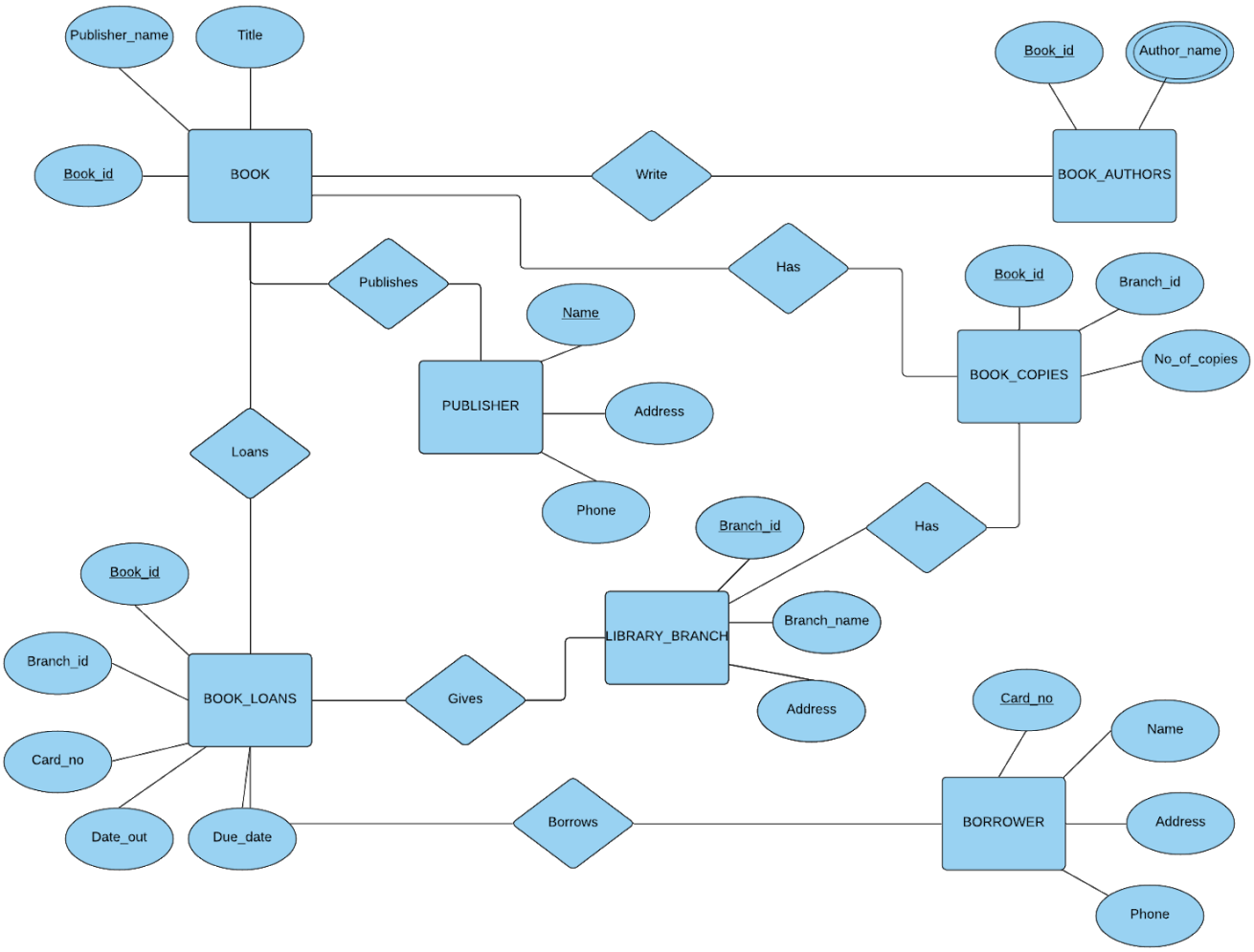
Homework 2

Problems From Elmasri Chapter 9

- Ch 9, #3: *Try to map the relational schema in Figure 6.14 [page 189] into an ER schema. This is part of a process known as reverse engineering, in which a conceptual schema is created for an existing implemented database. State any assumptions you make.*



- Ch 9, #7: *Is it possible to successfully map a binary M:N relationship type without requiring a new relation? Why or why not?*
    - No, it is not possible because we cannot represent an M:N relationship type by a single foreign key attribute in one of the participating relations because of the M:N cardinality ratio. You have to create a separate relationship relation *S.*

Problems From Elmasri Chapter 10

- Ch 10, #3: *Why is it important to design schemas and applications in parallel?*
    - Both activities are intertwined and strongly influence one another. For example, we can identify what date will be stored in the database by analyzing the database application and we will usually specify the database application design by referencing the database schema. If we do not design schemas and applications in parallel, we may have no idea how to design a scheme without knowing the data of the application or have such a rigidly defined database schema that cannot be easily modified at a later time.
- Ch 10, #4: *Why is it important to use an implementation-independent data model during conceptual schema design? What models are used in current design tools? Why?*
    - We want to the schema design to be as unbiased as possible, meaning to keep it as free as possible from implementation considerations that are common in any specific database management system. We use ER or ERR models while designing the schema because it is easy to map these high-level models to the database schema.
- Ch 10, #6: *Consider an actual application of a database system of interest. [NOTE: this means pick one you are familiar with to use for this exercise.] Define the requirements of the different levels of users in terms of data needed, types of queries, and transactions to be processed.*
    - Database: Fortnite
    - Data
        - Players
        - Store items
        - Challenges
        - Game modes
        - Weapons
        - News
    - Queries
        - getPlayerInfo()
        - getStoreItemInfo()
        - getChallengeInfo()
        - getGameModeInfo()
        - getWeaponInfo()
        - getNewsInfo()
    - Transaction
        - Get all the challenges for season 10.

          ```
          SELECT * FROM Challenges
          WHERE Season=10
          ```

Problems From Elmasri Chapter 15

- Ch 15, #5: *What is a functional dependency? What are the possible sources of the information that defines the functional dependencies that hold among the attributes of a relation schema?*
    - A functional dependency is a constraint between two sets of attributes from the database. In terms of the possible sources, for any relation R, attribute Y is *functionally dependent* on or *determined by* attribute X (usually the PK), if for every valid instance of X, that value of X uniquely determines the value of Y.
- Ch 15, #9: *What undesirable dependencies are avoided when a relation is in 2NF?*
    - Things that are avoided are non-fully functioning dependencies, such as *partial dependencies*, which is a situation where a non-prime attribute is functionally dependent on part of a primary key/candidate key.
- Ch 15, #10: *What undesirable dependencies are avoided when a relation is in 3NF?*
    - 3NF eliminates any transitive dependencies, which is when an indirect relationship causes a functional dependency. For example, within a functional dependency $X \rightarrow Y$ in a relational schema R, if X → Z and Z → Y, then X → Y is a transitive dependency.
- Ch 15, #13: *What is a multivalued dependency? When does it arise?*
    - A multivalued dependency is when the existence of one or more rows in a table implies one or more other rows in the same table. If a table has attributes P, Q and R, then Q and R are multi-valued facts of P. It arises when the database is not normalized in 4th normal form.

Problems From Elmasri Chapter 21

- Ch 21, #1: *What is meant by the concurrent execution of database transactions in a multiuser system? Discuss why concurrency control is needed, and give informal examples.*
    - Concurrent execution of database transactions in a multi-user system means that any number of users can use the same database at the same time. Concurrency control is needed in order to avoid inconsistencies in the database, because it allows for simultaneous operations to happen without conflicting with one another. If you have a bank, and simultaneously two people try to withdraw $100 from the same account with *only* $100 in it, concurrency control would mean that only *one* person could withdraw 100$. It can lead to problems such as the Lost Update, Dirty Read, Incorrect Summary, or the Unrepeatable Read problems.
- Ch 21, #6: *Discuss the atomicity, durability, isolation, and consistency preservations properties of a database transaction.*
    - A transaction is an atomic unit of processing–it should either be performed in its entirety or not performed at all. The atomicity property requires that we execute a transaction to completion. If it fails to complete, the recovery techniques must undo any effects of the transaction on the database.
    - The consistency preservation property means that a database program should be written in a way that guarantees that, if the database is in a consistent state before executing the transaction, it will be in that consistent state after the

complete execution of the transaction, assuming no interference with other transactions occurs.
    - The isolation property means that a transaction should appear as though it is being executed in isolation from other transactions, even though many transactions are executing concurrently. The execution of a transaction should not be interfered with by any other transactions executing concurrently. The isolation property is enforced by the concurrency control subsystem.
    - The durability properties means that changes applied to the database by a committed transaction must persist, and cannot be lost due to failure. The durability property is the responsibility of the recovery subsystem of a DBMS.

Problems From Van Bruggen Chapter 4

- Ch 4, #1: *The four fundamental data constructs of Neo4j are [select one and describe each of the items in your selection]*:
    - Node: Used to store entity data.
    - Relationship: Used to connect nodes explicitly, which structures the entities.This is equivalent to an explicitly stored join-like operation in a relational database management system.
    - Property: Name/value pairs that are used to add qualities to nodes and relationships. Nodes and relationships can have zero to many properties.
    - Label: Used to quickly and efficiently create subgraphs by grouping nodes into the same set.
- Ch 4, #3: *If you have a few entities in your dataset that have lots of relationships to other entities, then you can't use a graph database because of the dense node problem.*
    - False – you can very effectively use a graph database, but you should take precautions, for example, applying a fan-out pattern to your data