Course: CSC 460
Assignment: Program 4
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i. Conceptual database design:

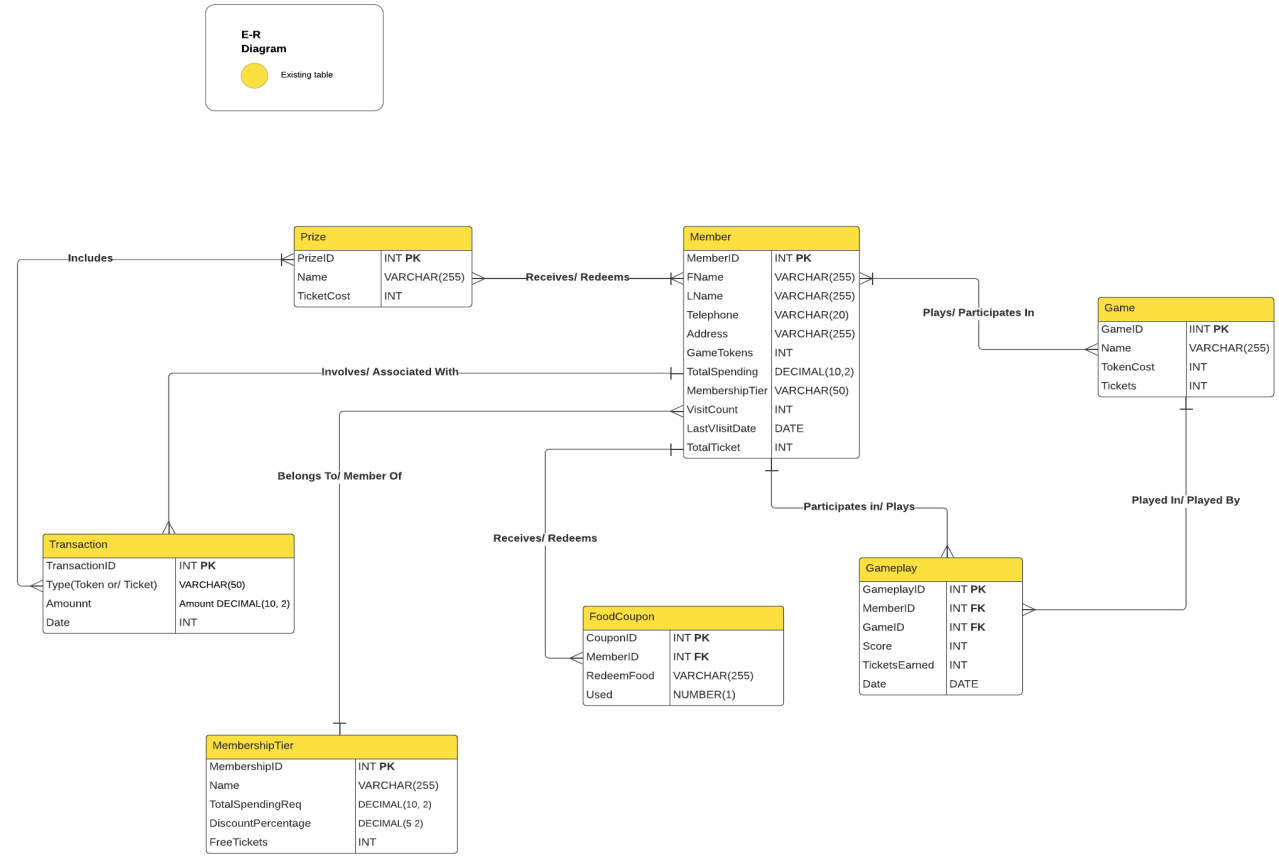
Rationale:

1. **Member Entity**:
    - **Attributes**: Contains essential information about arcade members, including their personal details (first name, last name, telephone number, address), engagement metrics (visit count, last visit date), membership-related data (membership tier, total spending), and in-game resources (game tokens, total tickets). These attributes collectively provide a holistic view of member activity and allow for personalized services and incentives based on member behavior and preferences.
    - **Purpose**: The Member entity serves as the foundation for managing member data, facilitating member engagement, tracking membership progress, and implementing loyalty programs.
2. **Game and Gameplay Entities**:
    - **Game Entity**: Stores details about arcade games, such as their names, token costs, and ticket rewards. This information is crucial for game management, pricing strategies, and assessing game popularity.
    - **Gameplay Entity**: Records individual gameplay instances, linking members to the games they played, the scores achieved, and the tickets earned. This data enables analysis of member gaming behavior, game performance, and ticket distribution.
3. **Prize and FoodCoupon Entities**:
    - **Prize Entity**: Manages the inventory of prizes available for redemption, specifying their names and ticket costs. This supports the arcade's ticket redemption system and enhances member engagement by offering desirable rewards.
    - **FoodCoupon Entity**: Handles food coupons issued to members as incentives, indicating the redeemed food item and the coupon's usage status. Food coupons serve as additional rewards to incentivize member visits and spending.
4. **MembershipTier Entity**:
    - **Attributes**: Defines different membership tiers with associated benefits, including total spending requirements, discount percentages, and free tickets. These attributes incentivize member spending, promote loyalty, and differentiate service levels.

- **Purpose**: The MembershipTier entity facilitates the implementation of a tiered membership system, allowing the arcade to reward loyal members, encourage spending, and provide enhanced benefits based on membership status.

5. **Transaction Entity**:
   - **Attributes**: Records various transactions within the arcade, such as token purchases and ticket redemptions, along with transaction types and amounts. This data facilitates financial tracking, revenue analysis, and auditing.
   - **Purpose**: The Transaction entity supports financial management by tracking revenue streams, monitoring transactional activities, and ensuring transparency in financial transactions.
6. **Relationships**:
   - The established relationships between entities (e.g., Member and Game, Member and Gameplay) capture the interactions and associations between different aspects of arcade operations. These relationships enable data retrieval, analysis, and decision-making by providing insights into member behavior, game performance, and reward distribution.

E-R Diagram:



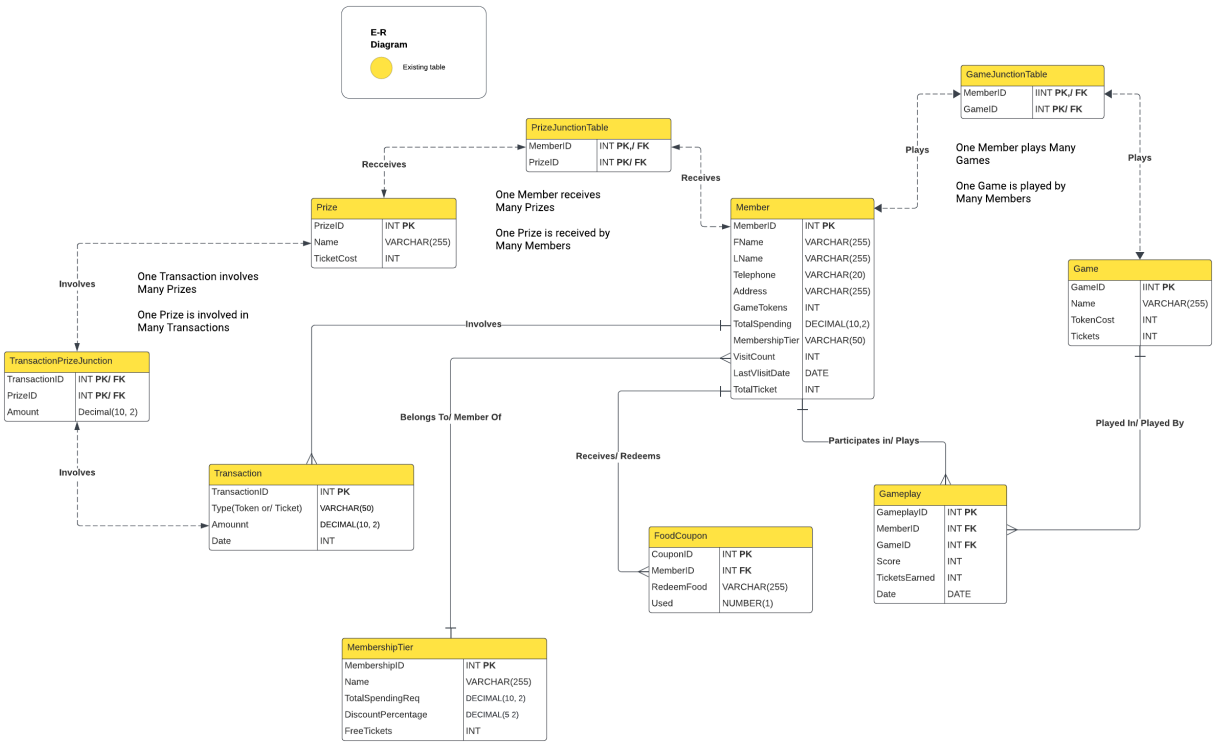
1. **Member Entity**:
    - **Constraints**:
        - MemberID: Primary Key, Unique identifier for each member.
        - TelephoneNum: Should be a valid phone number format.
        - TotalSpending: Should be non-negative.
    - **Additional Details**:
        - GameTokens: Represents the in-game currency available to the member for playing games.
        - VisitCount and LastVisitDate: Used to determine member eligibility for food coupons based on visit frequency.
        - TotalTickets: Indicates the total amount of tickets earned by the member, which can be used to redeem prizes.
2. **Game Entity**:
    - **Constraints**:
        - GameID: Primary Key, Unique identifier for each game.
        - TokenCost: Should be non-negative.
    - **Additional Details**:
        - Tickets: Specifies the number of tickets earned by a member when playing the game based on their score.
3. **Gameplay Entity**:
    - **Constraints**:
        - GameplayID: Primary Key, Unique identifier for each gameplay.
    - **Additional Details**:
        - Score: Represents the gameplay score achieved by the member.
        - TicketsEarned: Indicates the number of tickets earned by the member during the gameplay.
4. **Prize Entity**:
    - **Constraints**:
        - PrizeID: Primary Key, Unique identifier for each prize.
        - TicketCost: Should be non-negative.
    - **Additional Details**:
        - Represents the prizes available for redemption using earned tickets.
5. **FoodCoupon Entity**:
    - **Constraints**:
        - CouponID: Primary Key, Unique identifier for each food coupon.
    - **Additional Details**:
        - RedeemedFood: Specifies the food item redeemed using the coupon.
        - Used: Indicates whether the food coupon has been used or not.
6. **MembershipTier Entity**:
    - **Constraints**:

- MembershipID: Primary Key, Unique identifier for each membership tier.
- TotalSpendingReq: Should be non-negative.

- **Additional Details**:
  - Represents different membership tiers with associated benefits, such as discounts and free tickets.

7. **Transaction Entity**:
   - **Constraints**:
     - TransactionID: Primary Key, Unique identifier for each transaction.
     - Amount: Should be non-negative.
   - **Additional Details**:
     - Records various transactions within the arcade, including token purchases and ticket redemptions.

ii. Logical database design:



- Added junction tables for many-to-many relationships.

iii. Normalization Analysis:

For each entity set (table), let's identify the functional dependencies (FDs) and justify why the table adheres to 3NF (Third Normal Form) or BCNF (Boyce-Codd Normal Form).

Member table:
Functional dependencies:

- MemberID -> Fname, Lname, TelephoneNum, Address, GameTokens, TotalSpending, MembershipTier, VisitCount, LastVisitDate, TotalTickets
- LastVisitDate, VisitCount -> RedeemedFood (assuming a food coupon is redeemed based on the last visit date and visit count)
- TotalTickets -> PrizeID (assuming a member's total tickets are used to buy prizes)

Justification:

- The Member table satisfies 3NF because it does not contain any transitive dependencies. All non-prime attributes are fully functionally dependent on the primary key MemberID.

Game table:
Functional dependencies:

- GameID -> Name, TokenCost, Tickets

Justification:

- The Game table satisfies BCNF because there are no non-trivial functional dependencies where the determinant is not a superkey. The primary key GameID uniquely determines all other attributes.

Gameplay table:
Functional dependencies:

- GameplayID -> MemberID, GameID, Score, TicketsEarned
- MemberID, GameID -> Date

Justification:

- The Gameplay table satisfies BCNF because all attributes are fully functionally dependent on the primary key GameplayID.

Prize table:
Functional dependencies:

- PrizeID -> Name, TicketCost

Justification:

- The Prize table satisfies BCNF because all attributes are fully functionally dependent on the primary key PrizeID.

FoodCoupon table:

Functional dependencies:

- CouponID -> MemberID, RedeemedFood, Used

Justification:

- The FoodCoupon table satisfies BCNF because all attributes are fully functionally dependent on the primary key CouponID.

MembershipTier table:

Functional dependencies:

- MembershipID -> Name, TotalSpendingReq, DiscountPercentage, FreeTickets

Justification:

- The MembershipTier table satisfies BCNF because all attributes are fully functionally dependent on the primary key MembershipID.

Transaction table:

Functional dependencies:

- TransactionID -> Type, Amount, Date

Justification:

- The Transaction table satisfies BCNF because all attributes are fully functionally dependent on the primary key TransactionID.

iv. Query Description:

The self-designed query, queryD, is designed to answer the question: "What is the total number of tickets earned by each member for a specific game?" Utilities include:

- **Performance Evaluation:** By retrieving the total number of tickets earned by each member for a specific game, arcade management can evaluate the performance of different games in terms of member engagement. This information can help in assessing the popularity and profitability of various games.
- **Member Engagement Analysis:** Understanding how many tickets each member has earned for a particular game provides insights into member engagement levels. It allows the arcade to identify loyal members who frequently participate in specific games and tailor marketing strategies or rewards programs to incentivize continued engagement.

- **Game Optimization:** By analyzing the total tickets earned for each game, the arcade can identify which games are most successful in attracting member participation. This insight can guide decisions on game placement, maintenance, or potential updates to enhance the overall gaming experience and revenue generation.
- **Strategic Decision-Making:** The query results can inform strategic decisions related to game selection, promotions, and resource allocation. For example, if a particular game consistently generates high ticket earnings, the arcade may choose to allocate more resources towards its maintenance or introduce targeted promotions to further boost member participation.

By including the queryD in the system provides valuable data-driven insights that empower arcade management to make informed decisions aimed at enhancing member satisfaction, optimizing game offerings, and maximizing revenue.