Entity

Attribute

Relationship

Entity

TP03

Scenario: Public Library Management System (PLMS)

The Public Library System operates across several branches in a metropolitan region, with each branch having a unique branch ID, name, address (including street, city, and postal code), and a branch manager. Each library holds a diverse collection of physical and digital items, including books, magazines, DVDs, e-books, and audiobooks. Every item in the library catalog is assigned a unique item ID and classified by type, genre, publication year, and language. Physical items also have specific shelf locations and status indicators (available, checked out, lost, reserved, under repair), whereas digital items are accessed through the online portal and are not physically located in branches.

Members of the library system may register at any branch. Upon registration, a member receives a unique membership number, and their profile includes name, date of birth, phone number, email, home address, and a record of their registration date and preferred branch. Members can borrow items according to borrowing rules based on the item type: for example, books and DVDs may be borrowed for 14 days, while magazines for 7, and digital items vary based on license agreements. Each borrow transaction includes the item ID, member ID, branch, checkout date, and due date. When returned, the system records the return date and condition (especially for physical items). Overdue items incur fines calculated per day overdue, and these fines are tracked until paid.

Library employees are assigned to one branch and may have roles such as librarian, assistant, archivist, technician, or administrator. Employee records include employee ID, name, contact info, date hired, role, and assigned branch. One employee per branch is designated as the branch manager. Employees are also responsible for adding new items to the catalog, processing borrow/return transactions, and managing member records. Specific employees handle digital licensing and vendor management for digital collections.

Members can place holds or reservations on items currently checked out, which generates a hold record noting the item ID, member ID, date requested, and current status (waiting, ready for pickup, or cancelled). Holds are prioritized on a first-come, first-served basis. If the item is not picked up within a set period, the hold expires and is offered to the next person in the queue.

The library also hosts various programs, such as reading clubs, author talks, or coding workshops. Events have an event ID, title, description, date and time, target audience (e.g., children, teens, adults), and are associated with a specific branch. Members can register for events, and the system tracks attendance history.

Finally, monthly system reports summarize item circulation statistics, overdue trends, most borrowed genres, event participation, and digital access logs. The system also tracks acquisition history for each item, including vendor, purchase date, and cost. The library may collaborate with schools or community organizations through special access agreements, which include start/end dates and permitted services.

What you should do by using “Relational Algebra”

- Step 1: Draw Entity Relationship Diagram

- Step 2:

1. Prove or explain why they are equivalent.
2. Rewrite complex queries into simpler or optimized versions.

   Question:

   1) Find the names of members who registered at the 'Central' branch.
   2) Get the titles of all items that are currently checked out.
   3) Retrieve the IDs of items that are both DVDs and in English.
   4) List names of members who borrowed items from the 'West' branch.
   5) Get IDs of items that were borrowed and not yet returned.