

# ***Library Management System***

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## 1 Project Description

This program is a library management system. Initially, libraries were solely for storing collections of books, providing space for reading them, and loaning them out. Because of this, the library system's main functions would be to help manage and facilitate these collections for easier access, and to keep track of and facilitate the loaning transactions. Many libraries have expanded beyond just books and loaning services, and many have become study spaces, research centers, free internet sources, maker spaces, or general community hubs; So the systems that support these libraries should also expand to help facilitate these new library operations.

A modern library system should be able to, not only search for and rent out books, but also request books that are out of circulation, make new events, make appointments with librarians, rent out quiet study spaces, and request the use of equipment like printers or scanners. Being able to do as many of the above operations remotely is also an important function that allows the library to be more than just a building, but also helps users to access library resources from their homes. Many people go to libraries for a specific purpose, and if, for example, one can determine before visiting, whether a book is in circulation at a specific library, it prevents unnecessary visits and helps provide information in a more distributed and systematic method.

Related to the above point, many library systems don't take full advantage of the interconnectedness that a digital system offers. As an example, the presentation of a book to a user could be constructed such that the specific different editions are represented by different versions of a single parent object, similar to the way that a single Amazon product can have multiple variations, all in the same page and easily viewable. This makes it easier for users to track the history of the piece of media. This is just one example of how centralizing data can help a user navigate the complexity of book systems and understand the relationships between the different entities (something that relational databases are specifically good at, especially regarding modern library models like BIBFRAME or FRBR). Another example might be to digitize each book's works cited page to facilitate easy reference checking by just clicking a single link, which is traditionally hard to do with physical books since readers have to check the page, remember the name of the work cited, and then go find that book. This project aims to help manage this process, by structuring the large collections of media in a way that makes their interconnectedness more intuitive to navigate, while also supporting the new features that a modern library might have.

## 2 Use Cases

### 2.1 Use Case #1: Renting Books

Actors: Joe (member), Belmont Public Library (library)
Joe is a resident in the Belmont neighborhood, and frequently visits the Belmont public library. He often browses the catalog on the library computers and decides on which books to read based on how interesting their titles are. He sometimes borrows books to take home with him when he leaves. He is sometimes stressed because he needs to return the books, but hasn't read them all the way through.
Joe can use the system from the comfort of his home, to request an extension of his book rental, giving him more time to finish it before needing to return. He discovers he can also look up books on the system remotely as well, which will help streamline his browsing process. He also sees that his account shows his borrowing history, so he can easily remember which books he's rented in the past if he wants to borrow them again in the future. He sees a couple books he remembers liking a while ago that are being rented by someone else, and requests the library to reserve them for him once they've been returned.

### 2.2 Use Case #2: Using Printers

Actors: Angel (CSM student), College of San Mateo Library (library), Jesse (librarian)
Angel uses the 3D printer at the CSM Library. He remotely sends the appropriate files to the system which redirects the request to Jesse, the librarian. Jesse receives the files, and then sends them to the 3D printer to be printed. When Angel comes to pick up the project, He uses his card to confirm the pickup. Angel then decides to use the library printer to print some documents related to the printed project. He is confused because the system doesn't directly connect to the printer but instead has a print queue system that requires him to associate his print job with his account.
When Angel adds his print job to the queue, the system asks him for his information, which he provides. He then goes to the computer dedicated to the print station, and confirms with his information once again, that he is ready for the print job to be printed and picked up. The computer also notifies him that he has used a certain amount of free printing credit and tells him how much he has left associated with his library card.

### 2.3 Use Case #3: Organizing & Attending Library Events

Actors: Lester (member), Connor (child member), Petra (staff), Belmont Public Library (library)
Petra is a librarian who is organizing a new book club. Since it's a local event, she wants to make the event only visible to the Belmont Library event list and not the entire system.

Lester drops off his son, Connor, at the Belmont Public Library every Saturday after lunch. Connor hears about, and wants to attend the book club, but he is unable to because he is a minor and needs his guardian to do so for him.

Petra can use the library calendar to easily view events and see the reservations of different library room/equipment. Using this, she can schedule the book club at a good time and space. Lester can remotely sign Connor up for the event, allowing him to participate in the new book club. Petra can easily review the information and confirm Connor's registration for the event, allowing him to attend.

#### 2.4 Use Case #4: Adding Books to Library

Actors: Javier (librarian), Belmont Public Library (library)

Javier is a librarian at the Belmont Public Library. A set of books is being delivered for the library. Javier wants to sign off on the delivery and record each of the new books into the library's catalog. The new digital system can be hard for him to understand as someone less technologically immersed, and Javier is afraid that the process will be tedious and complicated. Javier decides to look at the returned books and scan them to confirm that they're returned as a warm-up since that'll be easier to do.

The scanned data is used to do a system search through the list of book rentals. Since the system has a newer data model, the data on the books is abstracted in a way that makes the user interface both fast and easy to understand for Javier. He can relate the metadata items to what he knows of bibliographic book data and get the cataloging process under way. Since some of the books are newer editions of already owned copies, they can be added as different instances of the same work without having to create new work entries. These small efficiencies help Javier stay motivated throughout the process and keep him from getting frustrated with the system.

#### 2.5 Use Case #5: Renting Library Spaces & Reserving Equipment

Actors: Janice (student), Charlotte (member), San Carlos Library (library), Study Room D (library space)

Janice wants to set up a study session with her classmates, but nobody lives in a quiet place, and they all value privacy during their studies. She sees that the local San Carlos Library has study spaces available for people to reserve. Currently, only Study Room D is available for the day she needs. It tells her how short/long in advance she can book the room, as well as for how long. Janice is concerned that the time available might not be enough, and she doesn't know if she can make it to the library in time for the booked slot, given her schedule. She is



also concerned because the system informs her that the library can cancel the reservation at any time if a higher priority event calls for it.

In the same notification, the system also informs her that students are an example of such priority holding members. She adds her student information to her library account, which allows her to see a wider range of booking options, and she books the room at a more comfortable time. When the booking is approved, the system informs Charlotte, who'd previously had Room D booked for her friend group's knitting session, that her reservation has been cancelled, and the system offers her some alternative booking options. She decides to just hold the session on the following day which has available booking options. After doing so, she notices that the library's sewing machine is open for booking that day as well, so she excitedly reserves it in anticipation for the meeting.

## 2.6 Use Case #6: Getting a Card & Searching for Media

Actors: Milton (guest), Brynn (librarian), Belmont Public Library (library)

Milton is visiting many libraries for a research project. Since he is not a registered user at the Belmont Public Library, he needs to register for a card. He submits a form, with his information, especially his address so that he can be verified as a resident of one of the system's associated regions. Brynn, processes the form, and Milton is mailed his library card.

Brynn has knowledge of the research topic. She can search the library's different floors, rooms, and shelves by subject to suggest Milton where to begin looking. Using the system, Milton can also filter search with many different keywords relating to an item's metadata such as subject, media format, author, publisher, date, language, length, and location. This way he can also access items in other libraries from the same system.

## 3 Database Requirements

### 3.1 Library

- 1.1 A library can have many memberships.
- 1.2 A library can have many equipment.
- 1.3 A library can have many floors.
- 1.4 A library can employ many staff.
- 1.5 A library can observe/host many library events.
- 1.6 A library can be located in at most one region.

### 3.2 Person

- 2.1 A person can create many memberships.
- 2.2 A person can complete many forms.
- 2.3 A person can attend many organized events.
- 2.4 A person can be located in at most one region.
- 2.5 A person can be many students.
- 2.6 A person can have many children.

### 3.3 Child

- 3.1 A child has at least one associated person (legal guardian).

### 3.4 Membership

- 4.1 A membership is created by one person.
- 4.2 A membership belongs to one library.
- 4.3 A member can borrow many physical items.
- 4.4 A member can reserve many physical items.
- 4.5 A member can reserve many equipment.
- 4.6 A member can reserve many reservable rooms.
- 4.7 A member can send print jobs to many printers.
- 4.8 A member can be a student.

### 3.5 Staff

- 5.1 A staff works for at most one library.
- 5.2 A staff can organize many organized events.
- 5.3 A staff can create many forms.
- 5.4 A staff processes many completed forms.
- 5.5 A staff can be a librarian.

### 3.6 Librarian

- 6.1 A librarian is a staff.
- 6.2 A librarian catalogs many items.

### 3.7 Form

- 7.1 A form is created by one staff.
- 7.2 A form can get completed by at least one person.

### 3.8 Complete Form

- 8.1 A complete form was completed by one person.
- 8.2 A complete form is an instance of one form.
- 8.3 A complete form can get processed by one staff.

### 3.9 Work

- 9.1 A work can reference many other works.
- 9.2 A work can have many instances.
- 9.3 A work can be contributed by many agents.
- 9.4 A work can discuss many subjects.
- 9.5 A work can describe many events.

### 3.10 Instance

- 10.1 An instance is an instance of at most one work.
- 10.2 An instance can reference many other instances.
- 10.3 An instance can be embodied by many items.
- 10.4 An instance can be issued by many publishers.
- 10.5 An instance can be mediated by many formats.

### 3.11 Item

- 11.1 An item embodies one instance.
- 11.2 An item can be a physical item.
- 11.3 An item can be a digital item.
- 11.4 An item is cataloged by one librarian.
- 11.5 An item is supplied by one vendor.

### 3.12 Digital Item

- 12.1 A digital item is an item.
- 12.2 A digital item can be an e-book.
- 12.3 A digital item can be an image.

### 3.13 Physical Item

- 13.1 A physical item is an item.
- 13.2 A physical item can be a book.
- 13.3 A physical item can be a DVD.
- 13.4 A physical item belongs to at most one shelf.
- 13.5 A physical item can be borrowed by many members.
- 13.6 A physical item can be reserved by many members.

### 3.14 Book

14.1 A book is a physical item.

### 3.15 DVD

15.1 A DVD is a physical item.

### 3.16 E-Book

16.1 An e-book is a digital item.

### 3.17 Image

17.1 An image is a digital item.

### 3.18 Floor

18.1 A floor belongs to one library.

18.2 A floor has at least one room.

### 3.19 Room

19.1 A room belongs to one floor.

19.2 A room can be a bookstack.

19.3 A room can be a reservable room.

### 3.20 Reservable Room

20.1 A reservable room is a room.

20.2 A reservable room can be reserved by at least one member.

### 3.21 Bookstack

21.1 A bookstack is a room.

21.2 A bookstack has at least one shelf.

### 3.22 Shelf

22.1 A shelf can belong to at most one bookstack.

22.2 A shelf can have many physical items.

### 3.23 Library Event

23.1 A library event can be observed/hosted by many libraries.

23.2 A library event can be an organized event.

### 3.24 Organized Event

24.1 An organized event is a library event.

24.2 An organized event is created/organized by one staff.

24.3 An organized event can be attended by at least one person.

### 3.25 Equipment

25.1 An equipment belongs to one library.

25.2 An equipment can be a computer.

25.3 An equipment can be a printer.

25.4 An equipment can be reserved by many members.

25.5 An equipment is supplied by one vendor.

### 3.26 Computer

26.1 A computer is an equipment.

### 3.27 Printer

27.1 A printer is an equipment.

27.2 A printer can accept jobs from many members.

### 3.28 Subject

28.1 A subject can be discussed by many works.

28.2 A subject can have many sub-topics.

### 3.29 Agent

29.1 An agent can contribute to many works.

### 3.30 Event

30.1 An event can be described by many works.

30.2 An event is located in at most one region.

### 3.31 Publisher

31.1 A publisher can issue many instances.

31.2 A publisher can be located in at most one region.

### 3.32 Format

32.1 A format can mediate many instances.

32.2 A format can contain many languages.

### 3.33 Language

33.1 A language can be used in many formats.

33.2 A language can be primarily used in many regions.

### 3.34 Vendor

34.1 A vendor supplies many items.

34.2 A vendor supplies many equipment.

34.3 A vendor is located in at most one region.

### 3.35 Student

35.1 A student can be one person.

35.2 A student is a member.

35.3 A student can belong to one school.

### 3.36 School

36.1 A school can enroll many students.

36.2 A school can have at most one library.

### 3.37 Region

- 37.1 A region can contain many persons.
- 37.2 A region can contain many libraries.
- 37.3 A region can contain many vendors.
- 37.4 A region can contain many publishers.
- 37.5 A region can contain many events.
- 37.6 A region primarily uses at most one language.

## 4 Entity Descriptions

### 4.1 Library (strong)

- 1.1 library\_id: key, numeric
- 1.2 name: alphanumeric
- 1.3 region\_fk: fk, numeric

### 4.2 Person (strong)

- 2.1 person\_id: key, numeric
- 2.2 name: alphanumeric, composite
- 2.3 email: alphanumeric
- 2.4 age: numeric
- 2.5 region\_fk: fk, numeric

### 4.3 Child (weak)

- 3.1 person\_fk: fk, numeric
- 3.2 name: alphanumeric, composite
- 3.3 email: alphanumeric
- 3.4 region\_fk: fk, numeric
- 3.5 guardian\_fk: fk, numeric (recursive)

### 4.4 Parent (weak)

- 4.1 person\_fk: fk, numeric
- 4.2 name: alphanumeric, composite
- 4.3 email: alphanumeric
- 4.4 region\_fk: fk, numeric

### 4.5 Membership (weak)

- 5.1 member\_id: key, numeric
- 5.2 person\_fk: fk, numeric
- 5.3 library\_fk: fk, numeric

### 4.6 Staff (strong)

- 6.1 staff\_id: key, numeric
- 6.2 name: alphanumeric, composite
- 6.3 library\_fk: fk, numeric

### 4.7 Librarian (weak)

- 7.1 staff\_id: key, numeric
- 7.2 librarian\_id: key, numeric
- 7.3 name: alphanumeric, composite
- 7.4 library\_fk: fk, numeric

#### 4.8 Form (weak)

- 8.1 form\_id: key, numeric
- 8.2 description: alphanumeric
- 8.3 creator\_fk: fk, numeric

#### 4.9 Complete Form (weak)

- 9.1 processing\_id: key, numeric
- 9.2 person\_fk: fk, numeric
- 9.3 form\_fk: fk, numeric
- 9.4 staff\_fk: fk, numeric

#### 4.10 Work (strong)

- 10.1 work\_id: key, numeric
- 10.2 title: alphanumeric
- 10.3 location: composite
- 10.4 date: composite, numeric

#### 4.11 Instance (strong)

- 11.1 instance\_id: key, numeric
- 11.2 title: alphanumeric (can be used for edition/revision)
- 11.3 date: numeric, composite
- 11.4 work\_fk: fk, numeric

#### 4.12 Item (weak)

- 12.1 item\_id: key, numeric
- 12.2 title: alphanumeric
- 12.3 instance\_fk: fk, numeric

#### 4.13 Digital Item (weak)

- 13.1 item\_id: key, numeric
- 13.2 title: alphanumeric
- 13.3 date: numeric, composite
- 13.4 instance\_fk: fk, numeric

#### 4.14 Physical Item (weak)

- 14.1 item\_id: key, numeric
- 14.2 title: alphanumeric
- 14.3 date: numeric, composite
- 14.4 instance\_fk: fk, numeric
- 14.5 barcode: alphanumeric
- 14.6 shelf\_fk: fk, alphanumeric
- 14.7 borrower\_fk: fk, numeric



#### 4.15 Book (weak)

- 15.1 ISBN: key, numeric
- 15.2 item\_id: key, numeric
- 15.3 title: alphanumeric
- 15.4 instance\_fk: fk, numeric
- 15.5 barcode: alphanumeric
- 15.6 shelf\_fk: fk, alphanumeric
- 15.7 borrower\_fk: fk, numeric

#### 4.16 DVD (weak)

- 16.1 dvd\_id: key, numeric
- 16.2 item\_id: key, numeric
- 16.3 title: alphanumeric
- 16.4 instance\_fk: fk, numeric
- 16.5 barcode: alphanumeric
- 16.6 shelf\_fk: fk, alphanumeric
- 16.7 borrower\_fk: fk, numeric

#### 4.17 E-Book (weak)

- 17.1 ISBN: key, numeric
- 17.2 item\_id: key, numeric
- 17.3 title: alphanumeric
- 17.4 instance\_fk: fk, numeric

#### 4.18 Image (weak)

- 18.1 image\_id: key, numeric
- 18.2 item\_id: key, numeric
- 18.3 title: alphanumeric
- 18.4 instance\_fk: fk, numeric

#### 4.19 Item Reservation (weak)

- 19.1 i\_reservation\_id: key, numeric
- 19.2 item\_fk: fk, numeric
- 19.3 member\_fk: fk, numeric
- 19.4 start: timestamp
- 19.5 duration: numeric

#### 4.20 Floor (weak)

- 20.1 floor\_id: key, numeric
- 20.2 name: alphanumeric
- 20.3 library\_fk: fk, numeric

#### 4.21 Room (weak)

- 21.1 room\_id: key, numeric
- 21.2 name: alphanumeric
- 21.3 floor\_fk: fk, numeric

#### 4.22 Reservable Room (weak)

- 22.1 room\_id: key, fk, numeric
- 22.2 name: alphanumeric
- 22.3 floor\_fk: fk, numeric
- 22.4 current\_reserver: fk, numeric

#### 4.23 Room Reservation (weak)

- 23.1 r\_reservation\_id: key, numeric
- 23.2 room\_fk: fk, numeric
- 23.3 member\_fk: fk, numeric
- 23.4 start: timestamp
- 23.5 duration: numeric

#### 4.24 Bookstack (weak)

- 24.1 room\_id: key, numeric
- 24.2 name: alphanumeric
- 24.3 floor\_fk: fk, numeric

#### 4.25 Shelf (strong)

- 25.1 shelf\_id: key, alphanumeric
- 25.2 name: alphanumeric (can be tables/displays too)
- 25.3 bookstack\_fk: fk, alphanumeric

#### 4.26 Library Event (strong)

- 26.1 lib\_event\_id: key, numeric
- 26.2 name: alphanumeric
- 26.3 start: timestamp
- 26.4 duration: numeric

#### 4.27 Calendar Event (weak)

- 27.1 cal\_event\_id: key, numeric
- 27.2 lib\_event\_fk: fk, numeric
- 27.3 library\_fk: fk, numeric

#### 4.28 Organized Event (weak)

- 28.1 org\_event\_id: key, numeric
- 28.2 lib\_event\_fk: fk, numeric

- 28.3 name: alphanumeric
- 28.4 start: timestamp
- 28.5 duration: numeric
- 28.6 organizer\_fk: fk, numeric
- 28.7 room\_fk: fk, numeric

#### 4.29 Attendance (weak)

- 29.1 attendance\_id: key, numeric
- 29.2 attendee\_fk: fk, numeric
- 29.3 org\_event\_fk: fk, numeric

#### 4.30 Equipment (weak)

- 30.1 equipment\_id: key, numeric
- 30.2 model: alphanumeric
- 30.3 serial\_num: alphanumeric
- 30.4 supplier\_fk: fk, numeric

#### 4.31 Equipment Reservation (weak)

- 31.1 e\_reservation\_id: key, numeric
- 31.2 equipment\_fk: fk, numeric
- 31.3 member\_fk: fk, numeric
- 31.4 start: timestamp
- 31.5 duration: numeric

#### 4.32 Computer (weak)

- 32.1 computer\_id: key, numeric
- 32.2 equipment\_fk: fk, numeric
- 32.3 model: alphanumeric
- 32.4 serial\_num: alphanumeric
- 32.5 supplier\_fk: fk, numeric
- 32.6 OS: alphanumeric

#### 4.33 Printer (weak)

- 33.1 printer\_id: key, numeric
- 33.2 equipment\_fk: fk, numeric
- 33.3 model: alphanumeric
- 33.4 serial\_num: alphanumeric
- 33.5 supplier\_fk: fk, numeric
- 33.6 type: numeric (colormode, laser, ink, 3D)

#### 4.34 Print Job (weak)

- 34.1 printjob\_id: key, numeric

- 34.2 printer\_fk: fk, numeric
- 34.3 member\_fk: fk, numeric
- 34.4 type: numeric (colormode, laser, ink, 3D)

#### 4.35 Subject (strong)

- 35.1 subject\_id: key, numeric
- 35.2 description: alphanumeric
- 35.3 overarching\_subject\_id: key, numeric (recursive?)

#### 4.36 Discussion (weak)

- 36.1 discussion\_id: key, numeric
- 36.2 subject\_fk: fk, numeric
- 36.3 work\_fk: fk, numeric

#### 4.37 Agent (strong)

- 37.1 agent\_id: key, numeric
- 37.2 name: alphanumeric, composite
- 37.3 description: alphanumeric
- 37.4 organization\_id: numeric (recursive?)

#### 4.38 Contribution (weak)

- 38.1 contribution\_id: key, numeric
- 38.2 agent\_fk: fk, numeric
- 38.3 work\_fk: fk, numeric
- 38.4 role: alphanumeric (author, creator, illustrator, etc.)

#### 4.39 Event (strong)

- 39.1 event\_id: key, numeric
- 39.2 description: alphanumeric
- 39.3 date: timestamp
- 39.4 location\_fk: fk, numeric

#### 4.40 Description (weak)

- 40.1 description\_id: key, numeric
- 40.2 event\_fk: fk, numeric
- 40.3 work\_fk: fk, numeric

#### 4.41 Publisher (strong)

- 41.1 publisher\_id: key, numeric
- 41.2 name: alphanumeric
- 41.3 region\_fk: fk, numeric

#### 4.42 Issue (weak)

- 42.1 issue\_id: key, numeric
- 42.2 publisher\_fk: fk, numeric
- 42.3 instance\_fk: fk, numeric
- 42.4 revision: numeric

#### 4.43 Format (strong)

- 43.1 format\_id: key, numeric
- 43.2 description: alphanumeric
- 43.3 language\_fk: fk, numeric

#### 4.44 Media (weak)

- 44.1 media\_id: key, numeric
- 44.2 format\_fk: fk, numeric
- 44.3 instance\_fk: fk, numeric

#### 4.45 Language (strong)

- 45.1 language\_id: key, numeric
- 45.2 name: alphanumeric
- 45.3 encoding\_type: numeric

#### 4.46 Text (weak)

- 46.1 text\_id: key, numeric
- 46.2 format\_fk: fk, numeric
- 46.3 language\_fk: fk, numeric

#### 4.47 Vendor (strong)

- 47.1 vendor\_id: key, numeric
- 47.2 name: alphanumeric
- 47.3 type: numeric (equipment, item, distribution, manufacture, etc.)
- 47.4 region\_fk: fk, numeric

#### 4.48 School (strong)

- 48.1 school\_id: key, numeric
- 48.2 region\_fk: fk, numeric
- 48.3 type: alphanumeric (university, high school, middle school)

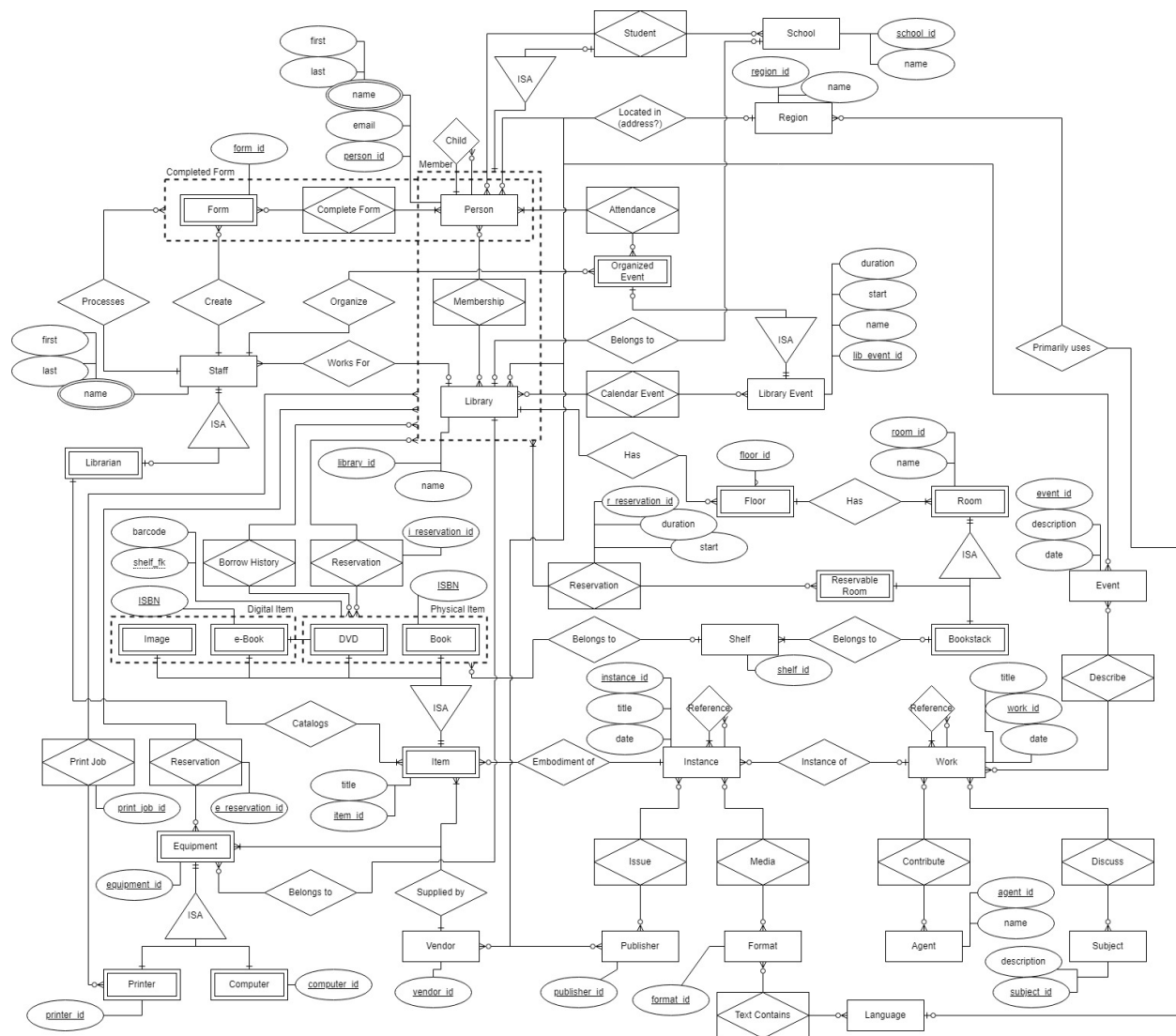
#### 4.49 Student (weak)

- 49.1 member\_id:fk, numeric
- 49.2 student\_id: key, alphanumeric
- 49.3 name: alphanumeric, composite
- 49.4 school\_fk: fk, numeric

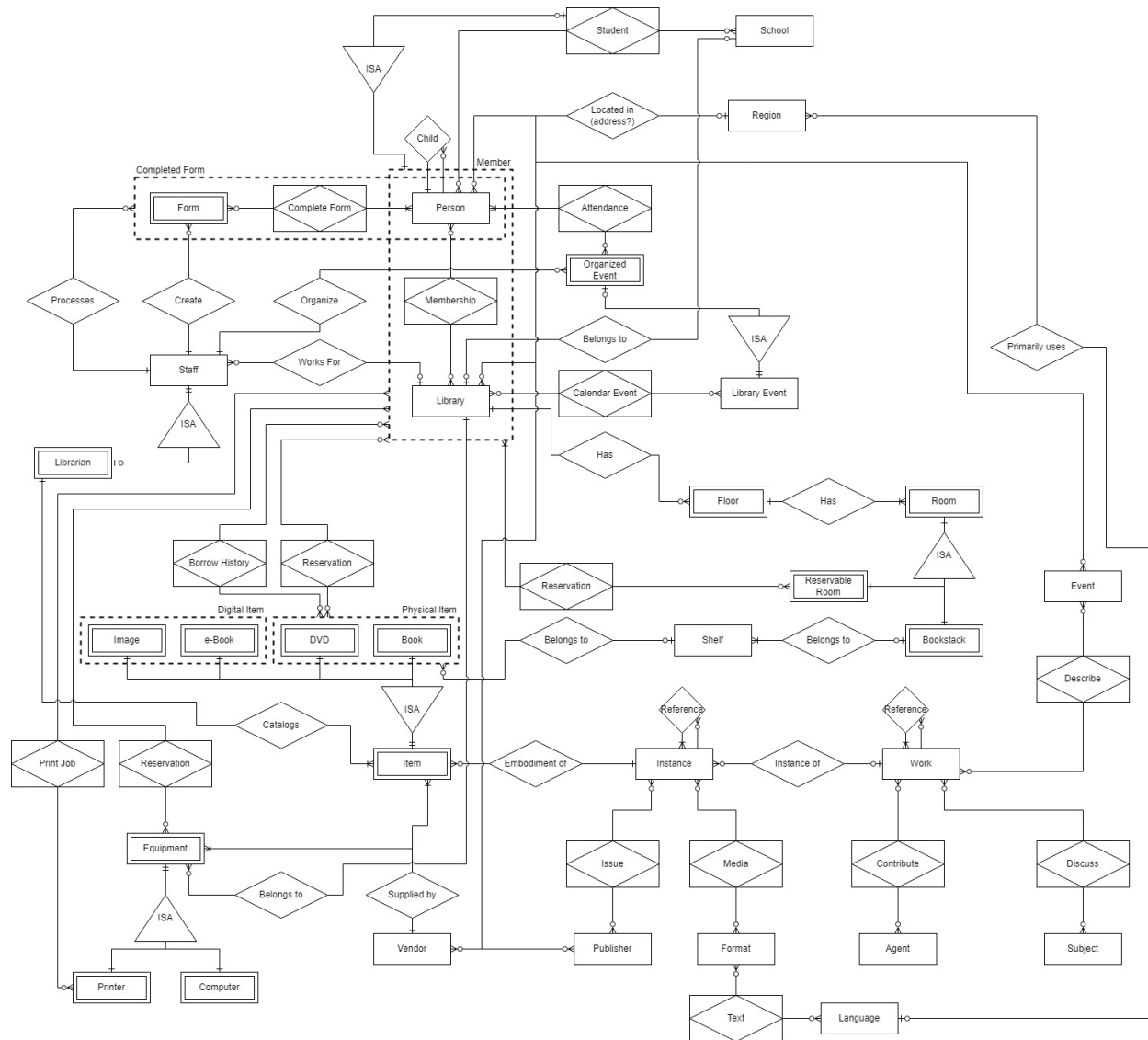
#### 4.50 Region (strong)

50.3 language\_fk: fk, numeric

### 5.1 With Attributes:



## 5.2 Without Attributes



## 6 Referenced Materials

<https://www.loc.gov/catworkshop/bibframe/BIBFRAME-PublicManual.pdf>

[https://en.wikipedia.org/wiki/Functional\\_Requirements\\_for\\_Bibliographic\\_Records](https://en.wikipedia.org/wiki/Functional_Requirements_for_Bibliographic_Records)