

Ulices Gonzalez

Public Library Catalog System

Student ID: 923328897

Github User: ulicessgg

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Project Description

As both a student and someone who feels strongly about the accessibility of information I believe that libraries are invaluable resources that can help educate us and provide us with various resources that can make a difference in our lives. I am a library worker and have been working at my local library for the past 3 years and over time I've seen the impact the resources we've provided the community has made. Having had experience for such a long time with my local library system I've seen the capabilities and the limitations the library can have which is why I intend to create a database that can address these. With any publicly available resource, there come issues when it grows in scale, specifically with the library it can lead to the mismanagement of items and user information that can negatively impact both the library and patrons alike. The most common issue I've seen is items appearing on patrons' accounts even after they've been checked in, deleted, and sometimes even paid for if they were fined. This leads to many difficult conversations and has led to these patrons no longer using the library. The unfortunate aspect is that it affects low-income patrons, teachers, and mostly children granted their library cards.

To address these issues I'd like to design my database to diversify the types of accounts available to users, rather than having a singular account classification. There should be many depending on the situation. Currently, many libraries offer welcome cards available to any Patron so long as they can provide contact information but have limitations placed on them for the same reason that they lack other information that can verify their identity if and when they need to be contacted. I am similarly adapting this by having specific types of accounts based on age, use, institutional affiliation, and personal circumstances. This will be a vast improvement upon the pre-existing Library systems Foundation-wide since most children will have the same

accessibility as adults and even institutional cards for teachers even though they should have limitations based on them to protect them and their families from having to pay needless fines. Personal circumstances can also be a factor in the way people use libraries because not everyone will have a stable housing situation or the means to come to the library physically which by having as a consideration will increase the accessibility of library resources. By creating this database in the manner described it can then be adapted to any County library system meaning that interlibrary loans will be much easier to manage and will make it possible for patrons to check out and return materials regardless of their registration within that County so long as they have some form of library affiliation.

As of right now, the two most commonly used services within Library systems are Carl X for internal transactions and Millennium which is now being phased out by Sierra for external transactions. Due to these Services being split up, it can cause various issues when it comes to interlibrary loans from one County to another leading to patrons being fined massive amounts for something that is potentially an error due to the software. The other issue is that because these software Solutions rely on Library systems having an already established database they often carry over outdated information which can sometimes result in decades-old transactions still appearing on someone's account. Using my database will allow software solutions such as Sierra and Carl X to work together seamlessly without any information you need to input manually or any conflicts due to potential differences in classifications and data fields.

Lastly, when thinking of use cases for the database the following three were the ones I had in mind to effectively display the use of the database model. Teachers placing holds and checking items out will be able to have priority for item holds, and extended loan periods, and the responsibility for the items will be on their institution. Children will have most of the same

access as a full-service card but their cards will be linked to that of their parents to ensure parents are aware of any issues such as fines, and items returned will be removed from their accounts immediately and placed onto a library review account to prevent potential mistakes. Adult patrons will be able to decide on the type of card they would like to sign up for based on their use and or circumstances, welcome cards in the form of E-Cards will be given. These only allow for the use of computers in the library and for patrons to access all online and digital materials and resources, and full-service cards will be given the same access but will also be able to check out items in person but without the restrictions of a welcome and child account.

Functional Requirements

1. Public Library
 - i. Shall have libraryId
 - ii. Must have a County Name
 - iii. Must have only one Library Address
 - iv. Shall have many branches

2. Library Branch
 - i. Shall have unique libraryId
 - ii. Shall have many Patrons
 - iii. Must have only one Library Address
 - iv. Shall have many Items
 - v. Shall have many transactions

Patrons

3. Patron
 - i. Shall have a Library Card Number
 - ii. Must have a Library Card Type
 - iii. Shall have access to many libraries
 - iv. Shall not check items out if delinquent
 - v. Must have only one email
 - vi. Can only have one account
 - vii. Can use one computer

Patron Types

4. E-Card
 - i. Can only check out many digital items
 - ii. Only has access to computer items in branch
 - iii. Must have a birthday
 - iv. Must have full name
5. Child
 - i. Must have at least one parent's full-service account linked
 - ii. Can check out 10 physical items and 15 digital items
 - iii. Must have a birthday
 - iv. Must have full name
6. Full-Service
 - i. Can have zero to many child accounts linked
 - ii. Can check out 100 physical items and 50 digital items
 - iii. Must have a phone number
 - iv. Must have a birthday
 - v. Must have full name
 - vi. Must have an Address

7. Institutional
 - i. Can have an additional full-service library card linked
 - ii. Can check out 250 physical items and no digital items
 - iii. Must have Institutional Address
 - iv. Must have full name
8. Staff
 - i. Can check out 250 physical items and 50 digital items
 - ii. Must have a phone number
 - iii. Must have a birthday
 - iv. Must have full name
 - v. Must have an Address

Addresses

9. Address
 - i. Shall have an address id
 - ii. Shall have one to many users linked
 - iii. Can have up to one address type
 - iv. Must have Street Number
 - v. Must have a Street Name
 - vi. Must have City
 - vii. Must have State
 - viii. Must have Zipcode

Address Types

10. Apartment Address
 - i. Shall have Apartment TypeID
 - ii. Must have a Building Number
 - iii. Must have Apartment Number
11. P.O. Box Address
 - i. Shall have P.O. BoxTypeID
 - ii. Must have P.O. Box Number
 - iii. Must have Servicer Listed
12. Institutional Address
 - i. Shall have Institutional TypeID
 - ii. Must have School District listed
 - iii. Must have School Name listed
13. Library Address
 - i. Shall have Library AddressTypeID
 - ii. Must have County Region
 - iii. Must have branch ID

Items

14. Item

- i. Shall only be checked out to one patron at a time
- ii. Must have Item barcode number
- iii. Must have Call Number
- iv. Must have Title
- v. Shall have item type
- vi. Shall at the most one owning library branch or none

Item Types

15. Computer

- i. Must have computer number
- ii. Shall have status of express or hourly
- iii. Must have area assigned
- iv. Shall have description (laptop or pc)

16. A/V

- i. Shall only be checked out when all materials are present
- ii. Must have a timestamp length
- iii. Must have an age rating
- iv. Must have an item count
- v. Must have a description

17. Fiction

- i. Must have at least one genre
- ii. Must have an Author
- iii. Must have an age rating
- iv. Must have a description

18. NonFiction

- i. Must have a Dewey decimal number
- ii. Must have a topic
- iii. Must have an Author
- iv. Must have an age rating

19. Archival

- i. Shall only be viewed inside the library
- ii. Must have a Dewey decimal number
- iii. Must have a topic
- iv. Must have a description

20. Periodical

- i. Current issues shall not be checked out
- ii. Must have an age rating
- iii. Must have Date
- iv. Must have Volume/Issue

- 21. Kit
 - i. Shall only be checked out when all materials are present
 - ii. Must have an age rating
 - iii. Must have a description
 - iv. Must have an item count
- 22. Pass
 - i. Shall only be checked out when all materials are present
 - ii. Must have a description
 - iii. Must have an item count
- 23. Digital Item
 - i. Must have Call Number
 - ii. Must have Title
 - iii. Must have description

Transactions

- 24. General
 - i. Must have patron Library Card Number
 - ii. Must have Transaction Type
 - iii. Must have transaction ID

Transaction Types

- 25. Payment
 - i. Must have staff library card number
 - ii. Must have total paid
 - iii. Must have date of transaction
- 26. Holds
 - i. Must have Item Barcode Number
 - ii. Must have Hold Library branch ID
 - iii. Must have Owning Library Branch ID
- 27. Checkout
 - i. Shall have one or many Item Barcode Numbers
 - ii. Must have item count
 - iii. Have date of transaction
 - iv. Must have Checkout Library branch ID
- 28. Return
 - i. Shall have one or many Item Barcode Numbers
 - ii. Must have item count
 - iii. Have date of transaction
 - iv. Must have Return Library branch ID

Non-Functional Requirements

1. Performance

- i. Library Transactions will be able to be performed simultaneously without conflicts and strain on the database
- ii. Requested and Held items will have status updates every day to prevent conflicting Patron Transactions
- iii. Digital Items will be separate from physical items on patron records to allow simultaneous transactions

2. Security

- i. Library card numbers are unique when created and assigned, upon the closure of an account or request for new library card old numbers are deleted and cannot be generated once more
- ii. Child account can only access account information in branch with Parent accounts being able to access information online and in branch
- iii. Accounts will be locked if library card is reported lost or stolen with a new library card number being assigned

3. Scalability

- i. Database is capability of expansion in order to account for new patrons, items, and transactions while avoiding compromising county wide performance
- ii. Data is stored locally and remotely, locally stored information is vital item, patron, and transaction information while remotely shared information is limited to allow branch level expansion without affecting other libraries
- iii. Main admin branch will be able to handle a large portion of the database in the form of transactions and general item and patron information taking a load off of the branches

4. Capability

- i. Items and Patrons are abstractions which will allow for future expansion on account types and new forms of materials
- ii. Digital Transactions such as Ebooks and Audio Books will be supported independently of in branch transactions
- iii. Account types will allow for different priority levels and capabilities to ensure patron need and circumstance is considered

5. Environmental

- i. Database will be hosted on server farm located in the main administrative branch with energy efficient design to remove the need for various large servers at each branch allowing for remote transfer and manipulation of data
- ii. In branch servers will be small raid configurations using solid state drives which can be stored in electrical room
- iii. As storage is expanded on servers old HDD's will be repurposed for archival and back up storage and be replaced with SSD's

6. Coding Standard

- i. Client Side support will be offered through the use of explicit error handling and reporting allowing staff to have accurate information on ongoing issues for them to generate work requests
- ii. Documentation and commenting will be common place and regularly updated for new and old staff to be able to work irregardless of familiarity with the database
- iii. Future Proofing will be essential and prioritized in order to make sure improvements and expansion to the database can be done without making it inaccessible county wide for a long period of time

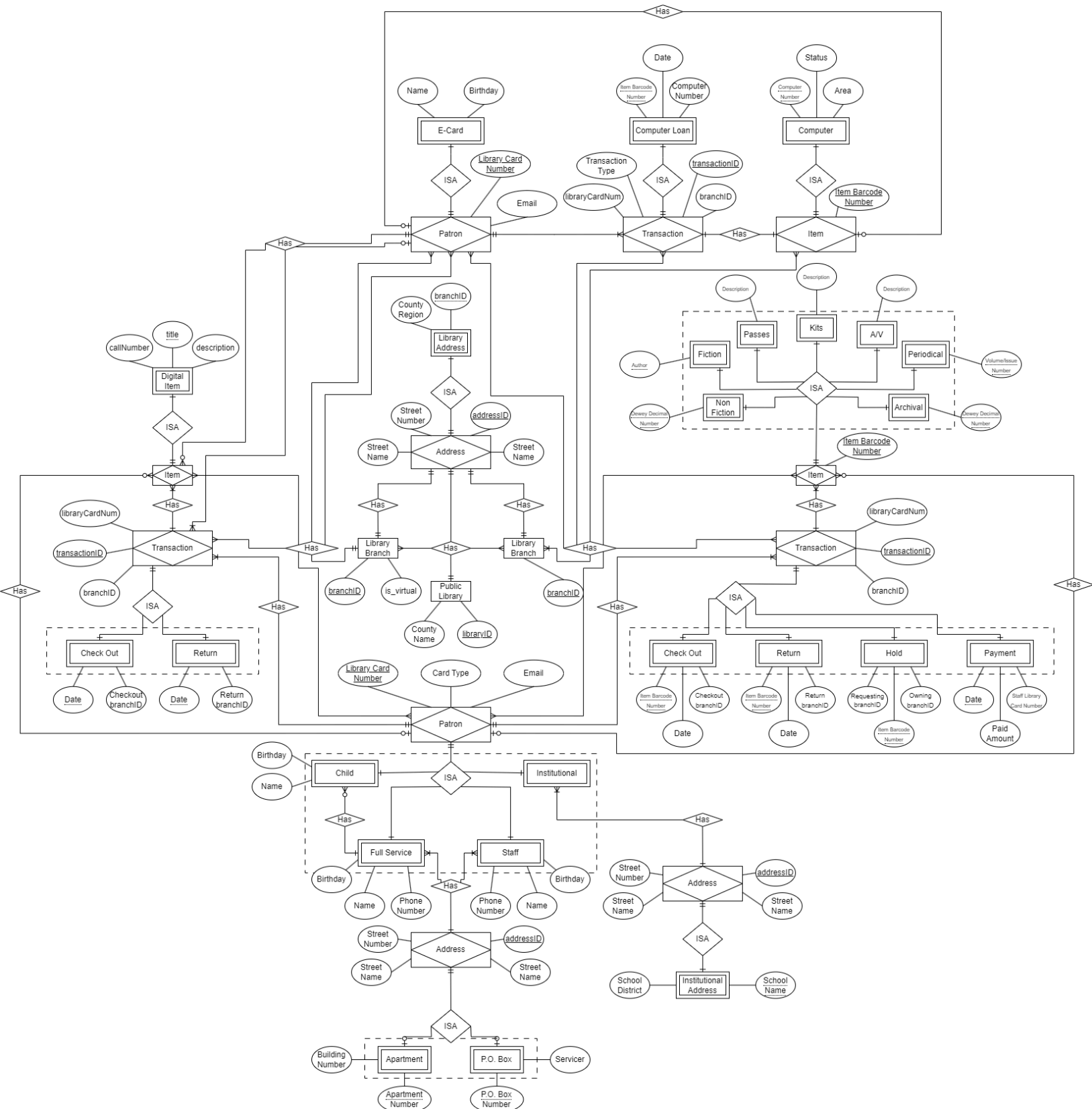
7. Storage

- i. Patron information will be stored remotely but split amongst libraries and main admin branch and provided a capacity of 10 terabytes with capability of expansion
- ii. Transaction information will be stored remotely but split amongst libraries and main admin branch and be given 2 terabytes
- iii. Item information will be stored primarily with owning branches and share limited information remotely to other branches, capacity will be based on patron count of respective library

8. Privacy

- i. Patrons can only access their accounts with their respective library card number and birthday
- ii. Patron transactions will be deleted from record upon return of items
- iii. Parent accounts can only see amount of items checked out and fines on account but cannot see item details and content matter

Entity Relationship Diagram



Entity Set Description

1. Public Library (Strong)
 - i. libraryID: numeric, unique, primary key
 - ii. County Name: alphanumeric, unique key
 - iii. address: numeric, foreign key
2. Library Branch (Strong)
 - i. branchID: numeric, unique, primary key
 - ii. libraryID: numeric, foreign key
 - iii. address: numeric, foreign key
 - iv. is_virtual: BOOLEAN

Patrons

3. Patron (Strong)
 - i. library_card_number: numeric, unique, primary key
 - ii. is_delinquent: BOOLEAN
 - iii. email: alphanumeric

Patron Types

4. E-Card (Weak)
 - i. e-cardID (library_card_number): numeric, unique, primary key, foreign key
 - ii. first_name: alphanumeric
 - iii. last_name: alphanumeric
 - iv. birthday: date
5. Child (Weak)
 - i. childID (library_card_number): numeric, unique, primary key, foreign key
 - ii. parentID (parent's typeID): numeric, foreign key
 - iii. first_name: alphanumeric
 - iv. last_name: alphanumeric
 - v. birthday: date
6. Full-Service (Weak)
 - i. patronID (library_card_number): numeric, unique, primary key, foreign key
 - ii. address: numeric, foreign key
 - iii. first_name: alphanumeric
 - iv. last_name: alphanumeric
 - v. birthday: date
 - vi. phone_number: alphanumeric
7. Institutional (Weak)
 - i. institutionalID (library_card_number): numeric, unique, primary key, foreign key
 - ii. address: numeric, foreign key
 - iii. first_name: alphanumeric
 - iv. last_name: alphanumeric
 - v. phone_number: alphanumeric

8. Staff (Weak)

- i. staffID (library_card_number): numeric, unique, primary key, foreign key
- ii. address: numeric, foreign key
- iii. first_name: alphanumeric
- iv. last_name: alphanumeric
- v. birthday: date
- vi. phone_number: alphanumeric

Addresses

9. Address (Strong)

- i. addressID: numeric, unique, primary key
- ii. addressTypeID: numeric, foreign key
- iii. street_number: numeric
- iv. street_name: alphanumeric
- v. city: alphanumeric
- vi. state: alphanumeric
- vii. zipcode: numeric

Address Types

10. Apartment Address (Weak)

- i. apartmentID (addressID): numeric, unique, primary key, foreign key
- ii. building_number: numeric
- iii. apartment_number: numeric

11. P.O. Box Address (Weak)

- i. po_boxID (addressID): numeric, unique, primary key, foreign key
- ii. po_box_number: numeric
- iii. servicer: alphanumeric

12. Institutional Address (Weak)

- i. institutionID (addressID): numeric, unique, primary key, foreign key
- ii. school_district: alphanumeric
- iii. school_name: alphanumeric

13. Library Address (Weak)

- i. libraryAddressID (addressID): numeric, unique, primary key, foreign key
- ii. county_region: alphanumeric
- iii. branchID: alphanumeric, foreign key

Items

14. Item (Strong)

- i. item_barcode_number: numeric, unique, primary key
- ii. call_number: alphanumeric
- iii. title: alphanumeric
- iv. branchID: numeric, foreign key

Item Types

15. Computer (Weak)

- i. computerID (item_barcode_number): numeric, unique, primary key, foreign key
- ii. computer_number: numeric
- iii. is_express: BOOLEAN
- iv. is_laptop: BOOLEAN
- v. area: alphanumeric
- vi. description: alphanumeric

16. A/V (Weak)

- i. avID(item_barcode_number): numeric, unique, primary key, foreign key
- ii. content_length: timestamp
- iii. age_rating: alphanumeric
- iv. item_count: numeric
- v. description: alphanumeric

17. Fiction (Weak)

- i. fictionID (item_barcode_number): numeric, unique, primary key, foreign key
- ii. genre: alphanumeric
- iii. author_first_name: alphanumeric
- iv. author_last_name: alphanumeric
- v. age_rating: alphanumeric
- vi. description: alphanumeric

18. NonFiction (Weak)

- i. nonFictionID(item_barcode_number): numeric, unique, primary key, foreign key
- ii. dewey_decimal_number: numeric
- iii. library_of_congress_classification: alphanumeric
- iv. topic: alphanumeric
- v. author_first_name: alphanumeric
- vi. author_last_name: alphanumeric
- vii. age_rating: alphanumeric

19. Archival (Weak)

- i. archivalID (item_barcode_number): numeric, unique, primary key, foreign key
- ii. dewey_decimal_number: numeric
- iii. library_of_congress_classification: alphanumeric
- iv. item_count: numeric
- v. description: alphanumeric

20. Periodical (Weak)

- i. periodicalID (item_barcode_number): numeric, unique, primary key, foreign key
- ii. publisher: alphanumeric
- iii. age_rating: alphanumeric
- iv. issue_date: date
- v. volume: numeric
- vi. issue: numeric

21. Kit (Weak)

- i. kitID (item_barcode_number): numeric, unique, primary key, foreign key
- ii. age_rating: alphanumeric
- iii. item_count: numeric
- iv. description: alphanumeric

22. Pass (Weak)

- i. passID (item_barcode_number): numeric, unique, primary key, foreign key
- ii. item_count: numeric
- iii. description: alphanumeric

23. Digital Item (Weak)

- i. digitalID (item_barcode_number): numeric, unique, primary key, foreign key
- ii. content_length: alphanumeric
- iii. description: alphanumeric

Transactions

24. Transaction (Strong)

- i. transactionID: numeric, unique, primary key
- ii. patronCardNumber: numeric, foreign key
- iii. transaction_branchID: numeric, foreign key
- iv. item_barcode_number: numeric, foreign key

Transaction Types

25. Payment (Weak)

- i. paymentID (transactionID), numeric, unique, primary key, foreign key
- ii. total_paid: numeric
- iii. date_paid: date

26. Holds (Weak)

- i. holdID (transactionID), numeric, unique, primary key, foreign key
- ii. owning_branchID: numeric, foreign key
- iii. holding_branchID: numeric, foreign key

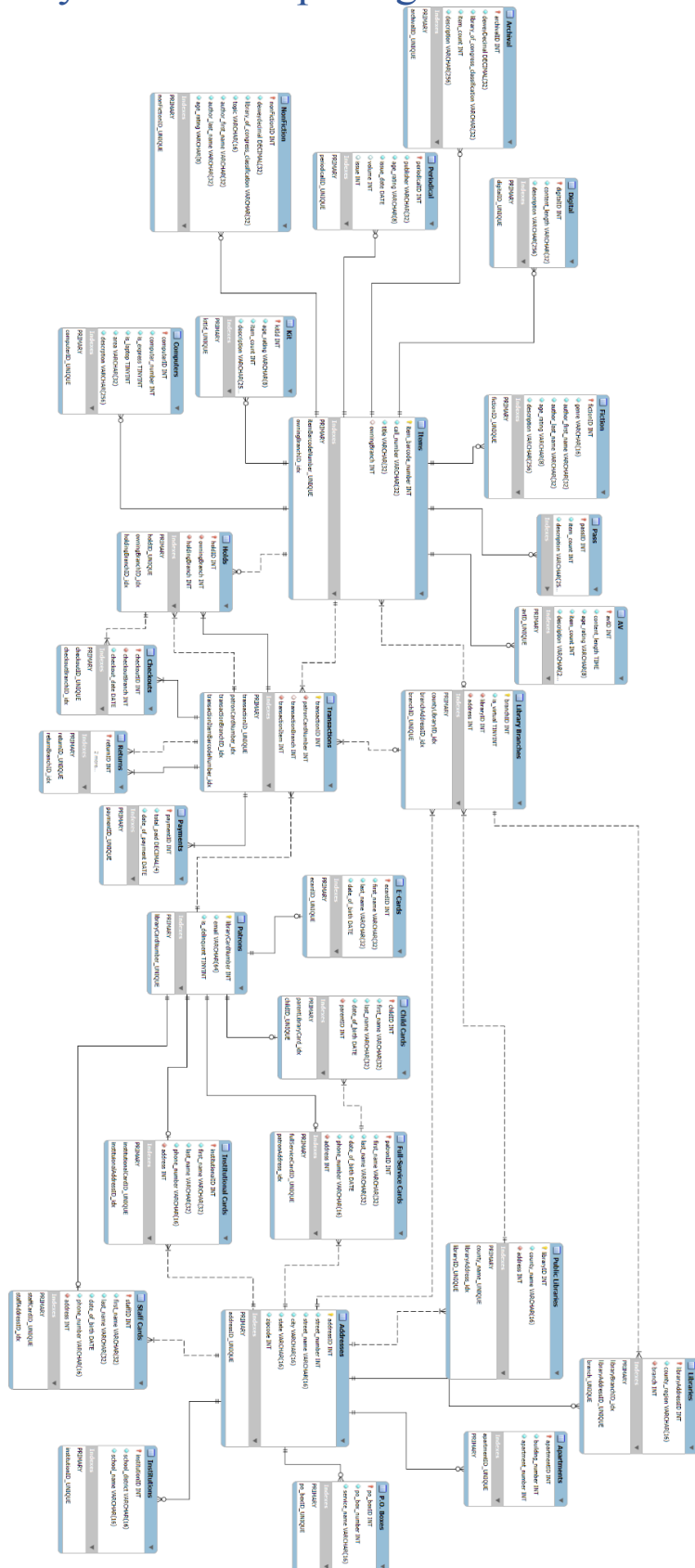
27. Checkout (Weak)

- i. checkoutID (transactionID), numeric, unique, primary key, foreign key
- ii. checkout_branchID: numeric, foreign key
- iii. checkout_date: date

28. Return (Weak)

- i. returnID (transactionID), numeric, unique, primary key, foreign key
- ii. return_branchID: numeric, foreign key
- iii. return_date: date

Enhanced Entity-Relationship Diagram



Normalization Techniques Used

1. Public Library

- i. In order to meet 3NF the branchID was removed from the entity as any others did not use it. Since the Public Library Entity uses a libraryID as its primary key there was no need for an additional key which informed the decision to remove the branchID.

2. Library Branch / E-Library

- i. Prior to normalization, the Library Branch and E-Library Entities shared the same attributes. To simplify the database and maintain 3NF, they were combined into a single entity. This new version of the Library Branch will still serve the same purpose, but the is_virtual boolean will serve as the distinguishing attribute that will separate Library Branches from Virtual or E-Library Branches.
- ii. When designed both Library Branch and E-Library entities relied on the libraryID of their parent Public Library as a primary key which led to both being weak entities. After combining the two it was necessary to change the branchID into the primary key of the new Library Branch entity. This was then followed by making the libraryID attribute into a foreign key referencing a Public Library which helped make a Library Branch into a Strong Entity once as intended while removing dependencies that broke 3NF.

3. Patron

- i. Addresses were removed from the Patron Parent entity as not all types of Patrons require them which helped simplify each entity. Now only Full Service, Institutional, and Staff Type entities have Addresses as attributes but not the Parent entity type itself.
- ii. Phone Numbers were changed from composite attributes into alphanumeric in all Patron Types to avoid relying on a new Phone Number entity table being created and allowing it to meet 3NF.

4. Child Patron Type

- i. Due to the child patron type relying on the primary key of their parent as a foreign key, there was no need to store either the address or phone number of the parent as derived attributes. By removing these the Child Patron type no longer breaks 3NF while still being able to access these Parent attributes through its primary key

5. Addresses

- i. To get rid of needless attributes that would rely on referencing specific entities phone numbers were removed from all Address types. If left it would link addresses to a single user as opposed to allowing many users to share an address.

ORM Architecture