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Student Name: MD MUNIF AKANDA

FIRST NAME

FAMILY / LAST NAME

Student Number: 3 5 5 1 1 3 3 Email: MDMUNIF.AKANDA@UON.EDU.AU

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Course Title

DATABASE MANAGEMENT 1

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Intro to University

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INFO6001 T1 2025

Assignment 1

Project: Database design of UNIE Library System

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Preface

The conceptual design of the UNIE Library System was developed using an Enhanced Entity-Relationship (EER) approach to capture resources, borrowing processes, membership management, and copy tracking within a consistent structure.

Core entities such as Item, Copy, Member, and Loan were first identified. Specialization was introduced to reflect domain differences that could not be represented effectively through a single entity structure.

Item was categorised into Book, Journal, and OnlineDatabase. Similarly, Copy was divided into PhysicalCopy and DigitalCopy. These generalisations were modelled as total and disjoint to prevent classification overlap, ensuring each instance is represented with clear semantic meaning.

The model also incorporates operational constraints observed in real library environments (Elmasri & Navathe, 2016). MembershipType and Privilege is used to control borrowing eligibility. HoldRequest is used to represent reservation behaviour. Resource procurement and collection expansion are handled through AcquisitionRequest to reflect acquisition workflows. Composite and multivalued attributes were introduced selectively to improve accuracy.

Overall, the model prioritises clarity, extensibility, and realistic constraint representation across physical and digital resource management contexts.

Part 1: Requirements

Data Requirements

Catalogue Services

Item

An Item in the UNIE library could be of various types such as Book, Journal, and Online Database. When an Item is created, information recorded includes a unique item number, title, publisher, author (up to 10), year, description, notes, and subject. Additional information is recorded based on the item type as:

- **Book:** edition, contents, summary, ISBN
- **Journal:** frequency, abbreviated title, main series, ISSN
- **Online Database:** contents, release date

An Item can have zero or more copies. Each Copy of an Item has a unique accession number with information on date added and cost. A Copy of an Item can be either a Physical Copy or a Digital Copy.

- **Physical Copy:** contains a barcode and status (available, on loan, on hold, damaged, withdrawn, lost).
- **Digital Copy:** contains URL, format, access period, size, and units of size.

Collection

A collection represents a physical grouping of resources within the library that helps users locate physical items. Each PhysicalCopy belongs to a single collection describing its campus and storage location.

Attributes include:

- collectionID (Primary Key)
- collectionName

- physicalLocation (Composite Attribute):
 - campus
 - building
 - shelf

Member

A member represents a user of the UNIE library who can borrow/loan physical items and place hold request. The system will store information such as personal details, contact details, and membership status to enable borrowing, notifications, and access control.

Attributes include:

- memberID (Primary Key)
- PIN
- name
- memberAddress (composite attribute)
 - street
 - city
 - postcode
- email
- contactNumber
- dateJoined
- dateOfBirth
- membershipStatus
- membershipExpirationDate

MemberType

MemberType represents a classification of library members such as student, staff, or external user. This is used to determine a member's borrowing privileges, renewal and loan limits, and any restrictions that apply to a member.

Attributes include:

- memberTypeID (Primary Key)
- typeName
- description
- additionalInformation

Privilege

Privilege defines borrowing and hold restrictions that apply to members based on their MemberType and the Collection of items that are being accessed. Privileges specify limits such as loan period, maximum items that can be borrowed, and maximum holds that are allowed.

Attributes include:

- PrivilegeID (Primary Key)
- privilegeName
- loanPeriod
- maxRenewals
- maxBorrowLimit

- maxHoldLimit

Loan

A Loan represents the borrowing of a physicalCopy of an Item by a member. This entity records current and past transactions including loan dates, due dates and loan status.

Attributes include:

- loanID (Primary Key)
- dateLoaned
- dueDate
- loanStatus
- renewalCount

HoldRequest

A HoldRequest will represent a reservation requested by a Member for an currently unavailable Item. HoldRequest are processed in a first in first out (FIFO) order.

Attributes include:

- holdRequestID (Primary Key)
- holdRequestDateTime
- holdStatus
- comments

AcquisitionRequest

An AccquisitonRequest represents a suggestion submitted by member to acquire a new item. Requests are reviewed by library management and may be approved or rejected.

Attributes include:

- accqisitonRequestID (Primary Key)
- requestedTitle
- requestedAuthor
- requestedDate
- requestStatus
- additionalComments

Transaction Requirements

Data Manipulation

The following data manipulation operations describe the core create, update, and removal activities required to maintain the integrity and accuracy of the UNIE Library System database.

- Insert, update, and delete Item records (Book, Journal, OnlineDatabase).
- Insert, update, and delete CopyOfItem records (PhysicalCopy and DigitalCopy).
- Insert and maintain Collection records and update the location of PhysicalCopies.
- Register a new Member and assign a PIN.
- Update Member details such as address, contact information, and membership status.
- Create and maintain MemberType records.
- Create and update Privilege rules for MemberTypes and Collections.
- Issue a Loan when a Member borrows a PhysicalCopy.
- Renew a Loan and update the dueDate and renewalCount.
- Close a Loan when a PhysicalCopy is returned and update its status.
- Create and cancel HoldRequests for unavailable Items.
- Submit and manage AcquisitionRequests.

Queries

The system must support a range of search and retrieval operations that enable efficient discovery of library resources and member activities.

- Search Items by title, author, subject, or publisher.
- Filter catalogue search results by subtype (Book, Journal, OnlineDatabase).
- Display all copies of an Item and indicate availability.
- Show the physical location (Collection) of a PhysicalCopy.
- List all current Loans for a Member with due dates and status.
- Identify overdue Loans.
- Display the HoldRequest queue for an Item ordered by requestDateTime.
- List Holds ready for pickup or nearing expiry.
- Generate a report of frequently borrowed Items.
- List AcquisitionRequests by status.

Business Rules

The following business rules define the operational constraints and policies governing resource management, borrowing activities, membership control, and reservation handling within the UNIE Library System.

Catalogue Rules

- An Item must belong to exactly one subtype: Book, Journal, or OnlineDatabase.
- Each Item is uniquely identified by itemNo.
- An Item may have zero or more copies.
- Each CopyOfItem must belong to exactly one Item.
- A CopyOfItem must be either a PhysicalCopy or a DigitalCopy.

- A PhysicalCopy has a status indicating availability (available, on loan, on hold, damaged, withdrawn, lost).

Circulation and Membership Rules

- Only registered Members can borrow PhysicalCopies.
- Each Member must belong to exactly one MemberType.
- Borrowing limits and renewal limits are determined by Privilege rules.
- A Loan must reference one Member and one PhysicalCopy.
- A PhysicalCopy cannot be loaned to more than one Member at the same time.
- Loan renewals are limited by maxRenewals.

Hold Rules

- Members can place HoldRequests on Items that are currently unavailable.
- HoldRequests are processed in FIFO order based on requestDateTime.
- When a PhysicalCopy becomes available, the next HoldRequest may be fulfilled and the member notified.
- If a held item is not collected within a defined pickup period, the HoldRequest expires.
- A Member's maximum number of holds is controlled by Privilege rules.

Acquisition Rules

- Members may submit AcquisitionRequests for new Items.
- AcquisitionRequests must be reviewed and either approved or rejected.
- The status of each AcquisitionRequest must be recorded.

Part 2: EER Model

The following Enhanced Entity-Relationship (EER) diagram illustrates the conceptual design of the UNIE Library System. It includes resource classification, copy management, membership, and circulation processes.

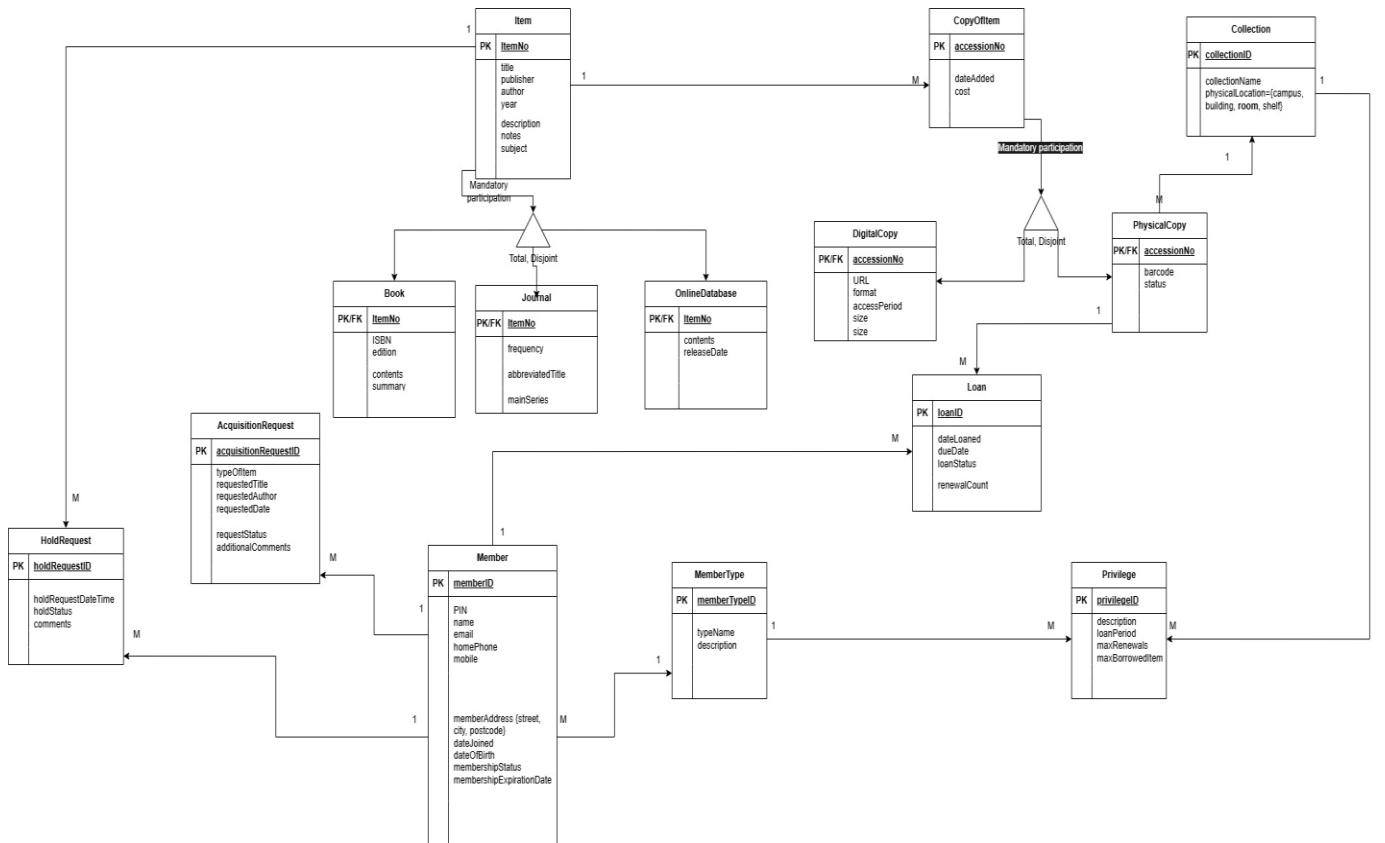


Figure 1: EER diagram representing the UNIE Library System.

Data Dictionary

Entity

The following table documents all entities in the EER model, including superclass and subclass entities.

Entity Name	Description	Aliases	Occurrences
Item	Central superclass representing any library resource catalogued by the UNIE library.	Resource	One per distinct library resource (itemNo).
Book	Subclass of Item representing a monographic publication.	Monograph	One per book title.
Journal	Subclass of Item representing a serial academic publication.	Periodical	One per journal title.
OnlineDatabase	Subclass of Item representing a digital subscription resource with no physical copies.	e-Database	One per database subscription.
CopyOfItem	Superclass representing an individual instance of an Item owned by the library.	Item Instance	One per copy accession record.
PhysicalCopy	Subclass of CopyOfItem representing a tangible library item that can be borrowed.	Physical Item	One per physical copy.
DigitalCopy	Subclass of CopyOfItem representing an electronic version of an Item.	e-Copy	One per digital copy.
Collection	Logical grouping used to organise PhysicalCopies within the library.	Library Collection	One per collection category.
Member	Registered user of the library who can borrow and request items.	Library Member	One per registered member.
MemberType	Classification defining borrowing privileges for members.	Membership Category	One per membership category.

Privilege	Borrowing and holding rules associated with a membership category.	Borrowing Rules	One per privilege rule set.
Loan	Record of a PhysicalCopy being borrowed by a Member.	Borrowing Record	One per borrowing transaction.
HoldRequest	Reservation placed by a Member for an unavailable Item.	Reservation	One per hold request.
AcquisitionRequest	Request submitted by a Member to add a new Item to the library.	Purchase Request	One per acquisition request.

Relationships

The following sections further document the relationships and attributes that support the entities defined above.

Entity Name	Multiplicity	Relationship	Multiplicity	Entity Name
Item	1	has	0..*	CopyOfItem
Item	Mandatory	Generalisation (Total, Disjoint)	Mandatory	Book
Item	Mandatory	Generalisation (Total, Disjoint)	Mandatory	Journal
Item	Mandatory	Generalisation (Total, Disjoint)	Mandatory	OnlineDatabase
CopyOfItem	Mandatory	Generalisation (Total, Disjoint)	Mandatory	PhysicalCopy
CopyOfItem	Mandatory	Generalisation (Total, Disjoint)	Mandatory	DigitalCopy
PhysicalCopy	0..*	located in	1	Collection
PhysicalCopy	1	loaned in	0..*	Loan
Member	1	borrowes	0..*	Loan
Member	1	places	0..*	HoldRequest

Item	1	requested in	0..*	HoldRequest
Member	1	submits	0..*	AcquisitionRequest
Member	0..*	belongs to	1	MemberType
MemberType	1	assigned	0..*	Privilege

Attributes:

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
Item	itemNo	Unique item identifier (PK)	CHAR(10)	N	N	N	—
Item	title	Title of the item	VARCHAR(200)	N	N	N	—
Item	publisher	Publisher name	VARCHAR(200)	Y	N	N	—
Item	author	Author(s) (max 10)	VARCHAR(200)	Y	Y	N	—
Item	year	Publication year	CHAR(4)	Y	N	N	—
Item	description	Item description	VARCHAR(500)	Y	N	N	—
Item	notes	Notes about the item	VARCHAR(300)	Y	N	N	—
Item	subject	Subject classification	VARCHAR(100)	Y	N	N	—

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
Book	itemNo	PK/FK referencing Item.itemNo	CHAR(10)	N	N	N	—
Book	ISBN	Book ISBN	CHAR(13)	Y	N	N	—
Book	edition	Edition info	VARCHAR(20)	Y	N	N	—
Book	contents	Table of contents / contents	VARCHAR(500)	Y	N	N	—
Book	summary	Book summary	VARCHAR(500)	Y	N	N	—

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default

Journal	itemNo	PK/FK referencing Item.itemNo	CHAR(10)	N	N	N	—
Journal	frequency	Publication frequency	VARCHAR(50)	Y	N	N	—
Journal	abbreviatedTitle	Abbreviated journal title	VARCHAR(100)	Y	N	N	—
Journal	mainSeries	Main series name	VARCHAR(100)	Y	N	N	—

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
OnlineDatabase	itemNo	PK/FK referencing Item.itemNo	CHAR(10)	N	N	N	—
OnlineDatabase	contents	Database contents/description	VARCHAR(500)	Y	N	N	—
OnlineDatabase	releaseDate	Release date	DATE	Y	N	N	—

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
CopyOfItem	accessionNo	Unique copy identifier (PK)	CHAR(15)	N	N	N	—
CopyOfItem	dateAdded	Date the copy was added	DATE	N	N	N	—
CopyOfItem	cost	Cost of this copy	DECIMAL(8,2)	Y	N	N	—

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
PhysicalCopy	accessionNo	PK/FK referencing CopyOfItem.accessionNo	CHAR(15)	N	N	N	—
PhysicalCopy	barcode	Physical barcode identifier	VARCHAR(20)	N	N	N	—
PhysicalCopy	status	Availability status	VARCHAR(20)	N	N	N	Available

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default

DigitalCopy	accessionNo	PK/FK referencing CopyOfItem.accessionNo	CHAR(15)	N	N	N	—
DigitalCopy	URL	Link to digital resource	VARCHAR(300)	N	N	N	—
DigitalCopy	format	File/resource format (e.g., PDF, HTML)	VARCHAR(20)	Y	N	N	—
DigitalCopy	accessPeriod	Access period/term	VARCHAR(50)	Y	N	N	—
DigitalCopy	size	Size value	DECIMAL(10,2)	Y	N	N	—
DigitalCopy	unitOfSize	Unit of size (MB/GB)	VARCHAR(10)	Y	N	N	—

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
Collection	collectionID	Unique collection identifier (PK)	CHAR(10)	N	N	N	—
Collection	collectionName	Name of collection	VARCHAR(100)	N	N	N	—
Collection	physicalLocation	Composite location string (campus/building/room/shelf)	VARCHAR(200)	Y	N	N	—

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
Member	memberID	Unique member identifier (PK)	CHAR(10)	N	N	N	—
Member	PIN	Member PIN	CHAR(4)	N	N	N	—
Member	name	Full name	VARCHAR(100)	N	N	N	—
Member	email	Email address	VARCHAR(150)	N	N	N	—
Member	homePhone	Home phone number	VARCHAR(20)	Y	N	N	—
Member	mobile	Mobile phone number	VARCHAR(20)	Y	N	N	—

Member	memberAddress	Composite address (street/city/postcode)	VARCHAR(200)	Y	N	N	—
Member	dateJoined	Date joined	DATE	N	N	N	—
Member	dateOfBirth	Date of birth	DATE	Y	N	N	—
Member	membershipStatus	Status (active/expired/suspended etc.)	VARCHAR(20)	N	N	N	Active
Member	membershipExpirationDate	Expiry date	DATE	Y	N	N	—

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
Privilege	privilegeID	Privilege identifier (PK)	CHAR(10)	N	N	N	—
Privilege	description	Privilege description	VARCHAR(200)	Y	N	N	—
Privilege	loanPeriod	Standard loan period (days)	INT	N	N	N	—
Privilege	maxRenewals	Max renewals allowed	INT	N	N	N	0
Privilege	maxBorrowLimit	Max physical items borrowable	INT	N	N	N	—
Privilege	maxHoldLimit	Max holds allowed	INT	N	N	N	—

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
Loan	loanID	Unique loan identifier (PK)	CHAR(12)	N	N	N	—
Loan	dateLoaned	Date loan started	DATE	N	N	N	—
Loan	dueDate	Due date	DATE	N	N	N	—
Loan	loanStatus	Status (open/closed/over due)	VARCHAR(20)	N	N	N	Open
Loan	renewalCount	Number of renewals used	INT	N	N	N	0

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
HoldRequest	holdRequestID	Unique hold request identifier (PK)	CHAR(12)	N	N	N	—
HoldRequest	holdRequestDateTime	Date/time hold was placed	DATETIME	N	N	N	—
HoldRequest	holdStatus	Status (pending/notified/fulfilled/cancelled/expired)	VARCHAR(20)	N	N	N	Pending
HoldRequest	comments	Optional comments	VARCHAR(300)	Y	N	N	—

Entity	Attributes	Description	Data Type & Length	Nulls	Multi-valued	Derived	Default
Acquisition Request	acquisitionRequestID	Unique acquisition request id (PK)	CHAR(12)	N	N	N	—
Acquisition Request	typeOfItem	Requested item type	VARCHAR(30)	Y	N	N	—
Acquisition Request	requestedTitle	Title requested	VARCHAR(200)	N	N	N	—
Acquisition Request	requestedAuthor	Author requested	VARCHAR(200)	Y	N	N	—
Acquisition Request	requestedDate	Date requested	DATE	N	N	N	—
Acquisition Request	requestStatus	Status (submitted/approved/rejected)	VARCHAR(20)	N	N	N	Submitted
Acquisition Request	additionalComments	Extra notes	VARCHAR(300)	Y	N	N	—

Summary

The developed EER model captures the core structure of the UNIE Library System. The model integrates resource classification, copy management, membership control, and borrowing activities within a unified conceptual framework. The introduction of specialisation enabled the model to separate resource and copy variations.

Key relationships were defined to mirror real library behaviour. This includes the dependency between Items and Copies, borrowing processes represented through Loan, and reservation handling through HoldRequest. Borrowing eligibility and usage restrictions are enforced through MembershipType and Privilege. This allows policy constraints to be expressed directly at the conceptual level rather than deferred to implementation stages.

The accompanying data dictionary strengthens the model by explicitly defining entities, attributes, and relationships, ensuring consistency between the conceptual diagram and its documentation. Design decisions prioritised structural clarity and constraint representation while maintaining flexibility for future extensions such as fine management or notification support.

Overall, the conceptual model establishes a consistent foundation which supports physical and digital resource management. The model provides a stable basis for subsequent logical database design and implementation.

References

- Elmasri, R., & Navathe, S. B. (2016). *Fundamentals of database systems* (7th ed.). Pearson.