



IE 4791 Project Report

Name	Contributions
Koh Yi Kun (Group Leader)	ER Diagram, Table structure 3NF
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Requirements for database

For this project we have chosen a Library management system as our choice of scenario, and we have listed the requirements for our database below:

1. Comprehensive Book Inventory: The database should provide a detailed record for each book, including details such as ISBN, title and Publishing year. It should allow for the association of books with authors, genres and publishers.
2. User management: Maintain records of all borrowers, including personal details and contact information, borrowing history and any fines for late returns.
3. Transaction handling: Record all transactions involving book checkouts and returns with timestamps and borrower details. It can also automate due date calculations and return reminders.
4. Reservation functionality: This enables borrowers to reserve books that are currently on loan and notify them when the reserved book becomes available.
5. Fines and payments: the database should track late returns and calculate fines based on the returned date

ER Diagram

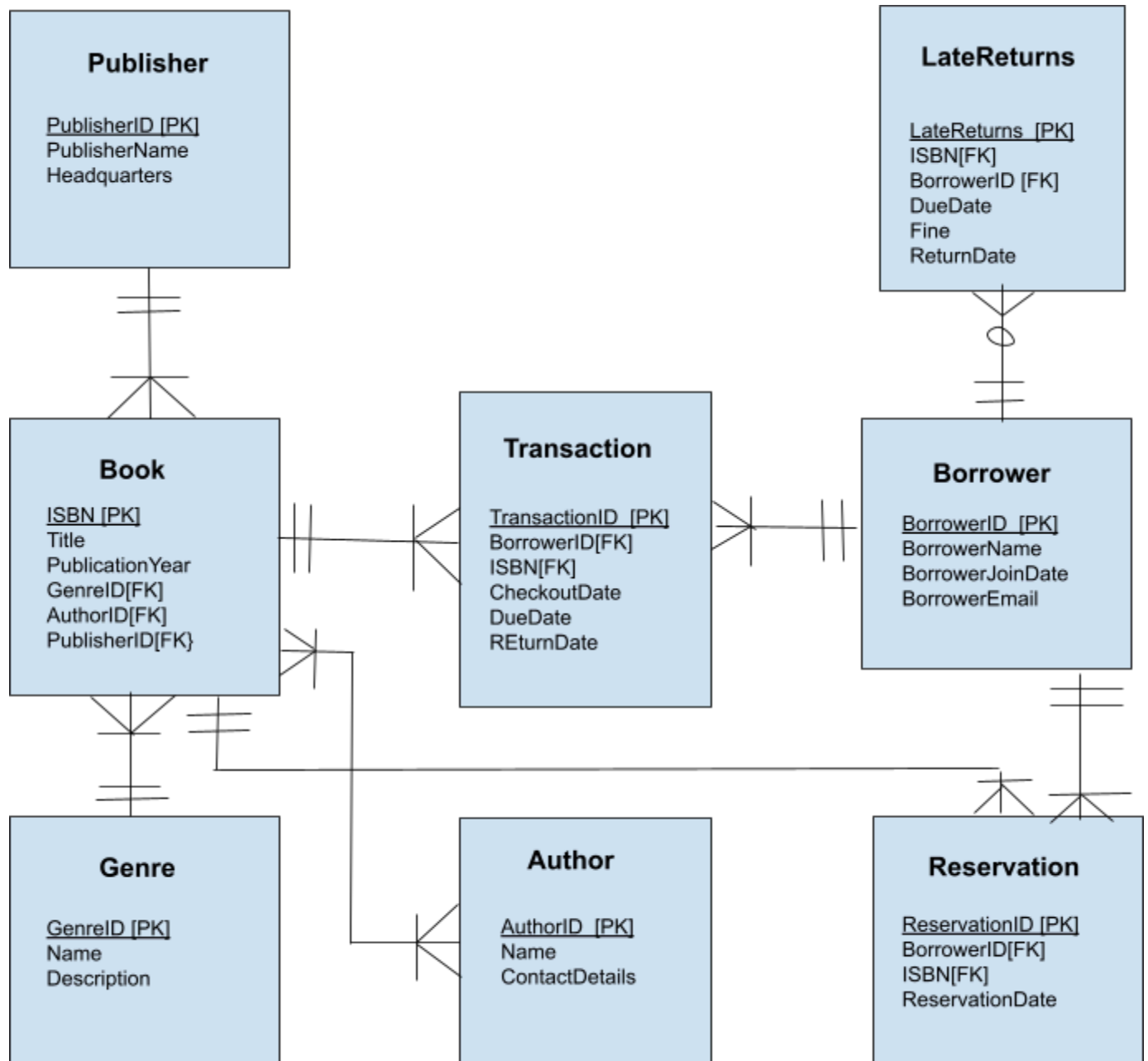


Table Structures (3NF)

- Book (ISBN [PK], Title, PublicationYear, GenreID [FK], AuthorID[FK],PublisherID [FK])
- Borrower (BorrowerID [PK], BorrowerName,BorrowerJoinDate, BorrowerEmail)
- Author (AuthorID [PK], Name, ContactDetails)
- Genre (GenreID [PK], Name, Description)
- Transaction (TransactionID [PK], BorrowerID [FK], ISBN [FK], CheckoutDate, DueDate, ReturnDate)
- Publisher (PublisherID[PK], PublisherName, Headquarters)
- LateReturns (LateReturnID[PK], ISBN [FK], BorrowerID [FK], ReturnDate, Fine)
- Reservations(ReservationID[PK], BorrowerID [FK], ISBN [FK], ReservationDate)

Book

<u>ISBN</u>	Title	PublicationYear	GenreID[FK]	AuthorID[FK]	PublisherID[FK]
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Borrower

<u>BorrowerID</u>	BorrowerName	BorrowerJoinDate	BorrowerEmail
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Author

<u>AuthorID</u>	AuthorName	ContactDetails
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Genre

<u>GenreID</u>	GenreName	GenreDescription
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Transaction

<u>TransactionID</u>	BorrowerID [FK]	ISBN [FK]	CheckoutDate	ReturnDate
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Publishers

<u>PublisherID</u>	PublisherName	PublisherHeadquarter
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LateReturns

<u>LateReturnID</u>	ISBN [FK]	BorrowerID [FK]	ReturnDate	Fine
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Reservations

<u>ReservationID</u>	BorrowerID [FK]	ISBN [FK]	ReservationDate
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Microsoft Access Tables

- 1) **Book (ISBN [PK], Title, PublicationYear, GenreID [FK], AuthorID [FK], PublisherID [FK])**

Table Design View


	Field Name	Data Type
	ISBN	Short Text
	Title	Short Text
	PublicationYear	Number
	GenreID	Number
	AuthorID	Number
	PublisherID	Number

Table with data

ISBN	Title	PublicationYear	GenreID	AuthorID	PublisherID
99-0002	Harry Potter and the Chamber of Secrets	1998	1	1	1
99-0001	Harry Potter and the Philosopher's Stone	1997	1	1	1
99-0003	Harry Potter and the Prisoner of Azkaban	1999	1	1	1
98-0102	Percy Jackson & the Olympians: The Lightning Thief	2005	1	2	2
98-0103	Percy Jackson & the Olympians: The Sea of Monsters	2006	1	2	2
91-2233	Red, White & Royal Blue	2019	4	5	5
94-1234	Rich Dad Poor Dad	1997	2	3	3
92-0007	The Haunting of Hill House	1995	3	4	4
91-4214	House of Flame and Shadow	2024	1	6	1

2) Borrower (BorrowerID [PK], BorrowerName, BorrowerJoinDate, BorrowerEmail)

Table Design View

	Field Name	Data Type
	BorrowerID	Short Text
	BorrowerName	Short Text
	BorrowerJoinDate	Date/Time
	BorrowerEmail	Short Text

Table with data

BorrowerID	BorrowerName	BorrowerJoinDate	BorrowerEmail
LB-1	John	1/1/2024	john@gmail.com
LB-2	Shaun	2/1/2024	shaun@gmail.com
LB-3	Jeremy	2/1/2024	jeremy@gmail.com
LB-4	Jane	4/1/2024	jane@gmail.com
LB-5	Mary	5/1/2024	mary@gmail.com

3) Author (AuthorID [PK], Name, ContactDetails)

Table Design View

	Field Name	Data Type
	AuthorID	Number
	AuthorName	Short Text
	ContactDetails	Short Text

Table with data

AuthorID	AuthorName	ContactDetails
1	J. K. Rowling	(641) 446-7777
2	Rick Riordan	(770) 385-0560
3	Robert Kiyosaki	(319) 935-3286
4	Shirley Jackson	(909) 338-4286
5	Casey McQuiston	(417) 673-9373
6	Sarah J. Maas	(425) 223-2351

4) Genre (GenreID [PK], Name, Description)

Table Design View

Field Name	Data Type
GenreID	Number
GenreName	Short Text
GenreDescription	Short Text

Table with data

GenreID	GenreName	GenreDescription
1	Fantasy	These are the stories that revolve around magic, witchcraft, and mythical creatures.
2	Personal Finance	Personal finance is the financial management that an individual or family undertakes to achieve their financial goals.
3	Horror	Horror is a genre that seeks to provoke fear, terror, shock, and suspense.
4	Romance	In romance novels, the plot is all about the relationship between two people.
5	Mystery	The mystery genre, sometimes called detective fiction, involves a crime or a puzzle that the reader must solve.

**5) Transaction (TransactionID [PK], BorrowerID [FK], ISBN [FK],
CheckoutDate, DueDate, ReturnDate)**

Table Design View

	Field Name	Data Type
	TransactionID	Number
	BorrowerID	Short Text
	ISBN	Short Text
	CheckoutDate	Date/Time
	DueDate	Date/Time
	ReturnDate	Date/Time

Table with data

TransactionID	BorrowerID	ISBN	CheckoutDate	DueDate	ReturnDate
1	LB-1	99-0001	25/1/2024	25/2/2024	24/3/2024
2	LB-1	98-0102	25/1/2024	25/2/2024	16/3/2024
3	LB-2	98-0103	1/2/2024	1/3/2024	12/3/2024
4	LB-3	94-1234	2/2/2024	2/3/2024	20/3/2024
5	LB-3	92-0007	3/2/2024	3/3/2024	20/3/2024
6	LB-4	99-0001	4/2/2024	4/3/2024	3/3/2024

6) Publisher (PublisherID [PK], PublisherName, Headquarters)

Table Design View

	Field Name	Data Type
	PublisherID	Number
	PublisherName	Short Text
	PublisherHeadquarter	Short Text

Table with data

PublisherID ▼	PublisherName ▼	PublisherHeadquarter ▼
1	Bloomsbury	UnitedKingdom
2	Miramax	United Kingdom
3	Plata Publishing	United States
4	Viking	United States
5	St Martin's Griffin	United States

7) LateReturns (LateReturnID [PK], ISBN [FK], BorrowerID [FK], DueDate , Fine, ReturnDate)

Table Design View

Field Name	Data Type
LateReturnID	Number
ISBN	Short Text
BorrowerID	Short Text
DueDate	Date/Time
Fine	Number
ReturnDate	Date/Time

Table with data

LateReturnID ▼	ISBN ▼	BorrowerID ▼	DueDate ▼	Fine ▼	ReturnDate ▼
1	92-0007	LB-3	4/3/2024	1	20/3/2024
2	94-1234	LB-3	2/3/2024	3	20/3/2024
3	98-0102	LB-1	25/2/2024	5	16/3/2024
4	98-0103	LB-2	1/3/2024	4	12/3/2024
5	99-0001	LB-1	25/2/2024	5	24/3/2024

**8) Reservations(ReservationID[PK], BorrowerID [FK], ISBN [FK],
ReservationDate)**

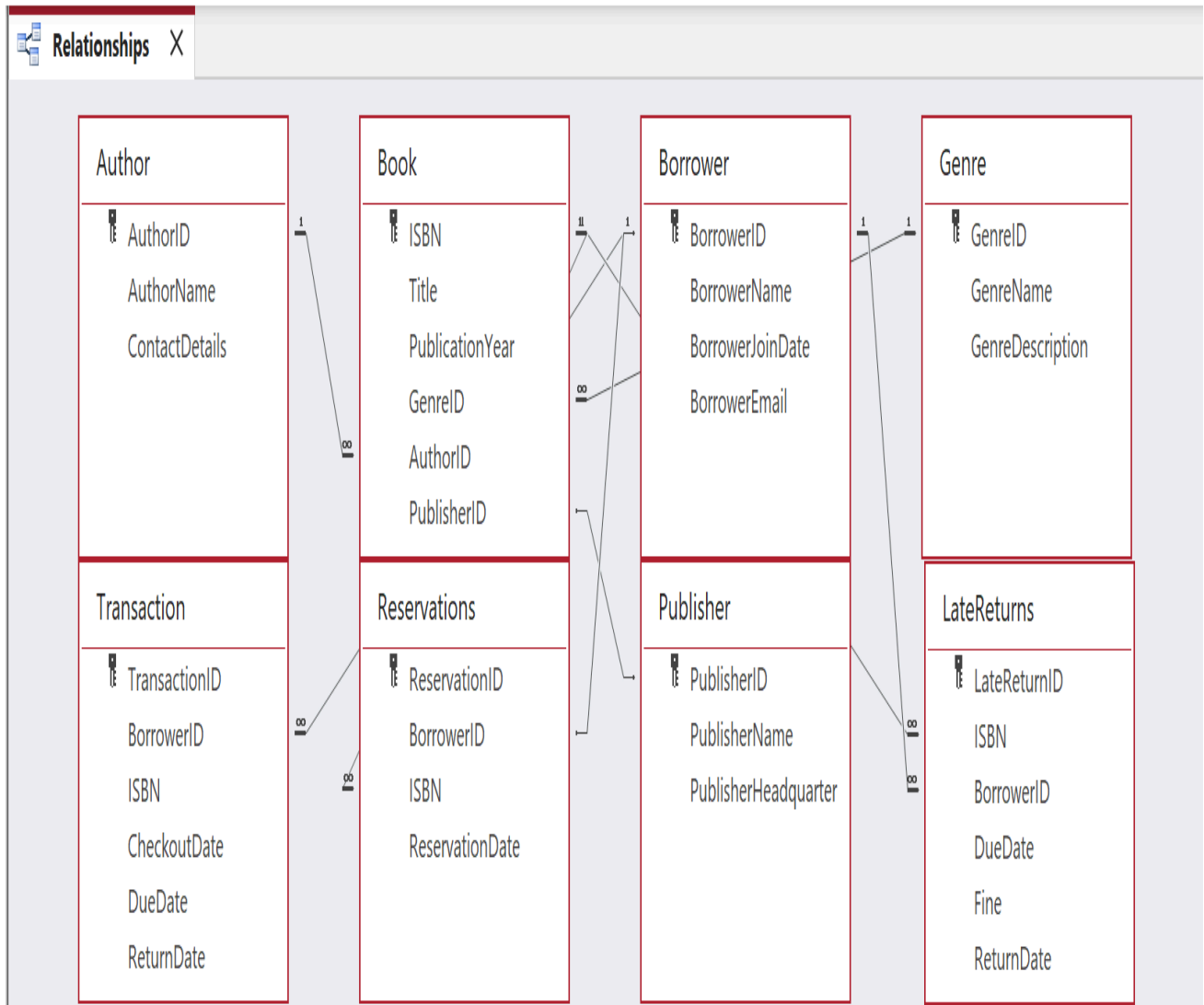
Table Design View

	Field Name	Data Type
	ReservationID	Number
	BorrowerID	Short Text
	ISBN	Short Text
	ReservationDate	Date/Time

Table with data

ReservationID	BorrowerID	ISBN	ReservationDate
1	LB-01	91-4214	1/3/2024
2	LB-01	92-0007	1/3/2024
3	LB-02	99-0001	23/2/2024
4	LB-03	91-4214	29/2/2024
5	LB-04	99-0002	2/3/2024

Overall Relationships



Microsoft access Forms, Queries, and Reports

1) Book

Data Entry Form Design View:

The design view of the 'Book' form shows a grid-based layout. The 'Form Header' section contains a title box labeled 'Book'. The 'Detail' section contains six text boxes for 'ISBN', 'Title', 'PublicationYear', 'GenreID', 'AuthorID', and 'PublisherID'. The 'GenreID' and 'AuthorID' boxes have dropdown arrows on their right sides. At the bottom of the detail section, there are two buttons: 'Add Record' and 'Delete Record'. The 'Form Footer' section is empty.

Data Entry View:

The data entry view of the 'Book' form shows the form with a light blue header bar containing the title 'Book'. Below the header, the form fields are populated with data: 'ISBN' is '99-0002', 'Title' is 'Harry Potter and the Chamber of Secrets', 'PublicationYear' is '1998', 'GenreID' is '1', 'AuthorID' is '1', and 'PublisherID' is '1'. The 'Add Record' and 'Delete Record' buttons are at the bottom.

2) Borrower

Data Entry Form Design View:

Form Header

Borrower

Detail

BorrowerID	BorrowerID
BorrowerName	BorrowerName
BorrowerJoinDate	BorrowerJoinDat
BorrowerEmail	BorrowerEmail

Add Record Delete Record

Form Footer

Data Entry View:

Borrower

BorrowerID	LB-1
BorrowerName	John
BorrowerJoinDate	1/1/2024
BorrowerEmail	john@gmail.com

Add Record Delete Record

3) Author

Data Entry Form Design View:

Form Header

Author

Detail

AuthorID

AuthorID

AuthorName

AuthorName

ContactDetails

ContactDetails

Add Record

Delete Record

Form Footer

Data Entry View:

Author

AuthorID	<input type="text" value="0"/>
AuthorName	<input type="text"/>
ContactDetails	<input type="text"/>

4) Genre

Data Entry Form Design View:

Form Header

Genre														

Detail

GenreID		GenreID												
GenreName		GenreName												
GenreDescription		GenreDescription												
										Add Record	Delete Record			

Form Footer

Data Entry View:

Genre	
GenreID	<input type="text" value="1"/>
GenreName	<input type="text" value="Fantasy"/>
GenreDescription	<input type="text" value="These are the stories that revolve around magic, witchcraft, supernatural, mythical creatures"/>
<div>Add Record Delete Record</div>	

5) Transaction

Data Entry Form Design View:

Form Header																	
Transaction																	
Form Detail																	
TransactionID		TransactionID															
BorrowerID		BorrowerID															
ISBN		ISBN															
CheckoutDate		CheckoutDate															
DueDate		DueDate															
ReturnDate		ReturnDate															
														Add Record		Delete Record	
Form Footer																	

Data Entry View:

Transaction	
TransactionID	<input type="text" value="1"/>
BorrowerID	<input type="text" value="LB-1"/>
ISBN	<input type="text" value="99-0001"/>
CheckoutDate	<input type="text" value="25/1/2024"/>
DueDate	<input type="text" value="25/2/2024"/>
ReturnDate	<input type="text"/>
<div>Add RecordDelete Record</div>	

6) Publisher

Data Entry Form Design View:

The design view of the Publisher data entry form is structured as follows:

- Form Header:** A light blue header bar with the title "Publisher" on the left.
- Detail:** A section containing three data entry fields:
 - PublisherID:** A small text box.
 - PublisherName:** A larger text box.
 - PublisherHeadquarter:** A text box.
- Form Footer:** A light blue footer bar containing two buttons: "Add Record" and "Delete Record".

Data Entry View:

The data entry view of the Publisher data entry form shows the following data:

Publisher	
PublisherID	1
PublisherName	Bloomsbury
PublisherHeadquarter	UnitedKingdom

At the bottom right, there are two buttons: "Add Record" and "Delete Record".

7) Late Returns

Data Entry Form Design View:

Form Header											
LateReturns											
Detail											
LateReturnID	LateReturnID										
ISBN	ISBN										
BorrowerID	BorrowerID										
DueDate	DueDate										
Fine	Fine										
ReturnDate	ReturnDate										
										Add Record	Delete Record
Form Footer											

Data Entry View:

LateReturns

LateReturnID	<input type="text" value="1"/>
ISBN	<input type="text" value="92-0007"/>
BorrowerID	<input type="text" value="LB-3"/>
DueDate	<input type="text" value="4/3/2024"/>
Fine	<input type="text" value="1"/>
ReturnDate	<input type="text"/>

8) Reservations

Data Entry Form Design View:

Form Header

Reservations														
--------------	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Detail

ReservationID		ReservationID												
BorrowerID		BorrowerID												
ISBN		ISBN												
ReservationDate		ReservationDate												
										Add Record	Delete Record			

Form Footer

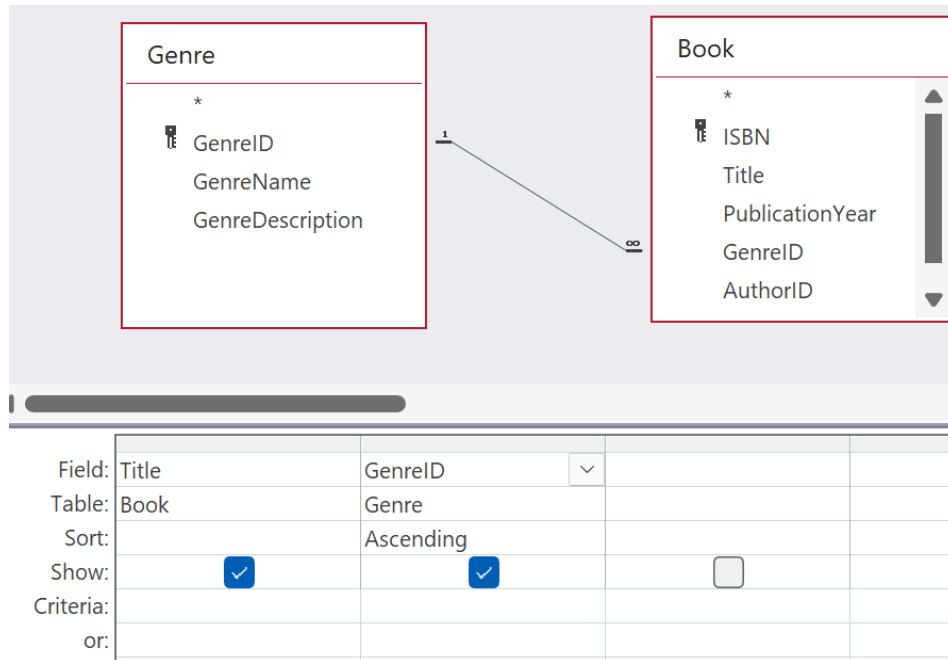
Data Entry View:

Reservations	
ReservationID	<input type="text" value="1"/>
BorrowerID	<input type="text" value="LB-01"/>
ISBN	<input type="text" value="91-4214"/>
ReservationDate	<input type="text" value="1/3/2024"/>
<div>Add RecordDelete Record</div>	

Query

1. List of Books by Genre:

Query Design View:

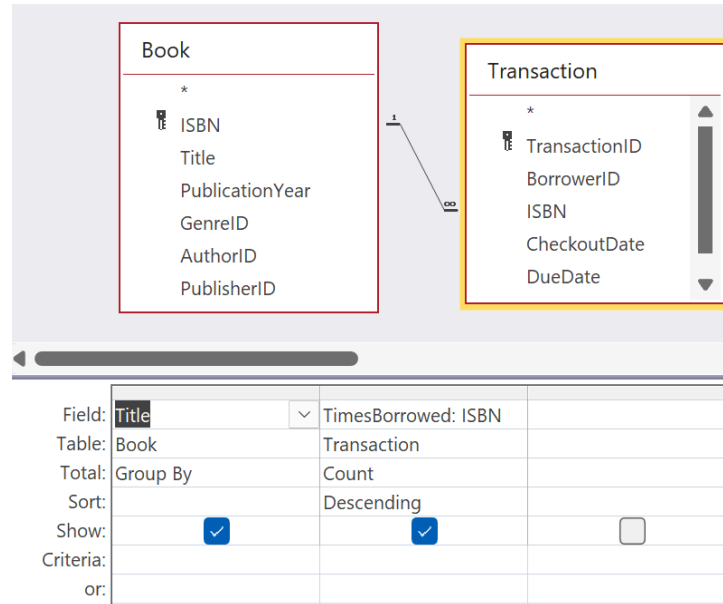


Query Result:

Title	GenreID
Percy Jackson & the Olympian	1
Percy Jackson & the Olympian	1
Harry Potter and the Prisoner of Azkaban	1
Harry Potter and the Chamber of Secrets	1
Harry Potter and the Philosopher's Stone	1
House of Flame and Shadow	1
Rich Dad Poor Dad	2
The Haunting of Hill House	3
Red, White & Royal Blue	4

2. Popular Books Based on Transactions:

Query Design View:

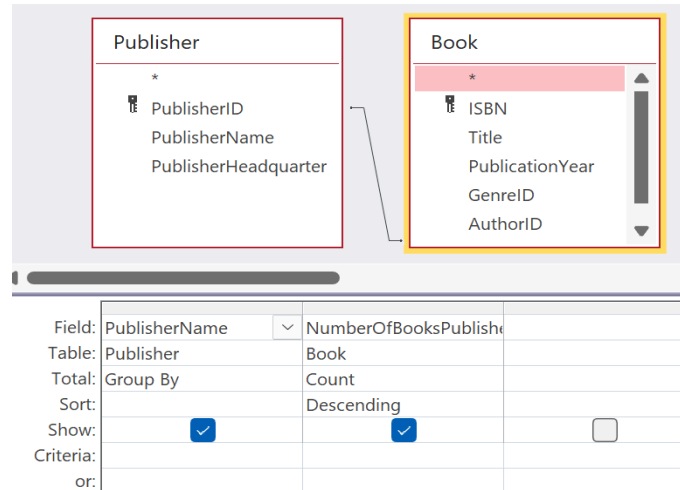


Query Result:

Title ▼	TimesBorrow ▼
The Haunting of Hill House	1
Rich Dad Poor Dad	1
Percy Jackson & the Olympians: The Sea of Monsters	1
Percy Jackson & the Olympians: The Lightning Thief	1
Harry Potter and the Philosopher's Stone	1

3. Publisher Book Count:

Query Design View:



	Publisher		Book
	*		*
	PublisherID		ISBN
	PublisherName		Title
	PublisherHeadquarter		PublicationYear
			GenreID
			AuthorID

Field:	PublisherName	▼	NumberOfBooksPublished	
Table:	Publisher		Book	
Total:	Group By		Count	
Sort:			Descending	
Show:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input type="checkbox"/>
Criteria:				
or:				

Query Result:

PublisherName ▼	NumberOfBooksPublished ▼
Bloomsbury	4
Miramax	2
Viking	1
St Martin's Griffin	1
Plata Publishing	1

4. Late Returns Report:

Query Design View:

Query Design View diagram showing relationships between Borrower, LateReturns, and Book tables. Borrower (1) is connected to LateReturns (8) via BorrowerID. LateReturns (1) is connected to Book (8) via ISBN. The Book table is highlighted with a yellow border.

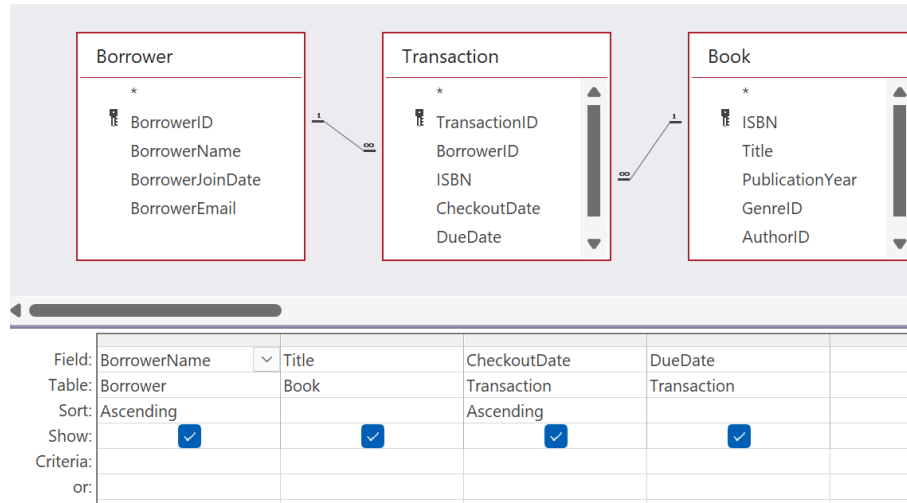
Field:	BorrowerName	Title	DueDate	Fine	DueDate	ReturnDate
Table:	Borrower	Book	LateReturns	LateReturns	LateReturns	LateReturns
Sort:				Descending	Ascending	
Show:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Criteria:						>[LateReturns].[DueDate] Or Is Null
or:						

Query Result:

BorrowerName	Title	DueDate	Fine
John	Percy Jackson & the Olympians: The Lightning Thief	25/2/2024	5
John	Harry Potter and the Philosopher's Stone	25/2/2024	5
Shaun	Percy Jackson & the Olympians: The Sea of Monsters	1/3/2024	4
Jeremy	Rich Dad Poor Dad	2/3/2024	3
Jeremy	The Haunting of Hill House	4/3/2024	1

5. Borrower Loan History:

Query Design View:

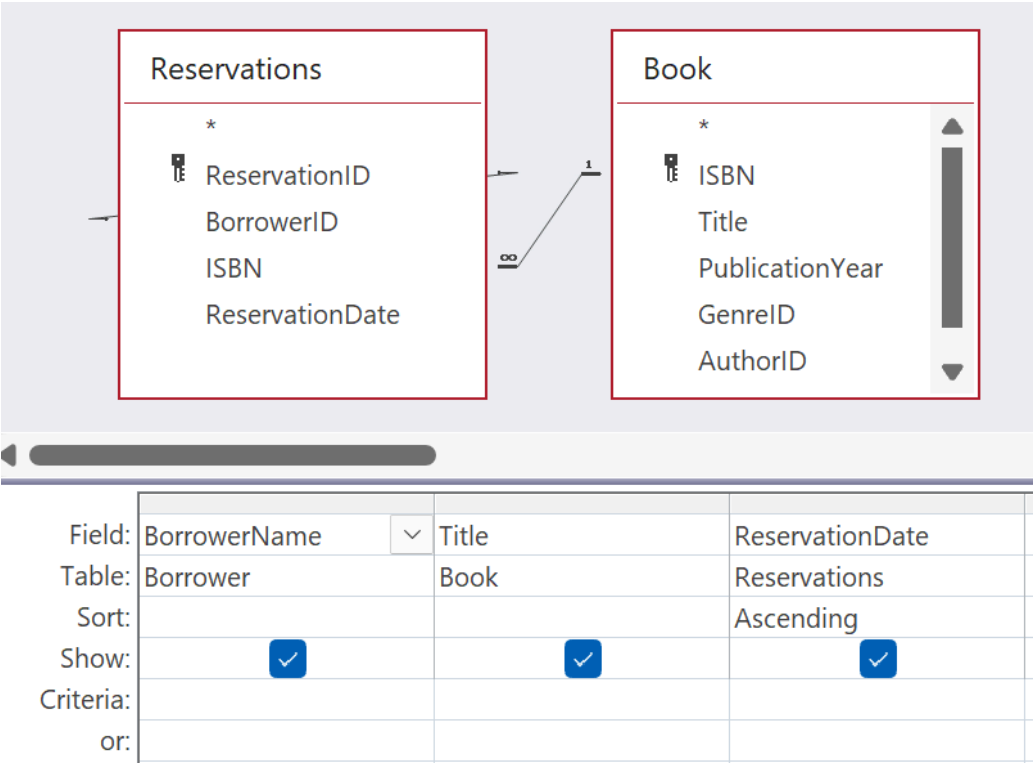


Query Result:

BorrowerName ▾	Title ▾	CheckoutDate ▾	DueDate ▾
Jeremy	Rich Dad Poor Dad	2/2/2024	2/3/2024
Jeremy	The Haunting of Hill House	3/2/2024	3/3/2024
John	Percy Jackson & the Olympians: The Lightning Thief	25/1/2024	25/2/2024
John	Harry Potter and the Philosopher's Stone	25/1/2024	25/2/2024
Shaun	Percy Jackson & the Olympians: The Sea of Monsters	1/2/2024	1/3/2024

6. Popular Books Based on Transactions:

Query Design View:



Query Result:

ReservationID	BorrowerID	ISBN	ReservationDate
1	LB-01	91-4214	1/3/2024
2	LB-01	92-0007	1/3/2024
3	LB-02	99-0001	23/2/2024
4	LB-03	91-4214	29/2/2024
5	LB-04	99-0002	2/3/2024

Access Report

Individual Book Report:

- Detail: Data about a specific book, including title, author, genre, and publication year.
- Itemized: List of all transactions associated with the book.
- Aggregate: Total number of times the book has been checked out.

Individual Book Report				
AuthorName	Title	PublicationYear	GenreName	CheckoutDate
Casey McQuiston	Red, White & Royal Blue	2019	Romance	
J. K. Rowling	Harry Potter and the Chamber of Secrets	1998	Fantasy	
	Harry Potter and the Philosopher's Stone	1997	Fantasy	
				4/2/2024
				25/1/2024
	Harry Potter and the Prisoner of Azkaban	1999	Fantasy	
Rick Riordan	Percy Jackson & the Olympians: The Lightning	2005	Fantasy	
				25/1/2024
	Percy Jackson & the Olympians: The Sea of	2006	Fantasy	

Borrower Loan History Report:

- Detail: Borrower's information, including name
- Itemized: List of all the books borrowed by the individual, including checkout date
- Aggregate: Total number of books borrowed

Borrower Loan History Record

BorrowerName	BorrowerID	CheckoutDate	Title
Jane	LB-4	4/2/2024	Harry Potter and the Philosopher's Stone
Jeremy	LB-3	2/2/2024	Rich Dad Poor Dad
		3/2/2024	The Haunting of Hill House
John	LB-1	25/1/2024	Percy Jackson & the Olympians: The Ligh
Shaun	LB-2	25/1/2024	Harry Potter and the Philosopher's Stone
		1/2/2024	Percy Jackson & the Olympians: The Sea

Publisher Catalog Report:

- Detail: Publisher's name and contact details.
- Itemized: Catalog of books published by them, including titles and authors.
- Aggregate: Total number of books published by the publisher.

Publisher

PublisherName	Title	AuthorName
Bloomsbury	Harry Potter and the Chamber of Secrets	J. K. Rowling
	Harry Potter and the Philosopher's Stone	J. K. Rowling
	Harry Potter and the Prisoner of Azkaban	J. K. Rowling
Miramax	House of Flame and Shadow	Sarah J. Maas
	Percy Jackson & the Olympians: The Ligh	Rick Riordan
	Percy Jackson & the Olympians: The Sea	Rick Riordan
Plata Publishing	Rich Dad Poor Dad	Robert Kiyosaki
St Martin's Griffin	Red, White & Royal Blue	Casey McQuiston
Viking	The Haunting of Hill House	Shirley Jackson

Book Genre Popularity Report:

- Detail: Specific genre information.

- Itemized: List of all books within that genre, including how often each was borrowed.
- Aggregate: Total number of books and total borrowings for that genre.

Book Genre Popularity Report				
GenreName	GenreDescription	BorrowCount	Title	ISBN
Fantasy	These are the stories that revolve around	0	House of Flame and Shadow	91-4214
		0	Harry Potter and the Prisoner of Azka	99-0003
		0	Harry Potter and the Chamber of Secr	99-0002
		1	Percy Jackson & the Olympians: The Sr	98-0103
		1	Percy Jackson & the Olympians: The Li	98-0102
		2	Harry Potter and the Philosopher's Stc	99-0001
Horror	Horror is a genre that seeks to provoke fear.			
		1	The Haunting of Hill House	92-0007
Personal Finance	Personal finance is the financial management that			
		1	Rich Dad Poor Dad	94-1234
Romance	In romance novels, the plot is all about the			
		0	Red, White & Royal Blue	91-2233

Late Returns Report by Borrower:

- Detail: Borrower's information.
- Itemized: List of all late returns by the borrower, including the fines incurred.
- Aggregate: Total number of late returns and total fines owed by the borrower.

Late Returns Report by Borrower

BorrowerName	BorrowerID	Title	ReturnDate	DueDate	IsLate
John	LB-1	Percy Jackson & the Olympians	16/3/2024	25/2/2024	Yes
		Harry Potter and the Philosoph	24/3/2024	25/2/2024	Yes
Shaun	LB-2	Percy Jackson & the Olympians	12/3/2024	1/3/2024	Yes
Jeremy	LB-3	The Haunting of Hill House	20/3/2024	3/3/2024	Yes
		Rich Dad Poor Dad	20/3/2024	2/3/2024	Yes

Reservation Activity Report:


- Detail: Data on a specific book.
- Itemized: List of all reservations made for the book, including borrower's names and reservation dates.
- Aggregate: Total number of reservations made for the book.


Total Reservations


Title	ISBN	ReservationDate	BorrowerName
House of Flame and Shadow	91-4214	29/2/2024	Jeremy
		1/3/2024	John
The Haunting of Hill House	92-0007	1/3/2024	John
		23/2/2024	Shaun
Harry Potter and the Philosopher's Stone	99-0001	2/3/2024	Jane
Harry Potter and the Chamber of Secrets	99-0002	2/3/2024	Jane
		2/3/2024	Jane


6. Indexes:

- Create indexes on fields frequently used in queries for faster data retrieval (e.g., ISBN, BorrowerID).


Indexes: Book
×

	Index Name	Field Name	Sort Order
	AuthorID	AuthorID	Ascending
	GenreID	GenreID	Ascending
	PrimaryKey	ISBN	Ascending
	PublisherID	PublisherID	Ascending


Indexes: Transaction
×

	Index Name	Field Name	Sort Order
	BorrowerID	BorrowerID	Ascending
	PrimarvKey	TransactionID	Ascending

Database Integration

Database Integration is the process of combining data from different sources or databases to provide a unified view or functionality. It involves merging data from different systems, formats or platforms into a single, coherent database. This allows for streamline data management which improves data accessibility, and facilitates efficient data analysis and reporting.

The three challenge for a DBMS to accomplish database integration

- 1) **Heterogeneous Data Formats and Structures:** Different databases may use different data types, schemas, and encoding standards, making it difficult to map and transform data from one format to another. For example, libraries may have data on transaction, book, borrower and other more in separate data systems. DBMS must implement robust data transformation mechanisms to reconcile these differences and ensure compatibility between integrated databases.
- 2) **Data Consistency and Quality:** Integrated databases may contain redundant, inconsistent, or conflicting data due to differences in data semantics, integrity constraints, or data entry errors. DBMS must implement mechanisms for data cleaning, validation, and reconciliation to detect and resolve discrepancies between integrated datasets.
- 3) **Real-Time Data Integration and Synchronization:** As data will be continuously modified or updated in different databases and to ensure that the changes can be synchronized and propagated in real-time, efficient data replication, transaction management and conflict resolution mechanisms will be important. DBMS will be required to implement processing methods or mechanisms to achieve real-time data integration and synchronization with minimal latency and overhead.

Proposed Approach to integrate

One approach will be Data Federation, it is a method of data integration that offers a cohesive perspective of dispersed data sources without the need to physically relocate or consolidate the data. It allows applications to query and access from multiple sources as if it were stored in a single database. Below will state some of the benefits of why data federation is cost effective and practical.

- **Reduce data redundancy:** Since this approach does not require data duplication, Organization can avoid replicating data across multiple systems thus leading to more efficient use of storage resources.
- **Scalability and Flexibility:** Data federation scales easily to accommodate growing data volumes, user concurrency and query complexity. This means that organisations can add new data sources or modify existing ones without disrupting existing systems.
- **Lower integration costs:** Compared to traditional data integration approaches such as ETL (Extract, Transform, Load), data federation can be much more cost-effective. As it eliminates the need of upfront data replication, transformation and consolidation efforts. Therefore reducing integration complexity and costs.