Alexandria University

Faculty of Engineering

Computer and Communications Engineering (CCE)

Online Bookstore System

Database Analysis, Design, and Implementation Report

Course: Database Systems (Fall 2025)

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1 Introduction

This report details the architectural design, database schema, and full-stack implementation of a robust Online Bookstore System. The project aims to simulate a real-world e-commerce environment facilitating interaction between two primary user roles: **Customers** and **Administrators**.

The system is designed to handle complex relational data including inventory management, automated procurement triggers, and secure transaction processing. Special attention was given to data integrity, ACID properties in transactions, and responsive user interface design.

1.1 Technology Stack

The system is built upon a modern, scalable architecture:

- **Frontend:** Client-side application for user interaction (React.js).
- **Backend:** Server-side logic handling API requests (Node.js/Express).
- **Database:** MySQL (Relational Database Management System).

2 Database Design

2.1 Entity Relationship Diagram (ERD)

The logical structure of the database models the complex relationships between Books, Authors, Publishers, and Users. The design adheres to normalization principles to reduce redundancy.

Below is the conceptual ERD using Crow's Foot notation to denote cardinality (One-to-Many, Many-to-Many).

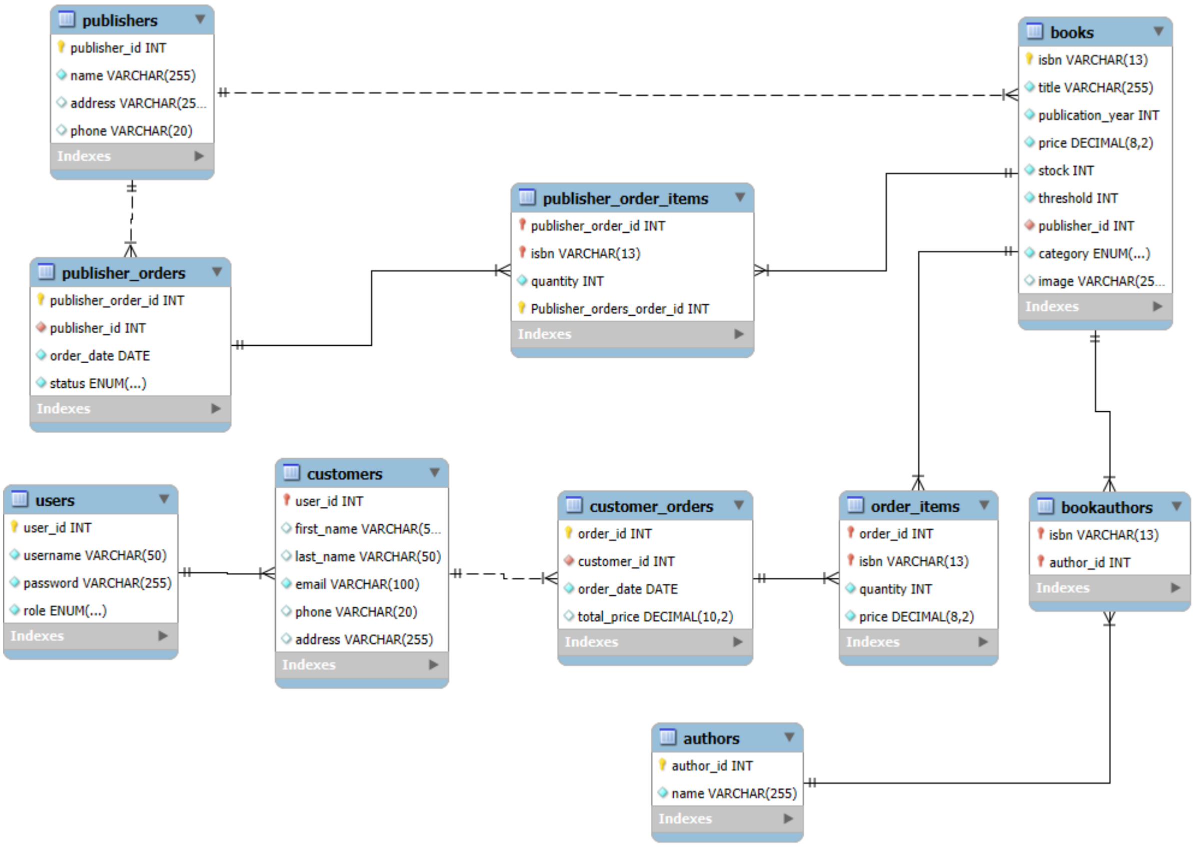


Figure 1: Bookstore System Entity Relationship Diagram

2.2 Relational Schema

The database implementation consists of the following normalized relations. Primary Keys (PK) are underlined, and Foreign Keys (FK) link entities.

users (user_id, username, password, role)

customers (user_id, first_name, last_name, email, phone, address)

publishers (publisher_id, name, address, phone)

books (isbn, title, publication_year, price, stock, threshold, category, image, publisher_id)

authors (author_id, name)

bookauthors (isbn, author_id)

customer_orders (order_id, customer_id, order_date, total_price)

order_items (order_id, isbn, quantity, price)

publisher_orders (publisher_order_id, publisher_id, order_date, status)

publisher_order_items (publisher_order_id, isbn, quantity)

3 System Implementation Features

3.1 Security Module

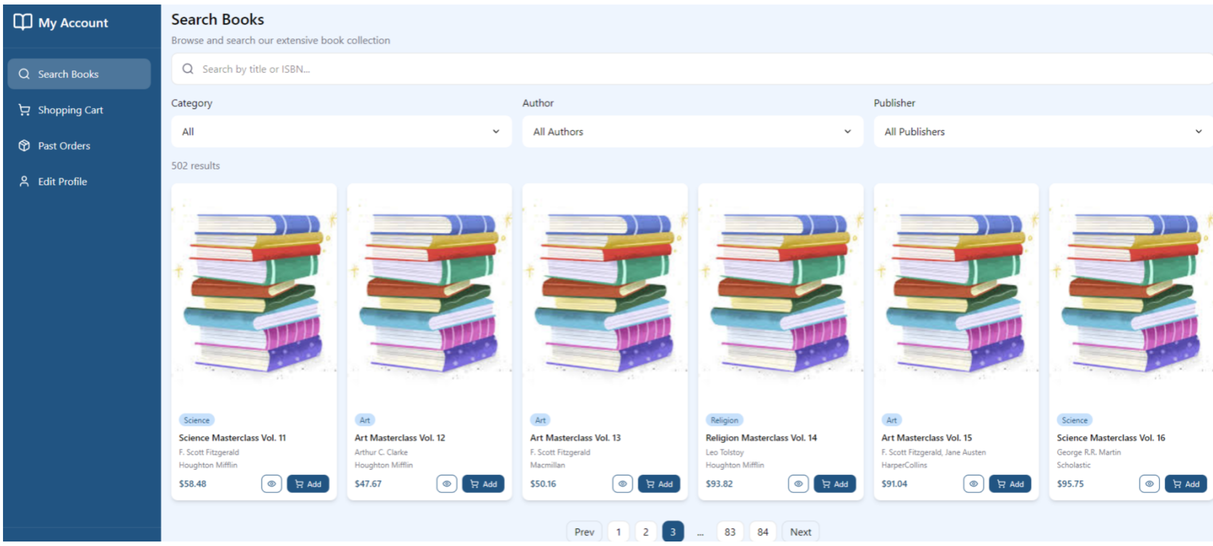
Security is enforced at both the database and application levels.

- **Password Hashing:** User passwords are never stored in plain text. The system uses secure hashing algorithms before storage.
- **Authentication:** Session management is handled via `access_token` stored in HTTP-Only cookies to prevent Cross-Site Scripting (XSS).
- **Role-Based Access Control (RBAC):** Middleware intercepts requests to ensure only users with role 'admin' can access inventory modification endpoints.

3.2 Customer Module

The customer interface focuses on a seamless shopping experience.

- **Advanced Search Filtering:** Users can filter the book catalog dynamically by Category, Author, or Publisher using optimized SQL queries.



Search Books

Browse and search our extensive book collection

Search by title or ISBN...

Category: All

Author: All Authors

Publisher: All Publishers

502 results

Science
Science Masterclass Vol. 11
F. Scott Fitzgerald
Houghton Mifflin
$58.48

Art
Art Masterclass Vol. 12
Arthur C. Clarke
Houghton Mifflin
$47.67

Art
Art Masterclass Vol. 13
F. Scott Fitzgerald
Macmillan
$50.16

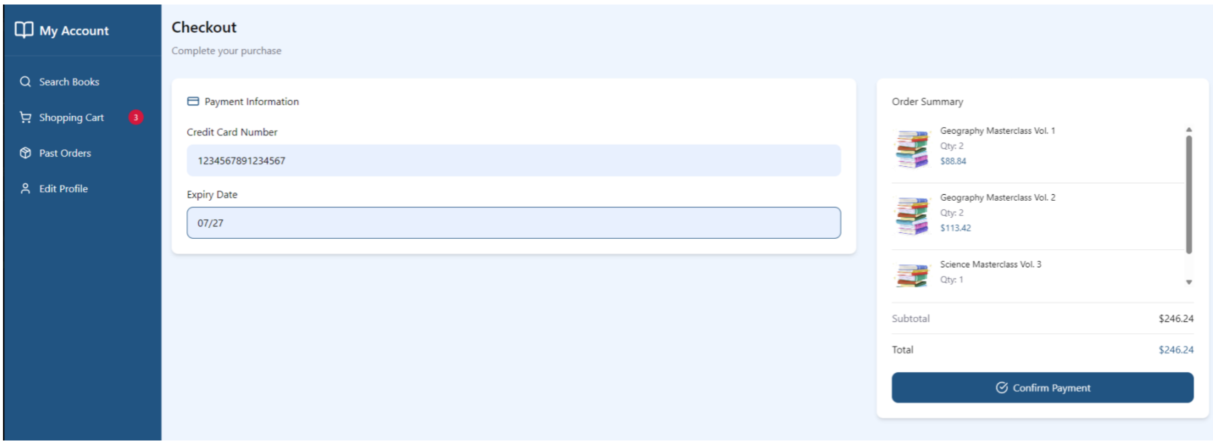
Religion
Religion Masterclass Vol. 14
Leo Tolstoy
Houghton Mifflin
$93.82

Art
Art Masterclass Vol. 15
F. Scott Fitzgerald, Jane Austen
HarperCollins
$91.04

Science
Science Masterclass Vol. 16
George R.R. Martin
Scholastic
$95.75

Figure 2: Bookstore System Entity Relationship Diagram

- **Shopping Cart Management:** A persistent client-side cart allows users to accumulate items before purchase.
- **Atomic Checkout:** The `/checkout` endpoint wraps multiple SQL operations (Order Creation, Order Items Insertion, Stock Deduction) into a single ACID transaction using `db.beginTransaction()` and `db.commit()`.



Checkout

Complete your purchase

Payment Information

Credit Card Number: 1234567891234567

Expiry Date: 07/27

Order Summary

Geography Masterclass Vol. 1
Qty: 2
$88.84

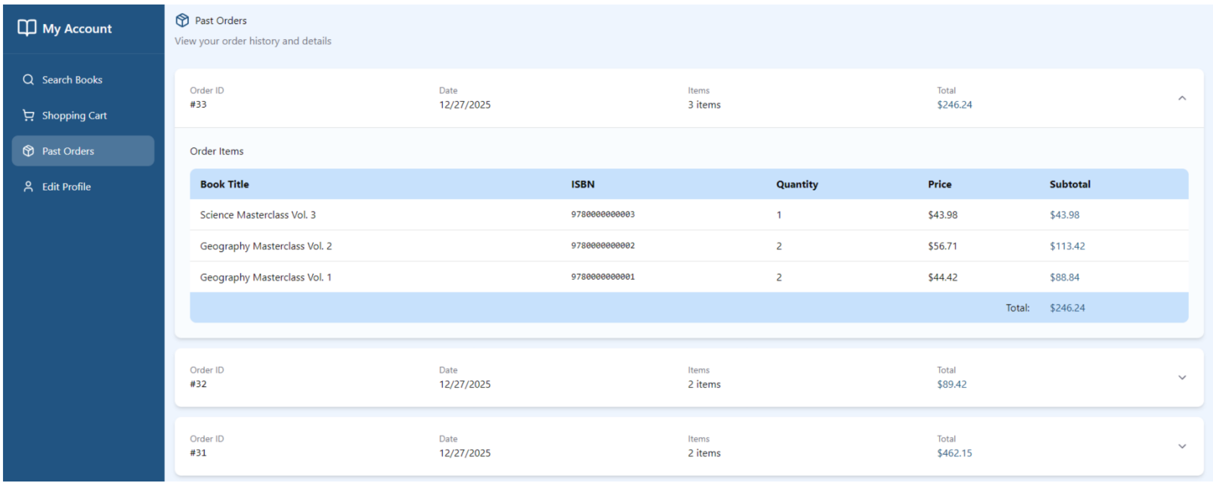
Geography Masterclass Vol. 2
Qty: 2
$113.42

Science Masterclass Vol. 3
Qty: 1

Subtotal	$246.24
Total	$246.24

Figure 3: Bookstore System Entity Relationship Diagram

- **Order History:** Customers can view a detailed log of their past purchases, including dates and total expenditure.



Past Orders

View your order history and details

Order ID	Date	Items	Total
#33	12/27/2025	3 items	$246.24

Order Items

Book Title	ISBN	Quantity	Price	Subtotal
Science Masterclass Vol. 3	9780000000003	1	$43.98	$43.98
Geography Masterclass Vol. 2	9780000000002	2	$56.71	$113.42
Geography Masterclass Vol. 1	9780000000001	2	$44.42	$88.84
			Total:	$246.24

Order ID	Date	Items	Total
#32	12/27/2025	2 items	$89.42
#31	12/27/2025	2 items	$462.15

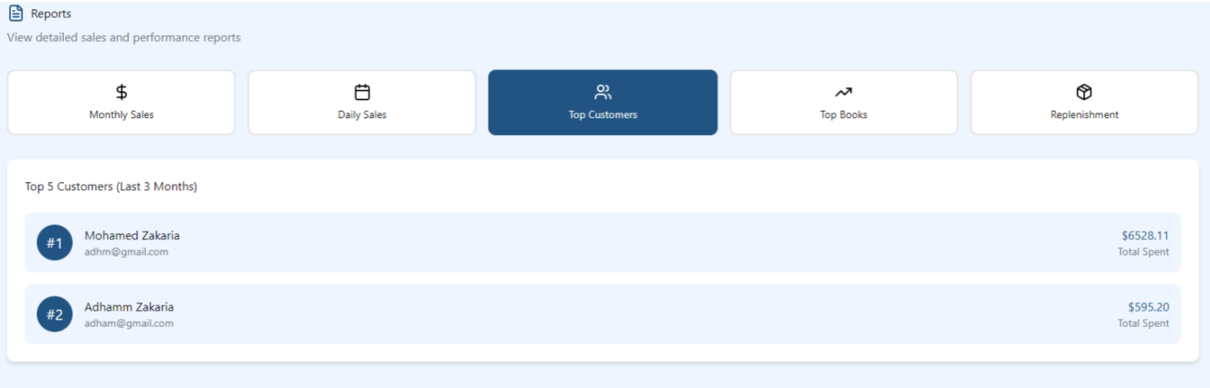
Figure 4: Bookstore System Entity Relationship Diagram

3.3 Administrator Module

The Admin Dashboard provides high-level control over the system's inventory and business logic.

- **Inventory Management:** Full CRUD capabilities for books. Admins can update pricing, upload cover images, and set stock thresholds.
- **Automated Stock Triggers:**
  - *Negative Stock Prevention:* A `BEFORE UPDATE` trigger rejects any transaction that would result in negative stock.
  - *Auto-Procurement:* An `AFTER UPDATE` trigger automatically generates a `publisher_order` when stock falls below the defined threshold.

- **Publisher Order Confirmation:** Admins can review pending orders generated by the system. Confirming an order automatically adds the quantity back to the book's stock via a stored procedure.
- **Analytics Dashboard:** Visualization of key performance indicators (KPIs) including:
  - Total Revenue (Last 30 Days)
  - Top 5 Best-Selling Books
  - Top 5 Most Active Customers



Top 5 Customers (Last 3 Months)

#1	Mohamed Zakaria adhm@gmail.com	$6528.11 Total Spent
#2	Adhamm Zakaria adham@gmail.com	$595.20 Total Spent

Figure 5: Bookstore System Entity Relationship Diagram

4 Team Contributions

The project workload was distributed to leverage individual strengths in Full-Stack development and Database theory.

Member	Role	Primary Responsibilities
Hazem Barakat	Frontend Lead	React UI architecture, State Management, Integration, Auth Pages, and UX Design.
Ahmed Saied	Backend Engineer	Customer API implementation, Secure Transaction/Checkout Logic, and Shopping Cart validation.
Adham Zakaria	Backend Engineer	Admin API implementation, System Reports (Analytics endpoints), and Publisher Order logic.
Begad Mohamed	Database Architect	ERD Design, Schema Normalization, SQL Triggers (Auto-Order, Stock Safety), and Data Seeding.

Table 1: Project Task Distribution