University of Minho
Department of Computer Science

Practical Assignment 2024/2025

Course: MSc in Informatics/ MSc in Bioinformatics
U.C.: NoSQL Databases

Library Database Project

The goal of this practical assignment is to equip students enrolled in the NoSQL Databases course with the necessary skills to understand and utilize different database paradigms. This includes their practical application in system design and implementation.

Each student group is expected to analyze, design, and implement a relational database alongside two non-relational database models. To achieve this, they must use the Bookstore Management System relational database, whose customized SQL scripts will be provided on the e-learning platform.

The provided Oracle database represents a fictitious library and includes various database objects such as tables, views, sequences, indexes, triggers, and procedures.

Database Structure

The relational database includes the following tables:

- **book**: a list of all books available in the store.
- **book_author**: stores the authors for each book, which is a many-to-many relationship.
- **author**: a list of all authors.
- **book_language**: a list of possible languages of books.
- **publisher**: a list of publishers for books.
- **customer**: a list of the customers of the Gravity Bookstore.
- **customer_address**: a list of addresses for customers, as a customer can have more than one address, and an address has more than one customer.
- **address_status**: a list of statuses for an address, because addresses can be current or old.
- **address**: a list of addresses in the system.
- **country**: a list of countries that addresses are in.
- **cust_order**: a list of orders placed by customers.
- **order_line**: a list of books that are a part of each order.
- **shipping_method**: the possible shipping methods for an order.
- **order_history**: the history of an order, such as ordered, cancelled, delivered.
- **order_status**: the possible statuses of an order.

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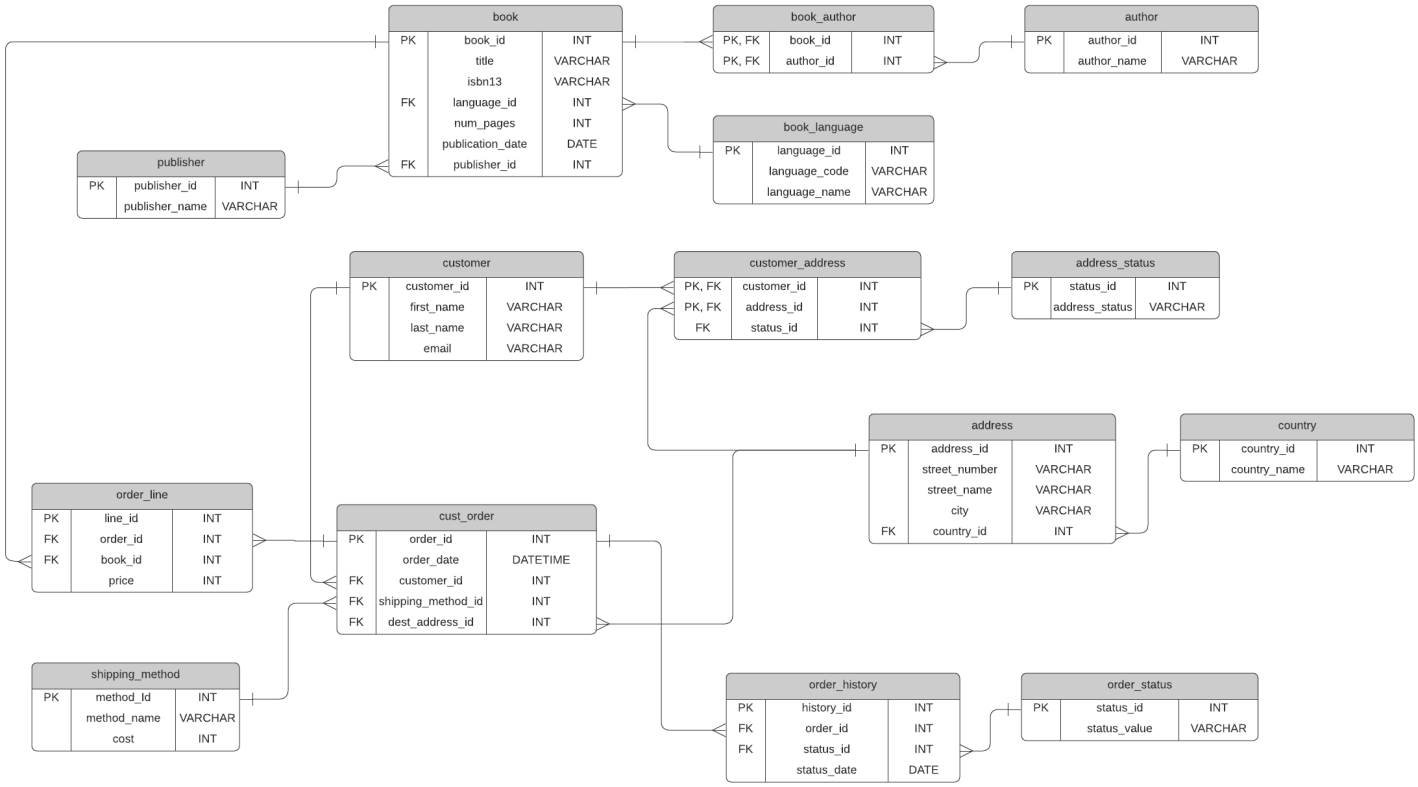

After implementing the relational model, students must convert the Bookstore Management System into two NoSQL database models: Document-oriented Database (MongoDB) and Graph Database (Neo4j).

After gaining familiarity with each database model, each group must undertake the following key tasks:

- **Data Modeling**: Analyze the requirements and design an appropriate data model tailored for the NoSQL database, taking into account the specific use case, scalability, and query patterns. Ensure the data model aligns with the strengths of the chosen NoSQL paradigm (e.g., document-based, key-value, column-family, or graph database).
- **Data Migration & Optimization**: Based on the provided relational schema, define and explain the processes required to migrate the data to the new non-relational systems while maximizing the benefits of each paradigm. It is recommended to use Python scripts.
- **Migration of Database Objects**: In addition to tables, students must migrate triggers, sequences, functions, stored procedures, and indexes, ensuring that business rules, data integrity, and system automation are properly replicated in the new NoSQL systems.
- **Query Implementation & Demonstration**: Design and execute a comprehensive set of queries to demonstrate the functionality and operability of the implemented NoSQL systems.
- **Comparative Analysis**: Conduct a critical evaluation of the work done, comparing the efficiency, scalability, and query capabilities of the NoSQL models with the original relational system.

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Report

At the project's conclusion, each group must create a clear, concise, and well-structured technical report that documents their work. The report should include:

- A detailed presentation of the implemented Database Management Systems (DBMS).
- Strategies for data migration and system implementation.
- A comparative analysis of the advantages and challenges of transitioning from relational to NoSQL databases.
- An evaluation of the performance, scalability, and efficiency of the tested database models.
- Approaches for migrating database objects like triggers, stored procedures, and sequences to NoSQL.
- Recommendations and future considerations for system improvements.

This project will allow students to understand the differences, advantages, and limitations of various database paradigms and their impact on system architecture and performance.

Submission and Presentation

The final report of the practical work, along with all relevant materials, must be submitted in a zip format on the eLearning by 24 hours on June 3, 2025. The zip file should be named: TP_[GROUPX].zip.

The presentation will be made to the course professors and will include an overview of the work completed, a demonstration of the implemented databases, and an exhibition of the defined and created queries. All group members are required to be present during the presentation.

Professors

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