**Data Structures and Algorithms**

**ASSIGNMENT 4**

**Spring 2024**

**Case Study: Online Bookstore Inventory Management**

You have been tasked with developing an inventory management system for an online bookstore using AVL trees to efficiently organize and manage book information. Each book in the inventory is identified by a unique ISBN (International Standard Book Number) and has the following attributes:

* ISBN
* Title
* Author
* Genre
* Price
* Quantity Available

Your task is to implement various functionalities to manipulate book information and inventory efficiently using AVL trees.

1. **AVL Tree Initialization:**
   * Implement a function/method to initialize an AVL tree to store book information.
2. **Insertion of Book Information:**
   * Write a function/method to insert new book information into the AVL tree based on the ISBN.
   * Ensure that the AVL tree remains balanced after each insertion operation.
3. **Deletion of Book Information:**
   * Implement a function/method to delete book information from the AVL tree based on the ISBN.
   * Ensure that the AVL tree remains balanced after each deletion operation.
4. **Search for Books:**
   * Write a function/method to search for books based on the ISBN, title, author, or genre.
   * Return a list of books that match the search criteria.
5. **Book Ordering:**
   * Implement a function/method to place an order for a specific quantity of books.
   * Update the quantity available for the ordered books accordingly.
6. **Inventory Replenishment:**
   * Write a function/method to replenish the inventory by adding a specific quantity of books to the existing stock.
   * Update the quantity available for the replenished books accordingly.
7. **Sales and Revenue Tracking:**
   * Implement functions/methods to track sales and revenue generated from book sales.
   * Update sales and revenue information whenever a book is sold.
8. **Display Book Inventory:**
   * Write a function/method to display the book inventory, including ISBN, title, author, genre, price, and quantity available.
9. **Performance Analysis:**
   * Analyze the performance of AVL trees in terms of insertion, deletion, and search operations for managing book information and inventory.
   * Compare the time complexity of these operations with those in other data structures such as hash tables or binary search trees.
   * Discuss the advantages of using AVL trees over other data structures for managing large-scale book inventories.
10. **Error Handling and Exception Handling:**
    * Handle possible errors or exceptional cases such as duplicate ISBNs during insertion, deletion of non-existent books, etc.

**Note:** You may choose any programming language to implement the functionalities mentioned above. Ensure that your implementation is well-commented and thoroughly tested with various scenarios to validate its correctness and efficiency.

**VERY IMPORTANT**

* Academic integrity is expected of all the students. Plagiarism or cheating in any assessment will result in negative marking or an **F** grade in the course, and possibly more severe penalties.