DEPARTMENT OF COMPUTER ENGINEERING

A. Y. 2025-26 Semester-I

MINI PROJECT REPORT

Subject: Data Structures Laboratory

Group No. : MP 1

Title of the Project: Library Management System

Group Members:

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Data Structures Used: Array,Simple queue (using array),Dictionary
Algorithm : Binary Search,Quick sort

Mini-Project Idea:
The Library Management System is designed to manage a digital library where users can search, add, remove, and issue books efficiently.
The system demonstrates how Data Structures and Algorithms can be applied to manage large collections of books quickly and effectively.

Input:

- Book details (Title, Author, ISBN, Genre)
- User requests (Search, Add, Issue, Return)

Output:

- Displays search results for books
- Shows successful addition, issue, or return messages
- Maintains lists of available and issued books

Techniques Used:

- Efficient searching using Binary Search
- Fast sorting using Quick Sort
- Data management using Array, Simple Queue, and Dictionary

Program:

Data Structure	**Purpose**	**Implementation**
Array (List)	To store the collection of books in sorted order for binary search	Python list
Simple Queue (using Array)	To maintain the waitlist for issued books	Enqueue and Dequeue operations implemented using lists

CODE:-

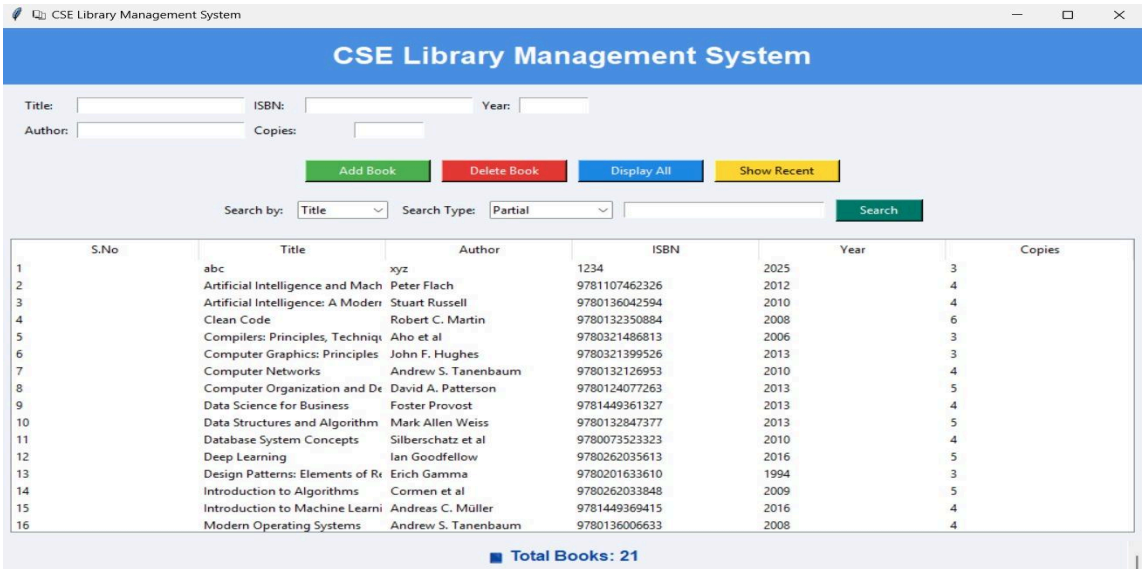
```
# ---------------------- DATA & GLOBALS ----------------------
books = []
recent_books = []
MAX_QUEUE_SIZE = 5
excel_file = "cse_books.xlsx"

# ---------------------- DATA STRUCTURE FUNCTIONS ----------------------
def quick_sort(arr, key="Title"):
    if len(arr) <= 1:
        return arr
    pivot = arr[len(arr)//2][key]
    left = [x for x in arr if x[key].lower() < pivot.lower()]
    middle = [x for x in arr if x[key].lower() == pivot.lower()]
    right = [x for x in arr if x[key].lower() > pivot.lower()]
    return quick_sort(left, key) + middle + quick_sort(right, key)

def binary_search(arr, keyword, key="Title"):
    low, high = 0, len(arr)-1
    keyword = keyword.lower()
    while low <= high:
        mid = (low+high)//2
        mid_val = arr[mid][key].lower()
```

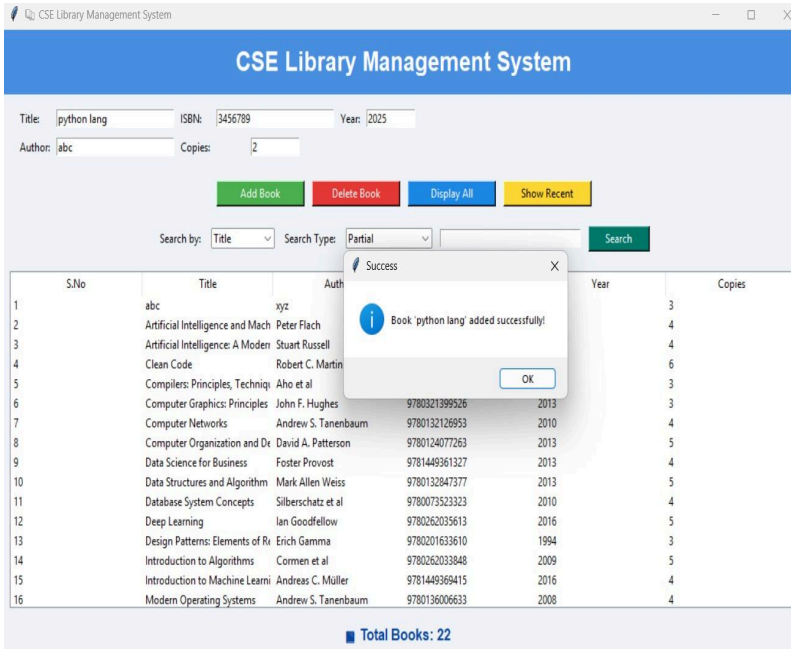
```
        if mid_val == keyword:
            return arr[mid]
        elif mid_val < keyword:
            low = mid+1
        else:
            high = mid-1
    return None

# ---------- LOAD & SAVE ----------
def load_books():
    global books
    if os.path.exists(excel_file):
        df = pd.read_excel(excel_file)
        books = df.to_dict('records')
    else:
        books = []
        save_books()

def save_books():
    df = pd.DataFrame(books)
    df.to_excel(excel_file, index=False)
    update_count_label()

# ---------- BOOK OPERATIONS ----------
def add_book():
    title = title_var.get().strip()
    author = author_var.get().strip()
    isbn = isbn_var.get().strip()
    year = year_var.get().strip()
    copies = copies_var.get().strip()

    if not title or not author or not isbn or not copies:
        messagebox.showwarning("Warning", "Please fill in all fields!")
        return

    try:
        year = int(year)
        copies = int(copies)
    except:
        messagebox.showwarning("Warning", "Year and Copies must be integers!")
        return

    books.append({"Title": title, "Author": author, "ISBN": isbn, "Year": year, "Copies": copies})
    recent_books.append(title)
    if len(recent_books) > MAX_QUEUE_SIZE:
```

```
        recent_books.pop(0)

    save_books()
    refresh_table()
    messagebox.showinfo("Success", f"Book '{title}' added successfully!")

def delete_book():
    selected = tree.focus()
    if not selected:
        messagebox.showwarning("Warning", "Select a book to delete!")
        return
    values = tree.item(selected, "values")
    title_to_delete = values[1]

    global books
    books = [b for b in books if b["Title"] != title_to_delete]

    save_books()
    refresh_table()
    messagebox.showinfo("Deleted", f"Book '{title_to_delete}' deleted.")

def search_books():
    keyword = search_var.get().strip()
    if not keyword:
        messagebox.showinfo("Info", "Enter a keyword to search.")
        return
    mode = search_mode.get()  # Title, Author, ISBN
    stype = search_type.get()  # Partial or Exact
    for row in tree.get_children():
        tree.delete(row)

    found = False
    if stype == "Exact (Binary)":
        sorted_books = quick_sort(books, key=mode)
        result = binary_search(sorted_books, keyword, key=mode)
        if result:
            tree.insert("", "end", values=(1, result["Title"], result["Author"], result["ISBN"], result["Year"],
result["Copies"]))
            found = True
    else:  # Partial search
        for i, book in enumerate(books):
            if keyword.lower() in str(book[mode]).lower():
                tree.insert("", "end", values=(i+1, book["Title"], book["Author"], book["ISBN"], book["Year"],
book["Copies"]))
                found = True
```

```
    if not found:
        messagebox.showinfo("No Results", "No books found matching your keyword.")

def display_all():
    refresh_table()

def show_recent():
    if not recent_books:
        messagebox.showinfo("Recent Books", "No recent books added yet.")
        return
    msg = "\n".join(recent_books)
    messagebox.showinfo("Recently Added Books", msg)
```

Output:

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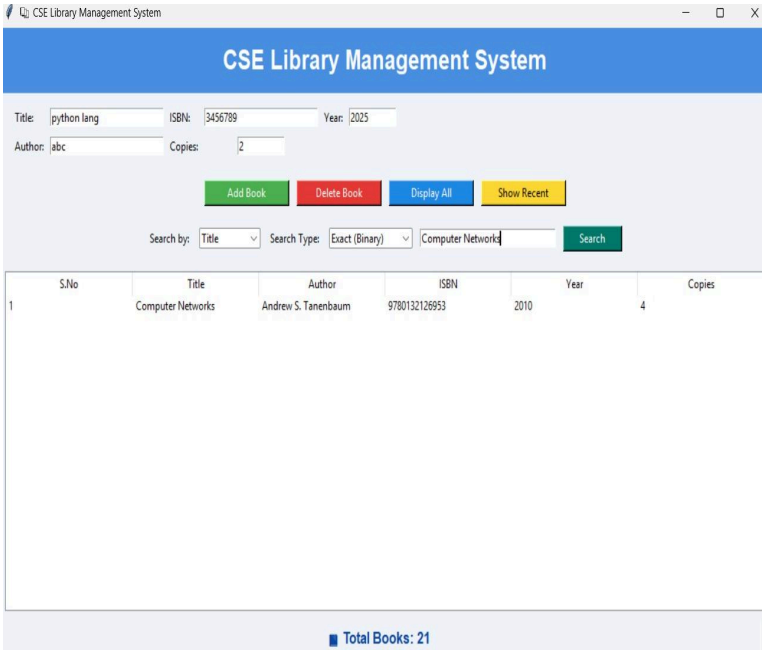
Total Books: 22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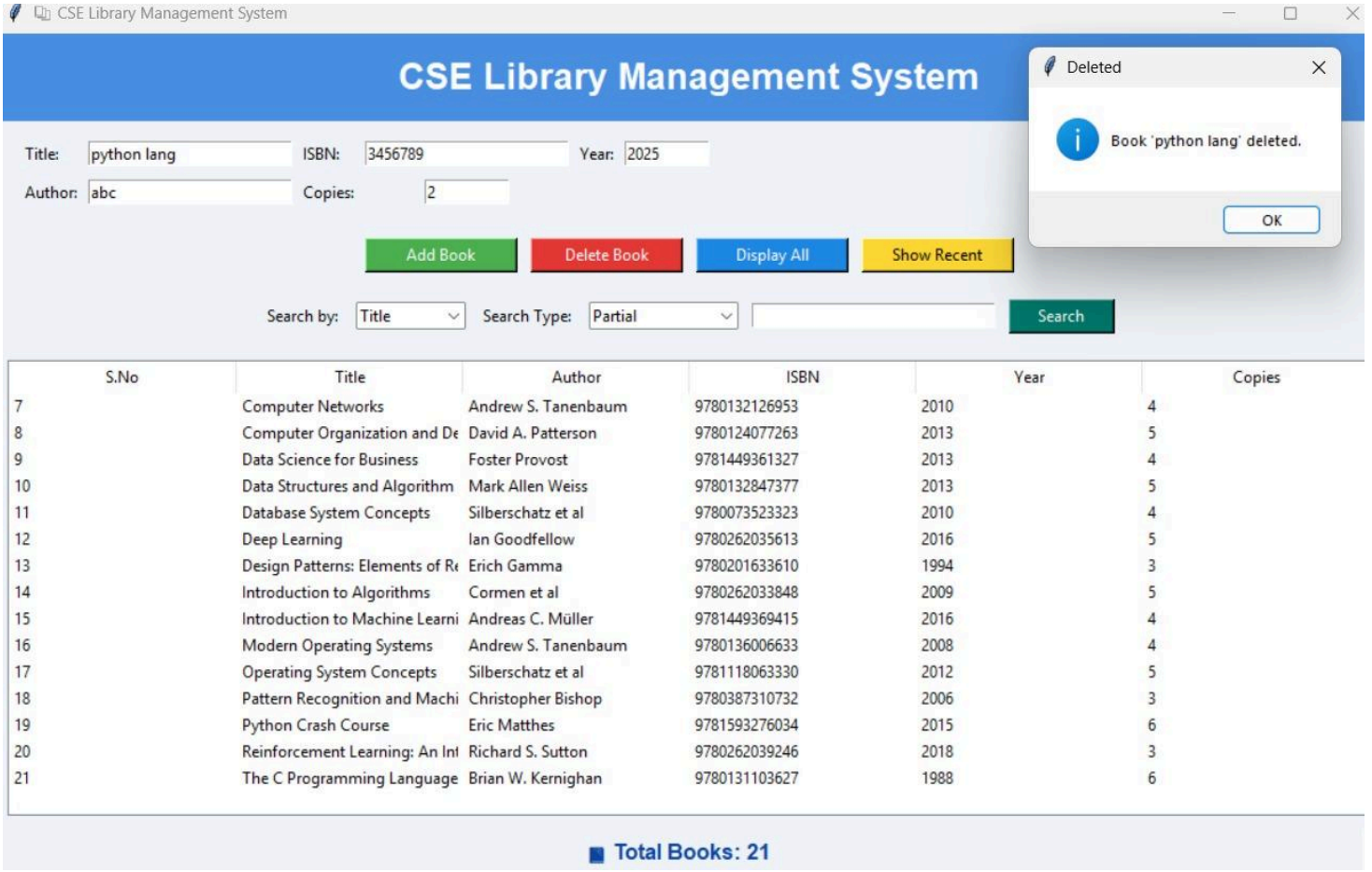
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Total Books: 21

Analysis:

Operation	Best Case	Average Case	Worst Case	Space Complexity
Add Book	O(n log n)	O(n log n)	O(n log n)	O(n)
Delete Book	O(1)	O(n)	O(n)	O(1)
Search Book	O(1)	O(log n)	O(n)	O(1)
Display Books	O(n)	O(n)	O(n)	O(1)
Quick Sort	O(n log n)	O(n log n)	$O(n^2)$	O(log n)

Final Overall Time Complexity:

Best Case: O(log n) — direct hit using binary search

Average Case: O(n log n) — sorting + searching + basic operations

Worst Case: O(n) — keyword search or full list traversal

Final Overall Space Complexity:

Best Case: O(n)

Average Case: O(n)

Worst Case: O(n)