Preface

Algorithms, along with Data Structure are utilized as an important part of the computer technology. They shape the backbone of the field. In computer technology, the algorithm gives the computer a particular set of instructions, which lets it do the whole job, from running a simple calculator to a huge rocket. Computer programs, in actual, are just algorithms implemented in a programming language, for the end user to make the computer understand. Scientists predict the complexity of different algorithms, before running them to predict how fast an algorithm is, and how much memory it will require. Data structures are used to store the data, while running a program.

Problem Statement

We were given a problem to maintain a library management system. The following functionalities were to be implemented on the system:

- **Add/Remove/Edit book:** To add, remove or modify a book or book item.
- **Search catalogue:** To search books by title, author, subject or publication date.
- **Register new account/cancel membership:** To add a new member or cancel the membership of an existing member.
- **Check-out book:** To borrow a book from the library.
- **Reserve book:** To reserve a book which is not currently available.
- **Renew a book:** To reborrow an already checked-out book.
- **Return a book:** To return a book to the library which was issued to a member

a. *Implement* and use any sorting algorithm to sort the books on the basis of any attribute (e.g., book ID, no. of books, author, title etc.).
b. *Prepare* the complete software (in Python)
    i. Insert at least 15 records in the system
    ii. Implement the feature to display the whole collection of books

Library Management System:

A library management system is used to maintain library records. It tracks the records of the number of books in the library, how many books are issued, or how many books have been returned or renewed or late fine charges, etc.

Features:

This library management system covers all the basic operations that are concerned with a real-world scenario, with the help of CRUD operations of the database That are:

- Adding a book
- Removing a book
- Editing a book's information
- Searching for a book
- Borrowing a book
- Renewing a book

- Reserving a book
- Returning a book
- Displaying all of the books
- Searching for a book
- Check out
- User log in
- User Deletion

Limitations:

- Since the data is saved in databases through the built-in library of python, namely sqlite3, in case of a data overload the database might get locked.
- The management system consists of a single representation of a title irrespective of its quantity.
- Some of the functions are not completely generalized and might result in expected outputs when the whole file is being imported.
- The program using Lite Databases at its core, can store a specific amount of characters per column which cannot be changed throughout the lifetime of the system itself.

Algorithms and Approaches:

The system deals with the most crucial task of sorting by means of **BUBBLE SORT** as the space complexity is kept a decisive factor in the system and which has a complexity of O(1). The time complexity in the system is narrowed down to O(n^2) and since this is recorded for the worst case, the system won't ever be taking any longer than that to sort all of its entries.

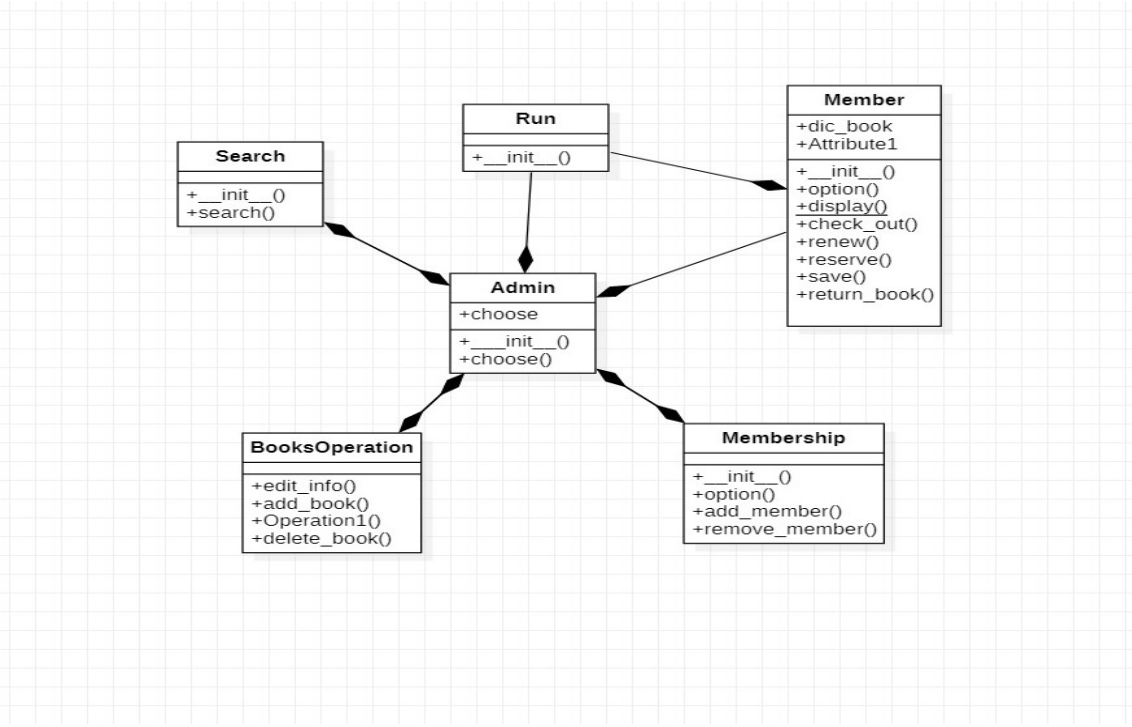
The searching is done through the iteration of list which is provided to it in a sorted manner through the implementation of bubble sort. The searching algorithm also deals with complexity of O(n^2).

Dictionaries are used as the main Data Structure for the renewal and reservation of books. Through Key value the mentioned methods are implemented with a complexity of O(1).

```python
def search_algo(items):
    search_lst = []
    new_items = []
    for item in items:
        # add to dic
        x = item[1]
        search_lst.append(x)
    search_lst = bubble_sort(search_lst)
    for i in search_lst:
        for j in items:
            if i == j[1]:
                new_items.append(j)
    return new_items


def bubble_sort(array):
    # loop to access each array element
    for i in range(len(array)):
        # loop to compare array elements
        for j in range(0, len(array) - i - 1):
            # change > to < to sort in descending order
            if array[j] > array[j + 1]:
                # swapping elements if elements
                # are not in the intended order
                temp = array[j]
                array[j] = array[j + 1]
                array[j + 1] = temp
    return array
```

Class Diagram:



Snapshots of the Data:

1	1	Advanced Data Structures	Peter Brass	DSA	8/5/1985	TRUE	FALSE
2	2	Chemistry For Dummies	John T. Moore	Chemistry	1/6/2006	TRUE	FALSE
3	3	Calculus with applications	Peter Lax	Mathematics	2/12/2014	TRUE	FALSE
4	4	Amazing Grace of Quantum ...	Dillard W. Faries	Physics	1/9/1997	TRUE	FALSE
5	5	War and Peace	Tolstoy	English Literature	3/6/1869	TRUE	FALSE
6	6	Semiconductor Radiation ...	Alan Owens	Physics	8/8/2019	TRUE	FALSE
7	7	Organic Chemistry	Maitland Jones Jr., Steven A. Fleming	Chemistry	1/5/2014	TRUE	FALSE
8	8	WINESBURG, OHIO	by Arthur Koestler	Picture Book	17/6/2011	TRUE	FALSE
9	9	TROPIC OF CANCER	by Henry Miller	Historical	19/11/1998	TRUE	FALSE
10	10	Pride and Prejudice	Jane Austen	English Literature	02/11/1813	TRUE	FALSE
11	11	Superheavy:Making and ...	Kit Chapman	Chemistry	3/3/2019	TRUE	FALSE
12	12	THE WAY OF ALL FLESH	by Samuel Butler	Fantasy	18/7/1987	TRUE	FALSE
13	13	1984	by George Orwell	Children's	25/7/1968	TRUE	FALSE
14	14	War and Peace	Tolstoy	English Literature	2/7/1869	TRUE	FALSE
15	15	Wuthering Heights	Emily Brontë	English Literature	6/1/1880	2 TRUE	ALSE
16	16	AN AMERICAN TRAGEDY	by Theodore Dreiser	Thrillers/Suspense	12/5/1990	TRUE	FALSE
17	17	THE HEART IS A LONELY HUNTER	by Carson McCullers	Middle Grade	16/9/1968	TRUE	FALSE
18	18	SLAUGHTERHOUSE-FIVE	by Kurt Vonnegut	Picture Book	12/11/2018	TRUE	FALSE
19	19	INVISIBLE MAN	by Ralph Ellison	Romance	13/7/1988	TRUE	FALSE
20	20	NATIVE SON	by Richard Wright	Historical	12/6/1990	TRUE	FALSE
21	21	HENDERSON THE RAIN KING	by Saul Bellow	Young Adult	15/5/1989	TRUE	FALSE
22	22	APPOINTMENT IN SAMARRA	by John O'Hara	Fantasy	21/11/20219	TRUE	FALSE
23	23	U.S.A.(trilogy)	by John Dos Passos	Children's	7/7/2016	TRUE	FALSE
24	24	SONS AND LOVERS	by Sherwood Anderson	Literary Fiction	2/6/2006	TRUE	FALSE
25	25	DARKNESS AT NOON	by E.M. Forster	Science Fiction	10/7/1967	TRUE	FALSE

	member_id	member_name	check_out	reserved
1	1	ahmed	TRUE	FALSE
2	2	fahad	15	TRUE

Flow Of the Code:

The complete program consists of 3 py files and 2 databases:

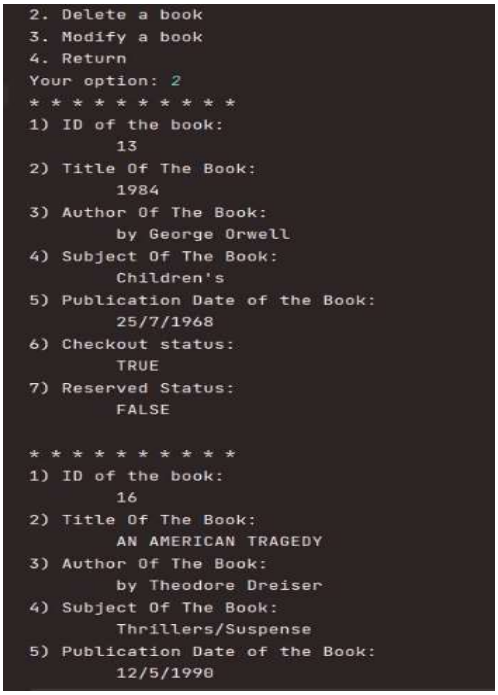
- Main.py
- Helper.py
- Member_functions.py
- UserDB.db
- BooksDB.db

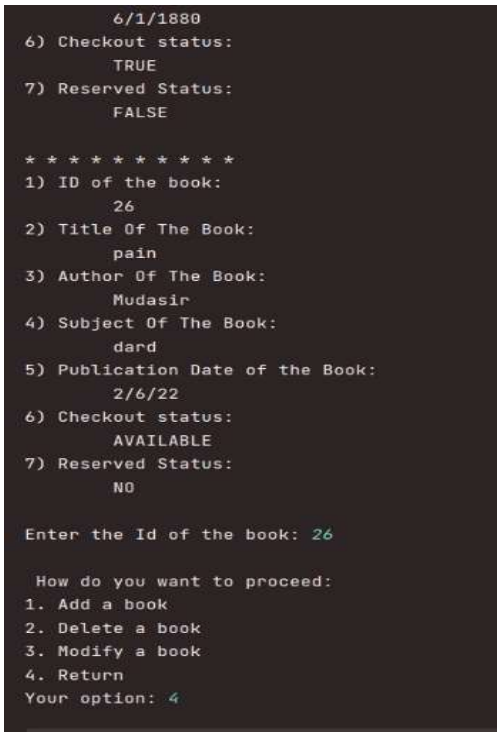
The program execution starts from the main.py which provides the implementation of the interface for the user and some nongeneralized functions which are to be implemented for the specific scenario.

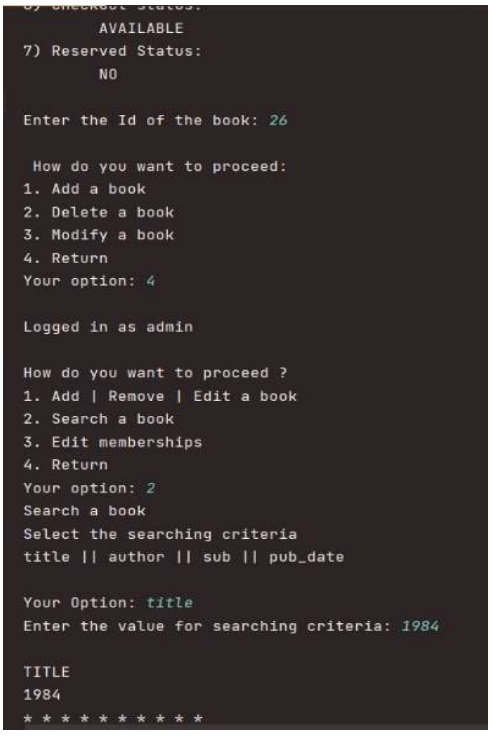
The other two files are there two simplify the flow of code with the “helper” containing all the helping functions related to the connectivity with sqlite database and some minor functions for the operations being performed in the BooksInfo table. “Member_functions.py” file contains all the code required for the connectivity of users’ database to the python script.

Both the files are imported in the main.py and provide the additional functionalities to the Admin, Run Member, Membership, Search and BookOperations classes. The Object-Oriented approach further breaks down the code into simpler fragments, helping in debugging, organizing and reusability of the code.

Snapshots of the output:







```
title || author || sub || pub_date

Your Option: title
Enter the value for searching criteria: 1984

TITLE
1984
* * * * * * * * * *
1) ID of the book:
        13
2) Title Of The Book:
        1984
3) Author Of The Book:
        by George Orwell
4) Subject Of The Book:
        Children's
5) Publication Date of the Book:
        25/7/1968
6) Checkout status:
        TRUE
7) Reserved Status:
        FALSE

Do you want to continue ?
1. Yes
2. No2

Logged in as admin

How do you want to proceed ?
1. Add | Remove | Edit a book
```

```
1. Yes
2. No2

Logged in as admin

How do you want to proceed ?
1. Add | Remove | Edit a book
2. Search a book
3. Edit memberships
4. Return
Your option: 3
Memberships
How do you want to proceed ?
1. Adding a new member
2. Cancelling a membership
3. Return
Your Option : 2
* * * * * * * * * * *
1ID of the member:
        1
2Name of the member:
        ahmed
3Check out:
        TRUE
4Reserved:
        FALSE

* * * * * * * * * *
1ID of the member:
        2
2Name of the member:
```

```
4Reserved:
        FALSE

* * * * * * * * * * *
1ID of the member:
        2
2Name of the member:
        fahad
3Check out:
        FALSE
4Reserved:
        TRUE

* * * * * * * * * * *
1ID of the member:
        3
2Name of the member:
        farhan
3Check out:
        TRUE
4Reserved:
        TRUE

command executed successfully
Enter the ID of the member 3
How do you want to proceed ?
1. Adding a new member
2. Cancelling a membership
3. Return
Your Option : 3
```

```
Enter the ID of the member 3
How do you want to proceed ?
1. Adding a new member
2. Cancelling a membership
3. Return
Your Option : 3

Logged in as admin

How do you want to proceed ?
1. Add | Remove | Edit a book
2. Search a book
3. Edit memberships
4. Return
Your option: 4
How do you want to log in as ?
1. Admin
2. Member
3. Exit

Your option: 2
Logging in as member
.
.
.
How do you want to proceed
1. Membership Details
2. Return
Your Option: 1
```

```
3. Exit

Your option: 2
Logging in as member
.
.
.
How do you want to proceed
1. Membership Details
2. Return
Your Option: 1


Enter your ID to login: 2
How do you want to proceed
1. Checkout
2. Renew
3. Reserve
4. Display all books
5. Return
Your option: 1
Checking out

Select from the following Books
* * * * * * * * * *
1) ID of the book:
        13
2) Title Of The Book:
        1984
3) Author Of The Book:
        by George Orwell
```

```
        War and Peace
3) Author Of The Book:
        Tolstoy
4) Subject Of The Book:
        English Literature
5) Publication Date of the Book:
        2/7/1869
6) Checkout status:
        TRUE
7) Reserved Status:
        FALSE

* * * * * * * * * *
1) ID of the book:
        15
2) Title Of The Book:
        Wuthering Heights
3) Author Of The Book:
        Emily Brontë
4) Subject Of The Book:
        English Literature
5) Publication Date of the Book:
        6/1/1880
6) Checkout status:
        TRUE
7) Reserved Status:
        FALSE


Please enter the book id: 15
True
```

```
Data updated
DO you want to Continue (y/n)?
:n
Updating Data
.
.
.
Data updated
DO you want to Continue (y/n)?
:y

Enter your ID to login: 3
How do you want to proceed
1. Checkout
2. Renew
3. Reserve
4. Display all books
5. Return
Your option: 3

No Member present under the mentioned name
You have already reserved a book

Do You want to continue (y/n)?n
Updating Data
.
.
.
Data updated
DO you want to Continue (y/n)?
:y
```