

Low-Level Design (LLD) – Library Management System (OOps in Python)

Difficulty Level: Easy | **Total Marks:** 20

Design Format: 1 Class with 6 Independent Methods | 6 Visible Test Cases

□ Summary of Design Requirements

- Implement a class `Library` using Object-Oriented Programming (OOP).
- The class should:
 - Track books and their availability.
 - Track transaction history.
- Each function must be **independent**:
 - Do **not rely on another method** to setup data.
 - Each method must work based on passed or internal data only.
- Use simple Python data structures (dict, list).
- Avoid external libraries.

□ Concepts Tested

- Python class and instance methods
- Data encapsulation using `self`
- Dictionary-based state tracking
- List manipulation and string formatting
- Pure function behavior with no cross-dependencies

□ Problem Statement

Design a Python class `Library` to manage a basic book tracking system with the following features:

- Add, borrow, and return books.
- Search for a book by title.
- View the full transaction history.

Each book has:

- Title (unique)
- Author
- Availability status (True/False)

Each transaction (add, borrow, return) should be recorded in a history list.

□ Operations (Methods)

1. Initialize Library

Create an empty dictionary of books and an empty list for transaction history.

```
def __init__(self):  
    • self.books → {title: {'author': str, 'available': bool}}  
    • self.history → list[str]
```

2. Add Book

Add a new book with title and author. Set its availability to `True`.

```
def add_book(self, title: str, author: str) -> None:  
    • Update self.books  
    • Append "Added: 'title' by author" to self.history
```

3. Borrow Book

Borrow a book by title if it is available.

```
def borrow_book(self, title: str, user: str) -> str:  
    • If available: set available = False, log "Borrowed: 'title' by user", return that string.  
    • Else: return "Not Available"
```

4. Return Book

Return a borrowed book by title.

```
def return_book(self, title: str, user: str) -> str:  
    • If exists: set available = True, log "Returned: 'title' by user", return that string.  
    • Else: return "Book not found"
```

5. Search Book

Check if a book exists.

```
def search_book(self, title: str) -> bool:
```

- Return True if the book is in self.books, else False.

6. View History

Return the full transaction history as a list of strings.

```
def view_history(self) -> list:
```

- Return self.history
- If empty, return list like ["No transactions yet."]

□ Test Cases & Marks Allocation

Test Case ID	Description	Method	Marks
TC1	Initialize library	<code>__init__()</code>	□ 3
TC2	Add book	<code>add_book()</code>	□ 3
TC3	Borrow book	<code>borrow_book()</code>	□ 3
TC4	Return book	<code>return_book()</code>	□ 3
TC5	Search book	<code>search_book()</code>	□ 4
TC6	View full transaction history	<code>view_history()</code>	□ 4

Total Marks: 20

□ Visible Test Case Descriptions

- □ **TC1:** Instantiating `Library()` should initialize books as a dict and history as a list.
- □ **TC2:** `add_book("Python 101", "Guido")` should update books and log the transaction.
- □ **TC3:** `borrow_book("Python 101", "Alice")` should change availability and return confirmation.
- □ **TC4:** `return_book("Python 101", "Alice")` should restore availability and log return.
- □ **TC5:** `search_book("Python 101")` returns True, `search_book("ABC")` returns False.

- ☐ **TC6:** `view_history()` returns all transaction messages in order.