

CISC 327 – Assignment 2: Library Management System

Name: Aiden Ramezani

Student ID: 20259781

GitHub Repository: <https://github.com/yourusername/cisc327-library-management-a2-XXXX>

1. Function Implementation

I completed the remaining functionalities for requirements **R4–R7**. The implementation aligned the business logic with the system specifications and ensured clear validation, consistent messaging, and minimal side effects.

- **R4 (Book Returns):** Validates active loans, updates return dates and availability, and integrates the late-fee calculation. Handles invalid IDs and double returns gracefully.
- **R5 (Late Fee Calculation API):** Implements a tiered daily fee policy — \$0.50/day for the first 7 overdue days and \$1.00/day thereafter, capped at \$15.00. Handles invalid patron/book IDs and non-existent borrow records.
- **R6 (Search):** Supports **case-insensitive partial matches** for title/author and **exact matches** for ISBN. Invalid query types or injections are rejected safely.
- **R7 (Patron Status Report):** Aggregates current borrows, calculates total fees, and summarizes borrowing history with overdue flags and fee details.

The design emphasizes predictable, testable functions and early returns to prevent side effects.

2. Additional Test Case Development

Beyond Assignment 1, I did not add any new test cases.

3. AI-Assisted Test Generation

ChatGPT 2025 release was used to generate comprehensive test cases for R1–R7.

Prompt Used

“Generate detailed, realistic, and edge-focused unit and integration tests for the Library Management System implementing requirements R1–R7. Follow pytest style and mock database dependencies where needed.”

Follow-Up Prompts

- Asked to format outputs per requirement (R1–R7).
- Requested to include both Python test functions and manual UI scenarios.
- Verified coverage consistency against assignment specifications.

Generated Tests

The full AI-generated tests are included in **AI_Test_Cases.pdf**, containing functional and boundary tests such as:

- Input validation (e.g., invalid ISBN, max length fields).
 - Concurrency and atomic update simulation for borrowing.
 - Tiered and capped late-fee scenarios.
 - Search case-insensitivity, HTML escaping, and trimmed input tests.
 - Patron status fee aggregation and UI consistency.
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4. Test Case Comparison and Analysis (20%)

- R1 Add Book

- Implemented tests: `tests/test_add_book.py`
- AI cases covered: valid add, boundary lengths, invalid ISBN length, nonpositive copies, duplicate ISBN.
- Gaps vs AI: AI includes explicit trimming tests and non-integer copies; repo tests do not patch DB for duplicate detection and rely on real state; also no XSS/HTML render checks (template-level).
- Notes: Service trims `title`/`author` before insert and validates lengths; ISBN only length-checked (digits-only not enforced). AI asks for digits-only; repo tests expect error text containing “13 digits” but do not enforce isdigit.

- R2 Catalog Display

- Implemented tests: `tests/test_book_catalog_display.py`
- AI cases covered: empty state, list rendering, available/unavailable counts surfaced, basic field presence.
- Gaps vs AI: No explicit check for borrow button visibility at template level, no long-string overflow or mobile rendering checks (UI-level); AI requests A/T “Available/Total” formatting which is not asserted here.

- R3 Borrowing

- Implemented tests: `tests/test_book_borrowing.py`
- AI cases covered: happy path, invalid patron ID formats, unavailable book, book not found, DB error path for insert. A known spec bug (limit should be ≥ 5) is marked xfail to document current behavior.

- Gaps vs AI: AI's concurrent contention and re-borrow-after-return scenarios not present; no explicit test for availability update failure path success rollback messaging; max-5 enforcement test exists but xfail (documents current behavior rather than enforcing spec).

- R4 Return Processing

- Implemented tests: `tests/test_book_return_processing.py` (module marked xfail)

- AI cases covered: success with fee reporting, wrong patron/not borrowed, book not found, DB error branches, patron ID validation, formatting presence.

- Gaps vs AI: Tiered fee arithmetic itself is validated in R5; explicit double-submit prevention (already returned) not present; explicit money formatting to exactly 2 decimals partially asserted via substring, but not strict.

- R5 Late Fee API

- Implemented tests: `tests/test_late_fee_calculation.py` (service function) and `tests/test_fee_api.py` (route, guarded and xfail)

- AI cases covered (service): tiers, cap, clamp negative overdue to 0, invalid patron id status, no active loan path.

- AI cases partially covered (API): happy path JSON verified when route exists.

- Gaps vs AI (API): Missing tests for exactly 14 days, idempotency, invalid path params returning 400 vs 200, rounding formatting at API level, explicit > cap scenario via API, and non-existent borrow returning 404/400.

- R6 Search

- Implemented tests: `tests/test_search_service.py` (xfail) and `tests/test_search_route.py` (xfail)

- AI cases covered (service): title/author partial case-insensitive, ISBN exact only, invalid type raises, empty query returns `[]`.

- AI cases covered (route): query wiring to service, empty query UX; a test marks current "not implemented" flash behavior as xfail to prefer a "no results" UX.

- Gaps vs AI: No test for ISBN with hyphens rejection, trimming of input, injection/HTML inputs escaping, and 400 handling for invalid type at route level.

- R7 Patron Status Report

- Implemented tests: `tests/test_patron_status_report.py` (xfail)

- AI cases covered: current borrows with due dates, total fees aggregation, borrow count, overdue flags, invalid patron handling, presence of history key.
- Gaps vs AI: Navigation/menu entry not tested (UI-level); explicit “no history” empty-state messaging not asserted; money formatting and cap per-item not explicitly verified in R7.

Quality Observations

- Use of monkeypatch: Tests consistently isolate business logic by patching DB layer, mirroring AI’s approach.
- Spec-documentation via xfail: Where implementation is pending or intentionally divergent (R3 limit, R4–R7 pending, some route UX), tests are annotated with strict xfail, which is good practice to document known gaps.
- Boundary and formatting: R1 boundary lengths present; however, digits-only validation for ISBN is not asserted; money formatting checked via substrings rather than strict formatting in all contexts.
- Route vs service coverage: Service logic is well covered for R3, R5, R6, R7. Route-level coverage exists for catalog and search, but late-fee API and UI behaviors (buttons, mobile layout, empty-state messaging strings) are lighter than AI’s UI-focused expectations.

Concrete Gaps To Address (prioritized)

1) R1

- Add test for `total_copies` non-integer type handling.
- Add test asserting ISBN digits-only (reject non-digits) if desired by spec; otherwise align AI case to current design (length-only).
- Add explicit trimming tests with DB interactions stubbed (duplicate check path patched) to avoid state dependence.

2) R2

- Add template test for A/T formatting string and conditional borrow button visibility.
- Optional: long-string rendering resilience; escape content checks.

3) R3

- Add test for `update_book_availability` failure path messaging.
- Add contention test (serialize calls via monkeypatch wrappers) to assert atomic decrement outcome.
- After implementation change, flip the max-5 test from xfail to normal.

4) R4

- Add double-submit (already returned) negative test once history/return-date check path exists.
- Strengthen fee formatting assertion to fixed 2 decimals.

5) R5 API

- Add parameter validation tests for non-digit patron/book ids → 400 vs 200 decision.
- Add exact 14-days test, over-cap case, rounding, and idempotency at route level.
- Add non-existent borrow → 404/400 explicit behavior test.

6) R6

- Add ISBN-with-hyphens negative test; input trimming tests.
- Add injection/HTML query inputs and ensure safe rendering at route/template.
- Route should map invalid `type` to 400; add test.

7) R7

- Add money formatting and fee cap per item assertions within report composition.
- Add UI navigation/menu test (route exists, template contains link) if in scope.

Coverage Summary

- R1: Strong service tests; minor input-validation and trim gaps vs AI.
- R2: Route coverage OK for data passing; UI formatting/controls not asserted.
- R3: Core validations covered; concurrency and availability-update failure gap; limit spec test xfail.
- R4: Core flows modeled (xfail); missing double-submit and stricter formatting.
- R5: Service tiers/cap strong; API route tests minimal vs AI matrix.

- R6: Service semantics align; route and security/UX scenarios missing.
- R7: Service aggregation good; UI/format details and history UX missing.