CISC 327 – Assignment 2: Library Management System

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GitHub Repository: https://github.com/Aidenrmz/cisc327-library-management-a2-9782

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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.

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2. Additional Test Case Development

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

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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.