

Board Game Library and Lending System Database

A. Description: This is a database management system for lending and record-keeping of a library of board games. Users can loan board games in a similar fashion to a book library.

B. Team Members:

1. Rohith Gowda Ranganatha
2. Kavitha Mehta

C. MongoDB Implementation:

1. “user” → “loan” (1:M) relationship converted into a simple array - “user_active_loans”.
2. “game” → “loan” (1:M) relationship converted into an array of subdocuments - “boardgames_with_borrowers”.
3. “user” → “loan” (1:M) relationship converted into an embedded subdocument - “users_with_loans”.

D. Entity Relationship Diagram:

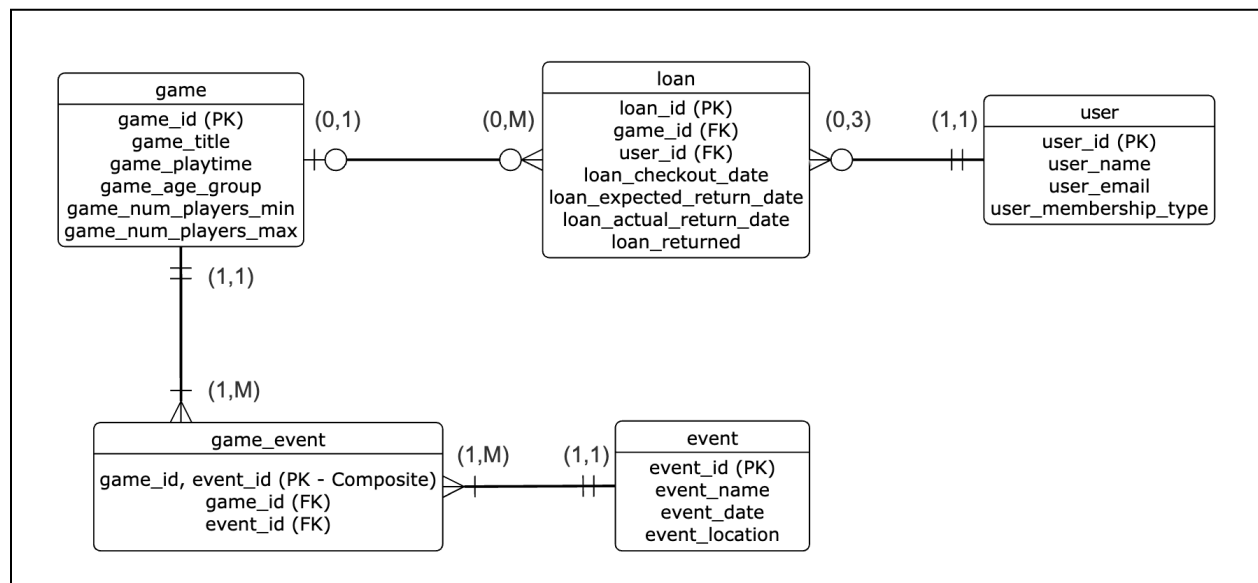


Fig. 1: Boardgames Library System ERD

E. Design 1: user_active_loans (Array)

- The document stores a user's active loan data.
- Users "David Lee" and "Grace Miller" each have two active loans, and their data is inserted into the MongoDB array "user_active_loans".
- The infinite array issue is handled by Business Rule 2: A user can't borrow more than 3 games at a time, i.e., a maximum of 3 active loans allowed.

Below is the structure breakdown:

Relationship Side	Field	Type	Rules
One	user_id	integer	Minimum value = 1
	user_name	string	Minimum length = 3
	user_email	string	
	user_membership_type	string	
Many	loan_id	integer array	Maximum length = 3

The screenshot shows the MongoDB Compass interface for the **board_game_library** database, specifically the **user_active_loans** collection. The left sidebar shows the database structure with **board_game_library** expanded, showing **boardgames_with_bor...** and **user_active_loans** (selected). The main panel displays the collection details: STORAGE SIZE: 36KB, LOGICAL DATA SIZE: 308B, TOTAL DOCUMENTS: 2, INDEXES TOTAL SIZE: 20KB. Below this, there are tabs for Find, Indexes, Schema Anti-Patterns, Aggregation, and Search Indexes. The **Find** tab is active, showing a filter bar with the text "Type a query: { field: 'value' }". Below the filter bar, two documents are displayed:

```

{
  "_id": ObjectId('6816d4e33886025d03128d5b'),
  "user_id": 4,
  "user_name": "David Lee",
  "user_email": "dl@yahoo.com",
  "user_membership_type": "Premium",
  "loan_id": Array (2)
    0: 4
    1: 14
}

{
  "_id": ObjectId('6816d4e33886025d03128d5c'),
  "user_id": 7,
  "user_name": "Grace Miller",
  "user_email": "gm@outlook.com",
  "user_membership_type": "Standard",
  "loan_id": Array (2)
    0: 7
    1: 17
}

```

Fig. 2: user_active_loans collection

F. Design 2: users_with_loans (Embedded Subdocuments)

- The document stores a user's active loan data.
- Users "David Lee" and "Bob Smith" each have two active loans, and their data is inserted into the subdocument structure "users_with_loans".
- Infinite document issue is handled by Business Rule 2: A user can't borrow more than 3 games at a time, i.e., a maximum of 3 active loans allowed. This is also ensured by the attribute rule "loan_returned" = false.

Below is the structure breakdown:

Relationship Side	Field	Type	Rules
One	user_id	integer	Minimum value = 1
	user_name	string	Minimum length = 3
Many	load_id	integer	Minimum value = 1
	game_id	integer	Minimum value = 1
	loan_checkout_date	date	
	loan_expected_return_date	date	
	loan_returned	boolean	Value = false

board_game_library.users_with_loans

STORAGE SIZE: 36KB LOGICAL DATA SIZE: 628B TOTAL DOCUMENTS: 2 INDEXES TOTAL SIZE: 36KB

Find Indexes Schema Anti-Patterns Aggregation Search Indexes

Generate queries from natural language in Compass

Filter Type a query: { field: 'value' } Reset Apply Options

QUERY RESULTS: 1-2 OF 2

```

{
  "_id": ObjectId('6816639d3886025d0312863d'),
  "user_id": 4,
  "user_name": "David Lee",
  "user_loans": Array (2)
  0: Object
    loan_id: 4
    game_id: 4
    loan_checkout_date: 2024-03-12T00:00:00.000+00:00
    loan_expected_return_date: 2024-04-19T00:00:00.000+00:00
    loan_returned: false
  1: Object
    loan_id: 14
    game_id: 3
    loan_checkout_date: 2024-04-12T00:00:00.000+00:00
    loan_expected_return_date: 2024-04-19T00:00:00.000+00:00
    loan_returned: false
}

```

Fig. 3: users_with_loans collection

board_game_library.users_with_loans

STORAGE SIZE: 36KB LOGICAL DATA SIZE: 628B TOTAL DOCUMENTS: 2 INDEXES TOTAL SIZE: 36KB

Find Indexes Schema Anti-Patterns Aggregation Search Indexes

Generate queries from natural language in Compass

Filter Type a query: { field: 'value' } Reset Apply Options

```

_id: ObjectId('68169cce3886025d031289e6')
user_id: "2"
user_name: "Bob Smith"
user_loans: Array (2)
  0: Object
    loan_id: 2
    game_id: 2
    loan_checkout_date: 2024-03-08T00:00:00.000+00:00
    loan_expected_return_date: 2024-03-15T00:00:00.000+00:00
    loan_returned: false
  1: Object
    loan_id: 11
    game_id: 2
    loan_checkout_date: 2024-03-10T00:00:00.000+00:00
    loan_expected_return_date: 2024-03-17T00:00:00.000+00:00
    loan_returned: false

```

Fig. 4: users_with_loans collection

G. Design 3: boardgames_with_borrowers (Array of Subdocuments)

- The document stores information about all active loans for a particular game.
- The game “Chess” is loaned by users “David Lee” and “Eve Adams”. Similarly, “Exploding Kittens” is loaned by users “Frank White” and “Hank Green”.
- Infinite document issue is handled by only inserting games with corresponding active loans. Once a loan is returned, the record is removed. This is ensured by the attribute rule “loan_returned” = false.

Below is the structure breakdown:

Relationship Side	Field	Type	Rules
One	game_id	integer	Minimum value = 1
	game_title	string	
Many	user_id	integer	Minimum value = 1
	user_name	string	Minimum Length = 3
	loan_checkout_date	date	
	loan_returned	boolean	Value = false
	load_id	integer	Minimum value = 1

DATABASES: 1 COLLECTIONS: 3 VISUALIZE YOUR DATA REFRESH

[+ Create Database](#)

Q Search Namespaces

board_game_library

boardgames_with_bo...

user_active_loans

users_with_loans

board_game_library.boardgames_with_borrowers

STORAGE SIZE: 36KB LOGICAL DATA SIZE: 623B TOTAL DOCUMENTS: 2 INDEXES TOTAL SIZE: 20KB

Find Indexes Schema Anti-Patterns Aggregation Search Indexes

Generate queries from natural language in Compass

INSERT DOCUMENT

Filter Type a query: { field: 'value' } Reset Apply Options

```

_id: ObjectId('681668b43886025d03128695')
game_id: 3
game_title: "Chess"
game_borrowers: Array (2)
  0: Object
    user_id: 4
    user_name: "David Lee"
    loan_checkout_date: 2024-04-12T00:00:00.000+00:00
    loan_returned: false
    loan_id: 14
  1: Object
    user_id: 5
    user_name: "Eve Adams"
    loan_checkout_date: 2024-03-01T00:00:00.000+00:00
    loan_returned: false
    loan_id: 15

```

Fig. 5: boardgames_with_borrowers collection

DATABASES: 1 COLLECTIONS: 3 VISUALIZE YOUR DATA REFRESH

[+ Create Database](#)

Q Search Namespaces

board_game_library

boardgames_with_bo...

user_active_loans

users_with_loans

board_game_library.boardgames_with_borrowers

STORAGE SIZE: 36KB LOGICAL DATA SIZE: 623B TOTAL DOCUMENTS: 2 INDEXES TOTAL SIZE: 20KB

Find Indexes Schema Anti-Patterns Aggregation Search Indexes

Generate queries from natural language in Compass

INSERT DOCUMENT

Filter Type a query: { field: 'value' } Reset Apply Options

```

_id: ObjectId('681668b43886025d03128696')
game_id: 7
game_title: "Exploding Kittens"
game_borrowers: Array (2)
  0: Object
    user_id: 6
    user_name: "Frank White"
    loan_checkout_date: 2024-03-09T00:00:00.000+00:00
    loan_returned: false
    loan_id: 16
  1: Object
    user_id: 8
    user_name: "Hank Green"
    loan_checkout_date: 2024-03-06T00:00:00.000+00:00
    loan_returned: false
    loan_id: 18

```

Fig. 6: boardgames_with_borrowers collection

H. JSON Schema for Design 1 “user_active_loans”:

- **Title:** board_game_library_schema
- **Description:** This schema defines the “user_active_loans”
- **Required Fields:** user_id; user_name; loan_id
- **Additional rules:**
 - Rule 1: user_id must be positive
 - Rule 2: user_name must be at least 3 characters
 - Rule 3: loan_id items must be positive
 - Rule 4: loan_id max length = 3
 - Rule 5: no duplicate loan_id items

The screenshot shows the JSON Schema Validator interface. On the left, a custom schema is defined for "UserWithActiveLoanIDs". It specifies an array of objects with the following properties:

- user_id:** integer, minimum 1, description: "Unique ID of the user"
- user_name:** string, minimum length 3, description: "Full name of the user"
- user_email:** string, description: "Email id of user"
- user_membership_type:** string, description: "Membership type of the user (Standard/Premium)"
- loan_id:** array

On the right, the "Input JSON" contains two objects:

```
[
  {
    "user_id": 4,
    "user_name": "David Lee",
    "user_email": "dl@yahoo.com",
    "user_membership_type": "Premium",
    "loan_id": [4, 14]
  },
  {
    "user_id": 7,
    "user_name": "Grace Miller",
    "user_email": "gm@outlook.com",
    "user_membership_type": "Standard",
    "loan_id": [7, 17]
  }
]
```

At the bottom, a green message states: "✓ No errors found. JSON validates against the schema".

Fig. 7: user_active_loans JSON Schema Validator

I. Queries:

1. Within the “boardgames_with_borrowers” collection, find games where any borrower has loan_id > 15.

```
{
  "game_borrowers.loan_id": { "$gt": 15 }
}
```

board_game_library.boardgames_with_borrowers

STORAGE SIZE: 36KB LOGICAL DATA SIZE: 623B TOTAL DOCUMENTS: 2 INDEXES TOTAL SIZE: 20KB

Find Indexes Schema Anti-Patterns Aggregation Search Indexes

Generate queries from natural language in Compass

Filter `{ "game_borrowers.loan_id": { "$gt": 15 } }` Reset Apply Options

QUERY RESULTS: 1-1 OF 1

```

_id: ObjectId('681668b43886025d03128696')
game_id: 7
game_title: "Exploding Kittens"
game_borrowers: Array (2)
  0: Object
    user_id: 6
    user_name: "Frank White"
    loan_checkout_date: 2024-03-09T00:00:00.000+00:00
    loan_returned: false
    loan_id: 16
  1: Object
    user_id: 8
    user_name: "Hank Green"
    loan_checkout_date: 2024-03-06T00:00:00.000+00:00
    loan_returned: false

```

Fig. 8: “Greater than or less than” query results

- Within the “users_with_loans” collection, find users who have exactly 2 loan records in the user_loans array.

`{ "user_loans": { "$size": 2 } }`

board_game_library.users_with_loans

STORAGE SIZE: 36KB LOGICAL DATA SIZE: 628B TOTAL DOCUMENTS: 2 INDEXES TOTAL SIZE: 36KB

Find Indexes Schema Anti-Patterns Aggregation Search Indexes

Generate queries from natural language in Compass

Filter `{ "user_loans": { "$size": 2 } }` Reset Apply Options

QUERY RESULTS: 1-2 OF 2

```

_id: ObjectId('6816639d3886025d0312863d')
user_id: 4
user_name: "David Lee"
user_loans: Array (2)
  0: Object
    loan_id: 4
    game_id: 4
    loan_checkout_date: 2024-03-12T00:00:00.000+00:00
    loan_expected_return_date: 2024-04-19T00:00:00.000+00:00
    loan_returned: false
  1: Object
    loan_id: 14
    game_id: 3
    loan_checkout_date: 2024-04-12T00:00:00.000+00:00
    loan_expected_return_date: 2024-04-19T00:00:00.000+00:00
    loan_returned: false

```

Fig. 9: “Query within an array” query results

board_game_library.users_with_loans

STORAGE SIZE: 36KB LOGICAL DATA SIZE: 628B TOTAL DOCUMENTS: 2 INDEXES TOTAL SIZE: 36KB

Find Indexes Schema Anti-Patterns 0 Aggregation Search Indexes

Generate queries from natural language in Compass

Filter [Filter](#) `{ "user_loans": { "$size": 2 } }` [Reset](#) [Apply](#) [Options](#)

```

_id: ObjectId('68169cce3886025d031289e6')
user_id: "2"
user_name: "Bob Smith"
user_loans: Array (2)
  0: Object
    loan_id: 2
    game_id: 2
    loan_checkout_date: 2024-03-08T00:00:00.000+00:00
    loan_expected_return_date: 2024-03-15T00:00:00.000+00:00
    loan_returned: false
  1: Object
    loan_id: 11
    game_id: 2
    loan_checkout_date: 2024-03-10T00:00:00.000+00:00
    loan_expected_return_date: 2024-03-17T00:00:00.000+00:00
    loan_returned: false

```

Fig. 10: “Query within an array” query results

3. Within the “users_with_loans” collection, find users who have a loan where loan_returned is true.

`{ "user_loans.loan_returned": true }`

DATABASES: 1 COLLECTIONS: 3 [VISUALIZE YOUR DATA](#) [REFRESH](#)

board_game_library.users_with_loans

STORAGE SIZE: 36KB LOGICAL DATA SIZE: 628B TOTAL DOCUMENTS: 2 INDEXES TOTAL SIZE: 36KB

Find Indexes Schema Anti-Patterns 0 Aggregation Search Indexes

Generate queries from natural language in Compass

Filter [Filter](#) `{ "user_loans.loan_returned": true }` [Reset](#) [Apply](#) [Options](#)

QUERY RESULTS: 0

Fig. 11: “Query within a subdocument” query results

Note: All the original entities and queries are saved as tables and views respectively in Orson’s user027_DB3 schema.