Big Data Assignment 1

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Contents

1 Find or Create a Suitable Data Set

1.1 Data Set Explanation

Link to the dataset: https://github.com/zygmuntz/goodbooks-10k

The dataset initially contained multiple csv files representing information on books, and user data on book ratings. This dataset was chosen as its ideal for a MongoDB database due to its semi-structured nature and nested data, which is particularly useful for storing ratings and book tags.

Dataset Content:

- **books.csv**: Each entry represents a book with a unique `book_id`. There are multiple data fields for a book:
  - **`book_id`, `goodreads_book_id`, `best_book_id`, `work_id`**: Unique id's representing a book, each with a different purpose. We only used `book_id` and `goodreads_book_id` as they're used to link books to user `ratings` and user `to_read` lists.
  - **`ratings_1`, `ratings_2`, `...`**: Number of user ratings by rating value. eg. `ratings_1` represents the number of 1 star ratings given to that book.
  - The rest of the fields are self explanatory but include info relating to authors, title, release date, and isbn number.
- **ratings.csv**: Each entry is a `user_id` to `book_id` mapping with a rating.
  - **`book_tags.csv`**: Each entry is a `book_id` to `tag_id` mapping.
  - **`tags.csv`**: Each entry is a tag_{id} to `tag_name` mapping.
  - **`to_read.csv`** : Each entry is a `user_id` to `goodreads_book_id` mapping which represents a user adding a book to their `to_read` list.

1.2 Data Pre-Processing

The data was processed such that the data was represented in JSON format with evidence of nested objects so that we could demonstrate the capabilities of MongoDB.

Here is a quick outline on how we processed the data to create JSON files:
Libraries used: `Pandas`, `PyArrow`, `Faker`

`Pandas` was used to load the csv files into dataframes where we merged data and applied `group by` aggregate functions to obtain lists of data objects per a unique entry id. This was useful, for example, when we obtained a list of tags per `book_id`.

`Faker` was used to generate random usernames for each id that were then written to `user_data.csv`. The `dataframes` were then converted into JSON files.

All data pre-processing code is in the data-processing directory but the output JSON files are included in the final submission.

2 Design a MongoDB Database

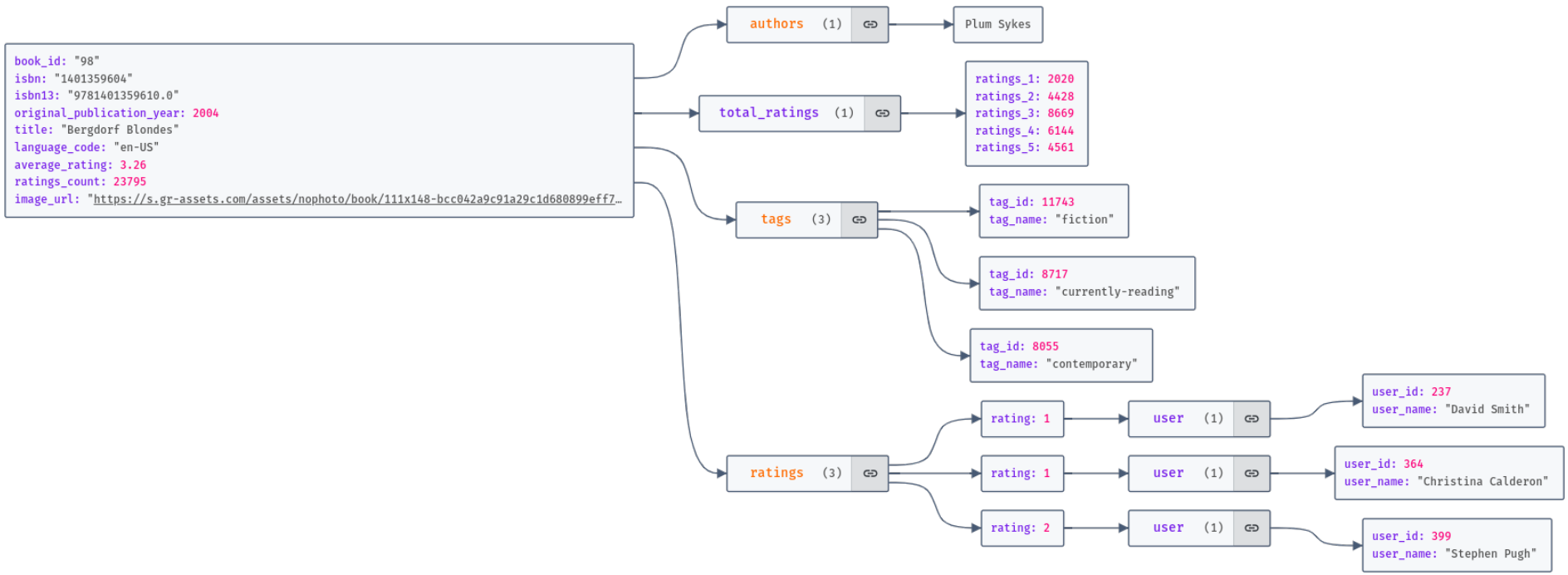
Both Collection Schemas were designed by creating hand-made JSON example objects. Each of these objects shows what a document in the DB would look like. Underneath each JSON example, we have included a diagram which represents the example's nesting visually.

2.1 Collection 1 - books

JSON example


```
{
    "book_id": "98",
    "isbn": "1401359604",
    "isbn13": "9781401359610.0",
    "authors": [
        "Plum Sykes"
    ],
    "original_publication_year": 2004,
    "title": "Bergdorf Blondes",
    "language_code": "en-US",
    "average_rating": 3.26,
    "ratings_count": 23795,
    "total_ratings": {
        "ratings_1": 2020,
        "ratings_2": 4428,
        "ratings_3": 8669,
        "ratings_4": 6144,
        "ratings_5": 4561
    },
    "image_url": "https://s.gr-assets.com/assets/nophoto/book/111x148-bcc042a9c91a29c1d680899eff700a03.png
    "tags": [
        {
            "tag_id": 11743,
            "tag_name": "fiction"
        },
        {
            "tag_id": 8717,
            "tag_name": "currently-reading"
        },
        {
            "tag_id": 8055,
            "tag_name": "contemporary"
        }
    ],
    "ratings": [
        {
            "user": {
                "user_id": 237,
                "user_name": "David Smith"
            },
            "rating": 1
        },
```

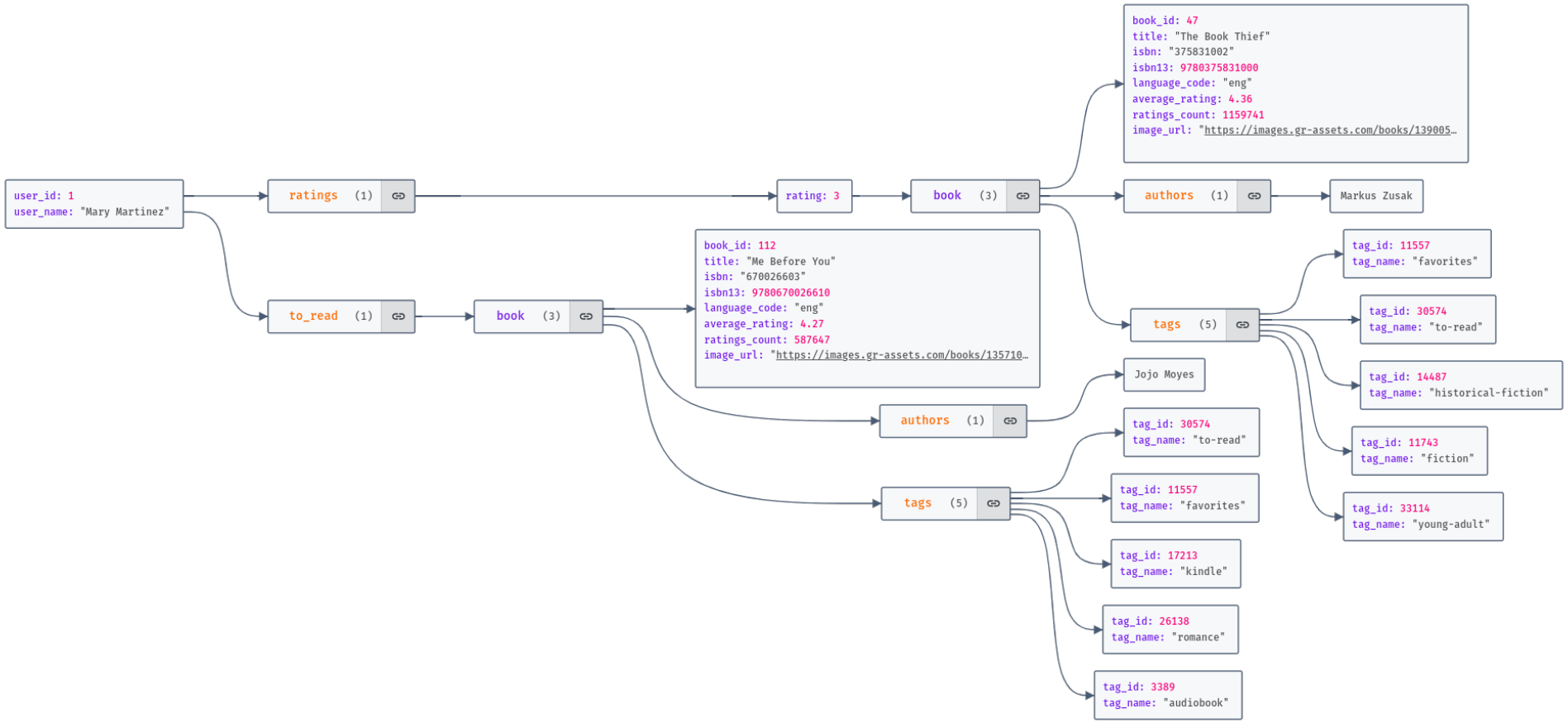
```
        {
            "user": {
                "user_id": 364,
                "user_name": "Christina Calderon"
            },
            "rating": 1
        },
        {
            "user": {
                "user_id": 399,
                "user_name": "Stephen Pugh"
            },
            "rating": 2
        }
    ]
}
```


book_id: "98"
isbn: "1401359604"
isbn13: "9781401359610.0"
original_publication_year: 2004
title: "Bergdorf Blondes"
language_code: "en-US"
average_rating: 3.26
ratings_count: 23795
image_url: "https://s.gr-assets.com/assets/nophoto/book/111x148-bcc042a9c91a29c1d680899eff7…
authors (1)
Plum Sykes
total_ratings (1)
ratings_1: 2020
ratings_2: 4428
ratings_3: 8669
ratings_4: 6144
ratings_5: 4561
tags (3)
tag_id: 11743
tag_name: "fiction"
tag_id: 8717
tag_name: "currently-reading"
tag_id: 8055
tag_name: "contemporary"
ratings (3)
rating: 1
user (1)
user_id: 237
user_name: "David Smith"
rating: 1
user (1)
user_id: 364
user_name: "Christina Calderon"
rating: 2
user (1)
user_id: 399
user_name: "Stephen Pugh"

2.2 Collection 2 - users


```
{
    "user_id": 1,
    "user_name": "Mary Martinez",
    "ratings": [
        {
            "book": {
                "book_id": 47,
                "authors": [
                    "Markus Zusak"
                ],
                "title": "The Book Thief",
                "isbn": "375831002",
                "isbn13": 9780375831000.0,
                "language_code": "eng",
                "average_rating": 4.36,
                "ratings_count": 1159741,
                "image_url": "https://images.gr-assets.com/books/1390053681m/19063.jpg",
                "tags": [
                    {
                        "tag_id": 11557,
                        "tag_name": "favorites"
                    },
                    {
                        "tag_id": 30574,
                        "tag_name": "to-read"
                    },
                    {
                        "tag_id": 14487,
                        "tag_name": "historical-fiction"
                    },
                    {
                        "tag_id": 11743,
                        "tag_name": "fiction"
                    },
                    {
                        "tag_id": 33114,
                        "tag_name": "young-adult"
                    }
                ]
            },
            "rating": 3
        }
    ],
    "to_read": [
```

```
        {
            "book": {
                "book_id": 112,
                "authors": [
                    "Jojo Moyes"
                ],
                "title": "Me Before You",
                "isbn": "670026603",
                "isbn13": 9780670026610.0,
                "language_code": "eng",
                "average_rating": 4.27,
                "ratings_count": 587647,
                "image_url": "https://images.gr-assets.com/books/1357108762m/15507958.jpg",
                "tags": [
                    {
                        "tag_id": 30574,
                        "tag_name": "to-read"
                    },
                    {
                        "tag_id": 11557,
                        "tag_name": "favorites"
                    },
                    {
                        "tag_id": 17213,
                        "tag_name": "kindle"
                    },
                    {
                        "tag_id": 26138,
                        "tag_name": "romance"
                    },
                    {
                        "tag_id": 3389,
                        "tag_name": "audiobook"
                    }
                ]
            }
        }
    ]
}
```


user_id: 1
user_name: "Mary Martinez"
ratings (1)
rating: 3
book (3)
book_id: 47
title: "The Book Thief"
isbn: "375831002"
isbn13: 9780375831000
language_code: "eng"
average_rating: 4.36
ratings_count: 1159741
image_url: "https://images.gr-assets.com/books/139005…
authors (1)
Markus Zusak
tags (5)
tag_id: 11557
tag_name: "favorites"
tag_id: 30574
tag_name: "to-read"
tag_id: 14487
tag_name: "historical-fiction"
tag_id: 11743
tag_name: "fiction"
tag_id: 33114
tag_name: "young-adult"
to_read (1)
book (3)
book_id: 112
title: "Me Before You"
isbn: "670026603"
isbn13: 9780670026610
language_code: "eng"
average_rating: 4.27
ratings_count: 587647
image_url: "https://images.gr-assets.com/books/135710…
authors (1)
Jojo Moyes
tags (5)
tag_id: 30574
tag_name: "to-read"
tag_id: 11557
tag_name: "favorites"
tag_id: 17213
tag_name: "kindle"
tag_id: 26138
tag_name: "romance"
tag_id: 3389
tag_name: "audiobook"

2.3 Explanation and Justification

The data in CSV format emulates the functionality of a relational database. Many of the fields have foreign keys that point to elements in the other CSV files. Document store database favour efficiency over consistency, thus, we have nested a copy of the relevant object where the value would have otherwise been a foreign key. The process by how this was achieved was highlighted in "Data Pre-Processing".

The data was seeded into the following 2 collections:

- `books`
- `users`

2.3.1 Books

The `books` collection roughly followed the format of `books.csv` (outlined in "Data Set Explanation") with some modifications. We omitted unnecessary information and altered the names of some of the properties to make their semantic meaning clearer. As a result each book document includes:

- General information about the book (`title`, `author`, `original_publication_year`, etc.).
- Aggregated rating values (`average_rating`, `total_ratings`, `ratings_counts`).
- A `ratings` list
  - Each element represents a `user`'s review of that book. It includes the `user`'s basic information and the assigned `rating` score.
- A `tags` list. Each tag represents a genre or category the book belongs to.

The most significant element of our design was the aforementioned nesting. Rather than store a separate `tags` collection, all the tags associated with the book are stored as a list of objects. The same is true for `ratings`, which is a list of rating objects.

Use case examples:

- Collection of books: Querying to see the average rating of a book and the distribution of ratings of a particular book

2.3.2 Users

Unlike `books`, the `users` collection does not directly correspond to a csv file. Instead, `users` was created by combining data from `ratings.csv`, `to_read.csv`, and `books.csv`. We chose to create the user collection in order to demonstrate the importance of collection design with regards to query efficiency. While the `users` contains a lot of duplicate data from `books`, it does so in a way that places information about the users at the top of the nesting hierarchy. This means that data about individual users can be obtained without performing expensive joins. The chosen collection design allows one to access, store and perform analytics from the perspective of the user. Each document in the `users` collection includes the following:

- A `user_id` and `user_name` (randomly generated, as explained in "Data Pre-Processing").
- A `ratings` list:
  - Each element represents a score that the user has given to a book.
  - The element includes a `book` object and a given `rating` score.
  - The nested `book` object includes all high-level data about that book, as would be found in the `books` collection.
- A `to_read` list.
  - Each element represents a book that the user has added to their `to_read` list (ie. plans to read that book).
  - The element is represented as a `book` object that is identical in structure to those represented in the `ratings` list.

Use case examples:
Collection of users: what books user X wants to read.

3 Create and Load This MongoDB Database

3.1 Load the Database

Loading via Python The database was loaded programatically via `PyMongo`. The script for which can be found as `load_database.py`. This was done that the process of seeding the databae could be done automatically such that it is identical for each member of our group. The script very simply reads in the json data produced in "1.2" and calls `insertMany` on the database.

Loading via shell However, the database can also be loaded via the following shell commands:

```
mongoimport --db goodbooks --collection users --file mongo-seed/users.json --jsonArray
mongoimport --db goodbooks --collection books --file mongo-seed/books.json --jsonArray
```

These commands similarly

3.2 Testing