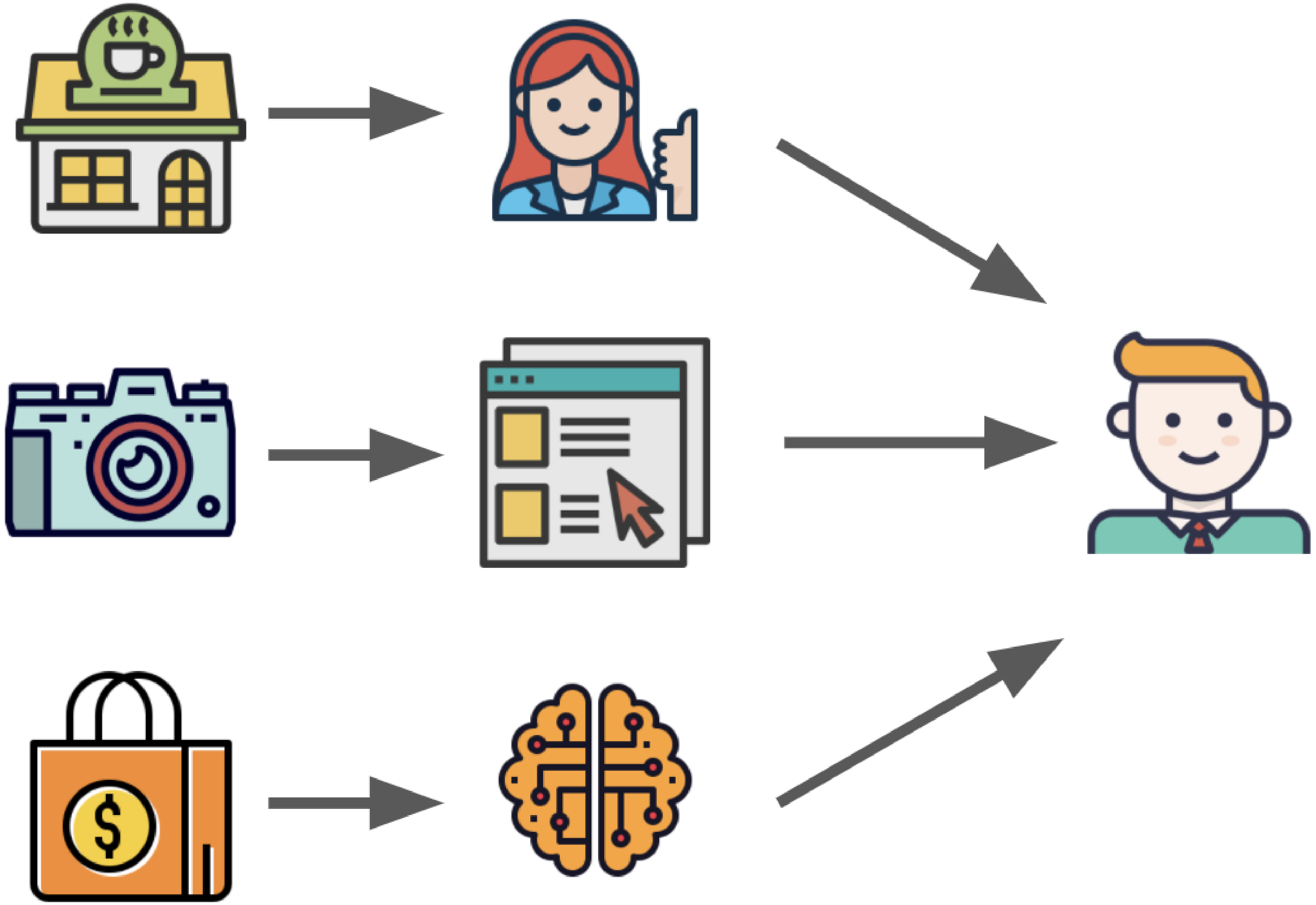
What are recommendation engines?

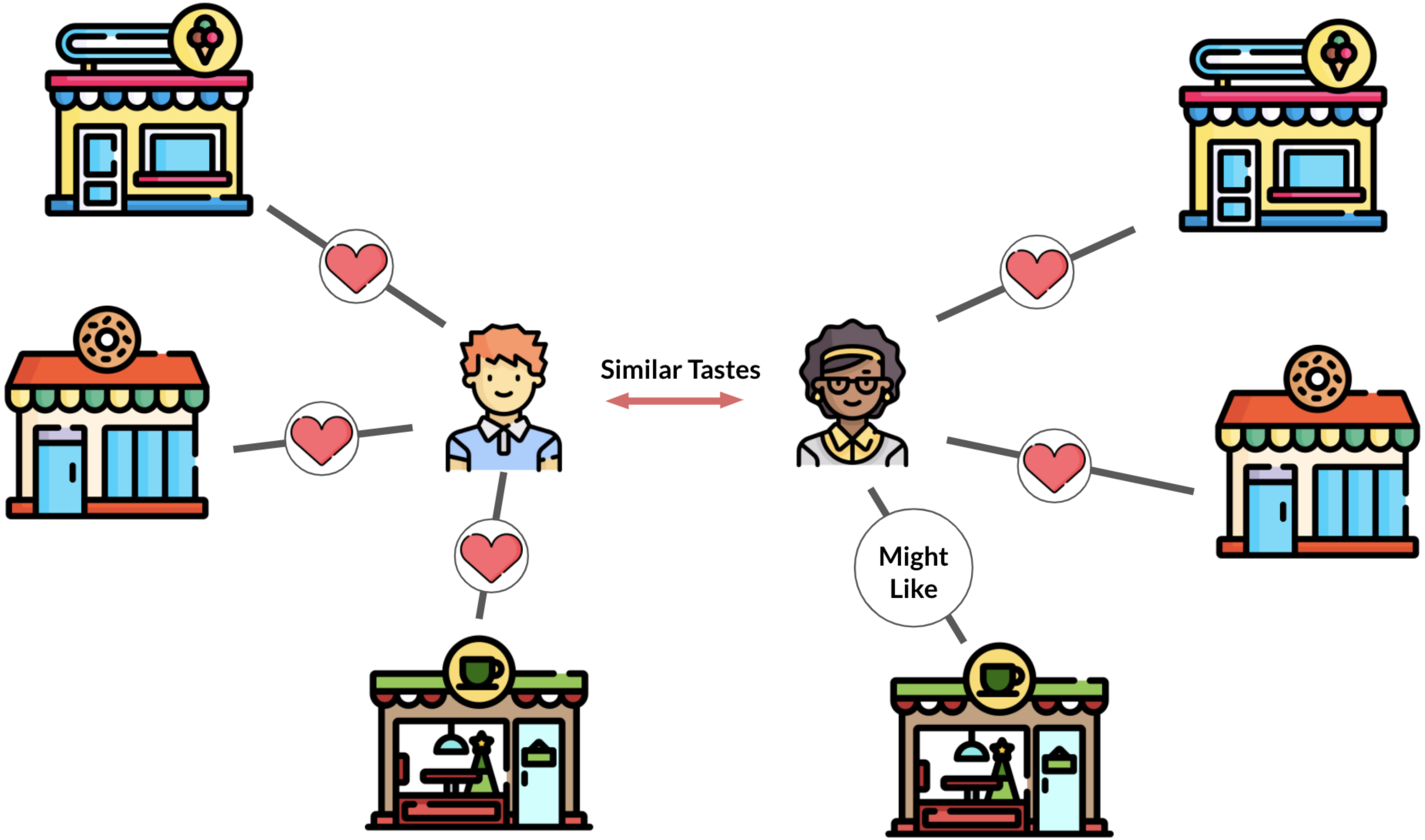
BUILDING RECOMMENDATION ENGINES IN PYTHON

Rob O'Callaghan
Director of Data

What are recommendation engines?



What kind of data do I need?



What kind of data do I need?

User ID	Item ID	Review
User 1	Item 1	😞
User 1	Item 4	😃
User 2	Item 2	😐
User 2	Item 4	😞
...	...	...

	Item 1	Item 2	Item 3	Item 4	Item 5
User 1	😞			😃	😞
User 2		😐	😞		
User 3	😃		😐		
User 4		😃		😃	😐
User 5	😞		😃		😐

What are recommendation engines useful for?

Recommendation Engines

What movie should a viewer watch?

Will a diner enjoy a restaurant?

Other Statistical Models

Will a movie sell a lot of tickets?

How much is a house worth?

Implicit vs. explicit data

Implicit Feedback

A user often selecting the same genre of music.

An item is repeatedly purchased by the same consumer.

A viewer gives up halfway on a movie they were watching.

Explicit Feedback

Ratings given on movie sites like Rotten Tomatoes.

A user telling a social media platform that an ad is not relevant to their interests.

A user gives a thumbs up or thumbs down on YouTube.

Let's practice!

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Non-personalized recommendations

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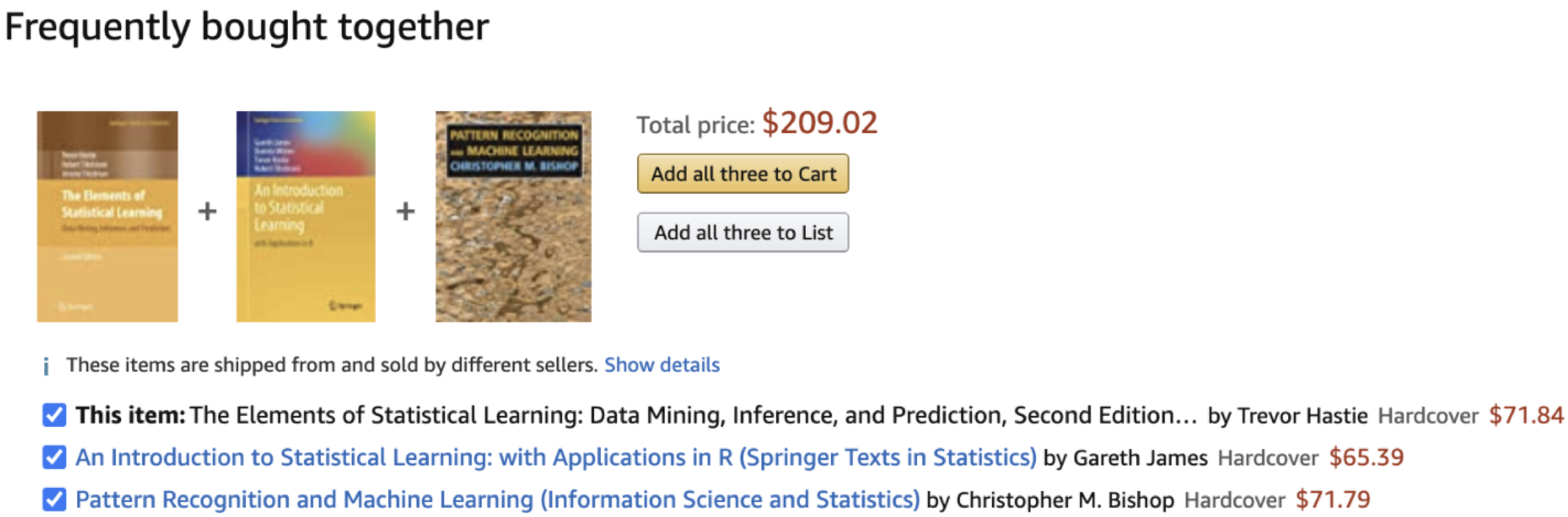
Non-personalized ratings



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Finding the most popular items

`book_df` DataFrame:

User	Book
User_233	The Great Gatsby
User_651	The Catcher in the Rye
User_131	The Lord of the Rings
User_965	Little Women
User_651	Fifty Shades of Grey
...	...

Finding the most popular items

```
book_df['book'].value_counts()
```

```
40 Shades of Grey                      524
Harry Potter and the Sorcerer's Stone  487
The Da Vinci Code                      455
The Twilight Saga                      401
Lord of the Rings                      278
                                     ...
```

Finding the most popular items

```
print(book_df.value_counts().index)
```

```
Index(['40 Shades of Grey', 'Harry Potter and the Sorcerer's Stone',
       'The Da Vinci Code', 'The Twilight Saga',
       'The Lord of the Rings'],
      dtype='object')
```

Finding the most liked items

`user_ratings` DataFrame:

User	Book	Rating
User_233	The Great Gatsby	3.0
User_651	The Catcher in the Rye	5.0
User_131	The Lord of the Rings	3.0
User_965	Little Women	4.0
User_651	Fifty Shades of Grey	2.0
...	...	...

Finding the most liked items

```python
avg_rating_df = user_ratings[["book", "rating"]].groupby(['book']).mean()
avg_rating_df.head()
```

```
                                      rating
title
Hamlet                                   4.1
The Da Vinci Code                       2.1
Gone with the Wind                       4.2
Fifty Shades of Grey                     1.2
Wuthering Heights                        3.9
                                          ...
```

Finding the most liked items

```
sorted_avg_rating_df = avg_rating_df.sort_values(by="rating", ascending=False)
sorted_avg_rating_df.head()
```

```
                                      rating
title
The Girl in the Fog                      5.0
Behind the Bell                          5.0
Across the River and into the Trees      5.0
The Complete McGonagall                  5.0
What Is to Be Done?                      5.0
                                          ...
```

Finding the most liked items

```
(user_ratings['title']=='The Girl in the Fog').sum()
```

```
1
```

```
(user_ratings['title']=='Valley of the Dolls').sum()
```

```
1
```

```
(user_ratings['title']=='Across the River and into the Trees').sum()
```

```
1
```

Finding the most liked popular items

```python
book_frequency = user_ratings["book"].value_counts()
print(book_frequency)
```

```
40 Shades of Grey                      524
Harry Potter and the Sorcerer's Stone  487
                                       ...
```

```python
frequently_reviewed_books = book_frequency[book_frequency > 100].index
print(frequently_reviewed_books)
```

```
Index([u'The Lord of the Rings', u'To Kill a Mockingbird', u'Of Mice and Men',
       u'1984', u'Hamlet'])
```

Finding the most liked popular items

```
frequent_books_df =  user_ratings_df[user_ratings_df["book"].isin(frequently_reviewed_books)]
```

```
frequent_books_avgs = frequently_reviewed_books[["title", "rating"]].groupby('title').mean()
print(frequent_books_avgs.sort_values(by="rating", ascending=False).head())
```

```
                                      rating
title
To Kill a Mockingbird                    4.7
1984.                                    4.7
Harry Potter and the Sorcerer's Stone    4.6
                                          ...
```

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Non-personalized suggestions

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Identifying pairs

```
0     User_223           The Great Gatsby <---| Read by the same user
1     User_223     The Catcher in the Rye <---|
2     User_131        The Lord of the Rings
3     User_965               Little Women <---| Read by the same user
4     User_965       Fifty Shades of Grey <---|
... ...
```

Permutations versus combinations

User	book_title
User_233	The Great Gatsby
User_233	The Catcher in the Rye

To:

	Book A	Book B
0	The Great Gatsby	The Catcher in the Rye
1	The Catcher in the Rye	The Great Gatsby

Books seen with `The Great Gatsby` -> `The Catcher in the Rye`

Books seen with `The Catcher in the Rye` -> `The Great Gatsby`

Creating the pairing function

```python
from itertools import permutations

def create_pairs(x):


  return pairs
```

Creating the pairing function

```python
from itertools import permutations

def create_pairs(x):
  pairs =                    permutations(x.values, 2)

  return pairs
```

- `permutations(list, length_of_permutations))` Generates iterable object containing all permutations

Creating the pairing function

```python
from itertools import permutations

def create_pairs(x):
  pairs =              list(permutations(x.values, 2))

  return pairs
```

- `permutations(list, length_of_permutations))` Generates iterable object containing all permutations
- `list()` Converts this object to a usable list

Creating the pairing function

```python
from itertools import permutations

def create_pairs(x):
  pairs = pd.DataFrame(list(permutations(x.values, 2)),
                           columns=['book_a','book_b'])
  return pairs
```

- `permutations(list, length_of_permutations))` Generates iterable object containing all permutations
- `list()` Converts this object to a usable list
- `pd.DataFrame()` Converts the list to a DataFrame containing the columns `book_a` and `book_b`

Applying the function to the data

```
book_pairs = book_df.groupby('userId')['book_title'].apply(perm_function)
print(book_pairs.head())
```

```
                                book_a                                   book_b
userId
User_223     0        The Great Gatsby                   The Catcher in the Rye
             1  The Catcher in the Rye                         The Great Gatsby
User_965     0            Little Women                        40 Shades of Grey
             1       40 Shades of Grey                             Little Women
User_773     0       The Twilight Saga    Harry Potter and the Sorcerer's Stone
                                                                            ...
```

Cleaning up the results

```
book_pairs = book_pairs.reset_index(drop=True)
print(book_pairs.head())
```

```
                     book_a                                   book_b
0          The Great Gatsby                   The Catcher in the Rye
1    The Catcher in the Rye                         The Great Gatsby
3              Little Women                        40 Shades of Grey
4         40 Shades of Grey                             Little Women
5         The Twilight Saga    Harry Potter and the Sorcerer's Stone
                                                                 ...
```

Counting the pairings

```
pair_counts = book_pairs.groupby(['book_a', 'book_b']).size()
```

```
book_a                                book_b
The Twilight Saga                     Fifty Shades of Grey          16
                                      Pride and Prejudice           12
                                                                   ...
```

```
pair_counts_df = pair_counts.to_frame(name = 'size').reset_index()
print(pair_counts_df.head())
```

```
     book_a                                book_b                      size
1    The Twilight Saga                     Fifty Shades of Grey          16
2    The Twilight Saga                     Pride and Prejudice           12
                                                                        ...
```

Looking up recommendations

```
pair_counts_sorted = pair_counts_df.sort_values('size', ascending=False)
```

```
pair_counts_sorted[pair_counts_sorted['book_a'] == 'Lord of the Rings']
```

```
                  book_a                                      book_b  size
137    Lord of the Rings                                  The Hobbit    12
147    Lord of the Rings      Harry Potter and the Sorcerer's Stone    10
143    Lord of the Rings                         The Colour of Magic     9
                                                                       ...
```

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