Recommender Systems

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Reference

- Chapter 5: **Building Recommender Systems**

- Prateek Joshi, **Artificial Intelligence with Python**, Packt, 2017
  - Material: https://github.com/PacktPublishing/Artificial-Intelligence-with-Python

Outline

1. Introduction
2. The MovieLens dataset
3. Similarity scores
4. Building a collaborative recommendation system
5. Open-source Python packages
6. Summary

1. Introduction

- YouTube Video: **Recommendation Systems - Learn Python for Data Science #3** by Siraj Raval

<div align="center">

https://youtu.be/9gBC9R-msAk

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1. Introduction

- A **Recommender System** predicts the likelihood that a user would prefer an item and it recommends items to the user.
- **Examples**
  - Facebook — "People You May Know"
  - Netflix — "Other Movies You May Enjoy"
  - LinkedIn — "Jobs You May Be Interested In"
  - Amazon — "Customer who bought this item also bought …"
  - Google — "Visually Similar Images"
  - YouTube — "Recommended Videos"

1. Introduction

- **Recommender System Types**
  1. A **collaborative filtering** algorithm works by finding a set of people with preferences or tastes like the target user. Using this smaller set of "similar" people, it constructs a ranked list of suggestions.
  2. **Content-based filtering** is based on a description of the item and a profile of the user's preferences to recommend items that are similar to those that a user liked.
  3. **Hybrid**

2. The MovieLens Dataset

- 100,000 ratings (1-5) from 943 users on 1682 movies.
- Includes users' data and ratings data

Users

(943, 5)

	user_id	age	sex	occupation	zip_code
0	1	24	M	technician	85711
1	2	53	F	other	94043
2	3	23	M	writer	32067
3	4	24	M	technician	43537
4	5	33	F	other	15213

Ratings

(100000, 4)

	user_id	movie_id	rating	unix_timestamp
0	196	242	3	881250949
1	186	302	3	891717742
2	22	377	1	878887116
3	244	51	2	880606923
4	166	346	1	886397596

3. Similarity Scores

1. **Euclidean score** (Euclidean distance, lower is better)

$$d(\boldsymbol{x}, \boldsymbol{y}) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2}$$
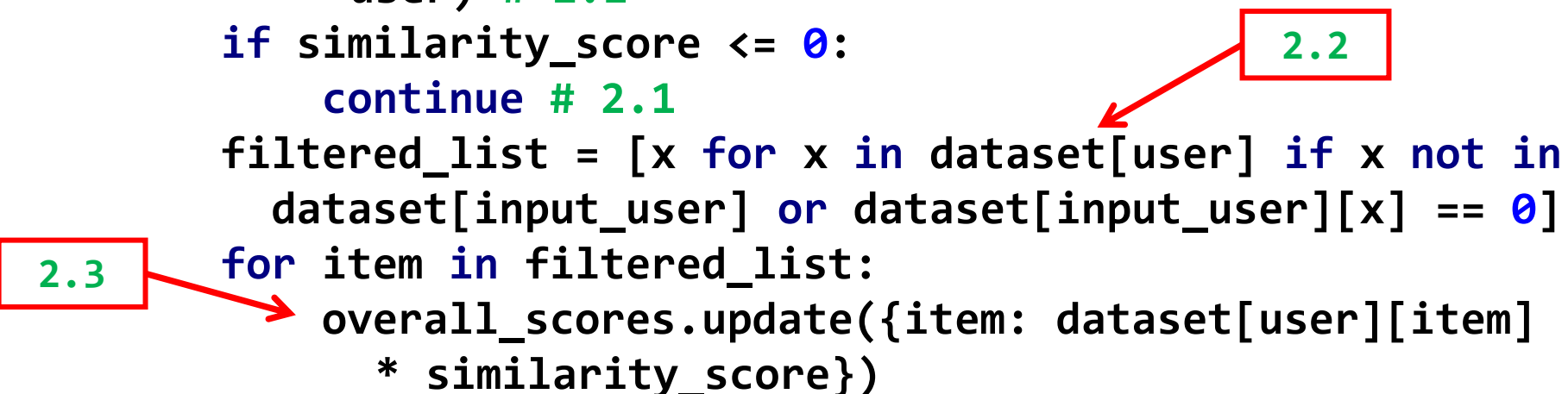
2. **Pearson score** (1 is best)

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

4. Building a Collaborative Recommendation System

1. Function to **recommend movies** for a user
2. **For each other user**:
   1. Find the **Pearson score of commonly rated movies**, ignoring dissimilar users.
   2. Extract a list of movies that have been **rated by this user** but **haven't been rated by the input user**.
   3. For each item in this list, keep a track of the **weighted rating** based on the similarity score.
3. Finally, **sort** the scores and **extract** the **movie recommendations**.

4. Building a Collaborative Recommendation System

```python
# Get movie recommendations for the input user
# Assume the input user is in the dataset
#  and there is at lease one recommendation
def get_recommendations(dataset, input_user): # 1
    overall_scores = {}
    similarity_scores = {}
    for user in [x for x in dataset if x != input_user]:
        similarity_score = pearson_score(dataset, input_user,
                user) # 2.1
        if similarity_score <= 0:                        2.2
            continue # 2.1
        filtered_list = [x for x in dataset[user] if x not in
            dataset[input_user] or dataset[input_user][x] == 0]
   2.3  for item in filtered_list:
            overall_scores.update({item: dataset[user][item]
                * similarity_score})
```
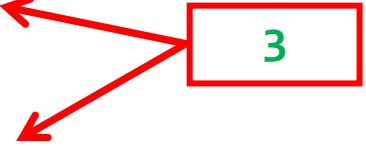
4. Building a Collaborative Recommendation System

```python
# Generate movie ranks
movie_scores = np.array([[score, item] for item, score in
        overall_scores.items()])

# Sort in decreasing order
movie_scores = movie_scores[
        np.argsort(movie_scores[:, 0])[::-1]]

# Extract the movie recommendations
movie_recommendations = [movie for _, movie in
        movie_scores]

return movie_recommendations
```

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5. Open-Source Python Packages

- [LightFM](#)
- [GraphLab](#)
- [Crab](#)
- [Surprise](#)
- [Python Recsys](#)
- [MRec](#)

Summary

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