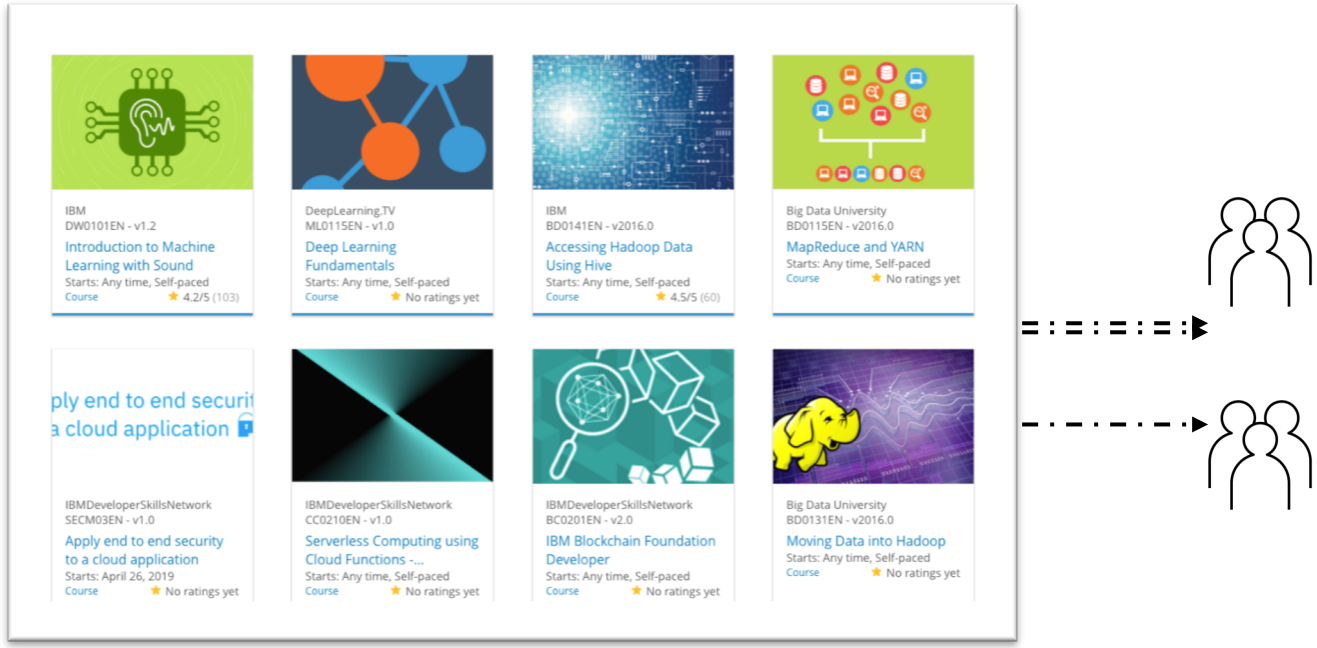
# Build a Personalized Online Course Recommender System with Machine Learning

NGOUMLA Denilson

29/03/2025



# Outline

- Introduction and Background
- Exploratory Data Analysis
- Content-based Recommender System using Unsupervised Learning
- Collaborative-filtering based Recommender System using Supervised learning
- Conclusion
- Appendix

# Introduction

- ## Project Background and Context

  Recommendation systems are essential for filtering and personalizing content across various domains (e-commerce, streaming, social media). This project aims to develop a recommendation system by exploring multiple approaches: collaborative filtering, content-based filtering, hybrid methods, and deep learning. The goal is to optimize the accuracy and relevance of recommendations based on user needs.

- ## Problem Statement and Hypotheses

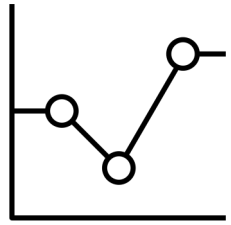
Problems:

- Data sparsity and cold start issues
- Scalability and real-time performance
- Bias and lack of diversity in recommendations

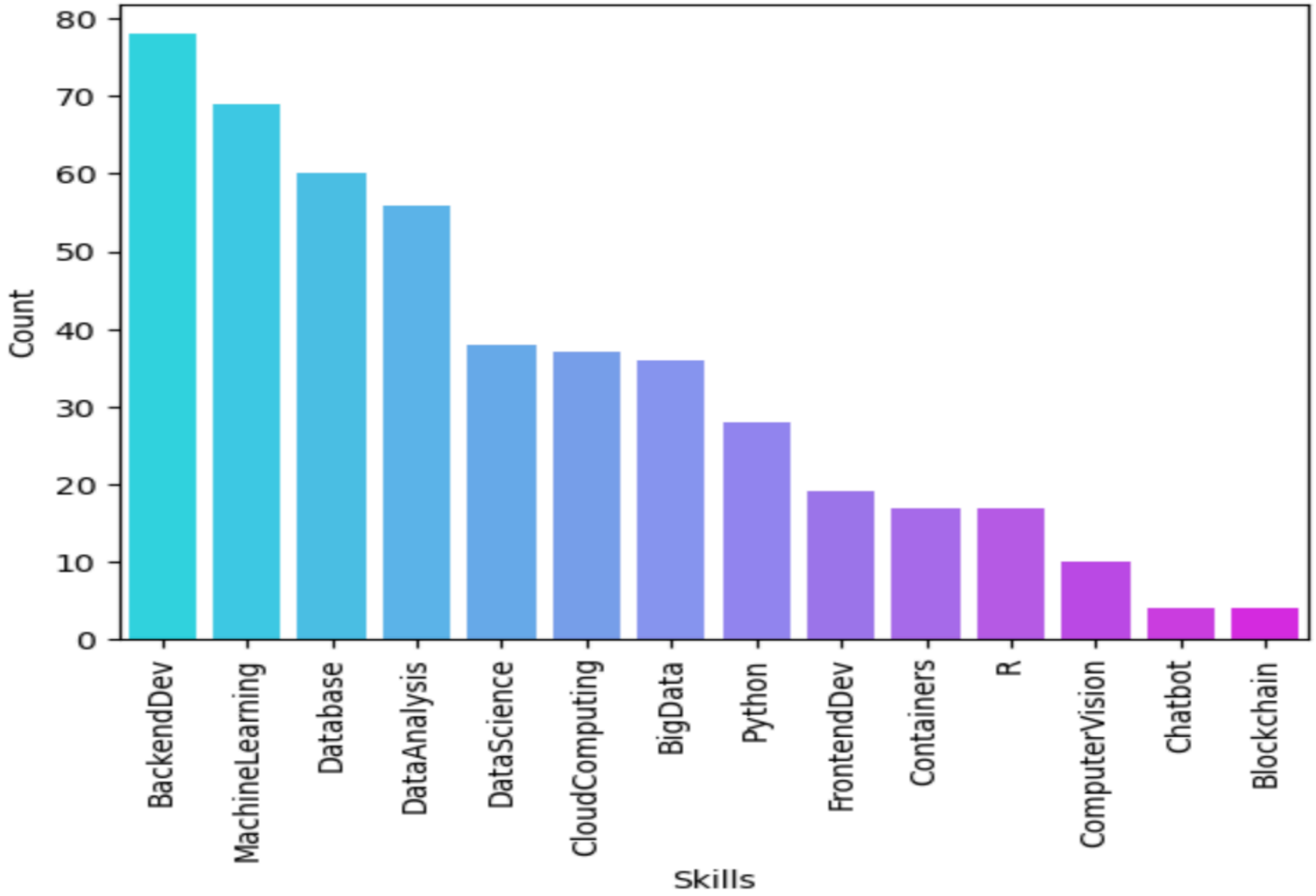
Hypotheses:

- Hybrid approaches improve accuracy
- Deep learning provides better recommendations
- Matrix factorization and graph-based methods reduce sparsity
- Dynamic personalization enhances user experience

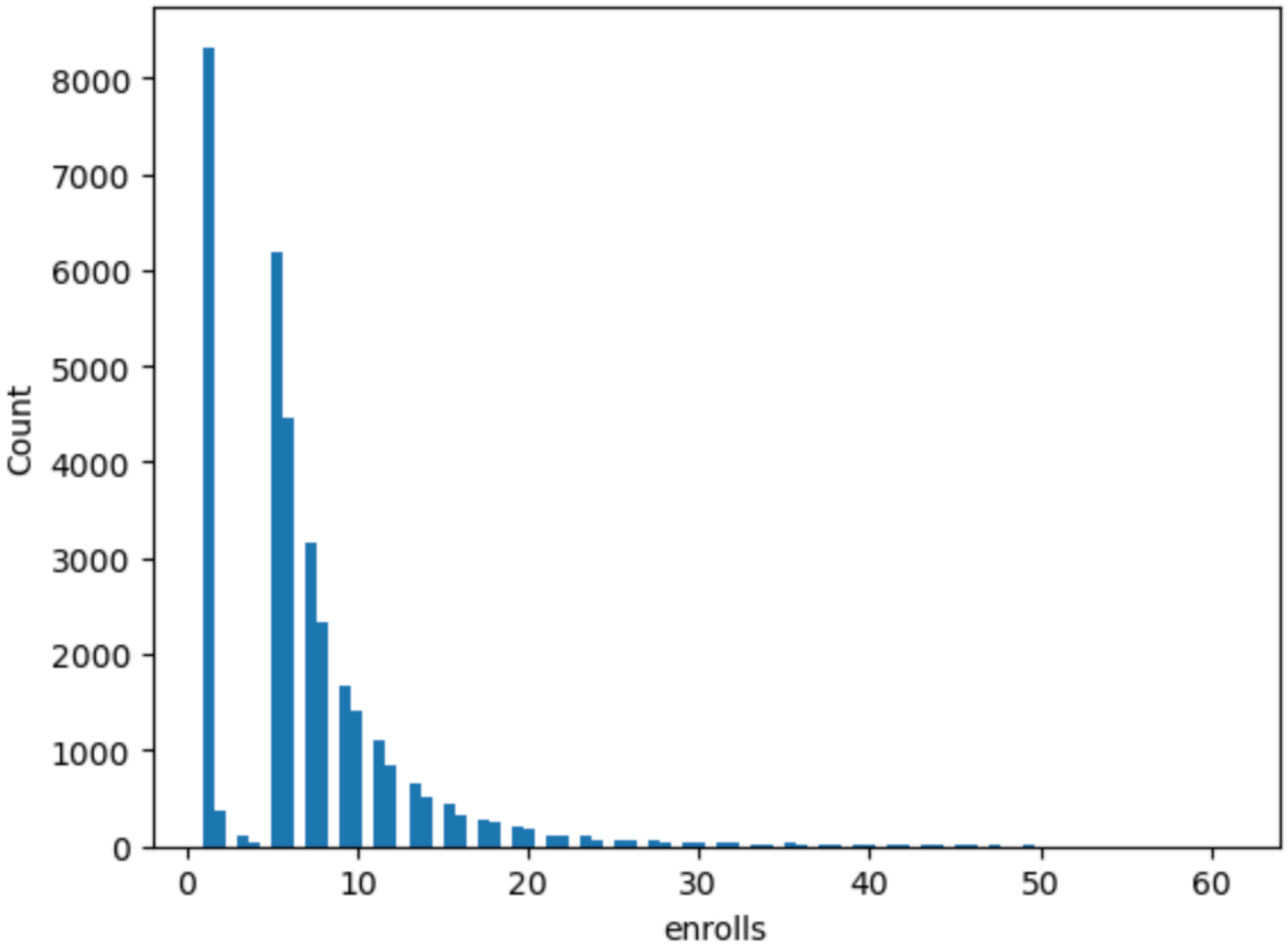
# Exploratory Data Analysis



# Course counts per genre



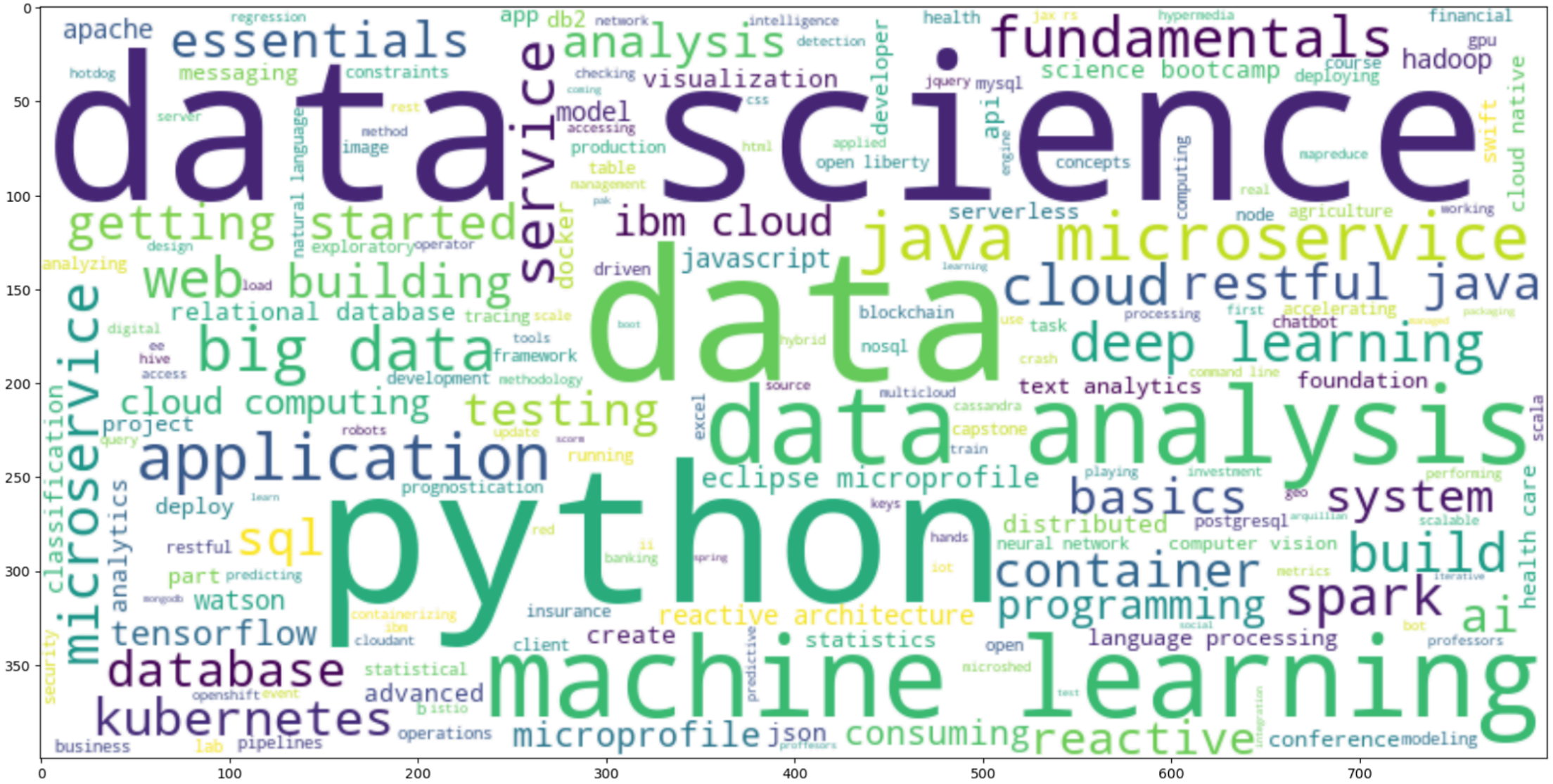
# Course enrollment distribution



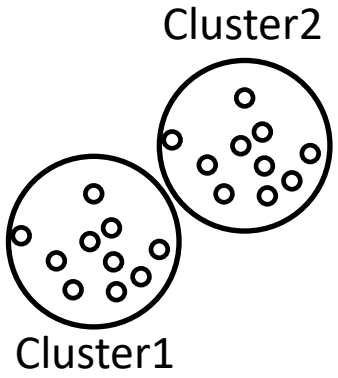
# 20 most popular courses

| | TITLE | Enrolls |
|---|---|---|
| 0 | python for data science | 14936 |
| 1 | introduction to data science | 14477 |
| 2 | big data 101 | 13291 |
| 3 | hadoop 101 | 10599 |
| 4 | data analysis with python | 8303 |
| 5 | data science methodology | 7719 |
| 6 | machine learning with python | 7644 |
| 7 | spark fundamentals i | 7551 |
| 8 | data science hands on with open source tools | 7199 |
| 9 | blockchain essentials | 6719 |
| 10 | data visualization with python | 6709 |
| 11 | deep learning 101 | 6323 |
| 12 | build your own chatbot | 5512 |
| 13 | r for data science | 5237 |
| 14 | statistics 101 | 5015 |
| 15 | introduction to cloud | 4983 |
| 16 | docker essentials a developer introduction | 4480 |
| 17 | sql and relational databases 101 | 3697 |
| 18 | mapreduce and yarn | 3670 |
| 19 | data privacy fundamentals | 3624 |

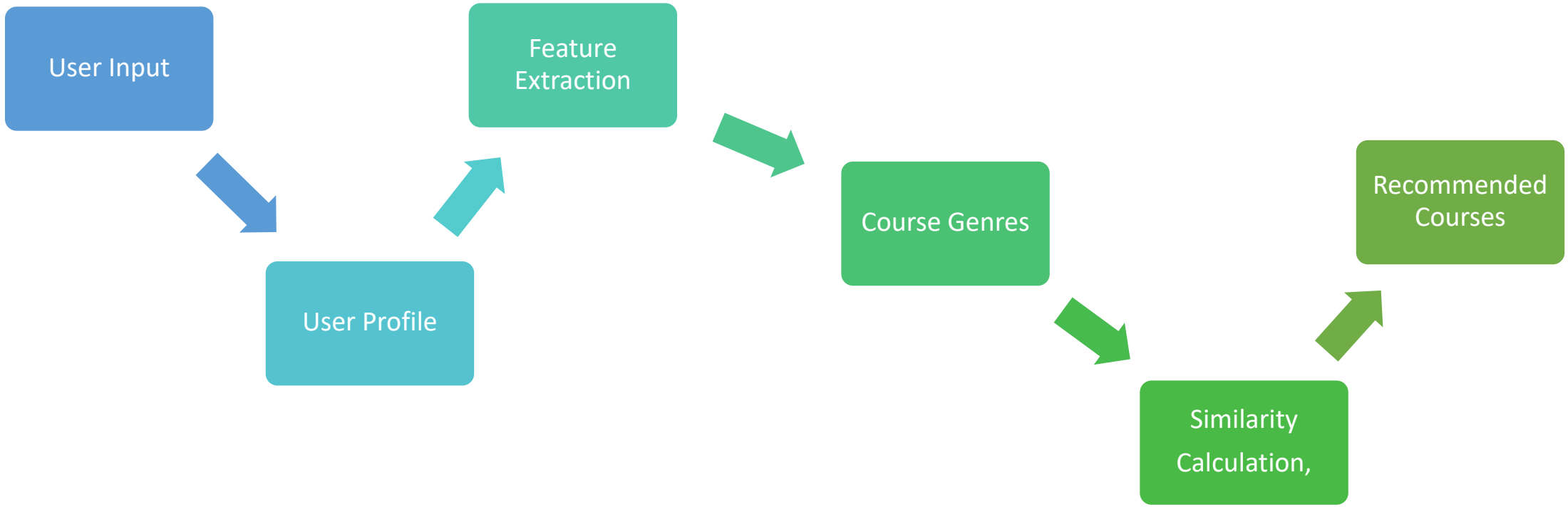
# Word cloud of course titles



# Content-based Recommender System using Unsupervised Learning



# Flowchart of content-based recommender system using user profile and course genres



# Evaluation results of user profile-based recommender system

score_threshold = 10.0

On average, how many new/unseen courses have been recommended per user (in the test user dataset)

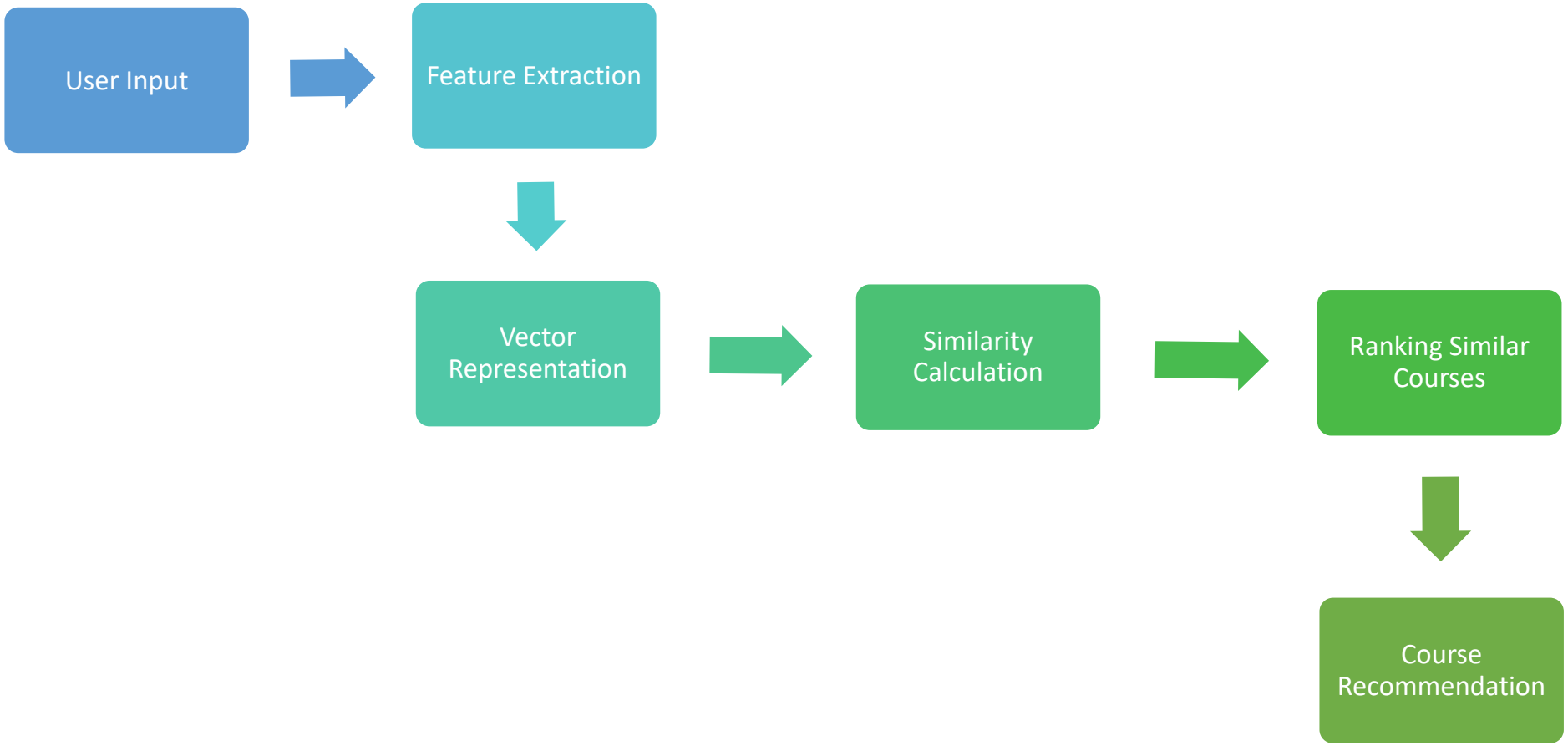
```
res_df['SCORE'].mean()
```

```
18.62679972290352
```

What are the most frequently recommended courses? Return the top-10 commonly recommended courses across all users

```
excourse22    579
excourse62    579
DS0110EN      562
excourse65    555
excourse63    555
excourse72    551
excourse68    550
excourse67    539
excourse74    539
BD0145EN      506
```

# Flowchart of content-based recommender system using course similarity



# Evaluation results of course similarity based recommender system

Threshold = 0.6

On average, how many new/unseen courses have been recommended per user (in the test user dataset)

```
s = 0
for i in range(len(res_df['COURSE_ID'])):
    s+=len(res_df['COURSE_ID'].iloc[i])
avg = s/len(res_df['COURSE_ID'])
```

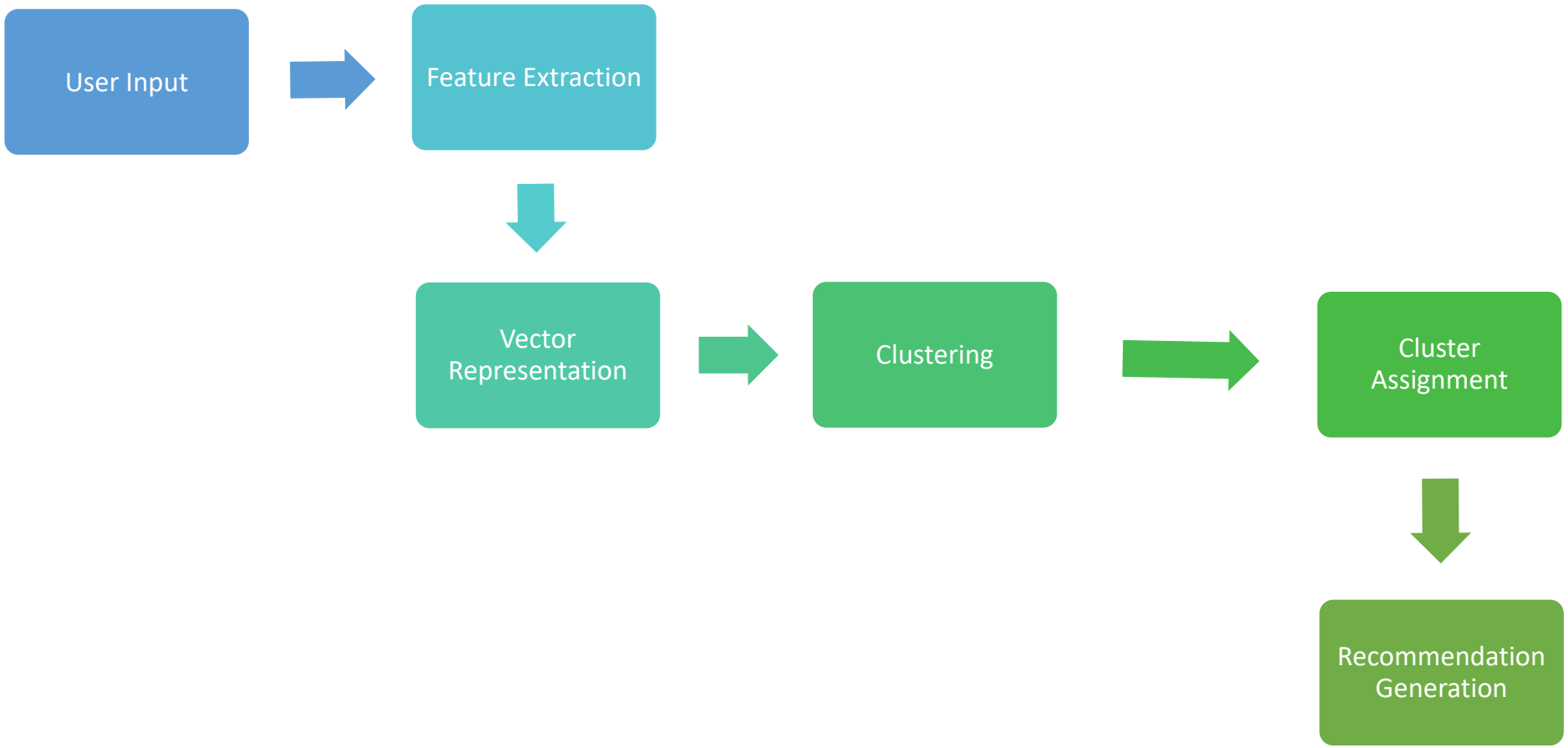
```
avg
```

```
11.377
```

What are the most frequently recommended courses? Return the top-10 commonly recommended courses

| | |
|---|---|
| excourse22 | 579 |
| excourse62 | 579 |
| DS0110EN | 562 |
| excourse65 | 555 |
| excourse63 | 555 |
| excourse72 | 551 |
| excourse68 | 550 |
| excourse67 | 539 |
| excourse74 | 539 |
| BD0145EN | 506 |

# Flowchart of clustering-based recommender system



# Evaluation results of clustering-based recommender system

Number of clusters = 20

On average, how many new/unseen courses have been recommended per user (in the test user dataset)

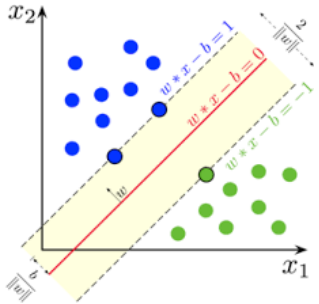
```
s = 0
for r in user_recommendations.value
    s+=r[1:].sum()
avg=s/len(user_recommendations)
print(avg)
```

```
5.733
```

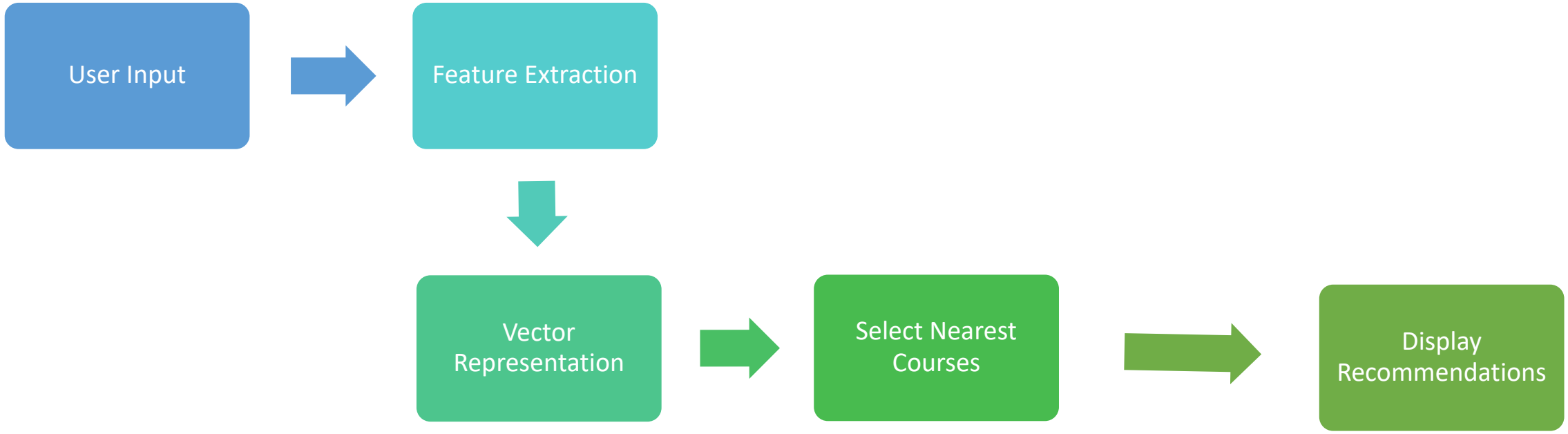
What are the most frequently recommended courses? Return the top-10 commonly recommended courses

| | |
|---|---|
| DS0103EN | 579 |
| DA0101EN | 532 |
| BD0111EN | 456 |
| DS0101EN | 444 |
| BD0101EN | 428 |
| PY0101EN | 386 |
| DS0105EN | 319 |
| ML0101ENv3 | 299 |
| BC0101EN | 296 |
| ML0115EN | 286 |

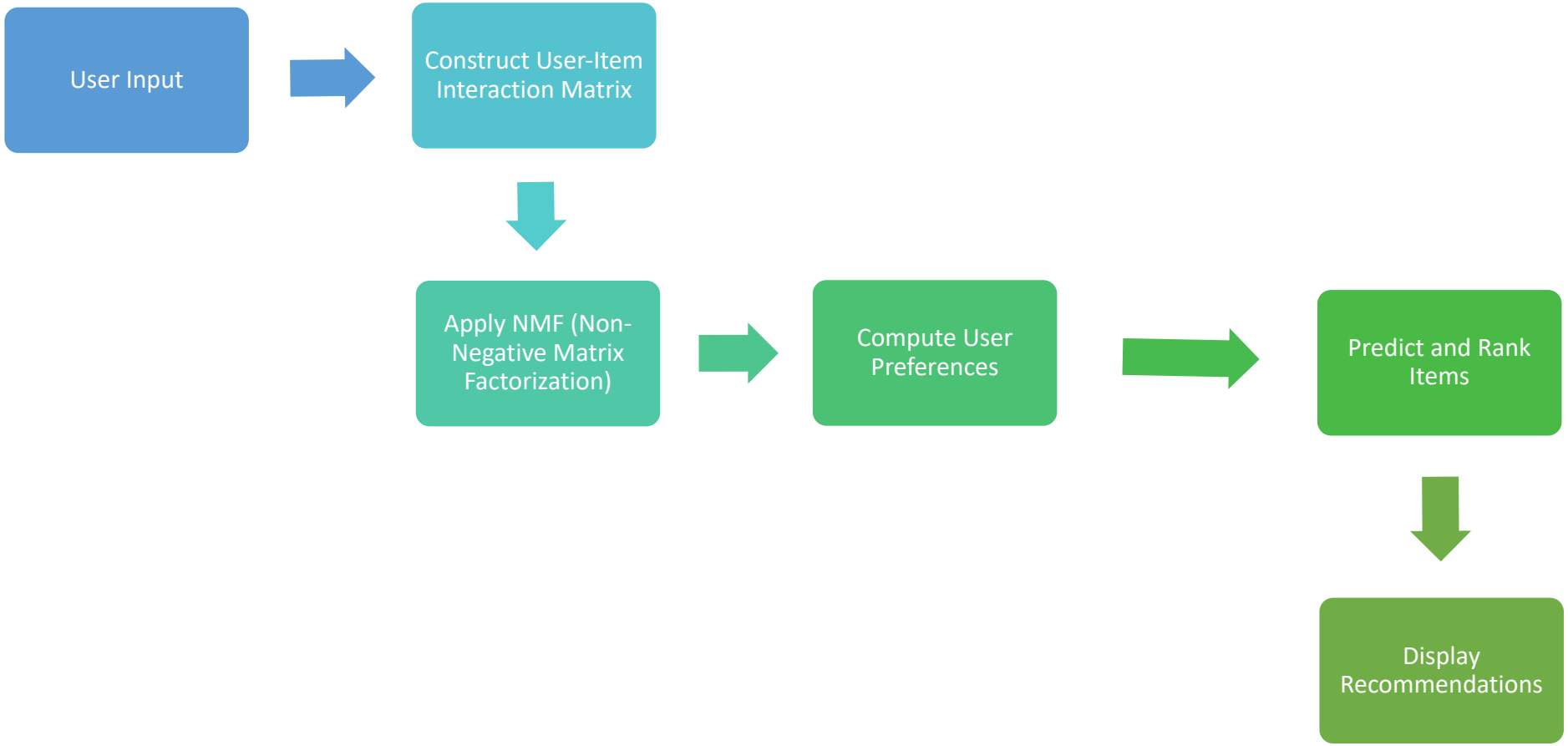
# Collaborative-filtering Recommender System using Supervised Learning



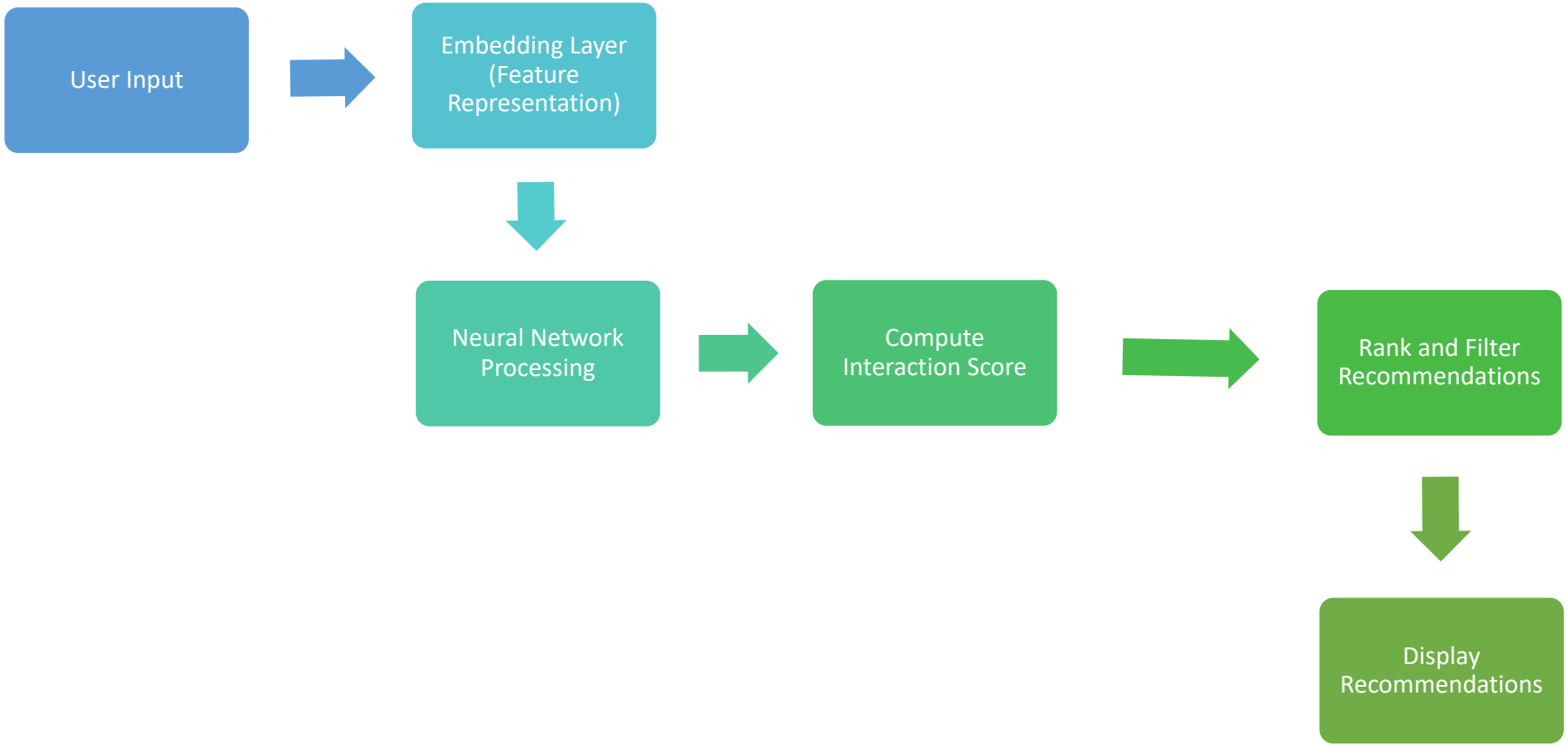
# Flowchart of KNN based recommender system



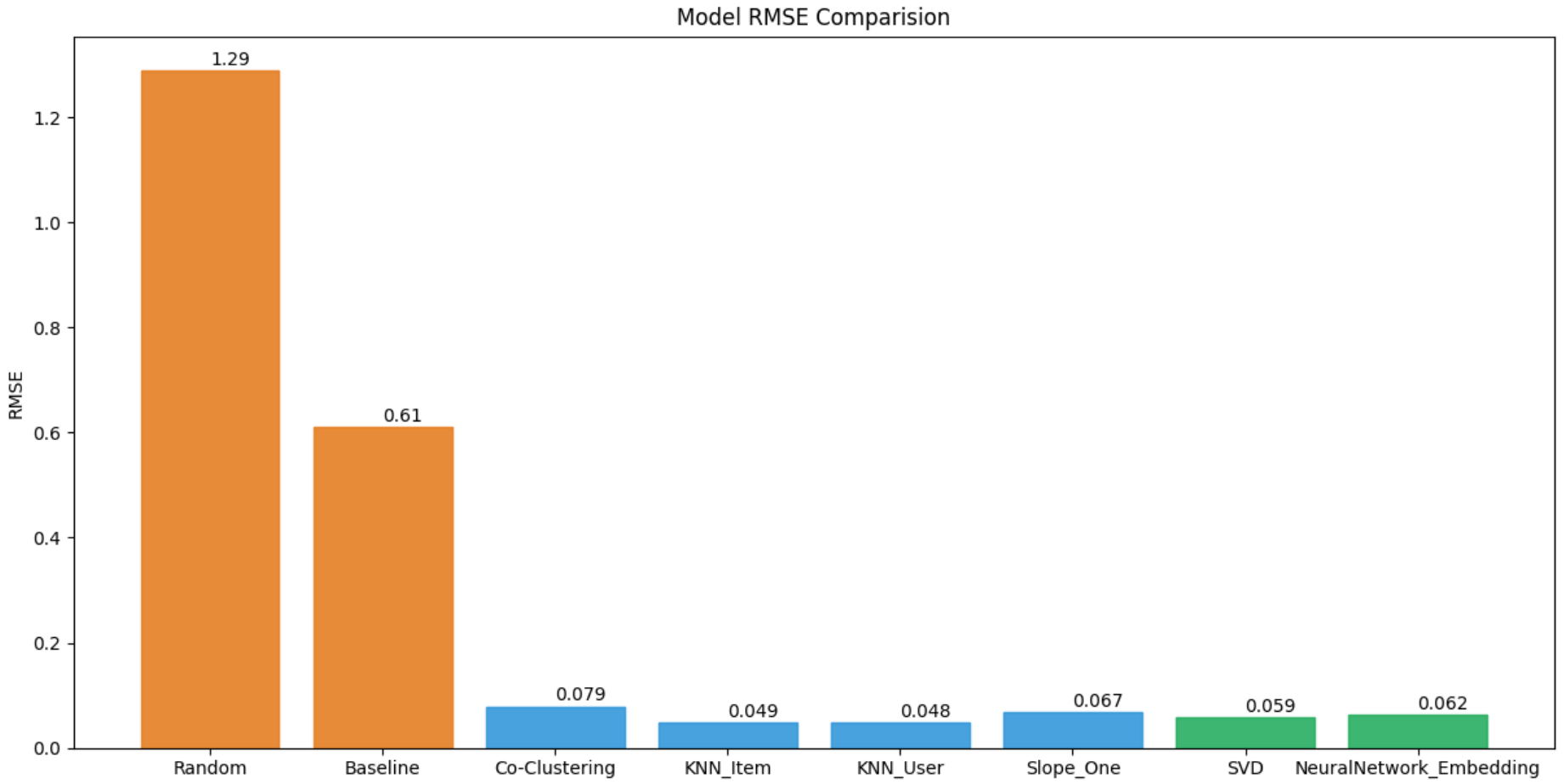
# Flowchart of NMF based recommender system



# Flowchart of Neural Network Embedding based recommender system



# Compare the performance of collaborative-filtering models



# Conclusions

- Similar performance of models
- User profile based has highest number of
- recommendations
- Stacking Classifier has best performance
- Similarity matrix’s high complexity
- NMF as a solution

# Appendix

A Neural Network Embedding-based Recommender System maps users and items into dense vectors, capturing hidden patterns. A neural network processes these embeddings to compute similarity or predict ratings. The system then ranks items and recommends the most relevant ones based on the predicted scores.