

# Movie Recommendation System with Machine Learning

```
In [1]: import pandas as pd
import numpy as np
```

With pandas we can efficiently handle and manipulate tabular data, while numpy provides powerful tools for numerical computations. The aliases pd and np make it more convenient to use these libraries throughout your code.

```
In [2]: credits = pd.read_csv(r'D:\GROWINTERN PROJECTS\MOVIE RECOMMENDATION SYSTEM\tmdb_5000_credits.csv')
movies = pd.read_csv(r'D:\GROWINTERN PROJECTS\MOVIE RECOMMENDATION SYSTEM\tmdb_5000_movies.csv')
credits.head()
```

Out[2]:	movie_id		title	cast	crew
0	19995		Avatar	[{"cast_id": 242, "character": "Jake Sully", "...	[{"credit_id": "52fe48009251416c750aca23", "de...
1	285	Pirates of the Caribbean: At World's End		[{"cast_id": 4, "character": "Captain Jack Spa...	[{"credit_id": "52fe4232c3a36847f800b579", "de...
2	206647		Spectre	[{"cast_id": 1, "character": "James Bond", "cr...	[{"credit_id": "54805967c3a36829b5002c41", "de...
3	49026	The Dark Knight Rises		[{"cast_id": 2, "character": "Bruce Wayne / Ba...	[{"credit_id": "52fe4781c3a36847f81398c3", "de...
4	49529	John Carter		[{"cast_id": 5, "character": "John Carter", "c...	[{"credit_id": "52fe479ac3a36847f813eaa3", "de...

```
In [3]: movies.head()
```

Out[3]:	budget	genres	homepage	id	keywords	original_language	original_title	overview
0	237000000	[{"id": 28, "name": "Action"}, {"id": 12, "name": "Adventure"}]	http://www.avatarmovie.com/	19995	[{"id": 1463, "name": "culture clash"}, {"id": 1464, "name": "culture clash"}]	en	Avatar	In the 22nd century, a paraplegic Marine is di...
1	300000000	[{"id": 12, "name": "Adventure"}, {"id": 14, "name": "Fantasy"}]	http://disney.go.com/disneypictures/pirates/	285	[{"id": 270, "name": "ocean"}, {"id": 726, "name": "pirates"}]	en	Pirates of the Caribbean: At World's End	Captain Barbosa, long believed to be dead, ha...
2	245000000	[{"id": 28, "name": "Action"}, {"id": 12, "name": "Adventure"}]	http://www.sonypictures.com/movies/spectre/	206647	[{"id": 470, "name": "spy"}, {"id": 818, "name": "based on novel"}]	en	Spectre	A cryptic message from Bond's past sends him o...
3	250000000	[{"id": 28, "name": "Action"}, {"id": 80, "name": "Drama"}]	http://www.thedarkknighttrises.com/	49026	[{"id": 849, "name": "dc comics"}, {"id": 853, "name": "superhero"}]	en	The Dark Knight Rises	Following the death of District Attorney Harve...
4	260000000	[{"id": 28, "name": "Action"}, {"id": 12, "name": "Adventure"}]	http://movies.disney.com/john-carter	49529	[{"id": 818, "name": "based on novel"}, {"id": 1464, "name": "culture clash"}]	en	John Carter	John Carter is a war-weary, former military ca...

```
In [4]: print("Credits:", credits.shape)
print("Movies Dataframe:", movies.shape)
```

Credits: (4803, 4)  
Movies Dataframe: (4803, 20)

This can be helpful for understanding the dimensions of the data you're working with.

```
In [16]: credits_column_renamed = credits.rename(index=str, columns={"movie_id": "id"})
movies_merge = movies.merge(credits_column_renamed, on='id')
print(movies_merge.head())
```

budget

genres \

```

0 237000000 [{"id": 28, "name": "Action"}, {"id": 12, "nam...
1 300000000 [{"id": 12, "name": "Adventure"}, {"id": 14, "...
2 245000000 [{"id": 28, "name": "Action"}, {"id": 12, "nam...
3 250000000 [{"id": 28, "name": "Action"}, {"id": 80, "nam...
4 260000000 [{"id": 28, "name": "Action"}, {"id": 12, "nam...

                                homepage      id \
0                               http://www.avatarmovie.com/ 19995
1 http://disney.go.com/disneypictures/pirates/           285
2 http://www.sonypictures.com/movies/spectre/           206647
3 http://www.thedarkknighttrises.com/                   49026
4 http://movies.disney.com/john-carter                   49529

                                keywords original_language \
0 [{"id": 1463, "name": "culture clash"}, {"id":...          en
1 [{"id": 270, "name": "ocean"}, {"id": 726, "na...          en
2 [{"id": 470, "name": "spy"}, {"id": 818, "name...          en
3 [{"id": 849, "name": "dc comics"}, {"id": 853,...          en
4 [{"id": 818, "name": "based on novel"}, {"id":...          en

                                original_title \
0                               Avatar
1 Pirates of the Caribbean: At World's End
2                               Spectre
3                               The Dark Knight Rises
4                               John Carter

                                overview popularity \
0 In the 22nd century, a paraplegic Marine is di... 150.437577
1 Captain Barbossa, long believed to be dead, ha... 139.082615
2 A cryptic message from Bond's past sends him o... 107.376788
3 Following the death of District Attorney Harve... 112.312950
4 John Carter is a war-weary, former military ca... 43.926995

                                production_companies ... runtime \
0 [{"name": "Ingenious Film Partners", "id": 289... ... 162.0
1 [{"name": "Walt Disney Pictures", "id": 2}, {""... ... 169.0
2 [{"name": "Columbia Pictures", "id": 5}, {"nam... ... 148.0
3 [{"name": "Legendary Pictures", "id": 923}, {""... ... 165.0
4 [{"name": "Walt Disney Pictures", "id": 2}] ... 132.0

                                spoken_languages status \
0 [{"iso_639_1": "en", "name": "English"}, {"iso... Released
1 [{"iso_639_1": "en", "name": "English"]} Released
2 [{"iso_639_1": "fr", "name": "Fran\u00e7ais"},... Released
3 [{"iso_639_1": "en", "name": "English"]} Released
4 [{"iso_639_1": "en", "name": "English"]} Released

                                tagline \
0                               Enter the World of Pandora.
1 At the end of the world, the adventure begins.
2                               A Plan No One Escapes
3                               The Legend Ends
4                               Lost in our world, found in another.

                                title_x vote_average vote_count \
0                               Avatar                7.2      11800
1 Pirates of the Caribbean: At World's End            6.9      4500
2                               Spectre                6.3      4466
3                               The Dark Knight Rises   7.6      9106
4                               John Carter            6.1      2124

                                title_y \
0                               Avatar
1 Pirates of the Caribbean: At World's End
2                               Spectre
3                               The Dark Knight Rises
4                               John Carter

                                cast \
0 [{"cast_id": 242, "character": "Jake Sully", "...
1 [{"cast_id": 4, "character": "Captain Jack Spa...
2 [{"cast_id": 1, "character": "James Bond", "cr...
3 [{"cast_id": 2, "character": "Bruce Wayne / Ba...
4 [{"cast_id": 5, "character": "John Carter", "c...

                                crew
0 [{"credit_id": "52fe48009251416c750aca23", "de...
1 [{"credit_id": "52fe4232c3a36847f800b579", "de...
2 [{"credit_id": "54805967c3a36829b5002c41", "de...
3 [{"credit_id": "52fe4781c3a36847f81398c3", "de...
4 [{"credit_id": "52fe479ac3a36847f813eaa3", "de...

```

[5 rows x 23 columns]

In this code operations is performing on two datasets (credits and movies).First renamed a column in the credits dataset, then merges it with the movies dataset based on a common column ("id"). Finally, it prints out the first few rows of the merged dataset.

```
In [14]: movies_cleaned = movies_merge.drop(columns=['homepage', 'title_x', 'title_y', 'status', 'production_countries'])
print(movies_cleaned.head())
print(movies_cleaned.info())
print(movies_cleaned.head(1)['overview'])
```

```
      budget      genres      id \
0  237000000 [{"id": 28, "name": "Action"}, {"id": 12, "nam... 19995
1  300000000 [{"id": 12, "name": "Adventure"}, {"id": 14, "... 285
2  245000000 [{"id": 28, "name": "Action"}, {"id": 12, "nam... 206647
3  250000000 [{"id": 28, "name": "Action"}, {"id": 80, "nam... 49026
4  260000000 [{"id": 28, "name": "Action"}, {"id": 12, "nam... 49529
```

```
      keywords original_language \
0 [{"id": 1463, "name": "culture clash"}, {"id": ... en
1 [{"id": 270, "name": "ocean"}, {"id": 726, "na... en
2 [{"id": 470, "name": "spy"}, {"id": 818, "name... en
3 [{"id": 849, "name": "dc comics"}, {"id": 853,... en
4 [{"id": 818, "name": "based on novel"}, {"id": ... en
```

```
      original_title \
0 Avatar
1 Pirates of the Caribbean: At World's End
2 Spectre
3 The Dark Knight Rises
4 John Carter
```

```
      overview popularity \
0 In the 22nd century, a paraplegic Marine is di... 150.437577
1 Captain Barbossa, long believed to be dead, ha... 139.082615
2 A cryptic message from Bond's past sends him o... 107.376788
3 Following the death of District Attorney Harve... 112.312950
4 John Carter is a war-weary, former military ca... 43.926995
```

```
      production_companies release_date      revenue \
0 [{"name": "Ingenious Film Partners", "id": 289... 2009-12-10 2787965087
1 [{"name": "Walt Disney Pictures", "id": 2}, {"... 2007-05-19 961000000
2 [{"name": "Columbia Pictures", "id": 5}, {"nam... 2015-10-26 880674609
3 [{"name": "Legendary Pictures", "id": 923}, {"... 2012-07-16 1084939099
4 [{"name": "Walt Disney Pictures", "id": 2}] 2012-03-07 284139100
```

```
      runtime      spoken_languages \
0 162.0 [{"iso_639_1": "en", "name": "English"}, {"iso...
1 169.0 [{"iso_639_1": "en", "name": "English"}]
2 148.0 [{"iso_639_1": "fr", "name": "Fran\u00e7ais"},...
3 165.0 [{"iso_639_1": "en", "name": "English"}]
4 132.0 [{"iso_639_1": "en", "name": "English"}]
```

```
      tagline vote_average vote_count \
0 Enter the World of Pandora. 7.2 11800
1 At the end of the world, the adventure begins. 6.9 4500
2 A Plan No One Escapes 6.3 4466
3 The Legend Ends 7.6 9106
4 Lost in our world, found in another. 6.1 2124
```

```
      cast \
0 [{"cast_id": 242, "character": "Jake Sully", "...
1 [{"cast_id": 4, "character": "Captain Jack Spa...
2 [{"cast_id": 1, "character": "James Bond", "cr...
3 [{"cast_id": 2, "character": "Bruce Wayne / Ba...
4 [{"cast_id": 5, "character": "John Carter", "c...
```

```
      crew
0 [{"credit_id": "52fe48009251416c750aca23", "de...
1 [{"credit_id": "52fe4232c3a36847f800b579", "de...
2 [{"credit_id": "54805967c3a36829b5002c41", "de...
3 [{"credit_id": "52fe4781c3a36847f81398c3", "de...
4 [{"credit_id": "52fe479ac3a36847f813eaa3", "de...
```

<class 'pandas.core.frame.DataFrame'>

Int64Index: 4803 entries, 0 to 4802

Data columns (total 18 columns):

#	Column	Non-Null Count	Dtype
0	budget	4803 non-null	int64
1	genres	4803 non-null	object
2	id	4803 non-null	int64
3	keywords	4803 non-null	object
4	original_language	4803 non-null	object
5	original_title	4803 non-null	object

```

6  overview                4800 non-null  object
7  popularity              4803 non-null  float64
8  production_companies    4803 non-null  object
9  release_date            4802 non-null  object
10 revenue                 4803 non-null  int64
11 runtime                 4801 non-null  float64
12 spoken_languages        4803 non-null  object
13 tagline                 3959 non-null  object
14 vote_average            4803 non-null  float64
15 vote_count              4803 non-null  int64
16 cast                    4803 non-null  object
17 crew                    4803 non-null  object
dtypes: float64(3), int64(4), object(11)
memory usage: 712.9+ KB
None
0    In the 22nd century, a paraplegic Marine is di...
Name: overview, dtype: object

```

```
In [7]: print(movies_cleaned.head(1)['overview'])
```

```

0    In the 22nd century, a paraplegic Marine is di...
Name: overview, dtype: object

```

drop :- It is used to remove specified columns from a DataFrame.

info() :- This method provides a summary of the DataFrame's structure, including the number of non-null entries, data types and memory usage.

overview:- This specifies that we're interested in the 'overview' column of the first row.

## Content Based Recommendation System

A recommendations based on the movie's plot summaries given in the overview column. So if our user gives us a movie title, our goal is to recommend movies that share similar plot summaries.

```
In [8]: from sklearn.feature_extraction.text import TfidfVectorizer
movies_cleaned['overview'].fillna('', inplace=True)
tfv = TfidfVectorizer(min_df=3, max_features=None,
                      strip_accents='unicode', analyzer='word', token_pattern=r'\w{1,}',
                      ngram_range=(1, 3),
                      stop_words = 'english')
```

In natural language processing, a common task is to convert text data into numerical form that machine learning algorithms can understand. The TfidfVectorizer is a tool that helps with this process.

.fillna("", inplace=True): The .fillna() method is used to replace missing values. In this case, missing values are replaced with an empty string. The inplace=True parameter ensures that the change is made in the original DataFrame.

```
In [9]: # Fitting the TF-IDF on the 'overview' text
tfv_matrix = tfv.fit_transform(movies_cleaned['overview'])
print(tfv_matrix)
print(tfv_matrix.shape)
```

```

(0, 148)      0.3091311403250014
(0, 1670)     0.2781519888709605
(0, 431)      0.2108476222845202
(0, 7055)     0.26867652924731417
(0, 6447)     0.25667782792456906
(0, 3582)     0.21788257757629861
(0, 9393)     0.24144219475319859
(0, 5907)     0.17992707015426695
(0, 9717)     0.24435395917916744
(0, 6543)     0.2959108637414298
(0, 5972)     0.2747332388389473
(0, 2634)     0.2818968058308858
(0, 5658)     0.2610479764815685
(0, 1514)     0.20118856027389756
(0, 147)      0.3091311403250014
(1, 1810)     0.36793229072333994
(1, 7159)     0.3031029042939378
(1, 2916)     0.30082125582474917
(1, 9609)     0.3355175975086389
(1, 2848)     0.21556897928560054
(1, 2872)     0.3232482593626707
(1, 4205)     0.30803003793564465
(1, 5263)     0.1333016217342793
(1, 1806)     0.2104623271234315
(1, 2318)     0.21892404835497967
:             :
(4802, 671)   0.15980375315748296
(4802, 2360)  0.15010502652571864
(4802, 677)   0.1348896650905315
(4802, 3736)  0.14859055527694667
(4802, 3480)  0.14340155530934393
(4802, 1252)  0.1517317799962251
(4802, 8137)  0.12006983014875616
(4802, 2754)  0.11415766885192152
(4802, 6989)  0.12818619387415678
(4802, 3238)  0.16238922347130244
(4802, 5303)  0.14458839172229582
(4802, 1224)  0.28917678344459163
(4802, 8494)  0.09380149874507987
(4802, 10327) 0.09392244189669113
(4802, 120)   0.13337519384175953
(4802, 9583)  0.10877695477061998
(4802, 9065)  0.08442386567407605
(4802, 2837)  0.14227560971626285
(4802, 6366)  0.07950988341697732
(4802, 10321) 0.08349947113256301
(4802, 10343) 0.1235202307747275
(4802, 6189)  0.0660620349546619
(4802, 5155)  0.10830486933954035
(4802, 10338) 0.08047421680114124
(4802, 7725)  0.16629792872798219
(4803, 10417)

```

```
In [10]: from sklearn.metrics.pairwise import sigmoid_kernel
```

```

# Compute the sigmoid kernel
sig = sigmoid_kernel(tfv_matrix, tfv_matrix)
print(sig[0])

```

```
[0.76163447 0.76159416 0.76159416 ... 0.76159416 0.76159416 0.76159416]
```

Above code computes the sigmoid kernel, which is a measure of similarity between documents based on their TF-IDF representations

## Reverse mapping of indices and movie titles

```

In [18]: # Reverse mapping of indices and movie titles
indices = pd.Series(movies_cleaned.index, index=movies_cleaned['original_title']).drop_duplicates()
print(indices)
print(indices['Newlyweds'])
print(sig[4799])
print(list(enumerate(sig[indices['Newlyweds']])))
print(sorted(list(enumerate(sig[indices['Newlyweds']])), key=lambda x: x[1], reverse=True))

```

```

original_title
Avatar                                0
Pirates of the Caribbean: At World's End  1
Spectre                               2
The Dark Knight Rises                  3
John Carter                           4
...
El Mariachi                           4798
Newlyweds                             4799

```

Signed, Sealed, Delivered 4800  
Shanghai Calling 4801  
My Date with Drew 4802  
Length: 4803, dtype: int64  
4799

[0.76159416 0.76159416 0.76159438 ... 0.76159432 0.76159416 0.76159478]  
[(0, 0.7615941559557649), (1, 0.7615941559557649), (2, 0.7615943791623508), (3, 0.7615945564232902), (4, 0.7615945779342556), (5, 0.7615943267971559), (6, 0.7615948190414071), (7, 0.761594346971664), (8, 0.7615943903358866), (9, 0.761594688255891), (10, 0.7615941559557649), (11, 0.7615941559557649), (12, 0.7615941559557649), (13, 0.7615941559557649), (14, 0.7615941559557649), (15, 0.7615941559557649), (16, 0.7615943548130525), (17, 0.761594965420998), (18, 0.7615942819944952), (19, 0.7615945082445131), (20, 0.7615942928381602), (21, 0.7615949832832596), (22, 0.7615941559557649), (23, 0.761594428370306), (24, 0.7615941559557649), (25, 0.7615941559557649), (26, 0.7615941559557649), (27, 0.7615944537585686), (28, 0.7615941559557649), (29, 0.7615943053510925), (30, 0.7615943361754078), (31, 0.76159445046522), (32, 0.7615941559557649), (33, 0.7615944286938301), (34, 0.7615941559557649), (35, 0.7615941559557649), (36, 0.7615941559557649), (37, 0.7615943949348412), (38, 0.7615942951956767), (39, 0.7615943572241238), (40, 0.7615941559557649), (41, 0.7615941559557649), (42, 0.7615943389572313), (43, 0.7615943523606733), (44, 0.7615941559557649), (45, 0.7615941559557649), (46, 0.7615941559557649), (47, 0.7615941559557649), (48, 0.7615941559557649), (49, 0.761594626876224), (50, 0.7615941559557649), (51, 0.7615944386932016), (52, 0.7615943652834535), (53, 0.7615945097210087), (54, 0.7615941559557649), (55, 0.7615944262418757), (56, 0.7615941559557649), (57, 0.7615943220932205), (58, 0.7615944884714907), (59, 0.7615946817768878), (60, 0.7615941559557649), (61, 0.7615941559557649), (62, 0.7615941559557649), (63, 0.7615943481350393), (64, 0.7615944547784749), (65, 0.7615941559557649), (66, 0.7615941559557649), (67, 0.7615941559557649), (68, 0.7615941559557649), (69, 0.7615941559557649), (70, 0.7615943606116174), (71, 0.7615943474291788), (72, 0.7615941559557649), (73, 0.7615941559557649), (74, 0.7615941559557649), (75, 0.76159436680847), (76, 0.7615941559557649), (77, 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[illegible]

[illegible]

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[illegible]

[illegible]



[illegible]

```
def give_recommendations(title, sig=sig):
    # Get the index corresponding to original_title
    idx = indices[title]

    # Get the pairwise similarity scores
    sig_scores = list(enumerate(sig[idx]))

    # Sort the movies
    sig_scores = sorted(sig_scores, key=lambda x: x[1], reverse=True)

    # Scores of the 10 most similar movies
    sig_scores = sig_scores[1:11]

    # Movie indices
    movie_indices = [i[0] for i in sig_scores]

    # Top 10 most similar movies
    return movies_cleaned['original_title'].iloc[movie_indices]
```

# Testing content-based recommendation system with the seminal film Spy Kids

```
In [13]: print(give_recomendations('Avatar'))
```

```
1341          Obitaemyy Ostrov
634          The Matrix
3604          Apollo 18
2130          The American
775          Supernova
529          Tears of the Sun
151          Beowulf
311  The Adventures of Pluto Nash
847          Semi-Pro
942          The Book of Life
Name: original_title, dtype: object
```