LAPTOP RECOMMENDATION SYSTEM

A PROJECT REPORT

Submitted by

CHAVA KRISHNA SATHWIK

in partial fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

In

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT

ANDHRA PRADESH- 92475

DECEMBER, 2020

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT ANDHRA PRADESH- 92475

BONAFIDE CERTIFICATE

Certified that this project report **"Laptop Recommendation System"** is the bonafide work of **"Chava Krishna Sathwik"** who carried out the project work under my supervision. This is to further certify to the best of my knowledge, that this project has not been carried out earlier in this institute and the university.

SIGNATURE

MR. MANOJ KUMAR BEHERA

(Asst.Professor of CSE Department)

Certified that the above-mentioned project has been duly carried out as per the norm of the college and statutes of the university

SIGNATURE

DR. SUJATA CHAKRAVARTY

HEAD OF THE DEPARTMENT

Professor of CSE department

DEPARMENTAL SEAL

ACKNOWLEDGEMENTS

It is our pleasure to be indebted to various people, who directly or indirectly contributed in the development of this work and who influenced my/our thinking, behavior and acts during the course of study.

We am/are thankful to Prof. Manoj Kumar Behera for his support, cooperation, and motivation provided to me/us during for constant inspiration, presence and blessings.

We also extend our sincere appreciation to Prof. Sujata Chakravarty, Head of Department who provided his valuable suggestions and precious time in accomplishing our academic project.

Name: Chava Krishna Sathwik
Reg-No: 181801120017

TABLE OF CONTENTS

ABSTRACT

Basically people do get confused over choosing an appropriate laptop with great configuration and at an affordable price. In pursuit of designing a solution and came up with a recommendation system using machine learning. Developing an recommendation system is a good way to overcome the problem of overloaded products information provided by the e-commerce enterprises. As there are a huge number of products on the Internet, it is impossible to recommend all kinds of products in one system. We believe that the personalized recommendation system should be built up according to the specific features of a certain sort of products, and forming professional recommendation systems for different products. In this paper, based on the consumer's specifications, we propose a content-based laptop recommendation system. A Recommendation system, can be thought of as a sub-division of information filtering system that seeks to predict the best "rating" or "preference" a user would give to an item which is obtained by optimizing for objectives like total clicks, total revenue, and overall sales.

1. INTRODUCTION

1.1 RECOMMENDATION SYSTEM

Recommendation systems is an Filtering technique, which provides users with information, which he/she may be interested. Recommender systems are widely used in product recommendations such as recommendations of music, movies, books, news, research articles, restaurants, etc. There are two popular methods for building recommender systems:

- Collaborative Based Filtering
- Content Based Filtering

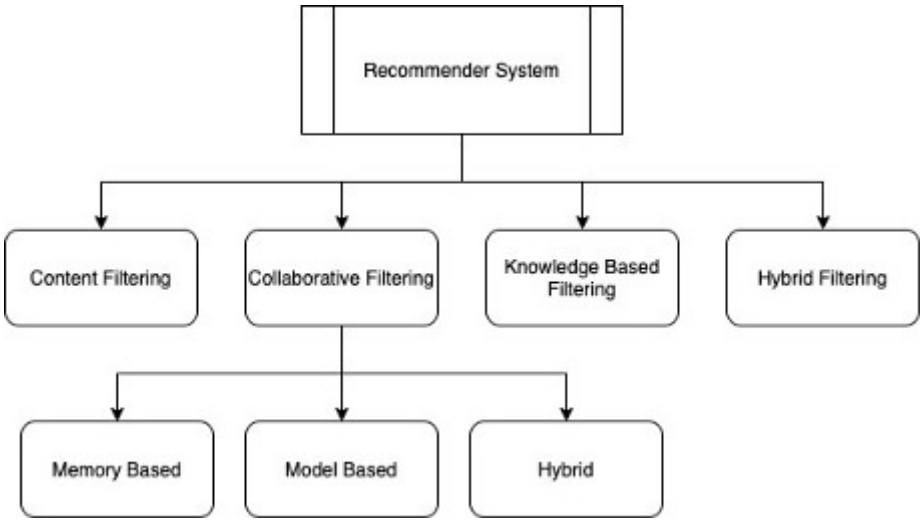


Fig 1

1.2 Collaborative Based Filtering

Collaborative filtering recommends items by identifying other users with similar taste; it uses their opinion to recommend items to the active user. Collaborative recommender systems have been implemented in different application areas. It is considered to be one of the very smart recommender systems that work on the similarity between different users and also items that are widely used as an e-commerce website and also online movie websites. It checks about the taste of similar users and does recommendations. The similarity is not restricted to the taste of the user moreover there can be consideration of similarity between different items also. The system will give more efficient recommendations if we have a large volume of information about users and items.

1.3 Content Based Filtering

It is another type of recommendation system which works on the principle of similar content. A content-based recommender works with data that the user provides, either explicitly (rating) or implicitly (clicking on a link). Based on that data, a user profile is generated, which is then used to make suggestions to the user. As the user provides more inputs or takes actions on those recommendations, the engine becomes more and more accurate. CB filtering techniques overcome the challenges of CF. They have the ability to recommend new items even if there are no ratings provided by users. So even if the database does not contain user preferences, recommendation accuracy is not affected. Also, if the user preferences change, it has the capacity to adjust its recommendations in a short span of time. They can manage situations where different users do not share the same items, but only identical items according to their intrinsic features.

1.4 How it Recommends?

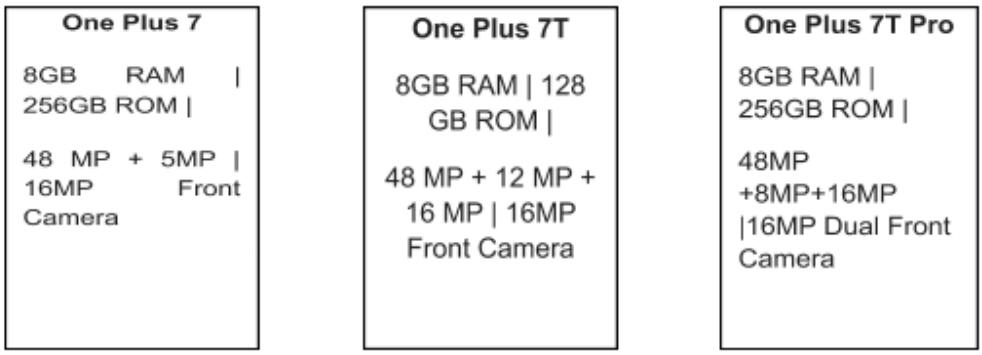


Fig 2

Figure 2 image shows the different models of one plus phone. If a person is looking for one plus 7 mobile then, one plus 7T and one plus 7 Pro is recommended to the user. To check the similarity between the products or mobile phone in this example, the system computes

distances between them. One plus 7 and One plus 7T both have 8Gb ram and 48MP primary camera. If the similarity is to be checked between both the products, Euclidean distance is calculated. Here, distance is calculated based on ram and camera.

2.ABOUT THE PROJECT

2.1 Problem statement

Laptops have become indispensable part of every people these days. Basically, people do get confused over choosing an appropriate laptop with great configuration and at an affordable price. In pursuit of designing a solution and came up with a recommendation system using machine learning. Laptops have become indispensable part of every people these days. Now-a-days, most of the works are running online. students or professionals are getting confused of buying laptops like what specifications suits. So, this recommendation systems provide them according to the input they provide. And there are nearly 5000 laptop models used in this project so, we'll have more efficiency in output.

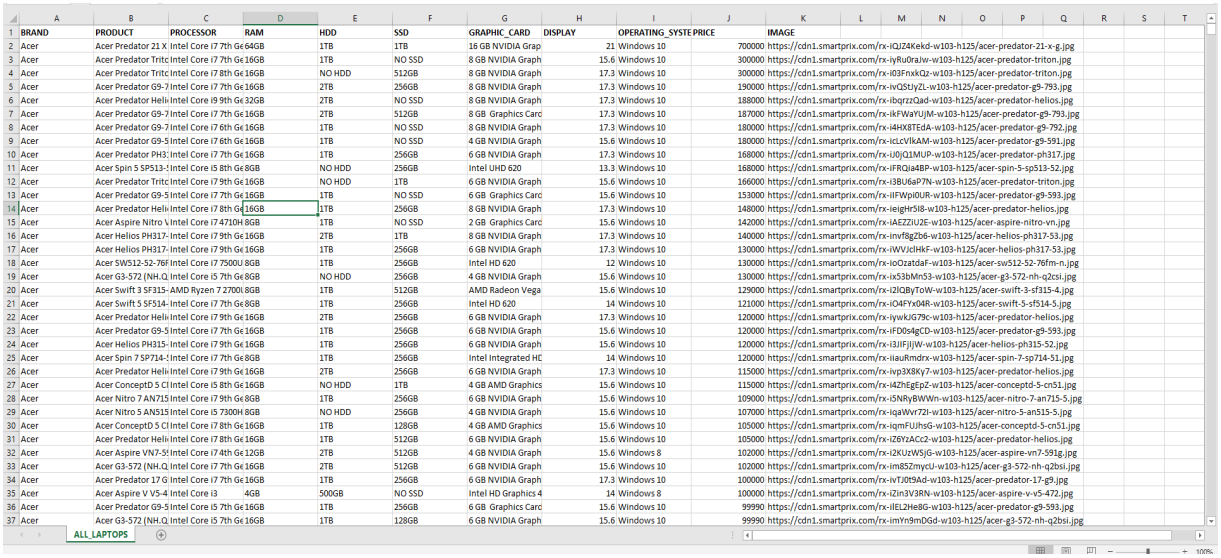
2.2 Idea Behind the Project

Idea is to build a content-based laptop recommendation system using python and flask web application. Where user is allowed to enter his/her laptop model and its specifications and it further recommends laptops similar to their specs including price.

3.DATASET

3.1 About the Dataset

This is my own dataset which I have collected all the samples scrapping a website SMARTPRIX.COM My data set consists of 5592 samples of laptops and there are 11 attributes like Processor, product name, ram, SSD, HDD, graphic card, display size, operating system, etc., This dataset consists of many missing values because most of the products does not have specifications mentioned in that website. So, I filled those values finding the specs from other websites. This dataset consists of both categorical values and integer values.



BRAND	PRODUCT	PROCESSOR	RAM	HDD	SSD	GRAPHIC_CARD	DISPLAY	OPERATING_SYSTE	PRICE	IMAGE
Acer	Acer Predator 21 X	Intel Core i7 7th Ge	64GB	1TB	1TB	16 GB NVIDIA Grap	21	Windows 10	700000	https://cdn1.smartprix.com/rx-iQJZ4Kekd-w103-h125/acer-predator-21-x-g.jpg
Acer	Acer Predator Trito	Intel Core i7 7th Ge	16GB	1TB	NO SSD	8 GB NVIDIA Graph	15.6	Windows 10	300000	https://cdn1.smartprix.com/rx-iyRu0ra/w-w103-h125/acer-predator-triton.jpg
Acer	Acer Predator Trito	Intel Core i7 8th Ge	16GB	NO HDD	512GB	8 GB NVIDIA Graph	17.3	Windows 10	300000	https://cdn1.smartprix.com/rx-i03FnxkQz-w103-h125/acer-predator-triton.jpg
Acer	Acer Predator G9-7	Intel Core i7 7th Ge	16GB	2TB	256GB	8 GB NVIDIA Graph	17.3	Windows 10	190000	https://cdn1.smartprix.com/rx-ivQStiyZL-w103-h125/acer-predator-g9-793.jpg
Acer	Acer Predator Helio	Intel Core i9 9th Ge	32GB	2TB	NO SSD	8 GB NVIDIA Graph	17.3	Windows 10	188000	https://cdn1.smartprix.com/rx-ibqrzzQad-w103-h125/acer-predator-helios.jpg
Acer	Acer Predator G9-7	Intel Core i7 7th Ge	16GB	2TB	512GB	8 GB Graphics Carc	17.3	Windows 10	187000	https://cdn1.smartprix.com/rx-ikFWaYUjM-w103-h125/acer-predator-g9-793.jpg
Acer	Acer Predator G9-7	Intel Core i7 6th Ge	16GB	1TB	NO SSD	8 GB NVIDIA Graph	17.3	Windows 10	180000	https://cdn1.smartprix.com/rx-i4HX8TEdA-w103-h125/acer-predator-g9-792.jpg
Acer	Acer Predator G9-5	Intel Core i7 6th Ge	16GB	1TB	NO SSD	4 GB NVIDIA Graph	15.6	Windows 10	180000	https://cdn1.smartprix.com/rx-icLcVlkAM-w103-h125/acer-predator-g9-591.jpg
Acer	Acer Predator PH3	Intel Core i7 7th Ge	16GB	1TB	256GB	6 GB NVIDIA Graph	17.3	Windows 10	168000	https://cdn1.smartprix.com/rx-i0jQ1MUP-w103-h125/acer-predator-ph317.jpg
Acer	Acer Spin 5 SP513-	Intel Core i5 8th Ge	8GB	NO HDD	256GB	Intel UHD 620	13.3	Windows 10	168000	https://cdn1.smartprix.com/rx-iFRQja4BP-w103-h125/acer-spin-5-sp513-52.jpg
Acer	Acer Predator Trito	Intel Core i7 9th Ge	16GB	NO HDD	1TB	6 GB NVIDIA Graph	15.6	Windows 10	166000	https://cdn1.smartprix.com/rx-i3BU6aP7N-w103-h125/acer-predator-triton.jpg
Acer	Acer Predator G9-5	Intel Core i7 7th Ge	16GB	1TB	NO SSD	6 GB Graphics Carc	15.6	Windows 10	153000	https://cdn1.smartprix.com/rx-iIFWpi0UR-w103-h125/acer-predator-g9-593.jpg
Acer	Acer Predator Helio	Intel Core i7 8th Ge	16GB	1TB	256GB	8 GB NVIDIA Graph	17.3	Windows 10	148000	https://cdn1.smartprix.com/rx-ieigHr5I8-w103-h125/acer-predator-helios.jpg
Acer	Acer Aspire Nitro V	Intel Core i7 4710H	8GB	1TB	NO SSD	2 GB Graphics Carc	15.6	Windows 10	142000	https://cdn1.smartprix.com/rx-iAEZZiU2E-w103-h125/acer-aspire-nitro-vn.jpg
Acer	Acer Helios PH317-	Intel Core i7 9th Ge	16GB	2TB	1TB	8 GB NVIDIA Graph	17.3	Windows 10	140000	https://cdn1.smartprix.com/rx-invf8gZb6-w103-h125/acer-helios-ph317-53.jpg
Acer	Acer Helios PH317-	Intel Core i7 9th Ge	16GB	1TB	256GB	6 GB NVIDIA Graph	17.3	Windows 10	130000	https://cdn1.smartprix.com/rx-iWVJclHkF-w103-h125/acer-helios-ph317-53.jpg
Acer	Acer SW512-52-76F	Intel Core i7 7500U	8GB	1TB	256GB	Intel HD 620	12	Windows 10	130000	https://cdn1.smartprix.com/rx-ioOzatdaF-w103-h125/acer-sw512-52-76fm-n.jpg
Acer	Acer G3-572 (NH.Q	Intel Core i5 7th Ge	8GB	NO HDD	256GB	4 GB NVIDIA Graph	15.6	Windows 10	130000	https://cdn1.smartprix.com/rx-ix53bMn53-w103-h125/acer-g3-572-nh-q2csi.jpg
Acer	Acer Swift 3 SF315-	AMD Ryzen 7 2700(	8GB	1TB	512GB	AMD Radeon Vega	15.6	Windows 10	129000	https://cdn1.smartprix.com/rx-i2lQByToW-w103-h125/acer-swift-3-sf315-4.jpg
Acer	Acer Swift 5 SF514-	Intel Core i7 7th Ge	8GB	1TB	256GB	Intel HD 620	14	Windows 10	121000	https://cdn1.smartprix.com/rx-iO4FYx04R-w103-h125/acer-swift-5-sf514-5.jpg
Acer	Acer Predator Helio	Intel Core i9 9th Ge	16GB	2TB	256GB	6 GB NVIDIA Graph	17.3	Windows 10	120000	https://cdn1.smartprix.com/rx-iywkJG79c-w103-h125/acer-predator-helios.jpg
Acer	Acer Predator G9-5	Intel Core i7 7th Ge	16GB	1TB	256GB	6 GB NVIDIA Graph	15.6	Windows 10	120000	https://cdn1.smartprix.com/rx-iFD0s4gCD-w103-h125/acer-predator-g9-593.jpg
Acer	Acer Helios PH315-	Intel Core i7 9th Ge	16GB	1TB	256GB	6 GB NVIDIA Graph	15.6	Windows 10	120000	https://cdn1.smartprix.com/rx-i3JIFjIjW-w103-h125/acer-helios-ph315-52.jpg
Acer	Acer Spin 7 SP714-5	Intel Core i7 7th Ge	8GB	1TB	256GB	Intel Integrated HD	14	Windows 10	120000	https://cdn1.smartprix.com/rx-iiauRmdrx-w103-h125/acer-spin-7-sp714-51.jpg
Acer	Acer Predator Helio	Intel Core i7 9th Ge	16GB	2TB	256GB	6 GB NVIDIA Graph	17.3	Windows 10	115000	https://cdn1.smartprix.com/rx-ivp3X8Ky7-w103-h125/acer-predator-helios.jpg
Acer	Acer ConceptD 5 CI	Intel Core i5 8th Ge	16GB	NO HDD	1TB	4 GB AMD Graphics	15.6	Windows 10	115000	https://cdn1.smartprix.com/rx-i4ZhEgEpZ-w103-h125/acer-conceptd-5-cn51.jpg
Acer	Acer Nitro 7 AN715	Intel Core i7 9th Ge	8GB	1TB	256GB	6 GB NVIDIA Graph	15.6	Windows 10	109000	https://cdn1.smartprix.com/rx-i5NRyBWWn-w103-h125/acer-nitro-7-an715-5.jpg
Acer	Acer Nitro 5 AN515	Intel Core i5 7300H	8GB	NO HDD	256GB	4 GB NVIDIA Graph	15.6	Windows 10	107000	https://cdn1.smartprix.com/rx-iqaWvr72I-w103-h125/acer-nitro-5-an515-5.jpg
Acer	Acer ConceptD 5 CI	Intel Core i7 8th Ge	16GB	1TB	128GB	4 GB AMD Graphics	15.6	Windows 10	105000	https://cdn1.smartprix.com/rx-iqmFUJhsG-w103-h125/acer-conceptd-5-cn51.jpg
Acer	Acer Predator Helio	Intel Core i7 8th Ge	16GB	1TB	512GB	6 GB NVIDIA Graph	15.6	Windows 10	105000	https://cdn1.smartprix.com/rx-iZ6YzACc2-w103-h125/acer-predator-helios.jpg
Acer	Acer Aspire VN7-5	Intel Core i7 4th Ge	12GB	2TB	512GB	4 GB NVIDIA Graph	15.6	Windows 8	102000	https://cdn1.smartprix.com/rx-i2KUzW5jG-w103-h125/acer-aspire-vn7-591g.jpg
Acer	Acer G3-572 (NH.Q	Intel Core i7 7th Ge	16GB	2TB	512GB	6 GB NVIDIA Graph	15.6	Windows 10	102000	https://cdn1.smartprix.com/rx-im85ZmycU-w103-h125/acer-g3-572-nh-q2bsi.jpg
Acer	Acer Predator 17 G	Intel Core i7 7th Ge	16GB	1TB	256GB	6 GB NVIDIA Graph	17.3	Windows 10	100000	https://cdn1.smartprix.com/rx-ivTJ0t9Ad-w103-h125/acer-predator-17-g9.jpg
Acer	Acer Aspire V V5-4	Intel Core i3	4GB	500GB	NO SSD	Intel HD Graphics 4	14	Windows 8	100000	https://cdn1.smartprix.com/rx-iZln3V3RN-w103-h125/acer-aspire-v-v5-472.jpg
Acer	Acer Predator G9-5	Intel Core i5 7th Ge	16GB	1TB	256GB	6 GB Graphics Carc	15.6	Windows 10	99990	https://cdn1.smartprix.com/rx-iIEL2Hn8G-w103-h125/acer-predator-g9-593.jpg
Acer	Acer G3-572 (NH.Q	Intel Core i5 7th Ge	16GB	1TB	128GB	6 GB NVIDIA Graph	15.6	Windows 10	99990	https://cdn1.smartprix.com/rx-imYn9mDGd-w103-h125/acer-g3-572-nh-q2bsi.jpg

ALL_LAPTOPS

Fig.3 DATASET

3.2 Data Acquisition

I did web scrapping using a tool called “Parse hub and Web Scrapper” to get data of all the products in ‘Smart Prix’ website. First the items were selected in the website which I wanted to scrap and then all the scrapped data is saved into a csv file. This scrapping of data took nearly 1 hour.

4.PROJECT WORK PART-1

4.1 Methodology Used

All my model was mainly based on NLP. And Fig.4 shows complete detailed structure of approach I gone through to build a Recommendation system.

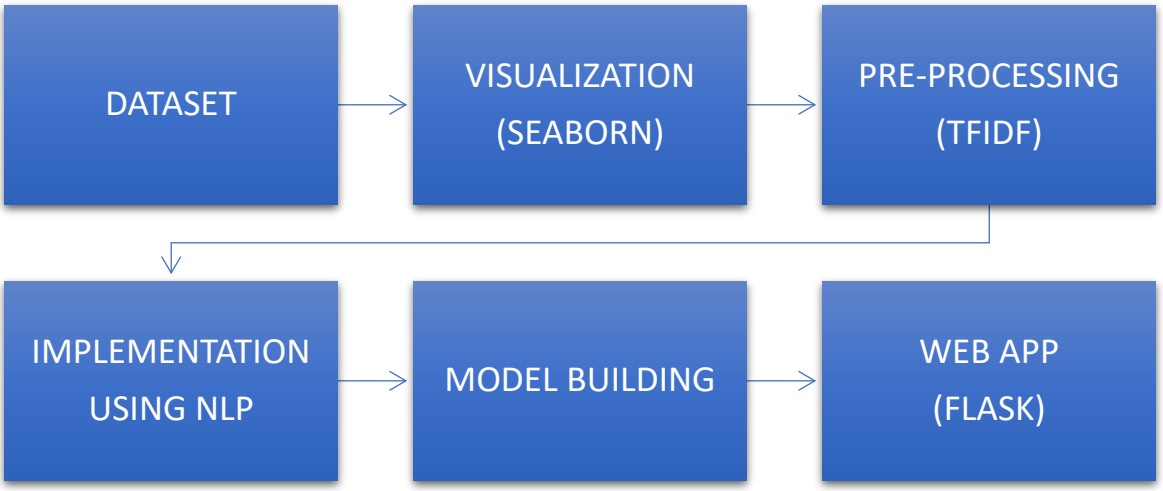


Fig.4

4.1.1 Dataset

This is my own dataset which I have collected all the samples scrapping a website SMARTPRIX.COM My data set consists of 5592 samples of laptops and there are 11 attributes like Processor, product name, ram, SSD, HDD, graphic card, display size, operating system, etc., This dataset consists of many missing values because most of the products does not have specifications mentioned in that website. So, I filled those values finding the specs from other websites. This dataset consists of both categorical values and integer values.

4.1.2 Visualization (seaborn)

Coming to visualization part I was plotting the some of my columns in bar graphs and here are the figures. Coming to remining columns there are more that 300 unique values which doesn't looks good to plot in graphs.

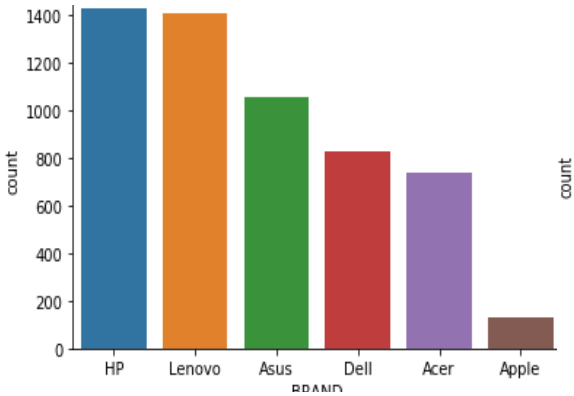


Fig.5 BRAND

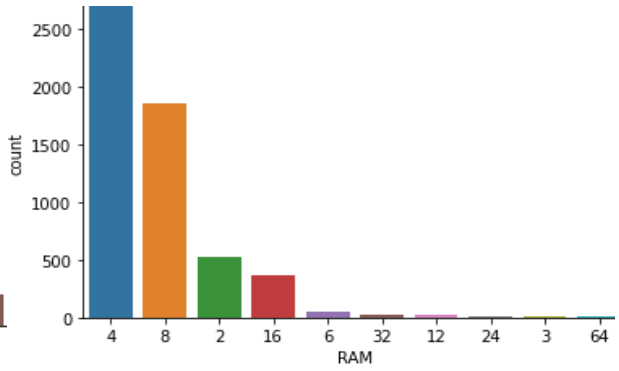


Fig.6 RAM

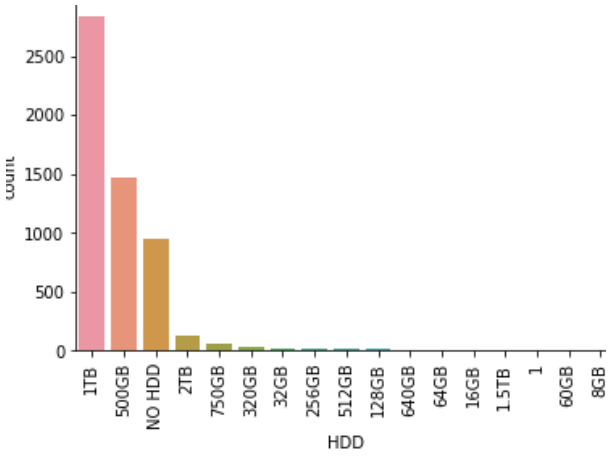


Fig.7 HDD

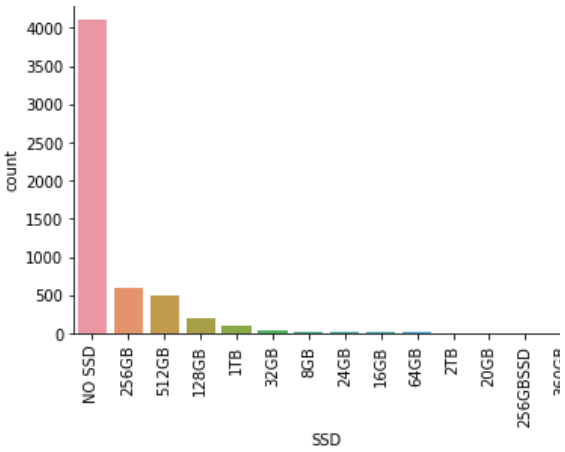


Fig.8 SSD

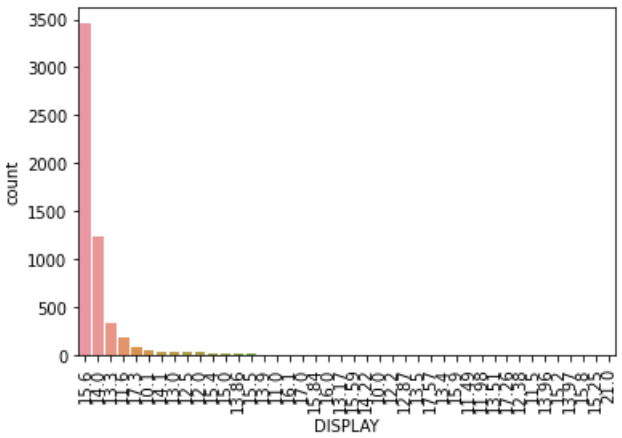


Fig.9 DISPLAY

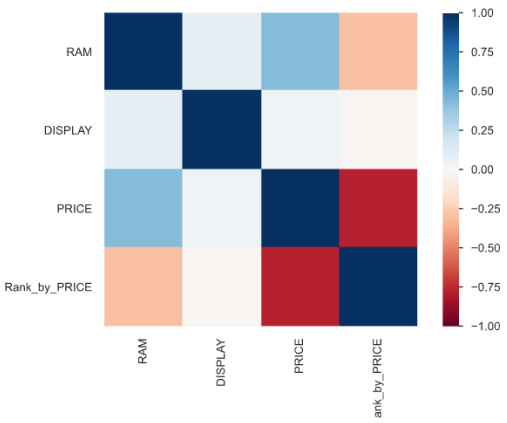


Fig.10 CORRELATIONS

4.1.3 Pre-Processing

Data preprocessing is an important step in the data mining process. The phrase "garbage in, garbage out" is particularly applicable to data mining and machine learning projects. Data-gathering methods are often loosely controlled, resulting in out-of-range values, impossible data combinations, and missing values, etc.

I started cleaning my data with removing spaces and brackets present in my data by using replace() function. I'm combining all the columns into one single data frame called specifications. I've dropped all the columns except 'Specifications and product' columns because that specifications column contains data of every column. And I'm saving the above data frame as a csv file for future use contains.

- Tfidf-Vectorizer

The Tfidf-algorithm is used to weigh a keyword in any document and assign the importance to that keyword based on the number of times it appears in the document. Put simply, the higher the TF*IDF score (weight), the rarer and more important the term, and vice versa.

Here I'm converting all my categorical data into numerical using Tfidf-Vectorizer By finding Euclidian distance between two point. And there I'm finding the distances for specification column., which is combination of all columns.

4.1.4 Implementation

I'm saving the file which I've converted to vectors into "**vector_pickle"** file. And also I was saving all process in a file called "**recommender_pickle**".So, we can just load this file instead of running all the cells again and again. So, coming to recommendations part the main thing left is to find the similar product in the dataset. We can find this using "Cosine Similarity".

- Cosine Similarity

Cosine similarity is a measure of similarity between two non-zero vectors of an inner product space. It is defined to equal the cosine of the angle between them, which is also the same as the inner product of the same vectors normalized to both have length 1. As shown in fig.11

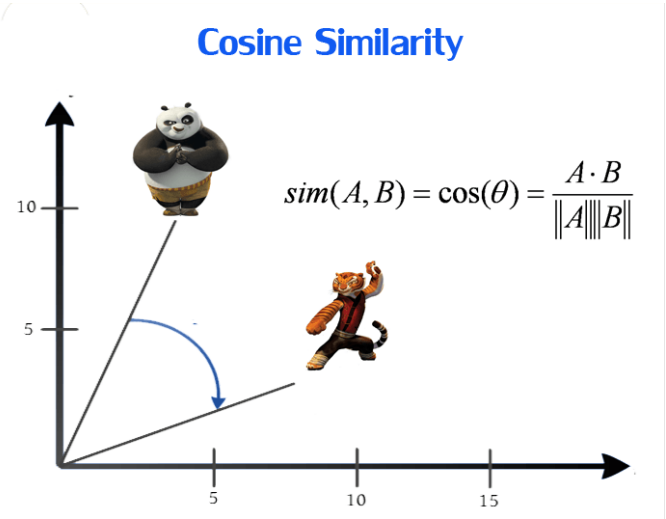


Fig.11 Cosine similarity

Here we've calculated the cosine similarity of each item with every other item in the dataset, and stored the values in res.

And then Finally we are finding the similarity between the products. So Here I'm defining functions called 'suggest' and 'suggest_by_specs' these both have their own importance for generating output. In the function suggest_by_specs I'm getting list which I've trained so that whenever we enter something other than specs and product name it won't consider them. Or else we have to type exact name of the product to get the output.

4.1.5 Flask App

Flask is a micro web framework written in Python. It is classified as a microframework because it does not require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions.

To build this application I'm first importing all the necessary libraries. The most important lib is pickle as we have to import our saved model, we need this. And later I'm importing requests and render_templetes because requests are used for making GET and POST requests to server. For this application I'm using html and CSS to create my front-end and flask bro backend recommendations. I'm saving all my built functions by defining an other .py file to load the recommender easily to application.

5. RESULT

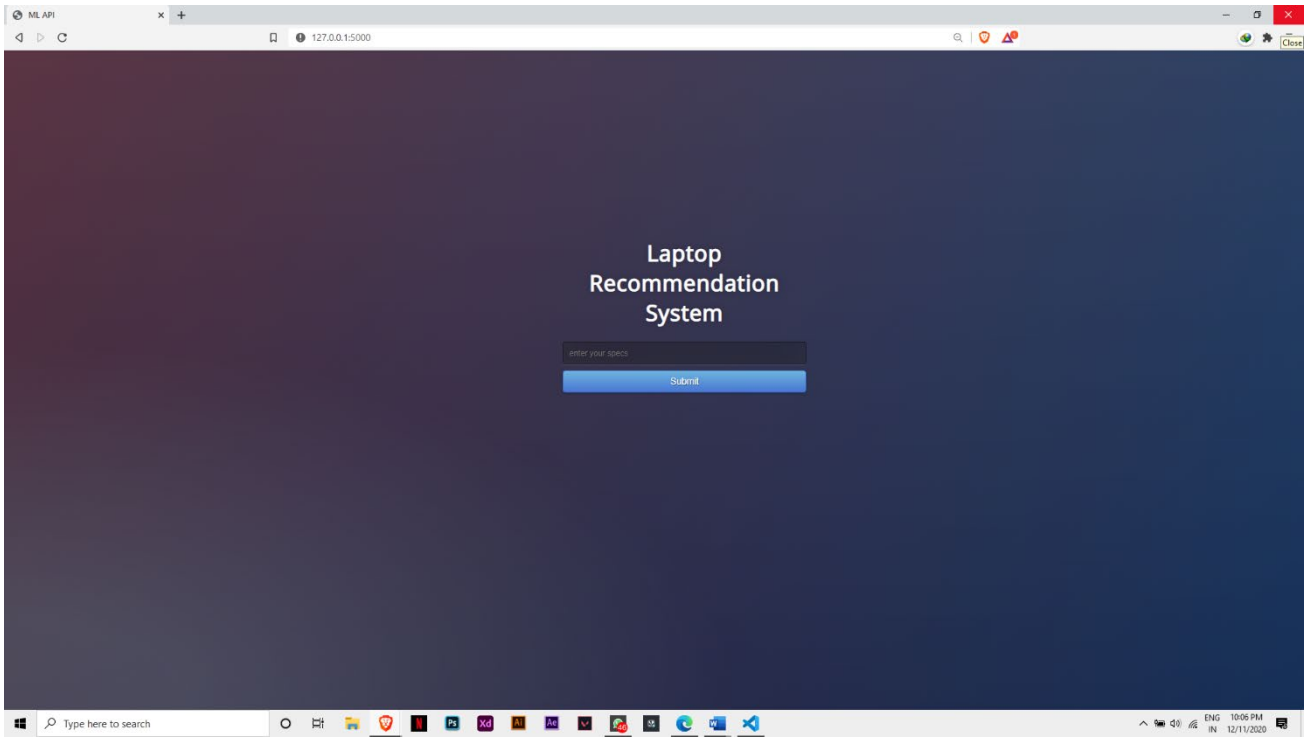


Fig.12 Web App

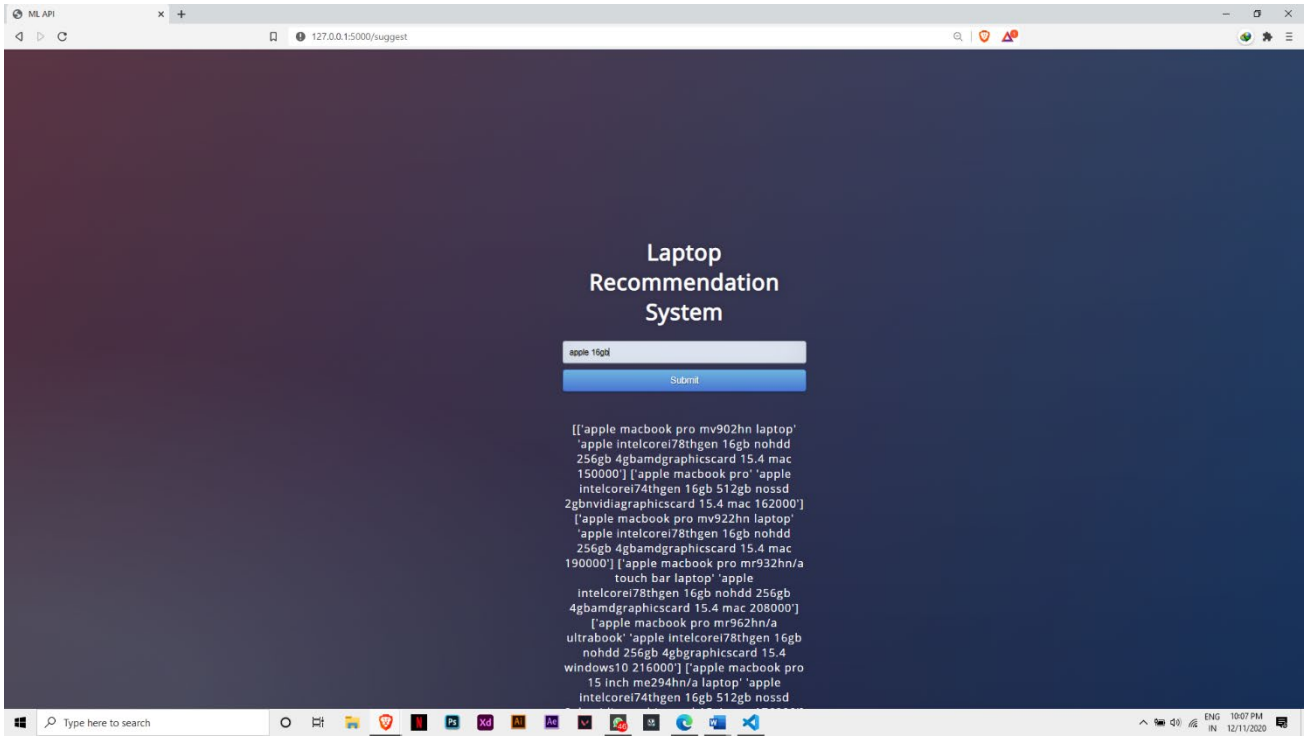


Fig.13 Result for entry

6. CONCLUSION

We have learned to make a fully-functional recommender system in Python with content-based filtering. But as we saw above, content-based filtering is not practical, or rather, not very dependable when the number of items increases along with a need for clear and differentiated descriptions. To overcome all the issues discussed earlier, we can implement collaborative filtering techniques, which have proven to be better and more scalable. We'll work on their implementations in the upcoming parts of the series. Recommender system open new opportunities of retrieving personalized information on the Internet. It also helps to alleviate the problem of information overload which is a very common phenomenon with information retrieval systems and enables users to have access to products and services which are not readily available to users on the system.

7.References

- J.A. Konstan, J. Riedl**Recommender systems: from algorithms to user experience** User Model User-Adapt Interact, 22 (2012), pp. 101-123

- Rashid AM, Albert I, Cosley D, Lam SK, McNee SM, Konstan JA et al. Getting to know you: learning new user preferences in recommender systems. In: Proceedings of the international conference on intelligent user interfaces; 2002. p. 127–34

- Chee, S.H.S., Han, J., Wang, K.: Rectree: An efficient collaborative filtering method. In: Kambayashi, Y., Winiwarter, W., Arikawa, M. (eds.) Proceedings of the 3rd International Conference on Data Warehousing and Knowledge Discovery, Munich, Germany, Springer-Verlag, DaWaK'01, pp 141–151 (2001)

- Chen, L., Wang, F.: Preference-based clustering reviews for augmenting e-commerce recommendation. Knowl. Based Syst. **50**, 44–59 (2013)

- Balabanović, M., Shoham, Y.: Fab: content-based, collaborative recommendation. Commun. ACM **40**(3), 66–72 (1997)

- **1.**M. Kumar, D. K. Yadav, A. Singh and V. K. Gupta, "A movie recommender system: Movrec", *International Journal of Computer Applications*, vol. 124, no. 3, 2015.

- A. Saranya and A. Hussain, "User Genre Movie Recommendation System Using NB Tree", *International Journal of Innovative Research in Science*, vol. 4, no. 7, 2015, July.