



CS6109 - Compiler Design

Project Documentation

Predicting and Classifying Interests of Users Based on Direct Interactions

Team - 3

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Introduction:

The basis of our project is to provide a textual analysis of the interactions between multiple users, and predict their interests, as well as categorize them.

This is an important function of recommendation systems, that is, to offer a personalized experience for each user, by understanding their preferences.

Direct interactions between users will be subject to lexical, syntax and semantic analysis, from which we will obtain their preferences to items, as well as actions and hobbies.

List of Modules:

We will employ the standard principles of compiler design, up to intermediate code generation. Lexical, syntax and semantic analysis will be used in the following order to analyse the input text:

1. Identify tokens (cricket, leather bag, smart phone) and verbs in the continuous sense (e.g. eating, playing) and such, using lexical analysis.
2. Obtain the sentiment of the users to find out whether they like the item or not, and show the dependency trees for each dialogue.
3. Getting a long, unorganized list of possible recommendations based on the users' interests, without sentiment considerations.
4. Recommending the products to the users with respect to sentiment, and recommending alternatives based on the interests of friends to users with negative sentiments.

The result will be an organized collection of information obtained from the interaction, showing the preferences and their respective categories.

Literature Survey:

No	Publication	Author, Year	Methodology	Advantages	Limitations
1.	Short systematic review on e-learning recommender systems	W.M.Chugtai, A.B.Selama, Imran Ghani (2013)	Content-Based Filtering, Hybrid-Based Filtering, Knowledge-Based Filtering	Useful insight on the cold-start issue in e-learning recommender systems.	Limited to four types of filtering approaches.
2.	A systematic review of scholar context-aware recommender systems	Z.D.Champiri, S.R.Shahamirib, S.S.B.Salima (2015)	Kitchenham Systematic Review Methodology	Categorises recommendations into user's context, document context and env. context.	Requires tracking and analyzing previous students' interactions.
3.	Recommender Systems: Review	Akshita.J, Smita.A (2013)	Content-Based Filtering	Discusses various techniques.	Requires combination with hybrid recommenders.
4.	A literature review and classifications of recommender systems research	D.H.Park, H.K.Kim, I.Y.Choi, J.K.Kim (2012)	Data Mining Techniques (K-Means, Link Analysis, etc.)	Provides insight about future trends in the field of recommender systems.	Limited to eight types of data mining techniques.
5.	The use of machine learning algorithms in recommender systems	Ivens Portugal, Paulo Alencar, Donald Cowan (2015)	Bayesian and Decision Tree Algorithms	Identifies research opportunities for software engineering research.	Nowadays, DL algorithms surpass ML algorithms in speed and power.

Problem Statement:

We can understand that we now have pre-trained deep learning models to work with, over machine learning models.

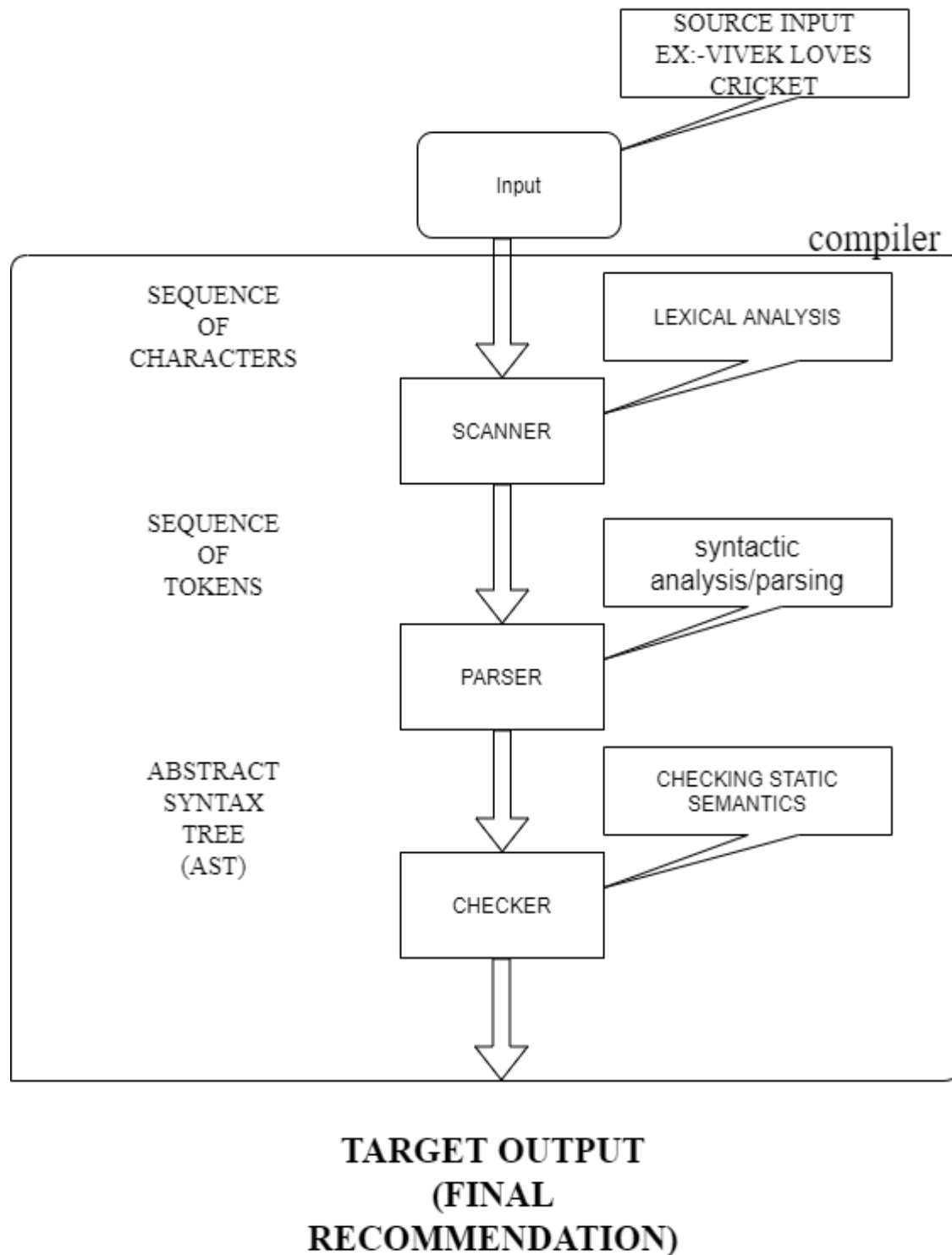
We will try to separate the tokens and tag them, whilst filtering out useless words.

The sentiment of the user's statement also needs to be considered while recommending.

To obtain the raw recommendations, we need to check for correlations between the tokens and the product names.

Organizing the recommendations and allocating them to each user will give us our final set of recommendations.

Architecture Diagram:



Pseudocode:

Module - I:

For each dialogue in conversation:

 Split dialogue in tokens and store them

 doc = nlp(dialogue)

 For each token in token_list:

 if tag == 'NOUN', add to noun_list

 else if tag == 'VERB' add to verb_list

 End for loop...

#Using Spacy's functions, we can identify entities.

 For entity in doc.ents:

 Append entity to users

 Append entity_lab to user_types

 End for loop...

End for loop....

#Remove any leftover stop words in the nouns list

nouns = [word for word in nouns if not word in stopwords.words()]

Store all tokens in a data frame, and return the data frame

Module - II:

#Obtain sentiments using the NLTK Vader Sentiment Analyzer

Create a data frame to store sentiment values

sid = SentimentIntensityAnalyzer()

For each dialogue in conversation:

 Calculate polarity scores for each dialogue

 Append values to sentiments data frame corresponding
 to each sentiment

 Return the sentiment values data frame

End for loop....

#Displaying the dependency trees....

For each dialogue in conversation:

#Use loaded dictionary of English words from Spacy library

 nlp = spacy.load('en_core_web_md')

 doc = nlp(dialogue)

#Displacy is a visualization library for NLP

 displacy.render(doc, style = 'dep')

End for loop...

Module - III:

For each noun in noun_list:

 For each item in complete_list:

 If lower(noun) is present in lower(item name):

 Append item name to temp_list

 End for loop...

 Append temp_list to init_rec

End for loop...

Return the list init_rec

Module - IV:

For index in the range of length of init_rec:

 If sentiment for user[index] is positive:

 Append random items to final_rec[index]

 If sentiment for user[index] is negative:

 Choose random items from other user interests

 Append those to final_rec[index]

#We have chosen to recommend 5 items per user

 If sentiment for user[index] is neutral:

 Append random items to final_rec[index]

End for loop...

Return the list of lists final_rec

List of Modules (in detail):

Module - 1:

The main focus of lexical analysis is to obtain tokens from the given text input.

We need to differentiate between entities (users, organizations, religion, etc.) and interests (garments, tech, etc.).

The technique we are going to employ is called POS tagging. (POS -> Part of Speech)

POS tagging algorithms allocate tags to each token, such as "NOUN", "VERB", "ADJ", etc., based on the similarity to their respective tagged categories.

We will be using the Spacy library, which contains pre-trained NLP models and a huge dictionary of words.

The input is parsed sentence by sentence, from which nouns, verbs, users, and user types are obtained. The respective information is summarized in a pandas data frame.

Keep in mind the input is made to understand short conversations - especially one-liners. Basically, we separate the text blob by the '\n', or newline symbol. This is done by using the splitlines() function.

If any respective dialogue consists of two lines, the parser will be confused and allocate an extra user to the extra line.

This is done with consideration to social messaging applications, as users frequently communicate with short dialogues.

Module - II:

The main point of understanding the syntax of the sentence is to check the order by which tokens are parsed.

For example, seeing a "not" before a verb, say "enjoying", can imply a negative sentiment.

Sentiment analysis is an important tool in recommendation - it helps recommend products to those who want it.

People who express negative sentiment towards a product will not receive recommendations on it.

Instead, they will get recommendations based on what their friends like.

The NTLK Vader Sentiment Analyzer is an excellent tool for quickly analyzing the sentiment of a sentence.

We will obtain the polarity scores in each sentiment category, i.e "Positive", "Negative", "Neutral", and "Compound", for each user.

The Spacy library consists of one more feature - the ability to show dependency trees. Dependency trees are useful in understanding the parsing process, in pursuit of finding the sentiments.

The arrows infer dependencies between words. If an arrow points from 'a' to 'b', then it can be understood that 'a' depends on 'b'.

This is useful in seeing how the tokens are tagged, and how the sentence is syntactically analyzed.

Finally, from experimentation, we have concluded that 0 is a suitable threshold to determine whether the said user should be recommended any products or not. The main reason is that, if the compound sentiment is zero or more, then the user is neutral or positive of the product, however if it is less than zero, the user does not like the product. Based on this logic, we recommend the products.

Module - III:

We will check the list of nouns from our summary of tokens to see what the interests of the users are.

If the particular noun is present in any product name, we will store that product name in a new list.

This new list is considered as our initial set of recommendations.

Now, our initial recommendations are quite a large number.

We will pick five products at random, to recommend to each user.

Of course, we do not want to get the same products again in our random selection.

This is easily achieved by using `random.sample(list, k)`, where `k` is the number of items selected. This function also ensures that there is no repetition in the selection of items.

Module - IV:

This is the final recommendation.

You can see the user's names followed by a list of recommendations based on their interests.

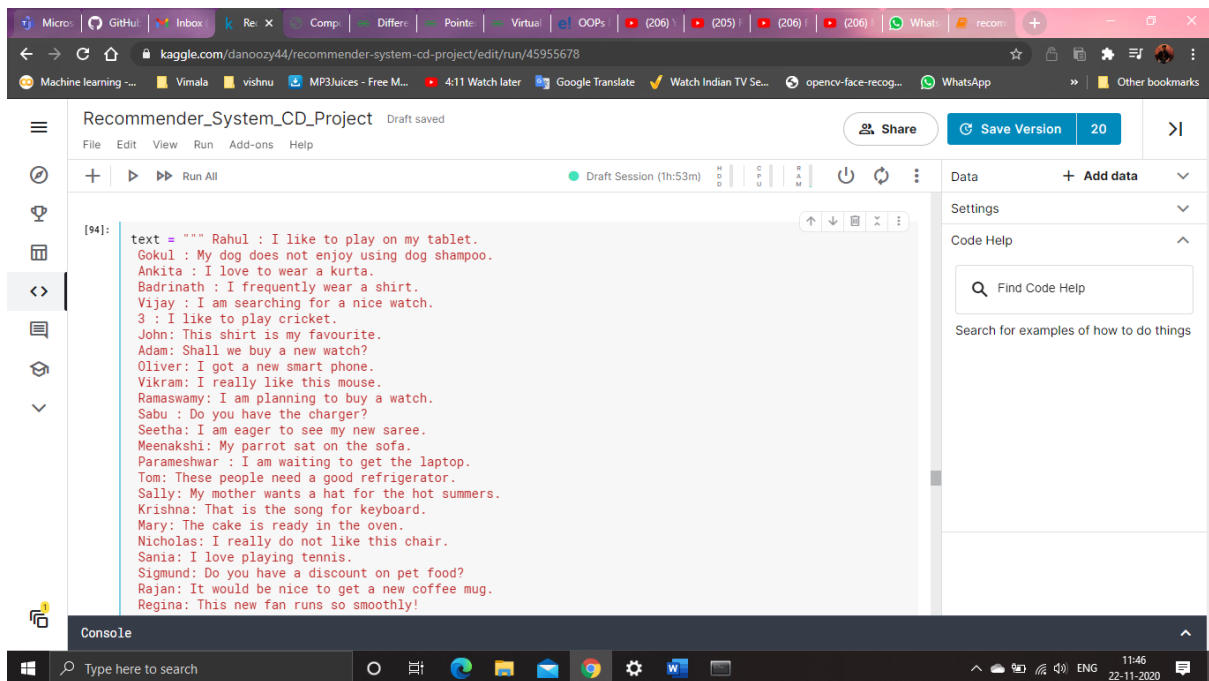
Keep in mind that for the most part the recommendations are accurate, but you may chance upon some outliers, due to the random nature of product selection.

As stated before, the sentiment of the user is considered as a factor in the recommendation process. The compounded polarity score is considered here.

If a user's sentiment is negative, then we pick a random recommendation based on the interests of that user's friends.

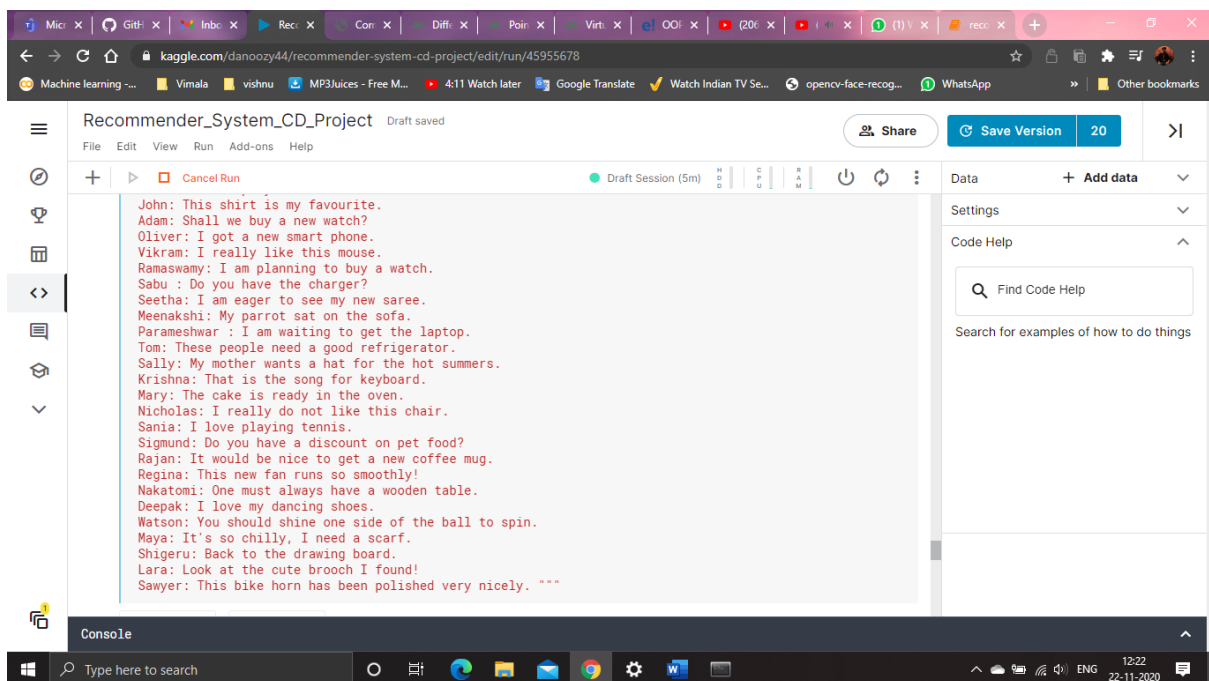
Otherwise, if it is positive or neutral, we can directly recommend based on their individual interest.

Input:



The screenshot shows a Kaggle Colab notebook interface. The notebook title is "Recommender_System_CD_Project". The code cell [94] contains a text variable with the following content:

```
text = """ Rahul : I like to play on my tablet.
Gokul : My dog does not enjoy using dog shampoo.
Ankita : I love to wear a kurta.
Badrinath : I frequently wear a shirt.
Vijay : I am searching for a nice watch.
3 : I like to play cricket.
John: This shirt is my favourite.
Adam: Shall we buy a new watch?
Oliver: I got a new smart phone.
Vikram: I really like this mouse.
Ramaswamy: I am planning to buy a watch.
Sabu : Do you have the charger?
Seetha: I am eager to see my new saree.
Meenakshi: My parrot sat on the sofa.
Parameshwar : I am waiting to get the laptop.
Tom: These people need a good refrigerator.
Sally: My mother wants a hat for the hot summers.
Krishna: That is the song for keyboard.
Mary: The cake is ready in the oven.
Nicholas: I really do not like this chair.
Sania: I love playing tennis.
Sigmund: Do you have a discount on pet food?
Rajan: It would be nice to get a new coffee mug.
Regina: This new fan runs so smoothly!
```



The screenshot shows a Kaggle Colab notebook interface. The notebook title is "Recommender_System_CD_Project". The code cell contains a text variable with the following content:

```
John: This shirt is my favourite.
Adam: Shall we buy a new watch?
Oliver: I got a new smart phone.
Vikram: I really like this mouse.
Ramaswamy: I am planning to buy a watch.
Sabu : Do you have the charger?
Seetha: I am eager to see my new saree.
Meenakshi: My parrot sat on the sofa.
Parameshwar : I am waiting to get the laptop.
Tom: These people need a good refrigerator.
Sally: My mother wants a hat for the hot summers.
Krishna: That is the song for keyboard.
Mary: The cake is ready in the oven.
Nicholas: I really do not like this chair.
Sania: I love playing tennis.
Sigmund: Do you have a discount on pet food?
Rajan: It would be nice to get a new coffee mug.
Regina: This new fan runs so smoothly!
Nakatomi: One must always have a wooden table.
Deepak: I love my dancing shoes.
Watson: You should shine one side of the ball to spin.
Maya: It's so chilly, I need a scarf.
Shigeru: Back to the drawing board.
Lara: Look at the cute brooch I found!
Sawyer: This bike horn has been polished very nicely. """
```

Output:

Module 1(Tokenization):

The screenshot shows the Kaggle Recommender System CD Project interface. The input code cell contains `token_summary`. The output cell displays a table with 13 rows of tokenized data. The table has four columns: Users, Nouns, Verbs, and User_Types. The data is as follows:

	Users	Nouns	Verbs	User_Types
0	[Rahul]	[tablet]	[like, play]	[PERSON]
1	[Gokul]	[dog, shampoo]	[enjoy, using]	[PERSON]
2	[Ankita]	[kurta]	[love, wear]	[PERSON]
3	[Badrinath]	[shirt]	[wear]	[PERSON]
4	[Vijay]	[watch]	[searching]	[PERSON]
5	[3]	[cricket]	[like, play]	[CARDINAL]
6	[John]	[shirt]	[]	[PERSON]
7	[Adam]	[watch]	[Shall, buy]	[PERSON]
8	[Oliver]	[phone]	[got]	[PERSON]
9	[Vikram]	[mouse]	[like]	[PERSON]
10	[Ramaswamy]	[watch]	[planning, buy]	[PERSON]
11	[Sabu]	[charger]	[]	[PERSON]
12	[Seetha]	[saree]	[see]	[PERSON]
13	[Meenakshi]	[parrot, sofa]	[sat]	[PERSON]

The screenshot shows the Kaggle Recommender System CD Project interface. The input code cell contains `token_summary`. The output cell displays a table with 18 rows of tokenized data (rows 13 to 30). The table has four columns: Users, Nouns, Verbs, and User_Types. The data is as follows:

13	[Meenakshi]	[parrot, sofa]	[sat]	[PERSON]
14	[Parameshwar]	[laptop]	[waiting]	[PERSON]
15	[Tom]	[people, refrigerator]	[need]	[PERSON]
16	[Sally]	[mother, hat, summers]	[wants]	[PERSON]
17	[Krishna]	[song, keyboard]	[]	[PERSON]
18	[Mary]	[cake, oven]	[]	[PERSON]
19	[Nicholas]	[chair]	[like]	[PERSON]
20	[Sania]	[tennis]	[love, playing]	[LOC]
21	[Sigmund]	[discount, food]	[]	[ORG]
22	[Rajan]	[coffee, mug]	[would]	[PERSON]
23	[Regina]	[fan]	[runs]	[PERSON]
24	[Nakatomi]	[table]	[must]	[PERSON]
25	[Deepak]	[dancing, shoes]	[love]	[ORG]
26	[Watson]	[side, ball]	[should, shine, spin]	[PERSON]
27	[Maya]	[scarf]	[need]	[PERSON]
28	[Shigeru]	[drawing, board]	[]	[PERSON]
29	[Lara]	[brooch]	[Look, found]	[PERSON]
30	[Sawyer]	[bike, horn]	[polished]	[PERSON]

Module 2(Syntax analysis):

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Out[52]:

	Dialogue	Compound	Negative	Neutral	Positive
0	Rahul : I like to play on my tablet.	0.5994	0.000	0.505	0.495
1	Gokul : My dog does not enjoy using dog shampoo.	-0.3875	0.247	0.753	0.000
2	Ankita : I love to wear a kurta.	0.6369	0.000	0.488	0.512
3	Badrinath : I frequently wear a shirt.	0.0000	0.000	1.000	0.000
4	Vijay : I am searching for a nice watch.	0.4215	0.000	0.641	0.359
5	3 : I like to play cricket.	0.5994	0.000	0.290	0.710
6	John: This shirt is my favourite.	0.0000	0.000	1.000	0.000
7	Adam: Shall we buy a new watch?	0.0000	0.000	1.000	0.000
8	Oliver: I got a new smart phone.	0.4019	0.000	0.597	0.403
9	Vikram: I really like this mouse.	0.4201	0.000	0.589	0.411
10	Ramaswamy: I am planning to buy a watch.	0.0000	0.000	1.000	0.000
11	Sabu : Do you have the charger?	0.0000	0.000	1.000	0.000
12	Seetha: I am eager to see my new saree.	0.3612	0.000	0.737	0.263
13	Meenakshi: My parrot sat on the sofa.	0.0000	0.000	1.000	0.000
14	Parameshwar : I am waiting to get the laptop.	0.0000	0.000	1.000	0.000
15	Tom: These people need a good refrigerator.	0.4404	0.000	0.633	0.367
16	Sally: My mother wants a hat for the hot summ...	0.0000	0.000	1.000	0.000

Console

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11:12 22-11-2020

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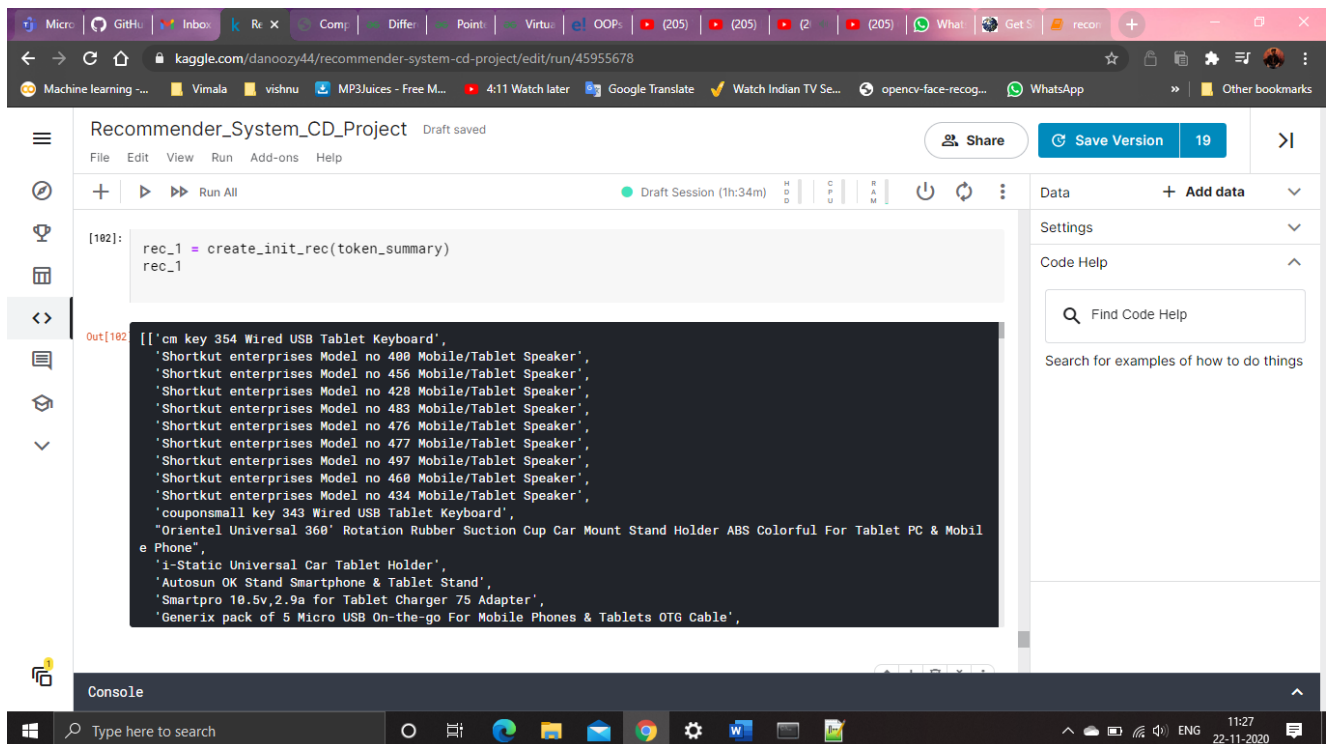
15	Tom: These people need a good refrigerator.	0.4404	0.000	0.633	0.367
16	Sally: My mother wants a hat for the hot summ...	0.0000	0.000	1.000	0.000
17	Krishna: That is the song for keyboard.	0.0000	0.000	1.000	0.000
18	Mary: The cake is ready in the oven.	0.3612	0.000	0.737	0.263
19	Nicholas: I really do not like this chair.	-0.3343	0.283	0.717	0.000
20	Sania: I love playing tennis.	0.7184	0.000	0.250	0.750
21	Sigmund: Do you have a discount on pet food?	0.0000	0.000	1.000	0.000
22	Rajan: It would be nice to get a new coffee mug.	0.4215	0.000	0.763	0.237
23	Regina: This new fan runs so smoothly!	0.3802	0.000	0.698	0.302
24	Nakatomi: One must always have a wooden table.	0.0000	0.000	1.000	0.000
25	Deepak: I love my dancing shoes.	0.6369	0.000	0.488	0.512
26	Watson: You should shine one side of the ball...	0.0000	0.000	1.000	0.000
27	Maya: It's so chilly, I need a scarf.	0.0000	0.000	1.000	0.000
28	Shigeru: Back to the drawing board.	0.0000	0.000	1.000	0.000
29	Lara: Look at the cute brooch I found!	0.5093	0.000	0.646	0.354
30	Sawyer: This bike horn has been polished very...	0.4927	0.000	0.715	0.285

Console

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Module 3(Top Recommendation):



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Run All

Draft Session (1h:34m)

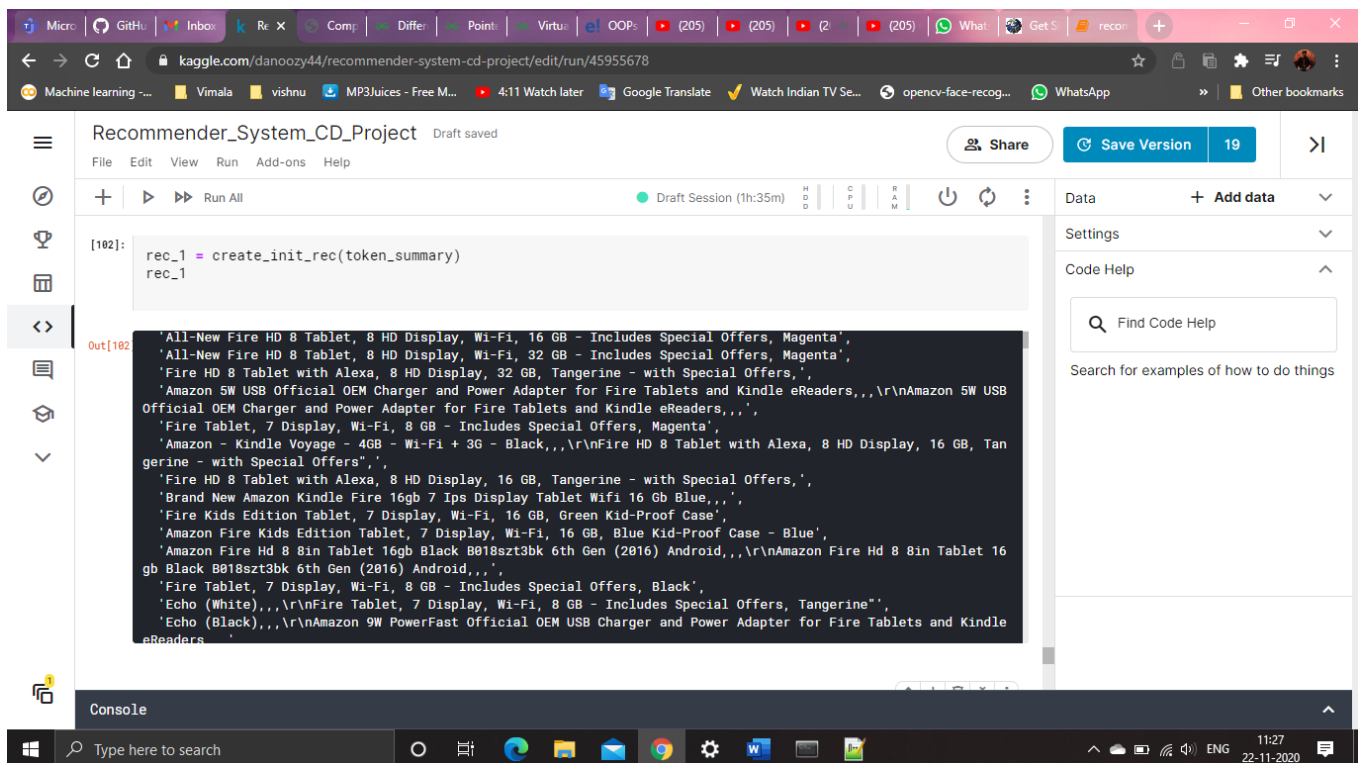
[102]:

```
rec_1 = create_init_rec(token_summary)
rec_1
```

Out[102]:

```
['cm key 354 Wired USB Tablet Keyboard',
'Shortkut enterprises Model no 400 Mobile/Tablet Speaker',
'Shortkut enterprises Model no 456 Mobile/Tablet Speaker',
'Shortkut enterprises Model no 428 Mobile/Tablet Speaker',
'Shortkut enterprises Model no 483 Mobile/Tablet Speaker',
'Shortkut enterprises Model no 476 Mobile/Tablet Speaker',
'Shortkut enterprises Model no 477 Mobile/Tablet Speaker',
'Shortkut enterprises Model no 497 Mobile/Tablet Speaker',
'Shortkut enterprises Model no 460 Mobile/Tablet Speaker',
'Shortkut enterprises Model no 434 Mobile/Tablet Speaker',
'couponsmall key 343 Wired USB Tablet Keyboard',
'Oriental Universal 360' Rotation Rubber Suction Cup Car Mount Stand Holder ABS Colorful For Tablet PC & Mobil
e Phone',
'i-Static Universal Car Tablet Holder',
'Autosun OK Stand Smartphone & Tablet Stand',
'Smartpro 10.5v,2.9a for Tablet Charger 75 Adapter',
'Generix pack of 5 Micro USB On-the-go For Mobile Phones & Tablets OTG Cable',
```

Console



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Run All

Draft Session (1h:35m)

[102]:

```
rec_1 = create_init_rec(token_summary)
rec_1
```

Out[102]:

```
'All-New Fire HD 8 Tablet, 8 HD Display, Wi-Fi, 16 GB - Includes Special Offers, Magenta',
'All-New Fire HD 8 Tablet, 8 HD Display, Wi-Fi, 32 GB - Includes Special Offers, Magenta',
'Fire HD 8 Tablet with Alexa, 8 HD Display, 32 GB, Tangerine - with Special Offers,',
'Amazon 5W USB Official OEM Charger and Power Adapter for Fire Tablets and Kindle eReaders,,,\\r\\nAmazon 5W USB
Official OEM Charger and Power Adapter for Fire Tablets and Kindle eReaders,,,\\r\\nAmazon 5W USB
Fire Tablet, 7 Display, Wi-Fi, 8 GB - Includes Special Offers, Magenta',
'Amazon - Kindle Voyage - 4GB - Wi-Fi + 3G - Black,,,\\r\\nFire HD 8 Tablet with Alexa, 8 HD Display, 16 GB, Tan
gerine - with Special Offers',
'Fire HD 8 Tablet with Alexa, 8 HD Display, 16 GB, Tangerine - with Special Offers,',
'Brand New Amazon Kindle Fire 16gb 7 Ips Display Tablet Wifi 16 Gb Blue,,,\\r\\n',
'Fire Kids Edition Tablet, 7 Display, Wi-Fi, 16 GB, Green Kid-Proof Case',
'Amazon Fire Kids Edition Tablet, 7 Display, Wi-Fi, 16 GB, Blue Kid-Proof Case - Blue',
'Amazon Fire Hd 8 8in Tablet 16gb Black B018s3t3bk 6th Gen (2016) Android,,,\\r\\nAmazon Fire Hd 8 8in Tablet 16
gb Black B018s3t3bk 6th Gen (2016) Android,,,\\r\\n',
'Fire Tablet, 7 Display, Wi-Fi, 8 GB - Includes Special Offers, Black',
'Echo (White),,,,\\r\\nFire Tablet, 7 Display, Wi-Fi, 8 GB - Includes Special Offers, Tangerine',
'Echo (Black),,,,\\r\\nAmazon 9W PowerFast Official OEM USB Charger and Power Adapter for Fire Tablets and Kindle
eReaders',
```

Console

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kaggle.com/danoozy44/recommender-system-cd-project/edit/run/45955678

Machine learning ... Vimala vishnu MP3Juices - Free M... 4:11 Watch later Google Translate Watch Indian TV Se... opencv-face-recog... WhatsApp >> Other bookmarks

Recommender_System_CD_Project

Draft saved

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Share Save Version 19

Run All Draft Session (1h:35m)

```
[102]: rec_1 = create_init_rec(token_summary)
rec_1
```

```
Out[102]: 'COMMON ON KIDS Printed Girl's Straight Kurta',
'stylishvilla Embroidered Kurta & Patiyala',
'stylishvilla Embroidered Kurta & Churidar',
'Khushi Fashions Printed Kurta & Pallazo',
'GO LUCKNOW Embroidered Women's Straight Kurta',
'Jbn Creation Boy's Kurta and Pyjama Set',
'Jaipurkurti Striped Women's Straight Kurta',
'Nut Khut Embroidered Kurta & Churidar',
'Aarika Self Design Kurta & Patiyala',
'Aarika Self Design Kurta & Pallazo',
'Saarah Self Design Kurta & Salwar',
'Royal Men's Kurta and Churidar Set',
'Arshia Fashions Printed Kurta & Leggings',
'AJ Dezines Boy's Kurta and Pyjama Set',
'FTCBAZAR Solid Men's Straight Kurta',
'FreeHand Solid Men's Straight Kurta',
'Yepme Embroidered Men's A-line Kurta',
'Royal Kurta Men's Pathani Suit Set',
```

Console

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Machine learning ... Vimala vishnu MP3Juices - Free M... 4:11 Watch later Google Translate Watch Indian TV Se... opencv-face-recog... WhatsApp >> Other bookmarks

Recommender_System_CD_Project

Draft saved

File Edit View Run Add-ons Help

Share Save Version 19

Run All Draft Session (1h:35m)

```
[102]: rec_1 = create_init_rec(token_summary)
rec_1
```

```
Out[102]: 'Favourite BikerZ FBZ 8780 112 dB Vehicle Horn',
'Xtreme MB Windtone For TVS Pep Plus 110 dB Vehicle Horn',
'Speedwav Twin Tone 2 Pipe Car Air Pressure -Fiat Palio 200 dB Vehicle Horn',
'Speedwav Car / Bike Loud Hooter Dog Horn-Hyundai Xcent 110 dB Vehicle Horn',
'MOCC New Horn Set Imported With 18 Tunes 110 dB Vehicle Horn',
'Xtreme 3 Pipe Air Pressure For Suzuki Sling Shot Plus 110 dB Vehicle Horn',
'Xtreme MB Windtone For Bajaj Discover 100 DTS-i 110 dB Vehicle Horn',
'Bosch 49605 110 dB Vehicle Horn',
'Speedwav Twin Tone 2 Pipe Car Air Pressure -Tata Safari Type 1 200 dB Vehicle Horn',
'Speedwav Twin Tone 2 Pipe Car Air Pressure -Nissan Evalia 200 dB Vehicle Horn',
'Type R G55 110 dB Vehicle Horn',
'Speedwav Tuk Tuk Reverse Gear Safety -Chevrolet Sail 200 dB Vehicle Horn',
'Speedwav Twin Tone 2 Pipe Bike Air Pressure -Royal Enfield Electra Twin Tone 2 Spark 200 dB Vehicle Horn',
'Super Hornet Fighter Aircraft Poster Paper Print',
'Bike World 3 Pipe Air Pressure for S6 110 dB Vehicle Horn',
'Bike World 3 Pipe Air Pressure for Etios Liva 110 dB Vehicle Horn',
'Bike World 3 Pipe Air Pressure for Evalia 110 dB Vehicle Horn']
```

Console

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Module 4(Final recommendation):

The screenshot shows a Kaggle notebook interface. The left sidebar contains the Kaggle logo and navigation links: Home, Compete, Data, Notebooks (selected), Discuss, Courses, and More. Below these are 'Recently Viewed' items: Recommender_Syst..., Haarcascades, Python Dataset Dow..., and Reddit India Flair De... The main area displays a code cell with the following text:

```
Recommendations are:
```

Rahul -> ['All-New Fire HD 8 Tablet, 8" HD Display, Wi-Fi, 32 GB - Includes Special Offers, Black', 'Amazon Fire Hd 6 Standing Protective Case(4th Generation - 2014 Release), Cayenne Red', 'Amazon 5W USB Official OEM Charger and Power Adapter for Fire Tablets and Kindle eReaders', 'Amazon 9W PowerFast Official OEM USB Charger and Power Adapter for Fire Tablets and Kindle eReaders', 'Amazon 9W PowerFast Official OEM USB C charger and Power Adapter for Fire Tablets and Kindle eReaders', 'Genesis Pack of 2 Micro USB On-the-go For Mobile Phones & Tablets OTG Cable', 'All-New Fire HD 8 Tablet, 8 HD Display, Wi-Fi, 16 GB - Includes Special Offers, Magenta']

Gokul -> ['All-New Fire HD 8 Tablet, 8 HD Display, Wi-Fi, 16 GB - Includes Special Offers, Magenta', 'Salwar Studio Self Design Kurta & Salwar', 'gurjari oxidised kurta button brooch Brooch', 'Threads & Pals Full Sleeve Printed, Solid Men's Sweatshirt', 'Rich Club Apple Shaped LED Digital Watch - For Boys, Girls', 'SS Ton Heritage English Willow Cricket Bat']

Ankita -> ['gurjari oxidised kurta button brooch Brooch', 'Salwar Studio Self Design Kurta & Salwar', 'Fab Nisa Solid Women's Straight Kurta', 'Cynthia's Fashion Women's, Girl's Kurta, Pyjama & Dupatta Set', 'Lajo Women's Kurta, Pyjama & Dupatta Set']

The right sidebar shows the notebook's version (18 of 18), a 'Notebook' tab, and a list of operations: CS6109 - Compiler Design Project, Importing Standard Libraries, Obtaining Data, Lexical Analysis, Syntax Analysis, Input (3), Execution Info, Log, and Comments (0).

The screenshot shows a Kaggle notebook interface. The left sidebar contains the Kaggle logo and navigation links: Home, Compete, Data, Notebooks (selected), Discuss, Courses, and More. Below these are 'Recently Viewed' items: Recommender_Syst..., Haarcascades, Python Dataset Dow..., and Reddit India Flair De... The main area displays a code cell with the following text:

```
Badrinath -> ["Threads & Pals Full Sleeve Printed, Solid Men's Sweatshirt", "Seven Days Men's Solid Formal Linen Shirt", "Colsa Women's Printed Casual Shirt", "Point Fit Solid Women's V-neck T-Shirt", "Jazzy Ben Women's Checkered Casual Shirt"]
```

Vijay -> ['Luba qw12 Stylo Analog Watch - For Men', 'Luba j52 Stylo Analog Watch - For Women', 'Britex BT9026 Bluetec Bucherer Analog Watch - For Boys, Men', 'Rich Club Apple Shaped LED Digital Watch - For Boys, Girls', 'Flipdd FDLSP1507 Analog Watch - For Women']

Srikanth -> ['Stanford League Special Cricket Ball - Size: 5.1\\2, Diameter: 1.5 cm', 'SG Prosoft Cricket Ball', 'Metro Sports Leather Cricket Ball - Size: 5, Diameter: 23 cm', 'SM Bravo Kashmir Willow Cricket Bat', 'SS Ton Heritage English Willow Cricket Bat']

Below the code cell, a message states: "You have reached the end of this notebook. Thank you for reading!"

The right sidebar shows the notebook's version (18 of 18), a 'Notebook' tab, and a list of operations: CS6109 - Compiler Design Project, Importing Standard Libraries, Obtaining Data, Lexical Analysis, Syntax Analysis, Input (3), Execution Info, Log, and Comments (0).

Results Discussion:

Since we've checked for subsequences of the occurring string, the nouns, inside product names, of course we cannot guarantee an accuracy of 100%.

Regardless, the recommendation system seems to work fairly well - it recommends what the users want based on their interests.

For users with negative sentiment - it doesn't recommend the products associated with the user. Rather, it recommends products associated with the user's friends.

We also ensure any product recommendation is not repeated for the same user.

The end result is fairly straight-forward. It works for most cases, with some exceptions, a rare case.

Module 1(Tokenization):

token_summary

	Users	Nouns	Verbs	User_Types
0	[Rahul]	[tablet]	[like, play]	[PERSON]
1	[Gokul]	[dog, shampoo]	[enjoy, using]	[PERSON]
2	[Ankita]	[kurta]	[love, wear]	[PERSON]
3	[Badrinath]	[shirt]	[wear]	[PERSON]
4	[Vijay]	[watch]	[searching]	[PERSON]
5	[3]	[cricket]	[like, play]	[CARDINAL]
6	[John]	[shirt]	[]	[PERSON]
7	[Adam]	[watch]	[Shall, buy]	[PERSON]
8	[Oliver]	[phone]	[got]	[PERSON]
9	[Vikram]	[mouse]	[like]	[PERSON]
10	[Ramaswamy]	[watch]	[planning, buy]	[PERSON]
11	[Sabu]	[charger]	[]	[PERSON]
12	[Seetha]	[saree]	[see]	[PERSON]
13	[Meenakshi]	[parrot, sofa]	[sat]	[PERSON]
14	[Parameshwar]	[laptop]	[waiting]	[PERSON]
15	[Tom]	[people, refrigerator]	[need]	[PERSON]
16	[Sally]	[mother, hat, summers]	[wants]	[PERSON]
17	[Krishna]	[song, keyboard]	[]	[PERSON]
18	[Mary]	[cake, oven]	[]	[PERSON]
19	[Nicholas]	[chair]	[like]	[PERSON]
20	[Sania]	[tennis]	[love, playing]	[LOC]
21	[Sigmund]	[discount, food]	[]	[ORG]
22	[Rajan]	[coffee, mug]	[would]	[PERSON]
23	[Regina]	[fan]	[runs]	[PERSON]
24	[Nakatomi]	[table]	[must]	[PERSON]
25	[Deepak]	[dancing, shoes]	[love]	[ORG]
26	[Watson]	[side, ball]	[should, shine, spin]	[PERSON]
27	[Maya]	[scarf]	[need]	[PERSON]
28	[Shigeru]	[drawing, board]	[]	[PERSON]
29	[Lara]	[brooch]	[Look, found]	[PERSON]
30	[Sawyer]	[bike, horn]	[polished]	[PERSON]

Module 2(Syntax analysis):

sentiments

	Dialogue	Compound	Negative	Neutral	Positive
0	Rahul : I like to play on my tablet.	0.5994	0.000	0.505	0.495
1	Gokul : My dog does not enjoy using dog shampoo.	-0.3875	0.247	0.753	0.000
2	Ankita : I love to wear a kurta.	0.6369	0.000	0.488	0.512
3	Badrinath : I frequently wear a shirt.	0.0000	0.000	1.000	0.000
4	Vijay : I am searching for a nice watch.	0.4215	0.000	0.641	0.359
5	3 : I like to play cricket.	0.5994	0.000	0.290	0.710
6	John: This shirt is my favourite.	0.0000	0.000	1.000	0.000
7	Adam: Shall we buy a new watch?	0.0000	0.000	1.000	0.000
8	Oliver: I got a new smart phone.	0.4019	0.000	0.597	0.403
9	Vikram: I really like this mouse.	0.4201	0.000	0.589	0.411
10	Ramaswamy: I am planning to buy a watch.	0.0000	0.000	1.000	0.000
11	Sabu : Do you have the charger?	0.0000	0.000	1.000	0.000
12	Seetha: I am eager to see my new saree.	0.3612	0.000	0.737	0.263
13	Meenakshi: My parrot sat on the sofa.	0.0000	0.000	1.000	0.000
14	Parameshwar : I am waiting to get the laptop.	0.0000	0.000	1.000	0.000
15	Tom: These people need a good refrigerator.	0.4404	0.000	0.633	0.367
16	Sally: My mother wants a hat for the hot summ...	0.0000	0.000	1.000	0.000
17	Krishna: That is the song for keyboard.	0.0000	0.000	1.000	0.000

18	Mary: The cake is ready in the oven.	0.3612	0.000	0.737	0.263
19	Nicholas: I really do not like this chair.	-0.3343	0.283	0.717	0.000
20	Sania: I love playing tennis.	0.7184	0.000	0.250	0.750
21	Sigmund: Do you have a discount on pet food?	0.0000	0.000	1.000	0.000
22	Rajan: It would be nice to get a new coffee mug.	0.4215	0.000	0.763	0.237
23	Regina: This new fan runs so smoothly!	0.3802	0.000	0.698	0.302
24	Nakatomi: One must always have a wooden table.	0.0000	0.000	1.000	0.000
25	Deepak: I love my dancing shoes.	0.6369	0.000	0.488	0.512
26	Watson: You should shine one side of the ball...	0.0000	0.000	1.000	0.000
27	Maya: It's so chilly, I need a scarf.	0.0000	0.000	1.000	0.000
28	Shigeru: Back to the drawing board.	0.0000	0.000	1.000	0.000
29	Lara: Look at the cute brooch I found!	0.5093	0.000	0.646	0.354
30	Sawyer: This bike horn has been polished very...	0.4927	0.000	0.715	0.285

Module 3(Top Recommendation):

```
[ 'cm key 354 Wired USB Tablet Keyboard',
  'Shortcut enterprises Model no 400 Mobile/Tablet Speaker',
  'Shortcut enterprises Model no 456 Mobile/Tablet Speaker',
  'Shortcut enterprises Model no 428 Mobile/Tablet Speaker',
  'Shortcut enterprises Model no 483 Mobile/Tablet Speaker',
  'Shortcut enterprises Model no 476 Mobile/Tablet Speaker',
  'Shortcut enterprises Model no 477 Mobile/Tablet Speaker',
  'Shortcut enterprises Model no 497 Mobile/Tablet Speaker',
  'Shortcut enterprises Model no 460 Mobile/Tablet Speaker',
  'Shortcut enterprises Model no 434 Mobile/Tablet Speaker',
  'couponsmall key 343 Wired USB Tablet Keyboard',
  "Orientel Universal 360' Rotation Rubber Suction Cup Car Mount
  Stand Holder ABS Colorful For Tablet PC & Mobile Phone",
  'i-Static Universal Car Tablet Holder',
  "RETAIL SHOP INDIA Printed Girl's Straight Kurta",
  "Love More Printed Women's Flared Kurta",
  'Saarah Self Design Kurta & Churidar',
  'Salwar Studio Geometric Print, Paisley Kurta & Salwar',
  'Salwar Studio Self Design Kurta & Salwar',
  'F-Loop Self Design Kurta & Churidar',
  "Aarika Girl's Kurta and Pallazo Set",
  "Swag India Girl's Kurta and Pallazo Set",
  "Retaaz Girl's Kurta and Leggings Set",
  "NIPPY Boy's Kurta, Waistcoat and Breeches Set",
  'JDK NOVELTY Brocade, Art Silk, Organza Floral Print Multi-purpose
  Fabric,
  Kurti Fabric, Blouse Material,
  Kurta Fabric, Dress/Top Material, Jacket Fabric, Kurta & Pallazo
  Material, Sherwani Fabric, Kurta & Churidar Material, Lace, Salwar
  Suit Material, Kurta & Patiyala Material, Lehenga Choli Material',
```

'JDK NOVELTY Brocade, Art Silk, Organza Self Design Multi-purpose Fabric, Kurti Fabric, Blouse Material, Kurta Fabric, Dress/Top Material, Jacket Fabric, Kurta & Pallazzo Material, Sherwani Fabric, Kurta & Churidar Material, Lace, Salwar Suit Material, Kurta & Patiyala Material, Lehenga Choli Material',

'JDK NOVELTY Brocade, Art Silk, Organza Floral Print Multi-purpose Fabric, Kurti Fabric, Blouse Material, Kurta Fabric, Dress/Top Material, Jacket Fabric, Lehenga Choli Material, Kurta & Patiyala Material, Salwar Suit Material, Lace, Kurta & Churidar Material, Sherwani Fabric, Kurta & Pallazzo Material',

"TSG Breeze Printed Women's Round Neck Multicolor T-Shirt",

"Starsy Printed Women's Round Neck Green T-Shirt",

"Clovia Women's T-Shirt Bra",

"run of luck Solid Women's Round Neck Dark Blue T-Shirt",

"Starsy Solid Women's Round Neck Green T-Shirt",

"Attitude Printed Women's Round Neck Black T-Shirt",

"The Cotton Company Solid Women's Polo Neck Pink T-Shirt",

'Adimani Mustuw Scarf Fabric Necklace',

'Adimani Felimq Scarf Fabric Necklace',

]

Module 4(Final Recommendation):

USERS	RECOMMENDED PRODUCTS
Rahul	'Brand New Amazon Kindle Fire 16gb 7 Ips Display Tablet Wifi 16 Gb Blue,,,', 'Amazon 9W PowerFast Official OEM USB Charger and Power Adapter for Fire Tablets and Kindle eReaders,,, \r\nAmazon 9W PowerFast Official OEM USB Charger and Power Adapter for Fire Tablets and Kindle eReaders,,,', 'All-New Fire HD 8 Tablet, 8 HD Display, Wi-Fi, 32 GB - Includes Special Offers, Black', 'Echo (White),,,, \r\nFire Tablet, 7 Display, Wi-Fi, 8 GB - Includes Special Offers, Tangerine"', 'All-New Fire HD 8 Tablet, 8 HD Display, Wi-Fi, 16 GB - Includes Special Offers, Blue'
Gokul	'Brand New Amazon Kindle Fire 16gb 7 Ips Display Tablet Wifi 16 Gb Blue,,,', "Gulmohar Jaipur Embroidered Women's Straight Kurta", 'Aarika Self Design Kurta & Pallazzo', "ShowTime Women's Full Coverage, T-Shirt Bra", 'HMT S3648 Analog Watch - For Men', 'Spick

	Cricket Shoes', 'Mast & Harbour Women's Printed Casual Shirt', 'Gift Island SW13390E Fashionin Digital Watch - For Men', 'AdroitZ Premium Phone Socket Holder For Nokia N9', 'Ekku Mickey Mouse - 15 inch', 'Disney DW100405 Digital Watch - For Boys', 'Hako 85W Magsafe Laptop Charger For APPLE MacBook Pro 17 MA897LLA 85 Adapter', 'AMY Karena Kapoor in Green Saree A5 Notebook Spiral Bound', 'Aadaa Terracotta - Reclining Ganesha on Sofa - Pink Showpiece - 11.9 cm', 'PRINT SHAPES Best green ball Laptop Skin with Mouse pad Combo Set', 'People Women's Checkered Formal Shirt', 'AKUP happy-mothers-day Ceramic Mug', 'Saco Karbonn Smart Ta Fone A37 Hd Tablet Wired USB Tablet Keyboard', 'MasterweaverIndia Cotton Woven Blouse Material', 'RoyalOak Metal Outdoor Chair', 'Dunlop Fort Tennis Ball - Size: 0, Diameter: 2.5 cm', 'Royal Canin Maxi Starter 1kg Vegetable Dog Food', 'Prithish Wild And Free Ceramic Mug', 'JRB 1019 Smallest Mobile Powered By OTG Enabled Android Smart Phone Portable 1019 USB Fan', 'Craft And Curtain Multicolor 178 cm Table Runner', 'N Five Running Shoes', 'Uniball Kurutoga Round Shaped Pencils', 'Dimpy Stuff Bear W/Scarf in Sitting 50Cm - 50 cm', 'Satzuma UCH100 USB Clapper Board', 'B-Fashionable Combo of Drop & Round Bead Kilangi Brooch', 'Cm Treder cm h4 light 145 Motorbike LED Bulb'
Ankita	"Gulmohar Jaipur Embroidered Women's Straight Kurta", "Jeet Boy's Kurta and Pyjama Set", "Gulmohar Jaipur Printed Women's Straight Kurta", 'Aarika Self Design Kurta & Pallazo', "Swag India Girl's Kurta and Pallazo Set"
Badrinath	"J Marks Men's Striped Formal Shirt", "ShowTime Women's Full

	Coverage, T-Shirt Bra", "Penny Pro Women's T-Shirt Bra", "Concepts Women's Printed Casual Shirt", "Omtex Solid Men's Polo Neck T-Shirt"
Vijay	'Now B170-SLL09 Now Analog Watch - For Girls', 'Cartier W6701005 Analog Watch - For Boys, Men', 'Zoop C4040PP03 Digital Watch - For Boys, Girls', 'Alfajr WQ18 Qibla Compass Digital Watch - For Men, Boys, Girls', 'HMT S3648 Analog Watch - For Men'

Conclusion:

The information obtained from direct interactions can be a valuable tool, as we can create recommendation systems on the basis of user-user interactions, such as comments on a forum, rather than user-site interactions.

Previous systems understand and provide recommendations based on similarities between users, which might lead to a bias evaluation for user preferences. This provides a solution for this issue by integrating direct interactions into recommendation systems.

However, there is still much left to improve, and a full accuracy of such systems is never guaranteed, but this approach will definitely up the bar in extending further recommendation systems.

References:

1. C.Li, F.Xiong, "Social Recommendations with Multiple Influence from Direct User Interactions", Aug. 2017.
2. C. Pan, W. Li, Research paper recommendation with topic analysis in Computer Design and Applications IEEE, 4 (2010), pp. V4-264
3. J.A. Konstan, J. Riedl, Recommender Systems: From Algorithms to User Experience, User Model User-Adapt Interact, 22 (2012), pp. 101-123