CS 6320.501 Natural Language Processing

Project Report: FAQ Matching Application

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1. Description

In this project we have implemented a Frequently Asked Questions (FAQs) semantic matching application for "UBER" that will produce improved results using NLP features and techniques. We have used a bag-of-words strategy and an improved strategy using NLP feature and techniques.

Input:

♦ Set of FAQs and Answers from Uber regarding their app, usage, promotions etc.
♦ User's input natural language question/statement

Output:

♦ One or more FAQs and Answers that match the user's input question/statement.

The project was implemented as following tasks:

Task 1: Collect 50 FAQs from the website of Uber about their service.

Task 2: Implement a shallow NLP pipeline and bag-of-words matching algorithm

Bag-of-words creation

♦ Tokenize the FAQs and Answers into bag-of-words
♦ Create a bag-of-words for each FAQ
♦ Tokenize the user's input natural language question/statement into a bagof-words.

Bag-of-words matching

♦ Return the FAQ and Answer whose bag-of-words best statistically matches the bag-of-words from the user's input natural language question/statement

Evaluate the results of at least 10 user questions/statements for the top-10 returned FAQ matches

Task 3: Implement a deeper NLP pipeline to extract semantically rich features from the FAQs and Answers.

♦ Tokenize the FAQs and Answers into sentences and words
♦ Remove stop-words
♦ Lemmatize the words to extract lemmas as features
♦ Stem the words to extract stemmed words as features
♦ Part-of-speech (POS) tag the words to extract POS tag features

- Perform dependency parsing or full-syntactic parsing to parse-tree based patterns as features
- Using WordNet, extract hypernymns, hyponyms, meronyms, AND holonyms as features

Task 4: Implement a statistical, or heurist based approach to semantically match the user's input question/statement to one or more FAQs

- Run the above described deeper NLP on an user's input natural language question/statement and extract semantic features
- Implement a statistical, or heuristic based approach to semantically match the user's input question/statement to one or more FAQs
- Evaluate the results of at least 10 user questions/statements for the top-10 returned FAQ matches

2. **Proposed Solution**

- We decided to solve the problem using Wordnet based tools such as NLTK, Stanford Dependency Parser for natural language processing and Apache Solr to perform customized search in the corpus.
- We used NLTK to tokenize each of the sentences.
- Apache Solr was used tool to create indexes and maintain server instance.
- Solr Server is invoked through pysolr.
- The user's question is passed to the python program and sent to Solr for search of: Tokens along with the following features to search.

 POS tags

Stem

Stopwords

Lemma

Dependency parse tree

Hypernyms

Hyponyms

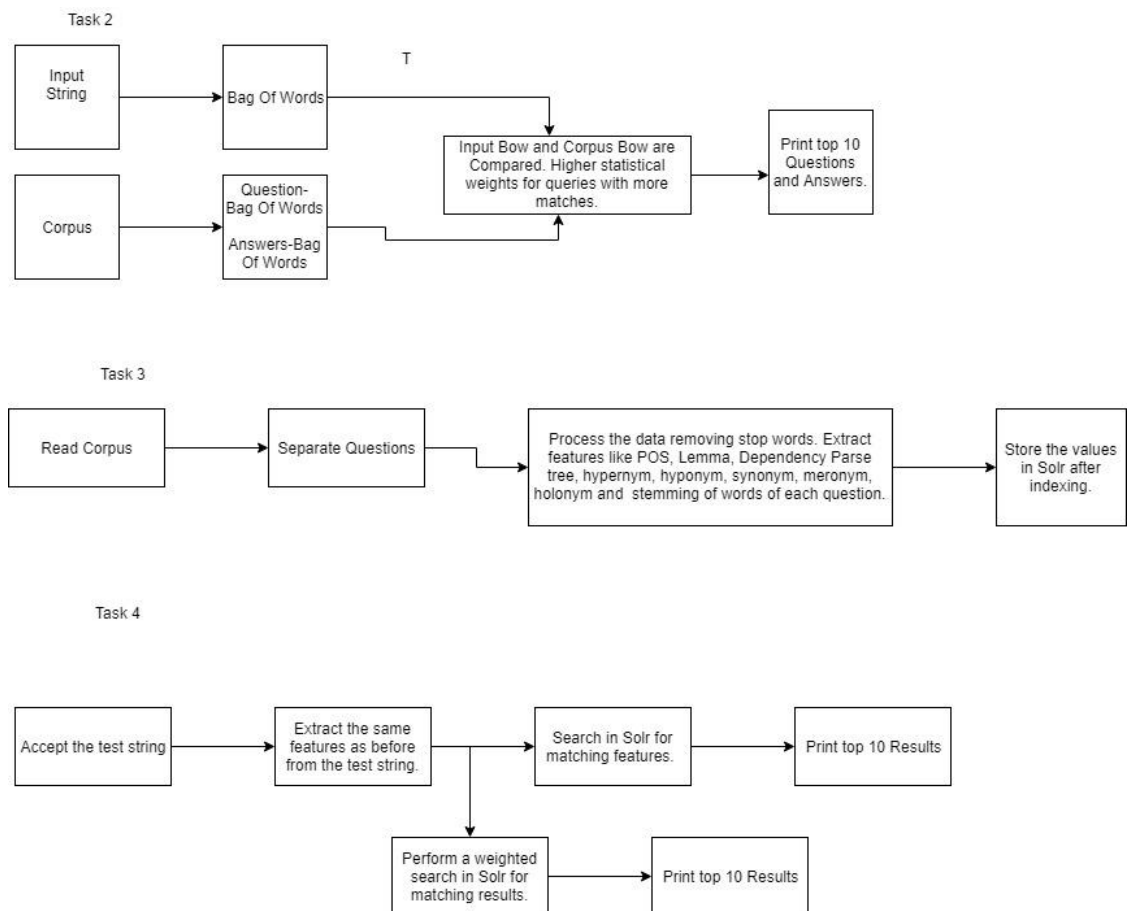Holonyms

Meronyms

Synonyms

Head Words

- Search for Tokens and features with selected weights on them. Some features could be set off completely.

3. Implementation Details

o Programming tools
- Python 3.5
- Apache Solr version 7.1.
- Nltk-3.2.5
  - Wordnet
  - Stopwords
  - StanfordDependencyParser
- Pysolr
- PrettyTable

o Architectural diagram

o Results and error analysis

Task 2: Output screen shot for 3 questions

1.

```
——*# print(scores)
——*return np.argsort(scores)[::-1]
main()
```

```
Enter your query : how to share my location
The top 10 matches for your question are :
{'', 'pick-up', 'location', 'possible', 'Is', 'to', 'it', 'change', 'my'}
{'', 'new', 'request', 'different', 'one', 'building\xa0', 'within', 'your', 'only', 'on', 'or', 'able', 'nearb
y.\xa0', 'by', '\xa0', 'screen.\xa0', 'also', '1.', 'When', 'do', 'label', 'can', '"Edit"', 'button', 'be', 'tim
e,', 'Changing', 'drag', 'a', 'map', 'location:', 'this:', 'locations', 'it', 'the', 'If', 'uses', "You'll", 'sug
gested', 'any', 'is', 'pickup', 'location', "that's", 'address', 'GPS', 'circle', 'Enter', 'not', 'you', 'Tap',
'You', 'To', 'Type', 'shown', 'pin', 'ride.', 'complete', '"Confirm"', 'of', 'Note:', 'uberPOOL.', '2.', 'availab
le', 'grey', 'Choose', 'ride,', '3.', 'adjust', 'best', 'suggest', 'need', 'from', 'to', 'change', 'moved', 'ap
p', 'and', 'next', 'after'}
 Is it possible to change my pick-up location?

When you request a ride, the app uses GPS to suggest the best pickup location nearby.

If you need a different pickup location:
1. Tap on the pickup location label on the map
2. Enter a new address or building
3. Choose from one of the locations suggested by the app
```

2.

```
——*# print(scores)
——*return np.argsort(scores)[::-1]
main()
```

```
Enter your query : How to request a ride
The top 10 matches for your question are :
{'', 'request', 'a', 'to', 'How', 'ride'}
{'', 'destination.', 'for', 'between', 'up', 'be', 'also', 'When', 'recent', 'default', 'Places"', 'the', 'tap',
'If', 'been', 'pickup', 'will', 'custom', 'vehicle', 'You', 'in', 'ride', 'picked', 'screen', '3.', 'from', 'se
e', 'toggle', 'request', 'one', 'your', 'options', 'on', 'are', 'or', 'driver', 'location.', 'Your', '1.', 'citie
s,', 'has', 'history', 'when', 'set', 'accept', 'you', 'some', 'point', 'time', 'bottom', 'asked', 'Shortcuts',
'to?"', 'Use', 'arrival', 'being', 'close', 'shortcut', 'notify', 'a', '"Request."', '(for', 'more', 'is', 'locat
ion', 'current', '5.', 'address', '6.', 'Enter', 'not', 'In', 'available', 'location,', 'estimated', 'Wait', 't
o', 'than', 'app', 'include', 'update', 'destination', '4.', 'destinations', 'example,', 'screen.', 'UberBLACK)',
'an', 'confirm', 'can', 'map', 'request.', 'accepted,', 'box,', "you'll", 'slider', 'uberX', 'GPS', 'icon', '"Whe
re', 'Tap', "driver's", 'at', 'of', '"Saved', '7.', 'may', '2.', 'and'}
 How to request a ride?

1. Enter your destination address in the "Where to?" box, or tap a shortcut icon at the bottom of your screen. Sh
ortcuts include recent destinations from your ride history or custom "Saved Places" you can set in your app
2. Your default pickup point is set to your current GPS location. If you are not being picked up at your current
location, tap your pickup location on the map and update the address
3. Use the slider at the bottom of your screen to toggle between available vehicle options (for example, uberX or
```

3

```
——*return np.argsort(scores)[::-1]
main()
```

```
Enter your query : Where is uber available
The top 10 matches for your question are :
{'', 'When', 'is', 'where', 'available', 'my', 'and', 'in', 'city', 'Uber'}
{'', 'where', 'request', 'an', 'Uber', 'can', 'days', 'operates,', 'a', 'week.', 'day,', 'the', 'city', 'any', 'i
s', 'account,', 'many', 'around', '24', 'you', 'in', 'With', 'ride', 'available', 'world.', '7', 'cities', 'hour
s'}
 When and where is Uber available in my city?

Uber is available in many cities around the world. With an Uber account, you can request a ride in any city where
Uber operates, 24 hours a day, 7 days a week.

{'', 'advance', 'can', 'schedule', 'rides', 'I', 'when', 'and', 'Where', 'in'}
{'', 'but', 'where', 'area.', 'times', 'request', 'your', 'for', 'are', 'trips', 'an', 'day.', 'Uber', 'can', 'ai
rport.', 'a', 'nearly', 'use', 'when', 'if', 'the', 'If', 'all', 'is', 'Check', 'schedule', 'as', 'currently', 'n
ot', 'leaving', 'airport', 'You', 'airport,', "you're", 'you', 'normally', 'at', 'Rides', 'available.', 'in', 'o
f', 'on-demand', 'ride', 'available', 'they', 'Scheduled', 'cities', 'to', 'app', 'see', 'would.', 'still'}
 Where and when can I schedule rides in advance?

You can schedule a ride in nearly all cities where Uber is available. Check your app to see if Scheduled Rides is
```

Task 3 and 4
Querying for the same questions as above with deeper NLP pipeline and Heuristic bases approach.

1.

```
                        'word': 'location'}})

Feature list obtained for the third task is as following:
+----------------+-------------------+-------------------+
| Feature Names  |       share       |     location      |
+----------------+-------------------+-------------------+
|     POS Tags   |        NN         |        NN         |
|     Lemma      |       share       |     location      |
|      Stem      |       share       |       locat       |
|    Synonym     |       parcel      |     placement     |
|    Hypernym    |       assets      |      object       |
|    Hyponym     |      allotment    |       base        |
|    Meronym     |  fetchedNULLvalue |  fetchedNULLvalue |
|    Holonym     |     net_income    |       space       |
+----------------+-------------------+-------------------+

length of the third task results 4
```

```
length of the third task results 4
Question is '18    '. How do I share my location
Question is '
Riders can show their exact location to their drivers by turning on Live Location Sharing.

This feature helps your driver locate you as you make your way to the pickup location.

HOW IT WORKS
When your driver arrives at the pickup spot, they will see an extra icon on their map indicating where you are. O
nce your trip begins, your driver will no longer be able to see your location.

TURN LOCATION SHARING ON OR OFF
You can switch the feature on/off by using the toggle in the bottom right of the map screen. You can also turn it
on or off within the Settings of your app. To do this:
1. Tap the menu icon
2. Select "Settings"
3. Swipe down and select "Privacy Settings"
4. Tap "Location"
5. Select "Share Live Location"
```

Same query with weighted search

```
The input query for the fourth task is (textsentence:share,location) AND (Stem:share,locat)^4 AND (Lemma:share,lo
cation)^4 AND (Synonym:parcel,placement)^4
(textsentence:share,location) AND (Stem:share,locat)^4 AND (Lemma:share,location)^4 AND (Synonym:parcel,placemen
t)^4

length of the fourth task results 4  with weights
Text ID is '18    '. How do I share my location
Question is '
Riders can show their exact location to their drivers by turning on Live Location Sharing.

This feature helps your driver locate you as you make your way to the pickup location.

HOW IT WORKS
When your driver arrives at the pickup spot, they will see an extra icon on their map indicating where you are. O
nce your trip begins, your driver will no longer be able to see your location.

TURN LOCATION SHARING ON OR OFF
You can switch the feature on/off by using the toggle in the bottom right of the map screen. You can also turn it
on or off within the Settings of your app. To do this:
```

2.

```
                    'rel': 'dobj',
                    'tag': 'NN',
                    'word': 'ride'}})
```

Feature list obtained for the third task is as following:

Feature Names	request	ride
POS Tags	NN	NN
Lemma	request	ride
Stem	request	ride
Synonym	request	drive
Hypernym	message	journey
Hyponym	application	joyride
Meronym	fetchedNULLvalue	fetchedNULLvalue
Holonym	fetchedNULLvalue	fetchedNULLvalue

length of the third task results 12
Question is '0   '. How to request a ride

```
length of the third task results 12
Question is '0     '. How to request a ride
Question is '
1. Enter your destination address in the "Where to?" box, or tap a shortcut icon at the bottom of your screen. Sh
ortcuts include recent destinations from your ride history or custom "Saved Places" you can set in your app
2. Your default pickup point is set to your current GPS location. If you are not being picked up at your current
location, tap your pickup location on the map and update the address
3. Use the slider at the bottom of your screen to toggle between available vehicle options (for example, uberX or
UberBLACK)
4. Tap "Request." You may be asked to confirm your pickup location.
5. Wait for a driver to accept your request.
6. When your request has been accepted, you'll see your driver's location on your map and an estimated time of ar
rival at your pickup location
7. Your app will notify you when your driver is close to your pickup location
In some cities, you can also request a ride to more than one destination.
'.
Question is '20     '. Can I request ride for my friends
Question is '
```

Same query with weighted search

```
The input query for the fourth task is (textsentence:request,ride) AND (Stem:request,ride)^4 AND (Lemma:request,r
ide)^4 AND (Synonym:request,drive)^4
(textsentence:request,ride) AND (Stem:request,ride)^4 AND (Lemma:request,ride)^4 AND (Synonym:request,drive)^4

length of the fourth task results 12  with weights
Text ID is '0     '. How to request a ride
Question is '
1. Enter your destination address in the "Where to?" box, or tap a shortcut icon at the bottom of your screen. Sh
ortcuts include recent destinations from your ride history or custom "Saved Places" you can set in your app
2. Your default pickup point is set to your current GPS location. If you are not being picked up at your current
location, tap your pickup location on the map and update the address
3. Use the slider at the bottom of your screen to toggle between available vehicle options (for example, uberX or
UberBLACK)
4. Tap "Request." You may be asked to confirm your pickup location.
5. Wait for a driver to accept your request.
6. When your request has been accepted, you'll see your driver's location on your map and an estimated time of ar
rival at your pickup location
7. Your app will notify you when your driver is close to your pickup location
In some cities, you can also request a ride to more than one destination.
'
```

3.

```
                    'word': 'available'}})
```

Feature list obtained for the third task is as following:

Feature Names	uber	available
POS Tags	NN	JJ
Lemma	uber	available
Stem	uber	avail
Synonym	uber	available
Hypernym	fetchedNULLvalue	fetchedNULLvalue
Hyponym	fetchedNULLvalue	fetchedNULLvalue
Meronym	fetchedNULLvalue	fetchedNULLvalue
Holonym	fetchedNULLvalue	fetchedNULLvalue

length of the third task results 9
Question is '2   '. When and where is Uber available in my city

```
length of the third task results 9
Question is '2      '. When and where is Uber available in my city
Question is '
Uber is available in many cities around the world. With an Uber account, you can request a ride in any city where
Uber operates, 24 hours a day, 7 days a week.
'.
Question is '36     '. Does Uber have recurring charges
Question is '
Good news! There are no recurring charges or membership fees for using Uber. You are only charged for the rides y
ou take.

'.
Question is '10     '. Can I use Uber for long trips
Question is '
If you are planning to take a long trip,it is a good practice to let your driver know in advance by calling your
driver after you have requested your trip. Many drivers need to make the return trip home after reaching your des
tination, so it's helpful to give them a heads up.

'
```

Same Query using weighted search

```
length of the fourth task results 9  with weights
Text ID is '2      '. When and where is Uber available in my city
Question is '
Uber is available in many cities around the world. With an Uber account, you can request a ride in any city where
Uber operates, 24 hours a day, 7 days a week.
'.
Text ID is '36     '. Does Uber have recurring charges
Question is '
Good news! There are no recurring charges or membership fees for using Uber. You are only charged for the rides y
ou take.

'.
Text ID is '11     '. Can I use uber to and from airports
Question is '
You can Uber to and from many major airports around the world.

RIDING TO AIRPORTS
When you have a flight to catch, check the ETA for your preferred vehicle option 15-30 minutes before you're read
```

- o **Problems Encountered and Resolution**

- o Solr setup and indexing consumed a lot of time.
- o Indexing is a slow process because of the usage of Stanford dependency parse tree.
- o Extracting and dealing with features and come up with a statistical model was a hard problem.

- o **Pending issues**

- o Synsets could also be explored in detail.
- o Machine Learning model could not be applied due to sparse data.

- o **Potential improvements**

- o A Term Frequency can be used to retrieve the best results.
- o Disambiguation of Uber related words can improve results.