Extracting Knowledge Base from Text

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Agenda

- What is Machine Reading?
- Text Extraction
- Parts of speech tagging
- Classification
- Demo and Explanations

Introduction

- We seek to apply Natural language, Information Extraction, and Machine learning concept to build TwitterWordCloud.
- TwitterWordCloud is an application that takes the data from twitter and process it to gather important information.

https://github.com/nilesh892003/TwitterWordCloud

Text Extraction

Generating a large-scale knowledge base from the text

- Information extraction (IE) [6]
- Information Retrieval

Need of Text Extraction

- Text is Fundamental repository of human knowledge
- Most updated data source
- Enormous text data sources available
- Additional text production engine i.e Twitter, Facebook
- Finding relevant text is challenge

Resources/Tools

- Twitter data

- Twitter Natural Language Processing Tool

- Processing (Word Cloud)

Why it is Interesting

What are we doing

- Real Time Twitter based Machine reading System.
- Extracting useful structured representations of events.

Why It is Interesting

How are we doing

- Twitter NLP is used to process the tweet data.
- It extract the relevant words with number of occurrences in current tweets.
- Displays the data so the end result is clearly visible as word cloud

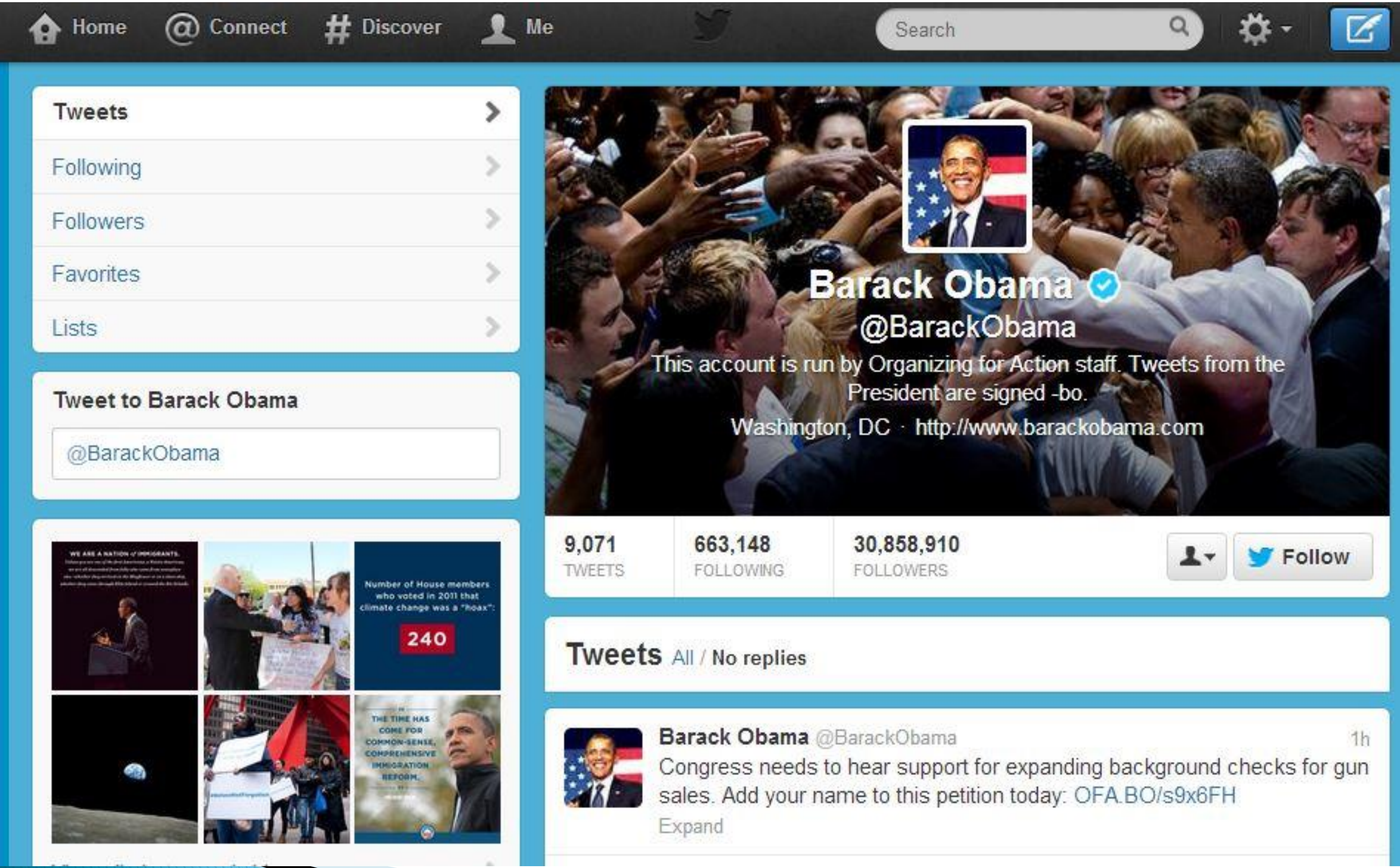
Why Twitter

- Tweets are the most up-to-date stream of information on current events
- short and self-contained nature of tweets
- The volume of Tweets is much larger than the volume of news article
- Free API to collect data

Tweet Format

- User can tag other user with ‘@’
- User can hash tag particular word with ‘#’
- Other user can see all tweets which have hash tagged words

Twitter Interface


Home
Connect
Discover
Me
Search
Tweets
Following
Followers
Favorites
Lists
WE ARE A NATION of IMMIGRANTS.
Number of House members who voted in 2011 that climate change was a "hoax":
240
THE TIME HAS COME FOR COMMON-SENSE, COMPREHENSIVE IMMIGRATION REFORM.
Follow

Tweet to Barack Obama

@BarackObama

Barack Obama
@BarackObama
This account is run by Organizing for Action staff. Tweets from the President are signed -bo.
Washington, DC · http://www.barackobama.com

9,071	663,148	30,858,910
TWEETS	FOLLOWING	FOLLOWERS

Tweets All / No replies

Barack Obama @BarackObama 1h
Congress needs to hear support for expanding background checks for gun sales. Add your name to this petition today: OFA.BO/s9x6FH
Expand

Challenges [1,2]

- Twitter users frequently mention mundane events in their daily lives
- Individual tweets often lack sufficient context to be categorized
- Temporal expressions: User can refer to same calendar date in different ways

  “Yesterday”, ‘Tomorrow”, “Last Friday”, “August 12th”
- Lexical Variation in Words:

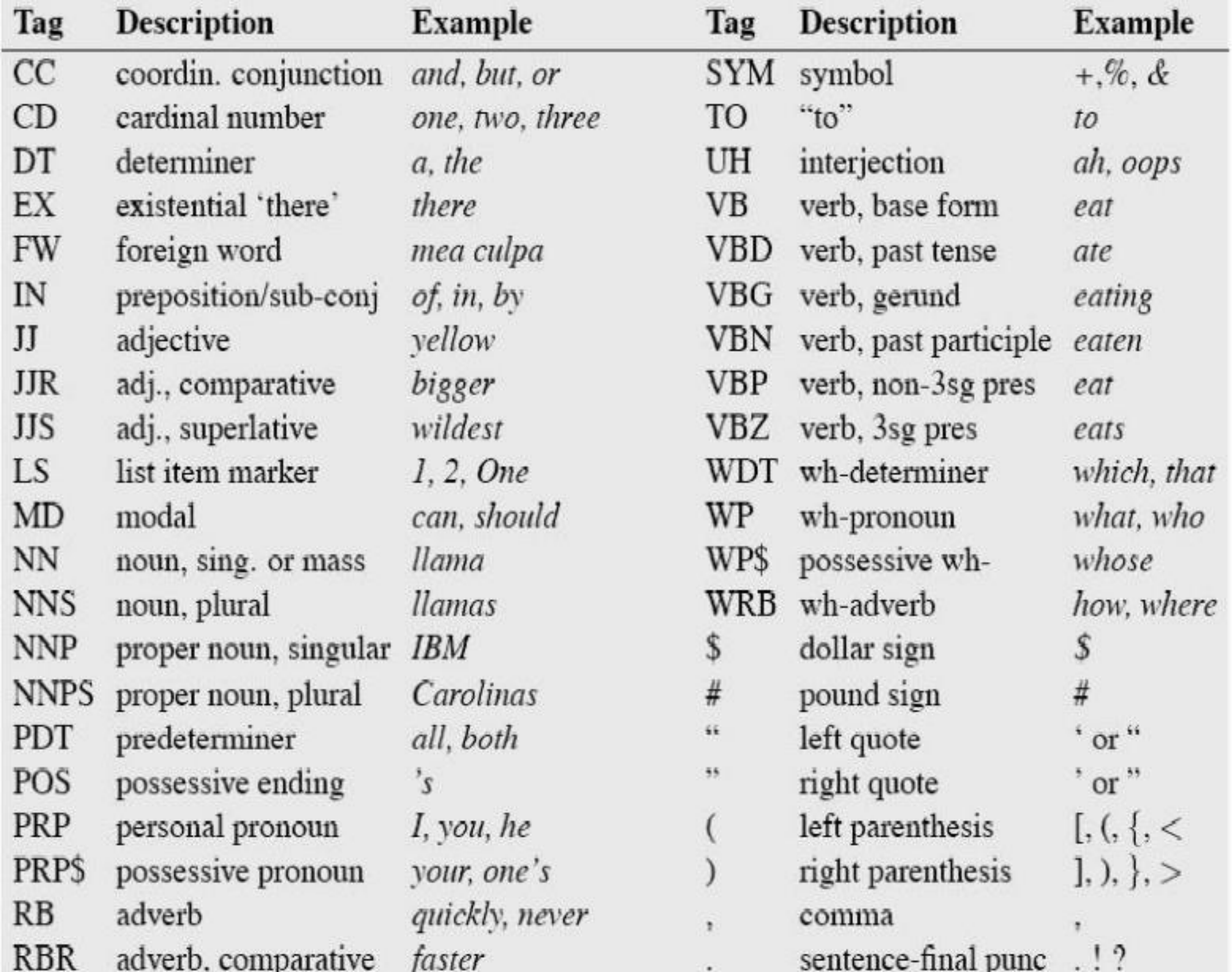
  Tomorrow : 2morrow, 2mro

  Wow: Woww, woow
- Poor performance for capitalization

Part of Speech(POS) Tagging

- Assign the correct part of speech (word class) to each word/token in a document

- We have used the Penn Treebank tag set which consist of 45 POS tags.[1]



Tag	Description	Example	Tag	Description	Example
CC	coordin. conjunction	*and, but, or*	SYM	symbol	+,%, &
CD	cardinal number	*one, two, three*	TO	"to"	*to*
DT	determiner	*a, the*	UH	interjection	*ah, oops*
EX	existential 'there'	*there*	VB	verb, base form	*eat*
FW	foreign word	*mea culpa*	VBD	verb, past tense	*ate*
IN	preposition/sub-conj	*of, in, by*	VBG	verb, gerund	*eating*
JJ	adjective	*yellow*	VBN	verb, past participle	*eaten*
JJR	adj., comparative	*bigger*	VBP	verb, non-3sg pres	*eat*
JJS	adj., superlative	*wildest*	VBZ	verb, 3sg pres	*eats*
LS	list item marker	*1, 2, One*	WDT	wh-determiner	*which, that*
MD	modal	*can, should*	WP	wh-pronoun	*what, who*
NN	noun, sing. or mass	*llama*	WP$	possessive wh-	*whose*
NNS	noun, plural	*llamas*	WRB	wh-adverb	*how, where*
NNP	proper noun, singular	*IBM*	$	dollar sign	*$*
NNPS	proper noun, plural	*Carolinas*	#	pound sign	#
PDT	predeterminer	*all, both*	“	left quote	‘ or “
POS	possessive ending	*'s*	”	right quote	’ or ”
PRP	personal pronoun	*I, you, he*	(	left parenthesis	[, (, {, <
PRP$	possessive pronoun	*your, one's*	)	right parenthesis	],), }, >
RB	adverb	*quickly, never*	,	comma	,
RBR	adverb, comparative	*faster*	.	sentence-final punc	. ! ?

Example of POS Tagging

“The/DT planet/NN Jupiter/NNP and/CC its/PPS moons/NNS are/VBP in/IN effect/NN a/DT mini-solar/JJ system/NN ,/, and/CC Jupiter/NNP itself/PRP is/VBZ often/RB called/VBN a/DT star/NN that/IN never/RB caught/VBN fire/NN ./.”

What are we interested in ?

- Nouns (Singular or plural)

eg: Jupiter,fire,Planet

- Adjectives(basic, comparative,superlative)
- Eg:Mini

- Adverbs

Eg:Beautifully

Ambiguities in POS tagging

- Current tools give almost a 90% accuracy
- “Around” can be a preposition, particle, or adverb
  - I bought it at the shop around/IN the corner
  - I never got around/RP to getting a car
  - A new Prius costs around/RB $25K

POS Tagging Approaches

- Rule-Based: Human crafted rules based on lexical and other linguistic knowledge.

- Learning-Based: Trained on human annotated corpora like the Penn Treebank.

  Hidden Markov Model (HMM), Maximum Entropy Markov Model (MEMM), Conditional Random Field (CRF), Transformation Based Learning (TBL)

Sequence Tagging (BIO encoding)

- B - Begin (Beginning a phrase)
- I –Inside (Inside a phrase)
- O –Outside (Outside a phrase)

- BIO encoding is used for encoding phrases (Named Entities, event phrases, and chunks)
- Assign the category to the word depending on the context. [2]

Example

- “The Town might be one of the best movies I have seen all year”

- After Applying BIO encoding:

  The/B Town/I might/B be/I one/B of/B the/B best/I movies/I I/B have/B seen/I all/B year/I

How To handle common Shortforms

- “fb” is commonly used for face book
- “ikr” is commonly used for I know right

- A bag of such words can be found at

http://www.ark.cs.cmu.edu/TweetNLP/

Twitter NLP

- Available at, http://github.com/aritter/twitter_nlp
- Tokenizes tweets
- Classify events
- Tag POS
- NER
- Tokenize events.

Combining all above concepts

- The output of our tool has the following format:
- GivenWord /Classifier with BIO /POS /BIO /Event relation
- Example:
- Town /0 /NNP /I-NP /I-movie
- Knicks /I-sportsteam /NNP /I-NP /O

Standard NLP vs Twitter NLP

- Degraded performance of standard NLP on twitter data.

- Twitter NLP redesigns the NLP pipeline by POS tagging, Classification, Chunking and NER.

- Twitter NLP`s F1 score is double than Standford NLP.

System requirement

- Operating System : Linux (Ubuntu), Windows 7
- Python IDE
- Java JDK
- Processing tool (http://processing.org/download/)

Twitter Data(REST Api)

- Twitter gives out recent tweets using RESTful web services
- It returns data in JSON format
- We have to parse this JSON file to text and remove important information i.e. Tweet text

Coding: Java

Twitter Data

- JSON file: 1 tweet record

{"completed_in":0.093,"max_id":328586609660399616,"max_id_str":"328586609660399616","next_page":"?page=2&max_id=328586609660399616&q=boston&rpp=100","page":1,"query":"boston","refresh_url":"?since_id=328586609660399616&q=boston","results":[{"created_at":"Sun, 28 Apr 2013 19:08:47 +0000","from_user":"EricGarment","from_user_id":285770446,"from_user_id_str":"285770446","from_user_name":"Eric Garment", "text":"RT @Mvlique: Its been 17 years and they still haven't found Tupac's or Biggie's killer\ud83d\udc82 but in 3 days they found the Boston bomber\ud83d\udca3, Oh.\ud83d\ude10\ud83d\ude12\u270b"}],"results_per_page":100,"since_id":0,"since_id_str":"0"}

From Tweet Text

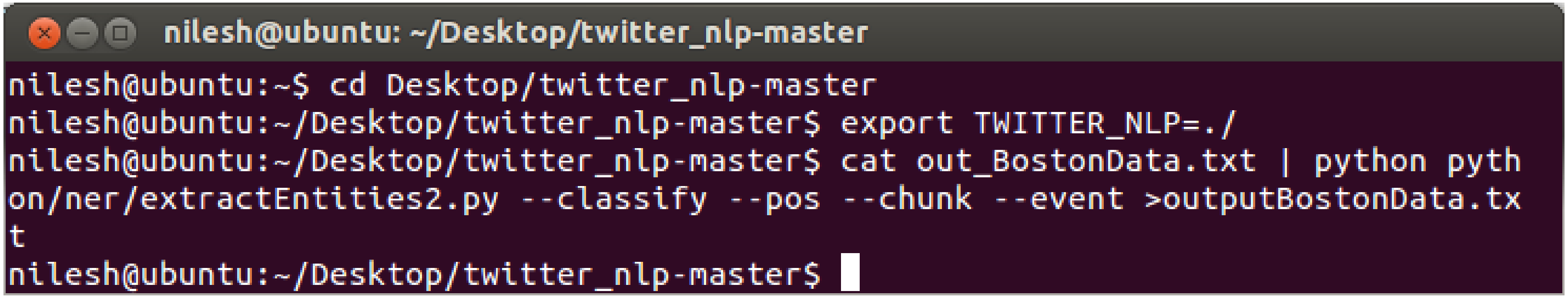
- Use Eclipse to setup and run twitterTweet.java
- The program will parse the JSON file into the normal tweet text file and save it as output.txt

- Output(Single tweet):

```
@stephenasmith lol who said the Knicks were too old, I guess Boston older then them cause look what they doing to Boston haha.
```

command

1. export TWITTER_NLP=./
2. cat TwitterBostonData.txt | python python/ner/extractEntities2.py --classify --pos --chunk --event >outputBoston.txt



```
nilesh@ubuntu:~$ cd Desktop/twitter_nlp-master
nilesh@ubuntu:~/Desktop/twitter_nlp-master$ export TWITTER_NLP=./
nilesh@ubuntu:~/Desktop/twitter_nlp-master$ cat out_BostonData.txt | python pyth
on/ner/extractEntities2.py --classify --pos --chunk --event >outputBostonData.tx
t
nilesh@ubuntu:~/Desktop/twitter_nlp-master$ 
```

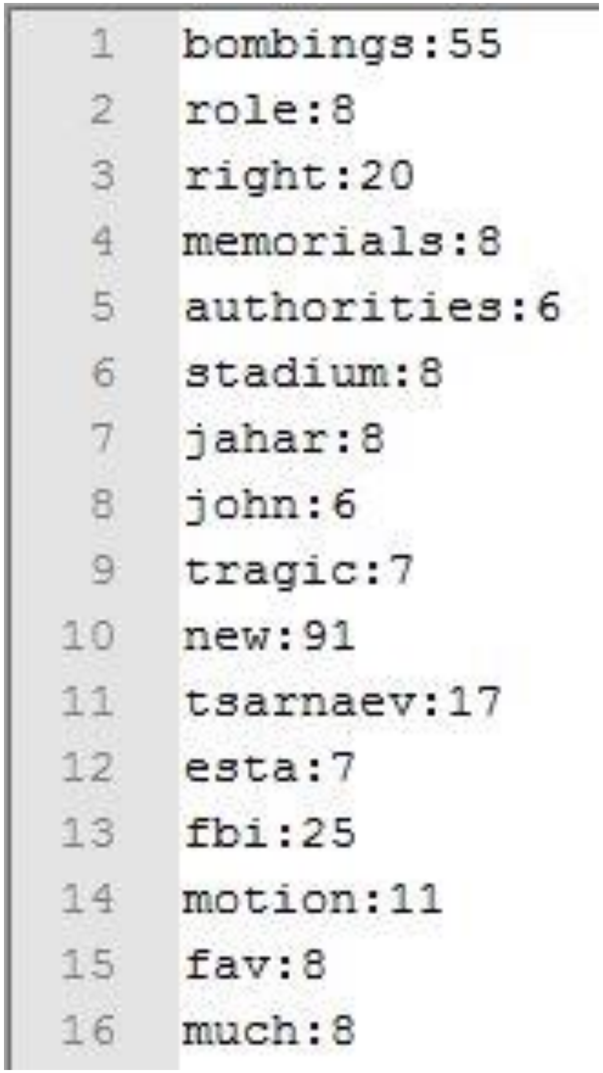
NLP output

- RT/O/RT/B-NP/O @olimpycs/O/USR/I-NP/O :/O//O/O Remember/O/VB/B-VP/B-EVENT when/O/WRB/B-ADVP/O people/O/NNS/B-NP/O made/O/VBN/B-VP/O manips/O/NNS/B-NP/B-EVENT with/O/IN/B-PP/O the/O/DT/B-NP/O boston/O/NN/I-NP/O bomber/O/NN/I-NP/O same/O/JJ/I-NP/O

Java Program (twitterWords.java)

- Extract information from the tagged NLP output
- Pass NLP output file to this program to extract personal Nouns from the tweet data
- Code calculated the occurrences of the Nouns and write the number of occurrence and noun in pair on .txt

Output



```
bombings:55
role:8
right:20
memorials:8
authorities:6
stadium:8
jahar:8
john:6
tragic:7
new:91
tsarnaev:17
esta:7
fbi:25
motion:11
fav:8
much:8
```

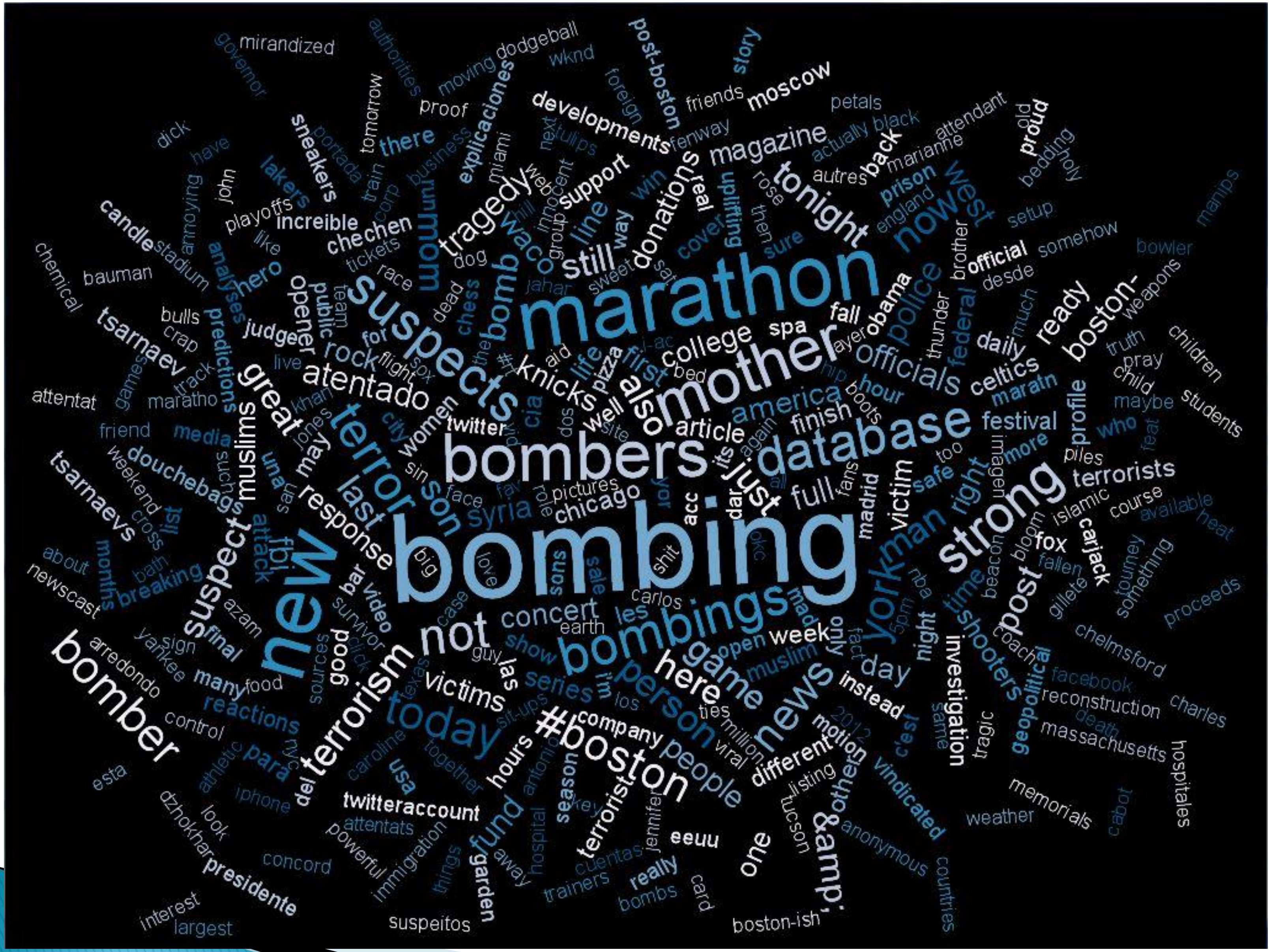
Processing IDE

- Processing is an open source programming language and environment
- Used to make Interactive programs using 2D, 3D and PDF output
- OpenGL integration for accelerated 3D

Setup Processing

- Copy processing setup folder anywhere in your computer.
- Open folder and start processing.exe Click file->preference and select your sketchbook location.
- Place processing folder to your sketchbook location.
- Click on open and import ".pde" file

Processing output



Future Scope

- Problem: In the TwitterWordCloud does not combine similar words into one.

  Eg: Similars and Similar

- The concept can be improved by taking consideration of lexical variation of the words.

Extracting and Resolving temporal expressions

- TempEx or SUTime can be used on the NLP processed data
- as input a reference date, some text, and parts of speech (from our Twitter-trained POS tagger) and marks temporal expressions with unambiguous calendar references.
- Efficiency: 94%

SUTime Output

- It provides output in XML format with temporal resolution.
- <TIMEX3 tid="t1" type="DATE" value="2013-04-26">4/26/13</TIMEX3>/O/NN/I-NP/O

Other Research

- Open Information Extraction[5]

  http://openie.cs.washington.edu/

- Twitter Calendar

  http://statuscalendar.cs.washington.edu/

- RevMiner: a novel smartphone interface that utilizes Natural Language Processing Techniques to analyze and navigate reviews

  http://jeffhuang.com/revminer_uist2012_preprint.pdf

What you should know?

- Extracting Knowledge Bases from Text is a concept of Machine Reading that on bigger scale is a concept of Machine Learning.
- It basically involves these process:

  1: Named Entity Segmentation

  2: Extracting Event Mentions

  3: Classification of Event Types

  4: Extracting and resolving temporal Expressions

References

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6. Michele Banko, Michael J Cafarella, Stephen Soderland, Matt Broadhead and Oren Etzioni, Open Information Extraction from the Web, IJCAI 2011
7. Twitter Rest API:

   https://dev.twitter.com/docs/api