

TwitterFlu

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Metis 2019



Why is predicting flu trends useful?

Customers:

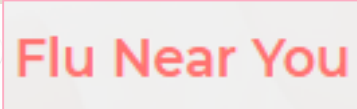
- General public,
- City officials
- Hospital managers,
- Epidemiologists & the CDC,
- Pharma



Haven't people already tried to predict the flu? And failed...?

- 2009 - Google Flu Tracker (ended 2015)
- 2011 - SickWeather (Twitter + Crowdsourcing)
- 2013 - CDC Challenge
- 2013 - U Colorado (Twitter + mechanical Turk)
- 2014 - Jeffrey Shaman and Alicia Karspeck(Columbia)'s model –forecasting
- 2016 - Theraflu Cold & Flu Tracker (GSK + The Weather Channel, uses SickWeather)
- 2017 - Flumoji – dedicated app; temporary study (GSK + MIT)
- 2017 - U Chicago Researchers - Evolution of the virus
- 2015 - FluNearYou – Crowdsourced manual entry

Currently in use



Data

Social Media Posts



Create labels to use in classifying tweet content as ill or not ill

Data

17,880 tweets collected with search terms:

Sick, Fever, Flu, Headache, Cough, Chills, Sore throat, Runny nose, Sneezing



Word Vectorize, Topic Modeling

(NMF, LDA, LSA)



Clustering

(Kmeans)



Create labels to use in classifying tweet content as ill or not ill

Topics can be Separated with NMF

nose, runni, runni nose, throat
runni, got runni

flu, shot, flu shot, got flu, season

cough, cough cough, cough runni,
nose cough, syrup

throat, sore, sore throat, throat
runni, woke

got, got flu, got chill, got runni,
got headach

chill, gave, gave chill, got chill,
watch

work, today, week, realli, home

say, thing, tell, cohen, Michael

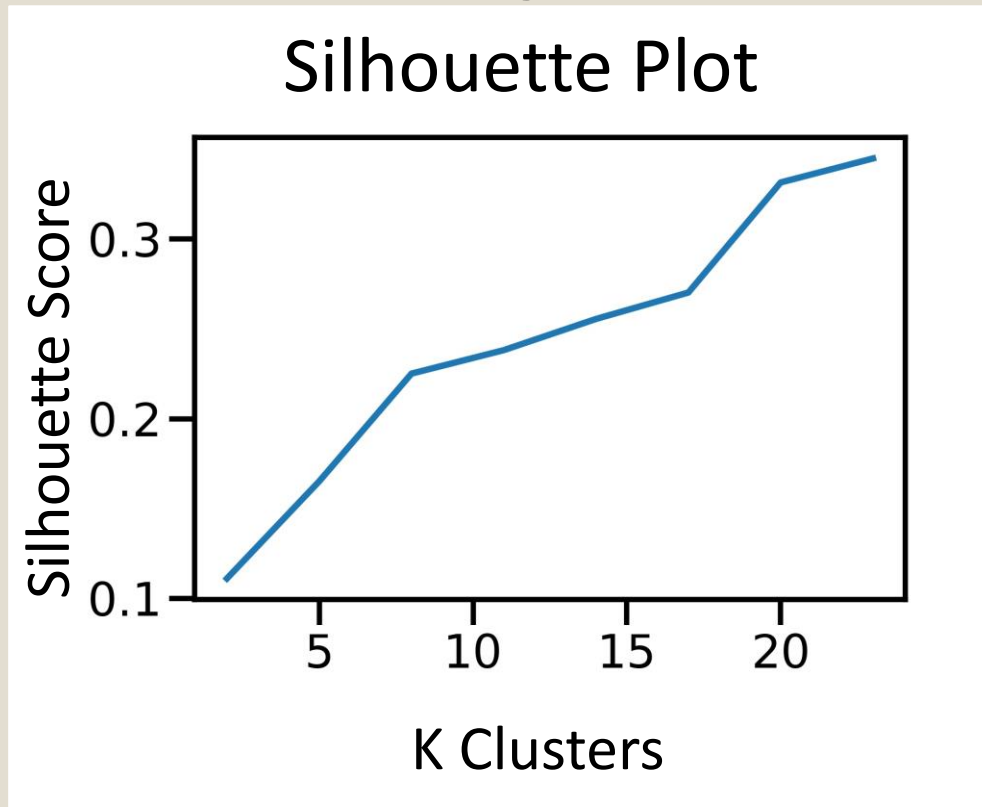
don, know, want, don know, whi

like, feel like, look, like runni, look
like

Representative 10
out of 25 topics

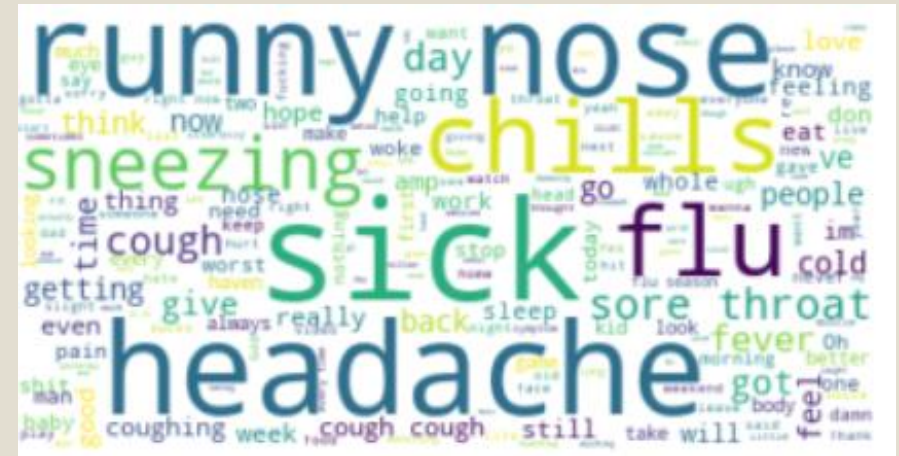
Separating the Semantic Meaning of Words is Harder

K Means Clustering



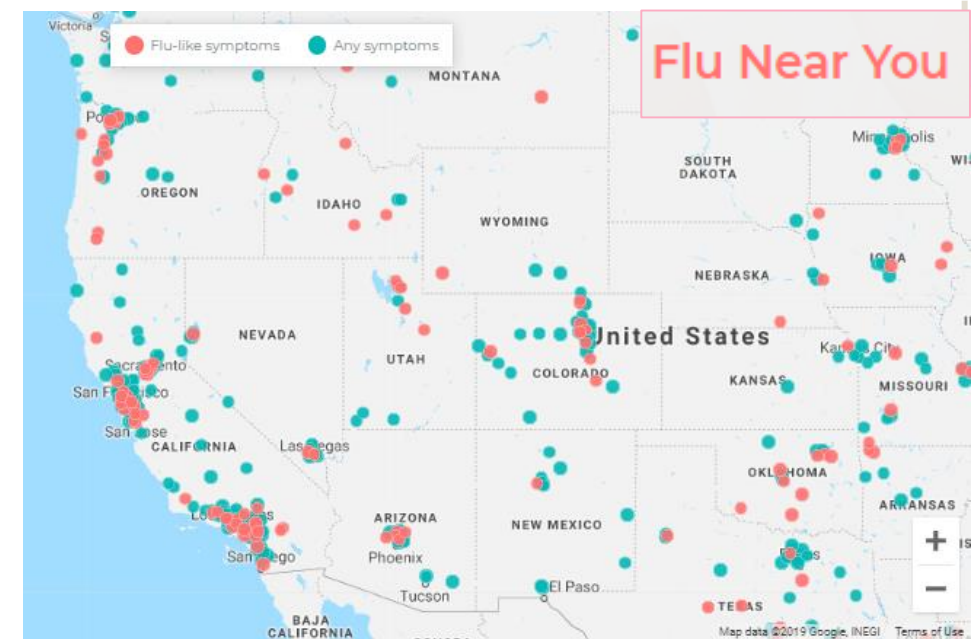
Choose $k = 8$

Representative 2 of 8 clusters



Future Directions

- Additional Clustering Models (Hierarchical Clustering, DBSCAN)
- BERT (neural networks)
- Annotated tweets available (University of Colorado, Boulder)
- Data Visualization – streaming data





Thank You!

Kristin Mussar
Metis February 2019

Appendix

Flu Prediction is a Large Project

DATA:

Social Media

Crowd Sourcing

CDC

Healthcare Entities

Government

Historical Records

Weather Sources

Virus Strain Info

Clustering
models to
label data

Classification
Models

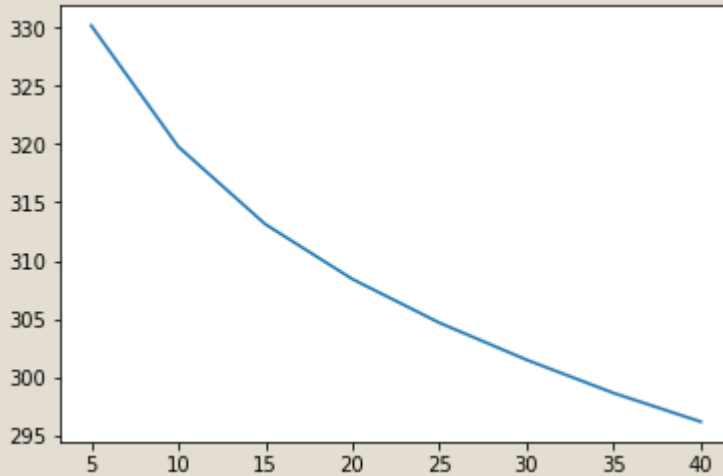
Real-time
Tracking
Tools

Prediction
Models



Reconstruction error (NMF metric)

All topic word lists



Number of components

- chill, gave, gave chill, got chill, watch
- like, feel like, look, like runni, look like
- say, thing, tell, cohen, Michael
- time, everi, everi time, chill everi, watch
- chills, gave, gave chills, love, got chills
- don, know, want, don know, whi
- work, today, week, realli, home

- nose, runni, runni nose, throat runni, got runni
- flu, shot, flu shot, got flu, season
- headach, worst, away, bad, worst headach
- cough, cough cough, cough runni, nose cough, syrup
- sick, peopl, feel sick, im, sick sick
- throat, sore, sore throat, throat runni, woke
- got, got flu, got chill, got runni, got headache
- just, just got, just want, headach just, want
- fever, night, babi, hay, hay feverz
- It, It It, wake, nose It, wake sore
- day, headach day, past, sick day, bed
- feel, feel like, better, feel sick, feel better
- headache, need, pain, help, bad
- sneez, stop, stop sneez, fuck, realli
- cold, cold flu, bad, season, come
- amp, amp runni, nose amp, night, amp flu
- make, make sick, want, peopl, sure

2 Clusters



KMM on topics trained on MVP sick only data

topics = 12 -- HEAD ("sneezing")

Not Sick

Sick

	text	cluster
1	Sources say next week's headlines will cover t...	0
2	Nothing makes you feels old like sneezing and ...	0
3	why does sneezing feel good.	0
4	Pregnancy is debating on if peeing on yourself...	0
5	yo the amount of dust that probably collected ...	0
6	Im the clumsiest person I know. I broke my gla...	0
7	SNEEZING WHILE DRIVING IS LITERALLY THE SCARIE...	0
9	I have a kink for guys sneezing (sue me 🙄...	0
10	I cant stop sneezing.	0
11	been sneezing for nth time 🙄	0

	text	cluster
0	wow lol..i really got sick again. i was good f...	1
8	STOP SNEEZING NIA STOP OH GOSH \n\nMy nose:	1
13	Almost cried because I have a blocked & sn...	1
18	BEEN SNEEZING AND BLOWING MY NOSE ALL DAY FOR ...	1
22	I'm	1
28	nah its not out of control my mistress you ju...	1
32	Thanks to everyone who spent their time with m...	1
40	Oh! My	1
43	Maybe they have asthma. It sucks to tell peop...	1
46	It's Friday but i'm not in love, i've failed R...	1

KMM on topics trained on sneezing
only data
topics = 12 -- HEAD
bi-grams included(w/o bi-grams it's
worse)

Not sick

text cluster

1	Sources say next week's headlines will cover t...	1
2	Nothing makes you feels old like sneezing and ...	1
3	why does sneezing feel good.	1
4	Pregnancy is debating on if peeing on yourself...	1
5	yo the amount of dust that probably collected ...	1
6	Im the clumsiest person I know. I broke my gla...	1
7	SNEEZING WHILE DRIVING IS LITERALLY THE SCARIE...	1
9	I have a kink for guys sneezing (sue me 🙄...	1
11	been sneezing for nth time 🙄	1
12	Sneezing feels really good.	1

Sick

text cluster

0	wow lol..i really got sick again. i was good f...	0
8	STOP SNEEZING NIA STOP OH GOSH \n\nMy nose:	0
10	I cant stop sneezing.	0
13	Almost cried because I have a blocked & sn...	0
14	Eating a leftover hamburger will stop you from...	0
16	How to sleep, whilst sneezing and\ncoughing.....	0
17	Coughing and sneezing and overall head cold ...	0
21	SAME!!!! I've wanted to move out when my roo...	0
22	I'm	0
23	i can't stop sneezing. 🙄.	0

KMM on topics trained on MVP sick only data

topics = 12 -- TAIL ("sick")

Not sick

Sick

	text	cluster
18779	I've had a slight sore throat and running nose...	0
18780	My dads favorite line : "Take a couple Tyleno...	0
18781	sore throat is killing me	0
18782	I don't know which is worse a sore throat or a...	0
18935	Yo on GOD I might actually be dying. I haven't...	0
19799	Punch me in the throat because I'm sick of avo...	0
19845	Punch me in the throat because I'm sick of avo...	0
21921	i was drinking iced coffee this morning and it...	0
23308	fun side fact: I've been sick for about 2 week...	0
23413	fun side fact: I've been sick for about 2 week...	0

	text	cluster
23848	please never discontinue the Spinach Miso sal...	1
23849	Wow I love being sick.	1
23850	Steve cleaned the whole house (without me aski...	1
23851	Hello There for FEMME show at opening this F...	1
23852	Somebody please rescue those children, and I...	1
23853	I'm sick (and old)..It's the first thing that...	1
23854	Sick of dudes tryng to flatter me all the time...	1
23855	I love to learn about other cultures. I would...	1
23856	Oh god no I feel sick. This movie has made me ...	1
23857	I'm sick and the only thing my mind can handle...	1

KMM on topics trained on MVP
sneezing only data
topics = 12 -- HEAD ("sneezing")
Includes n-grams & stemming

	text	cluster
4	Pregnancy is debating on if peeing on yourself...	0
6	Im the clumsiest person I know. I broke my gla...	0
10	I cant stop sneezing.	0
13	Almost cried because I have a blocked & sn...	0
14	Eating a leftover hamburger will stop you from...	0
20	Can't. Too busy sneezing.	0
22	I'm	0
23	i can't stop sneezing. 🤧.	0
28	nah its not out of control my mistress you ju...	0
29	"Crying is just your body expelling all the ba...	0

	text	cluster
0	wow lol..i really got sick again. i was good f...	1
1	Sources say next week's headlines will cover t...	1
2	Nothing makes you feels old like sneezing and ...	1
3	why does sneezing feel good.	1
5	yo the amount of dust that probably collected ...	1
7	SNEEZING WHILE DRIVING IS LITERALLY THE SCARIE...	1
8	STOP SNEEZING NIA STOP OH GOSH \n\nMy nose:	1
9	I have a kink for guys sneezing (sue me 🙄...	1
11	been sneezing for nth time 🤧	1
12	Sneezing feels really good.	1

WORSE

KMM on topics trained on sneezing only data
topics = 12 -- HEAD
bi-grams included(w/o bi-grams it's worse)

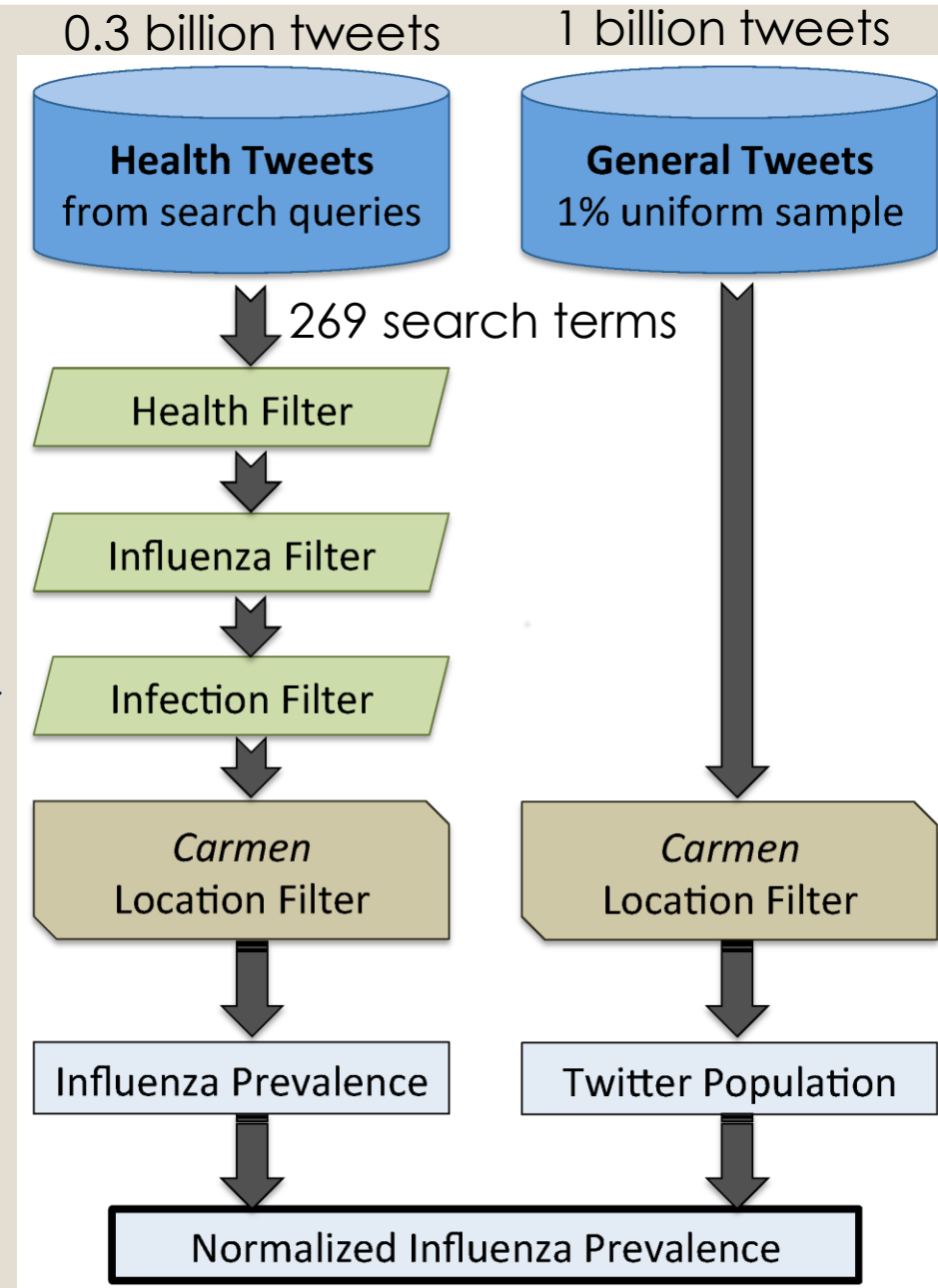
I can't even tell what categories these should

	text	cluster
2	Nothing makes you feels old like sneezing and ...	1
15	my sneeze is really really really quiet and i ...	1
29	"Crying is just your body expelling all the ba...	1
51	my frd said jin looks like hes sneezing im-	1
63	Sneezing is like vomiting on novice mode.	1
107	I've been sneezing like 24 times a day for the...	1
127	WHY DOES HE SOUND LIKE ME SNEEZING	1
130	It bothers me when people don't correctly cove...	1
135	Until you mix it soteh you will start smelling...	1
148	Recovering from two broken ribs sneezing felt...	1

	text	cluster
0	wow lol..i really got sick again. i was good f...	0
1	Sources say next week's headlines will cover t...	0
3	why does sneezing feel good.	0
4	Pregnancy is debating on if peeing on yourself...	0
5	yo the amount of dust that probably collected ...	0
6	Im the clumsiest person I know. I broke my gla...	0
7	SNEEZING WHILE DRIVING IS LITERALLY THE SCARIE...	0
8	STOP SNEEZING NIA STOP OH GOSH \n\nMy nose:	0
9	I have a kink for guys sneezing (sue me 🤔...	0
10	I cant stop sneezing.	0

David A. Broniatowski, Michael J. Paul , & Mark Dredze's approach

Amazon
Mechanical
Turk labeling



Data collected Sept 2012 – May 2013

