Yoga-Veganism: Correlation Mining of Twitter Health Data

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WISDOM'19@KDD'19, Anchorage, Alaska

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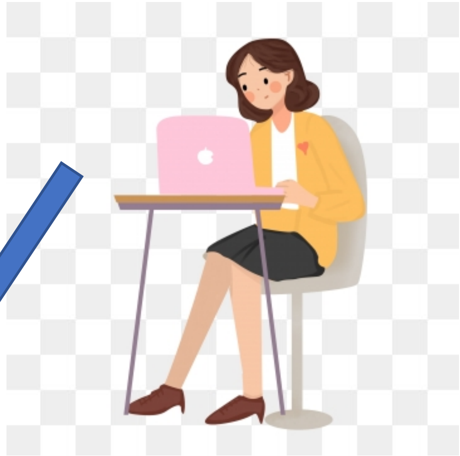
PURDUE UNIVERSITY

Motivation

Balanced diet



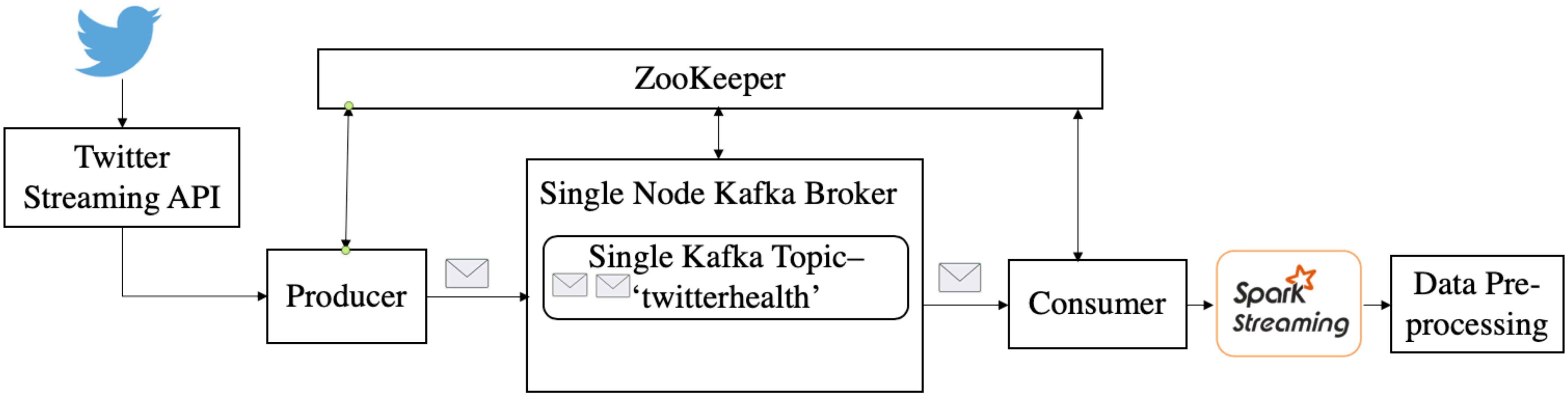
@vuthihoangquye1: RT @go1click: Ketogenic Diet The truth:> buff.ly/2NQr4jY #health #fitness #diet #healthy #fitness #weightloss #exercise #workout #sport #paleo #yoga #food #nutrition #fat #cbd #keto #wellness #news #ff #inspiration

Exercise

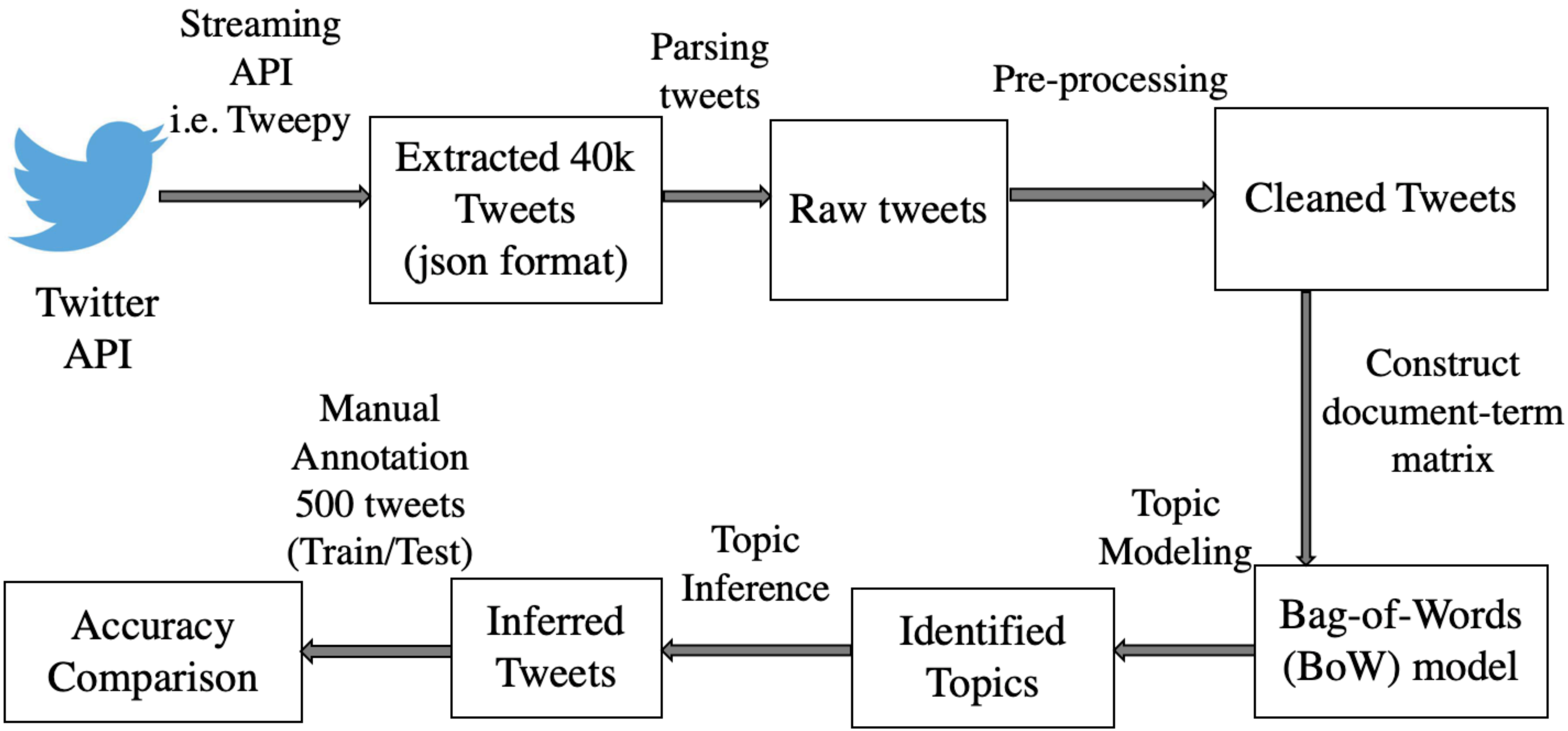
Running

Yoga

Twitter Data Collection



Methodology of Correlation Mining



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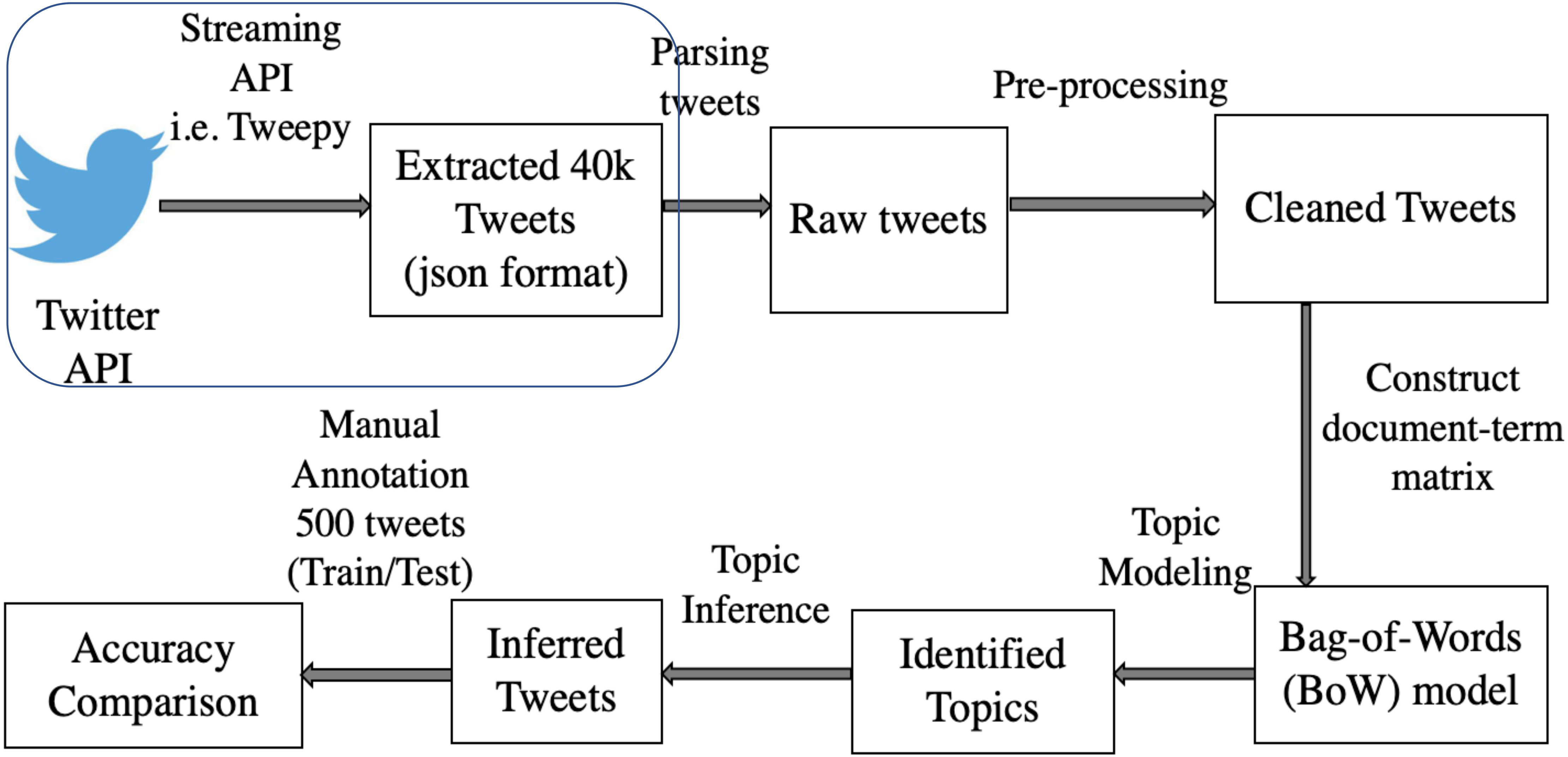

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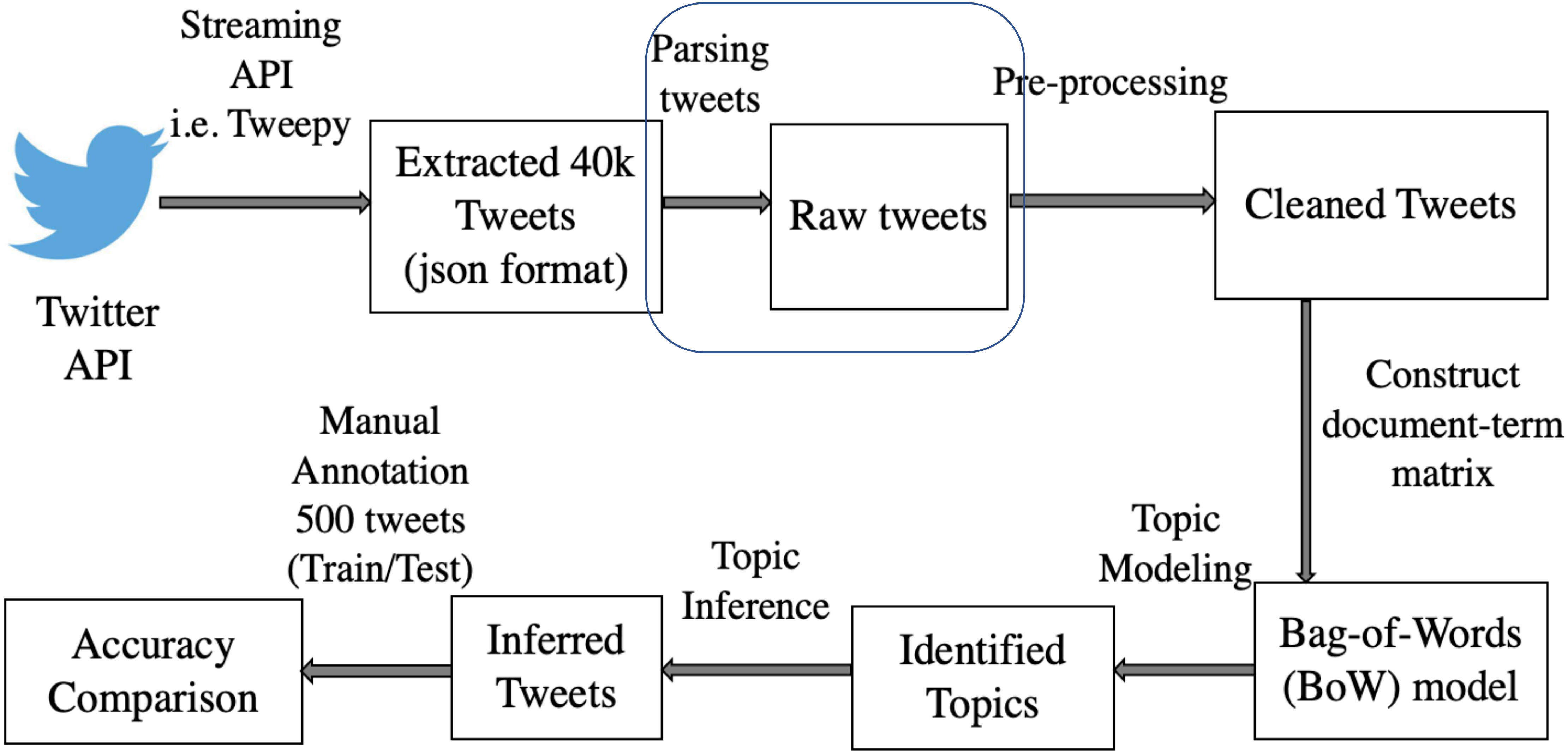

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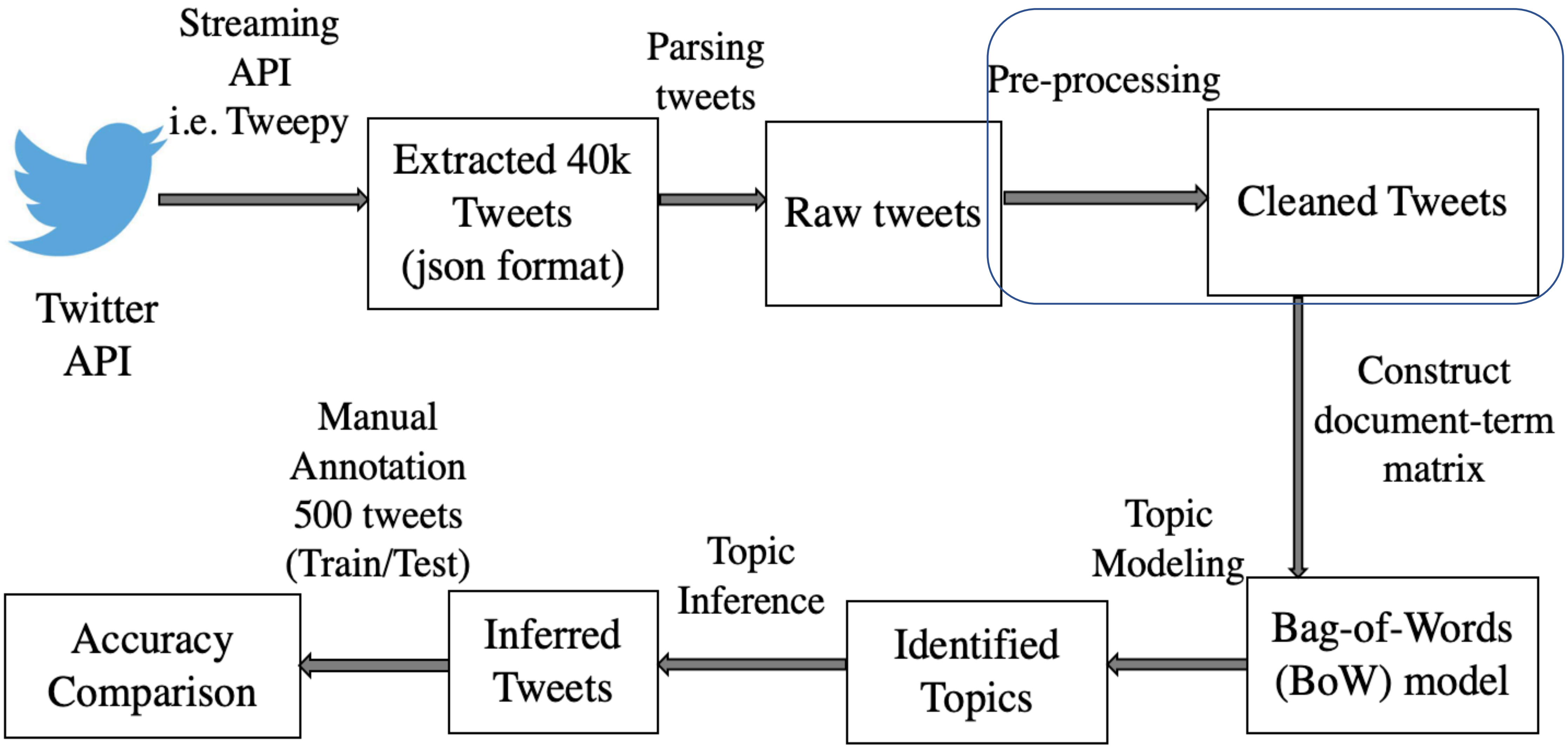

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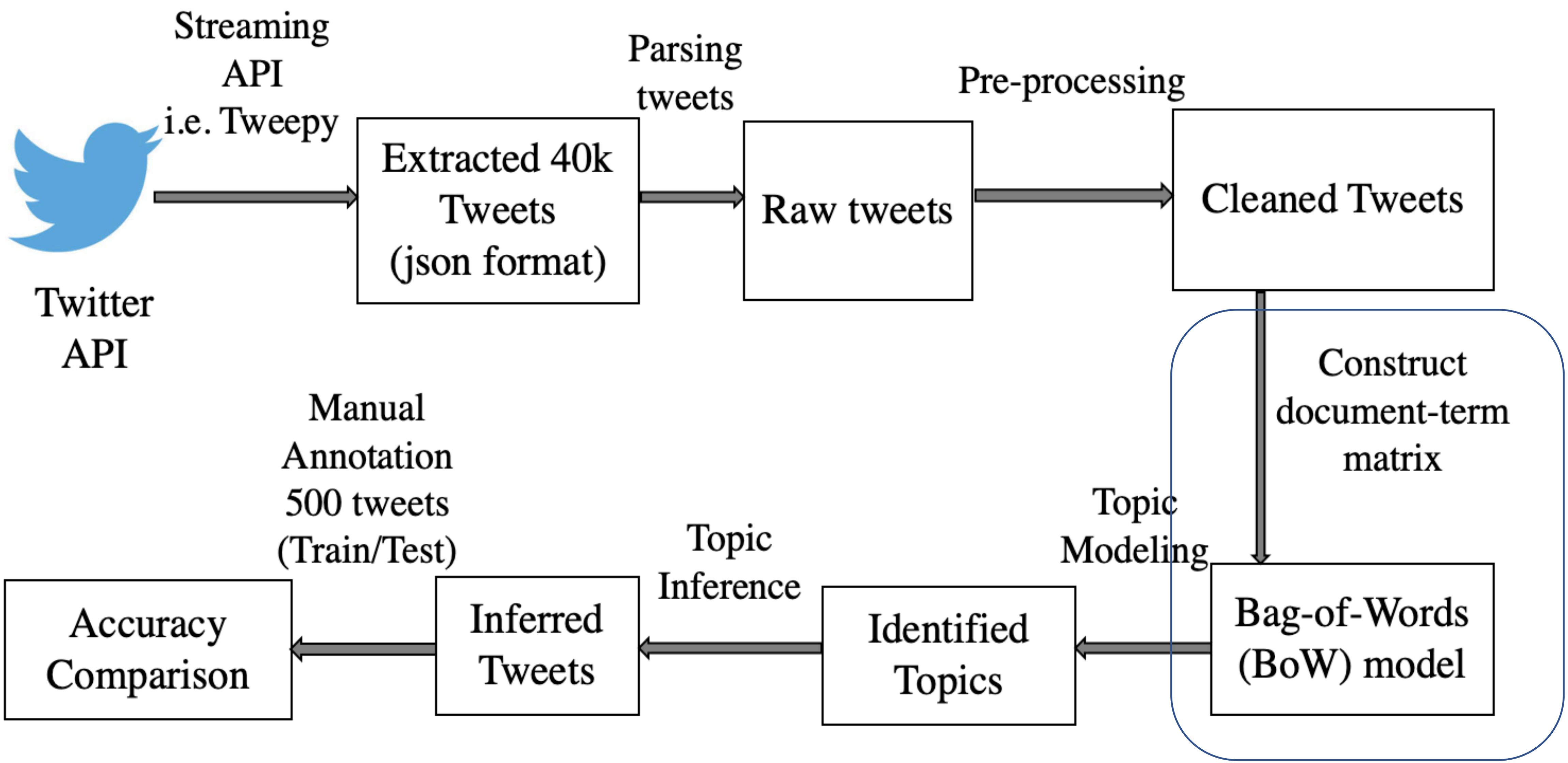

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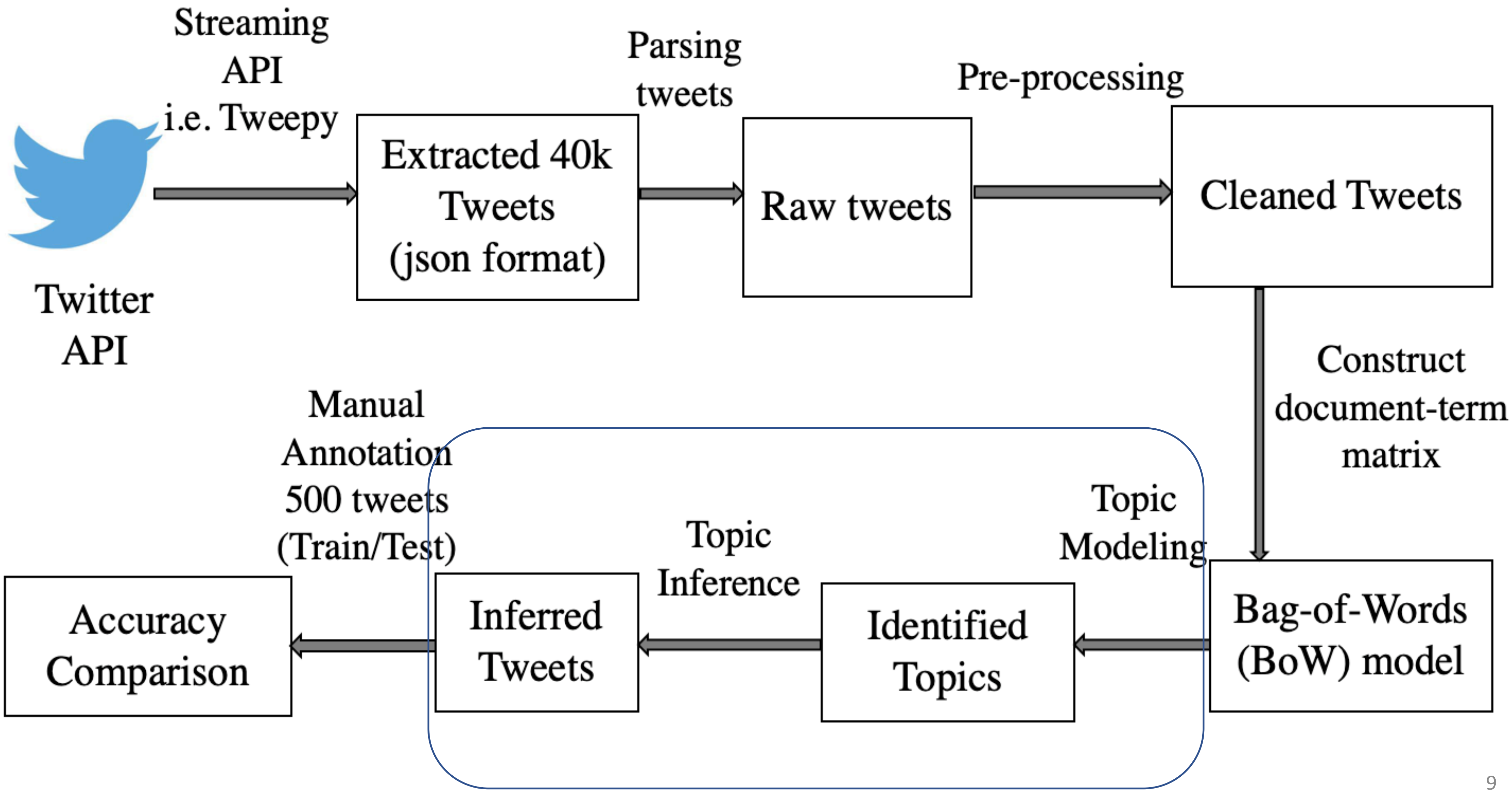

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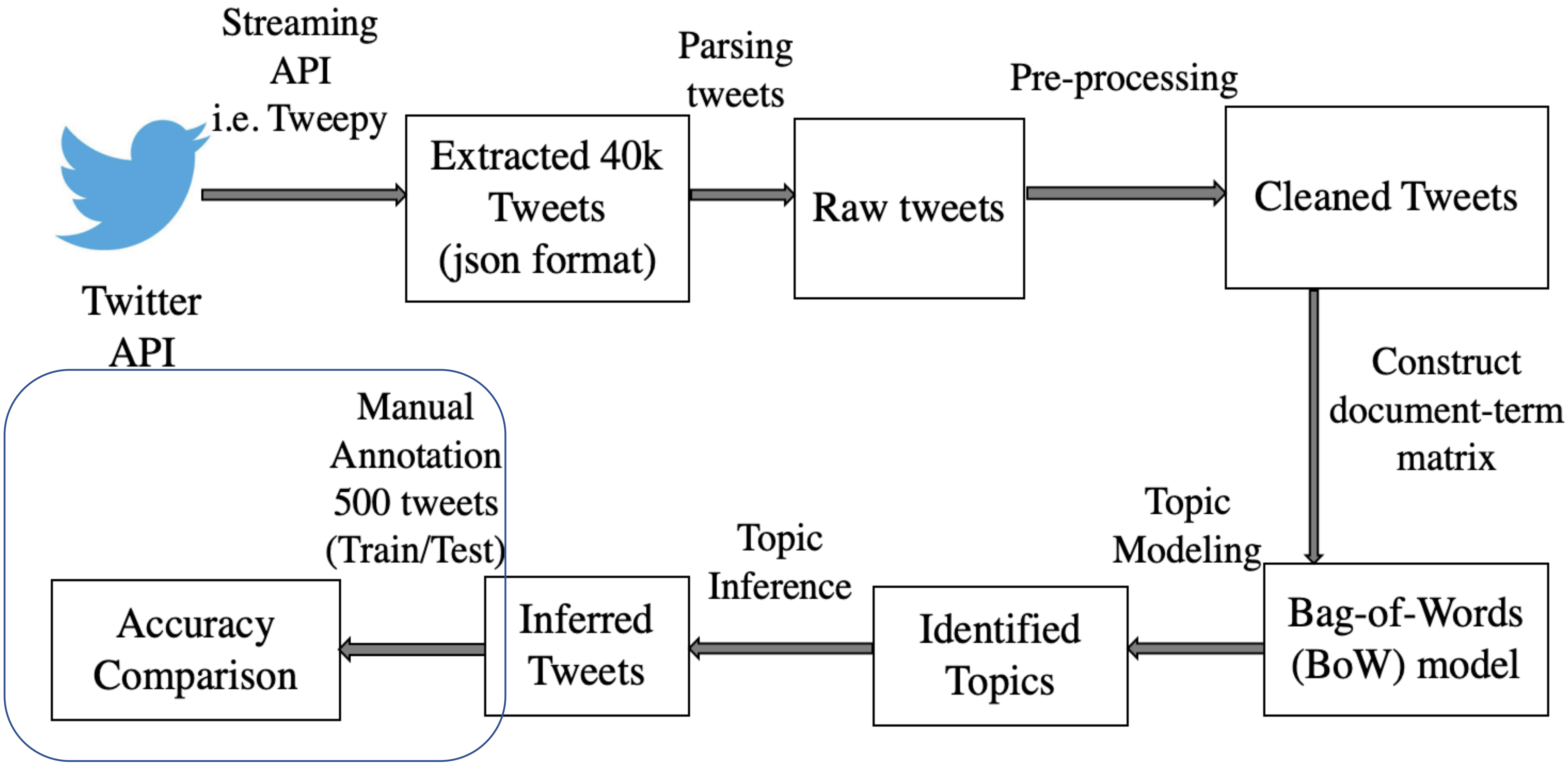
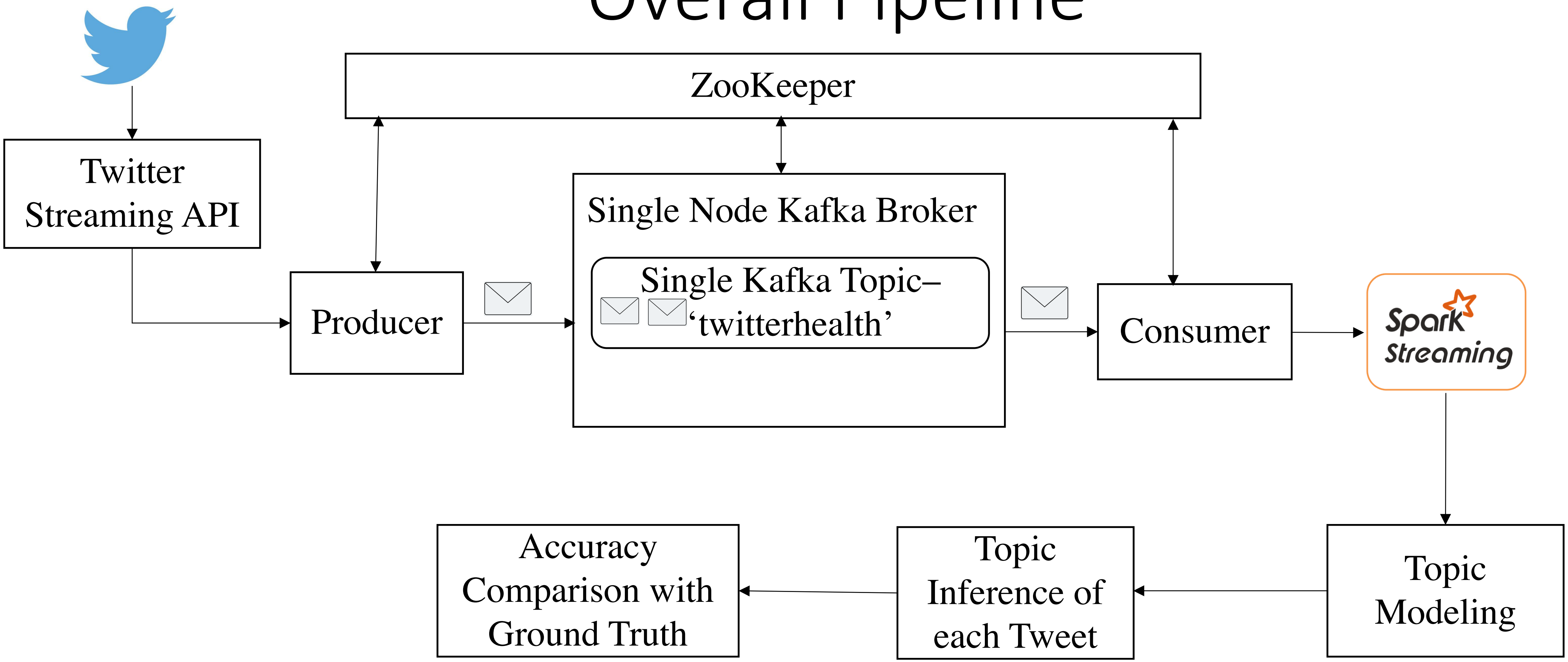
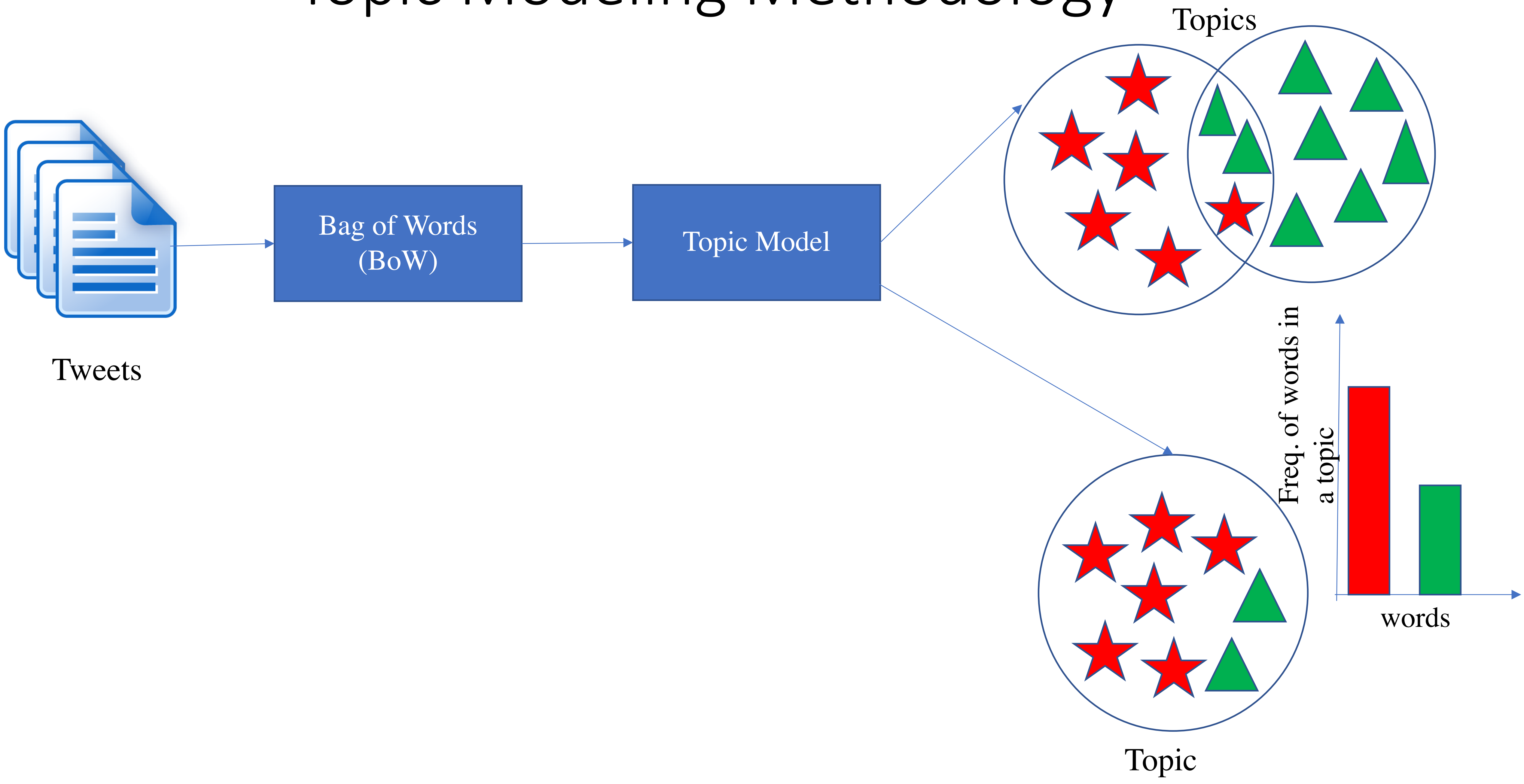


Overall Pipeline



Topic Modeling Methodology



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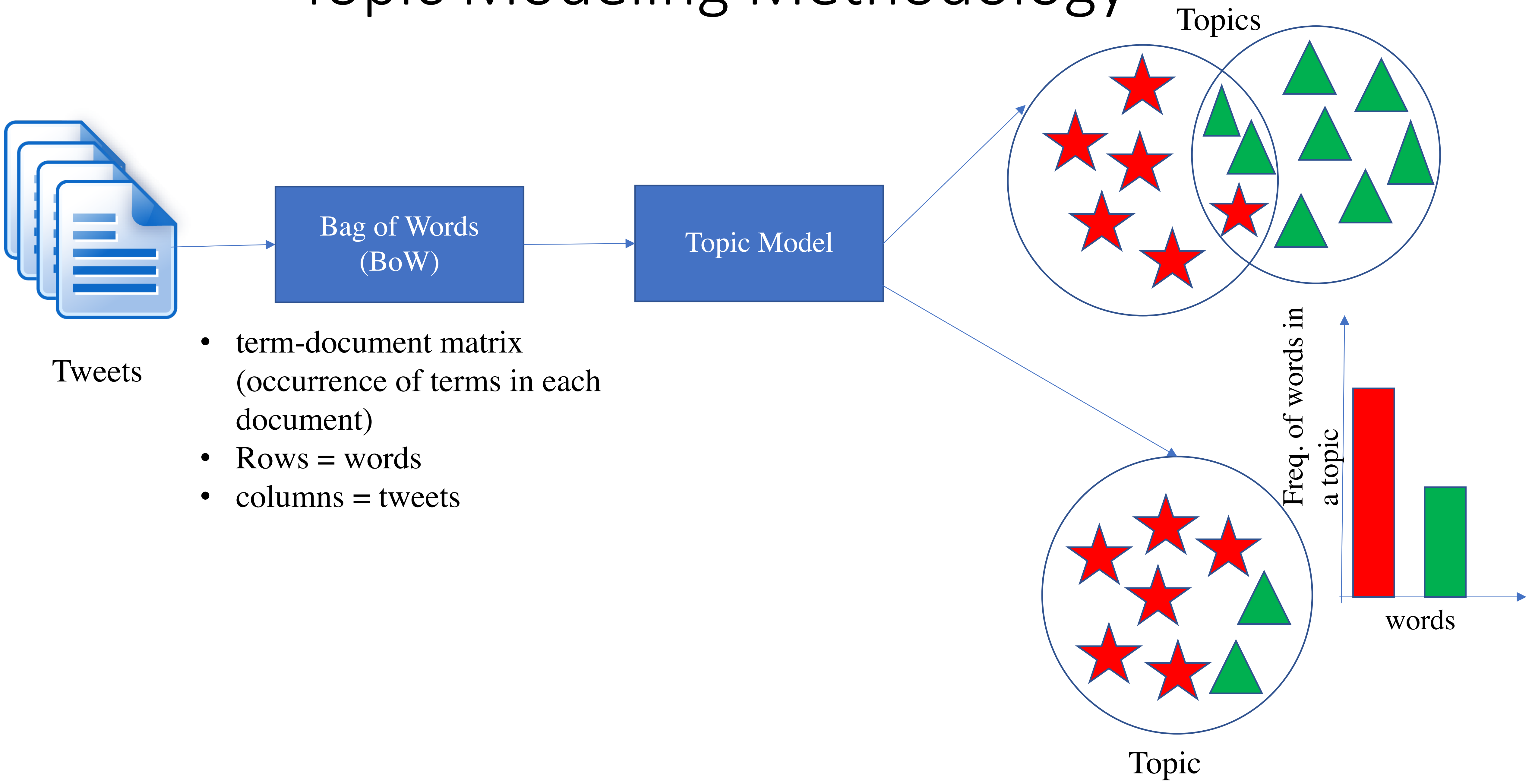

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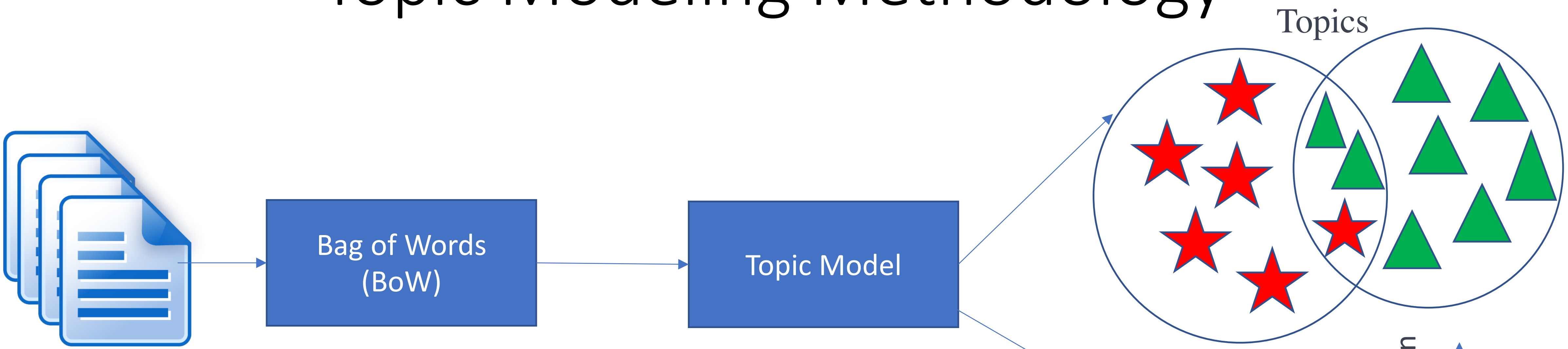
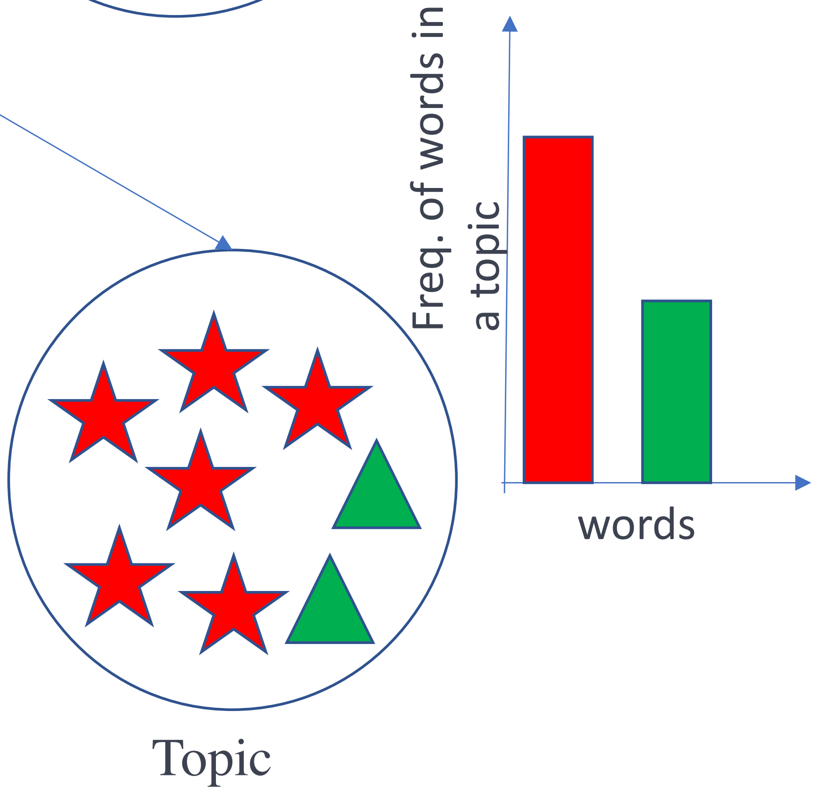


Tweets

- term-document matrix (occurrence of terms in each document)
- Rows = words
- columns = tweets

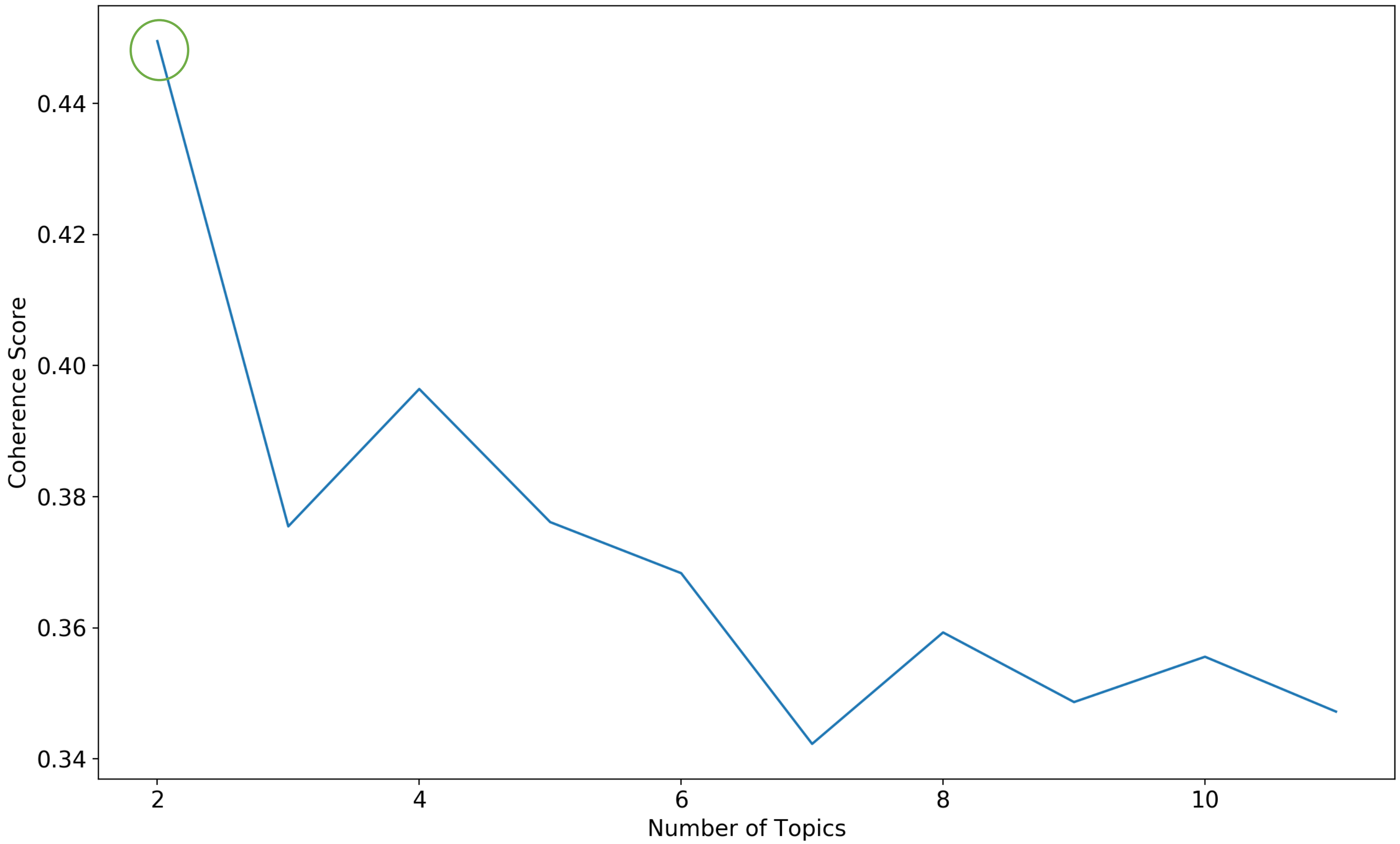
- Latent Semantic Analysis
  - Singular value decomposition
- Non-negative Matrix Factorization
  - Matrices are non-negative
  - Normalization with TF-IDF to give more weight to the "more" important terms
- Latent Dirichlet Allocation
  - Dirichlet distribution



How to choose optimal Number of Topics?

- Build many LSA, LDA, NMF models with different values of number of topics (k).
- pick k with highest coherence value.

Optimal Number of Topics vs Coherence Score LSA



K = 2
Coherence Value = 0.4495

Topics using LSA

Topic1

yoga
everi
life
job
remember
goe
woman
everyone
cook
therapy

Topic2

diet
vegan
fit
day
new
like
beyonce
amp
eat
workout

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- *highly dense matrix*.

Topics using LSA

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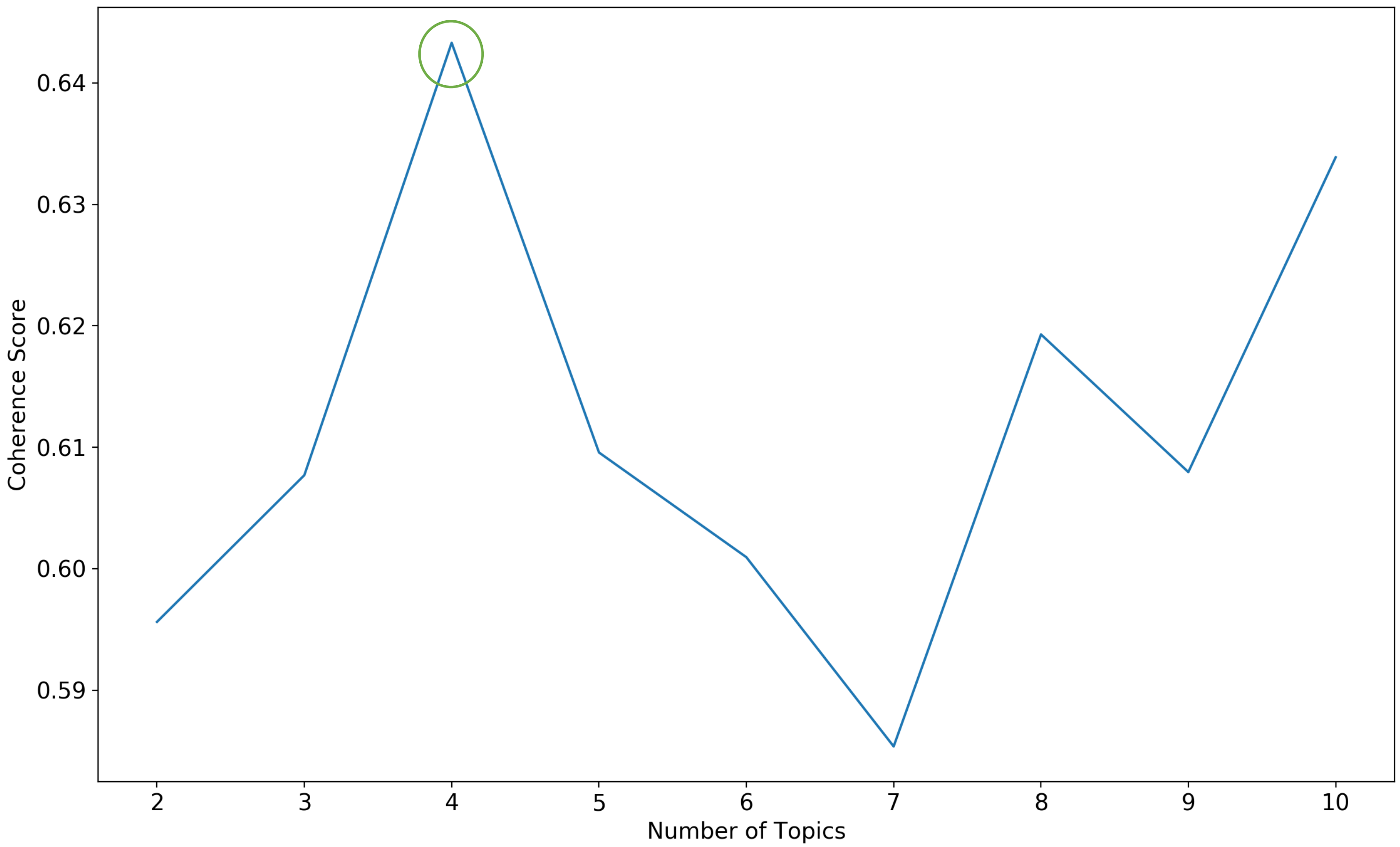
- *highly dense matrix*
- *unable to capture the meanings of words.*
- *lower accuracy*

Optimal Number of Topics vs Coherence Score NMF



K = 4
Coherence Value = 0.6404

Topic coherence measure TC-W2V

Topics using NMF

Topic1	Topic2	Topic3	Topic4
Yoga	diet	vegan	fitness
job	beyonce	go	workout
every_woman	new	eat	go
cooks_goe	bitch	make	good
therapy_remember	ciara_prayer	food	amp
life_juggl	day	day	day
everyone_birthday	eat	amp	yoga
boyfriend	go	shit	health
hot	fat	meat	gym
know	keto	vegetarian	today

Topics using NMF

- *sparse representations*

Topic1	Topic2	Topic3	Topic4
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Topics using NMF

- *sparse representations*
- *same keywords are repeated in multiple topics.*

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boyfriend	go	shit	health
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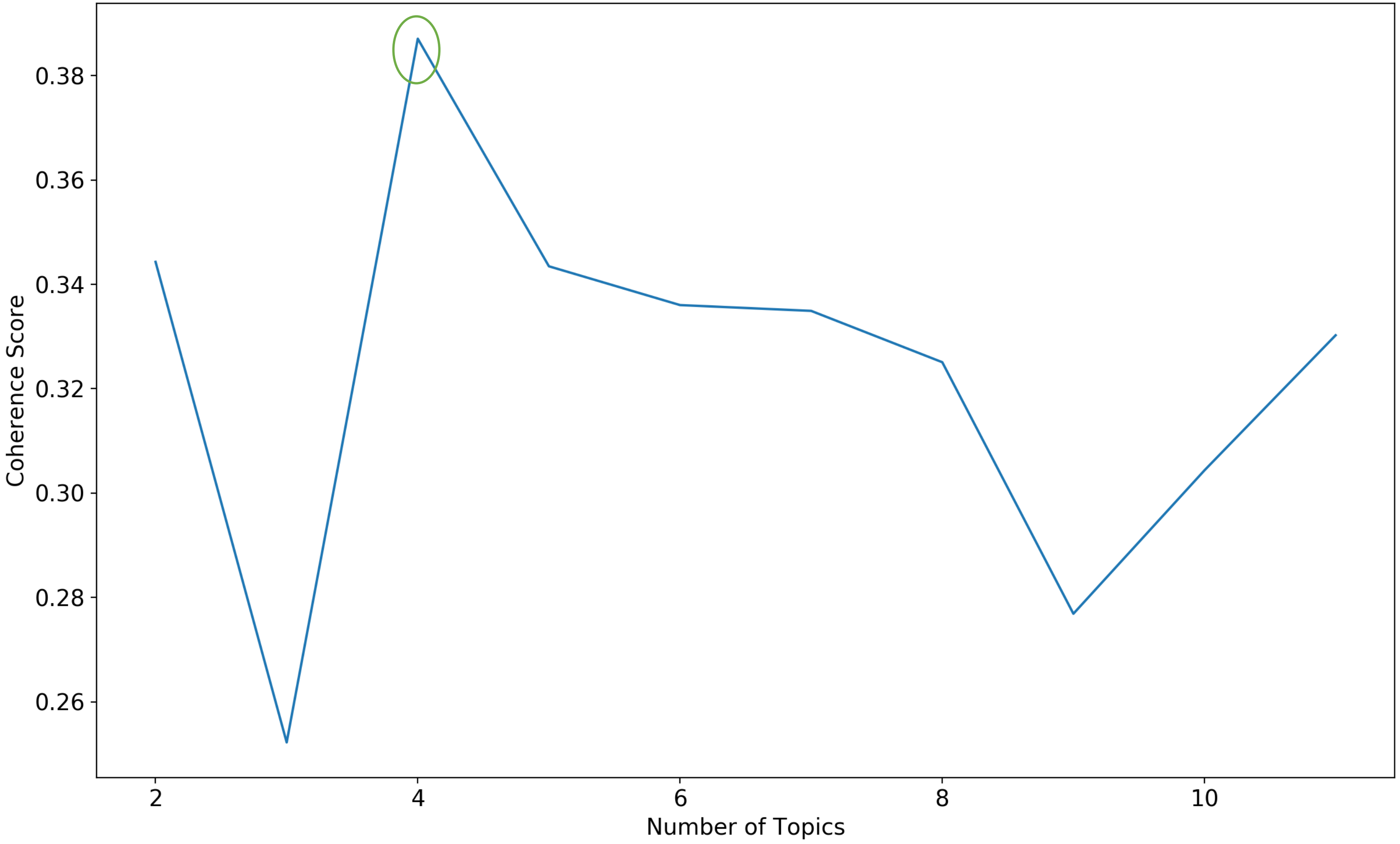
know	keto	vegetarian	today

Optimal Number of Topics vs Coherence Score LDA



K = 4
Coherence Value = 0.3871

Topics using LDA

Topic1	Topic2	Topic3	Topic4
diet	vegan	swimming	fitness
workout	yoga	swim	amp
new	job	day	wellness
go	every_woman	much	health
day	cooks_goe	support	time
beyonce	therapy_remember	really	great
get	life_juggle	try	look
today	everyone_birthday	always	hiking
bitch	eat	relationship	make
gym	boyfriend	pool	love

Topics using LDA

- *coherent topics*

Topic1	Topic2	Topic3	Topic4
diet	vegan	swimming	fitness
workout	yoga	swim	amp
new	job	day	wellness
go	every_woman	much	health
day	cooks_goe	support	time
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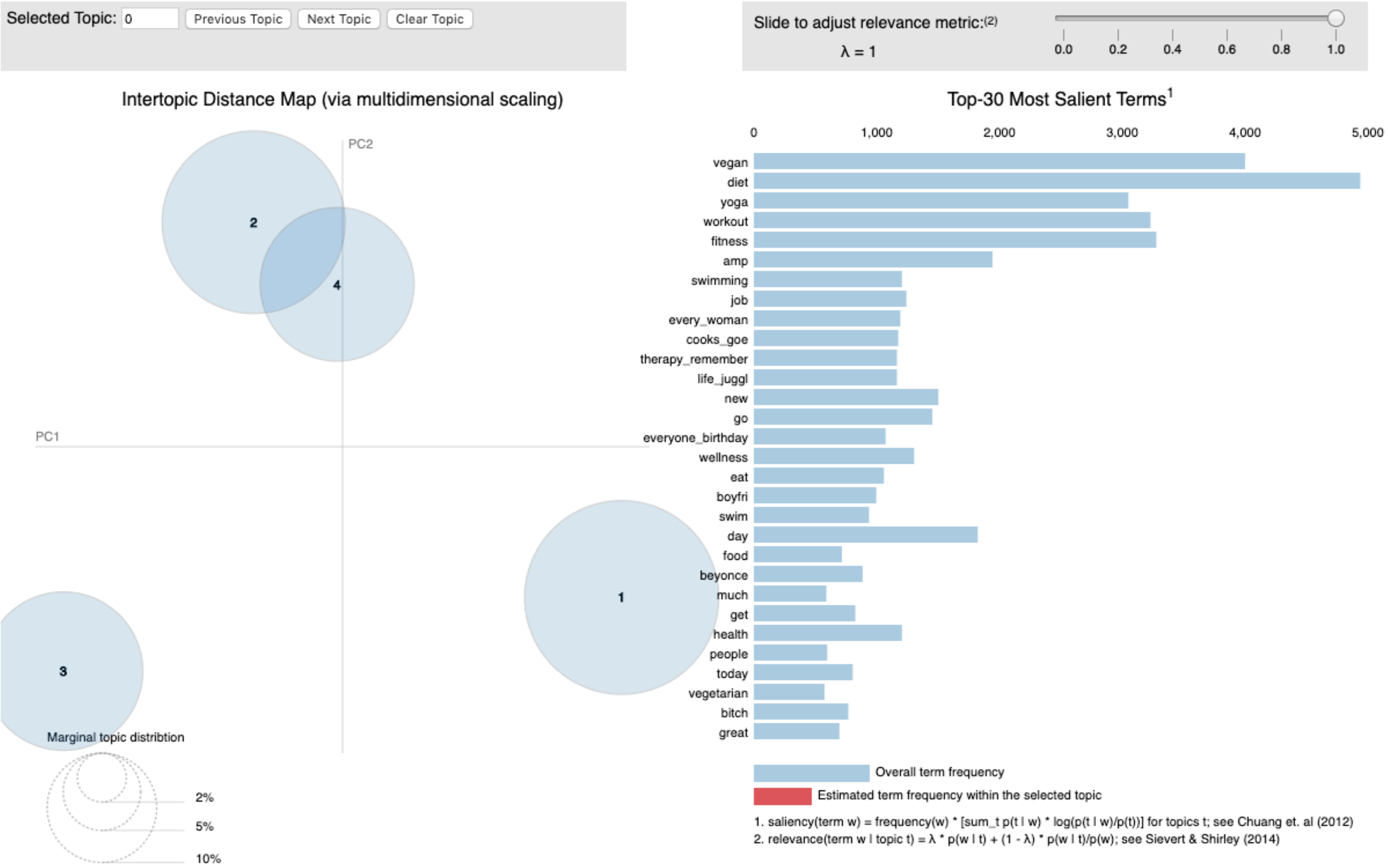
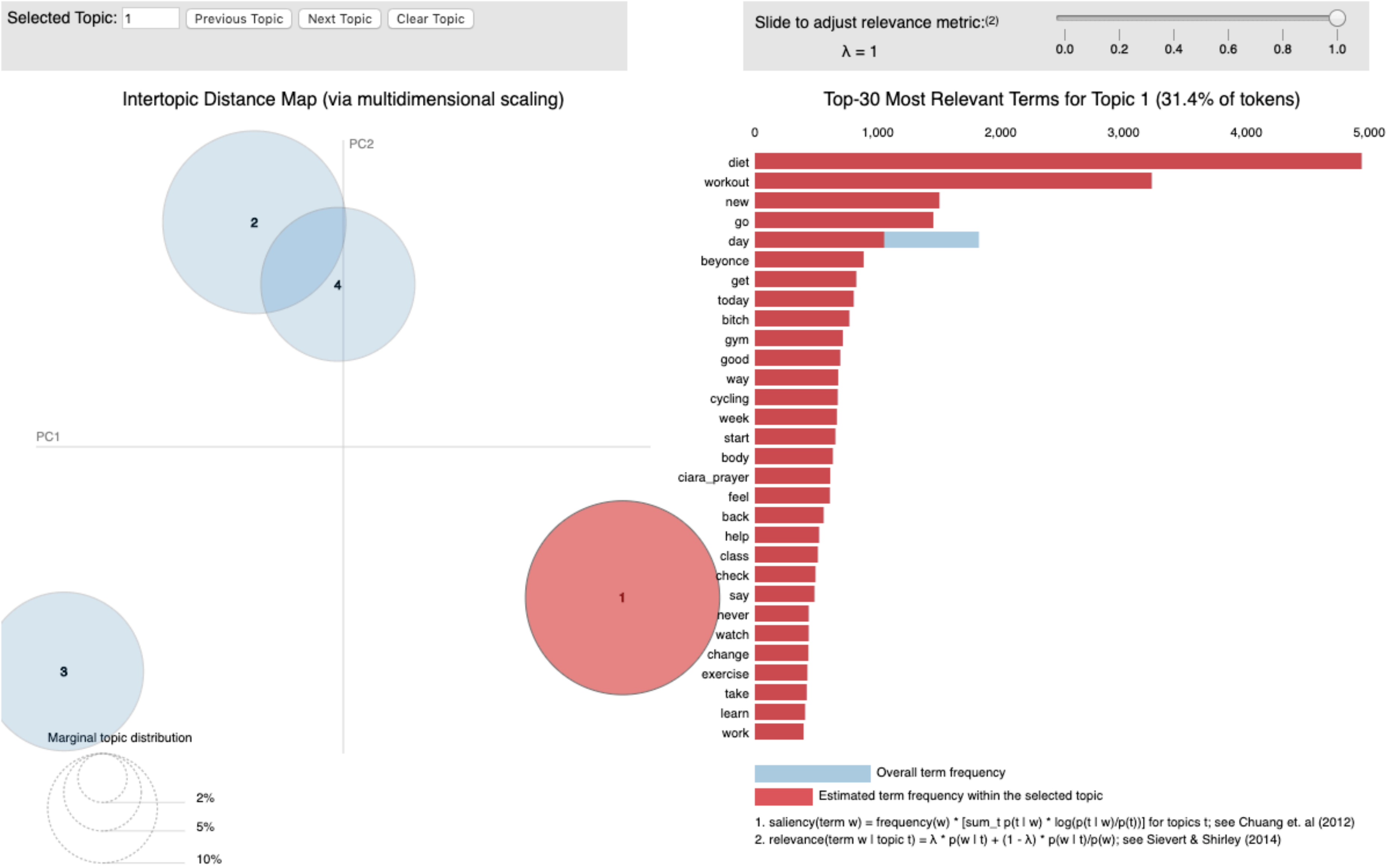
Visualization of Topics- pyLDAVIS



Online link: https://tunazislam.github.io/files/LDA_Visualization_t4.html

Visualization of Topics- pyLDAVIS



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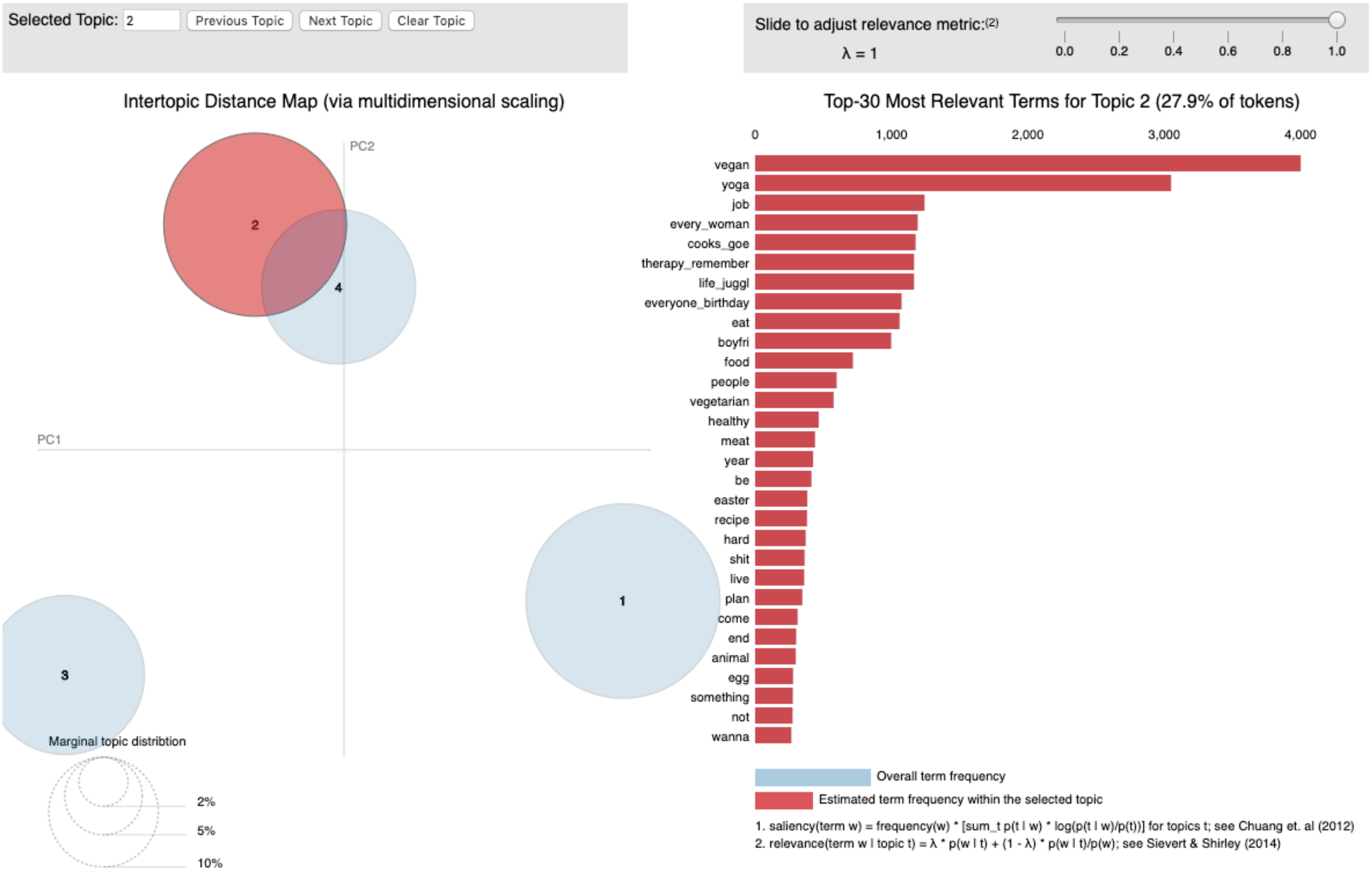

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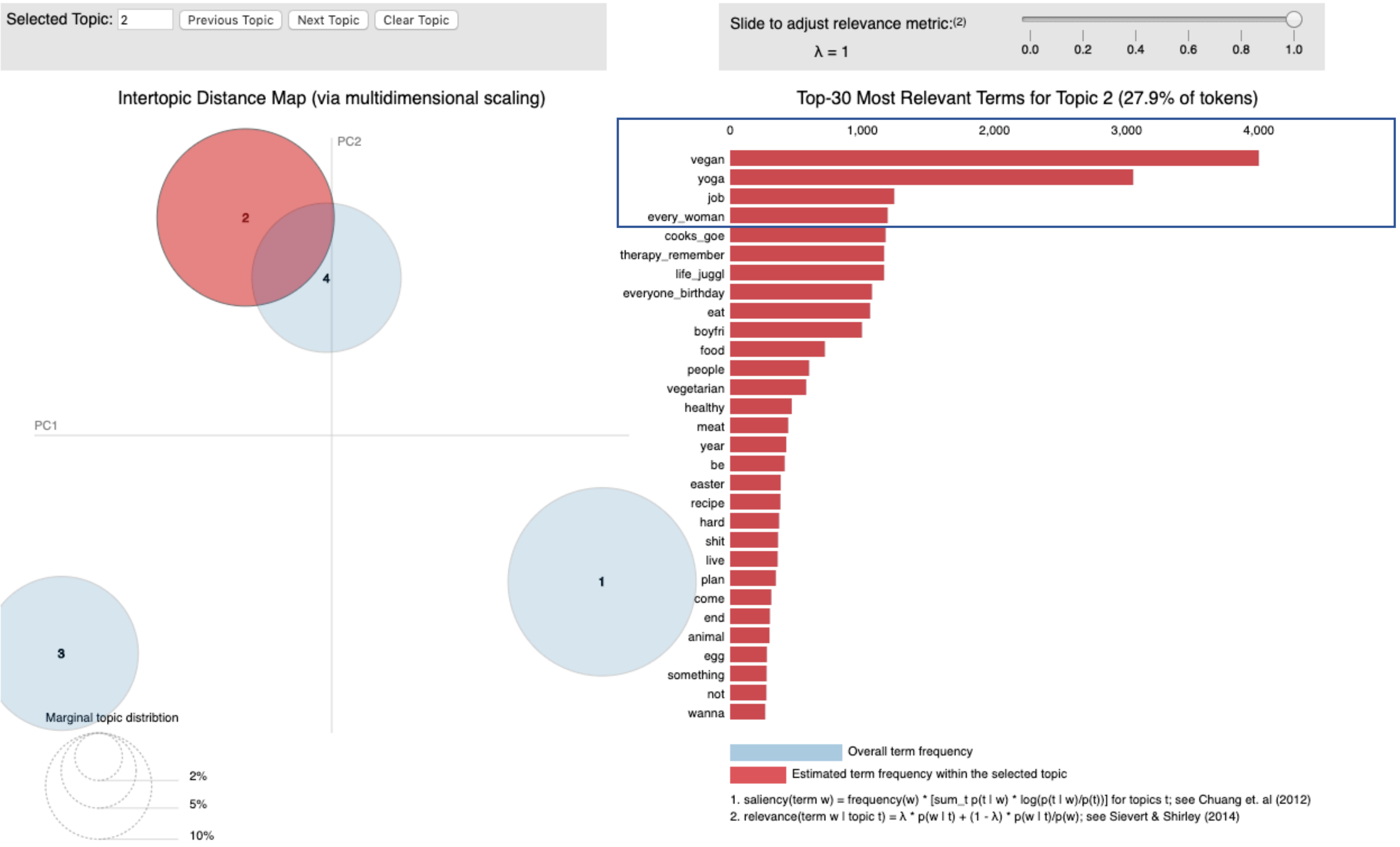


Top-4 co-occurring keywords

vegan

yoga

job

every_woman

Online link: https://tunazislam.github.io/files/LDA_Visualization_t4.html

Topic Inference (Train data)

- Observing dominant topic, 2nd dominant topic and its percentage of contribution in each Tweet.

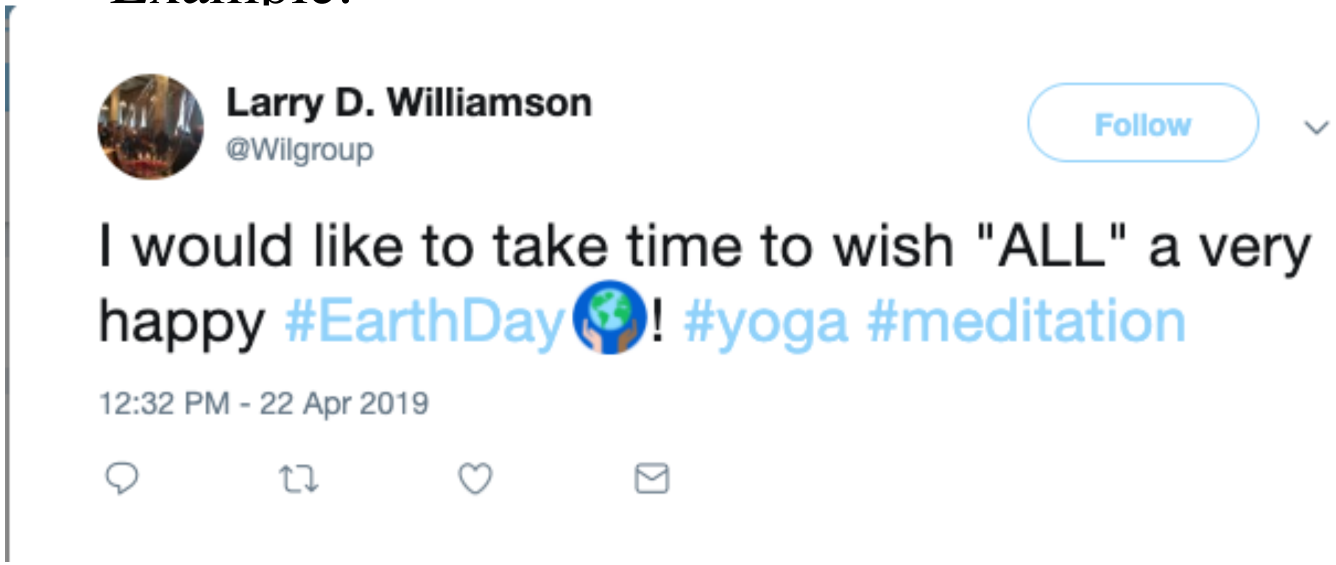
Example:

Dominant Topic	**2nd Dominant Topic**
Topic 2	Topic 1
vegan	*diet*
yoga	*workout*
job	*new*
every_woman	*go*
cooks_goe	*day*
therapy_remember	*beyonce*
life_juggle	*get*
everyone_birthday	*today*
eat	*bitch*
boyfriend	*gym*
61%	**18%**

Topic Inference on **New** Tweets (Test data)

- Observing dominant topic, 2nd dominant and its percentage of contribution to **new** Tweet.

Example:



Dominant Topic	**2nd Dominant Topic**
Topic 2	Topic 4
vegan	*fitness*
yoga	*amp*
job	*wellness*
every_woman	*health*
cooks_goe	*time*
therapy_remember	*great*
life_juggle	*look*
everyone_birthday	*hiking*
eat	*make*
boyfriend	*love*
33%	**32%**

Manual Annotation (Train/Test data)

- **100, 200, 300, 400, and 500** tweets from train data
- **New** tweets for test data
- Calculate accuracy with ground truth

Manual Annotation

- Intent of tweets.
- For example:
  - **Tweet 1:** *Learning some traditional yoga with my good friend*.

  - **Tweet 2:** *Why You Should #LiftWeights to Lose #BellyFat #Fitness #core #abs #diet #gym #bodybuilding #workout #yoga*

Manual Annotation

- Intent of tweets.
- For example:
  - **Tweet 1:** *Learning some traditional yoga with my good friend*.

    Yoga activity

  - **Tweet 2:** *Why You Should #LiftWeights to Lose #BellyFat #Fitness #core #abs #diet #gym #bodybuilding #workout #yoga*

    Workout, Diet

Manual Annotation

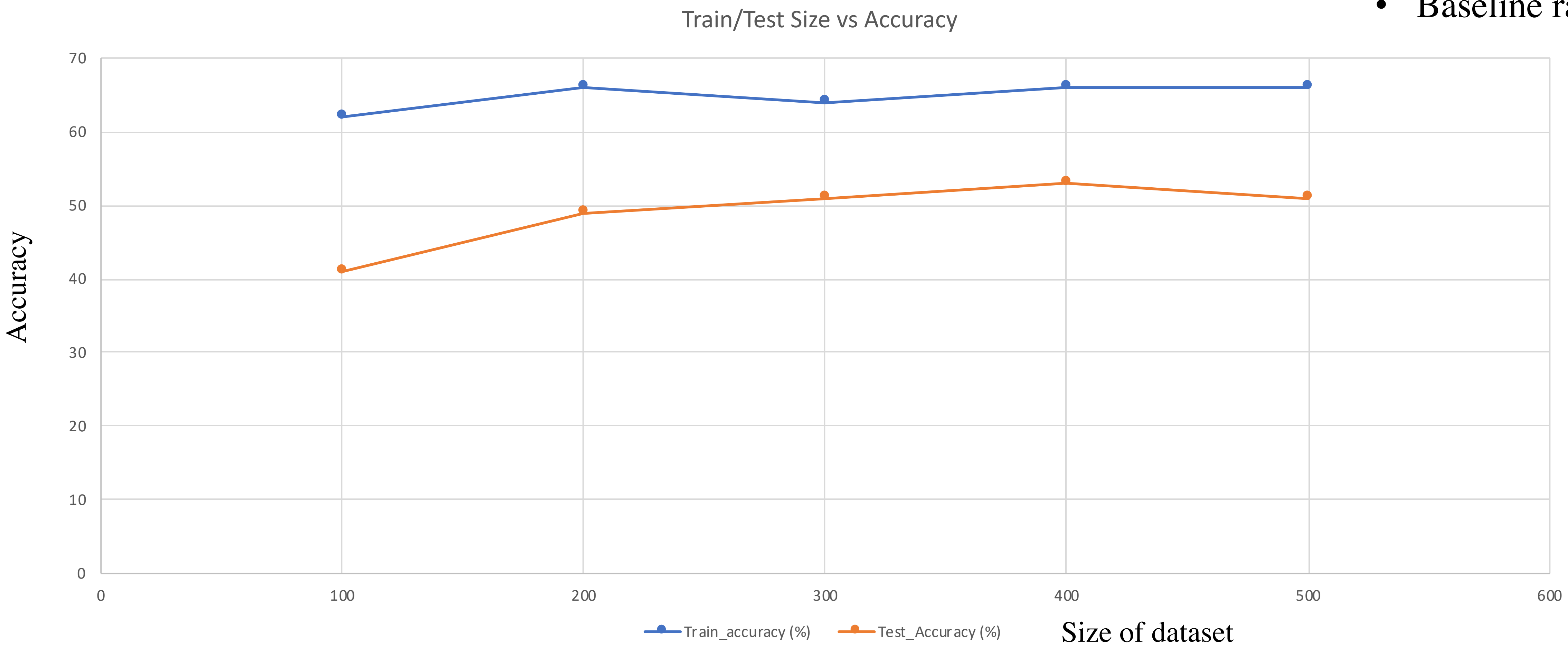
- Intent of tweets.
- For example:
  - **Tweet 1:** *Learning some traditional yoga with my good friend*.

    Topic 2
  - **Tweet 2:** *Why You Should #LiftWeights to Lose #BellyFat #Fitness #core #abs #diet #gym #bodybuilding #workout #yoga*

    Topic 1

Train/Test Accuracy with Ground Truth

- Train: 66%
- Test: 51%
- Baseline random: 25%



Observation 1

Dominant Topic	**2^{nd} Dominant Topic**
Topic 2	Topic 3
vegan	*swimming*
yoga	*swim*
job	*day*
every_woman	*much*
cooks_goe	*support*
therapy_remember	*really*
life_juggle	*try*
everyone_birthday	*always*
eat	*relationship*
boyfriend	*pool*
43%	**23%**

Observation 1

Miss Kate
@KateHagans
Follow

This morning I packed myself a salad. Went to yoga during lunch. And then ate my salad with water in hand.

I'm feeling so healthy I don't know what to even do with myself. Like maybe I should eat a bag of chips or something...

12:32 PM - 22 Apr 2019

17 Likes

17

Misleading topic

Dominant Topic	**2nd Dominant Topic**
Topic 2	Topic 3
vegan	*swimming*
yoga	*swim*
job	*day*
every_woman	*much*
cooks_goe	*support*
therapy_remember	*really*
life_juggle	*try*
everyone_birthday	*always*
eat	*relationship*
boyfriend	*pool*
43%	**23%**

Observation 1

Diet related topic (Topic 1)

Dominant Topic	**2nd Dominant Topic**
Topic 2	Topic 3
vegan	*swimming*
yoga	*swim*
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every_woman	*much*
cooks_goe	*support*
therapy_remember	*really*
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everyone_birthday	*always*
eat	*relationship*
boyfriend	*pool*
43%	**23%**

Observation 2


Jimmy from the BX @BloodwingBX · Apr 22
Replying to @HoarseWisperer @TheRickWilson
My extra sweet halfcaf double vegan soy chai pumpkin latte was 2 degrees hotter than it should have been and the foam wasn't very foamy. And they spelled my name Jimothy, "Jim" on the cup... it's a living hell here.
9 17 211

Dominant Topic	**2nd Dominant Topic**
Topic 3	Topic 2
swimming	*vegan*
swim	*yoga*
day	*job*
much	*every_woman*
support	*cooks_goe*
really	*therapy_remember*
try	*life_juggle*
always	*everyone_birthday*
relationship	*eat*
pool	*boyfriend*
37%	**33%**

Observation 2

Unrelated topic	Related topic
Dominant Topic	**2nd Dominant Topic**
Topic 3	Topic 2
swimming	*vegan*
swim	*yoga*
day	*job*
much	*every_woman*
support	*cooks_goe*
really	*therapy_remember*
try	*life_juggle*
always	*everyone_birthday*
relationship	*eat*
pool	*boyfriend*
37%	**33%**

Still Questionable!

- Why does the model give Misleading topic?
- Why does the model give Unrelated topic?
- Is there bias in data?

Still Questionable!

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Interpretability
&
Explainability

Still Questionable!

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- Why does the model give Unrelated topic?
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Interpretability
&
Explainability

Future Work

Still Questionable!

- Why does the model give Misleading topic?
- Why does the model give Unrelated topic?
- Is there bias in data?

Interpretability
&
Explainability

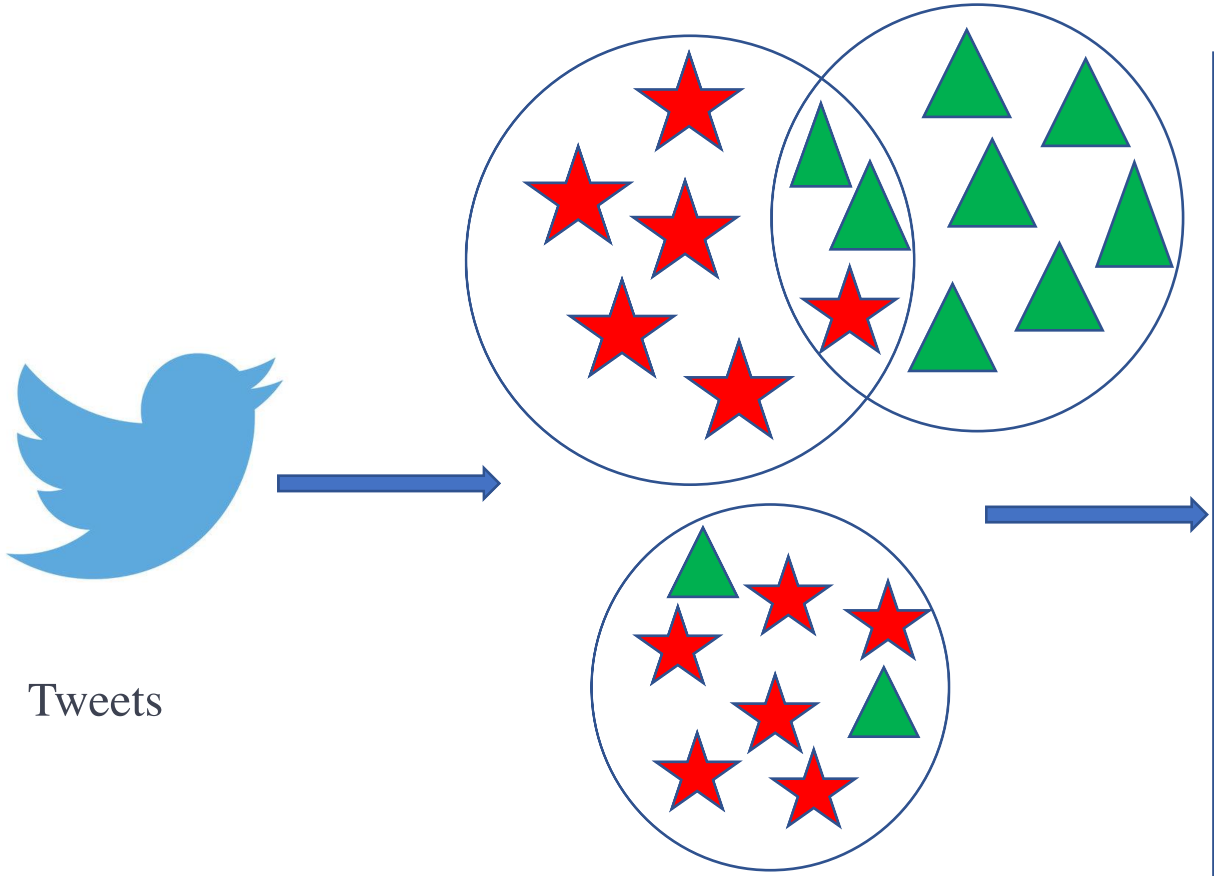
Future Work

- Analyze the Model interpretability

LIME: Local Interpretable model-agnostic Explanation

Ex-Twit: Explainable Twitter Mining on Health Data – Tunazzina Islam. Social NLP 2019 @IJCAI 2019.
Pre-print: https://arxiv.org/abs/1906.02132

Summary



Topic Modeling

LSA
NMF
LDA

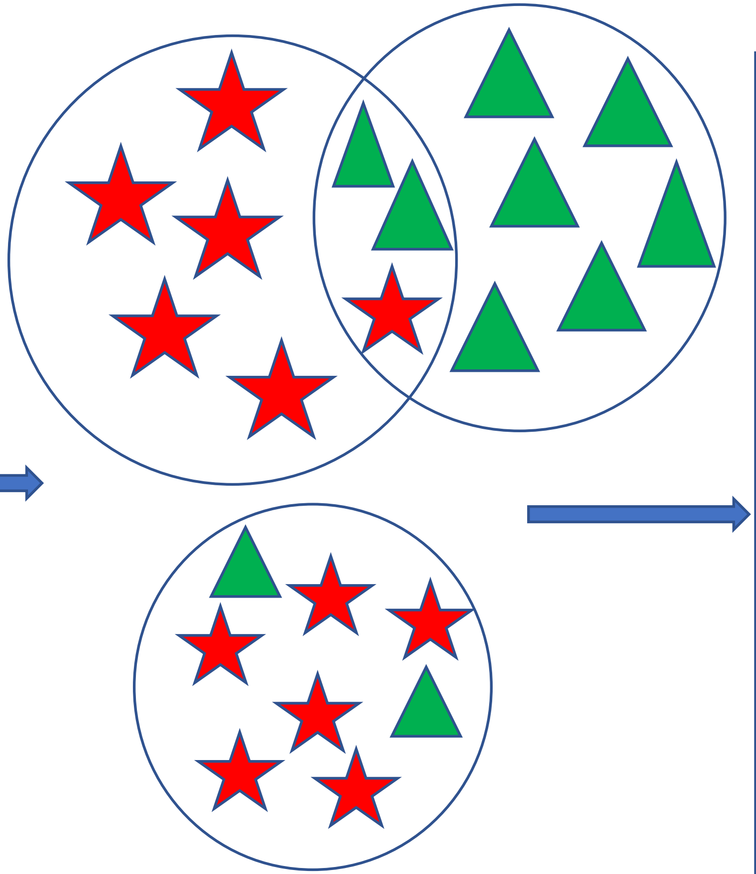
- Finding out dominant and 2nd dominant topic of each tweet (train data)
- Observing percentage of contribution of topic in each tweet
- Topic inference on new tweets (test data)
- Manual annotation both for train and test data to observe accuracy.
- Discovering interesting correlation

i.e. **Veganism and Yoga**

Topic Inference and Correlation Mining

QUESTION?

Tweets



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Topic Inference and
Correlation Mining

THANK YOU

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