Does Yoga Make You Happy? Analyzing Twitter User Happiness using Textual and Temporal Information

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PURDUE UNIVERSITY

Motivation

follow

Emily
@UCLA alumni, traveler, yoga and nature lover. Tend to think in 3+ different languages.

Los Angeles, CA

Smith
@Geologist, Believer in the Love religion, spontaneous fun maker.

Denver, CO

T1: Scorpion pose or Vrischikasana with a wall. Love this feeling. #yoga #scorpionpose.
T2: Busy day at work. Feeling energized after dancing @lafitness.

T1: Great job @Emily.
T2: Vegan Drive Through experience. we tried getting one of everything.

follow

lafitness
A welcoming dance & fitness facility for movers ages 13+. Streaming classes daily on YouTube, support us by joining our Patreon Community!

Los Angeles, CA

T1: Gentle #Yoga & Meditation w/ Michael. BreakOut Studios Online Classes.
T2: Join us for Saturday morning yoga class. #weekendyoga

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Location

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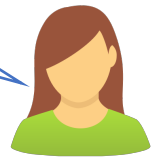
Practitioner

Other



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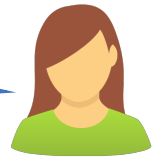

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Positive emotion

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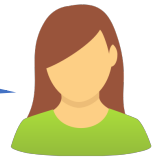

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Find Causal relationship between "*Practicing Yoga*" and "*Being Happy*"

Methodology

To find out causal features from the text, we measure two variables:

- **Yoga activity level** - content analysis.
- **Happiness level** - emotional state.

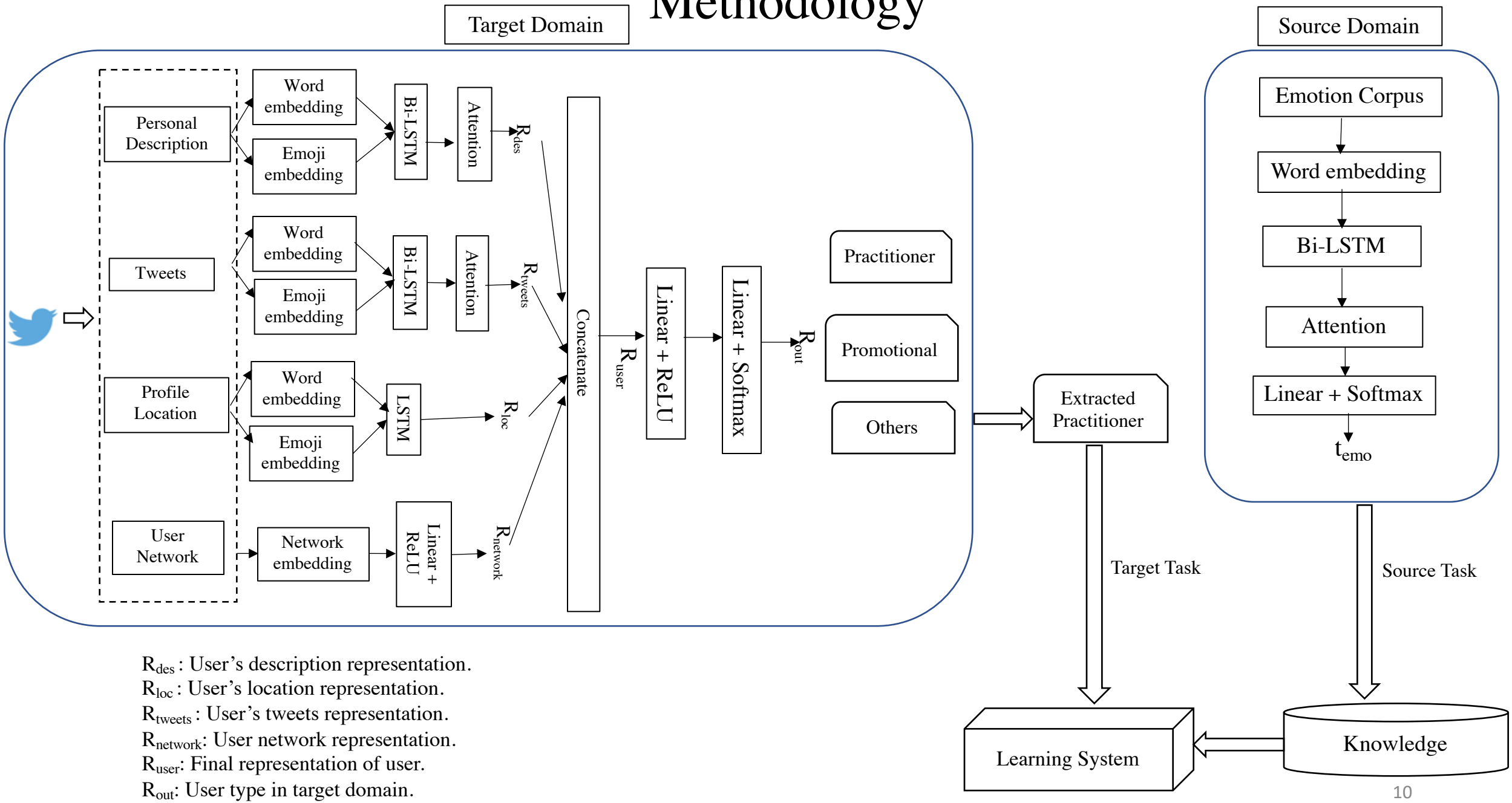
Model

- **Yoga User Network (YUN)** - a joint embedding model based on the fusion of neural networks with attention mechanism leveraging users' social and textual information to understand users' yoga activity.

- **Emotion Detection Model (BiLSTMAttEmo)** - an attention-based neural network model trained on emotion corpus (source domain).

- **Transfer learning** - transfers knowledge from source domain (emotion corpus) to measure the emotional state of yoga users (target domain).

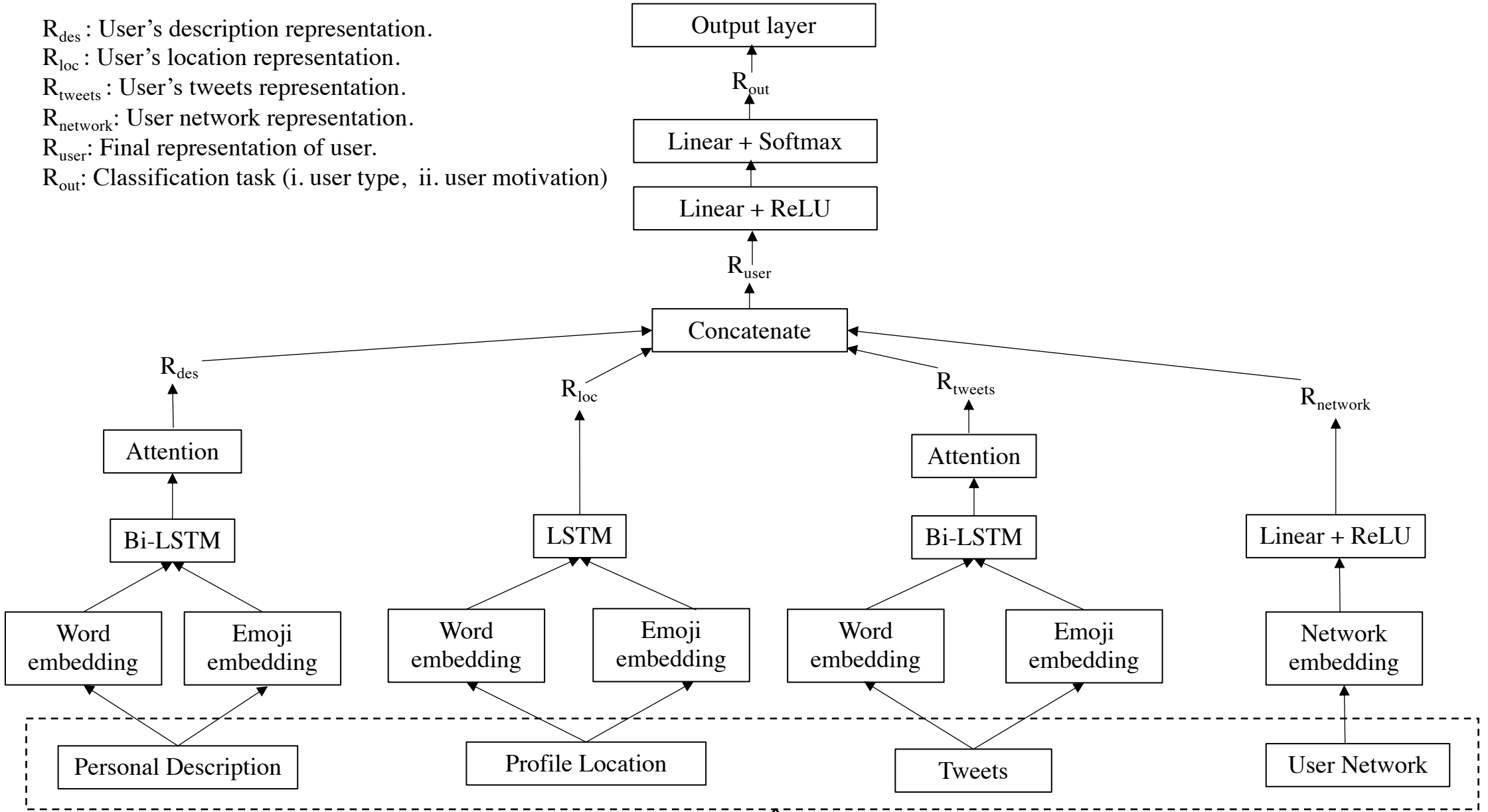
Methodology



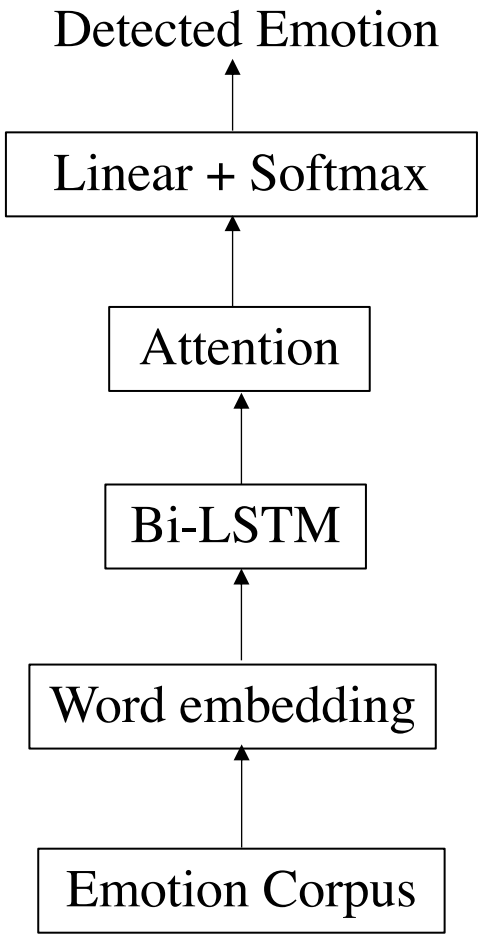
R_{des} : User's description representation.
R_{loc} : User's location representation.
R_{tweets} : User's tweets representation.
$R_{network}$: User network representation.
R_{user}: Final representation of user.
R_{out}: User type in target domain.
t_{emo}: Emotion of tweets in source domain.

YUN Model

R_{des} : User's description representation.
R_{loc} : User's location representation.
R_{tweets} : User's tweets representation.
$R_{network}$: User network representation.
R_{user}: Final representation of user.
R_{out}: Classification task (i. user type, ii. user motivation)



BiLSTMAttEmo Model



Dataset

- YUN model
  - ~ **0.4 million** yoga-related tweets from Twitter using Twitter streaming API (May to November of 2019) containing specific keywords.

  - **~15k** users have at least a yoga-related tweet in their timelines.
  - ~ **35 millions** of timeline tweets.

- Emotion Dataset
  - **~0.4 million** tweets annotated with 6 emotions *{joy, love, sadness, anger, fear, surprise}*

Baseline Models

- Emotion detection baseline – GRUEmo.
  - BiLSTMAttEmo performs better on target task.
- User type detection baseline – 10 baselines
  1. Description only;
  2. Location only;
  3. Tweets only;
  4. Network only;
  5. BERT finetuned with Description (Description_BERT);
  6. BERT fine-tuned with Location (Location_BERT);
  7. BERT fine-tuned with Tweets (Tweets_BERT);
  8. joint embedding on description and location (Des + Loc);
  9. joint embedding on description, location, and tweets (Des + Loc + Twt);
  10. joint embedding on description, location, and network (Des + Loc + Net).

  - YUN (Des + Loc + Twt + Net) outperforms those baselines.
    - Macro-avg F1 score: 74.2%

Causal Features

1. Yoga activity level
   - focuses on practitioner's first-hand experience.

   case (i): Explicitly having 1st Person Singular and 1st Person Plural Number.

   i.e. ***I loved yesterday's yoga session #motivational #calm.***

   - Rule-based approach

   case (ii): Implicit first-hand experience.

   i.e. ***feeling peaceful after doing morning yoga.***

   - Parts of speech tagging approach
     - filter out 2nd and 3rd Person Singular and Plural Number.
     - VBZ, NNP, NNS, NNPS, PRP, PRP$.

2. Yoga practitioner's happiness level
   - focuses on practitioner's two type of emotion *{joy, love}*

Granger Causality

- Granger causality has following two assumptions:
  (i) a cause occurs before its effect.
  (ii) knowledge of a cause can be used to predict its effect.

- A time series *X* (source) is said to Granger-cause a time series *Y* (target) if past values x_{t-i} are significant indicators in predicting y_t.

- In our work, we have source time series - Yoga activity level, *a* (cause) and target time series - Happiness level, *p* (effect). We calculate Granger causality as follows:

$$GC(p_t|p_{<t}, a_{<t}) = \sum_{i=1}^{m} \alpha_i p_{t-i} + \sum_{j=1}^{n} \beta_j a_{t-j} \ldots\ldots\ldots\ldots (1)$$

m *and* n *are the size of lags in the past observation,* α *and* β *are learnable parameters.*

Granger Causality

- Sort yoga activity level and happiness level based on DateTime.
- Apply Granger causality from (eqn.(1)) with different lags = 1, 2, 3, 4, 5.
- Null hypothesis "yoga activity does not Granger-cause happiness".
- Reject the null hypothesis if **p-value ≤ 0.05**, otherwise keep the null hypothesis.

Results and Analysis

- All Practitioners (~ 8k)
  1. **y + h** - considers all tweets containing 'yoga' and it does not include practitioner's first-hand experience.

  2. **Y + 1st + h** - focuses on yoga activity based on practitioner's first-hand experience.

TABLE 1: Granger causality result for lag = 5

Users	Feature	rn	kn	nc
All	y + h	1663	7120	2271
	y + 1^{st} + h	1447	4524	5083
Top 10%	y + h	700	399	6
	y + 1^{st} + h	546	551	8

rn: Number of users for whom we reject null hypothesis.
kn: Number of users for whom we keep null hypothesis.
nc: Number of users whose Granger Causality is not calculated.
y + h: Yoga and happiness.
y + 1^{st} + h: Yoga with 1^{st} hand experience and happiness.

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Results and Analysis

- Top 10% (~ 1.1k) – tweeted most about "Yoga".
  1. **y + h** - considers all tweets containing 'yoga' and it does not include practitioner's first-hand experience.

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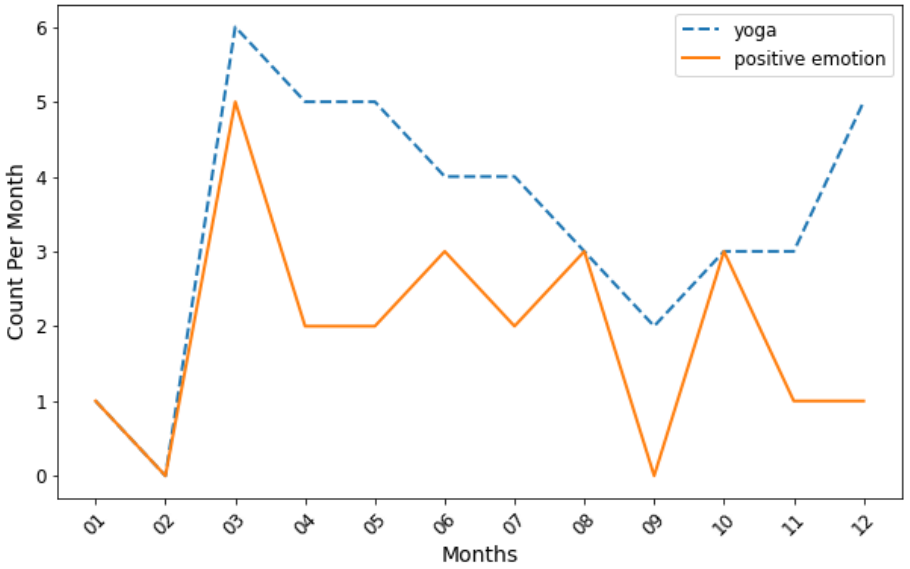
Results and Analysis

- Null hypothesis "Tweeting more does not Granger-cause positive emotion".

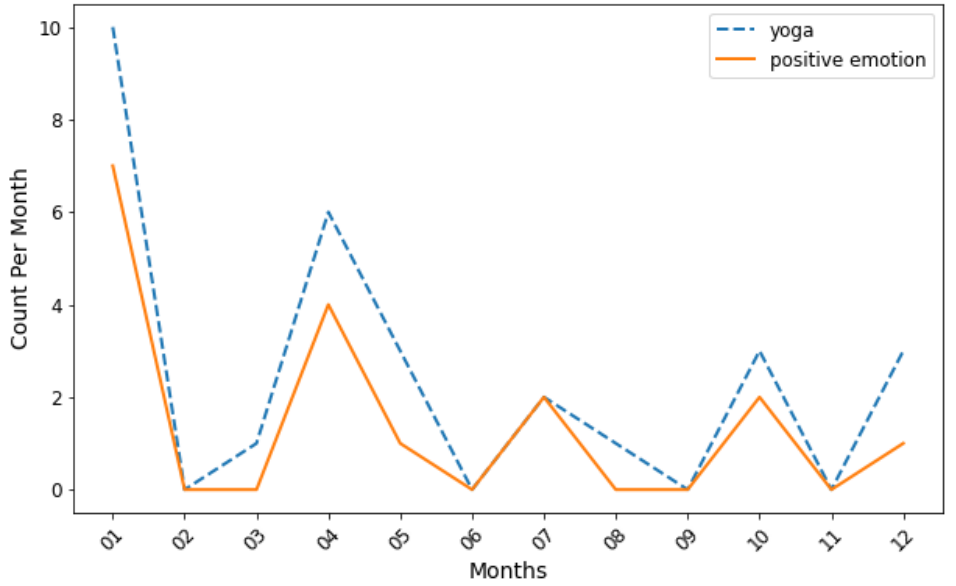
- Two causal features
  (i) number of tweets (cause)
  (ii) number of positive emotions (effect).

- **p-value > 0.05**, keep the null hypothesis which means the overall activity of the practitioners has no effect on happiness.

Results and Analysis



(a) Year 2018



(b) Year 2019

- Causal features: Yoga activity (blue dotted line) and Positive emotion (orange solid line).

- The causal feature temporally causes rise of positive emotion of the user in March 2018 and April 2019.

Discussion and Future Work

- Misclassifications in user type detection.
- Noisy transfer learning approach.
- Expensive data annotation.
- Develop a contextualized model to predict user type using minimal supervision.
- Similar for emotion detection.

THANK YOU ☺

Slide: https://tunazislam.github.io/files/IEEEBigData2020_causal_yoga_happiness.pdf

Questions?

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Backup Slides

Manual Annotation

- Intent of tweets.
- User description
- For example:
  - **Tweet 1:** *Learning some traditional yoga with my good friend*.
  - **Tweet 2:** *Our mission at 532Yoga is pretty simple; great teachers, great classes and superbly happy students #yoga*

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