

Do We Trust What They Say, or What They Do? A Multimodal User Embedding Provides Personalized Explanations

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Challenges in multimodal social media user representation learning

- Different groups of users behave very differently on social media.
- If one modality of user data is misleading, it could introduce noise to the representation learning process and make the performance worse than single-modality models.



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Reid Hoffman
@reidhoffman

Joe Biden is a leader who acts with the best interests of America in mind. Not seeking re-election is one of the most selfless acts we've seen from a politician in modern American history. This is what's right for our country—and our democratic future.

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Biden's rent control plan is a spasm of a dying campaign.

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I say this as someone whose political views, if you force them onto the left-right spectrum, probably end up about 80% toward the left. E.g. I've spent millions over the past several elections supporting the Democrats.

12:59 AM · Apr 16, 2022



Case study: fusing text and graph structure information

- Task 1: Predict the political ideology of Twitter/X users.
- Task 2: Predict whether a Twitter account is human or bot.
- Available data: Twitter text content & user interaction graph including follow, retweet, reply, etc.

| Algorithm | Encoder Variant | | Data Set | |
|---------------|-----------------|-------|---------------|---------------|
| | Text | Graph | TIMME | TwiBot-20-Sub |
| text-only | GloVe | N/A | 0.688 ; 0.681 | 0.565 ; 0.511 |
| | BERT | | 0.862 ; 0.859 | 0.731 ; 0.722 |
| link-only | N/A | MLP | 0.932 ; 0.930 | 0.707 ; 0.697 |
| | | R-GCN | 0.953 ; 0.953 | 0.735 ; 0.728 |
| simple fusion | GloVe | R-GCN | 0.840 ; 0.837 | 0.683 ; 0.675 |
| | BERT | R-GCN | 0.959 ; 0.959 | 0.791 ; 0.787 |

Table: Performance comparison between singlemodal and multimodal methods
(format: accuracy ; f1-score)



Problem definition

A social network user embedding fusion framework that could answer:

First objective

Which modality contributes more to the user attribute prediction, hence allowing more customized downstream user behavior analysis.

Second objective

Which modality is more reliable for each user, hence automatically filtering out the untrustworthy information when necessary.



Contribution-Aware Multimodal User Embedding (CAMUE)

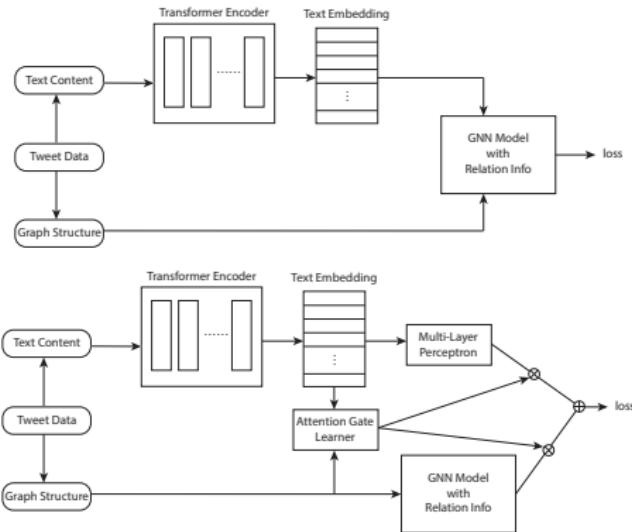


Figure: The architectures of our framework. top: simple fusion method, bottom: CAMUE



Results and analysis

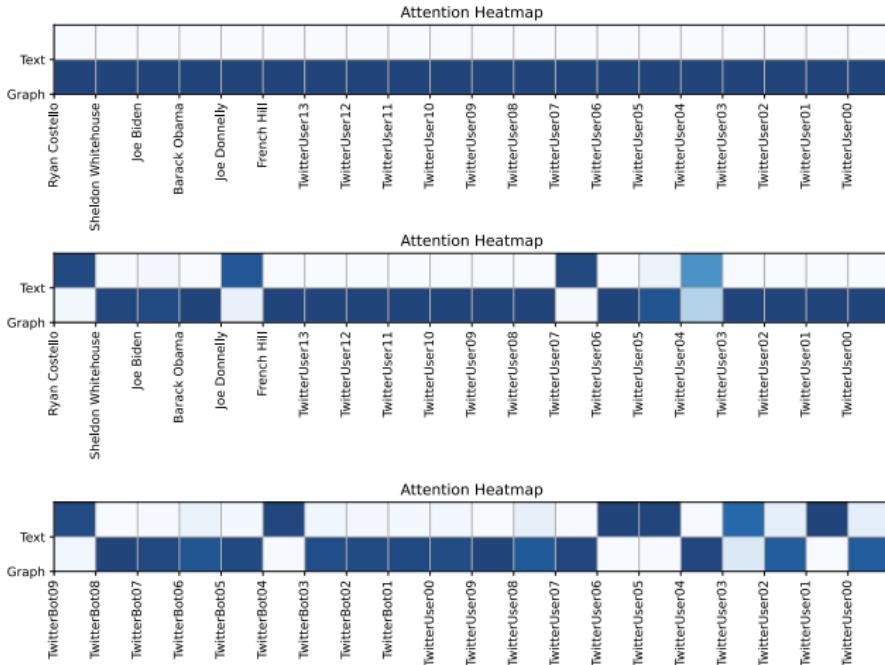


Figure: Contribution map, top: CAMUE(GloVe, R-GCN) for task 1, middle: CAMUE(BERT, R-GCN) for task 1, bottom: CAMUE(BERT, R-GCN) for task 2

Results and analysis

| Algorithm | Encoder Variant | | Data Set | |
|--------------------------|-----------------|-------|---------------|---------------|
| | Text | Graph | TIMME | TwiBot-20-Sub |
| CAMUE w. fixed params | GloVe | MLP | 0.938 ; 0.937 | 0.700 ; 0.691 |
| | | R-GCN | 0.952 ; 0.951 | 0.734 ; 0.727 |
| | BERT | MLP | 0.940 ; 0.938 | 0.732 ; 0.722 |
| | | R-GCN | 0.952 ; 0.951 | 0.779 ; 0.771 |
| CAMUE | GloVe | MLP | 0.945 ; 0.944 | 0.707 ; 0.697 |
| | | R-GCN | 0.954 ; 0.953 | 0.738 ; 0.731 |
| | BERT | MLP | 0.935 ; 0.933 | 0.744 ; 0.738 |
| | | R-GCN | 0.961 ; 0.960 | 0.782 ; 0.776 |

Table: Performance of CAMUE framework (format: accuracy ; f1-score)



Results and analysis

| | |
|---------------------------|---|
| Name | Ryan Costello |
| Ground Truth Party | Republican |
| Sample Graph Data | Liked Ben Rhodes (Democrat) 20 times. Liked Donald Trump 0 time. Following Mike Quigley (Democrat). |
| Sample Text Data | Despite Trump, Iran's elections & chaotic ME, some Democrats want to race ahead with ill-conceived Iran sanctions RT @SaeedKD: Iran's people care about elections. The so-called democratic fringe doesn't - by me |
| Graph-backbone Prediction | Democrat (Wrong) |
| Text-backbone Prediction | Republican (Right) |
| Simple Fusion Prediction | Democrat (Wrong) |
| CAMUE Prediction | Republican (Right) |

| | |
|---------------------------|---|
| Name | Sheldon Whitehouse |
| Ground Truth Party | Democrat |
| Sample Graph Data | Liked Senate Democrats Official Account 26 times. Not following Donald Trump. Following Barack Obama. |
| Sample Text Data | My Republican partner on the CARA bill, @SenRobPortman, writes a powerful editorial on the success of CARA and CURES (which provided a needed boost of funding to match CARA). Good move by Trump Administration. Cong. @JimLangevin & |
| Graph-backbone Prediction | Democrat (Right) |
| Text-backbone Prediction | Republican (Wrong) |
| Simple Fusion Prediction | Republican (Wrong) |
| CAMUE Prediction | Democrat (Right) |

Results and analysis

| Subgroup | % Users w/ graph contribution > text contribution |
|---|---|
| Democrats | 70.9 |
| Republicans | 76.1 |
| Politicians | <u>76.2</u> |
| Non-politicians with Party affiliations | 72.4 |
| Non-bot random users | 61.2 |
| Bot accounts | 77.3 |
| TIMME, aggregated | 73.5 |
| Twibot-20-Sub, aggregated | 70.1 |

| Name | Elon Musk | Lebron James | Lady Gaga | Bill Gates | Oprah Winfrey | Jimmy Fallon | Katy Perry | Justin Timberlake | Taylor Swift |
|-------------------------------|-----------|--------------|-----------|------------|---------------|--------------|------------|-------------------|--------------|
| Photo | | | | | | | | | |
| Field | Business | Sports | Music | Business | Television | Television | Music | Music | Music |
| Text or Graph? | Graph | Text | Text | Graph | Graph | Graph | Text | Graph | Graph |
| % Text | 1 | 93 | 100 | 33 | 15 | 0 | 96 | 58 | 1 |
| % Graph | 99 | 7 | 0 | 67 | 85 | 100 | 4 | 42 | 99 |
| Political Polarity Prediction | R | D | D | R | D | D | D | D | R |



Thank you!

