GCN for multimodal fake news detection

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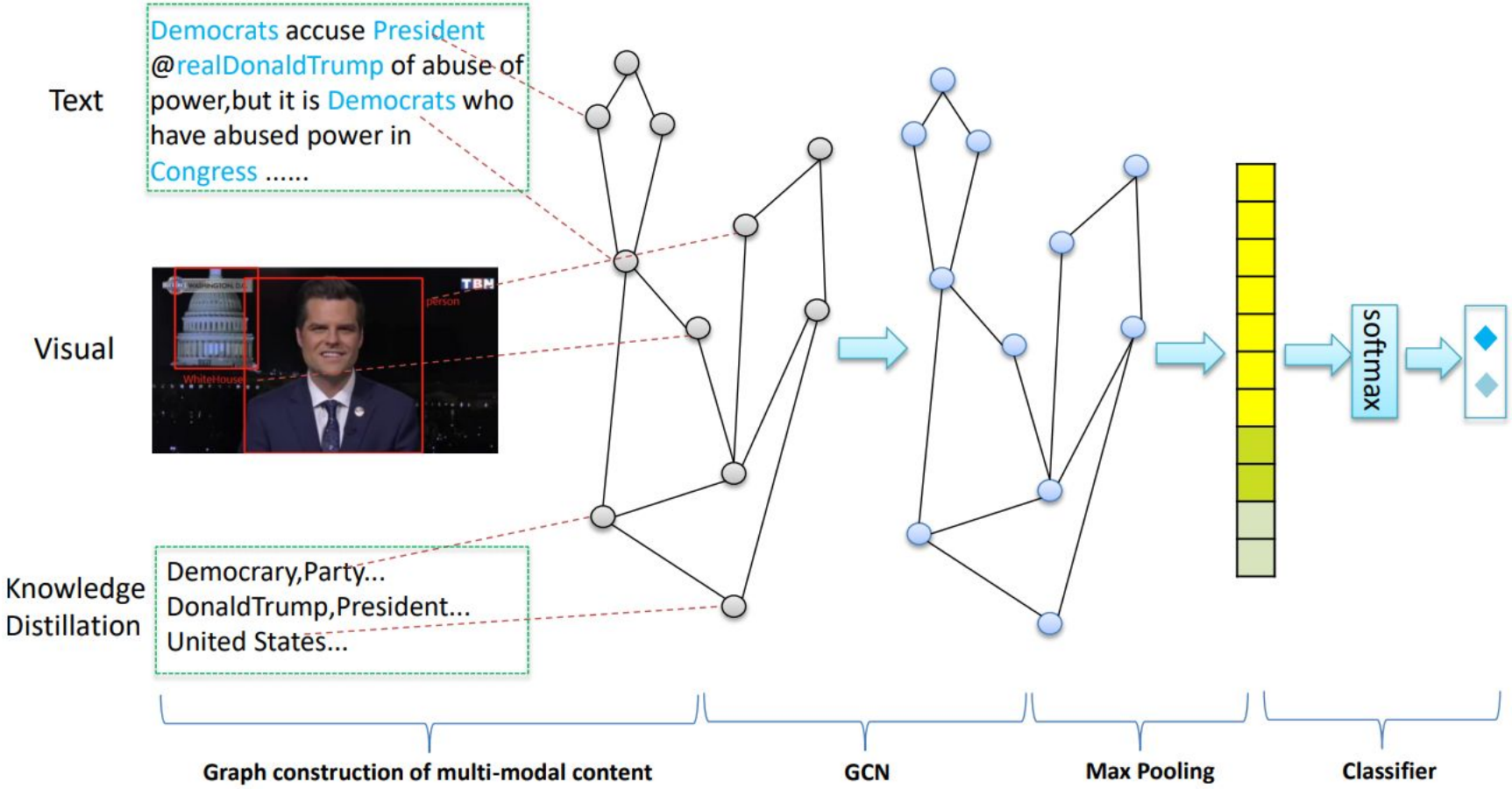
Workflow


Text
Democrats accuse President @realDonaldTrump of abuse of power,but it is Democrats who have abused power in Congress .....
Visual
TBN
person
WhiteHouse
Knowledge Distillation
Democrary,Party...
DonaldTrump,President...
United States...
softmax
Graph construction of multi-modal content
GCN
Max Pooling
Classifier

Graph-Construction

1.Each Post as an Undirected Graph:

- We represent each post's content as an undirected graph, where:
    - **Nodes** = Words from the post.
    - **Edges** = Relationships between words, weighted by Point-wise Mutual Information (PMI).

Graph-Construction

2. Mathematical Details of PMI Calculation

- **PMI Definition**:
  - To measure the strength of co-occurrence between two words w_i and w_j, we use PMI as follows:

$$\text{PMI}(w_i, w_j) = \log \frac{p(w_i, w_j)}{p(w_i)p(w_j)}$$

  - **Terms:**
    - $p(w_i) = \frac{W(w_i)}{|W|}$
      - $W(w_i)$: Number of sliding windows containing w_i.
      - $|W|$: Total number of sliding windows.
    - $p(w_i, w_j) = \frac{W(w_i, w_j)}{|W|}$
      - $W(w_i, w_j)$: Number of sliding windows containing both w_i and w_j.

Graph-Construction

- **Threshold for Edge Creation**:
  - Only **positive PMI scores** are retained for graph construction:

$$A_{ij} = \begin{cases} \text{PMI}(w_i, w_j) & \text{if PMI}(w_i, w_j) > 0 \\ 0 & \text{otherwise} \end{cases}$$

  - This thresholding creates an adjacency matrix A that emphasizes significant co-occurrences.

Graph-Construction

3. Incorporation of Multimodal Content

- **Visual Information**:
  - We detect semantic objects in post images using **YOLOv3**, with labels such as "person" or "gun".
  - These **visual labels** are treated as additional words and included in the text content.

- **Knowledge Concepts**:
  - To further enrich the representation, **knowledge concepts** from external knowledge graphs are added for entities in the post.

- **Final Graph Structure**:
  - The resulting graph combines **textual words**, **visual labels**, and **knowledge concepts**, creating a multimodal representation for each post.

Graph-Construction

4. Adjacency Matrix Construction

- After incorporating textual, visual, and knowledge data, an **adjacency matrix (A)** is built for each post.
- **Matrix Elements** A_{ij}: Represent PMI-weighted edges between words, visual labels, and knowledge concepts.

Dataset

1. Datasets Overview

- **PHEME Dataset**:
  - Collected based on **5 breaking news events**.
  - Contains a variety of **claims** related to each news event.
  - **Includes labeled articles and images** for each claim.
- **WEIBO Dataset**:
  - Collected from claims reported on www.weibo.com.
  - Each claim includes **text, image URLs, responses**, etc.
  - **Large volume** of labeled articles and images, ideal for model validation.

Table 1: The Statistics of the Real-World Datasets.

News	PHEME	WEIBO
Fake News	1972	2313
Real News	3830	2351
Images	3670	3989