

# LLMTaxo: Leveraging Large Language Models for Constructing Taxonomy of Factual Claims from Social Media

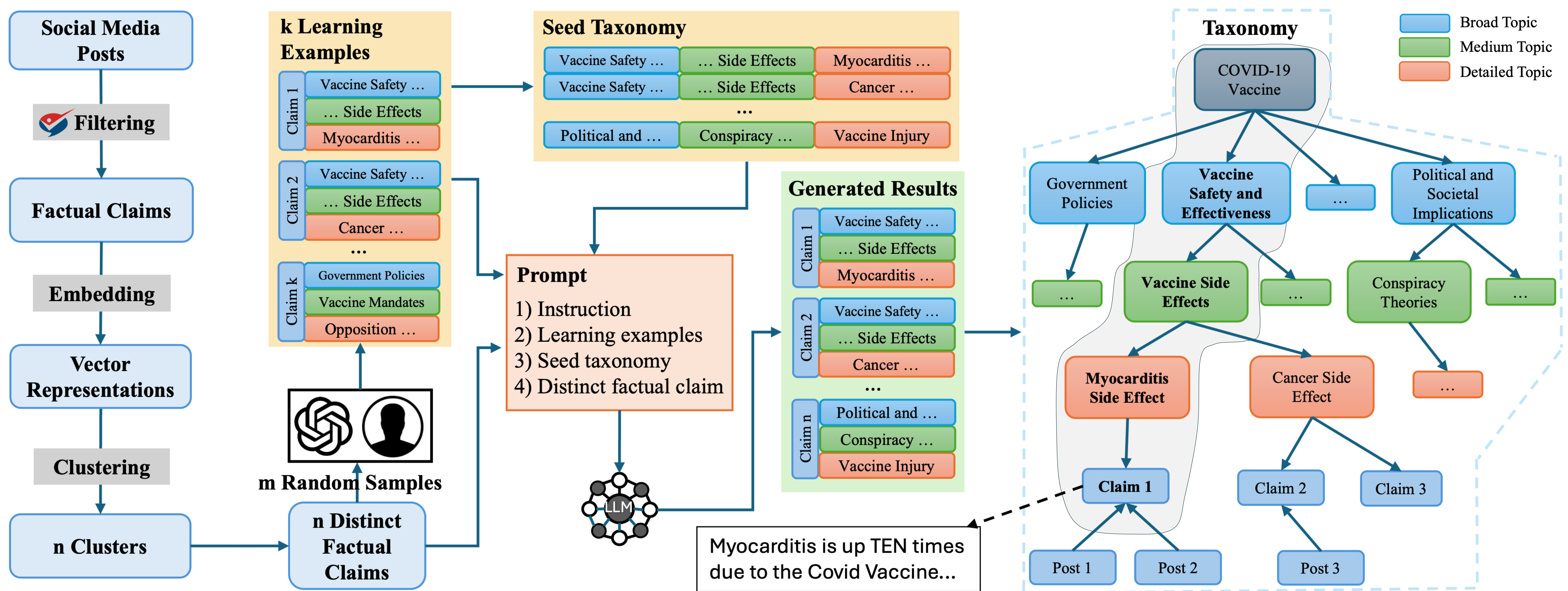
## Domain-Specific, Multi-Level Taxonomy of Factual Claims

- ❖ Help understand and analyze vast and diverse social media content
- ❖ First LLM-based automation framework for such taxonomy
- ❖ First multi-level (broad, medium, and detailed) taxonomy for factual claims

## Methodology

- ❖ **Claim Detection:** Apply ClaimBuster (Hassan et al., 2017) to identify check-worthy factual claims and retain claims with a score above 0.5.
- ❖ **Distinct Claim Identification:** Employ HDBSCAN (Campello et al., 2013) clustering and Sentence-BERT (Reimers et al., 2019) to group semantically similar posts and reduce redundancy.
- ❖ **Taxonomy Construction:**
  - *Seed taxonomy & learning examples:* A random samples of claims were selected for human annotation. Claims belonging to frequent topics are used as learning examples for LLMs, and these topics form a seed taxonomy.
  - *Topic generation:* Employ few-shot prompting with LLMs to generate hierarchical topics for each factual claim.
  - *Topic consolidation:* Taxonomy hierarchy formed based on generated topics.

## LLMTaxo Framework



## Quality Evaluation

- ❖ **Three Newly Created Datasets:**
  - *COVID-19 Vaccine (CV):* 384,676 tweets, 01/23-04/23.
  - *Climate Change (CC):* 229,913 Facebook posts, 01/24-05/24.
  - *Cybersecurity (CS):* 107,905 Facebook posts, 01/24-05/24.
- ❖ **Evaluators:** 11 humans and GPT-4.
- ❖ **Newly Designed Evaluation Metrics:**
  - Taxonomy quality: clarity ( $M_1$ ), hierarchical coherence ( $M_2$ ), orthogonality ( $M_3$ ), completeness ( $M_4$ ).
  - Claim-detailed topic alignment: accuracy (Ac), granularity (Gr).
- ❖ The results affirm the overall efficacy of our framework, with taxonomies generally receiving high ratings (above 3.0 across all metrics).
- ❖ GPT-4o mini consistently outperformed Zephyr and Gemini in taxonomy evaluation, suggesting its greater suitability for taxonomy construction.

Dataset	Evaluator	Model	$M_1$	$M_2$	$M_3$	$M_4$	Ac	Gr
CV	Human	Zephyr 7B Beta	4.2	4.0	3.3	4.3	4.7	3.6
		GPT-4o mini	4.3	4.2	3.8	4.7	4.4	4.6
		Gemini 2.0 Flash	4.4	3.9	3.5	3.9	4.4	4.6
	GPT-4	Zephyr 7B Beta	3.5	3.7	3.0	3.7	4.0	4.6
		GPT-4o mini	4.3	4.3	4.0	4.7	4.0	4.4
		Gemini 2.0 Flash	3.4	3.0	3.0	3.3	4.0	4.4
CC	Human	Zephyr 7B Beta	4.6	4.2	3.9	4.6	3.3	3.9
		GPT-4o mini	4.7	4.7	4.2	4.8	4.4	4.5
		Gemini 2.0 Flash	4.3	3.9	3.3	4.7	4.4	4.6
	GPT-4	Zephyr 7B Beta	3.5	3.3	4.0	4.0	3.4	3.4
		GPT-4o mini	4.3	4.0	4.5	4.3	3.8	4.5
		Gemini 2.0 Flash	3.8	3.7	3.5	3.7	3.8	4.4
CS	Human	Zephyr 7B Beta	4.3	3.9	3.7	4.4	3.8	4.0
		GPT-4o mini	4.5	4.0	4.0	4.6	4.7	4.6
		Gemini 2.0 Flash	4.6	3.6	3.5	3.9	4.8	4.6
	GPT-4	Zephyr 7B Beta	3.3	3.0	3.0	3.3	3.7	4.0
		GPT-4o mini	4.3	4.7	3.5	4.7	4.0	4.9
		Gemini 2.0 Flash	3.0	3.0	3.5	3.3	4.0	4.9

## GPT-4o mini Result Examples

Dataset	Claim	Broad Topic	Medium Topic	Detailed Topic
CV	John Stockton boldly suggests 'thousands' of pro athletes died after Covid vaccine shot https://t.co/nXbt6Apm2q via @marca	Vaccine Safety and Effectiveness	Vaccine Side Effects	Vaccine-Related Injuries and Deaths
	A lot of people in 'stage 4 cancer' after #Covid #Vaccine https://t.co/z0YAqGgQrL	Vaccine Safety and Effectiveness	Vaccine Side Effects	Cancer Side Effect
CC	Climate change is an existential threat to humanity. On Earth Day and every day, we remain committed to taking the most aggressive climate action ever.	Activism and Public Awareness	Climate Advocacy	Aggressive Climate Action
	Climate change causes Dry spell in Kashmir, The weather in Kashmir is warmer than Delhi and Chandigarh, No snow rain in Kashmir During Chillai Kalan	Environmental Impact	Global Warming	Climate Change Effects in Kashmir
CS	CBN Exempts 16 Items from Cybersecurity Levy...including Salary, Loans, Pension, Donations	Policies and Governance	Government Regulations	Cybersecurity Levy Exemptions
	Streaming giant Roku has recently been targeted by a pair of cyberattacks, and the company confirmed over a half million Roku accounts were compromised.	Threats	Cyberattacks	Roku Account Compromise

## Conclusions

- ❖ We introduced LLMTaxo, a novel framework that leverages LLMs to construct taxonomies of factual claims from social media within a topic domain.
- ❖ The proposed framework can effectively automate a three-level taxonomy construction. The results highlight its potential in reducing redundancy and improving information accessibility.
- ❖ Evaluation across different topic domains highlights its potential for broader applications.

This work is partially supported by the National Science Foundation award # 2346261. The authors acknowledge the Texas Advanced Computing Center (TACC) at The University of Texas at Austin for providing HPC resources that have contributed to the research results reported in this paper.