Double Decomposition with Web-Augmented Verification for Misinformation Detection

Hao Yu*, Vicky Dong*, Zachary Yang, Kellin Pelrine

McGill
Mila

Misinformation

- Misinformation and disinformation pose significant societal challenges
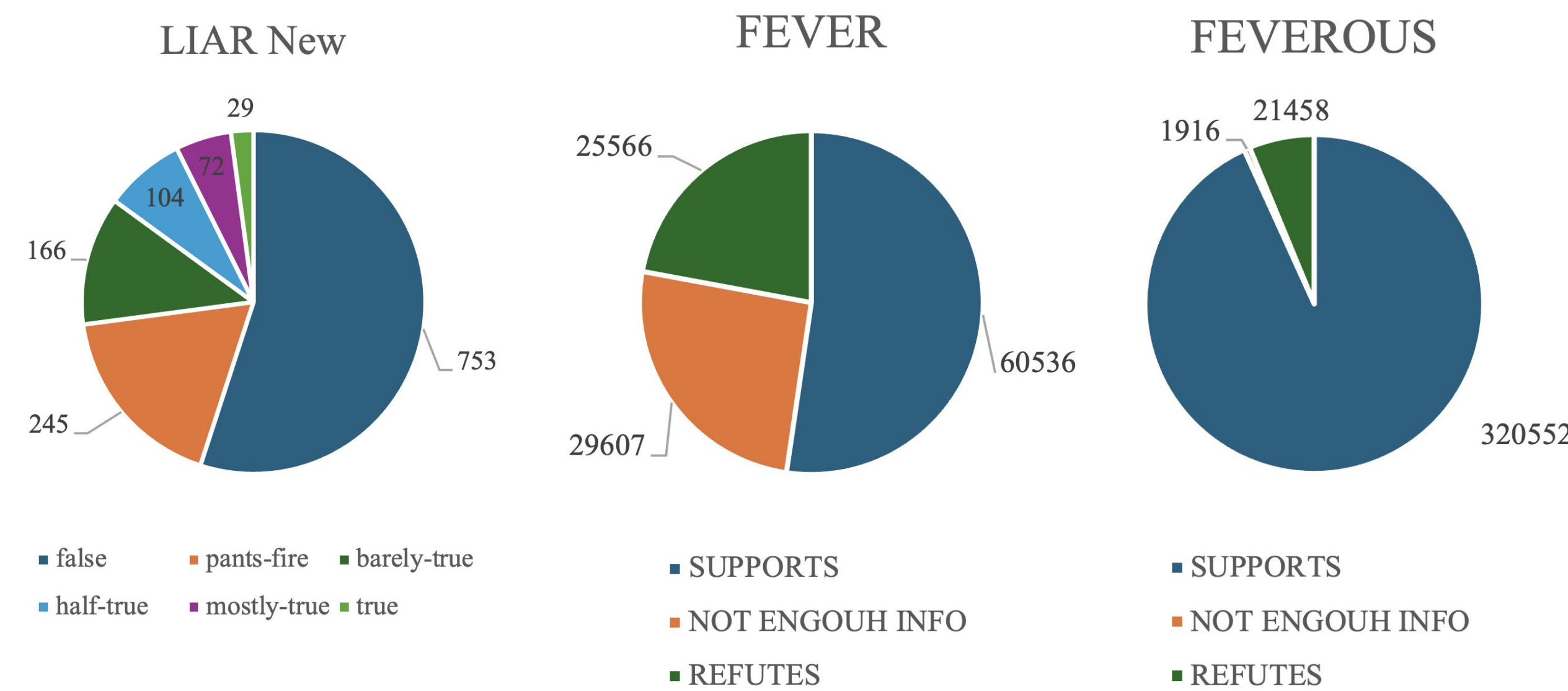- Even more prevalent and rampant with the release of LLMs

Evidence-Based Detection

1. Reason with **claim decomposition**
2. Generate **queries**, gather evidence.
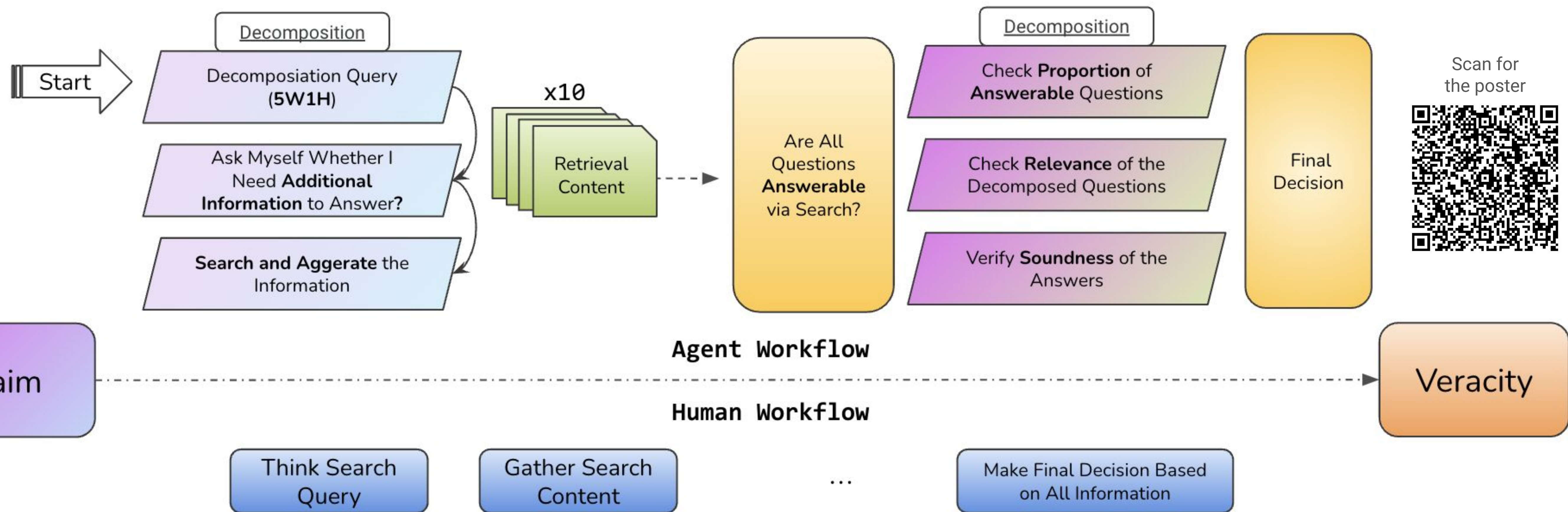3. Provide evidence through **RAgent**

Methodology

Multi-agent Framework
- Offline LLM agent: main conductor Strong reasoning needed
- Search agent:
  ○ *Google Search* – Web Search Engine
  ○ *DuckDuckGo* – Summarization of top 10 web sites (traditional web engine)
- Test w/ GPT-4o-mini, GPT-4o-preview on LIAR-NEW, FEVER, FEVEROUS.

Dataset Statistic

LIAR New
29
72
104
166
245
753

- false
- half-true
- pants-fire
- mostly-true
- barely-true
- true

FEVER
25566
29607
60536

- SUPPORTS
- NOT ENGOUH INFO
- REFUTES

FEVEROUS
1916 21458
320552

- SUPPORTS
- NOT ENGOUH INFO
- REFUTES

Resampling the *FEVER* and *FEVEROUS*, with balanced Supports and Refutes items for following test.

Agent Workflow

Human Workflow

Scan for the poster

Results

LIAR NEW	WikiChat GPT-3.5	HiSS GPT-3.5 (Zhang & Gao 2023)	HiSS GPT-3.5 Binary (Zhang & Gao 2023)		HiSS GPT-4 (Zhang & Gao 2023)
	54.00%	60.60%	62.70%		56.10%
RAG Evidence Based	EB + Offline	Cohere RAG	ΔF1	DuckDuckGo	ΔF1
claude3-haiku	64.1% ± 3.6%	71.3% ± 6.6%	+7.2%	67.1% ± 6.6%	+3.0%
gpt-3.5-turbo	59.3% ± 5.8%	64.7% ± 5.3%	+5.4%	60.3% ± 9.9%	+1.0%
gpt-4-0125	58.9% ± 7.7%	71.7% ± 4.5%	+12.8%	70.3% ± 8.5%	+11.4%
Ours	Offline	Google	ΔF1	DuckDuckGo	ΔF1
gpt-4o-mini	55.6% ± 4.2%	68.9% ± 4.3%	+13.3%	68.3% ± 5.5%	+12.7%
gpt-4o	56.1% ± 5.7%	**72.1% ± 4.1%**	+15.0%	70.7% ± 3.2%	+14.6%

Qualitative Analysis

Component	Description
Query	*In the World Veteran Championship for ITHF Thomas Petersson won in 2005, Alexey Titov of Russia is the only player to win twice.*
Decomposition	Enrichment: **'when'**: ['In which month and day did Thomas Petersson win the World Veteran Championship in 2005?'], **'where'**: ['Where was the World Veteran Championship held in 2005?'], **'what'**: ['What specific events or criteria define the World Veteran Championship for ITHF?'], **'who'**: ['Who are the other notable players who have competed in the World Veteran Championship besides Thomas Petersson and Alexey Titov?'], **'why'**: ['Why is Alexey Titov considered the only player to win the World Veteran Championship twice?'], **'how'**: ['How did Thomas Petersson and Alexey Titov achieve their victories in the World Veteran Championship?']}

Search Engine Powered Response (Summarized)	**When**: In 2005, the World Championship took place in Riga, Latvia, on **June 4th and 5th** **Where**: In 2005, the World Championship took place in **Riga**, Latvia, on June 4th and 5th **What**: To win the World Veteran Championship organized by the International Table Hockey Federation (ITHF), competitors must meet certain criteria, which include: 1. **Age Requirement**: Players must meet the age threshold set by the ITHF 2. **Club Affiliation**: Competitors may need to be affiliated with an ITHF-recognized club or national association 3. **Eligibility**: Players must not be barred from competition due to any disciplinary action or failure to meet the federation's standards. **Who**: Notable players who have competed in the World Veteran Championship include: • **Pontus Eriksson (Sweden)**: Winner of the veteran competition in 2009. • **Pavel Plesak (Czech Republic)**: Secured the veteran category title in 2007. • **Dmitriy Petrov (Russia)**: Crowned World Champion for veterans in 2011. • **Stanislav Lutay (Russia)**: Won the veterans' individual competition in 2015. **Why**: Alexey Titov is distinguished as the only player to have **won the World Veteran Championship twice,** achieving victories in 2013 and 2015 **How**: Both Thomas Petersson and Alexey Titov demonstrated exceptional skill and consistency to achieve their respective titles. ...
Final Output	- **Factuality**: "**False statement; Factuality: 1**", - **summary**: "Thomas Petersson won the veteran title at the 2005 World Veteran Championship held in Riga, Latvia. Alexey Titov is recognized as the only player to have won the championship twice, achieving victories in 2013 and 2015. These facts align with the verified history of the event.", - **key_facts**: ["Thomas Petersson of Sweden won the veteran category at the 2005 World Veteran Championship.", "Alexey Titov of Russia won the World Veteran Championship twice, in 2013 and 2015, and is the only player to have done so.",.../]
GT	**False Statement**

Conclusion and Future Direction

- Retrieval can hugly **improve the performance** of detecting misinfor.
- Simulating human workflow with powerful LLMs is still **helpful**.
- From human workflow, **enhance the interpretability** of reasoning chain.
- In future, we target to scale up the system through parallel search.
- And incorporate human feedback loops to continuously improve decomposition and verification strategies, with auto workflow generation.
- Expand the framework to handle multi-modal claims and evidence, such as video.