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PACAR: Automated Fact-Checking with Planning and Customized Action Reasoning using Large Language Models

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Background

- The widespread misinformation has prompted a pressing need to develop automated fact-checking tools.
- Verifying the veracity of claims is an intricate task that requires a thorough understanding of the claim and the accompanying evidence that either supports or contradicts it.

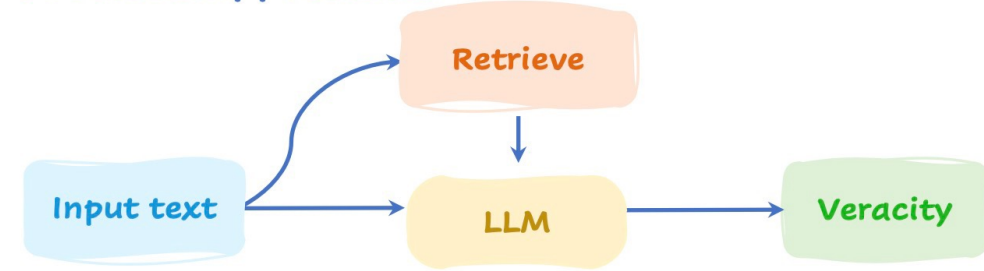
Current Challenges:

1. Previous approaches that rely on a single sequence of actions for decision-making
2. Make veracity judgments based on the collected evidence in only one step

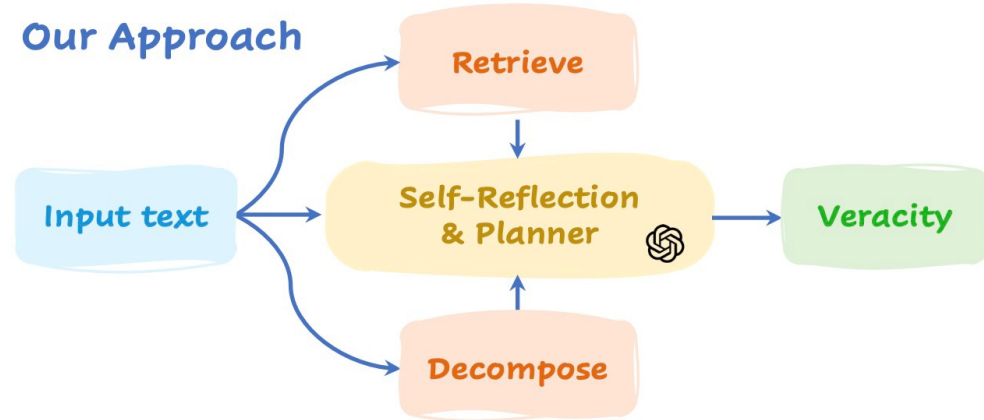
Our Approach aims to

1. Provide an explainable reasoning process for the parts of a complex claim.
2. Leverage the instruction-following capability of the LLM to decompose the claim.
3. Adaptively retrieve external resources to aid in assessing the veracity of claims.

Previous Approaches



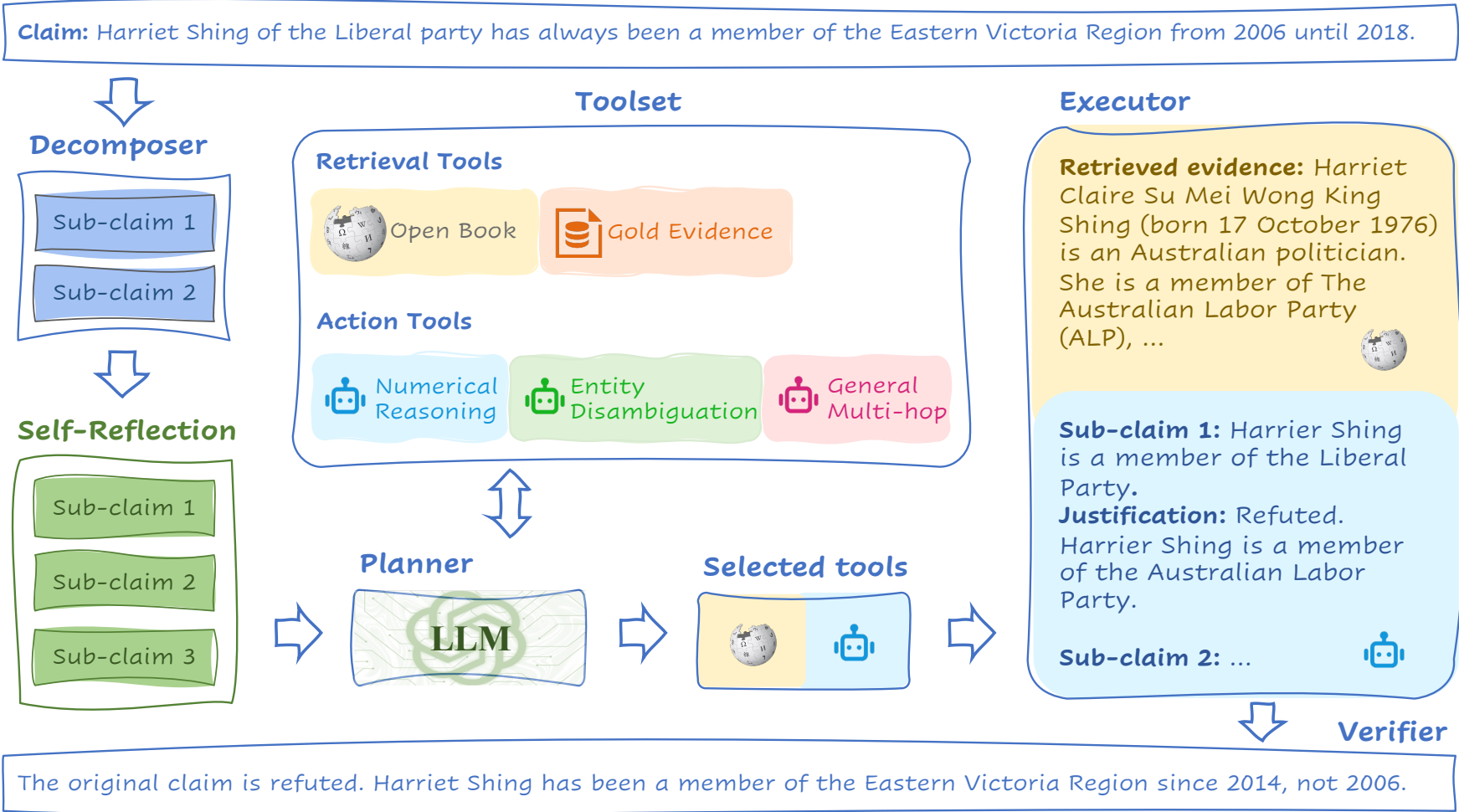
Our Approach



Contribution

1. We propose a novel automated fact-checking framework comprising four components, each designed to enhance the utility of LLMs or tailored to **accommodate the specific characteristics of fact-checking tasks**.
2. We design a novel **self-reflection module** to proactively address potential error accumulation within the pipeline. Additionally, **our customized agents** are strategically crafted to adeptly improve the inference process, ensuring accurate reasoning from multiple evidence sources.
3. Our proposed **zero-shot framework** outperforms all the baselines, spanning various categories, such as LLM-based, few-shot, and conventional fine-tuning methods.

Framework



Method

- **Claim decomposer with self-reflection:** break down complex claims into sub-claims, backward self-reflection, aimed at enhancing the reliability of the decomposition process.

$$C \leftrightarrow \{c_1, c_2, \dots, c_k\}$$

- **Planner module:** utilize a customized toolset to manage actions at each reasoning step, including Retrieval Planner and Action Planner
- **Executor:** execute the plan, including Evidence Executor and Action Executor.
- **Verifier module:** assess the veracity of the original claim and generates explanations based on the overall reasoning process.

Experimental Results

Models	OPEN-BOOK					GOLD-EVIDENCE				
	HOVER			FEVEROUS	SciFact	HOVER			FEVEROUS	SciFact
	2-hop	3-hop	4-hop			2-hop	3-hop	4-hop		
Fine-tuning										
BERT-FC	50.68	49.86	48.57	51.67	-	53.40	50.90	50.86	74.71	-
LisT5	52.56	51.89	50.46	54.15	-	56.15	53.76	51.67	77.88	-
RoBERTa-NLI	63.62	53.99	52.40	57.80	-	74.62	62.23	57.98	88.28	-
MULTIVERS	60.17	52.55	51.86	56.61	44.90	68.86	59.87	55.67	86.03	<u>72.54</u>
Few-shot										
CodeX	65.07	56.63	57.27	62.58	-	70.63	<u>66.46</u>	63.49	89.77	-
FLAN-T5	69.02	60.23	55.42	63.73	-	73.69	65.66	58.08	90.81	-
ProgramFC	<u>69.36</u>	<u>60.63</u>	<u>59.16</u>	<u>67.80</u>	<u>56.34</u>	<u>74.10</u>	66.13	<u>65.69</u>	<u>91.77</u>	71.82
Zero-shot										
ChatGPT	66.94	60.56	58.73	55.72	45.32	71.42	64.87	63.65	83.49	65.60
PACAR (Ours)	73.13	64.07	63.82	72.61	61.24	76.86	70.10	69.95	94.43	75.06

Table 2: Main results (macro-F1 in %) on of HOVER, FEVEROUS, and SciFact datasets. The best and second-best results in each column are in **bold** and underlined respectively.

Experimental Results

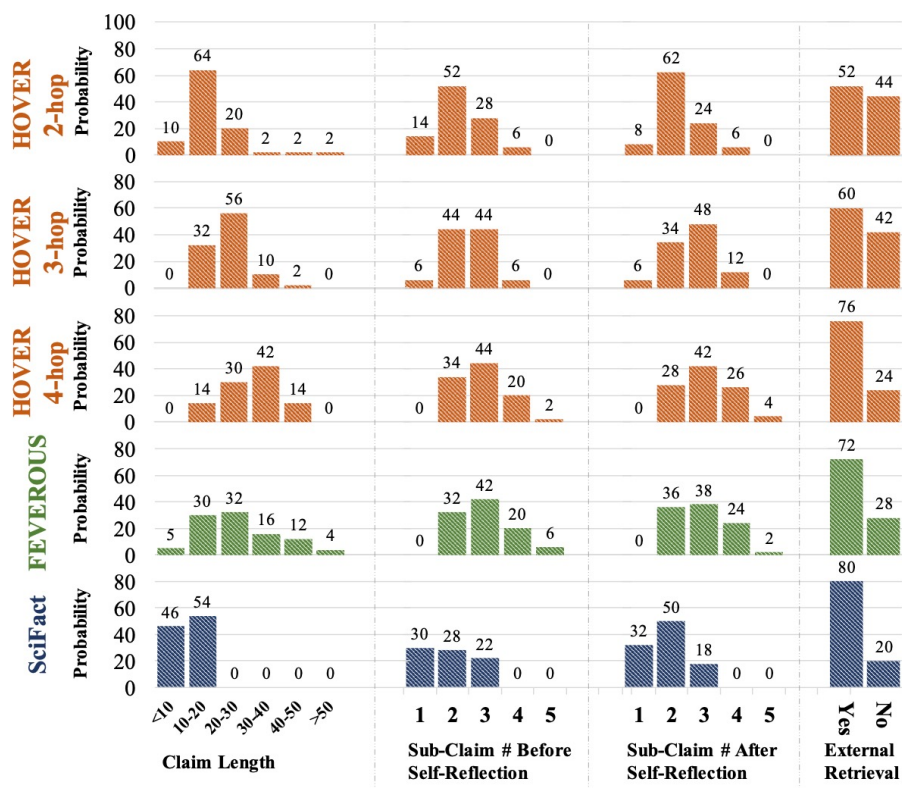


Figure 5: Distribution of the length of claims, the number of sub-claims, and whether need to retrieve evidence, respectively.

Source	Example
	Claim: Harrier Shing of the Liberal party has always been a member of the Eastern Victoria Region from 2006 until 2018.
	Decomposition: Sub-claim 1: Harrier Shing was a member of the Liberal Party from 2006 until 2018. Sub-claim 2: Harrier Shing was a member of the Eastern Victoria Region from 2006 until 2018.
	Self-Reflection: Sub-claim 1: Harrier Shing is a member of the Liberal party. Sub-claim 2: Harrier Shing is a member of the Eastern Victoria Region. Sub-claim 3: Harrier Shing was a member of the Eastern Victoria Region from 2006-2018.
	Retrieve: Yes
	Harriet Claire Su Mei Wong King Shing (born 17 October 1976) is an Australian politician. She is a member of The Australian Labor Party (ALP), also simply known as Labor, is the major centre-left political party in Australia and one of two major parties in Australian politics, along with the centre-right Liberal Party of Australia. Australian Labor Party member of the Victorian Legislative Council, having represented the Eastern Victoria Region since 2014. Shing is the first openly lesbian member of the Parliament of Victoria.
	Retrieve Result:
	Sub-claim 1: REFUTED. Harrier Shing is a member of the Australian Labor Party.
	Sub-claim 2: SUPPORTED. Harrier Shing has been a member of the Eastern Victoria Region since 2014.
	Sub-claim 3: REFUTED. Harrier Shing has been a member of the Eastern Victoria Region since 2014.
	Claim Veracity: REFUTES
	Overall Reason: Harriet Shing has been a member of the Eastern Victoria Region since 2014, not 2006.

Thank You!