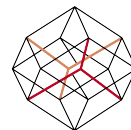# EXPLAINABLE FACT-CHECKING THROUGH QUESTION ANSWERING

Jing Yang[1], Didier Vega-Oliveros[1], Tais Seibt[2], Anderson Rocha[1]

[1] Artificial Intelligence Lab., Recod.ai, Institute of Computing, University of Campinas, Brazil
[2] Department of Journalism, Universidade do Vale do Rio dos Sinos, Brazil

Why Explainable Fact-checking?
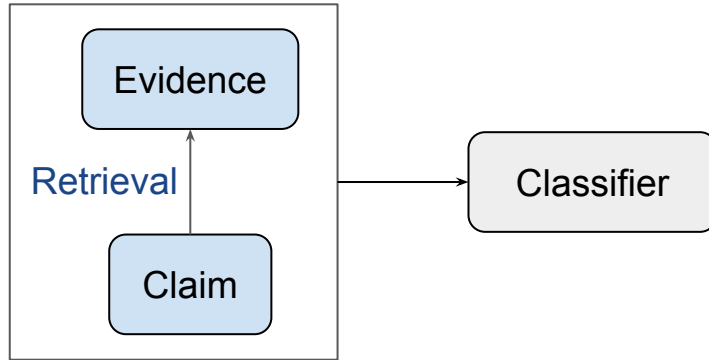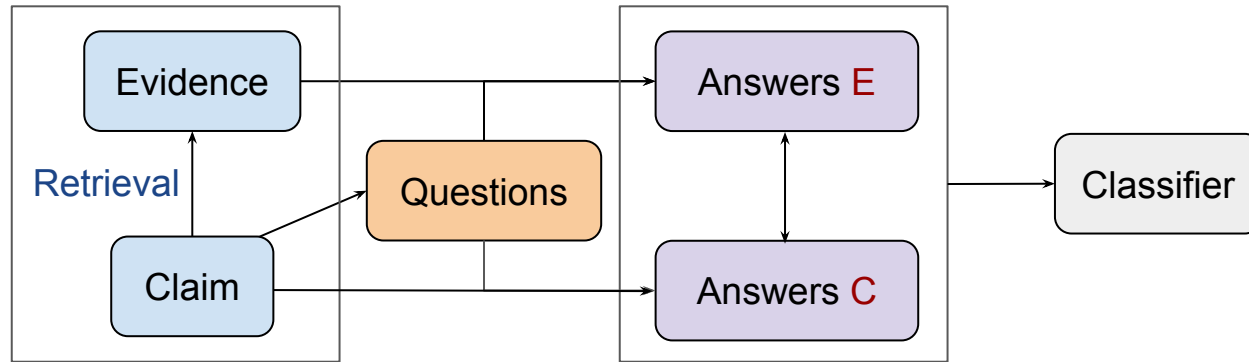

Transparency

Detail

Simplicity

Question Answering as a Proxy

Traditional pipeline

Question Answering as a Proxy

QA pipeline: extract answer pairs as rationales

Question Answering as a Proxy

QA pipeline: extract answer pairs as rationales

Claim: *Lee MacPhail passed away at his home at the age of 92.*

Evidence: *MacPhail lived in Delray Beach, Florida, where he died November 8, 2012, at his home. He was 95. At time of his death he was the oldest living Hall of Famer.*

Question	Answer for claim	Answer for evidence
Who passed away at home?	*Lee MacPhail*	*MacPhail*
How old was MacPhail when he died?	**92**	**95**
Where did MacPhail die?	*at his home*	*Delray Beach, Florida, at his home*

Research Questions

Q1: Given a claim to be checked, how to automatically **generate questions related to** its **factuality**?

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Q1: Given a claim to be checked, how to automatically **generate questions related to** its **factuality**?

Q2: Given answer pairs asked from claim and evidence, respectively, how to **compare their similarities** and **aggregate the results** to provide a prediction?

Proposed Pipeline
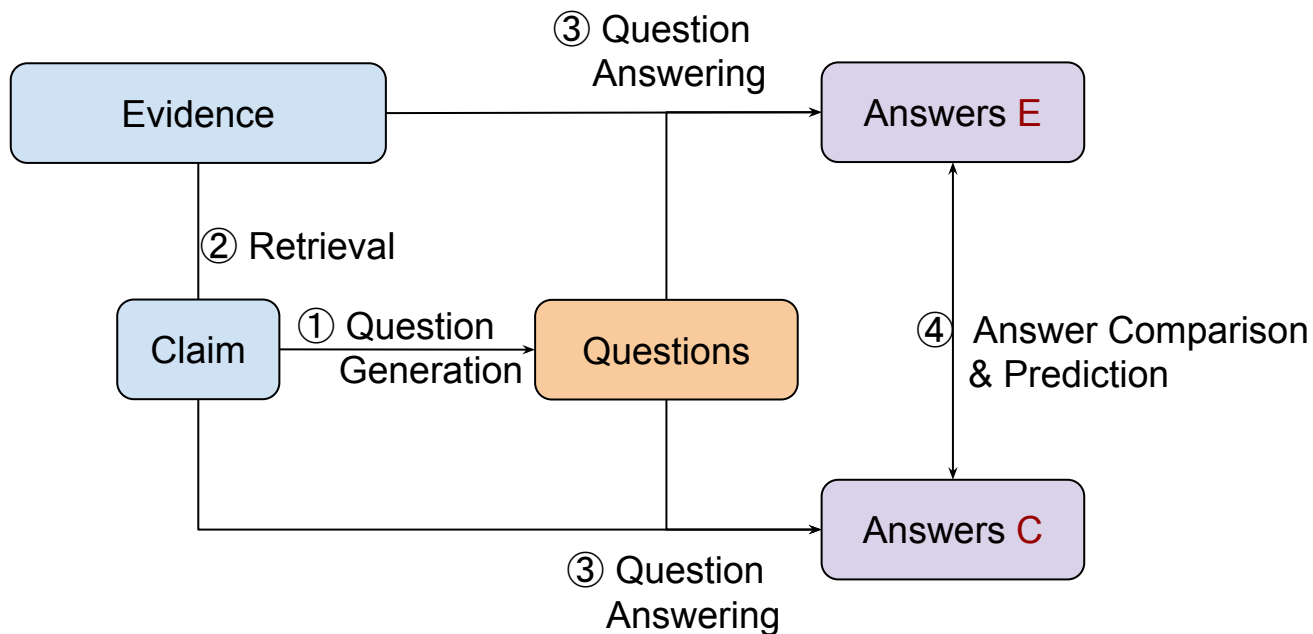
Current Methodology
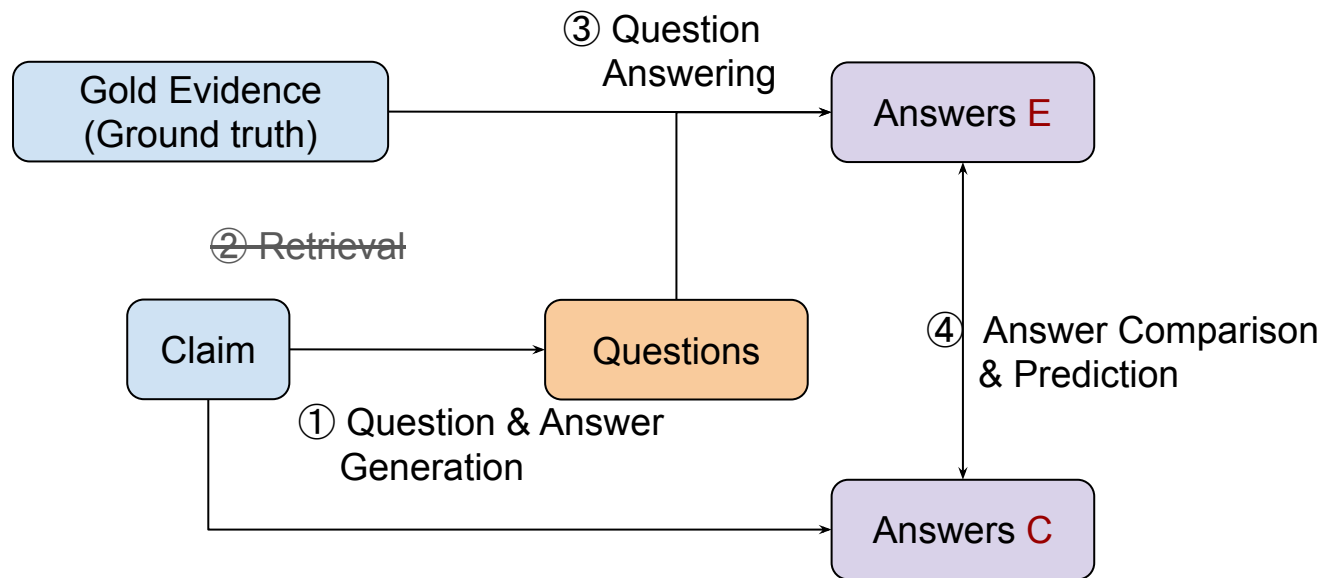
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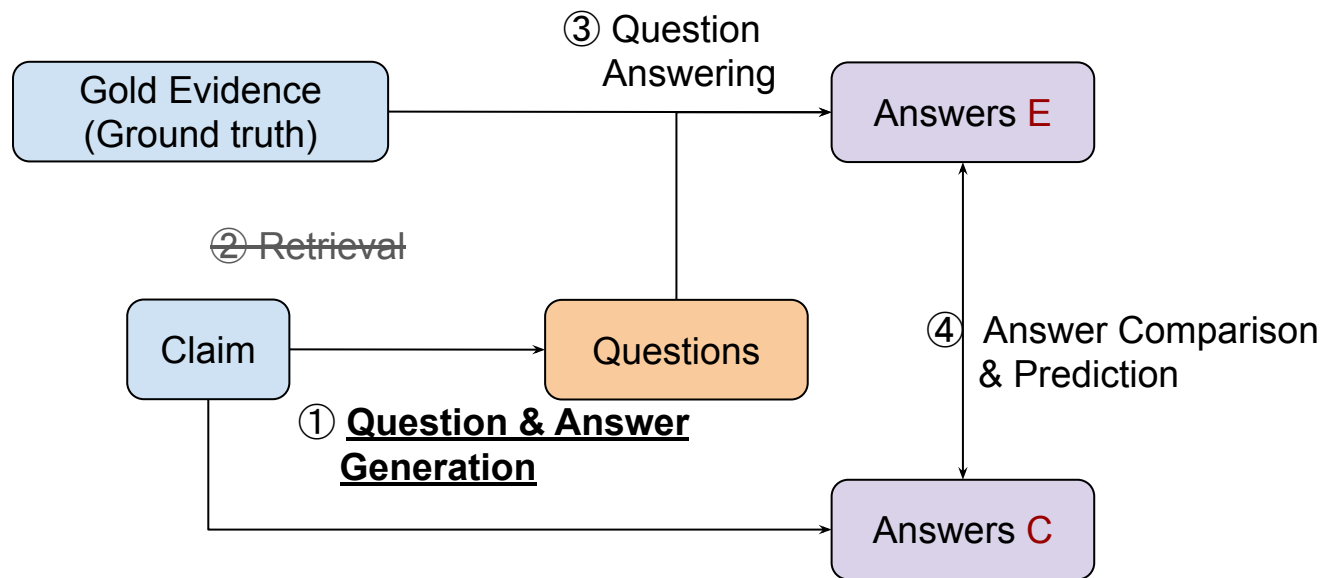
① Fine-tuning BART on the SQuAD and NewsQA datasets [1]

[1] Nan, Feng, et al. "Improving Factual Consistency of Abstractive Summarization via Question Answering." ACL-IJCNLP 2021.

Current Methodology

① Fine-tuning BART on the SQuAD and NewsQA datasets [1]

③ Apply *deepset/bert-large-uncased-whole-word-masking-squad2*

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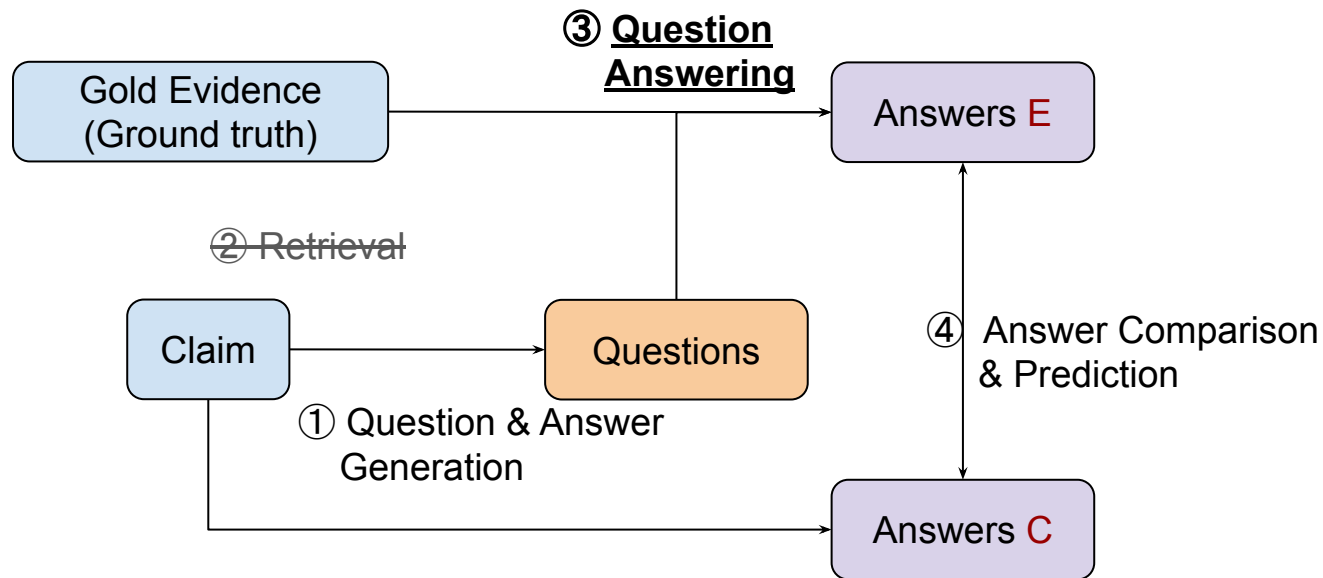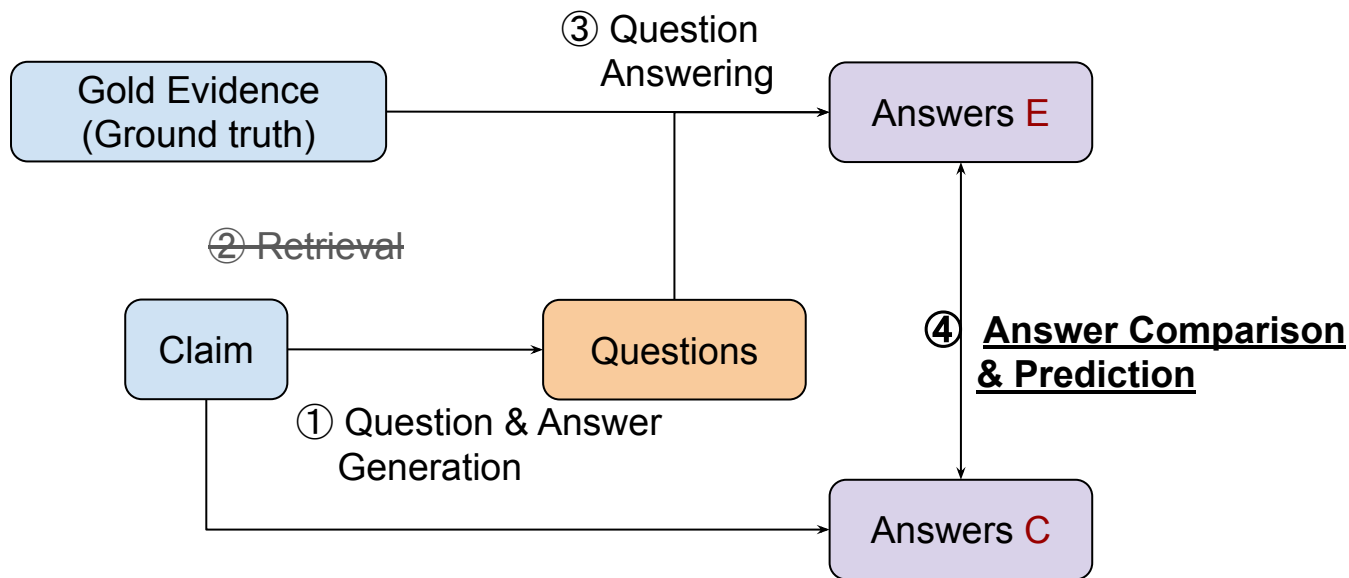
Proposed Answer Pair Comparison
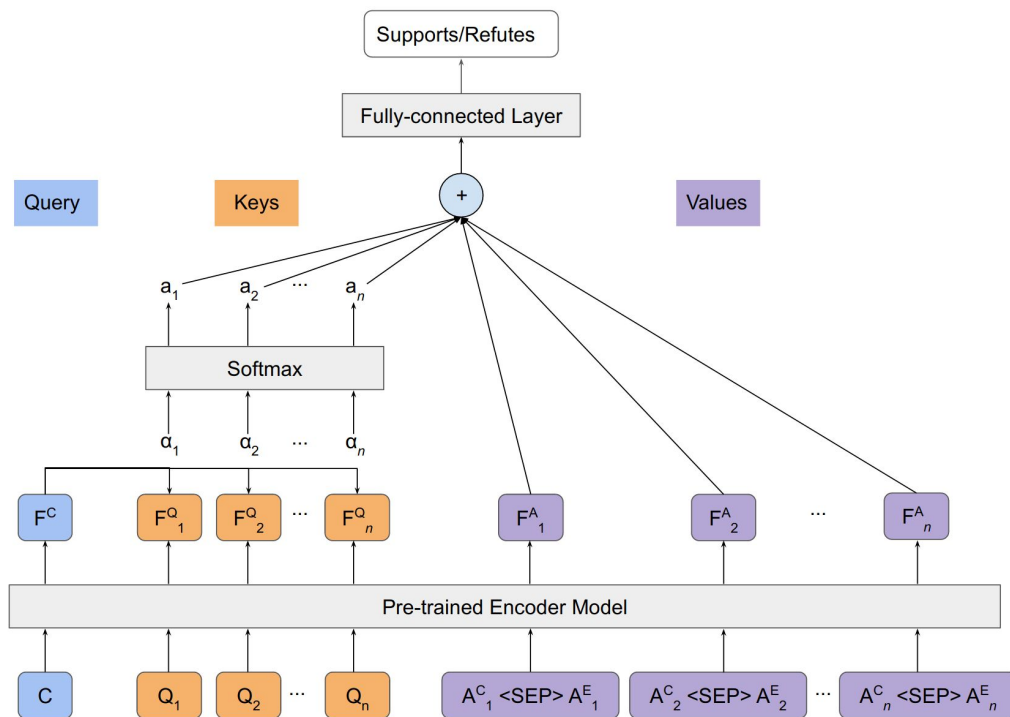
$$f_{\text{att}}\left(F^C, F^Q{}_j\right) = \mathbf{W}_3 \tanh\left(\mathbf{W}_1 F^C + \mathbf{W}_2 F^Q{}_j\right)$$

$$a_j = \text{softmax}(f_{\text{att}}\left(F^C, F^Q{}_j\right))$$

$$\mathbf{F} = \sum_j a_j F_j^A$$

Dataset

Fool-Me-Twice (FM2) [2]

	Claims	Entailed Proportion	Pages	Avg. # Tokens	
				Claim	Evidence
Train	10,419	49.2%	1,811	15	30
Dev	1,169	51.0%	209	15	31
Test	1,380	49.4%	234	15	31
Total	12,968	49.4%	2,254	15	30

Stage 1: Players write claims to fool others

"Venus's craters are difficult to measure due to erosion."

Stage 2: Players mark evidence that entails/refutes the claim

On Earth it is caused by wind and rain erosion. On Venus, about 85% of the craters are in pristine condition. Venusian craters range from 3 to 280 km.

Stage 3: Players spot the refuted claim

"Snoop Dogg portrayed Moses in a rap battle"

"Venus's craters are difficult to measure due to erosion."

Stage 4: Players get points

Players that correctly spotted the refuted claim and authors of challenging claims are rewarded — 100

Repeat

Stage 5: Automatically build dataset

Keep highest quality claims with their selected evidence — FM2

[2] Eisenschlos, Julian, et al. "Fool Me Twice: Entailment from Wikipedia Gamification." *NAACL*. 2021.

Comparison with baselines

Methods	Dev Acc	Test Acc
Blackbox (**No X-AI**)	**76.17±1.23**	**74.58±1.66**
QUALS	56.12	56.01
BERTscore	58.68	62.32
Cosine similarity	61.16	62.75
F1-score	64.07	63.77
Attention C-Q-AA (**Ours, X-AI**)	<u>75.44±0.52</u>	<u>73.43±0.83</u>

Fact-checking label accuracy of different methods

Ablation Study
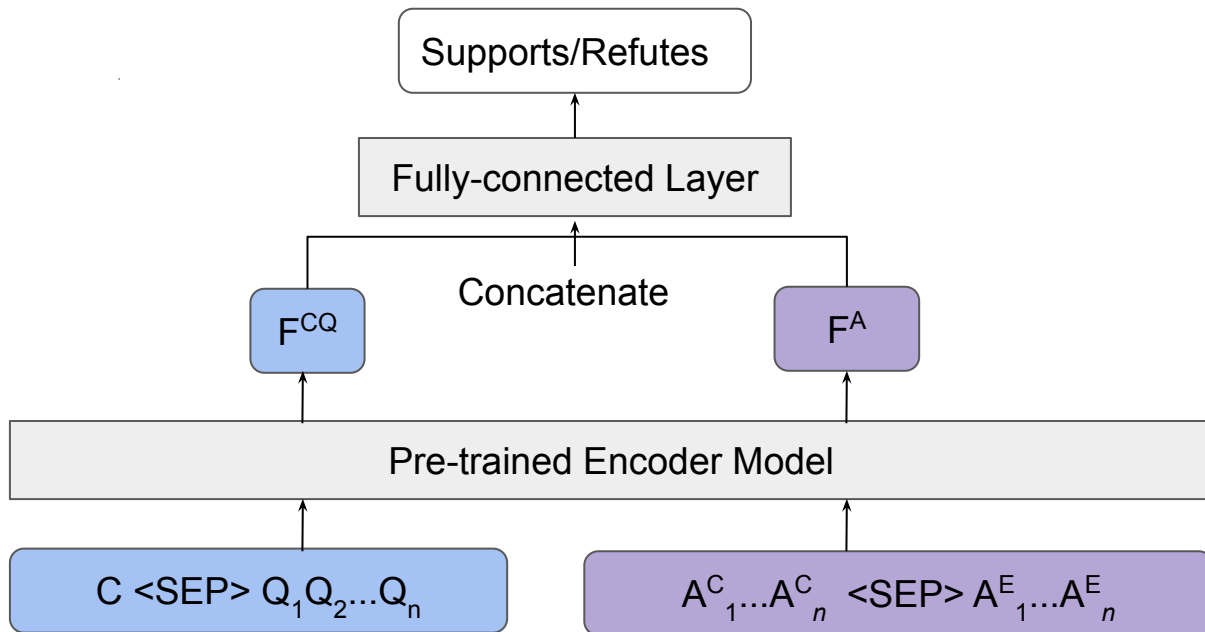
Ablation Study

Inputs	Dev Acc	Test Acc
C	59.15±1.22	61.57±1.67
Q	56.22±1.37	56.90±0.90
AA	74.15±1.33	72.61±1.04
Q AA	74.46±0.80	72.62±1.59
C Q AA	74.88±0.81	72.89±1.14
Attention C-Q-AA	**75.44±0.52**	**73.43±0.83**

Ablation study of the model without attention

Attention Visualization

Example 1

Claim: *Lee MacPhail passed away at his home at the age of 92.*
Evidence: *MacPhail lived in Delray Beach, Florida, where he died November 8, 2012, at his home. He was 95. At time of his death he was the oldest living Hall of Famer.*
Predicted label: REFUTES
Gold label: REFUTES

Question	Answer for claim	Answer for evidence	Attention weight (%)
How old was MacPhail when he died?	*92*	*95*	12.17
Where did MacPhail die?	*at his home*	*Delray Beach, Florida*	4.29
Who died at the age of 92?	*MacPhail*	*no_answer*	1.66
When did MacPhail die?	*at the age of 92*	*November 8, 2012*	3.23
What was MacPhail's age?	*92*	*95*	13.19
At what age did MacPhail die?	*92.*	*95*	18.87
Where did MacPhail die?	*his home*	*Delray Beach, Florida*	4.29
What age was MacPhail when he died?	***92.***	***95***	**20.67**
At what age did MacPhail die?	*92*	*95*	18.87
Who died at age 92?	*MacPhail*	*no_answer*	2.75

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Attention Visualization

Example 2

Claim: *Gordon was listed **7th** in **MLB history** in double plays.*

Evidence: *He ranked **sixth** in **major league history** in double plays (1,160) upon retiring, and was sixth in AL history in games (1,519), putouts (3,600), assists (4,706) and total chances (8,566) and seventh in fielding percentage (.970).*

Predicted label: REFUTES
Gold label: REFUTES

Question	Answer for claim	Answer for evidence	Attention weight (%)
Where is he ranked in MLB history in double plays?	7th	sixth	28.91
How many double plays did he play?	7	1,519	4.30
In what position is MLB history in double plays?	7th in MLB history	no_answer	8.10
Along with double plays, what is a notable accomplishment of Babe Ruth?	double plays	sixth in AL history	4.54
With whom was Babe Ruth listed 7th of all time in double plays?	MLB history	no_answer	9.72
Betts ranks 7th in MLB history with what type of double plays?	double plays.	no_answer	8.36
What rank is Cabrera listed in MLB history in double plays?	7th	sixth	21.61
What rank did the MLB list Bonds' double plays in?	7th in MLB history	sixth	3.82
Bauer ranks 7th in MLB history with what type of double plays?	double plays	no_answer	6.35
How many double plays did he play?	7th	1,519	4.30

Attention Visualization

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Conclusion

A novel fact-checking pipeline with **QA as a proxy**

An answer comparison model with **attention mechanism**

Future Work

Improve **question generation quality**

Study the **impact of evidence retrieval** on the pipeline

THANK YOU!

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Didier Vega-Oliveros: davo@unicamp.br
Tais Seibt: tseibt@unisinos.br
Anderson Rocha: arrocha@unicamp.br

Code & Data: https://github.com/jingyng/explainable-fact-checking

Question Answering as a Proxy

QA pipeline: extract answer pairs as rationales

Claim: *Lee MacPhail passed away **at his home** at the age of **92***.

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Rationale Extraction and Alignment