

MultiVerS

Improving scientific claim verification with weak supervision and full-document context

CS221.O12.KHCL

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Group 15

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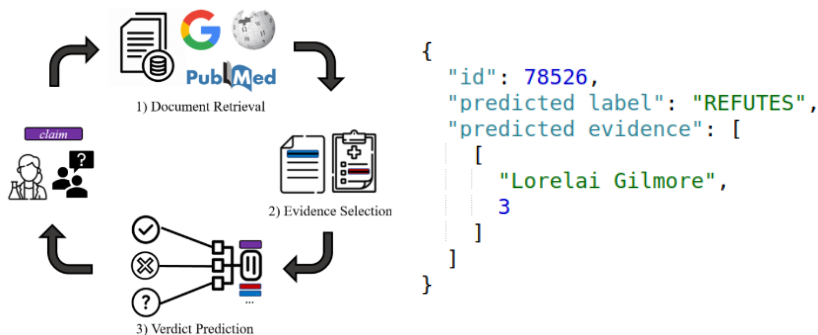
December 17, 2023

Definition of scientific claim verification from the SCIFACT task:

Given a claim c and a collection of *candidate abstracts*.

Label $y(c, a) \in \{SUPPORTS, REFUTES, NEI\}$.

Identify rationales $R(c, a) = \{r_1(c, a), \dots, r_n(c, a)\}$.



Claim:

Advil (ibuprofen) worsens
COVID-19 symptoms

Evidence abstract:**Covid-19 and avoiding
Ibuprofen.**

...

Increased risk of COVID-19
infection was feared with
ibuprofen use

...

At this time, there are no
findings discouraging the use
of ibuprofen

Claim:

Advil (ibuprofen) worsens
COVID-19 symptoms

Label: Refuted

Evidence abstract:**Covid-19 and avoiding
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Task Outputs

- ① Fact-checking label

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Task Outputs

- ① Fact-checking label
- ② Rationales justifying the label

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Rationale

Claim:

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Label: Refuted

Task Outputs

- ① Fact-checking label
- ② Rationales justifying the label

Evidence abstract:

Covid-19 and avoiding Ibuprofen.

...

Increased risk of COVID-19 infection was feared with ibuprofen use

Context required

...

At this time, there are no findings discouraging the use of ibuprofen

Rationale

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Evidence abstract:

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Prior work: Extract-then-label

Claim:

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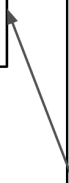
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Drawbacks of extract-then-label:

- ① Rationales may lack context
- ② Requires rationale supervision during training

These models make predictions in 2 steps:

Predict rationales $\hat{R}(c, a) = \{\hat{r}_1(c, a), \dots \hat{r}_n(c, a)\}$

Then, make a label prediction $\hat{y}(c, f_R(\hat{R}(c, a)))$

Given a claim c and candidate abstract a

A multitask system for full-context scientific claim verification

- Predict $\hat{y}(c, a)$ directly based on an encoding of the entire claim and abstract.
- Enforce consistency of $\hat{R}(c, a)$ with $\hat{y}(c; a)$ during decoding.

Long document encoding:

A claim c and candidate abstract a consisting of title t and sentences s_1, \dots, s_n .

The $\langle /s \rangle$ token following each sentence s_i is notated as $\langle /s \rangle_i$.

$$\langle s \rangle \ c \ \langle /s \rangle \ t \ \langle /s \rangle \ s_1 \ \langle /s \rangle_1 \ \dots s_n \ \langle /s \rangle_n$$

Global attention is assigned to $\langle s \rangle$ token, all tokens in c and all $\langle /s \rangle$ tokens.

Claim

Advil (ibuprofen)
worsens COVID-19
symptoms

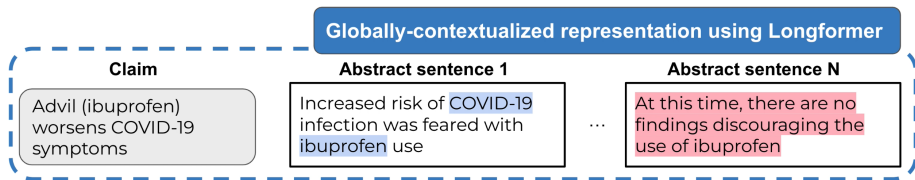
Abstract sentence 1

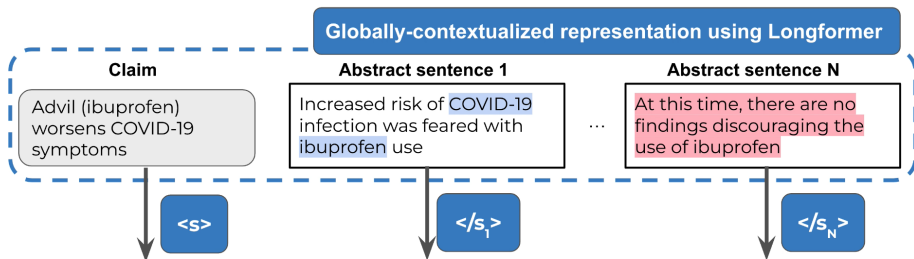
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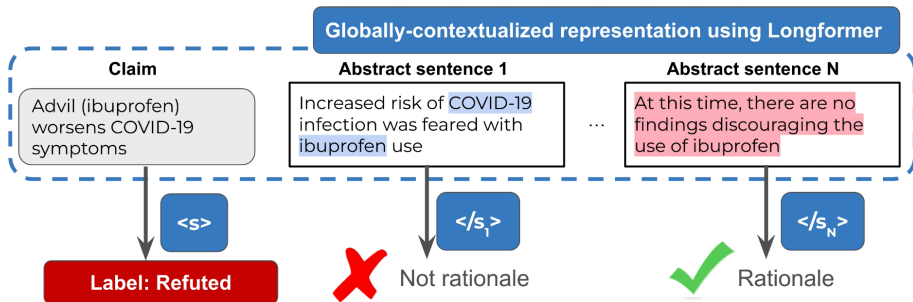
Abstract sentence N

At this time, there are no
findings discouraging the
use of ibuprofen



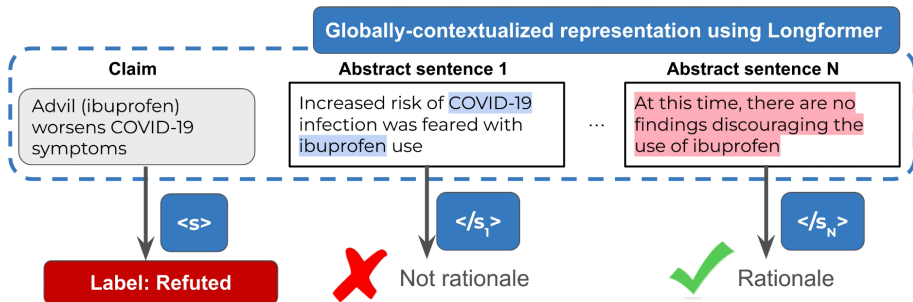


Rationale Prediction: The model analyzes each sentence's ending `</s>` to decide if it justifies the claim, using a binary classification.



Label Prediction: A special $\langle s \rangle$ token captures the essence of both the claim and the abstract through "global attention".

→ Enabling accurate fact-checking label prediction for the abstract.



$$\mathcal{L} = \mathcal{L}_{label} + \lambda_{rationale} \mathcal{L}_{rationale}$$

Benefits of multitask approach:

- ① Incorporates all relevant context
- ② Can train on instances with no rationale annotations

Experiments

Dataset	Domain	Claim source	Open	Has NEI	Claim complexity	Negation method	Train claims	Eval claims	> 512 tokens
HealthVer	COVID	TREC-COVID	✗	✓	Complex	Natural	1,622	230	14.9%
COVIDFact	COVID	Reddit	✗	✗	Complex	Automatic	903	313	12.4%
SCIFACT	Biomed	Citations	✓	✓	Atomic	Human	1,109	300	27.4%
FEVER	Wiki	Wikipedia	-	✓	Atomic	Human	130,644	-	33.2%
PUBMEDQA	Biomed	Paper titles	-	✓	Complex	Automatic	58,370	-	12.1%
EVIDENCEINFERENCE	Biomed	ICO prompts	-	✓	Atomic	Automatic	7,395	-	42.7%

Table: Summary of datasets used in experiments

Experiments

Target datasets:

- HealthVer
- COVID-Fact
- SciFact

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Roughly 1000 claims / dataset.

Expert annotations are expensive

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Traning procedure:

- **Stage 1:** Train on a combination of *labeled out of domain data* and *weakly-labeled in-domain data*.
- **Stage 2:** Continue training on data from each target dataset.

Experiments

Target datasets:

- HealthVer
- COVID-Fact
- SciFact

Roughly 1000 claims / dataset.

Expert annotations are expensive

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- **Stage 1:** Train on a combination of *labeled out of domain* data *weakly-labeled in-domain* data.
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Domain adaptation settings:

- **Zero-shot:** Stage 1 training only.
- **Few-shot:** 45 instances from target datasets.
- **Full-supervised:** All target data.

Data: Stage 1

Supervised out-of-domain
data (FEVER)

LeBron James was born in
Ohio

Label: Supported

LeBron James is an American
basketball player. He was born
in Akron, Ohio.

Data: Stage 1

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Label: Supported

LeBron James is an American basketball player. He was born in Akron, Ohio.

Weakly-supervised in-domain data

Diabetes increases risk of depression

Abstract

...
...
...

Label: Supported

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} Claim: Paper title

Abstract

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Rationales likely to appear in abstract, but are not annotated

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Label: Supported

Claim: Paper title

Rationales likely to appear in abstract, but are not annotated

MultiVerS can train on these examples, even though no rationale annotations are provided

Abstract-level evaluation:

- Identifying abstracts that SUPPORT or REFUTE each claim.
- Predicting the correct label $y(c, a)$ is sufficient

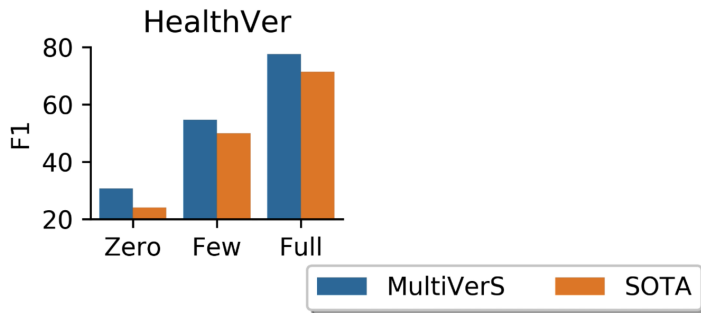
Sentence-level evaluation:

- It combines the accuracy of abstract-level label prediction with the precision of rationale identification.

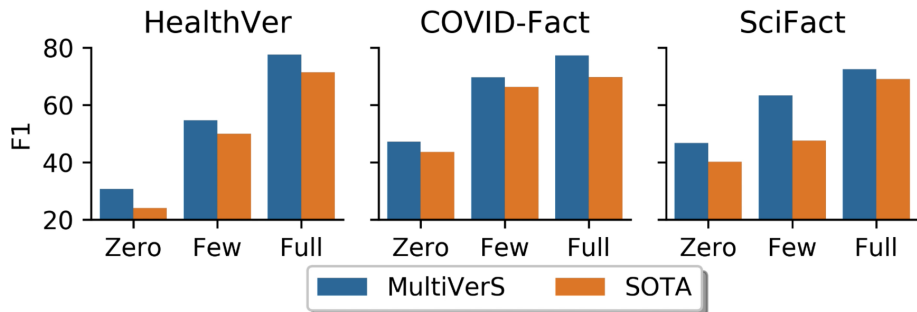
Setting	Model	HealthVer						COVIDFact						SciFact					
		Abstract			Sentence			Abstract			Sentence			Abstract			Sentence		
		P	R	F1	P	R	F1	P	R	F1	P	R	F1	P	R	F1	P	R	F1
Zero	PARAGRAPHJOINT	72.3	14.4	24.0	22.9	2.7	4.9	51.3	37.9	43.6	31.5	16.0	21.3	52.9	32.4	40.2	36.4	14.9	21.1
	MULTIVERS	60.6	20.5	30.7	25.0	4.6	7.8	48.8	45.7	47.2	32.7	18.5	23.6	49.0	44.6	46.7	39.0	21.6	27.8
Few	PARAGRAPHJOINT	62.7	41.6	50.0	46.0	29.3	35.8	73.3	60.6	66.3	44.3	30.6	36.2	44.4	51.4	47.6	33.0	35.1	34.0
	MULTIVERS	63.6	47.9	54.7	41.9	31.0	35.7	71.3	68.1	69.7	39.5	35.4	37.4	76.4	54.1	63.3	51.7	40.3	45.3
Full	VERT5ERINI	71.3	74.0	72.6	65.6	61.2	63.3	76.6	52.7	62.4	44.8	27.2	33.9	64.0	73.0	68.2	60.6	66.5	63.4
	PARAGRAPHJOINT	75.0	68.3	71.5	69.9	60.6	64.9	71.5	68.1	69.8	41.4	40.3	40.8	75.8	63.5	69.1	68.9	54.6	60.9
	MULTIVERS	78.9	76.3	77.6	71.4	67.0	69.1	77.3	77.3	77.3	41.5	46.1	43.7	73.8	71.2	72.5	67.4	67.0	67.2

Table 2: Performance of MultiVerS and baselines.

Results

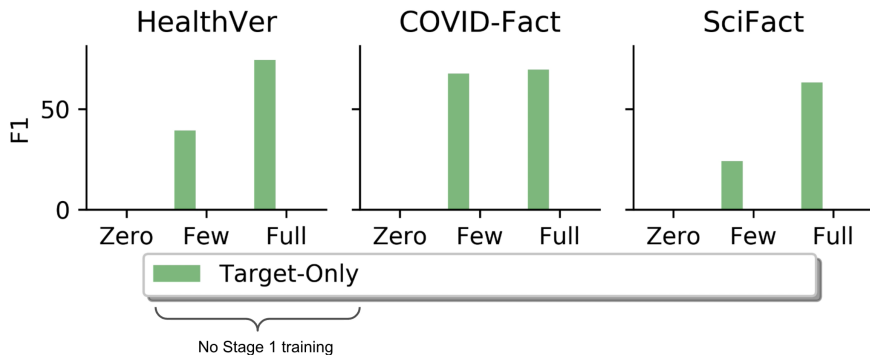


Results

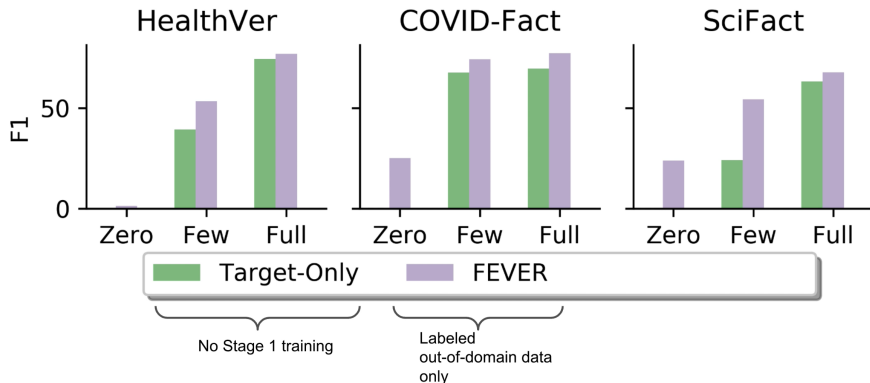


MultiVerS outperforms SOTA on all datasets

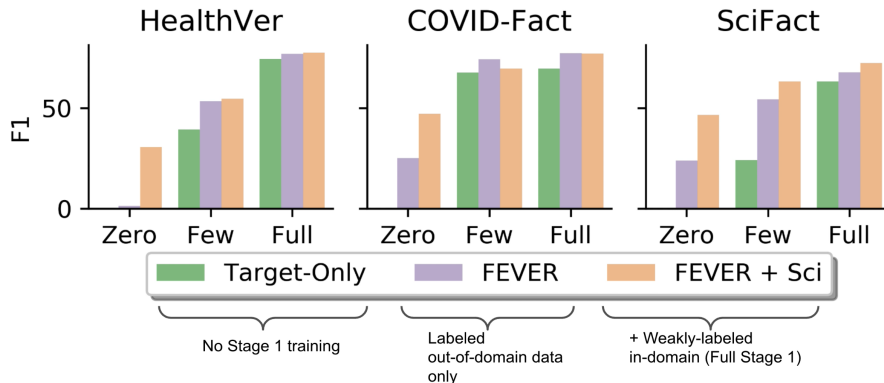
Ablations: Training strategy



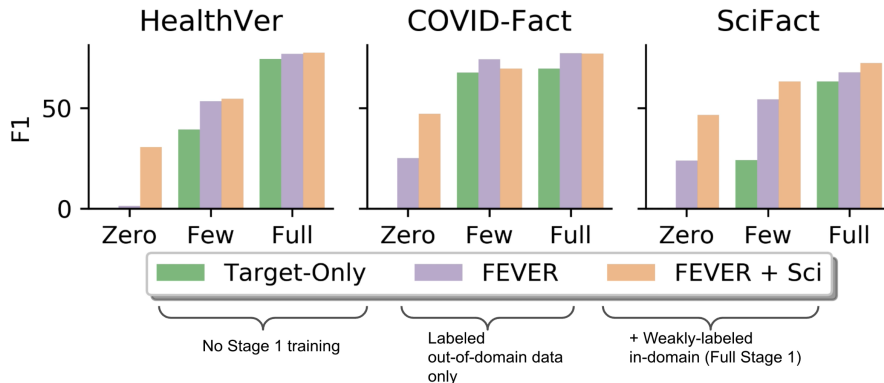
Ablations: Training strategy



Ablations: Training strategy



Ablations: Training strategy



Pretraining with weakly-supervised in-domain data improves few / zero shot performance.

Reference



MULTIVERS: Improving scientific claim verification with weak supervision and full-document context



Scientific Fact-Checking: A Survey of Resources and Approaches
Juraj Vladika and Florian Matthes



Longformer: The Long-Document Transformer
Iz Beltagy, Matthew E. Peters and Arman Cohan



[Code and model checkpoints for the MultiVerS model](#)
[dwadden/multivers](#)

Thanks for listening!

Q&A section