MultiVerS

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

CS431.O12.KHCL

Instructor: Nguyen Duy Khanh

Group 13

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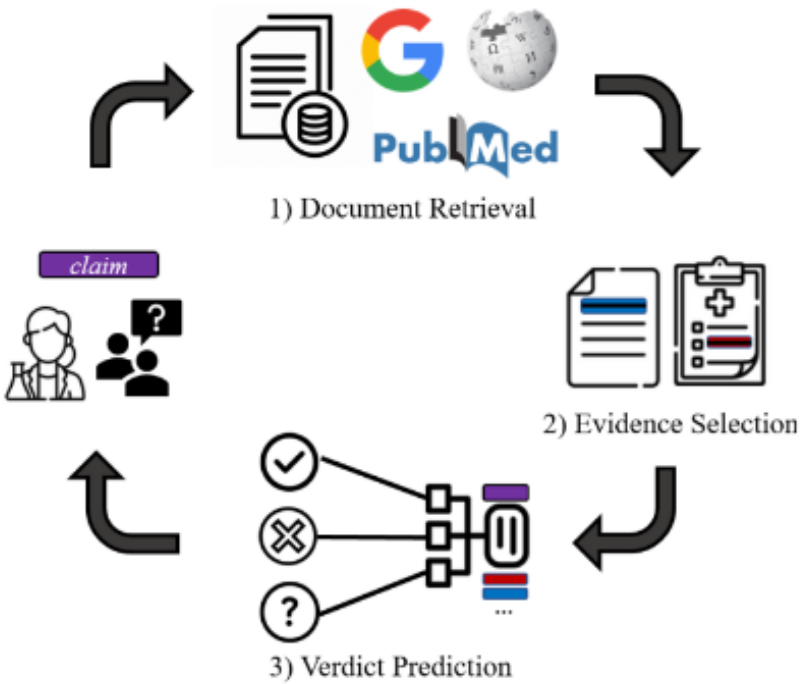
Task

Definition of scientific claim verification from the SCIFACT task:

Given a claim c and a *candidate abstract* a.

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

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

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  "predicted label": "REFUTES",
  "predicted evidence": [
    [
      "Lorelai Gilmore",
      3
    ]
  ]
}
```

Task

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

Task

Claim:

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Evidence abstract:

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Task Outputs

1. Fact-checking label

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

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Rationale

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Context required

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Prior work: Extract-then-label

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Drawbacks of extract-then-label:

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

Prior models

Given a claim c and candidate abstract a

These models make predictions in 2 steps:

Predict rationales $\hat{R}(c, a) = \{\hat{r_1}(c, a), ...\hat{r_n}(c, a)\}$

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

MultiVerS

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:

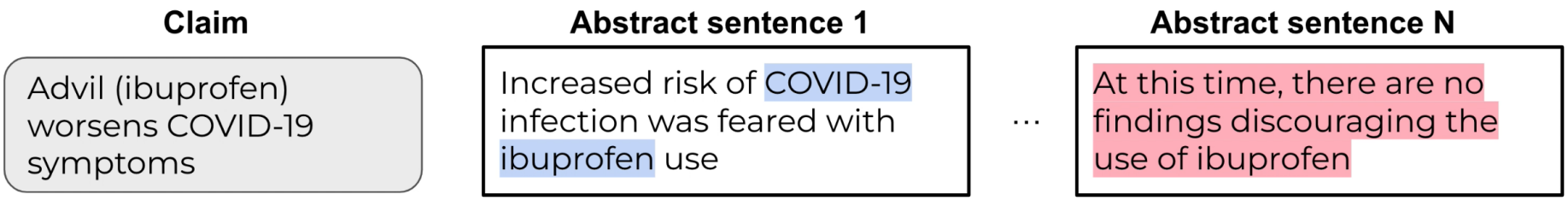
A claim c and candidate abstract a consisting of title t and sentences $s_1, ..., s_n$.

The $< /s >$ token following each sentence s_i is notated as $< /s >_i$.

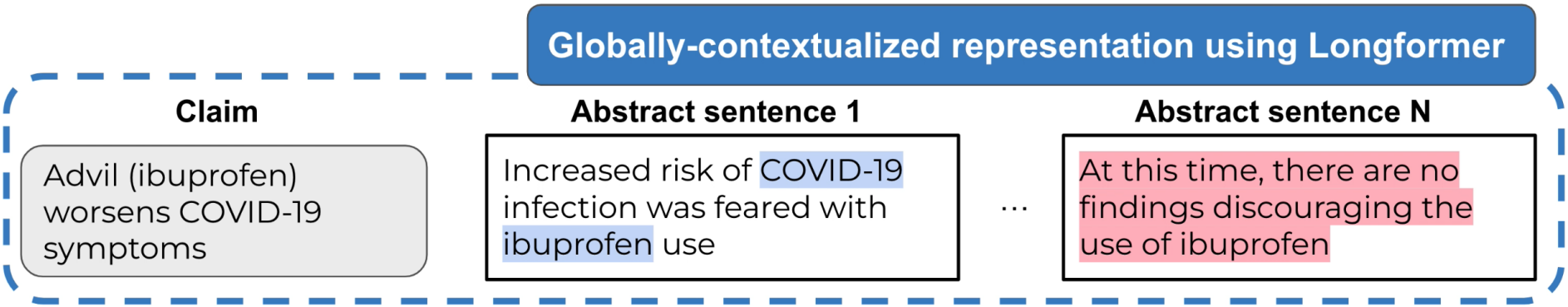
$$<\text{s}> c <\!/\text{s}> t <\!/\text{s}> s_1 <\!/\text{s}>_1 \ldots s_n <\!/\text{s}>_n$$

Global attention is assigned to $< s >$ token, all tokens in c and all $< /s >$ tokens.

MultiVerS


Claim
Advil (ibuprofen) worsens COVID-19 symptoms
Abstract sentence 1
Increased risk of COVID-19 infection was feared with ibuprofen use
...
Abstract sentence N
At this time, there are no findings discouraging the use of ibuprofen

MultiVerS


Globally-contextualized representation using Longformer
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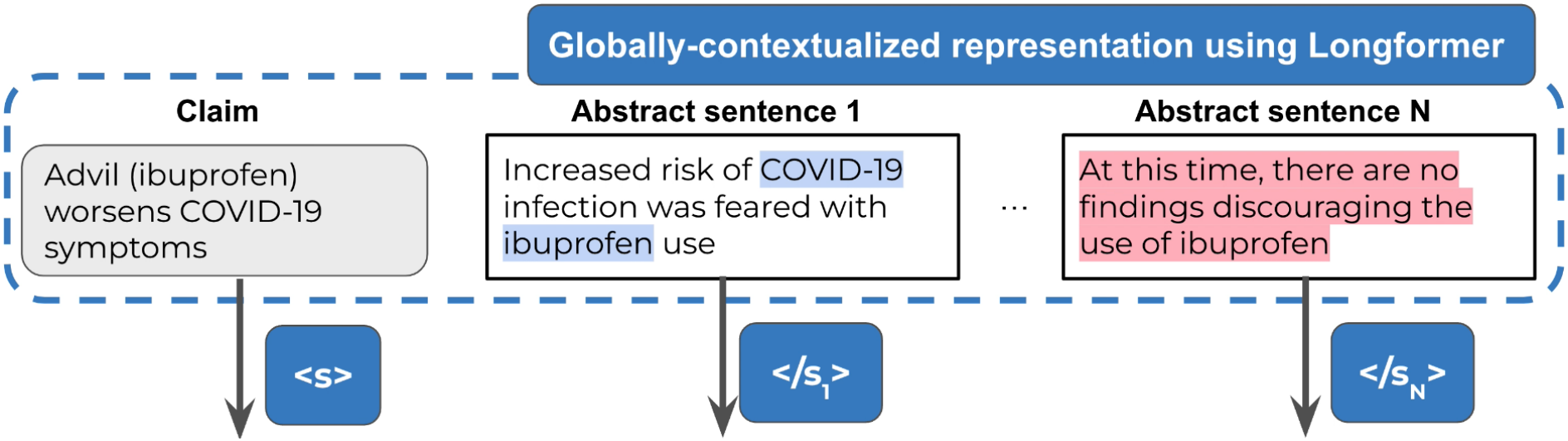
MultiVerS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<s>
</s1>
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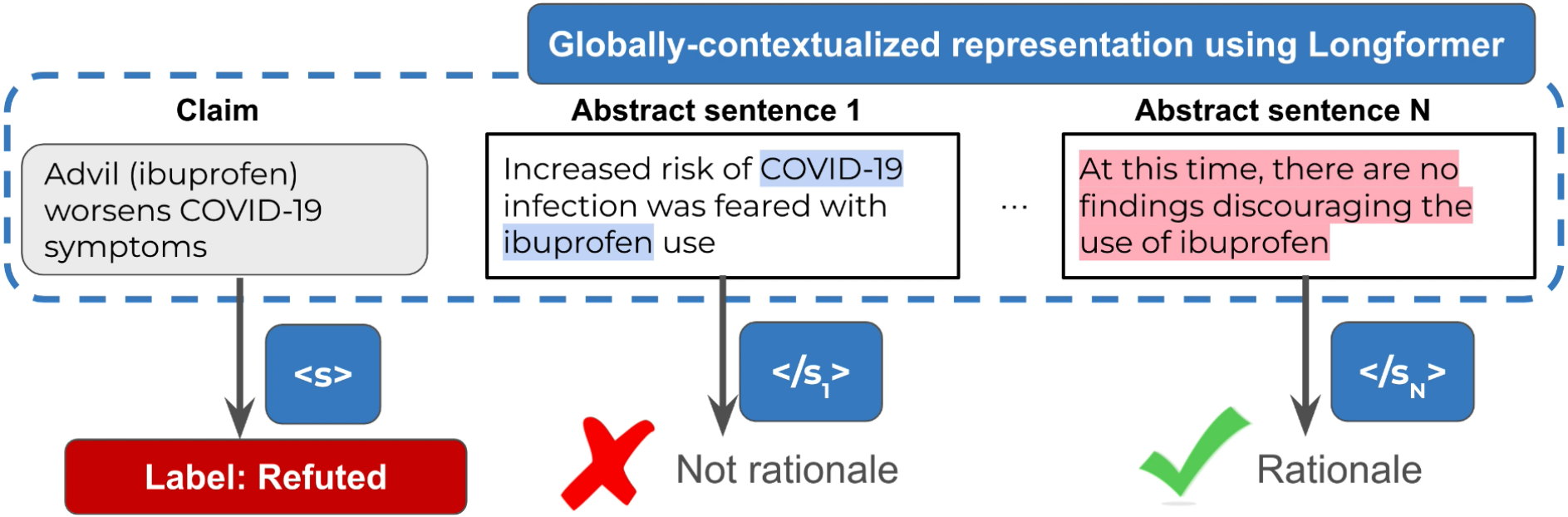
MultiVerS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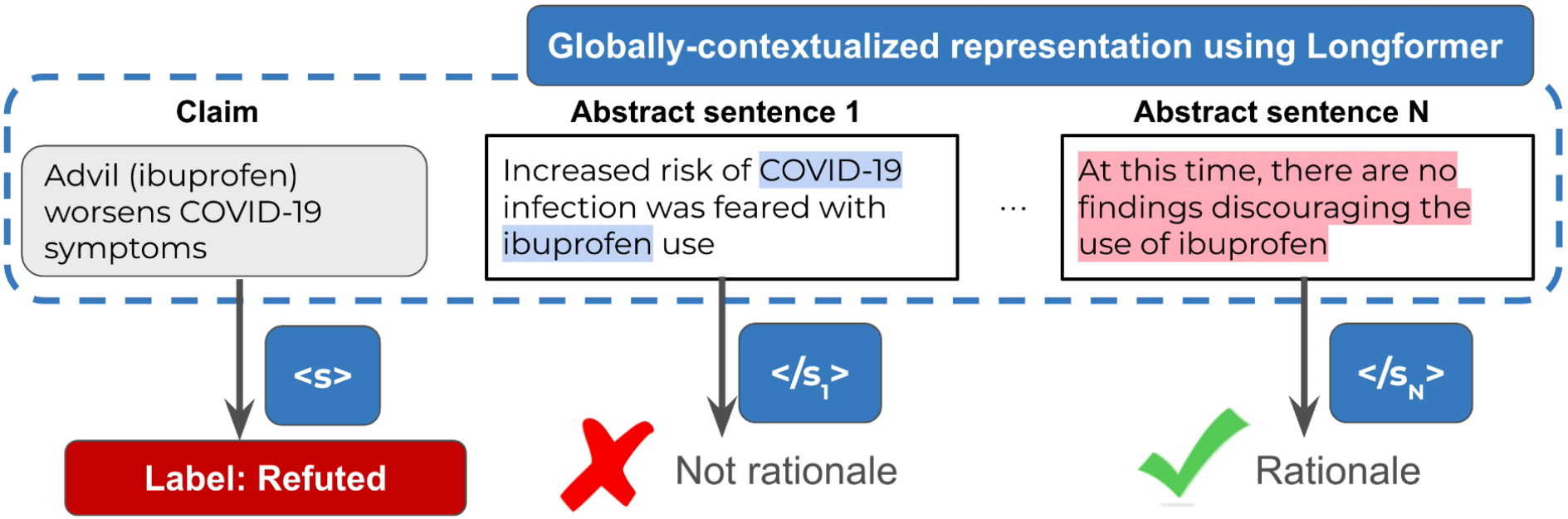
<s>
</s1>
</sN>
Label: Refuted
Not rationale
Rationale

MultiVerS



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

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 *weakly-labeled in-domain data.*
- **Stage 2:** Continue training on data from each target dataset.

Experiments

Target datasets:

- HealthVer
- COVID-Fact
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Roughly 1000 claims / dataset.

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Traning procedure:

- **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

Supervised out-of-domain data (FEVER)

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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

Data: Stage 1

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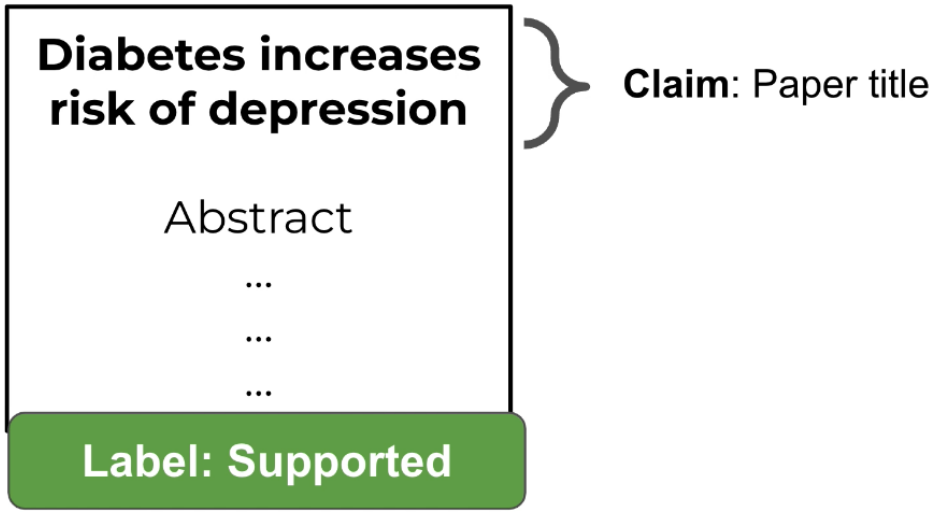
Weakly-supervised in-domain data



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Weakly-supervised in-domain data

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

Evaluation

Abstract-level evaluation:

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

Sentence-level evaluation:

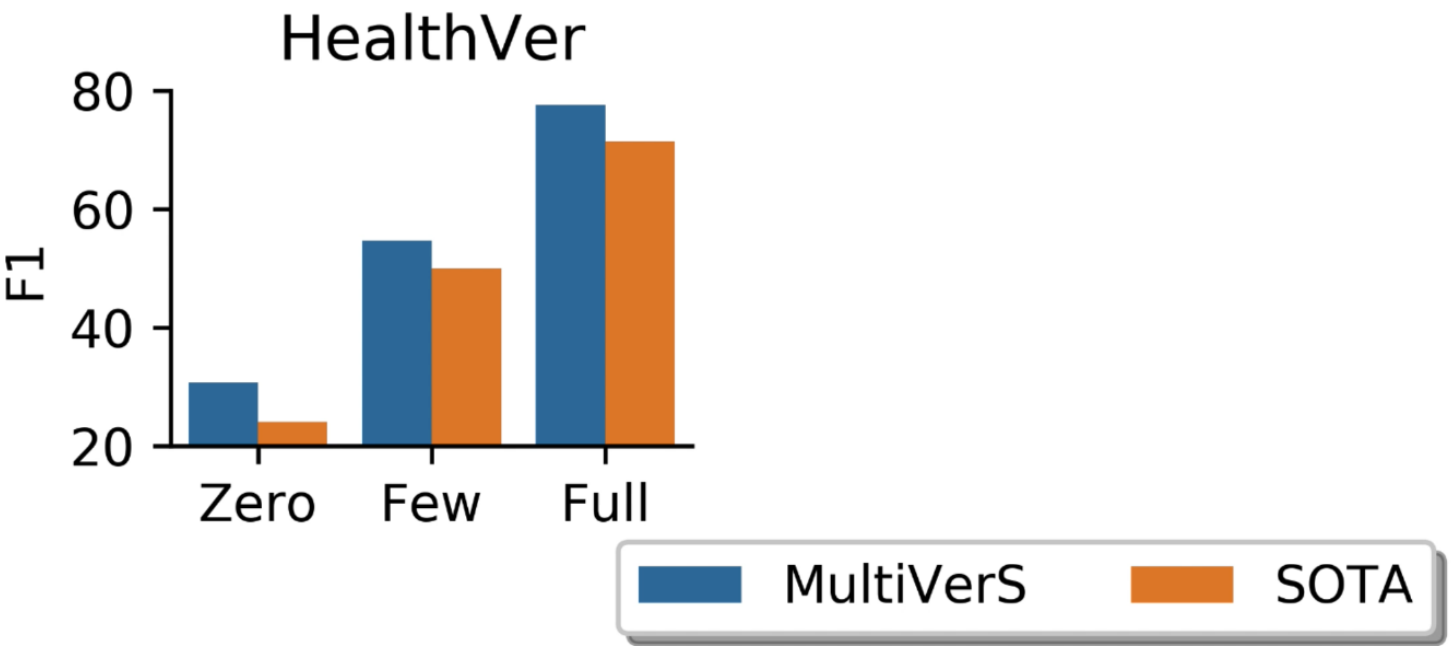
- It combines the accuracy of abstract-level label prediction with the precision of rationale identification.

Evaluation

		HealthVer						COVIDFact						SciFact					
		Abstract			Sentence			Abstract			Sentence			Abstract			Sentence		
Setting	**Model**	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



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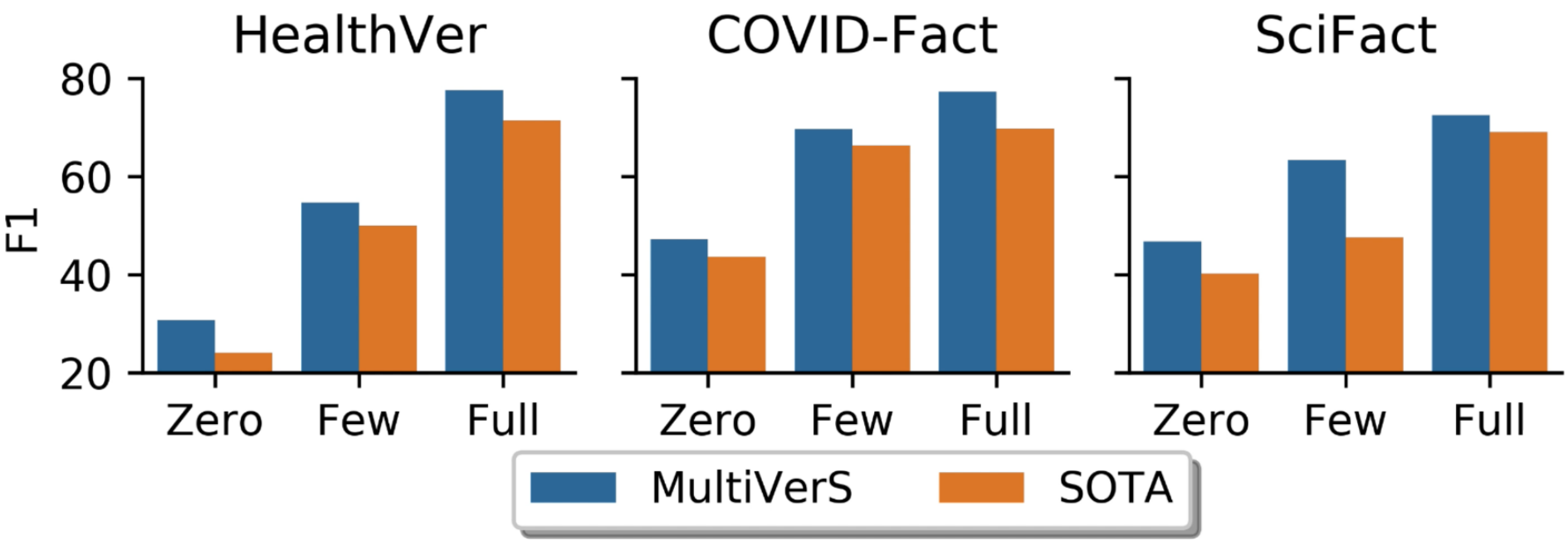
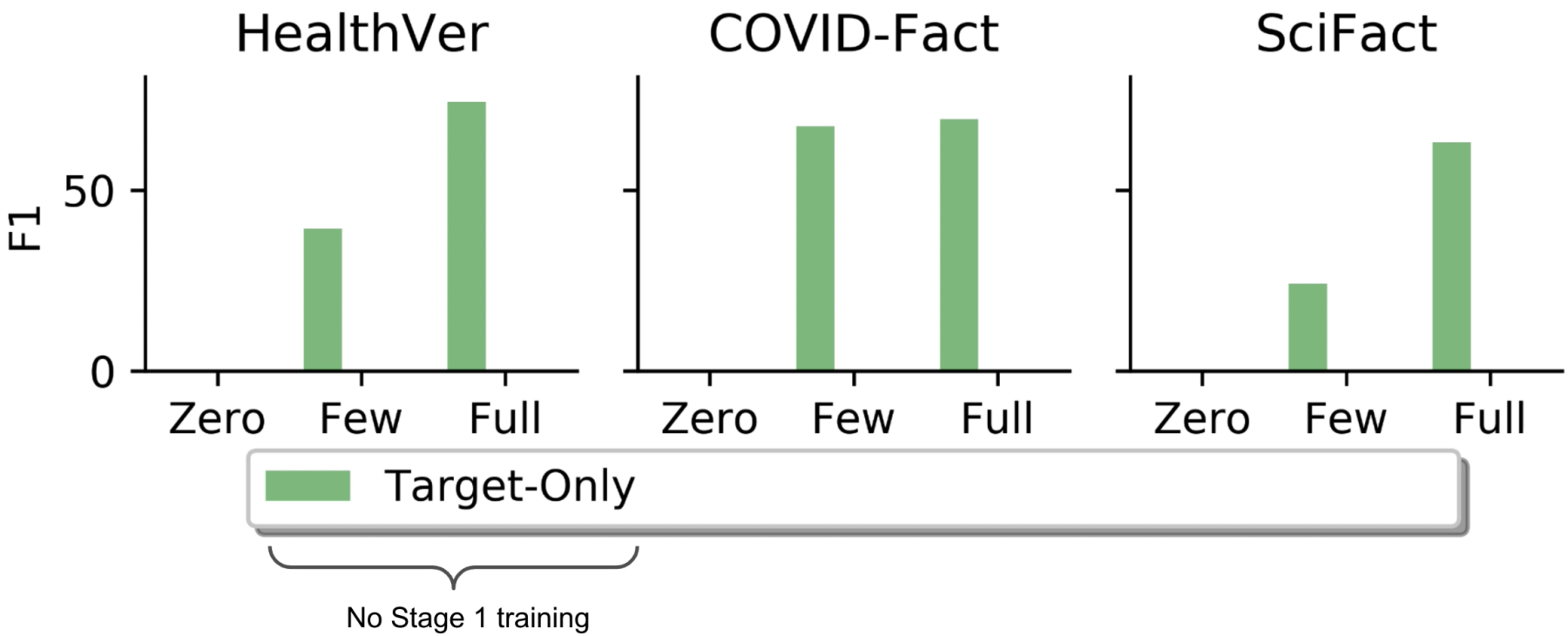


MultiVerS outperforms SOTA on all datasets

Ablations: Training strategy



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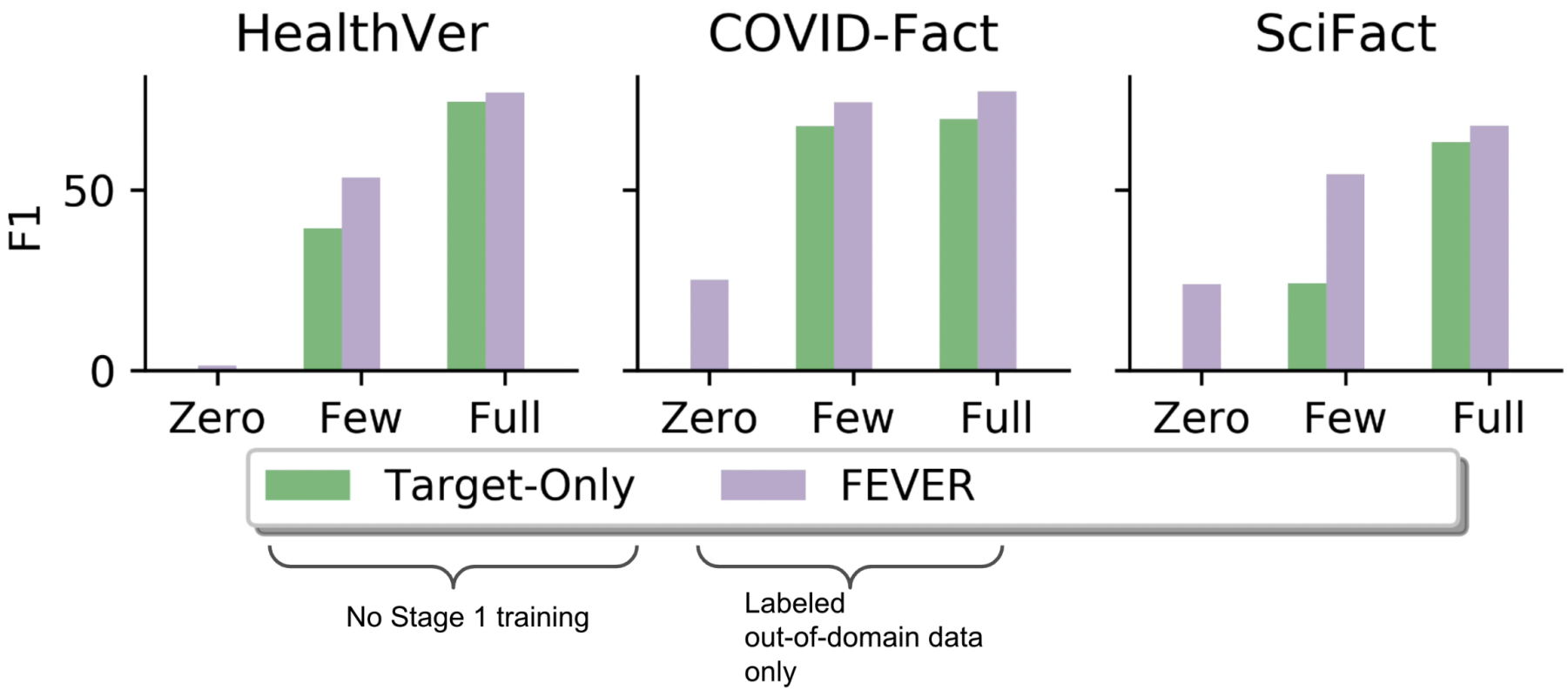

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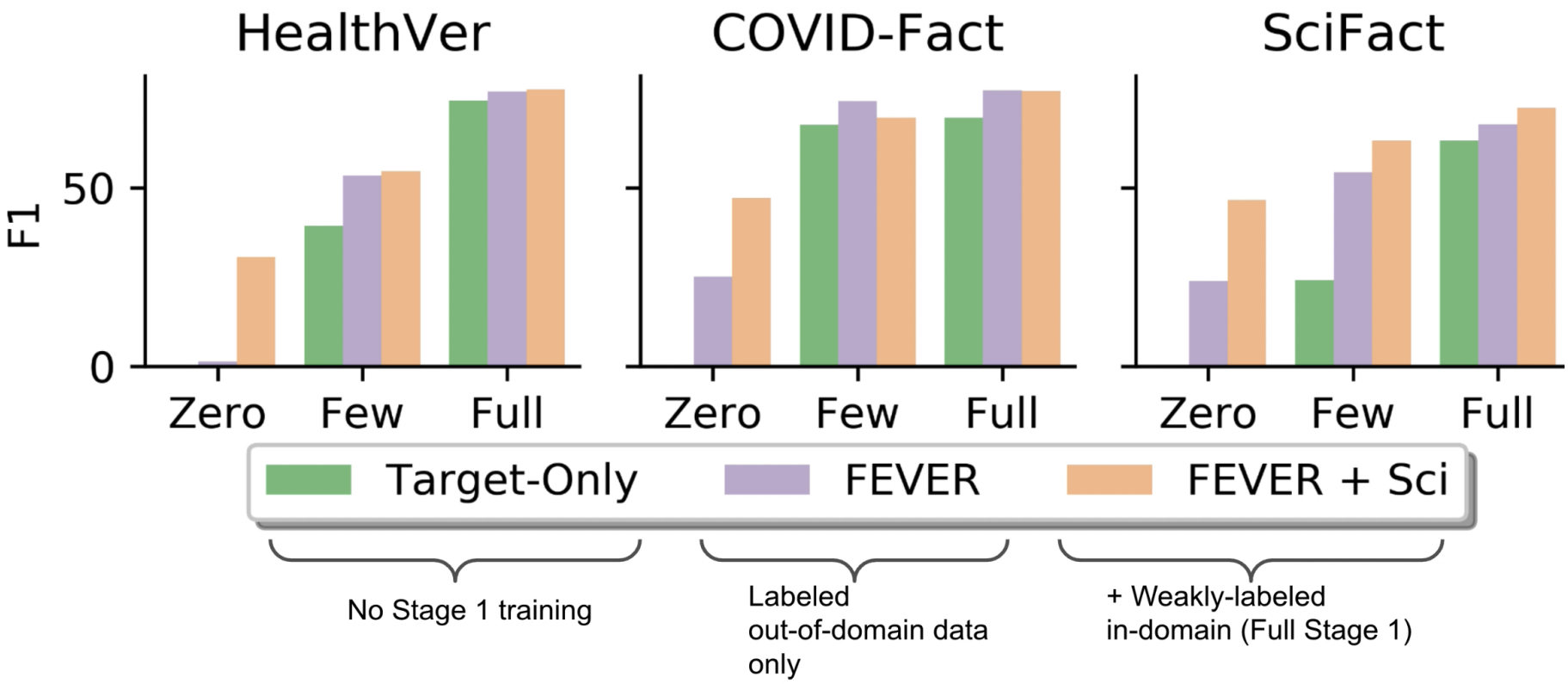

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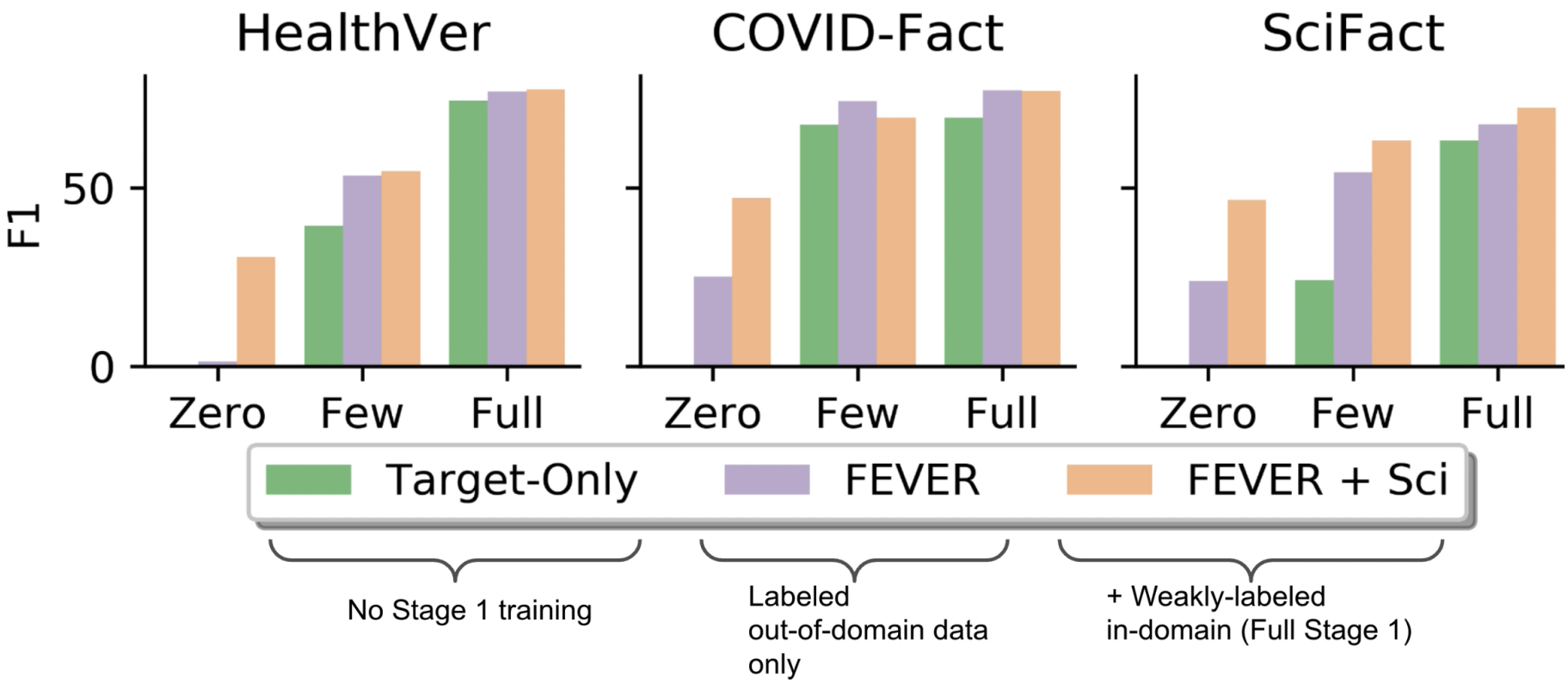

Pretraining with weakly-supervised in-domain data improves few / zero shot performance.

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