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Detecting Stance of Tweets Toward Truthfulness of Factual Claims

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Overview

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Image source: https://indepest.com/2020/05/08/fake-news/

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- False information can be **easily internalized** and true fact can be **unacknowledged** by social media users.
- The spread and influence of factual claims are reflected by public opinion toward their veracity.

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- The quest to **discern the public opinions** toward the veracity of factual claim.
  - Our society is damaged by the dispute of social media users who believe
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  - Our society is damaged by the dispute of social media users who believe
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    - a true fact is false
  - Journalists are working hard on
    - comprehending the spreading of misinformation
    - mitigating the vicious impact of misinformation

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- What is stance detection in general?
  - Determining whether a user **supports or refutes** a **target** based on their social media post.

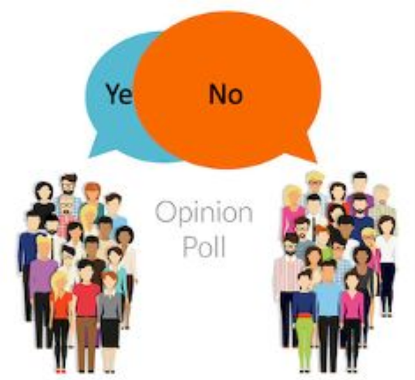

Image source: https://www.jdsupra.com/legalnews/don-t-fully-trust-public-opinion-polls-25406/

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    - Target: **Immigration**
    - Tweet: “Unregulated immigration that hurts working Americans and globalism which only further weakens America!”
    - Stance: **Refute**

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Claim: Rep. Paul Gosar asks Capitol Police to arrest illegal immigrants attending State of the Union.

Tweet: They don't even try to hide their racism anymore! Remember his name at Election time! GOP Rep. Paul Gosar asks Capitol Police to arrest undocumented immigrants at State of the Union.

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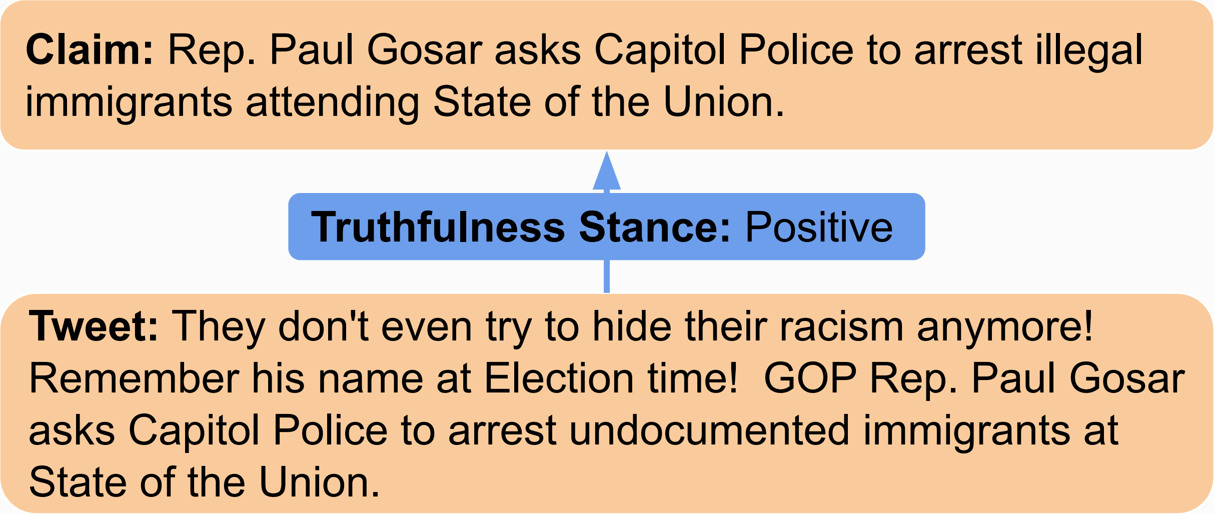


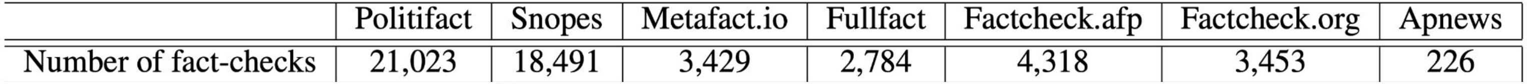
Claim: Rep. Paul Gosar asks Capitol Police to arrest illegal immigrants attending State of the Union.

Truthfulness Stance: Positive

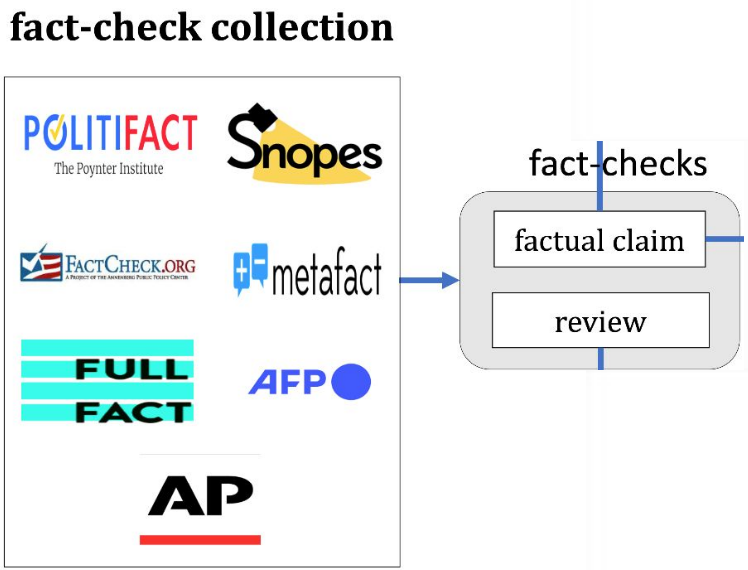
Tweet: They don't even try to hide their racism anymore! Remember his name at Election time! GOP Rep. Paul Gosar asks Capitol Police to arrest undocumented immigrants at State of the Union.

Data Collection

- We extracted factual claims and reviews from various trust-worthy websites.

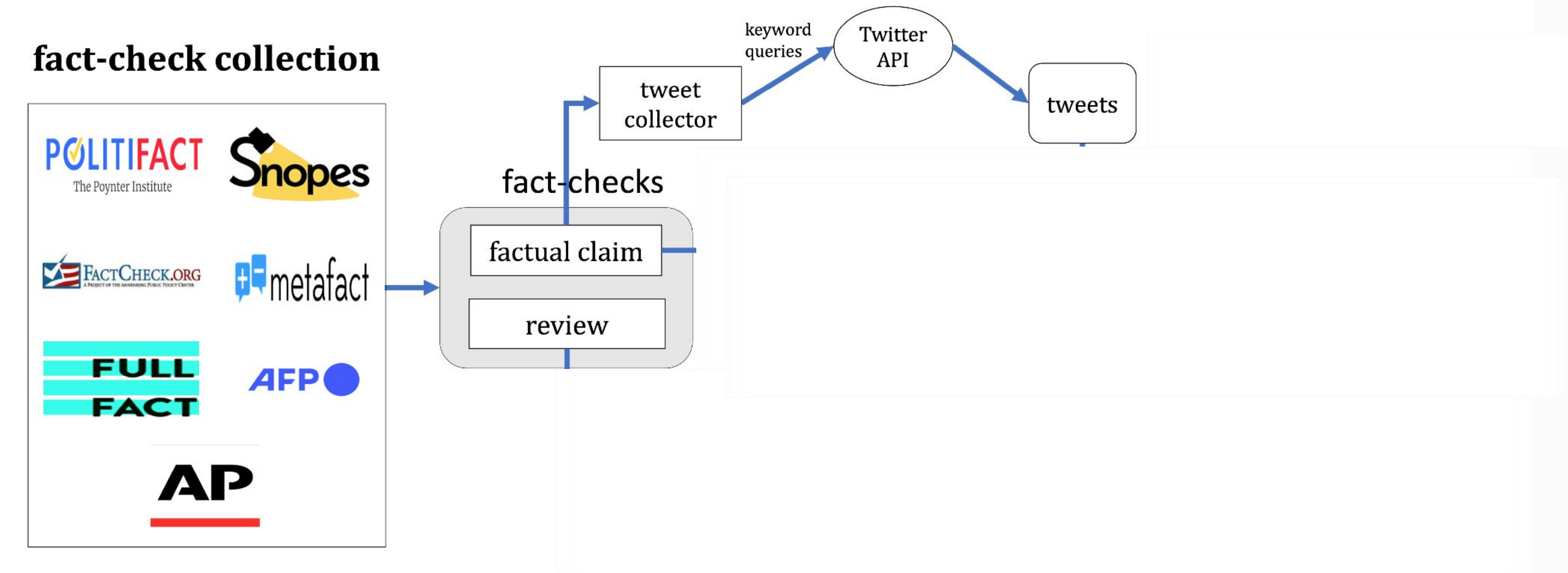


	Politifact	Snopes	Metafact.io	Fullfact	Factcheck.afp	Factcheck.org	Apnews
Number of fact-checks	21,023	18,491	3,429	2,784	4,318	3,453	226



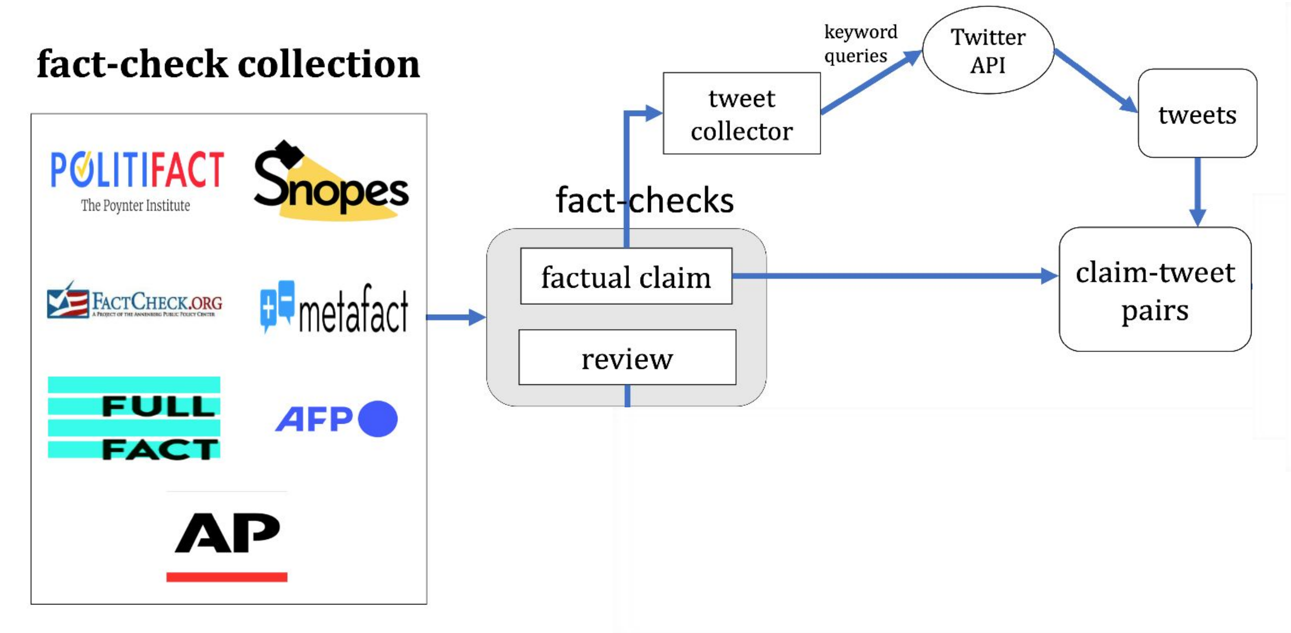
Data Collection

- We fetched claim-related English tweets using keyword queries to Twitter API.



Data Collection

- We annotated claim-tweet pairs by five options:
  Positive, Negative, Neutral, Unrelated, Invalid.
- The claim-tweet pairs are used for training stance detection model which take claim-tweet pair as input and generate the stance prediction.



Methodology

- Further pretraining language model
  - Language models are **large neural networks** that are used in a wide variety of natural language processing tasks.

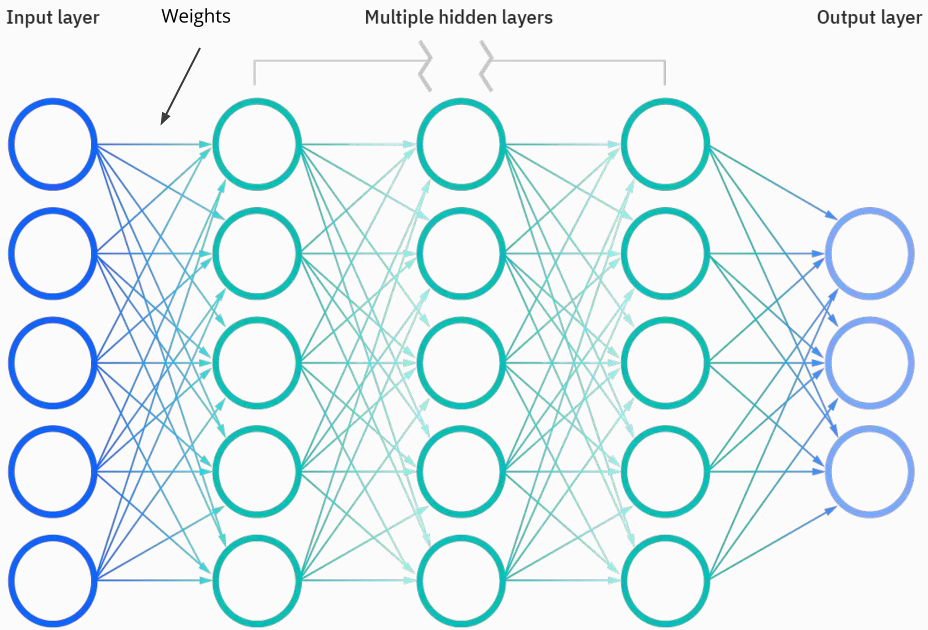


Image source: https://www.ibm.com/cloud/learn/neural-networks

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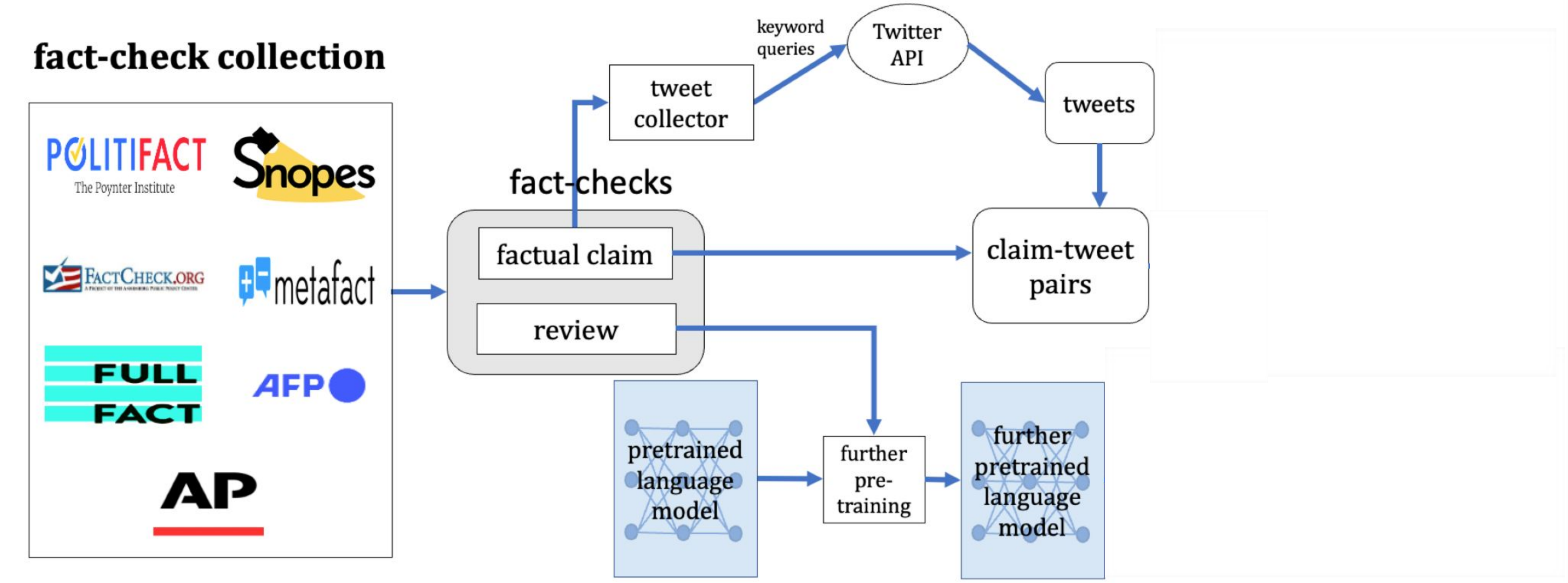
  - Language models are **large neural networks** that are used in a wide variety of natural language processing tasks.
  - Language models that have been trained with a large corpus still **don’t have domain knowledge about journalism**.
  - Further pretrain language model on fact-check reviews can guide language models to **comprehend the semantics of factual claims.**

Methodology

- Further pretraining language model on fact-check reviews



Methodology

- Fine-tune language model
  - Fine-tune refers to the procedure of **re-training a language model** on annotated claim-tweet pairs.
  - **The weights of the language model are updated** to account for the claim-tweet pairs' characteristics of the stance detection.

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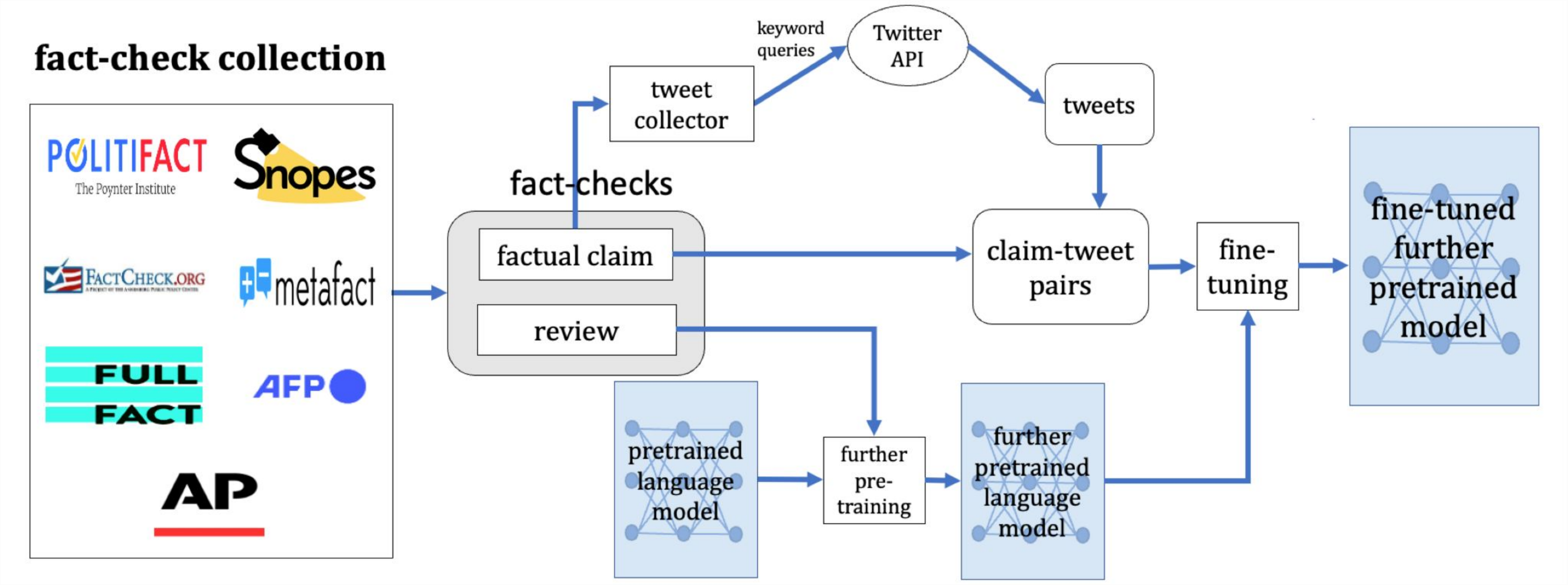
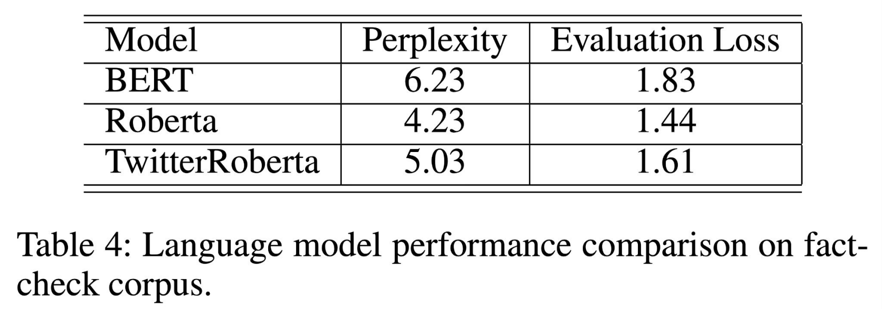


Model Evaluation: Further pretrain

- Roberta outperformed BERT and TwitterRoberta in predicting tokens in fact-checks by two evaluation metrics: perplexity (the lower the better) and loss (the lower the better).

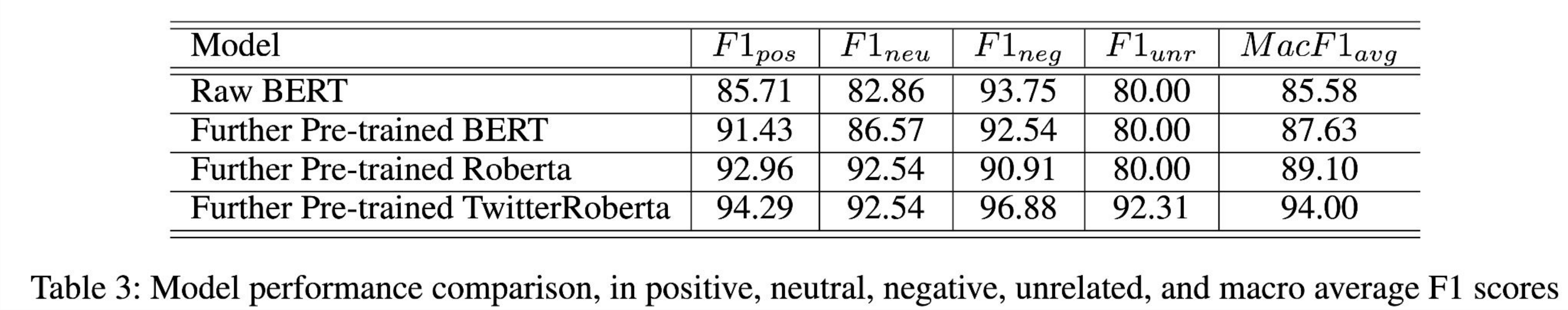


Model	Perplexity	Evaluation Loss
BERT	6.23	1.83
Roberta	4.23	1.44
TwitterRoberta	5.03	1.61

Table 4: Language model performance comparison on fact-check corpus.

Model Evaluation: Stance detection

- TwitterRoberta outperformed all other further pre-trained language models in predicting truthfulness stance by F1 score.



Model	$F1_{pos}$	$F1_{neu}$	$F1_{neg}$	$F1_{unr}$	$MacF1_{avg}$
Raw BERT	85.71	82.86	93.75	80.00	85.58
Further Pre-trained BERT	91.43	86.57	92.54	80.00	87.63
Further Pre-trained Roberta	92.96	92.54	90.91	80.00	89.10
Further Pre-trained TwitterRoberta	94.29	92.54	96.88	92.31	94.00

Table 3: Model performance comparison, in positive, neutral, negative, unrelated, and macro average F1 scores

Model Evaluation: Stance detection

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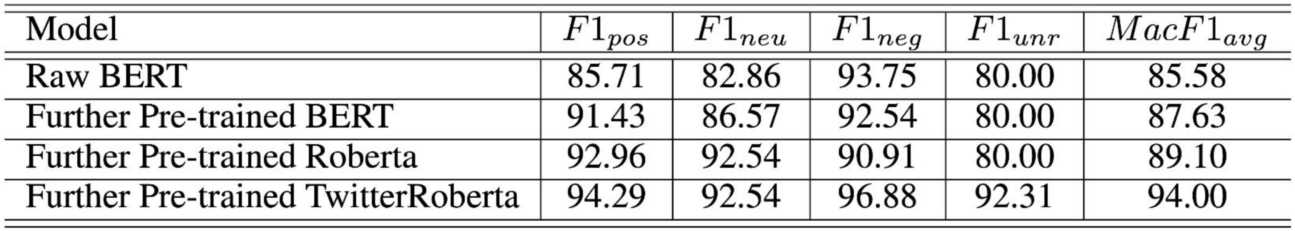
  - F1 score considers both
    - how many of the predictions are correct.
    - how many of the class samples are correctly predicted



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Conclusion

- We formulated the concept of truthfulness stance detection.
- We proposed a novel stance detection model which is based on additional pre-training of pre-trained language models using fact-checks.
- We created an API to allow for programmatic and large-scale usage of the tool.