PADERBORN UNIVERSITY

HybridFC: A Hybrid Fact-Checking Approach for Knowledge Graphs

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DICE

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Introduction

Motivation

These false facts, according to widely published accounts, all appeared on the Wikipedia site at some point.

- Robbie Williams eats domestic pets in pubs for money. ...
- David Beckham was a Chinese goalkeeper in the 18th century. ...
- Paul Reiser's dead. ...
- Sinbad's dead. ...
- Sergey Brin's sexy, dating Jimmy Wales, and dead.

Weitere Einträge... • 21.09.2009

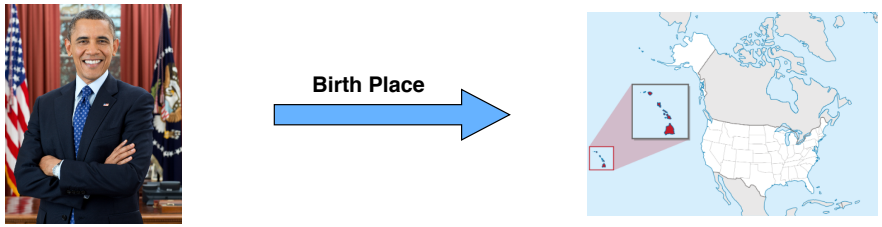
www.nbcnews.com › biggest-wikipedia-blunders

15 biggest Wikipedia blunders - Technology & science - Tech ...

- DBpedia 3.6 ca. 80% correct (Gerber et al., 2015; Rula et al., 2019)
- Unknown for a number of enterprise knowledge graphs

Introduction

Families of approaches



- Given: Knowledge graph $\mathbb{G}$ and an assertion $t = (s, p, o)$
- Goal: Compute $P(t)$

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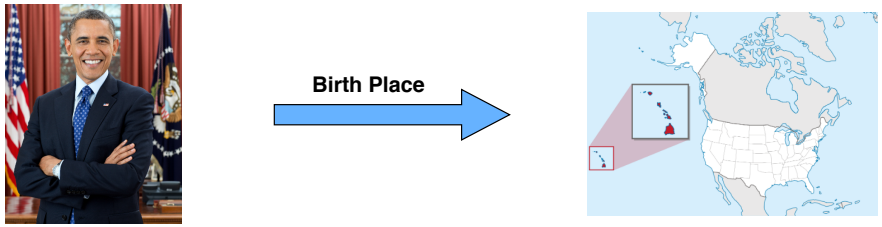

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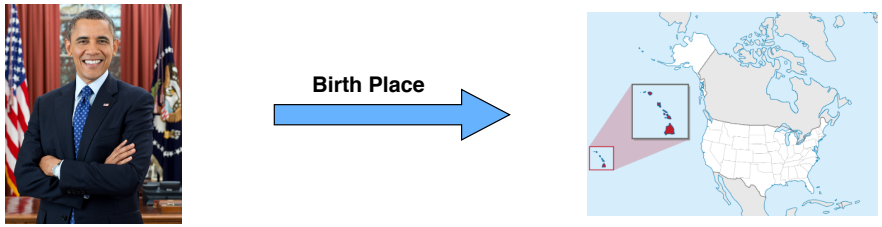

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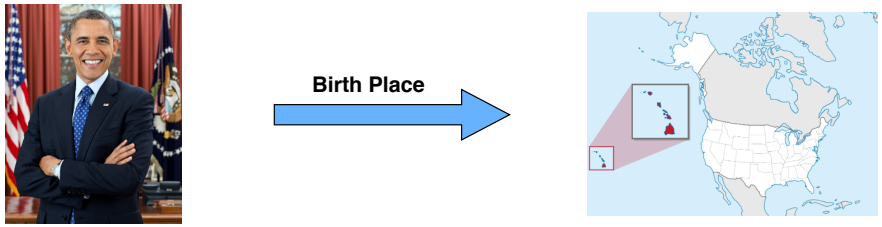

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3. Embedding-based solutions
   - Representation in continuous high-dimensional vector space

Limitations of existing solutions

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- Examples

```
PREFIX dbr: <http://dbpedia.org/resource/>
PREFIX dbo: <http://dbpedia.org/ontology/>
Assertion: dbr:Johnny_Carson dbo:deathPlace dbr:West_Hollywood,_California
=========================================================
FactCheck Result: Score: 0.0
COPAAL Result: Score: 0.99
```

```
Assertion: dbr:T._S._Eliot dbo:award dbr:Nobel_Prize_in_Literature
=========================================================
COPAAL Result: Score: 0.0
TransE Result: Score: 0.90
```

Proposed Approach (HybridFC)

Architecture

Text-based component

KG-based component

Input triple

(s, p, o)

Path-based component

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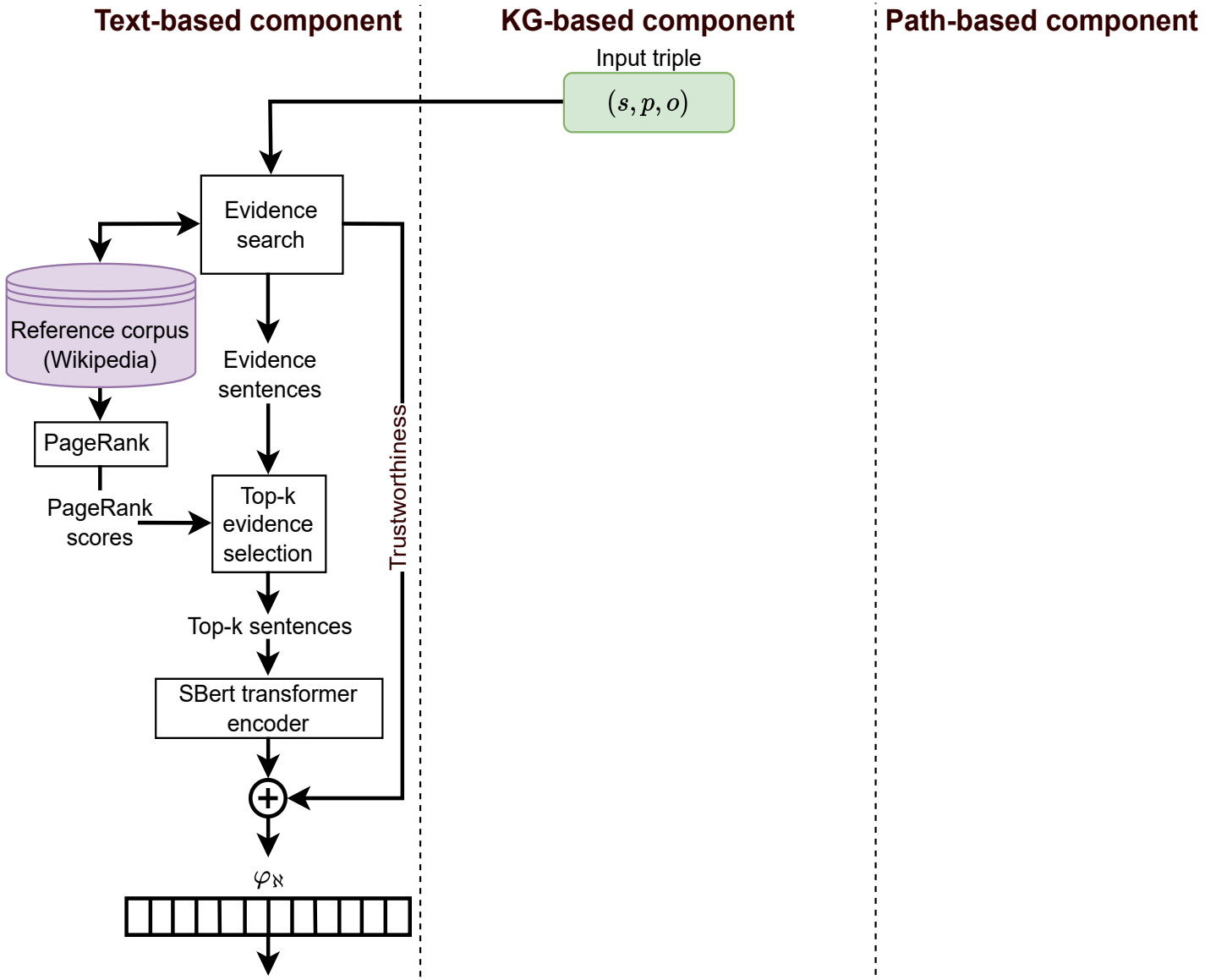

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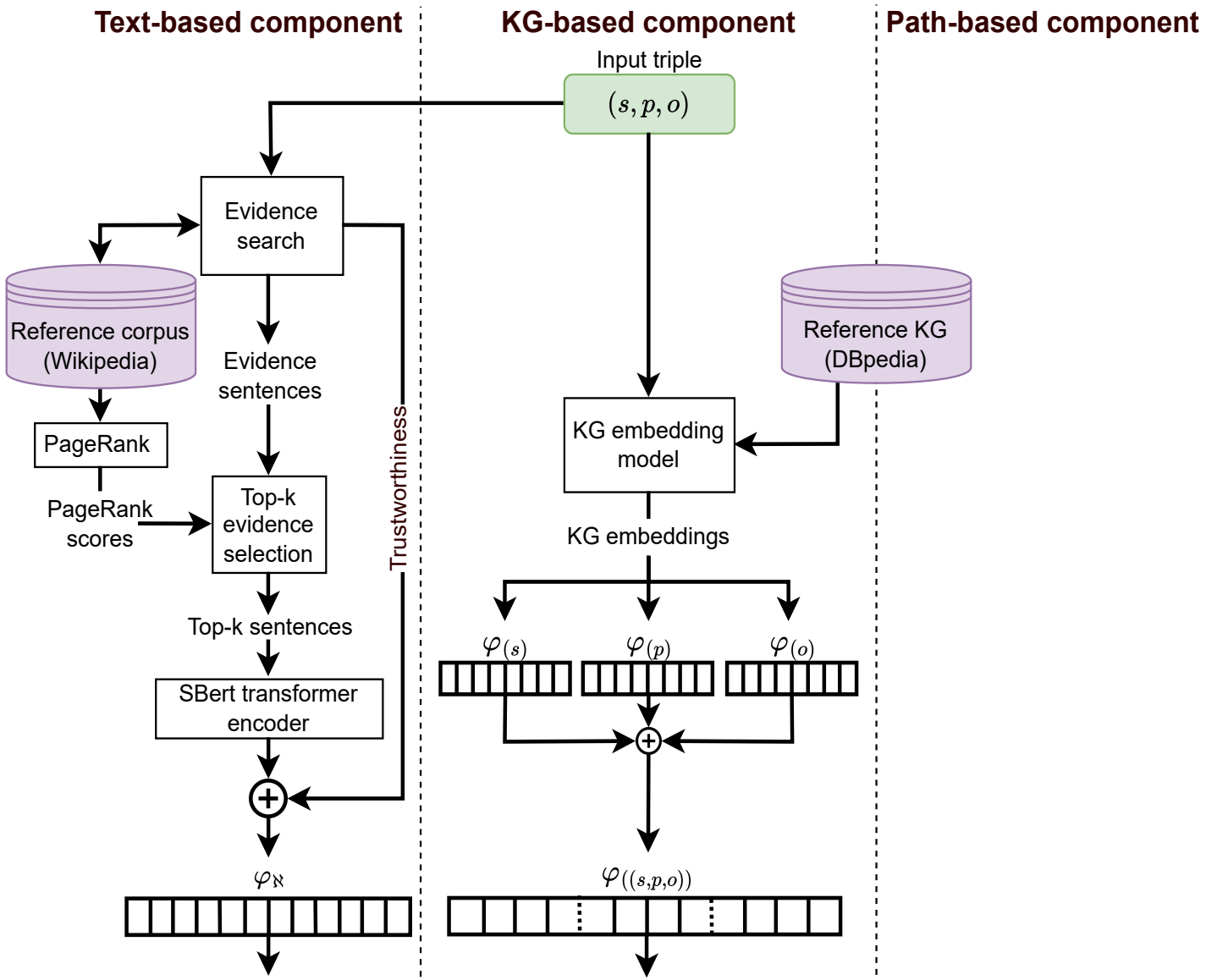

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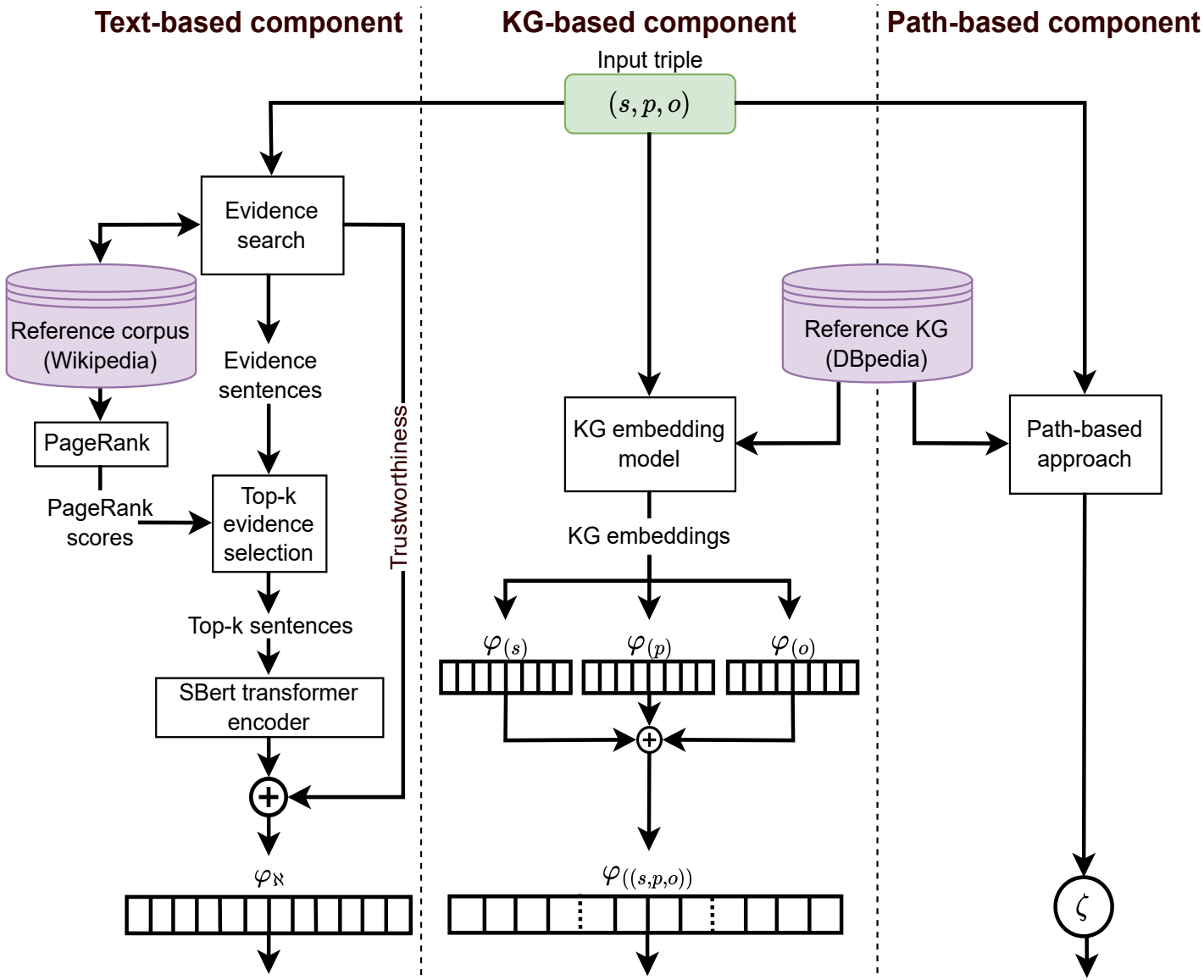

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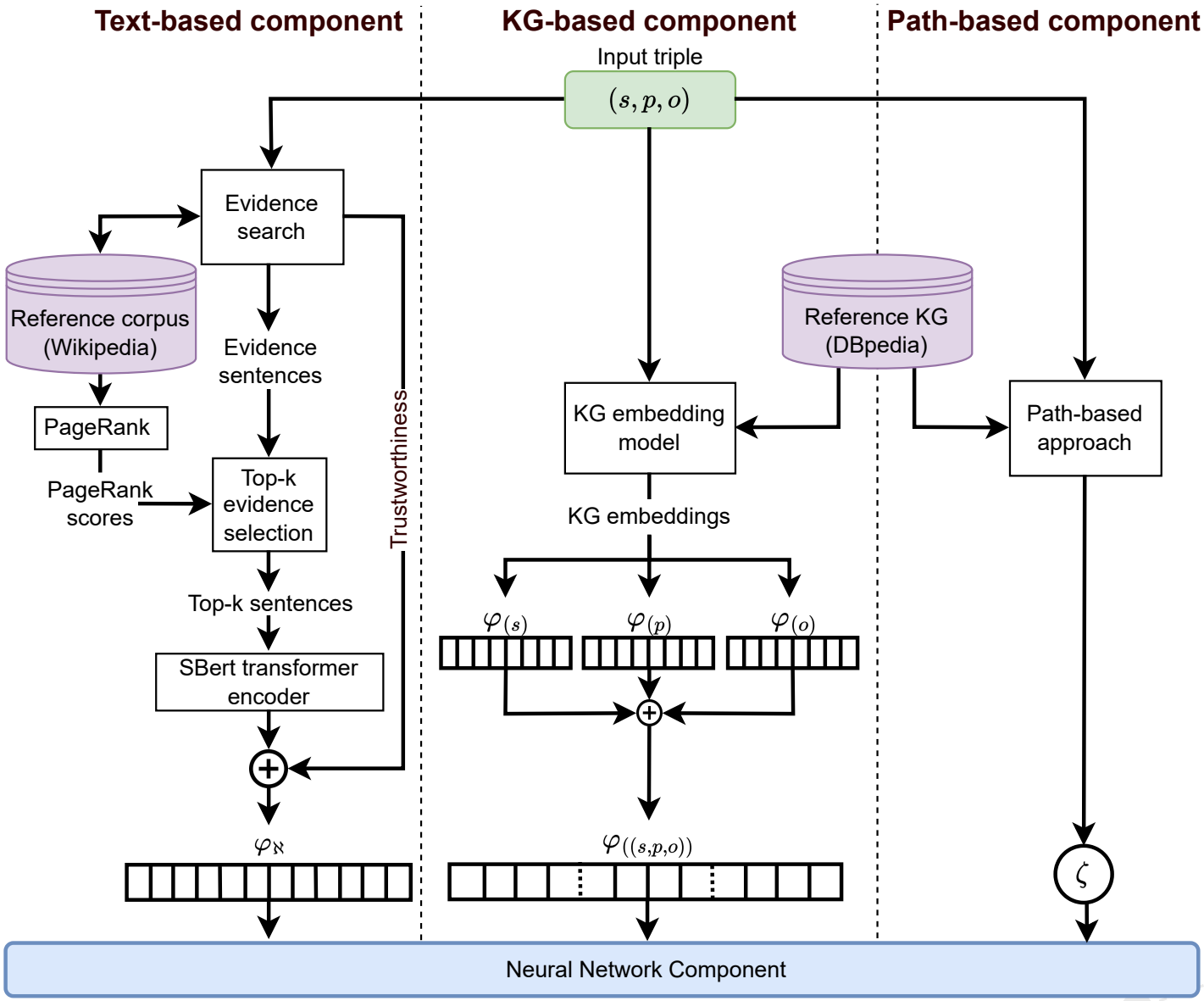

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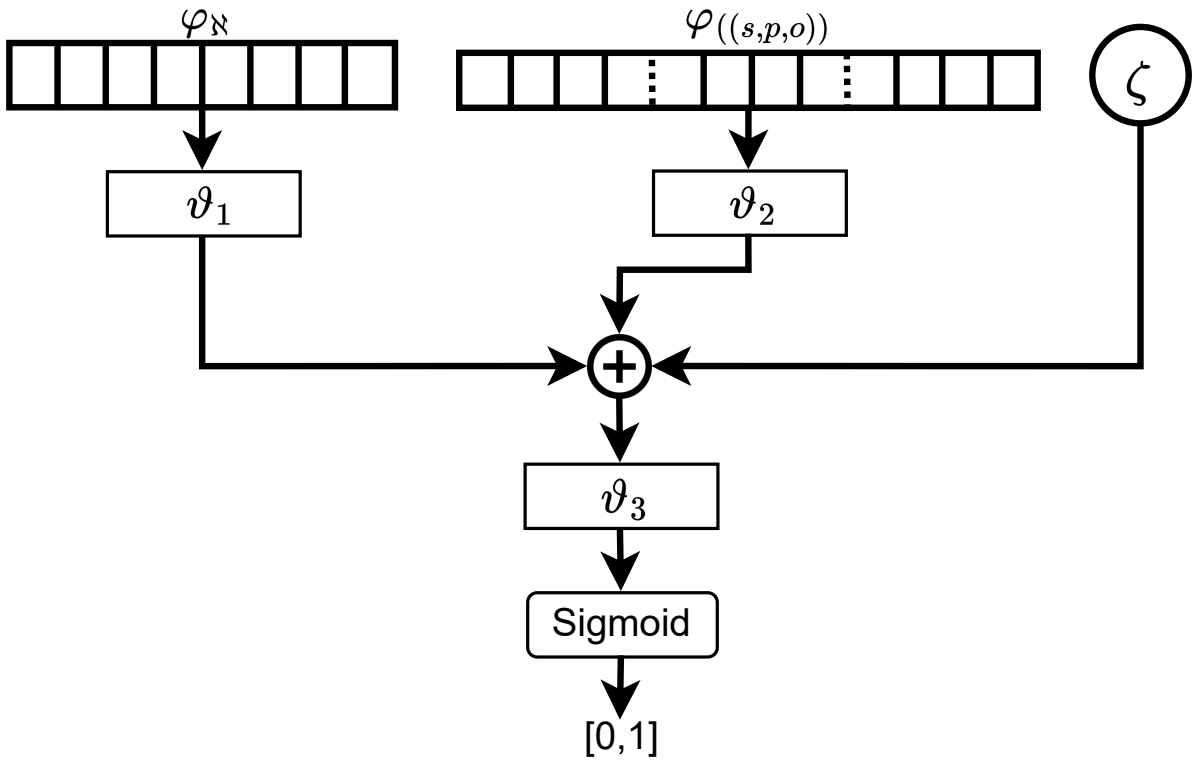
Neural Network Component



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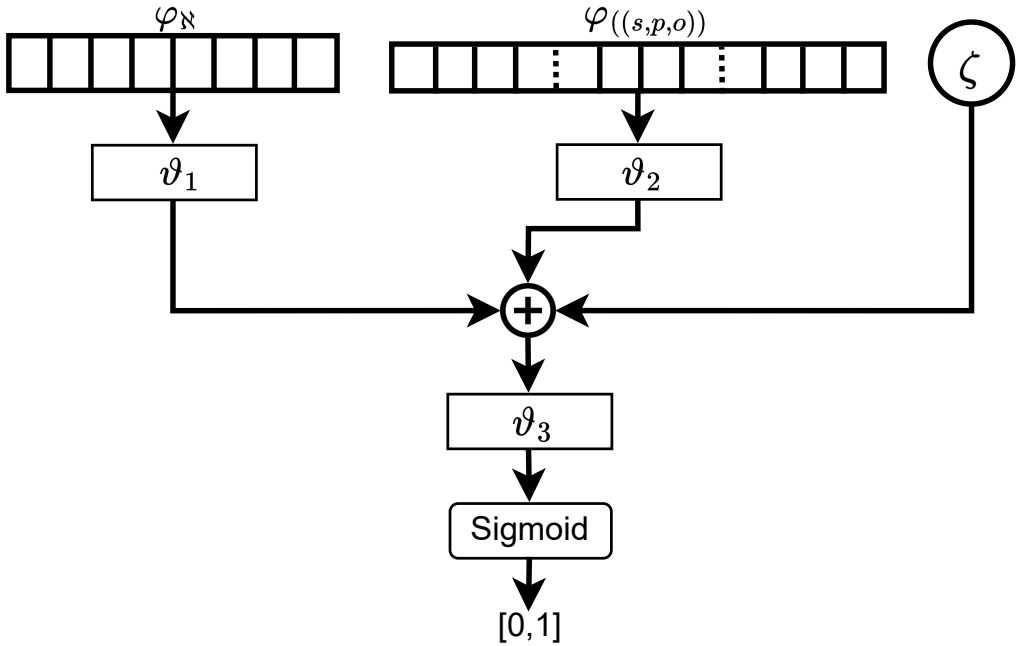

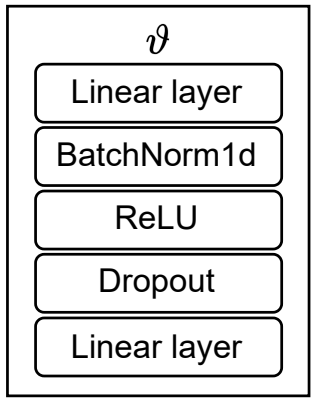

$$\omega = \sigma\left(w_{\sigma}^{T}\vartheta_3\left(\vartheta_1(\varphi_{\aleph}) \oplus \vartheta_2(\varphi((s,p,o))) \oplus \zeta\right)\right) \quad (1)$$

Experiments

Setup details

- We used 2 state-of-the-art fact-checking datasets
  - Factbench [6]
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- We use the area under the receiver operator characteristic curve (AUROC) in our evaluation [4, 7, 6]

Experiments

Test Results comparison

		Domain	Range	DomainRange	Mix	Random	Property	Avrg.
T	FactCheck [6]	0.67	0.67	0.66	0.61	0.66	0.59	0.64
P	COPAAL [7]	0.67	0.68	0.68	0.65	0.69	0.69	0.68
R	KV-Rule [4]	0.57	0.57	0.57	0.58	0.61	0.62	0.59
KG-emb	TransE [1]	0.63	0.60	0.63	0.64	0.87	0.96	0.72
	ConEx [3]	0.50	0.50	0.50	0.52	0.60	0.60	0.54
	ComplEx [8]	0.58	0.58	0.52	0.62	0.86	0.95	0.69
	QMult [2]	0.57	0.62	0.55	0.69	0.84	0.93	0.70
	RDF2Vec [5]	–	–	–	–	–	–	–
HybridFC[1]	TransE	**0.80**	**0.80**	**0.81**	**0.78**	**0.95**	**0.99**	**0.86**
	ConEx	0.77	0.78	0.79	0.71	0.80	0.70	0.75
	ComplEx	0.75	0.76	0.74	0.72	0.93	0.97	0.81
	QMult	0.69	0.73	0.71	0.69	0.91	0.94	0.77

[1] We use a Wilcoxon signed rank test with a significance threshold $\alpha = 0.05$.

Ablation Study

Test Results

	D	R	DR	Mix	Ran.	Prop.	Avg.
TC	0.76	0.77	0.76	0.69	0.77	0.64	0.73
PC	0.68	0.69	0.69	0.65	0.70	0.69	0.68
EC	0.63	0.61	0.62	0.64	0.86	0.97	0.72
TC+EC	0.76	0.78	0.76	0.74	0.92	0.98	0.82
TC+PC	0.77	0.77	0.77	0.7	0.79	0.67	0.74
PC+EC	0.71	0.7	0.69	0.72	0.89	0.97	0.78
HybridFC [2]	**0.80**	**0.80**	**0.81**	**0.78**	**0.95**	**0.99**	**0.86**

[2] We use a Wilcoxon signed rank test with a significance threshold $\alpha = 0.05$.

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Conclusion and Future Work

- Current approaches have certain limitations, e.g.,
  - Manual feature engineering
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- HybridFC alleviate the problem of single category of approaches by combining these three categories of approaches
- Our experiments show that our hybrid approach is able to outperform competing approaches in the majority of cases
- As future work, we will exploit the modularity of HybridFC by integrating other families of approaches

Summary

That's all folks!

HybridFC exploits the diversity of existing families of fact-checking approaches within an ensemble learning setting

Web: dice-research.org

Code: github.com/dice-group/HybridFC

Twitter: @DiceResearch

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