Predicting Sentence-Level Factuality of News Source for Fact-Checking

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Introduction and Research Gaps

- Nowadays, fact-checking organizations (e.g. PolitiFact) have provided **lists of unreliable news articles and media sources**.
- Most existing **news credibility verification systems** have addressed **article-level analysis** of news for news source reliability estimation.
- Nevertheless, each news article comprises **multiple sentences**, which may contain **factual and biased information**, as well as **misinformation**.
- Automated fact-checking and news credibility verification at scale require **accurate prediction**.

Misinformation

N.	Sentence-level news article	Label
Title	President **lowers** Brazil's image with repeated misinformation and does not receive attention from global leaders.	Bias
S1	President Jair Bolsonaro **touch a sore point of** Europeans when he pointed out that the increased use of fossil fuels is a **serious** environmental setback, in his opening speech at the UN General Assembly, Tuesday (20).	Bias
S2	Germany received criticism from the UN for the investment agreement with Senegal for the production of gas in the African country.	Fact
S3	"This constitutes a serious setback for the environment", he said, referring to the Europeans	Quotes
S4	However, Bolsonaro signed favorable measures for environmental protection during the four years of the Brazilian government.	Fake
S5	There is **a huge difference** between speaking at the UN and being heard at the UN.	Bias

Motivations

- **Low-credibility** media outlets may potentially be targeted for the **spreading of misinformation**.
- While **fake news** is mostly spreading on **social media** before it is necessary a **source media** where they would have been posted originally.
- Since websites have published **low-credible news** in the past, it is likely to happen again.

The Proposed Method

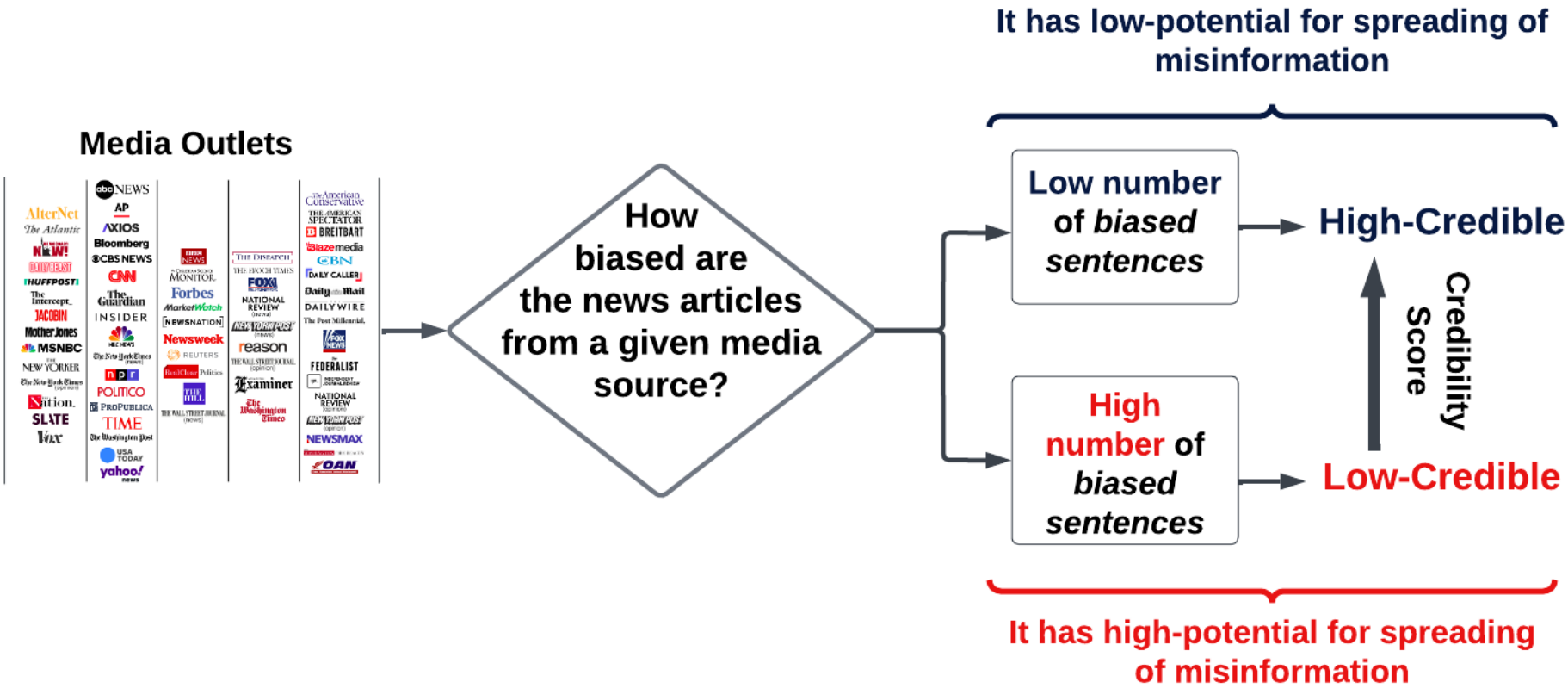


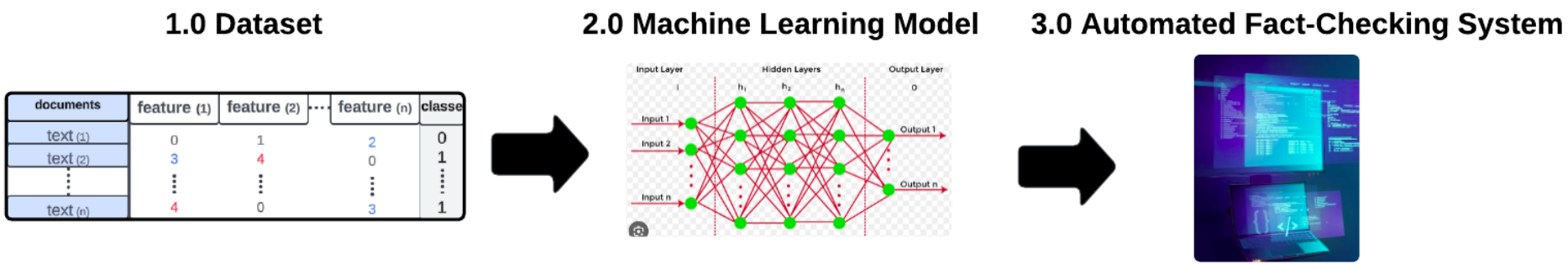
Figure: Sentence-Level Factuality Prediction of News Source.

Media Bias Definition

Figure: Types of Media Bias Defined by AllSides[1].

[1] https://www.allsides.com/media-bias/how-to-spot-types-of-media-bias

Building Dataset, ML Models and Automated Systems



1.0 Dataset

- **FactNews dataset**[2]: *6,191 sentences* manually annotated by 2 annotators into *factual (4,302)*, *biased (558)*, and *quote (1,389)* spans.

- We selected **3 different well-known and relevant media outlets** in Brazil and extracted **the same story** from each one of them.

[2] https://github.com/franciellevargas/FactNews

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Media	News Reporting
Folha	O presidente Jair Bolsonaro colocou o dedo na ferida dos europeus ao apontar que o aumento do uso de combustíveis fósseis é um grave retrocesso ambiental, em seu discurso de abertura da Assembleia-Geral da ONU na manhã desta terça-feira (20). *President Jair Bolsonaro touch a sore point of Europeans when he pointed out that the increased use of fossil fuels is a serious environmental setback, in his opening speech at the UN General Assembly this Tuesday morning (20) (...)*
Estadão	O presidente Jair Bolsonaro encerrou seu discurso na Assembleia-Geral da ONU, nesta terça-feira, 20, afirmando que o povo brasileiro acredita em "Deus, Pátria, família e liberdade", que tem inspiração no fascismo de Benito Mussolini (1883-1945). *President Jair Bolsonaro ended his speech at the UN General Assembly, this Tuesday, 20, stating that the Brazilian people believe in "God, Fatherland, family and freedom", which has by the fascism of Benito Mussolini (1883-1945) (...)*
O Globo	O presidente Jair Bolsonaro seguiu o roteiro de campanha em seu discurso na Assembleia Geral da Organização das Nações Unidas (ONU), em Nova York (EUA), e aproveitou para atacar o ex-presidente Luiz Inácio Lula da Silva nesta terça-feira (20)(...) *President Jair Bolsonaro followed the campaign script in his speech at the General Assembly of the United Nations (UN) in New York (USA), and took the opportunity to attack former president Luiz Inácio Lula da Silva this Tuesday (20)(...)*

FactNews Dataset Analysis

Description		Folha de São Paulo			Estadão			O Globo			All
		factual	quotes	biased	factual	quotes	biased	factual	quotes	biased	
#Articles			100			100			100		300
#Sentences		1,494	450	231	1,428	483	182	1,320	458	145	6191
#Words		30,374	7,946	5,177	30,589	8,504	4,002	25,505	7,740	3,195	123,032
Avg Sentences/Article		14.94	7.03	3.78	14.28	7.00	3.19	13.20	7.15	2.84	8.15
Avg Words/Sentences		**20.33**	17.65	**22,41**	**21,45**	17,60	**21,98**	**19,32**	16,89	**22,03**	19,96
Body/Title	*Body*	1,337	440	207	1,218	473	162	1,089	441	131	5,498
	Title	157	10	24	210	10	20	231	17	14	693
Domains	*Political*	912	340	130	870	352	106	748	351	64	3,873
	World	224	48	31	224	49	27	216	32	29	880
	Sports	100	23	34	124	25	29	98	18	39	490
	Daily	132	11	2	98	7	4	148	7	4	413
	Culture	98	26	32	72	42	15	77	45	5	412
	Science	28	2	2	40	8	1	33	5	4	123
Part-of-speech (Avg)	*Noun*	4.85	4.09	**5.72**	5.21	4.12	**5.60**	4.59	3.82	**5.19**	4.79
	Verb	2.20	2.55	**2.60**	2.28	2.51	**2.53**	2.00	2.44	**2.57**	4.18
	Adjective	1.03	1.03	**1.32**	1.11	1.08	**1.32**	0.94	0.97	**1.48**	1.14
	Adverb	0.67	0.82	**0.93**	0.67	0.94	**0.90**	0.59	0.90	**0.94**	0.81
	Pronoun	0.52	1.02	**0.73**	0.51	0.97	**0.56**	0.47	0.90	**0.59**	0.69
	Conjunction	0.51	0.55	**0.61**	0.54	0.57	**0.73**	0.51	0.88	**0.70**	0.62
Emotions (Avg)	*Happiness*	0.12	0.22	**0.20**	0.16	0.28	**0.26**	0.13	0.28	**0.22**	0.20
	Disgust	0.03	0.06	**0.05**	0.04	0.06	**0.03**	0.04	0.04	**0.04**	0.04
	Fear	**4.18**	**3.80**	**4.63**	**4.41**	**3.77**	**4.56**	**4.05**	**3.60**	**4.50**	4.16
	Anger	0.05	0.06	**0.13**	0.07	0.07	**0.12**	0.06	0.08	**0.20**	0.09
	Surprise	0.01	0.03	**0.03**	0.01	0.03	**0.05**	0.01	0.02	**0.01**	0.02
	Sadness	**5.86**	**5.71**	**6.52**	**6.17**	**5.55**	**6.48**	**5.56**	**5.40**	**6.19**	5.93
Polarity (Avg)	*Positive*	2.41	3.25	2.93	2.55	3.22	2.95	2.26	3.26	2.96	2.86
	Negative	0.05	0.06	0.05	0.07	0.10	0.09	0.06	0.07	0.06	0.06
	Neutral	9.55	9.77	10.93	9.92	9.52	11.03	8.91	9.28	10.56	9.94

Table: FactNews dataset statistics.

FactNews Dataset Analysis

- The distribution of **factuality** is *constant* across domains and media outlets.
- The distribution of **bias** *varies* according to the domain and media outlet.

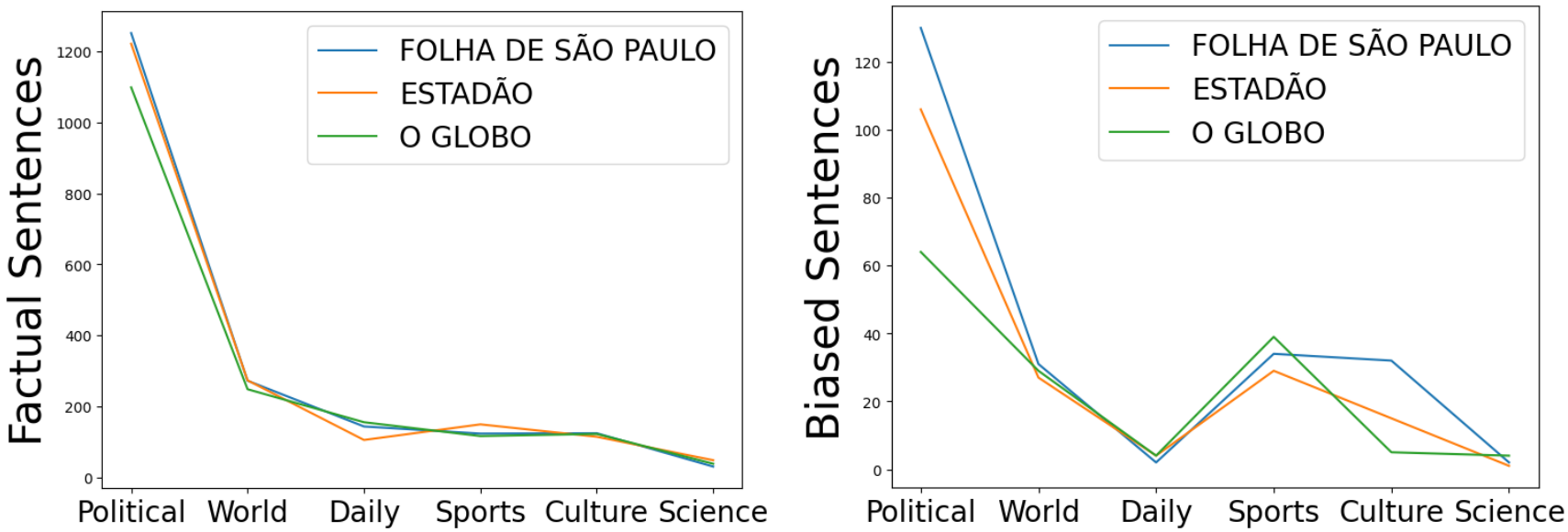

Figure: The cross-domain distribution of factual and biased sentences.

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2.0 Machine Learning Model

Sentence-Level **Factuality** Prediction

Biased Spans and **Quotes** (1,949 labels) x **Factual Spans** (1,949 labels).

- Since factual sentences are impartially focused on **objective facts**, in contrast to the biased ones that are partially presented and focused on **subjective interpretations**, we built a model to predict sentence-level factuality based on aspects of **text subjectivity** and **text impartiality**.

Machine Learning Model Performance: Results

Sentence-Level Factuality	Precision	Recall	F1-Score
BERT fine-tuning	**0.89**	**0.89**	**0.88**
Part-of-speech	0.77	0.77	0.76
TF-IDF (baseline)	0.81	0.69	0.66
Polarity-lexicon	0.63	0.62	0.62
Emotion-lexicon	0.61	0.61	0.61
Sentence-Level Media Bias	**Precision**	**Recall**	**F1-Score**
BERT fine-tuning	**0.70**	**0.68**	**0.67**
Part-of-speech	0.67	0.66	0.66
Polarity-lexicon	0.50	0.50	0.50
Emotion-lexicon	0.53	0.52	0.50
TF-IDF (baseline)	0.78	0.58	0.48

Table: Sentence-level factuality and bias prediction.

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3.0 Automated Fact-Checking System

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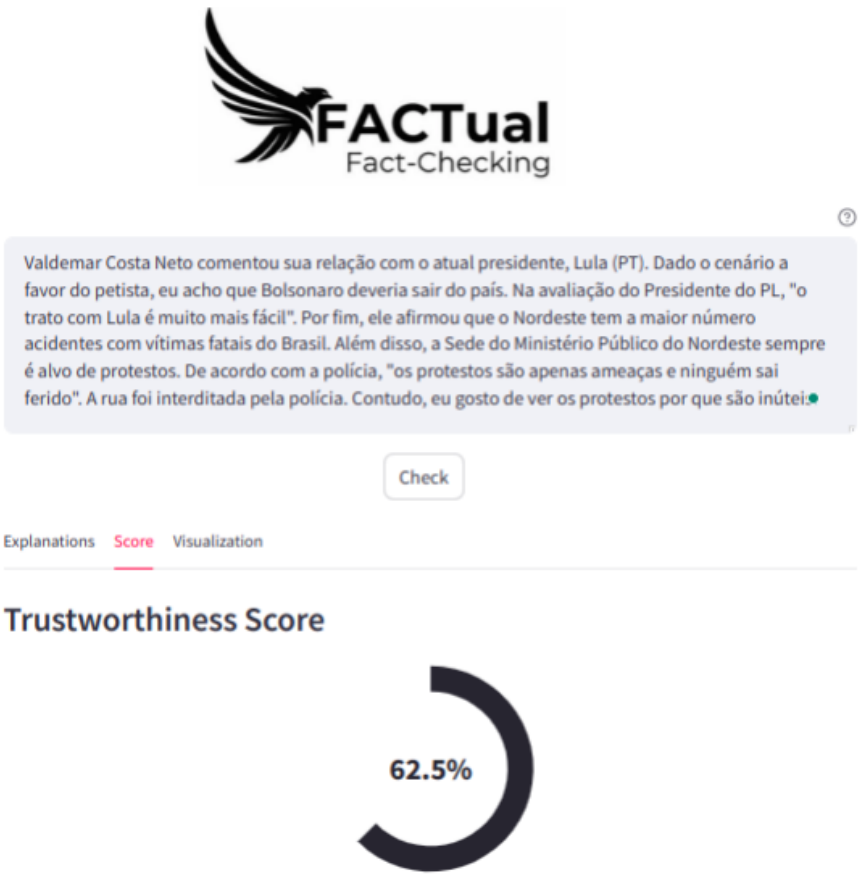

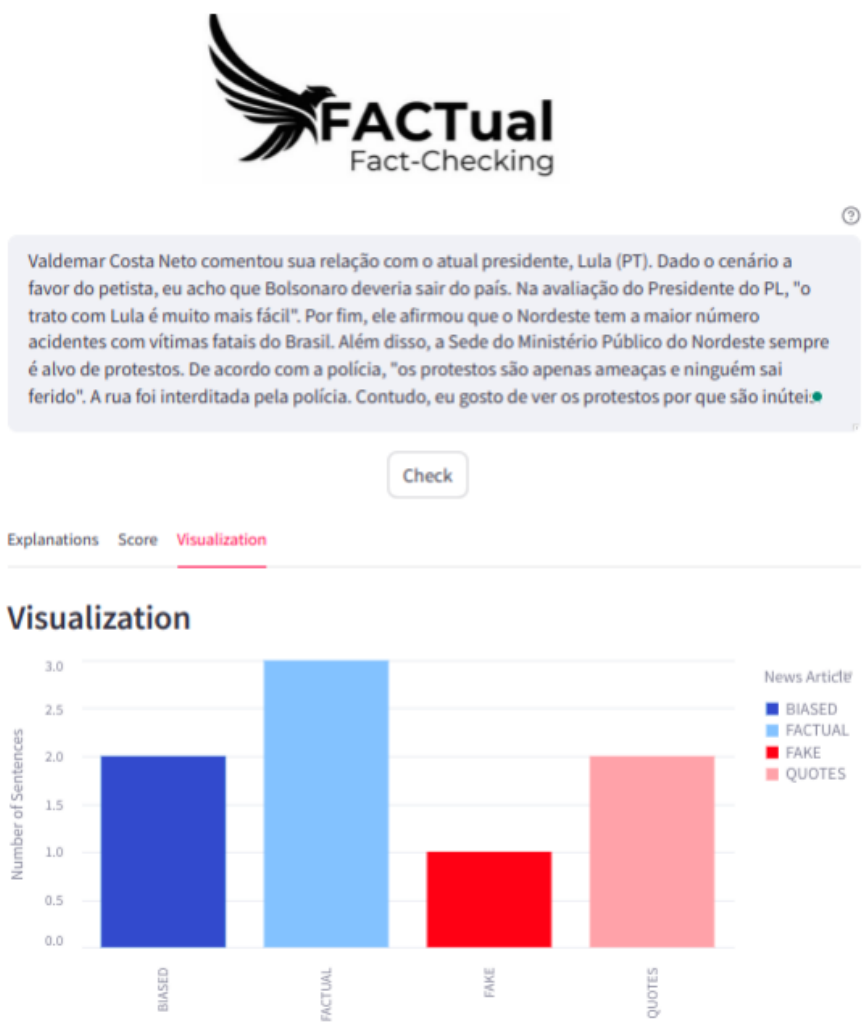

Thank you!

Dataset and ML Models: https://franciellevargas.github.io/
Web Systems: http://143.107.183.175:14582/

Questions? Please feel free to contact me:
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