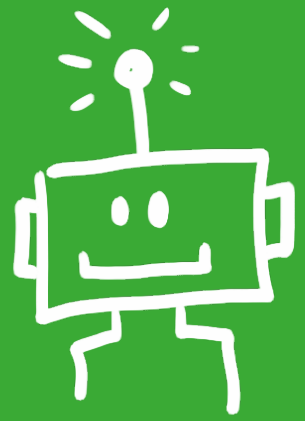
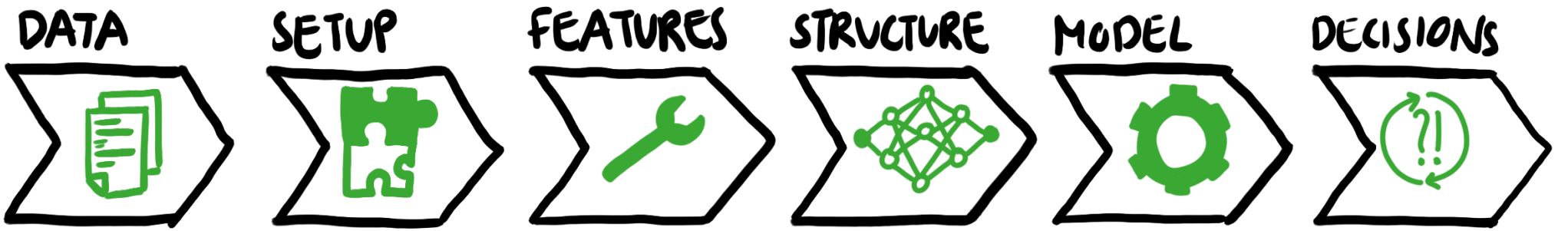
XAI meets Natural Language Processing



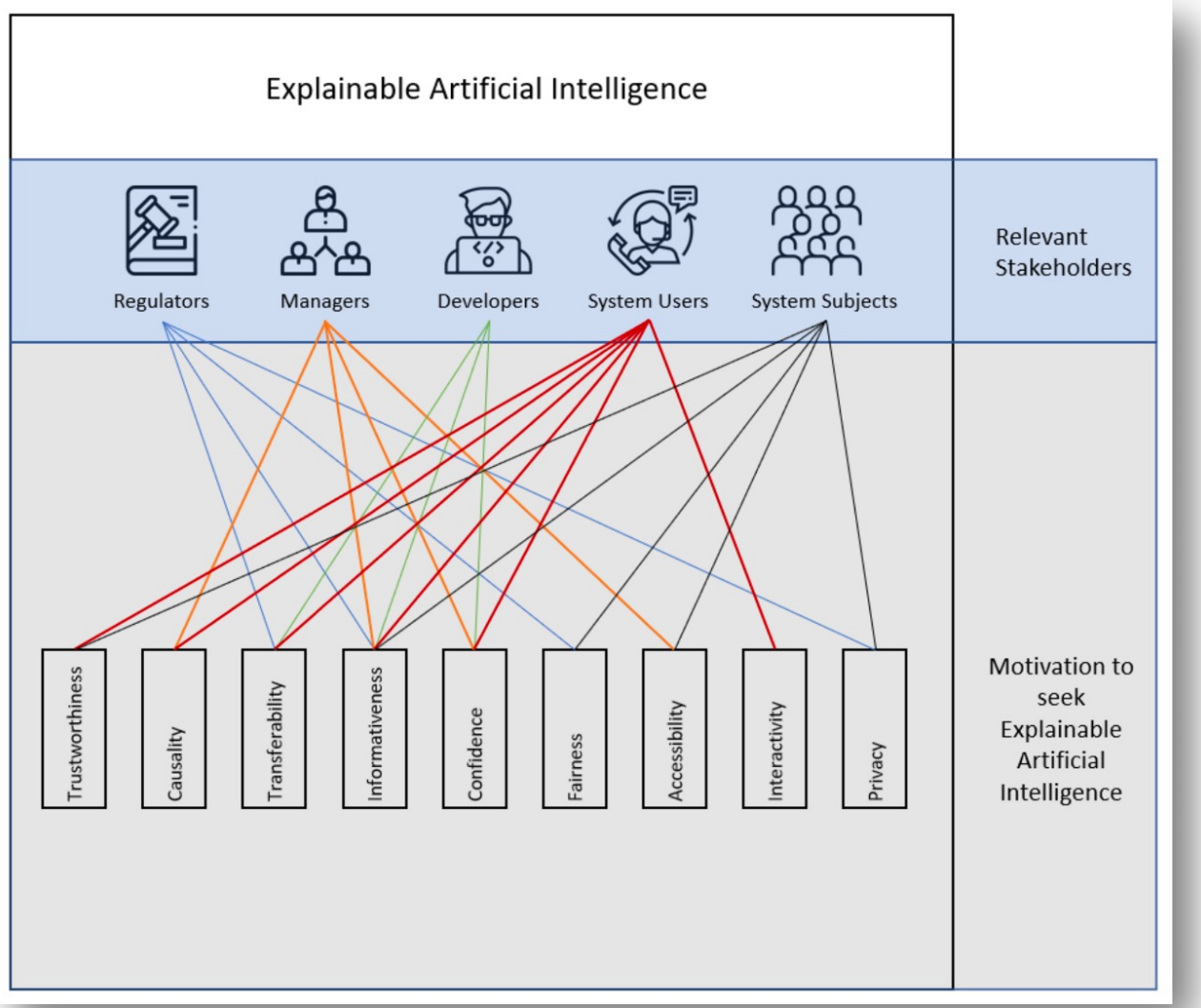
sovanta AG, 13.04.22
Larissa Haas

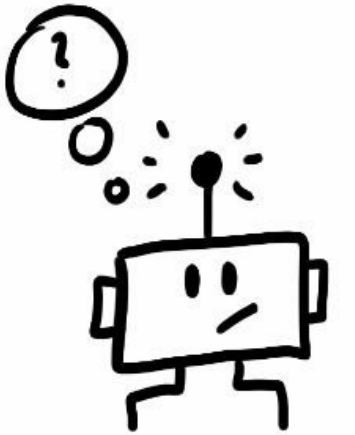
@l_r_ss_

What is Explainable AI?

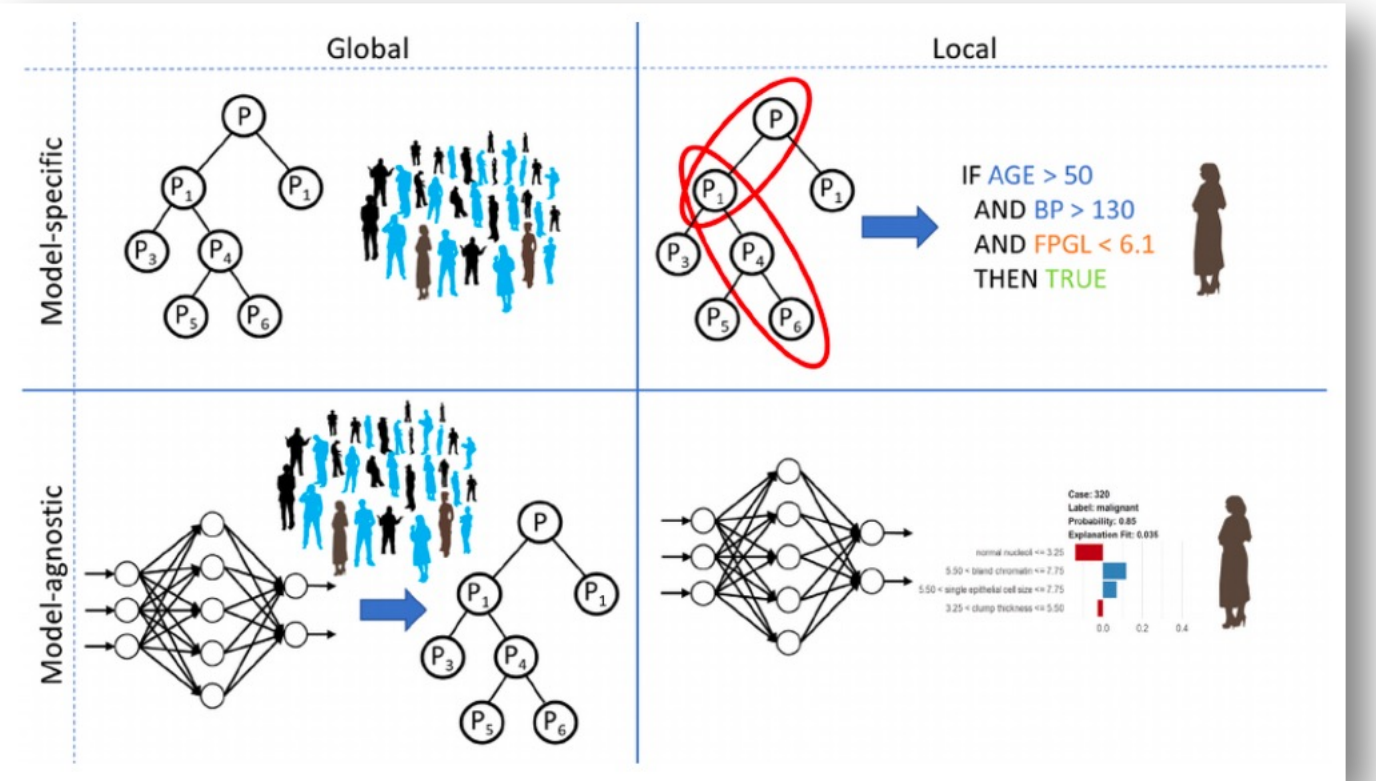


Why bother?


Explainable Artificial Intelligence
Regulators
Managers
Developers
System Users
System Subjects
Relevant Stakeholders
Trustworthiness
Causality
Transferability
Informativeness
Confidence
Fairness
Accessibility
Interactivity
Privacy
Motivation to seek Explainable Artificial Intelligence



Common Approaches & Evaluations

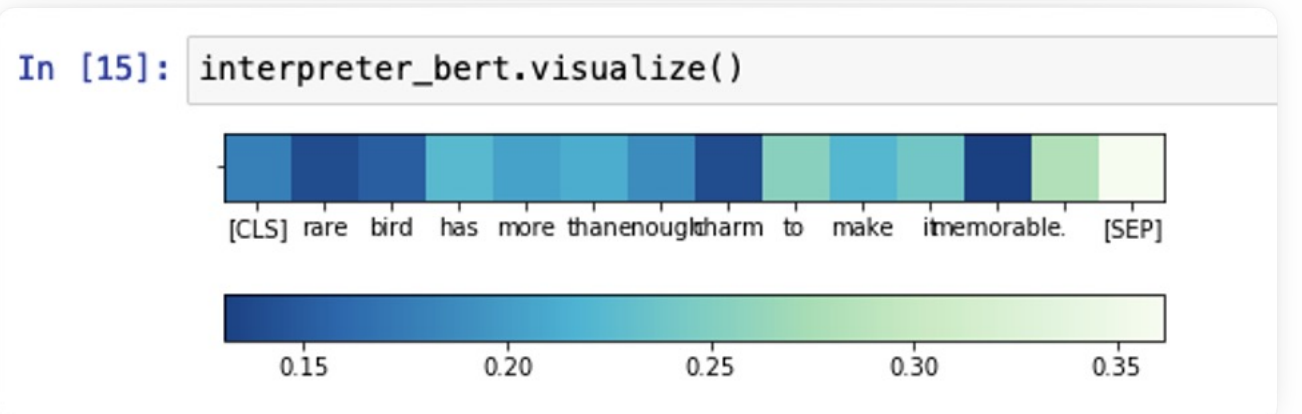


Common Approaches & Evaluations

- Human annotations
- Feature importances and model structures
- Understandable models
- Correlations like LIME, SHAP, ELI5
- Graphical representations

Feature Imporance & Model Structures

- Use layers of BERT model to compute interpreter instances
- Sigma = the range that every word can change without changing **s** too much
- Sigma stands for the information loss of word $\mathbf{x}_i$ when it reaches **s**



Understandable Models

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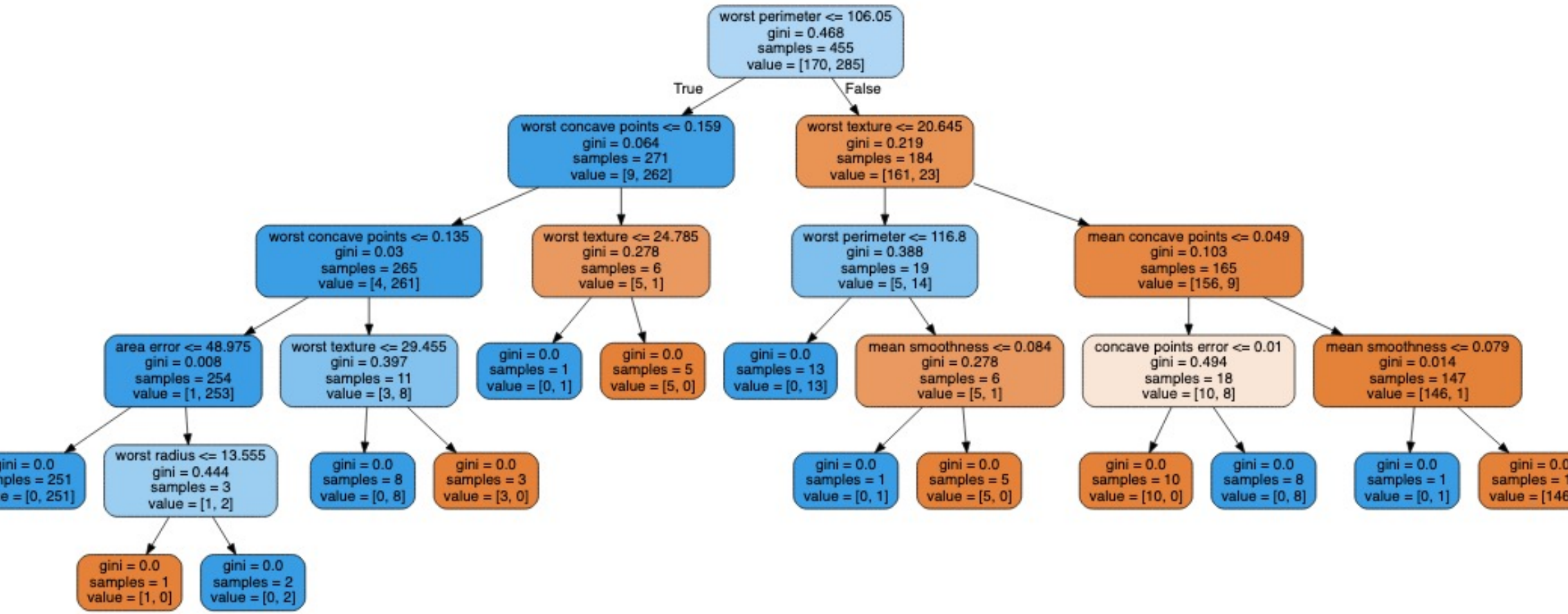
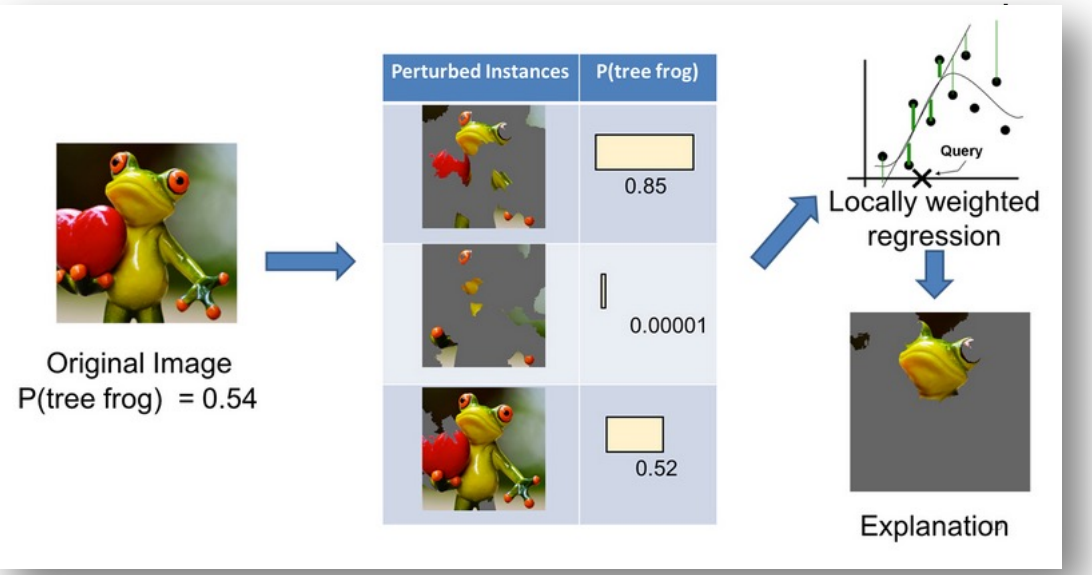
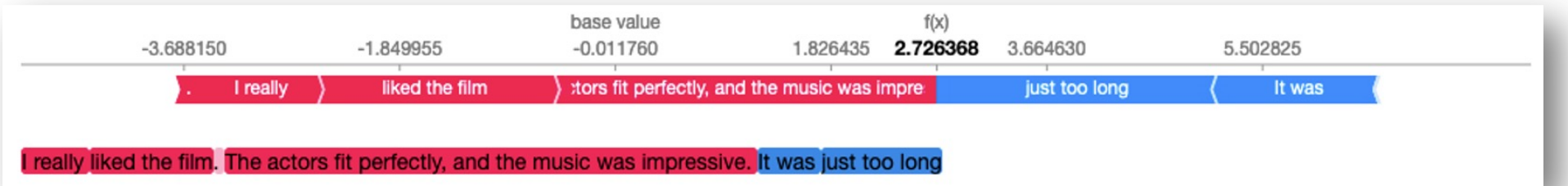


LIME & SHAP

- LIME (= Local Interpretable Model-agnostic Explanations)
  - only locally



- SHAP values (= SHapley Additive exPlanations)



  - locally and globally, but more costly

Difference between LIME & SHAP

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- ”For Christmas song visit my channel!” → SPAM

For	Christmas	Song	Visit	My	Channel	Prob	LIME	SHAP
1	0	1	1	0	0	0.17	0.5	0.42
0	1	1	1	1	0	0.17	0.67	0.68
1	0	0	1	1	1	0.99	0.67	0.68
1	0	1	1	1	1	0.99	0.83	0.91
0	1	1	1	0	0	0.17	0.5	0.42
0	0	0	0	0	1	0.83	0.17	0.91

- LIME: weighting on closeness to original
- SHAP: weighting on coalitings (high amount of 1s, high amount of 0s)

Example extended from https://christophm.github.io/interpretable-ml-book/lime.html#lime

ELI5

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In [31]:
```
import eli5

eli5.explain_prediction(gnb, datarows["text_new"][2741], vec=tfid, target_names=['fake', 'true'])
```

Out[31]:

y=fake (score **-0.862**) top features

Contribution[?]	Feature
+0.632	Highlighted in text (sum)
+0.230	<BIAS>

reuters news agency declares war on trump in the most perfect way, trump humiliated donald trump s treatment of journalists is so bad that the reuters news agency is now advising reporters to treat trump like they would treat a foreign dictator.on tuesday, trump and his team announced that they will no longer send surrogates to appear on cnn, an escalation of the war trump has been waging against the news network, which he calls fake news because they won t promote his agenda.trump has even praised fox new s biased reporting as something cnn should copy.furthermore, trump and his team have repeatedly threatened and tried to intimidate journalists for doing their jobs just because they aren t writing puff pieces that kiss trump s ass.well, reuters is doing something about it.for 165 years, reuters has been bringing us news from around the world. they ve been in the most peaceful and democratic places, but they ve also been in war zones and reported on the most dangerous and tyrannical regimes in world history.in a message to staff on tuesday, reuters editor-in-chief steve adler advised his reporters to start dealing with trump the way they have dealt with brutal dictators in the past. it s not every day that a u.s. president calls journalists among the most dishonest human beings on earth or that his chief strategist dubs the media the opposition party, adler wrote. it s hardly surprising that the air is thick with questions and theories about how to cover the new administration. adler then revealed his solution for how reporters should handle trump.so what is the reuters answer? to oppose the administration? to appease it? to boycott its briefings? to use our platform to rally support for the media? all these ideas are out there, and they may be right for some news operations, but they don t make sense for

ELI5

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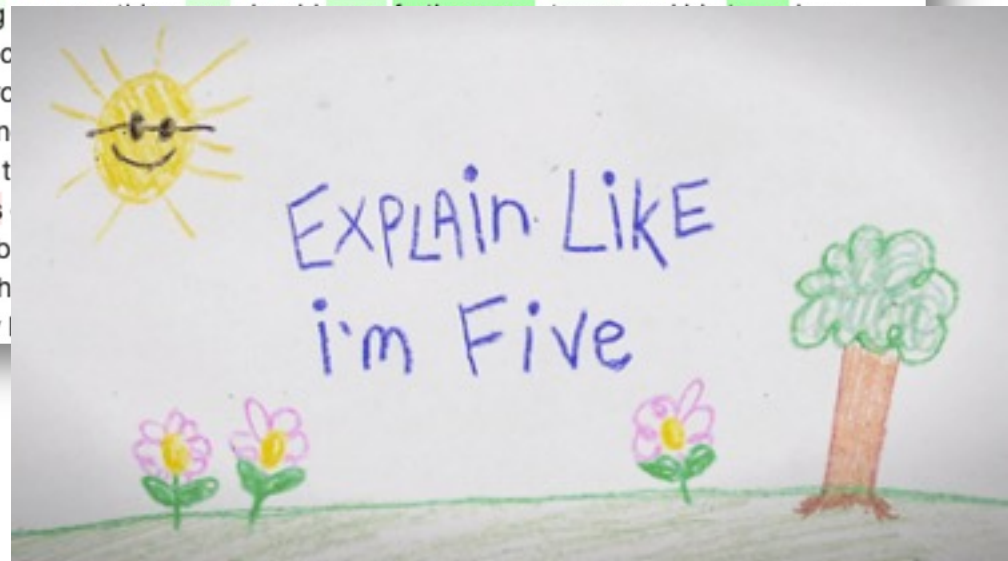
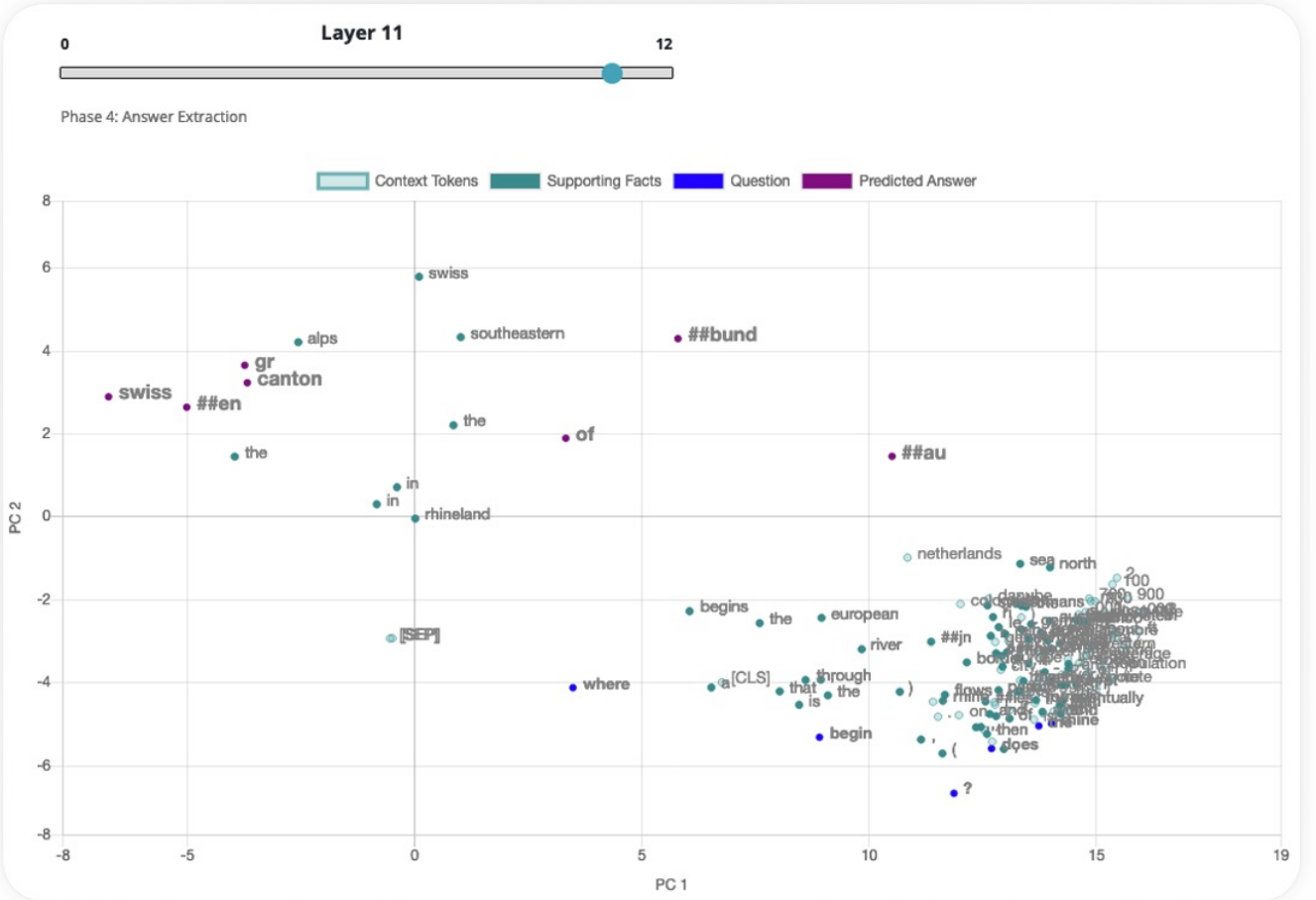


Graphical Representations



- good for word embeddings
- but only with dimensionality reduction

https://visbert.demo.datexis.com/

Common Approaches & Evaluations

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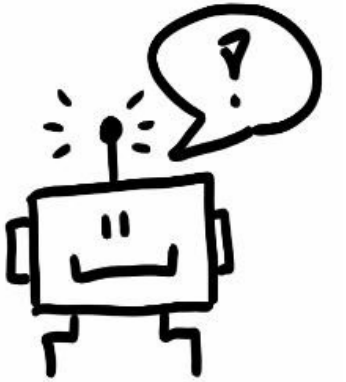

Common Approaches & Evaluations

approach	evaluation for NLP
human annotations	for all kinds of applications difficult, except if you have / create the right data
Feature importances & model structures	depends on model
understandable models & feature importances	depending on preprocessing: but mostly not applicable
correlations (LIME, SHAP, ELI5)	depending on preprocessing & model: can work quite well downside: slow can be manipulated by researcher
graphical representations	good e.g. for evaluating embeddings / word vectors, but also only via SVD / PCA / t-SNE

- See also https://www.arxiv-vanity.com/papers/2106.07410/

Difficulties for NLP Models

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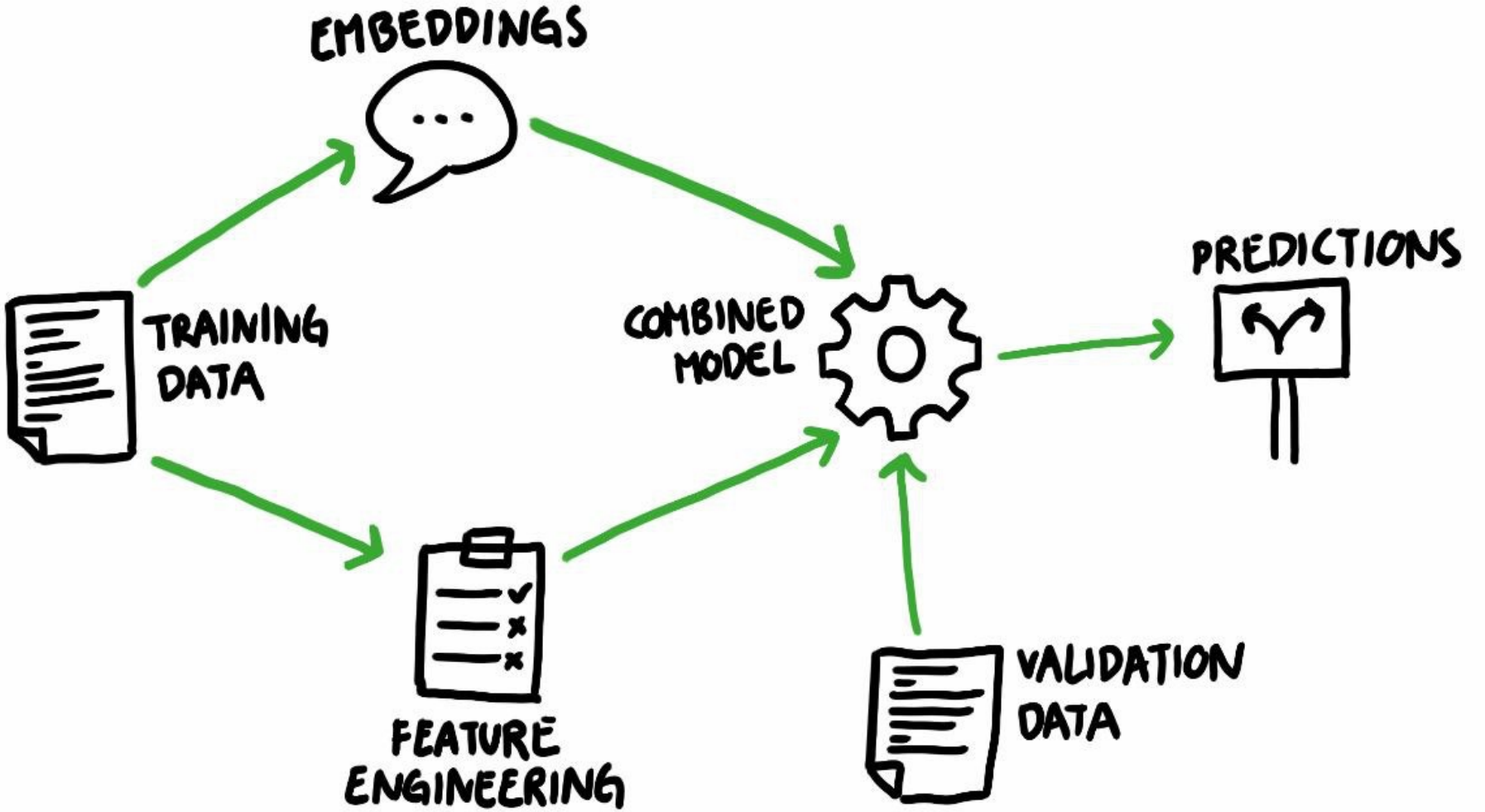
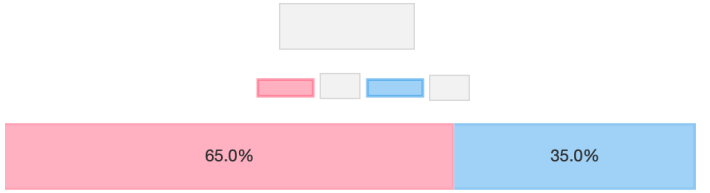
- Dimensions
- Variability in models and representations
- Set of tokens != variables
- Local → global
- Difficult to show graphically
- Joint effects and effects of absent words

Real World Example- Setup

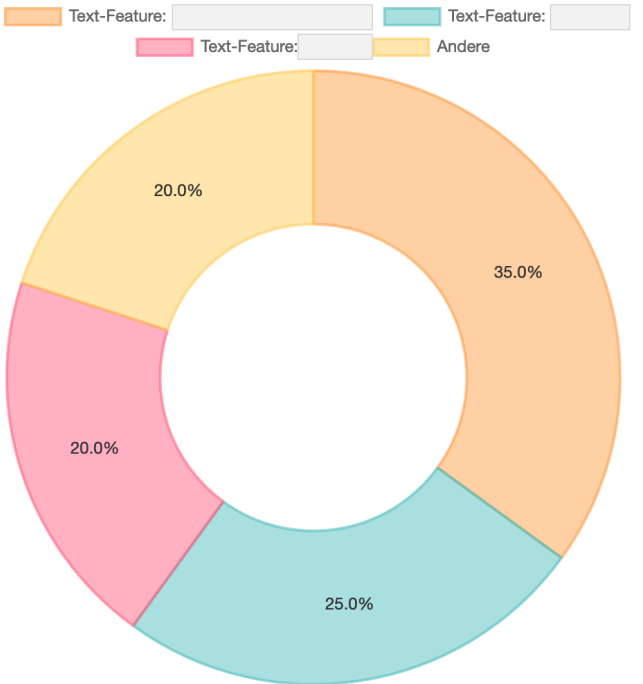


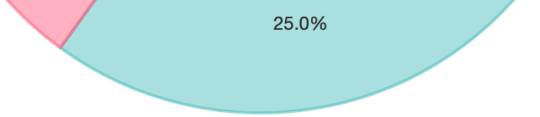
Ergebnisse:

Vorhersage und Verteilung:

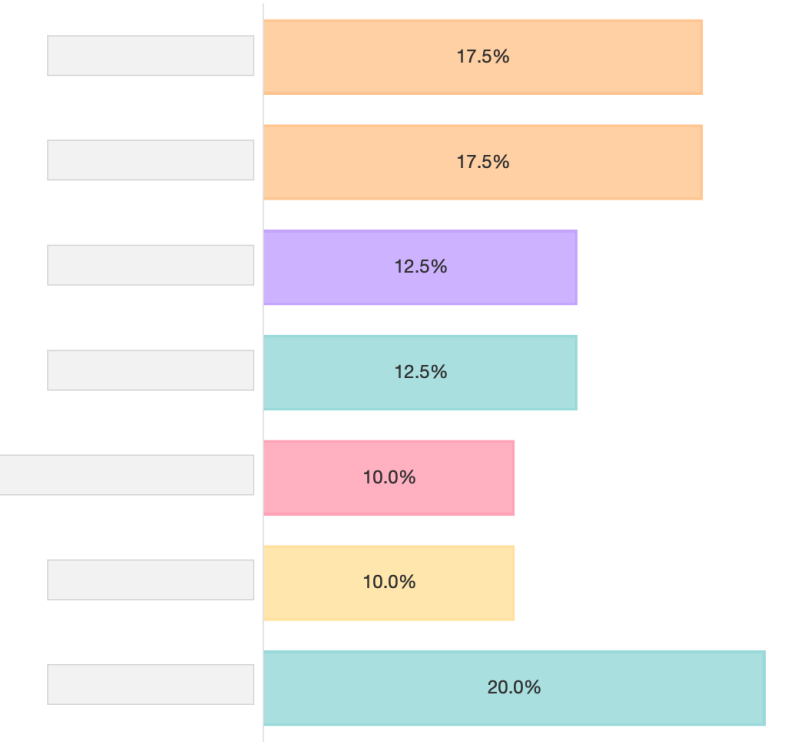


Text-Indikatoren (Zusammenfassung)





Feature-Indikatoren



Kommentar

Lessons Learned

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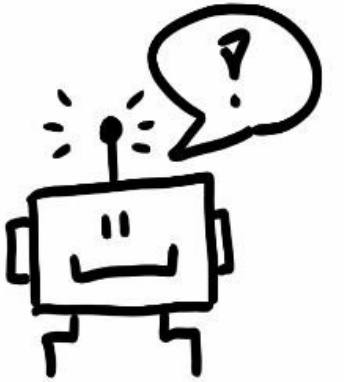
- Explain the explainability
- Absense of words
- Local impact VS global impact
- Find a fitting graphical representation
- Reduce complexity
- Include help texts



Links & Further Reading

- https://volpato.io/articles/1907-nlp-xai.html
- https://www.arxiv-vanity.com/papers/2106.07410/
- https://analyticsindiamag.com/hands-on-guide-to-interpret-machine-learning-with-shap/
- https://github.com/RajkumarGalaxy/StructuredData/blob/master/Interpret_ML_with_SHAP.ipynb
- https://christophm.github.io/interpretable-ml-book/shap.html
- https://shap.readthedocs.io/en/latest/index.html
- http://lineardigressions.com/episodes/2019/8/18/data-shapley
- https://eli5.readthedocs.io/en/latest/overview.html
- https://mapmeld.medium.com/deciphering-explainable-ai-with-eli5-22c90a06a32a
- https://towardsdatascience.com/visualizing-word-embedding-with-pca-and-t-sne-961a692509f5
- https://microsoft.github.io/nlp-recipes/examples/model_explainability/
- https://visbert.demo.datexis.com/
- Alejandro Barredo Arrieta, Natalia D´ıaz-Rodr´ıguez, Javier Del Ser, Adrien Bennetot, Siham Tabik, Alberto Barbado, Salvador Garc´ıa, Sergio Gil-Lo´pez, Daniel Molina, Richard Benjamins, et al. Explainable artificial in- telligence (xai): Concepts, taxonomies, opportunities and challenges toward responsible ai. *Information Fusion*, 58:82–115, 2020.
- Gregor Stiglic, Primoz Kocbek, Nino Fijacko, Marinka Zitnik, Katrien Ver- bert, and Leona Cilar. Interpretability of machine learning-based prediction models in healthcare. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, 10(5):e1379, 2020.

Thanks!

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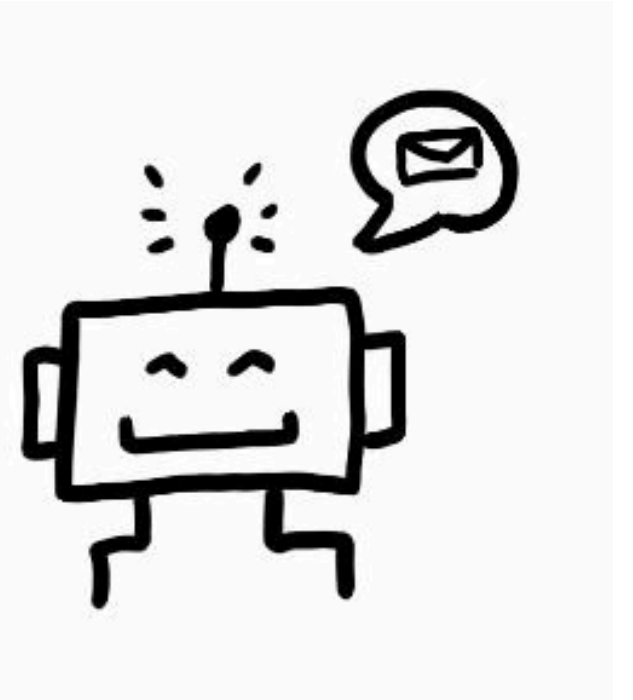
- Twitter @l_r_ss_
- LinkedIn



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