

# HUMORERKENNUNG IM NATURAL LANGUAGE PROCESSING

DBE Projekttag | Projekt 2 | 14.03.2023

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# **Projekt 1**

## *in a nutshell*

# Das eigene Humorverständnis wird durch viele Faktoren geprägt.



Cattell & Luborsky, 1947



**Humor erkennen und verstehen ist  
für Menschen oft einfach.**

**Für Computersysteme  
immer schwierig.**



# Natural Language Processing

NLP nutzt verschiedene Ansätze, um **menschliche Sprache verarbeiten und interpretieren** zu können.

Ziel ist, dass ein Computer **Sprache semantisch und kontextuell „verstehen“** kann.



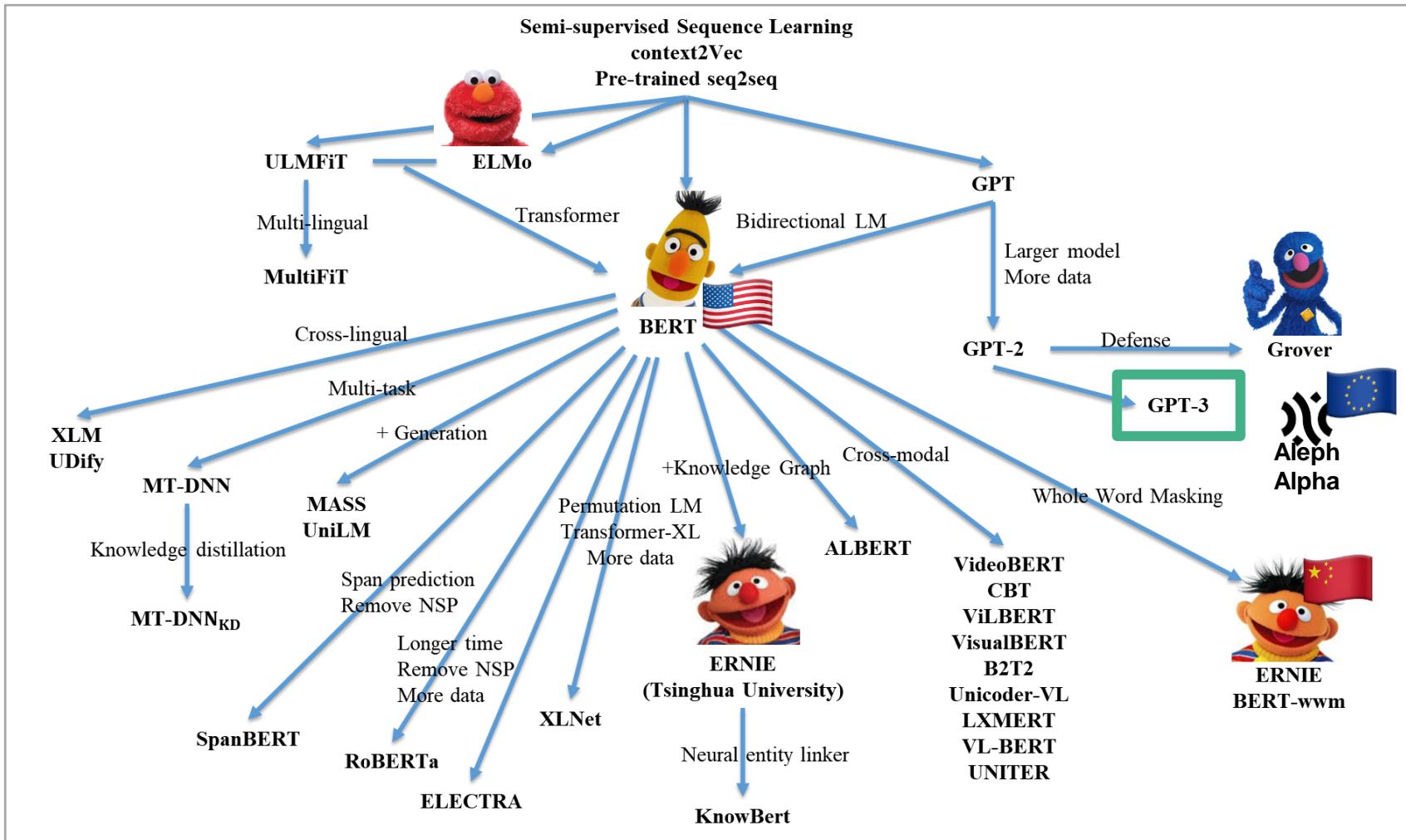
Google Assistant



amazon alexa



**ChatGPT**



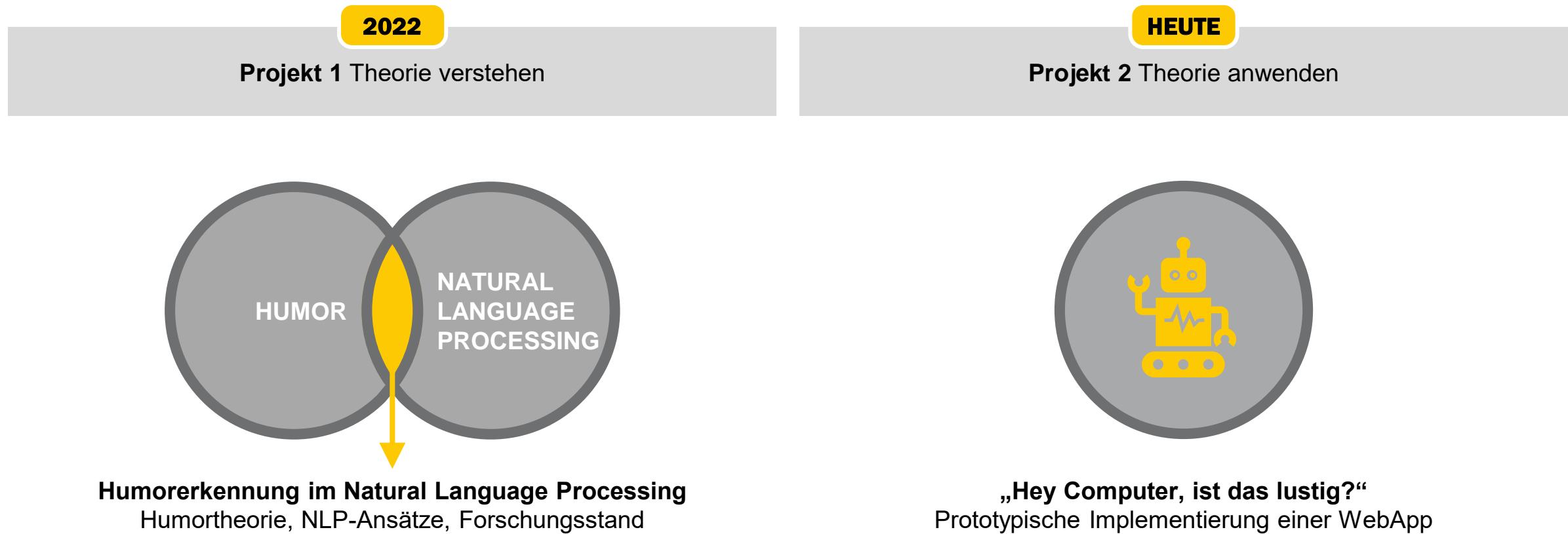
GPT-3 und GPT-4-unreleased  
sind nicht mehr open source

The screenshot shows a dark-themed chat interface from [chat.openai.com/chat](https://chat.openai.com/chat). At the top, there's a navigation bar with a home icon, a lock icon, the URL, a '60' badge, and a three-dot menu. Below that is a header with a menu icon, the title 'Humor Detection limitations', and a plus sign for creating a new conversation. The main area shows a message from 'GA' asking 'can you detect humor?'. The AI response, preceded by its logo, states: 'I can detect some forms of humor, but my understanding of it may be limited. My primary goal is to provide accurate and informative responses to user inquiries, so my ability to detect and understand humor may not be as advanced as that of a human. Additionally, the interpretation of humor can be highly dependent on context and personal experience, which can be difficult for a machine to fully understand.' There are like and dislike buttons at the bottom of the AI message.

GA can you detect humor?

I can detect some forms of humor,  
but my understanding of it may be  
limited. My primary goal is to provide  
accurate and informative responses  
to user inquiries, so my ability to  
detect and understand humor may  
not be as advanced as that of a  
human. Additionally, the  
interpretation of humor can be highly  
dependent on context and personal  
experience, which can be difficult for  
a machine to fully understand.

# Projektplan



**01**

Trainingsdatensatz

**02**

Technische Realisierung

**03**

Evaluation der Ergebnisse

**04**

Prototypische WebApp

**01**

**Trainingsdatensatz**

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# Auswahl von unimodalem Datensatz aufgrund Leistungsverfügbarkeit

## UR-FUNNY: A Multimodal Language Dataset for Understanding Humor

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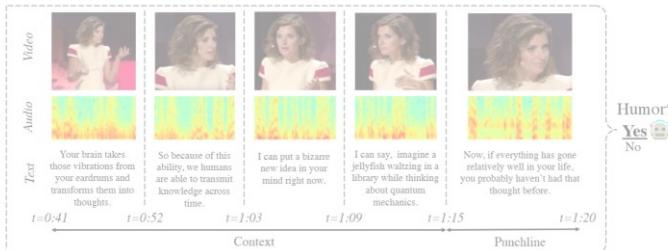


Figure 1: An example of the UR-FUNNY dataset. UR-FUNNY presents a framework to study the dynamics of humor in multimodal language. Machine learning models are given a sequence of sentences with the accompanying modalities of visual and acoustic. Their goal is to detect whether or not the sequence will trigger immediate laughter after the punchline.

[github.com/ROC-HCI/UR-FUNNY](https://github.com/ROC-HCI/UR-FUNNY)

„UR-FUNNY“

Multimodaler Datensatz  
Gestik / Mimik (visuell)  
Prosodie (akustisch)  
Worte / Sätze (textuell)

## Multimodal Learning using Optimal Transport for Sarcasm and Humor Detection

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### Abstract

*Multimodal learning is an emerging yet challenging research area. In this paper, we deal with multimodal sarcasm and humor detection from conversational videos and image-text pairs. Being a fleeting action, which is reflected across the modalities, sarcasm detection is challenging since large datasets are not available for this task in the literature. Therefore, we primarily focus on resource-constrained training, where the number of training samples is limited. To this end, we propose a novel multimodal learning system, MuLOT (Multimodal Learning using Optimal Transport), which utilizes self-attention to exploit intra-modal correspondence and optimal transport for cross-modal correspondence. Finally, the modalities are combined with multimodal attention fusion to capture the inter-dependencies across modalities. We test our approach for multimodal sarcasm and humor detection on three benchmark datasets - MUSTARD [7] (video, audio, text), UR-FUNNY [20] (video, audio, text), MST [3] (image, text) and obtain 2.1%, 1.54% and 2.34% accuracy improvements over state-of-the-art.*

[github.com/soujanyaaporia/MUSTARD](https://github.com/soujanyaaporia/MUSTARD)



Sheldon: It's just a privilege to watch your mind in work

Figure 1: Sample sarcastic utterance from the MUStARD dataset along with its transcript. Sheldon's comment (text) with a straight face (visual) and a clinical tone (acoustic) makes the instance sarcastic.

in conversations, building trust [55] and creating a positive impact on mental health [29]. However, existing deep neural systems often struggle to understand such fine-grained multimodal sentiments.

**Motivation:** The most common form of sarcasm and humor has traditionally been delivered using text. However, sarcasm in multimodal data often requires precise inter-modal cues to reveal the speaker's intentions. For instance, it can often be expressed using a combination of verbal and non-verbal

## Computational Humor Using BERT Sentence Embedding in Parallel Neural Networks

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### Abstract

Automation of humor detection and rating has interesting use cases in modern technologies, such as humanoid robots, chatbots, and virtual assistants. In this paper, we propose a novel approach for detecting and rating humor in short texts based on a popular linguistic theory of humor. The proposed technical method initiates by separating sentences of the given text and utilizing the BERT model to generate embeddings for each one. The embeddings are fed to separate lines of hidden layers in a neural network (one line for each sentence) to extract latent features. At last, the parallel lines are concatenated to determine the congruity and other relationships between the sentences and predict the target value. We accompany the paper with a novel dataset for humor detection consisting of 200,000 formal short texts. In addition to evaluating our work on the novel dataset, we participated in a live machine learning competition focused on rating humor in Spanish tweets. The proposed model obtained F1 scores of 0.982 and 0.869 in the humor detection experiments which outperform general and state-of-the-art models. The evaluation performed on two contrasting settings confirm the strength and robustness of the model and suggests two important factors in achieving high accuracy in the current task: 1) usage of sentence embeddings and 2) utilizing the linguistic structure of humor in designing the proposed model.

[github.com/Moradnejad/ColBERT-Using-BERT-Sentence-Embedding-for-Humor-Detection](https://github.com/Moradnejad/ColBERT-Using-BERT-Sentence-Embedding-for-Humor-Detection)

Unimodaler Datensatz

Worte / Sätze (textuell)

# „One Liner“ Gelabelte Daten 99.965 Witze 100.001 Nicht-Witze Englischsprachig

```
text,humor
"Joe biden rules out 2020 bid: 'guys, i'm not running'",False
Watch: darvish gave hitter whiplash with slow pitch,False
What do you call a turtle without its shell? dead.,True
5 reasons the 2016 election feels so personal,False
"Pasco police shot mexican migrant from behind, new autopsy shows",False
"Martha stewart tweets hideous food photo, twitter responds accordingly",False
What is a pokemon master's favorite kind of pasta? wartortellini!,True
Why do native americans hate it when it rains in april? because it brings mayflowers.,True
"Obama's climate change legacy is impressive, imperfect and vulnerable",False
"My family tree is a cactus, we're all pricks.",True
Donald trump has found something mysterious for rudy giuliani to do,False
How donald trump and ted cruz's love affair is all relationships,False
Want to know why athletes chose to #takeaknee? look at our broken justice system,False
How are music and candy similar? we throw away the rappers.,True
Famous couples who help each other stay healthy and fit,False
Study finds strong link between zika and guillain-barre syndrome,False
Alec Baldwin and wife hilary welcome another baby boy,False
"Trump says iran is complying with nuclear deal, but remains a dangerous threat",False
Kim kardashian baby name: reality star discusses the 'k' name possibility (video),False
"I just ended a 5 year relationship i'm fine, it wasn't my relationship :p",True
Here's what the oscar nominations should look like, False
Dating tip: surprise your date! show up a day early.,True
Reflections from davos: leaders deliberate what's next for climate action after paris deal,False
What do you call an explanation of an asian cooking show? a wok-through.,True
Swimming toward a brighter future: how i was introduced to the world of autism,False
Why did little miss muffet have gps on her tuffet? to keep her from losing her whey.,True
The pixelated 'simpsons' should be a real couch gag,False
All pants are breakaway pants if you're angry enough,True
Watch: former british open champ makes embarrassing putting fail,False
Chrissy teigen's 2015 grammy dress is skintight and perfect,False
"Ugh, i just spilled red wine all over the inside of my tummy.",True
The next iphone update will help you save lives,False
Celebrating the fourth of july with airport profiling,False
"The big bend, a u-shaped skyscraper, could become the longest in the world",False
Oscars 2016 red carpet: all the stunning looks from the academy awards,False
Why do jews have big noses? because the air is free, True
Interesting fact: by the year 2020 all actors on american tv shows will be australian.,True
I'd tell you a chemistry joke but i know i won't get a reaction, True
Arkansas approves law to let people carry guns in bars and at public colleges,False
On set with paul mitchell: from our network, False
Did you know diarrhea is genetic? it runs in your jeans, True
"My sons ebola joke what do africans have for breakfast? ebola cereal :) (be kind,he's only 14 lol)",True
What was the sci-fi remake of a streetcar named desire? interstelllllllaaaaaar, True
What do you call a clan of barbarians you cant see? invisigoths, True
```

**01**

Trainingsdatensatz

**02**

**Technische Realisierung**

**03**

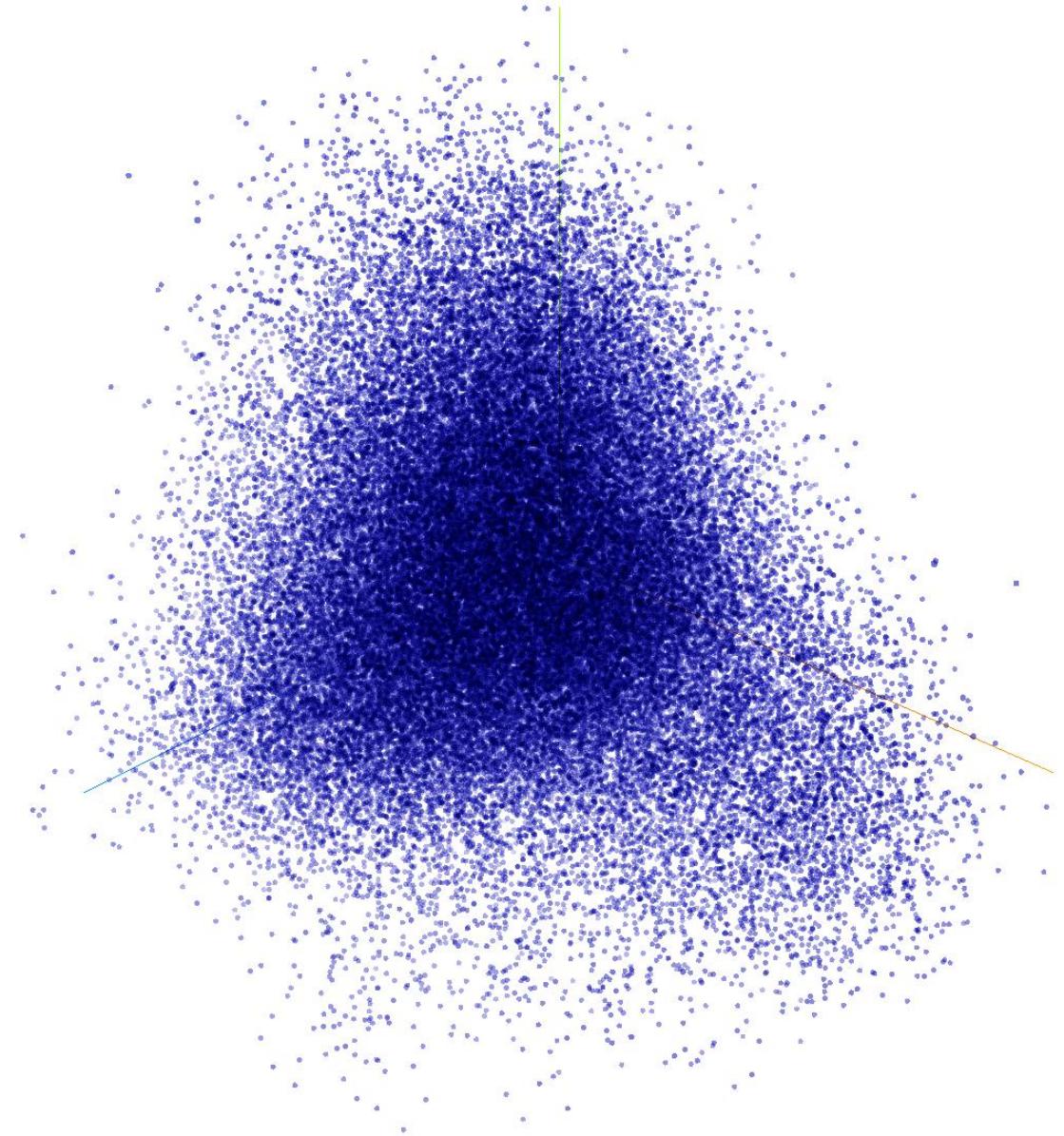
Evaluation der Ergebnisse

**04**

Prototypische WebApp

# TensorFlow Projector

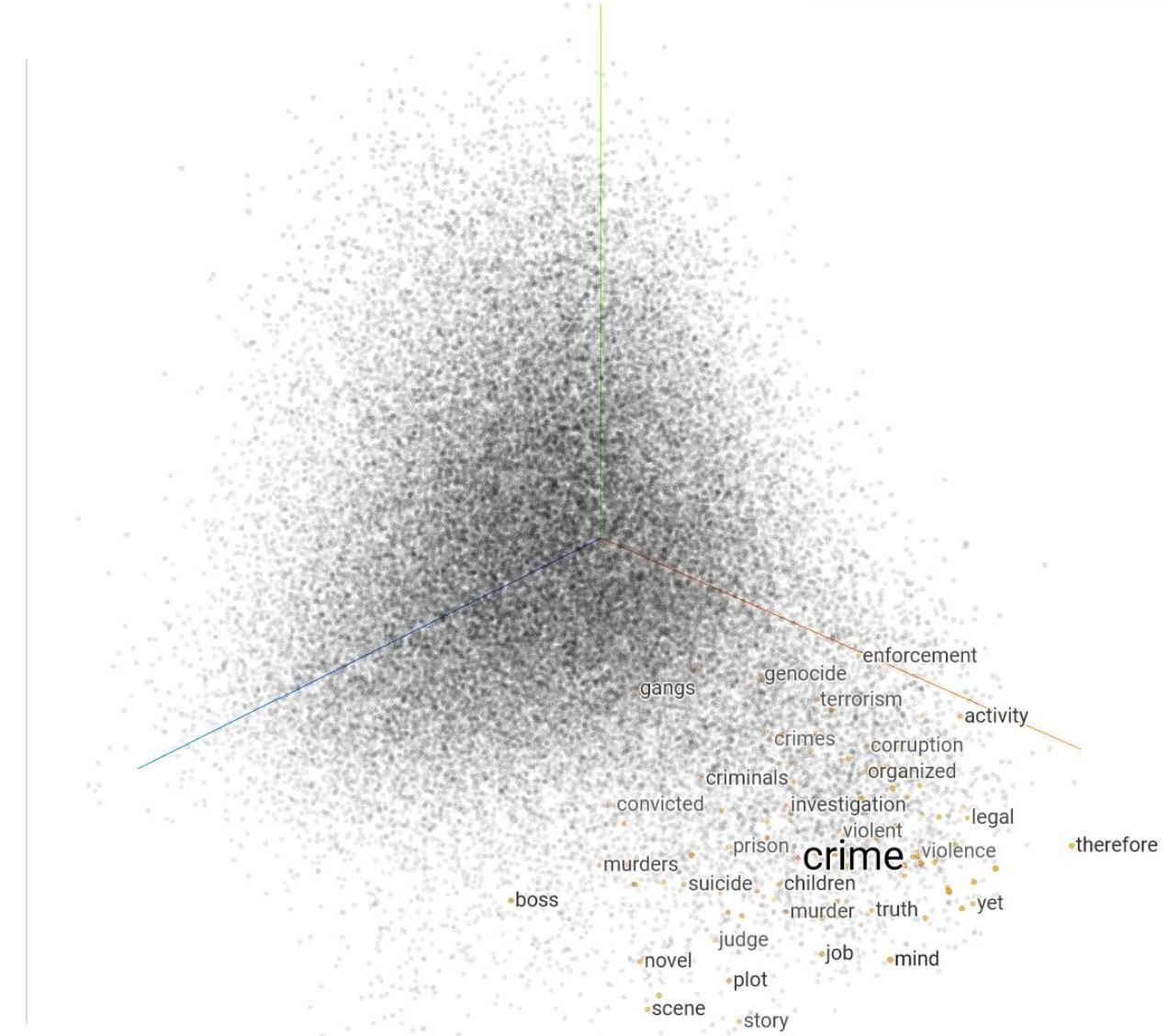
Visualisiert hochdimensionale Daten sowie deren Metadaten, indem sie in einen 3D-Raum projiziert werden.

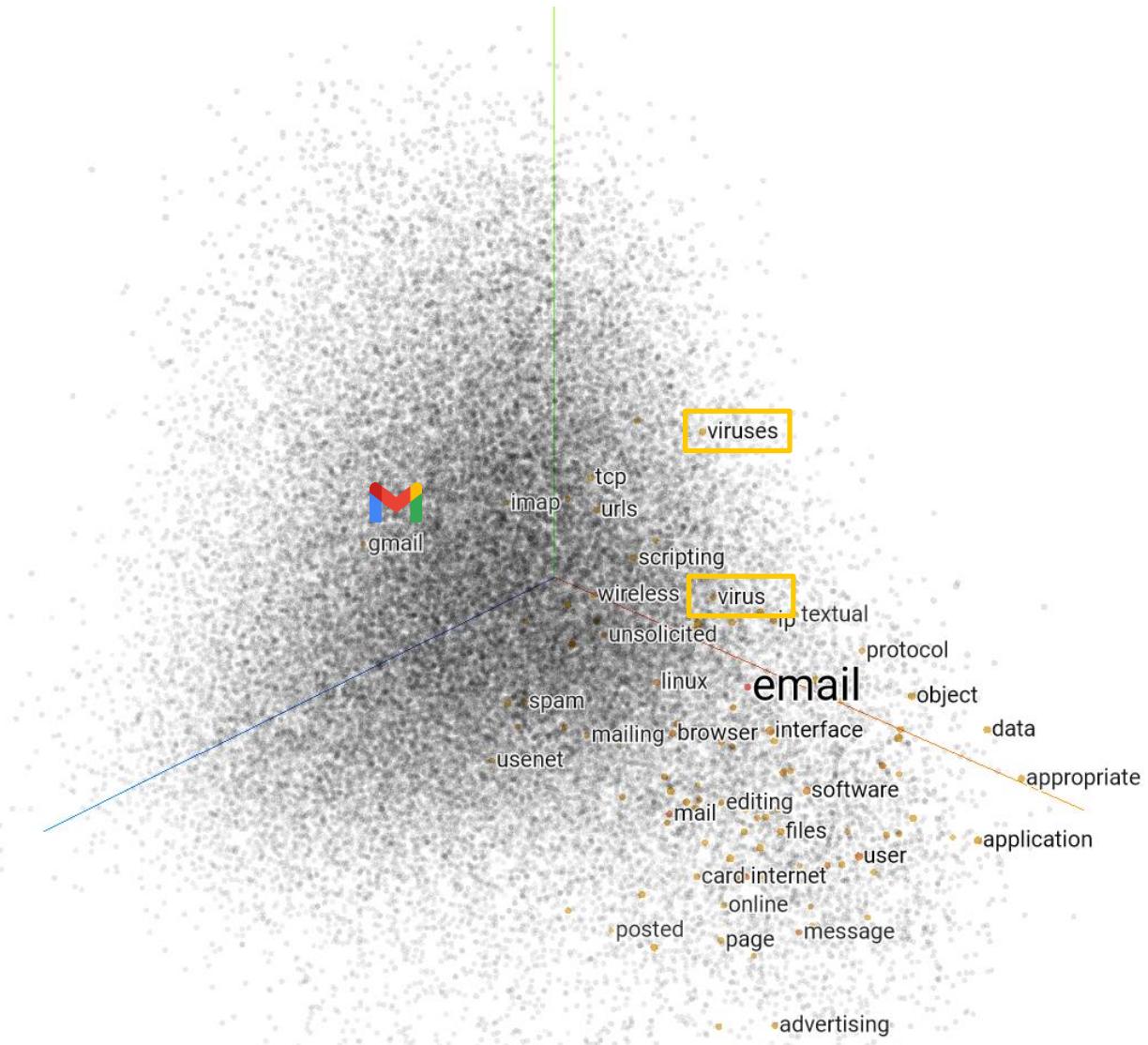
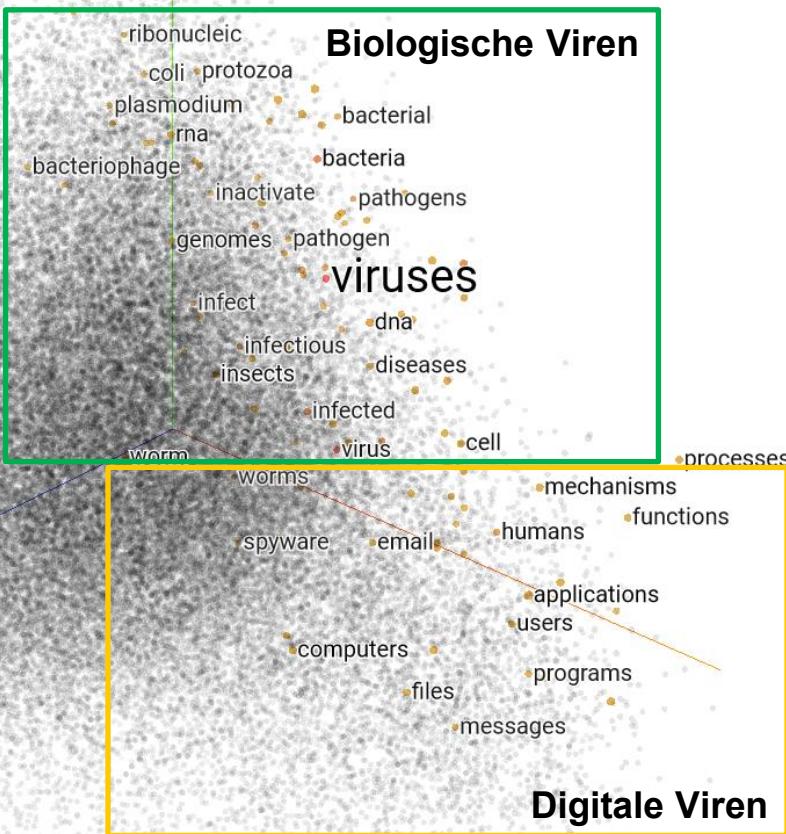


## Beispiel

### Word2Vec 71k

Umwandlung von 71.291 Wörtern in numerische Repräsentationen (= Vektoren), um mathematische Zusammenhänge der Wörter zueinander berechnen und erkennen zu können.





# BERT als Pre-Trained Language Model für NLP-Aufgaben

## Bidirectional Encoder Representations from Transformers

BERT ist ein vortrainierter, transformer-basierter, bidirekionaler Machine Learning-Ansatz für NLP-Aufgaben



Devlin et al., 2018

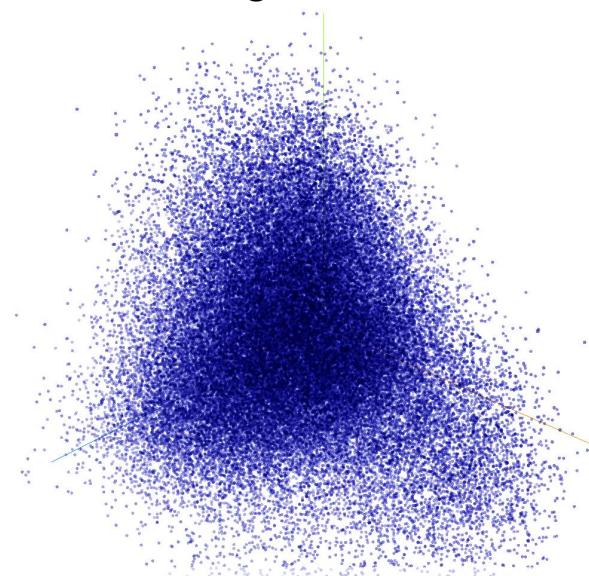
# Word2Vec

## ► Kontext-unabhängig

Ein Vektor (Embedding) für jedes Wort

## ► Reihenfolge-unabhängig

Keine Beachtung der Wortreihenfolge



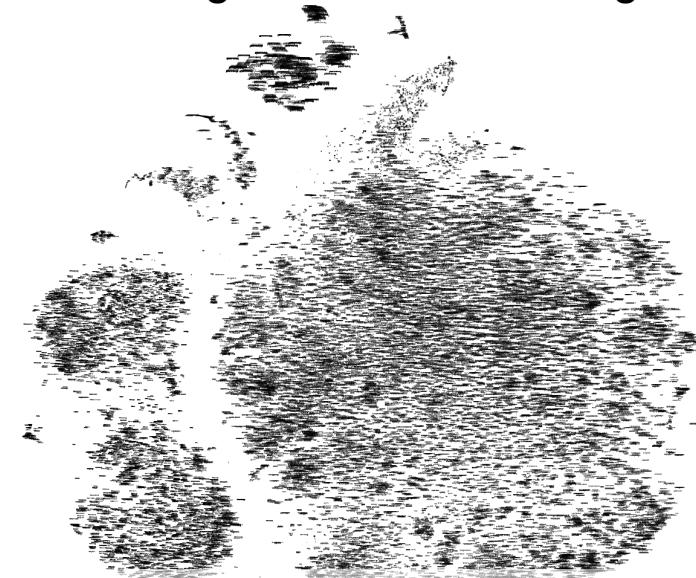
# BERT

## ► Kontext-abhängig

x Vektoren (Embeddings) für jedes Wort  
*Sitzbank vs Geldbank*

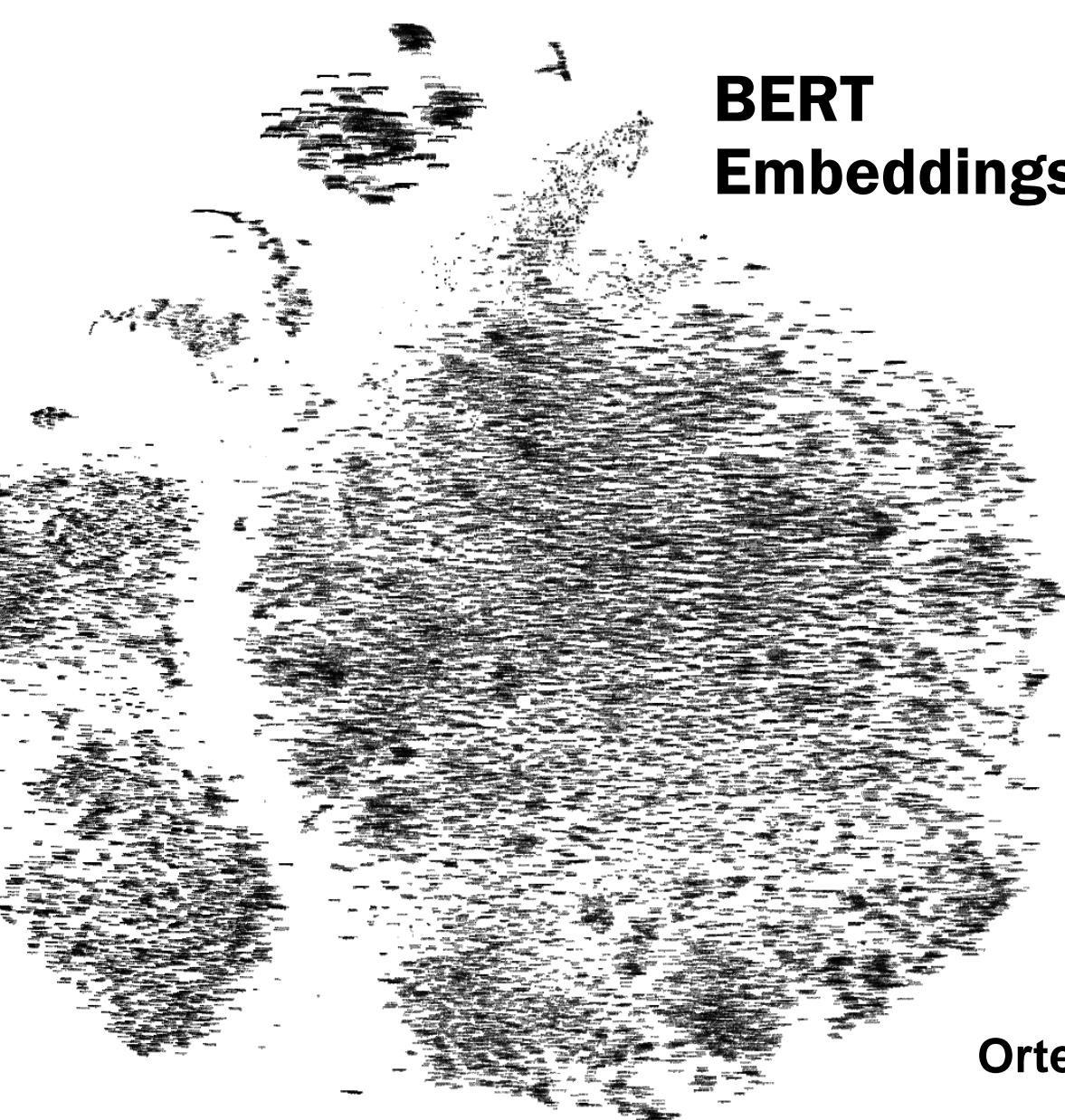
## ► Reihenfolge-abhängig

Beachtung der Wortreihenfolge im Satz



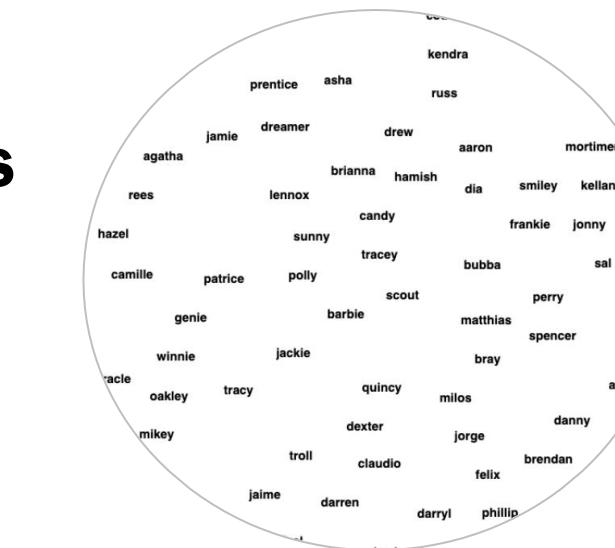
Sprachmodelle berechnen die kontextuellen Beziehungen (Korrelationen) zwischen Wörtern und repräsentieren damit die natürliche Sprache als Vektor. Diese Vektoren sind für den Einsatz in Deep Learning Methoden geeignet.

# BERT Embeddings

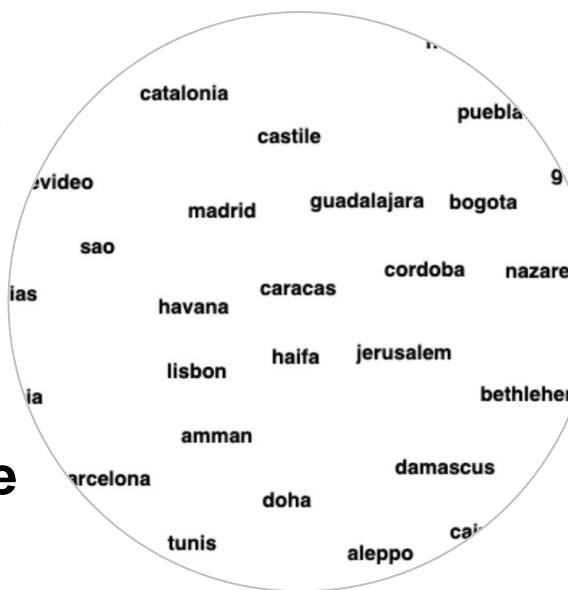


Orte

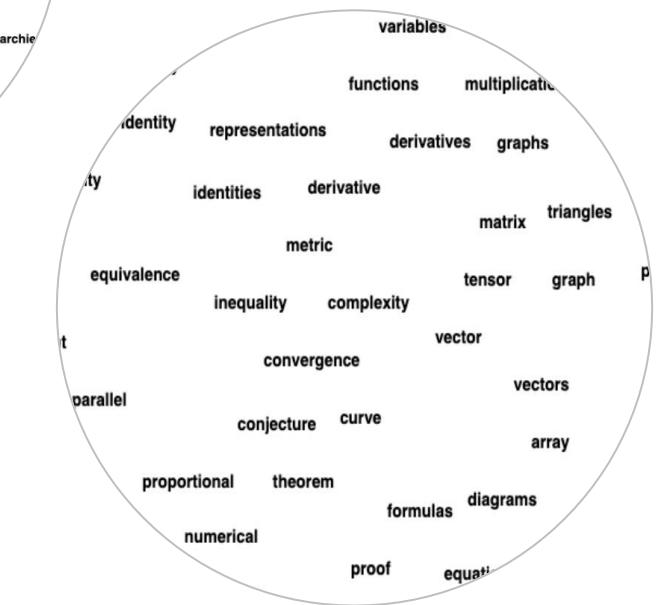
Hu, ohne Jahr



Namen



Orte



Mathematik

# Technische Implementierung

```
texts.json  
{"text": "Trump has been hit by a series of scandals and controversies in recent months.", "label": "False"},  
{"text": "Trump's policies have been criticised for being anti-environmental.", "label": "False"},  
{"text": "The US president has faced numerous lawsuits over his business deals and personal conduct.", "label": "False"},  
{"text": "Trump's tax returns remain under investigation by the US Congress and the Internal Revenue Service.", "label": "False"},  
{"text": "The president has been accused of being racist and discriminatory towards certain groups.", "label": "False"},  
{"text": "Trump's handling of the COVID-19 pandemic has been widely criticised as inadequate.", "label": "False"},  
{"text": "The president has faced calls for his impeachment due to his actions during the January 6th riot at the US Capitol.", "label": "True"},  
{"text": "The president has been accused of being sexist and making inappropriate comments towards women.", "label": "False"},  
{"text": "Trump has been accused of being a 'bully' and using his power to intimidate political opponents.", "label": "False"},  
{"text": "The president has faced criticism for his handling of foreign policy issues such as the Iran nuclear deal and the美朝 summit.", "label": "False"},  
{"text": "Trump has been accused of being a 'conman' who只关心自己 and putting personal利益 above the needs of the country.", "label": "True"},  
{"text": "The president has faced accusations of being a 'russian asset' and colluding with the Trump campaign.", "label": "False"},  
{"text": "Trump has been accused of being a 'racist' and making discriminatory statements towards minorities.", "label": "True"},  
{"text": "The president has faced criticism for his handling of the 9/11 terrorist attacks and the subsequent War on Terror.", "label": "False"},  
{"text": "Trump has been accused of being a 'coward' and fleeing the White House during the 2017 inauguration.", "label": "False"},  
{"text": "The president has faced accusations of being a 'liar' and providing false information to the public.", "label": "True"},  
{"text": "Trump has been accused of being a 'dictator' and having absolute power over the executive branch.", "label": "False"},  
{"text": "The president has faced criticism for his handling of the Black Lives Matter movement and police brutality.", "label": "False"},  
{"text": "Trump has been accused of being a 'bully' and using his power to intimidate political opponents.", "label": "False"},  
{"text": "The president has faced accusations of being a 'russian asset' and colluding with the Trump campaign.", "label": "False"},  
{"text": "Trump has been accused of being a 'racist' and making discriminatory statements towards minorities.", "label": "True"},  
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{"text": "Trump has been accused of being a 'coward' and fleeing the White House during the 2017 inauguration.", "label": "False"},  
{"text": "The president has faced accusations of being a 'liar' and providing false information to the public.", "label": "True"},  
{"text": "Trump has been accused of being a 'dictator' and having absolute power over the executive branch.", "label": "False"},  
{"text": "The president has faced criticism for his handling of the Black Lives Matter movement and police brutality.", "label": "False"}}
```

One Liner  
Trainingsdatensatz  
& Pre-Processing

Google  
**BERT**

Pre-trained Language Model  
smallBERT Konfigurationen

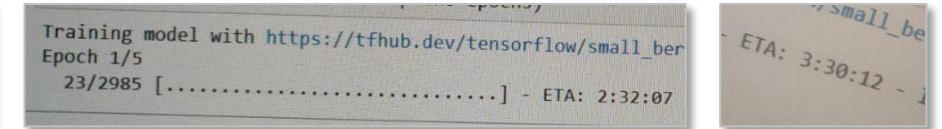
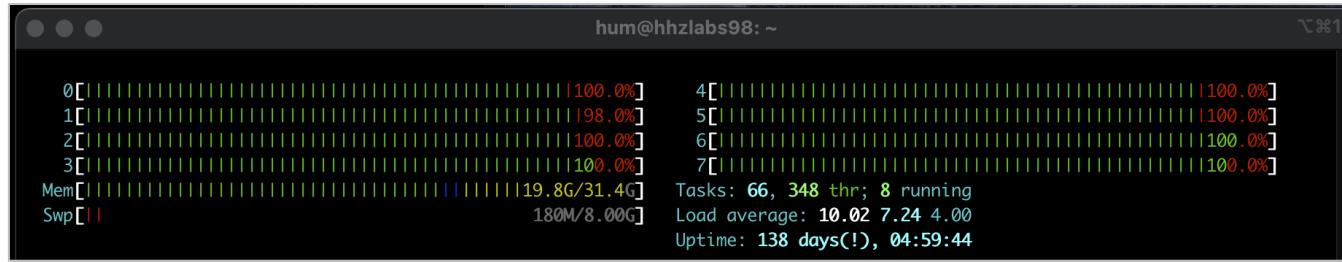
TensorFlow

Deep Learning Model  
Classifier

# Kritische Reflexion der Implementierung

## ► Erkenntnis

Trainieren von NLP-Modellen bedarf sehr vieler Ressourcen



## ✖ Problem & Lösungsversuch

- > Limitierte Ressourcen des INF-Servers (Intel Xeon 8-core, 32GB RAM)
- > IBM Cloud: leider konnte das Skript nicht adhoc auf den GPUs initialisiert werden

```
hum@hhzlab98
-----
OS: Ubuntu 22.04.1 LTS x86_64
Host: VMware Virtual Platform None
Kernel: 5.15.0-50-generic
Uptime: 138 days, 4 hours, 54 mins
Packages: 814 (dpkg), 4 (snap)
Shell: bash 5.1.16
Resolution: 800x600
Terminal: /dev/pts/1
CPU: Intel Xeon E5-2640 0 (8) @ 2.500GHz
GPU: 00:0f.0 VMware SVGA II Adapter
Memory: 4892MiB / 32104MiB
```



## Ergebnis

- > Automatisiertes Skript für das Pre-Processing und zum Trainieren sowie Abspeichern der Modelle
- > Sieben smallBERT Konfigurationen konnten erfolgreich trainiert werden (26 Modelle mit 7 verschiedenen Konfigurationen)

**01**

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Prototypische WebApp

# Evaluation der Modellgüte

## Probleme

### ► Fehler im Python-Skript

Alle Modelle wurden nur mit der standardmäßigen Accuracy-Metrik trainiert und gespeichert; die Implementierung von weiteren Custom-Metriken wurde nicht bedacht

→ Accuracy = wie wahrscheinlich, dass Humor

→  $1 - \text{Accuracy}$  = wie wahrscheinlich, dass kein Humor

### ► Fehler in der Entwicklungsumgebung

Zellen-Output ist in remote Jupyter Notebooks nicht mehr aufrufbar; somit sind die Metriken, die während des Trainings dargestellt worden sind, verloren gegangen

## Lösung

### ► Eigene Evaluationslogik mit Testdatensatz entwickelt

### ► 30 Witze und 30 Nicht-Witze in englischer Sprache

### ► Logik Best Case Accuracy

→ 30 Witze à 100% und 30 Nicht-Witze à 0% Accuracy

→ Optimaler Wert = 30 (ergibt sich aus  $30 * 100\% + 30 * 0\%$ )

→ Summe aller 60 Accuracy-Kennzahlen pro Modell

→ Ermittlung des Abstands zum Optimum

→ Je kleiner der Abstand, desto höhere Modellgüte

→ Zusätzlich farbliche Codierung der Ergebnisse



=ABS(SUMME(Accuracy)-30)



# Das Modell mit der höchsten Güte



`model_small_bert_bert_en_uncased_L-2_H-128_A-2`

Kompakte BERT-Konfiguration  
nach Turc et al., 2019

Modellfamilie

Vortrainiert auf Englisch

Keine Beachtung von  
Groß-/Kleinschreibung

Hidden Layer

Hidden Size

Attention Heads

Zum Vergleich

BERT base `model_bert_en_uncased_L-12_H-768_A-12`

BERT large `model_bert_en_uncased_L-24_H-1024_A-16`

# Subjektive Entdeckungen in den Testdaten über alle Modelle hinweg

- ▶ **BERT-konfigurationspezifische Eigenheiten:** Englische Sprache wird am besten erkannt; Groß-/Kleinschreibung wird nicht beachtet; Bedeutung mehrdeutiger Wörter wird richtig erkannt
- ▶ Einige Modelle scheinen **nicht-englische Eigennamen** (Orte, Flüsse, Personen) nicht richtig einordnen zu können  
Beispiele: Flüsse Fulda und Werra, Olaf Scholz → **Zusammenhang mit englischer Sprache?**
- ▶ **Schwarzer Humor** (Verbrechen, Krankheit, Tod) wird teilweise nicht erkannt; anderseits werden aber auch teilweise **unangemessene Inhalte** als Humor klassifiziert → **Zusammenhang mit Trainingsdatensatz oder BERT-Entwicklungsethik?**
- ▶ Themen wie **Politik, Religion und Ethik** werden von guten Modellen scheinbar **neutral betrachtet** → **Zusammenhang mit Trainingsdatensatz oder mit BERT-Entwicklungsethik?**
- ▶ Einige der umfangreicheren Modell-Konfigurationen neigen zu **starkem Overfitting** → **Datensatz zu „klein“?**

# Vermutung: Antrainierte AI-Neutralität bei spezifischen Themen

GÜTE	MODELL	Atheism is a non-prophet organization.
9.6	model_small_bert_be	24.28%
9.7	model_small_bert_be	24.61%
11.9	model_albert_en_bas	26.47%
12.1	model_small_bert_be	31.64%
13.1	model_small_bert_be	46.50%
14.6	model_small_bert_be	55.80%
15.5	model_small_bert_be	14.80%
17.2	model_small_bert_be	33.09%
17.2	model_small_bert_be	9.68%
19.8	model_small_bert_be	89.51%
20.0	model_small_bert_be	99.98%
20.6	model_small_bert_be	81.32%
20.8	model_small_bert_be	92.74%
21.7	model_small_bert_be	52.21%
23.5	model_small_bert_be	62.23%
23.6	model_small_bert_be	83.40%
23.9	model_small_bert_be	59.40%
24.4	model_small_bert_be	99.67%
24.5	model_small_bert_be	79.45%
24.5	model_small_bert_be	69.35%
24.7	model_small_bert_be	99.08%
25.4	model_small_bert_be	93.77%
25.5	model_small_bert_be	85.92%
26.3	model_small_bert_be	96.13%
26.3	model_small_bert_be	87.89%
27.6	model_small_bert_be	94.55%



► Eigentlich zuverlässige Modelle verhalten sich neutral und klassifizieren den religiösen Witz als Nicht-Witz

► Lediglich die Overfitting-Modelle klassifizieren den religiösen Witz als Witz

**01**

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Prototypische WebApp

# Genutzte Technologien

---



**IBM**  
Cloud Code Engine



# JOKY

The Joke Detector

Let an AI decide if you're funny!



Enter your sentence here

Check



## Funktionsweise

1. User tippen englischen Satz ein
2. Modell berechnet, mit welcher Wahrscheinlichkeit es sich bei der Eingabe um einen Witz bzw. nicht um einen Witz handelt
3. Direkte Ausgabe der Wahrscheinlichkeit und entsprechende schlagfertige Rückmeldung an die User

⚠ Aktuell ist kein Filter für unangemessene Inhalte implementiert ⚠

# JOKY

The Joke Detector

Let an AI decide if you're funny!



Did you copy that from Wikipedia or the news?

This is not a joke and I'm 76.5% sure about it.

Berlin is the capital and largest city of Germany by both area and population.

Check

# JOKY

The Joke Detector

Let an AI decide if you're funny!



Damn, that's funny as hell! Have you ever tried a comedy career?

This is a joke and I'm 98.5% sure about it.

Yesterday I saw a guy spill all his Scrabble letters on the road. I asked him, "What's the word on the street?"

Check

# JOKY

The Joke Detector

Let an AI decide if you're funny!



"I don't get this joke... Maybe it's because it isn't one?"

This is not a joke and I'm 52.5% sure about it.



It was the second major conflict in the Opium Wars, which were fought over the right to import opium to China, and resulted in a second defeat for the Qing dynasty and the forced legalisation of the opium trade.

Check



<http://bitly.ws/BdPg>

**Ausprobieren  
und gemeinsam  
Ergebnisse  
diskutieren.**

# RECAP

```
file = None
.fingerprints = set()
.logduplicates = True
.debug = debug
.logger = logging.getLogger()
path:
    self.file = open(os.path.join(path, "fingerprint.log"), "a")
    self.file.seek(0)
    self.fingerprints.update(fp for fp in self.file.read().split("\n"))
method
from settings import Settings, SettingsError
debug = Settings("debug").getboolean("debug", False)
return Settings("logduplicates").getboolean("logduplicates", False)
request_seen(self, request):
    fp = self.request_fingerprint(request)
    if fp in self.fingerprints:
        return True
    self.fingerprints.add(fp)
    if self.file:
        self.file.write(fp + os.linesep)
    request_fingerprint(self, request)
    return request_fingerprint(self, request)
```

## Ziele Projekt 1

- ✓ Darstellung von Humortheorien aus der Philosophie
- ✓ Analyse von NLP-Ansätzen und dem aktuellen Stand der Forschung im Spannungsfeld Computerlinguistik

## Ziele Projekt 2

- ✓ Analyse der verschiedenen Ansätze zur Humorerkennung in der Computerlinguistik
- ✓ Verstehen von Algorithmen zur Humorerkennung
- ✓ Training und Evaluation sowie Implementierung des erfolgversprechendsten Modells in eine prototypische WebApp zur Humorerkennung



## Inhaltliche Aspekte

- ▶ NLP ist verdammt **komplex!** Humorerkennung ist **noch komplexer!**
- ▶ Unsichere Interpretation der Genauigkeit, da BERT-Embeddings für uns eine nicht zu kontrollierende **Blackbox** sind und es sich um ein sehr **subjektives Thema** handelt
- ▶ Durch die Nutzung von BERT ist ein genereller **englischer Sprach- und Kultur-Bias** zu erwarten
- ▶ Durch die gelabelten Trainingsdaten (isJoke = TRUE / FALSE) wurde bereits ein **spezifisches, subjektives Humorempfinden** (= Bias) in das Modelltraining eingebracht
- ▶ Auch eine **menschliche Testgruppe** (bspw. mittels Amazon Mechanical Turk) hätte **keine 100% Genauigkeit beim Thema Humor**



# LESSONS LEARNED

## Technische Aspekte

- ▶ Einbindung von NLP-Modellen bedarf **großer Rechenleistung**
- ▶ Der **INF-Server** hatte für größere BERT-Modelle zu wenig Leistung
- ▶ Auf der **IBM Cloud mit GPUs** (*Danke an Lukes Manager bei IBM*) konnte unser automatisiertes Skript leider nicht adhoc initialisiert werden; da uns die IBM Cloud nur für ein paar Stunden zu Verfügung stand, konnten wir den GPU-Support nicht in unser Skript implementieren
- ▶ Ein **remote Jupyter Notebook** ist nicht ideal für den Use Case  
„Automatisiertes Training von ML-Modellen im Hintergrund“  
Zellen-Output geht verloren, siehe [Restoring computation output after disconnect in Jupyter notebook](#)
- ▶ **Wenig praxisnahe Dokumentation** zur Optimierung von BERT in Zusammenspiel mit Tensor Flow

# Q&A

good  
vote.

+HUX

# Quellenverzeichnis und Dokumentation

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WebApp



[github.com/skywalkeretw/DBE-Humor-Prototype](https://github.com/skywalkeretw/DBE-Humor-Prototype)