The Mushroom Effect

Or Why You Need Knowledge Graphs for Dialogue Systems

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Dresden

Outline

Background

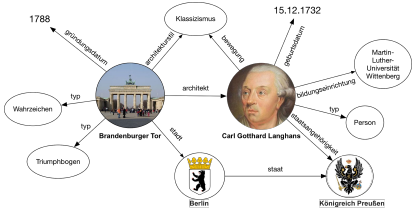
Mushrooms?

With KG Flavors

About us: CEE AI Dresden

Background

We build conversational AI platforms



Background

We build conversational AI platforms

Powered by knowledge graphs

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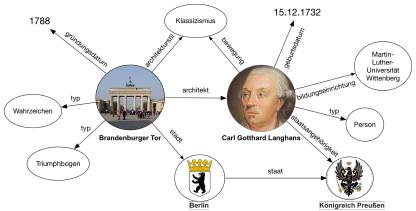
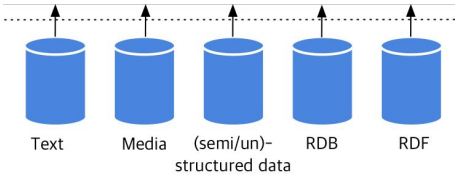


Powered by knowledge graphs



Obtained by integrating heterogeneous data

Mushrooms?

Berlin Hbf

What is this building?

Q

Mushrooms?

What is this building? Q

A This is Berlin Hauptbahnhof

Mushrooms?

Berlin Hbf

What is this building? Q

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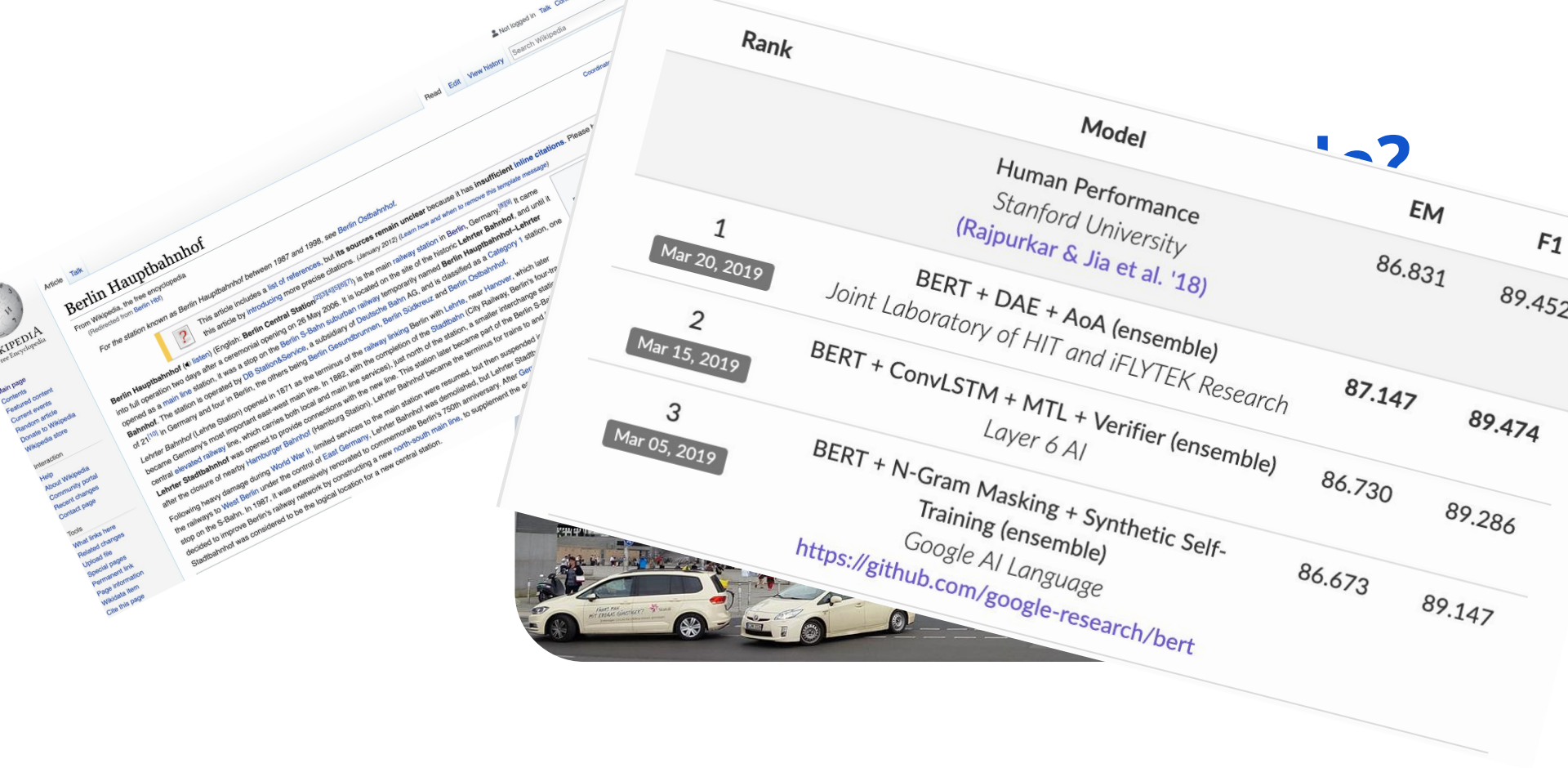
What is its architectural style? Q

What is its architectural style?

What is its architectural style?

Wikipedia


Berlin Hauptbahnhof
Rank
Model
EM
F1
1
Mar 20, 2019
Human Performance
Stanford University
(Rajpurkar & Jia et al. '18)
86.831
89.452
2
Mar 15, 2019
BERT + DAE + AoA (ensemble)
Joint Laboratory of HIT and iFLYTEK Research
87.147
89.474
3
Mar 05, 2019
BERT + ConvLSTM + MTL + Verifier (ensemble)
Layer 6 AI
86.730
89.286
BERT + N-Gram Masking + Synthetic Self-Training (ensemble)
Google AI Language
https://github.com/google-research/bert
86.673
89.147

SQuAD

MS MARCO Home Dataset Leaderboard Submission About Contact us

Passage Retrieval(10/26/2018-Present)

Rank	Model	Ranking Style	Submission Date	MRR@10 On Eval	MRR@10 On Dev
1	**Enriched BERT base + AOA index V1** Ming Yan	Full Ranking	May 13th, 2019	0.383	0.397
2	**Enriched BERT base + AOA index V2** Ming Yan	Full Ranking	May 13th, 2019	0.380	0.389
3	**BERT^2** (1)Rodrigo Nogueira, (2)Wei Yang, (3)Jimmy Lin, (4)Kyunghyun Cho - New York University(1,4), University of Waterloo(2,3), Facebook AI Research(4)	Full Ranking	May 13th, 2019	0.375	0.386
4	**Enriched BERT base + AOA index** Ming Yan	Full Ranking	May 6th, 2019	0.373	0.387
5	**BERTter Indexing** (1)Rodrigo Nogueira, (2)Wei Yang, (3)Jimmy Lin, (4)Kyunghyun Cho - New York University(1,4), University of Waterloo(2,3), Facebook AI Research(4) [Nogueira et al. '19] and [Code]	Full Ranking	April 8th, 2019	0.368	0.375

EM F1

86.831 89.45

87.147 89.474

86.730 89.286

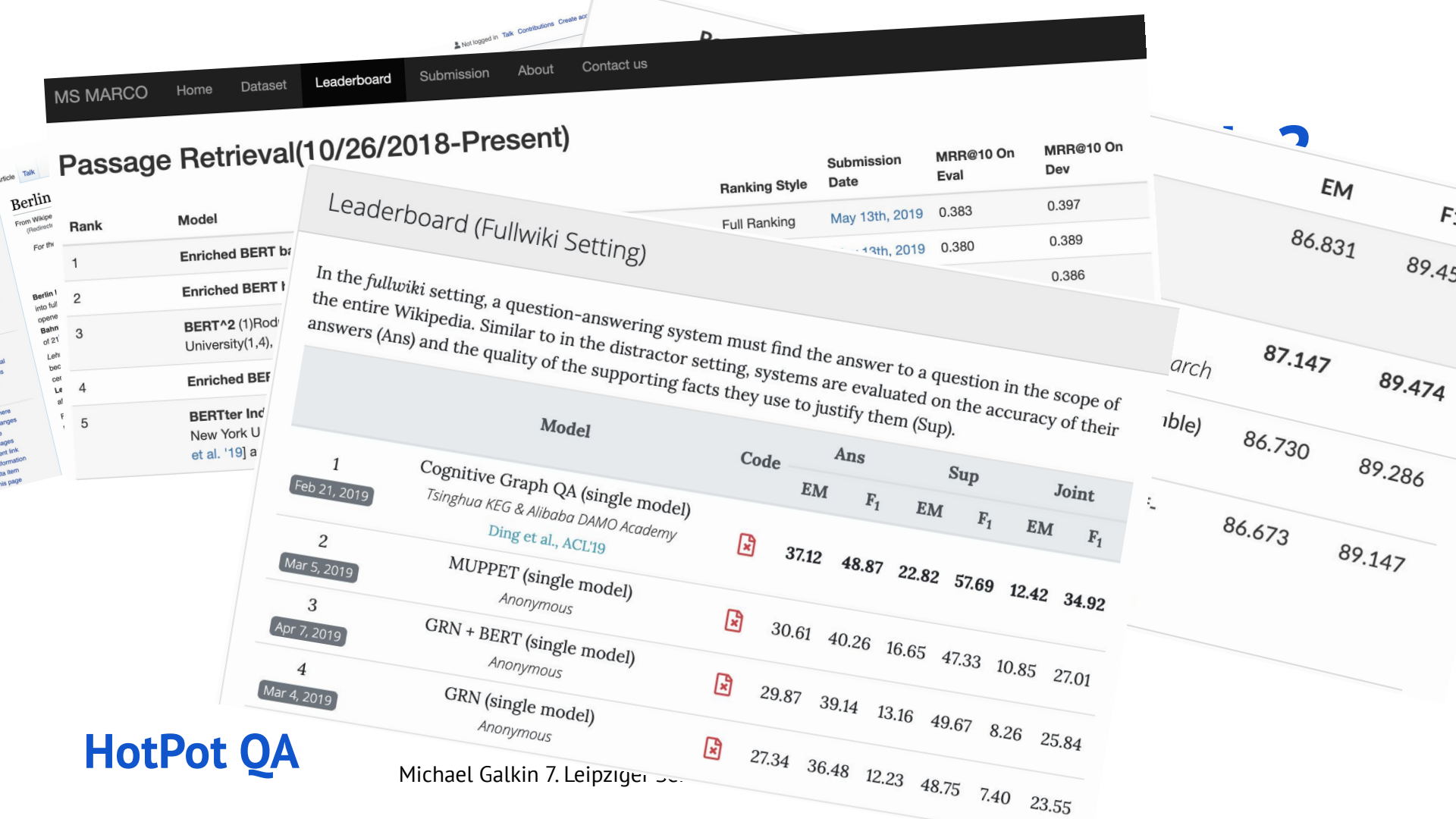
86.673 89.147

N-Gram Masking + Synthetic Self-Training (ensemble)

Google AI Language

https://github.com/google-research/bert

MS MARCO



HotPot QA

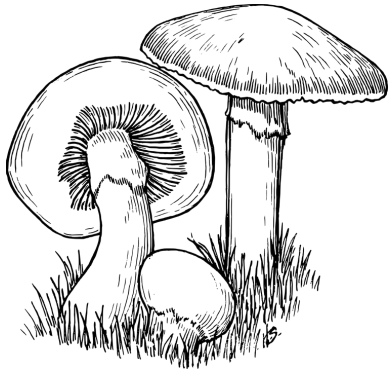
Michael Galkin 7. Leipziger

Mushrooms!

What is this building? Q

A This is Berlin Hauptbahnhof

What is its architectural style? Q



A Mushroom

Mushrooms!

What is its architectural style? Q

Function [edit]

The Berlin Hauptbahnhof is part of the mushroom concept that was being made in Berlin, in which the station forms as a connecting point for converging and intersecting lines, of different modes of public transport there.

Planning the new station [edit]

Soon after the fall of the Berlin Wall in 1989, city planners began work on a transport plan for reunified Berlin. One element of this became the "Pilzkonzept" (mushroom concept), in which a new north-south railway line intersecting the Stadtbahn was to be constructed. The name derived from the shape formed by the new line and existing lines, which vaguely resembles a mushroom.

Mushrooms!

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- ✓ its = Berlin Hauptbahnhof
- ✓ In Berlin
- ✓ Concept ~ Style

- ❌ Applicable to the city concept, not architectural style of the station
- ❌ Close, but not correct

With KG flavors

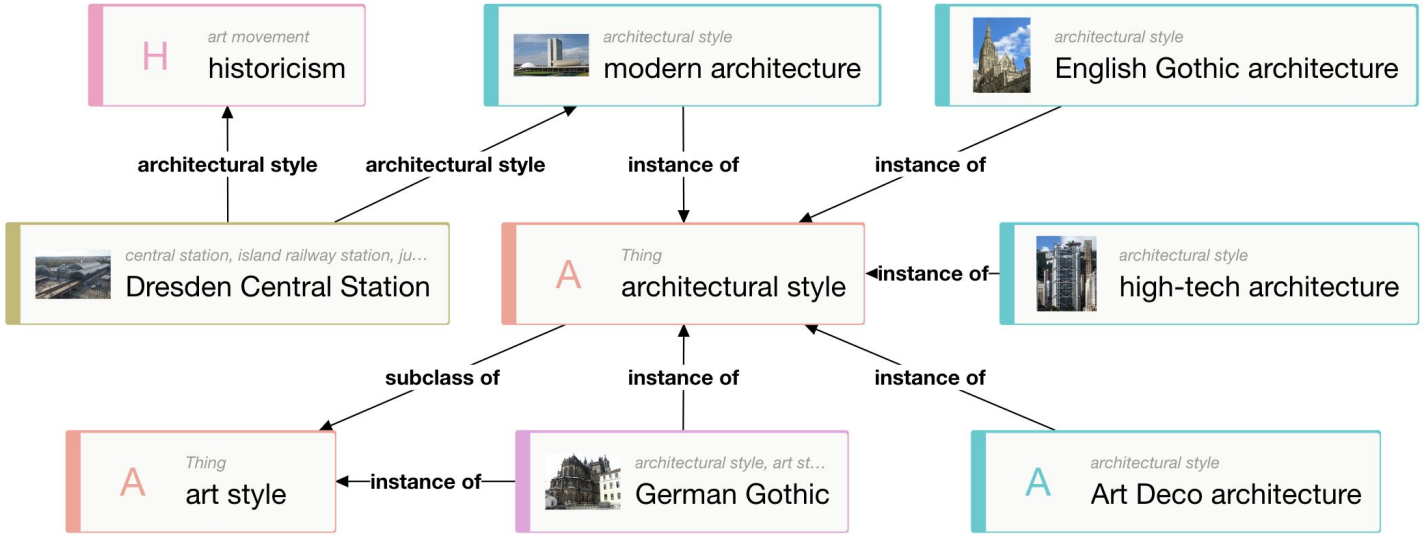
Can mushrooms be an architectural style?

With KG flavors

Can mushrooms be an architectural style?

Probably not

If not, what can be an appropriate value?



So why you need graphs?

How many children does Berlin Hbf have?

Implicit or explicit constraints on produced answers

So why you need graphs?

How many children does Berlin Hbf have?

Train stations don’t have kids

Implicit or explicit constraints on produced answers

- reduce candidates space
- help to fight the mushroom effect
- **ontologies help**

So why you need graphs?

How many children does Berlin Hbf have?

Train stations don't have kids

What is the busiest train station in Germany?

Implicit or explicit constraints on produced answers

- reduce candidates space
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- **ontologies help**

Complex QA via (sub)graphs aggregations

So why you need graphs?

How many children does Berlin Hbf have?

Train stations don't have kids

What is the busiest train station in Germany?

Hamburg Hbf

Implicit or explicit constraints on produced answers

- reduce candidates space
- help to fight the mushroom effect
- **ontologies help**

Complex QA via (sub)graphs aggregations

```
select ?station ?visits where {
 ?station wdt:P31 wd:Q18543139 .      # central stations
 ?station wdt:P17 wd:Q183 .           # in Germany
 ?station wdt:P1373 ?visits .         # daily visits
} ORDER BY DESC(?visits) LIMIT 1      # sort
```

So why you need graphs?

Takeaway 1

Graphs significantly improve reasoning compared to sole natural language inference

So why you need graphs?

Takeaway 1

Graphs significantly improve reasoning compared to sole natural language inference

Takeaway 2

Reasoning outcomes are explainable and traceable

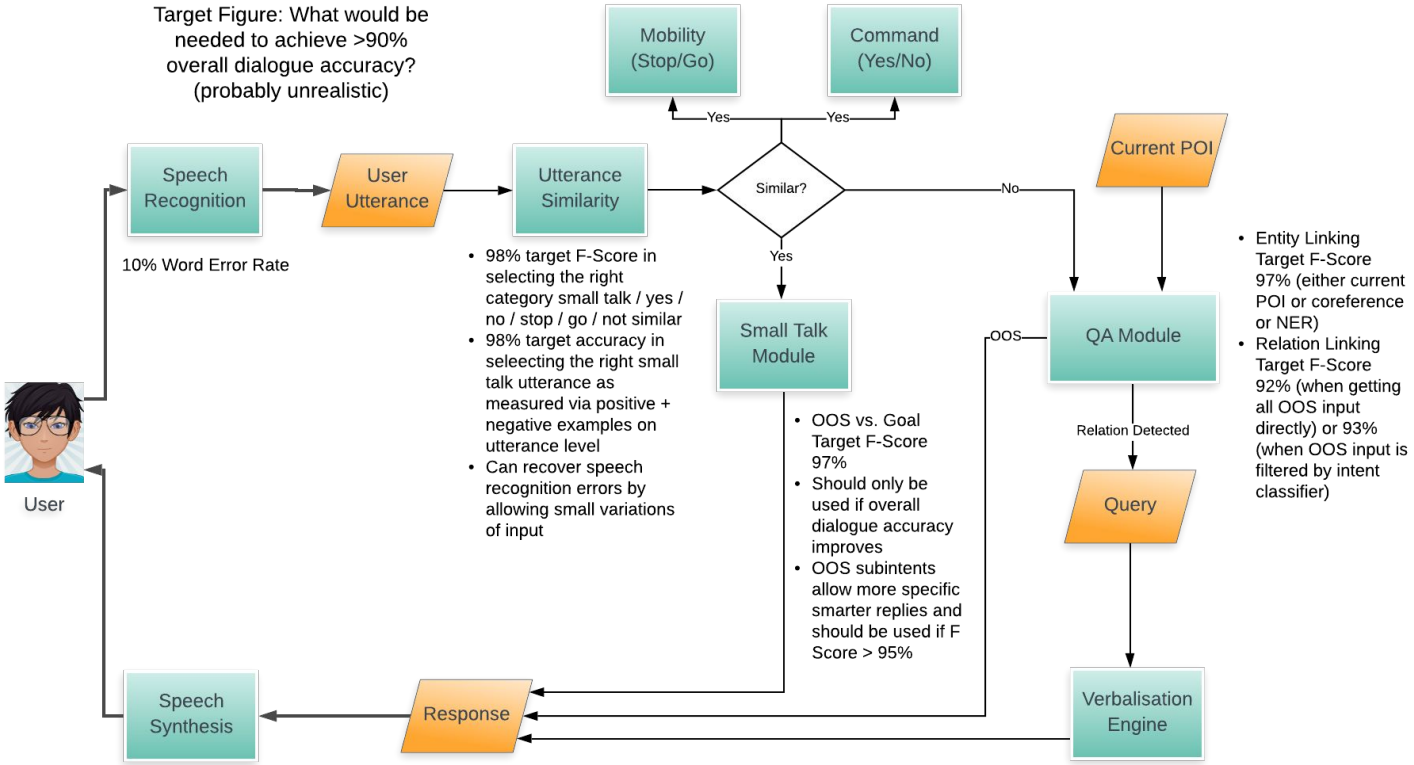
KDDS

Knowledge-driven in-car dialogue system (EN/DE)

Full DBpedia 2019 (wikidata branch)

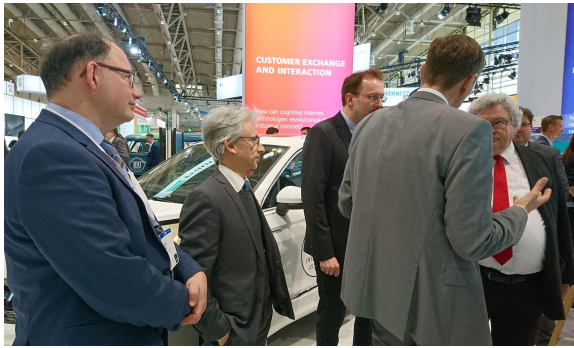
> 50M entities

> 4B triples



KDDS @ Hannover-Messe

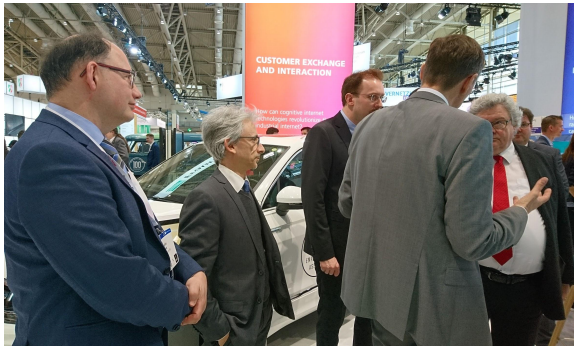
Building KGs from enterprise sources is still a challenge



KDDS @ Hannover-Messe

Building KGs from enterprise sources is still a challenge

Depth of knowledge vs variety of domains

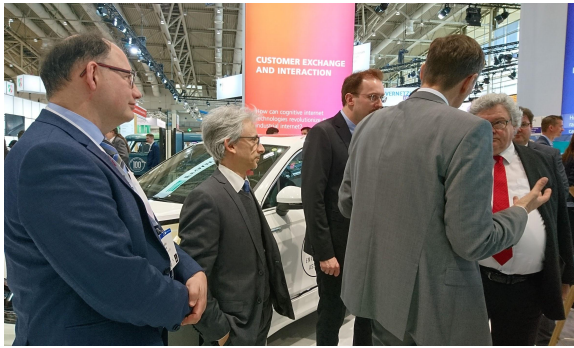


KDDS @ Hannover-Messe

Building KGs from enterprise sources is still a challenge

Depth of knowledge vs variety of domains

Explainability is crucial



Fraunhofer IAIS
Standort Dresden

Fraunhofer-Alliance Big Data AI
The biggest Fraunhofer alliance with > 30 institutes led by IAIS

ML2R
National Competence Center for Machine Learning Rhein-Ruhr

AI4EU
EU Lighthouse Project for AI

Fraunhofer Center for Machine Learning
IAIS-led part of Fraunhofer Cluster of Excellence Cognitive Internet Technologies

CEE AI
Center for Explainable and Efficient AI Technologies with TU Dresden

International Data Spaces Association
Data sovereignty for Big Data and AI, 100+ companies

Fraunhofer IAIS Dresden

Center for Efficient and Explainable AI

- Efficient AI
  - Hardware and software are usually decoupled instead of embedded
  - 100-times more energy efficient by 2030
- Explainable AI
  - Make AI more traceable
  - Make AI decisions more explainable

TECHNISCHE UNIVERSITÄT DRESDEN

Prof. Lehmann

Prof. Fitzek

Fraunhofer

SUPPORTING AI LIGHTHOUSES

AI APPROACH LIGHTHOUSES

AI APPLICATION LIGHTHOUSES

FOR THE PEOPLE

CEE AI
Dresden

Center for Explainable and Efficient AI

Supporting AI lighthouses

CEE AI can build on strong structures at the TU Dresden campus: advantages can be used from the beginning for big data, microelectronics, connectivity, and cyber-physical systems.

- Efficient
- Connected
- Scalable
- Cooperative

Lighthouse AI approaches

In CEE AI, we will draw on the expertise of the Next Generation Machine Learning Lab of Technische Univerität Dresden and Fraunhofer IAIS as the leading Fraunhofer institute on AI.

- Explainable (XAI)
- Knowledge-driven
- Ground-breaking
- Certified

Lighthouse AI applications

Fraunhofer institutes in the Dresden region that provide applications for industry as central part of their mission; and TU Dresden reaching out to other organisations and industry.

- Human-centric
- Flexible
- Mobile
- Reliable

AI for us

CEE AI will detail value and ris of AI for the society and will teach AI concepts for a responsible and informed society by combining excellen research and practical applications.

- Social
- Educated
- Applied
- Excellent