What's understanding?

What's the problem with transformers?

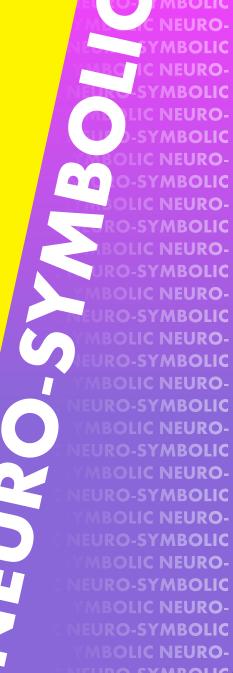
How can neurosymbolism help?

WHAT'S NEXT IN NLU?

Advances in learning & reasoning toward NLU

What's next in Al

IBM Research Francois Luus



UNDERSTANDING UNDERSTAN **UNDERSTANDING UNDERSTANI UNDERSTANDING UNDERSTAIL** UNDERSTANDING UNDERSTAN **UNDERSTANDING UNDERSTAND UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERSTAN** UNDERSTANDING UNDERSTANI **UNDERSTANDING UNDERSTAN** UNDERSTANDING UNDERSTAN **UNDERSTANDING UNDERSTAND UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERSTAND UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERSTA UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERST UNDERSTANDING UNDERSTA UNDERSTANDING UNDERSTAN UNDERSTANDING UNDERS UNDERSTANDING UNDERST. UNDERSTANDING UNDERSTA UNDERSTANDING UNDERSTA**

WHY DO WE WANT NLU?

Natural Language Understanding

Automated NLU capability

Industry and creativity

BERT serving 4 Billion UNDERSTANDIN **UNDERSTANDING** UNDERSTANDING **UNDERSTANDIN UNDERSTANDING UNDERSTANDING UNDERSTANDIN UNDERSTANDING UNDERSTANDING UNDERSTANDING UNDERSTANDING UNDERSTANDING UNDERSTANDING UNDERSTANDING UNDERSTANDING UNDERSTANDIN UNDERSTANDING UNDERSTANDIN** UNDERSTANDIN UNDERSTANDIN **UNDERSTANDIN** UNDERSTANDI **UNDERSTANDIN** UNDERSTANDII UNDERSTANDI UNDERSTANDI **UNDERSTANDI** UNDERSTAND UNDERSTAND **UNDERSTAND UNDERSTAND UNDERSTANDII**

text → external referent context → truth

Referentialism

WHAT'S UNDER-STANDING?

Philosopy of

understanding in the

context of language

text → internal object/process

Internalism

text → pattern

Pragmatism

Attention-based transformers self-superv. & auto-regression

ELMO, BERT, GPT-*: transformer language models

Linguistic capability and adaptability

WHAT'S THE BEST NLU?

The best NLU machine learning models





WHAT'S THE PROBLEM?

The problem with Deep Learning NLU models

Fluency & plausibility

Ungrounded: entity unknown

Stochastic parrots



WHAT'S THE PROBLEM?

The problem with Deep Learning NLU models

Emergence: implicit induce

Statistical co-occurrence

Explanations: soundness concern

Lacks systematicity: unmapped capability

TRANSFORMER

WHAT'S AN EXAMPLE?

Right for the Wrong Reasons:

Diagnosing Syntactic Heuristics in

NLI

McCoy et al. 2019

If **the artist slept**, the actor ran → *The artist slept*

Constituent

The doctor near **the actor danced** → *The actor danced*

Subsequence

The doctor was paid by the actor

→ The doctor paid the actor

Lexical overlap

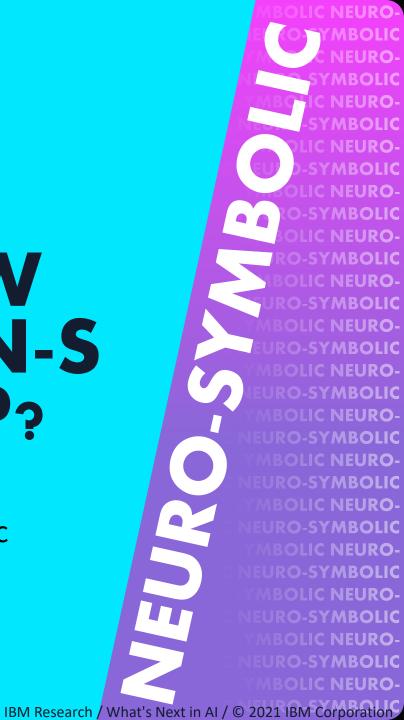
Grounded language learning

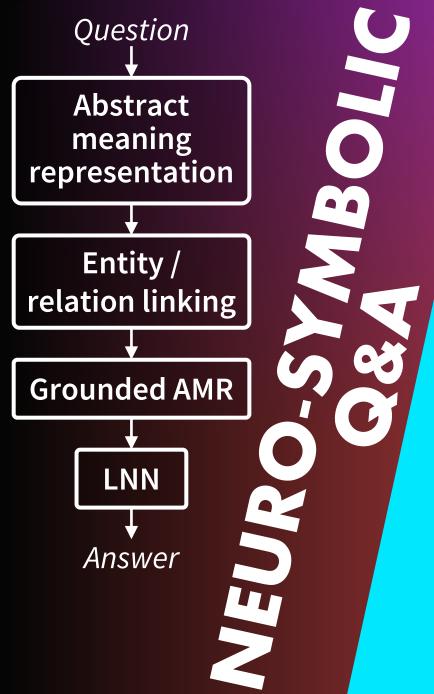
Language acquisition efficiency

Auditable rules: behavior mapping

HOW CAN N-S HELP?

Benefits of the Neuro-Symbolic approach





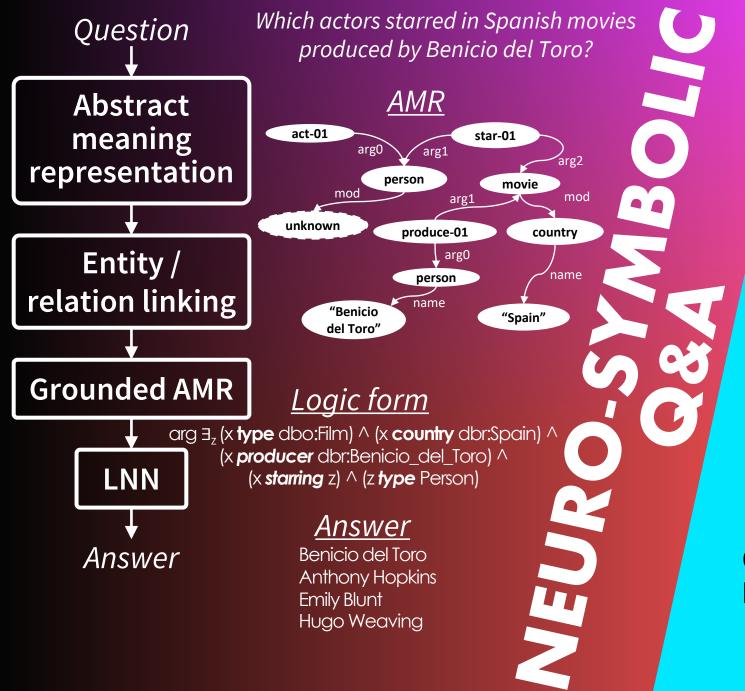
Referentialism

WHAT'S AN EXAMPLE? **Grounded:** entities & relations

Knowledge base: known properties

Leveraging AMR for KB Question and Answering **Kapanipathi et al. 2021**

Logical inference: sound reasoning



METHOD	QALD-9 (F1)	LC-QuAD 1 (F1)
WDAqua	24.99	28.00
gAnswer	29.81	33.00
NSQA	31.26	44.45

WHAT'S AN EXAMPLE?

Leveraging AMR for KB Question and Answering **Kapanipathi et al. 2021** NEURO-SYMBO **SYMBOLIC NEUR NEURO-SYMBO**I **SYMBOLIC NEUR NEURO-SYMBOL SYMBOLIC NEUR NEURO-SYMBO NEURO-SYMBC NEURO-SYMB SYMBOLIC NEU NEURO-SYME NEURO-SYMI SYMBOLIC NE NEURO-SY** SYMBOLIC N

Resource reqs >> HW improvements

WHAT'S NEXT IN NLU?

Improve interpretability: Examine inner working

Advances in learning & reasoning toward NLU

What's next in Al

IBM Research Francois Luus Logical Neural Networks: next-gen representation