

**What's understanding?**

**What's the problem with transformers?**

**How can neuro-symbolism help?**

# WHAT'S NEXT IN NLU?

Advances in learning & reasoning toward NLU

**What's next in AI**

IBM Research  
*Francois Luus*

**NEURO-SYMBOLIC**

**UNDERSTANDING**

# WHY DO WE WANT NLU?

Natural Language Understanding

**Automated NLU capability**

**Industry and creativity**

**BERT serving 4 Billion**

# UNDERSTANDING

## WHAT'S UNDERSTANDING?

Philosophy of understanding in the context of language

text  $\mapsto$  external referent  
context  $\mapsto$  truth

**Referentialism**

text  $\mapsto$  internal  
object/process

**Internalism**

text  $\mapsto$  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

**TRANSFORMERS**







**Grounded language learning**

**Language acquisition  
efficiency**

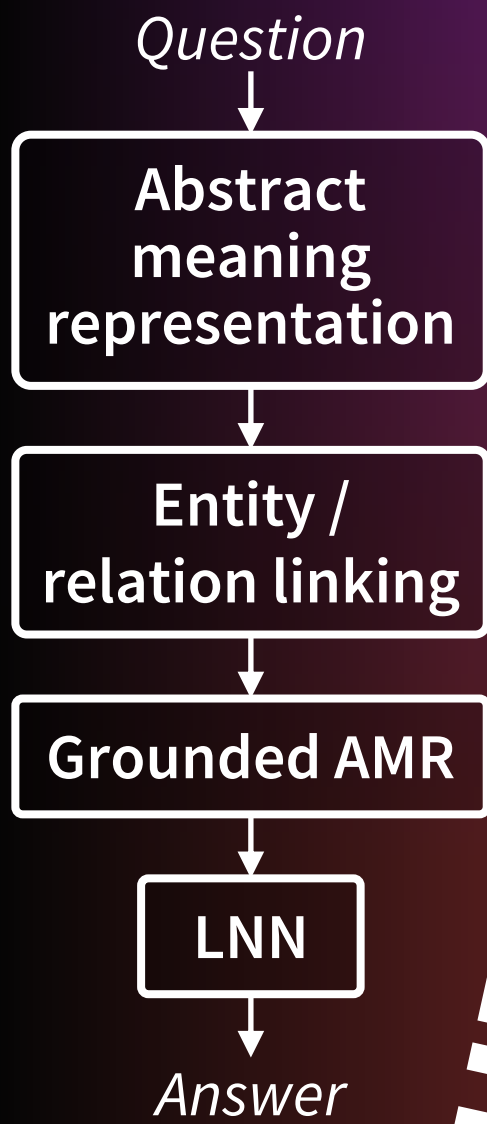
**Auditable rules:**  
*behavior mapping*

**HOW  
CAN N-S  
HELP?**

Benefits of the  
Neuro-Symbolic  
approach

**NEURO-SYMBOLIC**





# NEURO-SYMBOLIC Q&A

## WHAT'S AN EXAMPLE?

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

**Referentialism**

**Grounded:**  
*entities & relations*

**Knowledge base :**  
*known properties*

**Logical inference :**  
*sound reasoning*

Question

Which actors starred in Spanish movies produced by Benicio del Toro?

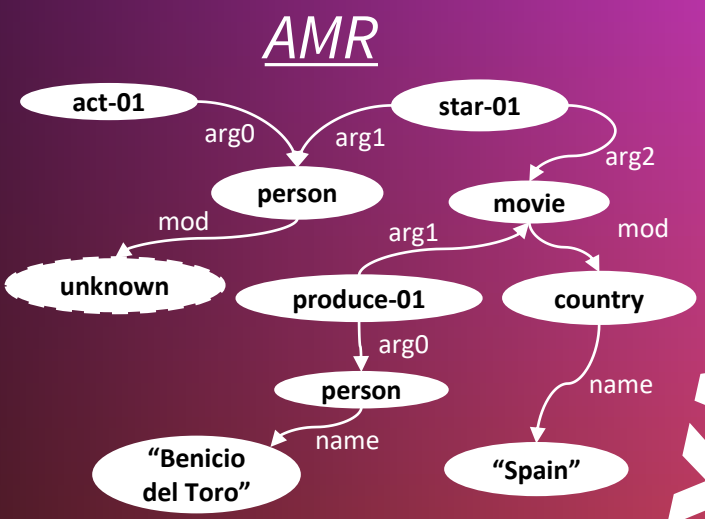
Abstract meaning representation

Entity / relation linking

Grounded AMR

LNN

Answer



Logic form

$$\text{arg} \exists_z (x \text{ type } \text{dbo:Film}) \wedge (x \text{ country } \text{dbr:Spain}) \wedge (x \text{ producer } \text{dbr:Benicio\_del\_Toro}) \wedge (x \text{ starring } z) \wedge (z \text{ type } \text{Person})$$

Answer

- Benicio del Toro
- Anthony Hopkins
- Emily Blunt
- Hugo Weaving

# NEURO-SYMBOLIC Q&A

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

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