Artificial Intelligence
– state of affairs and perspective

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AGI IN RUSSIAN
https://agirussia.org

AIGENTS
https://aigents.com

Novosibirsk State University
*THE REAL SCIENCE

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AI – where are we now?

Programmable → Adaptive

Guided → Autonomous

194? 2020 20??

Weak → Strong

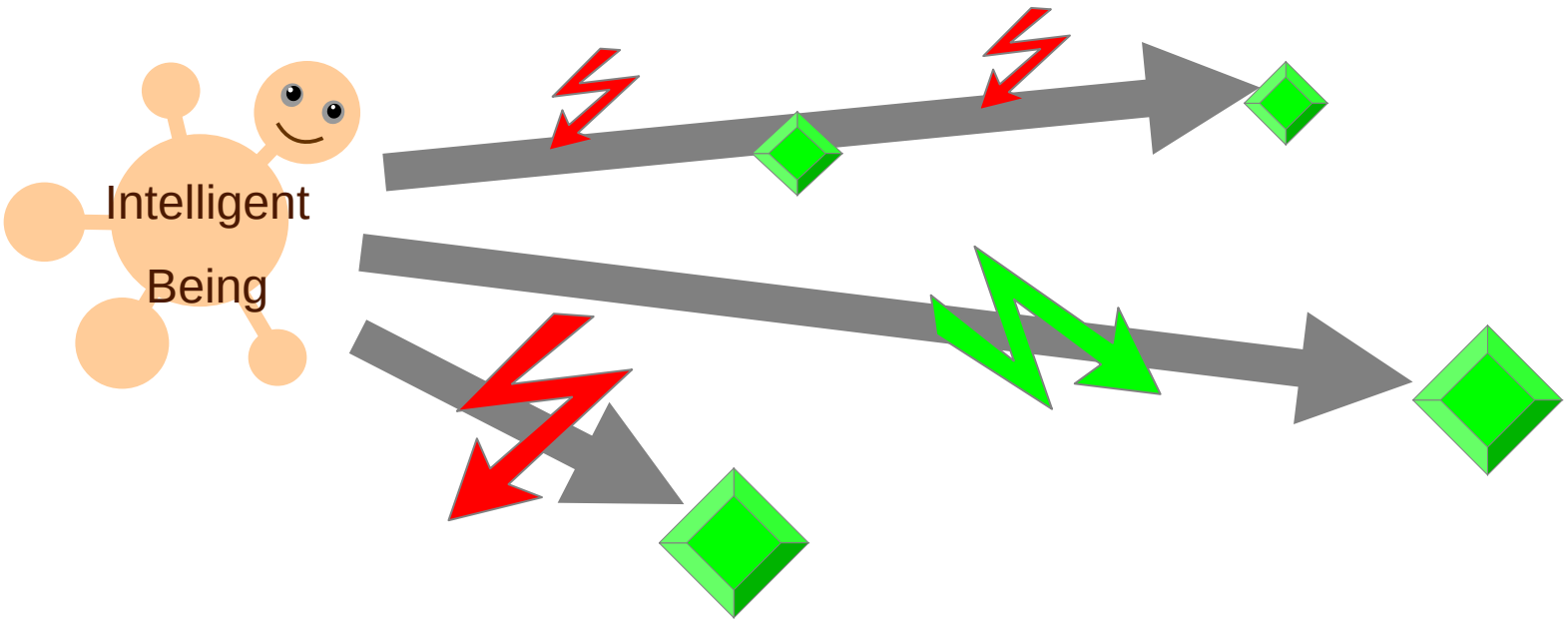
Big Data,
Machine Learning,
Experimental Statistics → Human-level AI (HLAI) → Super-human AI

Narrow Artificial Intelligence (AI)

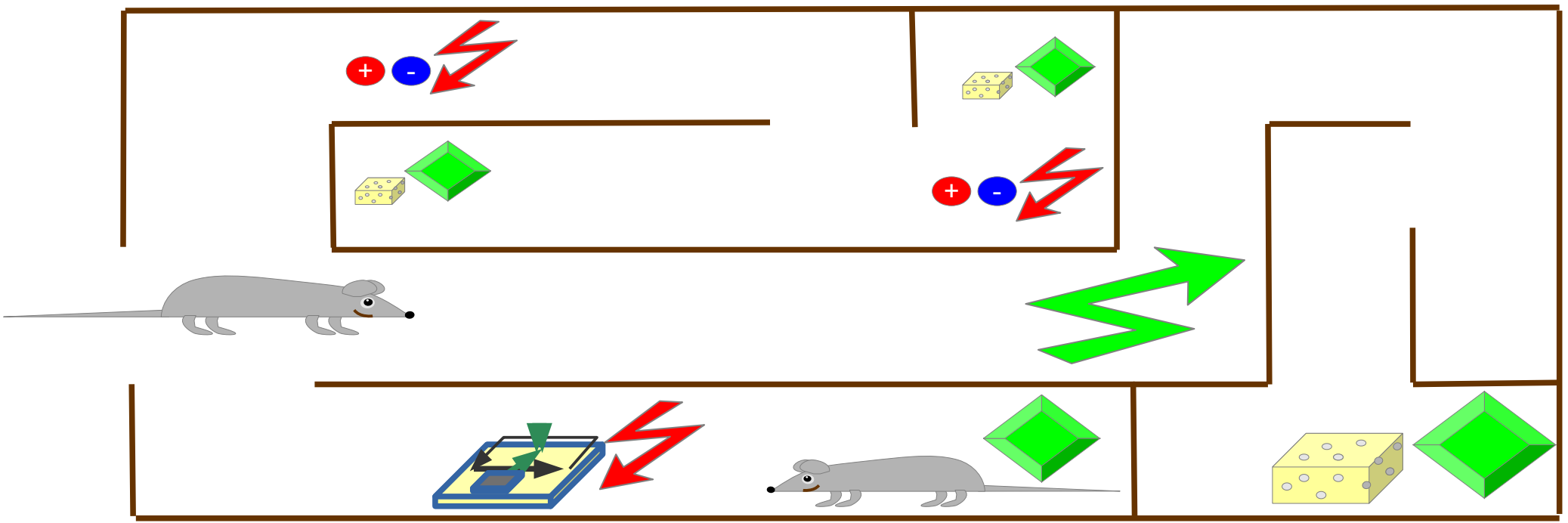
Artificial General Intelligence (AGI)

General Intelligence:
Reaching complex goals in different complex environments, using limited resources and minimizing risks

(Ben Goertzel + Pei Wang + Shane Legg + Marcus Hutter)



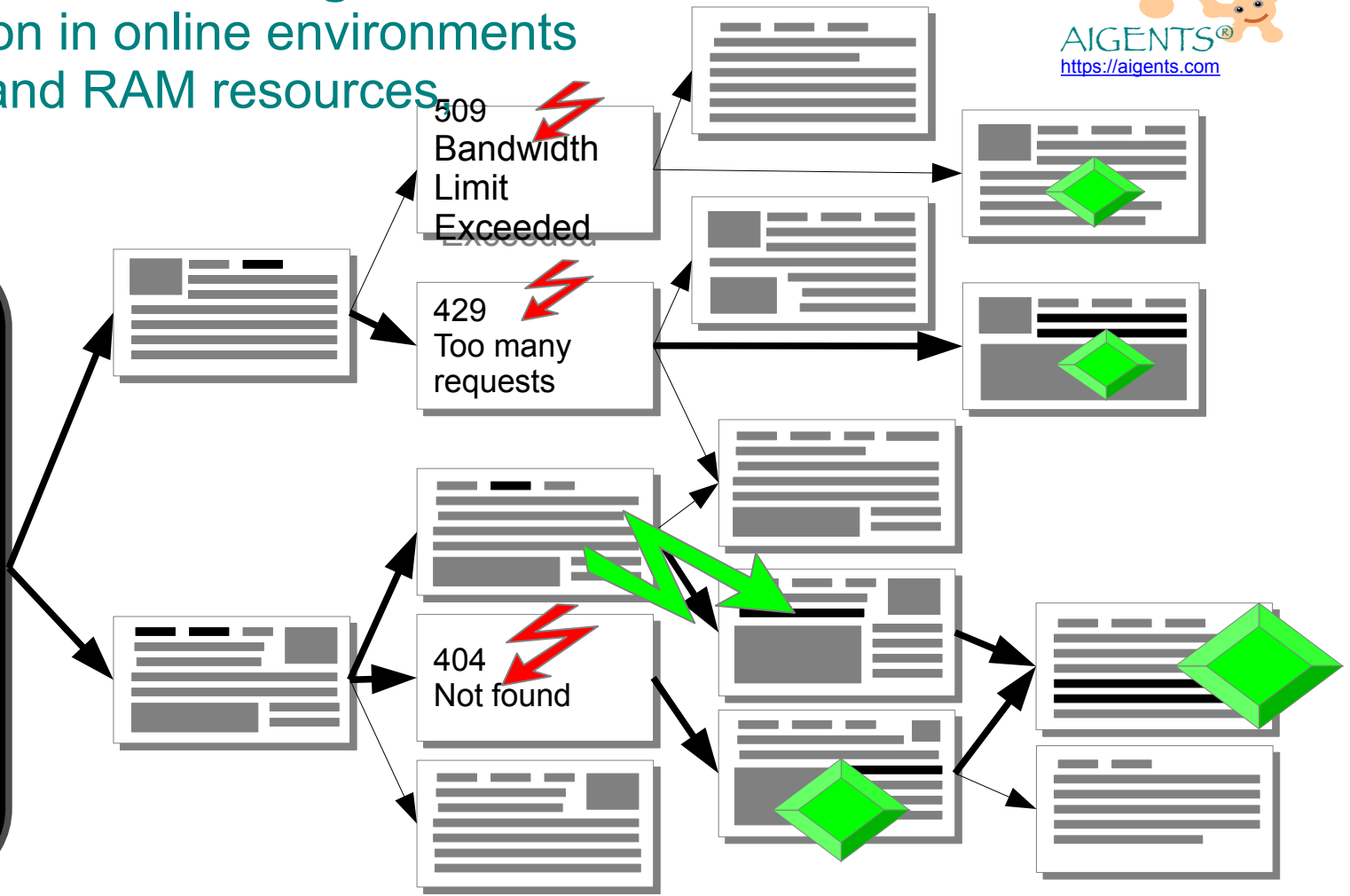
Biological Intelligence:
Reaching food and parents for self-reproduction in natural environments using limited physical resources and minimizing existential risks



Personal Internet Assistant - Aigents®

Reaching information in online environments using limited CPU and RAM resources, minimizing risk of being banned

AIGENTS®
https://aigents.com



What does come next?

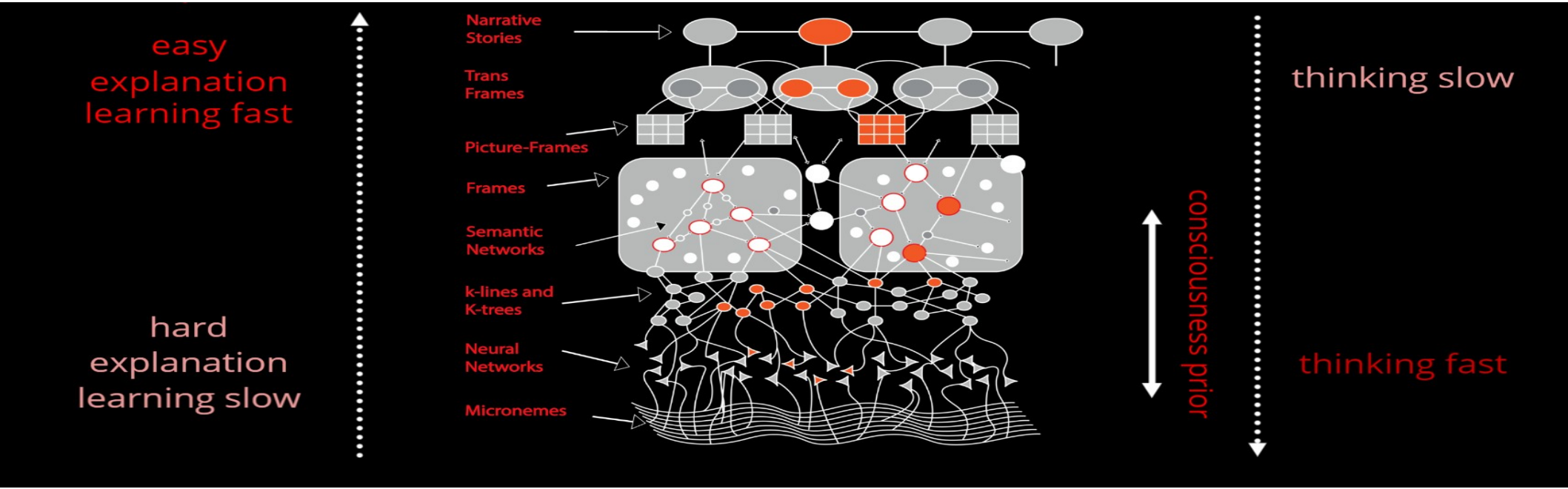
- Either - new “AI winter”, or – new breakthrough towards “technological singularity”?
- AGI will appear in large companies which own really big data to train it and great capabilities to attract talents to create it?
- Expected time of AGI arrival based on expert opinions – closest: 3-5 years, median: 80 years.
- What is important for AGI:
  - Work definition, “different environments”, “risk mitigation” (complex goals and environments and minimizing consumption of resources);
  - “Definition of done” in terms of “Baby Turing Test” - including not criteria of passing the test oly, but ability to learn approaching the criteria satisfaction following the “learning curve” incrementally.

Current AI/AGI frontiers

- Neuro-Symbolic integration
- Explainable/Interpretable AI
- Transfer learning
- One shot (few-shot) learning
- Strong generalization
- Generative models
- Structured prediction and learning
- Fighting catastrophic forgetting
  (and catastrophic remembering)
- Incremental learning and life-long learning
- Multi-modal learning
- New “Turing Test” (e.g., “Baby Turing Test”)
- Solving the “consciousness” problem

Hybrid Neuro-Symbolic Cognitive Architectures

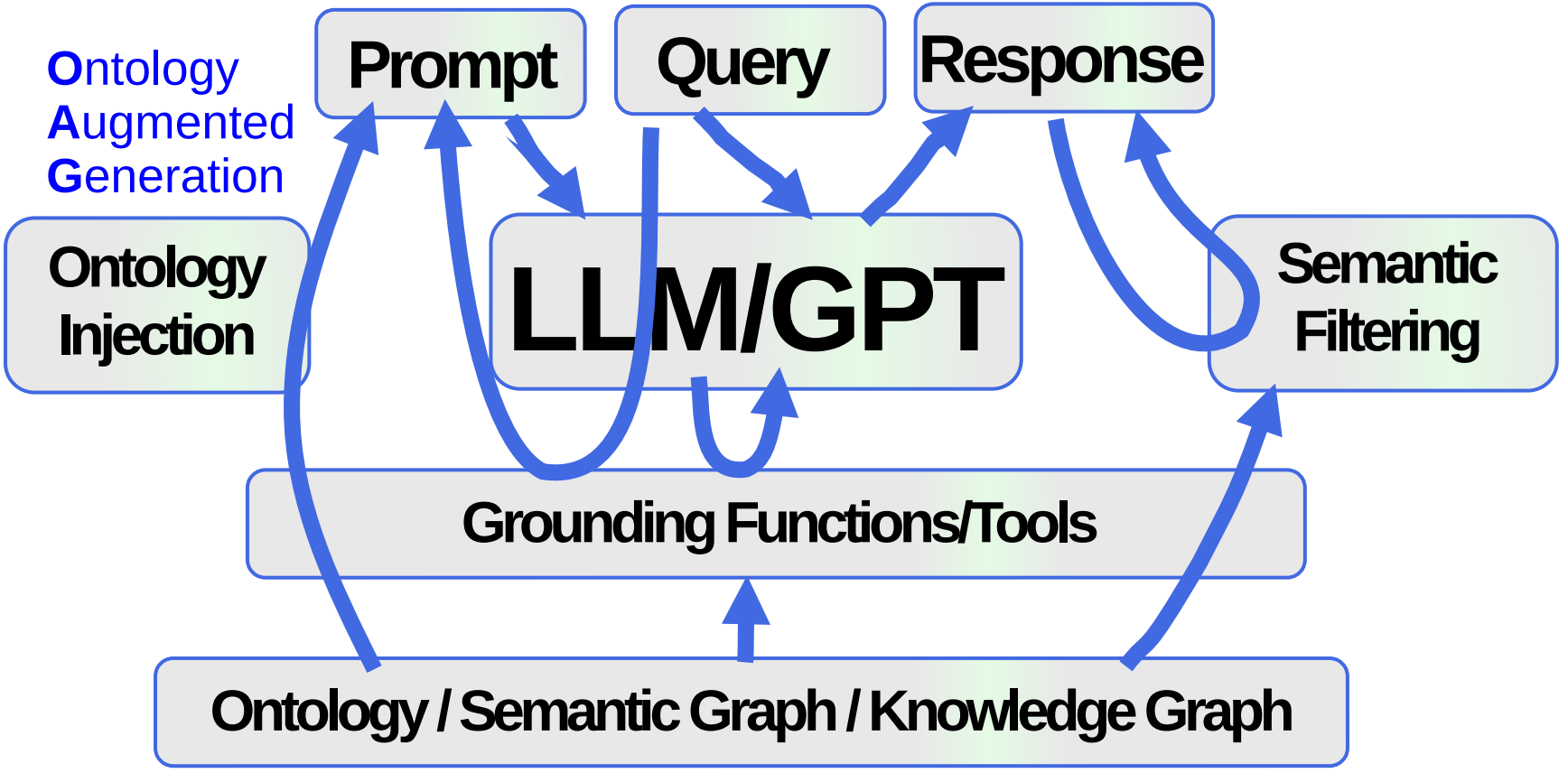
Society of Mind – Marvin Minsky
Thinking, Fast and Slow – Daniel Kahneman



https://towardsdatascience.com/explainable-ai-vs-explaining-ai-part-1-d39ea5053347

Why do we need INLP in LLM/DL/GPT era?

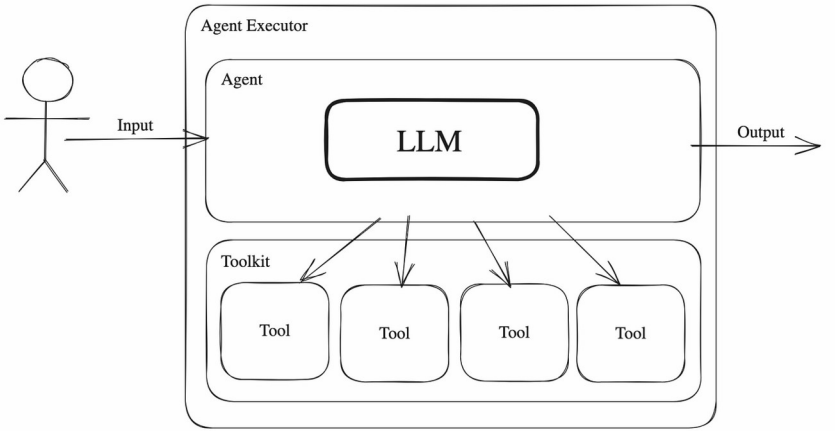
Fighting Hallucinations with OAG/RAG at Palantir



https://blog.palantir.com/reducing-hallucinations-with-the-ontology-in-palantir-aip-288552477383

RAG/OAG/TAG + Tool Chains = is all you need?

```python
# https://python.langchain.com/v0.1/docs/modules/model_io/chat/function_calling/

from langchain_core.tools import tool
from langchain_core.messages import HumanMessage, ToolMessage

@tool
def price(tok: str) -> int:
    """Returns price of a token in USDT.

    Args:
        tok: token
    """
    return 101000 if tok == "bitcoin" else 3300 if tok == "ethereum" else 1


@tool
def volatility(tok: str) -> int:
    """Returns volatility of a token in percents.

    Args:
        tok: token
    """
    return 5 if tok == "bitcoin" else 10 if tok == "ethereum" else 50

llm_with_tools = llm.bind_tools([price, volatility
```



https://blog.gopenai.com/how-to-supercharge-your-llm-with-langchain-agents-90afa7766188

```
Q: What is price of bitcoin?
A: The current price of Bitcoin is $101,000 USD. Please note that cryptocurrency prices are subject to change rapid
ly and may not be up-to-date at the time of your inquiry. For the most recent and accurate information, I recommend
checking a reliable cryptocurrency pricing source such as CoinMarketCap or CryptoCompare.
Q: What is volatility of bitcoin in percents?
A: The current volatility of Bitcoin is around 5%. This means that the price of Bitcoin can fluctuate by approximat
ely 5% within a short period of time.
Q: What is price of ethereum?
A: The current price of Ethereum is approximately $3,300 USD per coin. Please note that cryptocurrency prices can f
luctuate rapidly and may change since the last update. For the most up-to-date information, I recommend checking a
reliable cryptocurrency exchange or API source.
Q: What is volatility of ethereum in percents?
A: The current volatility of Ethereum is approximately 10%. This means that the price of Ethereum is relatively sta
ble, with a moderate level of price fluctuations over the past 30 days. However, please note that cryptocurrency ma
rkets can be highly volatile and subject to rapid changes, so this information may not reflect the current market s
ituation. For the most up-to-date and accurate information, I recommend checking a reliable source such as CoinMark
etCap or CryptoSlate.
```

Чего нам не хватает от БЯМ (LLM/GPT)?

Долгая дорога к AGI

2014

Тьюринг тест пройден формально «инженерным методом»

Бот «Евгений Густман»

Владимир Веселов

Сергей Уласень

Евгений Демченко

2023

Тьюринг тест пройден неформально

LLM ChatGPT

Сэм Альтман

Грег Брокман

Илья Суцкевер

202?

LLM/GPT научились справляться с галлюцинациями - на основе онтологий, которые не нужно создавать вручную, а которые «как-то» строятся сами?

203?

LLM/GPT *(или то, что придет за ними)* научились инкрементальному обучению, до-обучению и переобучению на протяжении всего жизненного цикла, без катастрофического забывания/запоминания?

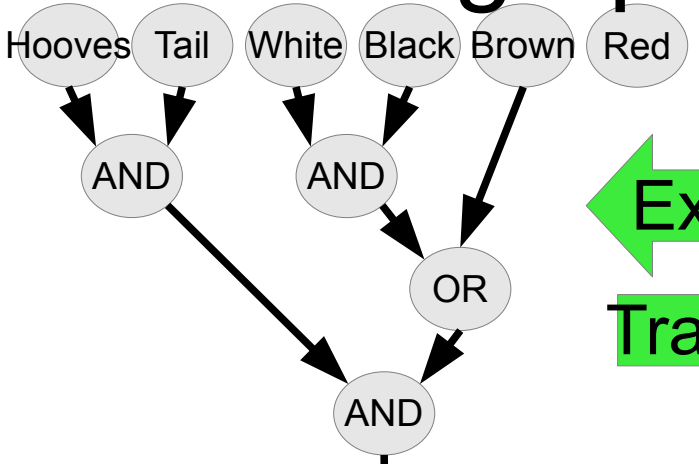
204?

Мы можем тренировать AGI на смартфоне?

Мы можем доверить AGI энергоблок АЭС или ПВО отдельно взятой страны?

Bridging the Symbolic-Subsymbolic gap for “explainable AI” and “transfer learning”

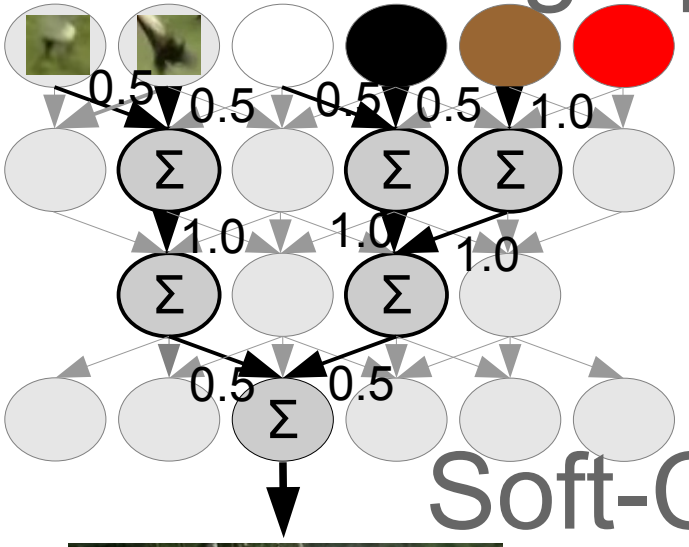
Labeled graph



Explain

Transfer

Unlabeled graph



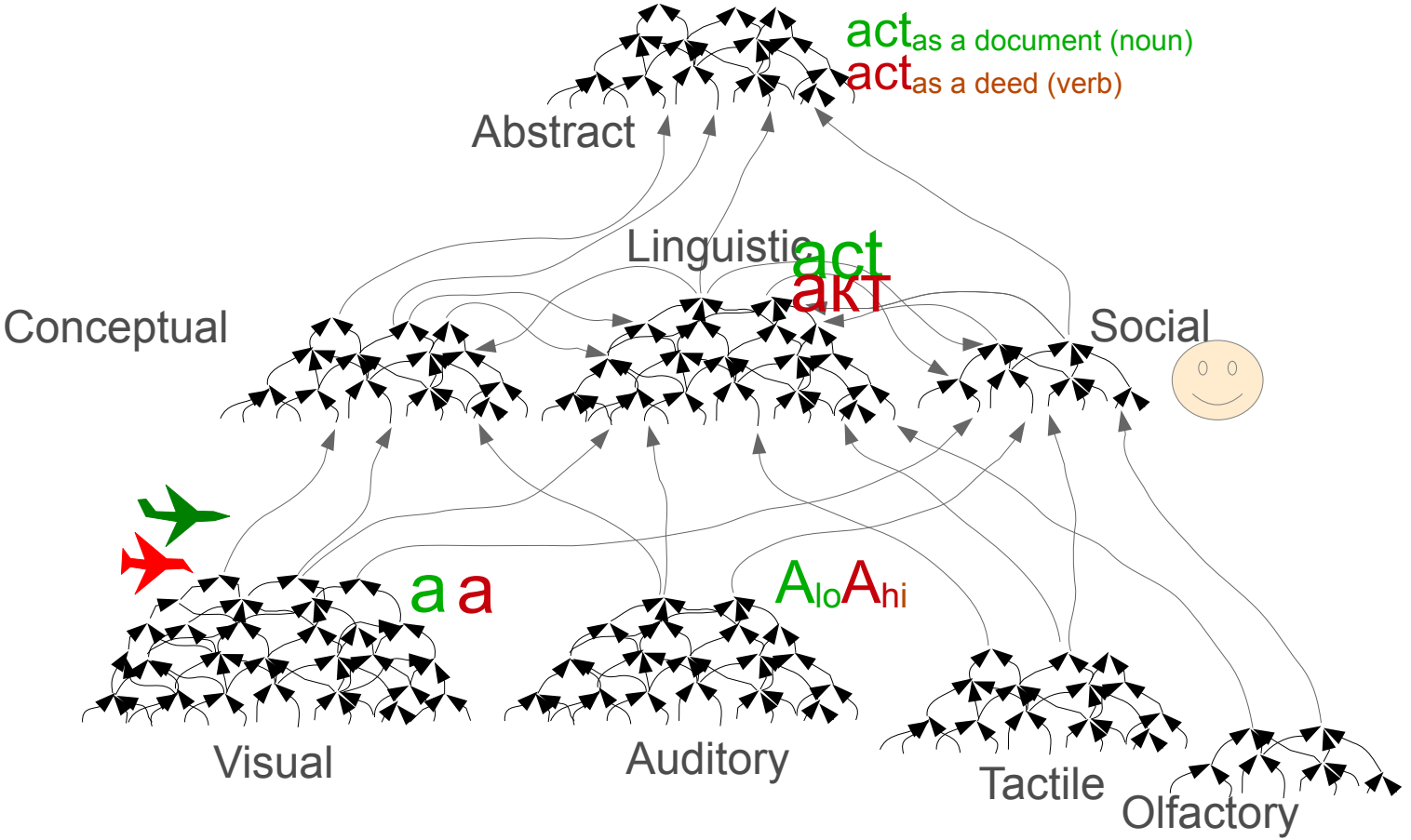
CNF

(Hooves AND Tail) AND
((White and Black) OR Brown)

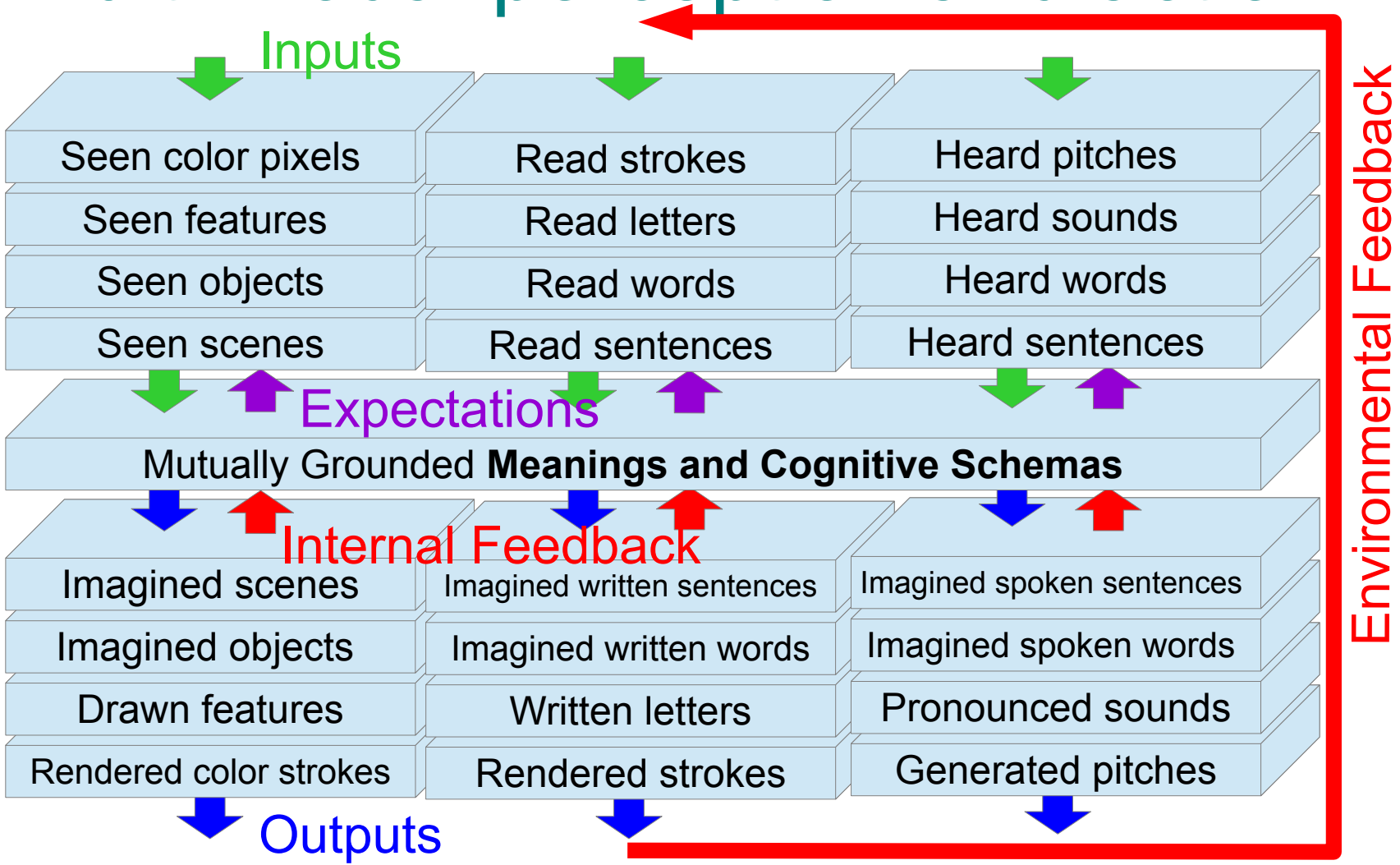
=> Horse

Soft-CNF

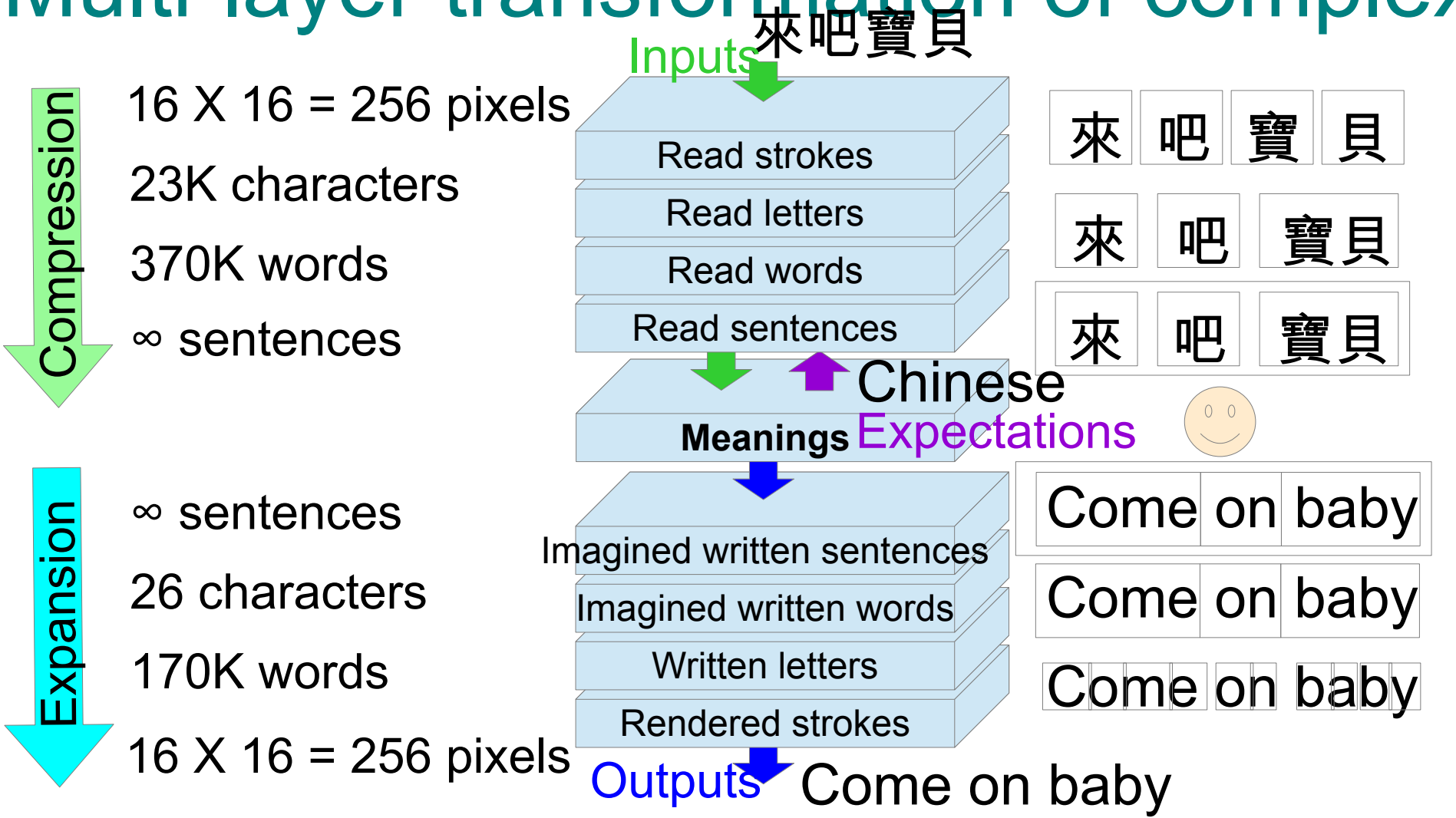
Physiological Plausibility – different segments of cortex responsible for different level of abstractions



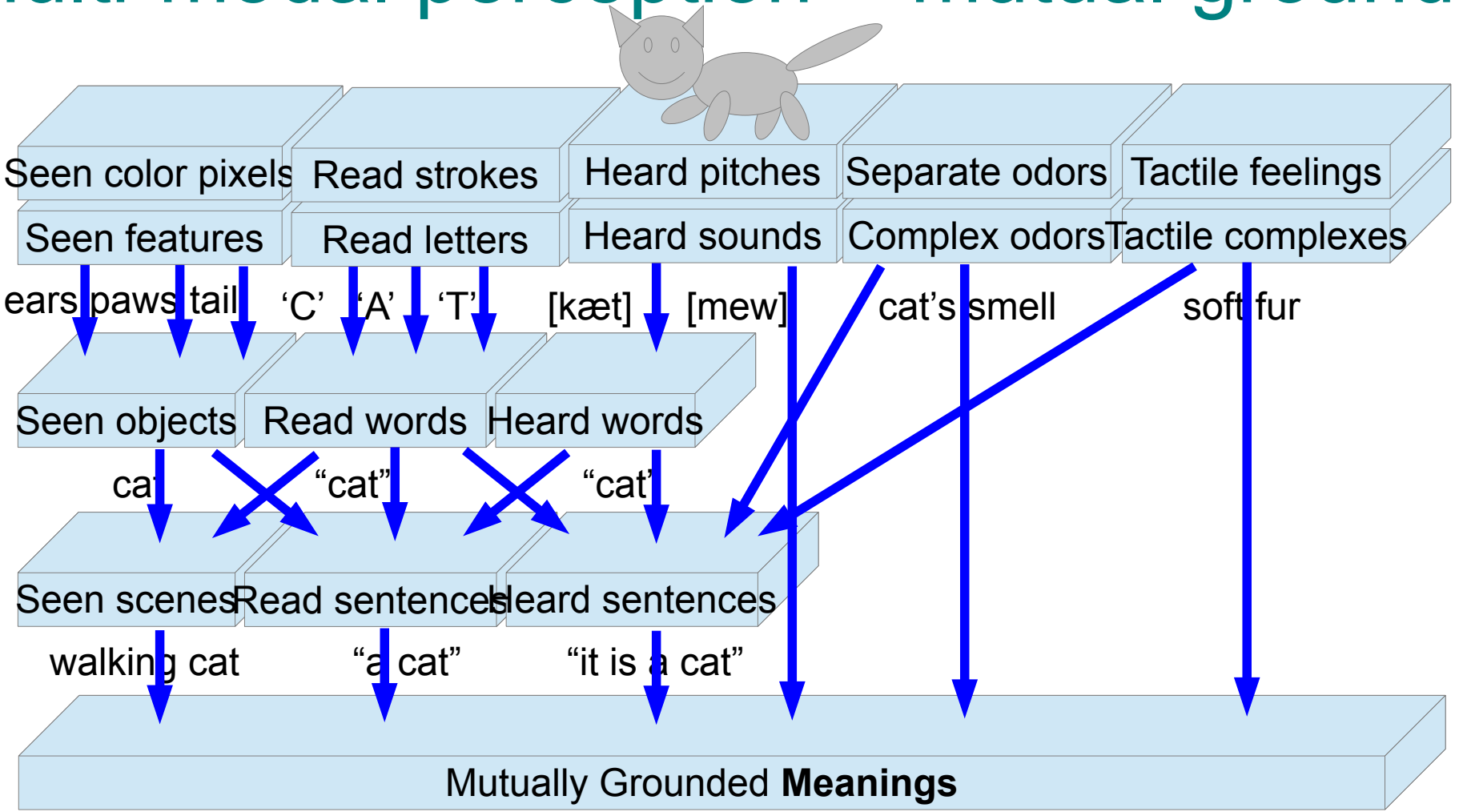
Multi-modal perception and action



Multi-layer transformation of complexity

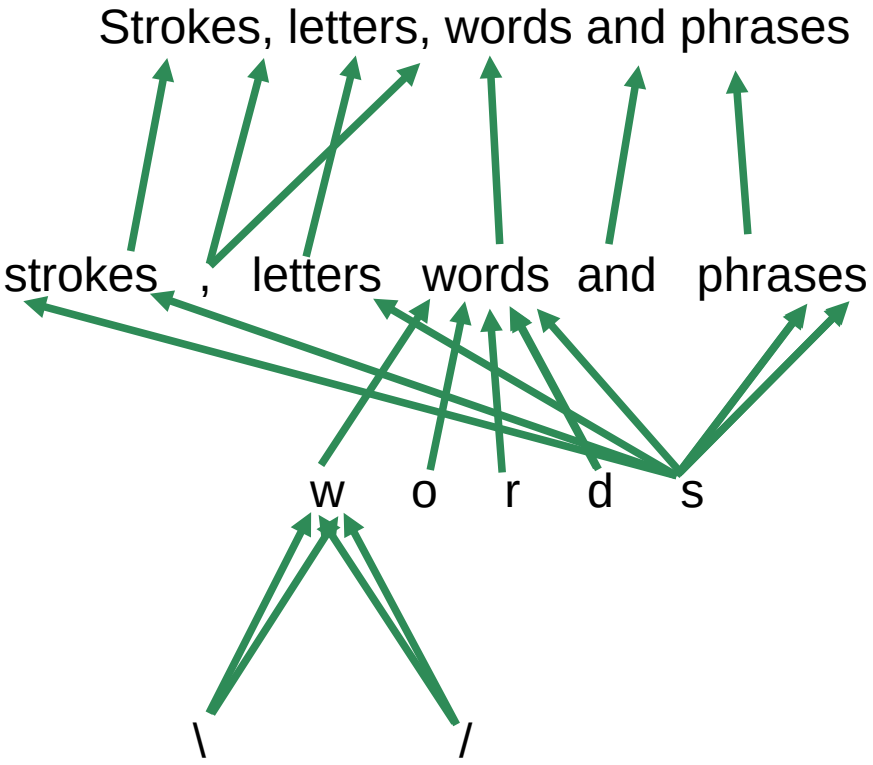


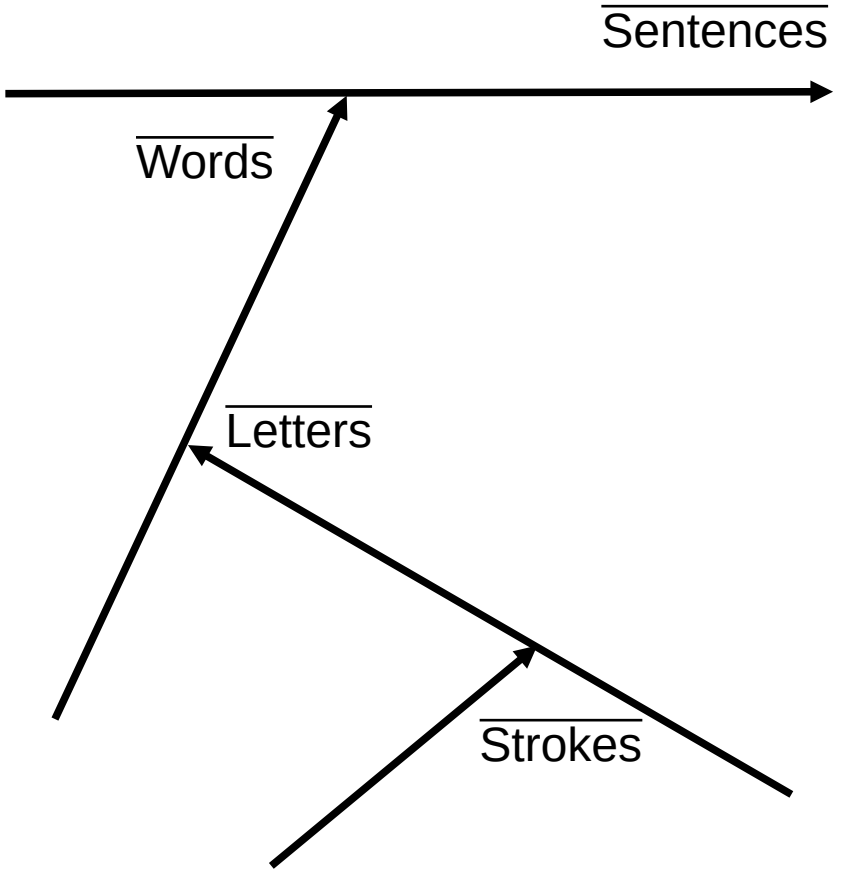
Multi-modal perception + mutual grounding



This walking cat is mewing!

Graphs vs. Tensors

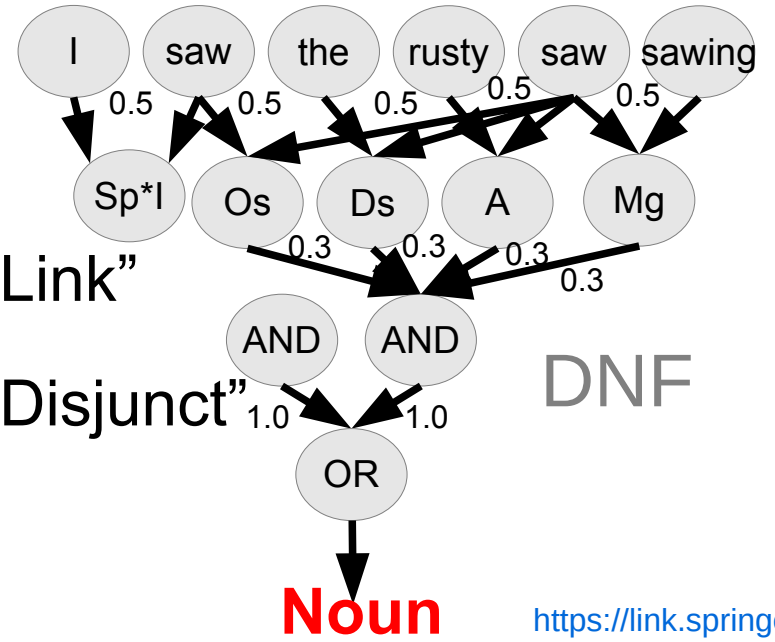




Bridging the Symbolic-Subsymbolic gap in NLP

Formal Link Grammar

```
+--------Os-------+
|     +-----Ds-----+
|  +Sp*i+     |    +---A--+---Mg--+
|  |    |     |    |     |       |
I.p saw.v the rusty.a saw.n sawing.v
```



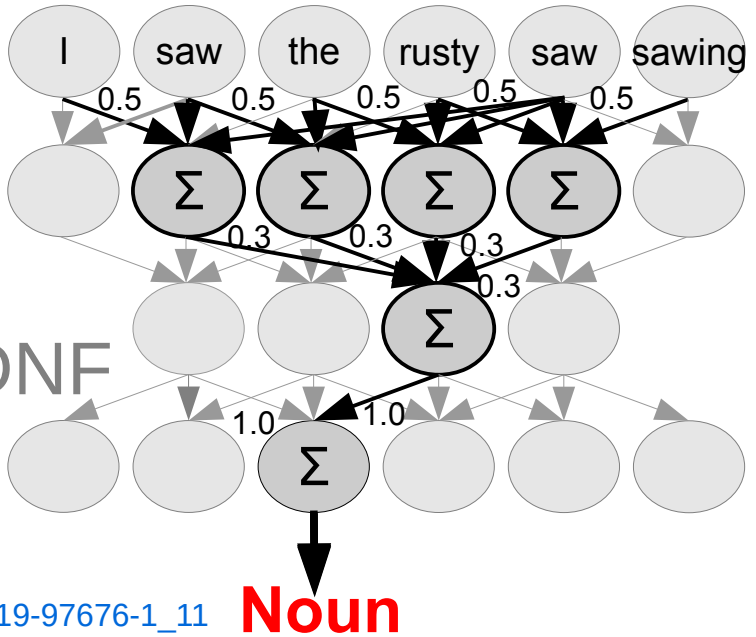
Explain

Transfer

DNF

Soft-DNF

Deep Language Model



https://link.springer.com/chapter/10.1007/978-3-319-97676-1_11
https://doi.org/10.1007/978-3-030-27005-6_11
https://github.com/singnet/language-learning/

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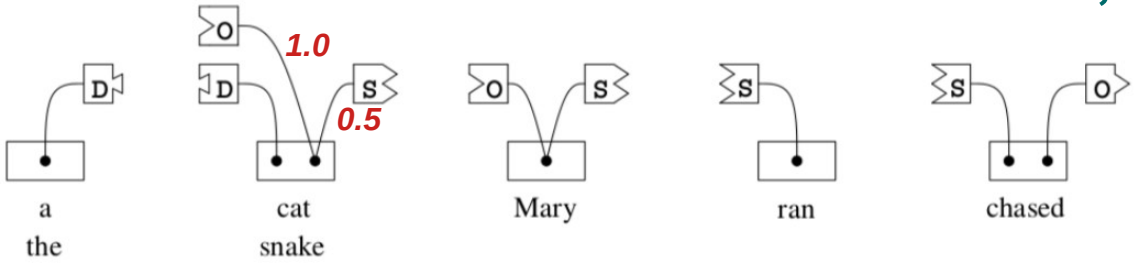
Link Grammar – Connectors/Costs, Disjuncts

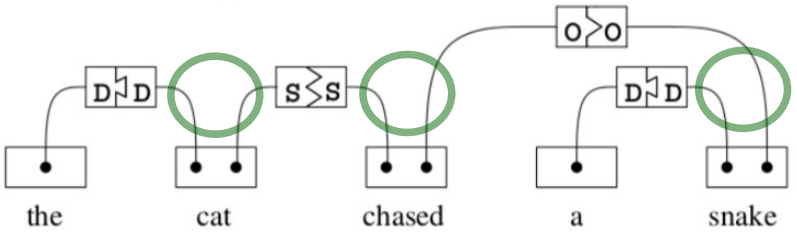


Connectors & Costs

An illustration of Link Grammar connectors and disjuncts. The connectors are the jigsaw-puzzle-shaped pieces; connectors are allowed to connect only when the tabs fit together. A disjunct is the entire (ordered) set of connectors for a word. As lexical entries appearing in a dictionary, the above would be written as

```
a the: D+;
cat snake: D- & (S+ or O-);
Mary: O- or S+;
ran: S-;
chased S- & O+;
```

Note that although the symbols ‘‘&’’ and ‘‘or’’ are used to write down disjuncts, these are ***not*** Boolean operators, and do ***not*** form a Boolean algebra. They do form a non-symmetric compact closed monoidal algebra. The diagram below illustrates puzzle pieces, assembled to form a parse:



Disjuncts of Connectors

https://arxiv.org/abs/1401.3372
https://en.wikipedia.org/wiki/Link_grammar
https://github.com/opencog/link-grammar

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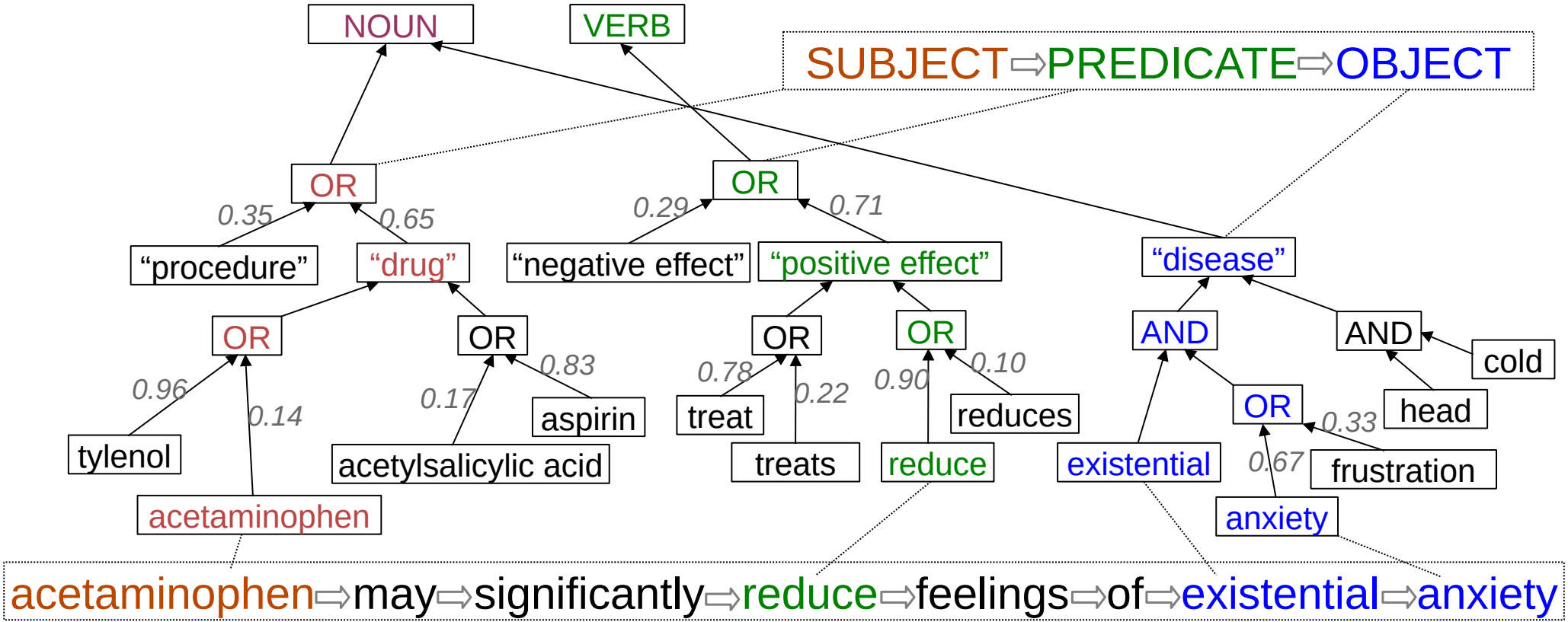
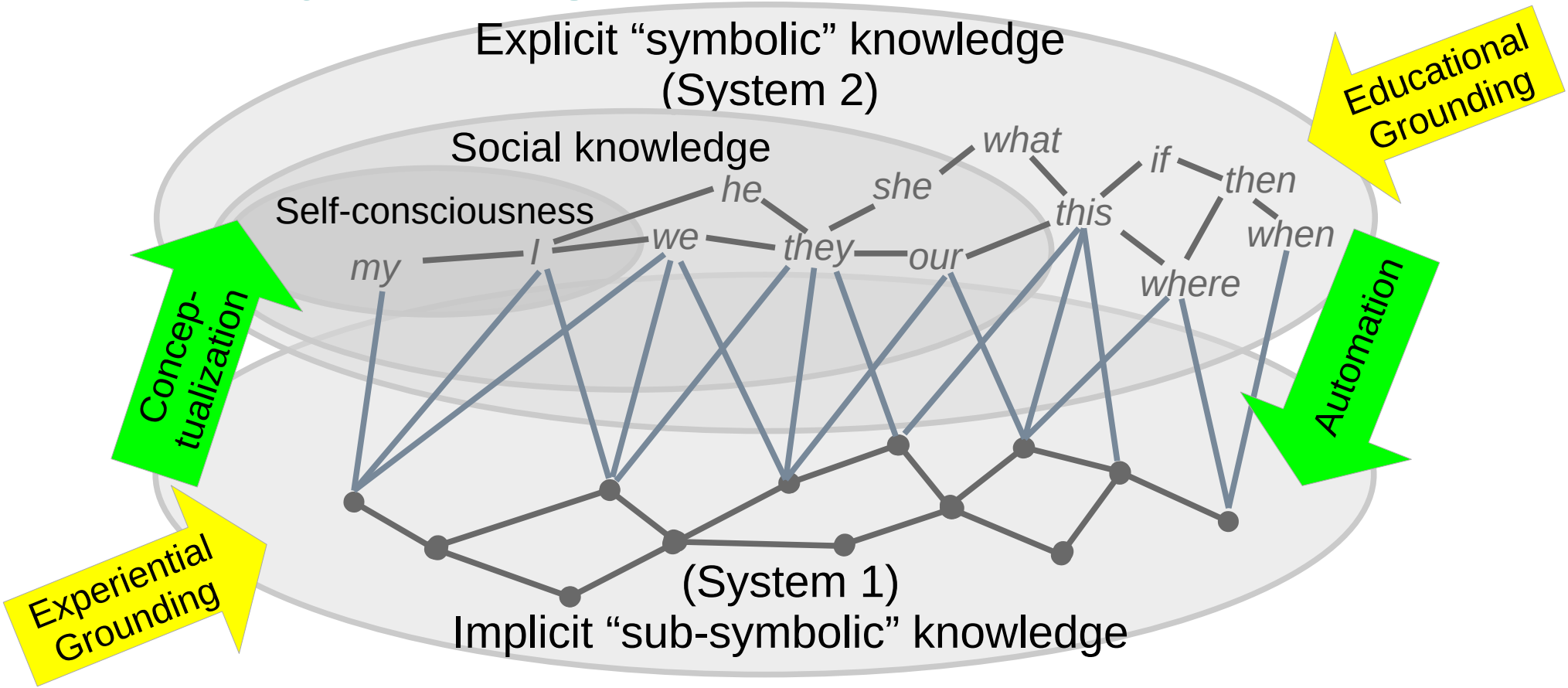
NLP patterns (words, punctuation, phrases) for Interpretable Natural Language Processing (Aigents® “Deep Patterns”)



https://ieeexplore.ieee.org/document/7361868
https://github.com/aigents/aigents-java

Knowledge as a **graph** with maintenance **cost**



https://www.amazon.com/Thinking-Fast-Slow-Daniel-Kahneman/dp/0374533555
https://amit02093.medium.com/atomspace-hyper-graph-information-retrieval-system-450cab9d751e

Explainability vs. Interpretability

https://arxiv.org/abs/2406.02981

Local vs. Global Interpretability: A Computational Complexity Perspective

Term	Definition	Source
Interpretability	*"level of understanding how the underlying (AI) technology works"*	ISO/IEC TR 29119-11:2020(en), 3.1.42[39]
Explainability	*"level of understanding how the AI-based system ... came up with a given result"*	ISO/IEC TR 29119-11:2020(en), 3.1.31[39]

https://en.wikipedia.org/wiki/Explainable_artificial_intelligence