Artificial Intelligence
– state of affairs and perspective

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AI – where are we now?

Programmable ⟶ Adaptive

Guided ⟶ Autonomous

194? 2019 20??

Weak ⟶ Strong

Big Data, Machine Learning, Experimental Statistics ⟶ Human-level AI (HLAI) ⟶ Super-human AI
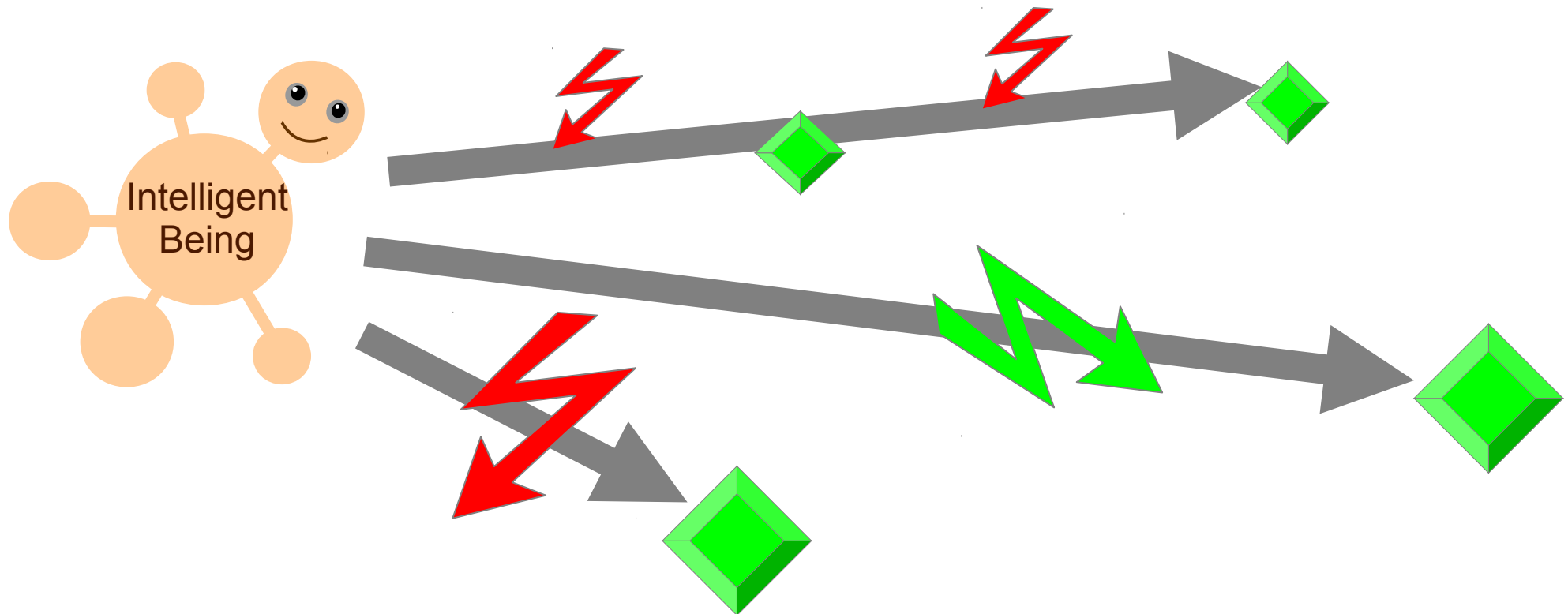
Narrow Artificial Intelligence (AI) ⟶ Artificial General Intelligence (AGI)

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

(Ben Goertzel, 1999)

Biological Intelligence:
Reaching food and parents for self-reproduction in natural environments using limited physical resources and minimizing existential risks
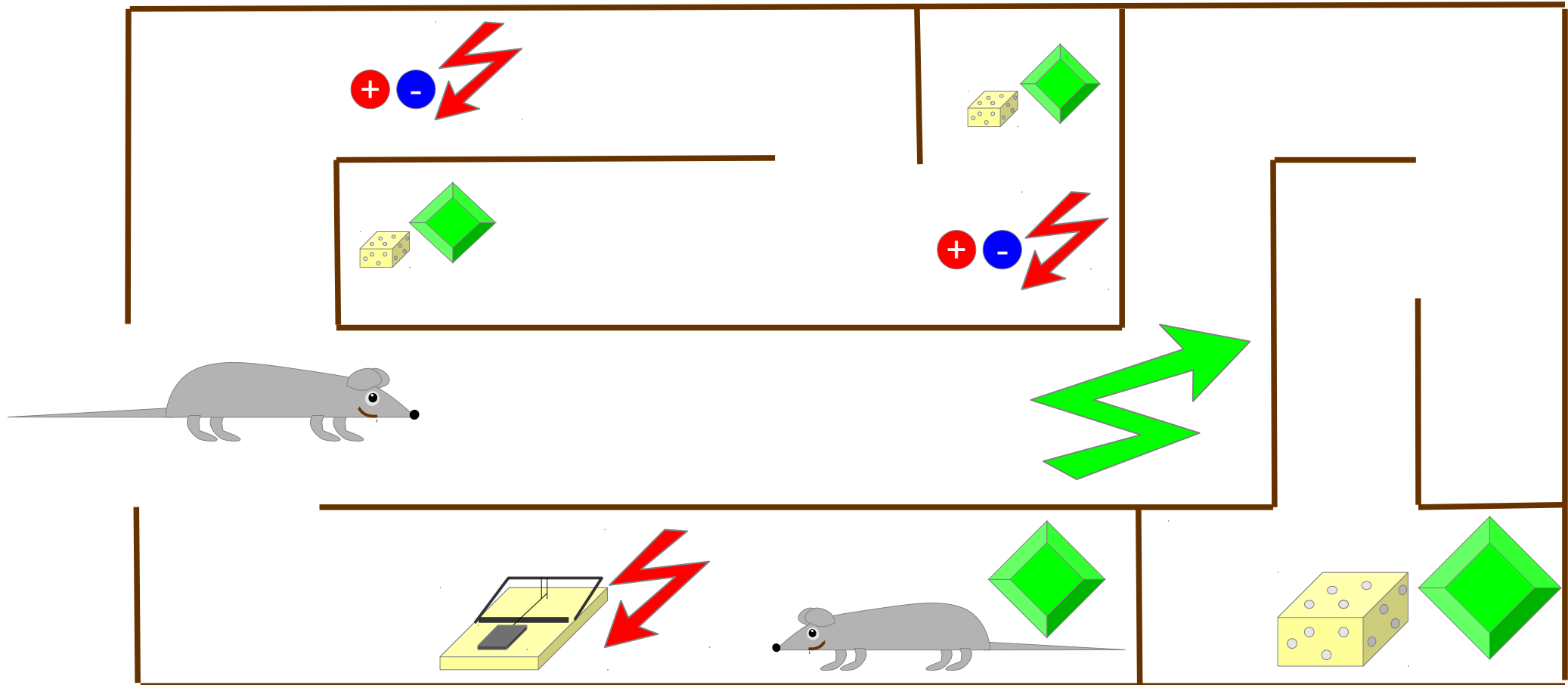
Personal Internet Assistant Aigents®: Reaching information in online environments using limited CPU and RAM resources, minimizing risk of being banned

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509 Bandwidth Limit Exceeded

429 Too many requests

404 Not found
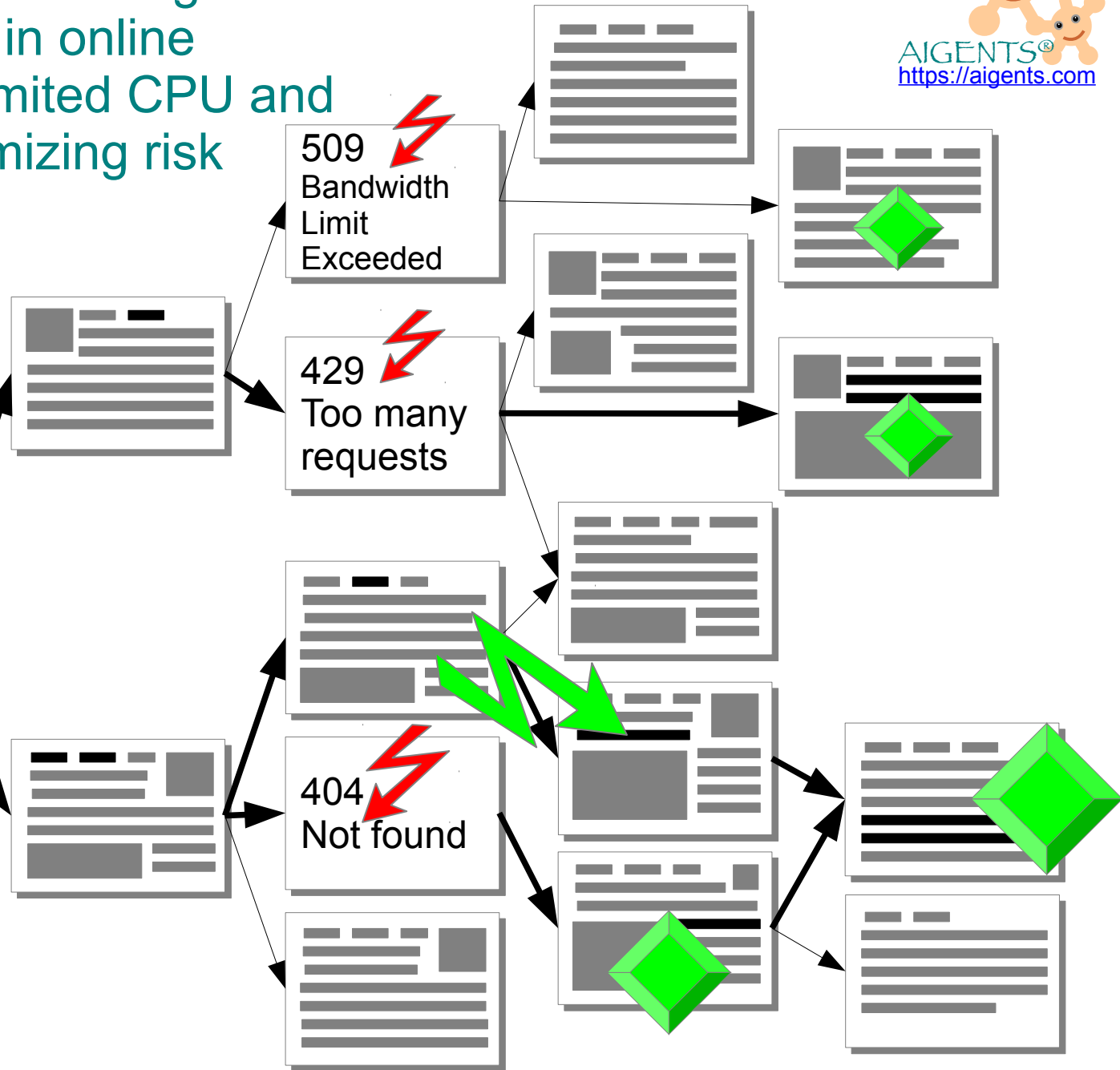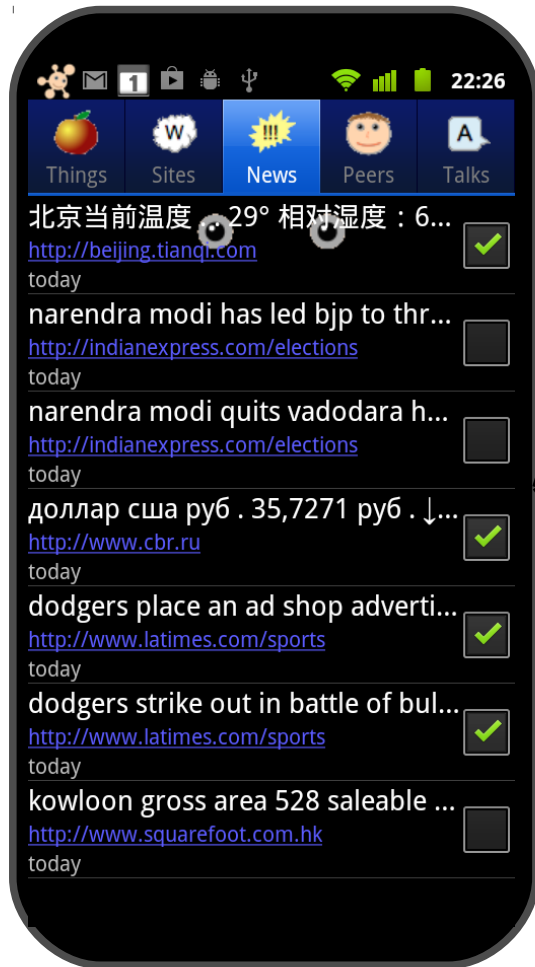
What does come next?

- 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 – progress in 2019
- Explainable AI – progress in 2019
- Transfer learning – progress in 2019
- One shot (few-shot) learning
- Strong generalization
- Generative models
- Structured prediction and learning
- Fighting catastrophic forgetting (and catastrophic remembering)
- Incremental learning and life-time learning
- New "Turing Test" (e.g., "Baby Turing Test")
- Solving the "consciousness" problem

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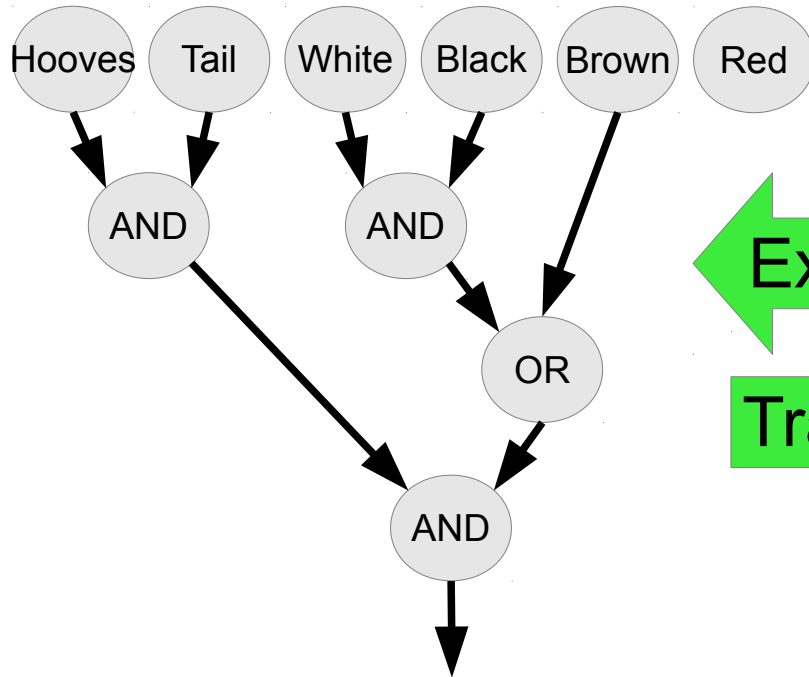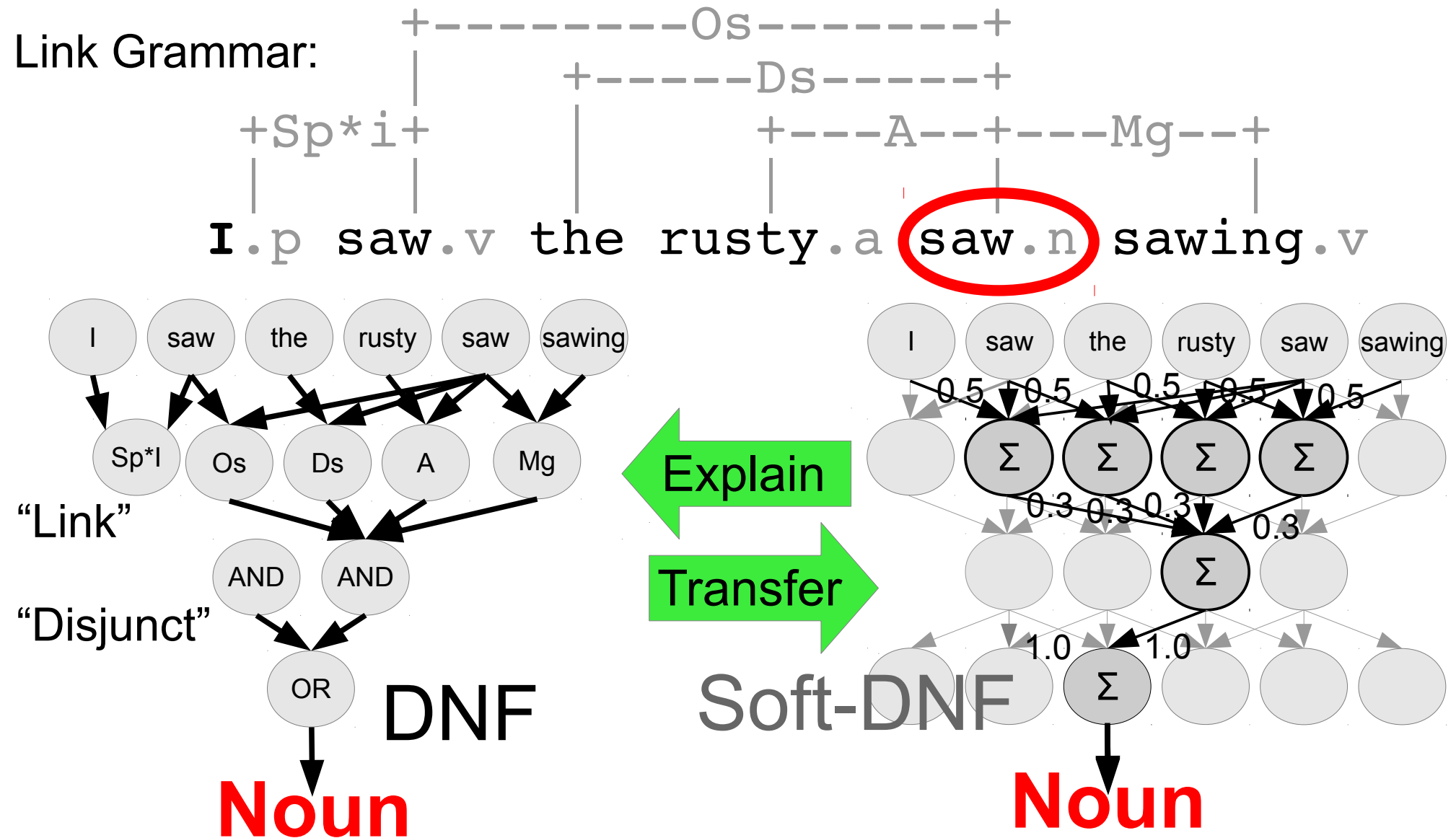

(Hooves AND Tail) AND
((White and Black) OR Brown)

=> Horse
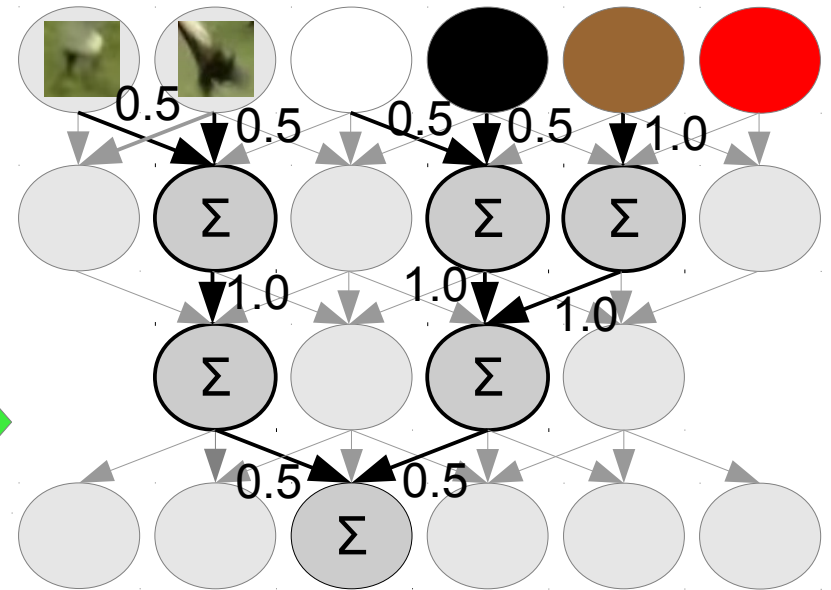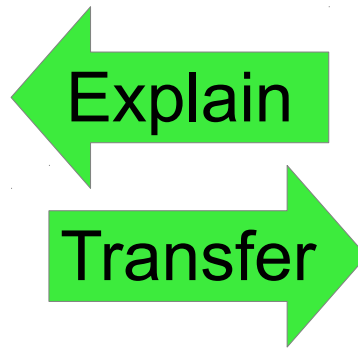
Bridging the Symbolic-Subsymbolic gap in NLP between distributed representations and formal grammars with ontologies

"Explainable AI" (XAI) - approaches

XAI representations
    Deep Bayes
    Deep Random Forest
    Soft Decision Trees
    Probabilistic/Fuzzy Logic
        OpenCog/PLN
        NARS
        "Discovery"
    Formal Concept Analysis (FCA)

XAI techniques
    "Dual" systems (like DNN + CBR)
    Transformation to "soft" CNF/DNF rules (softmax, arg max)
    XAI LIME
    XAI SHAP
    Life-long & Incremental Learning
        (compression/forgetting–extraction–injection–extension)

New (and forgotten old) approaches

Convergence

    Joining neural networks into cognitive architectures

        Complex DNN Architectures

            Attention-allocation networks

                Contextual question answering and sentiment analysis

            3D CNN for spatiotemporal predictions

    Hybridization of neural networks with probabilistic programming

    Integration of neural networks with semantic networks ("knowledge graphs")

AGI

    Narrow AGI (Ben Goertzel, SingulariytNET)

    Probabilistic programming

        It is in the state of "neural networks" 20 years ago and may turn revolutionary in just few years (Alexey Potapov, SingulariytNET)

    Agent Models

        AIXI – universal compressor and predictor (Marcus Hutter, Arthur Franz)

        Anokhin's Theory of Functional Systems (TFS) extension (Evgenii Vityaev)

        Reinforcement Learning based on "fluents" (state variables or atoms representing the states)

    Ecosystem approach

        No one knows how to make AGI (so "let all colors bloom")

        Brain on itself is not the same (different brain regions have totally different "architectures")

New (and forgotten old) approaches

Deep Learning for AGI

    Demis Hassabis: "transfer learning is a key ... to general intelligence"

    Yan Lecun: "learn models of the world"

    Cognitive Pyramid:

        Casuality

            Reinforcement-learning

                Transfer-learning

            Meta-learning (Learning to Learn)

                DL

                GANs

                ML

                ...

    World<->ControlNetwork<->ModelNetwork *("Learn how to Learn")*

A lot to study, still

    Dedrites/synapses branching

    Holobionts - synergetically interacting societies

        (matching studies by Jeff Hawkins,
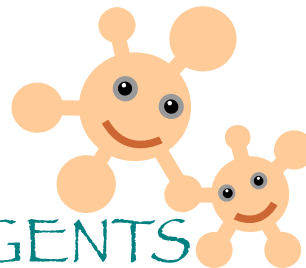
        who suggested the HTMs, preceding the DNNs)

    Neuron Microtubules

Thank you and welcome!

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