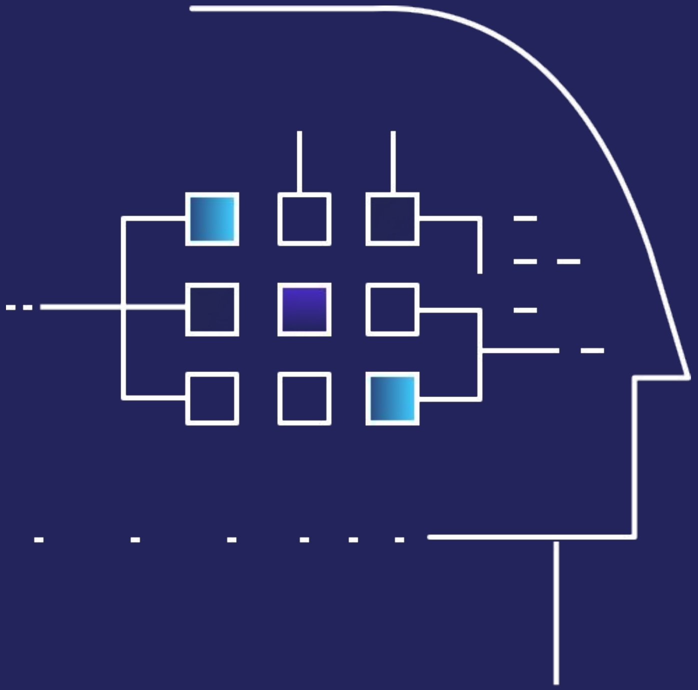
SingularityNET

Technical Deep Dive

OpenCog Workshop, Tokyo 2019



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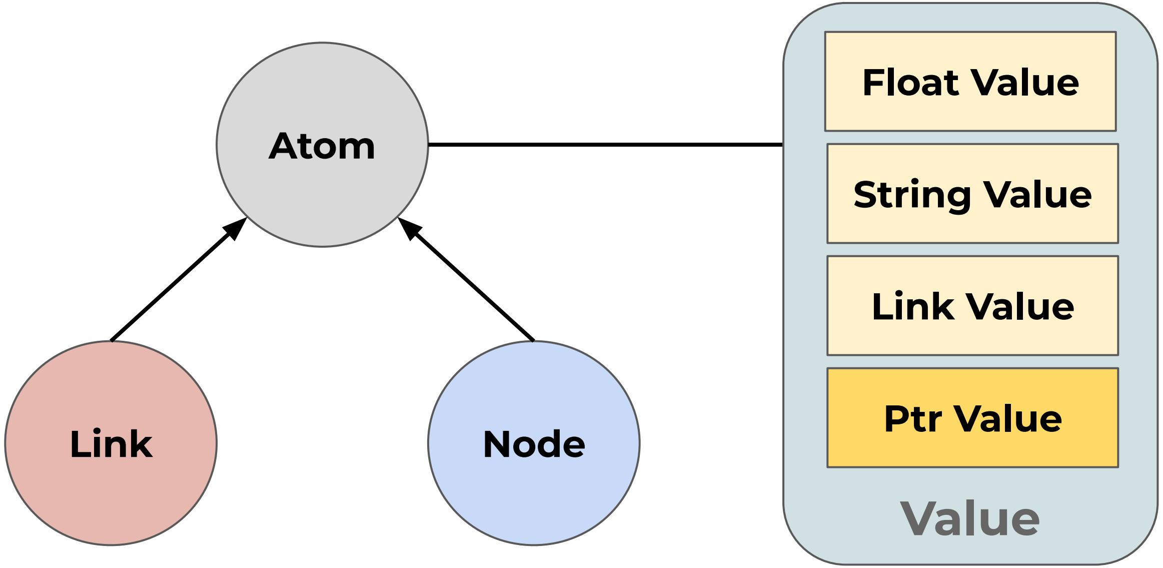
https://github.com/singnet/opencog-workshops

OpenCog - The Open Cognition Project

- Open source framework for Artificial General Intelligence (AGI)
- Diverse assemblage of cognitive algorithms, e.g.
  - ECAN - Economic Attention Allocation System
  - PLN - Probabilistic Logic Networks
  - OpenPsi
  - MOSES - Meta-Optimizing Semantic Evolutionary Search
  - Natural Language Processing & Generation

AtomSpace

- Hypergraph database
- Holds ATOMS together with their VALUES



Bindings

Scheme

```
scheme@(guile-user)> (use-modules (opencog))

scheme@(guile-user)> (define my_atomspace (cog-new-atomspace))
```

Python

```
>>> from opencog.atomspace import AtomSpace

>>> my_atomspace = AtomSpace()
```

Haskell

Demo: **Knowledge Representation**

atomese.ipynb

Pattern Matcher

- Query engine
- Finds graphs that match the given template
- Evaluates and executes certain subgraphs

Pattern:

```
InheritanceLink
    VariableNode $x
    ConceptNode “animal”
```

Practice: **Pattern Matcher**

pattern_matching.ipynb

evaluation_and_execution.ipynb

Unified Rule Engine (URE)

- Generic rule engine
- Supports forward chaining and backward chaining
- Built mostly on top of the Pattern Matcher
- Rules are written as BindLink
- Rules can be organized as a Rule Base, with customizable control policy for controlling the inferences

Rule Structure

```
BindLink
    <variables>
    AndLink
        <premise-1>
        …
        <premise-n>
    <conclusion-pattern>
```

Deduction Rule Example

```
Premise         condition = AndLink(BA, CB)

A -> B          BA = InheritanceLink(var_b, var_a)

B -> C          CB = InheritanceLink(var_c, var_b)
```

Ergo: A -> C

```
Rewrite = ExecutionOutputLink(

                GroundedSchemaNode("scm: deduction-formula"),

                ListLink(CA, CB, BA))

deduction_link = BindLink(condition, rewrite)
```

Probabilistic Logic Networks (PLN)

- Carries out uncertain inference
- Allows basic probabilistic inference to interact with other kinds of inference
- Supports sophisticated control mechanism enabling inference control meta-learning

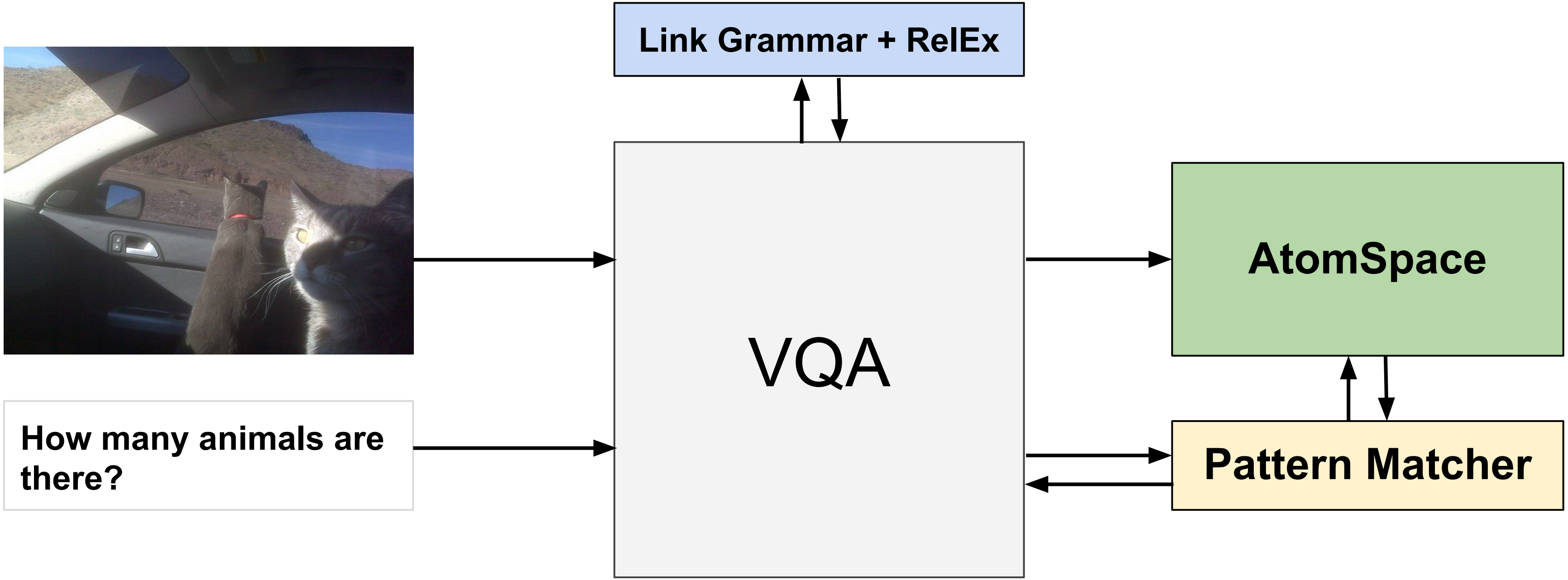
Demo: **Reasoning**

reasoning.ipynb

Visual Question Answering (VQA)

- Atomspace for storing facts about world
- Link Grammar + RelEx for text processing
- Faster-RCNN for bounding box and feature extraction
- Our neural network models for classification
- Unified Rule Engine and Pattern Matcher for answer searching

Visual Question Answering (VQA)



How many animals are there?

VQA

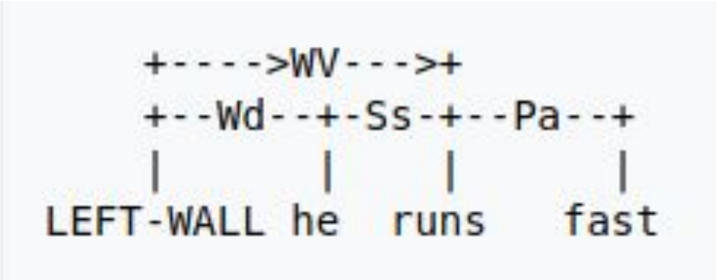
Link Grammar + RelEx

AtomSpace

Pattern Matcher

Link Grammar

- A syntactic parser
- Builds relations between pairs of words
- e.g. “he runs fast”



```
    +---->WV--->+
    +--Wd--+-Ss-+--Pa--+
    |      |    |      |
LEFT-WALL he  runs   fast
```

RelEx

- Dependency Relationship Extractor for English

Dependency relations:

_advmod(run, fast)

_subj(run, he)

Attributes:

pos(run, verb)

penn-POS(run, VBZ)

penn-POS(fast, RB)

definite-FLAG(he, T)

pos(he, noun)

penn-POS(he, PRP)

tense(run, present)

pos(fast, adv)

noun_number(he, singular)

gender(he, masculine)

pronoun-FLAG(he, T)

Demo: **Visual Question Answering (VQA)**

vqa.ipynb

GHOST

- General Holistic Organism Scripting Tool
- Allows human authors to script behaviors for artificial characters
- Inspired by ChatScript in its syntax
- Translates human-authored rules into OpenPsi-rules:

  context AND procedure IMPLIES goal

GHOST

- A typical GHOST rule:

```
goal: ( please_human=0.8 )

r: ( hi robot ) hello human
```

- Supports scripting nonverbal behaviors as well

```
r: ( ^is_face() ) hello human ^smile()
```

Rule Discovery via ECAN

- Stimulates related Atoms based on perception inputs (words, faces etc)
- Propagates to the neighboring Atoms
- Rules in the attentional focus will be evaluated

Action Selection via OpenPsi

- Determine what action to take
- Rule/Action selection process is probabilistic, driven mainly by
  - Satisfiability of the context of the rule
  - Importance of the rule
  - Urges of the goals

Demo: **GHOST**

ghost.ipynb

Resources

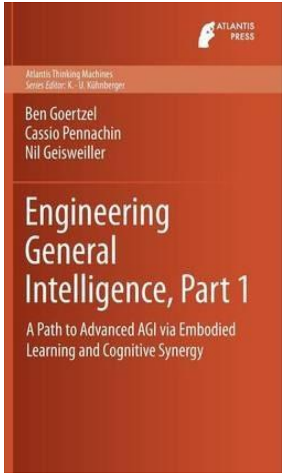
wiki.opencog.org

blog.opencog.org

github.com/opencog

opencog@googlegroups.com

opencog.slack.com



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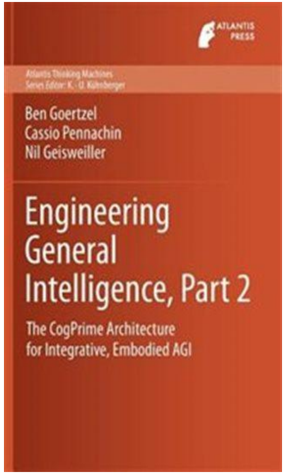
Engineering General Intelligence, Part 1

A Path to Advanced AGI via Embodied Learning and Cognitive Synergy



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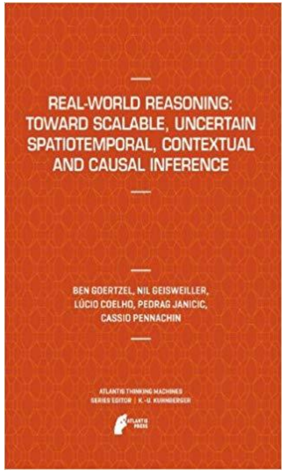
Engineering General Intelligence, Part 2

The CogPrime Architecture for Integrative, Embodied AGI



REAL-WORLD REASONING: TOWARD SCALABLE, UNCERTAIN SPATIOTEMPORAL, CONTEXTUAL AND CAUSAL INFERENCE

BEN GOERTZEL, NIL GEISWEILLER, LÚCIO COELHO, PEDRAG JANICIC, CASSIO PENNACHIN

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