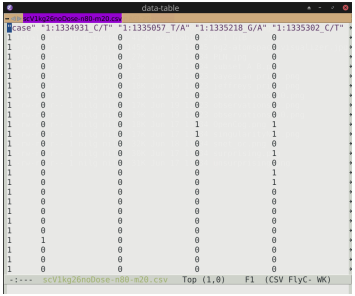
Combining learning and reasoning for Bio-AI

Nil Geisweiller

SingularityNET & OpenCog Foundations

Why?

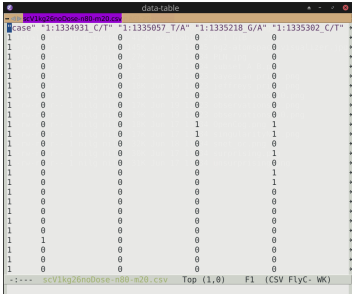
Why combining machine learning and reasoning?



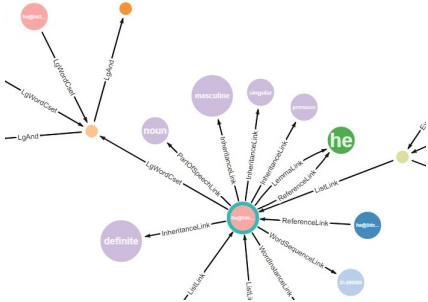
⊗

Why?

Why combining machine learning and reasoning?



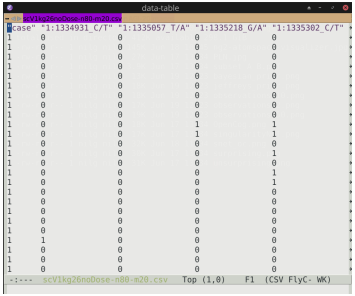
⊗



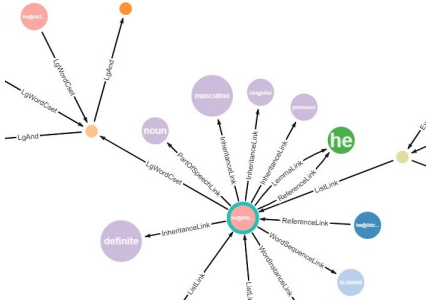
Massive amount of indirect evidence

Why?

Why combining machine learning and reasoning?



⊗



Massive amount of indirect evidence

Ultimate answer to overfitting

Why?

What about simulation?

Impractical without abstractions

Reasoning
⇓
Abstractions

Why?

Help learning (and reasoning)

- Reasoning for meta-learning
  - Filter relevant features
  - Guide optimization
- Learning for meta-reasoning
  - Discover inference control patterns
  - Create contextual Hebbian links

Learning & reasoning over the Bio-AtomSpace

- Learning:
  - MOSES (program evolution)
    ⇒ Predictive models
  - Pattern Miner (frequent pattern mining)
    ⇒ Discover abstractions
- Reasoning:
  - Pattern Miner
  - PLN (Probabilistic Logic Networks)
    ⇒ Use existing and discovered background knowledge

Example

Example of reasoning involving MOSES model + discovered pattern + background knowledge.

Status

- Discovered simple patterns
  - Pattern size: 2 conjuncts
  - GO + SMP dataset: 1M atoms
  - Time: couple hours
- Inferred short trails
  - Trail size: about 8 steps
  - GO dataset: 650K atoms
  - Time: couple hours
- Focused on longevity

Difficulties

- Porting data into the atomspace
- Finding good queries
- Very resource hungry (millions of atoms)
  - CPU: 1 single step can take 20+ minutes
  - RAM: 1 single step can take 64GB+
  - Need ECAN!
- Advanced forms of reasoning
  - Stress-test on PLN

To do

- Experiment with other domains, COVID-19, Cancer
- Complete Multi-threaded Rule Engine
- Integrate ECAN
- Integrate spatio-temporal reasoning
- Experiment with inference control meta-learning