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InPhO

the Indiana Philosophy Ontology project

Answer Set Programming on Expert Feedback to Populate and Extend Dynamic Ontologies

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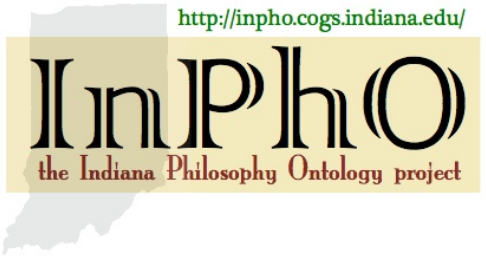
The Stanford Encyclopedia of Philosophy

- *Dynamic:* new and revised entries come online each month
- *Substantial and Complex:* More than 9 million words of sophisticated humanities content
- *Open-access:* content and code is freely available
- *Expert-driven:* more than 1,100 professional philosophers serve as authors and editors
- **Our goals:** Semantic search, automatic generation of cross-references, ontology-driven conceptual navigation

Bridging the Data-Metadata Gap

- Two "extremes":
  - Tagging approaches, folksonomies.
    Problem: Do not meet academic standards; noisy/inelegant.
  - Hire experts to design and maintain an ontology.
    Problem: Labor-intensive, expensive; in areas like philosophy difficult to justify "one ontology" dictated by a single expert.
- **Our approach:** Use overlapping *expert* feedback from multiple authors and editors of the SEP.

InPhO: The Indiana Philosophy Ontology



- Initial Ontology Design (ideas, thinker, *taxonomic*, and *non-taxonomic relations*)
- Use statistical text processing/machine learning tools and external sources to derive potential instances of the relations
- Present "uncertain" recommendations to authors and editors for verification/integration
- Expert feedback stored as first-order facts
- Answer Set Programming puts the pieces of knowledge together into a global populated ontology

Author Interfaces – The "OntoTree"

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InPhO

the Indiana Philosophy Ontology project

« myspace

- philosophy
  - aesthetics and philosophy of art
  - ethics
  - feminist philosophy
  - history of philosophy
  - logic
  - metaphysics
  - philosophy of language
  - philosophy of mind
    - **artificial intelligence**
      - computation and representation
      - computationalism
      - connectionism
      - dynamic system
      - thinking machine
    - consciousness and qualia
    - consciousness and science
    - mental content
    - metaphysics of mind
    - philosophy of psychology
  - philosophy of science and the sciences
  - social and political philosophy

SEP OntoTree

This is the page for the node artificial intelligence

You can navigate through the taxonomy by clicking on the topic node on the left. Clicking on a node expands it into the available subtopics. If no terms appear below, on the right side of this page, then please follow links until some do.

For each term shown below on the left, please indicate its relationship to the topic node selected (i.e., artificial intelligence). You may skip any items you are unsure about. For more information about what you are being asked to do, please click here.

Page 1 2 3 4 5 6 7 8 9 10 11 12 Add your own | Jump to submit button

unrelated ○ ○ ○ ○ ● highly related reset

defeasible reasoning | is more specific than | artificial intelligence

unrelated ○ ○ ○ ○ ○ highly related reset

turing machine | | artificial intelligence

- is more specific than
- is more general than
- is as general as
- incomparable/either

unrelated ○ ○ ○ ○ ● highly r reset

symbolic processing | is more specific than | artificial intelligence

Jean-Paul Sartre

Year of birth: 1905 Month of birth: June Day of birth: 21

Year of death: 1980 Month of death: April Day of death: 15

Nationality/Ethnicity:
- French

Occupation(s):
- dramatist
- philosopher
- screenwriter

Alternative names:

Has influenced:
- Judith Butler
- Albert Camus
- Simone de Beauvoir
- Gilles Deleuze
- Frantz Fanon

Add

Indicate degree of influence for selected thinkers
no influence ( ) ( ) ( ) ( ) ( ) strong influence Mark

Influenced by:
- Albert Camus
- Simone de Beauvoir
- Friedrich Engels
- Martin Heidegger
- Alexander Herzen

A

Add

- Firmin Abauzit
- Nicola Abbagnano
- Muhammad Abduh
- Jacob Friedrich von Abel
- Peter Abelard
- John Abercrombie

ience for selected thinkers
( ) ( ) strong influence Mark

Teacher of:

Add

Answer Set Programming

- Logic programs consist of three parts:
  - Signature: predicate symbols (e.g., desc) and set of objects (here: terms referring to ideas in Philosophy)
  - Declaration: Set of expert feedback facts, (e.g., more-specific(*Neural Network, Connectionism*)) and the facts given by the existing ontological structure (e.g., is-a(*Thinking Machines*, *Artificial Intelligence*))
  - Regular Part (set of rules)

Answer Set Programming
The Regular Part

- **Rule format:**

  $L_1 \vee L_2 \vee \ldots L_i \leftarrow L_{i+1}, \ldots, L_n, not\ L_{n+1}, \ldots, not\ L_z.$

  – Head = $\{L_1, L_2, \ldots, L_i\}$, body = $\{L_{i+1}, \ldots, L_z\}$

  – Fact is a rule with no body

- Examples:

  – a.

    b :- a. {a, b}

  – a :- not b.

    b :- not a. {a}, {b}

Answer Set Programming Examples

Examples:

- ms(X, Y) :- mg(Y, X).
- pins(X, Y) :- s4(X, Y), ms(X, Y), class(Y), not class(X).
- nins(X, Y) :- pins(X, Z), desc(Z, Y), class(Y), class(Z), not class(X).
- instance-of(X, Y) :- pins(X, Y), not nins(X, Y).

Predicate Key

pins = evidence for instance

nins = strong evidence against instance

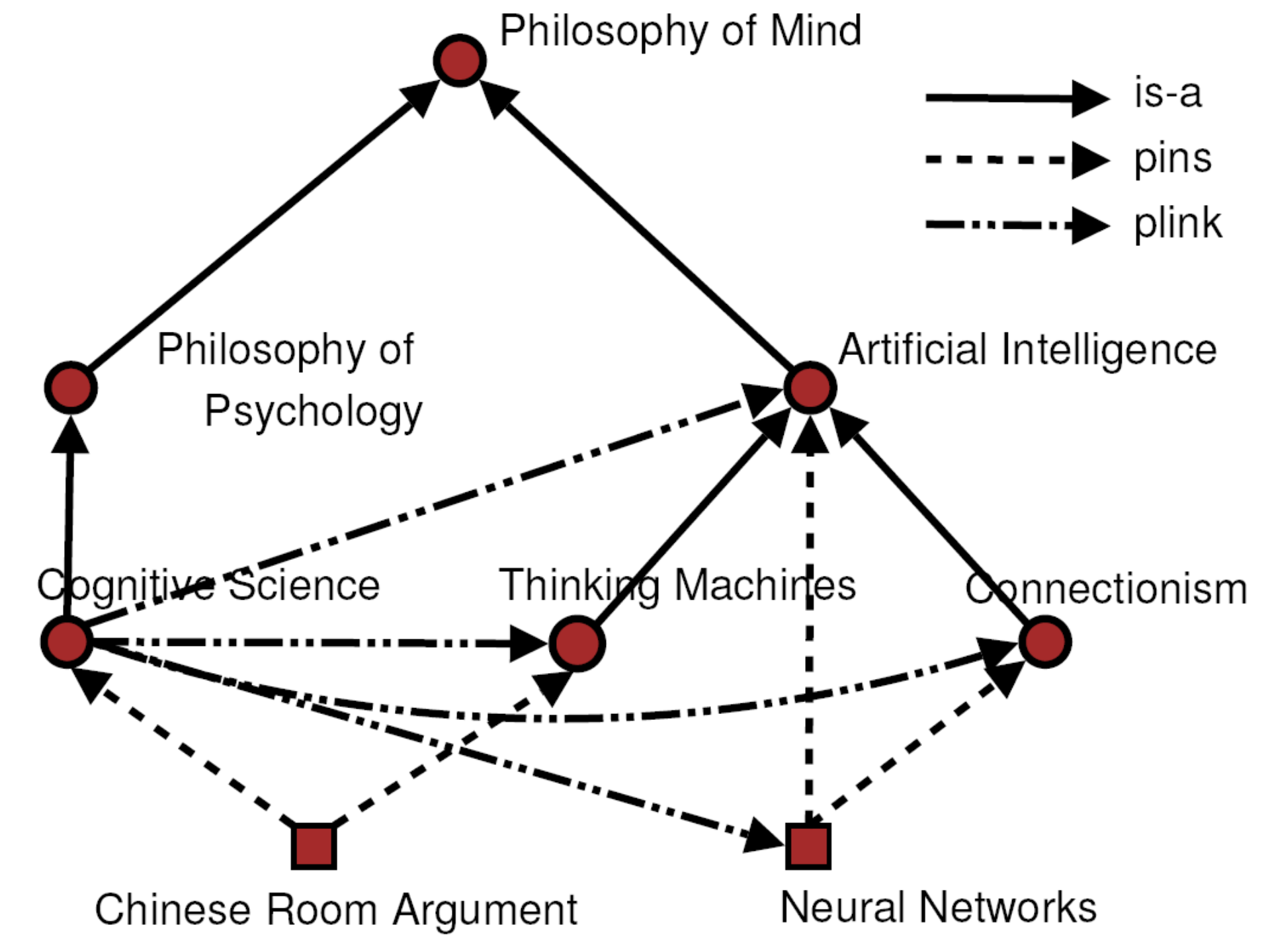
s4...s0 = highly similar ... highly dissimilar

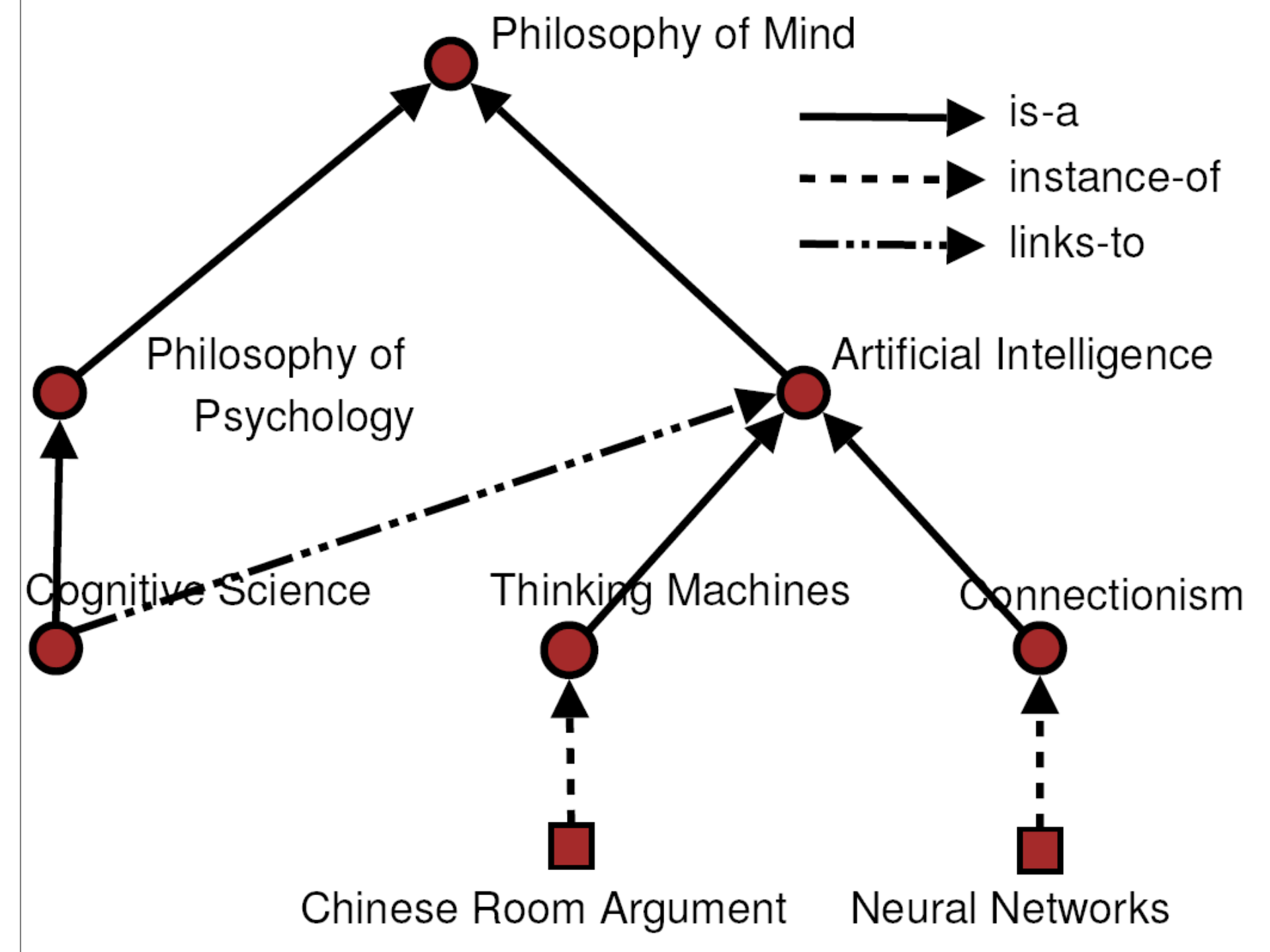
ms = more specific

mg = more general

Answer Set Programming and Conflicting Feedback

- Conflicting feedback is possible!
- Modeled using predicate ic (inconsistent):
  - ic(X, Y) :- ms(X, Y), mg(X, Y).
- Can be used to model "semantic links" between incomparable ideas:
  - plink(X, Y) :- s4(X, Y), ic(X, Y), class(X), not desc(X, Y).


Philosophy of Mind
is-a
pins
plink
Philosophy of Psychology
Artificial Intelligence
Cognitive Science
Thinking Machines
Connectionism
Chinese Room Argument
Neural Networks


Philosophy of Mind
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Conclusions and Future Work

- Answer set programming deals well with conflicting expert feedback
- Elegant and concise language (only 21 rules for the InPhO taxonomy)
- Puts pieces of local knowledge together to a global populated ontology
- Evaluation and long-term behavior?
- Ontology will be used for: Visualization, Cross-Referencing, “Semantic Search”

Acknowledgments

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