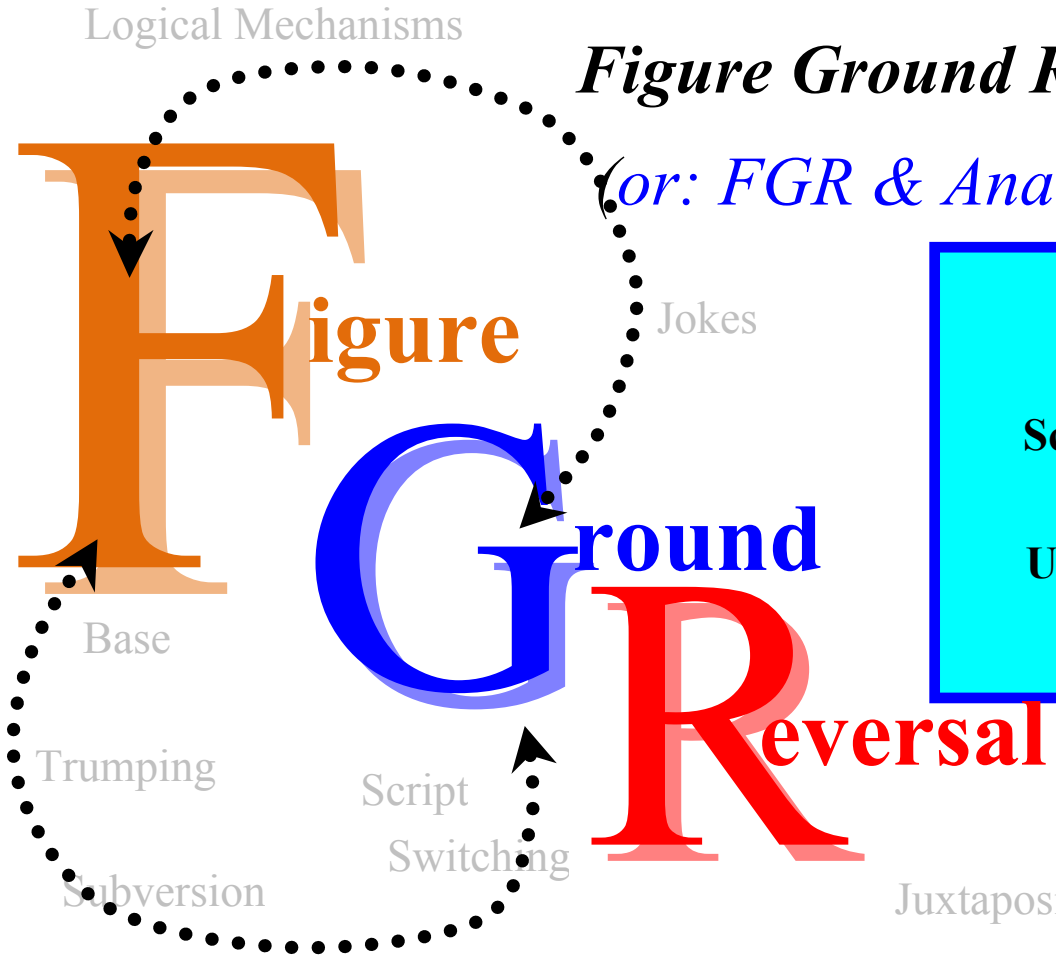

Figure Ground Reversal (Part 2):

*(or: FGR & Analogy in **HowNet**)*

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University College Dublin

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Types of Ontological Abstraction

- **Form (shape, physical structure, etc.)** — **E.g., Biology**

  Linnaean-style classification on the basis of physical features

- **Behaviour** — **Mentalese**

  Classification based on behavioural features (sharp, fast, warm, etc.)

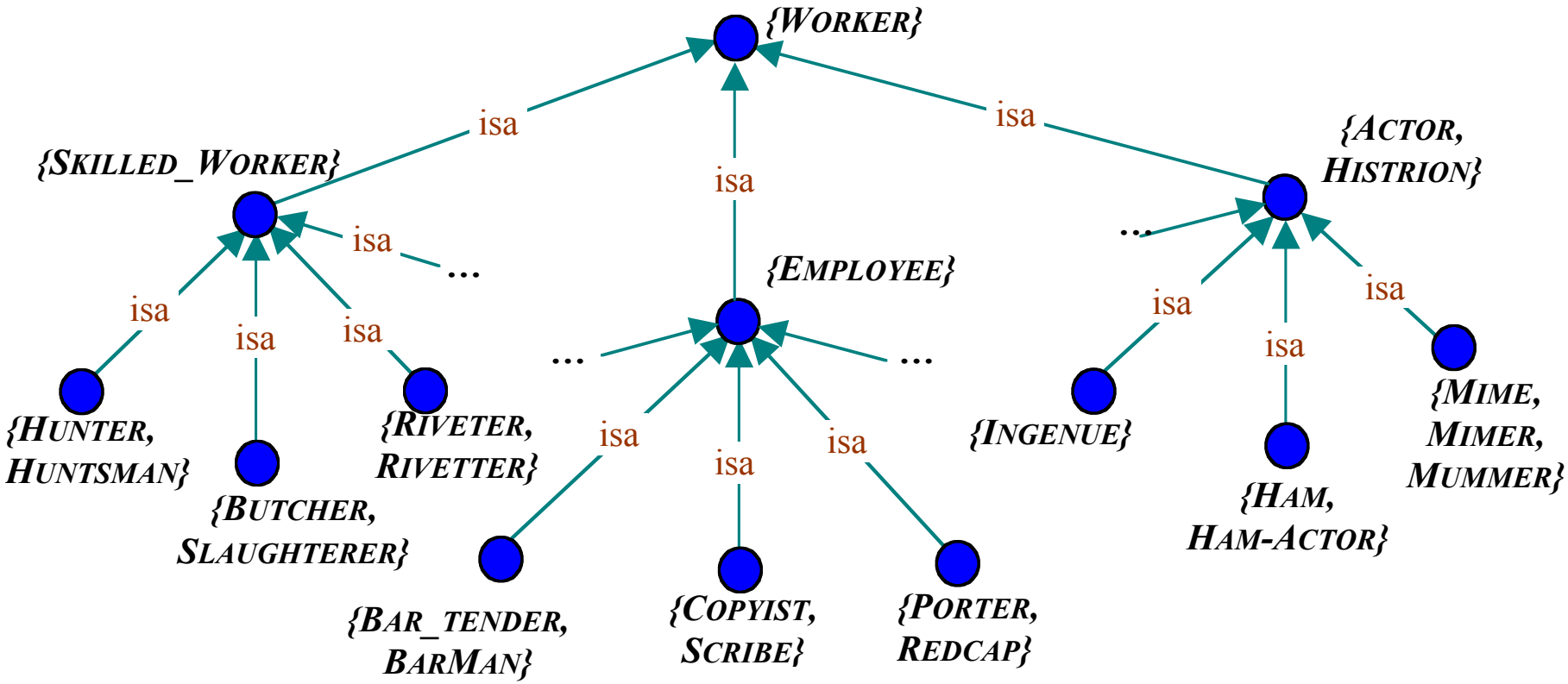
- **Function** — **Generative Lexicon**

  Classification based on designated function (cutting, covering, carrying, etc.)

- **Conventional Categories of Being** — **Types / Sorts**

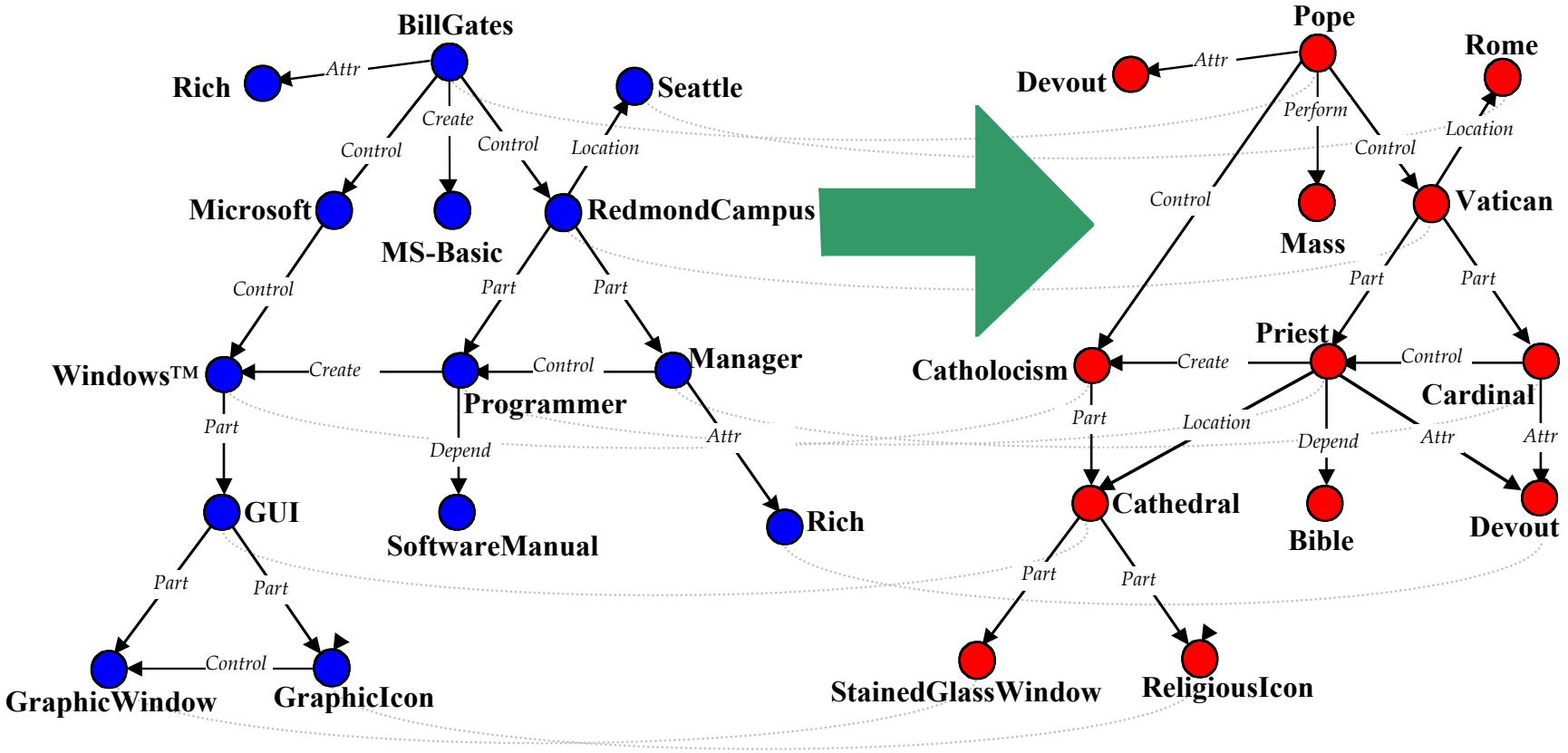
  Human, Artefact, Vehicle, Food, Container, Weapon, etc. as in WordNet

WordNet: A Lightweight Ontology of Lexical Concepts



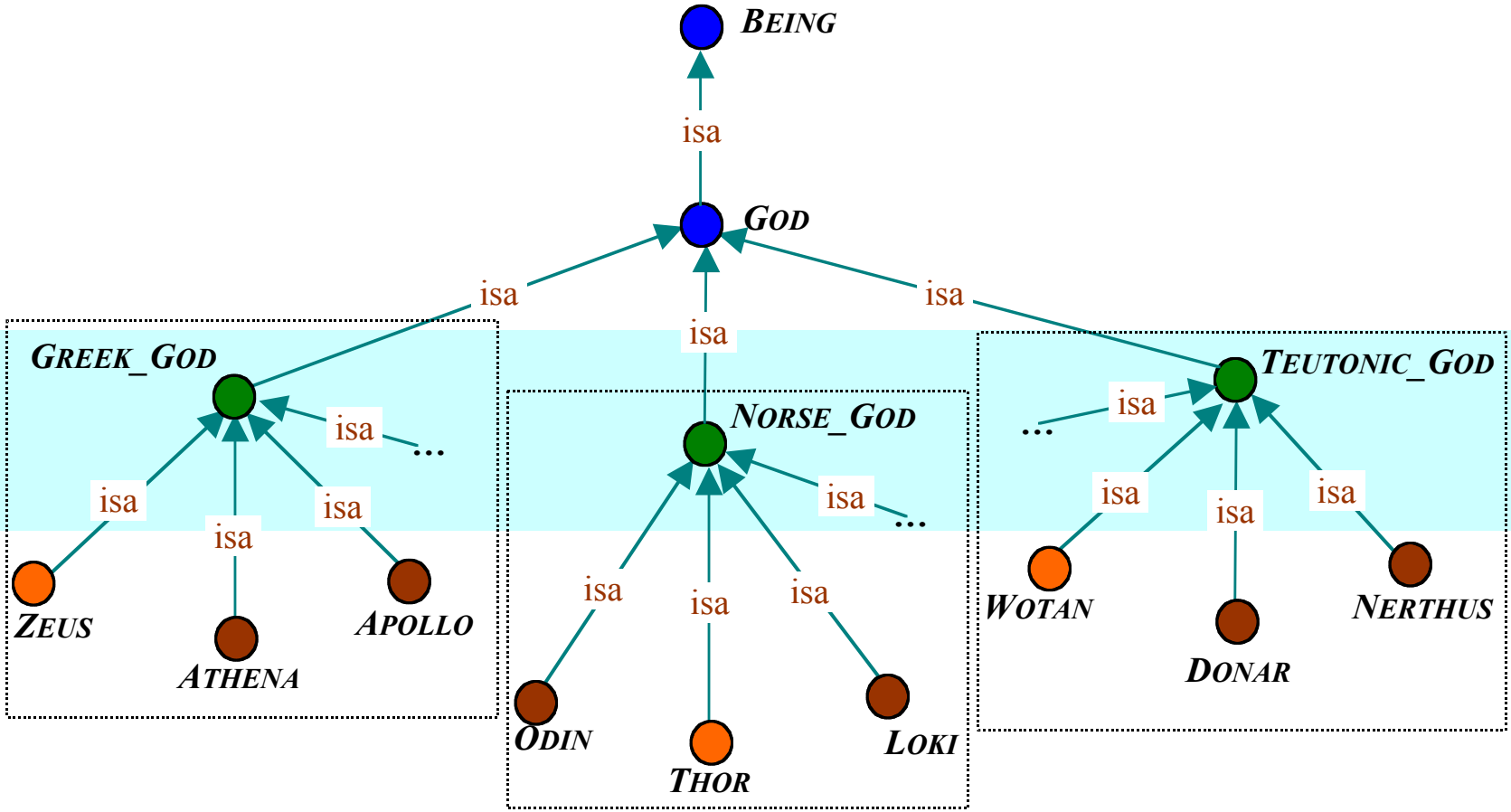
Concepts are SynSets (Synonym Sets) **Nouns hierarchy is organized by isa links**

Our Focus: Creative Analogy

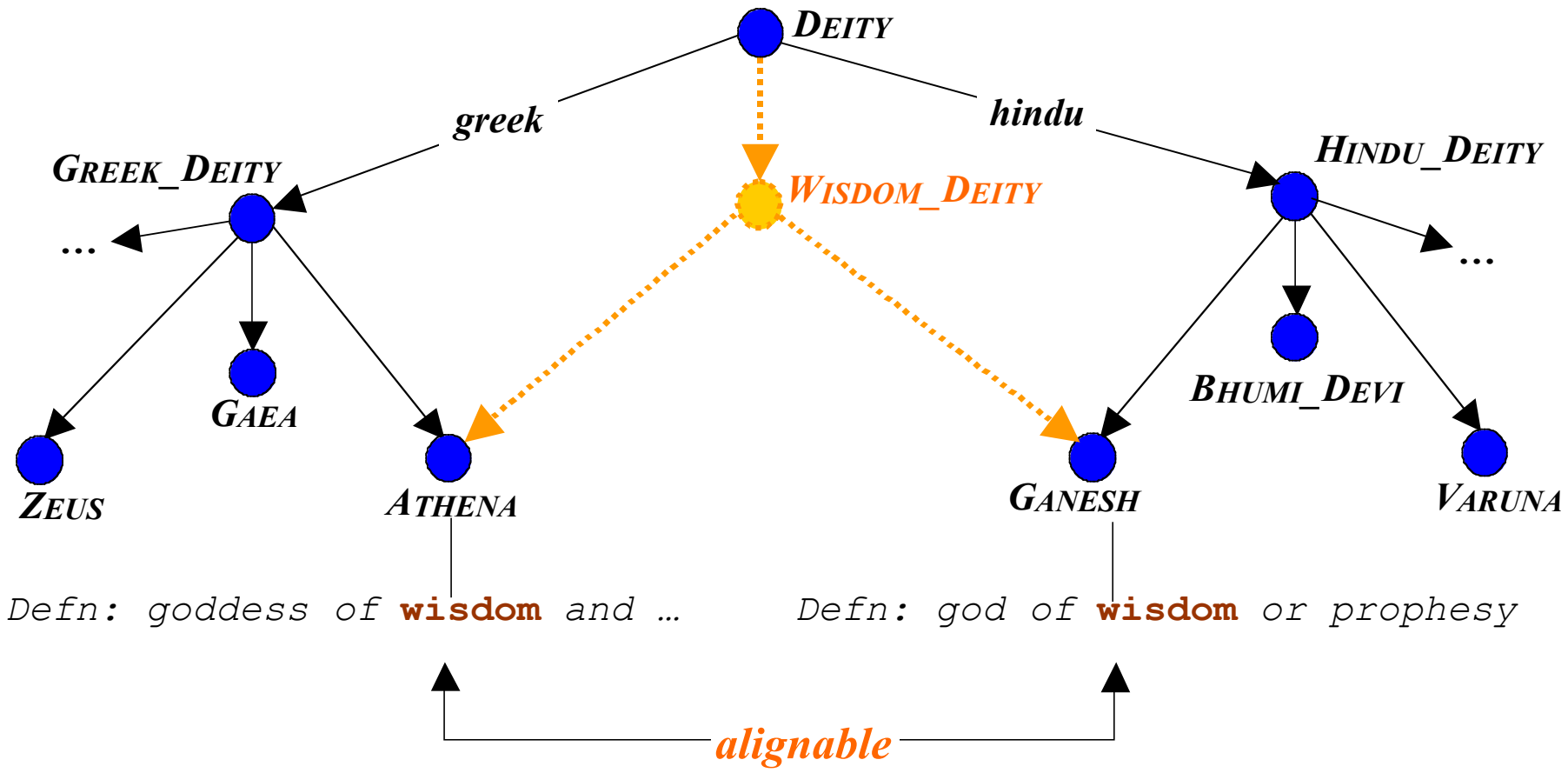


Relational-networks structure are connected using an isomorphic mapping

Taxonomic Analogy: Lack of Discriminating Structure



Avoiding Trivialization: Feature Reification in WordNet

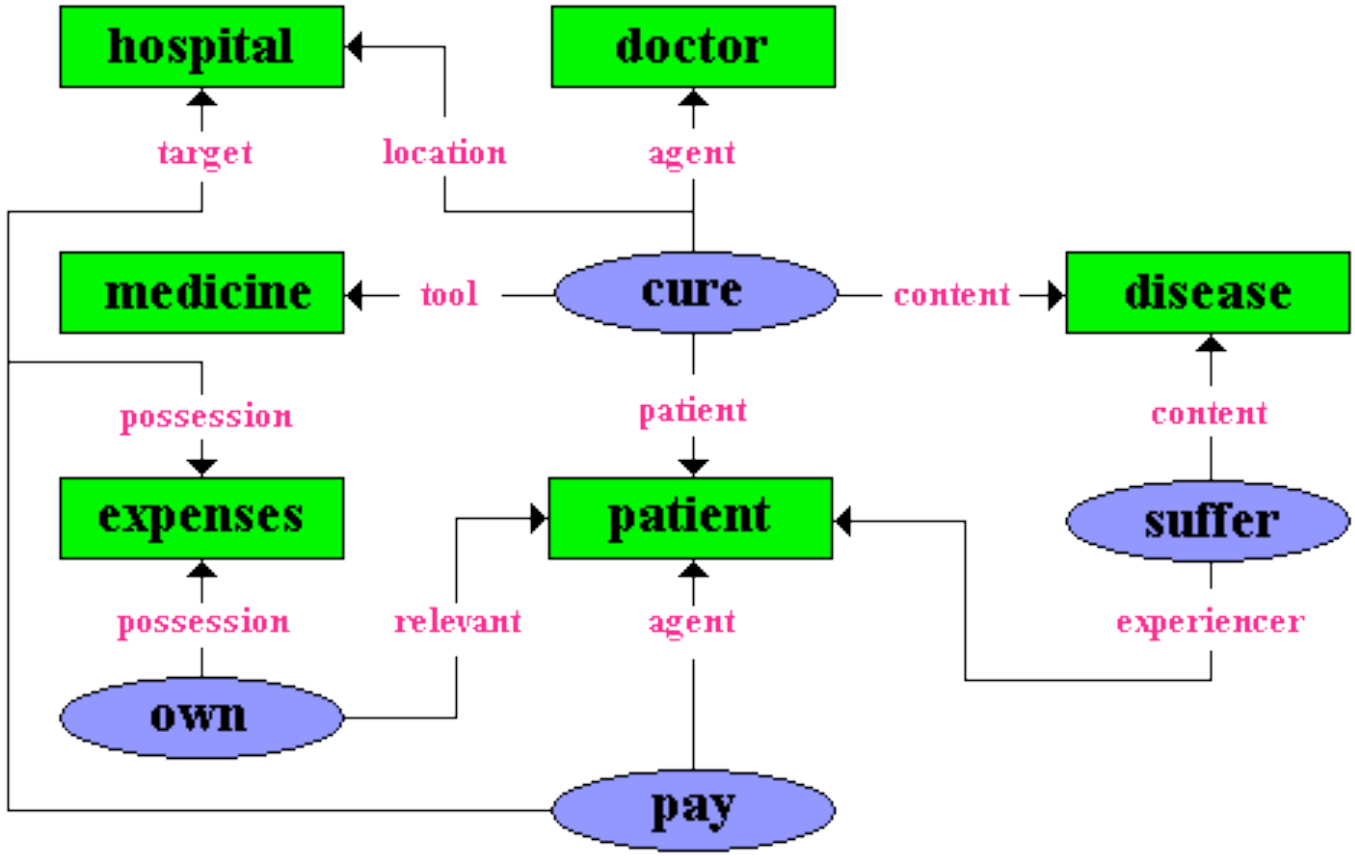


Empirical Evaluation: Analogical Retrieval with WordNet

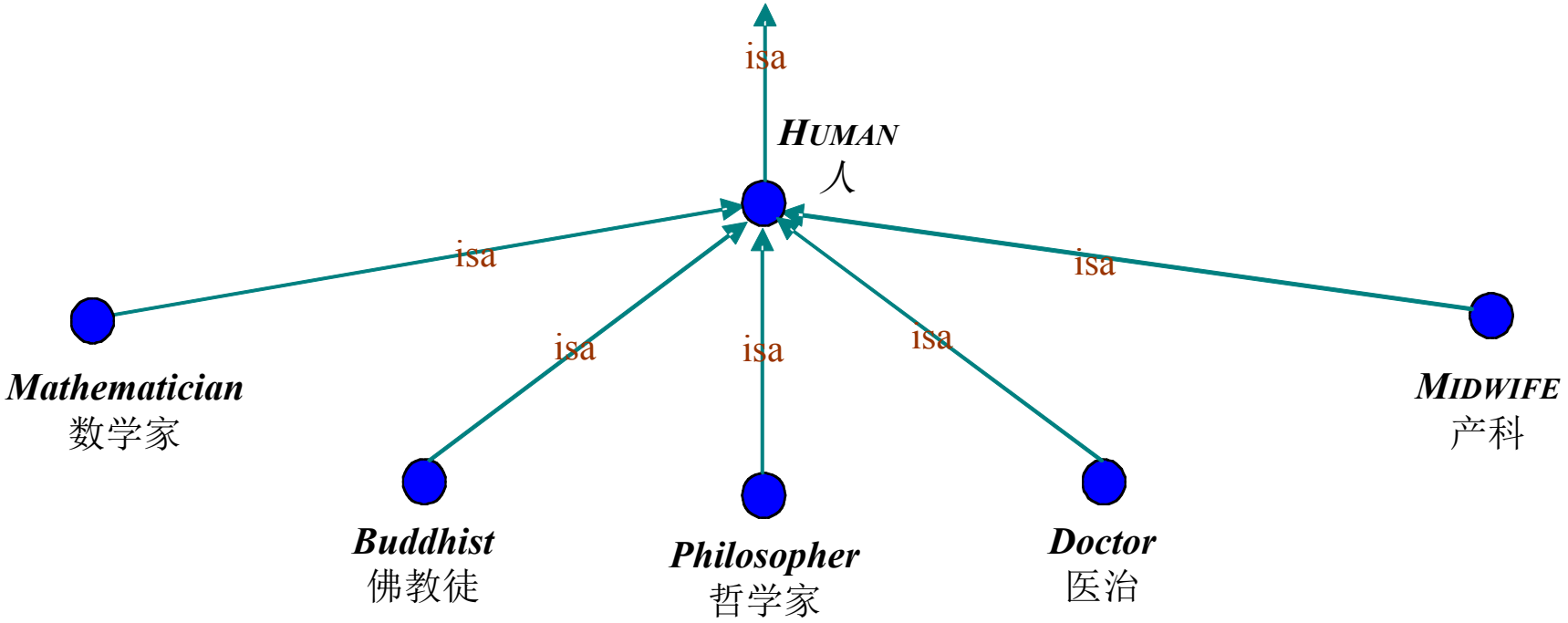
Deity to Deity Task	Precision	Recall
Static WN representations	***0.115***	***0.34***
Dynamic WN representation *(+ gloss-feature reification)*	***0.935***	***0.61***

Letter to Letter Task	Precision	Recall
Static WN representations	***0.04***	***0.98***
Dynamic WN representation *(+ gloss-feature reification)*	***0.96***	***0.98***

Conceptual Graph Structures in HowNet



Taxonomic Structure in HowNet



HowNet Semantics: A Bilingual Constructivist Ontology

HowNet is an English / Chinese ontology in which entries are semantically defined:

surgeon|医生

{human| 人:HostOf={Occupation}, domain={medical}},

*{**cure**|医治:agent={~}}*

repairman|修理工

{human|人:HostOf={Occupation}},

*{**repair**|修理:agent={~}}*

…

resume | 恢复

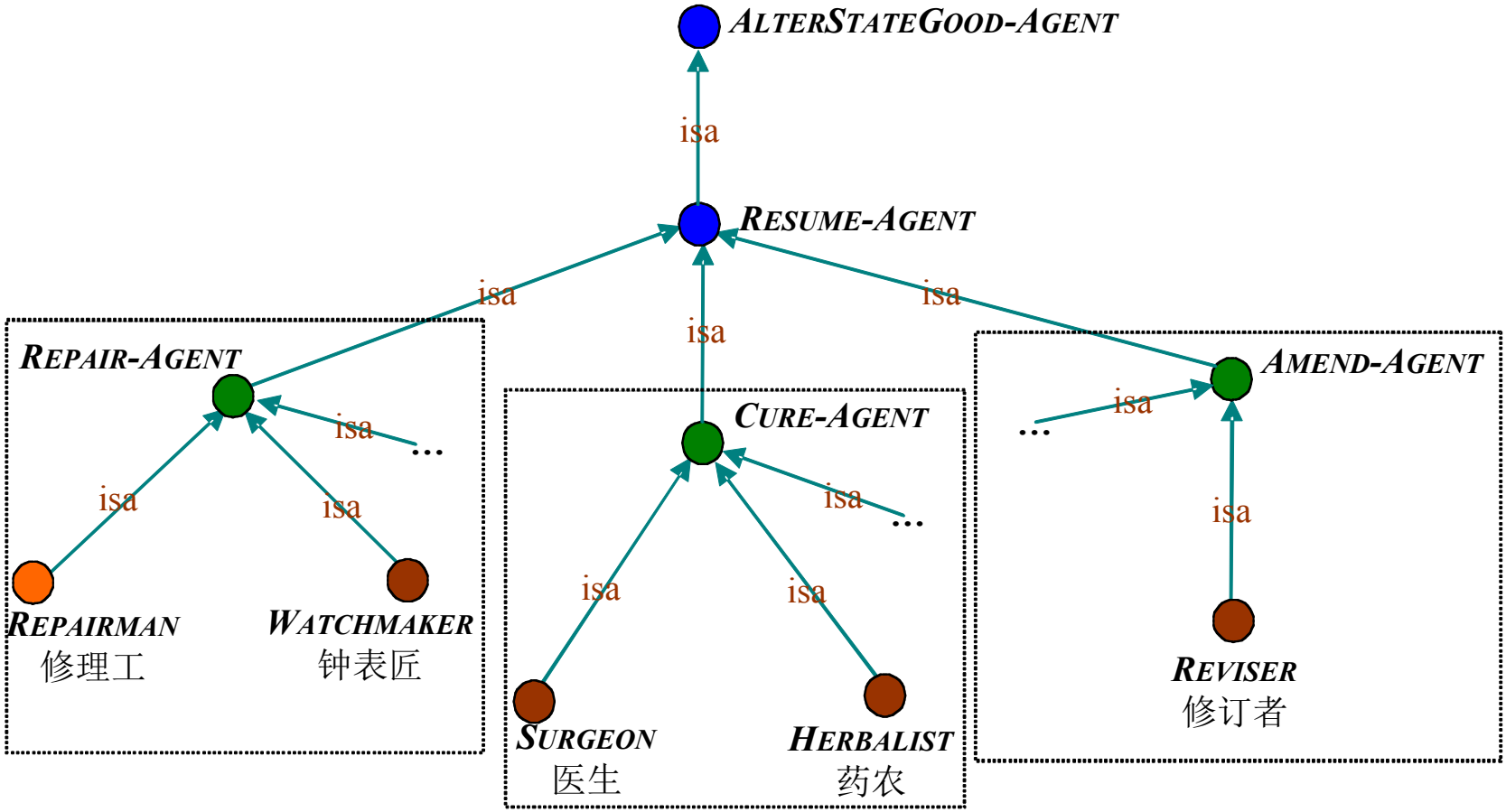
cure | *医治*

repair | *修理*

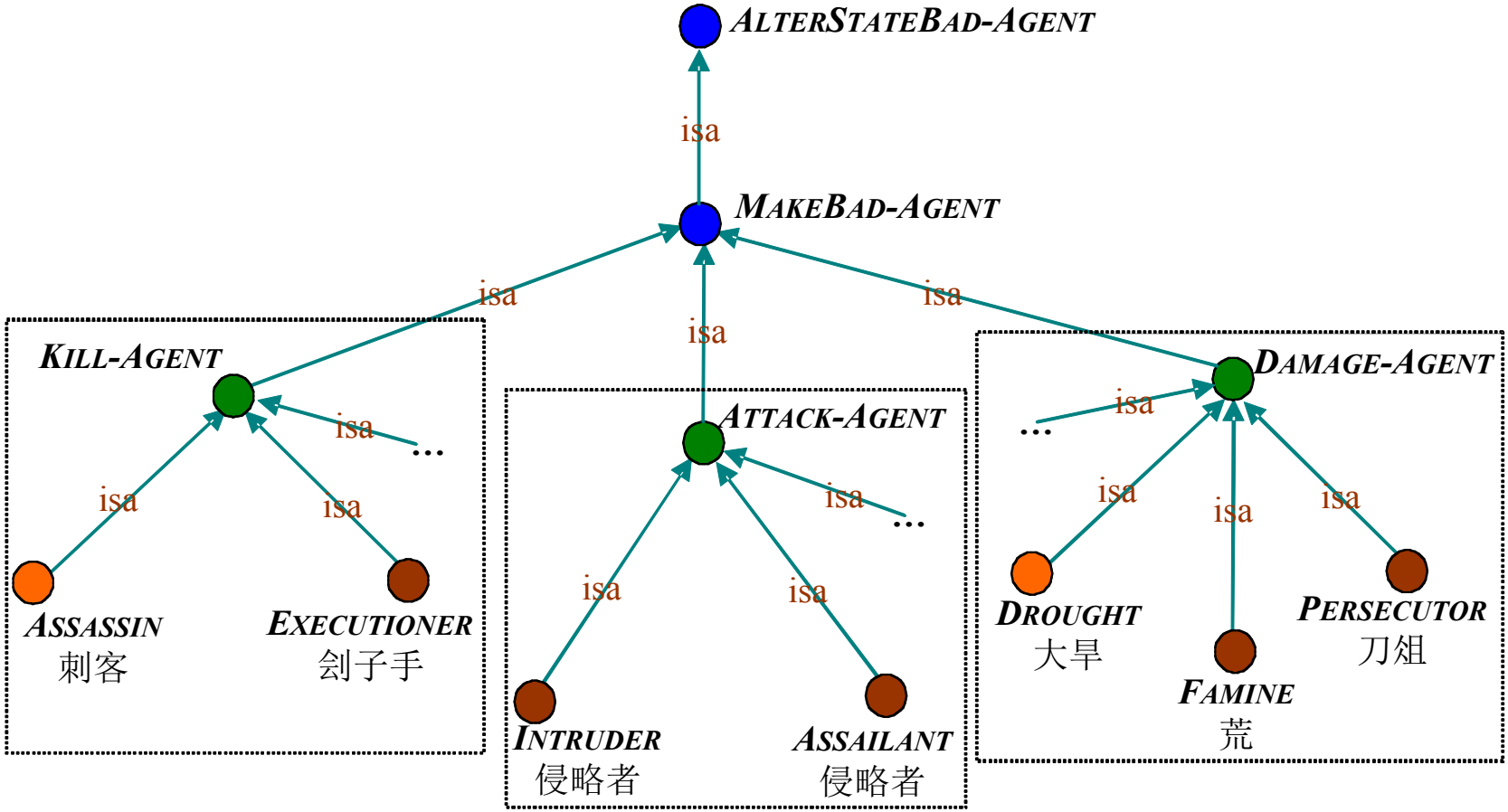
amend | 改正

…

Functional Abstraction in HowNet

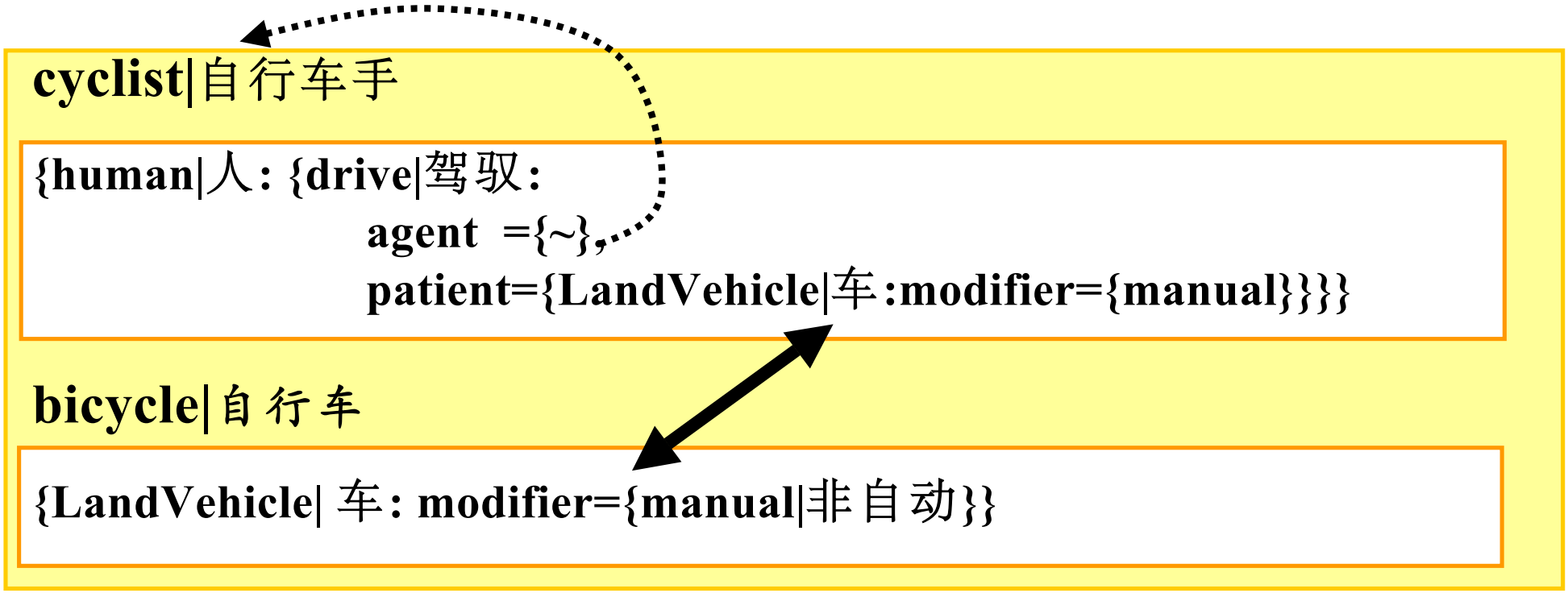


Functional Abstraction in HowNet



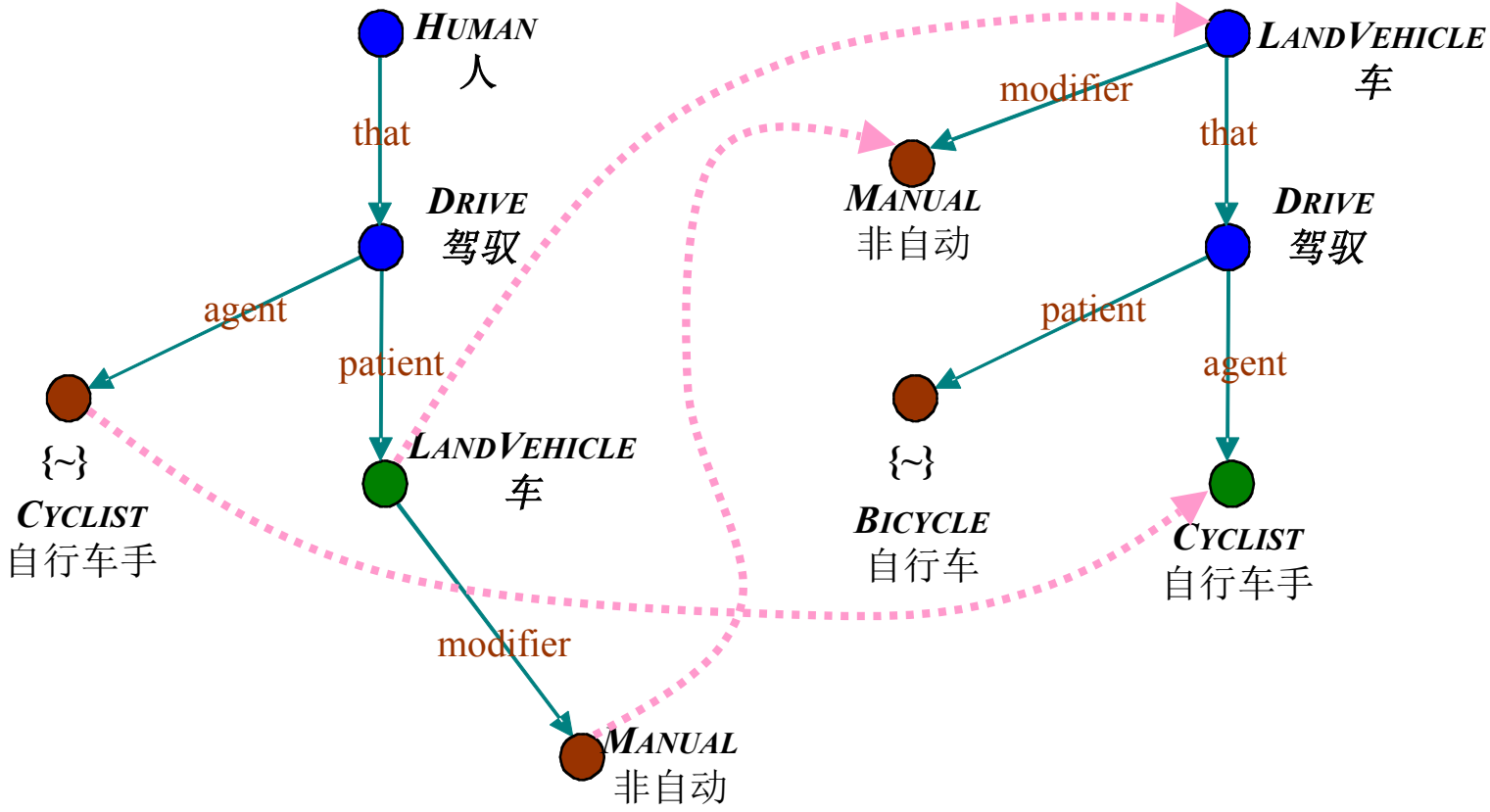
HowNet Semantics: Underspecified and Often Unstructured

HowNet is an English / Chinese ontology in which entries are semantically defined:



N.B. cyclist = (bicycle)自行车 (person good at job)手

Structural-Inversion: Converting one definition into another



Bicycle: {LandVehicle: {drive:agent={cyclist}, patient={~}}}

Characterizing HowNet for Analogical Reasoning

- **# unique structured definitions in HowNet** — **23,507**

These definitions are used to define 95,407 unique lexical entries

- **# of self-referencing structural definitions** — **6430 (27%)**

Functional Abstractions can only be derived from defns. containing **{~}**

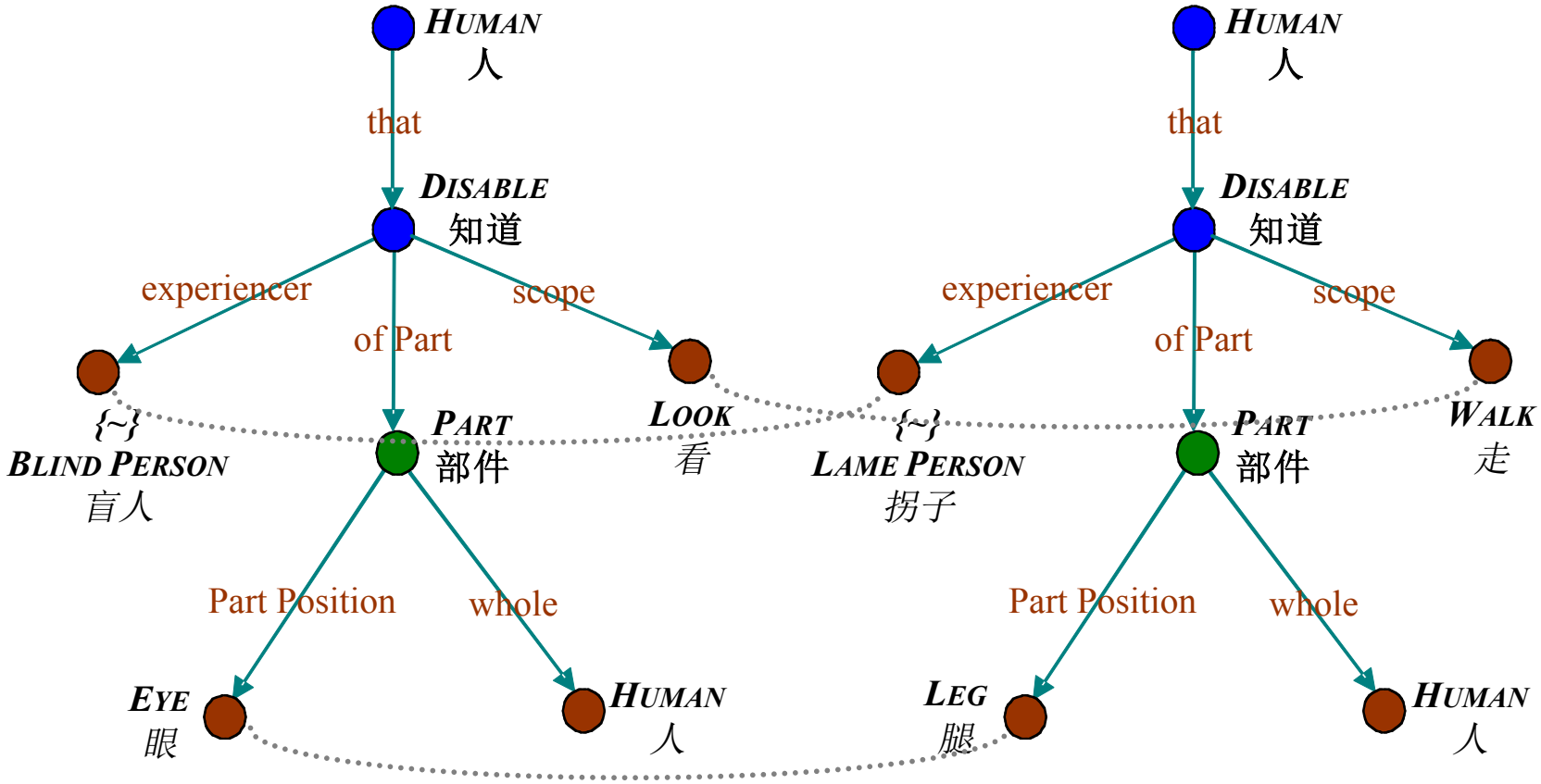
- **# unique structured definitions after inversion** — **24,514 (+4%)**

Structural inversion allows us to formulate ***new defns*** for a concept

- **# of self-referencing definitions after inversion** — **7437 (+15%)**

These definitions may be shared by a much greater # of concepts

Structure-Mapping in HowNet



Struct Hash: **{?:{ill|病态:OfPart={?},experiencer={~},scope={?}}}**

Characterizing HowNet for Analogical Reasoning

- **# unique structured definitions in HowNet** — **23,507**

These definitions are used to define 95,407 unique lexical entries

- **# of self-referencing structural definitions** — **6430 (27%)**

Functional Abstractions can only be derived from defns. containing **{~}**

- **# unique functional abstractions (*like KILL-AGENT*)** — **2219**

1 in 10 structured definitions contain just a hypernym or a domain tag.

- **# unique structural signatures / hashes** — **11,762**

These can be further generalized to yield multiple signatures per defn (***21159*** in all)

Analogical Generation: Abstraction vs. Structure-Mapping

	Abstraction	Structure-Mapping	Combined
Coverage	.27	.90	.90
Recall	.26	.61	**.72**
Parsimony	.59	.21	.24
Mapping Richness	1	2.48	2.24

Coverage: *% of HowNet concepts to which a non-trivial signature is **assigned***

Recall: *the ability to **retrieve** a non-trivial analogy for a given HowNet concept*

Parsimony: *% of **useful** signatures that index two or more different definitions*

Analogical Generation: Abstraction with Structure Inversion

	Abstraction	+ Structure Inversion	Added Effect
Coverage	.27	.31	+15%
Recall	.26	.30	**+15%**
Parsimony	.59	.59	0%

Coverage: *% of HowNet concepts to which a non-trivial signature is* ***assigned***

Recall: *the ability to* ***retrieve*** *a non-trivial analogy for a given HowNet concept*

Parsimony: *% of* ***useful*** *signatures that index two or more different definitions*

Conclusions

- **HowNet Semantics: good but underspecified and imbalanced**

  Analogical Recall / Parsimony measures are good measures of onto. fitness

- **Functional Abstraction**

  Potent analogical role, but fundamentally limited by use of self-reference **{~}**

- **Structure-Mapping**

  Works well with functional abstraction; may be seen as a form of abstraction

- **Application: The Analogical Thesaurus** **http://afflatus.ucd.ie**

  Allows a user to retrieve words and concepts using analogy and metonymy