

Ontologies and thesauri

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Overview

- 1 Ontology
- 2 Sāṅkhya ontology
- 3 Vaiśeṣika ontology
- 4 Amarakoṣa
- 5 Problems with extending Vaiśeṣika ontology
- 6 Semantic networks

Ontology

- Ontology is the study of existence, of all the kinds of entities—abstract and concrete—that make up the world.
- The subject of ontology is the study of the categories of things that exist or may exist in some domain. (Sowa 2000: 492)
- The two sources of ontological categories are observation and reasoning. Observation provides knowledge of the physical world, and reasoning makes sense of observation by generating a framework of abstractions called *metaphysics*.
- A choice of ontological categories is the first step in designing a database, a knowledge base, or an object-oriented system

Sowa, John, 2000, *Knowledge representation: logical, philosophical, and computational foundations*, (Brooks Cole) p. 51

Aristotelean ontology

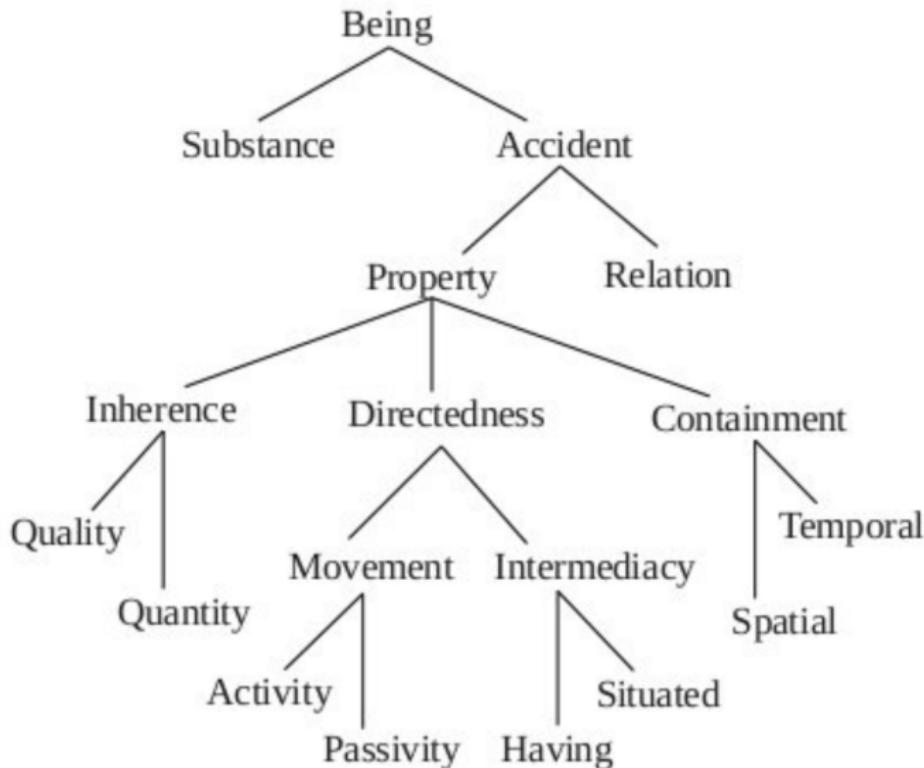
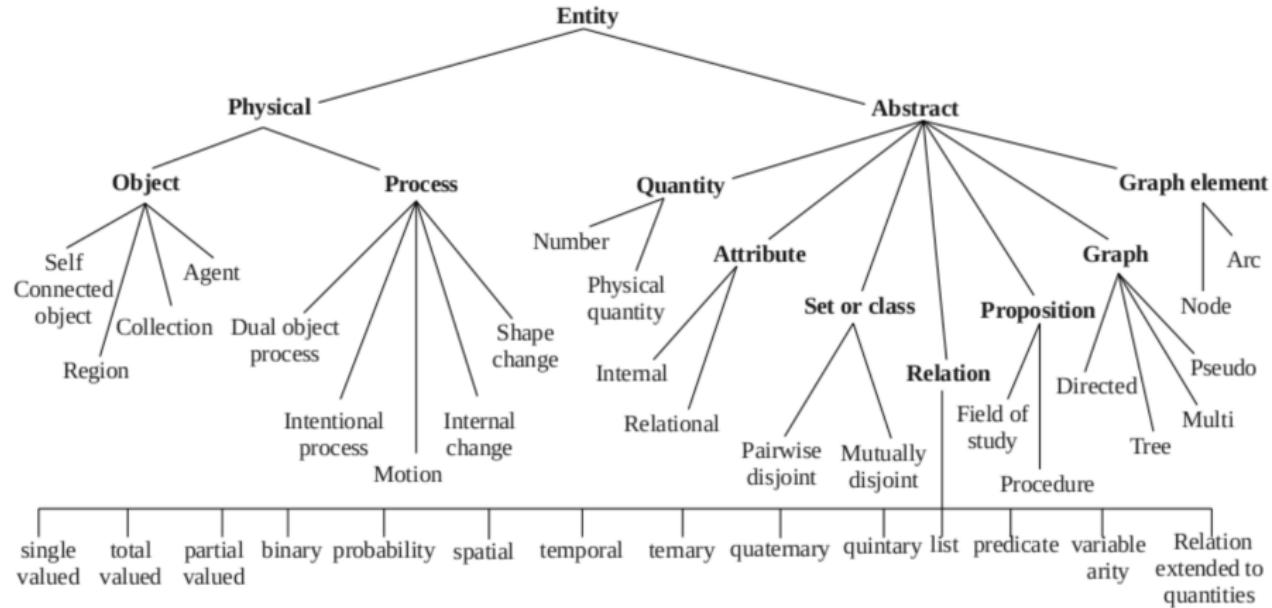


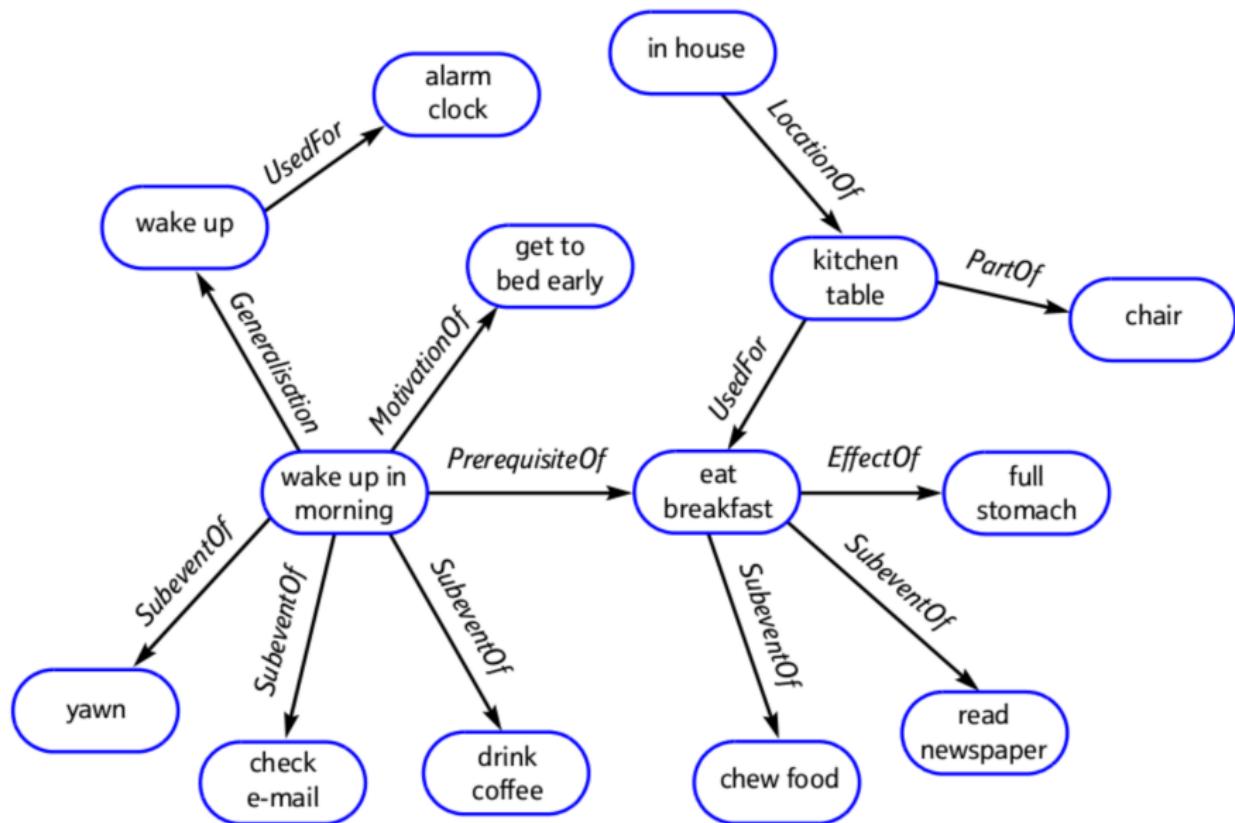
Figure: Franz Brentano. 1862.

Suggested upper merged ontology (SUMO)



Nair 2011: 72

ConceptNet



Overview

1 Ontology

2 Sāṅkhya ontology

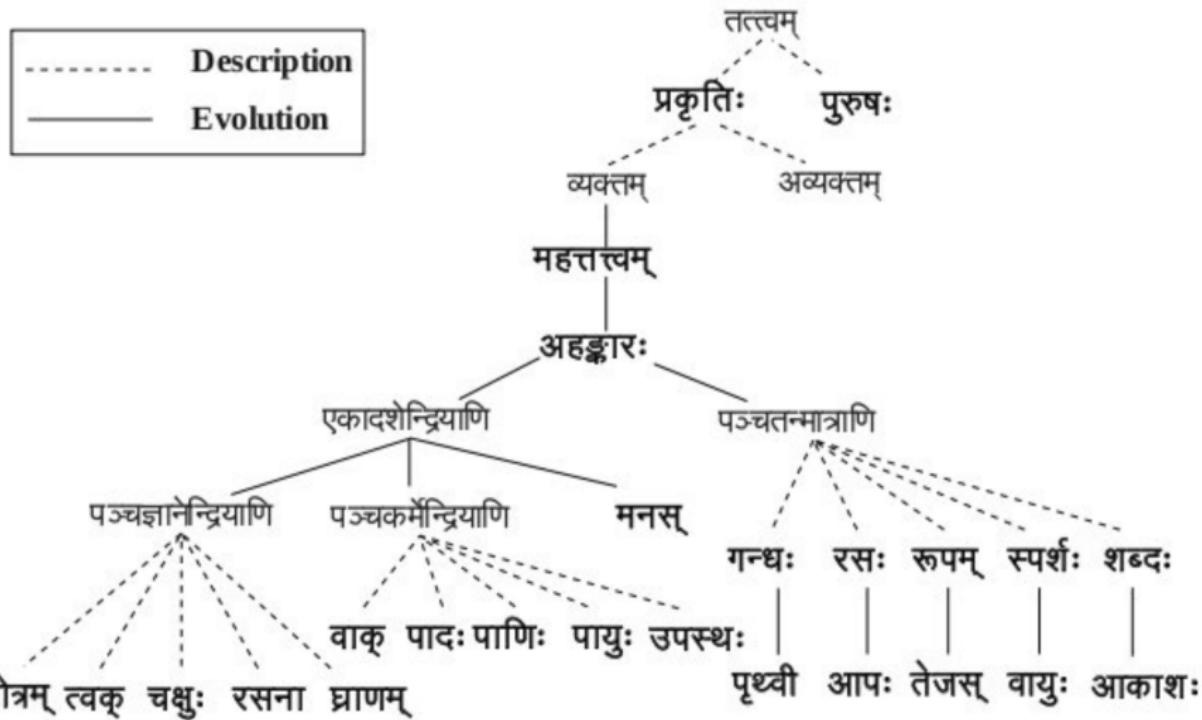
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Sāṅkhya ontology



Nair 2011: 69

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Vaiśeṣika ontology

- ① substance (*dravya*)
- ② quality (*guṇa*)
- ③ action (*kriyā*)
- ④ generic property (*sāmānya*)
- ⑤ individuality (*viśeṣa*)
- ⑥ inherence (*samavāya*)
- ⑦ absence (*abhāva*)

Substance (*dravya*)

- ① earth (*pr̥thivi*)
- ② water (*ap*)
- ③ fire (*tejas*)
- ④ air (*vāyu*)
- ⑤ empty space (*ākāśa*)
- ⑥ time (*kāla*)
- ⑦ direction (*dik*)
- ⑧ pure consciousness (*ātman*)
- ⑨ focal point of attention (*manas*)

Quality (*guna*) I

- ① sight (*rūpa*)
- ② taste (*rasa*)
- ③ smell (*gandha*)
- ④ touch (*sparsā*)
- ⑤ number (*sankhyā*)
- ⑥ measure (*parimāna*)
- ⑦ separation (*prthaktva*)
- ⑧ conjunction (*samyoga*)
- ⑨ division (*vibhāga*)
- ⑩ furtherhood (*paratva*)
- ⑪ nearness (*aparatva*)
- ⑫ heaviness (*gurutva*)
- ⑬ liquidity (*dravatva*)

Quality (*guna*) II

- ⑯ viscosity (*sneha*)
- ⑰ sound (*śabda*)
- ⑯ intelligence (*buddhi*)
- ⑰ sorrow (*duḥkha*)
- ⑯ happiness (*sukha*)
- ⑯ desire (*icchā*)
- ⑯ aversion (*dveṣa*)
- ⑯ effort (*prayatna*)
- ⑯ merit (*dharma*)
- ⑯ demerit (*adharma*)
- ⑯ refinement (*saṃskāra*)

Motion (*kriyā*) I

- ① throwing up (*utkṣepaṇa*)
- ② throwing away (*apakṣepaṇa*)
- ③ contraction (*ākuñcana*)
- ④ expansion (*prasāraṇa*)
- ⑤ locomotion (*gamana*)

Generic properties versus attributes

- A generic property (*jāti*) is the essential property of a thing.
- An attribute (*upādhi*) any other characteristic feature.

Features that prevent an attribute from being a generic property (*jātibādhaka*) I

- ① singularity (*vyaktyabheda*), e.g. spacehood (*ākāśatva*)
- ② equivalence (*tulyatva*), e.g. potness (*ghaṭatva*) and jugness (*kalaśatva*)
- ③ mixture (*saṅkara*), e.g. being an element (*bhūtatva*) is in the five elements, shape (*mūrtatva*) is in the four common elements and manas
- ④ infinite regress (*anavasthiti*), e.g. universality (*jātitva*) in universals
- ⑤ self-contradiction (*rūpahāni*), e.g. particularity in particularities would make them fail to be unique
- ⑥ baselessness (*asambandha*), e.g. inherencehood (*samavāyatva*), absencehood (*abhbāvatva*)

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Bibliography

- Sivaja Nair. “The Knowledge Structure in Amarakośa.” Phd. diss. University of Hyderabad. Hyderabad: Department of Sanskrit Studies, 2011.
- Sivaja Nair. “Extended Nyāya-Vaiśeṣika ontology as applied to Amarakośa KnowledgeNet.” *EProceedings of the 5th International Sanskrit Computational Linguistics Symposium, IIT Bombay, 4–6 January 2013*
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- Amarasiṁha composed the *Nāmalingānuśāsana* in the fourth century CE
- 1608 verses in Aanuṣṭubh meter in 3 chapters (*kāṇḍa*).
- 26 commentaries on the complete work
- 48 commentaries on an abridged version
- Sivaja Nair's Knowledge-Net: <http://sanskrit.uohyd.ac.in/scl/amarakosha/index.html>

Amarakośa structure

- content words: 11,580 tokens, 9,031 types
- sets of synonyms
- polysemous words
- lexical relations
- semantic relations
 - hierarchichal
 - associative

Lexical relations

- synonymy
- antonymy
- pertainymy, e.g. bicentennial pertains to centennial, which pertains to century; animatedly pertains to animated

Hierarchical semantic relations

- ① hypernym-hyponym: class-subclass (*parāparājāti*)
- ② holonym-meronym: whole-part (*avayavāvayavī*); includes:
 - ① constituents, e.g. paper consists of cellulose
 - ② member, e.g. an island is a member of an archipelago
 - ③ parts, e.g. a chapter is a part of a book
- ③ troponym: manner of engaging in an activity, e.g. limping is a manner of walking
- ④ entailment: included within an activity, e.g. snoring in sleeping so snoring entails sleeping
- ⑤ attribute: that of which x is a value
- ⑥ similarity of one adjective to another, e.g. {last, past}, {last, dying}

Associative semantic relations

- ① child-parent (*janyajanakabhāva*): father, son, grandson
- ② husband-wife (*patipatnībhāva*)
- ③ brother (*bāndhava*)
- ④ property-owner (*svasvāmibhāva*): charioteer, minister, vehicle, weapons, ornaments
- ⑤ profession-livelihood (*ājīvikā*)
- ⑥ substrate-attribute (*ādhārādheya*)
- ⑦ lineage-member (*vamśavamśīya*)

First chapter *Prathamākāṇḍa*

Ten chapters (*varga*)

- ① svarga ‘heaven’
- ② vyoman ‘sky’
- ③ dig ‘direction’
- ④ kāla ‘time’
- ⑤ dhī ‘cognition’
- ⑥ śabda ‘sound’
- ⑦ nāṭya ‘drama’
- ⑧ pātālabhogin ‘dweller in the nether world’
- ⑨ naraka ‘hell’
- ⑩ vāri ‘water’

Second chapter *Dvitiyākānda*

Ten chapters (*varga*)

- ① bhūmi 'earth'
- ② pura 'city'
- ③ śaila 'mountain'
- ④ vanauṣadhi 'forest and herb'
- ⑤ simhādi 'lions, etc.'
- ⑥ manusya 'mankind'
- ⑦ brahman 'scholars'
- ⑧ kṣatriya 'rulers'
- ⑨ vaiśya 'businessmen'
- ⑩ śūdra 'laborers'

Third chapter *Trtīyākāṇḍa*

Ten chapters (*varga*)

- ① viśeṣyanighna ‘adjectives’
- ② śaṅkīrṇa ‘miscellaneous’
- ③ nānārtha ‘polysemous’
- ④ avyaya ‘indeclineables’
- ⑤ liṅgādisaṅgraha ‘gender’

Viṣṇu

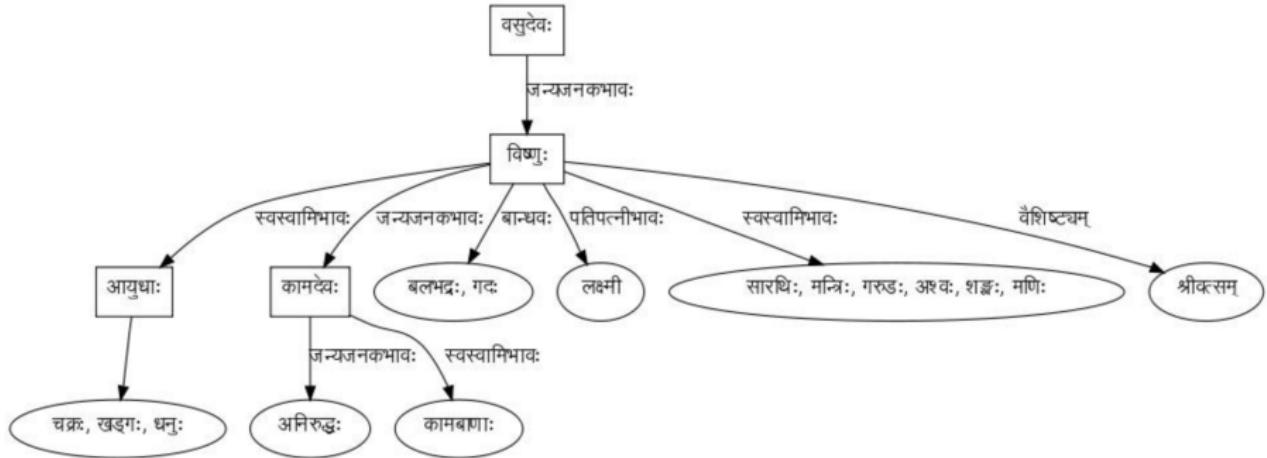


Figure: Relations of Viṣṇu

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Amarakośa semantic classification

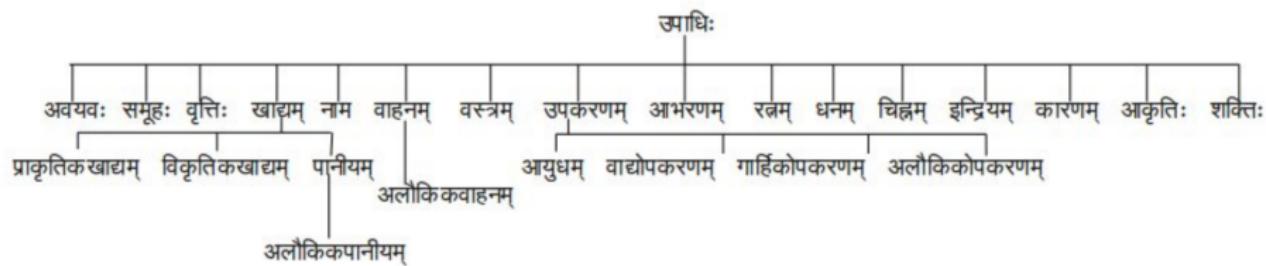


Figure: Semantic classes subordinated to upādhi ‘attribute’

Problems with the extention of Vaiśeṣika ontology

- “All those words which we could not classify are classified under śesah.” (Nair 2011: 77)
- “Further sub-classified three [dravyas]” (Nair 2011: 77–78)
 - earth (*pr̥thivī*) source of class structure?
 - fire (*tejas*) "
 - soul (*ātman*) "
- The plant world is also classified according to the modern science only.
- While Vaiśeṣika differentiates the ultimate universal (*sattā* ‘existence’) from subordinate essential properties (*aparajāti*), Sivaja differentiates *jāti* ‘essential property’ and *avasthā* ‘condition’

Subclasses of earth (*prthivi*)

Source of class structure?

- living/non-living (*sajīva/ajīva*)
- animate/inanimate (*cala/acala*)
- worldly/celestial (*laukika/alaukika*)

Subclasses of living (*sajīva*): animate (*cala*)

Source of class structure?

- human (*manuṣya*)
- non-human (*manuṣyetara*)
- conscious celestial (*alaukikacetana*)

Subclasses of non-human (*manuṣyetara*)

Mixed classes:

- “non-human living being” (*jantu*) (Nair 2011: 80)
- celestial (*alaukikaprāṇin*)

Subclasses of non-human (*jantu*)

Source of classification?

- water (*jalīya*)
- water and earth (*ubhayacara*)
- reptiles (*sarīṣṛpa*)
- mammals (*stanapāyin*)
- birds (*pakṣin*)
- insects (*kīṭa*)

Vaiśeṣika subclasses of fire (*tejas*)

- earthly (*bhauma*)
- divine (*divya*)
- digestive (*udarya*)
- precious stones and metals (*ākaraja*)

Sivaja's subclasses of fire (*tejas*)

Source of classification?

- “*Bhauma tejas* will go under the node *tejas*.”
- “*divya tejas* is divided into two according to our necessity as *nakzatram* and *grahah*.”
- “Examples of *udarya tejas* is not available in *Amarakośa* so this class is totally avoided.”
- “*ākaraja* is named as (*dhātu*).”

Vaiśeṣika subclasses of self (*ātman*)

- individual self (*jīvātman*)
- universal self (*paramātman*)

Sivaja's subclasses of self (*ātman*)

Source of classification: Purāṇas

- lord (*īśvara*) including just Brahmā, Viṣṇu, and Maheśvara
- deity (*devatā*) including all other gods
- seer (*r̥si*) sages including Buddha
- divine offspring (*devayoni*)

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Senamtic networks

- ① WordNet <https://wordnet.princeton.edu>
- ② EuroWordNet
- ③ MultiWordNet
<http://multiwordnet.fbk.eu/english/home.php>
- ④ VerbNet <http://verbs.colorado.edu>
- ⑤ Cyc knowledge base <http://www.cyc.com>
- ⑥ ConceptNet <http://conceptnet.io>
- ⑦ PropNet
<https://github.com/materialsintelligence/propnet>
- ⑧ FrameNet
<https://framenet.icsi.berkeley.edu/fndrupal/>

Thank you for your attention.

Questions?