

COMP318

Ontologies and Semantic Web

Ontology based information systems - Part 1



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Why do we need ontologies

- Ontologies provide a common vocabulary and definition of rules defining the use of the terms by independently developed resources, processes, services
- That means....



An example

42

An example

42

The password for a Microsoft Windows domain will expire by default after 42 days

Answer to the Ultimate Question of Life, the Universe, and Everything

A track in the 2008 Coldplay album Viva la vida

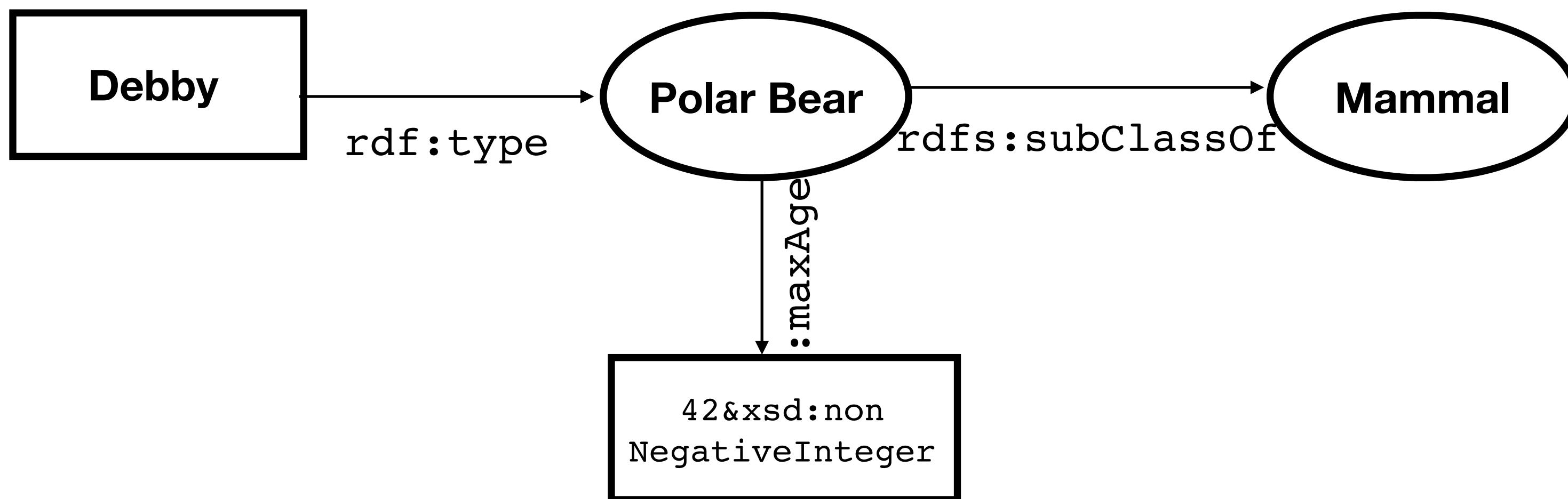
The angle (rounded to whole degrees) for which a rainbow appears

An example

42 years

An example

- Max recorded age for a polar bear in captivity
 - The oldest polar bear on record was Debby, who died at Assiniboine Park Zoo, Canada, in 2008 aged 42

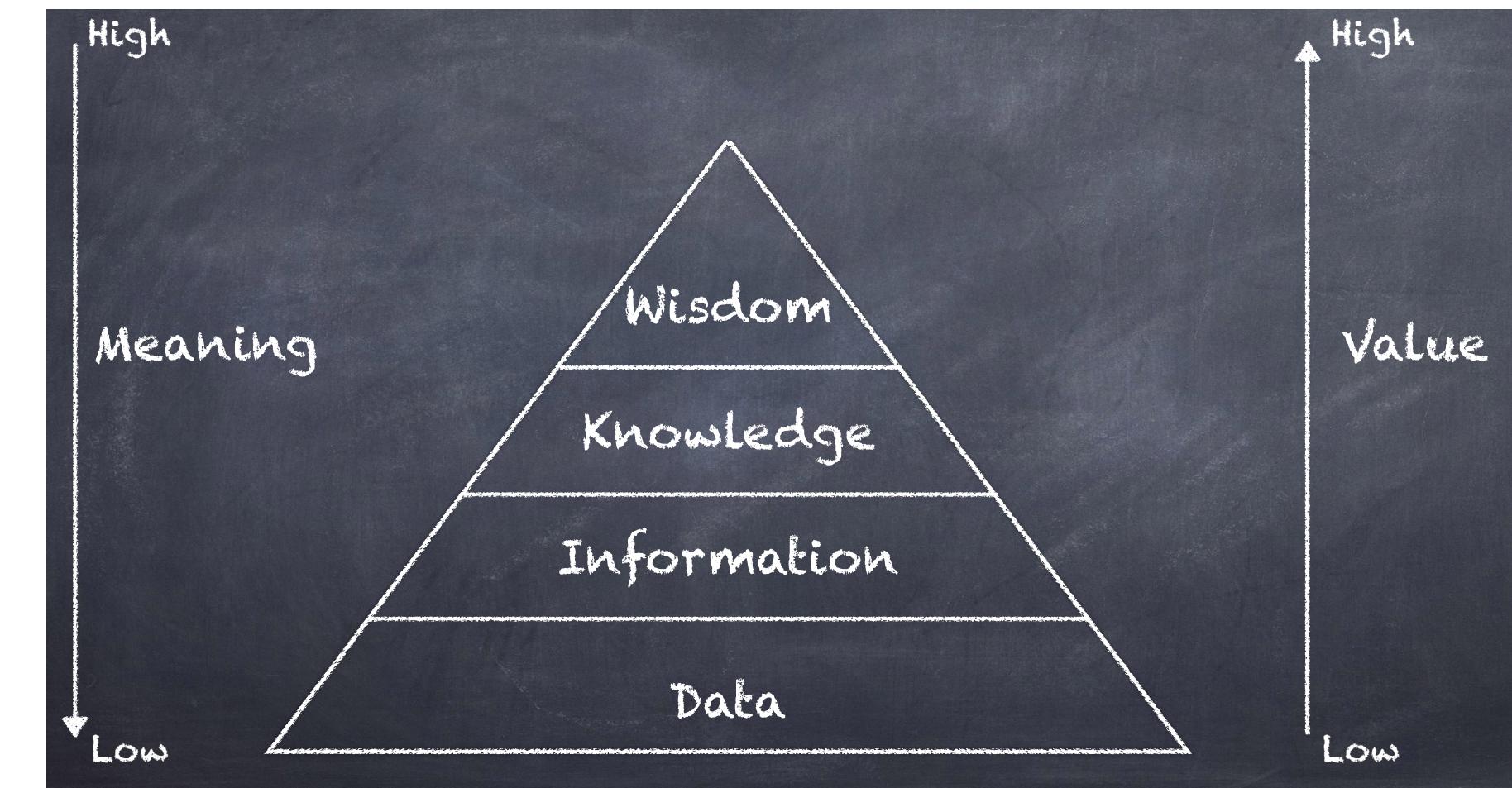


Class: PolarBear SubClassOf: Mammal and maxAge only 42



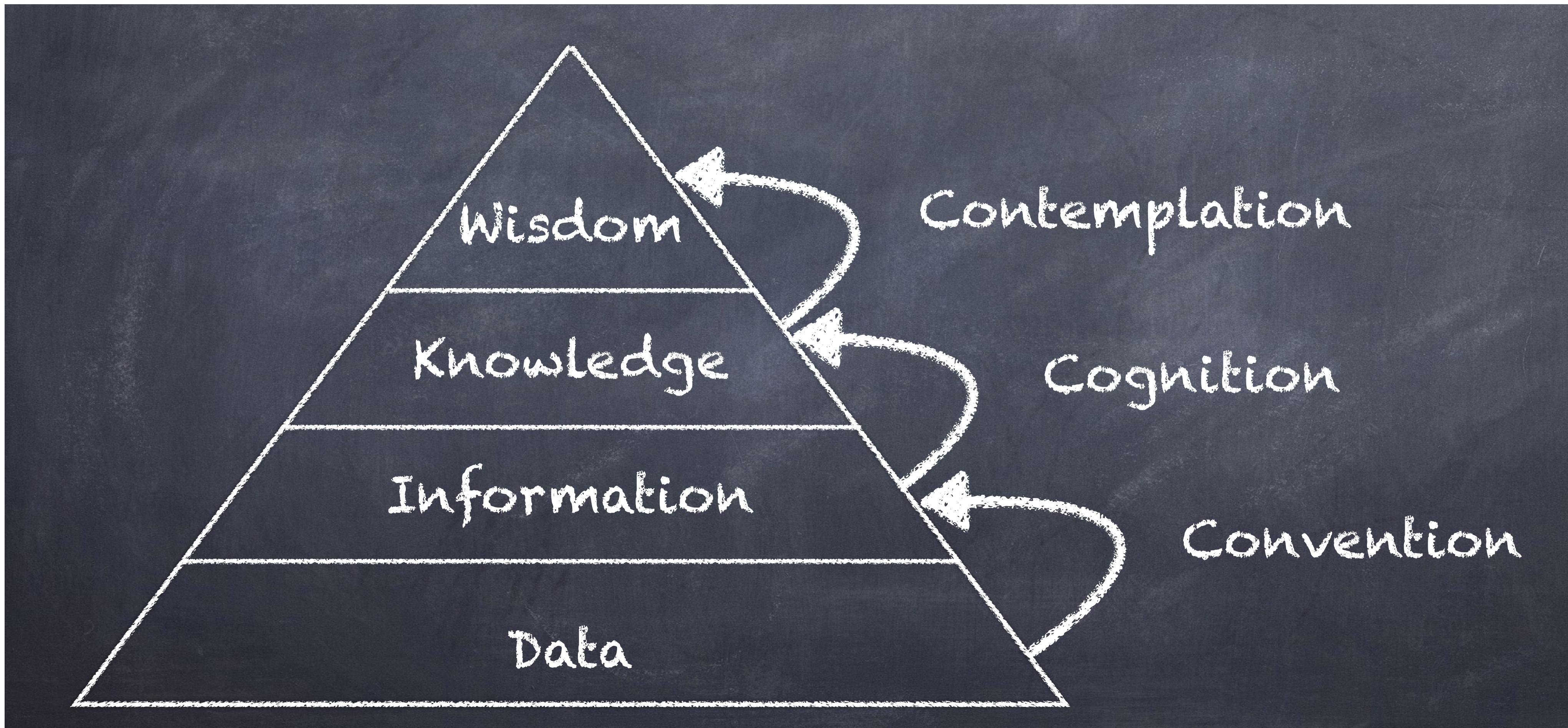
DIKW model

- **Data:** unorganised and unprocessed discrete, objective facts or observations
 - have no meaning or value because of lack of context and interpretation (e.g. raw data)
- **Information:** organised or structured data, processed in such a way that the information now has relevance for a specific purpose or context
 - meaningful, valuable, useful and relevant
 - that which reduces uncertainty (Shannon)
- **Knowledge:** Different perspectives:
 - a mix of contextual information, values, experience and rules;
 - know-how;
 - information combined with understanding and capability;
 - belief structuring" and "internalization with reference to cognitive frameworks
- **Wisdom:** the knowledge and insights into a learning experience that guides our actions
 - evaluated understanding

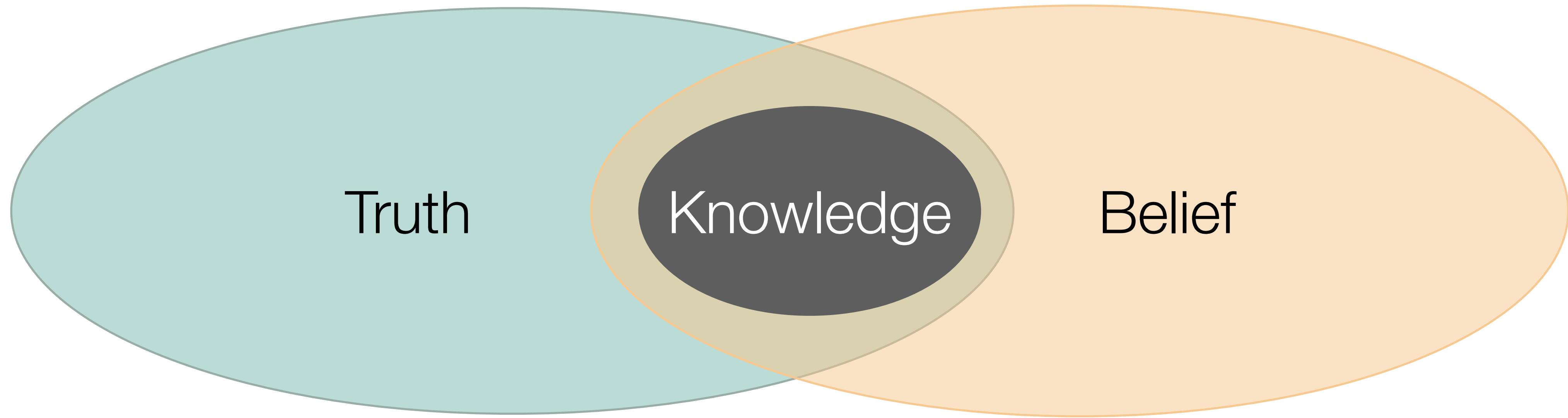


"Big data is not knowledge"
Y. Frégnac, Science 358, 6362 (2017)

DIKW model



What is knowledge



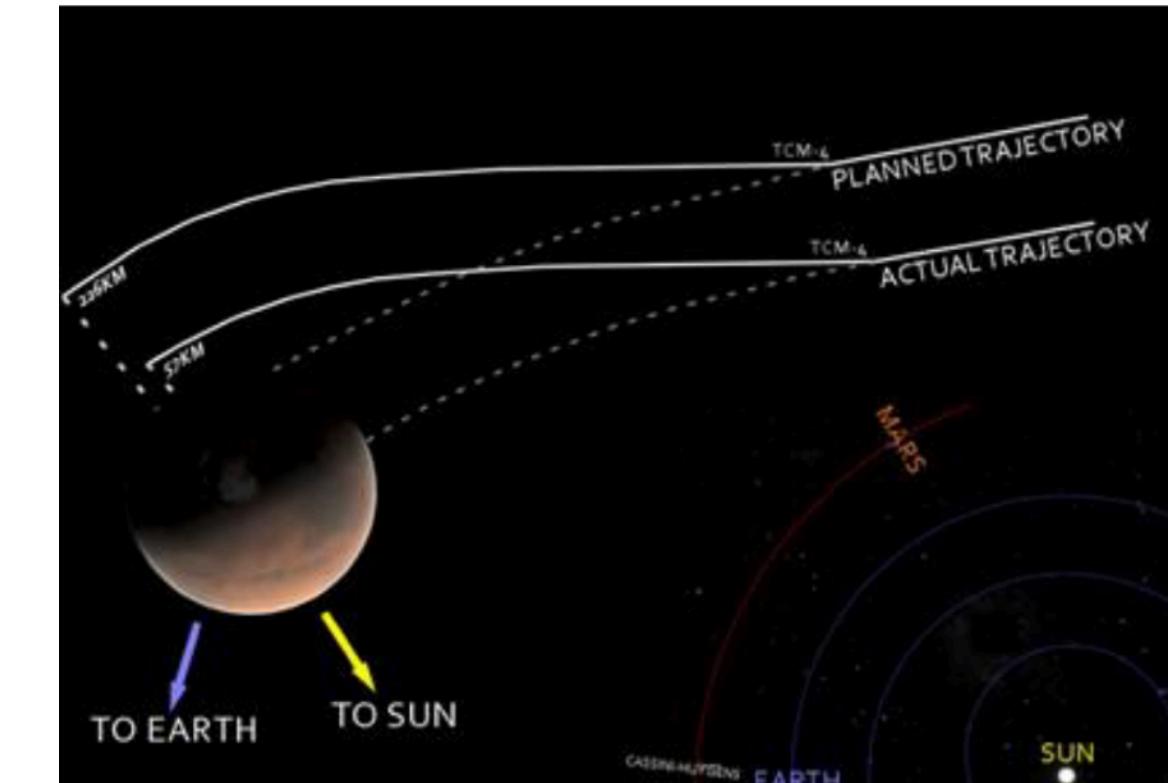
Knowledge sharing

- Sharing knowledge depends on having:
 - common symbols and concepts (**Syntax**)
 - agreement about their meaning (**Semantics**)
 - classification of concepts (**Taxonomy**)
 - associations and relations of concepts (**Thesauri**)
 - rules and knowledge about which relations are allowed and make sense (**Ontologies**)



NASA and ontology standardisation

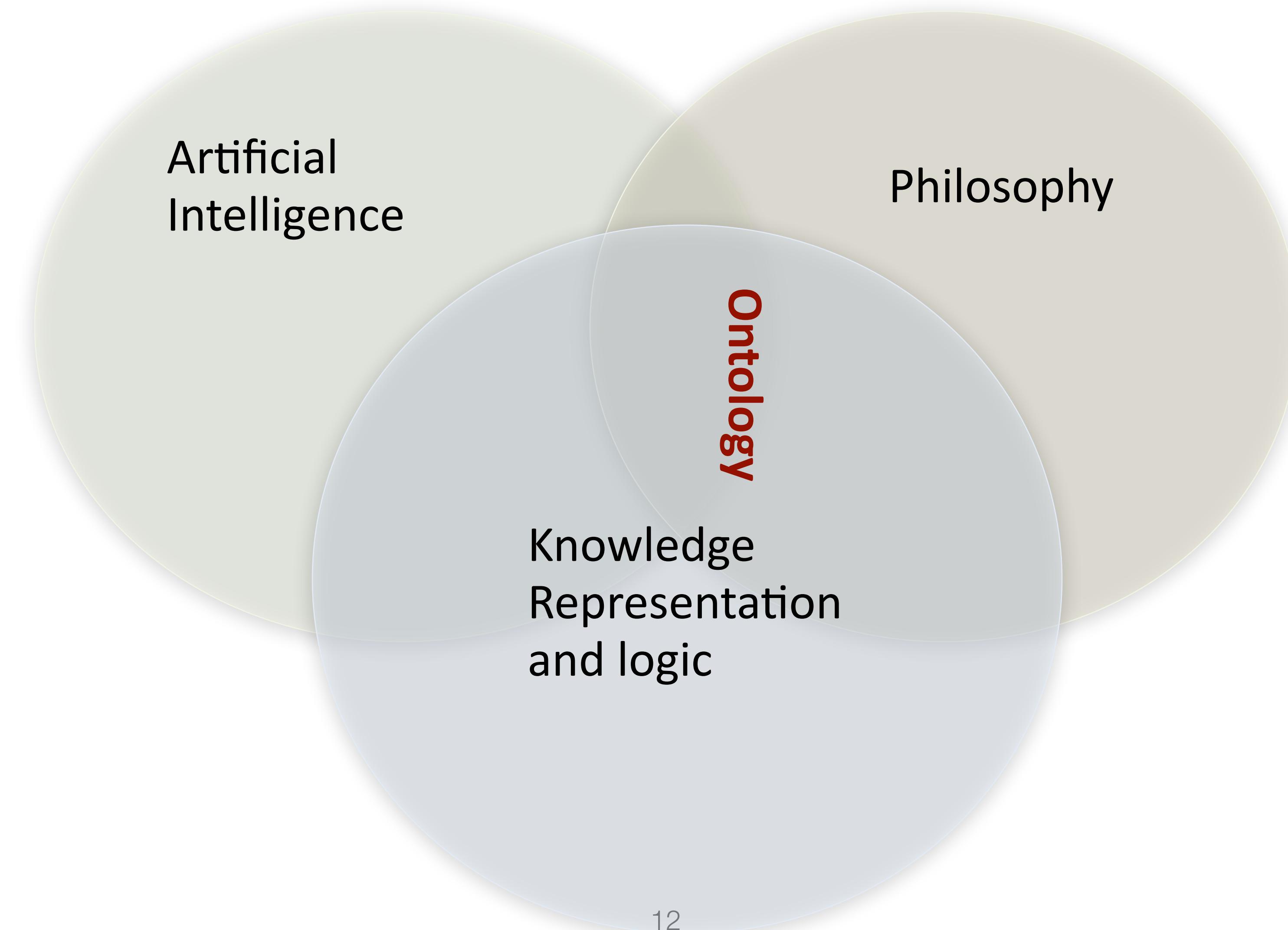
- NASA metric confusion caused the Mars Orbiter loss in 1999.



The failure to use metric units in the coding of a ground software title, **SMALL FORCES**, used in trajectory models. Specifically, thruster performance data in English units instead of metric units was used in the software application code titled **SM_FORCES** (small forces). The output from the **SM_FORCES** application code as required by a **MSOP** Project Software Interface Specification (SIS) was to be in metric units of Newton-seconds (N-s). Instead, the data was reported in English units of pound-seconds (lbf-s).

NASA Mishap Investigation Board Report

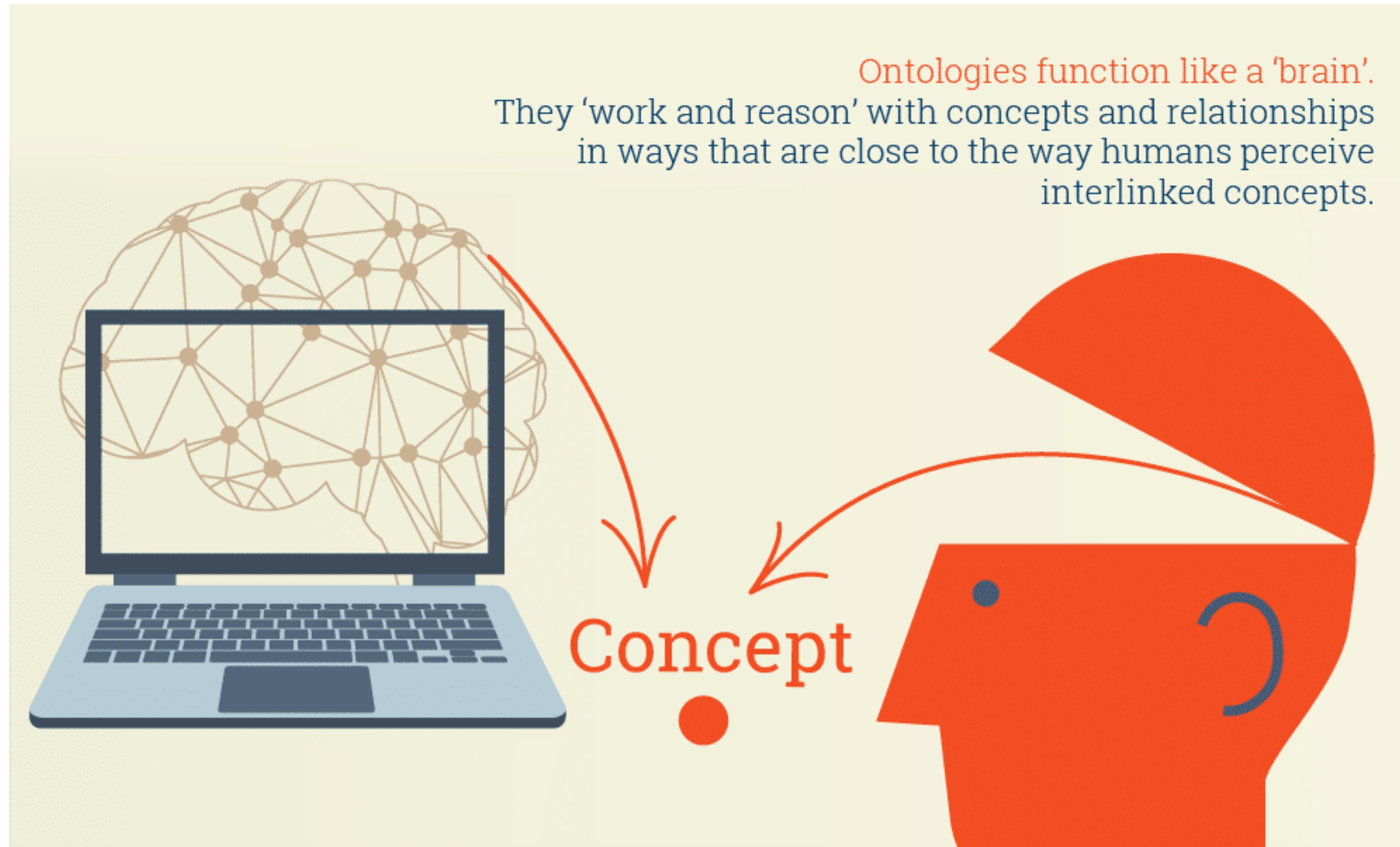
Ontology



From philosophy to computer science

- Socrates questions of being, Plato's studies of epistemology:
 - the nature of knowledge
- Aristotle's classifications of things in the world and contribution to syllogism and inductive inference:
 - logic as a precise method for reasoning about knowledge
- In computer science an unambiguous description of the concepts and relationships that can exist for one or more agents, so they can ***understand, share, and use*** this description to accomplish ***(cooperatively)*** some task on behalf of users

Ontologies are the “brain” of your app



So what is an ontology then?

“...An ontology is a (formal), explicit specification of a shared conceptualisation...”

formal: an ontology
should be machine-
readable

shared: an ontology captures consensual
knowledge, that is not private to some
individual, but accepted by a group

explicit: the types of concepts
used, and the constraints on
their use are explicitly defined

conceptualisation: an abstract model of some
phenomenon in the world which identifies the
relevant concepts of that phenomenon

Ontologies and KG

- Ontologies enhance the graph data model in a knowledge graph by providing:
 - “**...a formal specification of a shared conceptualisation**” (Gruber, 1993)
 - “**... an abstract symbolic representation of a domain expressed in a formal language**” (Borst et al, 1999)

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End of ontology based
information systems
- Part 1



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