Concept Modelling Panel: Semantic Modelling

EDOC conference

10 October 2022

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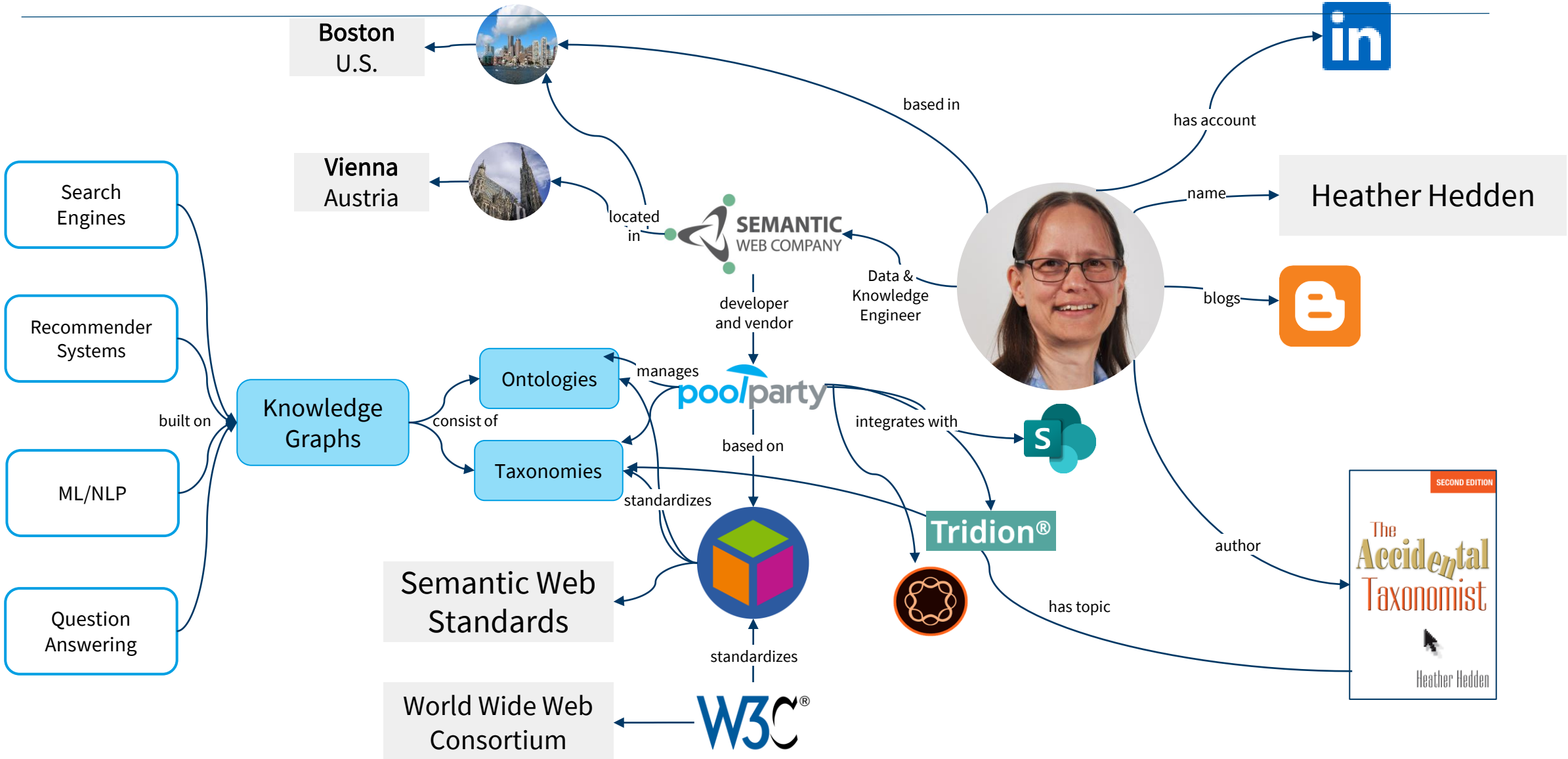
About me and my employer



Conceptual Modelling vs. Semantic Modelling

Conceptual modeling	Semantic modeling
Especially for systems or problems	Especially for knowledge or subject matter
Usually about a capability pertaining, for example, to inventories, process, locations, roles, timing, goals	About concepts
Specific purpose, predefined concepts	More generic and flexible
Concepts have unique representations	Concepts belong to classes of the same kind
Concepts have predefined properties	Properties are types with instances
Connections might be sequential, spatial, collaborative, cyclic, motivational, etc.	Connections between concepts are relations: strictly verbal or logical statements
Always depicted graphically	Often, but not always depicted graphically
Target is anything to design or engineer	Target is a knowledge domain
Especially for human interpretation	Especially for machine interpretation

Conceptual vs. *Concepts*

From Conceptual Modelling to Knowledge Modelling

Semantic models vs. knowledge models

- Semantic *data* models vs. knowledge models for data and *content*
- Issue of emphasis on *how* (semantics) vs. *what* (knowledge)
- Semantic modelling tends to refer to ontology creation (loosely defined)
- Knowledge modelling includes all forms of *knowledge organization systems*: ontologies and controlled vocabularies, such as taxonomies, thesauri, terminologies, etc.

Knowledge Organization Systems

Knowledge organization system (KOS)

- Any system of terms, terminology, classification, etc.
  to organize, define, manage, and/or retrieve information.
- Not any method to organize knowledge directly, but a scheme to organize concepts/terms for classifying, defining, tagging, or retrieving information.
- Broader, includes more than just “controlled vocabularies”

KOS types:

- term lists
- synonym rings
- name authorities
- taxonomies
- thesauri

} Controlled Vocabularies for tagging and retrieval

- glossaries
- dictionaries
- gazetteers
- terminologies
- categorization schemes
- classification schemes
- subject heading schemes
- semantic networks
- ontologies

Knowledge Organization Systems

Term List	Name Authority	Taxonomy	Thesaurus	Ontology
Ambiguity control	Ambiguity control Synonym control (Attributes)	Ambiguity control (Synonym control) Hierarchical relationships	Ambiguity control Synonym control Hierarchical relationship Associative relationships	Ambiguity control Semantic relationships Attributes Classes

Knowledge Organization Systems

Controlled vocabularies

- Term lists/Pick lists
- Synonym rings
- Authority files
  - Name authorities
- Taxonomies
- Subject heading schemes
- Thesauri

Defined vocabularies

- Dictionaries
- Glossaries
- Gazetteers
- Terminologies

Classification systems

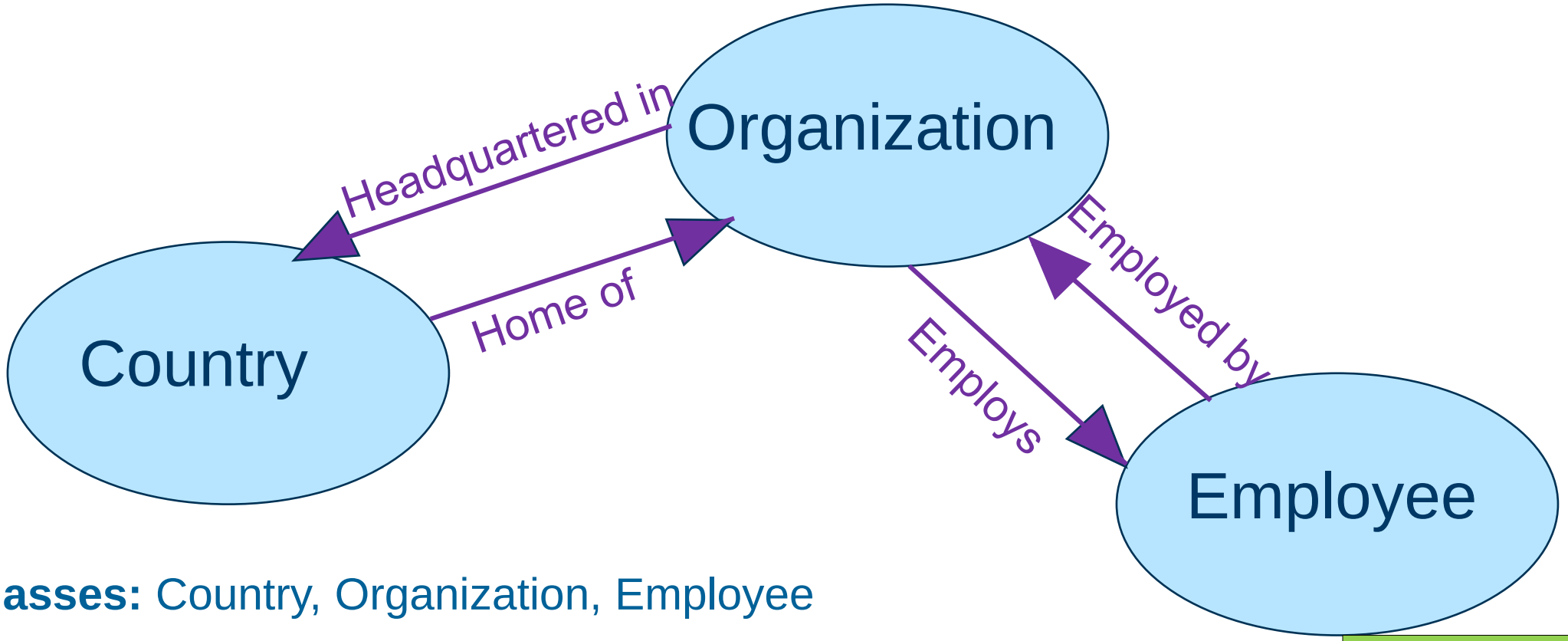
- Cataloging systems
- Categorization schemes
- Classification schemes

Semantic models

- Mind maps
- Topic maps
- Semantic networks
- Ontologies

Ontologies

Ontology excerpt example



Classes: Country, Organization, Employee

Relations: Headquartered in < > Home of
Employed by < > Employs

Attributes: Email address, Job title

Ontology Standards: OWL – Web Ontology Language

OWL-Defined Ontology Components

Entities – subjects (domains) or objects (ranges) of properties, within RDF triples

- **Classes**
  - Named sets of concepts that share characteristics and relations
  - May contain subclasses or individuals (instances of the class)
- **Individuals**
  - Members or instances of a class. Unique named entities.

Properties – predicates about individuals (instances)

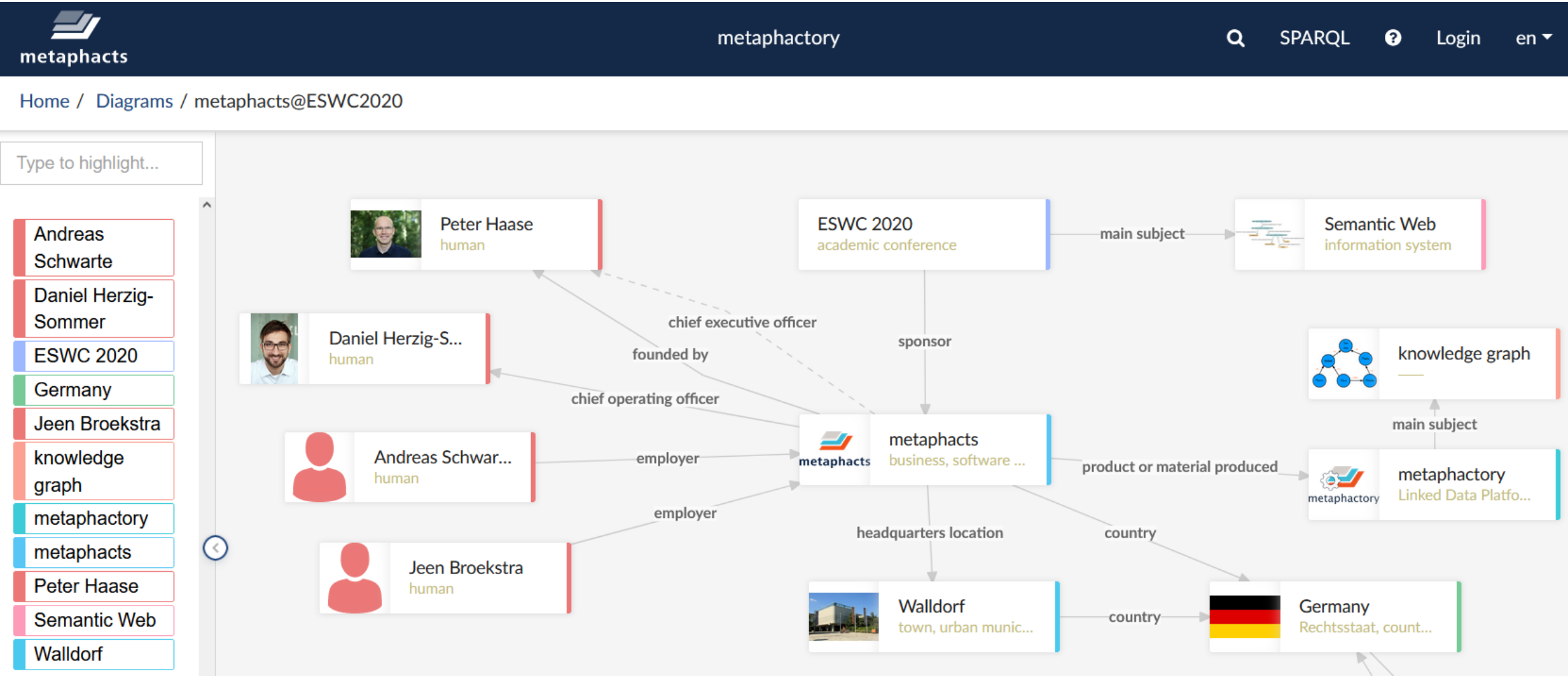
- **Object properties**
  - Relations between individuals
  - May be directed (single direction), symmetric, or with an inverse (different in each direction)
- **Datatype properties**
  - Attributes or characteristics of individuals
  - The object of a datatype property is a *value*.

Literals – values of attributes, with just a *lexical form* and a *datatype.*

https://www.w3.org/OWL

Ontologies

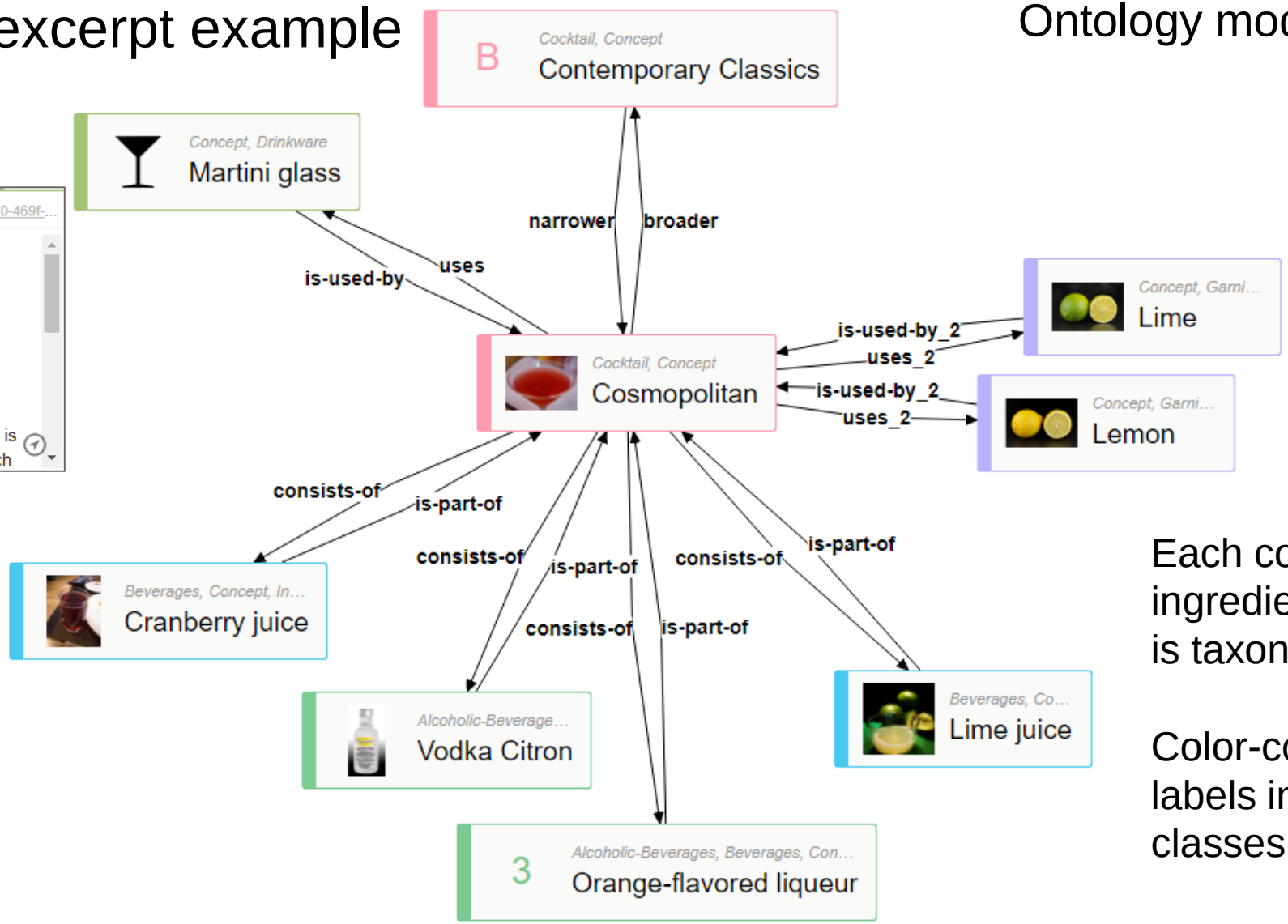
Ontology excerpt example with individuals/instances



Ontologies

Ontology excerpt example

Ontology model + entities



Each cocktail, ingredient, glass type, is taxonomy concept.

Color-coding and italics labels indicate the classes

Knowledge Organization Systems

Term List	Name Authority	Taxonomy	Thesaurus	Ontology
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Knowledge Organization Systems

Ontology			
Term List	**Name Authority**	**Taxonomy**	**Thesaurus**
Ambiguity control	Ambiguity control	Ambiguity control	Ambiguity control
	Synonym control	(Synonym control)	Synonym control
		Hierarchical relationships	Hierarchical relationship
			Associative relationships
	(Attributes)		

Ontology Design – Semantic Modelling

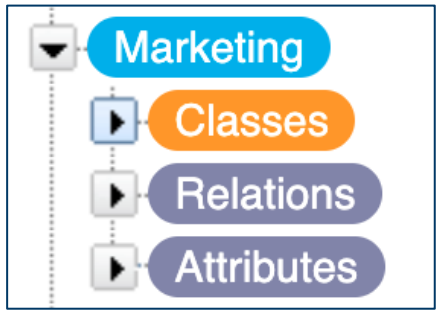
Identify and define **Classes**

- Categories for which there is a use case to create semantic relations between
- Specific enough for business needs
- Generic enough to include various, multiple instances

Product

Region

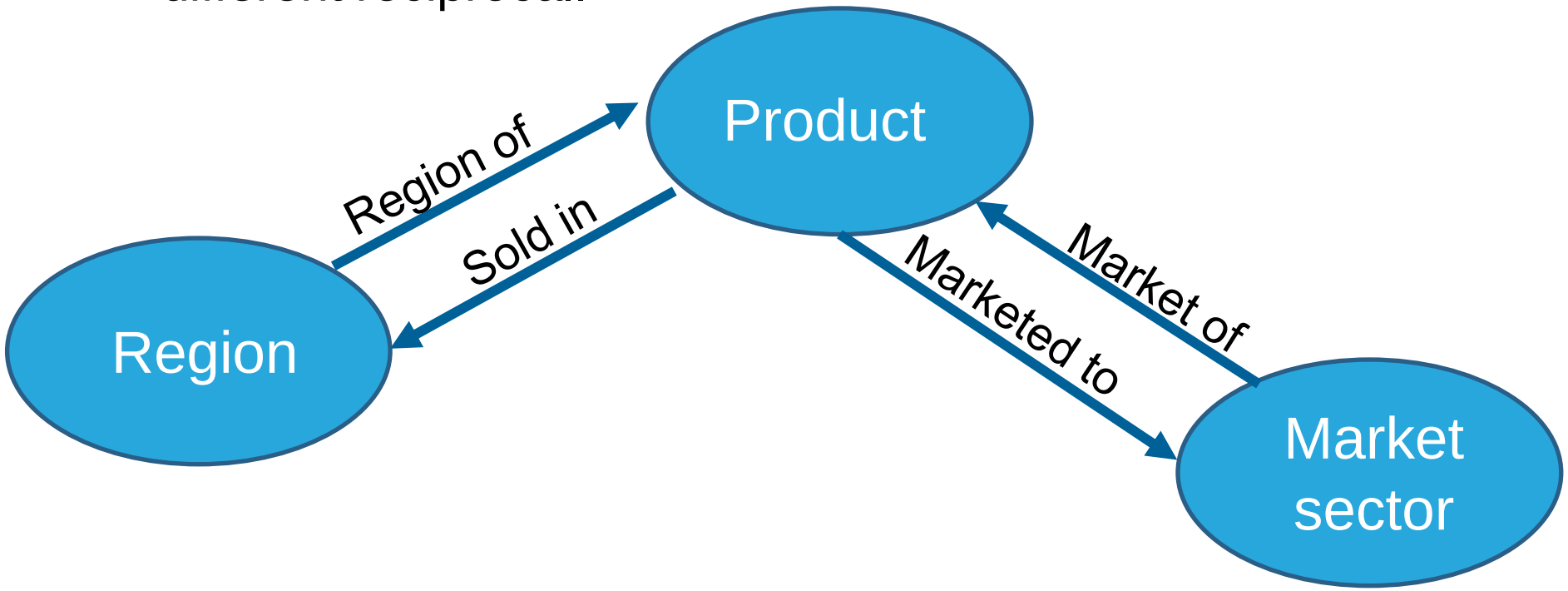
Market sector

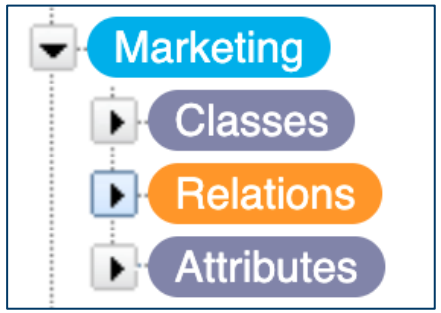


Ontology Design – Semantic Modelling

Identify and define **Relations** between pairs of Classes

- Relations are relevant (inherited) between all instances of each Class.
- Relations typically are (although not required to be) bidirectional: with an inverse.
- With inverses, relation names are confined to a pair and cannot be reused with a different reciprocal.

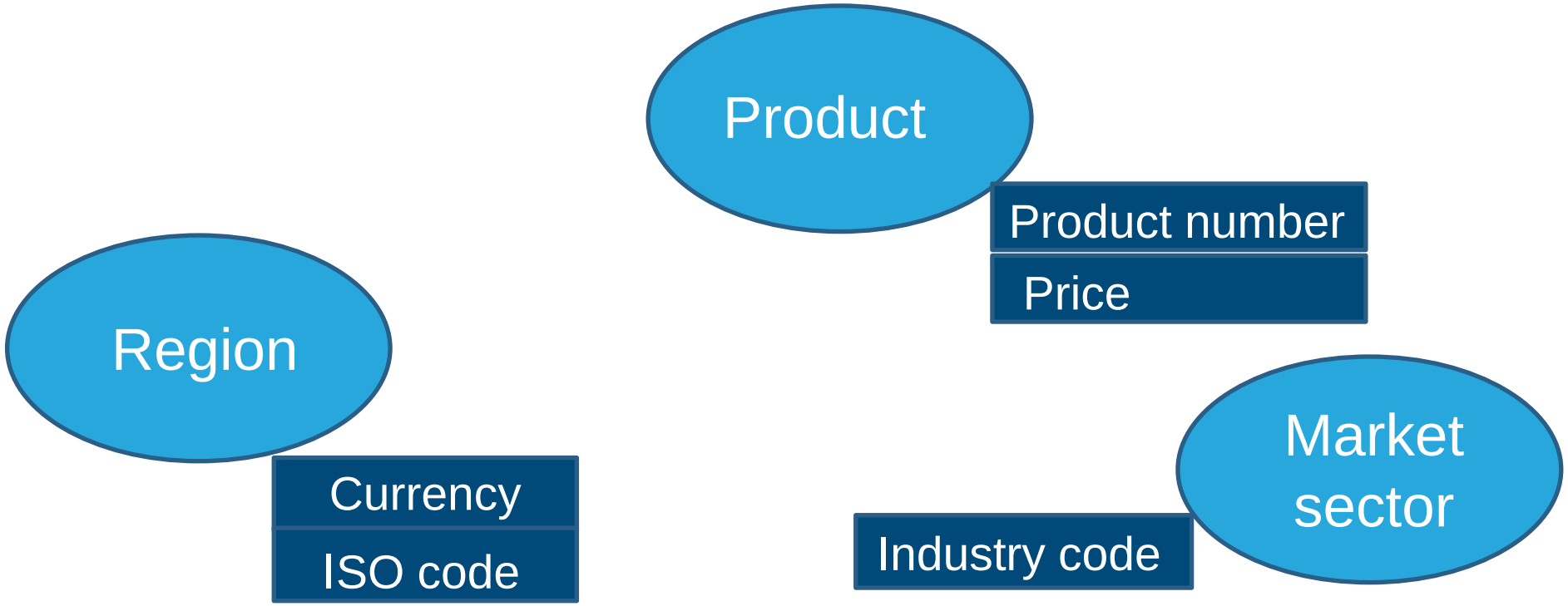


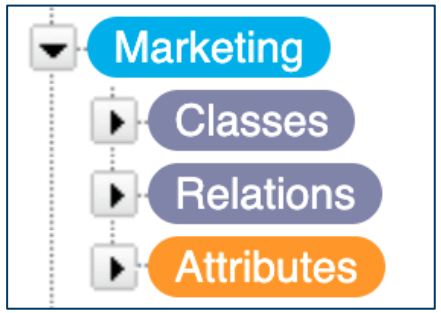


Ontology Design – Semantic Modelling

Specify the desired **Attributes** for each Class

- Simple properties for a specific Class. Just enough for business needs.
- Also applicable to all instances within the Class.
- Same Attributes may be used in multiple Classes. Some Classes may have no Attributes.





Resources

- Goss, Ronald G. "Conceptual Model vs. Concept Model: Not the Same!" Business Rules Community, Business Rules Solutions (BRS)
- Alexopoulos, Panos. *Semantic Modeling for Data: Avoiding Pitfalls and Breaking Dilemmas*. Sebastopol, CA: O'Reilly Media, Inc., 2020.
- Allemang, Dean, James Hendler, and Fabien Gandon. *Semantic Web for the Working Ontologist: Effective Modeling for Linked Data, RDFS, and OWL*. 3rd ed. New York: Association for Computing Machinery (ACM), 2020.
- Uschold, Michael. *Demystifying OWL for the Enterprise*. San Rafael, CA: Morgan & Claypool Publishers, 2018.
- Bob DuCharme's Weblog

- Hedden, Heather. *The Accidental Taxonomist, 3rd edition.* Medford, NJ: Information Today Inc., 2022

Questions/Contact

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