Multi-Agent and Semantic Web Systems: Ontologies

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But this is completely misconceived!

What is an ontology?

- A notion of relevant knowledge is highly subjective
  - Which parts of the world it is important to talk about;
  - How to segregate and organise the world;
- What terms to use.
- Ontologies are designed by individuals: central control is impossible and undesirable.

What is an ontology?

- But ontological differences are desirable and essential:
  - Freedom of expression;
  - Ability to adapt to task;
  - Changing environment.
- Even direct contradictions can be desirable
- Is a tomato a fruit or a vegetable?
- The crucial task is managing these differences.

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But what does this mean?

What is an ontology?

- Essentially: a way of encoding domain knowledge.
- But there are many different choices as to *how* this is done.
- The word *ontology* is over loaded: it means different things to different people.

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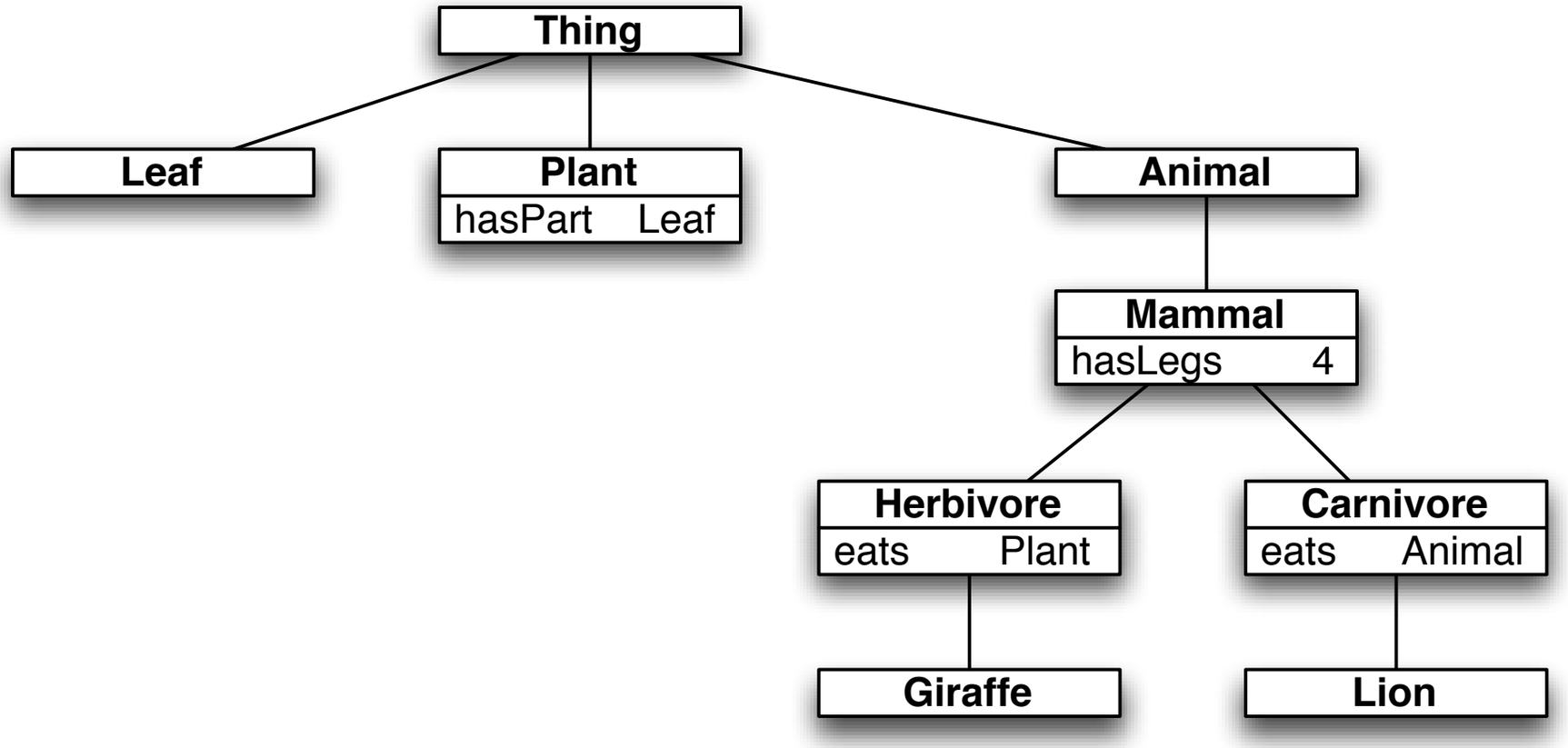
In reality this depends on how complex the ontology is.

Much effort devoted to developing alternatives which were seen as more tractable.

Hierarchies and Frames



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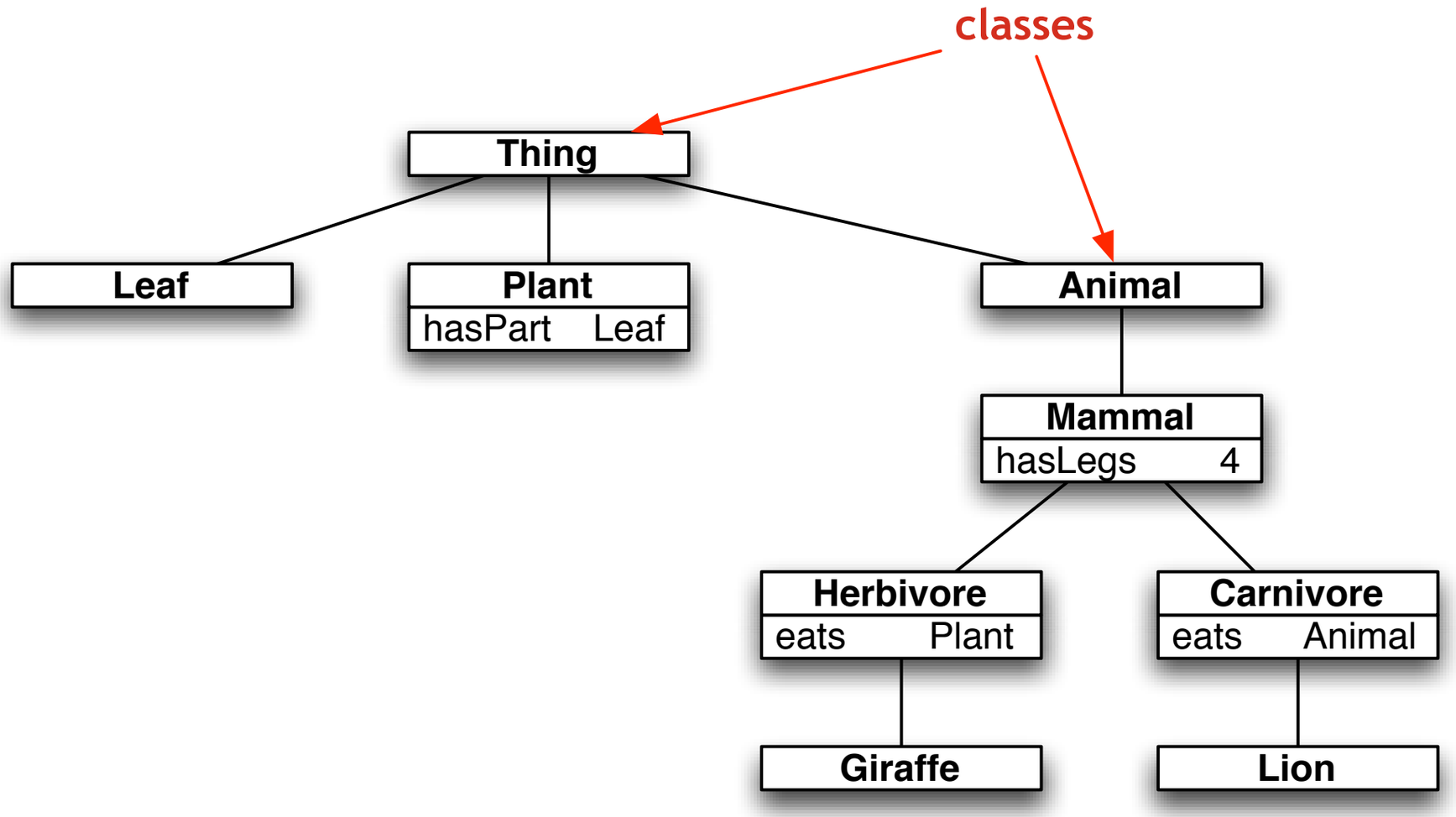

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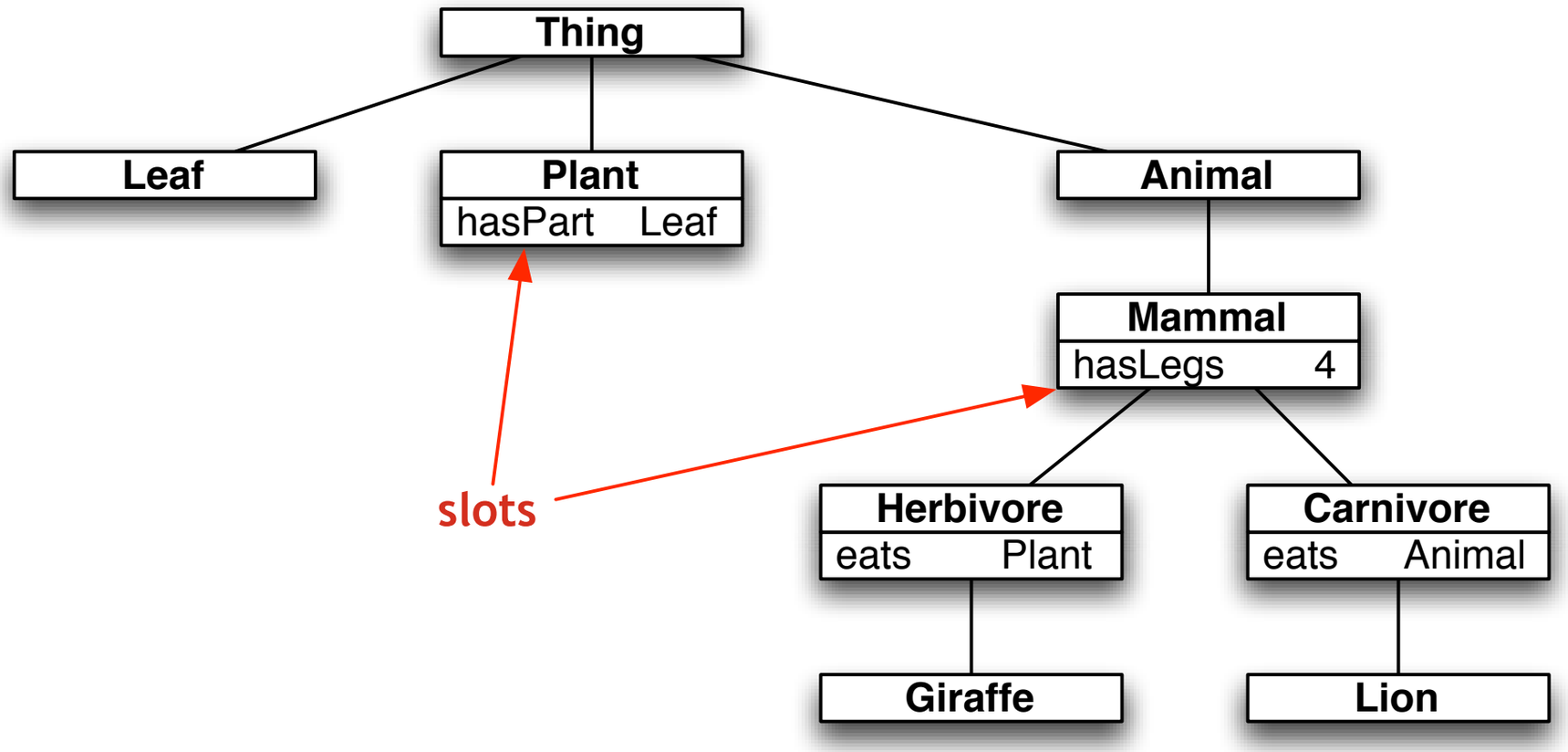

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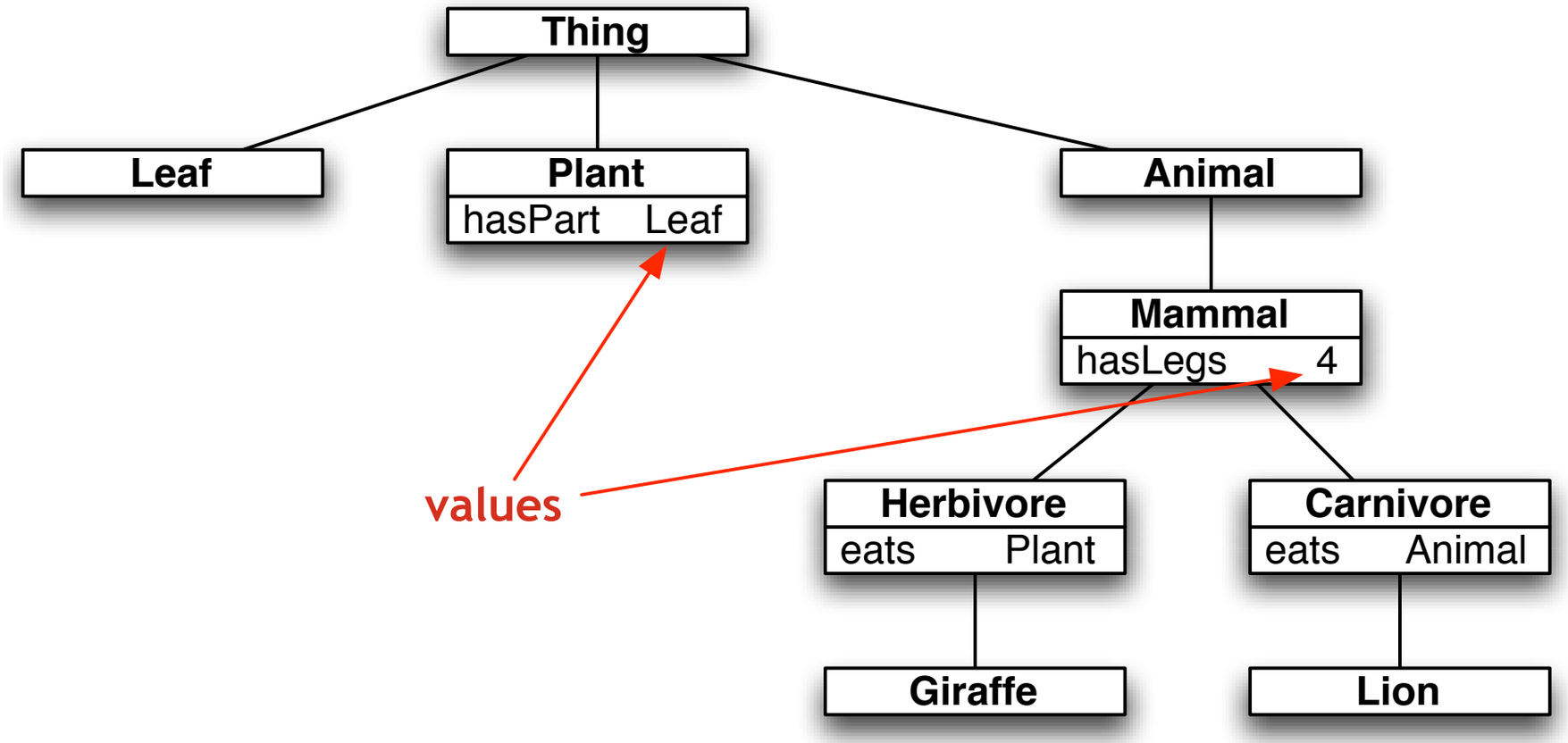


Hierarchies and Frames

Frames are a way of describing classes or concepts or types.

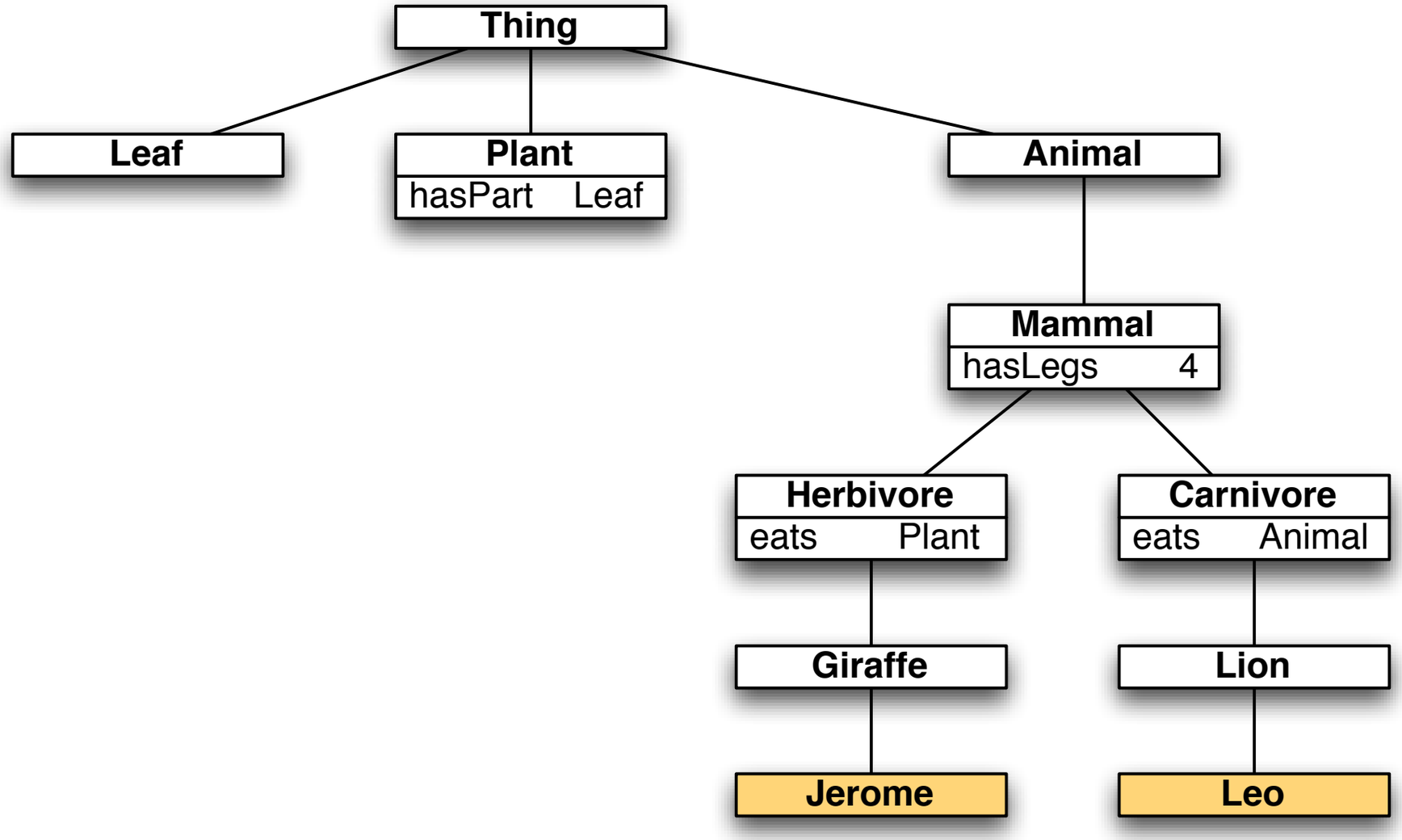
Usual to think of classes in terms of sets of individuals.

Frames contain slots with values.

Values can be restricted in various ways:

- Integer, boolean or literal values;
- enumerated values;
- instances of a specified class.

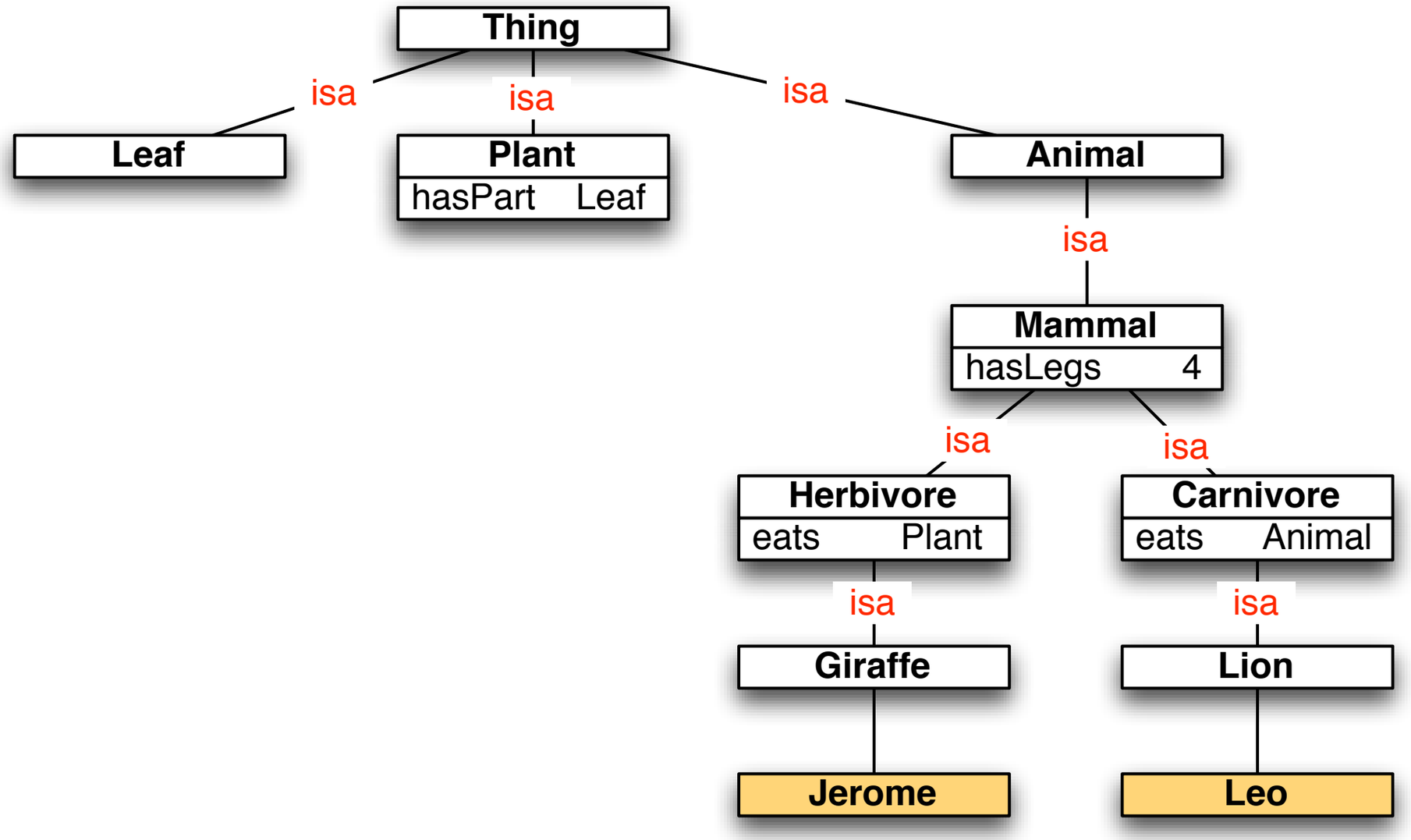
Classes and Individuals



Classes and Individuals

- Ambiguity about nature of the edge in the graph. Reflected in English:
  - A lion is a carnivore
  - *Jerome is a giraffe*
- Two different relations / labels:
  - ISA: taxonomic — a carnivore is a kind of mammal
  - IO: instance-of / membership — Jerome is a member of the class of giraffes
- Lion $\subseteq$ Carnivore
- Jerome $\in$ Giraffe

Classes and Individuals



Inheritance

How many legs does Jerome have?

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Mammals have 4 legs.

So the attribute of having 4 legs is inherited by Giraffe from Mammal.

Assertion vs Terminology

- Assertions - simple facts about the world:
  - Joe is married to Sue
  - Bill has a brother with no children
  - Harry's friends are Bill's cousins
- Terminology:
  - *ancestor* is the transitive closure of *parent*
  - *brother* is *sibling* restricted to males
  - *favourite-cousin* is a special type of *cousin*
- The KRYPTON system (Brachman, Fikes Levesque, 1983) proposed dividing KR system into two main components:
  - ABox (assertions)
  - TBox (terminological structure)

Folksonomy

Folksonomy ⇐ Folk + Taxonomy

- Folksonomy emerged from growing practise of ad hoc tagging and labelling
  - e.g., Delicious, Flickr
  - tagging seemed to help discovery of related resources "*tagging that works*"

- Unlike most formal ontologies, collaborative tagging is not hierarchical, or centrally controlled.

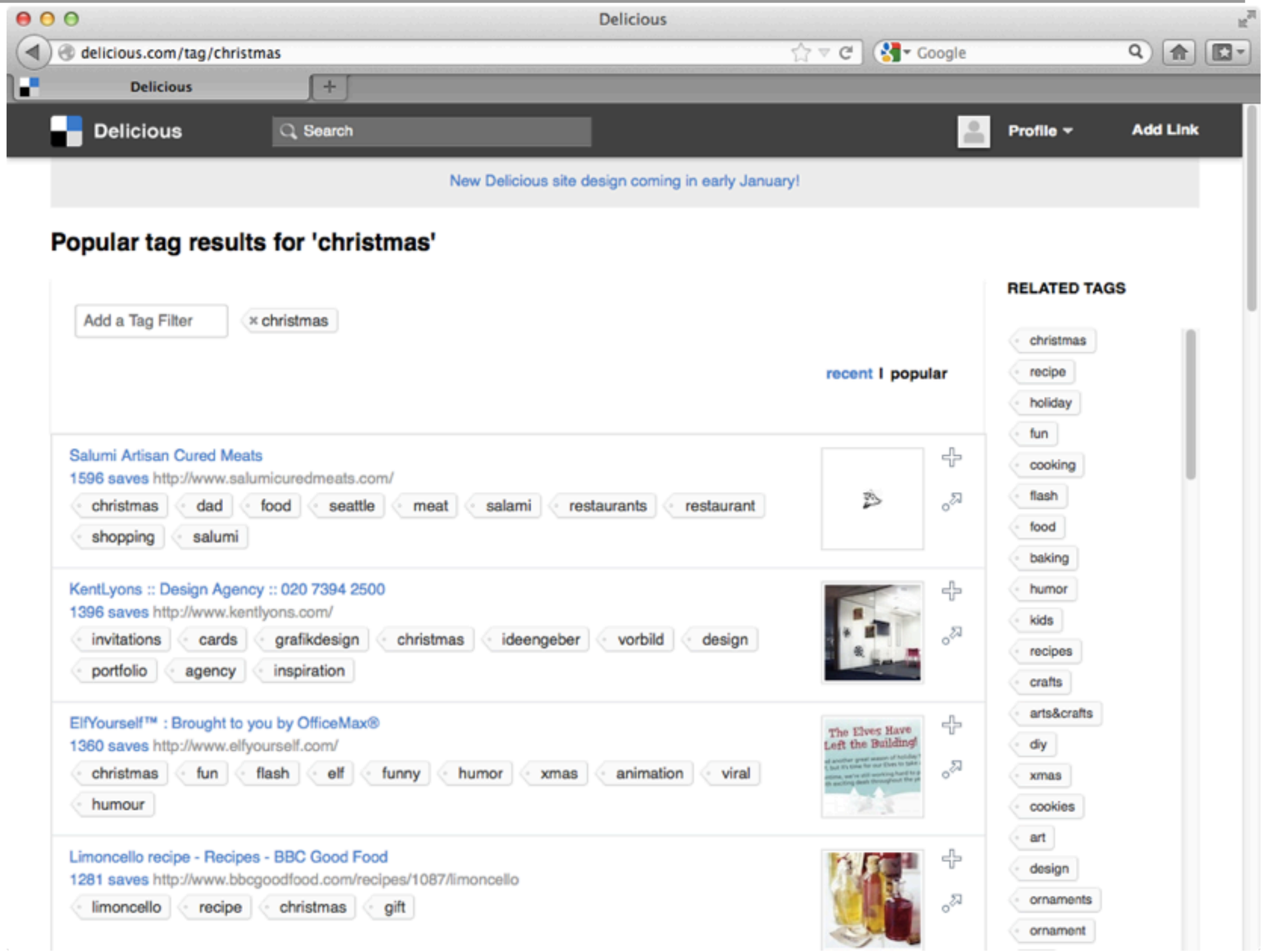
- Folksonomy brings agents back into process of constructing meaning.

Tags on Flickr (21-12-12)

All time most popular tags

animals architecture art asia australia autumn baby band barcelona beach berlin bike bird birds birthday black blackandwhite blue bw california canada canon car cat chicago china christmas church city clouds color concert dance day de dog england europe fall family fashion festival film florida flower flowers food football france friends fun garden geotagged germany girl graffiti green halloween hawaii holiday house india instagramapp iphone iphoneography island italia italy japan kids la lake landscape light live london love macro me mexico model museum music nature new newyork newyorkcity night nikon nyc ocean old paris park party people photo photography photos portrait raw red river rock san sanfrancisco scotland sea seattle show sky snow spain spring square squareformat street summer sun sunset taiwan texas thailand tokyo travel tree trees trip uk unitedstates urban usa vacation vintage washington water wedding white winter woman yellow zoo

Tags on Delicious



Folksonomy - Vander Wal (2007)

- result of personal free tagging of information and objects for one's own retrieval
- done in a social environment (usually open and shared)
- value is derived from people using their own vocabulary and adding explicit meaning
- not so much categorizing, as providing a means to connect items

Folksonomy vs Formal ontology

- Vander Wal: folksonomy is not categorization
- Shirky: folksonomy is a more robust and scalable approach to categorization than formal ontology

Folksonomy v Formal Ontology

Shirky (2005), 'favourable characteristics'

Domain to be organised	*Participants*
Formal Ontology	
Small corpus Formal categories Stable entities Restricted entities Clear edges	Expert catalogers Authoritative sources of judgement Coordinated users Expert users
Tagging	
Large corpus No formal categories Unstable entities Unrestricted entities No clear edges	Naive catalogers No authority Uncoordinated users Amateur users

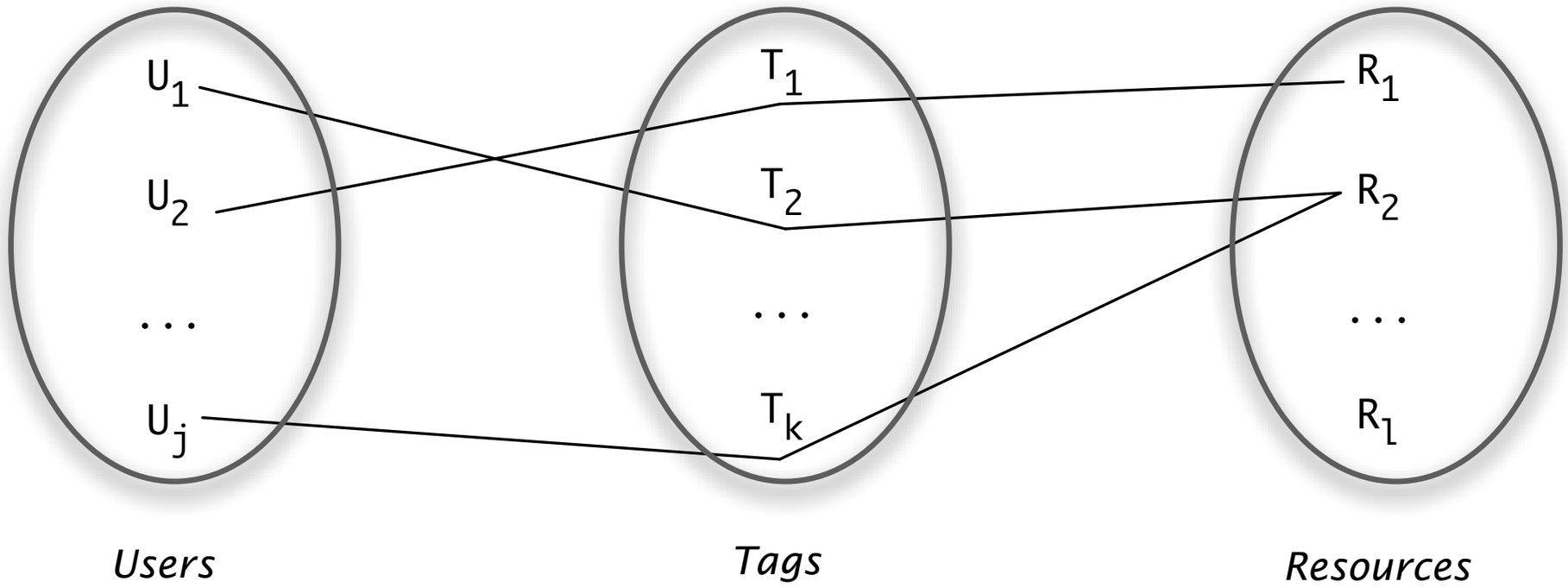
Categorisation vs Classification - Jacob (2004)

Categorisation: division of world of experience into groups that share some perceptible similarity in a given context; context dependence provides categorisation with its power and flexibility.

Classification: orderly assignment of each entity to one and only one class within a system of of mutually exclusive and non-overlapping classes.

- Distinction is not the same as common usage
- But formal ontologies aspire to classification, in the above sense.

Graph Structure of Tagging Systems



A tagging instance is a triple (user, tag, resource)

Tag distribution - Halpin et al (2007)

- What is the distribution of tags used to categorise a specific resource (e.g., a Delicious bookmark)?
- Observation: tagging distribution is stable in the sense that a small proportion of tags are consistently used to label the resource; and
- new users tend to reinforce tags in the same frequency as the stable distribution.
- Can be viewed as a 'collective categorization scheme'; i.e., ontology can emerge from collaborative tagging.

Emergent Semantics - Mika (2005)

- Emergent semantics: interaction of large number of agents leads to global semantic effects.
- Ontology arises from activity within network as opposed to a fixed, limited contract.
- Goal: more scalable and easily maintainable Semantic Web, incorporating social context.

The bigger picture