Knowledge Representation

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Contents

Overview of Knowledge Representation 知识表示概述

What is knowledge representation
什么是知识表示

- Focus on designing computer representations that capture knowledge about the world that can be used to solve complex problems.
  关注于设计计算机表示来采集关于世界的知识，可用于解决复杂的问题。
- Make complex software easier to define and maintain than procedural code and can be used in expert systems.
  与过程性代码相比，使复杂的软件容易定义和维护，可用于专家系统。

Why use knowledge representation
为什么采用知识表示

- Conventional procedural code is not best formalism to solve complex problems.
  传统的过程性代码并非是解决复杂问题的最好形式。

Core Issues of Knowledge Representation 知识表示的核心问题

Primitive 原语

- The underlying framework used to represent knowledge, e.g., semantic network, first-order logic, and etc.

  用于表示知识的基础框架，例如：语义网络、一阶逻辑、等等。

Meta-representation 元表示

- The knowledge representation language is itself expressed in that language, e.g., in Frame based environments, all frames would be instances of a frame.

  知识表示语言用该语言本身表示，例如：在Frame环境中，所有的frames都是某个frame的实例。

Incompleteness 不完备性

- To associate certainty factors with rules and conclusions, e.g., "Socrates is human with confidence 50%".

  将确定性因子与规则和结论相关联，例如：苏格拉底是人，具有50%的置信度。

Core Issues of Knowledge Representation 知识表示的核心问题

Universals vs. Facts 共性与事实

- Universals: general statements about the world, e.g., “All humans are mortal”.
  共性：关于世界的一般性描述。例如：所有的人都会死。
- Facts: specific examples of universals, e.g., “Socrates is a human and therefore mortal”.
  事实：共性中的具体事例。例如：苏格拉底是人，因此他会死。

Expressive adequacy 表现的充分性

- How expressive they intend their representation to be.
  它们想要的表示是如何表现的。

Reasoning efficiency 推理的有效性

- Refer to the run time efficiency of the system.
  指的是该系统运行时的有效性。

Typical Methods of Knowledge Representation 典型的知识表示方法

- Bayesian Network 贝叶斯网络
- First Order Logic 一阶逻辑
- Frame-based System 基于Frame的系统
- Ontology 本体
- Production System 产生式系统
- Script 脚本
- Semantic Network 语义网络

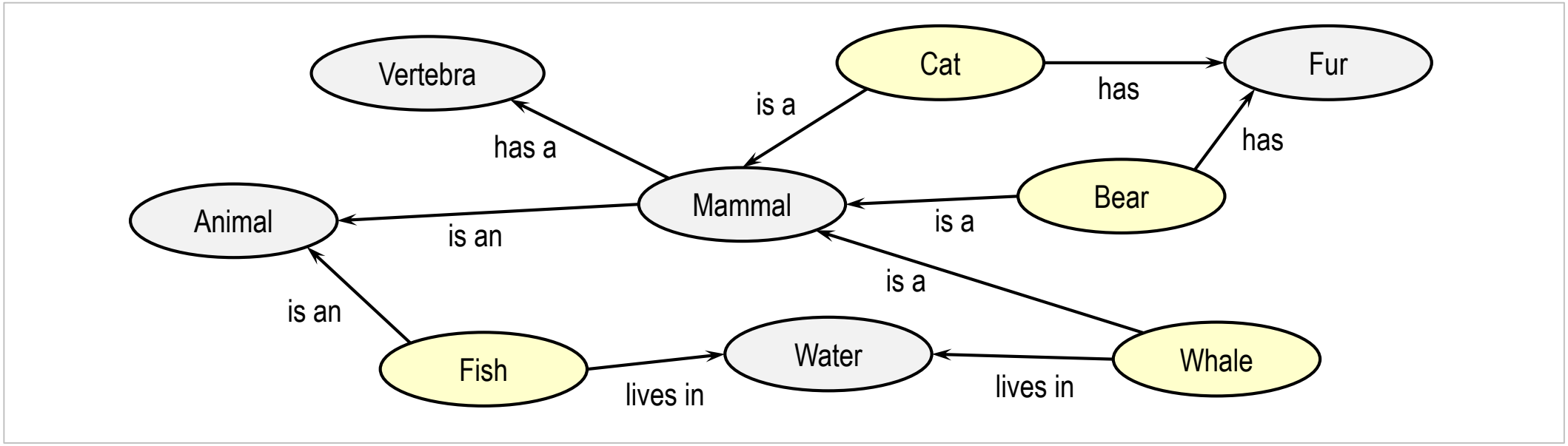
What is Semantic Network 什么是语义网络

- It is network which represents semantic relations between concepts.

  它是一种表示概念间语义关系的网络。

- It is a directed or undirected graph consisting of nodes and arcs, where nodes: represent concepts, arcs: semantic relations between the concepts.

  它是一种由节点和弧组成的有向或无向图，其中，节点：表示概念，弧：概念间的语义关系。



Example: A Semantic Network in Lisp 用Lisp语言表示的语义网络

- Using an association list. 采用关联表。

```
(defun a-knowledge-base ()
    ((canary  (is-a bird)
              (color yellow)
              (size small))
     (penguin (is-a bird)
              (movement swim))
     (bird    (is-a vertebrate)
              (has-part wings)
              (reproduction egg-laying))))
```

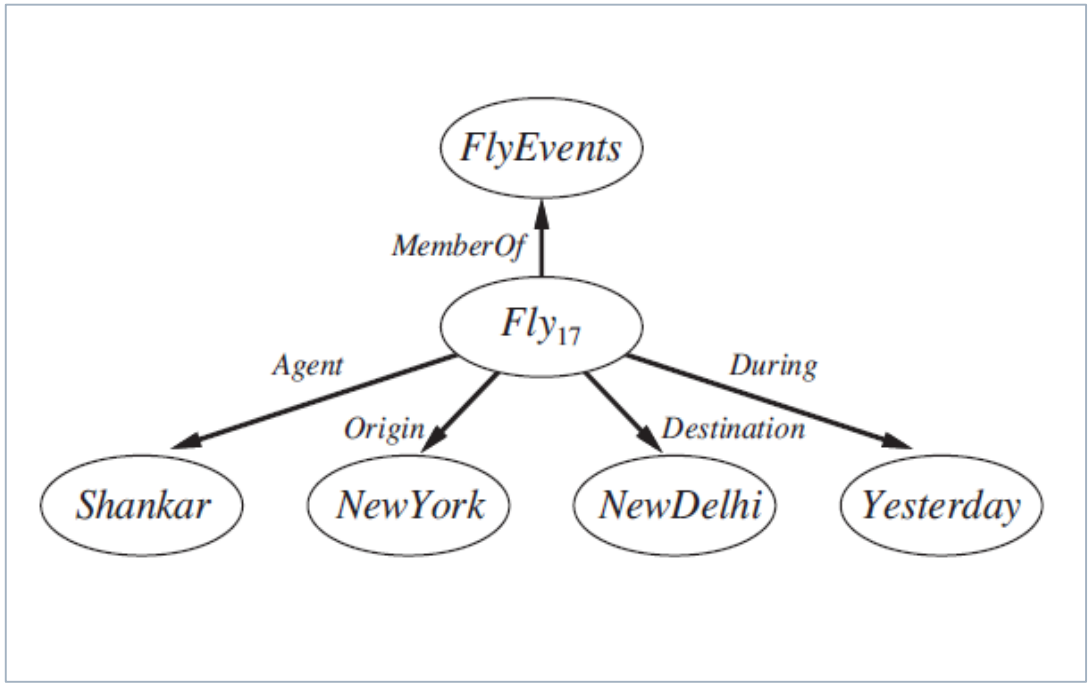
Use “assoc” function with a key of “canary” to extract all information about “canary” type.

使用“assoc”函数与关键字“canary”来提取关于“canary”类型的所有信息。

Basics of Semantic Network 语义网络的基本概念

- Semantic networks are cognitively based, organized into a taxonomic hierarchy.
  语义网络是基于认知的，被组织成为一个分类层次结构。
- A semantic network is used when one has knowledge that is best understood as a set of concepts that are related to one another.
  语义网络被采用的情形是当某种知识可以很好地化解为一组彼此相关的概念时。
- But, it is intractable for large domains, and can not represent performance or meta-knowledge very well.
  但是，它难以驾驭大型领域，并且不能很好地表现性能或者元知识。
- Some properties are not easily expressed, e.g.,
  某些特性也不易表达，例如：
  - negation, disjunction, or general non-taxonomic knowledge.
    否定、析取、或者一般的非分类知识。

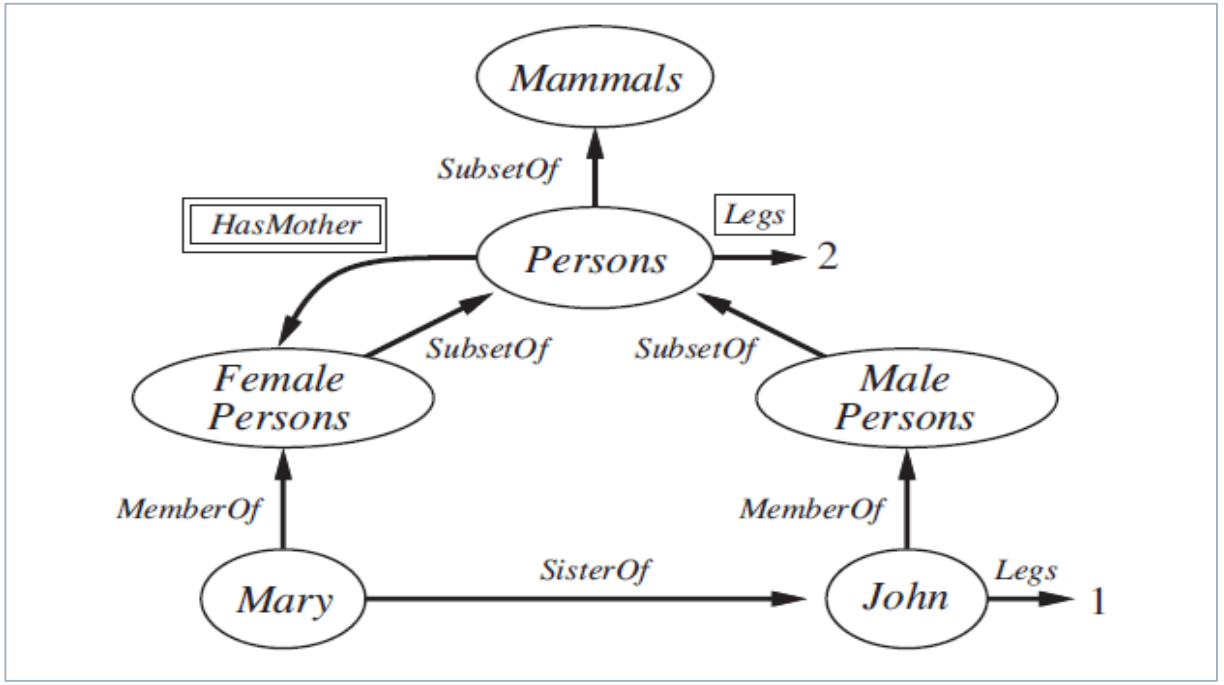
Examples



A semantic net of the logical assertion

一个逻辑断言的语义网络

Fly(*Shankar, NewYork, NewDelhi , Yesterday*)



A semantic net with categories and objects

一个具有类别和对象的语义网络

Mary ∈ *FemalePersons*, *John* ∈ *MalePersons*,

SisterOf (*Mary*, *John*)

∀*x* *x* ∈ *Persons* ⇒ [∀*y* *HasMother* (*x*, *y*) ⇒ *y* ∈ *FemalePersons*]

Thank you for your attention!

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