Lecture 23

-Semantic Networks and frames

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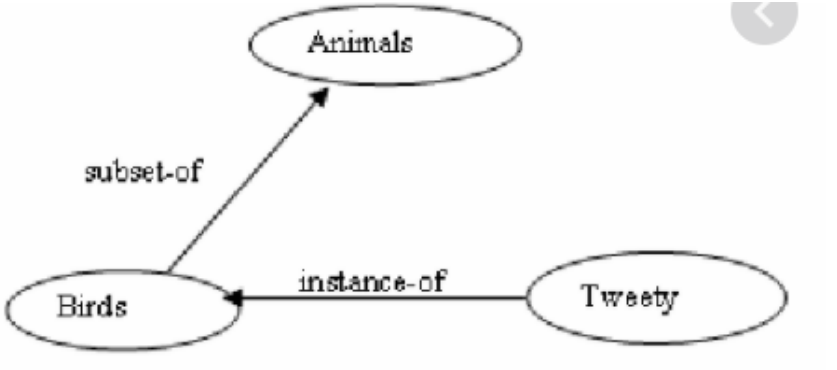
Semantic networks



- Alternative to FOL (First order logic)
- Visualization of KB + Inferencing is possible through the inheritance algorithm
- member-of(Tweety, Birds) [Tweety: object, Birds: category]
- subset-of(Birds, Animals) [Birds: small category, Animals:big category]

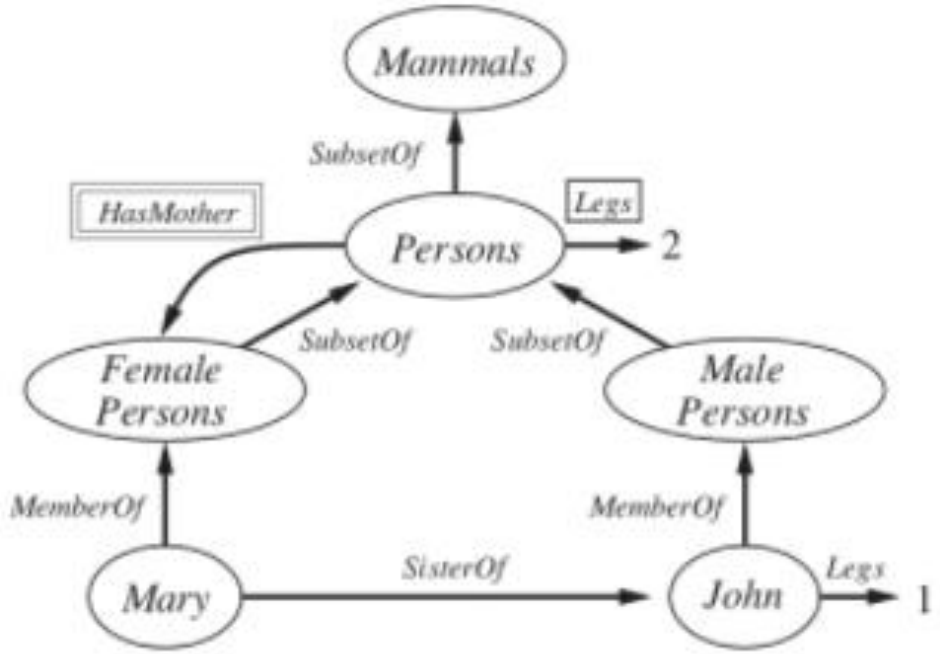
Ontological knowledge representation:

✓**Objects are members of categories**

✓**Small categories are subsets of larger categories**

Semantic networks and Inheritance algorithm

- Semantic networks (KB)



- Inheritance algorithm (navigating through the semantic network to answer a query)

❑Start from the bottom (object) and go upwards following the arrow

❑Stop the first time you reach the value

❑Categories: Mammals, Persons, Female persons, Male persons

❑Objects: Mary, John, 1, 2

❑Single box : Legs (value=2 **for each member in the category** Persons)

❑Double box : HasMother (unique one-to-one mapping **between members of two categories**)

❑Q. How many **legs** does Mary have? (2)

❑Q. How many **legs** does John have? (1)

Pseudocode

```
function MEMBER?(element,category) returns True or False

  for each c in MEMBERSHIPS[element] do
      if SUBSET?(c, category) then return True
  return False

function SUBSET?(sub, super) returns True or False

  if sub = super then return True
  for each c in SUPERS[sub] do
      if SUBSET?(c, super) then return True
  return False

function RELATED-TO?(source,relation, destination) returns True or False

  if relation appears in RELS-OUT(source) then
      return MEMBER([relation, destination], RELS-OUT(node))
  else for each c in MEMBERSHIPS(source) do
      if ALL-RELATED-TO?(c, relation, destination) then return True
  end
  return False

function ALL-RELATED-TO?(source, relation, destination) returns True or False

  if relation appears in ALL-RELS-OUT(source) then
      return MEMBER([relation,destination], ALL-RELS-OUT(node))
  else for each c in SUPERS(category) do
      if ALL-RELATED-TO?(c, relation, destination) then return True
  end
  return False
```

Figure 10.10 Basic routines for inheritance and relation testing in a simple exception-free semantic network. Note that the function MEMBER? is defined here to operate on semantic network nodes, while the function MEMBER is a utility that operates on sets.

Frames

(Each node in the semantic network is a two column table of slots and values that indicate properties)

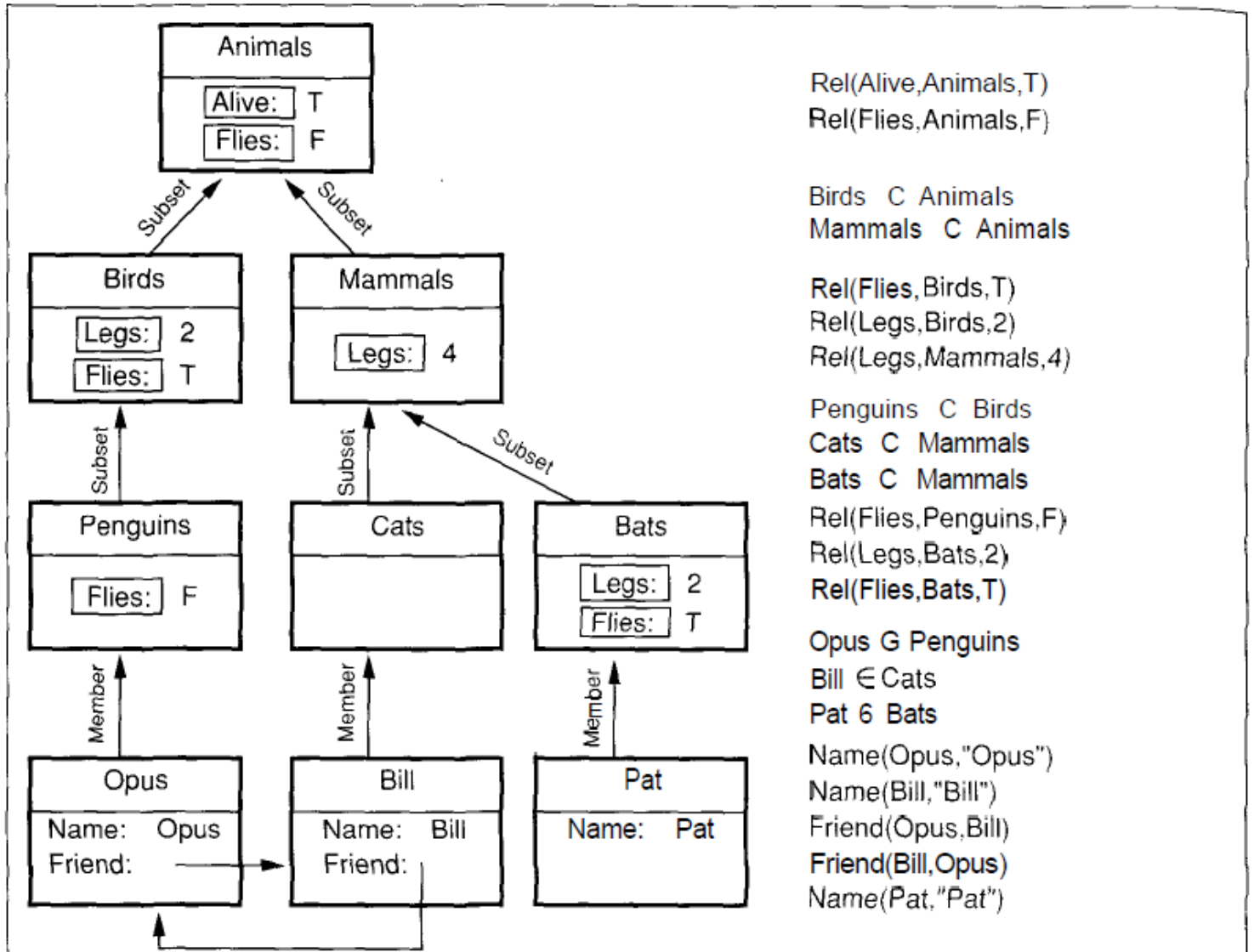


Figure 10.7 A frame-based network and a translation of the network into first-order logic. Boxed relation names in the network correspond to relations holding for all members of the set of objects.

Frames....

Link Type	Semantics	Example
$A \xrightarrow{Subset} B$	$A \subset B$	*Cats C Mammals*
$A \xrightarrow{Member} B$	$A \in B$	*Bill* G *Cats*
$A \xrightarrow{R} B$	$R(A, B)$	*Bill* $\xrightarrow{Age}$ 12
$A \xrightarrow{\boxed{R}} B$	$\forall x \; x \in A \Rightarrow R(x, B)$	*Birds* $\xrightarrow{Legs}$ 2
$A \xrightarrow{\boxed{\boxed{R}}} B$	$\forall x \; \exists y \; x \in A \Rightarrow y \in B \wedge R(x, y)$	*Birds* $\xrightarrow{Parent}$ *Birds*

Figure 10.8 Link types in semantic networks, and their meanings.

Conflicting inheritance (issues-difficult to decide)

-same object Opus belongs to two higher-level categories so two different values for the property Vocalization (which is the correct value as per the semantic network - Speech or Squawks?)

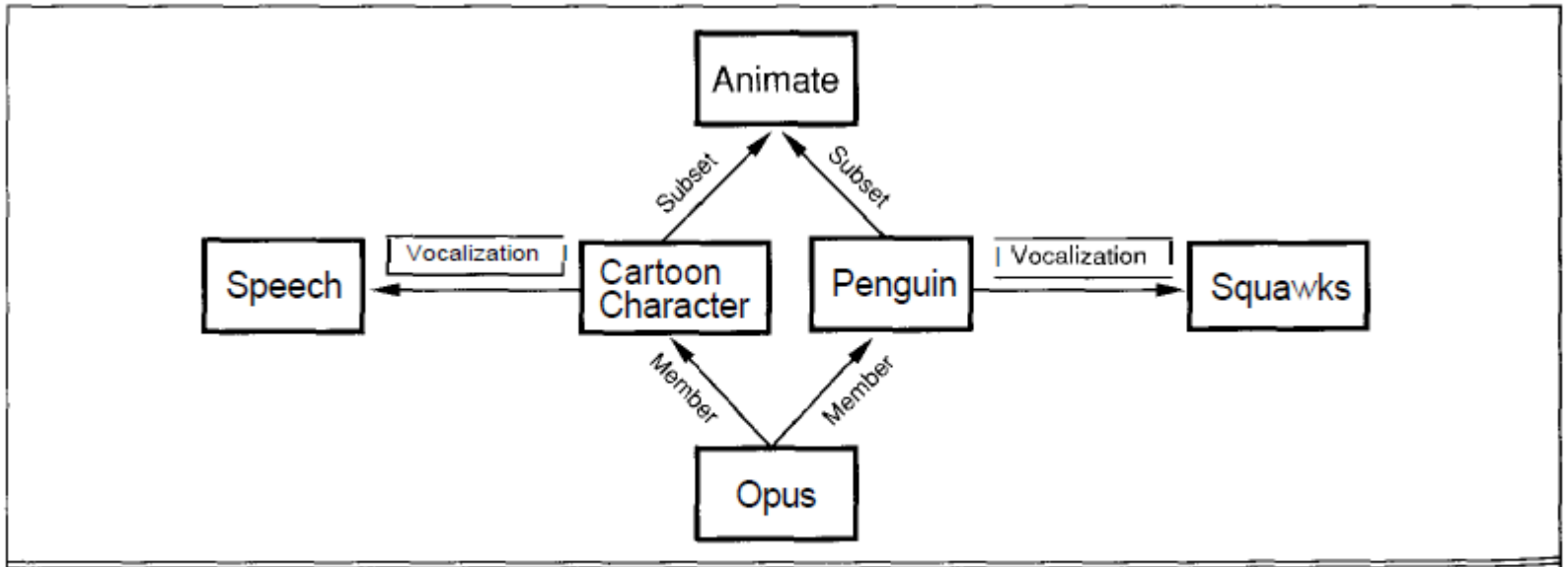


Figure 10.9 An example of conflicting inferences from multiple inheritance paths.