TARC
TUNKU ABDUL RAHMAN UNIVERSITY COLLEGE

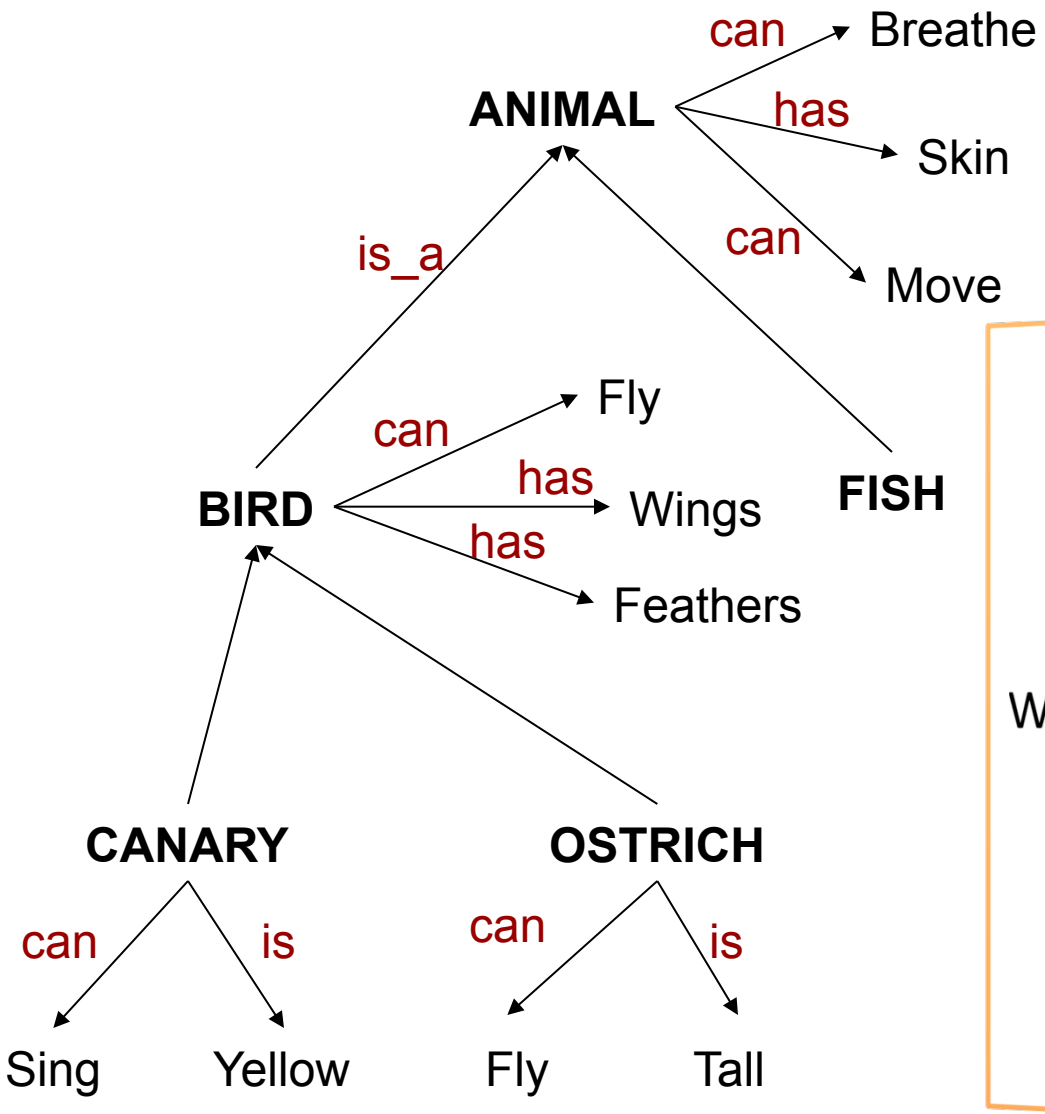
BACS2003 Artificial Intelligence

Chap 5: Knowledge Representation (Semantic Nets and Ontology)

Aims

- Semantic Network
- Conceptual Graph
- And/Or Graph
- Ontology

Example of semantic network

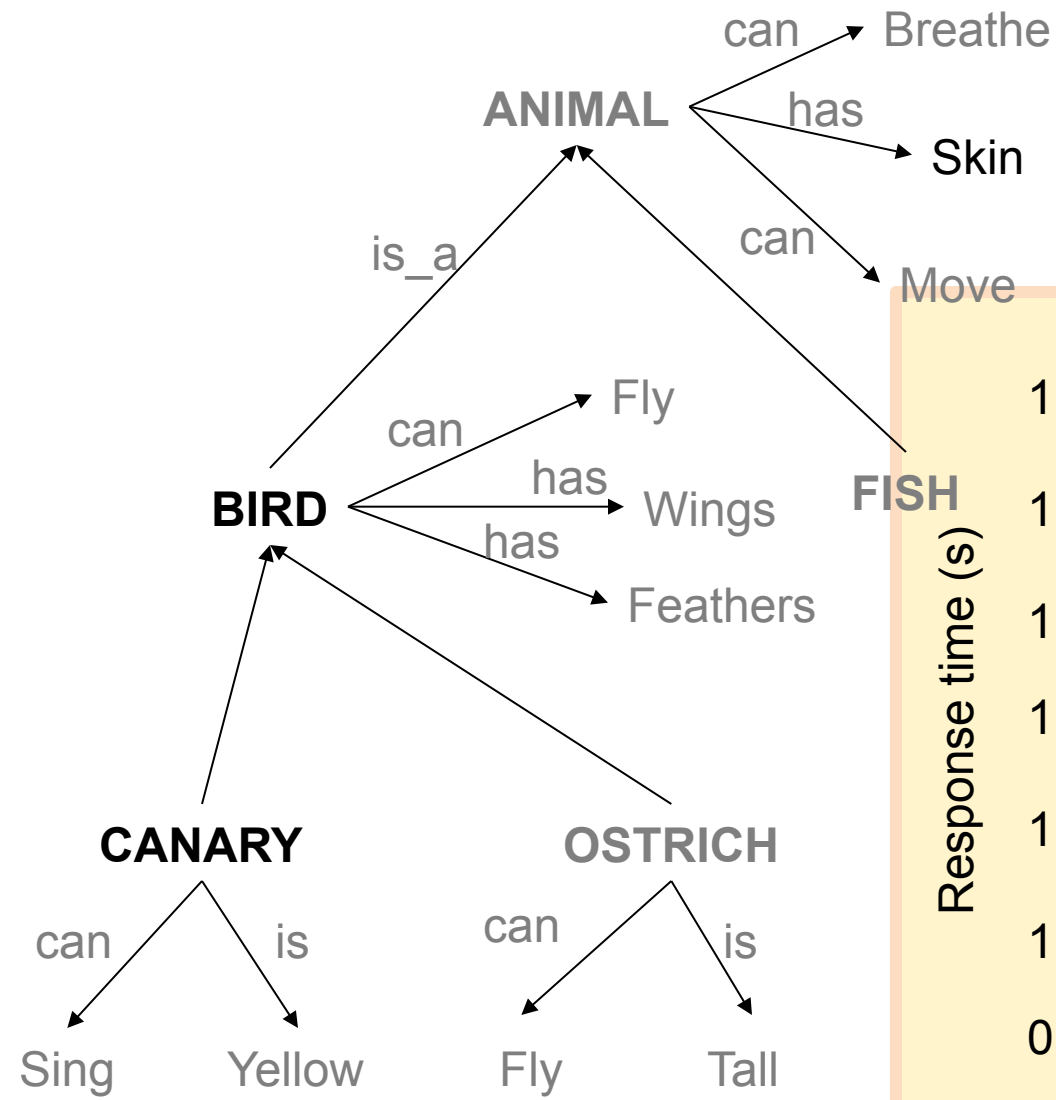


Consider these sentences:

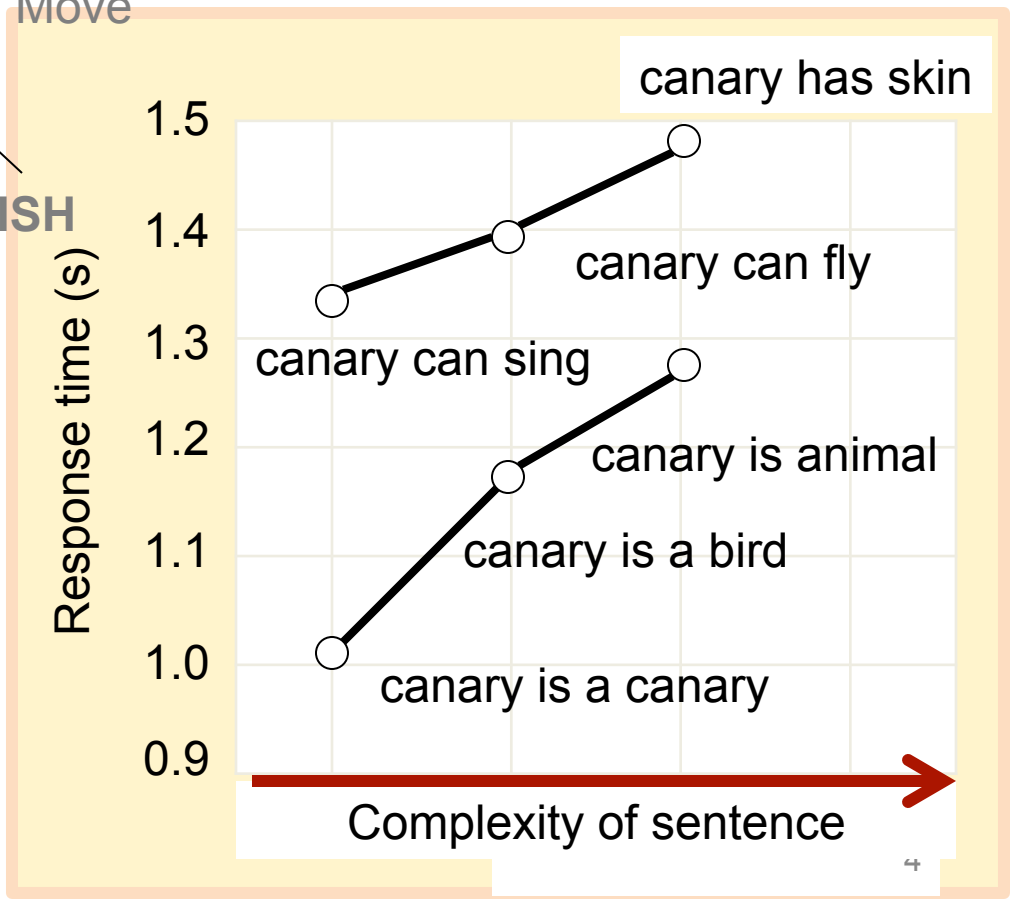
1) Canary is canary
2) Canary is a bird
3) Canary has skin

Which of the above needs longer processing time?

human information storage and response times



Research by Collins & Quillian



Semantic Nets

Relationship to other concepts

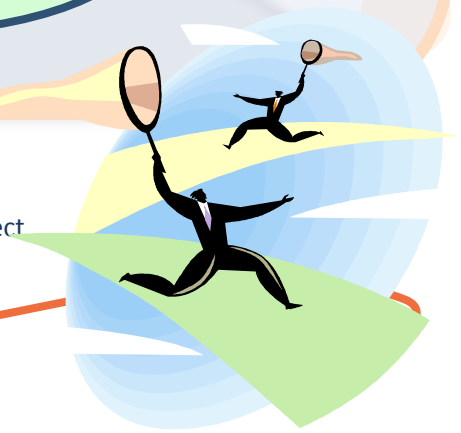
concepts: interconnecting nodes

Semantic Nets

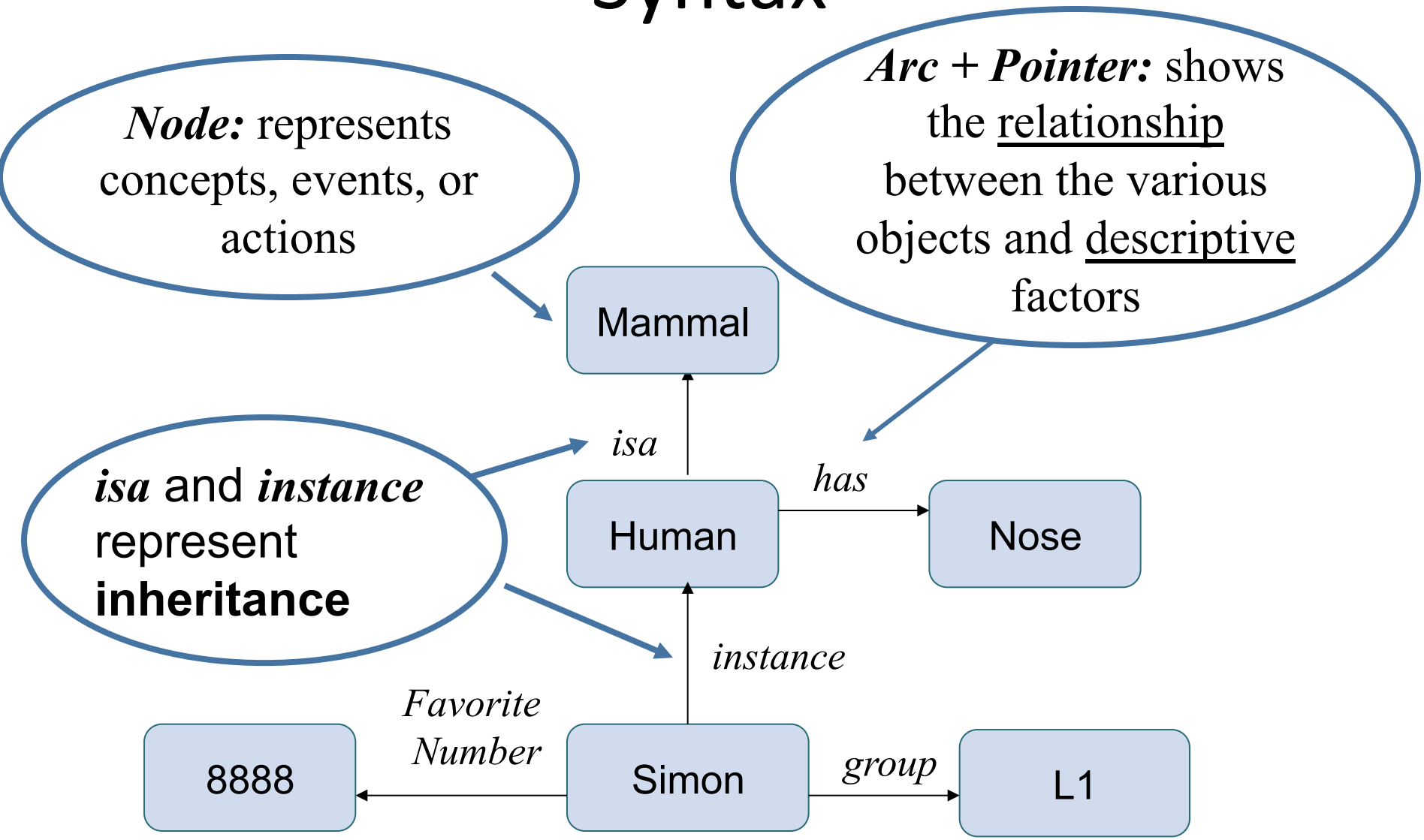
relationships: Labelled arcs

Associationist Theory

- The meaning of a concept comes from its relationship to other concepts
- *Associationist* theories: define the meaning of an object in terms of a network of associations with other object
- The information is stored by interconnecting nodes with labelled arcs

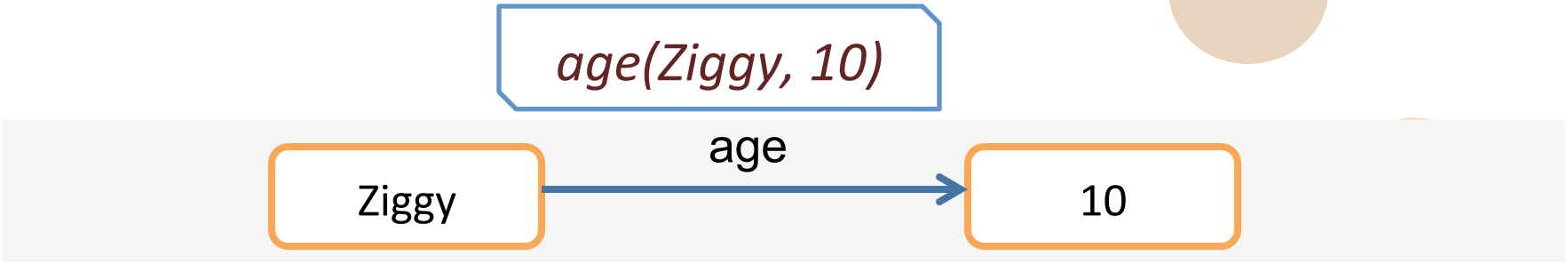


Syntax

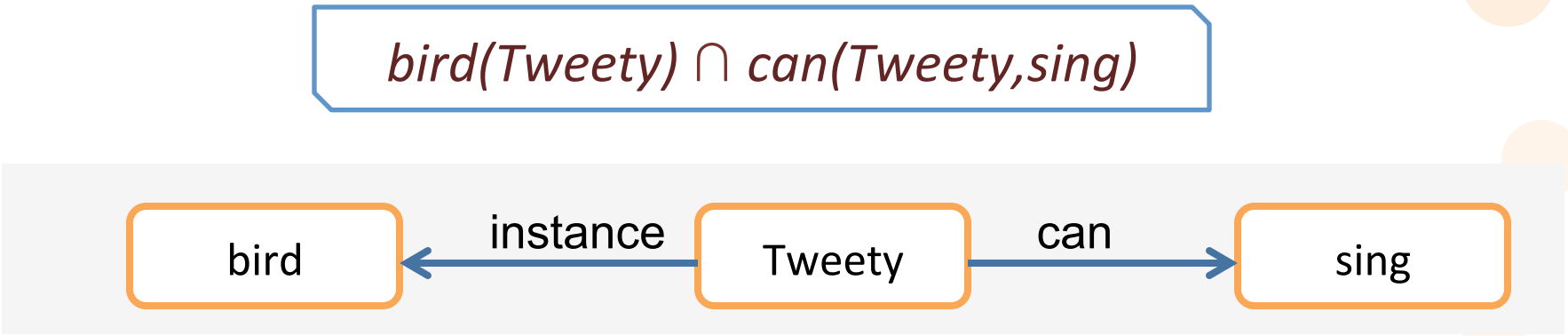

Node: represents concepts, events, or actions
Arc* + *Pointer: shows the relationship between the various objects and descriptive factors
isa and ***instance*** represent **inheritance**
Mammal
isa
Human
has
Nose
instance
Favorite Number
8888
Simon
group
L1

Example

1. "Ziggy is 10 years old"



2. "Tweety the bird, can sing"



Question

1. Represent the following statement into ONE semantic network.

   “Ice is cold and clear”

Question

Represent the terms below into **ONE** semantic network.

construction(human, biological).

construction(robot, mechanical).

isa(X, human)→ isa(X,autonomous-system).

isa(X,robot) → isa(X,autonomous-system).

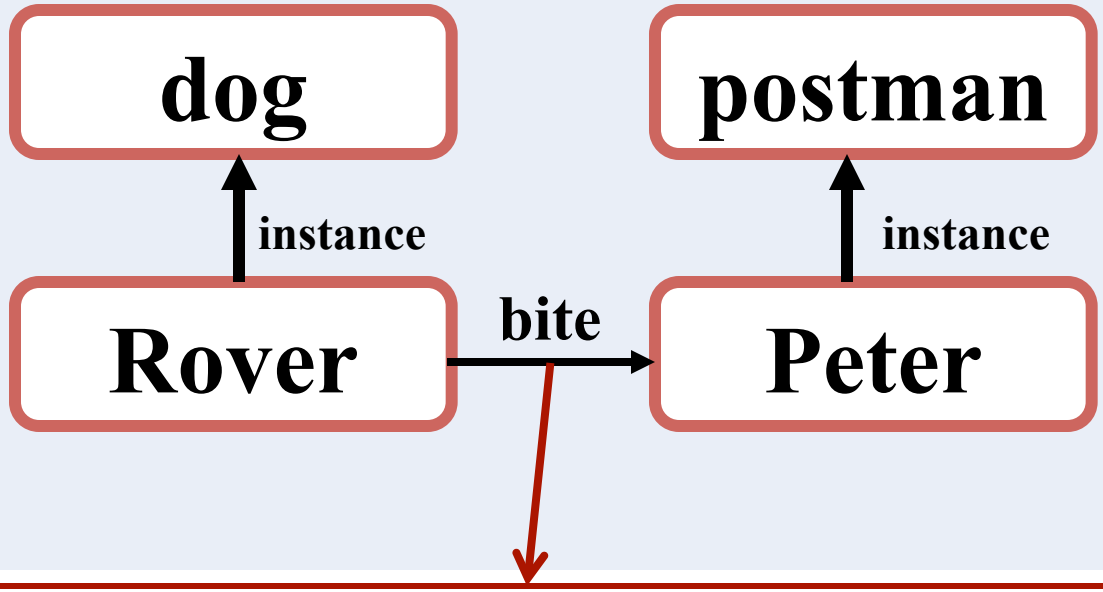
isa(John, human).

isa(Roomba, robot).

Extending Sem. Nets (Not quantified)

Rover, the dog bit Peter, the postman

dog(Rover) ^ bite(Rover, Peter) ^ postman(Peter)

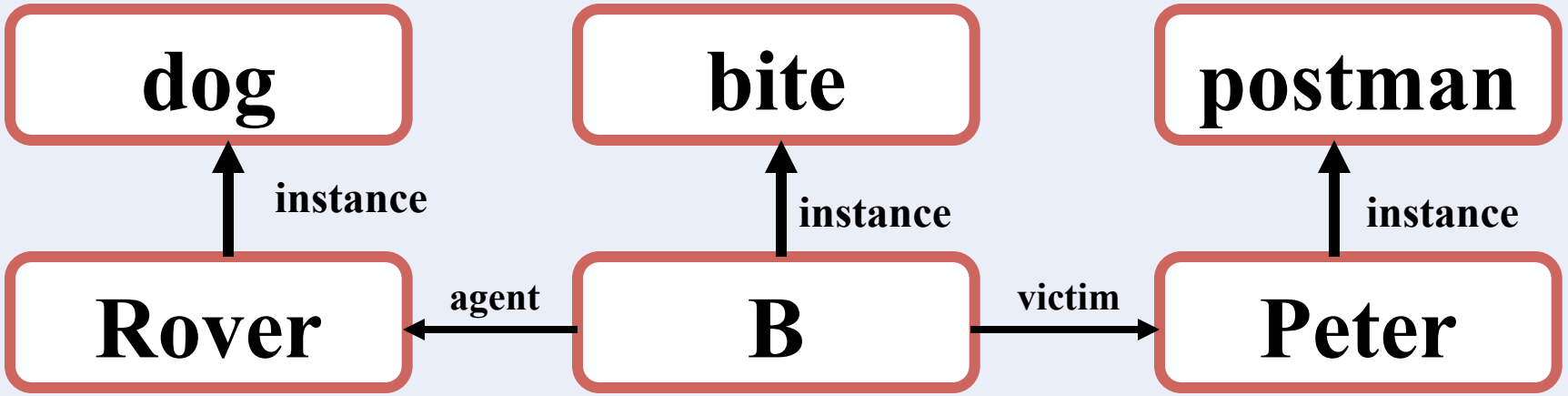


if we also would like to extend the event *bite*…

Extending Sem. Nets (Not quantified)

Rover, the dog bit Peter, the postman

dog(Rover) ^ bite(Rover, Peter) ^ postman(Peter)

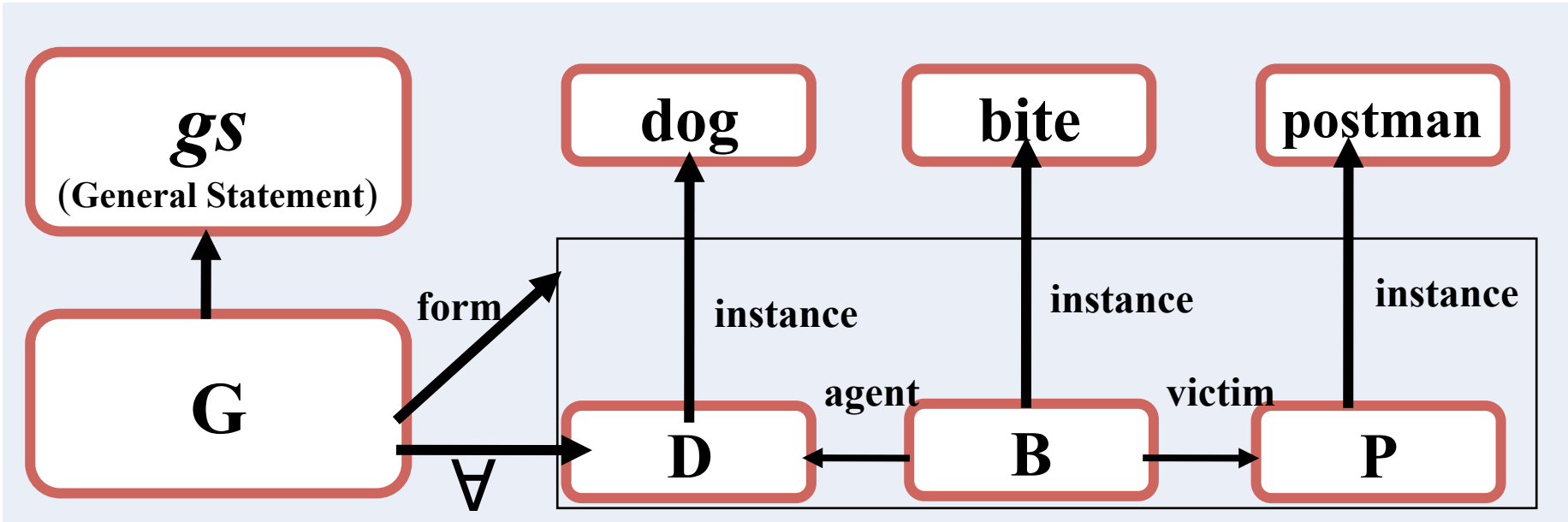


Extending Sem. Nets (quantified)

Partitioned Semantic Networks allow expressions to be quantified.

Every dog has bitten a postman

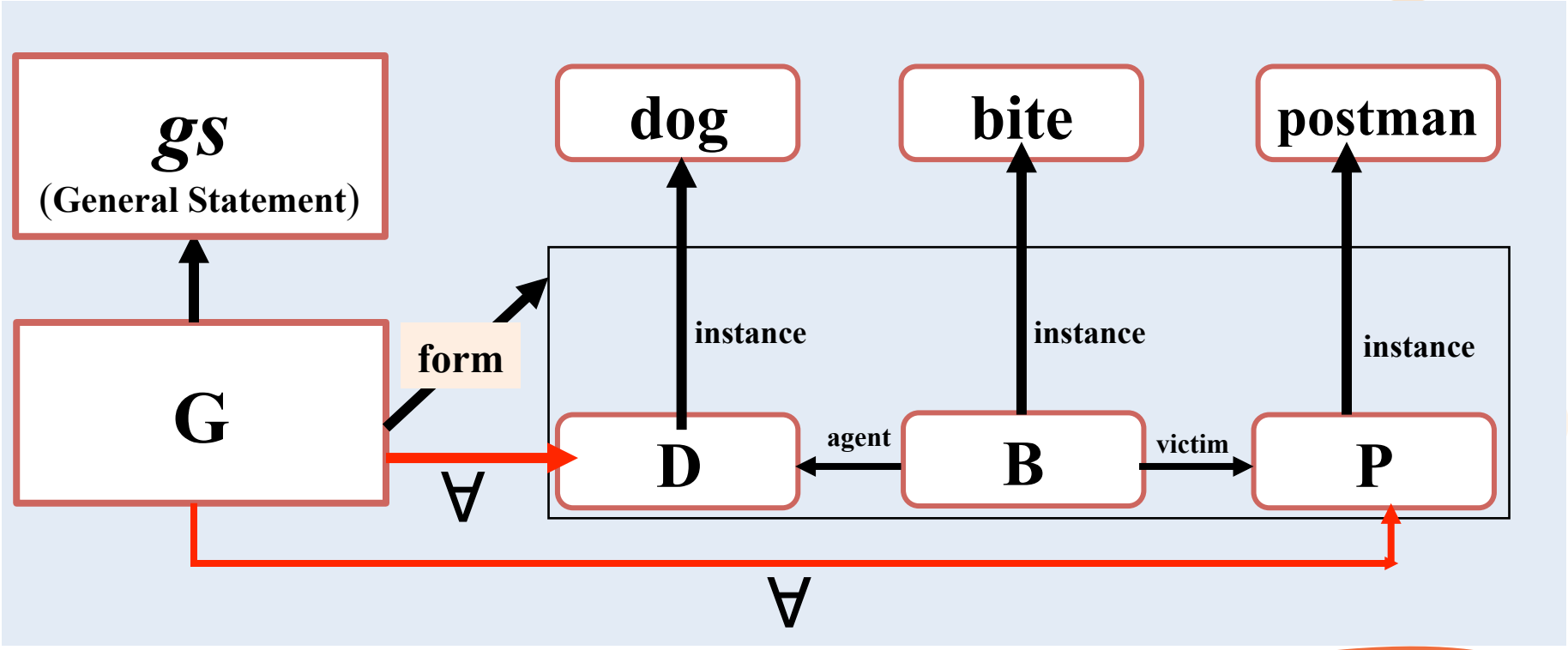
$$\forall D: dog(D) \rightarrow bite(D, P) \wedge postman(P)$$



Extending Sem. Nets (quantified - 2)

Every dog has bitten every postman

$$\forall D\ \forall P: dog(D) \rightarrow bite(D, P) \wedge postman(P)$$



Representing Non-binary Predicates

Binary predicate involves only 2 arguments/objects, e.g.

- ***team(Ronaldo, RealMadrid).***

Non-binary predicate involves more than 2 arguments, e.g.

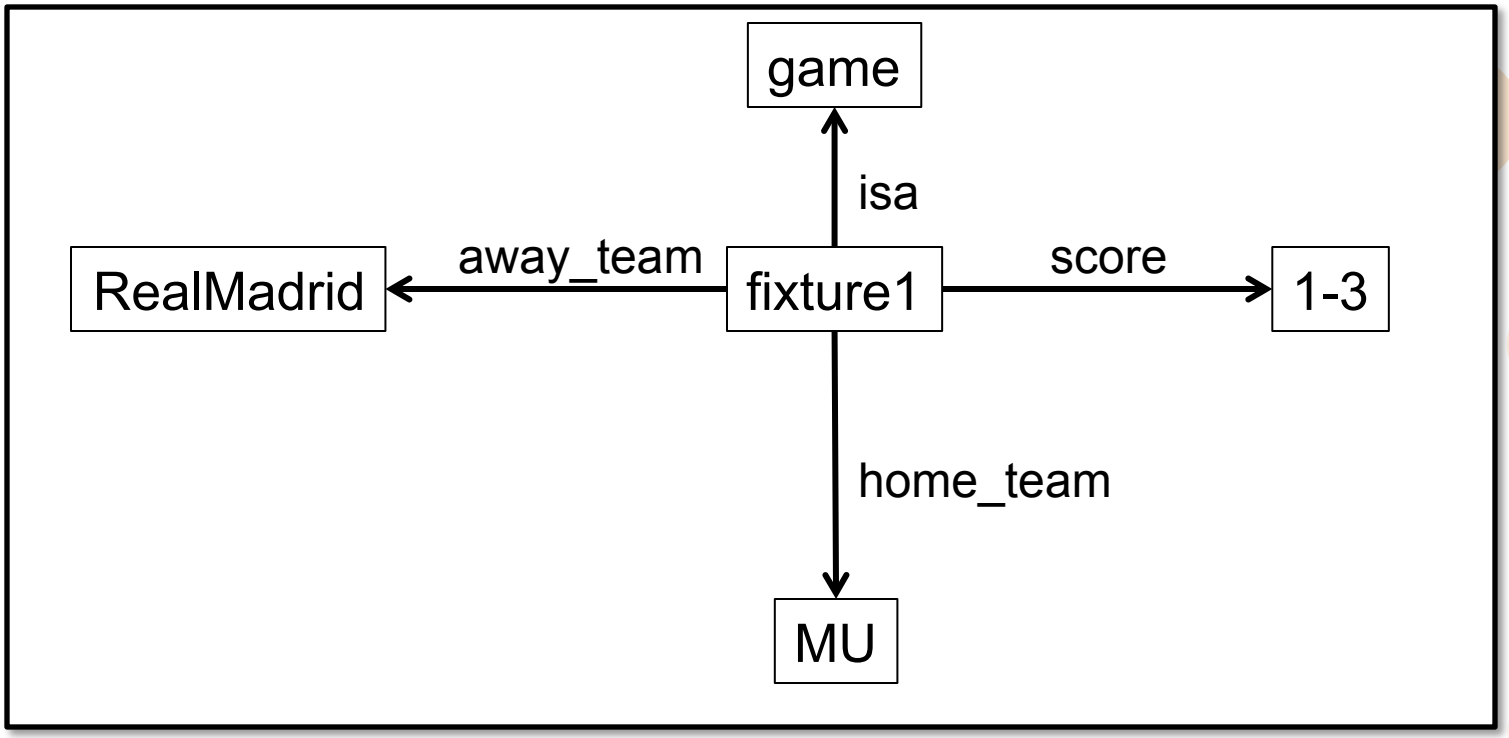
- ***score(RealMadrid, MU, 1-3).***

To create a semantic network that represents non-binary predicate:

1. Create new nodes (add more information)
2. Relate (new) information to nodes

Example

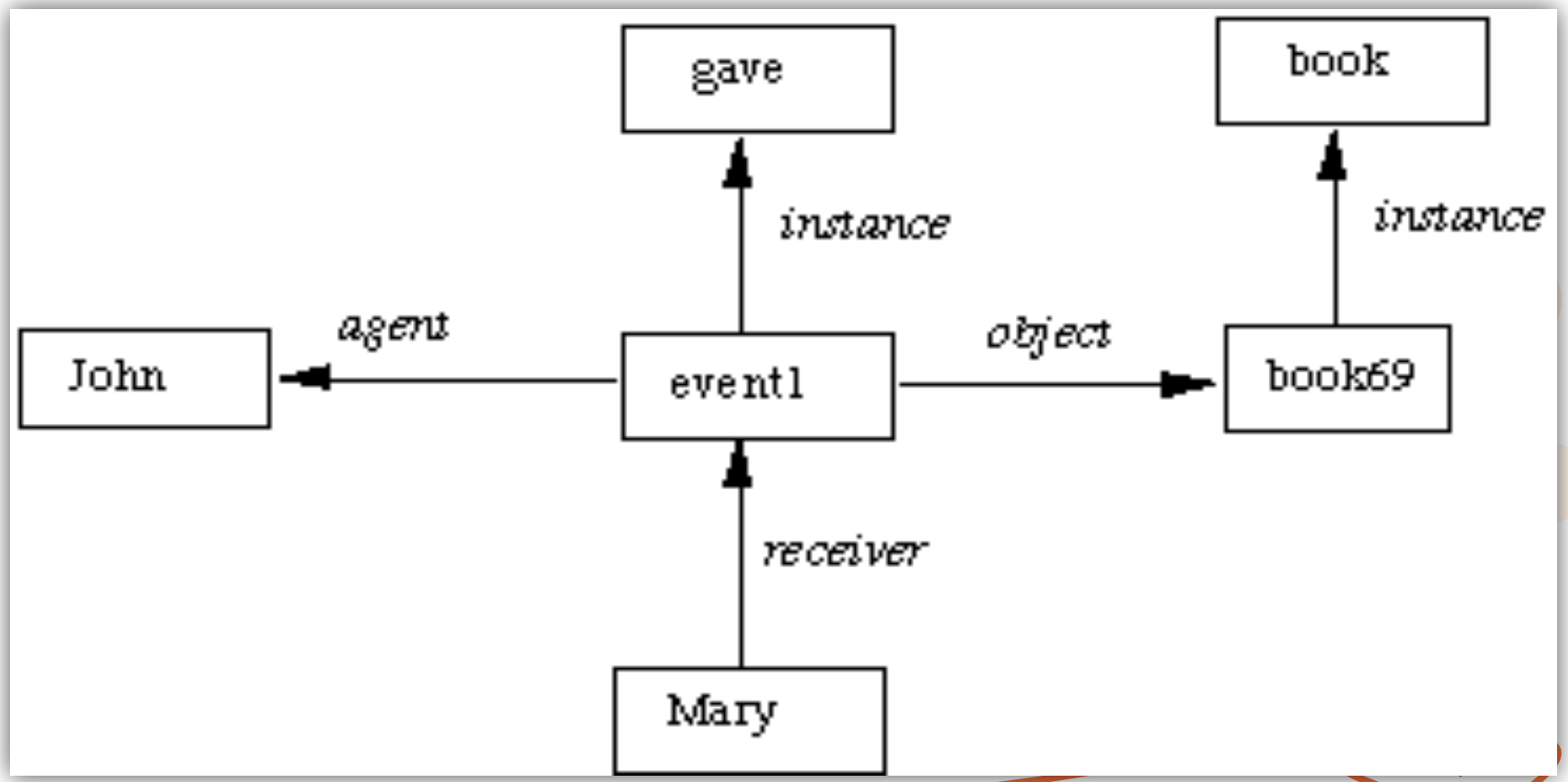
score(RealMadrid, MU, 1-3)



Example

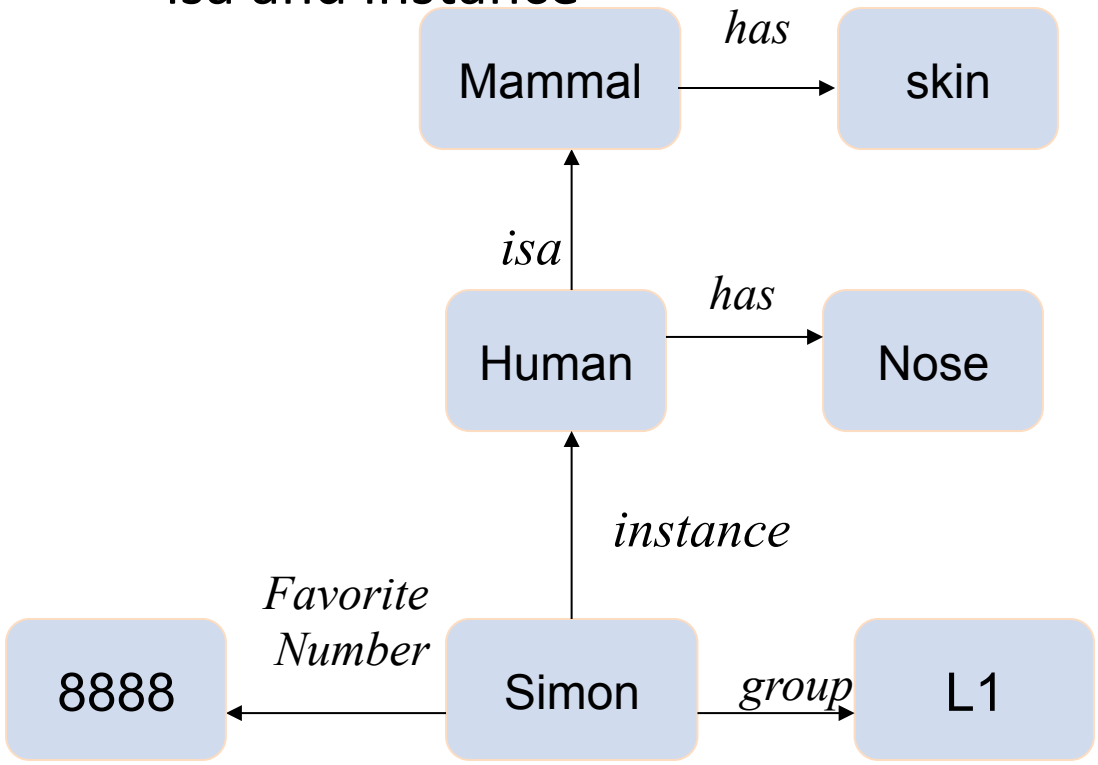
"John gave the book to Mary."

gave(John, Mary, book)



Inference in Semantic Nets

- Follow between nodes
- Intersection search
- Inheritance
  - isa and instance



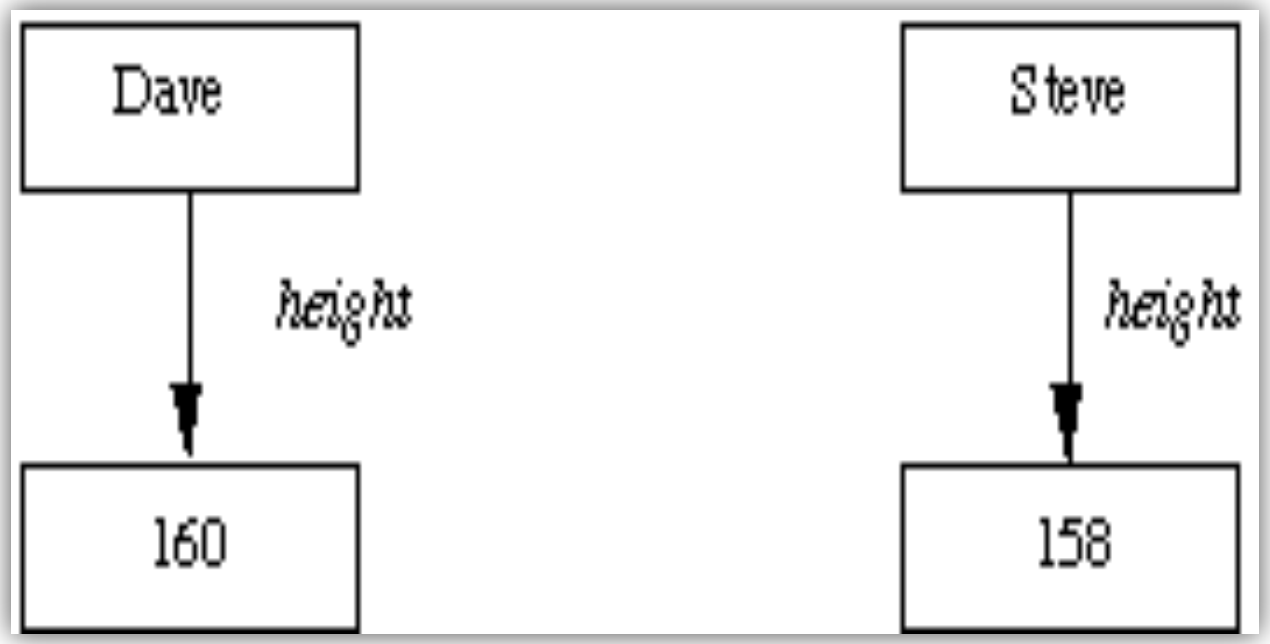
Consider these queries:

1) What is a mammal?
2) Who is Simon?
3) Simon has What?

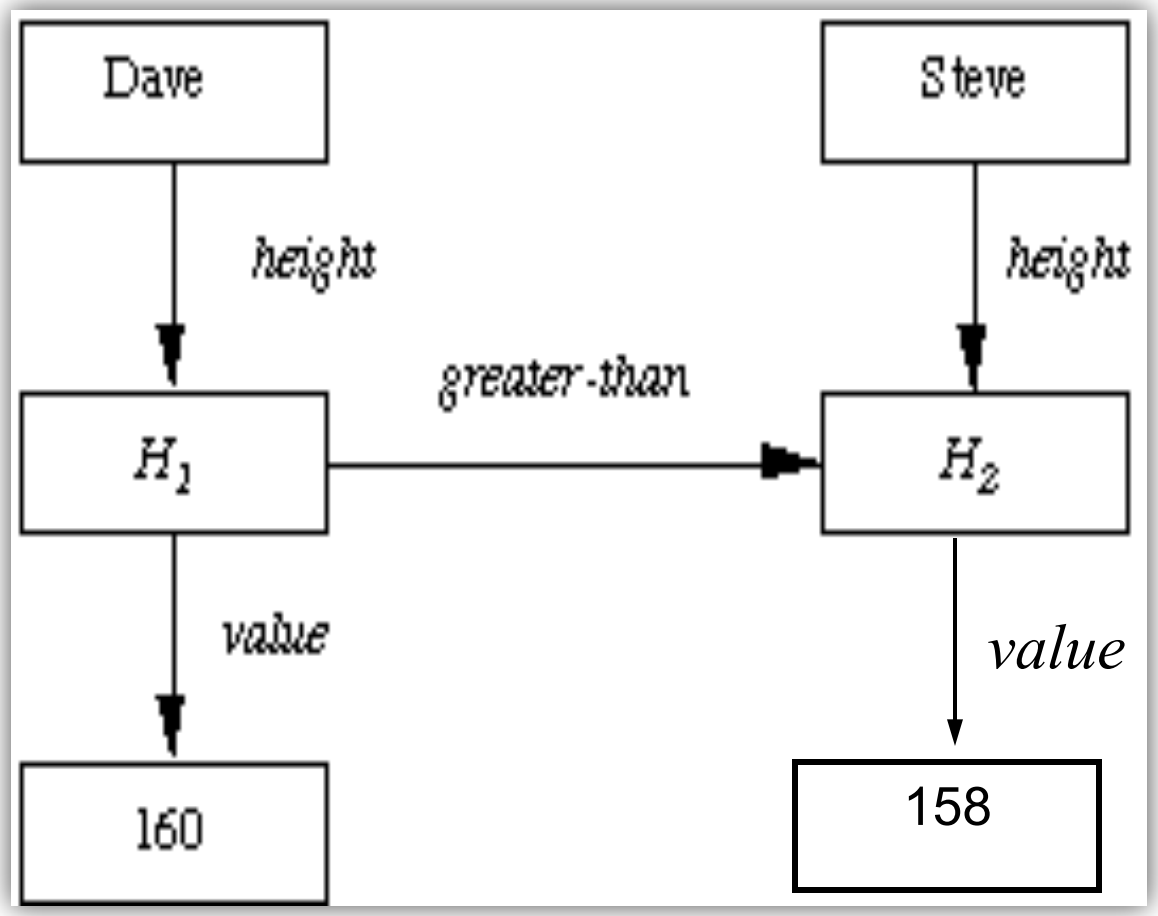
What are the outputs?

Comparing 2 Objects

- The height of two people is depicted as below:

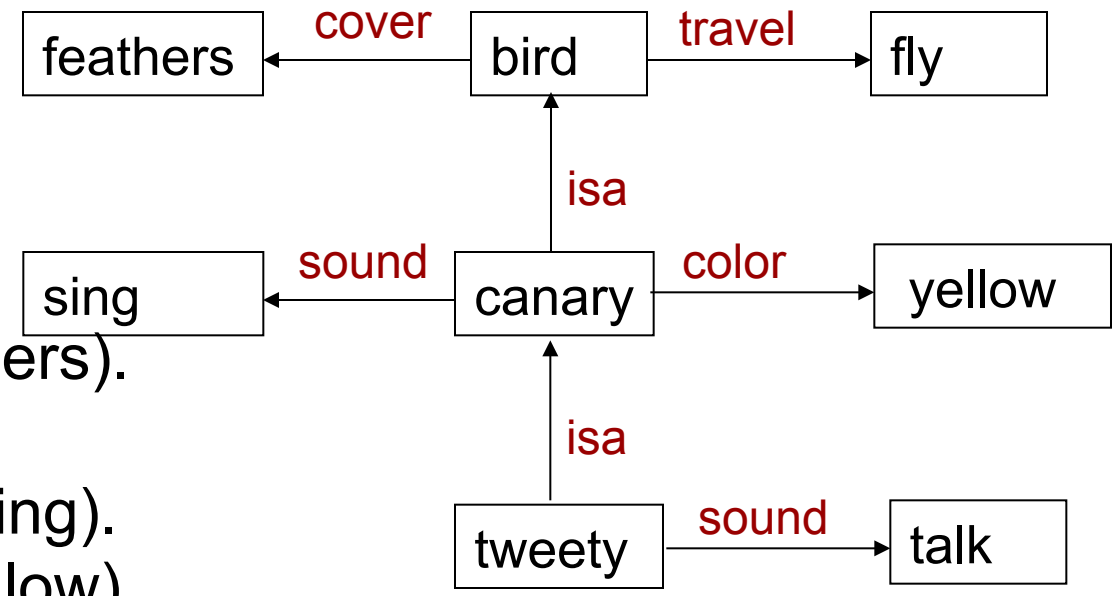


Comparing 2 Objects (cont)



Special procedures are needed to process these nodes, but without this distinction the analysis would be very limited.

Implementing semantic net in Prolog




```
%bird hierarchy
isa(canary,bird).
isa(tweety,canary).
hasprop(bird,cover,feathers).
hasprop(bird,travel,fly).
hasprop(canary,sound,sing).
hasprop(canary,color,yellow).
hasprop(tweety,sound,talk).
```

```
hasproperty(Object,Property,Value):-
        hasprop(Object, Property, Value).

hasproperty(Object,Property,Value):-
        isa(Object,Parent), % Inheritance
        hasprop(Parent, Property, Value).
```

Knowledge Representation

CONCEPTUAL GRAPH

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Conceptual Graph

- The nodes of the graph are either concepts or conceptual relations.
- Do not use labeled arcs
- Conceptual relations nodes represent relations between concepts.

Example

the following information is given:

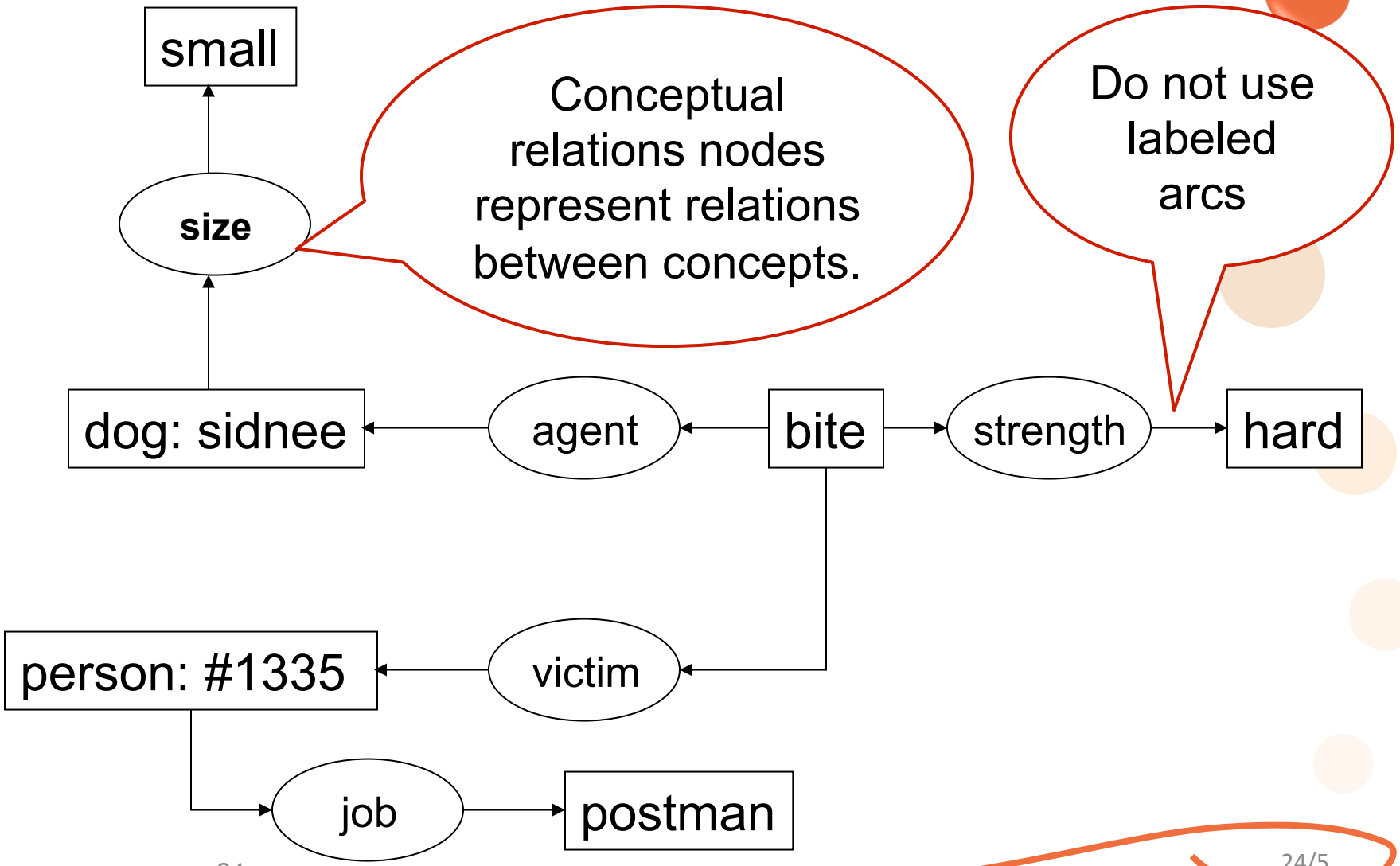
Sidnee is a small dog.

Sidnee bites a postman very hard.

instance(sidnee, dog), size(sidnee, small)

bites(sidnee, postman), strength(bite,hard)

Example (cont) - Conceptual Graph



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Knowledge Representation

AND/OR GRAPH

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And/Or Graphs

- It's known as *hypergraph.*
- Some call it as *inference network*

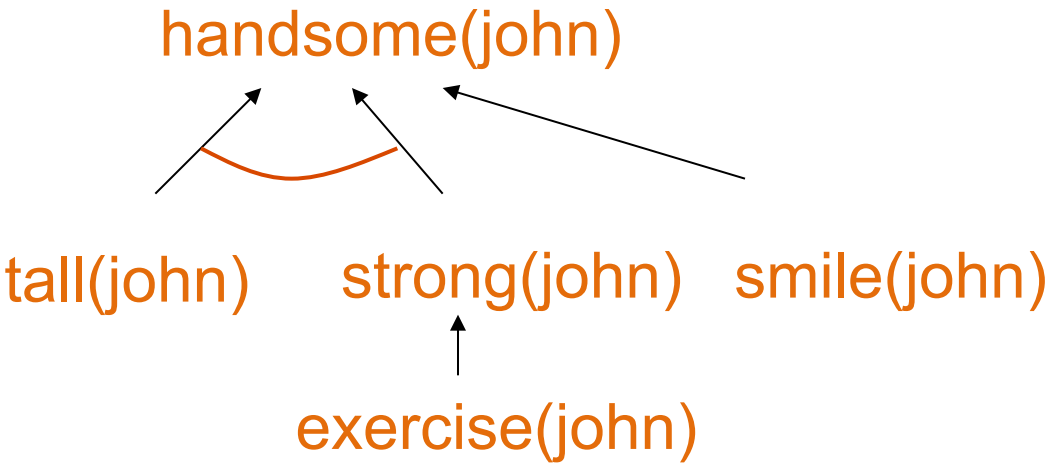
And/Or Graphs

- Involves logical operators **and** and **or**
- expression **q ^ r → p**
  - (both **q** and **r** must be true for **p** to be true)
- Expression **q V r → p**
  - (**q** or **r** is sufficient to prove **p** is true)
  - Also can be written as **q → p , r → p**

Example

- IF john smiles, THEN he looks handsome
- IF john is tall and strong, THEN he looks handsome
- IF john does exercise, THEN he is strong

The graph will look like this:



Try This

Rule 1:

IF	The condition of car is poor	E1
OR	The price of the car is high	E2
THEN	Don't buy the car	H1

Rule 2:

IF	Mileage on the car >100,000	E3
AND	The car is city driven	E4
AND	The body of the car is bad	E5
THEN	The condition of the car is poor	E1

Rule 3:

IF	The car has dents	E6
THEN	The body of the car is bad	E5

Rule 4:

IF	The car has rust	E7
THEN	The body of the car is bad	E5

Next

NATURAL LANGUAGE PROCESSING

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