Artificial Intelligence

Open Elective

Module 3: Weak Slot And Filler Structures CH9

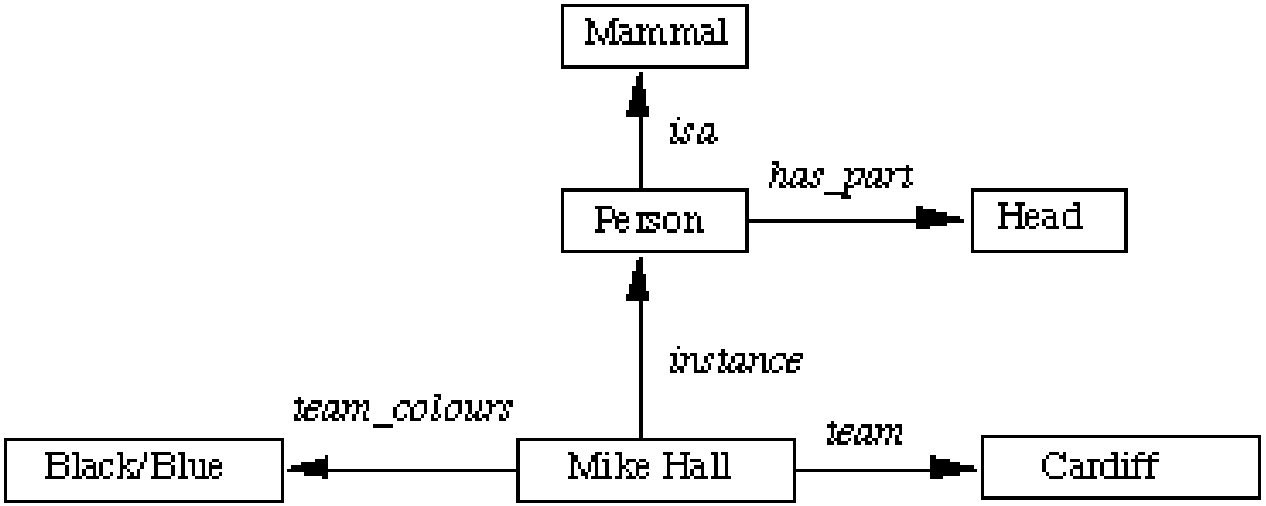
Dr. Santhi Natarajan
Associate Professor
Dept of AI and ML
BMSIT, Bangalore

Semantic Nets

Why semantic nets?

- The meaning of a concept comes from its relationship to other concepts.
- The information is stored by interconnecting nodes with labelled arcs.

A Semantic Network

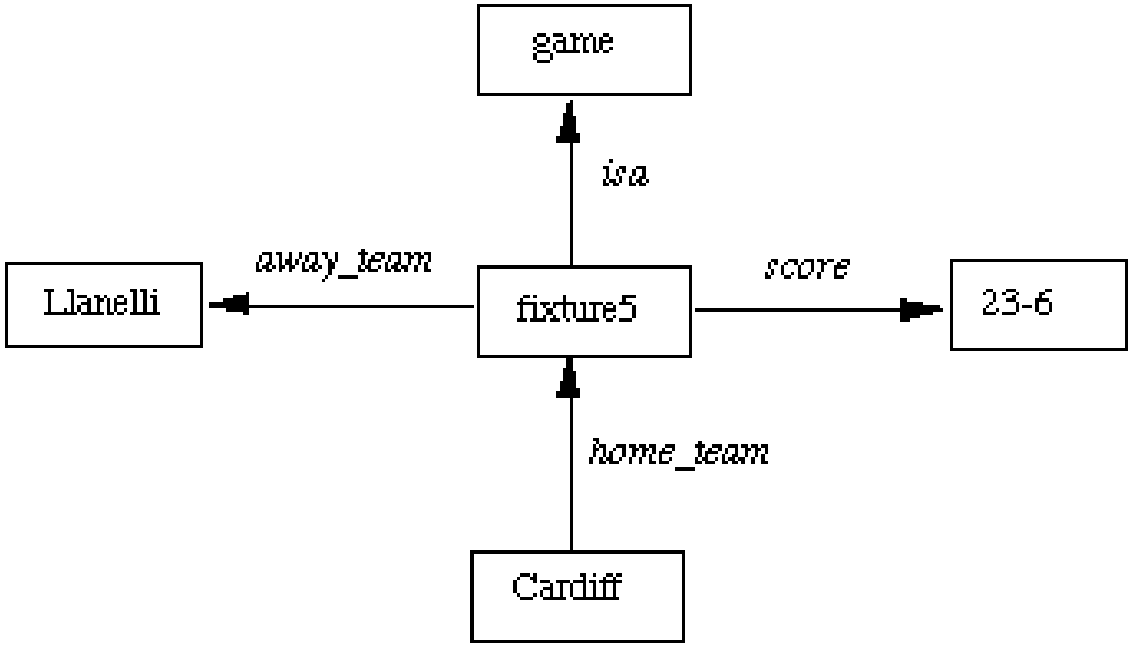


isa(person, mammal), instance(Mike-Hall, person) team(Mike-Hall, Cardiff)

Semantic Nets

A Semantic Network for *n*-Place Predicate

score(Cardiff, Llanelli, 23-6)



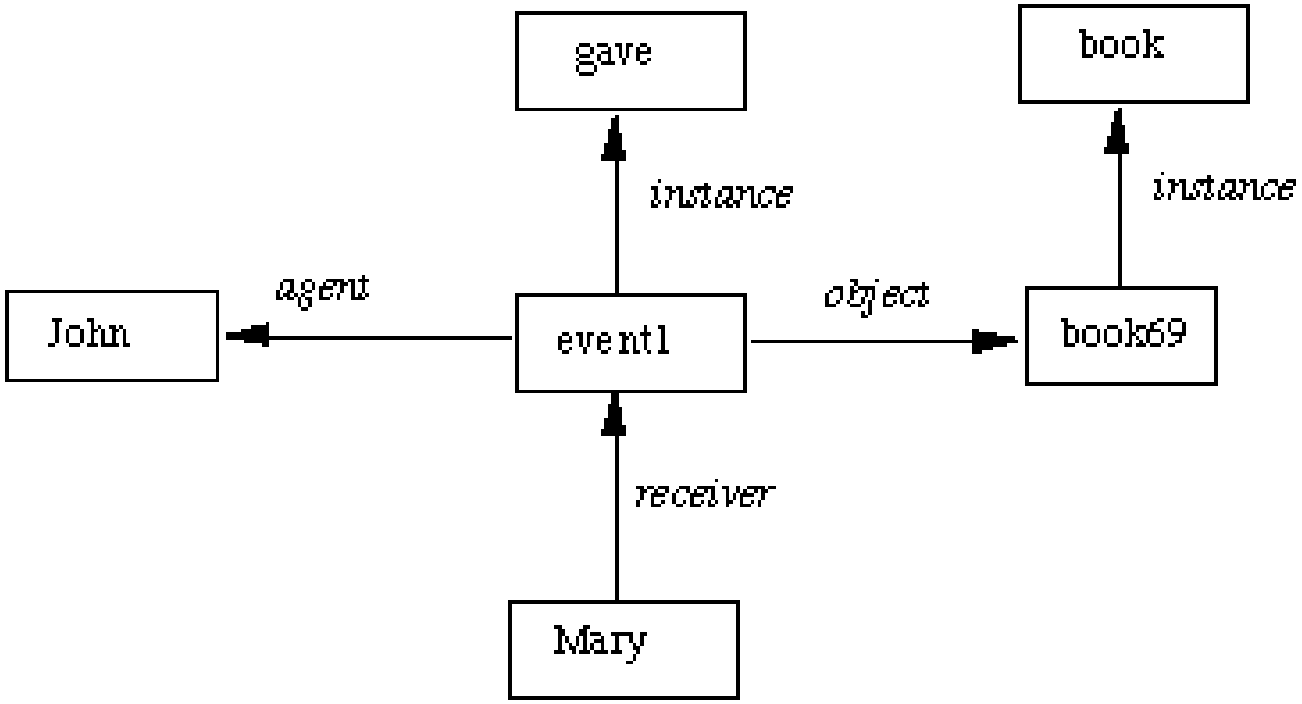
- Create new nodes to represent new objects either contained or alluded to in the knowledge, *game* and *fixture* in the current example.

- Relate information to nodes and fill up slots

Semantic Nets

A Semantic Network for a Sentence

John gave Mary the book



Semantic Nets

Basic inference mechanism: *follow links between nodes*.

Two methods to do this:

Intersection search–

- The notion that *spreading activation* out of two nodes and finding their intersection finds relationships among objects.
- This is achieved by assigning a special tag to each visited node.
- Many advantages including entity-based organisation and fast parallel implementation.
- However very structured questions need highly structured networks.

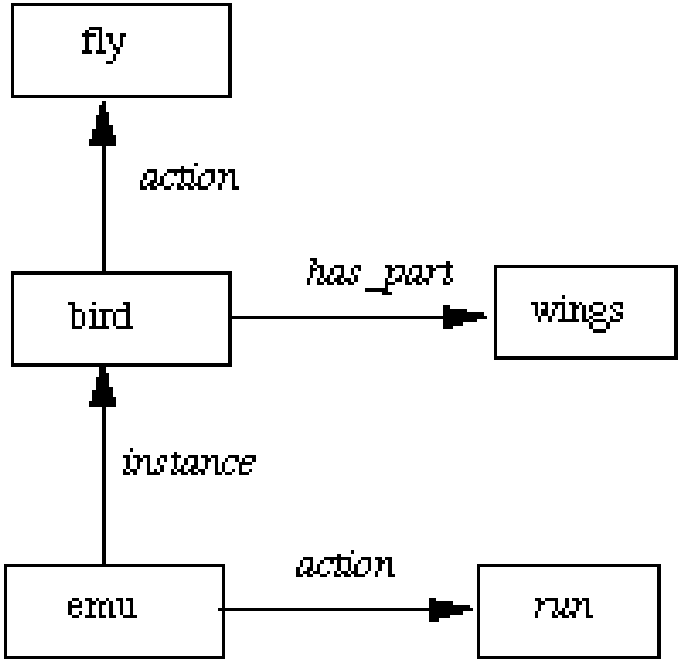
Inheritance

- The *isa* and *instance* representation provide a mechanism to implement this.

- Inheritance also provides a means of dealing with *default reasoning*

Semantic Nets

A Semantic Network for a Default Reasoning



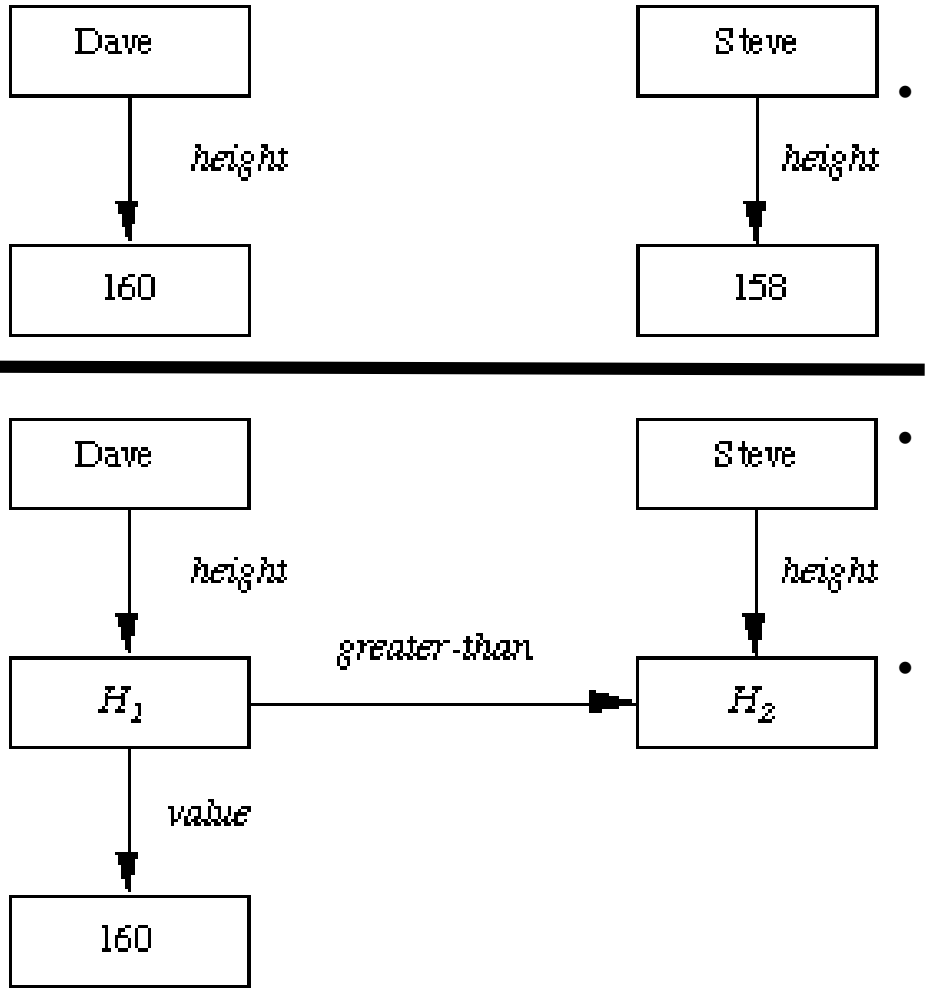
Inheritance also provides a means of dealing with *default reasoning*.

E.g. we could represent:

- Emus are birds.
- Typically birds fly and have wings.
- Emus run.

Semantic Nets

A Semantic Network for a Distinguishing



- In making certain inferences we will also need to *distinguish between the link that defines a new entity and holds its value and the other kind of link that relates two existing entities*.
- Consider the example shown where the height of two people is depicted and we also wish to compare them.
- We need extra nodes for the concept as well as its value

Semantic Nets

Extending Semantic Nets

Here we will consider some extensions to Semantic nets that overcome a few problems (see Exercises) or extend their expression of knowledge.

Partitioned Networks

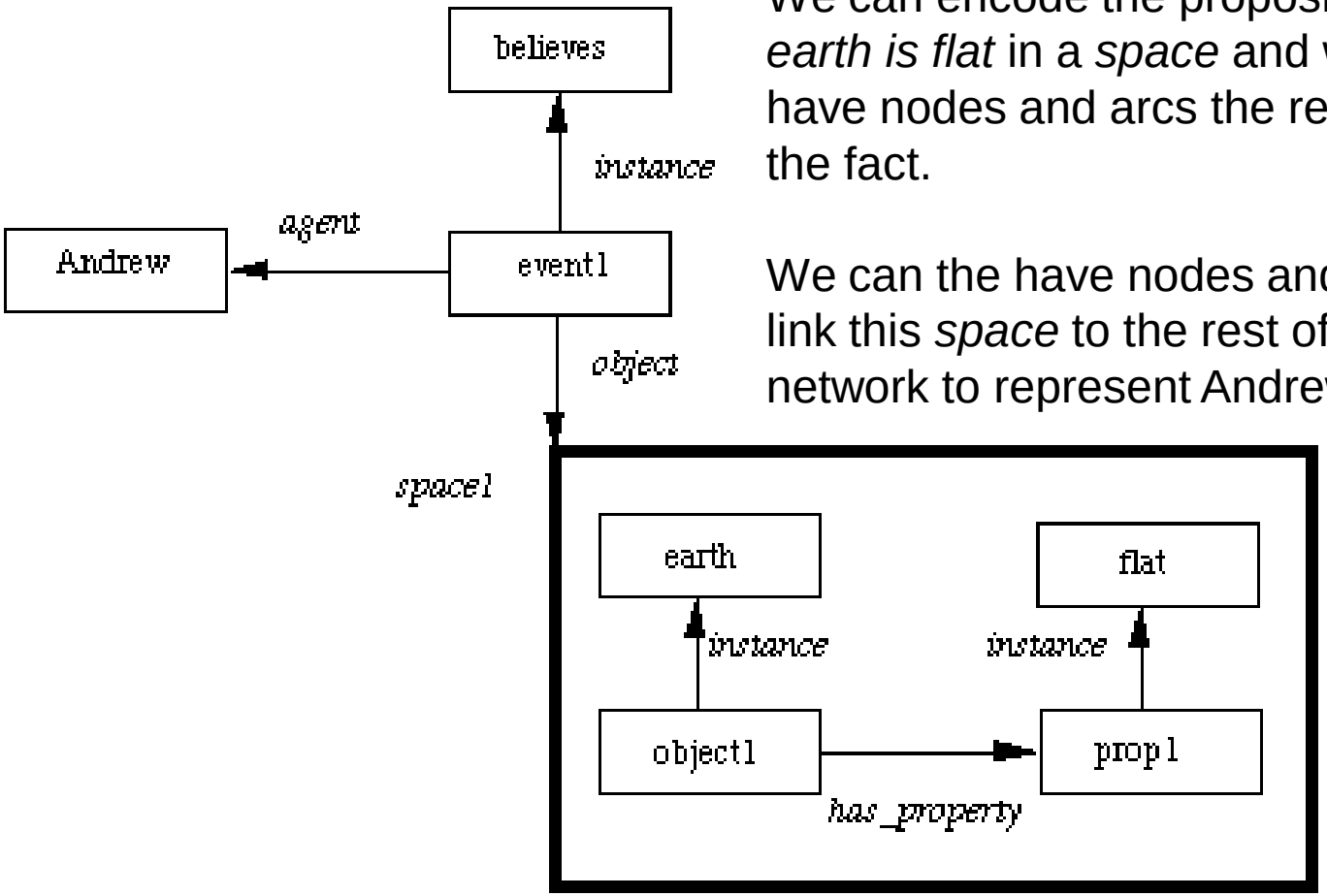
Partitioned Semantic Networks allow for:

- Propositions to be made without commitment to truth.
- Expressions to be quantified.
- Basic idea: *Break network into **spaces** which consist of groups of nodes and arcs and regard each **space** as a node.*

Semantic Nets

Extending Semantic Nets

Partitioned Network



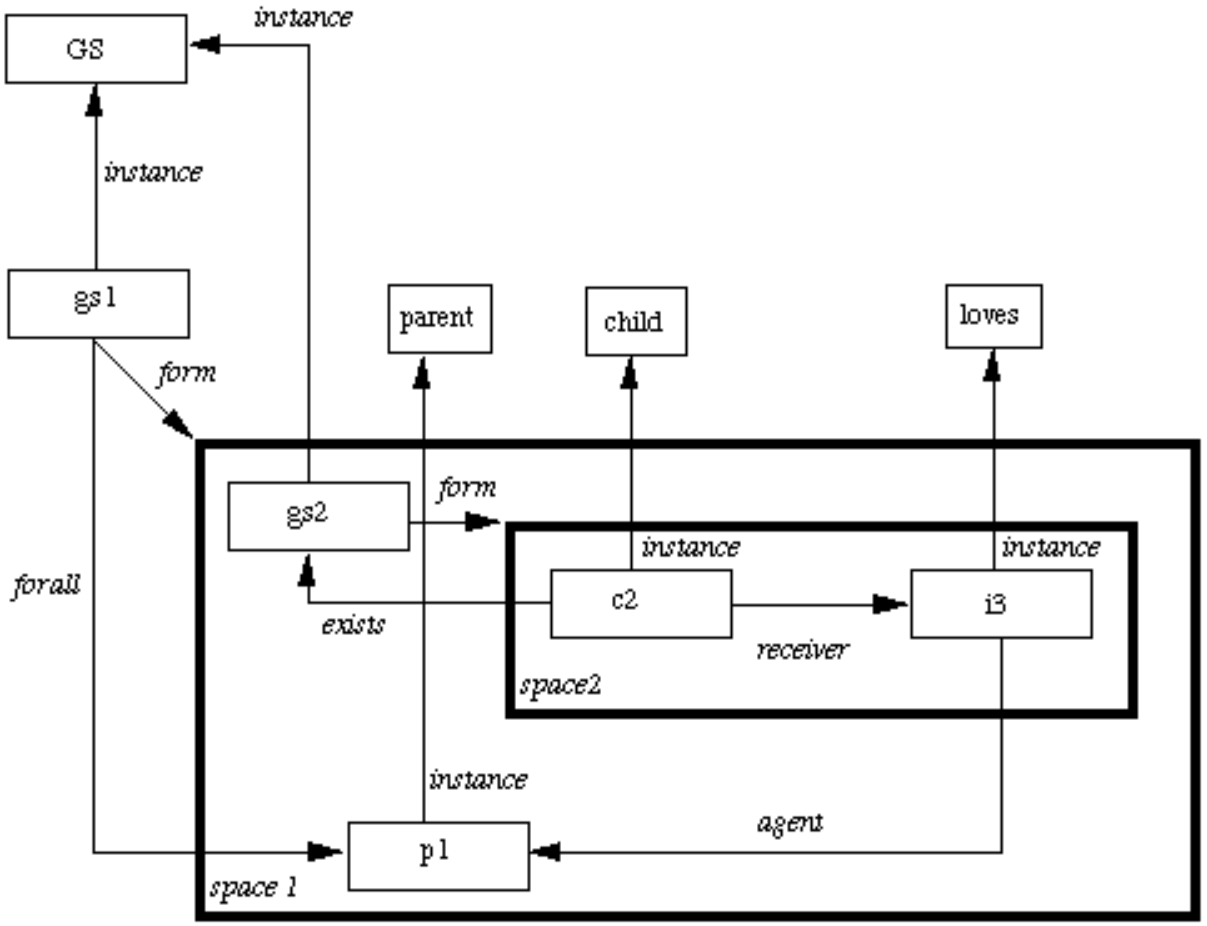
Andrew believes that the earth is flat.

We can encode the proposition *the earth is flat* in a *space* and within it have nodes and arcs the represent the fact.

We can the have nodes and arcs to link this *space* to the rest of the network to represent Andrew's belief.

Semantic Nets

Extending Semantic Nets: Partitioned network "Every parent loves their child"



Semantic Nets

Extending Semantic Nets: Partitioned network "Every parent loves their child"

$$\forall x : parent(x) \rightarrow \exists y: child(y) \wedge loves(x,y)$$

- Create a *general statement*, GS, special class.
- Make node g an instance of GS.
- Every element will have at least 2 attributes:
  - A *form* that states which relation is being asserted.
  - one or more *forall* () or *exists* () connections -- these represent universally quantifiable variables in such statements *e.g. x*, *y*

- Also If we change the sentence to *Every parent loves child* then the node of the object being acted on (*the child*) lies outside the form of the general statement. Thus it is not viewed as an existentially qualified variable whose value may depend on the agent.

Frames

- Frames can also be regarded as an extension to Semantic nets.
- Indeed it is not clear where the distinction between a semantic net and a frame ends.
- Semantic nets initially we used to represent labelled connections between objects.
- As tasks became more complex the representation needs to be more structured.
- The more structured the system it becomes more beneficial to use frames.
- A *frame* is a collection of attributes or slots and associated values that describe some real world entity.
- Frames on their own are not particularly helpful but frame systems are a powerful way of encoding information to support reasoning.
- Set theory provides a good basis for understanding frame systems. Each frame represents:
  - A class (set)
  - An instance (an element of a class).

Frames

Cardiff-RFC

instance:	*Rugby-Team*
Team-size:	*15*
Coach:	*Terry Holmes*
Players:	*{Robert-Howley, Gwyn-Jones, ...}*

Person

isa:	*Mammal*
Cardinality:	*...*

Adult-Male

isa:	*Person*
Cardinality:	*...*

Rugby-Player

isa:	*Adult-Male*
Cardinality:	*...*
Height:	
Weight:	
Position:	
Team:	*Team-Colours:*

Back

isa:	*Rugby-Player*
Cardinality:	*...*
Tries:	

Mike-Hall

instance:	*Back*
Height:	*6-0*
Position:	*Centre*
Team:	*Cardiff-RFC*
Team-Colours:	*Black/Blue*

Rugby-Team

isa:	*Team*
Cardinality:	*...*
Team-size:	*15*
Coach:	