Semantic Nets

- The meaning of a concept comes from the ways in which it is connected to other concepts.
- Information is represented as a set of nodes connected to each other by a set of labelled arcs.
  - The arcs represent the relationships among the nodes.
- Already seen the baseball player example.

Semantic Nets

- Representing Nonbinary Predicates
  - SN are a natural way to represent ground instances of binary predicates in predicate logic.
    - isa(Person, Mammal)
    - instance(Bob, Person)
    - team(Bob, Cubs)
  - But what about unary relations like man(Marcus)

Semantic Nets

- Can rewrite as instance(Marcus, Man) making it easy to represent.
- Three or more place predicates can also be converted.
  - Score(Cubs, Dodgers, 5-3)

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Semantic Nets

- What about representing sentences?
  - John gave the book to Mary.
  - Use the same technique as the game. Create an event…

Semantic Nets

- the net below represents objects that exist independently of their relationship to each other.

- What about representing that John is taller than Bill?
Semantic Nets

- H1 and H2 represent the heights of John and Bill.
  - Using these representations, it is possible to represent the fact that John's height changes (could not do this before).
  - To show it explicitly, use the “value” arc.

- Procedures that operate on SN can exploit the fact that some arcs define new entities (height) while others describe the relationships between existing entities (greater than).
- To represent simple quantified expressions:
  - can partition the semantic net into a hierarchical set of spaces - each corresponds to one or more variables.

Semantic Nets

- With the statement “The dog bit the postman”, draw a semantic net.
  - Nodes dogs, bite, postman represent the classes
  - d, b, p are instances of these classes.
  - Easily represented by a single net with no partitioning.
- What about “Every dog has bitten a postman”?

Semantic Nets

- $\forall x \text{Dog}(x) \rightarrow \exists y \text{Postman}(y) \land \text{Bite}(x, y)$
- To represent the “every dog…” statement
  - encode the scope of the universally quantified variable x.
    - partition the net as shown in the next slide.
    - g is an instance of the class GS (general statements)
    - Every element of GS has at least two parts.
      - Forms stating the relation being asserted
      - one or more $\forall$ connections
Semantic Nets

- Spaces in a partitioned net are related by an inclusion hierarchy.
  - When a search operates in a partitioned space, it can explore nodes and arcs in the space from which it starts, and in other spaces that contain the starting point.
    - It cannot go downwards.
    - Starting at D, we can find that D is a dog, but starting at Dogs we do not find D as it is in a lower space than where we started.

Semantic Nets

- Expanding the range of problems to be represented, the representation becomes more complex.
  - In this situation, it can be useful to assign more structure to the nodes themselves as well as the links.
    - The more this structure is implemented, the more the system becomes a Frame System.

Frames

- A collection of attributes (slots) and associated values and constraints on those values.
- Single frames are rarely of use, its only when you put together a system built from a collection of frames that it gets interesting.
  - Frames are connected in many ways - value of one attribute may be another frame and inheritance are two.

Frames

- Similar in concept to Object Oriented Programming.
- Translation between Semantic Nets and frames is straight forward.
  - Node become objects
  - Links become slots
  - The node at the other end becomes the slot value.

Frames

- Slots can hold default values that maybe inherited in lower level classes.
  - Can have properties typical of a class, and then have exceptions to the rule.
- Can also support multiple inheritance
  - But there must be a way to resolve conflicts in possible values.