Knowledge Representation

Knowledge Representation

Unstructured

Structured

Primitive Oriented

Semantic Nets

Predicate calculus

Conceptual Dependencies

Frames

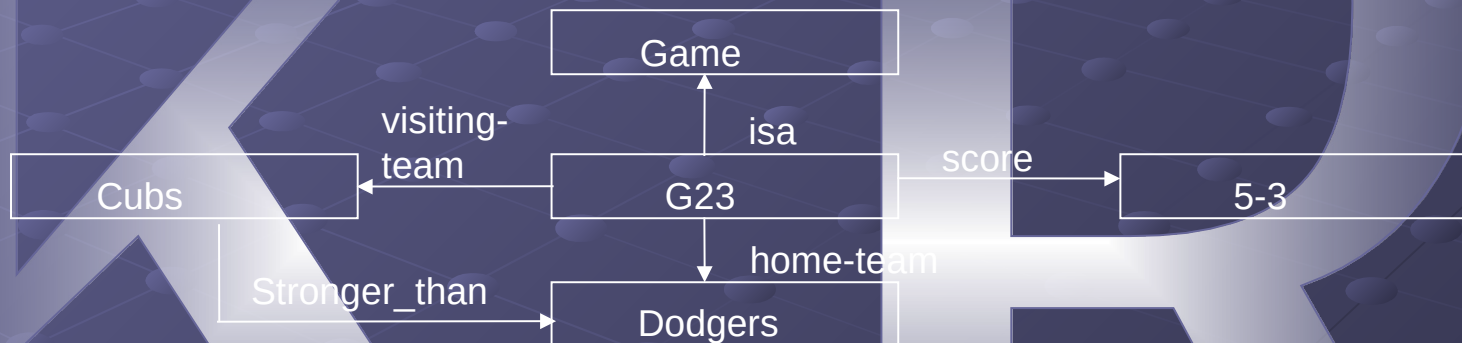Scripts

Predicate Calculus

- By Gottlob Frege

- Key points
  - Simplest type of representation
  - Fully logic based
  - Deduction, Abduction and Induction
  - Resolution and Refutation

- Application: In rule-based systems

Semantic Nets

- By Richard H. Richens in 1956
- "The meaning of a concept comes from the ways in which it is connected to the other concepts"

- Links can define new entities, e.g. *score* link between **G23** and **5-3** nodes.
- Links can also relate two existing entities, e.g. *Stronger_than* link between **Cubs** and **Dodgers**.

Frames

- By Marvin Minsky in 1970

- Evolution of Frame System

- Definition- A collection of attributes and associated values that describe some entity in the world

- Differs from semantic nets in a way that frames may involve procedural embedding in place of values of attributes. (which are called as fillers)

Frames example

EPL-Team	
isa:	Team
cardinality :	20
*team-size :	
*manager :	

Chelsea	
instance :	EPL-Team
team-size :	24
manager :	L. P. Scholari
players :	{deco, terry, …}

| Striker	
isa:	EPL-Player
*total-goals:	
*team :	
*stamina :	

Drogba	
instance:	Striker
total-goals :	15
team :	Chelsea
stamina :	90%

- This is an example of a part of a frame system involving four frames.
- *EPL-Team*, *Chelsea*, *Striker*, *Drogba* are all frames.
- *EPL-Team* has *isa* and *cardinality* as its class attributes.
- *EPL-Team* has *team-size* and *manager* attributes which are inherited by its objects. (indicated by *)

Conceptual Dependency

I gave the man a book

$$p \quad\quad\quad o$$

to

man

R

I ⟺ ATRANS ← book ←

from

I
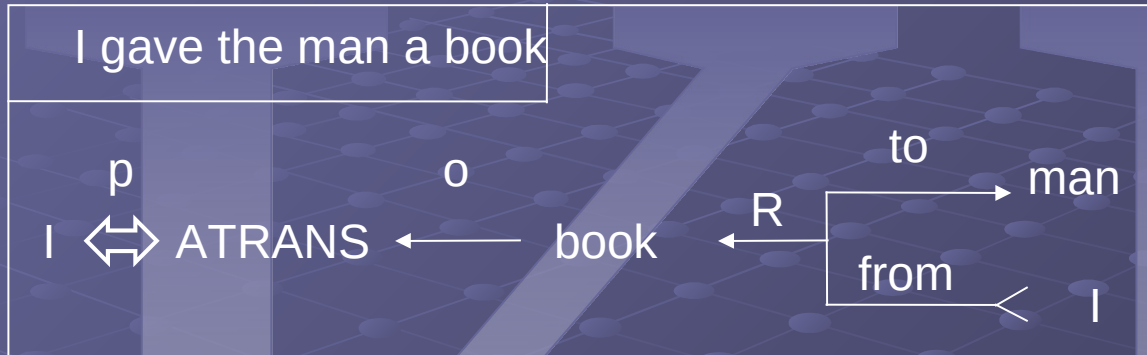
- Arrows indicate direction of dependency
- Double arrow indicates two way link between actor and action
- p indicates past tense.
- ATRANS is a primitive act
- o indicates object case relation.
- R indicates recipient case relation.

- By Roger Schank
- Not word primitives, but conceptual primitives are represented.

Conceptual Dependency contd…

- A typical set of primitive acts and their descriptions:
  - ATRANS: Transfer of abstract relationship (e.g. give)
  - PTRANS: Transfer of physical location of object (e.g. go)
  - PROPEL: Application of physical force to an object (e.g. push)
  - MOVE: Move of body part by its owner (e.g. kick)
  - GRASP: Grasping of an object by an actor (e.g. clutch)
  - INGEST: Ingestion of an object by an animal (e.g. eat)
  - MTRANS: Transfer of mental information (e.g. tell)
  - MBUILD: Building new information from old (e.g. decide)
  - SPEAK: Production of sound (e.g. say)
  - ATTEND: Focus of a sense organ toward a stimulus (e.g. listen)

Conceptual Dependency contd…

- Advantages:
  - Fewer Inference Rules are needed than would be required if knowledge was not broken down into primitives: Rules are represented once for each primitive act rather than once for each verb that describes that act.
  - Many Inferences are already contained in the representation itself.
  - The initial structure that is built to represent the information contained in one sentence will have holes that need to be filled. These holes can serve as an attention focuser for the program that must understand ensuing sentences.

- Disadvantages:
  - It requires that all knowledge be decomposed into fairly low-level primitives. So it gets inefficient in some situations.
  - It is only a theory of representation of events . There have been attempts to describe a set of primitives that can be used to describe other kinds of knowledge, but this has not been subjected to same amount of empirical investigation.

Scripts

Entering a Restaurant:
S PTRANS S into restaurant
S ATTEND eyes to tables
S MBUILD where to sit
S MOVE S to sitting position

Ordering:
S MBUILD choice of F
S MTRANS signal to W
W PTRANS W to table
S MTRANS "I want F" to W

Eating:
C ATRANS F to W
W ATRANS F to S
S INGEST F

Exiting:
W ATRANS bill to S
S ATRANS money to W
S PTRANS S to out of restaurant

- By Roger Schank and Robert P. Abelson
- Represents **Sequence** of Events
- Events are *giant casual chain*

Scripts contd…

- Advantages:
  - Ability to predict events that have not been explicitly observed.
    - John went out to a restaurant last night. He ordered steak. When he paid for it, he noticed that he was running out of money. He hurried home since it had started to rain.

      Question: Did John eat dinner last night?????

      >> Though not explicitly mentioned it can be inferred from the sequence of events in the representation.
  - It focuses attention on unusual events.
    - John went to a restaurant. He was shown to his table. He ordered a large steak. He waited there for a long time. He got mad and left.

      >> The story represents an unexpected set of events. So once the typical set of events is interrupted the script can no longer be used to predict other events. So here we should not infer that John paid his bill but we can infer that he saw menu since reading the menu would have occurred before the interruption.
- Though Scripts are less general structures than are frames, they can be very effective for representing the specific kinds of knowledge for which they were designed.