

KR, Frames, Scripts, and CD

Knowledge Representation: The relationship between frames, scripts, and contextual dependency

KR: Why bother?

Answer: Intelligence and Knowledge

- Reacting to sensory information.
 - Produce correct / appropriate response.
- Using tools.
 - Efficiency / usability.
- Communication.
 - Generation of what to communicate.
- Learning.
 - Adding to knowledge.
- Human knowledge organisation.
 - Efficiency.

Psychological perspective

Interlinking (associating)

- Voice – person – mood.
- Sound/smell – memory – reminiscence.
- Visual observation – properties – ownership.

Psychological perspective (cont)

Cognitive limitations

- Levels of information and retrieval.
 - How brain stores information.
- Attention.
 - How long concentration lasts.
- Short-term memory.
 - How much can be stored for quick retrieval.
- Field dependency.
 - Link between items of information.

Physiological perspective

- Perceptive pre-processing
 - Affects knowledge storage.
- Brain areas and malfunctions
 - Memory freezing.
 - Unknown ownership / name.

Who cares?

- Chaos
 - Resolution of.
- Complexity
 - Reduction of.
- Emergent behaviour
 - Determination of trends / prediction.

Why bother? A language example

- The old man the boats.
- I saw the racing pigeons flying to Paris.
- I saw the Eiffel Tower flying to Paris.
- The boy kicked the ball under the tree.
- The boy kicked the wall under the tree.
- Put the apple in the basket on the shelf.

Need knowledge to make sense of these.

KR: What is it?

- Declarative forms
 - Data
 - Facts
- Procedural forms
 - Processing
 - Retrieval / linking / lumping
- Inference
 - Deriving new knowledge from existing knowledge.

KR: What do we represent?

- Objects (and their relationships)
- Events (and sequences)
- Performance (and cause and effect)
- Meta knowledge
 - Knowledge about knowledge
 - E.g. Extent, Priority, Strategy, Reliability, Performance

KR: Strategies

- Facts and rules.
- Logic.
- Semantic nets.
- Frames.
- Scripts.
 - A series of linked sentences recording normal series of events for a given type of occurrence.
- Conceptual dependency.
 - Graphical representation where 2 sentences with same meaning have identical graphs.

Frames (recap)

- Means of representing knowledge textually.
- Frames suitably named to indicate their use.
- Consist of attributes and values (*slots* and *slot values*)
- Can represent knowledge already gathered in a semantic net.
- Represent *generalization/specialization* via *subclass*.
- Represent *is_a* relationships via *instance*.

Frames (recap cont.)

- Can have default values which may be modified by subframes.
- Can have frames as slot values where their use would increase the level of detail of description.
- Can have conditional slot values via the IF..THEN..OTHERWISE keywords.
- Slots are not order-specific, though convention places

Frames: A perspective

- Frames can be viewed as a network of nodes and relations.
- Top levels of the frame represent attributes which are always true.
- Lower levels of the frame have slots which must be filled by specific instances or data.

Filling slots

- Construction often manual: 'hand coding'.
- Could use recognition software (covered in later lectures) to perform analysis.

Example: analysing news stories

Determine the following:

- actors: who/what is in the story.
- roles: what part they play in the story.
- time of occurrence: when did it happen.
- place of occurrence: where did it happen.
- ...

Filling slots (cont.)

Other values which could be determined:

- Culpability: who/what was to blame.

Common features

- particular genres of story
- genres lead to particular types of frame.

Questions:

1. What do you perceive are the difficulties with filling slots from (for example) a story in the news?
2. How could these be addressed or simplified.

Filling slots (cont.)

Some answers

Difficulties:

- Recognising the type of story.
- Isolating particular slots e.g. roles, actors, etc.

Solutions

- Reduction of the problem domain: apply software only on tighter scenarios.

Conceptual Dependency (recap)

- CD developed by Schank in 1970s.
- A means of representing Natural Language (NL) from sentences.
- Used to map NL to a *conceptual base* during understanding.
- Conceptual base allows prediction of the type of conceptual information which follows initial input.
- Useful when there's no strict grammar.
- Can be represented as text or diagrammatically.
- Useful for inferencing.

See previous lecture by Simon on CD for more detail

Scripts

- Result of work by Schank and Abelson.
- Resemble frames but have additional information about:
 - an *expected sequence of events*.
 - *goals*] of the actors involved
 - *plans*]
- Effective at reducing a story to a set of semantic primitives e.g.
 - actions: propel, speak, move_object
 - perception: see, smell, hear, feel
 - mental & social acts: conclude, think_about, transfer_possession

Scripts (cont.)

- Use *conceptual dependency* to answer questions not specifically stated in the story.

An example script

Eat_at_restaurant script

Props: (Restaurant, Money, Food, Menu, Tables, Chairs)

Roles: (Hungry_persons, Wait_persons, Chef_persons)

Point_of_view:

Hungry_persons

Time_of_occurrence:

(Times_of_operation of restaurant)

Place_of_occurrence:

(Location of restaurant)

Continued on next slide

An example script (cont.)

Event_sequence:

First: Enter_restaurant_script
Then: IF[wait_here_sign]
THEN [get_maitre_d's_attention script]
Then: Please_be_seated_script
Then: Order_food_script
Then: Eat_food_script UNLESS[long_wait]
WHEN[exit_restaurant_angry script]
Then: IF[food_quality was better than palatable]
THEN[compliments_to_the_chef script]
Then: Pay_for_it_script
Finally: Leave_restaurant_script

Scripts (cont.)

- Define required values in same way as for frames.
- Define an event sequence using FIRST, THEN, FINALLY keywords.
- Order of event sequence determines order in which other scripts are invoked.
- The example illustrates a script hierarchy with the Eat_at_restaurant script at the top level and other scripts at a lower level.
- Possible to have other scripts at the second level referencing other scripts to produce a deeper hierarchy.
sub-scripts — sub-frames

Features and capabilities

1. Provide a natural way of representing "common sense information".
2. Implement a hierarchical structure of scripts and subscripts.
3. Other knowledge representation formalisms can be incorporated into the script formalism.

The result of (1..3) give the following capabilities:

- Scripts can predict events and answer questions about information not stated in the story line.
- Scripts provide a framework for integrating a set of observations into a coherent interpretation.
- Scripts provide a scheme for detecting unusual events.

Multiple event sequences

- Unusual events can disrupt normal sequence of events e.g. put coat on; got dog's lead; put lead on dog; opened door; went outside; locked door; walked down path; saw neighbour's car explode...
- Switch to a totally different event sequence.
- Removal of the mundane leads to isolating of the unusual event.
- Switching of events within a sequence can lead to the unexpected.
- Switching of actors from those that are expected.
- A basis of humour is actor/event switching.



Scripts Summary

- Form of knowledge representation.
- A series of linked sentences recording normal series of events for a given type of occurrence.
- Close links to frames and reliance on CD
- Slots are order specific.