1. Computational Foundations of Cognition

“(C)omputation is cognition. This hypothesis permits the rigorous analysis of cognition—even at its most abstract—through a formal characterization of cognitive calculation. But computation is a rich notion that can be formalized in many ways. So the fundamental hypothesis of cognitive science—cognition is computation—immediately gives rise to the fundamental question of human cognitive architecture: just what type of computation is cognition?” (Smolensky & Legendre, 2006, vol. I, p. 5, emphases are original).

AIM: to understand the data structures and algorithms in our mind/brain.

Data structures: numbers, character strings, graphs, feature matrices, distributed activation patterns, etc.

Algorithms: rewrite rules, symbol manipulating, programs, differential equations, activation spreading, etc.

PROPOSAL: as data structures, let us use

AVMs = attribute-value matrices

a.k.a. [typed] feature structures, widespread in linguistics (HPSG, LFG, some Construction Grammars, etc.) since the 1980s.

2. Cognitive Science of Religion

2.1. Aims

AIM: to understand the mental representations in [religious] cognition.

The building blocks of the mental representations in [religious] cognition:

- Entities:
  - Ontological categories: human, animal, plant, object, artifact...
  - Apparent vs. non-autonomous: Involves presence or counterinvolvement (Boyer, 1994).

- Epistemic modality: real, culturally postulated, fictive, hypothetical, counterfactual...

- Actions, events:
  - Thematic roles: AGENT, PATIENT, RECIPIENT, INSTRUMENT...
  - Past-and-modality: past, present, future, wish, precept, prohibition, etc.

- Epistemic modality: real, culturally postulated, fictive, hypothetical, counterfactual...

2.2. Theoretical models

A useful research strategy: I learned it in linguistics.

- a. Develop some formalism, such as context-free grammars or AVMs.
- b. Describe as many cultural, religious, etc. phenomena with this formalism, as possible.
- c. Gradually refine the formalism: revise it, restrict it, and embed it in a larger theory.

3. Context-free grammars (CFGs) and trees

In linguistics, context-free grammars were introduced to account for the linear order of the constituents, e.g., of the words in a sentence. To more efficiently account for further phenomena, such as agreement, the CFG formalism has been generalized and modified, giving rise to alternatives. Many of these alternatives, including unification grammars, employ attribute-value matrices.

In fact, Lawson and McCauley (1990)’s analysis focuses not on the linear order of the participants in a ritual, but on the thematic roles they fill. These can be more perspicuously expressed using AVMs.

4. AVMs: attribute-value matrices

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5. Complex religious system

Thus far: representing knowledge about entities and actions/events, both real and culturally postulated.

Entities include: counternautive agents, objects with supernatural power, artifacts with religious significance.

Actions, events and states-of-affairs include: rituals, prohibitions, mythological and ontological events, etc.

Motivation and expressions: a series of culturally postulated past events, prohibited and prescribed actions.

Cultural and religious knowledge modelled as a set of AVMs: cult postulated entities and actions.

AVM formalism also introduces:

- Unification: a representation is counternautive if it cannot be unified with a constraint provided by some folk theory.

- Co-indexation. A series of recurrent structures: such as

6. Summary

Conclusions:

- Attribute-value matrices (AVMs) show how to be an effective descriptive tool as a data structure in formal-computational models of cultural and religious cognition.

- Enabling a uniform framework for representing and manipulating real and culturally postulated entities, actions and narratives, hard and soft constraints, ... and hopefylly much more.

Moreover, thanks to the decades-long expertise in computational and theoretical linguistics with AVMs,

- AVMs come with strong mathematical foundations.

- AVMs come with extensive literature on their computational implementations.

NEXT: describe more and new phenomena, in order to refine the formalism.

Towards a unified framework of human (higher) cognition.

I believe, if a formalism adequately describes two very different domains of human (higher) cognition (such as linguistics and religion, or culture in general), then its general cognitive adequacy—-as a horizontally integrating theory (Smolensky & Legendre, 2006)—can be further corroborated.

References


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