# The Generation of Creative Inferences

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## Two Kinds of Inferences

Inferences are typically generated by applying some inference schemata to a body of knowledge. In deductive reasoning, a schema like the modus ponens (P, P->Q, ⊢ Q) may be applied to a rule set and thereby produce some inference (e.g. Q). Inductive inferences are generated by an inference schema which replaces specific by more general terms. The inference of "fruits are eatable" may thus be induced from the assertion "apples are eatable". In a way, such inferences are already implicitly contained in the knowledge base and the inference schemata. In other words, inferencing is often the explication of implicit information.
*Creative inferences*, on the other hand, are constructed as novel knowledge units which are not even implicitly contained in the terminology of the knowledge base. Such *creative inferences* may be produced by relating separate terminologies to one another. For example, Boden (1991) has described Kekulé's discovery of the benzene ring as such a creative insight (or inference) where the knowledge about strings of carbon atoms became associated with the knowledge about snakes. A snake which bit its own tail could thus generate the idea of a ring (rather than a string) of carbon atoms. This would be impossible to deduce with the original terminology about carbon atoms. In this paper, we describe a computational model which produces creative inferences.

## Model of Creative Inferences

Norvig (1988) has recently described an inferencing method which may also be applied for connecting two separate terminologies or conceptual spaces. By using a marker passing procedure, paths are found which connect concepts from different conceptual spaces. From these paths new hypotheses or assertions are compiled, which are neither implicitly contained in the first nor second conceptual space. Figure 1 shows a schematic diagram of the knowledge construction and inference generation processes which are performed by the computational model. There are six different conceptual spaces. Each one is structured according to a class hierarchy. The conceptual space of THINGS may contain all kinds of physical and living objects. The conceptual space of IDEAS contains abstract concepts like "peace", "justice", "friendships" and other personal relationships. ACTIONS represent goal-oriented changes and EVENTS represent incidental changes of THINGS. Similarly, THOUGHTS represent goal-oriented changes and INSIGHTS represent incidental changes of IDEAS. By CROSS_LINKS, concepts can be connected between and within different conceptual spaces.

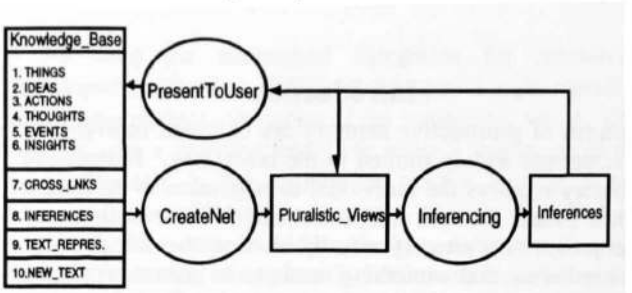


Figure 1: Schematic Diagram of Inference Generation

The computational model is used for simulating creative inferences during text comprehension. A NEW_TEXT is therefore also entered by its conceptual units. The computational model processes a segment of the NEW_TEXT and relates its conceptual units to the appropriate concepts in the respective knowledge bases. A semantic net is thus obtained, which is called Pluralistic_Views. An inference can then be generated by marking two concept nodes of the Pluralistic_Views. A marker passing process will find the connecting paths between these concepts along certain types of links. The marker can be programmed by the user so that its resources for passing different types of links are limited. Furthermore, the order in which different types of links can be traversed may be partially or completely specified. The marker passing process thus implements a spreading activation process which will find specific sequences of links in knowledge bases.
By compilation, an inference can be produced from each path. This inference is then linked to the Pluralistic_Views. The model is intended to simulate knowledge construction processes of Kintsch's (1988) construction-integration theory. It is implemented in C++ and will use EXCEL as a user interface. Simple texts which consist of up to four sentences are applied to demonstrate the capabilities of the model.

Boden, M. A. (1991) The creative mind: Myths and mechanisms. New York: Basic Books Inc. Publishers.
Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. Psychological Review, 95, 163-182.
Norvig, P. (1989). Marker passing as a weak method for text inferencing. Cognitive Science, 13, 569-620.