Using a Semantic Information Network to Develop Computer Literacy

Steward A. Denenberg, SUNY Plattsburgh

"'what is knowledge?'.... Drucker's (1967) definition: 'knowledge is the systematic organization of information and concepts' will be useful as an operational definition (without operational definitions of 'information' and 'concepts'). Organization (for 'structure' is the key word with regard to knowledge -- some pattern must be discernable to earn the label of 'knowledge.' Within AI, there are currently two methods for representing knowledge: the procedural representation and the declarative representation."

"...we shall view a procedural representation of knowledge as a set of procedures (which could be computer programs) which by itself can search a set of data for the presence of certain patterns; if a match is found then the content and/or structure of that data set is usually modified....In this sense, the subprogram that recognizes horizons is a procedural representation of the horizon."

"A declarative representation can be symbolized by a statement such as 'All cows have four legs' and can be stored within a computer as data rather than as a program. These data can be represented hierarchically using a tree structure or more generally in a graph so that associations between the data can be richer."

"A hierarchical structure for representing knowledge or information is similar to a topical filing system or a card catalog in a library. Major topics (categories or headings) are broken down into subcategories within each major category. The subcategories are then broken down again until the level of detail is fine enough to encompass all of the information in the total system."

"There are several disadvantages to using a hierarchical structure to represent information or knowledge. Category codes, no matter how carefully chosen will most likely change, especially in such a dynamic field as computer literacy."

"A given set of category codes usually becomes outmoded or outdated after a certain period of time."

"A second disadvantage to the hierarchical structure is possible replication of information. The same information may appear under different categories.... The more the information is replicated within a hierarchical structure, the higher the probability of an incomplete update procedure."

"Perhaps the most important disadvantage to hierarchical
structures for representing information is that only
the hierarchical structure of the information is illuminated.
Only the 'general-specific' relation is implicitly shown
between a category and its sub-categories in a hierarchical
structure. For example, in the Yellow Pages, when 'George
Washington Federal' appears under the category of 'Banks,'
all the user can surmise is that 'Bank' is the generic term
for 'George Washington Federal' and conversely a specific
instance of a ba-k is 'George Washington Federal.' Not
apparent is the conncetion between 'George Washington
Federal' and the category 'Automobiles' if 'George Washington
Federal' issues automobile loans."

"Now if the knowledge is declaratively represented as
heterarchical (term coined by Minsky and Papert) topics
or nodes in a knowledge space, what mechanism is used to
organize the topics? Some organization or structure must
be present to meet our operational definition of knowledge.
One way to structure the topics is to associate them by
means of a set of relationships -- when this is done, that
structure is called a semantic information network."

"Semantic information networks or 'semantic nets' evolved
as attempts to model the associative way knowledge is
perhaps stored and retrieved in the human mind.... semantic
nets are a declarative representation of knowledge consisting
of a set of relationships between a set of topics.... A convenient
symbolism for a semantic net is a graph where the topics are
nodes and the relations between the topics are arcs. A
semantic net can be understood as a graph representation of
topics with relationships between these topics."

"Redundancy or replication of information is not a problem
in a semantic net. Information need not be duplicated
at more than one node in the network -- all of the information
which defines a node can reside at that node only; and the
relations can be used to refer to other nodes which also
contain that information."

"The other weakness in the hierarchical structure that is
overcome by the semantic net representation is that very
little of the structure ofthe knowledge was revealed. A
semantic net can show structure to a much richer and deeper
level through the use of appropriately chosen relationships;
the more types of relations that can be identified, the more
structure between the topics is revealed."

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"A semantic net is an extremely useful and powerful way to represent knowledge; when represented as a graph, it comes very close to being a picture of the reality it attempts to represent.   Another useful feature of the semantic net is that it can be used as a map of a knowledge space -- not only does it reveal the structure of the space via the relationships, but it can also be used as a search tool to find topics that are of interest to the user."

"Finally the use of a semantic net in itself can be an educational experience for the user. Since every topic in a semantic net is connected by certain relationships to various other topics in the net, the user can begin to see that the meaning of any topic is not absolute but relative to its relationships with other topics. As a matter of fact, themeaning of any topic can be defined as the rest of the semantic network as seen through that topic."