

Chapter 1

MEANING AND ITS REPRESENTATION

What is meaning? Or what is the meaning of meaning? “Meaning” is really a very difficult issue. Traditionally, meaning is discussed in the subject fields of philosophy and linguistics. This book is intended to discuss meaning in terms of HLT in general, and the construction of computer-oriented knowledge resources and the computation of meaning in particular. Linguistically, meaning exists in various levels such as word sense, the meaning of a phrasal structure, sentential meaning, and textual meaning. In this book, we would like to focus on the meaning of concepts, or linguistically, on senses of words and expressions. The computer-oriented understanding of meaning differs greatly from the human-oriented one.

First of all, let’s take a look at some definitions of word in human-oriented lexicons. Suppose we want to know the meaning of the English word “possess”, we may look it up in an English dictionary, say, Longman Dictionary of Contemporary English (LDOCE) and then find that the first sense of the word “possess” is defined as follows:

1 to own; have: *He possesses 2 cars*

If we do not know the meaning of “own” yet, we have to go on to look it up again, and find the definition is as follows:

1 to possess (something), esp. by lawful right, *who owns this house/this dog?*

So here we find a loop: starting from “possess”, and then to “own” and going back to “possess”. It is not unique, but has its counterpart. In

Chinese dictionaries the cases of recursive definitions can also be found here and there. Needless to say, to humans all the above definitions may be perfect. If a computer could really understand and process them, then all the tasks of HLT might have been fulfilled! That is the reason why we need computer-oriented representation.

How can we testify that someone really understand the meaning of “possess”? Let’s make a simple experiment by asking him the following questions:

- “If you possess a car, do you have the car?”
- “If you possess a car, does the car belong to you?”
- “If you buy a car, do you possess it?”
- “If you borrow a car, do you possess it?”
- “If you possess a car, can you give it to anybody?”

If anyone can give correct answers to the questions, we take it for granted that he may have understood the meaning of “possess”.

Secondly, let’s compare the definitions of the word “paper” in three different dictionaries: WordNet, LDOCE and Contemporary Chinese Dictionary (bilingual version) and try to see its meaning in them.

- (1) Definition in WordNet:
“a material made of cellulose pulp derived mainly from wood or rags or certain grasses”
- (2) Definition in LDOCE:
“material made in the form of sheets from very thin threads of wood or cloth, used for writing or printing on, covering parcels or walls, etc.”
- (3) Definition in Contemporary Chinese Dictionary
“substance made from cellulose fibers derived from rags, wood, etc. often with other additives, and formed into flat thin sheets suitable for writing, painting or printing on, or for decorating walls, wrapping, etc.”

If we make analysis of these definitions, we may extract the following understandings:

- (a) Paper is a kind of material or substance;
- (b) it is made from cellulose pulp derived from wood, rags, etc.;
- (c) paper is in the form of sheet;
- (d) it can be used for writing, painting, wrapping, etc.

We may be enlightened by the aforesaid experiment and comparison that meaning can be understood through the relations. We can understand the concept of “possess” through its relations with some other concepts, like the concepts of “buy”, “belong”, “own”, “lose”, “give”, etc. Similarly, the concept of “paper” can be understood through its relations with the concepts of “material”, “write”, “print” and “wrap”, etc., and the relations based on the attributes such as form, use, softness, contrast, and so on. The relations which represent meanings can be divided into two categories: Concept Relation (CR) and Attribute Relation (AR).

When we say we understand the meaning of a concept, it means that we know its concept relations and its attribute relations to some extent. For example, when we say we understand the meaning of “chair”, we may know that it is a piece of furniture on which one person can sit, which typically has a back. Our understanding of the meaning of “chair” may be represented by the relations among the concepts “chair” and “furniture”, “sit”, etc., and by the relations among the attributes “form”, “weight”, “size”, “color”, etc., which a chair may have.

It should be pointed that any concept relation will fall into a net, which is called Concept Relation Net (CRN) and any attribute relation will fall into a net too, which is called Attribute Relation Net (ARN).

1.1. Concept Relation Net (CRN)

As discussed above, it is believed that every concept has a relation net, called Concept Relation Net (CRN), by which the actual meaning of the concept is represented, and by which computers, or even human, can understand and manipulate its meaning. CRN consists of 3 components: concept nodes, connection arcs, and relations. See Fig. 1.1.

Concept nodes: “doctor”, “disease”, “hospital”, “patient”...

Relation arcs: \rightarrow , \leftarrow , \leftrightarrow

Relations: [hypernym], [hyponym], [antonym], [meronym], [agent], [patient], [instrument], [location]...

CRN is elastic or extendable as it varies with individual persons. In other words, different individual has different CRN, even of the same concept. This reflects different levels of knowledge among people. The more knowledge one masters, the more concepts he will master, and what is more, the larger or more complicated CRN of the concepts he will know. It can be imagined that a 6-year child may know “doctor” but his CRN of “doctor” would be far from that as shown in Fig. 1.1, which is believed to be mastered by an ordinary adult. The same case goes with mankind as a whole. Mankind increases his knowledge with each passing year when he enlarges his volume of concepts and at the same time, the CRN of the concepts.

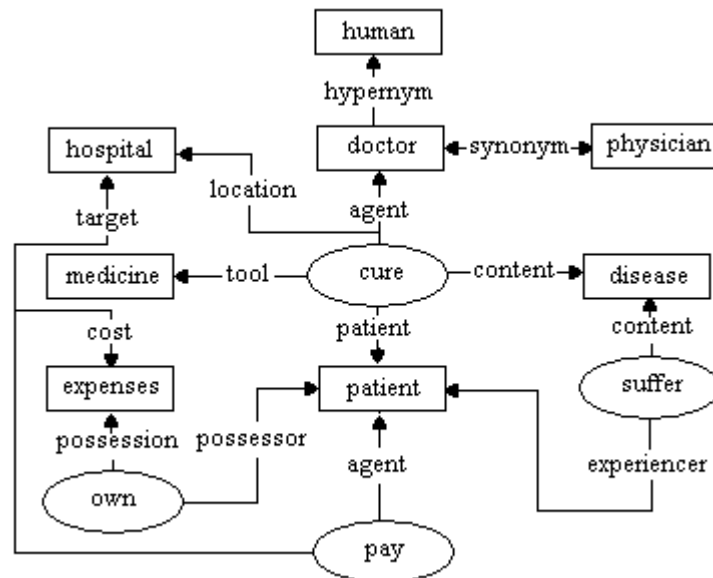


Fig. 1.1. Concept Relation Net (CRN) of “doctor”.

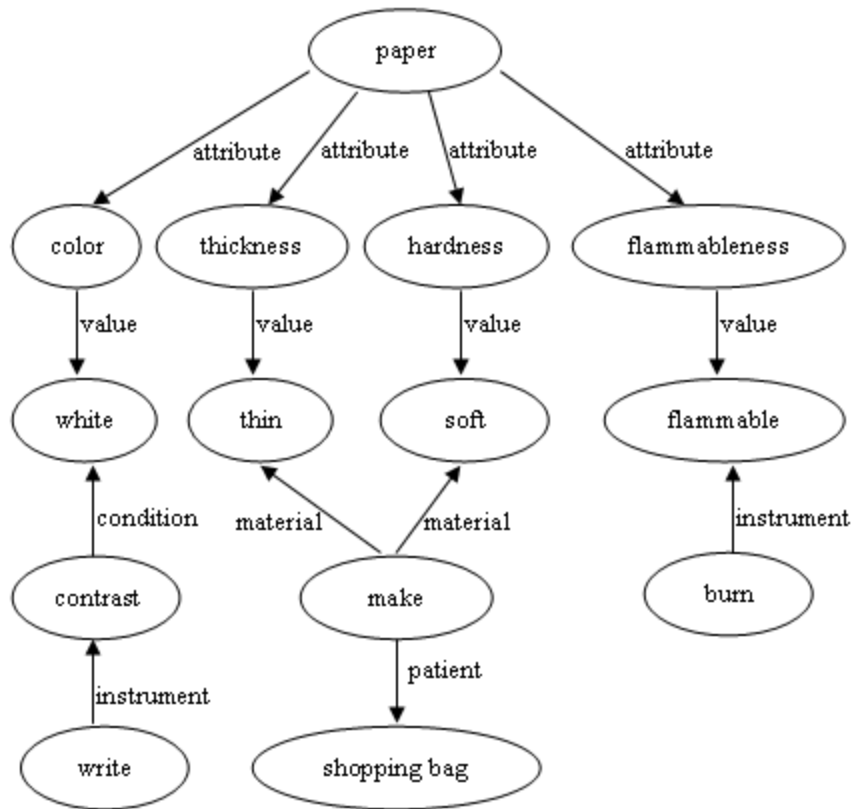


Fig. 1.2. Attribute Relation Net (ARN) of “paper”.

1.2. Attribute Relation Net (ARN)

Careful observations find that the meanings of concepts are displayed not only by their CRN but also by the relations among attributes of the concepts, as called Attribute Relation Net. That is to say, in many cases it is the attributes of a concept that act in the role of meaning representation. Figure 1.2 reveals that it is not “paper” as a whole that is related to “write”, but only one of its attributes, say “color”, is related to “write” with “contrast” as the condition. Therefore in a strict sense, “paper” is not necessarily related to “write”. We can sometimes even write on the

sand with a twig or on the table with our wet finger. On the contrary, we cannot write on a piece of white paper with a chalk or on the blackboard in black ink. Therefore, for writing, what affects may not be the whole lot of the concept like “paper”, but some attributes of the concept. Besides, we can use “paper” to wrap up something because of its attributes of the material which are almost the same as cloth or plastic.

Meanings at all levels, say, of a word, of a sentence, or of a text, can be represented and understood through relations. The meaning of a word and the meaning of a sentence differs in that the former is static and the latter is dynamic.

To take the word “buy” as an example. “Buy” is represented by several relation nets as follows:

(a) Hypernymous net:

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event
  ==> act
    ==> ActSpecific
      ==> AlterSpecific
        ==> AlterRelation
          ==> AlterPossession
            ==> take
              ==> buy

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(a-1) Relation of possession:

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event
  ==> static
    ==> relation
      ==> possession
        ==> own
          ==> possess

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Here (a) and (a-1) indicate that when the action of “buy” happens, it will change the relation of possession. If you buy anything, you will possess it.

(b) Hyponymous net:

The hyponymous net of the word “buy” is exemplified by the following words and expressions:

act as a purchasing agent, book, book a ticket, booking, buy and get everything ready, buy at a high price, buy at negotiated price, buy at reduced prices, buy goods wholesale, buy grain, buy liquor and imbibe it, buy on credit, buy more of the same securities, buy property, buy the whole lot, buy to resell, buying and selling, deal in, deal in small business, fraudulently purchase, illegally buy up, go shopping, insure, mail order, order, place an order, purchase by mail, purchase from abroad, purchase in advance, renew one's subscription, rush to purchase, shopping, subscribe

Hyponymous net makes “buy” connect all its hyponyms.

(c) Role of agent — Who buys

The role of agent of the word “buy” represented by the following words and expressions:

bargainer, buyer, buying party, client, customer, empor, frequenter, home buyer, itinerant trader, orderer, patron, pedlar, policy-holder, purchaser, purchasing agent, purchasing station, regular customer, shopper, stockbroker, stockjobber, subscriber, vendee

(d) Role of location — Where one buys

The role of location of the word “buy” represented by the following words and expressions:

24-hours shop, bazar, black market, book store, car market, chain store, chemist's shop, cigarette stall, cloth store, confectionery, convenience store, fair, fish market, flagship store, flea market, florist, food market, shopping mall

Roles usually play a significant part in relation net in representing static meanings, and even more important part in representing dynamic meanings. If we want to test whether a person comprehend a sentence or a paragraph, a common method we usually adopt is to raise a few questions about the sentence or the paragraph. For example, if we have a testing sentence as follows:

“Mary’s brother bought her the book their father wrote in 1980”.

The questions we can put to test a person's comprehension of the sentence. It is believed that all the questions are relation-oriented, for instance:

- (1) Who bought the book? — Agent
- (2) For whom did Mary's brother buy the book? — Beneficiary
- (3) What did Mary's brother buy? — Possession
- (4) Whose father wrote the book bought by Mary's brother? — Agent
- (5) When did Mary's father write the book? — Time

It would not matter whether a person knows the names of relations, such as "agent", "possession", and "time". If a person comprehends the sentence and can answer the questions correctly, he would be clear about the relations.