a i John is a *doctor*
ii John is an *aardvark*

b i Mary is *shouting*
ii Mary is *whispering*

c i You should paint the whole thing *red*
ii You should paint the whole thing *turquoise*

d i Dark Rum is a *stallion*
ii Dark Rum is a *mare*

4.19 In (4.7), the implication relation went in the same direction as the hyponymity relation. In the following examples it goes in the opposite direction. Draw the Venn diagrams and explain why.

a i Tiny is not a dog.
ii Tiny is not an alsatian.

b i They want to ban drink.
ii They want to ban beer.

c i Sport is forbidden.
ii Football is forbidden.

NOTE

1 Many books refer to them simply as 'antonyms' and 'contradictories' respectively.

MEANING RELATIONS (2) 5

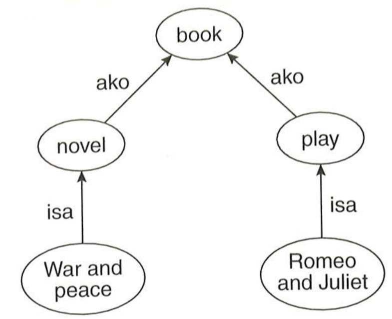
It was suggested in Chapter 1 that the sense of an expression can be seen as a way of classifying things. (I deliberately leave the word 'things' as vague as possible, because to call them anything else would suggest that they have already been classified!). Thus the word 'book', used of the thing you now have in front of you, refers to it as a *book*, i.e. an instantiation of a particular bundle of properties which are shared by other books, but not by cats, or chocolates.

This classification however does not consist of just putting objects into arbitrary pigeon-holes. The hyponym relation means that an object can be classified at a more general level or at a more specific level. For example *textbook* is a hyponym of *book* (or let's say $book_1$, as there may be other senses associated with the English word 'book'). $Book_1$ can be used to classify more objects than *textbook* can. But *textbook* is more informative; it pins the object down more precisely. This flexibility allows you to classify an object in different ways depending on how much information it is desirable to commit yourself to in the context.

The hyponym relation between senses should be distinguished carefully from the relation between a sense and the individuals which it classifies (its denotation). The object in front of you 'is a' textbook, and also 'is a' book, in that it instantiates (is an INSTANCE of) these word senses. On the other hand a textbook (or more precisely the concept *textbook*) is a kind of *book*, in that it is a species or type of book. In artificial intelligence the two different relations are sometimes known by the mnemonics 'isa' and 'ako' respectively. These simple relations can be used to build up a 'semantic network'.

instance

(5.1)



EXERCISE

5.2 Draw semantic networks based on the following concepts (word senses) and named objects:

a mammal mouse babe micky pig animal
b london new_york country city france capital tokyo place port
c jane_eyre film star_wars novel book story crime_and_punishment

What exactly the 'bundle of properties' is which defines each of these concepts is a complicated question. For example, why do you call this object in front of you a 'book'? Probably because it is made of sheets of paper in a particular configuration, and is covered with markings which are the written form of a known human language. Because of this, you can infer that a reasonable thing to do with it is to read it, and not to eat it or stroke it. But suppose you saw the same writing in electronic form on my computer screen? Or conversely if you opened the book and it contained no writing. Would you still call it a book? Probably. The two have no obvious properties in common, but both have a resemblance (a different resemblance) to the book you are reading. This notion of 'resemblance' appears to play an important part in how things are classified.

There is another related question: how much of the information that goes into the lexicon (or into a semantic network) is information about words (senses) and how much is about facts. This was touched on in Chapter 1, where it was suggested that knowing the meaning of a word shouldn't depend too much on knowledge of 'trivia' (i.e. facts!). This is often put by linguists in terms of a distinction between 'lexical' and 'encyclopaedic' knowledge. This exploits the difference between a lexicon (or mental dictionary) and an encyclopaedia, which is pretty well entrenched in our culture. But is there a difference in principle, or is it only a matter of degree? For example, knowing the meaning of the word 'elephant' would involve some idea of an elephant's characteristic shape and size, whereas the fact that it evolved in Asia and Africa might reasonably be assigned to an encyclopaedia. But other details of an animal's anatomy, evolutionary history and habitat might seem to fall somewhere between the two. (Compare polar bears, for example, where the name itself makes reference to the habitat.)

EXERCISE

5.3 List three facts you can infer from each of these sentences. Would you expect to find them in a dictionary or an encyclopedia entry under the word in italics? Or neither?

a Mary is a *mathematician*.
b This is a photograph of a *nebula*.
c Lobsters are related to *sea-scorpions*.
d John is becoming a *Buddhist*.

Certainly one important point about classifying things with words is that it enables you to draw certain conclusions about the objects. If you know that an object is classified by the word *snake*, then a natural reaction is to give it a wide berth. The word seems to associate the information about a thin wriggly object with a scenario which involves getting bitten. Moreover because of language we are able to acquire this anti-snake prejudice without ever having seen one.

It is worth dwelling a little on this because, despite the so-called logical basis of language, the logic behind it is not at all obvious. It is not true that all snakes will bite humans, only that some snakes will. (It is also true that some snakes are green, but this does not lead to an assumption that all snakes are green.) What seems to be at work here is that some pieces of information about snakes are picked out as being particularly important, and made into part of a stereotype. Obviously this ability to form stereotypes has a certain survival value, even though the chain of reasoning involved is dubious. An organism whose brain was programmed with first order logic wouldn't follow this reasoning. (On the other hand such an organism might not last long.)

Thus, classifying an object by a given word sense is felt to have certain consequences, but these consequences are not so hard-and-fast as the implications we were looking at in earlier chapters. Take the sentence 'if it is a snake then it bites'. On the basis of what was said about implications, we would not expect to find any case of a snake that does not bite. Since there are such cases, the implication does not hold. Nonetheless there is an 'expectation' that a snake will bite, and a snake which does not is felt to be less typical than a snake which does. A good way of testing for expectations involves the conjunctions 'so' and 'but':

(5.4) 1 'That is a snake, so it will bite.'
2 'That is a snake, but it won't bite.'

If you change the conjunctions round, it sounds strange:

(5.5) 1 ? 'That is a snake, but it will bite.'
2 ? 'That is a snake, so it won't bite.'

And if it is used for information which is not related to the stereotype, the result is odd whichever conjunction is used.

(5.6) 1 ? 'That is a snake, but it is green.'
2 ? 'That is a snake, so it is green.'

EXERCISE

5.7 What expectations would you associate with the following concepts? Test them using the conjunctions 'so' and 'but'.

city	priest	comedy	nazi	library
alsatian	professor	dolphin	bestseller	teenager
feminist				

prototype

So where does all this leave the idea that the denotation of a word sense can be modelled as a set (Chapter 4)? At the very least we now have to distinguish between the typical members which form the core of the set (many writers use the term PROTOTYPE) and others which are untypical in some way. Often the untypicality of these entities can be traced to their membership of a particular subset, which is the denotation of a hyponym. This subset may have its own built-in expectations. Thus *penguin* is a hyponym of *bird*; but whereas birds are expected to be able to fly, penguins are not:

(5.8) 1 'That is a penguin, so it can't fly.'
2 'That is a penguin, but it can fly.' (A magic penguin)

What this tells us is that the expectations associated with a more specific word sense cancel out (or take priority over) those of a more general concept. In this case the relevant hyponym or subset was ready-made for us, but in most cases it is possible to make one anyway by combining words. For example we can make a set of *flightless_birds,* which will be a subset of *birds* to which the expectation of flightlessness applies. At the same time the use of such phrases seems to emphasize the expectation of flight associated with birds in general. A good example of this effect is the phrase 'working mother', which has been objected to as perpetuating certain stereotypes about mothers.

default

The 'expectations' associated with word senses are often known as DEFAULT inferences, and can be studied using a suitably adapted logic called default logic. Such logics are unfortunately beyond the scope of this book, but they are playing an increasingly important part in semantics research. The idea is that such an inference holds 'provided there is no information that is incompatible with the conclusion'. Thus if Tweety is a bird, then we can infer that Tweety flies – provided we do not know that Tweety is a flightless bird, say a penguin.

EXERCISE

5.9 Look again at your answers to (5.7) and find subclasses to which the expectations you listed might not apply.

inherits

In a semantic network, all the properties associated with a concept are automatically associated also with any concept which stands in an 'ako' relation with it (i.e. all its hyponyms). For example, the concept *animal* involves being able to move, needing to eat, and so on. A pig has these same properties precisely because it is an animal. We can say that it INHERITS these properties from the more general concept of which it is a hyponym. (It also introduces extra properties of its own, like having a curly tail.)

A concept can be a hyponym of several more general concepts at once. For example, *coin* is a kind of metallic object and at the same time a kind of medium of exchange. It will inherit from both of these more general concepts. So on the one hand it has a particular economic value, and on the other hand it has the properties associated with a metallic object.

EXERCISE

5.10 List two or three properties associated with the following concepts, and try to find more general concepts from which these properties are inherited. (These more general concepts need not correspond to a single word.)

tree	gold	murder	red	mackerel	miner
bulldozer	triangle				

5.1 SUMMARY

semantic networks

The focus of this chapter has been on lexical meaning relations, and to what extent these follow the logical patterns outlined at the end of the last chapter. Word meanings are related by networks sometimes known as SEMANTIC NETWORKS. These relations are responsible for expectations which enable us to draw certain conclusions. However, in many cases these conclusions cannot be drawn firmly but only by default.

5.2 SUPPLEMENTARY EXERCISES

converse

5.11 One kind of antonymy occurs when one predicate expresses the same relation as the other but with the arguments reversed – the CONVERSE of the relation (Chapter 3). Give converses for the following predicates, and state both sentences as predicate-argument formulas.

a 12 is twice 6.
b Tokyo is bigger than London.
c Chomsky was a student of Harris.
d Elizabeth I succeeded Mary.
e Belgrade is below Vienna (on the Danube).

5.12 Strictly speaking only two-place relations have converses. However some three-place predicates are related by a similar permutation of their arguments (e.g. 'John gave the book to Mary' vs 'Mary received the book from John'). Imagine the following scenario: Don Marino hands Antonio a gun, and Antonio hands Don Marino a thousand dollars. Express this using the three-place verbs 'buy', 'sell', 'cost' and 'fetch'.

5.13 The levels of a semantic network do not seem to have the same status. Study the following examples.

a The following form part of a semantic network:

labrador dog bitch mammal
animal quadruped

i Draw the network
ii It was suggested above that properties were 'inherited' by more specific nodes from more general nodes. What are the most general nodes introducing the following properties, and which hyponyms inherit them?
1 Need for exercise.
2 Ability to suckle offspring.
3 Having four legs.
iii Which words fit more naturally into the following sentences:
1 It's time to take my [ ] for a walk.
2 Look at that [ ] suckling its puppies.
3 My [ ] is on heat.
4 That [ ] is limping around on three legs.

Which word would you *expect* the properties described to be associated with, given your answers to a(ii)?

THINGS AND EVENTS 6

At the top level (the most general level) of a semantic network, most word senses can be grouped under certain extremely general concepts such as *thing* or *event*. These have certain important semantic characteristics, which have important effects on the ways in which they can be expressed in language. It will be convenient to discuss them by taking nouns and verbs in turn – though you should be careful of assuming that this distinction always corresponds to that between things and events.

First consider the following scenario, and the various ways in which it might appropriately be described. A dragon has his eye on a hoard of treasure, comprising gold rings.

(6.1) 1 (a) *The dragon saw a gold.
(b) The dragon saw some gold.
(c) *The dragon saw some golds.
(d) The dragon saw a heap/some heaps of gold.

2 (a) The dragon saw a ring.
(b) *The dragon saw some ring.
(c) The dragon saw some rings.
(d) The dragon saw a heap/some heaps of rings.

This shows that 'gold' and 'ring' are acceptable in different kinds of syntactic environment. This is due, however, to an important *semantic* difference. The point is that gold is conceptualized as a substance, whereas artefacts like rings are thought of as individual items. This correlates with a number of differences, both linguistic and non-linguistic. For example rings are countable in a straightforward way, whereas you can only compare quantities of gold by introducing some notion of measure (even a crude measure like a *heap* that a dragon might be able to individuate). Moreover if you divide gold into pieces each piece remains *gold*, whereas if you break up a ring what you have left is not a ring. However if you scatter