esoteric to being commonplace within the last five years. For the example, let us assume that the hearer perceives the sounds and recovers the spoken words perfectly. (In Chapter 24 we see how this might be done.)

ANALYSIS

Analysis. We divide analysis into two main parts: syntactic interpretation (or parsing) and semantic interpretation. Semantic interpretation includes both understanding the meanings of words and incorporating knowledge of the current situation (also called pragmatic interpretation).

PARSING

The word **parsing** is derived from the Latin phrase *pars orationis*, or "part of speech," and refers to the process of assigning a part of speech (noun, verb, and so on) to each word in a sentence and grouping the words into phrases. One way of displaying the result of a syntactic analysis is with a **parse tree**, as shown in Figure 22.1. A parse tree is a tree in which interior nodes represent phrases, links represent applications of grammar rules, and leaf nodes represent words. If we define the **yield** of a node as the list of all the leaves below the node, in left-to-right order, then we can say that the meaning of a parse tree is that each node with label X asserts that the yield of the node is a phrase of category X.

PARSE TREE

SEMANTIC INTERPRETATION

Semantic interpretation is the process of extracting the meaning of an utterance as an expression in some representation language. In Figure 22.1 we show two possible semantic interpretations: that the wumpus is not alive, and that it is tired (a colloquial meaning of *dead*). Utterances with several possible interpretations are said to be **ambiguous**. We use logic as the representation language, but other representations could be used. **Pragmatic interpretation** is the part of semantic interpretation that takes the current situation into account.[2] In the example, all that pragmatics does is replace the constant *Now* with the constant S_3, which stands for the current situation.

PRAGMATIC INTERPRETATION

DISAMBIGUATION

Disambiguation. Most speakers are not intentionally ambiguous, but most utterances have several legal interpretations. Communication works because the hearer does the work of figuring out which interpretation is the one the speaker probably meant to convey. Notice that this is the first time we have used the word *probably*, and disambiguation is the first process that depends heavily on uncertain reasoning. Analysis generates possible interpretations; if more than one interpretation is found, then disambiguation chooses the one that is best.

INCORPORATION

Incorporation. A totally naive agent might believe everything it hears, but a sophisticated agent treats the words W and the derived interpretation P_i as additional pieces of evidence that get considered along with all other evidence for and against P_i.

Note that it only makes sense to use language when there are agents to communicate with who (a) understand a common language, (b) have a shared context on which to base the conversation, and (c) are at least somewhat rational. Communication does not work when agents are completely irrational, because there is no way to predict how an irrational agent will react to a speech act. Interestingly, communication can work when agents are uncooperative. Even if you believe that another wumpus world explorer would lead you astray in order to get the gold all for itself, you can still communicate to help each other kill the wumpus or perform some other task that is helpful to both agents. Returning to Africa for another example, when an antelope sees a

[2] Thus, pragmatic interpretation associates meanings with *utterances* made in specific contexts, whereas the rest of semantic interpretation associates meanings with *strings* in isolation. This is controversial, and other authors draw the line between semantics and pragmatics in different places, or just group them together. Also, some authors use the term **parsing** to encompass all of what we call analysis.