This book has analyzed the transfer of information from the speaker to the hearer. The framework used is the SLIM theory of language, which is based on Surface compositional, Linear, Internal Matching. This theory is mathematically explicit, of low complexity, and suitable for computational implementation. It may be summarized as the following schema of an artificial cognitive agent, called a SLIM machine:

**A SLIM machine interacts with the external world by means of recognition and action at the levels of both language (components 3–6) and context (components 8–14). The connection between the two levels is provided by the procedure of internal matching 7. The interfaces to external reality are sign recognition and synthesis (components 1 and 2), and contextual recognition and action (components 15 and 16). Internal recognition and action are indicated as 17 and 18, respectively.**

The traditional components of grammar (cf. 1.2.2) and the components of the SLIM machine are related as follows:

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22 See also p. 457, 465 et seq.

A SLIM machine also contains a number of components which are not part of traditional natural language analysis and are therefore usually left untreated. All the components are named below, and related passages in this book are cited by page number.

COMPONENTS OF A SLIM MACHINE

1. Interface of sign recognition
   Transfer from a realization-dependent into a realization-independent medium (d⇒i), pp. 23–24; OCR systems, p. 24; desiderata of today’s speech recognition systems, their quality, and preconditions for their improvement, pp. 25–26; processing of language signs, p. 70; transition from icon to letter, p. 120.

2. Interface of sign synthesis
   Transfer from a realization-independent into a realization-dependent medium (i⇒d), speech synthesis, pp. 23–24; processing of language signs, p. 70.

3. Analyzed surfaces of language input and output

4. Algorithm of language interpretation

5. Algorithm of language production
6. **Semantic representation of language input and output**  
Representing content by means of concatenated propositions, pp. 62–63; processing of language signs, p. 70; meaning₁ and PoP-1, pp. 72–77; the sign types of symbols, indices, and names, pp. 103–117; representing concatenated propositions in a word bank, pp. 434–436; definition of L-proplets, p. 440; components of a meaning₁ and formal reconstruction of PoP-1, p. 501.

7. **Interface of internal matching**  
Principles of the SLIM theory of language, p. 8; 2+1 level analysis of reference, p. 74; schema of language interpretation and production, pp. 97 and 442; semantic interpretation of natural language, p. 374; the four basic ontologies of semantic interpretation, pp. 399–402; SLIM 1–10, pp. 467–471; internal matching between a meaning₁ and a task analysis, p. 502.

8. **Task analysis**  
STAR, pp. 69–120; the sign types of symbols, indices, and names, pp. 103–117; the basic reference mechanisms in non-verbal communication, pp. 106–107; relating stored content to the current situation, pp. 494–498; primary vs. secondary task analysis, pp. 494–495; inference-based mapping between a meaning₂ and a task analysis, pp. 496–497.

9. **Inferences**  

10. **LA-MOTOR**  

11. **Word bank**  
The nonlinguistic nature of the internal context, pp. 63–64; 2+1 level analysis of reference, p. 74; immediate and mediated reference, pp. 75–76; finding the correct subcontext, pp. 93–96; the four basic ontologies of semantic interpretation, pp. 399–402; context as a knowledge base, p. 429; model- and frame-theoretic attempts at defining the context, pp. 431–434; proplets in a word bank, pp. 435–439; the LA-grammars of the context-level, p. 457; immediate and mediated subcontexts, pp. 462–464; SLIM 1–10, pp. 467–471; context as a word bank, 481–483;
navigation through a word bank, pp. 484–485; relation between a context and a task analysis, pp. 494–496, 502.

12. Algorithm of contextual recognition

13. Algorithm of contextual action

14. Analyzed recognition and action
   Natural and artificial vision, p. 54; reconstructed patterns, logical analysis, and classification, p. 55.

15. Interface of contextual external recognition
16. Interface of contextual external action
17. Interface of contextual internal recognition
18. Interface of contextual internal action

There is great variation in the number of pages devoted to each component. This reflects the historical development and the current state of research in the fields constituting computational linguistics.

For example, the syntactic research in linguistics, the semantic research in logic, and the technology of parsing are all biased towards analyzing given language signs – as in the hearer mode. The corresponding speaker mode of language production, in contrast, is a much more recent, less well established, smaller, application-oriented topic whose relation to the hearer mode is usually left unaddressed.23

Similarly, the analysis of the language level is developed much further than that of the context level. In fact, much of the literature on semantics has taken great pains to avoid an analysis of cognitive states, using hand-crafted models of the external world as the level of reference instead.24 Even in artificial intelligence the difficulties of building artificial cognitive agents capable of recognition and action in the real world are avoided by designing virtual agents.25

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23 See the different architectures of natural language generation (NLG) in Section 24.2.
24 See the discussion of [±constructive, ±sense] ontologies in Sections 20.2–20.5.
25 See the discussion of cognitive modeling in Section 23.4.