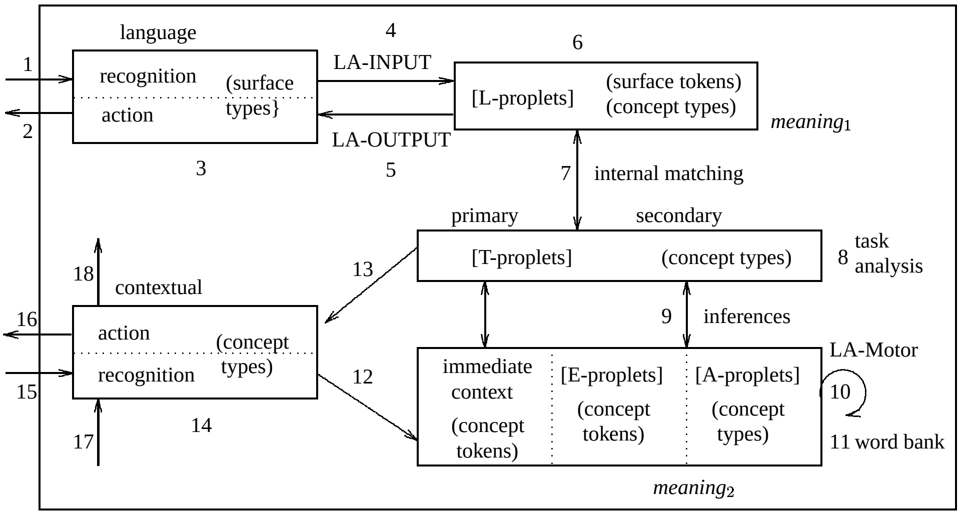
Schematic summary

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 **S**urface compositional, **L**inear, **I**nternal **M**atching. 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:[22]

SCHEMA OF 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:

[22] See also p. 457, 465 et seq.

Component 3 contains morphology in combination with lexical look-up and automatic word form recognition. Component 4 comprises syntactic analysis and semantic interpretation. Component 6 contains the semantic representation of natural language meaning. Pragmatics is analyzed in terms of the inference component 9.

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*
   Language interpretation and production, pp. 97 and 442; realization-independent analysis of word, word form, morpheme and allomorph in morphology, pp. 241–250; lexical look-up, pp. 250–53 and 269–272; methods of automatic word form recognition, pp. 253–257; LA-MORPH, pp. 259–278; lexical frames for the parts of speech, pp. 478–479 and p. 522.
4. *Algorithm of language interpretation*
   Surface compositionality, pp. 77–86 and 416–420; formal grammar, computational complexity, comparison of C-, PS- and LA-Grammar, type transparency, input-output equivalence with the speaker-hearer, complexity of natural language, pp. 125–238; time-linear syntactic analysis of natural language, pp. 301–366; comparison of logic, programming, and natural languages, distinction between metalanguage-based and procedural semantics, ontologies of semantic interpretation, pp. 371–406; schema of the hearer's language interpretation, p. 438; language recognition grammar LA-RCN-L, p. 466; SLIM 4, 6, and 8, pp. 468–470; semantic interpretation of LA-grammar rules, p. 478; definition of LA-INPUT, p. 479; example of a syntactic-semantic derivation, pp. 480–481; mapping a meaning_1 into a meaning_2, p. 500.
5. *Algorithm of language production*
   LA-generator, pp. 193–195; schema of the speaker's language production, p. 437; language action grammar LA-ACN-L, p. 466; SLIM 5, 7, and 9, pp. 469–470; definition of LA-OUTPUT, p. 486; example of a semantic-syntactic derivation, pp. 486–487; mapping a meaning_2 into a meaning_1, p. 499.

6. *Semantic representation of language input and output*
Representing content by means of concatenated propositions, pp. 62–63; processing of language signs, p. 70; $meaning_1$ 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 $meaning_1$ 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 $meaning_1$ 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 $meaning_2$ and a task analysis, pp. 496–497.

9. *Inferences*
Generalization, p. 441; episodic and absolute inferences, p. 442; spatio-temporal inferencing, pp. 444–450; inference grammars LA-INF-G (generalization), LA-INF-E (episodic inference), and LA-INF-A (absolute inference), p. 466; modus ponens, pp. 490–491; inference rules E-inf_{be} and A-inf_{be}, pp. 491-493; implication rules imp_{find} and imp_{seek}, pp. 493–494; index-introducing (ID) and -eliminating (DI) inferences ID-inf_{T}, ID-inf_{R}, DI-inf_{T}, and DI-inf_{R}, pp. 496–497.

10. *LA-MOTOR*
De Saussure's second law, pp. 97–98; thought as navigation through propositional content, pp. 99–101; schema of the speaker's language production, p. 437; definition of LA-MOTOR, p. 458; extrapropositional id- and cnj-navigation, pp. 458–459; autonomous control structure and tracking principles, p. 459–462; example of a navigation based on LA-MOTOR and the word bank 24.1.11, pp. 484–485; mapping a $meaning_2$ into a $meaning_1$, p. 499.

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*
    From perception to recognition, pp. 53–56; contextual recognition and action, p. 58 and pp. 65–67; external recognition grammar LA-RCN-E and internal recognition grammar LA-RCN-I, p. 466.
13. *Algorithm of contextual action*
    Contextual recognition and action, p. 58 and pp. 65–67; external action grammar LA-ACN-E and internal action grammar LA-ACN-I, p. 466.
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]

[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.