Contents

1	Commutational Analysis of Natural Language	
1.	Computational Analysis of Natural Language	<i>3</i>
	The second company of the second contract of	7
	1.2 Language Sciences and Their Components	12
	1.3 Methods and Applications of Computational Linguistics	
	1.4 Electronic Medium in Recognition and Synthesis	13
	1.5 Second Gutenberg Revolution	16
	Exercises	22
2.	Smart vs. Solid Solutions	25
	2.1 Indexing and Retrieval in Textual Databases	25
	2.2 Using Grammatical Knowledge	29
	2.3 Smart vs. Solid Solutions in Computational Linguistics	31
	2.4 Beginnings of Machine Translation	33
	2.5 Machine Translation Today	37
	Exercises	42
3.	Cognitive Foundations of Semantics	45
	3.1 Prototype of Communication	45
	3.2 From Perception to Recognition	47
	3.3 Iconicity of Formal Concepts	50
	3.4 Context Propositions	56
	3.5 Recognition and Action	59
	Exercises	62
4.	Language Communication	65
	4.1 Adding Language	65
	4.2 Modeling Reference	68
	4.3 Using Literal Meaning	71
	4.4 Frege's Principle	73
	4.5 Surface Compositionality	76
	Exercises	84

хi

5.	Usir	ng Language Signs on Suitable Contexts	87
	5.1	Bühler's Organon Model	87
	5.2	Pragmatics of Tools and Pragmatics of Words	89
	5.3	Finding the Correct Subcontext	91
	5.4	Language Production and Interpretation	94
	5.5	Thought as the Motor of Spontaneous Production	97
	Exe	rcises	99
6.	Stru	acture and Functioning of Signs	103
	6.1	Reference Mechanisms of Different Sign Kinds	103
	6.2	Internal Structure of Symbols and Indexicals	107
	6.3	Repeating Reference	110
	6.4	Exceptional Properties of Icon and Name	114
	6.5	Pictures, Pictograms, and Letters	118
	Exe	rcises	121
Par	t II.	Theory of Grammar	
7.	For	mal Grammar	127
	7.1	Language as a Subset of the Free Monoid	127
	7.2	Methodological Reasons for Formal Grammar	132
	7.3	Adequacy of Formal Grammars	133
	7.4	Formalism of C Grammar	134
	7.5	C Grammar for Natural Language	138
		rcises	141
8.	Lan	guage Hierarchies and Complexity	143
	8.1	Formalism of PS Grammar	144
	8.2	Language Classes and Computational Complexity	146
	8.3	Generative Capacity and Formal Language Classes	149
	8.4	PS Grammar for Natural Language	154
•		Constituent Structure Paradox	159
		rcises	163
9.	Bas	ic Notions of Parsing	167
	9.1	Declarative and Procedural Aspects of Parsing	167
	9.2	Fitting Grammar onto Language	169
	9.3	Type Transparency Between Grammar and Parser	174
	9.4	Input-Output Equivalence with the Speaker-Hearer	180
	9.5	Desiderata of Grammar for Achieving Convergence	183
		rcises	185
10.	Lef	t-Associative Grammar (LAG)	189
	10.1	Rule Kinds and Derivation Order	189
	10.3	Formalism of I A Grammar	103

		Contents	xiii
	10.3 Time-Linear Analysis		196 198 201 207
11.	Hierarchy of LA Grammar 11.1 Generative Capacity of Unrestricted LAG 11.2 LA Hierarchy of A, B, and C LAGs 11.3 Ambiguity in LA Grammar 11.4 Complexity of Grammars and Automata 11.5 Subhierarchy of C1, C2, and C3 LAGs Exercises		209 209 212 215 218 221 227
	LA and PS Hierarchies in Comparison 12.1 Language Classes of LA and PS Grammar 12.2 Subset Relations in the Two Hierarchies 12.3 Nonequivalence of the LA and PS Hierarchy 12.4 Comparing the Lower LA and PS Classes 12.5 Linear Complexity of Natural Language Exercises		231 231 233 235 237 239 245
Par	t III. Morphology and Syntax		· ·
13.	Words and Morphemes		249 249 254 257 258 262 266
14.	Word Form Recognition in LA Morph 14.1 Allo Rules		269 269 273 279 282 285 289
15.	Corpus Analysis		291 291 295 297 300

xiv

	15.5 Statistical Tagging	304 308
16.	Basic Concepts of Syntax	311
10.	16.1 Delimitation of Morphology and Syntax	311
	16.2 Valency	314
	16.3 Agreement	316
	16.4 Free Word Order in German (LA DI)	319
	16.5 Fixed Word Order in English (LA E1)	324
	Exercises	326
17	LA Syntax for English	329
17.	17.1 Complex Fillers in Pre- and Postverbal Position	329
	17.2 English Field of Referents	334
	17.3 Complex Verb Forms	330
	17.4 Finite State Backbone of LA Syntax (<i>LA E2</i>)	339
	17.5 Yes/No-Interrogatives (<i>LA E3</i>) and Grammatical Perplexity	34.
	Exercises	348
18.	LA Syntax for German	35
	18.1 Standard Procedure of Syntactic Analysis	35
	18.2 German Field of Referents (<i>LA D2</i>)	354
	18.3 Verbal Positions in English and German	359
	18.4 Complex Verbs and Elementary Adverbs (<i>LA D3</i>)	362
	18.5 Interrogatives and Subordinate Clauses (LA D4)	368
	Exercises	374
Par	rt IV. Semantics and Pragmatics	
19.	Three Kinds of Semantics	379
	19.1 Basic Structure of Semantic Interpretation	379
	19.2 Logical, Programming, and Natural Languages	38
	19.3 Functioning of Logical Semantics	383
	19.4 Metalanguage-Based or Procedural Semantics?	38
	19.5 Tarski's Problem for Natural Language Semantics	39
	Exercises	39.
20.	Truth, Meaning, and Ontology	39
	20.1 Analysis of Meaning in Logical Semantics	39
	20.2 Intension and Extension	40
	20.3 Propositional Attitudes	40
	20.4 Four Basic Ontologies	40′
	20.5 Sorites Paradox and the Treatment of Vagueness	41
	Exercises	41:

\sim		
n	tents	
-con	wiits	

xv

21.	Absolute and Contingent Propositions	417
	21.1 Absolute and Contingent Truth	417
	21.2 Epimenides in a [+sense, +constructive] System	421
	21.3 Frege's Principle as Homomorphism	424
	21.4 Time-Linear Syntax with Homomorphic Semantics	428
	21.5 Complexity of Natural Language Semantics	431
	Exercises	434
22.	Database Semantics	437
	22.1 Database Metaphor of Natural Communication	437
	22.2 Descriptive Aporia and Embarrassment of Riches	440
	22.3 Combining Categorial Operation and Semantic Interpretation	444
	22.4 Reference as Pattern Matching	447
	22.5 Repercussion of the Semantic Interpretation on the DBS Syntax	449
	Exercises	452
23.	Semantic Relations of Structure	455
	23.1 Coding Content at the Elementary, Phrasal, and Clausal Levels	455
	23.2 Storing Content in a Word Bank	457
	23.3 Representing the Semantic Relations of Structure Graphically	461
	23.4 Paraphrase and the Universalist/Relativist Dichotomy	464
	23.5 The Ten SLIM States of Cognition	467
	Exercises	473
24	Conclusion	475
- ¬.	24.1 Hear Mode	475
	24.2 Speak Mode	476
	24.3 Questions and Answers	479
	24.4 Autonomous Control	483
	24.5 Coherence	486
	Exercises	488
Bib	oliography	491
Nai	me Index	503
Sub	oject Index	507