Contents

1	Introduction						
	1.1	Background Knowledge	1				
	1.2	The Structure of the Book	2				
2	The ACT-R Cognitive Architecture and Its pyactr						
	Impl	ementation	7				
	2.1	Cognitive Architectures and ACT-R	7				
	2.2	ACT-R in Cognitive Science and Linguistics 1					
	2.3	ACT-R Implementation 1					
	2.4	Knowledge in ACT-R	13				
		2.4.1 Declarative Memory: Chunks	13				
		2.4.2 Procedural Memory: Productions	14				
	2.5	The Basics of pyactr: Declaring Chunks	15				
	2.6	Modules and Buffers	18				
	2.7	Writing Productions in pyactr	20				
	2.8	Running Our First Model	24				
	2.9	Some More Models	27				
		2.9.1 The Counting Model	27				
		2.9.2 Regular Grammars in ACT-R	31				
		2.9.3 Counter Automata in ACT-R	34				
	2.10	Appendix: The Four Models for Agreement, Counting,					
		Regular Grammars and Counter Automata	36				
3	The l	Basics of Syntactic Parsing in ACT-R	39				
	3.1	Top-Down Parsing	39				
	3.2	Building a Top-Down Parser in pyactr	41				
		3.2.1 Modules, Buffers, and the Lexicon	42				
		3.2.2 Production Rules	44				
	3.3	Running the Model	48				
	3.4	Failures to Parse and Taking Snapshots of the Mind					
		When It Fails	50				

	3.5 3.6					
4		EXAMPLE A Cognitive Process: Left-Corner Parsing Visual and Motor Interfaces The Environment in ACT-R: Modeling Lexical Decision	57			
		Tasks4.1.1The Visual Module4.1.2The Motor Module	57 59 60			
	4.2 4.3	The Lexical Decision Model: Productions Running the Lexical Decision Model and Understanding	60			
		 4.3.1 Visual Processes in Our Lexical Decision Model 4.3.2 Manual Processes in Our Lexical Decision Model 	63 65 67			
	4.4 4.5	A Left-Corner Parser with Visual and Motor Interfaces Appendix: The Lexical Decision Model	68 81			
5	Brief Introduction to Bayesian Methods and pymc3					
	for L 5.1 5.2 5.3	inguists The Python Libraries We Need The Data Prior Beliefs and the Basics of pymc3, matplotlib	83 85 85			
	5.4 5.5	and seaborn Our Function for Generating the Data (The Likelihood) Posterior Beliefs: Estimating the Model Parameters	89 92			
	5.6 5.7	and Answering the Theoretical Question Conclusion Appendix	98 102 103			
6	Mode 6.1 6.2 6.3 6.4 6.5	Eling Linguistic Performance The Power Law of Forgetting The Base Activation Equation The Attentional Weighting Equation Activation, Retrieval Probability and Retrieval Latency Appendix	105 106 115 120 127 132			
7	Competence-Performance Models for Lexical Access					
	and S 7.1 7.2 7.3	Syntactic Parsing Syntactic Parsing The Log-Frequency Model of Lexical Decision The Simplest ACT-R Model of Lexical Decision The Second ACT-R Model of Lexical Decision: Adding	133 133 137			
	7.4	the Latency Exponent	142 146			

Contents

		7.4.1 The Bayes+ACT-R Lexical Decision Model	1.45			
		 Without the Imaginal Buffer	147			
		Imaginal Buffer	154			
		Buffer and 0 Delay	157			
	7.5	Modeling Self-paced Reading with a Left-Corner Parser	159			
	7.6	Conclusion	165			
	7.7	Appendix: The Bayes and Bayes+ACT-R Models	166			
		7.7.1 Lexical Decision Models	166			
		7.7.2 Left-Corner Parser Models	167			
8		ntics as a Cognitive Process I: Discourse Representation				
		tures in Declarative Memory	169			
	8.1	The Fan Effect and the Retrieval of DRSs from Declarative				
		Memory	172			
	8.2	The Fan Effect Reflects the Way Meaning Representations				
		(DRSs) Are Organized in Declarative Memory	178			
	8.3	Integrating ACT-R and DRT: An Eager Left-Corner				
		Syntax/Semantics Parser	182			
	8.4	Semantic (Truth-Value) Evaluation as Memory Retrieval,				
		and Fitting the Model to Data	192			
	8.5	Model Discussion and Summary	203			
	8.6	Appendix: End-to-End Model of the Fan Effect				
		with an Explicit Syntax/Semantics Parser	204			
		8.6.1 File ch8/parser_dm_fan.py	204			
		8.6.2 File ch8/parser_rules_fan.py	205			
		8.6.3 File ch8/run_parser_fan.py	205			
		8.6.4 File ch8/estimate_parser_fan.py	205			
9		ntics as a Cognitive Process II: Active Search for Cataphora				
		edents and the Semantics of Conditionals	207			
	9.1	Two Experiments Studying the Interaction Between				
		Conditionals and Cataphora	209			
		9.1.1 Experiment 1: Anaphora Versus Cataphora				
		in Conjunctions Versus Conditionals	210			
		9.1.2 Experiment 2: Cataphoric Presuppositions				
		in Conjunctions Versus Conditionals	214			
	9.2	Mechanistic Processing Models as an Explanatory Goal				
		for Semantics	218			
	9.3	Modeling the Interaction of Conditionals and Pronominal				
		Cataphora	221			

		9.3.1	Chunk Types and the Lexical Information Stored	
			in Declarative Memory	222
		9.3.2	Rules to Advance Dref Peg Positions, Key Presses	
			and Word-Related Rules.	228
		9.3.3	Phrase Structure Rules	230
		9.3.4	Rules for Conjunctions and Anaphora Resolution	239
		9.3.5	Rules for Conditionals and Cataphora Resolution	249
	9.4	Model	ling the Interaction of Conditionals and Cataphoric	
		Presu	ppositions	262
		9.4.1	Rules for 'Again' and Presupposition Resolution	262
		9.4.2	Rules for 'Maximize Presupposition'	271
		9.4.3	Fitting the Model to the Experiment 2 Data	275
	9.5	Conclu	usion	278
	9.6	Apper	ndix: The Complete Syntax/Semantics Parser	280
		9.6.1	File ch9/parser_dm.py	280
		9.6.2	File ch9/parser_rules.py	280
		9.6.3	File ch9/run_parser.py	281
		9.6.4	File ch9/estimate_parser_parallel.py	281
10	Futu	re Dire	ctions	283
Bib	liograj	ohy		287