## **CONTENTS**

PREFACE			хi
1	INTRODUCTION		
	1.1	Data Models in Shared and Distributed Systems	2
	1.2	Concerns of This Book	3
2 7	TH	E SEMANTIC DATA MODELS: EXAMPLES	6
	2.1	The Semantic Graph Data Model	6
	2.2	The Semantic Relation Data Model	9
	2.3	Equivalence Properties	17
3	RE	LEVANT WORK OF OTHERS	18
	3.1	The Codasyl DBTG Data Model	18
	3.2	The Relational Data Model	23
	3.3	Semantic Networks	26
	3.4	The Entity-Relationship Model	27
		Multiple Data Model Database System Architecture	29
	3.6	Previous Work on Equivalence	31
4	FR	AMEWORK FOR DATA MODEL DEFINITION	33
	4.1	Application Models	34
	4.2	Operation Types	35
	4.3	Databases	36
5	TH	E SEMANTIC GRAPH DATA MODEL	38
	5.1	The Semantic Graph Application Model Schema	38
	5.2	The Semantic Graph Database State	44
	5.3	The Semantic Graph Operation Types	47
	5.4	Definitions of Valid Operations and Valid States	<b>5</b> 9

6	THE SEMANTIC RELATION DATA MODEL	62	
	6.1 Semantic Relation Statements	62	
	6.2 The Semantic Relation Application Model Schema	70	
	6.3 The Semantic Relation Database State	71	
	6.4 The Semantic Relation Operation Types	72	
	6.5 Definitions of Valid Operations and Valid States	92	
7	DATA MODEL EQUIVALENCE: DEFINITIONS		
	7.1 Database State Equivalence	94	
	7.2 Operation and Application Model Equivalence	96	
	7.3 Data Model Equivalence	105	
8	THE RESTRICTED SEMANTIC RELATION		
	DATA MODEL	107	
9	THE RESTRICTED SEMANTIC RELATION		
	DATA MODEL: CONSTRAINTS	128	
	9.1 The Semantic Relational Algebra	128	
	9.2 Constraint Types	129	
	9.3 The Constraint Definition Algorithm	131	
	9.4 Discussion	158	
10	CONSTRUCTIVE PROOF OF DATA MODEL		
	EQUIVALENCE	177	
	10.1 State Equivalence for the Restricted Semantic		
	Relation Data Model	178	
	10.2 Proof of Data Model Equivalence	184	
	10.3 Discussion	204	
11	CONCLUSIONS	206	
	11.1 Summary	206	
	11.2 Relational vs. Network: Some Observations	208	
	11.3 Foundation for a User Interface	210	
	11.4 Inferential Knowledge Representation Systems	215	

11.5 Other Applications and Semantic Data	Model
Extensions	216
11.6 Conclusion	219
APPENDIX A The Semantic Graph Data Mode	el:
Formal Specifications	221
APPENDIX B The Semantic Relation Data Mo	odel:
Formal Operation Specifications	237
APPENDIX C The Semantic Relation Data Mo	odel:
Formal Constraint Specification	s 245
BIBLIOGRAPHY	257
INDEX	267