

Contents

1	Concepts of Maps	1
1.1	An Idea of Maps	3
1.2	Towards Maps as a Fundamental Data Type	3
1.3	Fundamental Components of Maps.	4
1.3.1	Types of Maps	5
1.3.2	Maps in Robotics	7
1.3.3	Cognitive Maps.	8
1.3.4	Geometric Maps	9
1.3.5	Thematic Maps	10
1.4	A Map Framework	12
	References.	13
2	A Formal Model of Maps as a Fundamental Type	15
2.1	Spatial Data Models	15
2.2	Topological Relationships.	17
2.3	An Informal Overview of Spatial Partitions	20
2.4	Spatial Partitions: A Mathematical Model of Maps	21
2.4.1	Notation	21
2.4.2	Spatial Partitions	22
2.5	Summary	25
	References.	25
3	PLR Partitions: Extending Maps to Include Point and Line	27
	Features	27
3.1	Spatial Data Models	27
3.2	A Need for PLR Partitions	29
3.3	An Informal Overview of PLR Partitions	31
3.4	Notation	32
3.5	Spatial Mapping	33
3.6	PLR Partitions	34
3.6.1	Components of PLR Partitions	34
3.6.2	PLR Partition Definition	38

3.7	Using PLR Partitions to Define Points, Lines, and Regions	39
3.8	Summary	41
	References.	42
4	Foundational Operations for Maps	45
4.1	Intersection	45
4.1.1	Constructing the Intersection Operation.	46
4.1.2	Type Closure.	49
4.1.3	Alternate Construction of Intersection	50
4.2	Relabel	51
4.2.1	Constructing the Relabel Operation.	51
4.2.2	Type Closure.	52
4.3	Refine	53
4.3.1	Constructing the Refine Operation	53
4.3.2	Type Closure.	55
4.3.3	Alternate Construction of Refine	56
4.4	Closure of the Fundamental Map Operations	56
	References.	57
5	Constructing Map Operations Using the Fundamental Map Operations	59
5.1	Identification of Operations.	59
5.2	Overlay Operations.	60
5.3	Cover	61
5.4	Difference	61
5.5	Superimpose	64
5.6	Window	64
5.7	Operations to Support Layering	65
5.8	Summary	66
	References.	67
6	Extended Operations Over Maps	69
6.1	Motivating Query Scenarios	69
6.1.1	Map Joining Scenarios	70
6.1.2	Complex Connectivity Scenarios.	72
6.2	Formalization of Operations	72
6.2.1	Join Operations	73
6.2.2	Basic Connectivity Using Joins.	74
6.2.3	Formalization of Complex Connectivity Operations	76
6.3	Summary	78
	References.	79
7	Topological Relationships Between Maps	81
7.1	Topological Relationships Between Points, Lines, and Regions	82
7.2	Data Model.	84

7.3	Topological Relationships Between Map Geometries	84
7.4	Computing Topological Relationships Between Map Geometries Using Topological Relationships Between Regions	90
	References.	93
8	A Discrete Model of Maps	95
8.1	Definitions from Graph Theory.	96
8.2	Representing Spatial Partitions as Graphs.	97
8.3	Properties of Spatial Partition Graphs.	102
8.4	Deriving Spatial Partitions from Spatial Partition Graphs	105
8.5	Summary	106
	References.	106
9	Implementing Maps: Map2D	107
9.1	Data Model.	107
9.1.1	Overview of the Plane Sweep Algorithm	109
9.1.2	Implementation Aspects of the Plane Sweep Algorithm	110
9.2	Building Maps	113
9.2.1	Preparing the Input	113
9.2.2	Spatial Processing of a Halfsegment	113
9.2.3	Thematic Processing of a Halfsegment	114
9.2.4	A Note on External Memory.	119
9.2.5	A Note on Topological Predicates.	119
9.3	The Intersection Operator.	120
9.4	The Relabel Operator	122
9.5	The Refine Operator.	123
9.5.1	Walking Cycles in Regions.	124
9.5.2	Classifying Outer and Hole Cycles	126
9.5.3	Walking Cycles.	128
9.5.4	Walking Cycles in Maps.	129
9.5.5	Extending the Label Table	130
9.6	Combining Operations to Form New Operations	132
9.7	Querying Maps.	132
9.7.1	Creating Maps.	133
9.7.2	General Map Queries	134
9.7.3	Map Attribute Queries.	135
9.7.4	Component Attribute Queries	136
9.7.5	Component Queries.	137
9.8	Summary	138
	References.	138

Map Framework

A Formal Model of Maps as a Fundamental Data Type in
Information Systems

McKenney, M.; Schneider, M.

2016, XI, 140 p. 43 illus., Hardcover

ISBN: 978-3-319-46764-1