

# Contents

## 1 Introduction

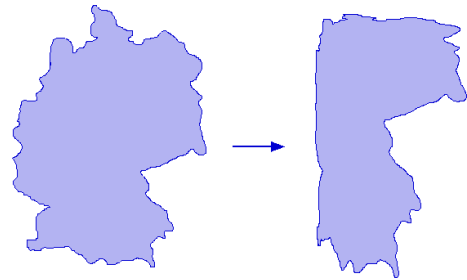
### 1.1 Motivation

### 1.2 Organizational Issues

### 1.3 Content and Overview

### 1.4 Literature

Books, Articles, Student Works



## 2 Spatial Data Modelling

### 2.1 Introduction

Discreta/Continua, Topology

### 2.2 Geometry

Raster Data Model, Vector Data Model

### 2.3 Conversion between Vector and Raster Models

Rasterization, Vectorization

### 2.4 Topology

Spaghetti Data Structure, Edge List, Winged Edge List

### 2.5 Fields

Nearest Neighbour, Voronoi Diagram, Triangulation, Inverse Distance Weighting, Kriging

### 2.6 AAA-Project

### 2.7 Operations

Metric and Euclidean Algorithms, Bentley-Ottmann Algorithm, Shortest Path, Map Algebra



## 3 Mapping of Spatial Data

### 3.1 Properties of Maps

Projections, Gauss-Krüger Coordinate System

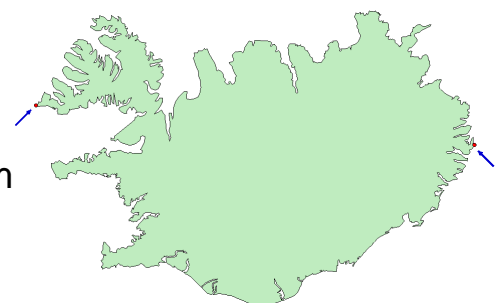
### 3.2 Signatures, Text, Color

### 3.3 Geometric Generalization

Elementary Operations, Low-pass Filter, Douglas/Peucker Algorithm, Polygon to Polyline Conversion, Simplification of Polygons

### 3.4 Label and Symbol Placement

Greedy Algorithm, Simulated Annealing, Case Studies



## 4 Spatial Queries

### 4.1 Development of SQL

SQL/MM Part 3: Spatial

### 4.2 Core SQL Queries

### 4.3 Spatial Queries and Core SQL

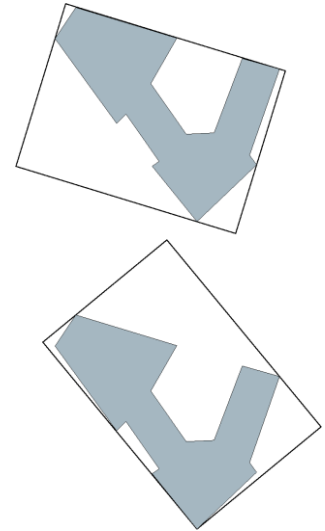
Distance between Buildings, Perimeter of Polygons

### 4.4 Spatial Extensions of SQL

Oracle Spatial, SDO Geometry, PostgreSQL

### 4.5 Evaluation of Spatial Queries

Conservative Approximation,  
Minimum Area Bounding Rectangle,  
Progressive Approximation



## 5 Spatial Access Methods

B<sup>+</sup>-tree, Z-order

### 5.1 Quadtree

Insert, Delete, Range Query

### 5.2 R-tree

Construction, Insert, Overflow Handling, Delete, Update, R<sup>+</sup>-tree

### 5.3 K-d tree

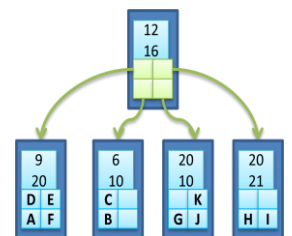
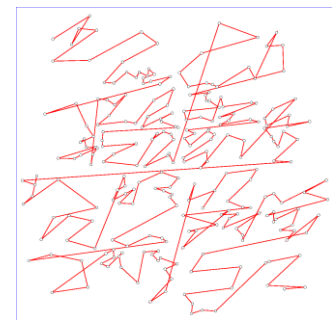
Construction, Delete

### 5.4 BSP tree

Choice of Split Plane, Application in Computer Graphics

### 5.5 Grid file

Components, Properties, Insert



## 6 Spatial Data and XML

### 6.1 Standards

ISO, OGC, AdV

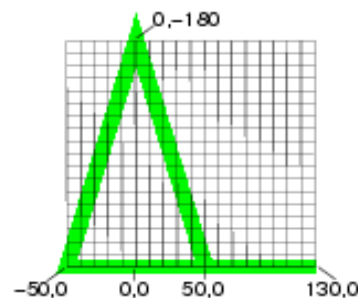
### 6.2 XML

Context-free Grammar, Element, Attribute, XML-Schema

### 6.3 GML

### 6.4 SVG

Path, Text, CSS



## 7 Application Programming

### 7.1 Connecting SQL with Programming Languages

Embedded SQL, Call Level Interface, JDBC

### 7.2 PostgreSQL and JDBC

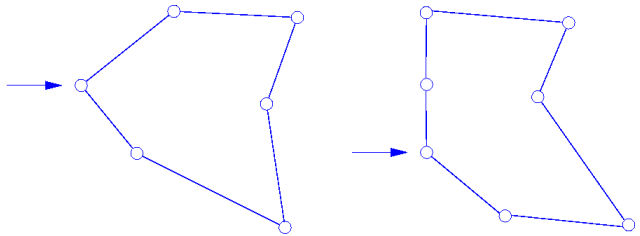
PObject, Polygon Normal Form

### 7.3 Oracle Spatial and JDBC

JGeometry, Load, Store

### 7.4 Processing of GML-based Data

SAX, DOM, Case Study



## 8 Architecture of Geographic Information Systems

### 8.1 GIS Hardware and Software

### 8.2 Hybrid vs. Integrated Systems

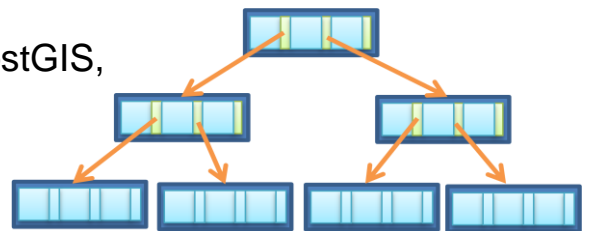
File based, Hybrid, Layer-oriented, Integrated, Spatial Join

### 8.3 Clients and Servers

Common GIS Servers, PostgreSQL → PostGIS, Common GIS Clients

### 8.4 Web-based Spatial Databases

OpenStreetMap



## 9 Remote Sensing

### 9.1 Physical Basics

Electromagnetic Waves, Atmospheric Window, Orbits

### 9.2 Recording Techniques

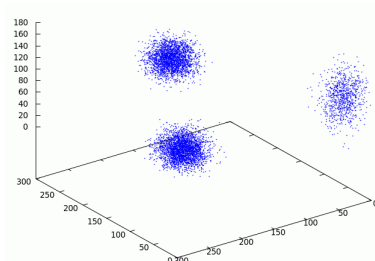
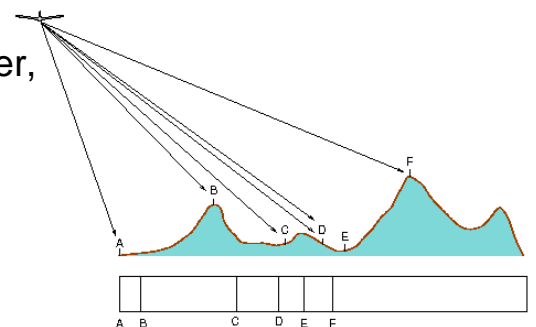
Photographic Systems, Whisk Broom Scanner, Push Broom Scanner, Radar, LIDAR

### 9.3 Image Processing

Geometric Errors, Geometric Corrections, Image Rectification, Image Enhancement

### 9.4 Thematic Classification

Image Interpretation, Multispectral Classification



## 10 Location Based Services

### 10.1 Positioning

GPS, Location Transponder

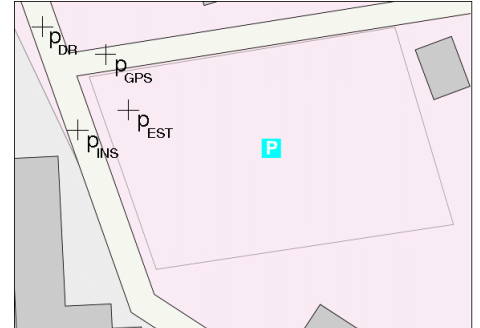
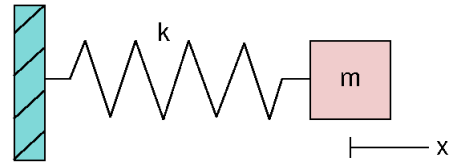
### 10.2 Car Navigation

GDF, MEMS Sensors, Sensor Fusion

### 10.3 Map Matching

### 10.4 Privacy

Quadtree Spatial Cloaking,  
Cliques Cloak Algorithm



## 11 Environmental Information Systems

### 11.1 Environmental Data

Example: Forrest Inventory

### 11.2 Collection of Environmental Data

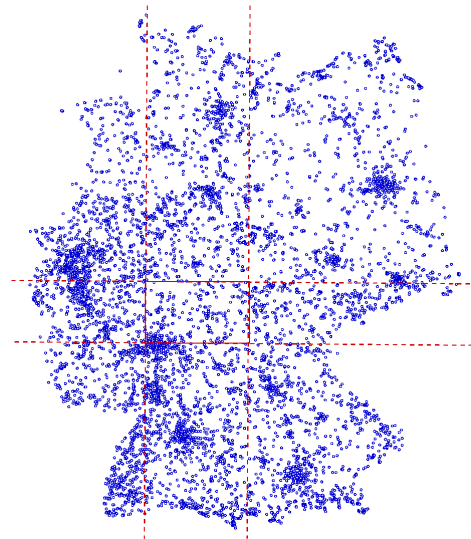
Laser Rangefinder, Field Survey

### 11.3 Monitoring Networks

TAO, ODL

### 11.4 Laboratory Data

Sampling, Spectroscopy,  
Chromatography



## 12 Review and Outlook

### 12.1 Review

### 12.2 Outlook