

ECS 266

Spatial Databases

Michael Gertz

0. Organizational Issues

ECS 266 – Spatial Databases
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Organizational Issues

Class Web site:

- <http://dbis.ucdavis.edu/courses/ECS266-SQ08>

Announcements and News:

- Class Web site and in class

Time and Place:

- Class: MWF 2:10-3:00pm, 1062 Bainer

Instructor:

- Michael Gertz
3029 Kemper Hall
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Office hours: T 12:30-1:30pm (and by appointment)

Organizational Issues (2)

Course Objectives:

- Principles and requirements of spatial data, spatial databases, and GIS
- Spatial concepts and models, representations of spatial objects
- Computational geometry techniques for spatial objects
- Spatial access methods (many, many index structures....)
- Query language and query processing concepts
- Models and techniques for moving object databases
- Spatial data mining concepts
- Open source and commercial Spatial DBMSs/GIS

Prerequisites:

- Database systems (in particular data modeling, query languages, query processing, index structures)
- Algorithms and data structures
- Unix/Linux and C/C++

Organizational Issues (3)

Textbooks and Reading:

There is no required textbook. Recommended literature includes

1. Philippe Rigaux, Michel Scholl, Agnès Voisard: *Spatial Databases with Applications to GIS*. Morgan Kaufman, 2002. [RVS02]
2. Shashi Shekhar, Sanjay Chawla: *Spatial Databases – A Tour*. Prentice Hall, 2003. [SC03]
3. Hanan Samet: *Foundations of Multidimensional and Metric Data Structures*. Morgan Kaufmann, 2006. [Sam06]
4. Mark de Berg, Marc van Krefeld, Mark Overmars, Otfried Schwarzkopf: *Computational Geometry – Algorithms and Applications*. Springer, 2000. [BKO00]
5. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind: *Geographic Information Systems and Science*. Wiley, 2001. [LGM01]

Several supplementary papers will be provided on class' Web site.

Computer Science Bibliography <http://www.informatik.uni-trier.de/~ley/db/>

ACM Digital Library <http://portal.acm.org/dl.cfm>

IEEE Xplore <http://ieeexplore.ieee.org>

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Course Policy:

- Assignments 40%, project 45%, final 15%
- See course and grading policy on class Web site!

Assignments & Computer Usage:

- At least 4 assignments covering class topics
- Group project (2 students per group); involves design and implementation of application using spatial DB components; project report should have the form of a research paper
- You can use your own computer (Linux, Windows XP)

Final:

- Take home final to be handed out Monday, June 2.
Final has to be turned in by Friday, June 6 at 5:00pm.

Organizational Issues (5)

Course outline and schedule (tentative)

1. Introduction to Spatial Databases

- Review: Databases and Database Management Systems
- Terminology and vocabulary in (geo)spatial database applications
- Principles and requirements of (geo)spatial data
- DBMS support for (geo)spatial data
- Example applications and application domains for (geo)spatial data

2. Spatial Concepts and Representation of Spatial Objects

- Review of space concepts: Euclidean space, topology, metric space
- Geographic space modeling (entity- versus field-based)
- Representation models (tessellation, vector model)
- Representing geometry of collection of objects (Spaghetti, network, topological model)
- Spatial ADTs (operations, (topological) predicates, and relationships between spatial objects)

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3. Computational Geometry

- Review: Algorithm analysis, complexity, and data structures
- Algorithmic strategies (convex hull, half-plan intersection, sweep-line method, polygon partitioning)
- Algorithms for spatial databases (points in polygon, polyline intersection, polygon intersection, windowing and clipping)

4. Spatial Access Methods (Spatial Indexing)

- Review: One-dimensional access methods (B⁺-trees, hashing)
- Space-driven versus data-driven structures; point versus region structures
- Cost factors and models; main-memory versus external structures
- Grid file
- Quadtree and variants; cost models
- R-tree and variants; cost models
- Kd-tree
- ...

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5. Query Languages, Query Processing and Optimization

- Spatial data models, type systems, and algebras
- Evaluation of spatial operations
- Spatial join
- Spatial extensions to SQL (SQL-MM standard)

6. Indexing Moving Objects and Trajectories

- Specifics of spatio-temporal objects
- Basics of spatio-temporal index structures
- TPR-tree, STR-tree, TB-tree, ...

7. Overview of Spatial Data Mining

- Overview of pattern discovery
- Spatial data mining concepts and techniques
- Clustering and outlier detection

** Commercial and Open Source SDBMS and GIS

- PostGIS, Oracle Spatial, GRASS, ArcInfo