

# **SPATIAL DATA: FROM SHAPEFILES TO DATA WAREHOUSES**

**Dr. Elzbieta Malinowski**

**Department of Computer Science and Informatics**

**University of Costa Rica**

elzbieta.malinowski@ucr.ac.cr

## **CONTENTS:**

1. Introduction:
  - a. Spatial data in different kinds of applications.
  - b. GISs versus Spatial DBMSs.
  - c. Shapefiles and their characteristics.
  - d. The importance of having and using standards.
2. Spatial reference systems:
  - a. Spatial data capture.
  - b. Datum and reference ellipsoid.
  - c. Coordinate reference systems.
  - d. Geographic and projected coordinate systems.
  - e. Spatial reference identifiers.
3. Spatial object:
  - a. Concept of spatial objects.
  - b. Spatial data types in the SQL/MM standard.
  - c. Topological relationships.
  - d. Operations on spatial objects according to the standard SQL/MM.
  - e. Query model.
4. Spatial database design:
  - a. Conceptual design of spatial databases.
  - b. Mapping to logical model.
  - c. Different kinds of spatial data representation on the physical level.
  - d. Spatial index structure: R-trees.
5. Oracle Spatial:
  - a. Oracle object-relational representation of spatial objects.
  - b. Geometry types.
  - c. DDL and DML for Oracle Spatial.
  - d. Examples.
6. Spatial data warehouses:
  - a. General overview of data warehouse and OLAP concepts and architecture.
  - b. Conceptual model for representing spatial data warehouses.
  - c. Different types of spatial hierarchies.
  - d. Spatial dimensions and measures.
  - e. Spatial extension of OLAP tools.
  - f. Method for (spatial) data warehouse design.
7. Temporal extensions to spatial data and research challenges:

- a. GIS approach for managing time.
- b. Spatio-temporal DBs: two approaches.
- c. Spatial data warehouses and options for temporal extensions.
- d. Some research topics: spatial data quality, volunteered geographic information, moving objects databases.

## REFERENCES

1. Castelein W, Grus L., Crompvoets J., and Bregt A. "A characterization of Volunteered Geographic Information", *13th AGILE International Conference on Geographic Information Science*, pp. 1-10, 2010.
2. Coleman D., Georgiadou Y, and Labonte J. "Volunteered Geographic Information: the nature and motivation of producers", *Journal of Spatial Data Infrastructures Research*, Vol. 4, 2009.
3. Coleman D., Sabone B., and Nkheanana N. "Volunteering geographic Information to Authoritative Databases: Linking Contributors Motivations to Program Characteristics", *Geomatica* 64(1): 383-396, 2010.
4. ESRI, *Shapefile Technical Description*, white paper, 1998, <http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf>.
5. Freelan S. "Developing a Quasi-Temporal GIS for Archival Map Data", *Huxley College of the Environment*, <http://myweb.facstaff.wvu.edu/stefan/tgis/tgis.htm>.
6. Goofchild M. "Citizens as sensors: the world of volunteered geography", *GeoJournal*: 69:211-221, 2007.
7. Güting R. and Schneider M. "Moving objects databases", Morgan Kaufman, 2005.
8. ISO/TC211 *Geographic Information – Spatial Schema*, ISO19107, 2001.
9. ISO/TC211 *Geographic Information – Spatial referencing by coordinates*, ISO19111, 2003.
10. ISO/TC211 *Geographic Information – Metadata*, ISO19115, 2003.
11. Malinowski E and Zimányi E. "Designing Conventional, Spatial, and Temporal Data Warehouses". Springer, 2008.
12. Kothuri R., Godfrind A. y Beinat E. "Pro Oracle Spatial". Apress, 2004.
13. Melton, J. "Advanced SQL:1999: Understanding Object-Relational and Other Advanced Features", Morgan Kaufmann Publishers, 2003.
14. OGC, *Standards and Specifications*, <http://www.opengeospatial.org/standards>, accessed May 2010.
15. Rigaux P., Scholl M. y Voisard A. "Spatial Databases with Application to GIS". Morgan Kaufmann Publishers, 2002.
16. Shekhar S. y Chawla S. "Spatial Databases: A Tour". Prentice Hall, 2003.
17. SQL/MM ISO/IEC 13249-3 *SQL Multimedia and application packages – Part3: Spatial*, 2006.
18. Stolze K. "SQL/MM Spatial: The standard to manage spatial data in relational database systems". *Proceeding of the 10<sup>th</sup> Conference on Database Systems for Business, Technology, and Web (BTW)*, 2003.
19. Worboys M. y Duckham M. "GIS: A Computing Perspective", segunda edición, CRC Press, 2004.
20. Yeung A. y Hall B. "Spatial Database Systems: Design, Implementation and Project Management". Springer, 2007