Temporal and Spatial Data Management
Fall 2017

Summary and Exam

Exam information:

- **Date**: January 8, 2018
- **Time**: 14:00 - 15:00
- **Location**: 2.A.01
- **Form**: written, closed book

- Solve examples (use exercises for preparation)
- Understand principles (multiple choice, analyze solutions)

Coalescing, Time Domain, Time Granularity

- **Coalescing**
  - SQL, procedural, analytic functions
- Time domain:
  - **Time domain**: set of instants with a total order
  - **Structure** of time: linear versus branching
  - **Density** of time: discrete, dense, continuous
  - **Boundness** of time: bound versus unbound
  - **Relative** (unanchored) versus **absolute** (anchored) time
- Time granularity and calendars
  - A **granularity** partitions the time line (chronons) into a set of **granules**
  - The granules are labeled with their distance from the anchor point.
  - A granularity maps a label to the corresponding set of chronons.
  - A **calendar** is generated from a single bottom granularity through **granularity operations**.

Temporal Data Models

- M. H. Böhlen, C. S. Jensen, Temporal Data Model and Query Language Concepts, Encyclopedia of Information Systems, 2003.
- **Modeling temporal model:** $M = (DS, QL)$
  - **Dimensions** of time; valid time, transaction time, ...
  - **Types** of timestamps: points, periods, elements
  - **Semantics** of timestamps: point versus interval semantics
  - **Scope** of timestamps: tuple versus attribute timestamping
- **Temporal data models**
  - Snodgrass's tuple timestamped data model
  - Jensen's backlog data model
  - Ben-Zvi tuple timstamped data model
  - Gadia's attribute value timestamped data model
- **Temporal query languages**:
  - SQL + ADT, IXSQL, SQL/TP, TSQL2, ATSQL

Sequenced Semantics

- Anton Dignös, Michael H. Böhlen, Johann Gamper: Temporal alignment, SIGMOD 2012.

- **Snapshot equivalence**: $\tau^V_{t_2}(\rho^B_{t_1}(r)) = \tau^V_{t_2}(\rho^B_{t_1}(s))$

- **Snapshot reducibility**: $\tau^V_t(r \times^V s) \stackrel{s}{\equiv} \tau^V_t(r) \times \tau^V_t(s)$

- **Sequenced semantics**: properties and implementation
  - alignment of time intervals
  - two new algebraic primitives:
    - normalize
    - align
  - Temporal extension of PostgreSQL

Spatial Database Systems

- R. H. Güting: An introduction to spatial database systems. *VLDB Journal* 3:357–399 (1994)

- A *spatial database system* is a database system with principled support for handling spatial data

- **Key Components of a Spatial Database System**
  - Representations for the data types (points, lines, regions) of a spatial algebra
  - Spatial index structures (z-order, kD tree, space transformation, R tree)
  - Filter and refine techniques

Spatial Network Databases

- D. Papadias, J. Zhang, N. Mamoulis, and Y. Tao: Query processing in spatial network databases. In *Proc. of the VLDB*, 2003.

- Dijkstra's single source shortest path

- Incremental Euclidean Restriction (IER)

- Incremental Network Expansion (INE)

Thanks

- All the best for the exam!
- Thanks for course evaluation. Any other comments about course, project, literature, etc is welcome.
- I am happy to discuss BSc and MSc theses, PhDs, internships, tutoring, summer jobs, projects with external companies, etc.
- DBTG is a good match if you like
  - to be precise,
  - algorithms,
  - a healthy mix of implementation and analysis,
  - real world data and problems.