

Temporal and Spatial Data Management

Fall 2019

Summary and Exam

Exam information:

- ▶ **Date:** January 6, 2020
- ▶ **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, window 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

▶ Chronons, granules and calendars

- ▶ A **granularity** partitions the time line 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**.

Sequenced Semantics

- ▶ A. Dignös, M. H. Böhlen, J. Gamper, C. S. Jensen, Extending the Kernel of a Relational DBMS with Comprehensive Support for Sequenced Temporal Queries, TODS 2016.
- ▶ **Snapshot equivalence:** $\forall t : \tau_t(r) = \tau_t(s)$
- ▶ **Snapshot reducibility:** $\forall t : \tau_t(r \times^T s) \stackrel{s}{\equiv} \tau_t(r) \times \tau_t(s)$
- ▶ **Sequenced semantics:** properties and implementation
 - ▶ alignment of time intervals
 - ▶ two new algebraic primitives:
 - ▶ normalize
 - ▶ align
 - ▶ Temporal extension of PostgreSQL

Temporal Data Models

- ▶ K. Kulkarni, J.-E. Michels, Temporal features in SQL:2011, SIGMOD Record, 2012.
- ▶ 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 timestamped data model
 - ▶ Gadia's attribute value timestamped data model
- ▶ **Temporal query languages:**
 - ▶ SQL + ADT, IXSQL, SQL/TP, TSQL2, ATSQL

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, R tree, space transformation)
 - ▶ Filter and refine techniques

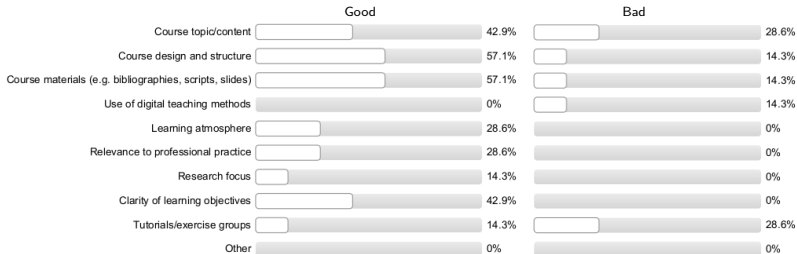
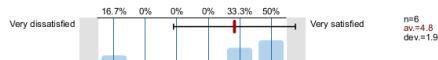
Spatial Network Databases

- ▶ 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)

Course Evaluation/1

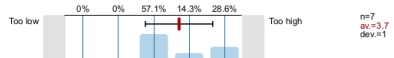
- Thanks for your evaluations.

How satisfied are you with this course overall?

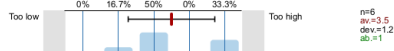


Course Evaluation/2

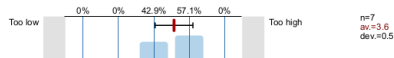
How do you rate the **level of difficulty** of this course?



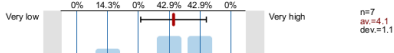
How do you rate your **workload** of this course?



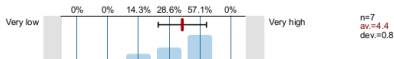
How do you rate the **student participation** of this course?



How do you rate your **own acquisition of skills** of this course?



How do you rate your **value for your overall studies** of this course?



► Any other comments about course, exercises, literature, etc?

Thanks

- ▶ 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
 - ▶ algorithms,
 - ▶ to be precise,
 - ▶ a healthy mix of implementation and analysis,
 - ▶ real world data and problems.
- ▶ All the best for the exam!