CSci8715 – Spatial databases: Project (Formal Proposal)
Group: G4
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Introduction:

Spatial data warehouses aim at effective and efficient querying of spatial data. Spatial databases are suited for answering regular transactional queries where there is not a lot of historical component or aggregation. The class of queries that are needed to support the decision making process are difficult on spatial data bases. This gave a rise to the field of spatial data warehouses which is idea of combining the traditional data warehouses with spatial databases. We would be doing a survey on spatial data warehouses with a focus on topics like conceptual models, Indexing, Aggregation and general SOLAP concepts.

Questions:

1. What are spatial data warehouses and what is the need for spatial data warehouses?
2. What are the models for representation of spatial data warehouses?
3. How are spatial data warehouses made more effective?
4. What are the benchmarks for evaluation of queries on spatial data warehouses?
5. What are the latest trends in spatial data warehouses?

Motivation and Related Work:

Spatial data warehouses and SOLAP is widely gaining importance due to the capabilities it provides. To our knowledge, there is no recent survey paper in literature on spatial data warehouses. There exists some literature on overview of general concepts of spatial data warehouses [19] [20] but we could not find a recent detailed survey which covers all the important aspects of a spatial data warehouse. There are many open research issues in spatial data warehouses and we would like to classify them and present them in a consolidated manner. We would be also analysing trends like spatiotemporal data warehouses and why they are gaining importance.

Key Concepts: Survey topics and description

Our survey would cover the following broad topics and the papers. Description of the paper is also briefly mentioned here:

1. Indexes for Spatial Data warehouses:
   Below are some proposed Index structures for spatial data warehouses or SOLAP:
1. **aR-tree [8]**: Aggregation R tree is an extension of R tree which stores aggregates for each MBR.
2. **GIST [27]**: Extending GIST and its query algorithm to favour OLAP aggregation queries.
3. **R*a-tree [10]**: Extension of the R*-tree for efficient OLAP range queries.
4. **aR-tree Implementation [7]**
5. **Spatiotemporal indexes [9]**: aRB-tree, generalization of aRB-trees, aHRB-tree and a3DRB-tree.

2 **Conceptual Models for Spatial Data warehouses**
Conceptual models like ER or even pictograms cannot be used to represent hierarchies needed for spatial data warehouses. Conceptual models for spatial data warehouses have spatial dimensions and measures.

2. Spatial multidimensional model [1]: Convert spatial measures to spatial dimensions.
3. Mapping of Conceptual model to Physical schema[3]
4. Extension of MultiDimER for Continuous fields [6].

3 **Aggregation in Spatial Data warehouses**
Aggregating of data in spatial data warehouses is required to for OLAP operations like drill up, drill down. As the hierarchies for spatial data may be irregular, aggregation of data poses a challenge.

1. Problems and solutions in Pre aggregation over Irregular OLAP hierarchies [28] [30].
2. Formal model for spatial aggregation [29].

4 **Selective materialization**
Materialization of a data cube means pre computation of results of queries so that the when they are run by the user, the execution is very fast. The selective materialization of a spatial data cube is partial materialization of spatial objects resulting from spatial operations.

1. General Selective materialization [31]

5 **Spatial OLAP: SOLAP**
The techniques for efficient processing of data in a spatial data warehouse for analysis and querying is called Spatial OLAP. SOLAP are meant to be client applications sitting on top of a multi-scale spatial data warehouse [19].

1. User Centric SOLAP [21]
2. Analysis of SOLAP tools [20] [32]
3. Extension of OLAP Cubes [18]
4. Products: Microsoft Terraserver [17]
6 Benchmarking Spatial Data warehouses
Evaluation of query performance of spatial data warehouses

I. Extension of star schema benchmark (SSB) for spatial Data warehouses [25].

7 Trends: Spatio temporal Data warehouses
I. General concepts [13] [14] [16] [20]

Validation Methodology

As we are doing a survey paper we would be analyzing the papers according to the key concepts/topics we have mentioned above.

For every topic we would:

- Summarize the approach discussed in the papers.
- Compare the limitations of one approach over the other (if applicable).

Criteria for comparison (may vary):

- Performance
- Storage
- Scalability
- Robustness

Key assumptions

- When applicable, the topics can be evaluated on the basis of the comparison criteria listed above.

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