CSCI 5980: From GPS and Google Earth to Spatial Computing

Fall 2012 Midterm Presentation
Chapter 7: Architectures

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Chapter 7: Architectures

Course Materials from Textbook

*What is a system architecture?*
*What are the main characteristics?*

Interoperability: ability to share data, information, processing
Modularity: composed of independent units with defined functions

- **7.1** Hybrid, Integrated, Composable Architectures
- **7.2** Syntactic and Semantic Heterogeneity
- **7.3** Distributed Systems
- **7.4** Distributed Databases
- **7.5** Location-aware Computing
Chapter 7: Architectures

Encyclopedia Articles

- National Spatial Data Infrastructure (NSDI), J. Maitra, pp. 767-771.
- University of Minnesota Map Server pp. 1197-1205
- Mobile P2P Databases, Y. Luo, O. Wolfson, pp. 671-677
Relevance to Course

- **NSDI** – Manages and distributes spatial data
- **ISO 191xx Standards** – Standardize spatial data
- **OGC Web Services** – Provides a framework for storing spatial data
- **Remote Sensing** – Creation of spatial data
- **ArcGIS** – Manipulation of spatial data
- **Intergraph** – Software for creating and sharing various types of spatial data
- **UMN Map Server** – Provides a means of easily accessing relevant spatial data
- **Mobile P2P Databases** – Cloud computing/storage of spatial data
Related Material in Textbook

- **NSDI** – Provides standards to reduce heterogeneity and a database system architecture
- **ISO 191xx Standards** – Standardize spatial data to reduce problems stemming from heterogeneity
- **OGC Web Services** – Provides a distributed architecture for database managers
- **Remote Sensing** – Location sensing is an important part of location-aware computing
- **ArcGIS** – A common software used which provides a form of component systems
- **Intergraph** – Software for maintaining databases and location-aware computing (emergency response system) and analyzing spatial data
- **UMN Map Server** – A format for database systems
- **Mobile P2P Databases** – An interesting form of distributed databases
Related Material in Textbook

Course Materials from Textbook

Interoperability: ability to share data, information, processing
Modularity: composed of independent units with defined functions

• 7.1 Hybrid, Integrated, Composable Architectures

• 7.2 Syntactic and Semantic Heterogeneity
  (NSDI, ISO 191xx, Remote Sensing Standards)

• 7.3 Distributed Systems
  (OGC Web Services)

• 7.4 Distributed Databases
  (Mobile P2P)

• 7.5 Location-aware Computing
  + Applications  (UMN Map Server, ArcGIS, Intergraph)
Novelty in Encyclopedia Articles

- Practical Applications: ArcGIS, Intergraph, UMN Map Server.
- NSDI: national strategies, manages the distribution of spatial data across all interconnected systems.
- ISO 191xx standards, provide structure for application development (19107 Spatial Schema, 19108 Temporal Schema, 19115 Metadata, etc.)
- Remote Sensing standards: major data collection method, core of NSDI. Addresses metadata, content, quality, etc.
- OGC Web Services: standards-based framework, integration of distributed geo-processing/location services, communicate using XML, HTTP.
- Mobile P2P Database: distributed data stored in mobile peers, communicate using short-range wireless protocols (802.11, Zigbee, Bluetooth, etc.), reports and queries to neighbors directly, propagate by transitive multi-hop transmissions.
Societal Motivation

- NSDI: geospatial data accuracy & availability to state, local, and tribal governments, academia and the private sector.
- Privacy/Security for personal data, Accuracy for statistical data.
- Avoid duplication, erroneous modification to spatial data.
- Standards (ISO) increases interoperability of geographic information.
- Easier for users to find and retrieve geographic data.
- Reduce the effects of syntactic heterogeneity.
- Improve disaster management, global warming, traffic management, etc. applications. (integrate data from different sources)
Computer Science Motivation

- Geo-spatial information database design
- Geo-spatial information data modeling
- OGC Web Services architecture: distributed architecture, better services integration
- Mobile P2P: transitive multi-hop propagation. Matchmaking, resource discovery services in many application domains, (social networks, mobile ecommerce, etc.)
Distributed Databases & Mobile P2P

- Logically related data, Multiple sites, Connected by network.

- Advantages: Decentralization, Availability and Reliability, Performance, Modularity.

Mobile P2P Databases:
  - Stores all data in the peers of a mobile P2P network
  - Mobile peers talk with via broadband short-range wireless protocols (IEEE 802.11, Bluetooth, and Zigbee, etc.)
  - Each peer stores a local database.
  - Peers communicate reports & queries to neighbors directly
  - Reports and queries propagate by transitive multi-hop transmissions.
Distributed Databases & Mobile P2P

Mobile P2P Database:
- Applications: matchmaking, resource discovery services in several application domains (social networks, transportation, mobile ecommerce, emergency response, etc.)
- Searching local, temporary information.
- Advantages: higher reliability, better privacy & performance, lower cost, and independence of any fixed infrastructure.
- Don’t guarantee completeness

Challenges: Complexity, Security, Integrity
( vs. NoSQL ? )
Any Questions?

- Thank you!