PURDUE UNIVERSITY

CS34800
Information Systems

Heterogeneous Databases

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5 December 2016

Indiana Center for Database Systems

1

Heterogenous Databases

- Problem: Data "grows up" in different silos
  - Independent systems
  - Designed for different purposes
  - No thought of sharing/interaction
- Sources
  - Company mergers
  - Small-scale systems that grow
    - E.g., Access databases
  - Cross-border

2

Heterogeneous Distributed Databases

- Many database applications require data from a variety of preexisting databases located in a heterogeneous collection of hardware and software platforms
- Data models may differ (hierarchical, relational , etc.)
- Transaction commit protocols may be incompatible
- Concurrency control may be based on different techniques (locking, timestamping, etc.)
- System-level details almost certainly are totally incompatible.
- A **multidatabase system** is a software layer on top of existing database systems, which is designed to manipulate information in heterogeneous databases
  - Creates an illusion of logical database integration without any physical database integration

Approaches

- Database conversion
  - Merge into a single format/model/system
    - Single schema
    - Single system, but separate schemas
  - *Often used with data warehousing*
- Multidatabase
  - Utilize existing, separated databases
  - Tools or APIs allowing interoperation

Advantages

- Preservation of investment in existing
  - hardware
  - system software
  - Applications
- Local autonomy and administrative control
- Allows use of special-purpose DBMSs
- Step towards a unified homogeneous DBMS
  - Full integration into a homogeneous DBMS faces
    - Technical difficulties and cost of conversion
    - Organizational/political difficulties
      - Organizations do not want to give up control on their data
      - Local databases wish to retain a great deal of **autonomy**

Unified View of Data

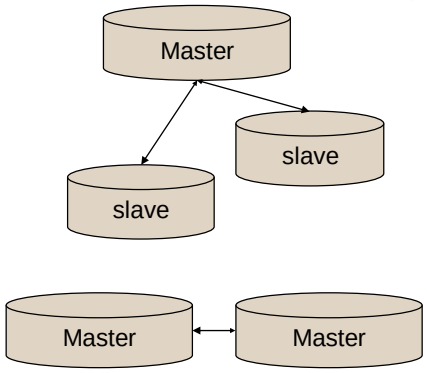
- Agreement on a common data model
  - Typically the relational model
- Agreement on a common conceptual schema
  - Different names for same relation/attribute
  - Same relation/attribute name means different things
- Agreement on a single representation of shared data
  - E.g. data types, precision,
  - Character sets
    - ASCII vs EBCDIC
    - Sort order variations
- Agreement on units of measure
- Variations in names
  - E.g. Köln vs Cologne, Mumbai vs Bombay

Problems to be Solved

- System Interoperability
  - Communications
  - Transaction Management
- Schema Integration
  - Schema matching
  - Schema mapping
- Record Linkage

System Interoperability

- Easiest: Common API (JDBC, ODBC)
  - Typically designed for client/server
  - "One-way" view of interoperation
- Distributed database APIs
  - Typically vendor-specific, may not be open
- Wrappers
  - Make one system "look like" another



Schema Matching

ID	Name	Birthdate	Course	Grade
7239	Chris Clifton	33/13/1872	CS34800	A

Last Name	First Name	ID	Time
Clifton	Chris	348	MWF 11:30

- Inconsistent terminology
  - Synonyms, homonyms
- No direct mappings
- Lack of documentation

9

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10

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- Rules for mapping
  - Name = First Name || ‘ ‘ || Last Name
- Wrappers
  - Build with views?

Record Linkage

- Identifying when records refer to the same entity
  - Mismatch (e.g., different keys)
  - Data inconsistencies
    - Noise
    - intentional

Type	Time	Days	Where	Date Range	Schedule Type	Instructors
Class	11:30 am - 12:20 pm	MWF	Neil Armstrong Hall of Engr 1010	Aug 22, 2016 - Dec 10, 2016	Lecture	Clifton W Bingham (P (Primary)) (mailto:clifton@purdue.edu)

CS 34800	Information Systems	Christopher Clifton	Time

Problems Interact

- Linked records can suggest schema mappings
- Knowledge of relationships within database can influence both
  - Keys
  - Functional Dependencies

Mediator Systems

- **Mediator** systems are systems that integrate multiple heterogeneous data sources by providing an integrated global view, and providing query facilities on global view
  - Unlike full fledged multidatabase systems, mediators generally do not bother about transaction processing
  - But the terms mediator and multidatabase are sometimes used interchangeably
  - The term **virtual database** is also used to refer to mediator/multidatabase systems

Problems often inexact

- Matches, mappings, linkage may be context dependent
  - "The same" isn't always clear or consistent
- Often amenable to machine learning
  - Inexact answers
- Open area of research