Day 1: Introduction to Database Theory and Design

Database Theory and Design
Tyler Peterson

International Summer School on Language Documentation and Description
Leiden University Centre for Linguistics, Leiden

November 26, 2011
My Details:

Tyler Peterson

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Room 205a

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office hours: Most afternoons until 18:00

▷ Please fill out the short survey, and don’t hesitate to contact me!
Goals for the Course:

- Databases: what they are, what linguists can use them for.
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- **Day 5:** Implementation
Goals for Today:

The Database as a Concept and Tool
Understanding what a database is
Using databases in linguistics

The Database model and its Evolution
The ‘Flat’ database
The Database Management System (DBMS)
Types of Databases Models

Database Applications
Choosing the right Database Application
Linguistic DBMS and Interfaces
Non-Linguistic DBMS and Interfaces
References and Suggested Readings
What is a database?

- **The database as a concept**: A structured collection of data, or *structured information*:
What is a database?

- **The database as a concept:** A structured collection of data, or *structured information*:
  - Index cards in a shoebox.
What is a database?

- **The database as a concept**: A structured collection of data, or *structured information*:
  - Index cards in a shoebox.
  - A table in a spreadsheet.
What is a database?

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Table: Structured Information: a Gitksan (Tsimshianic) word list
What is a database?

▶ The database as an application, or a kind of ‘processor’:
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- Different types of processors:
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  - Word processor: processes words (!)
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- The digital presentation of structured information through an application: MS Access; OpenOffice Calc; FileMaker Pro; MySQL with a PHP server; etc.
What is a database?

- Spreadsheets are actually a kind of database: both organize information into tables.
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- The primary differences between a spreadsheet and database: different types of queries.
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  - Spreadsheets use functions to ask questions of numbers. “What’s the average daily rainfall for the first six months of this year?”
- Databases use functions to ask questions about structured information: “Do we have any books on designing databases in our library? If so, on which shelves are they located?”
- Retrieval, and presentation: Today’s database applications are designed to retrieve and present data through queries through specially designed forms, within a database application, or on the web.
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Why use databases in linguistics?

- Linguistic research is a data-rich enterprise:
  - Archiving massive amounts of language/linguistic data.
  - Lexicography and dictionary making.
  - Enables collaboration through client-server applications over a network.
  - Database applications are particularly well-suited to linguistic research (cf. Nerbonne 1997; Everaert et al 2009):
    - Cross-linguistic and typological research.
    - Tools for verifying and evaluating contrasting empirical and theoretical claims.
    - Specialized queries that can yield new insights into data.
  - Consistency and integrity: imposing a structure on information can help reduce inaccuracies and redundancies.
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What can databases be used for in linguistics?

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- Both are conceived, designed and implemented using the same principles.
A common starting point: the ‘Flat’ database

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Table: A ‘Flat’ Database of a Gitksan (Tsimshianic) word list
A common starting point: the ‘Flat’ database

Language data in field notes, a numbered arrangement; Possibly transferred onto cards.
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- A ‘flat’ database.
Limitations of a Flat database

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- **For language data:** can obscure potentially meaningful implications, relationships and generalizations.
## Limitations of a Flat database cont.

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**Table:** A ‘Flat’ Database of a Gitksan (Tsimshianic) word list
The Solution:

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  II. An application to interact with the DBMS.
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- Several “industrial-strength” DBMS:
  - Oracle
  - Microsoft SQL Server
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Four types of database models:

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- **An Object-Oriented database**
  - Data are modeled as objects of various types that share or inherit properties according to their type.
  - For example, a database about word classes could let objects of the type transitive verb inherit properties of the type verb.
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- **Stand-alone desktop databases**: MS Access
- **The network database**: WordNet
Stand-alone desktop databases

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- MS Access, FileMaker Pro, OpenOffice Calc.
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- Most of the same functions with stand-alone databases can be used in network databases.
Comparing Pros and Cons

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- Network databases
  - **Pros:** Free, with more or less the same functionality as a stand-alone, proprietary database.
  - **Cons:** Extensive computer knowledge required (i.e. setting up a server, making the connections, knowledge of HTML)
Criteria

- General:
  - Who produced the software, which platforms the software runs on?
    - Is other software needed?
  - Is it easy to use? Is it well-supported/documentated? Cost?

- Technical:
  - Ability to import and export data (i.e. text, XML files).
  - Are the pre-defined and/or user-defined options helpful? Can they be easily modified?
  - Is the application scalable?

- Linguistic:
  - Unicode compatibility, special character input methods, and the ease of character input.
  - Ability to handle texts, interlinearized material.
  - Allows you to follow the best practices for archiving linguistic data (i.e. XML, E-MELD emeld.org).
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Databases designed for linguistics

- Stand-alone: SIL Shoebox 5.0 with Toolbox 1.2
  - Runs on both Windows and Mac. Proprietary, but not too expensive.
  - Not very well supported, problems exporting XML files.
  - A native environment for text interlinearization and analysis.
  - Uses filter-type searches, not structured queries.
The Players

- Stand-alone, relational databases:

  - MS Access: powerful and customizable form and query tools. Proprietary and not cheap.
  - FileMaker Pro: also with customizable form and query tools. Proprietary and not cheap.
  - OpenOffice Calc: less features than Access or FileMaker, but has the same core functionality. Open source (free), but somewhat unstable.
  - Network: MySQL (http://www.mysql.com/); Apache server with PHP; Google Chrome – all free.
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- FileMaker and Calc are suited to smaller, less-complex projects.
- All are XML compatible and network ready.
There are countless resources on the web on database design, theory, and implementation.

Specific references on linguistic databases: