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Introduction to Relational Databases

Vessela Ensberg, Associate Director, Data Management, UC Davis Library

John Daniels, Statistical Programming Consultant and Systems Administrator for the Social Science Data Service

Learning outcomes

- You will know whether you should switch to a relational database
- You will be able to apply best practices to set up a database in SQLite
- You will be able to do SELECT FROM WHERE, LIKE and JOIN queries

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When and why use databases?

- Your spreadsheets have more than 1000 entries
- Your excel files have multiple tabs that relate to each other
- You are concerned about overwriting your data
- You need multiple users to access the data
- Time to compute
- Universal principles and language

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2-D vs 3-D Data

- Introducing the practice dataset
  - Cohort→Individual
  - Cross date and parentage
  - Length, weight and brilliance through growth and development
- Purpose of data
  - Track multiple measurements
  - Identify most successful crosses
- How many tables?

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Flat file

Ind_id	Cohort_id	Parent_1	Parent_2	Location	Cross date	Length_mm	Weight_g	Brilliance
NULL	e342fg	ew3483	gi02r9	Pool_1	20180304	34	23	Bright
W1343fg	e342fg	ew3483	gi02r9	Tank_19	20180304	205	103	Bright

Constant

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More than one table

Ind_id	Cohort_id	Length_mm	Weight_g	Brilliance
NULL	e342fg	34	23	Bright
W1343fg	e342fg	205	103	Bright

Ind_id	Cohort_id	Location
W1343fg	e342fg	Tank_19

Cohort_id	Parent_1	Parent_2	Location	Cross date
e342fg	ew3483	gi02r9	Pool_1	20180304

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Messy data

Ind_id	Cohort_id	Parents	Location	Cross date	Length	Weight	Brilliance
	e342fg	ew3483, gi02r9	Pool_1	20180304	34 mm	23 g	Brigth

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Keeping data tidy

- One data type per cell
- One data point per cell
- Avoid highlighting
- Use data validation—pre-defined consistent categories
- Declare missing values: NULL

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Creating a database schema

- Normalization (avoid duplication)
- Every record has a unique identifier: Primary key
- Restrict data types:
  - Numeric, integer, text, blob
  - Check
  - Foreign key—but avoid circular reference

Ind_id	Cohort_id	Location
W1343fg	e342fg	Tank_19

Cohort_id	Parent_1	Parent_2	Location	Cross date
e342fg	ew3483	gi02r9	Pool_1	20180304

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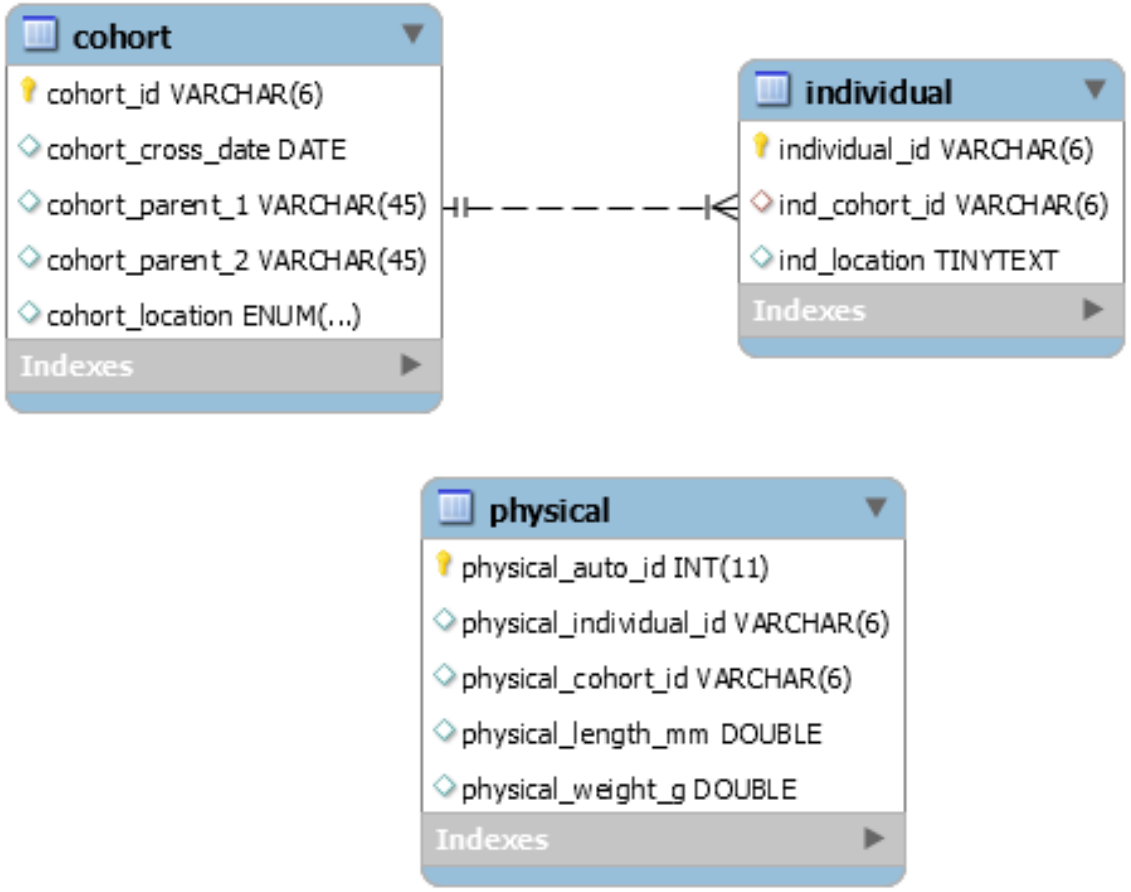
Data schema vs dictionary

- Table
- Field name
- Data type
- 1-2 sentences explain the purpose of the field



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Structured Query Language

- Origins in the 70's and standard for most RDBMS today
- Language is standardized but still considerable drift between systems
- Open-source flavors
  - SQLite & DB Browser
  - MySQL (or MariaDB)
  - PostGreSQL

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SQL Syntax Elements

- case insensitive
- insignificant whitespace
- “;” semi-colon statement terminator
- non-procedural (i.e. no loops)
- single-quotes to denote string

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Operators

- = equals
- <> (or != sometimes)
- > greater than
- < less than
- >= greater than or equal to
- <= less than or equal to
- LIKE pattern matching
- BETWEEN within a range
- IN within a list
- IS NULL
- IS NOT NULL

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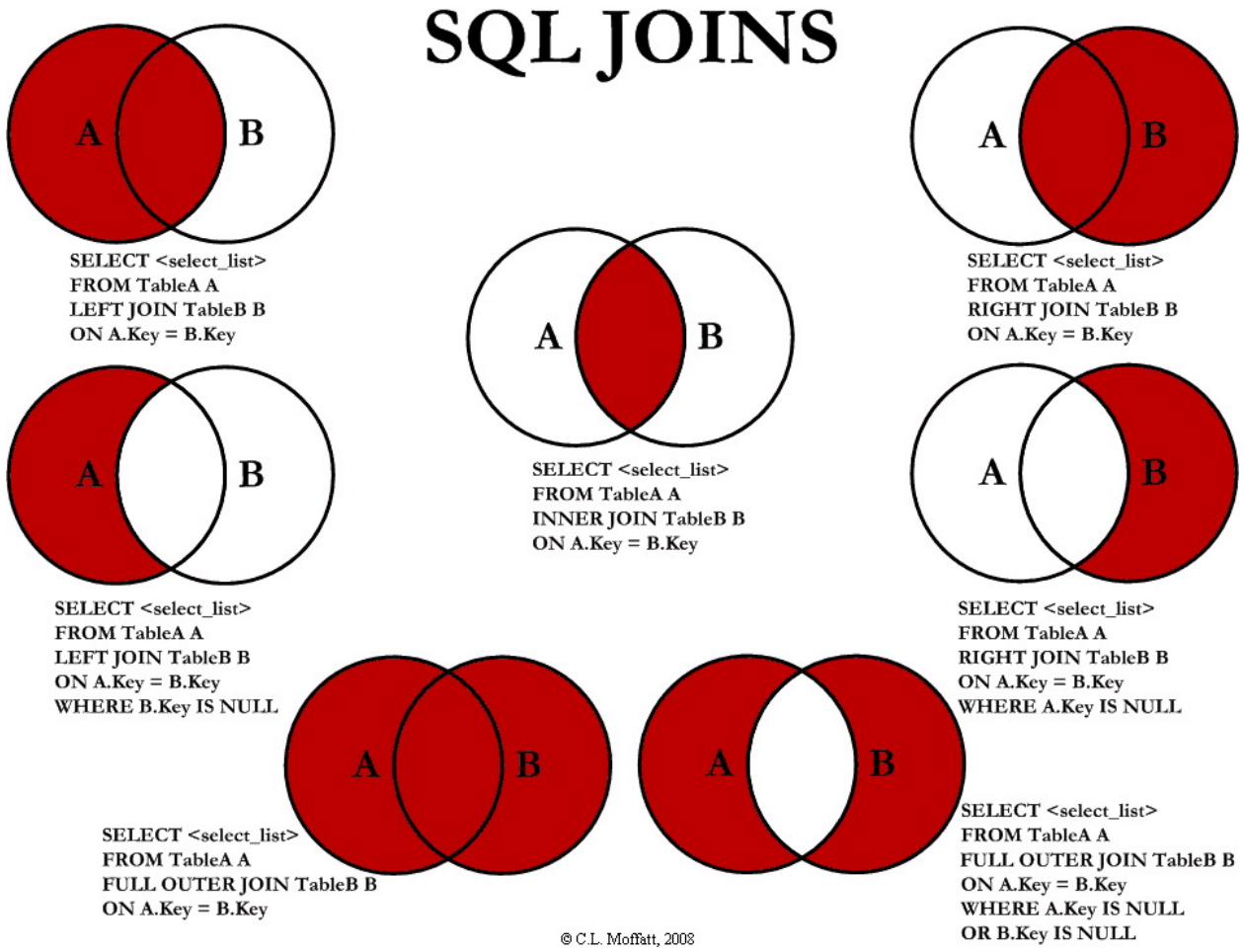
SQL Joins



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