McMaster University

Family Medicine

Frontend and Backend Database Development, Application Architecture, Software Development

Watch a recording of the session here

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January 22nd, 2019

@McMasterFamMed

Michael G. DeGroote SCHOOL OF MEDICINE

McMaster University

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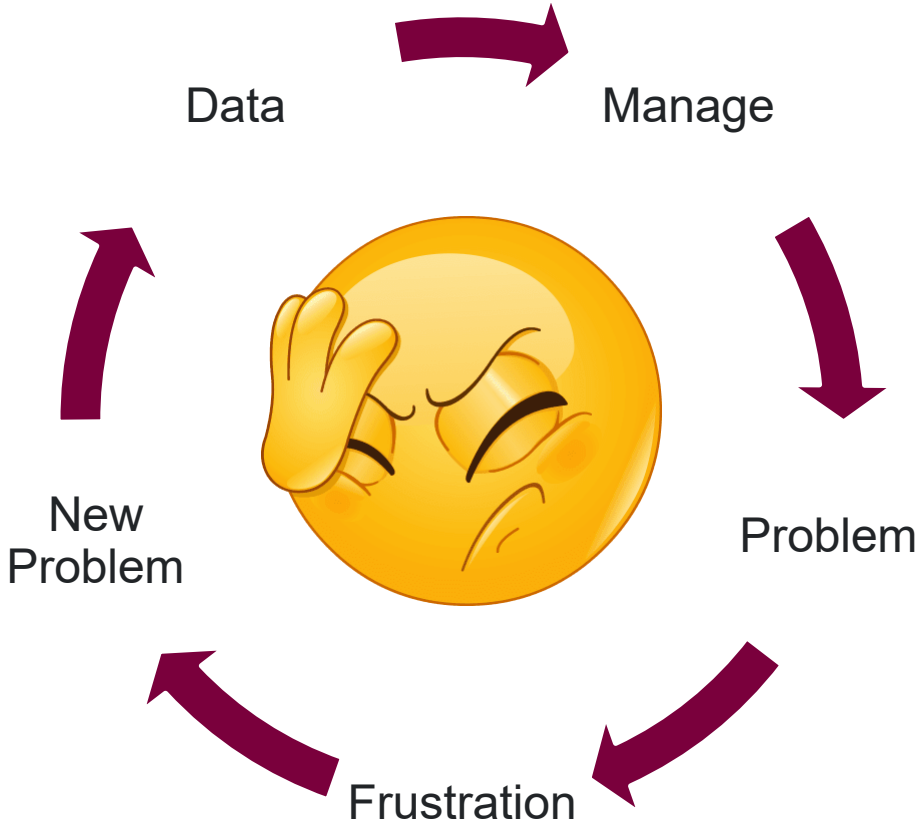
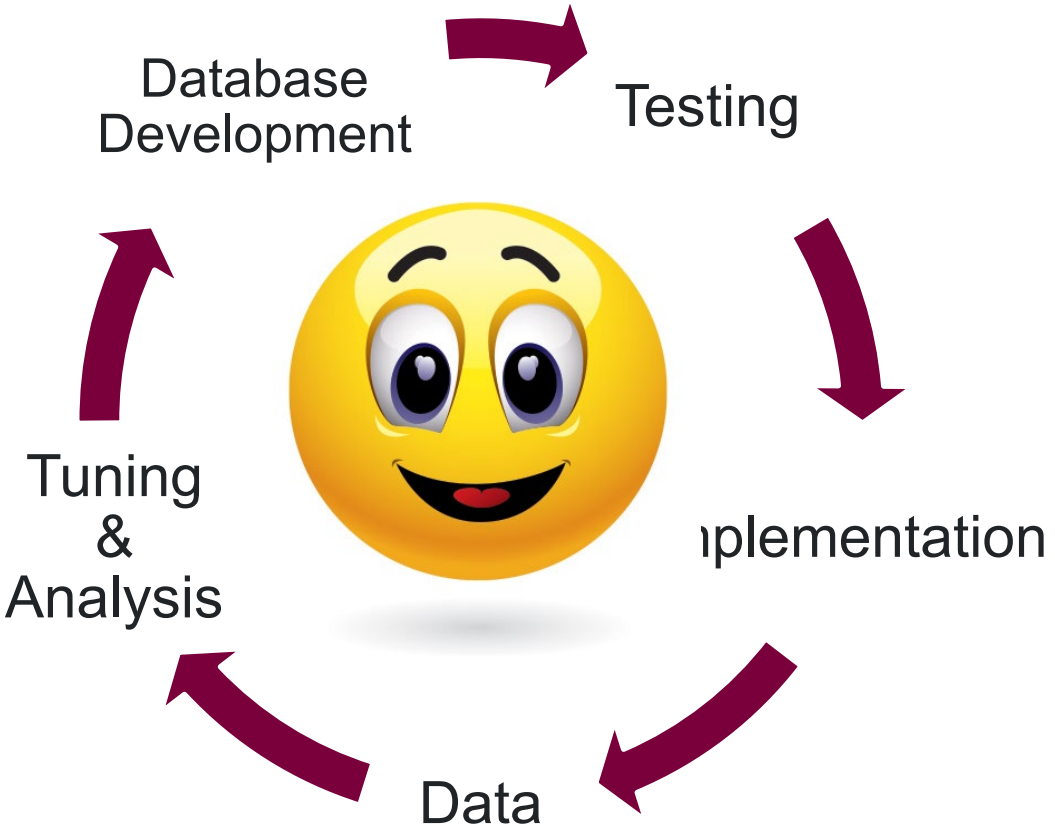

Data
Manage
Problem
Frustration
New Problem


Database
Development
Testing
Tuning
&
Analysis
Data

Learning Objectives

- Describe the functionality of databases
- Understand DMPs for database development
- Recognize good and bad database practices

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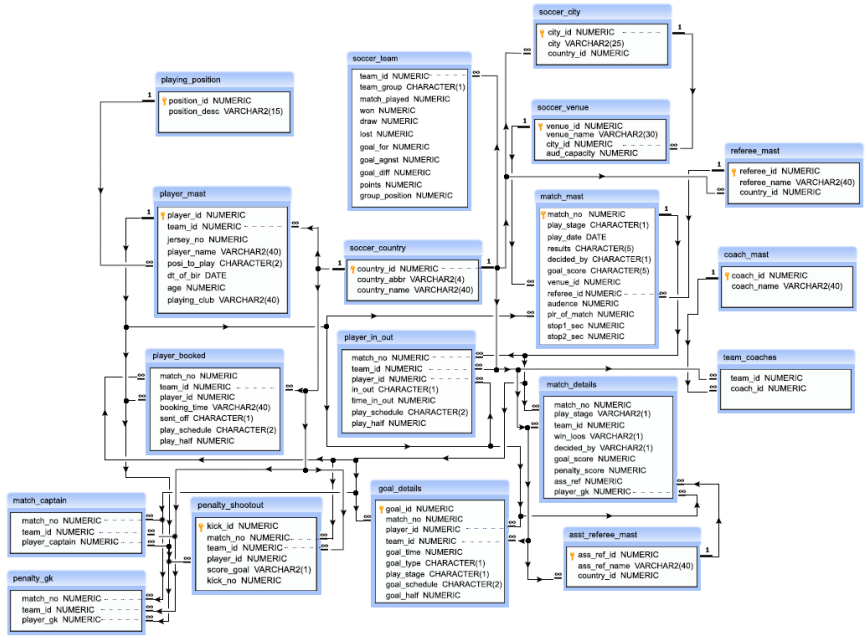
Databases

- Organized collections of data
- Coordinated set of tables designed to satisfy some specified requirements

Bootstrap Data Table

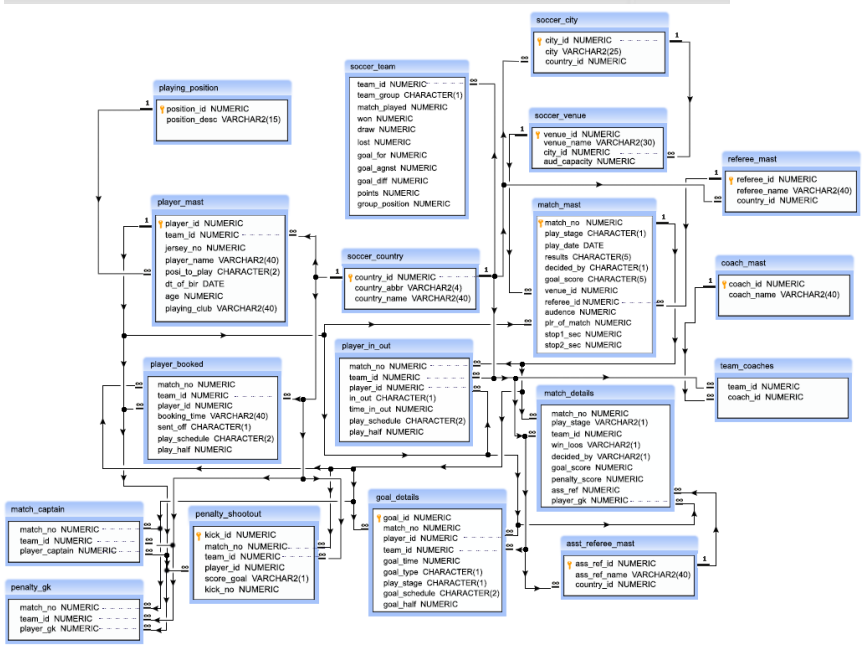
Search...

#ID	Username	First Name	Last Name
200	janedoe	Yane	Doe
100	zanedoe	Jane	Moe
300	aanedoe	Lane	Doe
100	canedoe	Jane	Boe
100	janedoe	Jane	Doe



Single and Multi-file Databases

- Demographics
  - Names, Age, Sex, etc.
- Participant data
  - Answers, lab results, calculations, etc.
- Link together
  - Interaction between the two tables, gathering data from each
  - **Relational Database**



Relational Databases

- Two or more tables with connected information
- Relational database management system (RDBMS)
  - Query data (ask questions)
  - Sort and edit data
  - Produce reports
  - Validate data points and check for inconsistencies
  - Includes a built-in programming language to automate some of these functions, such as SQL

SQL – Structured Query Language

- Programming language for accessing and manipulating databases
  - Executing queries
  - Retrieving data
  - Editing data: inserting, updating, deleting, or creating new records
  - Creating views
  - Setting permissions
  - Creating new databases

Back-end Vs. Front-end Development

- Back-end
  - ‘Server-side’
  - Stores data (tables)
  - Connected to front-end through an API

- Front-end
  - ‘User-side’
  - Provides an interface to fetch, store and display data
  - Data inputted and sent to back-end

Databases

- More than just a table or spreadsheet
  - Broad searching functionality
  - Update records in bulk
  - Cross-reference records in different tables
  - Perform complex calculations across multiple tables
  - Enforce consistency and data integrity

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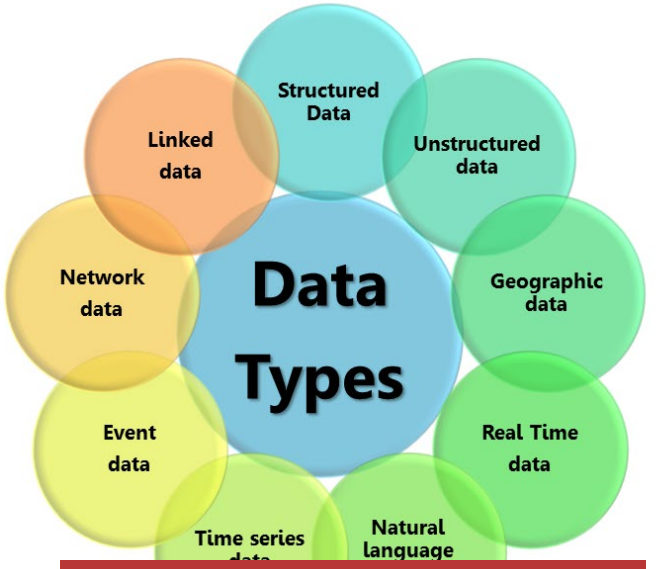
Database Development - DMPs

- Use a Data Management Plan (DMP)
  - Collection
  - Documentation and Metadata
  - Storage and Backup
  - Sharing

portage
SERVICES PARTAGÉS POUR LES DONNÉES DE RECHERCHE
SHARED STEWARDSHIP OF RESEARCH DATA

Data Collection

- Type(s) of data and **source**
- Where will data be collected?
- Multiple users?
- Software & file type(s)
- Naming conventions



Documentation and Metadata

- Information that enhances understanding of the data
  - Methods (surveys, queries), coding (scoring)
  - Archives and version histories
  - Data dictionaries
- Metadata
  - Consistent description; structure and meaning of data
    - Enables linking of data/databases
    - Enhances discoverability
    - i.e., Keywords, Descriptions, Data Dictionaries

Storage and Backup

- Where and how will the data be stored and backed-up?
- Provide capabilities for research team to:
  - Access
  - Modify
  - Contribute
- Physical, administrative and technical levels
  - Ethics, protocol

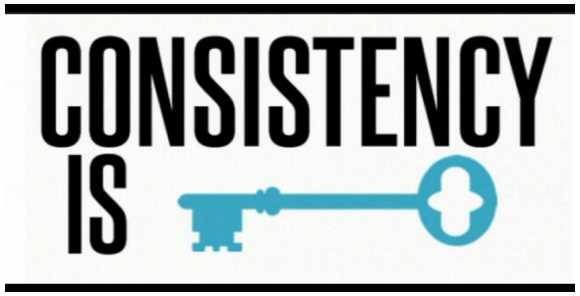
Data Sharing

- What data will be shared?
  - Different forms – raw, processed, analyzed
- Central repository?
  - Easy to import, store, find, replace and re-use project-related items

Database Development

- DMPs should be consulted and updated throughout project
- Great for quality control

- Reduces likelihood of data misuse



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Good Database Properties

Property	Outcome
Comprehensive	Ensures that users can access the data they want (includes ad hoc queries)
Reliable	Ensures that data is both consistent and correct
Flexible	Ensures that a database can evolve (without requiring excessive effort) to changing user requirements
Efficient	Ensures that users do not have long response times when accessing data
Easy to Use	Ensures that data can be accessed and manipulated to match user requirements

Not-so-good Database Properties

- Doesn’t satisfy all user requirements
- Contains inconsistent documentation
- Requires excessive effort to change
- Contains duplicate and/or invalid data
- Slow to use for achieving a desired outcome

Tips

- Use multiple software – maximizing their strengths
  - Some software are better for multiple users
- Front-end: don't be afraid to use colour
  - Conditional formatting
- The data type should be what is needed (e.g., dates should be dates, not text)

Example: Frailty

- Data type: Validated survey
- Source: Find original survey
  - Preamble/instructions
  - Questions
  - Answer options
  - Reliability and validation
- Find information on scoring
  - Reverse coding (consistency on scales)
  - Item scoring
  - Subscale/scale calculation
  - Grouping (1-2, 3-4, 5+)

Example: Frailty

- Edmonton Frail Scale
- Original citation: Rolfson et al. (2006)
- Information found in Table 1 and ‘Methods’ section

Questions

Answer options

Scoring

Table 1. The Edmonton Frail Scale

The Edmonton Frail Scale:				Score: ___/17
Frailty domain	Item	0 point	1 point	2 points
Cognition	Please imagine that this pre-drawn circle is a clock. I would like you to place the numbers in the correct positions then place the hands to indicate a time of 'ten after eleven'	No errors	Minor spacing errors	Other errors
General health status	In the past year, how many times have you been admitted to a hospital?	0	1–2	≥2
	In general, how would you describe your health?	'Excellent', 'Very good', 'Good'	'Fair'	'Poor'
Functional independence	With how many of the following activities do you require help? (meal preparation, shopping, transportation, telephone, housekeeping, laundry, managing money, taking medications)	0–1	2–4	5–8
Social support	When you need help, can you count on someone who is willing and able to meet your needs?	Always	Sometimes	Never
Medication use	Do you use five or more different prescription medications on a regular basis?	No	Yes	
	At times, do you forget to take your prescription medications?	No	Yes	
Nutrition	Have you recently lost weight such that your clothing has become looser?	No	Yes	
Mood	Do you often feel sad or depressed?	No	Yes	
Continence	Do you have a problem with losing control of urine when you don't want to?	No	Yes	
Functional performance	I would like you to sit in this chair with your back and arms resting. Then, when I say 'GO', please stand up and walk at a safe and comfortable pace to the mark on the floor (approximately 3 m away), return to the chair and sit down'	0–10 s	11–20 s	One of >20 s patient unwilling, or requires assistance
Totals	Final score is the sum of column totals			

Scoring

A google search

"The participants were classified conventionally into three categories, and a higher score represents a higher degree of fragility. Severe Frail and non-frail participants were defined according of the EFS score from No frailty (≤5 points) Apparently vulnerable (6 ≤ n ≥ 11 points) and Severe frailty (12 ≤ n ≥ 17) respectively. "

~Perna et al (2016) BMC Geriatrics

Grouping

The Edmonton Frail Scale

NAME : _____

d.o.b. : _____ **DATE :** _____

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Scoring :
0 - 5 = Not Frail
6 - 7 = Vulnerable
8 - 9 = Mild Frailty
10-11 = Moderate Frailty
12-17 = Severe Frailty

TOTAL /17

Administered by : _____

Develop a DMP before data collection or as early into the project as possible

Be consistent in your data documentation

Maintain archives (digital footprints)

Look for original source

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Resources

- CIHR, Research Data Management (https://bit.ly/2R3mgaX)
- OpenLearn, The database development life cycle (https://bit.ly/2MpfQSu)
- Portage Network, DMP Assistant (https://bit.ly/2S0iZxp)
- Upwork, A Guide to Database Technology **(**https://bit.ly/2biBDcd)

McMaster University

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