CIT 225 Lesson 1

High Level Overiew of Databases

Who has ever used a database?

Who has ever used a database? (continued)

- If you didn't raise your hand you should have.
- Databases are everywhere whether you know it or not
    - If you have a bank account, social media accounts or use Amazon, you're using databases on a daily bases.
    - Databases are one of the core building blocks of most of our modern technology.

Data vs. Information

Data - Raw facts, or facts that have not yet been processed to reveal their meaning to the end user.

Information - The result of processing raw data to reveal its meaning. Information consists of transformed data and facilitates decision making.

Data vs. Information an Example

Let's use our bank accounts as an example:

The debits and deposits to your bank account would be *data*.

Transaction Date	Transaction Amount	Transaction Description
2025-01-01	-$25.00	Habitat for Huge Manitees
2025-01-01	-$80.38	Paddy's Pub
2025-01-02	-$19.99	Prawn Hub
2025-01-03	+$1,200.76	Direct Deposit

Data vs. Information an Example (continued)

The budgeting tools offered by your bank would be *information*.

Total Monthly Expenditure	Category	Percent
$170	Bars & Restaurants	10%
$340	Groceries	20%
$1700	Rent	50%

Your monthy bank statement listing the total debits and deposits could also be considered information.

Starting Balance	Ending Balance	Total Deposits	Total Debits
$3,500.27	$2,624.31	$2,401.52	$3,277.52

What is a database?

A shared, integrated computer structure that houses a collection of related data. A database contains two types of data: end-user data (raw facts) and metadata.

- Typically it's the third tier of the traditional three-tier architecture that consists of the presentation tier (user interface), the logical/application tier and the data tier.

[Relational] Database Management System ([R]DBMS)

The collection of programs that manages the database structure and controls access to the data stored in the database.

- Simply put, it's the translation layer between an end user request (input) and returned result (output). The majority of this is hidden from your view.

Examples of RDBMS'

Propietary Software

- Microsoft SQL Server
- MySQL
- IBM DB2
- Google BigQuery

Free Open Source Software (FOSS)

- SQLite
- Postgres
- MariaDB
- DuckDB

Types of Datbases

- **Operational or Transactional Database (OLTP)**
  - Typically the backend of a production system.
  - Optimized for real-time, concurrent data capture.
  - Think of this as where the raw data is stored.
- **Analytical Database (OLAP)**
  - May also be known as a data warehouse, data lake, etc.
  - Optimized for analytics and business intelligence.
  - Think of this as where the information is stored.

Structured vs. Unstructured Data

Unstructured Data - Data that exists in its original, raw state; that is, in the format in which it was collected.
Semistructured Data - Data that has already been processed to some extent.
Structured Data - Data that has been formatted to facilitate storage, use, and information generation.

Structured vs. Unstructured Data Examples

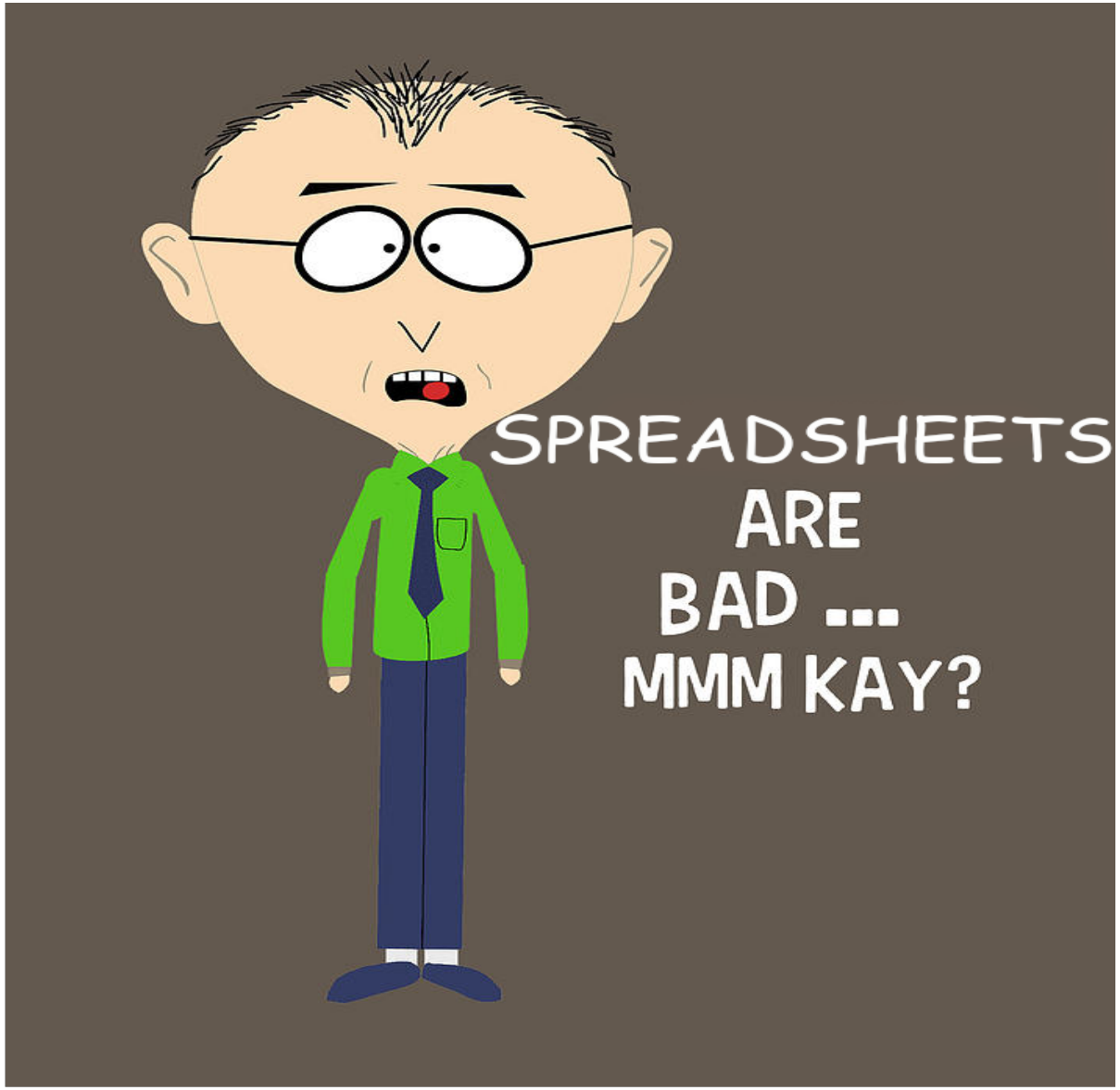
Unstructured Data - PDFs, word documents, images, audio files, etc.
Semistructured Data - XML, JSON, HTML, YAML, Spreadsheets, etc.
Structured Data - Relational Databases

A spreadsheet is not a database

- Now or in the future you might have co-workers say "let me share this database with you" and they email or slack you an .xlsx file or a share a google sheet.
- **Question: Why might a spreadsheet be a poor choice for long-term data storage?**

A few reasons why databases are better

- Security and access control
- Persistence (more on this down the road)
- Reduction of Data Inconsistenies
- Redundancy
- History
- Metadata
- Atomicity, Consistency, Isolation, and Durability aka ACID (more on this down the road too)


SPREADSHEETS
ARE
BAD ...
MMM KAY?

Metadata

- Defined as data about data.
- Data such as data type, length (if applicable), precision (if applicable),relationships, constraints, etc.
- Metadata is fundamental to how a DBMS works.

Databases and Data Types

- We'll discuss dive into how to choose data types when we talk about data modelling.
- Data types (especially properly chosen ones) are essential to building a database.

Numeric Data Types

- Integers (INT, BIGINT, SMALLINT)
  - 10, 100000, 1
- Fixed Point Numbers (DECIMAL, NUMERIC)
  - 1.2
- Floating Point Number (FLOAT, DOUBLE)
  - 3.1415

Text Data Types

VARCHAR, NVARCHAR and TEXT

- "I'm always going to use nvarchar(max), because I cannot anticipate the length of the data"

Dates and Times

- Date (DATE): 2025-01-01
- Datetime (DATETIME): 2025-01-01T00:00:00Z
- Timestamps (TIMESTAMP): 2025-01-01T00:00:00Z

Spatial Data Types

- Geometry: 'LINESTRING (100 100, 20 180, 180 180)'
- Geography: 'POLYGON((-122.358 47.653 , -122.348 47.649, -122.348 47.658, -122.358 47.658, -122.358 47.653))'

JSON Data

```
{
    "student": {
                "first_name": "Hugh",
                ,"last_name": "Jass"
                ,"id": 199199,
                ,"active": true
    }
}
```

XML Data

```
<?xml version="1.0" encoding="UTF-8"?>
<note>
  <to>The World</to>
  <from>Dan</from>
  <heading>XMHell</heading>
  <body>XML makes me sad whenever I see it.</body>
</note>
```

NULLs Matter

While NULLs themseleves are not a datatype, they are

NULL != ''

NULL != ' '

NULL != 0

Data Management

- Data management is a shared responsible between business and technology teams.
- Your goal as a technologist is to use a database the right way in order to mitigate some of the common problems that arise in data management.

Structural In/dependence

Structural Dependence - A data characteristic in which a change in the database schema affects data access, thus requiring changes in all access programs.

Structural Independence - A data characteristic in which changes in the database schema do not affect data access.

Data In/dependence

Data Dependence – A data condition in which data representation and manipulation are dependent on the physical data storage characteristics.

Data Independence – A condition in which data access is unaffected by changes in the physical data storage characteristics.

Logical Data Format - How we view and interpret data within a given context.

Physical Data Format - How a computer is storing the data.

Structured Query Language (SQL)

- Pronounced "sequel" not "squil", "squell"..."S-Q-L" is acceptable, but everyone will know you're a n00b.
- SQL is used to query data from a database, but also used to perform tasks such as creating or altering tables, implementing secuirty or CRUD'ing records.

```
/*This is an example of what a SQL query looks like*/
SELECT *
FROM LANGUAGES
WHERE LOWER(DESCRIPTION) = LOWER('greatest f**king language ever')
```

SQL

Query - A question or task asked by an end user of a database in the form of SQL code. A specific request for data manipulation issued by the end user or the application to the DBMS.

Adhoc Query - Questions that are more "one off" in nature.

Query Result Set - The rows of data that are returned by a query.

Terminology: Columns/Fields and Rows/Records can be used interchangebly.

Homework

- Read Chapters 1 and 2
- Create a Github Account if you don't have one