DataSci 400

lesson 2: nature of data

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today's agenda

- **data structures:**
  - tabular, semi-structured, unstructured...
  - trade-offs of each
- **data types:**
  - numeric, categorical...
- **data shapes:**
  - long vs wide

overview of data structures

- different structures or **representation** for data
  - **tabular (structured)**: relational tables (`SQL`), matrices, `DataFrame` , ...
  - **semi-structured**: `JSON` , `XML` , `MongoDB` , graph datatabases, ...
  - **unstructured**: raw text, images, sound, video, ...
- most ML algorithms only work with **tabular data**
- once data is made tabular, we still need to do a lot of pre-processing prior to ML

choosing data structures

- in a **data lake**, data is in its raw format which includes unstructured and semi-structured
  - data lakes are ideal for **storage**
- for analytics, raw data from a data lake is processed and curated and stored in a **data warehouse** often in tabular form
  - data warehouses are ideal for **analytics**
- **data admins** handle data storage and governance
- **data scientists** handle data transformation and schema conversion

break time

everyone has their jargon

- for ML data almost always needs to be **converted to tabular**
- **rows** - observation, example, record, data points, item, instance
- **columns** - variables, attributes, properties, features, fields, dimensions
  - **target** - label, response variables, dependent variable, outcome
  - **features** - explanatory variable, independent variable, predictors, covariates
    - **numeric**: dates, counts, amounts, etc.
    - **categorical**: grouping variables, identifiers

data types (aka schemas)

- **numeric data**:
  - this is data that we often do **math operations** with
  - **floats** (dollar spend, ratio, percentage, etc.) **integers** (counts, rounded numbers, etc.), **dates and times**
- **categorical data**:
  - also called **grouping variables** because we often group by them when we summarize or visualize the data
  - **low-cardinality** (few groups) vs. **high-cardinality** (many groups)
  - **interactions**: combining multiple variables into one

data shapes

- tabular data can be in **long** format or **wide** format
- if data is very **sparse**, the long format is usually better because it requires less storage
- for data exploration, there is no hard rules about which format to choose, it all **depends on the analysis** and to some extent on **personal preference**
- for machine learning, data **usually** needs to be in wide format
- transforming data from long to wide or vice versa is usually called **pivoting** or **reshaping**

book title	lang	auth_1	auth_2	pub_1	pub_2
How to drink water	Eng	Walter	Habib	2008	2012
⋮	⋮	⋮	⋮	⋮	⋮

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lab time

- in the previous lab, we saw the same data represented in the tabular format in two ways: long and wide
- using by far the most common language for querying tables, `SQL`, write queries against the **long table** and **wide table** to find
  1. the number of authors per book title
  2. the average number of years between the first and second publication of a book
- in each case, which query seem more natural?

further reading

the `pandas` and `seaborn` documentation pages linked below contain good tutorials and lots of examples to learn from

- check out the tutorials on [`pandas`]:
  - https://pandas.pydata.org/
- check out the tutorials on [`seaborn`]:
  - https://seaborn.pydata.org/

the end