Data Exploration

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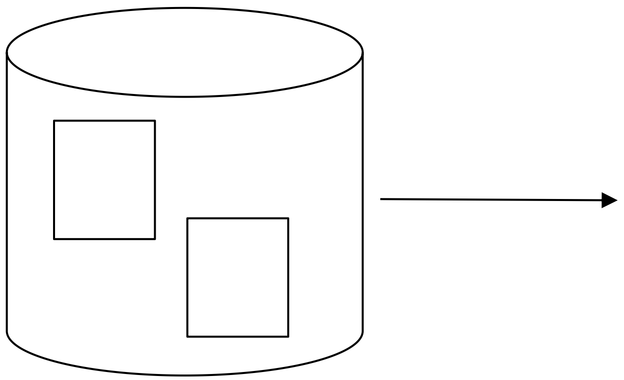
Motivation

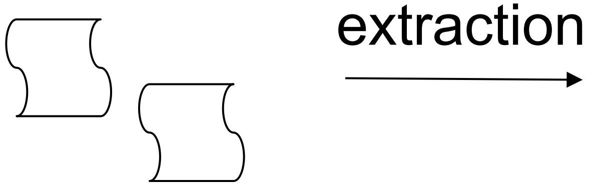


X

id	name	loc
x_1	Apple	CA
x_2	IBM	NY

news articles

data extraction



Y

id	cname	address	rev
y_1	IBM Corp	CA	25
y_2	Apple Inc	CA	51
y_3	GE	NY	351

X

id	name	loc
x_1	Apple	CA
x_2	IBM	NY

Y

id	cname	address	rev
y_1	IBM Corp	CA	25
y_2	Apple Inc	CA	51
y_3	GE	NY	351

data cleaning: GE revenue: 351 ⟶ 35.1

schema matching: name = cname
loc = address

schema merging:

$$\left.\begin{array}{l} \text{X(name, loc)} \\ \text{Y(cname, address, rev)} \end{array}\right\} \text{Z(name, loc, rev)}$$

data matching:

M

xid	yid
x_1	y_2
x_2	y_1

data merging: for name, return the longer string from X.name and Y.cname
for loc, return X.loc

schema mapping: Z = select merge_name(X.name, Y.cname), X.loc, Y.rev
from X, Y, M
where X.id = M.xid and Y.id = M.yid

X

id	name	loc
x_1	Apple	CA
x_2	IBM	NY

Y

id	cname	address	rev
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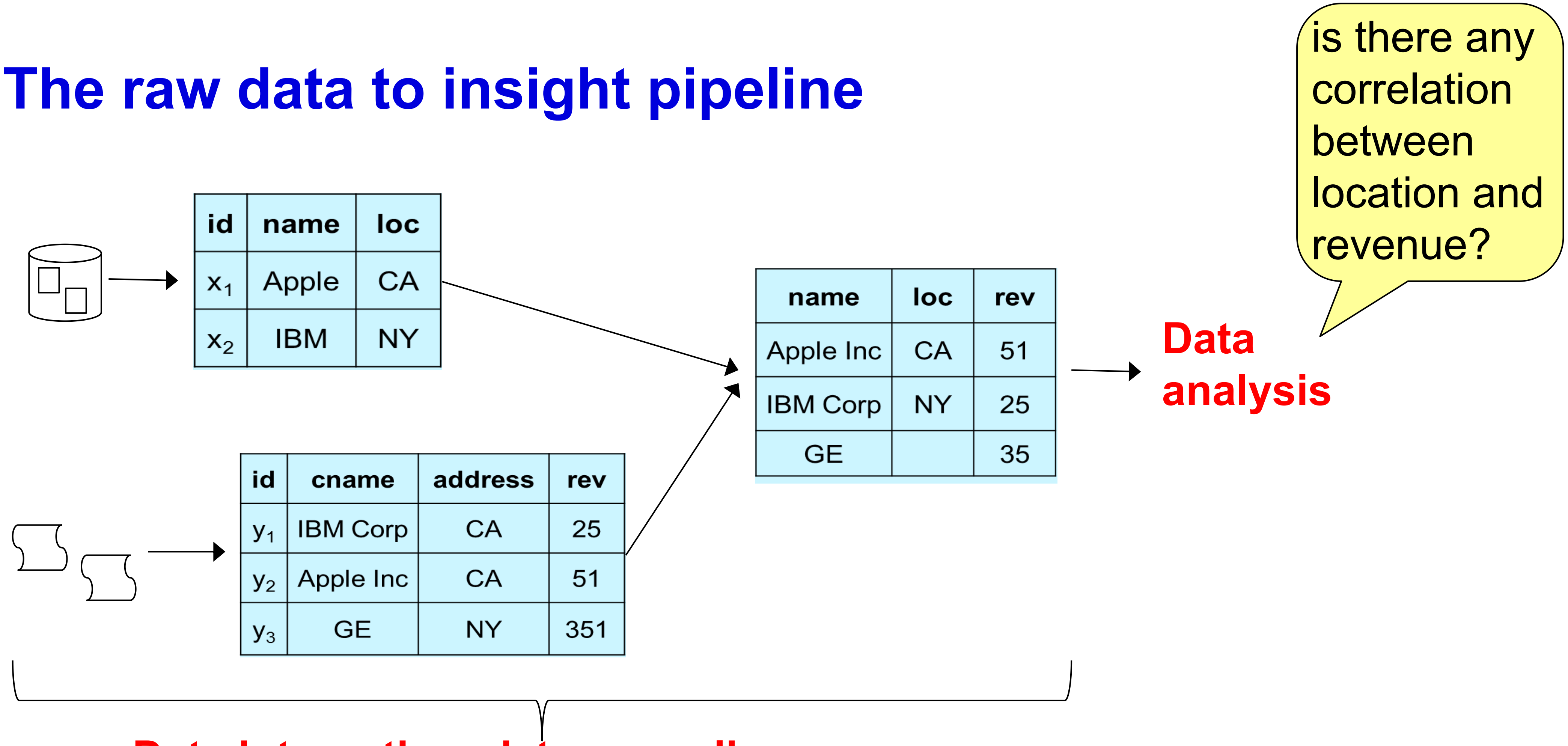
→

Z

name	loc	rev
Apple Inc	CA	51
IBM Corp	NY	25

Another Example

- **The raw data to insight pipeline**



id	name	loc
x_1	Apple	CA
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id	cname	address	rev
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name	loc	rev
Apple Inc	CA	51
IBM Corp	NY	25
GE		35

Data analysis

is there any correlation between location and revenue?

Data integration, data wrangling, …

Three Goals for Data Exploration

- **Understand the data**
  - basic characteristics, structure
- **Find interesting stuff**
- **Find quality issues**

- **These help decide what to do later, influence downstream actions**

- **Data exploration is also often known as exploratory data analysis (EDA)**

Basic Operations

- **Browse and query**
- **Visualize**
- **Profile (mostly with automatic programs)**
  - compute statistics
  - detect more stuff (e.g., meta-data such as keys) about the data
  - find data quality problems

- **Two papers to read**
  - a book chapter called “data exploration”
  - a survey paper: “profiling relational data: a survey”
  - will provide them later

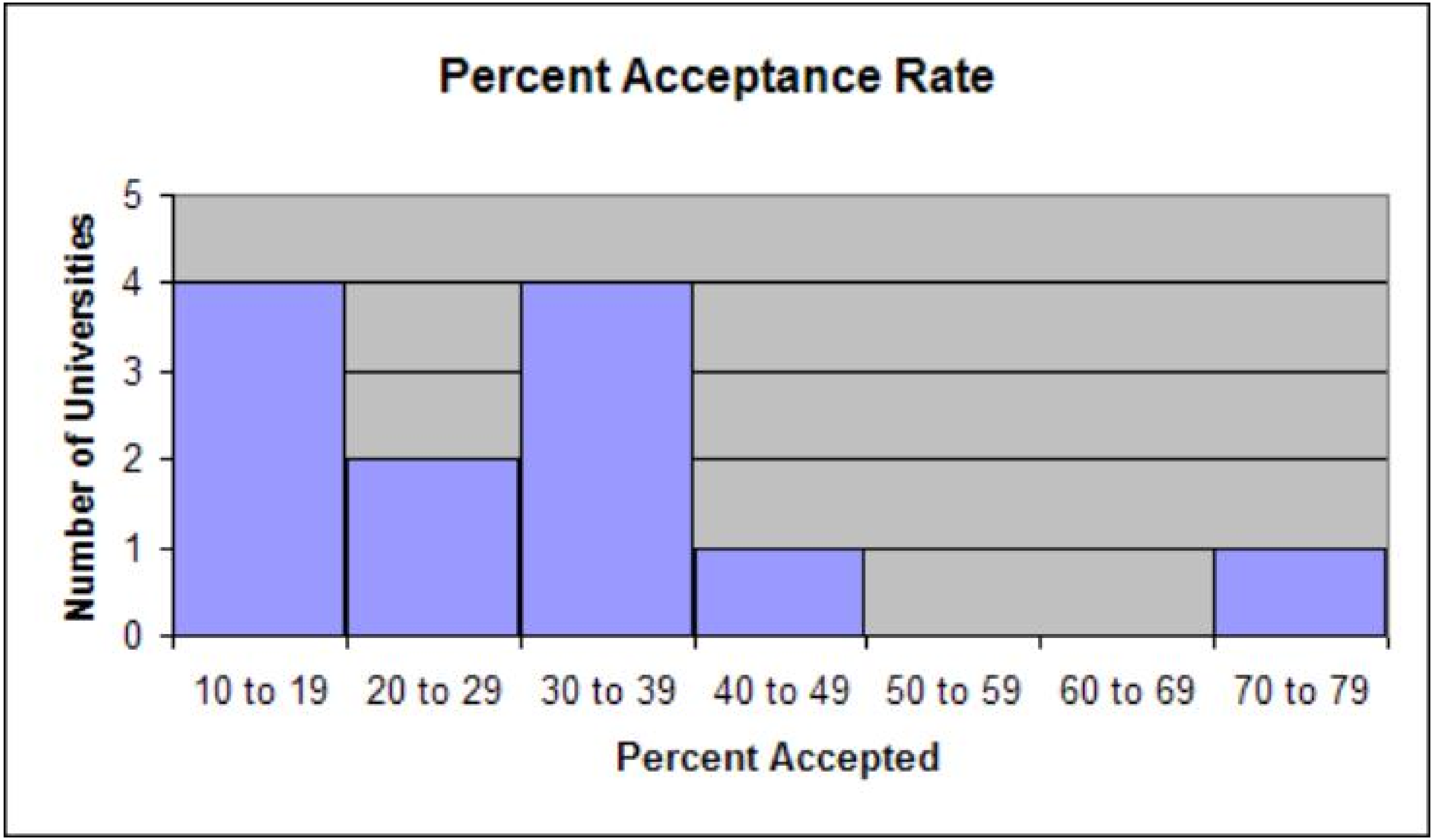
Browse and Query

- **The simplest operations**
- **Yet difficult to do well today**
  - there is no good tool to browse a large table
  - no good tool to query large tables (e.g., 5G) quickly
  - no tool to allow users to ask NL queries (though they start appearing)
- **Today most folks in industry still use Excel**
  - show an example

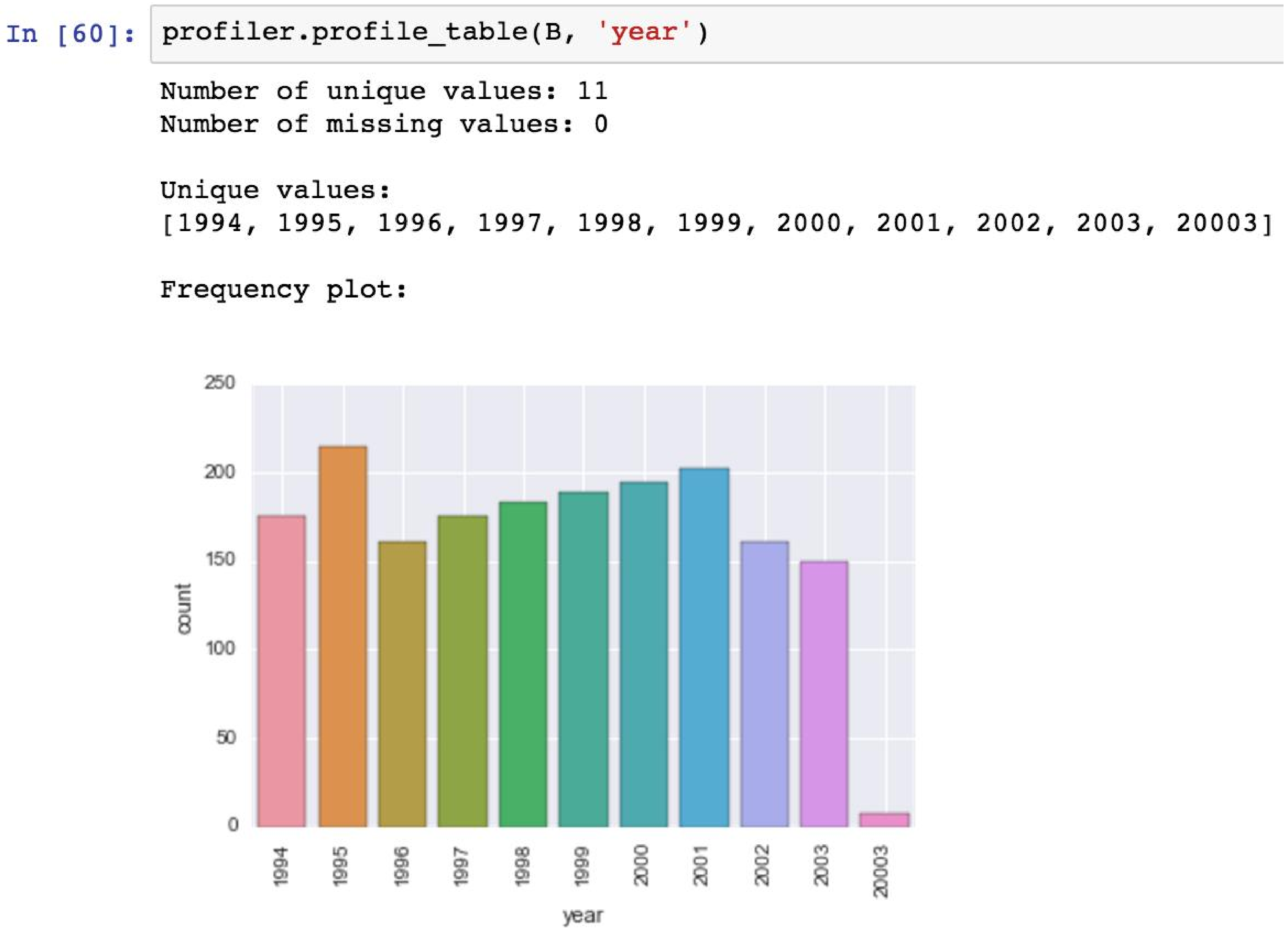
Visualize

- **Why?**
  - can display a lot of information at once (dense information)
  - can leverage human eyes, which are very good at detecting patterns and anomalies (thousands of years of evolution)
- **Basic types of visualization**
  - visualizing a single attribute (aka column)
  - visualizing several attributes
  - visualizing a large number of attributes
- **Visualizing a single attribute**
  - histogram and more (see chapter)

Histogram Example



Histogram Example



```
In [60]: profiler.profile_table(B, 'year')
```

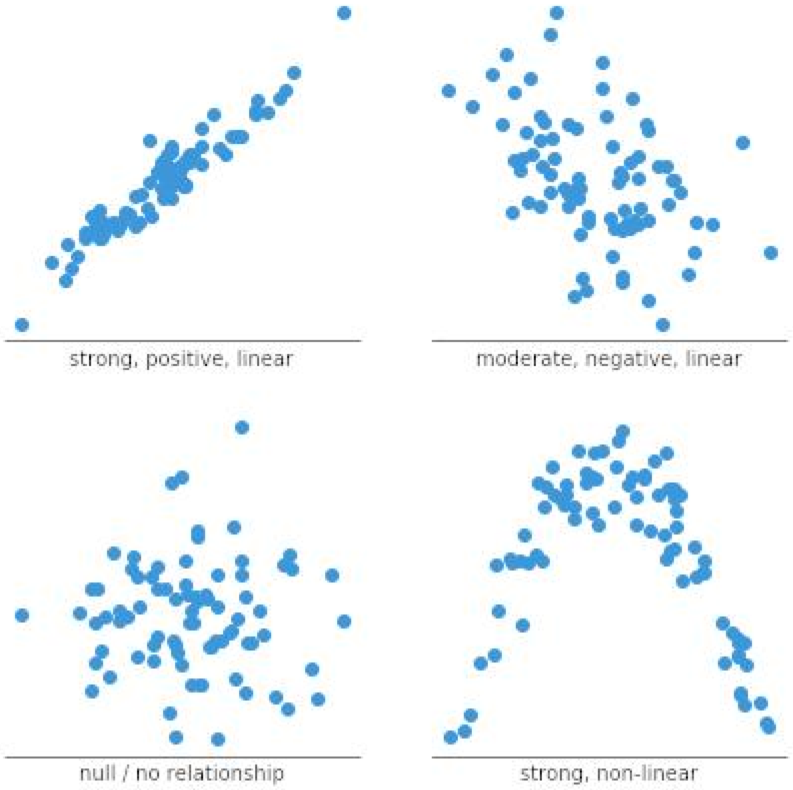
```
Number of unique values: 11
Number of missing values: 0

Unique values:
[1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 20003]

Frequency plot:
```

Visualizing Multiple Attributes

- **Usually 2-4 attributes at the same time**
- **Scatterplot is a well-known technique**



strong, positive, linear

moderate, negative, linear

null / no relationship

strong, non-linear

- **More in the book chapter**

Basic Operations

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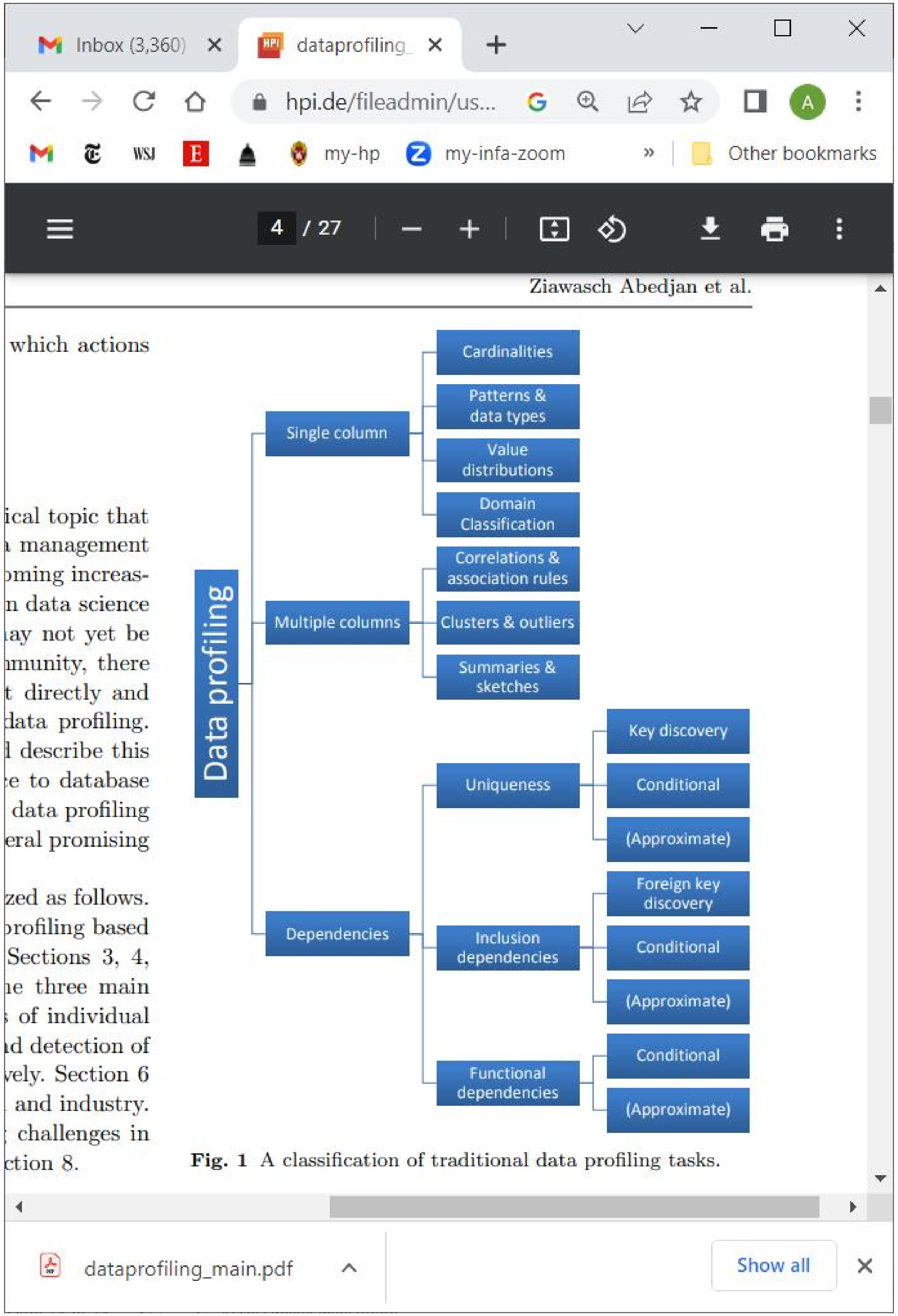
Types of Profiling



Ziawasch Abedjan et al.

which actions

ical topic that ı management oming increas- n data science ay not yet be nmunity, there t directly and data profiling. l describe this e to database data profiling eral promising

zed as follows. profiling based Sections 3, 4, he three main s of individual ıd detection of vely. Section 6 and industry. challenges in ction 8.

Fig. 1 A classification of traditional data profiling tasks.

More Types of Profiling

- Can target specifically at detecting certain data quality problems
- See the google doc “data-profiling-cleaning-examples”

More Advanced Stuff

- **30% of values in Salary column are missing, can you explain why?**
  - 95% are missing for Temp workers in the state CA
  - suggest a systematic error here

Summary of Data Exploration

- **Basic operations**
  - Browse and query
  - Visualize
  - Profile (mostly with automatic programs)
    - compute statistics
    - detect more stuff (e.g., meta-data such as keys) about the data
    - find data quality problems
- **Guidance on how to use them**
- **Systems that incorporate the above tools**