Introduction to Data, Pandas and SQL

Part A – Data and Databases

Pavlos Protopapas

Lecture Outline

Part A: Data and Databases

What is data and how can we store it?

Part B: Pandas and SQL

Tools to inspect data

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Part B: Pandas and SQL

Tools to inspect data

The Data Science Process

Ask an interesting question

Get the Data

Explore the Data

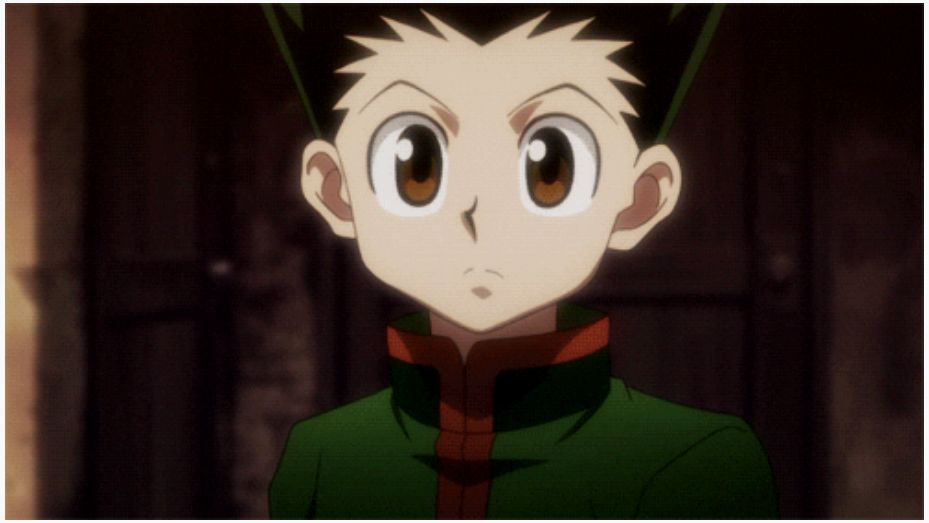
Model the Data

Communicate/Visualize the Results

What is the scientific goal?

What would you do if you had all of the data?

What do you want to predict or estimate?



Credit: CS109A

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How were the data sampled?

Which data are relevant?

Are there privacy issues?

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Plot the data.

Are there anomalies or egregious issues?

Are there patterns?

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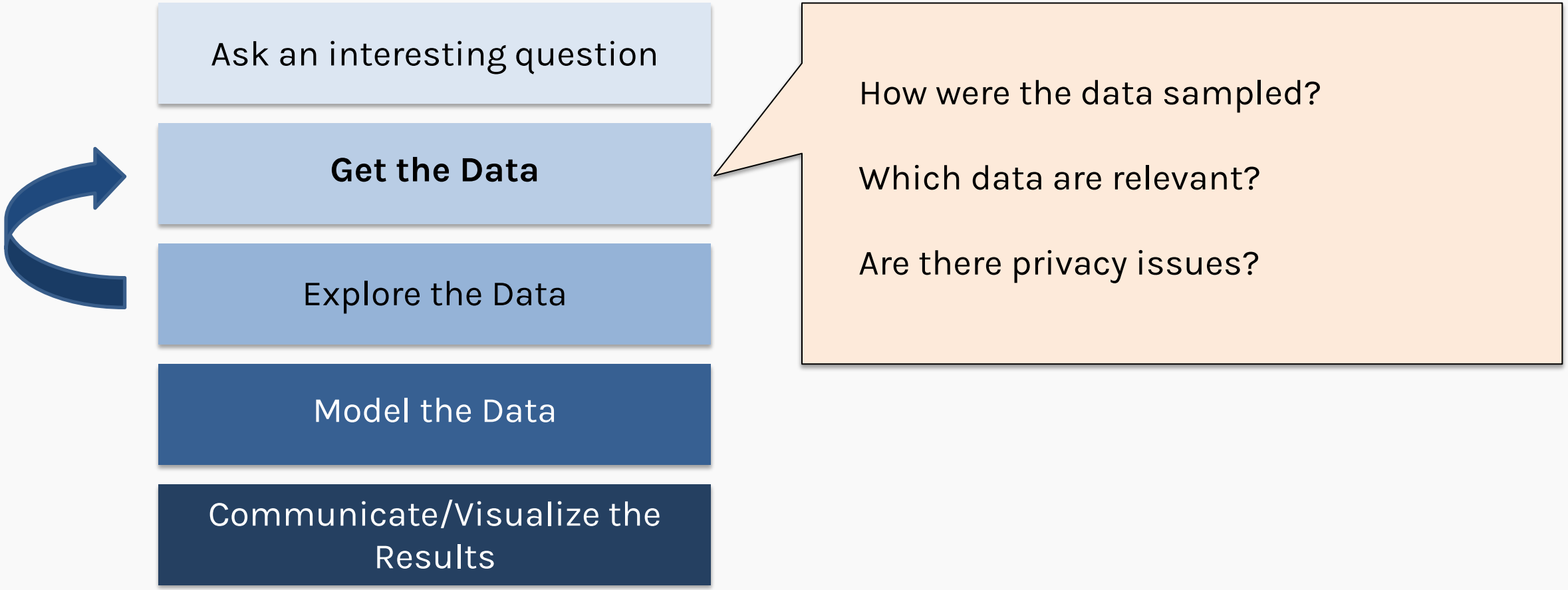

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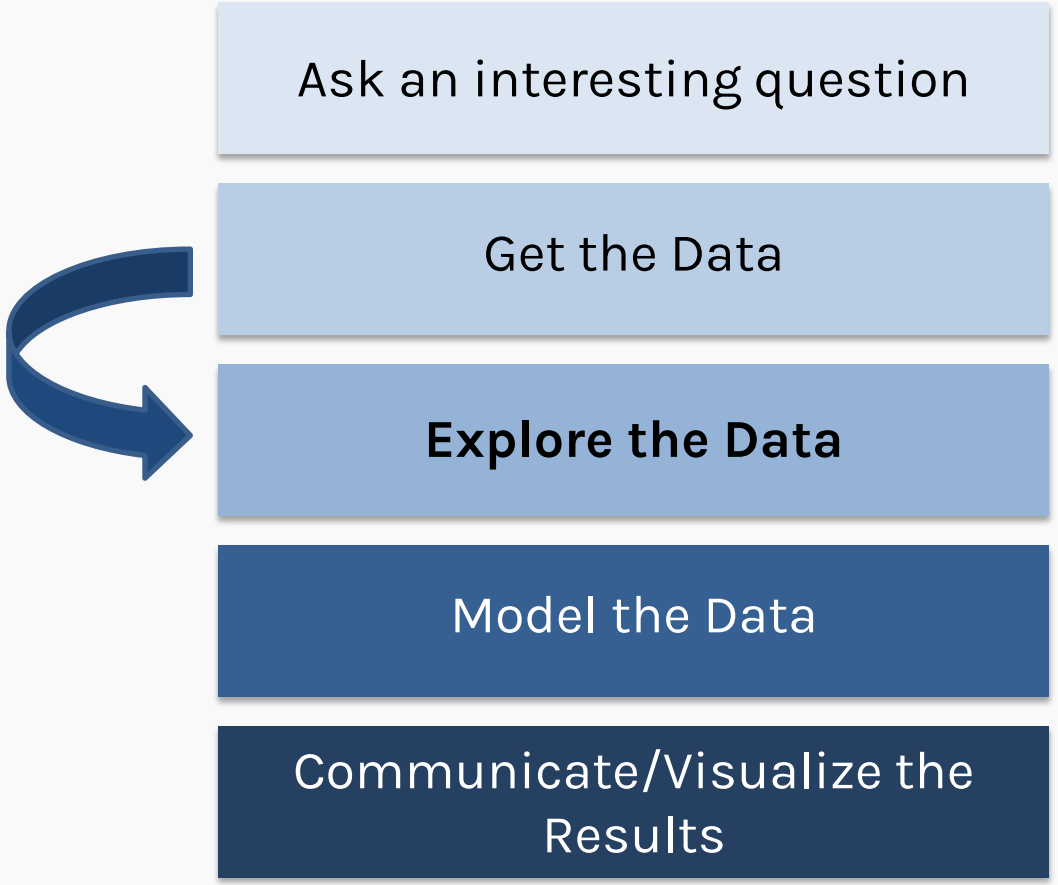

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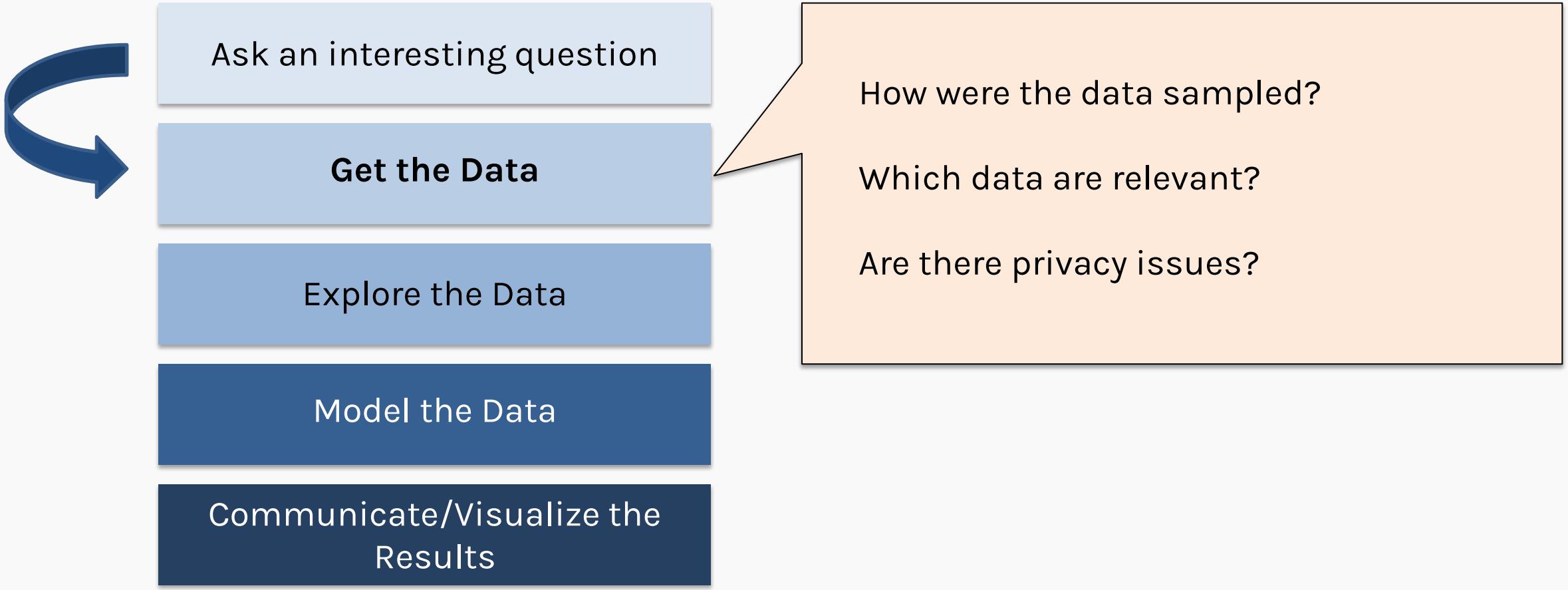

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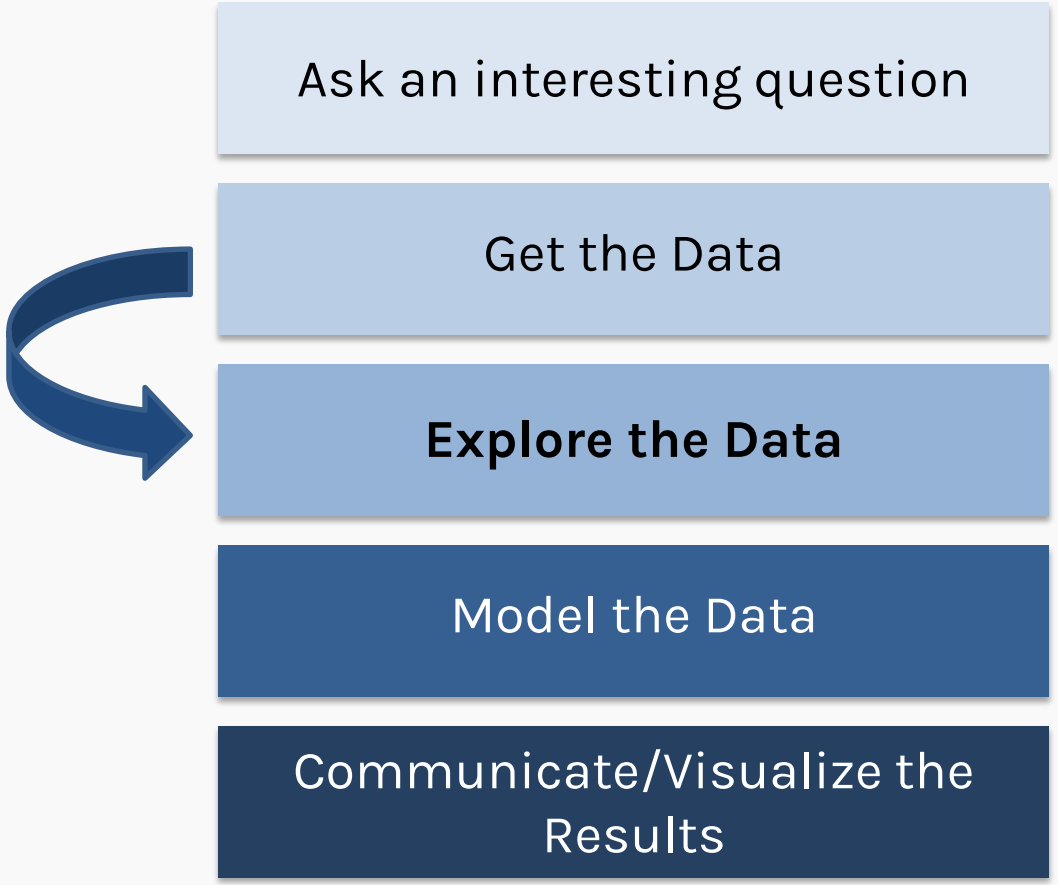

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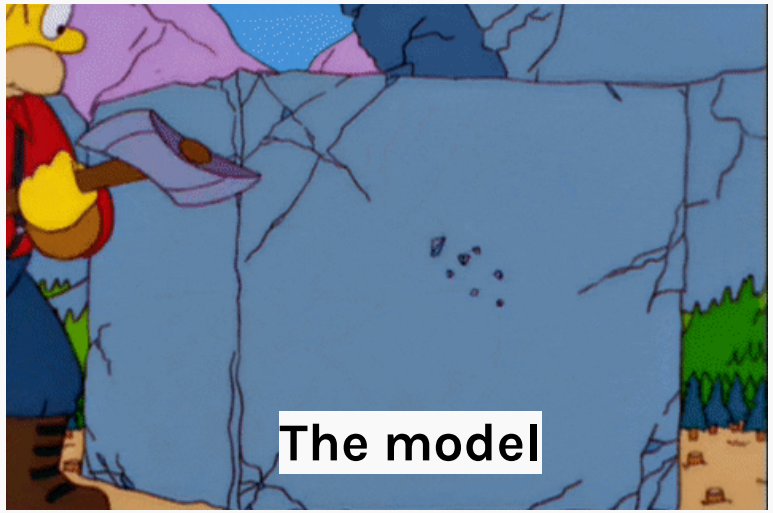

Build a model.

Fit the model.

Validate the model.

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What did we learn?

Do the results make sense?

Can we effectively tell a story?

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What is data?

Datum	A single piece of information, which can be treated as an observation
Data	The plural of datum; multiple observations
Dataset	A homogenous collection of data (each datum must have the same focus)

What is data?

Everything can be data! Just requires making observations.

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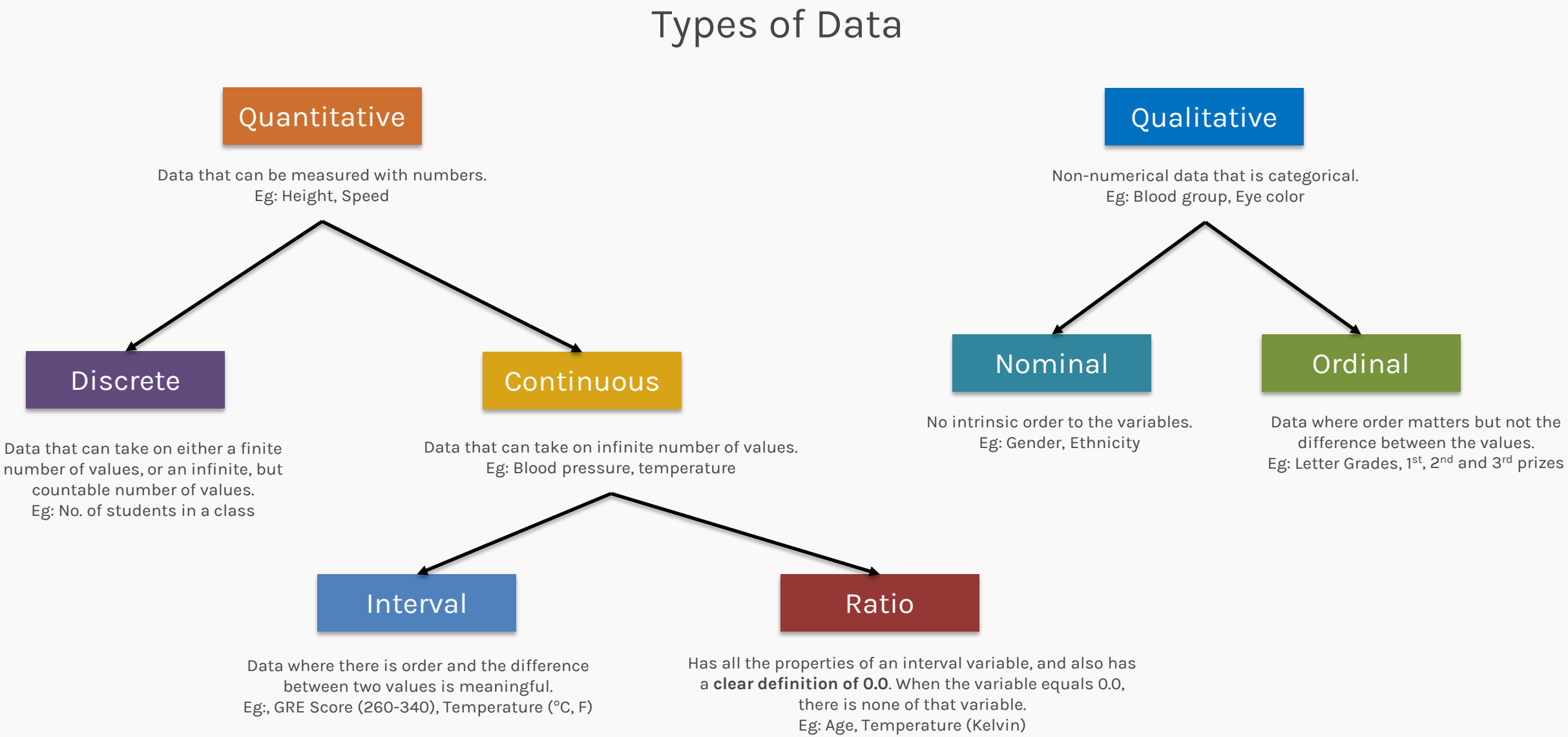
Obtaining Data

You can obtain data if

- You curate it.
- Someone else provides it- all pre-packaged for you in files.
- Someone else provides an API.
- Someone else has available content, and you try to take it (web scraping).

Types of Data

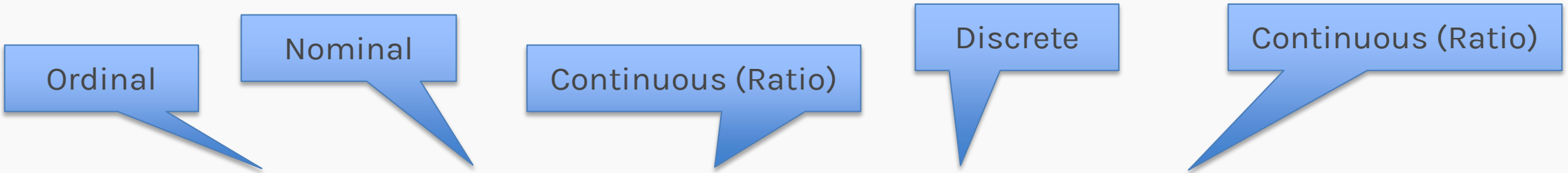


Types of Data

quality	type	price	quantity	total
High	Toy	20	5	100
Low	Book	5	3	15
Medium	Craft	12	4	48
Medium	Book	10	10	100

Guess the type of data in each column!

Types of Data



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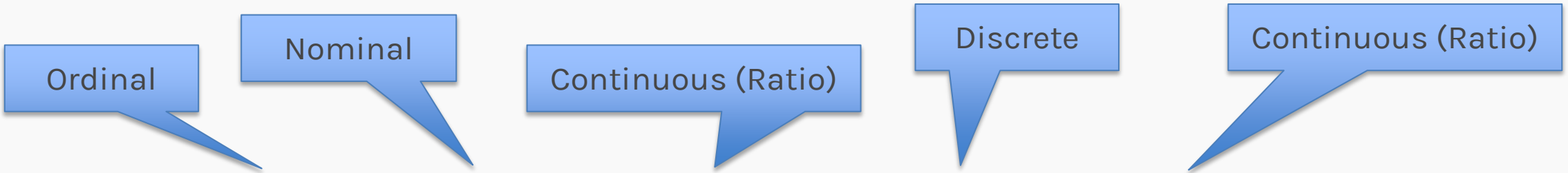

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Often you must encode the data in some form to be useful. For example, you might use integers to encode the ordinal column “quality” here.

Encoding types

Pandas dtype	Python type	NumPy type	Usage
object	str	string_, unicode_	Text
int64	int	int_, int8, int16, int32, int64, uint8, uint16, uint32, uint64	Integer numbers
float64	float	float_, float16, float32, float64	Floating point numbers
bool	bool	bool_	True/False values
datetime64	NA	datetime64[ns]	Date and time values
timedelta[ns]	NA	NA	Differences between two datetimes
category	NA	NA	Finite list of text values

Types of Data

Table: contributors

New Record | Delete Record

	id	last_name	first_name	middle_name	street_1	street_2	city	state	zip	amount	date	candidate_id
	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
1	1	Agee	Steven	NULL	549 Laurel ...	NULL	Floyd	VA	24091	500	2007-06-30	16
2	5	Akin	Charles	NULL	10187 Suga...	NULL	Bentonville	AR	72712	100	2007-06-16	16
3	6	Akin	Mike	NULL	181 Baywo...	NULL	Monticello	AR	71655	1500	2007-05-18	16
4	7	Akin	Rebecca	NULL	181 Baywo...	NULL	Monticello	AR	71655	500	2007-05-18	16
5	8	Aldridge	Brittni	NULL	808 Capitol...	NULL	Washington	DC	20024	250	2007-06-06	16
6	9	Allen	John D.	NULL	1052 Cann...	NULL	North Augu...	SC	29860	1000	2007-06-11	16
7	10	Allen	John D.	NULL	1052 Cann...	NULL	North Augu...	SC	29860	1300	2007-06-29	16
8	11	Allison	John W.	NULL	P.O. Box 10...	NULL	Conway	AR	72033	1000	2007-05-18	16
9	12	Allison	Rebecca	NULL	3206 Sum...	NULL	Little Rock	AR	72227	1000	2007-04-25	16

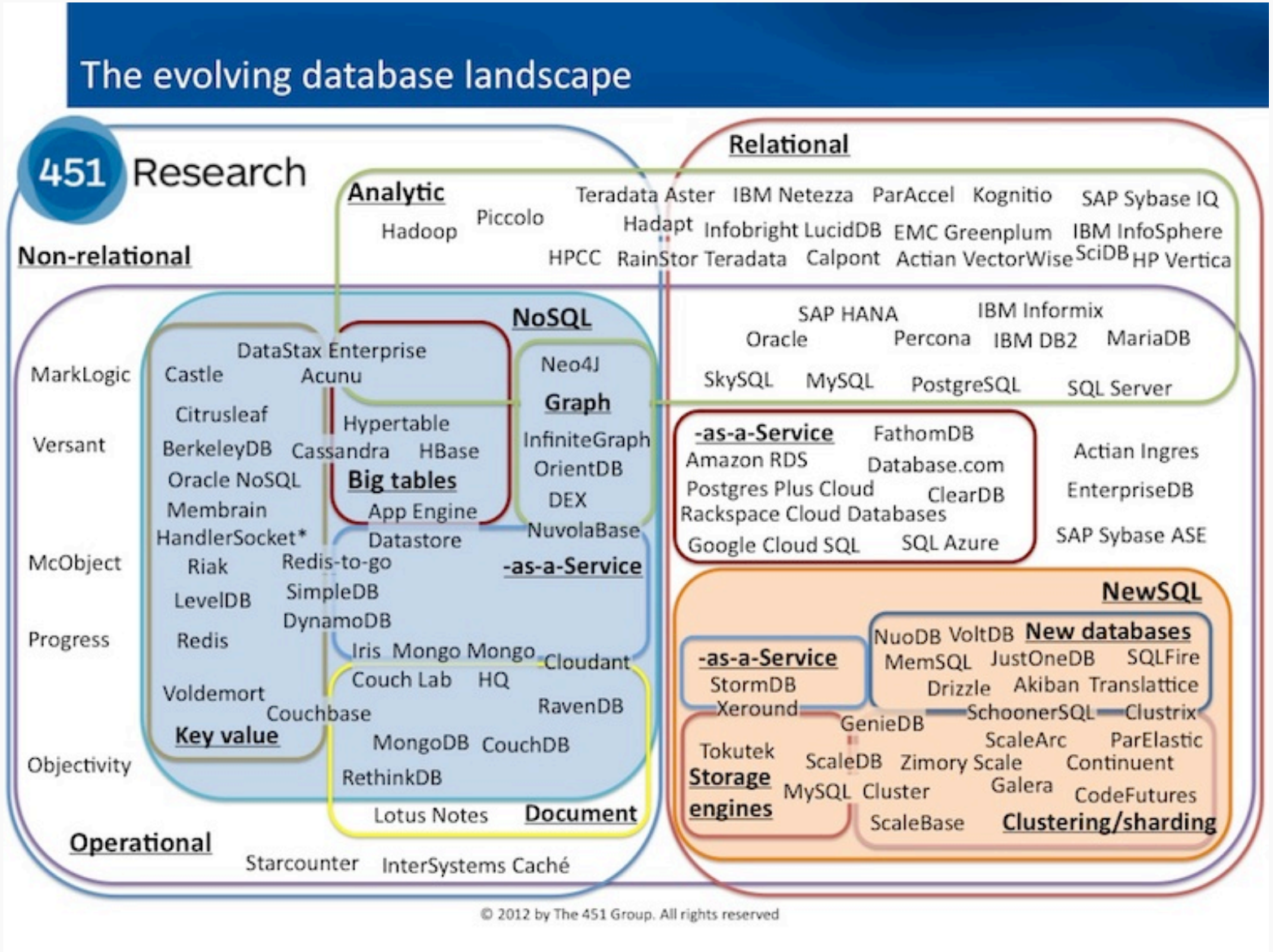
Now guess the type of data in each column and mention the data type you would encode it with.

How do we store data?

A database is an organized collection of structured information, or data, typically stored electronically in a computer system.

Databases

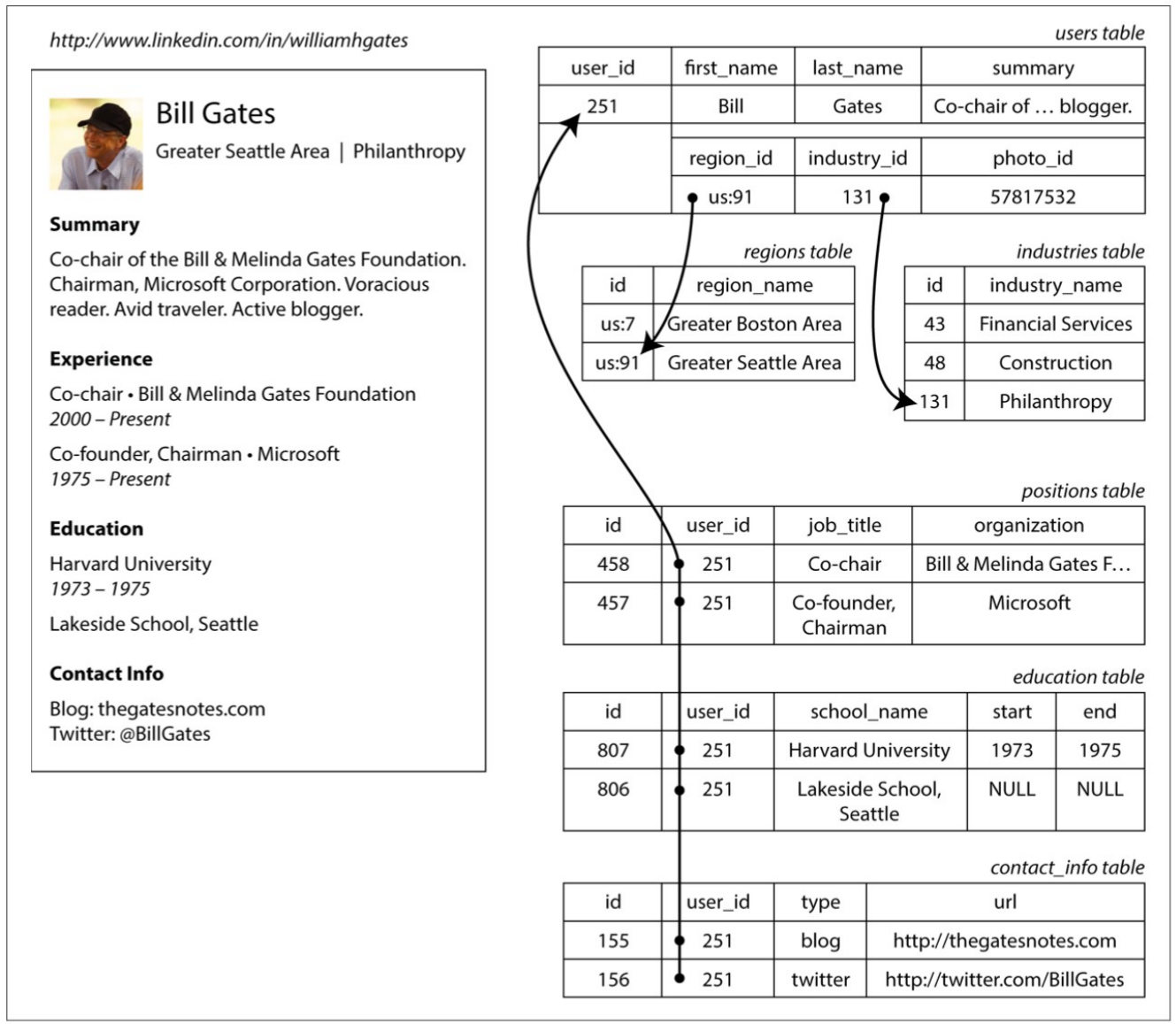
Types of databases



Relational Database

Relational databases organize data in multiple, related tables

Example: Pandas,
SQL: Postgres, SQLite,
Hbase, VoltDB



Document Database

Document Databases use JSON/xml like documents to organize data instead of rows and columns

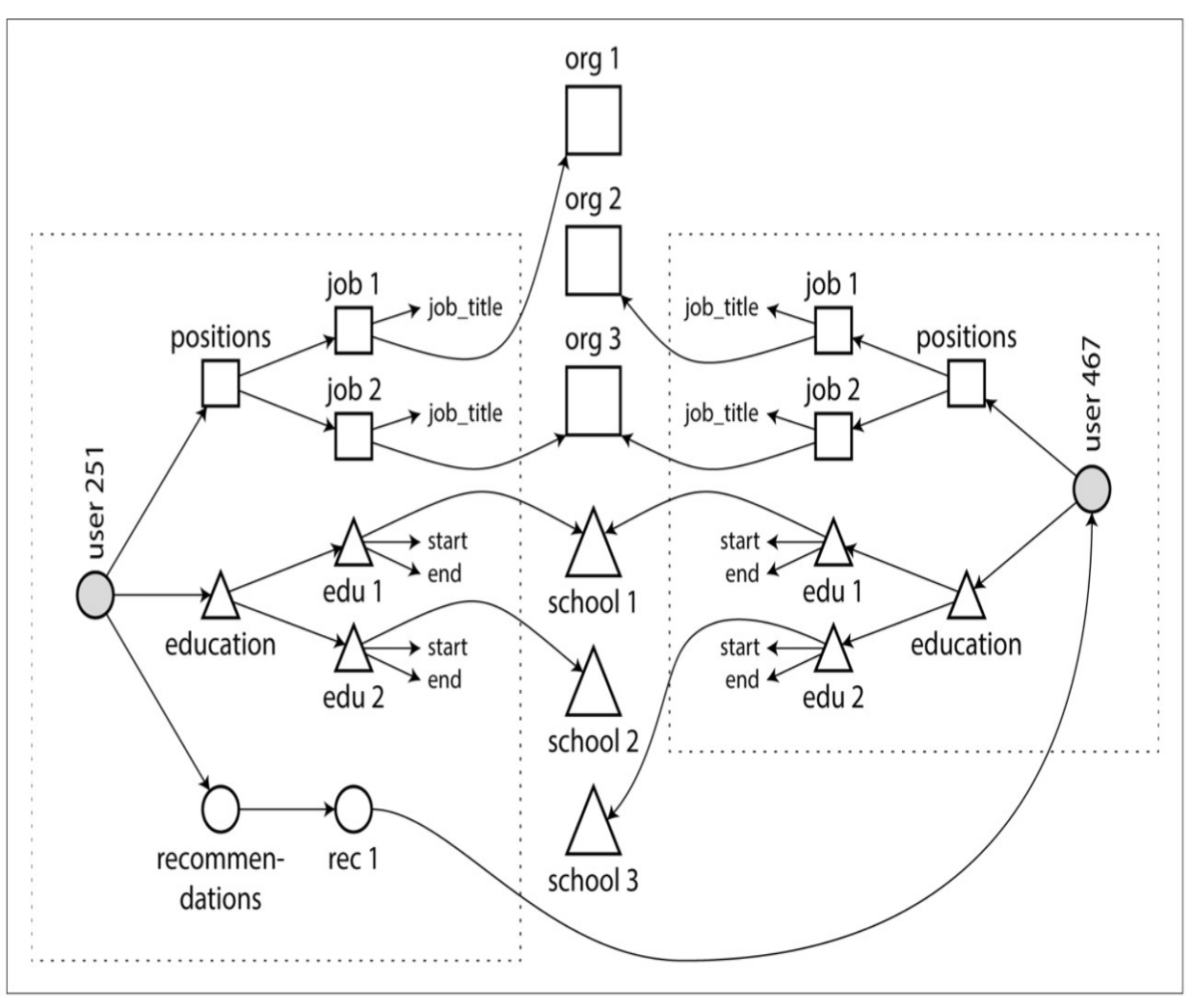
Example: MongoDB, CouchDB, Amazon DocumentDB


```
{
  "user_id":     251,
  "first_name":  "Bill",
  "last_name":   "Gates",
  "summary":     "Co-chair of the Bill & Melinda Gates... Active blogger.",
  "region_id":   "us:91",
  "industry_id": 131,
  "photo_url":   "/p/7/000/253/05b/308dd6e.jpg",
  "positions": [
    {"job_title": "Co-chair", "organization": "Bill & Melinda Gates Foundation"},
    {"job_title": "Co-founder, Chairman", "organization": "Microsoft"}
  ],
  "education": [
    {"school_name": "Harvard University",       "start": 1973, "end": 1975},
    {"school_name": "Lakeside School, Seattle", "start": null, "end": null}
  ],
```

Graph Database

Graph Databases establish connections between data using nodes, edges and properties

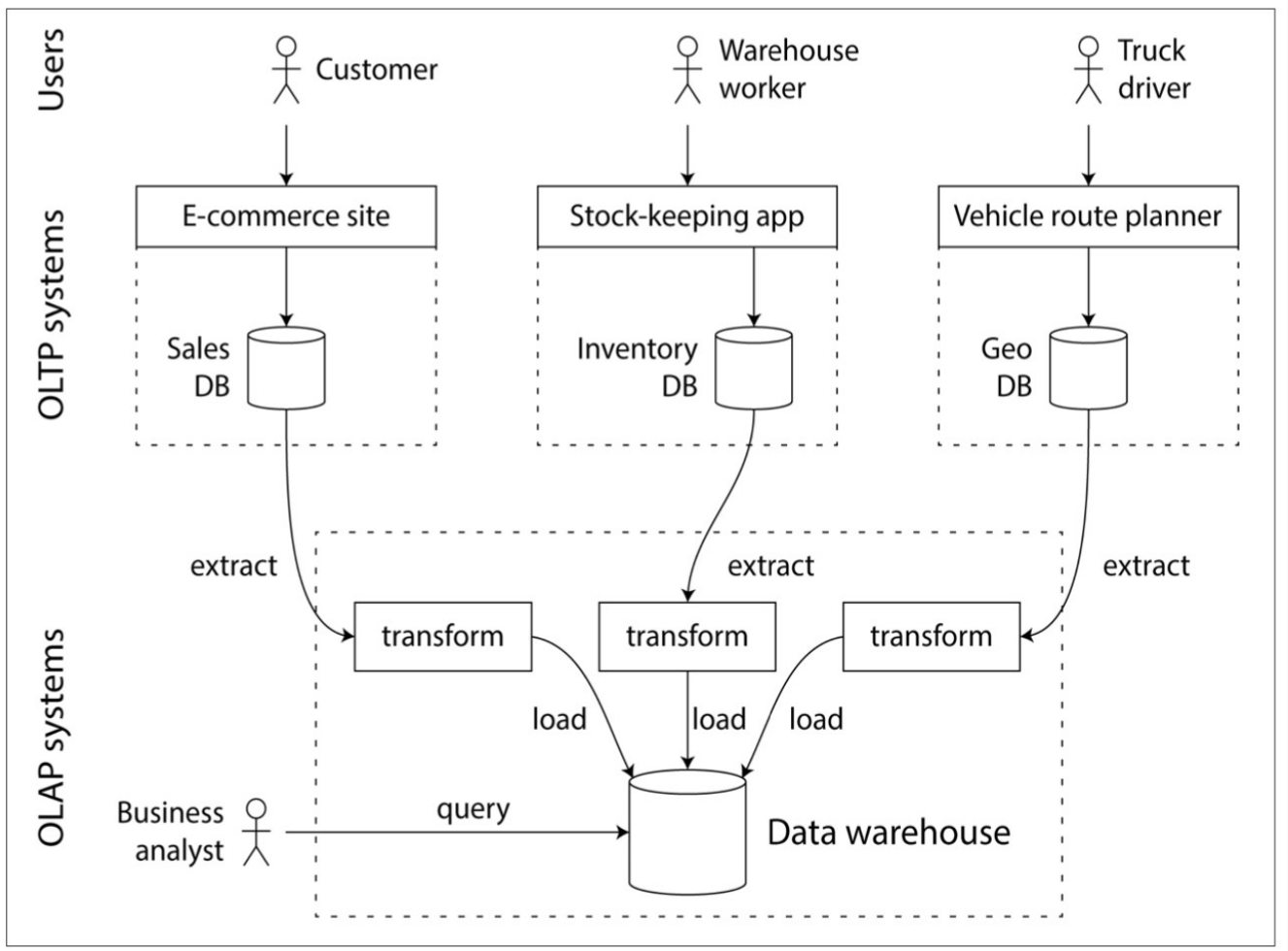
Example: Neo4J



OLTP and OLAP

OLTP: Online Transaction processing: look up a few records by some key, using an index. Insertion or updating based on users clicks, input. Ecommerce!

OLAP: Queries for business intelligence. Join lots of tables, get information about an entity of interest, such as a user, or a product. Typically, ETL (Extract-Transform-Load) scripts sit on OLTP databases to produce OLAP ones.




we use a database management system
be honest
i am being honest
which one?
Excel
thank you