MY472 - Week 9: Working with Online Databases

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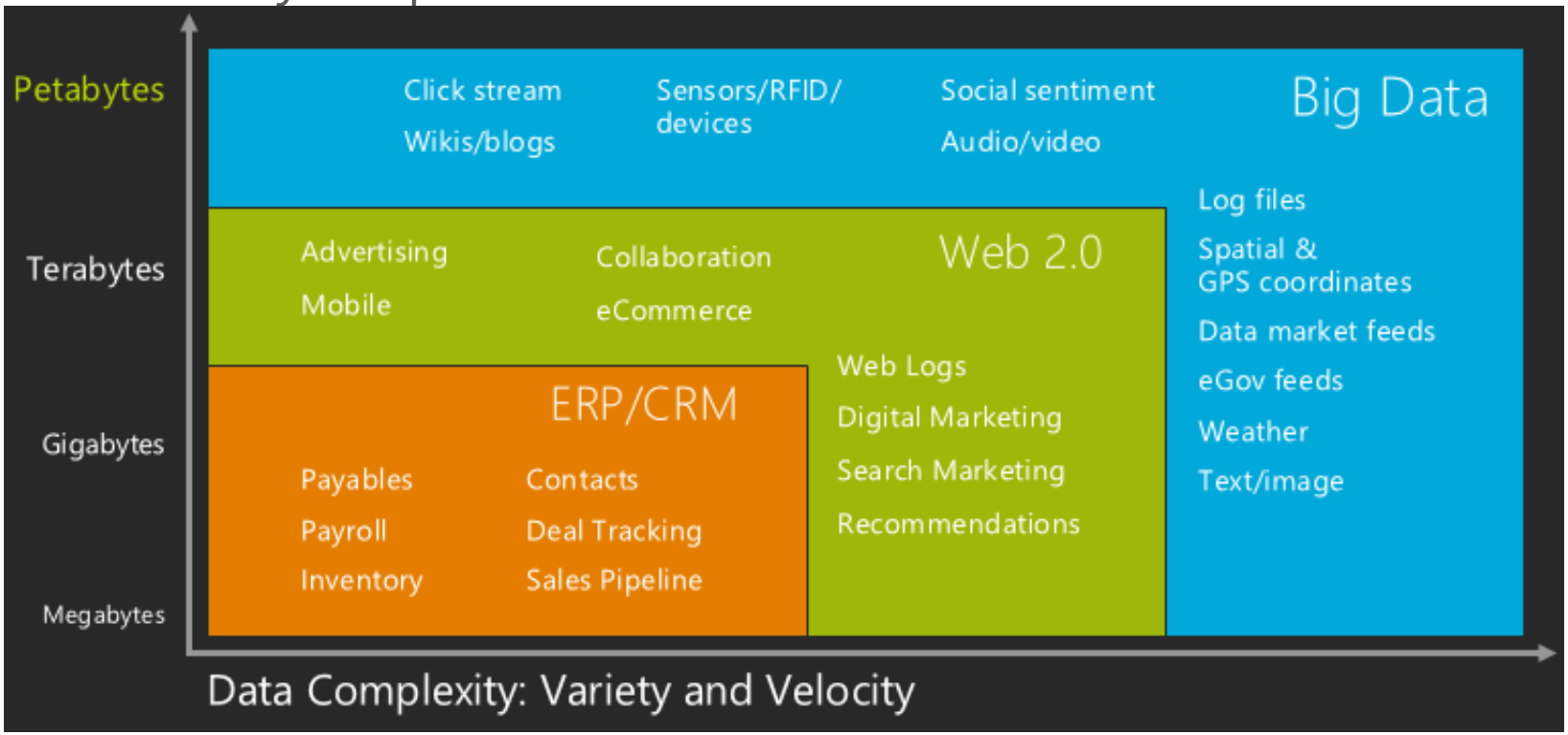
Outline

- Database Solution for Big Data
- SQL vs noSQL
- Cloud solutions
    - GCP Bigquery
    - AWS Redshift/DynamoDB
- Examples
    - Mongo DB
    - Google Bigquery

Big Data

- Your data can be really big
  - Gigabytes? Terabytes? Petabytes or more?
- And also very complicated



Database Solutions Big Data

- Different types of databases (SQL vs NoSQL)
- Cloud solution using fully managed services

SQL or noSQL

SQL?

SQL: **S**tructured **Q**uery **L**anguage

- We have learned how to run query in SQL databases
- Example:

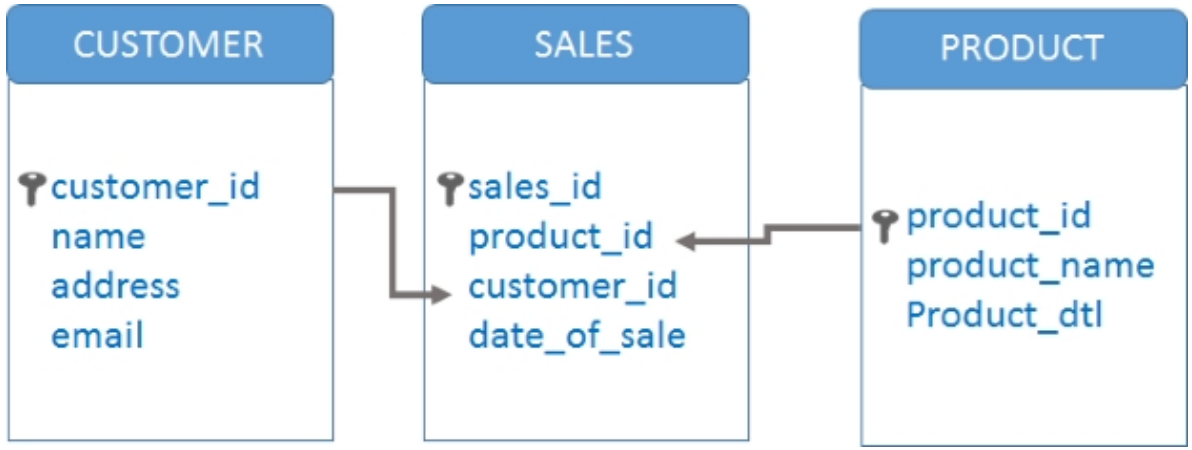
```
SELECT name, party FROM congress;
```

- SQL databases has a strict structure

SQL Structure

It’s all about relations

A simple e-commerce example



SQL: Review

- The result of an SQL query is always a table
- There are a number of commands, and many of them are about the relations between tables SELECT columns
  - **FROM** a table in a database
  - **WHERE** rows meet a condition
  - **GROUP** BY values of a column
  - **ORDER** BY values of a column when displaying results
  - **LIMIT** to only X number of rows in resulting table
  - Always required: **SELECT** and **FROM**.
- Rest are optional.
  - **SELECT** can be combined with operators such as **SUM, COUNT, AVG**…
  - To merge multiple tables, you can use **JOIN**

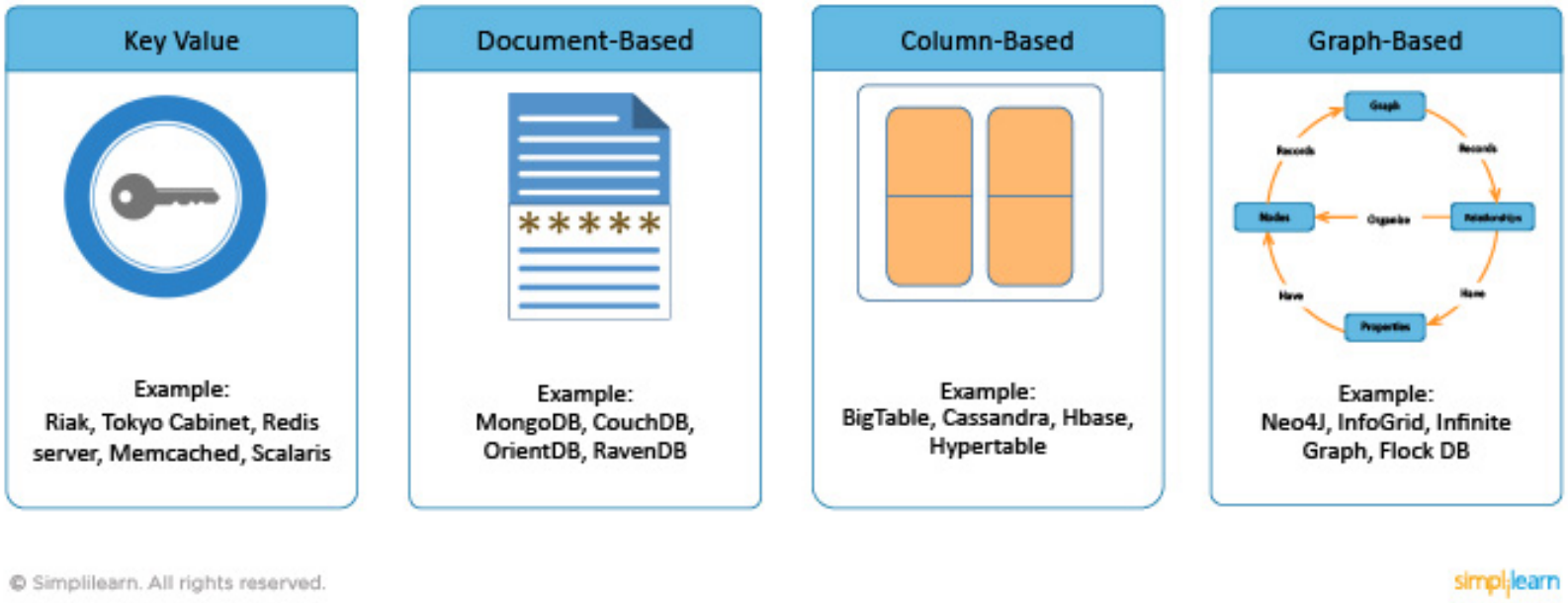
noSQL

A noSQL (originally referring to “non SQL”, “non relational” or “not only SQL”) database provides a mechanism for storage and retrieval of data which is modeled in means other than the tabular relations used in relational databases.

noSQL databases are good for the data with:

- High data **velocity** – lots of data coming in very quickly
- Data **variety** – data can be structured, semi-structured and unstructured
- Data **volume** - total size of data
- Data **complexity** - stored in many locations

noSQL: types



From: Simplelern

noSQL: Pros and Cons

PROS	CONS
Massive scalability	Limited query capabilities
High availability	Not standardized
Schema flexibility	Not matured
Sparse and semistructured data	Developer heavy

MongoDB

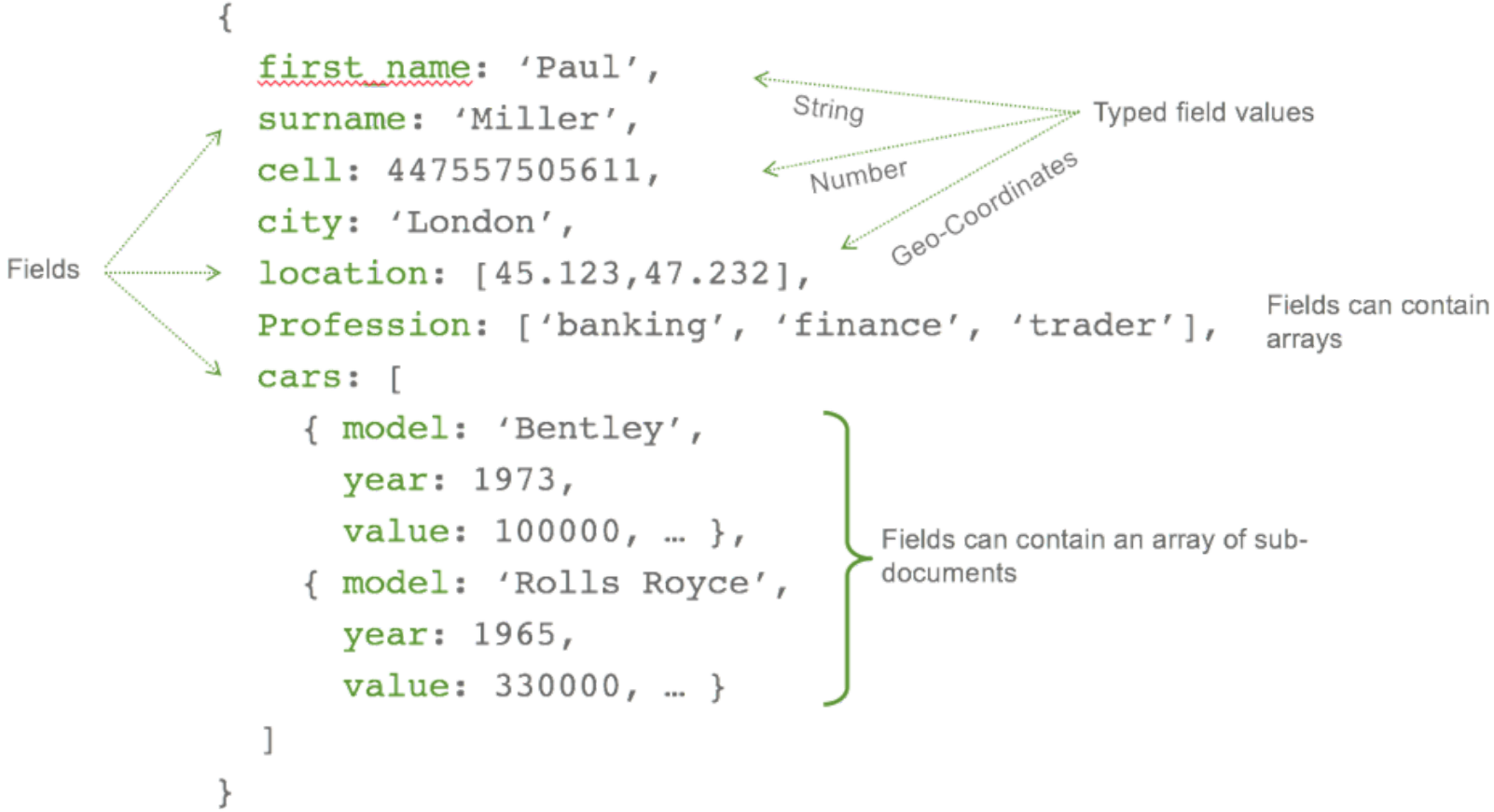
- **Document** based database
- Concept mapping:

SQL Terms/Concepts	MongoDB Terms/Concepts
database	database
table	collection
row	document or BSON document
column	field

- Each document is constructed as a **BSON** (Binary JSON)

MongoDB documents

A document looks like this:



From datawow.io

MongoDB Example

See `mongodb-demo.rmd`

- We will see the replication of SQL Basics in the last week using MongoDB
- For a simple selection of documents (i.e. rows in SQL), we will use `find()` method
- For a bit more sophisticated query, we will use `aggregate()` method
- Search query is in **BSON**
- For your reference, we will see the equivalent syntax of SQL right above the MongoDB query

MongoDB: JOIN?

- Use **$lookup**

```
dbMongo$aggregate([
  { "$match": { "party": "Republican" } },
  { "$sort": { "shares_count": -1 } },
  { "$limit": 10 },
  { "$lookup": {
    "localField": "screen_name",
    "from": "congress", "foreignField": "screen_name",
    "as": "congress"
  } }])
```

- This is close to

```
dbGetQuery(db,  "SELECT posts.*, congress.*
  FROM posts JOIN congress ON congress.screen_name = posts.screen_name
  WHERE party = 'Republican'
  ORDER BY shares_count DESC LIMIT 10")
```

MongoDB: JOIN?

- This will work, but it is not as powerful as SQL's **JOIN**. In the end, "if you have relational data, use a relational (SQL) database!".

Managed services in the cloud

Services

Database Type	AWS	GCP	Azure
Managed RDS	Amazon RDS	Cloud SQL	Azure SQL
Data Warehousing	Redshift	Bigquery	Snowflake
NoSQL (simple key-value)	DynamoDB	BigTable	Azure Tables
NoSQL (document)	MongoDB on EC2	MongoDB on GCE	DocumentDB

Google Cloud Platform: Bigquery

- GCP's data warehousing
- Integration with other Google data storage solutions (Google Drive, Google Cloud Storage)
- Scalable: same SQL syntax for datasets of *any* size
- Easy to collaborate and export results
- Affordable pricing and cost control
- API access allows integration with R or python
- Excellent documentation

Bigquery pricing

Operation	Pricing	Details
Active storage	$0.023 per GB	The first 10 GB is free each month. See Storage pricing for details.
Long-term storage	$0.016 per GB	The first 10 GB is free each month. See Storage pricing for details.
Streaming Inserts	$0.0126 per 200 MB	You are charged for rows that are successfully inserted. Individual rows are calculated using a 1 KB minimum size. See Streaming pricing for details.
Queries (analysis)	$9.35 per TB	First 1 TB per month is free, see On-demand pricing for details. Flat-rate pricing is also available for high-volume customers.

Bigquery example

- `Bigquery-demo.rmd`

This week's lab

- SQL topics: JOINs and sub queries
- Problem Set 8 (Assessed Assignment #4)