Chapter #2 – Data Models and Query Languages

Most applications are built by layering one data model on top of another

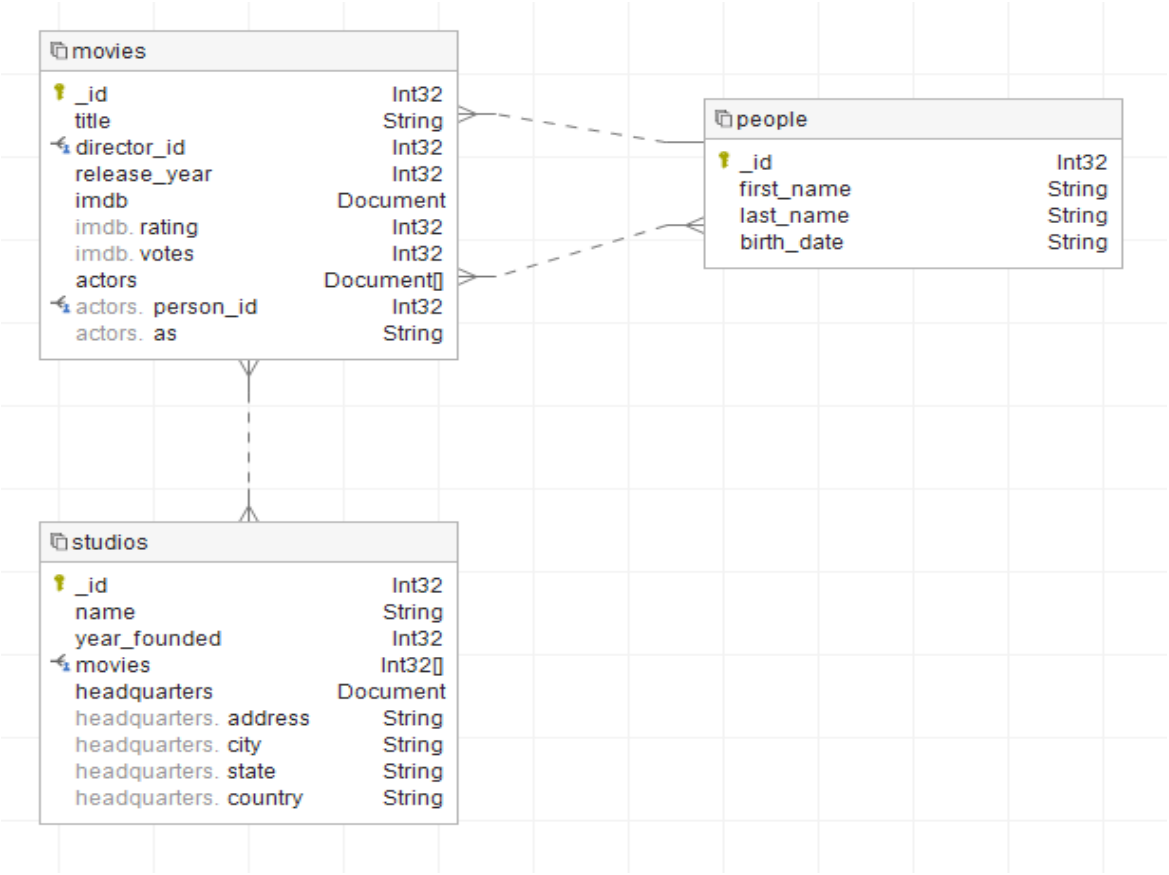
- Application developer looks at the real world and model it in terms of objects or data structures
- Data structures must be stored internally in terms of a general-purpose data model such as JSON or XML documents, tables in a relational database, or a graph model.
- Database software decided on a way of representing that JSON/XML/relational/graph data in terms of bytes in memory, on disk, or on a network. The representation may allow the data to be queried, searched, manipulated, and processed in various ways.
- Lowest level needs to represent information as bytes in terms of electrical currents, pulses of light, magnetic fields, and more.

Relational Model Versus Document Model

- SQL vs NoSQL
- What else? Graph Based Model

Relational Model

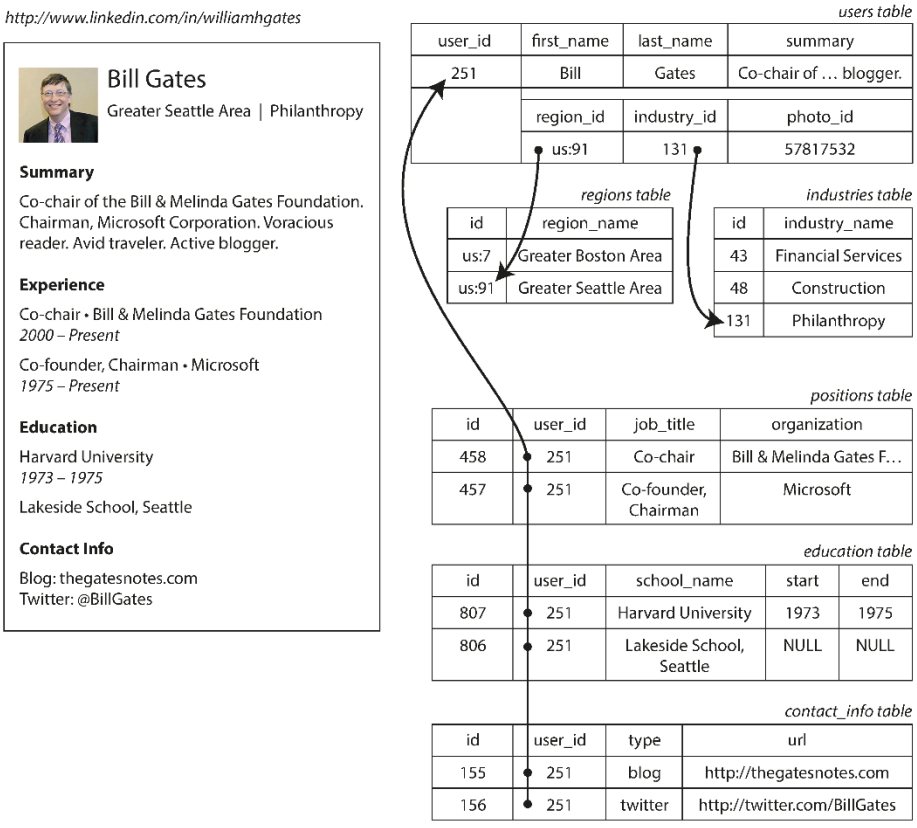
- SQL Database



- SQL is a declarative query language

```
SELECT b.id, b.title, a.first_name, a.last_name
FROM books b
INNER JOIN authors a
ON b.author_id = a.id
ORDER BY b.id;
```

Document Model



http://www.linkedin.com/in/williamhgates

Bill Gates

Greater Seattle Area | Philanthropy

Summary

Co-chair of the Bill & Melinda Gates Foundation. Chairman, Microsoft Corporation. Voracious reader. Avid traveler. Active blogger.

Experience

Co-chair • Bill & Melinda Gates Foundation
2000 – Present

Co-founder, Chairman • Microsoft
1975 – Present

Education

Harvard University
1973 – 1975

Lakeside School, Seattle

Contact Info

Blog: thegatesnotes.com
Twitter: @BillGates

users table

user_id	first_name	last_name	summary
251	Bill	Gates	Co-chair of … blogger.

region_id	industry_id	photo_id
us:91	131	57817532

regions table

id	region_name
us:7	Greater Boston Area
us:91	Greater Seattle Area

industries table

id	industry_name
43	Financial Services
48	Construction
131	Philanthropy

positions table

id	user_id	job_title	organization
458	251	Co-chair	Bill & Melinda Gates F…
457	251	Co-founder, Chairman	Microsoft

education table

id	user_id	school_name	start	end
807	251	Harvard University	1973	1975
806	251	Lakeside School, Seattle	NULL	NULL

contact_info table

id	user_id	type	url
155	251	blog	http://thegatesnotes.com
156	251	twitter	http://twitter.com/BillGates

Example 2-1. Representing a LinkedIn profile as a JSON document

```
{
  "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}
  ],
  "contact_info": {
    "blog":    "https://www.gatesnotes.com/",
    "twitter": "https://twitter.com/BillGates"
  }
}
```

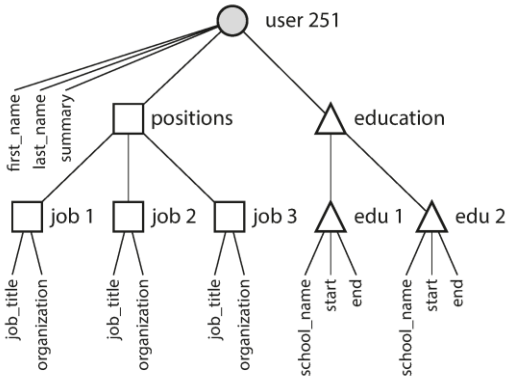


Figure 2.2 One-to-many relationships forming a tree structure

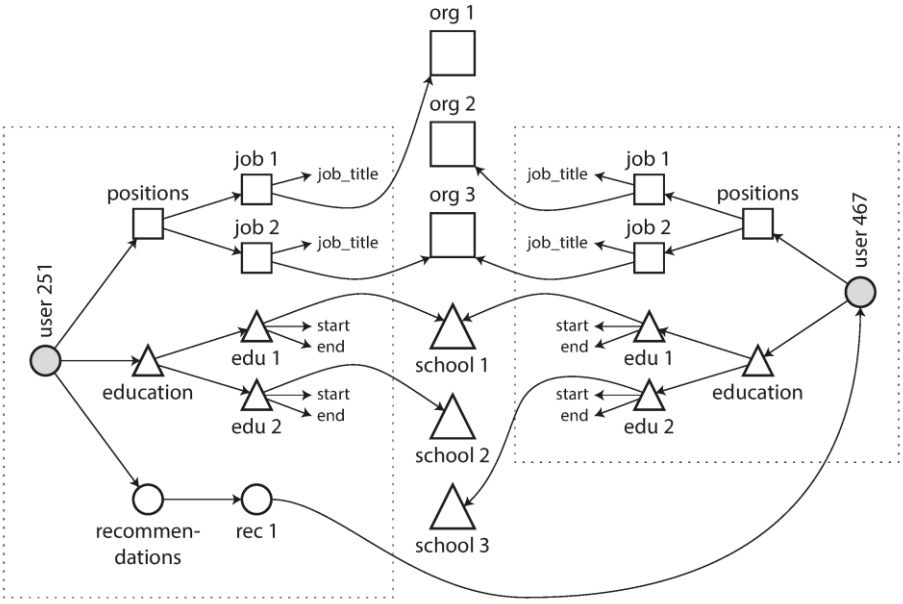


Figure 2.4 Many-to-many relationship example

Graph Based Model

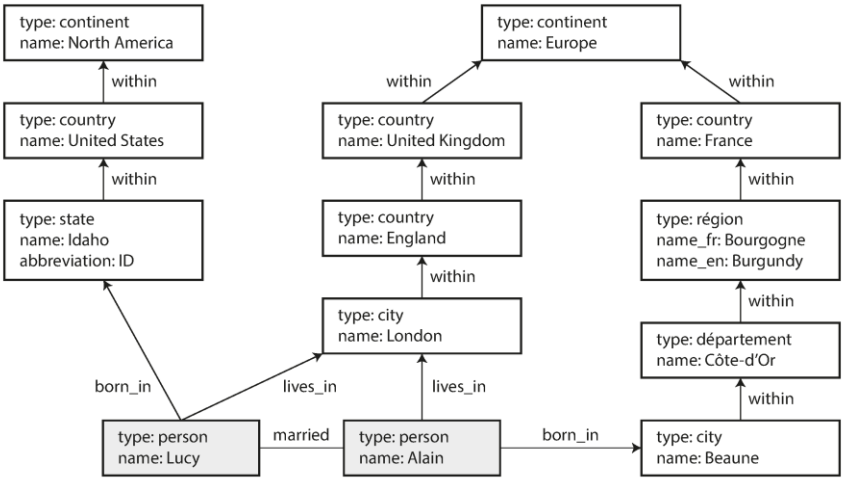


Figure 2-5. Example of graph-structured data (boxes represent vertices, arrows represent edges)