GENERAL ASSEMBLY

INTRO TO DATA SCIENCE

LECTURE 14: DATABASES

I. INTRO TO DATABASES
II. RELATIONAL DATABASES
III. NOSQL DATABASES

I. INTRO TO DATABASES

Databases are a **structured** data source optimized for efficient **retrieval and storage**

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structured : we will have to define some pre-defined organization strategy

retrieval : the ability to read data out

storage: the ability to write data and save it

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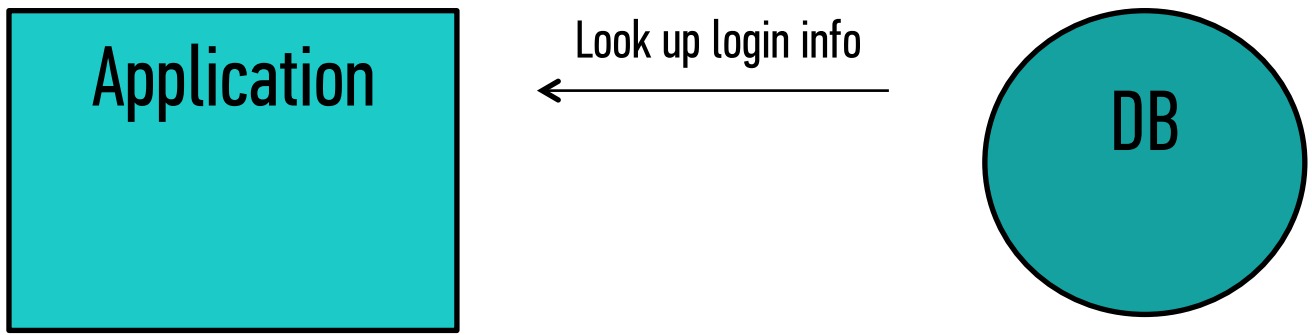
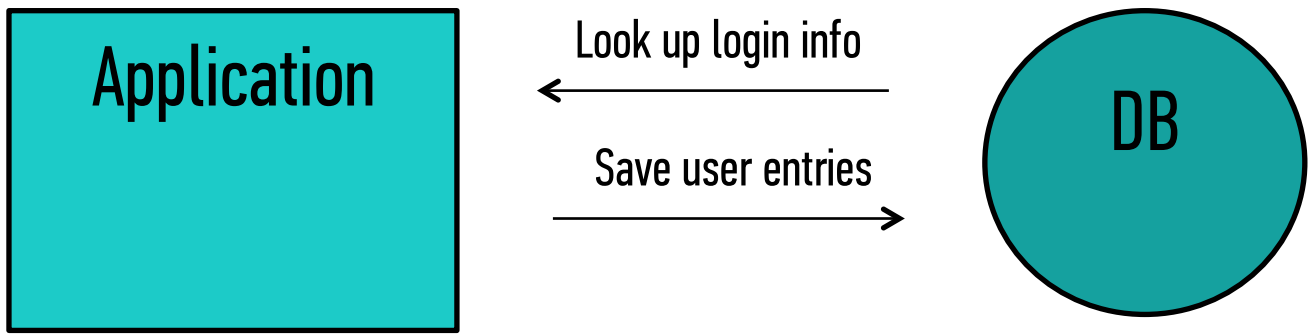
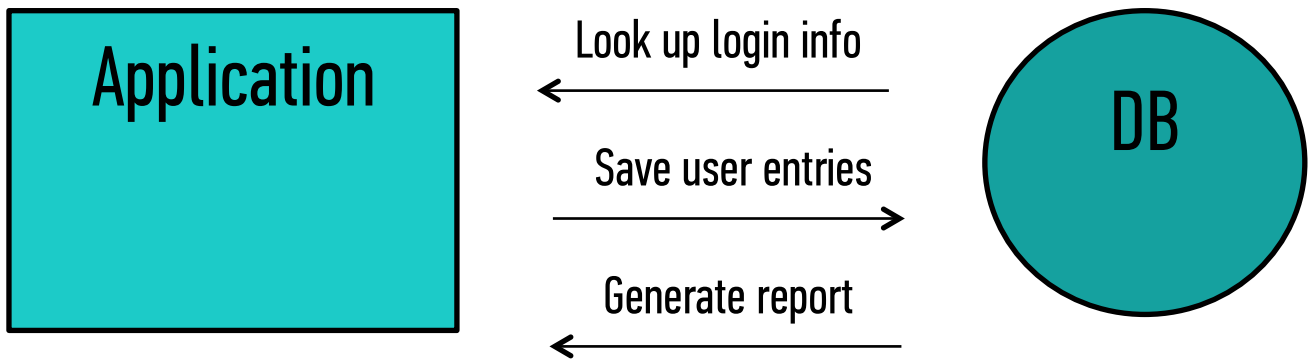
Application
DB


Application
Look up login info
DB


Application
Look up login info
Save user entries
DB

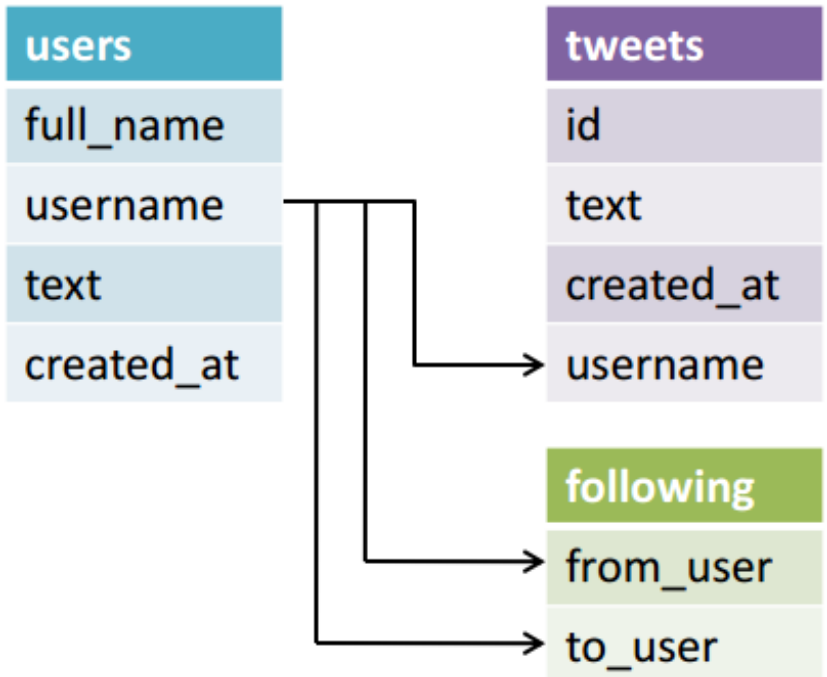

Application
Look up login info
Save user entries
Generate report
DB

II. RELATIONAL DATABASES

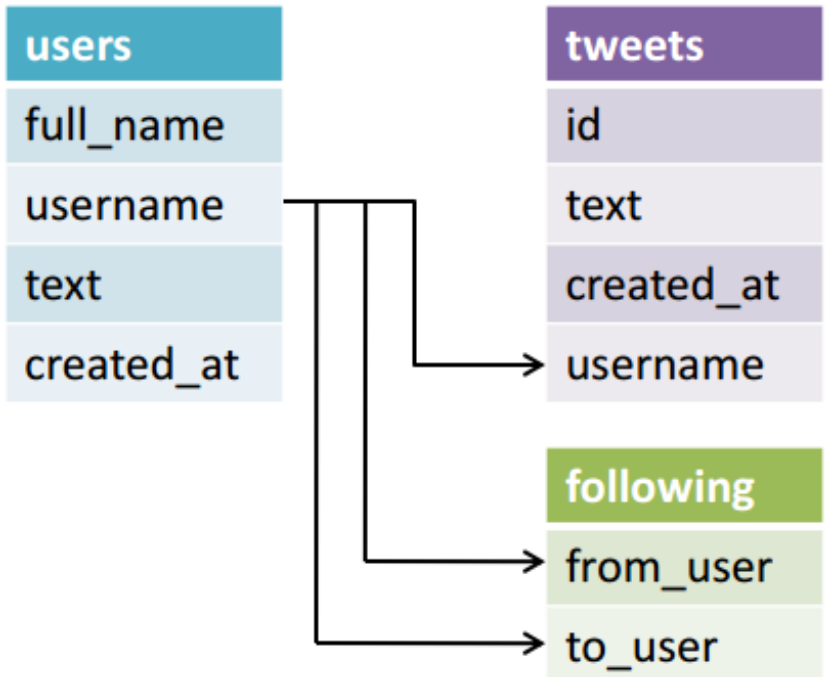
Relational database are traditionally organized in the following manner:

A database has **tables** which represent individual entities or objects

Tables have a predefined **schema** - rules that tell it what columns exist and what they look like


users
full_name
username
text
created_at
tweets
id
text
created_at
username
following
from_user
to_user

Each table should have a **primary key** column– a unique identifier for that row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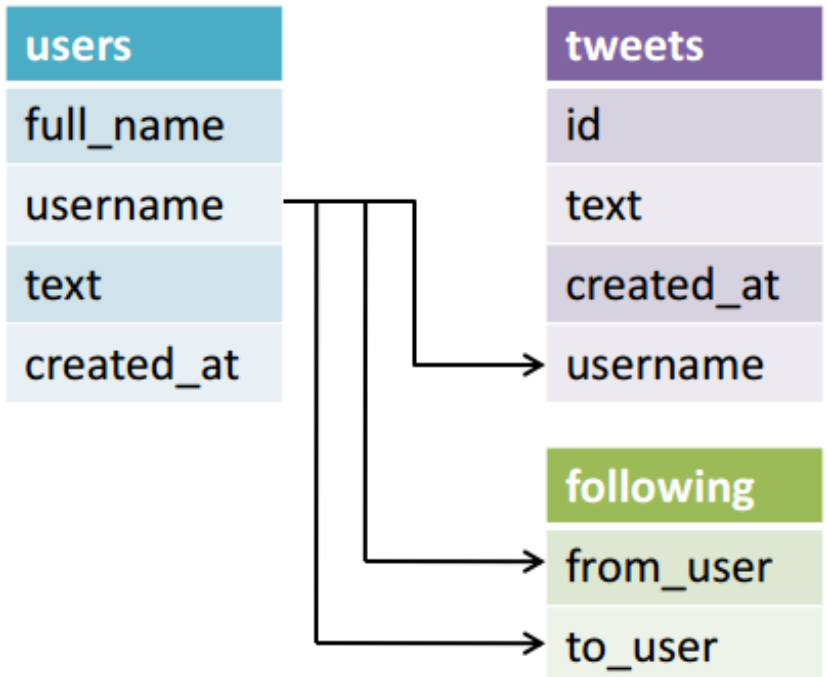
Each table should have a **primary key** column– a unique identifier for that row

Additionally each table can have a **foreign key** column- an id that links this to table to another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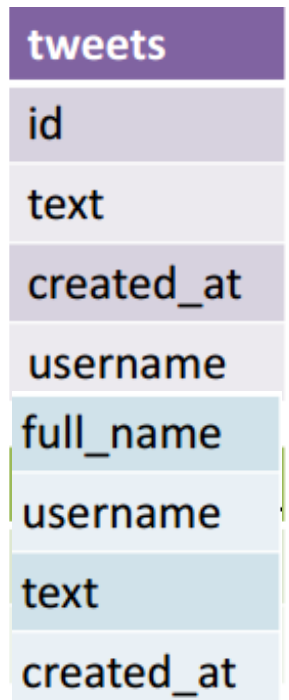
We could have had a table structure as follow:

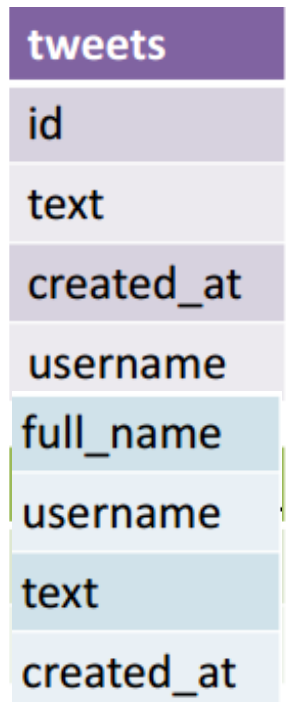
Why is this different?



We could have had a table structure as follow:
Why is this different?

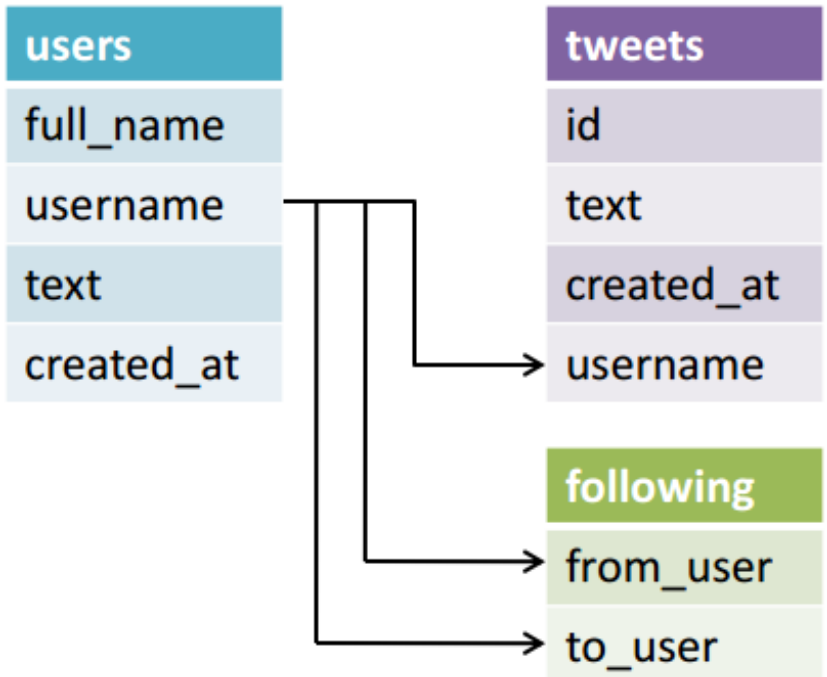
We would repeat the user information on each row.

This is called denormalization



Normalized Data: Many tables to reduce redundant or repeated data in a table

Denormalized Data:
Wide data, fields are often repeated but removes the need to join together multiple tables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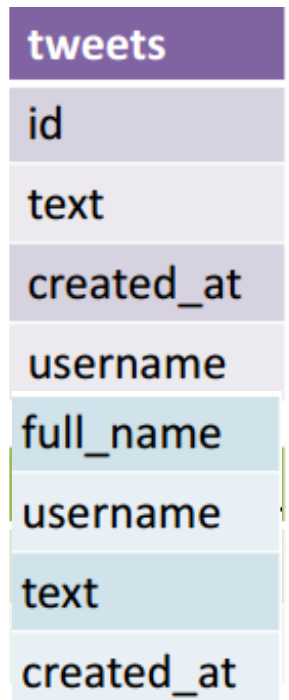
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username
full_name
username
text
created_at

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Trade off of speed vs. storage

Q: How do we commonly evaluate databases?

read-speed vs. write speed

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read-speed vs. write speed
space considerations
(...and many other criteria)

Q: Why are normalized tables (possibly) slower to read?

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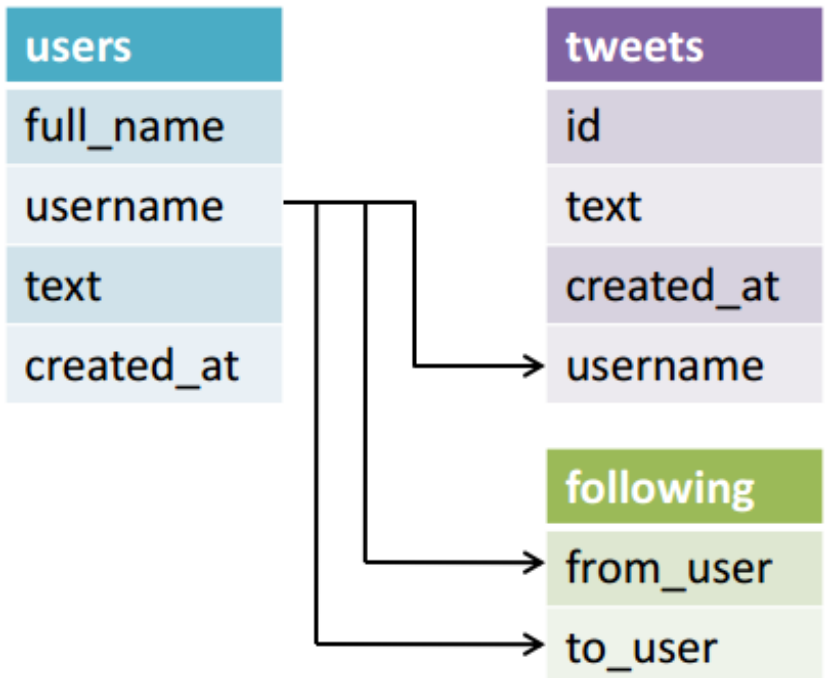

Q: Why are normalized tables (possibly) slower to read?

A: We'll have to get data from multiple tables to answer some questions.

Q: Why are denormalized tables (possibly) slower to write?

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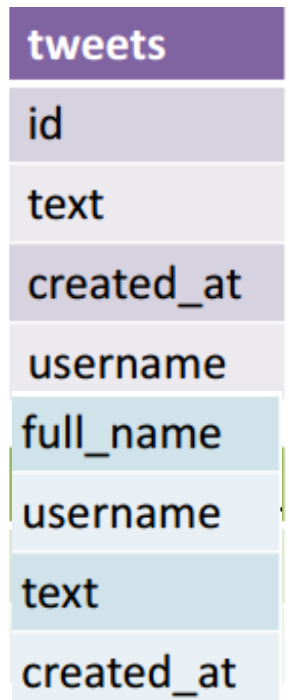

Q: Why are denormalized tables (possibly) slower to write?

A: We'll have to write more information on each write

SQL is a query language to load, retrieve and update data in relational databases

SELECT: Allows you to **retrieve** information from a table

Syntax:

SELECT col1, col2 FROM table WHERE <some condition>

Example:
SELECT poll_title, poll_date FROM polls WHERE romney_pct > obama_pct

GROUP BY: Allows you to **aggregate** information from a table

Syntax:

SELECT col1, AVG(col2) FROM table GROUP BY col1

Example:
SELECT poll_date, AVG(obama_pct) FROM polls GROUP BY poll_date

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Syntax:

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There are usually a few common built-in operations:
SUM, AVG, MIN, MAX, COUNT

JOIN: Allows you to **combine** multiple tables

Similar to merge in R

Syntax:

```
SELECT table1.col1, table1.col2, table2.col2
FROM  table1 JOIN table2 ON table1.col1 = table2.col2
```

JOIN: Allows you to **combine** multiple tables

Similar to merge in R

Syntax:

```
SELECT table1.col1, table1.col2, table2.col2
FROM  (JOIN table1, table2 ON table1.col1 = table2.col2)
```

INSERT: Allows you to **add** data to tables

Syntax and Example:

```
INSERT INTO <table> (col1, col2)
VALUES( ...)

INSERT INTO classroom (first_name, last_name)
VALUES('John', 'Doe);
```

II. NO-SQL DATABASES

NO-SQL databases are a new trend in databases

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The title **NOSQL** refers to the lack of a relational structure between stored objects

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Most importantly, they often attempt to minimize the need for **JOIN** operations

Memcached

Apache HBase

Cassandra

MongoDB

Memcached	::	LiveJournal
Apache HBase	::	Google BigTable
Cassandra	::	Amazon Dynamo
MongoDB		

Memcached was:

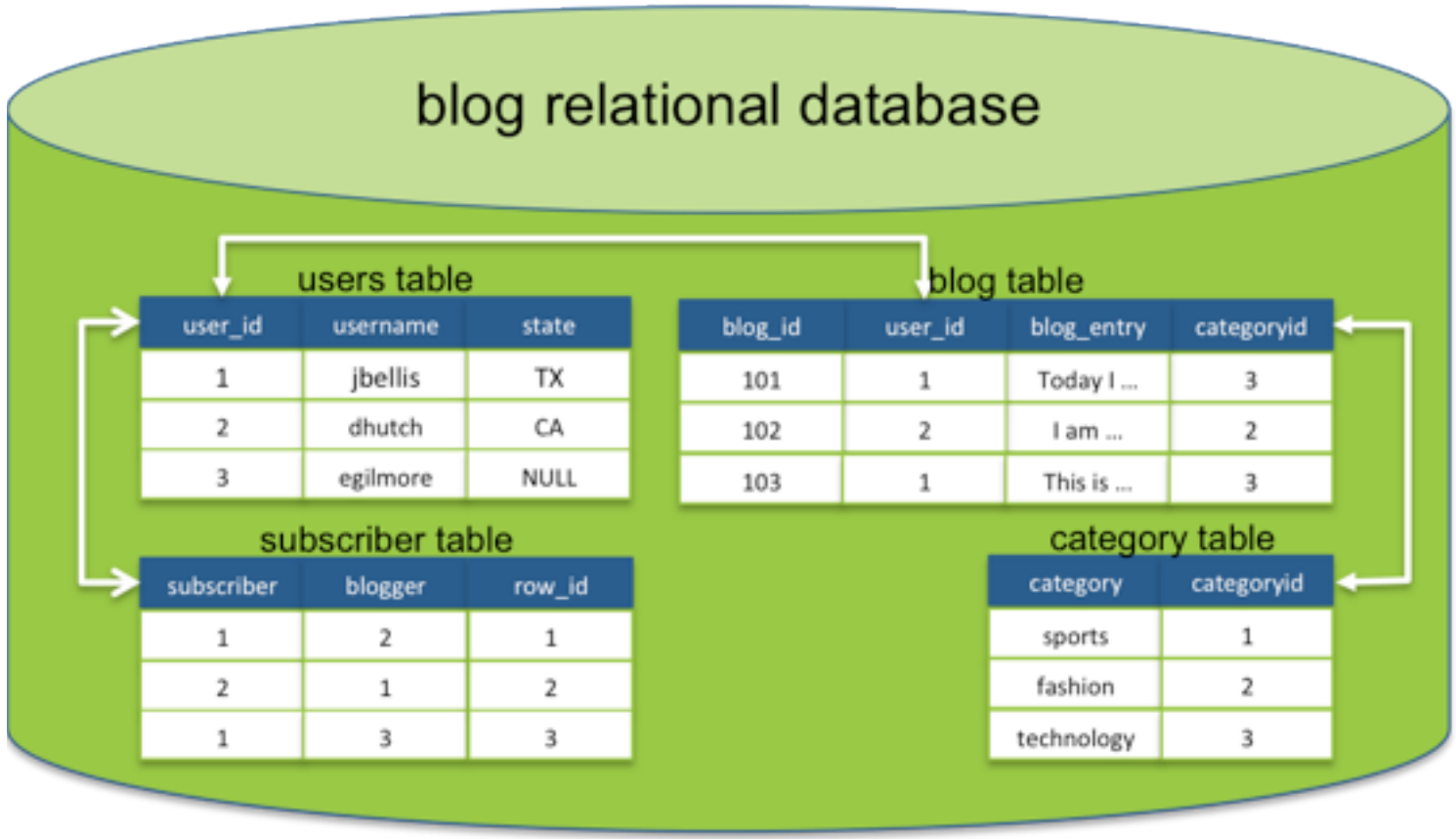
- developed by LiveJournal
- distributed key-value store (HashMap or Python Dict)
- Support two operations:
  get and **set**

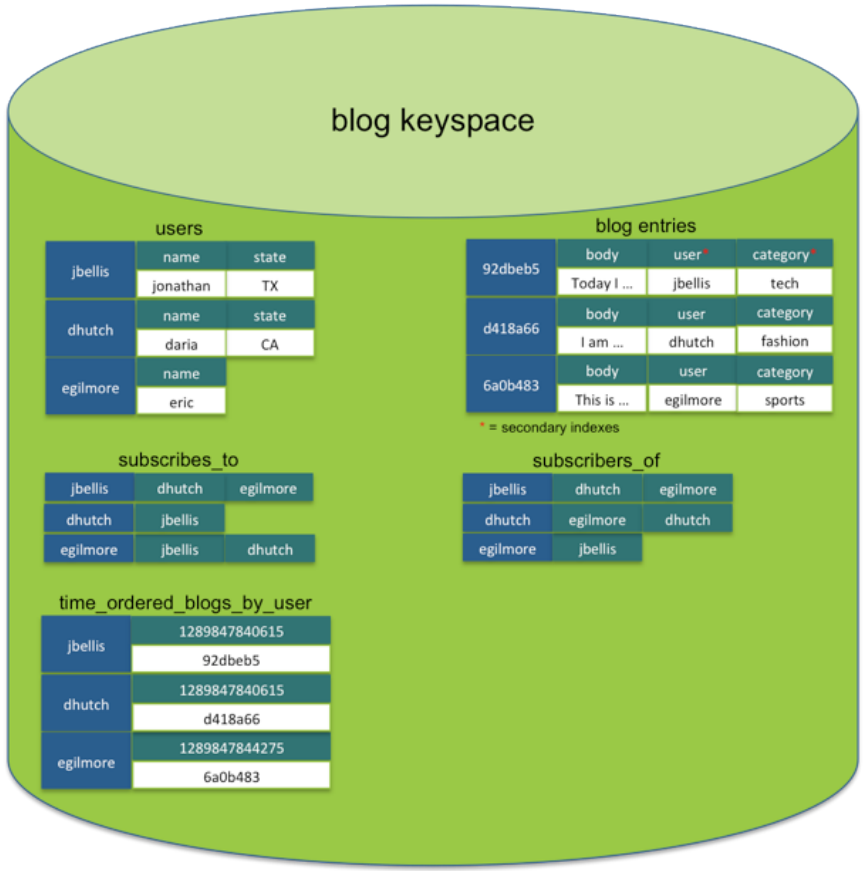
Memcached was:

- developed by LiveJournal
- distributed key-value store (HashMap or Python Dict)
- Support two **very fast** operations:
  get and **set**

Cassandra was

- developed by Facebook
- Messages application and Inbox Search
- Key-Value **(-ish)**
  - supports query by key or key range
- Very fast writing speeds
- Useful for record keeping, logging


blog relational database
users table
user_id username state
1 jbellis TX
2 dhutch CA
3 egilmore NULL
blog table
blog_id user_id blog_entry categoryid
101 1 Today I ... 3
102 2 I am ... 2
103 1 This is ... 3
subscriber table
subscriber blogger row_id
1 2 1
2 1 2
1 3 3
category table
category categoryid
sports 1
fashion 2
technology 3


blog keyspace
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category*
Today I ...
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d418a66
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category
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