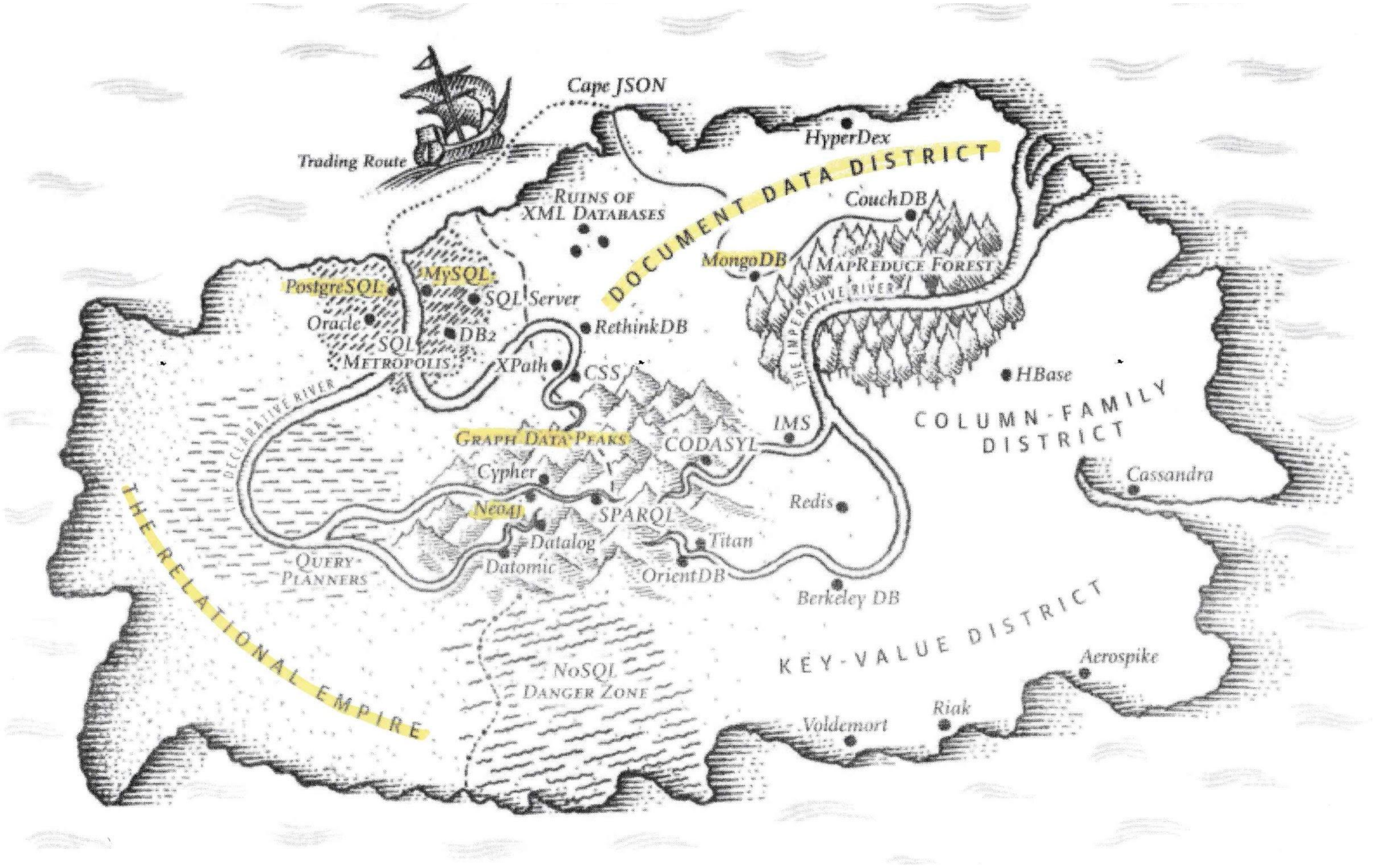
CS 327E Class 5

Oct 2, 2020

Announcements

- Test 1 feedback
- GCP billing errors



Source: Martin Kleppmann, Designing Data-Intensive Applications, O’Reilly 2017.

Why non-relational systems?

- Need for greater scalability
  - Throughput
  - Response time
- More expressive data models and schema flexibility
- Object-relational mismatch
- Preference for open-source software

Why Firestore?

- Document database system
- Fully serverless
- Integrated with GCP
- Simple APIs for reading and writing
- Supports transactions
- Provides strong consistency (uses Spanner for storage)
- Designed for mobile, web and IoT apps
- Comes in two modes: native and datastore
- Clients can listen for document updates (native mode only)
- Massive scale (10+M requests/sec, PBs of storage)
- Write throughput limits in native mode (10K writes/sec)

Firestore's Data Model

- Firestore is a document database system
- Firestore *document* == set of typed key, value pairs
- Primitive types: String, Int, Float, Bool, Datetime
- Complex types: Array, Map, Geo points

- Documents are grouped into *collections*
- Documents of the same type can have different schemas
- Documents have unique identifiers (id)
- Documents can store hierarchical data with *subcollections*

Writing to Firestore

- Set method converts Python dictionary into Firestore document
- Every document has unique identifier
- Writes must also update indexes on documents

```python
from google.cloud import firestore
db = firestore.Client()

author = {
    'id': 'aaa',
    'name': 'Mary Tuma',
    'section': 'news',
    'active': True,
    'start_date': '2019-01-20'
}

db.collection('author').document('aaa').set(author)
```

Example 1: writes into author collection

```python
from google.cloud import firestore
db = firestore.Client()

article = {
    'id': '1',
    'title': 'Turmoil at the Zoo',
    'published': True,
    'publication_date': '2019-01-26',
    'auth_id': 'aaa',
    'clicks': 120,
    'likes': 45,
    'dislikes': 9,
    'comments': 13
}

db.collection('article').document('1').set(article)
```

Example 2: writes into article collection

Writing to Firestore

```
tag = {
    'id': '1',
    'tag': 'politics',
    'article_ids': ['1', '2', '3', '4', '5', '6', '7']
}

db.collection('tag').document('1').set(tag)

tag = {
    'id': '2',
    'tag': 'austin',
    'article_ids': ['1', '8', '9', '10']
}

db.collection('tag').document('2').set(tag)
```

Example 3: writes into tag collection

```
tag1 = {
    'id': '1',
    'tag': 'politics',
}

tag2 = {
    'id': '2',
    'tag': 'news',
}

tags = []
tags.append(tag1)
tags.append(tag2)

nested_article = {
    'id': '1',
    'title': 'Turmoil at the Zoo',
    'published': True,
    'publication_date': '2019-01-26',
    'auth_id': 'aaa',
    'clicks': 120,
    'likes': 45,
    'dislikes': 9,
    'comments': 13,
    'tags': tags
}

db.collection('nested_article').document('1').set(nested_article)
```

Example 4: writes into nested_article collection

Reading from Firestore

- Get(id) method fetches single document
- Stream method fetches all documents in collection
- Stream + where methods filter documents in collection
- Order by and limit methods available
- All reads require indexes!

```python
doc_ref = db.collection('author').document('aaa')

doc = doc_ref.get()

if doc.exists:
    print(f'{doc.id} => {doc.to_dict()}')
else:
    print('No such author!')
```

Example 1: reads single document

```python
docs = db.collection('article').stream()

for doc in docs:
    print(f'{doc.id} => {doc.to_dict()}')
```

Example 2: reads all documents in collection

```python
docs = db.collection('author').where('name', '==', 'Nina Hernandez').stream()

for doc in docs:
    print(f'{doc.id} => {doc.to_dict()}')
```

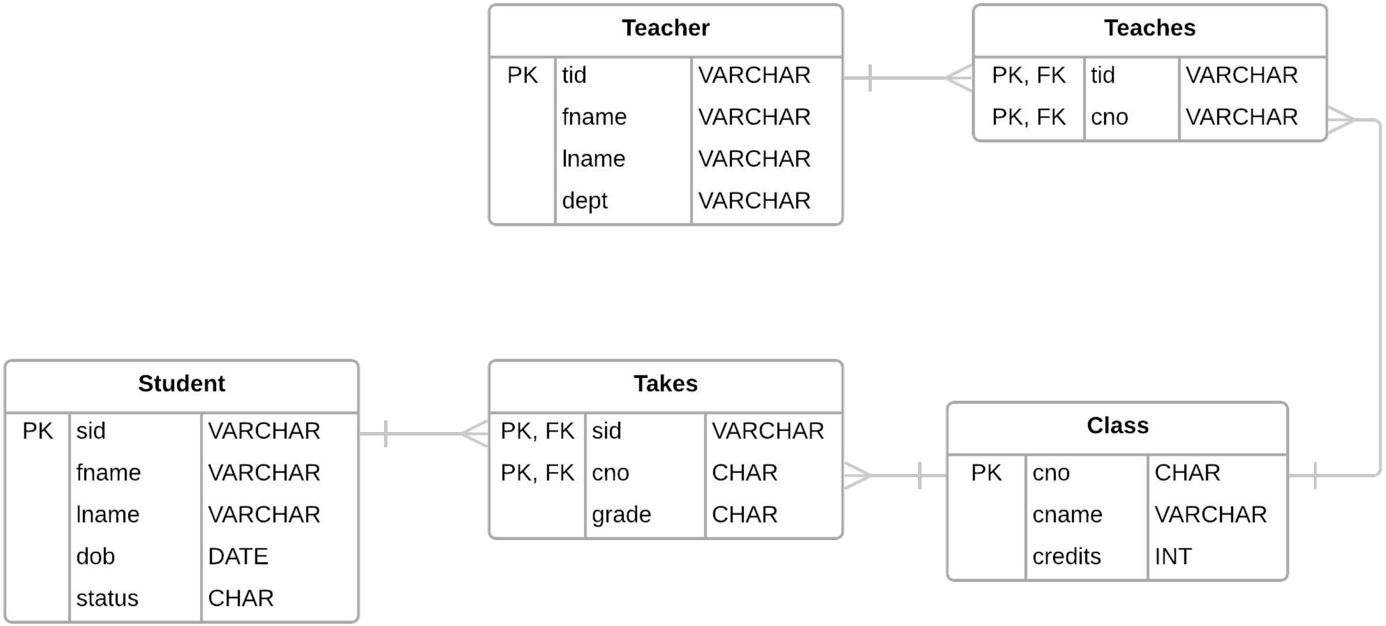
Example 3: filters documents in collection

Document Database Design Principles

1. Know problem domain and understand usage patterns.
2. Group entities into *top-level* and *lower-level* types.
3. Make each top-level entity type its own Firestore collection.
4. Embed lower-level entities into their related top-level entity when they share a *1:m* relationship.
5. Merge lower-level entities with their related top-level entity when they share a *1:1* relationship.
6. Eliminate *m:n* relationships by embedding both sides of the relationship into parent entities.

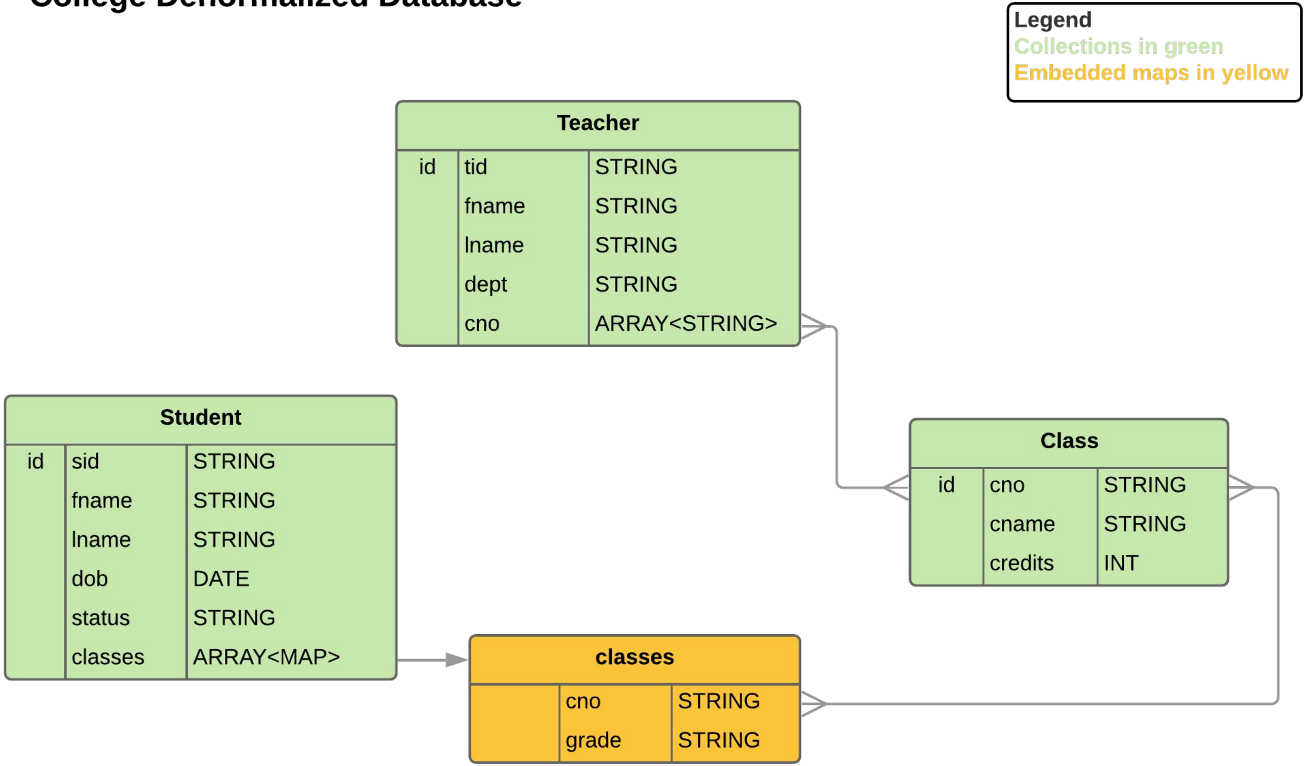
Schema conversion example

College Normalized Database



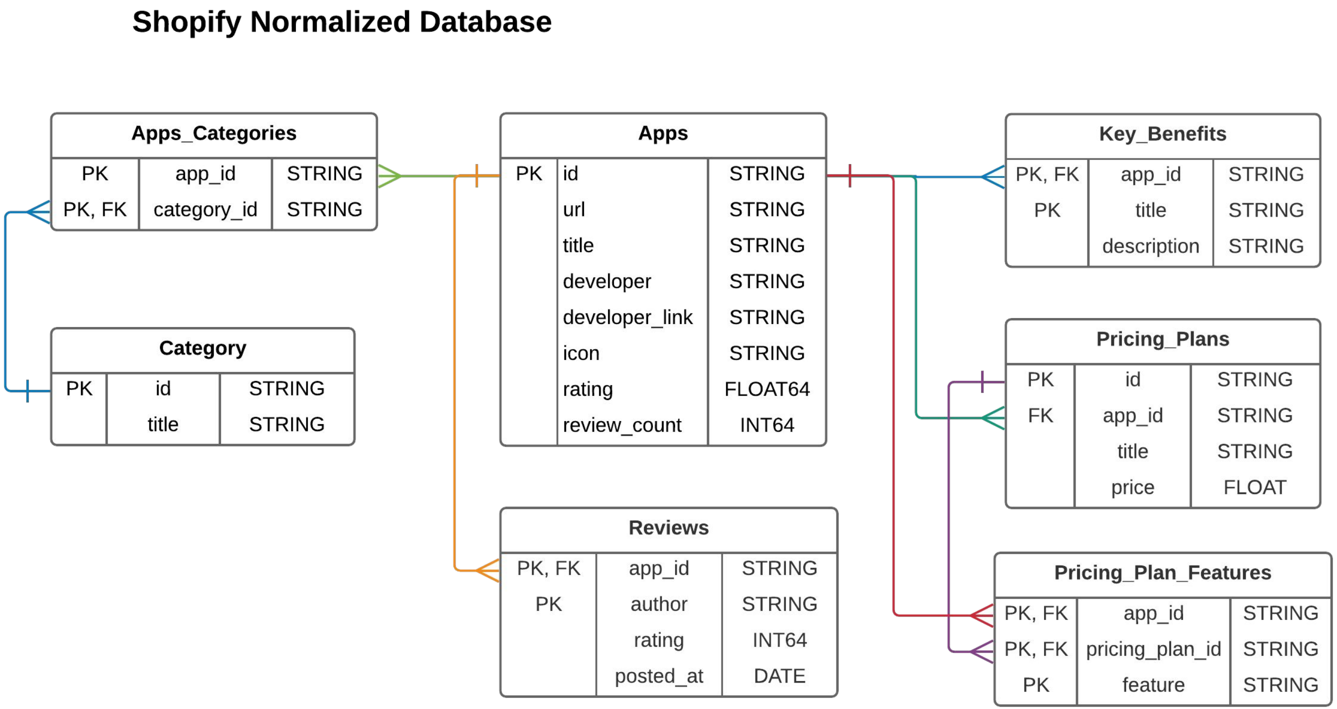
Schema conversion example

College Denormalized Database



Practice Problem 1

How would you remodel the Shopify database for Firestore?



Set up Firestore

https://github.com/cs327e-fall2020/snippets/wiki/Firestore-Setup-Guide

Practice Problem 2

Find all classes taught by Prof. Cannata. Return their cid.

Project 4

http://www.cs.utexas.edu/~scohen/projects/Project4.pdf