Class 7 Firestore

Elements of Databases

Oct 13, 2023

Instapolls and Logistics

- Exam feedback
- Office hours for next week
- Revised week-by-week schedule
- Firestore setup

The "NoSQL Movement"

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

```
{
  "@context": "https://schema.org",
  "@type": "Restaurant",
  "address": {
    "@type": "PostalAddress",
    "addressLocality": "Sunnyvale",
    "addressRegion": "CA",
    "postalCode": "94086",
    "streetAddress": "1901 Lemur Ave"
  },
  "aggregateRating": {
    "@type": "AggregateRating",
    "ratingValue": "4",
    "reviewCount": "250"
  },
  "name": "GreatFood",
  "openingHours": [
    "Mo-Sa 11:00-14:30",
    "Mo-Th 17:00-21:30",
    "Fr-Sa 17:00-22:00"
  ],
  "priceRange": "$$",
  "servesCuisine": [
    "Middle Eastern",
    "Mediterranean"
  ],
  "telephone": "(408) 714-1489",
  "url": "http://www.greatfood.com"
}
```

Source: schema.org

Firestore Overview

+ Distributed system
+ Fully "serverless"
+ Simple APIs for reading and writing
+ Supports ACID transactions (uses Spanner behind the scenes)
+ Designed for mobile, web, and IoT apps
+ Implements document model
+ Change data capture for documents
+ Inexpensive
+ Scales to millions of writes per second
- Only runs on Google Cloud
- Does not offer a declarative query language

Firestore’s Document Model

- Firestore *document* == collection of typed <key, value> pairs
- Primitive types: String, Number, Bool, Timestamp
- Complex types: Array, Map, Geopoint

- Documents Concepts:
  - grouped into *collections*
  - same type documents can have different schemas
  - assigned unique identifiers (id)
  - store hierarchical data in *subcollections*

Writing Single Documents

- Every document has unique identifier of String type
- The `set` method converts a Python dictionary into Firestore document
- A document write must also update any existing indexes on the collection

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


author = {
    'id': 'sarah.asch',
    'first_name': 'Sarah',
    'last_name': 'Asch',
    'job_title': 'Reporter',
    'seniority': 'L3',
    'hire_date': '2018-01-01',
    'employed_full_time': True,
    'primary_specialty': 'Entertainment',
    'secondary_specialties': ['Business', 'State Government'],
    'articles_to_date': 351,
}

db.collection('authors').document('sarah.asch').set(author)
```

Writing Nested Documents

- Subcollections are nested under documents
- Subcollections can be nested under other subcollections (max depth = 100)

```python
import datetime

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

ts = datetime.datetime.now().strftime('%Y-%m-%d-%H-%M-%S')

article = {
    'id': ts,
    'author_names': ['sarah.asch', 'atuma'],
    'author_details': {
        'lead_author': 'sarah.asch',
        'supporting_author': 'atuma'
    },
    'title': 'Why stores say Austin book lovers should shop early for holidays',
    'source': 'Austin 360',
    'section': 'Life',
    'release-date': ts,
    'last-updated': None,
    'num_clicks': 821,
    'contains_photos': True,
    'contains_videos': False
}

db.collection('authors').document('sarah.asch').collection('articles').document(ts).set(article)
```

Writing Multiple Documents

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

author = {
    'id': 'sarah.asch',
    'first_name': 'Sarah',
    'last_name': 'Asch',
    'job_title': 'Reporter',
    'seniority': 'L3',
    'hire_date': '2018-01-01',
    'employed_full_time': True,
    'primary_specialty': 'Entertainment',
    'secondary_specialties': ['Business', 'State Government'],
    'articles_to_date': 351,
}

for i in range(399):

    author_ref = db.collection('authors').document('sarah.asch' + str(i))
    batch.set(author_ref, author)

batch.commit()
```

- Write multiple documents as a logical unit of work using a batch
- Batches have atomic property
- Batches can contain documents for multiple collections
- Batches can contain inserts, updates, and delete operations

Reading Single Documents

- The `get` method fetches a single document
- The `stream` method fetches all documents in collection or subcollection
- `stream` + `where` methods filter documents in collection or subcollection
- `order_by` method for sorting results
- `limit` method for limiting number retrieved
- All reads require an index, **query will fail if an index does not exist**

```
1  from google.cloud import firestore
2
3  db = firestore.Client()
4  doc = db.collection('authors').document('sarah.asch').get()
5
6  if doc.exists:
7      print('Document: ' + str(doc.to_dict()))
8  else:
9      print('No such document')
```

Reading Multiple Documents

```python
from google.cloud import firestore
from google.cloud.firestore_v1.base_query import FieldFilter

db = firestore.Client()
authors_ref = db.collection('authors')
query = authors_ref.where(filter=FieldFilter('seniority', '==', 'L3')) \
                   .order_by('last_name').limit(5)
results = query.stream()

for doc in results:
    print(doc.to_dict())
```

```python
from google.cloud import firestore
from google.cloud.firestore_v1.base_query import FieldFilter

db = firestore.Client()
authors_ref = db.collection('authors')
query = authors_ref.where(filter=FieldFilter('secondary_specialties', 'array_contains', 'Business')) \
                   .where(filter=FieldFilter('articles_to_date', '>', 100))
results = query.stream()

for doc in results:
    print(doc.to_dict())
```

Reading Nested Documents

```python
from google.cloud import firestore
from google.cloud.firestore_v1.base_query import FieldFilter

db = firestore.Client()
articles_ref = db.collection('authors').document('sarah.asch').collection('articles')
query = articles_ref.where(filter=FieldFilter('num_clicks', '>', 100))

results = query.stream()

for doc in results:
    print(doc.to_dict())
```

Getting a Document Count

```python
from google.cloud import firestore
from google.cloud.firestore_v1.base_query import FieldFilter
from google.cloud.firestore_v1 import aggregation

db = firestore.Client()
authors_ref = db.collection('authors')
query = authors_ref.where(filter=FieldFilter('seniority', '==', 'L3'))
aggregate_query = aggregation.AggregationQuery(query)
aggregate_query.count()
results = aggregate_query.get()

for result in results:
    print(f"Number of authors who have L3 seniority: {result[0].value}")

```

Updates and Deletes

```
from google.cloud import firestore

db = firestore.Client()
author_ref = db.collection('authors').document('sarah.asch')
author_ref.update({'articles_to_date': firestore.Increment(1), 'seniority': "L4"})
```

```
from google.cloud import firestore

db = firestore.Client()
author_ref = db.collection('authors').document('sarah.asch')
author_ref.update({'articles_to_date': firestore.DELETE_FIELD})
```

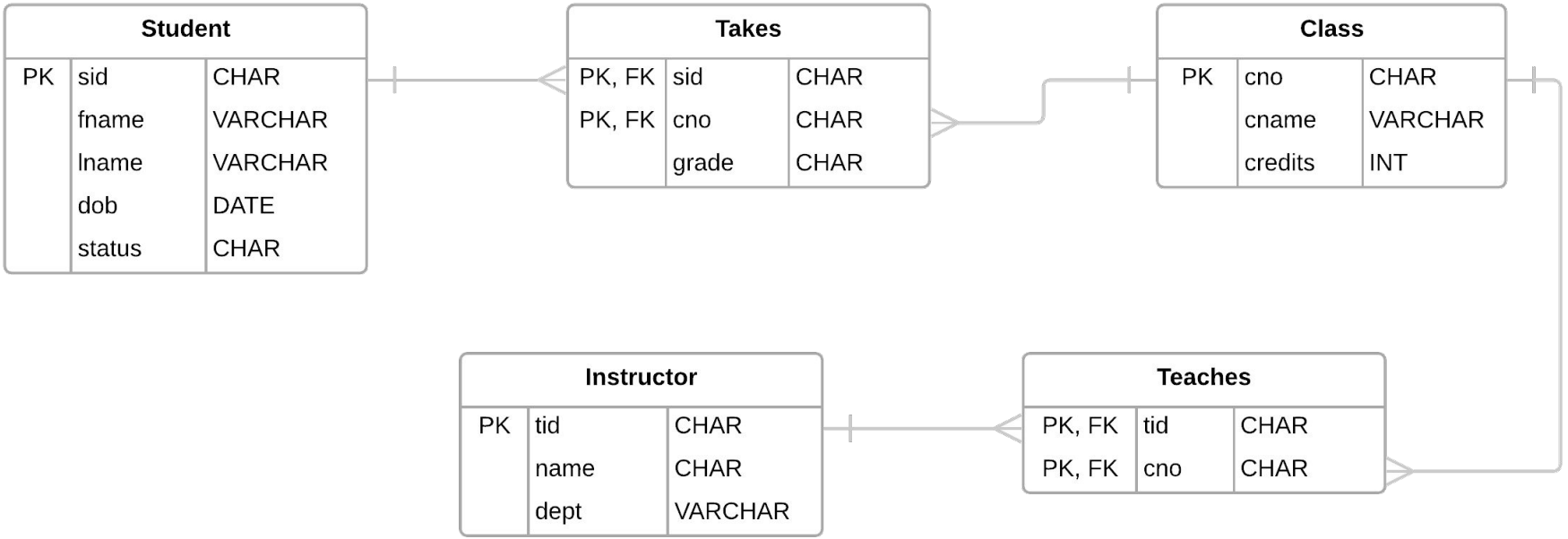
```
from google.cloud import firestore

db = firestore.Client()
db.collection('authors').document('sarah.asch').delete()
```

College Schema

Read access patterns:

1. Get classes by cname
2. Get students and their classes by sid
3. Get instructor and their classes by tid

Convert this relational model to Firestore.



College Schema

Converted relational model to Firestore.

Access patterns:

1. Get classes by cname
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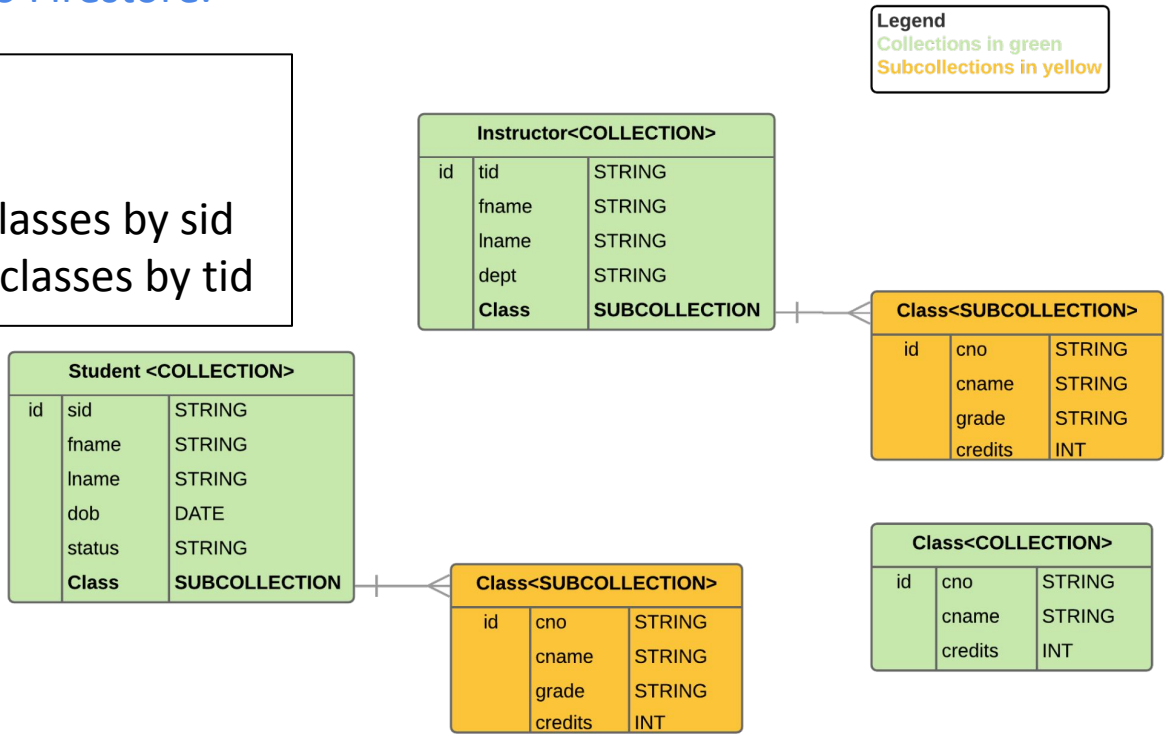


Design Guidelines for Document Databases

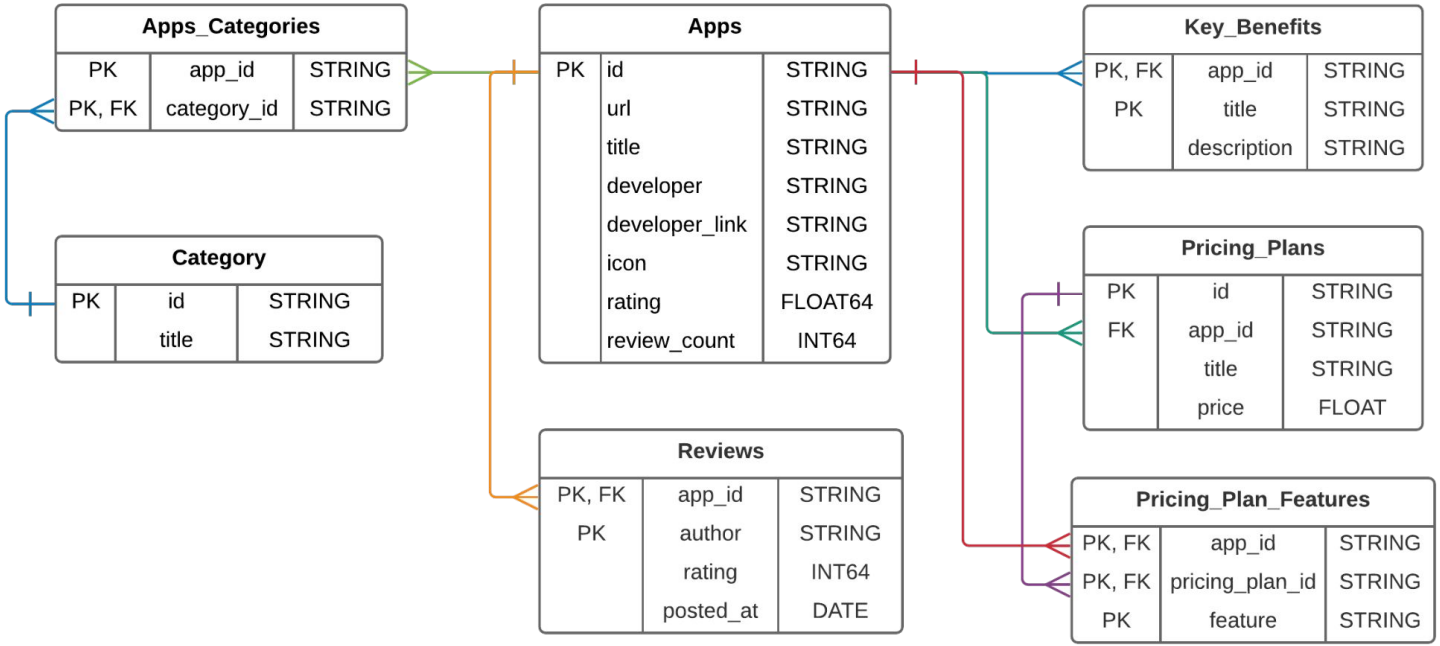
- Identify the expected access patterns against the database.
- For each access pattern, group entities into a hierarchy: *top-level* and *lower-level* types.
- Convert each top-level entity into a Firestore collection.
- Convert each lower-level entity into a Firestore subcollection nested in its parent collection.
- Construct a single unique identifier for each document by using the Primary Key column as is or concatenating multiple Primary Key columns.

Exercise: Data Modeling

Convert Shopify schema to Firestore.

Access patterns:

1. Get apps by category (Category.title)
2. Get apps with highest review_count
3. Get pricing plan details by app (Apps.id)
4. Get key benefits by app (Apps.id)



Firestore Code Lab

- Clone snippets repo
- Open firestore notebook
- Create college database in Firestore
- Practice reading and writing CRUD operations
- Answer two prompts

Project 5

http://www.cs.utexas.edu/~scohen/projects/project-5.pdf