Data Modeling in NoSQL (C*) - Advanced

Big Data Systems

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Happens to the best

- In 2019 Jennifer Aniston joined Instagram and posted a single photo
- 1m followers after 5 hour and 16 minutes from registering
  world record
- More than 7m follower (24 hours)
- More than 9m likes for that photo (24 hours)

- Instagram crashed temporarily

Previously we learned

- Each query should be satisfied by one partition
  denormalization…

videos_by_genre	
genre	K
release_date	▼
video_id	▼

videos_by_id	
video_id	K
release_date	
title	
rating	
duration	
{genres}	

Previously we learned

- Each query should be satisfied by one partition
  denormalization…

videos_by_genre	
genre	K
release_date	▼
video_id	▼

videos_by_id	
video_id	K
release_date	
title	
rating	
duration	
{genres}	

```
SELECT video_id
FROM videos_by_genre
WHERE genre = "action"
```

↓

```
for (video : result){
    SELECT *
    FROM videos_by_id
    WHERE video_id = video
}
```

How many queries can this generate?

Previously we learned

- Each query should be satisfied by one partition
  denormalization…

videos_by_genre	
genre	K
release_date	🔻
video_id	🔻

videos_by_id	
video_id	K
release_date	
title	
rating	
duration	
{genres}	

videos_by_genre	
genre	K
release_date	🔻
video_id	🔻
title	
rating	
duration	

Previously we learned

- Each query should be satisfied by one partition
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videos_by_genre	
genre	K
release_date	▼
video_id	▼

videos_by_id	
video_id	K
release_date	
title	
rating	
duration	
{genres}	

```
SELECT *
FROM videos_by_genre
WHERE genre = "action"
```

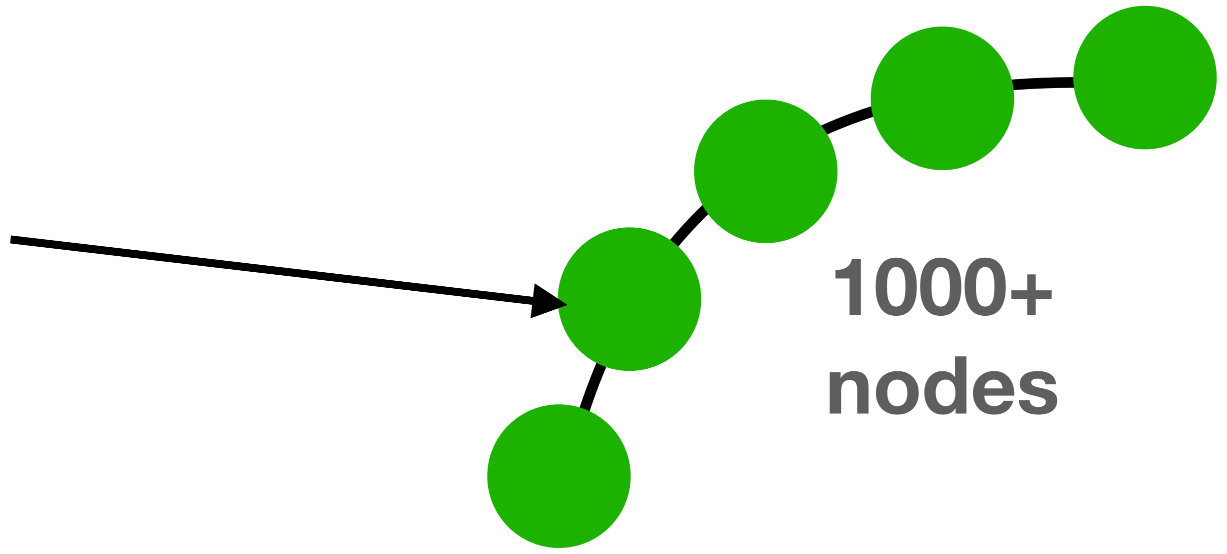
We add ("duplicate") all the attributes we need for the query

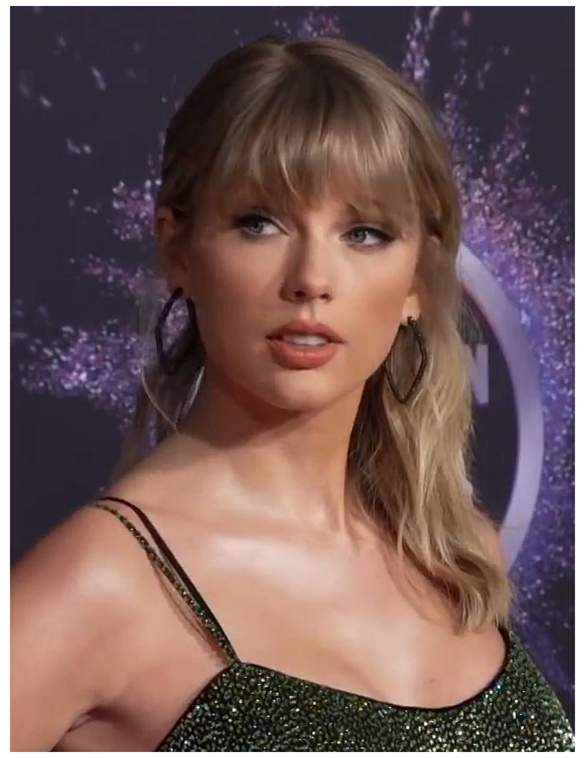
videos_by_genre	
genre	K
release_date	▼
video_id	▼
title	
rating	
duration	

But what happens if the partition is “large”

- There can be more than 10m rows in this partition

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	





* images by Wikipedia

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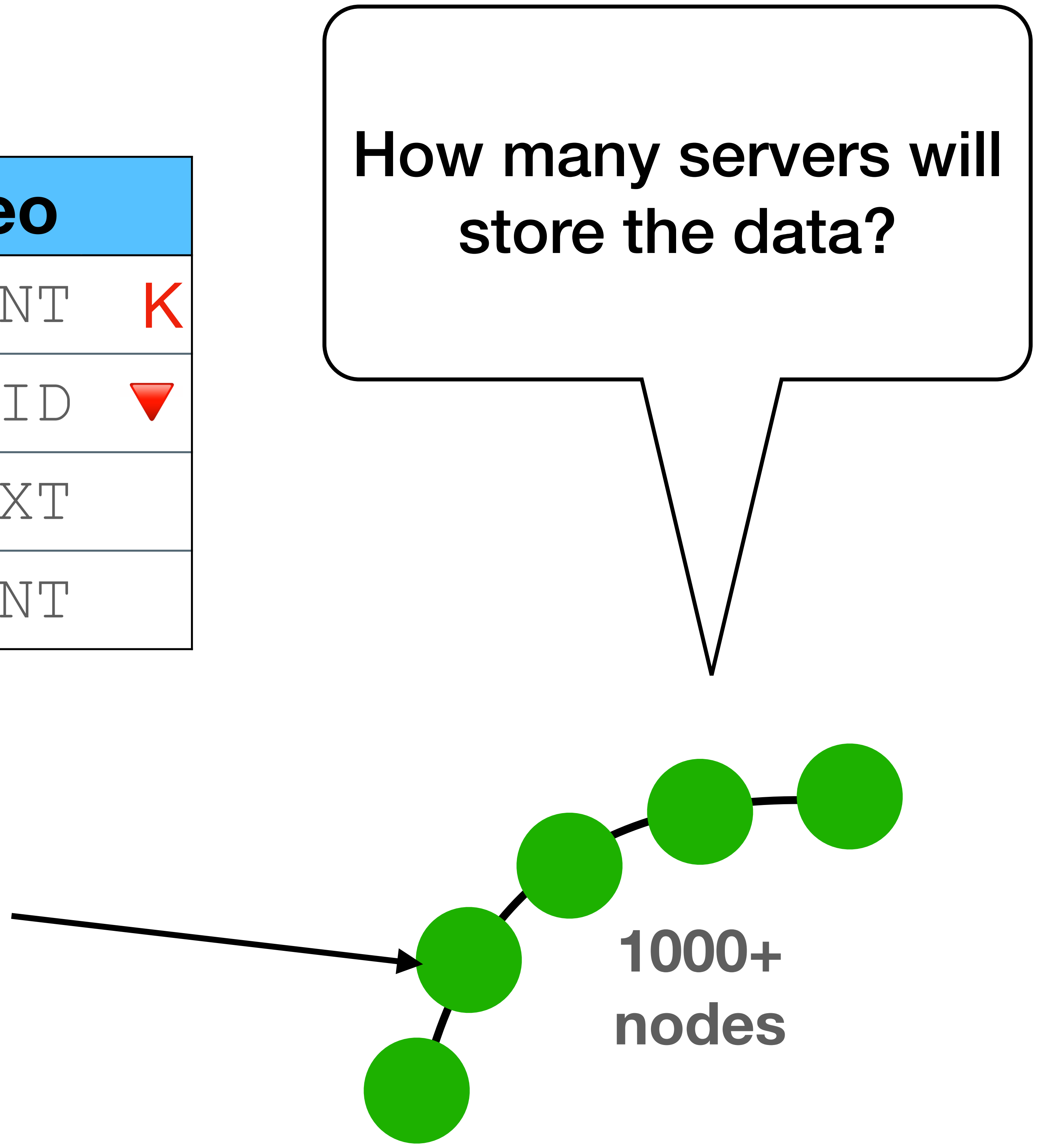
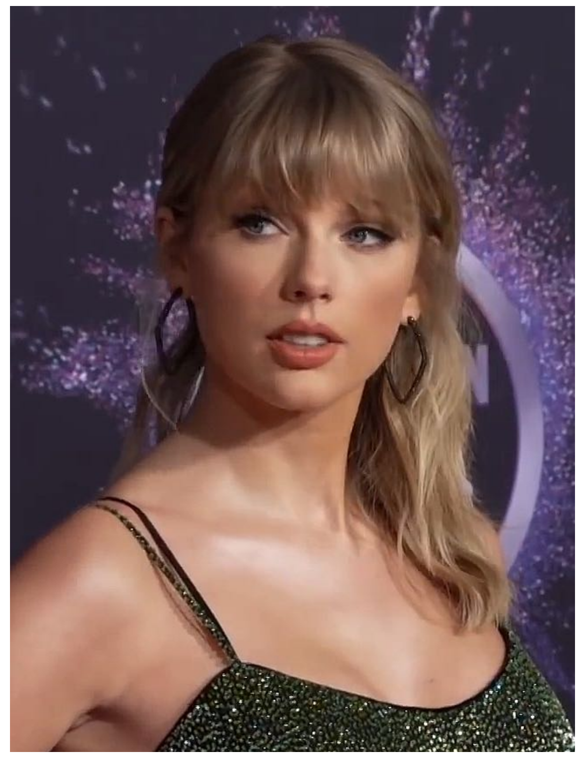
- There can be more than 10m rows in this partition

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	





* images by Wikipedia

Large partitions

- Cause performance issues:
  - compactions are slower
  - queries are slower
  - repairs can fail
  - adding more nodes won’t help
- Can cause hotspots
  more on this later
- Data is not distributed evenly throughout the cluster
- We need to model differently to avoid

Large partitions in Cassandra

- Rule of thumb: partition size < 100MB size / 100k rows

  You can go higher with newer Cassandra versions

- You would need to estimate the size in advance

  Unless you learn the hard way you have a problem

How to avoid large partitions?

- What do you think?

How to avoid large partitions?

- The solution is easy:
  split the data into more partitions

- **When querying, the data is too big anyway for a single call**
  The driver automatically breaks the result into “pages” (default = 5000) even for a single partition

How to avoid large partitions?

- The solution is easy:
  split the data into more partitions

- **When querying, the data is too big anyway for a single call**
  The driver automatically breaks the result into “pages” (default = 5000) even for a single partition

How to split is the name of the game

“Choosing how to partition the data is not trivial,

it is hard.”

What is a good split?

views_by_user		
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
video_id	BIGINT	

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

What is a good split?

This is great as a single user probably won't view over 100k videos

views_by_user		
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
video_id	BIGINT	

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

What is a good split?

This is great as a single user probably won't view over 100k videos

views_by_user		
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
video_id	BIGINT	

Problematic as some videos has more than 10m views

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

What is a good split?

This is great as a single user probably won’t view over 100k videos

views_by_user		
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
video_id	BIGINT	

Problematic as some videos has more than 10m views

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

It depends on the query we need to answer

AND the data distribution

Points to remember when splitting

- Size limit
  large partitions causes performance issues
- Over shrinking
  when querying, it is better to contact 1 partition with 10k rows vs 10k partitions with 1 row
- "Known" partition keys
  when querying, the values of the partition keys are needed
- Hot spots
  undistributed writes/reads causes performance issues
- Tombstones
  too much deletes within a partition causes performance issues

Points to remember when splitting

- Size limit
  large partitions causes performance issues

Points to remember when splitting

- Size limit
  large partitions causes performance issues

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

10m views for a single video

Points to remember when splitting

- Over shrinking

  when querying, it is better to contact 1 partition with 10k rows vs 10k partitions with 1 row

Points to remember when splitting

- Over shrinking

  when querying, it is better to contact 1 partition with 10k rows vs 10k partitions with 1 row

views_by_time		
year	INT	K
month	INT	K
day	INT	K
hour	INT	K
minute	INT	K
view_id	TIMEUUID	▼
video_id	BIGINT	
device	TEXT	
user_id	BIGINT	

A partition for every minute

A partition for every day

views_by_time		
year	INT	K
month	INT	K
day	INT	K
view_id	TIMEUUID	▼
video_id	BIGINT	
device	TEXT	
user_id	BIGINT	

Points to remember when splitting

- Over sh
  when que ... artitions
  with 1 rov

views_b		...	time	
year			INT	K
month			INT	K
day			INT	K
hour			UUID	▼
minute			GINT	
view_id	TI		TEXT	
video_id	I		GINT	
device	TEXT			
user_id	BIGINT			

NOTE

It does not mean you should always partition by day and not by minute.

Sometimes you would need to partition by 12 seconds

remember: **AND the data distribution**

Points to remember when splitting

- "Known" partition keys
  when querying, the values of the partition keys are needed

Points to remember when splitting

- "Known" partition keys
  when querying, the values of the partition keys are needed

views_by_view		
view_id	TIMEUUID	K
video_id	BIGINT	
device	TEXT	
user_id	BIGINT	

How can we know the view_id values?

Points to remember when splitting

- Hot spots
  undistributed writes/reads causes performance issues

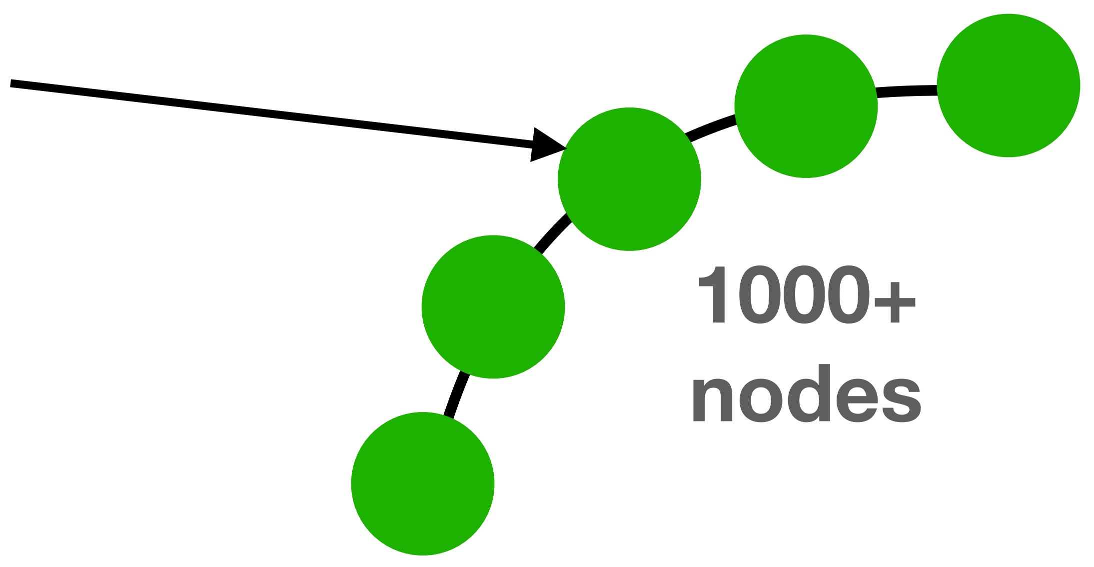
Points to remember when splitting

views_by_time		
year	INT	K
month	INT	K
day	INT	K
view_id	TIMEUUID	▼
video_id	BIGINT	
device	TEXT	
user_id	BIGINT	

- During each day only 1 node handles all the writes
- Assuming a 10k node cluster, 9999 server are unused (CPU & Storage)

- Hot spots

  undistributed writes/reads causes performance issues



Points to remember when splitting

- Tombstones
  too much deletes within a partition causes performance issues

Points to remember when splitting

queues		
queue_name	TEXT	K
task_id	TIMEUUID	▲
task_desc	TEXT	

A queue for managing tasks (FIFO)
Once a task is done, it is deleted from the queue

Recall - during `gc_grace_seconds` (10 days):

- Warnings after 1k tombstones
- Partition crash after 100k tombstones

- Tombstones
  too much deletes within a partition causes performance issues

Again - this is important!

- Size limit
  large partitions causes performance issues
- Over shrinking
  when querying, it is better to contact 1 partition with 10k rows vs 10k partitions with 1 row
- "Known" partition keys
  when querying, the values of the partition keys are needed
- Hot spots
  undistributed writes/reads causes performance issues
- Tombstones
  too much deletes within a partition causes performance issues

Splitting strategies

- You can NOT satisfy all requirements for any strategy

- One is not better or worse than the other
  only more suitable to a specific example and data distribution

- Goal: learn different strategies and match the best model to each different problem

Option 1 - split with existing column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

Option 1 - split with existing column

Note - the query needed is “by video” although we add more partition keys

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

Option 1 - split with existing column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	

vs

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	K
device	TEXT	
user_id	BIGINT	

vs

views_by_video		
video_id	BIGINT	K
device	TEXT	K
view_id	TIMEUUID	▼
user_id	BIGINT	

Option 1 - split with existing column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	

size limit
over shrinking
known partitions
hot spots
tombstones

vs

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	K
device	TEXT	
user_id	BIGINT	

vs

views_by_video		
video_id	BIGINT	K
device	TEXT	K
view_id	TIMEUUID	▼
user_id	BIGINT	

Option 1 - split with existing column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	

- 👍 size limit
- ❌ over shrinking
- ❌ known partitions
- 👍 hot spots
- 👍 tombstones

vs

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	K
device	TEXT	
user_id	BIGINT	

vs

views_by_video		
video_id	BIGINT	K
device	TEXT	K
view_id	TIMEUUID	▼
user_id	BIGINT	

Option 1 - split with existing column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	

- 👍 size limit
- ❌ over shrinking
- ❌ known partitions
- 👍 hot spots
- 👍 tombstones

vs

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	K
device	TEXT	
user_id	BIGINT	

size limit
over shrinking
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tombstones

vs

views_by_video		
video_id	BIGINT	K
device	TEXT	K
view_id	TIMEUUID	▼
user_id	BIGINT	

Option 1 - split with existing column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	

- 👍 size limit
- ❌ over shrinking
- ❌ known partitions
- 👍 hot spots
- 👍 tombstones

vs

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	K
device	TEXT	
user_id	BIGINT	

- 👍 size limit
- ❌ over shrinking
- ❌ known partitions
- 👍 hot spots
- 👍 tombstones

vs

views_by_video		
video_id	BIGINT	K
device	TEXT	K
view_id	TIMEUUID	▼
user_id	BIGINT	

Option 1 - split with existing column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	

- 👍 size limit
- ❌ over shrinking
- ❌ known partitions
- 👍 hot spots
- 👍 tombstones

vs

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	K
device	TEXT	
user_id	BIGINT	

- 👍 size limit
- ❌ over shrinking
- ❌ known partitions
- 👍 hot spots
- 👍 tombstones

vs

views_by_video		
video_id	BIGINT	K
device	TEXT	K
view_id	TIMEUUID	▼
user_id	BIGINT	

- size limit
- over shrinking
- known partitions
- hot spots
- tombstones

Option 1 - split with existing column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
user_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	

- 👍 size limit
- ❌ over shrinking
- ❌ known partitions
- 👍 hot spots
- 👍 tombstones

vs

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	K
device	TEXT	
user_id	BIGINT	

- 👍 size limit
- ❌ over shrinking
- ❌ known partitions
- 👍 hot spots
- 👍 tombstones

vs

views_by_video		
video_id	BIGINT	K
device	TEXT	K
view_id	TIMEUUID	▼
user_id	BIGINT	

- ❌ size limit
- 👍 over shrinking
- 👍 known partitions
- ? hot spots
- ? tombstones

Option 2 - split with artificial (time) column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

Option 2 - split with artificial (time) column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

Option 2 - split with artificial (time) column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

What to do if this partition is not small enough?

Option 2 - split with artificial (time) column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
day	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

Option 2 - split with artificial (time) column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
day	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

We can have the same problem. How can we solve it <u>without the need to change the schema each time</u>?

Option 2 - split with artifi

Assume the time is 2021/12/22 14:54:34:3233

Round the TS before you insert the data

- By year use 2021/01/01 00:00:00:0000
- By month use 2021/12/01 00:00:00:0000
- By day use 2021/12/22 00:00:00:0000
- By hour use 2021/12/22 14:00:00:0000
- By minute use 2021/12/22 14:54:00:0000
- …
- * use GMT=0 to avoid timezones / daylight

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
day	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
ts_partition	TIMESTAMP	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

Option 2 - split with artificial (time) column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
day	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
ts_partition	TIMESTAMP	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

size limit
over shrinking
known partitions
hot spots
tombstones

Option 2 - split with artificial (time) column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
day	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

For most days ok,
except aired date of
new episodes

views_by_video		
video_id	BIGINT	K
ts_partition	TIMESTAMP	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- ? size limit
- ? over shrinking
- 👍 known partitions
- ? hot spots
- ? tombstones

Option 2 - split with artificial (time) column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
year	INT	K
month	INT	K
day	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

views_by_video		
video_id	BIGINT	K
ts_partition	TIMESTAMP	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

Note - “by minute” might be needed for “Game of Thrones” but not for all other 5000 shows

For most days ok, except aired date of new episodes

- ? size limit
- ? over shrinking
- 👍 known partitions
- ? hot spots
- ? tombstones

Option 3 - split with bucket column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

Option 3 - split with bucket column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- Start with bucket 0.
- If more than X (50k?) views, advance to bucket 1
- …

Option 3 - split with bucket column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
bucket	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- Start with bucket 0.
- If more than X (50k?) views, advance to bucket 1
- …

This table will help us “count” the number of view per bucket

views_by_video_buckets		
video_id	BIGINT	K
buckets	INT	▼
views	COUNTER	++

Option 3 - split with bucket column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
bucket	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- Start with bucket 0.
- If more than X (50k?) views, advance to bucket 1
- …

size limit
over shrinking
known partitions
hot spots
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views_by_video_buckets		
video_id	BIGINT	K
buckets	INT	▼
views	COUNTER	++

This table will help us “count” the number of view per bucket

Option 3 - split with bucket column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
bucket	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- Start with bucket 0.
- If more than X (50k?) views, advance to bucket 1
- …

👍 size limit
👍 over shrinking
👍 known partitions
? hot spots
👍 tombstones

Great option,
but not trivial to maintain the logic on the backend

This table will help us "count" the number of view per bucket

views_by_video_buckets		
video_id	BIGINT	K
buckets	INT	▼
views	COUNTER	++

Pros

- Guaranteed max size
- Can grow without a limit
- When queuing - optimized for the number of calls
  - we do not have "small" partitions
- Ordered by TS across all partitions (only if we always add "new" data)

Cons

- If we add "old" data, the TS is NOT ordered across all partitions
- We can NOT "find" a specific event as we do not know on which partition the data is saved
  in the example - we can NOT know if a specific view_id exists without reading all partitions

bucket column

deo	
GINT	K
UUID	▼
TEXT	
GINT	

ideo	
IGINT	K
INT	K
EUUID	▼
TEXT	
IGINT	

_buckets		
	BIGINT	K
buckets	INT	▼
views	COUNTER	++

- 👍 size limit
- 👍 over shrinking
- 👍 known partitions
- ? hot spots
- 👍 tombstones

Great option,
but not trivial to maintain the logic on the backend

Option 4 - split with partition column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

Option 4 - split with partition column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

- Decide on max partition size (1000?)

- Use a “hash function” to distribute the data evenly across the partition

Option 4 - split with partition column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
partition	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- Decide on max partition size (1000?)
- Use a “hash function” to distribute the data evenly across the partition

Option 4 - split with partition column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
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⬇

views_by_video		
video_id	BIGINT	K
partition	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- Decide on max partition size (1000?)
- Use a “hash function” to distribute the data evenly across the partition
- For example modulo:

```
partition =
user_id % 1000
```

Option 4 - split with partition column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
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views_by_video		
video_id	BIGINT	K
partition	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- Decide on max partition size (1000?)
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- For example modulo:
  `partition = user_id % 1000`

Data is distributed evenly

Option 4 - split with partition column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
partition	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

size limit
over shrinking
known partitions
hot spots
tombstones

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view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

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👍 size limit
? over shrinking
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👍 tombstones

Not all videos need the same partition size

Option 4 - split with partition column

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
partition	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

What about the order of the data?

- 👍 size limit
- ? over shrinking
- 👍 known partitions
- 👍 hot spots
- 👍 tombstones

Not all videos need the same partition size

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views_by_video		
video_id	BIGINT	K
partition	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- Decide on max partition size (1000?)
- Use a "hash function" to distribute the data evenly across the partition
- For example modulo:

```
partition =
user_id % 1000
```

When we read the data, it is NOT ordered by the "global" view_id, but per partition.

Can (maybe) cause logic problems for the client

- 👍 size limit
- ? over shrinking
- 👍 known partitions
- 👍 hot spots
- 👍 tombstones

Not all videos need the same partition size

Option 5 - combo (variable partition size)

views_by_video		
video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

Option 5 - combo (variable partition size)

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view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- Variable max partition size per video

- Use a “hash function” to distribute the data evenly across the partition (with special logic)

Option 5 - combo (variable partition size)

views_by_video		
video_id	BIGINT	K
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device	TEXT	
user_id	BIGINT	

⬇

views_by_video		
video_id	BIGINT	K
partition	INT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

- Variable max partition size per video

- Use a "hash function" to distribute the data evenly across the partition (with special logic)

views_by_video_paritions		
video_id	BIGINT	K
partitions_total	INT	

"Normal" videos:

```
partition_total = -1
```

"Popular" videos:

```
partition_total = user_id % 1000
```

Option 5 - combo (variable partition size)

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video_id	BIGINT	K
view_id	TIMEUUID	▼
device	TEXT	
user_id	BIGINT	

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views_by_video		
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partition	INT	K
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size limit
over shrinking
known partitions
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partition	INT	K
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device	TEXT	
user_id	BIGINT	

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partitions_total	INT	

- Variable max partition size per video
- Use a "hash function" to distribute the data evenly across the partition (with special logic)

A logic is required to set the right partitions_total for each video

- 👍 size limit
- 👍 over shrinking
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user_id	BIGINT	

views_by_video_paritions		
video_id	BIGINT	K
partitions_total	INT	

Discussion - why did we chose “-1” for “normal” users and not “0”

A logic is required to set the right partitions_total for each video

- 👍 size limit
- 👍 over shrinking
- 👍 known partitions
- 👍 hot spots
- 👍 tombstones

“Normal” videos:

```
partition_total = -1
```

“Popular” videos:

```
partition_total = user_id % 1000
```

riable partition size)

We want to support the option to “transition” state from “normal” to “poplar”

—> we need to use “different” partitions for each state in order to “reinsert” the data on “transition”

“Normal” videos:

```
partition_total = -1
```

“Popular” videos:

```
partition_total = user_id % 1000
```

“Super popular” videos:

```
partition_total = 10000 + (user_id % 10000)
```

	EXT	
	INT	

deo		
	GINT	K
	INT	K
	UUID	
	TEXT	
	GINT	

- distribute the data evenly across the partition (with special logic)

Discussion - why did we chose “-1” for “normal” users and not “0”

A logic is required to set the right partitions_total for each video

- size limit
- over shrinking
- known partitions
- hot spots
- tombstones

views_by_video_paritions		
video_id	BIGINT	K
partitions_total	INT	

“Normal” videos:

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riable partition size)

We want to support the option to “transition” state from “normal” to “poplar”

—> we need to use “different” partitions for each state in order to “reinsert” the data on “transition”

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partition_total = -1
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“Popular” videos:

```
partition_total = user_id % 1000
```

“Super popular” videos:

```
partition_total = 10000 + (user_id % 10000)
```

Discussion - why did we chose “-1” for “normal” users and not “0”

A logic is required to set the right partitions_total for each video

- 👍 size limit
- 👍 over shrinking
- 👍 known partitions
- 👍 hot spots
- 👍 tombstones

ID	
EXT	
INT	

deo		
GINT	K
INT	K
UUID	▼
TEXT	
GINT	

distribute the data evenly across the partition (with special logic)

views_by_video_paritions		
video_id	BIGINT	K
partitions_total	INT	

“Normal” videos:

```
partition_total = -1
```

“Popular” videos:

```
partition_total = user_id % 1000
```

Why did Instagram crushed?

- Instagram has different write paths for “top users”
  that is, different **data models** and different **app logic**
- There is an application logic that transition a user from a “regular” user to a “top user”
- **The (regular) data model used did not scaled**

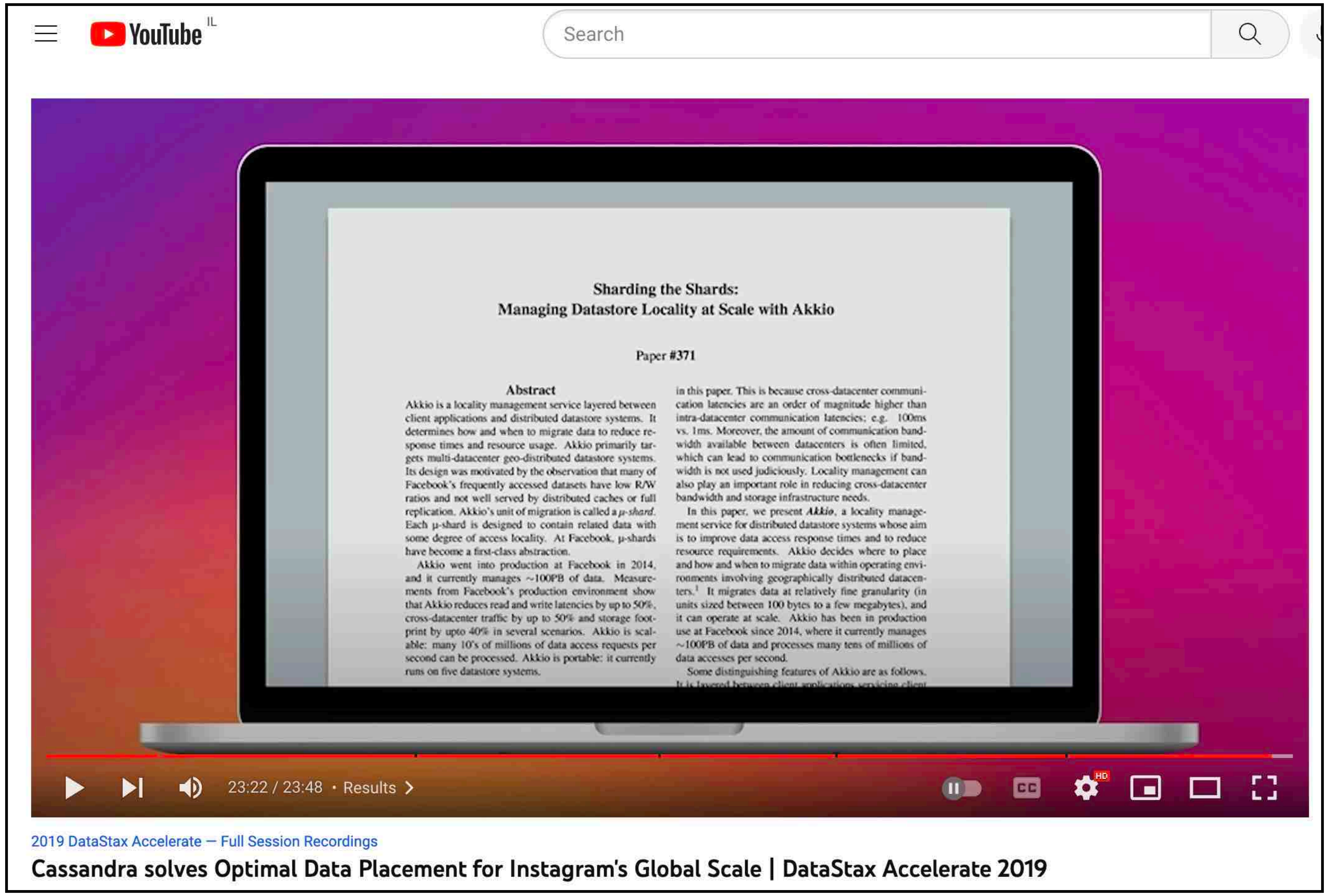
*1 - speculation

*2 - more info on “data modeling examples”

Splitting strategies - reminder

- One is not better or worse than the other
  only more suitable to a specific example and data distribution

When sharing is not enough…



Only if you are a “data nerd”..

https://www.youtube.com/watch?v=Sr0sX-TId-g