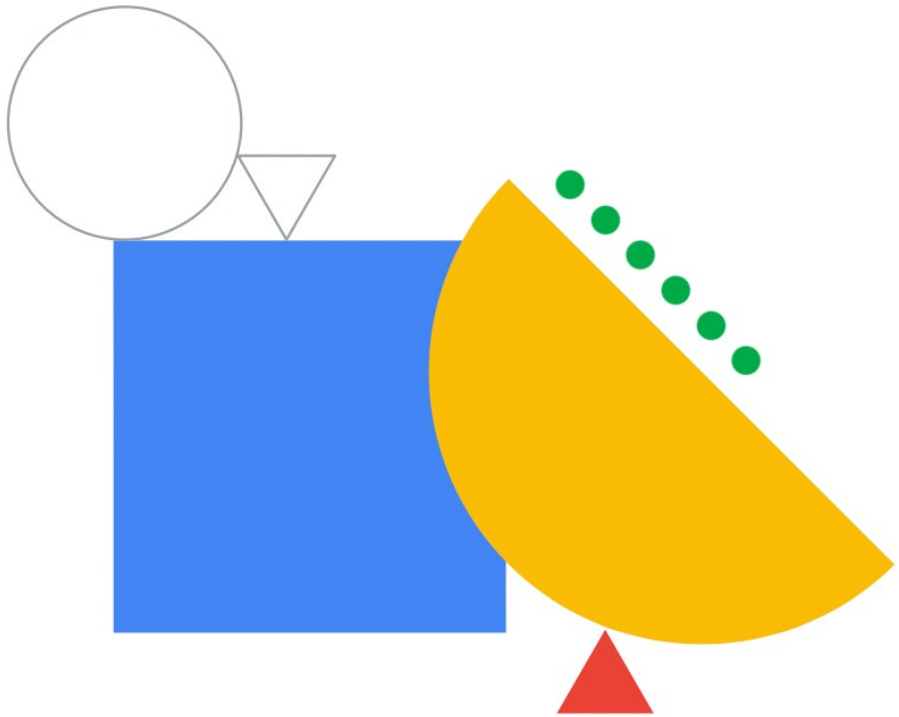
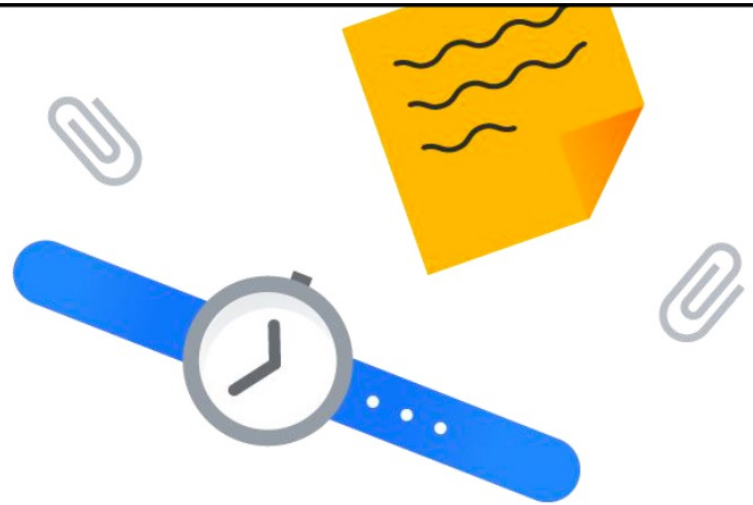
Google Cloud

# High-Throughput BigQuery and Bigtable Streaming Features





# Module agenda

01 Streaming into BigQuery and Visualizing Results

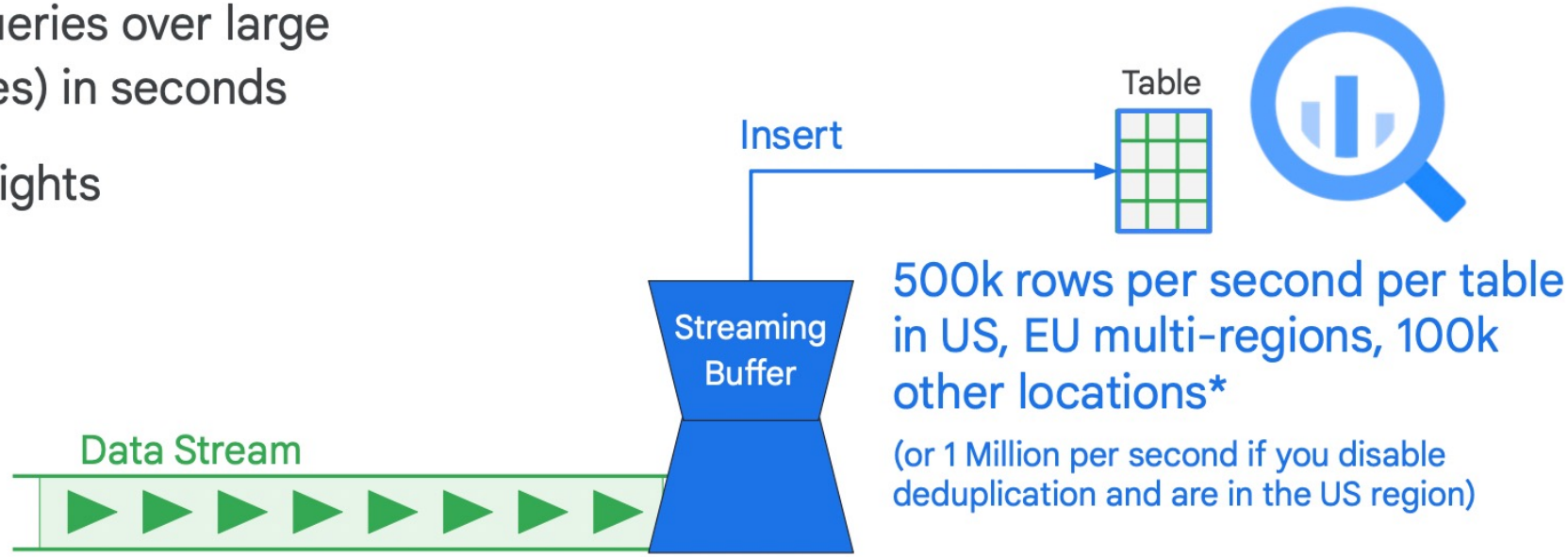
02 High-Throughput Streaming with Cloud Bigtable

03 Optimizing Cloud Bigtable Performance


# Streaming into BigQuery and Visualizing Results

# BigQuery allows you to stream records into a table; query results incorporate latest data

- Interactive SQL Queries over large datasets (petabytes) in seconds
- Near-real-time insights




500k rows per second per table in US, EU multi-regions, 100k other locations*

(or 1 Million per second if you disable deduplication and are in the US region)

**Note:**
Unlike load jobs, there is a cost for streaming inserts (see **quota and limits**)

# Insert streaming data into a BigQuery table

```
export GOOGLE_APPLICATION_CREDENTIALS="/home/user/Downloads/[FILE_NAME].json"
```

Credentials

The service must have Cloud IAM permissions set in the Web UI

```
pip install google-cloud-bigquery
```

Install API

Python

```
from google.cloud import bigquery
client = bigquery.Client(project='PROJECT_ID')

dataset_ref = bigquery_client.dataset('my_datasset_id')
table_ref = dataset_ref.table('my_table_id')
table = bigquery_client.get_table(table_ref)

# read data from Cloud Pub/Sub and place into row format
# static example customer orders in units:
rows_to_insert = [
    (u'customer 1', 5),
    (u'customer 2', 17),
    ]
errors = bigquery_client.insert_rows(table, rows_to_insert)
```

Get table access from API

Create a client

Access dataset and table

Insert rows into table

Perform insert

# Review streaming data in BigQuery

Query editor

```
1 select * from cloud-training-demos.demos.current_conditions;
```

Run | Save query | Save view | Schedule query | More

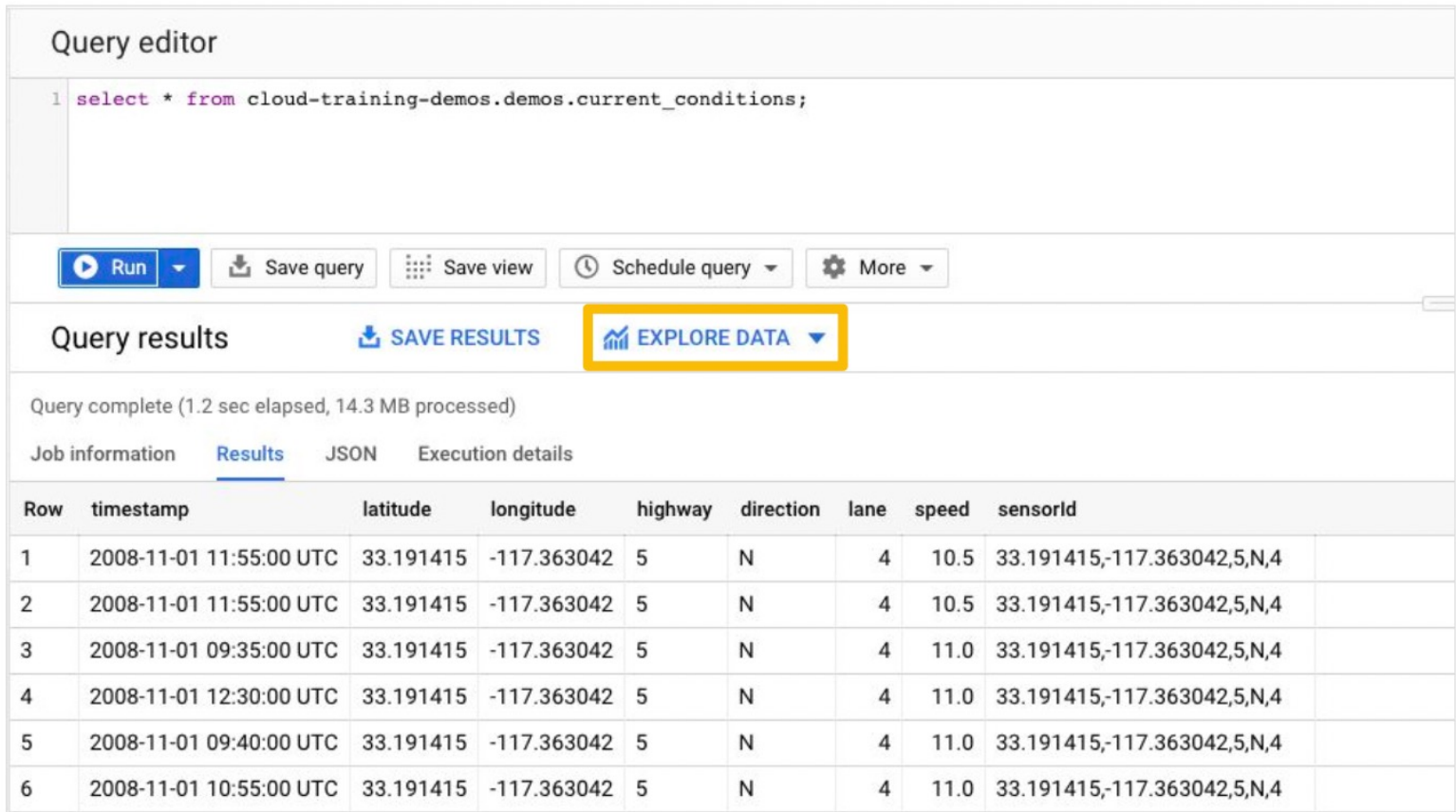
Query results | SAVE RESULTS | EXPLORE DATA

Query complete (1.2 sec elapsed, 14.3 MB processed)

Job information | Results | JSON | Execution details

| Row | timestamp | latitude | longitude | highway | direction | lane | speed | sensorId |
|---|---|---|---|---|---|---|---|---|
| 1 | 2008-11-01 11:55:00 UTC | 33.191415 | -117.363042 | 5 | N | 4 | 10.5 | 33.191415,-117.363042,5,N,4 |
| 2 | 2008-11-01 11:55:00 UTC | 33.191415 | -117.363042 | 5 | N | 4 | 10.5 | 33.191415,-117.363042,5,N,4 |
| 3 | 2008-11-01 09:35:00 UTC | 33.191415 | -117.363042 | 5 | N | 4 | 11.0 | 33.191415,-117.363042,5,N,4 |
| 4 | 2008-11-01 12:30:00 UTC | 33.191415 | -117.363042 | 5 | N | 4 | 11.0 | 33.191415,-117.363042,5,N,4 |
| 5 | 2008-11-01 09:40:00 UTC | 33.191415 | -117.363042 | 5 | N | 4 | 11.0 | 33.191415,-117.363042,5,N,4 |
| 6 | 2008-11-01 10:55:00 UTC | 33.191415 | -117.363042 | 5 | N | 4 | 11.0 | 33.191415,-117.363042,5,N,4 |

# Want to visualize insights? Explore Google Data Studio insights right from within BigQuery




| Row | timestamp | latitude | longitude | highway | direction | lane | speed | sensorId |
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| 1 | 2008-11-01 11:55:00 UTC | 33.191415 | -117.363042 | 5 | N | 4 | 10.5 | 33.191415,-117.363042,5,N,4 |
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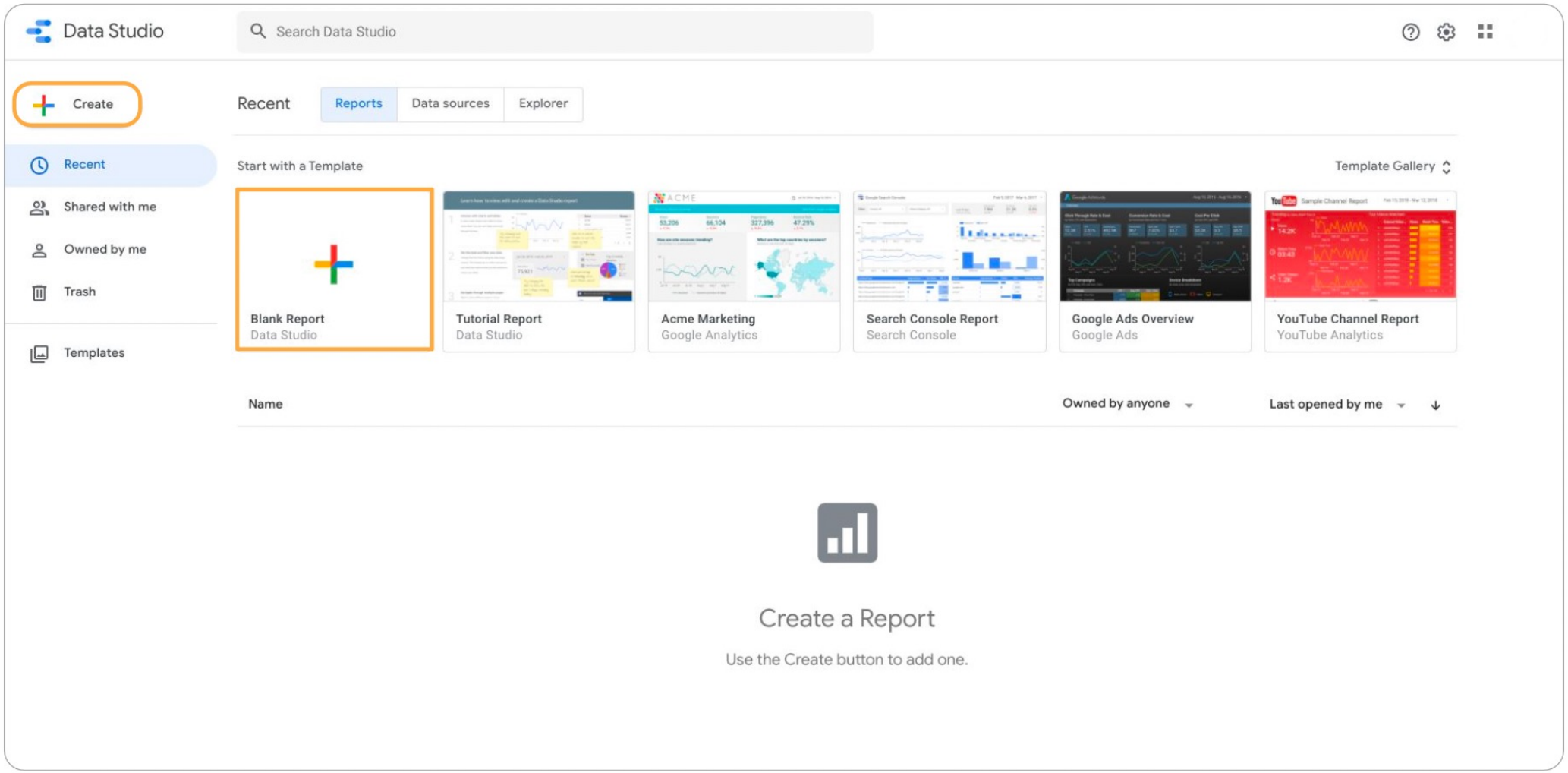
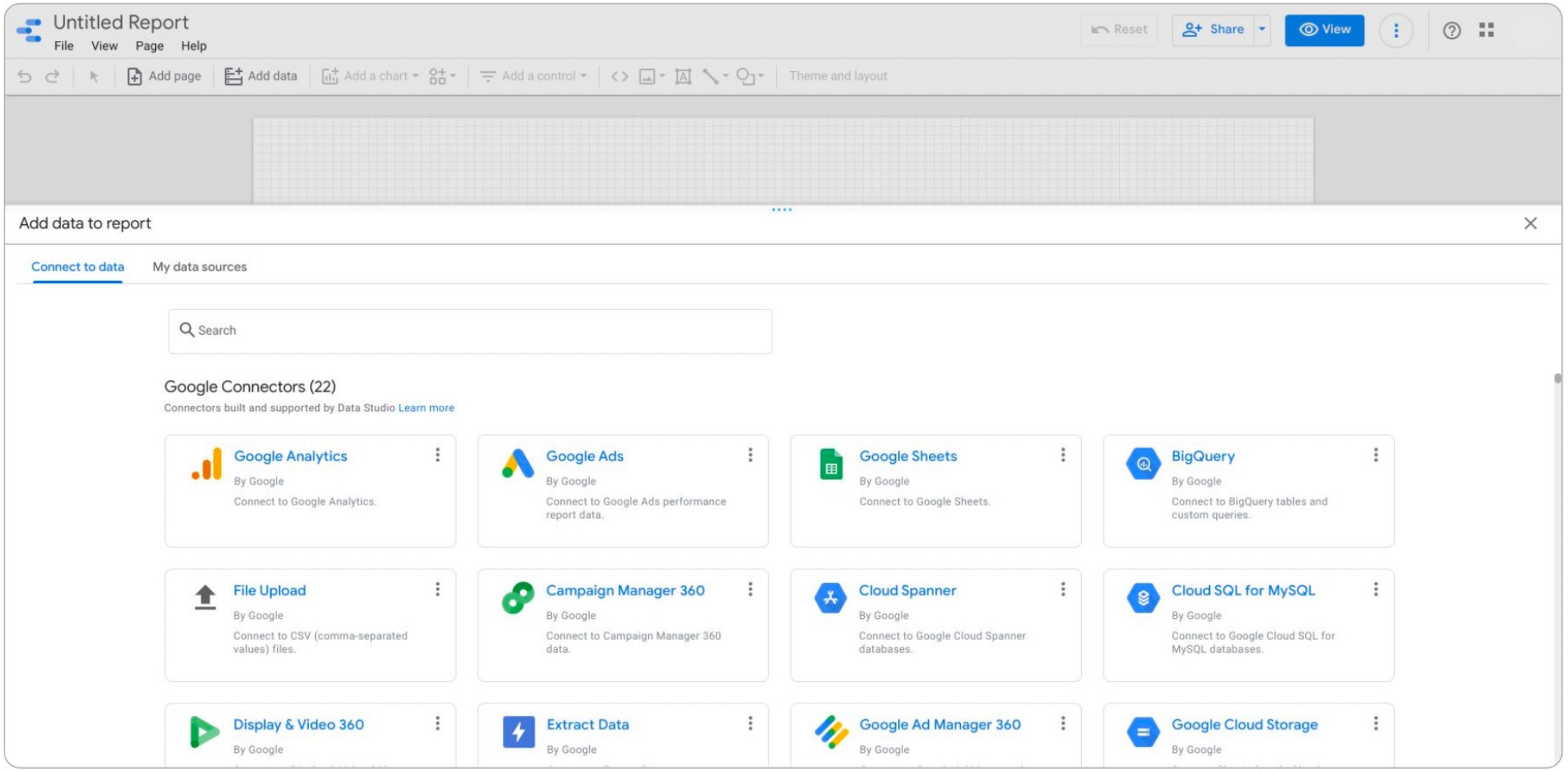
| 6 | 2008-11-01 10:55:00 UTC | 33.191415 | -117.363042 | 5 | N | 4 | 11.0 | 33.191415,-117.363042,5,N,4 |

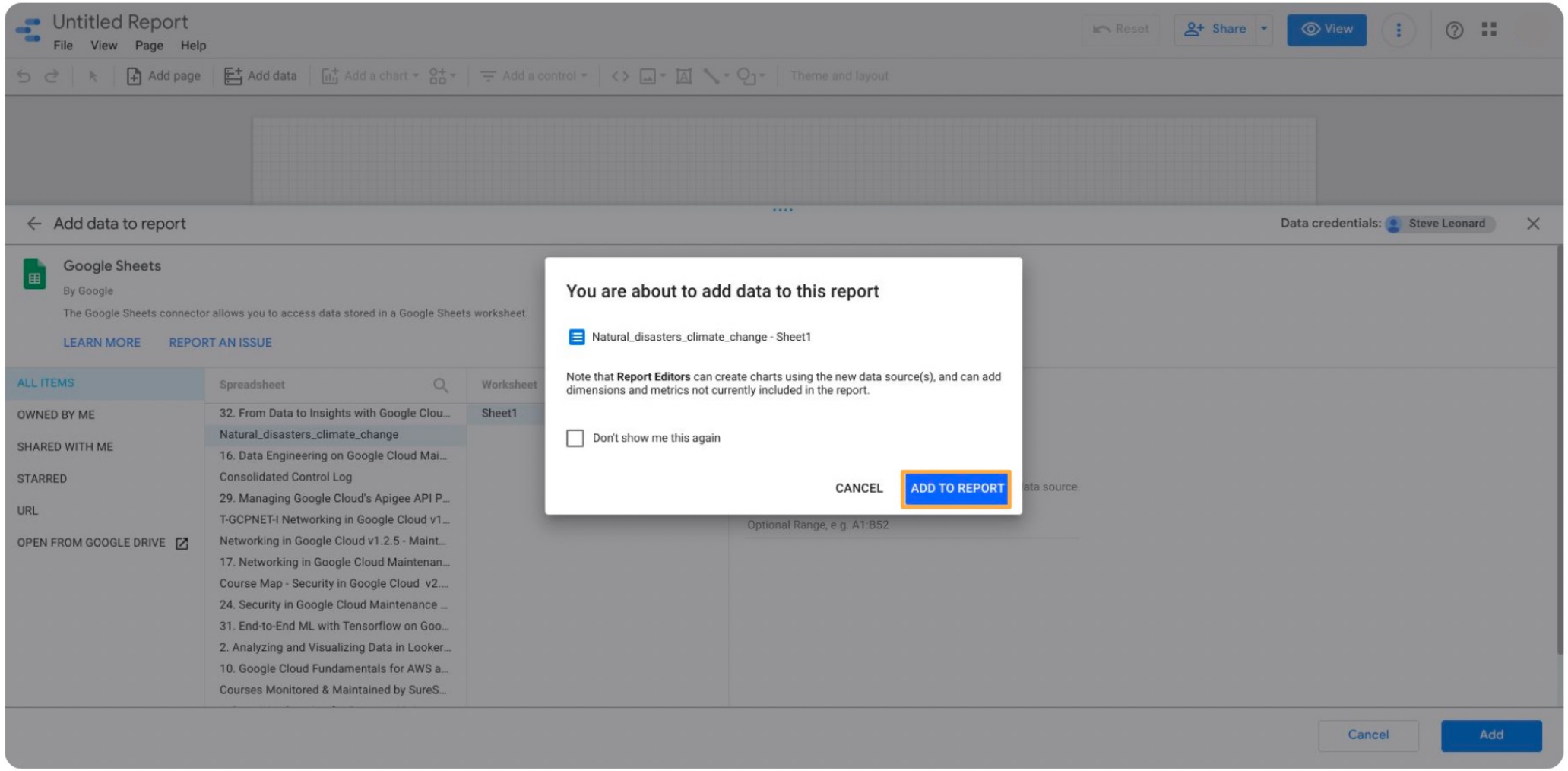
# Create new reports in the Data Studio UI



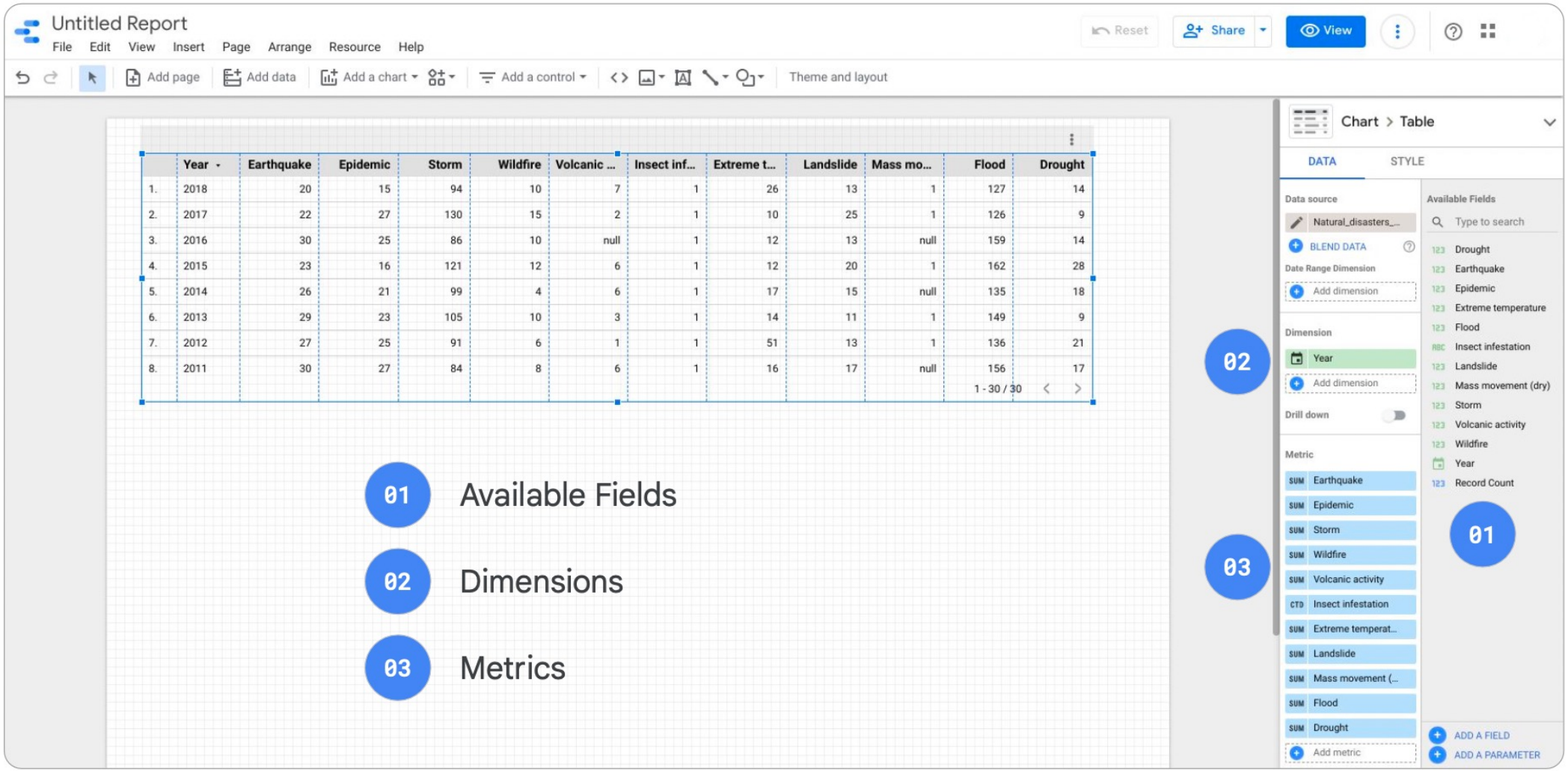
# Connect to multiple different types of data sources



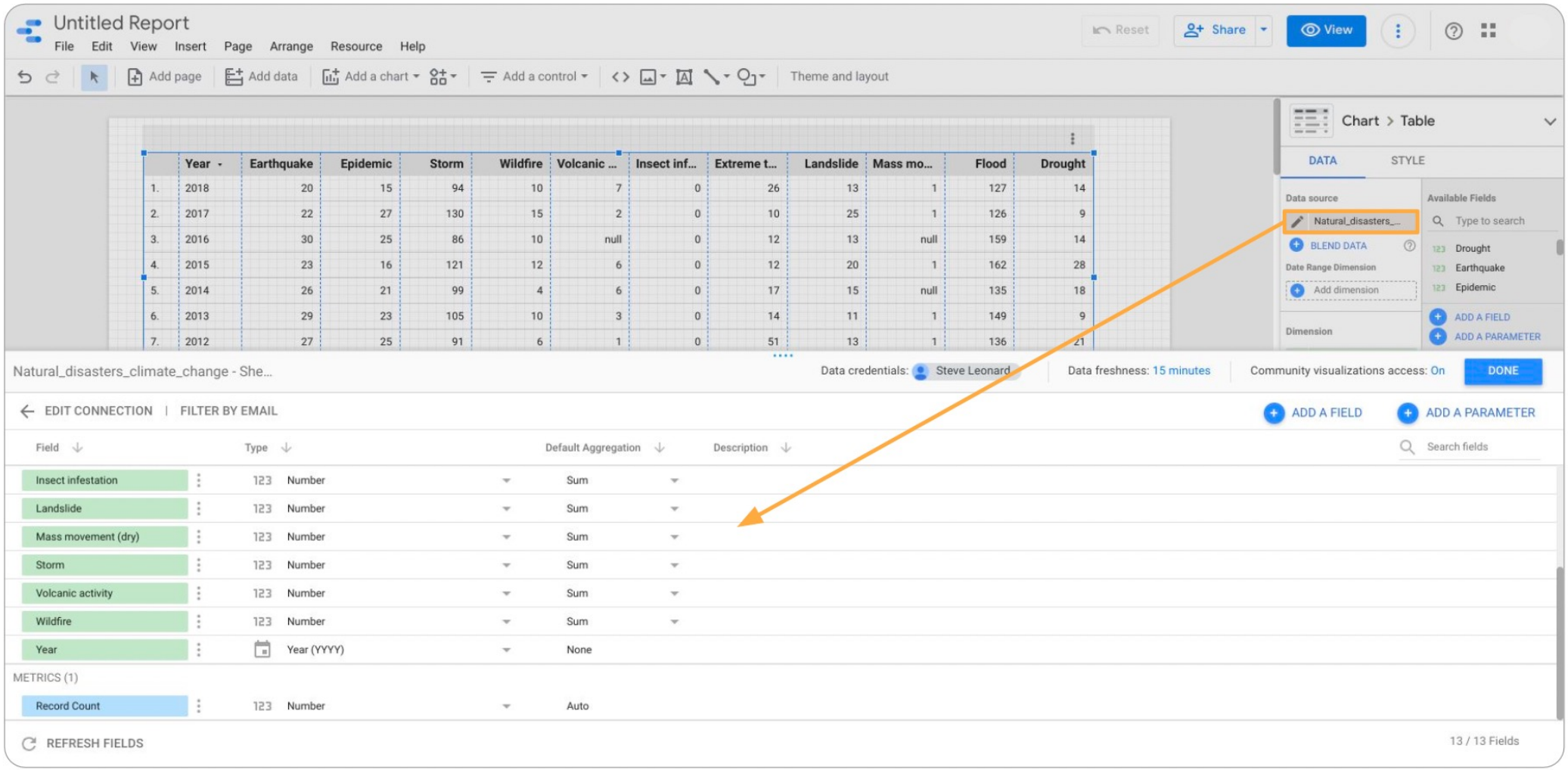
# Add the data source to your report



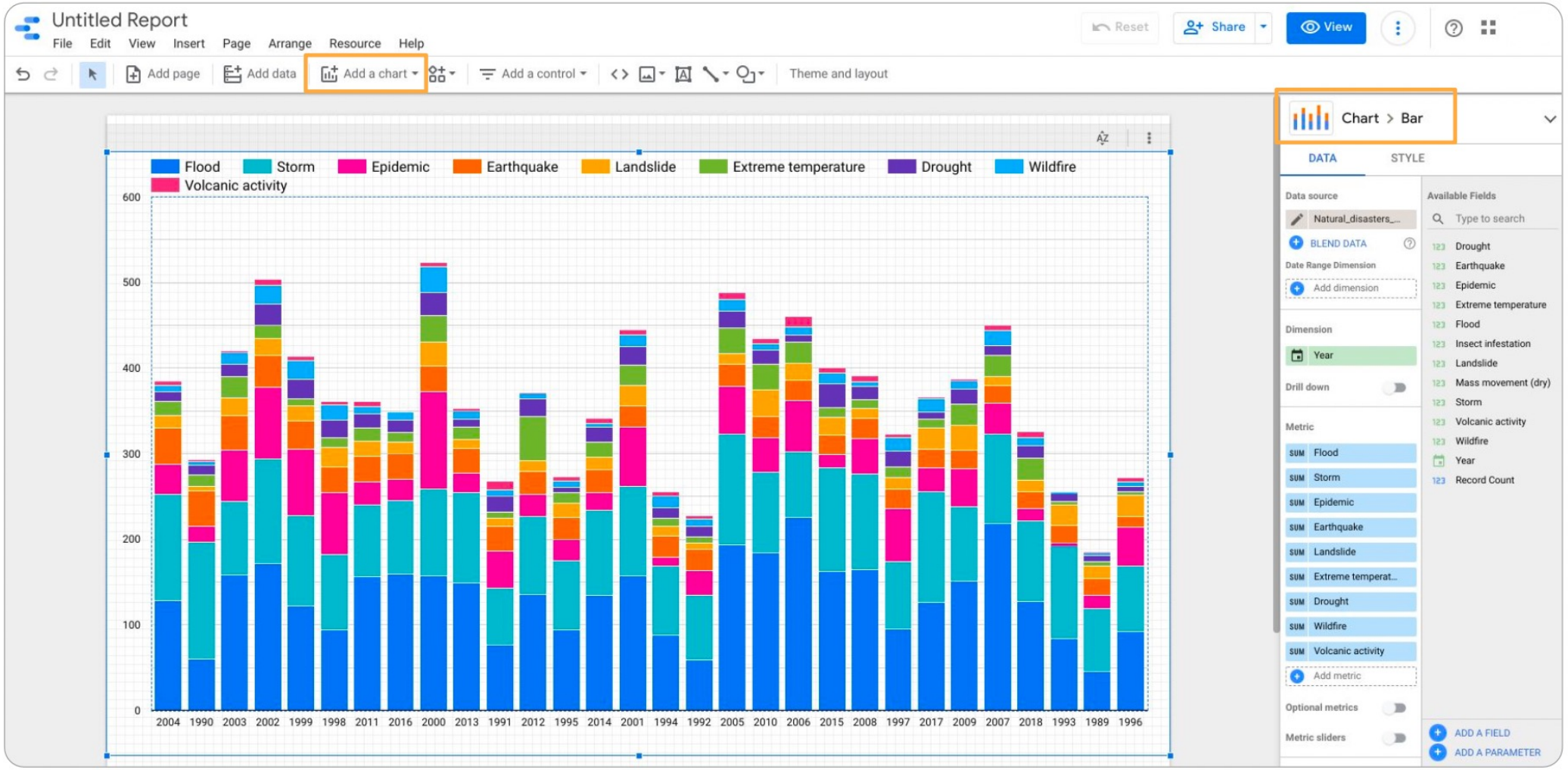
# Select your data fields to build your visualizations



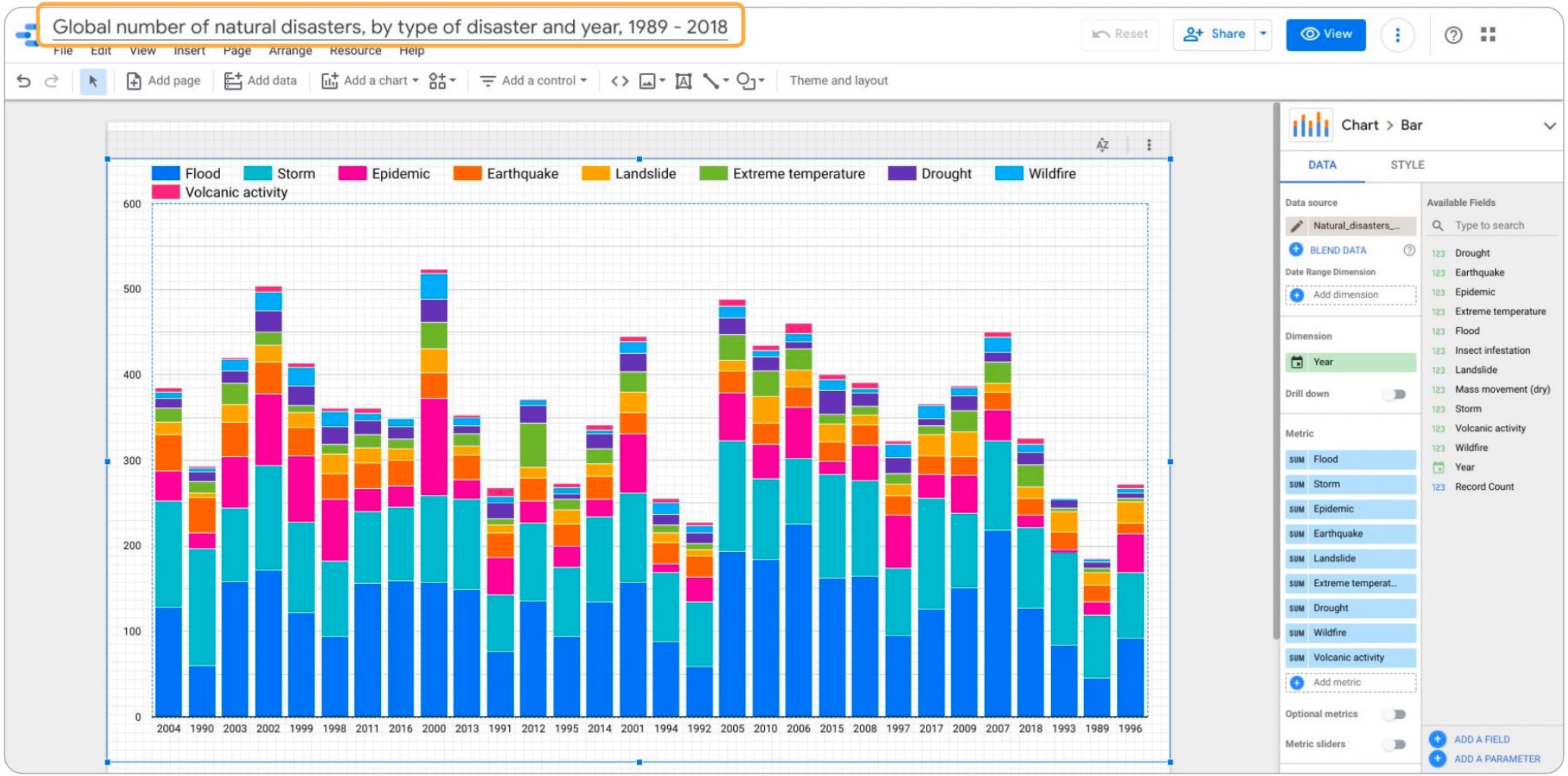
# Edit your data source fields, if necessary



# Create charts to visualize data relationships

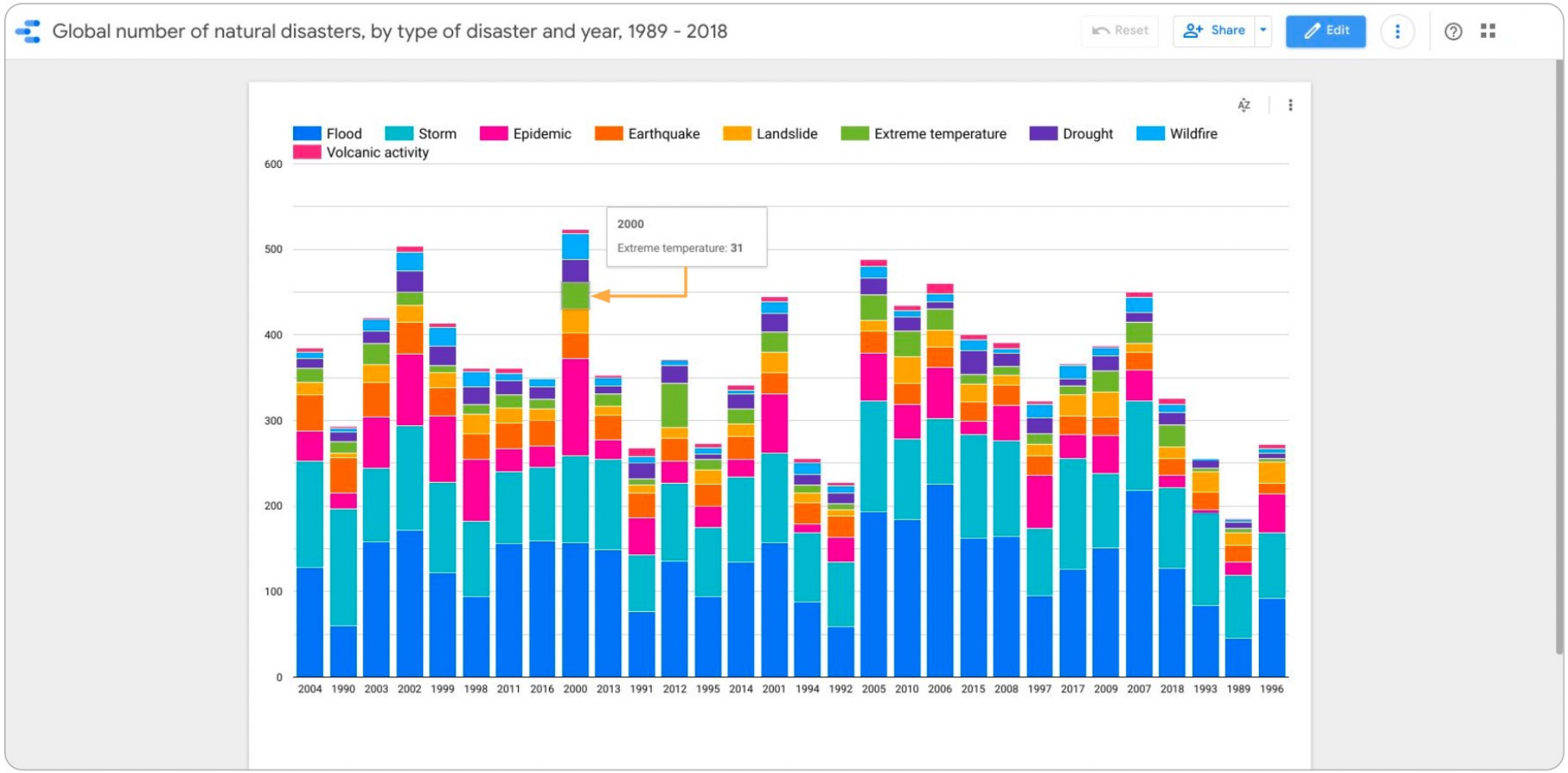


# Add a descriptive name to your report



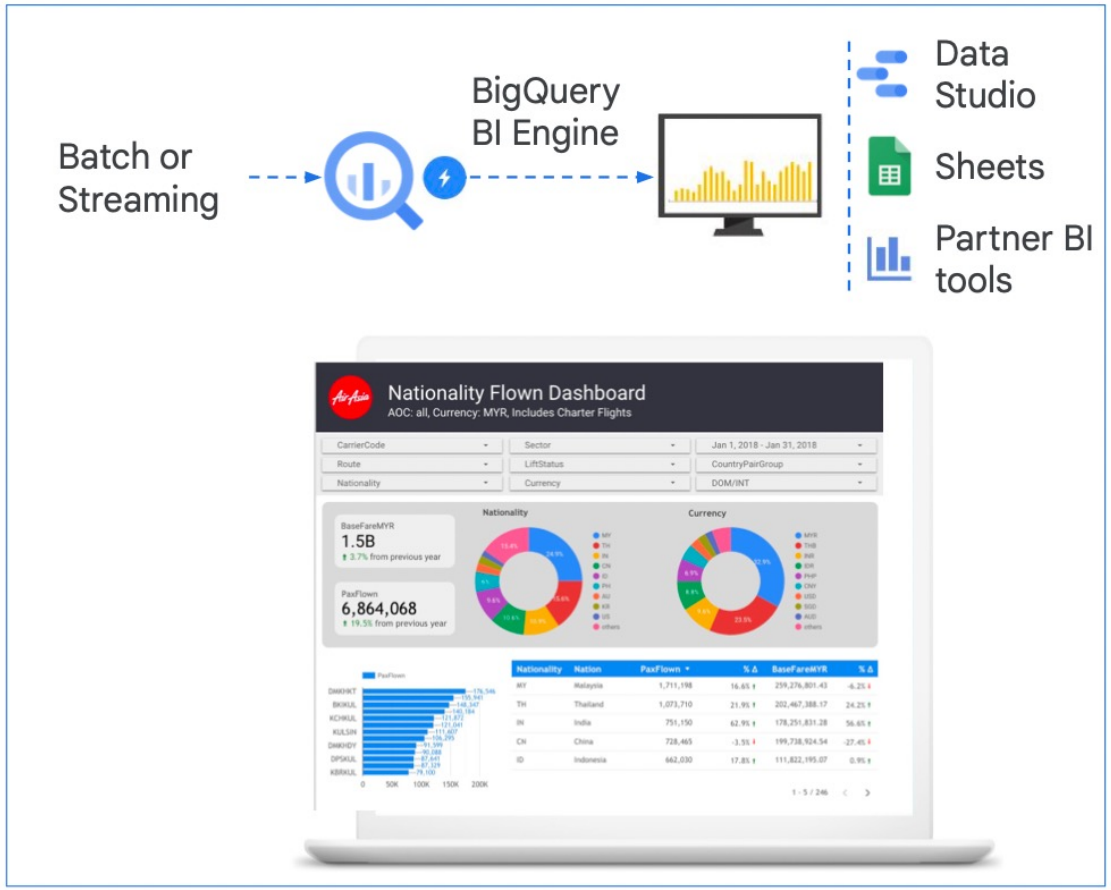
# View the end-user version of the report

# View your report as an end-user



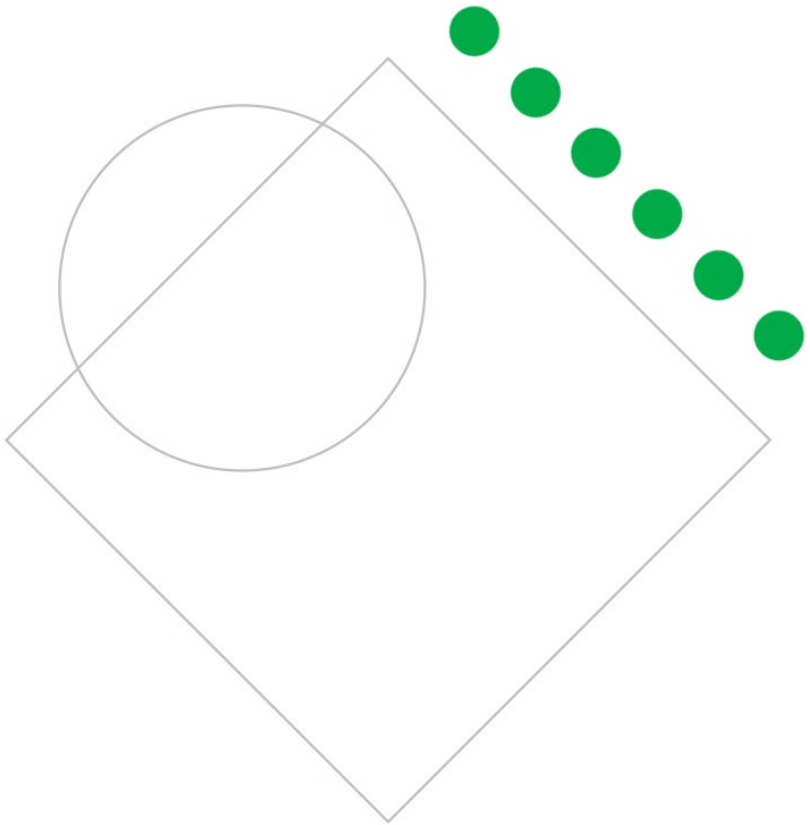
# Add value: BI Engine for dashboard performance

- No need to manage OLAP cubes or separate BI servers for dashboard performance.
- Natively integrates with BigQuery streaming for real-time data refresh.
- Column oriented in-memory BI execution engine.



# Lab Intro

Streaming Data Processing:
Streaming Analytics and Dashboards




# High-Throughput Streaming with Cloud Bigtable

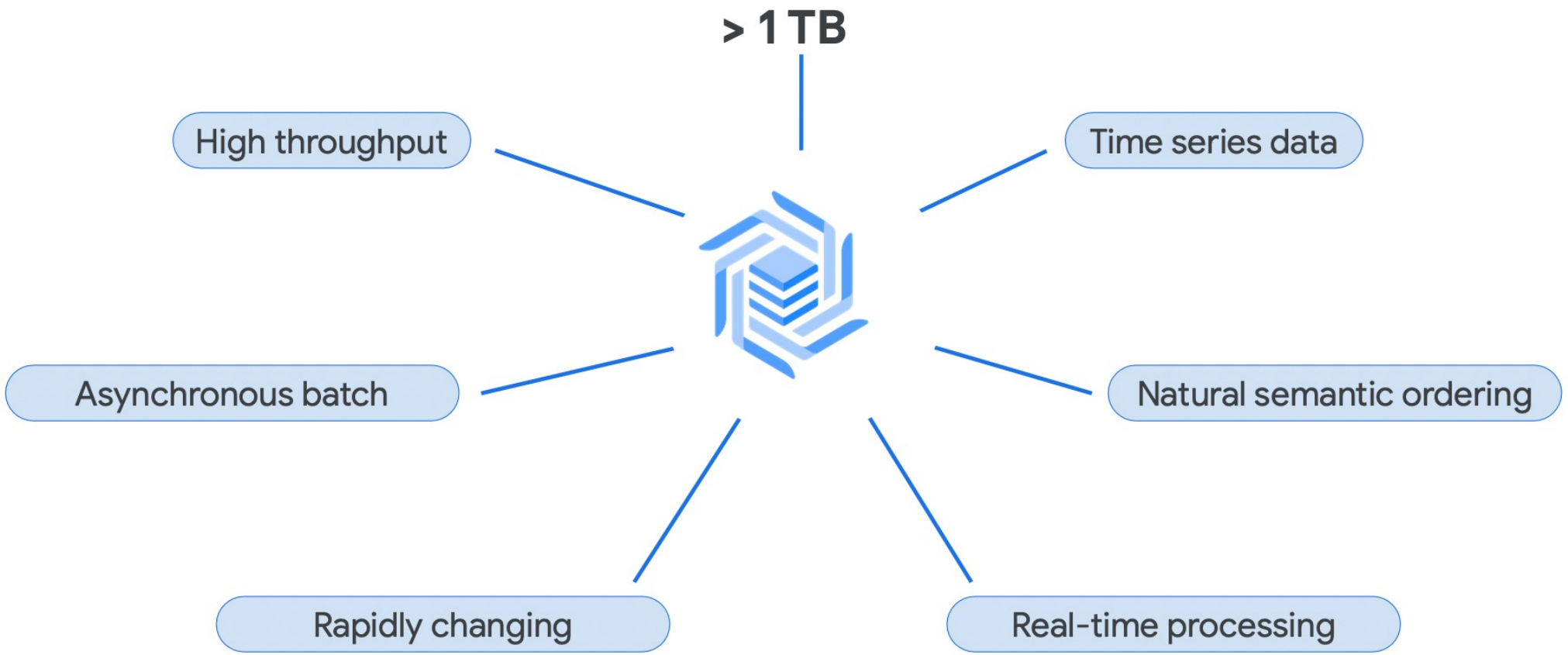
# Cloud Bigtable

Qualities that Bigtable contributes to data engineering solutions:

- NoSQL Queries over large datasets (petabytes) in milliseconds
- Very fast for specific cases

# How to choose between Bigtable and BigQuery

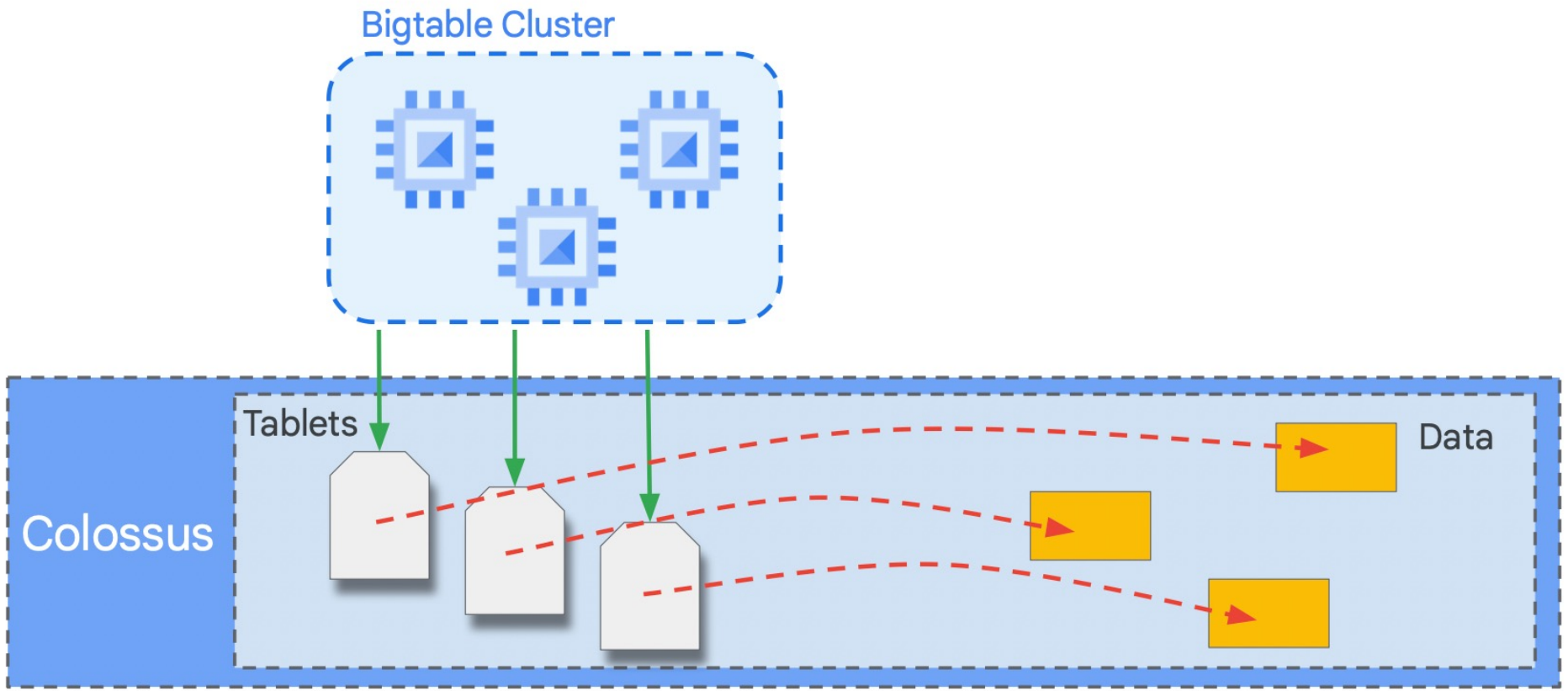
# Consider Bigtable for these requirements



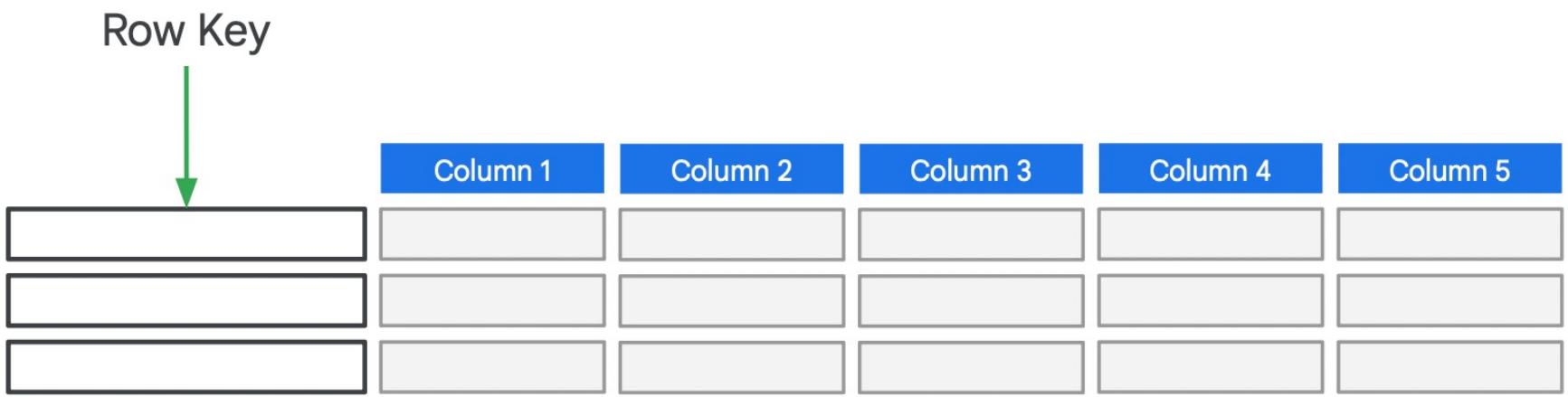
# The most common use of Bigtable

Productionize a real-time lookup as part of an application, where speed and efficiency are desired beyond that of other databases.

# How does Bigtable work?

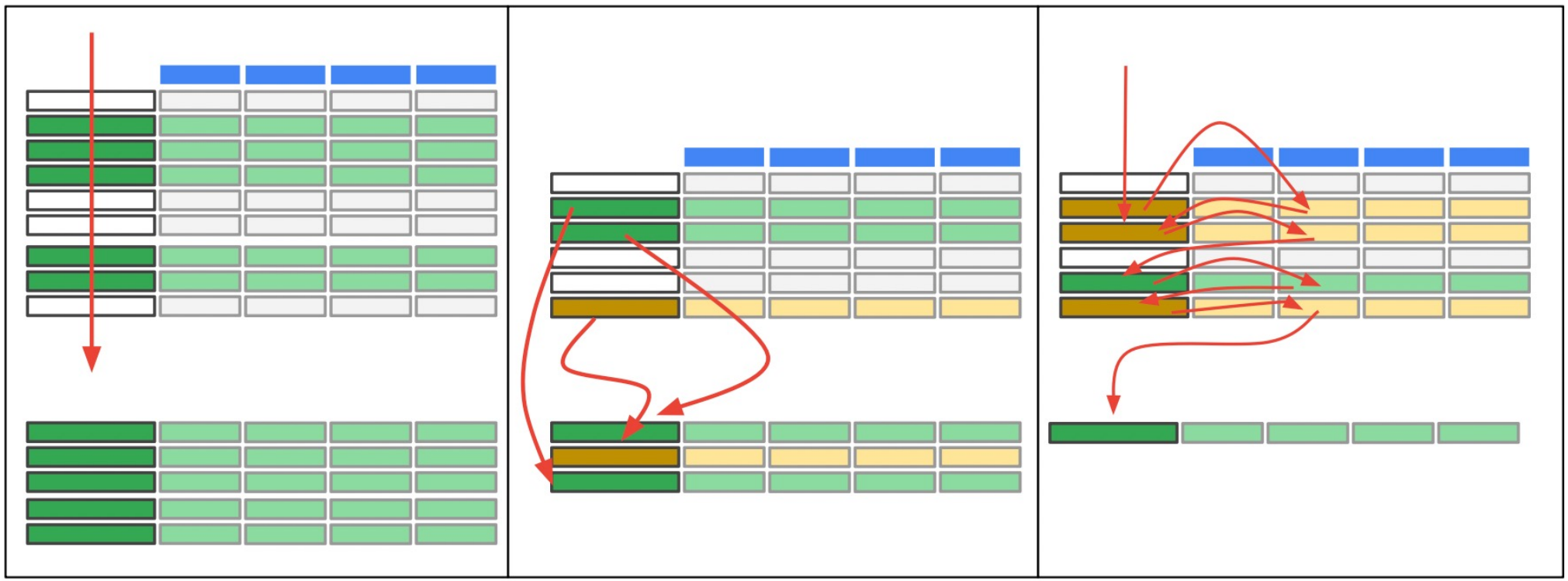


# Bigtable design idea is "simplify for speed"




The Row Key is the index.
And you get only one.

# But speed depends on your data and Row Key

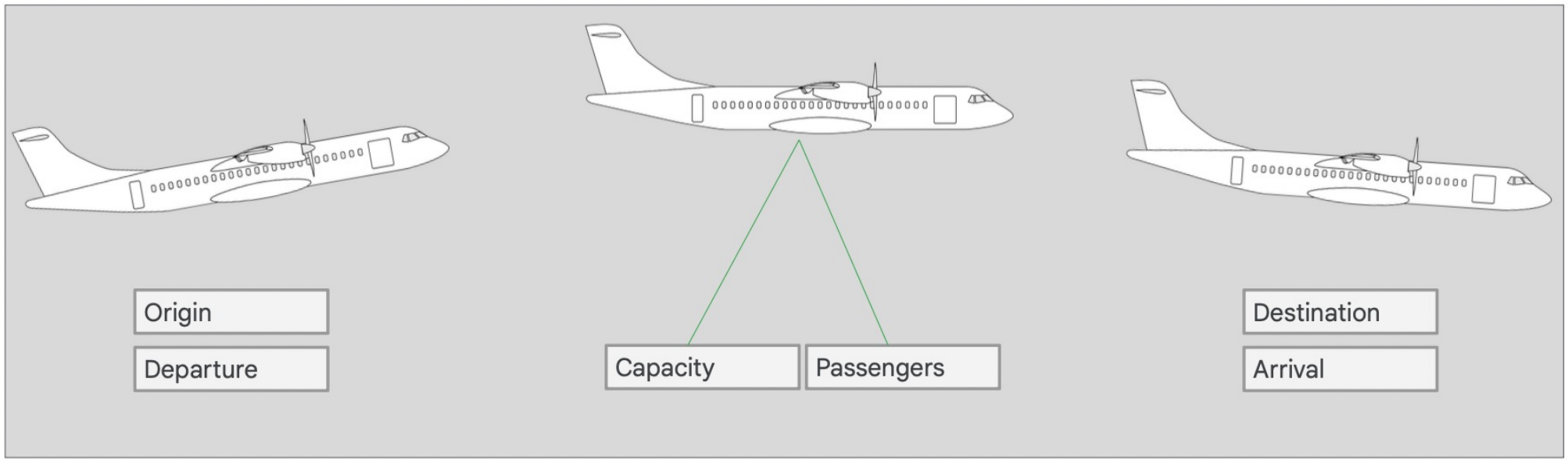


# Flights of the world: Reviewing the data

Make

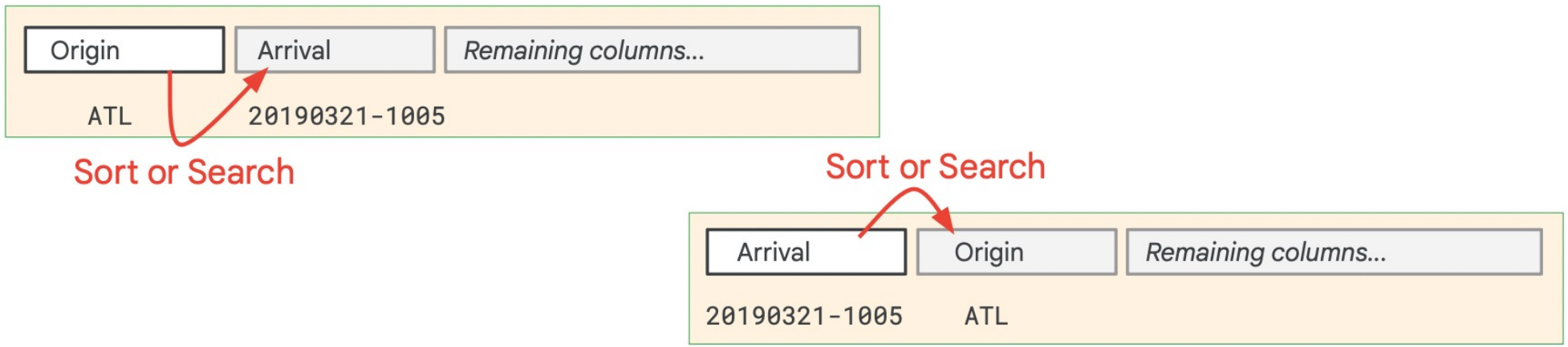
Model

Age



# What is the best Row Key?

**Query:** All flights originating in Atlanta and arriving between March 21st and 29th



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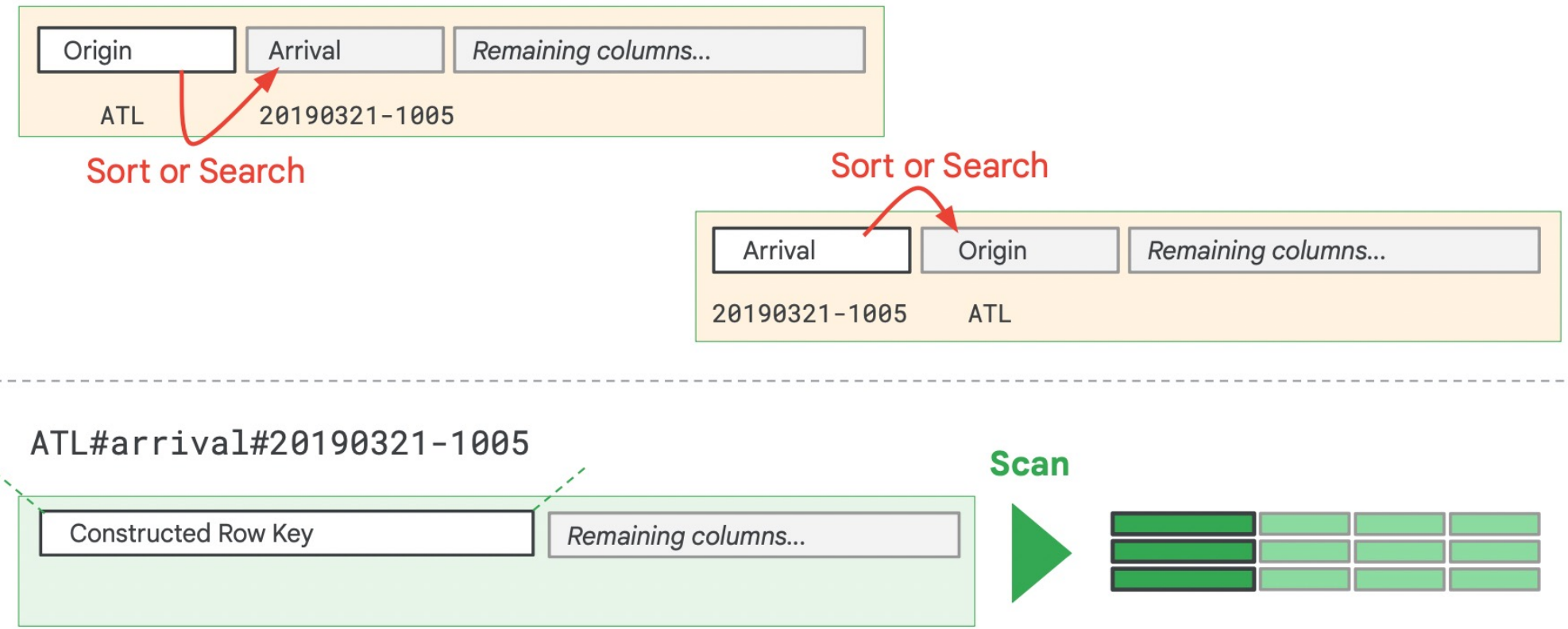


# Bigtable schema organization

Column Families

| | Flight_Information | | | | | Aircraft_Information | | | |
|---|---|---|---|---|---|---|---|---|---|
| Row Key | Origin | Destination | Departure | Arrival | Passengers | Capacity | Make | Model | Age |
| ATL#arrival#20190321-1121 | ATL | LON | 20190321-0311 | 20190321-1121 | 158 | 162 | B | 737 | 18 |
| ATL#arrival#20190321-1201 | ATL | MEX | 20190321-0821 | 20190321-1201 | 187 | 189 | B | 737 | 8 |
| ATL#arrival#20190321-1716 | ATL | YVR | 20190321-1014 | 20190321-1716 | 201 | 259 | B | 757 | 23 |

# Queries that use the row key, a row prefix, or a row range are the most efficient

**Query:** Current arrival delay for flights from Atlanta

**1**

row key based on atlanta arrivals
e.g. ORIGIN#arrival
( ATL#arrival#20190321-1005 )

Puts latest flights at bottom of table

**2**

reverse timestamp to the rowkey
e.g. ORIGIN#arrival#RTS
( ATL#arrival#560549313 )

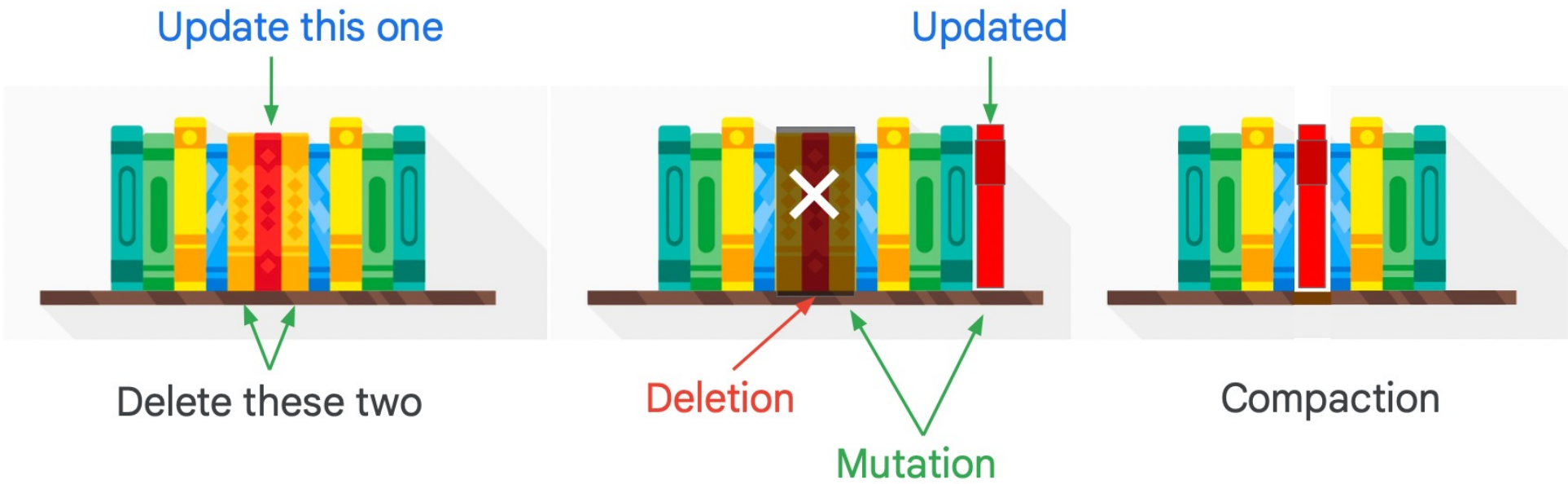
Puts latest flights at top of table

# Use reverse timestamps when your most common query is for the latest values

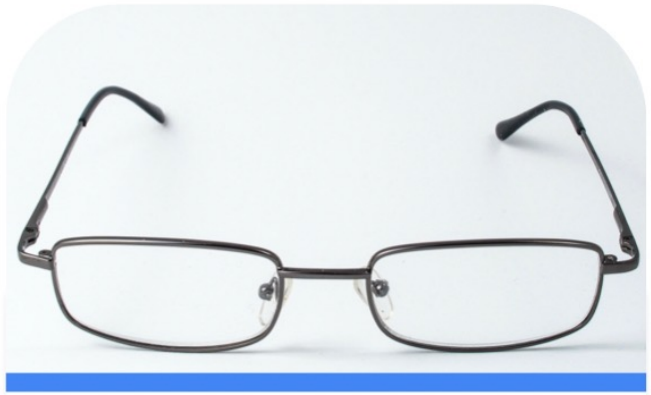
**Query:** Current arrival delay for flights from Atlanta

```
// key is ORIGIN#arrival#REVTS
String key = info.getORIGIN() //
   + "#arrival"  //
   + "#" + (Long.MAX_VALUE - ts.getMillis()); // reverse timestamp
```

# What happens when data in Bigtable is changed?



# Optimizing data organization for performance



Group related data for more efficient reads

Example row key:

```
DehliIndia#2019031411841
```

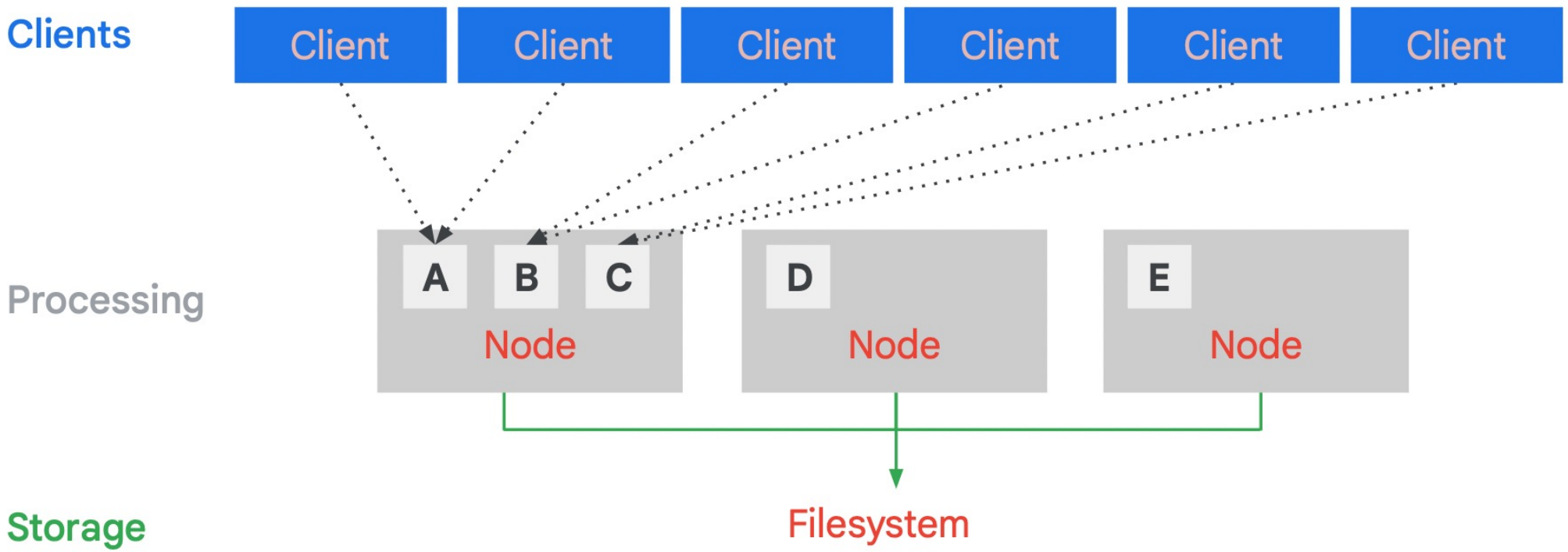
Use column families

Distribute data evenly for more efficient writes

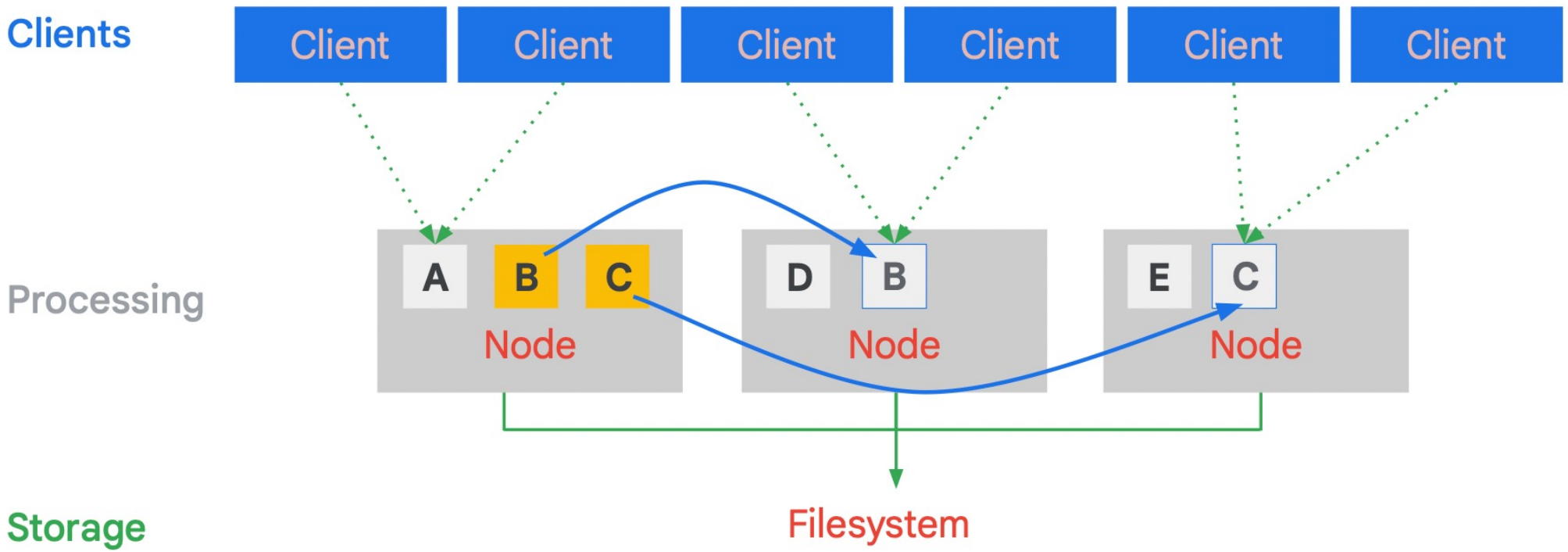
Place identical values in the same row or adjoining rows for more efficient compression

Use row keys to organize identical data

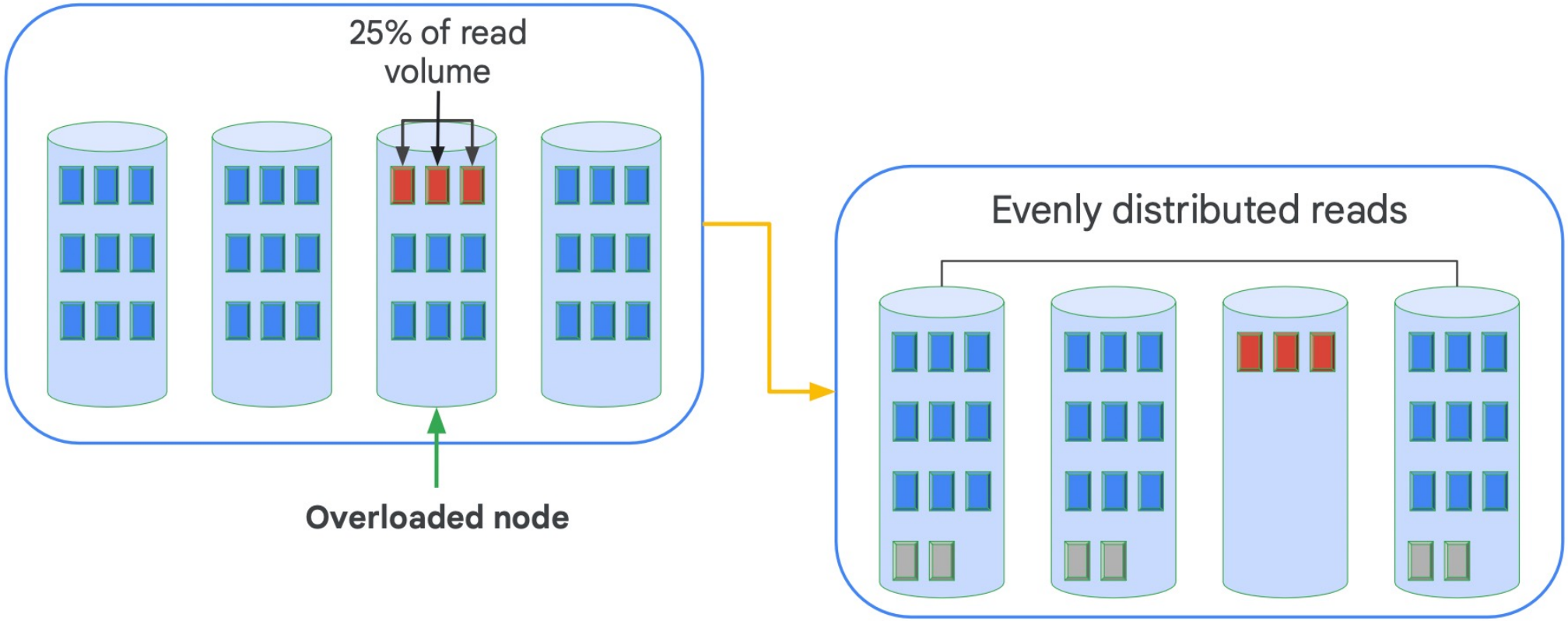
# Bigtable self-improves by learning access patterns ...



# ...and rebalances data accordingly



# Rebalance strategy: Distribute reads

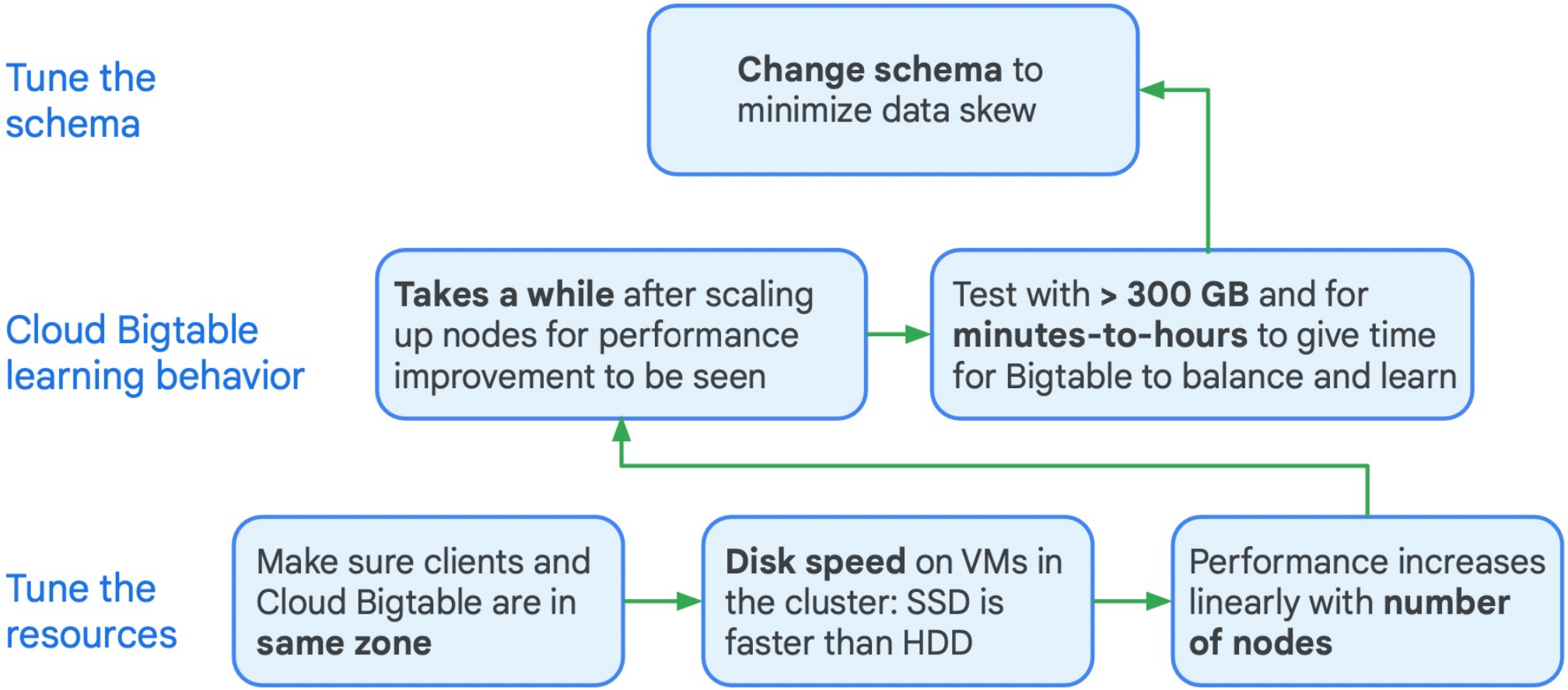


# Real world use case: Spotify

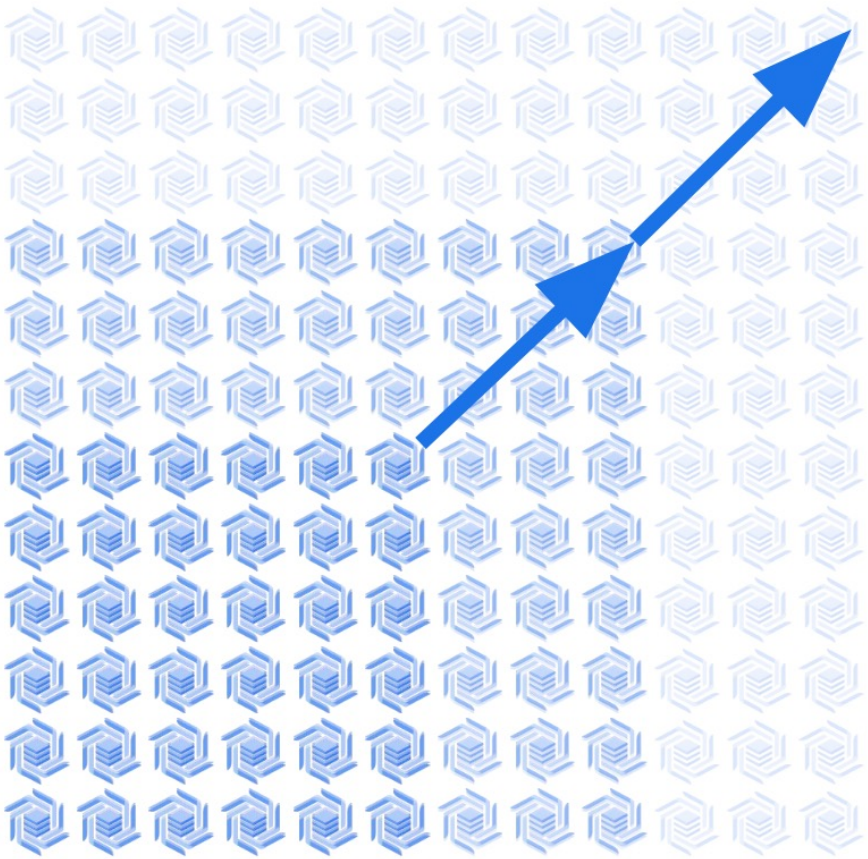

In 2019, Spotify ran the largest Dataflow job ever at the time with Bigtable "...used as a remediation tool between Dataflow jobs in order for them to process and store more data in a parallel way, rather than the need to always regroup the data"

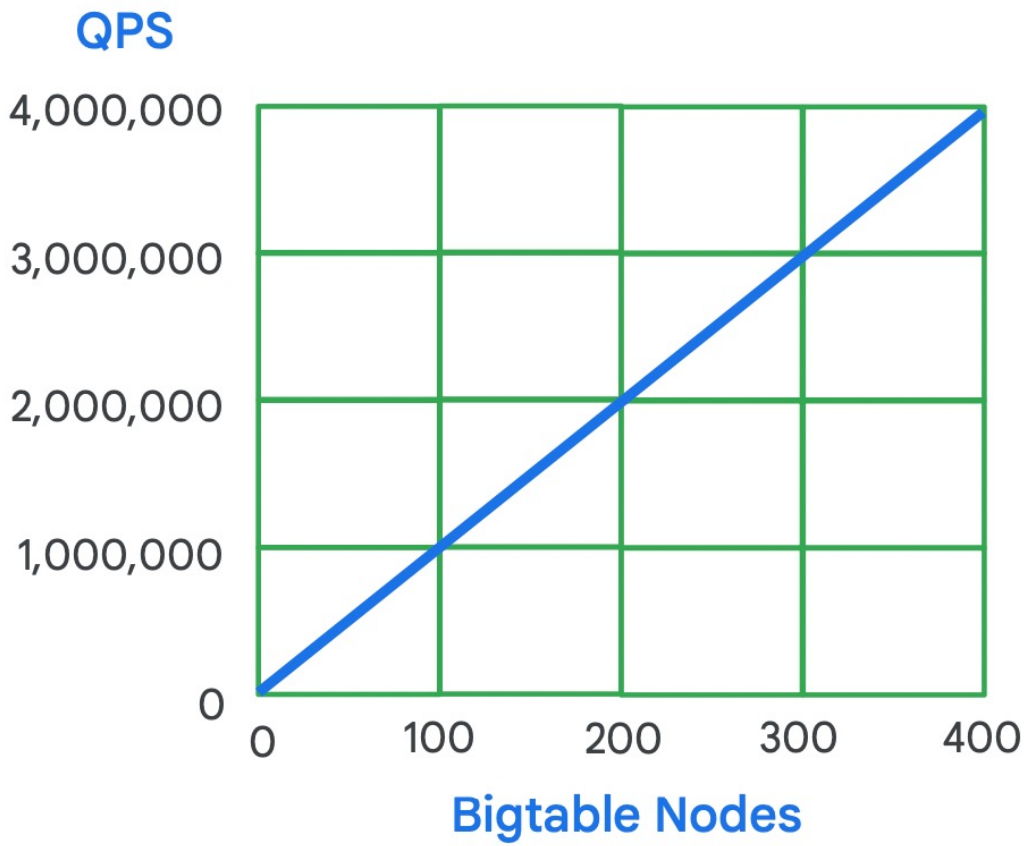

# Optimizing Cloud Bigtable Performance

# Optimizing Bigtable performance

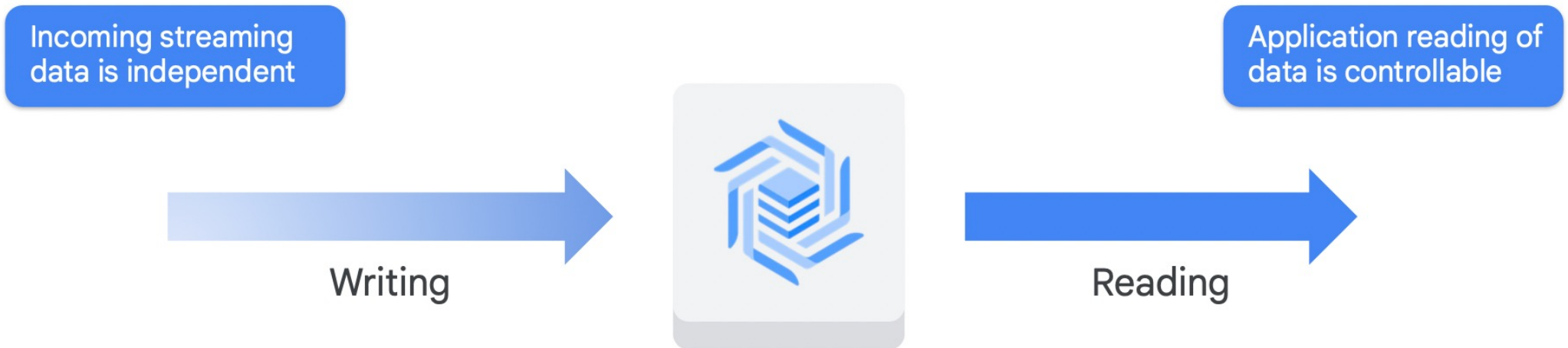


# Throughput can be controlled by node count

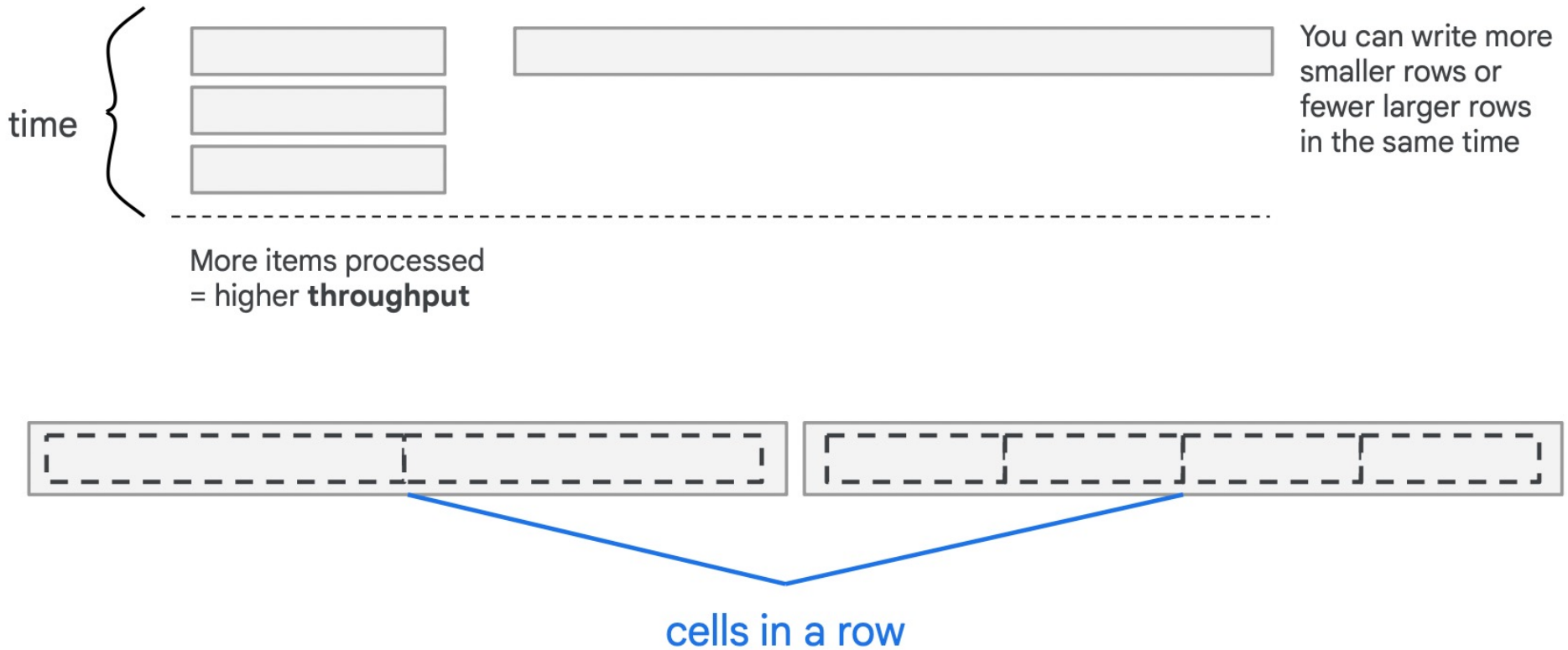




# Features for Bigtable streaming



# Schema design is the primary control for streaming

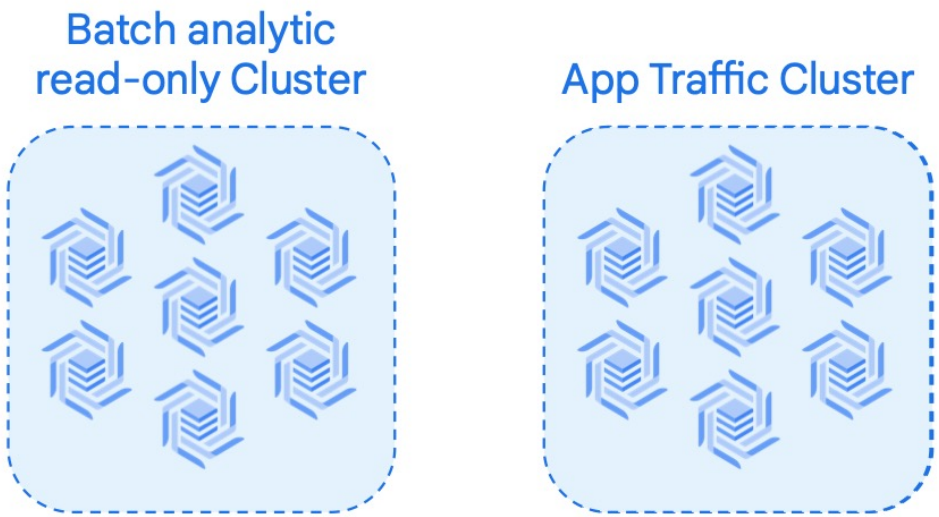


# Use Bigtable replications to improve availability

## Why perform replication?

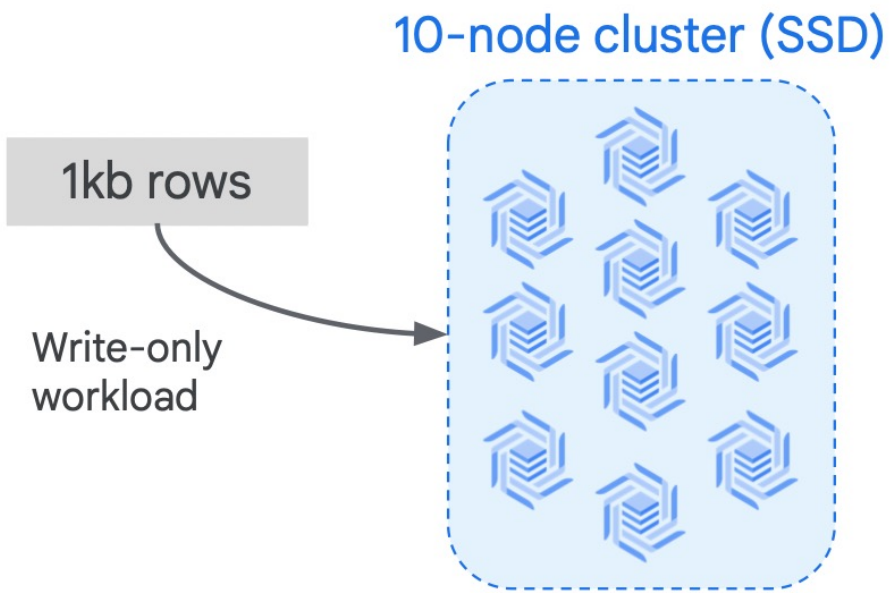
- Isolate serving applications from batch reads
- Improve availability
- Provide near-real-time backup
- Ensure your data has a global presence

```
gcloud bigtable clusters create CLUSTER_ID \
    --instance=INSTANCE_ID \
    --zone=ZONE \
    [--num-nodes=NUM_NODES] \
    [--storage-type=STORAGE_TYPE]
```

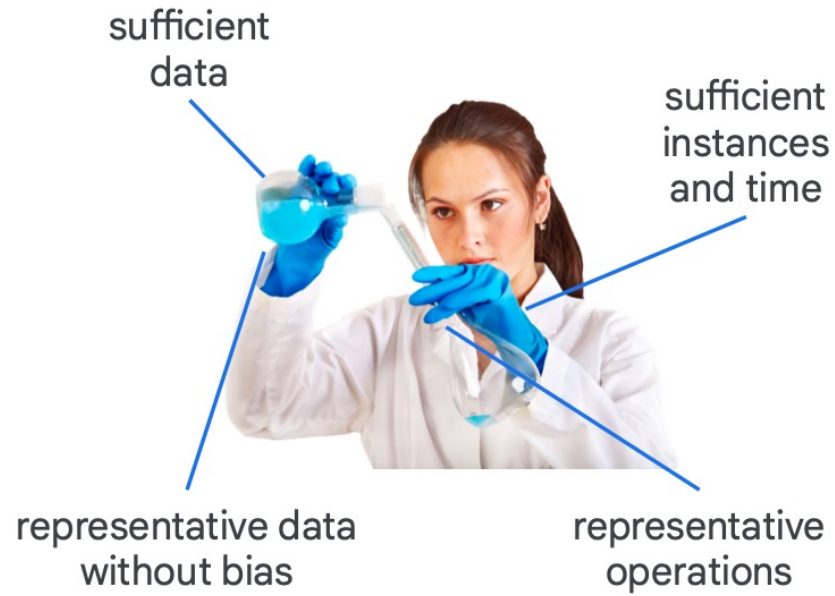


# Run performance tests carefully for Bigtable streaming

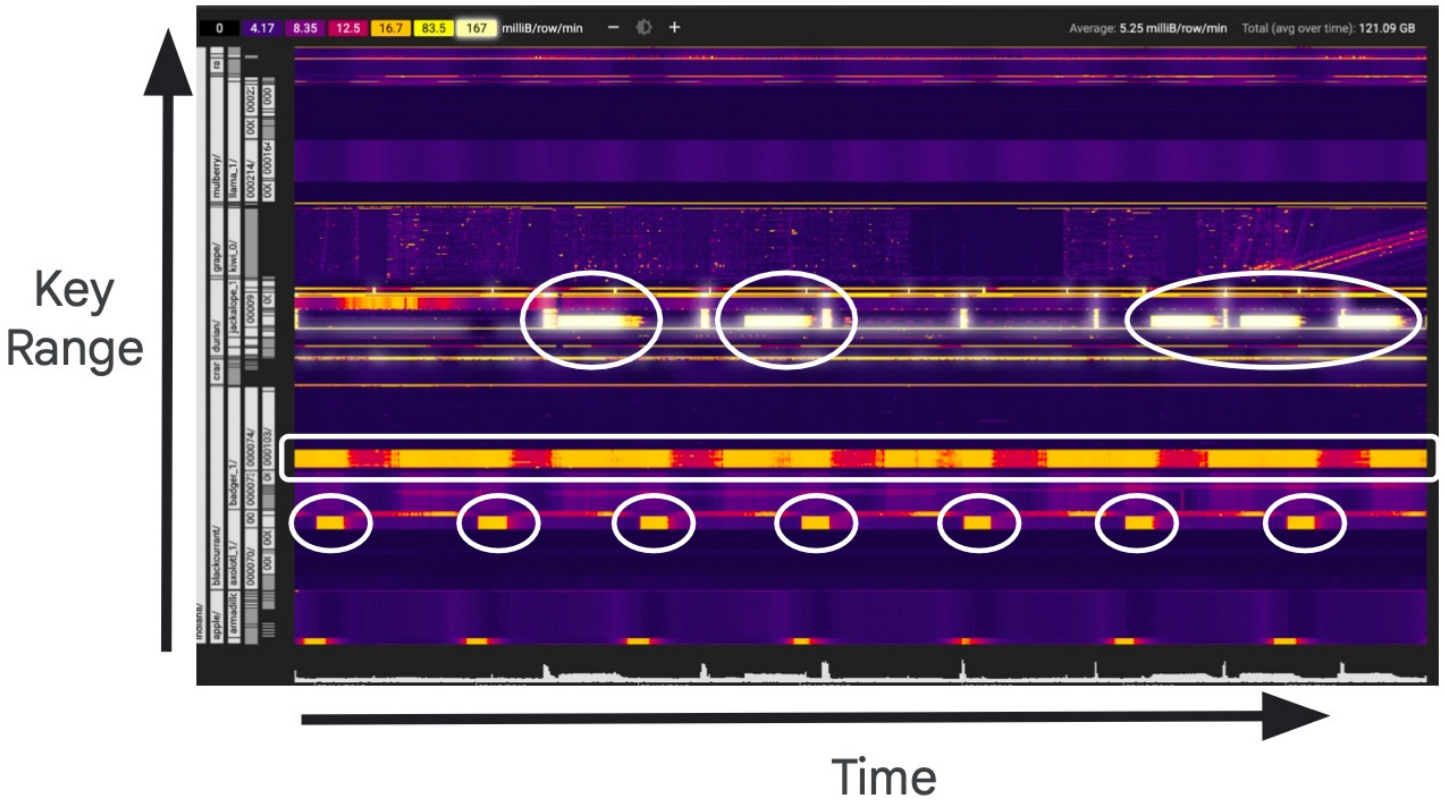
## Ideal




## Real



# Key Visualizer exposes read/write access patterns over time and key space




- find/prevent hotspots
- find rows with too much data
- see if your key schema is balanced

# Lab Intro

Streaming Data Processing: Streaming Data Pipelines into Bigtable