Google Cloud

Real-time Dashboards with Pub/Sub, Dataflow, and Data Studio

Agenda

Modern data pipeline challenges

Message-oriented architectures

Serverless data pipelines

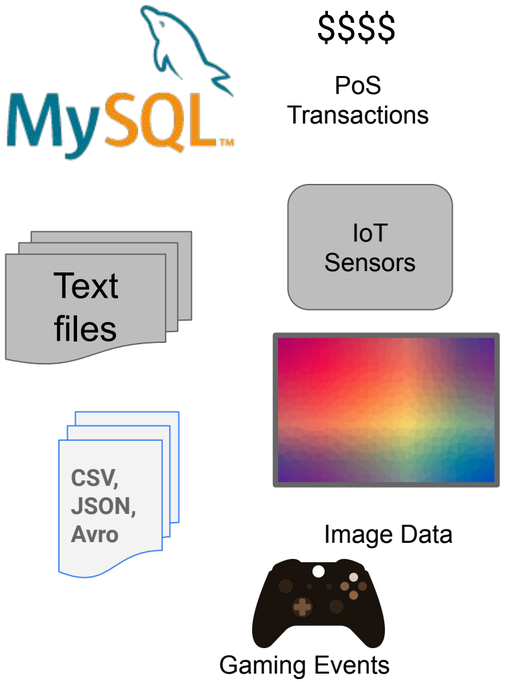
- Designing streaming pipelines with Apache Beam
- Implementing streaming pipelines on Cloud Dataflow

Data Visualization with Data Studio

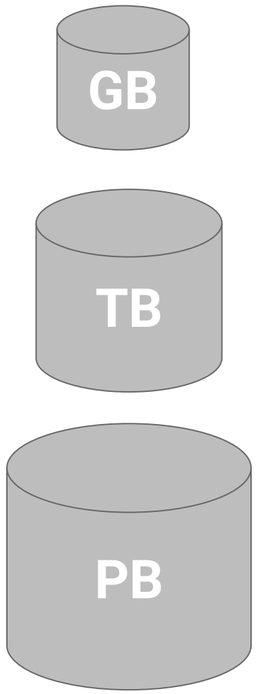
- Building collaborative dashboards
- Tips and tricks to create charts with the Data Studio UI

Modern big data pipelines face many challenges

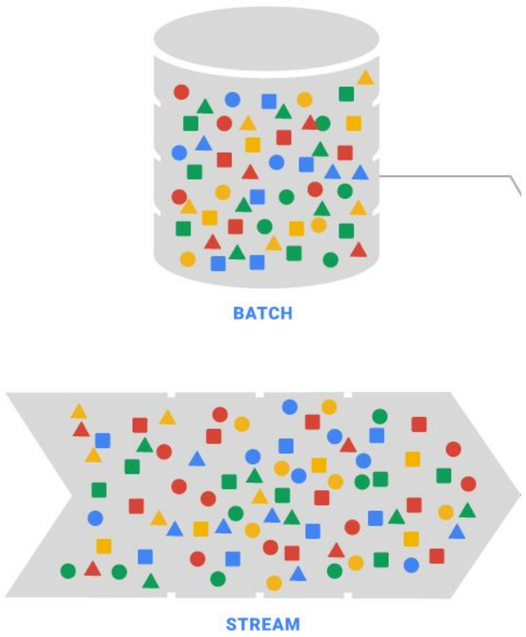
Variety



Volume



Velocity



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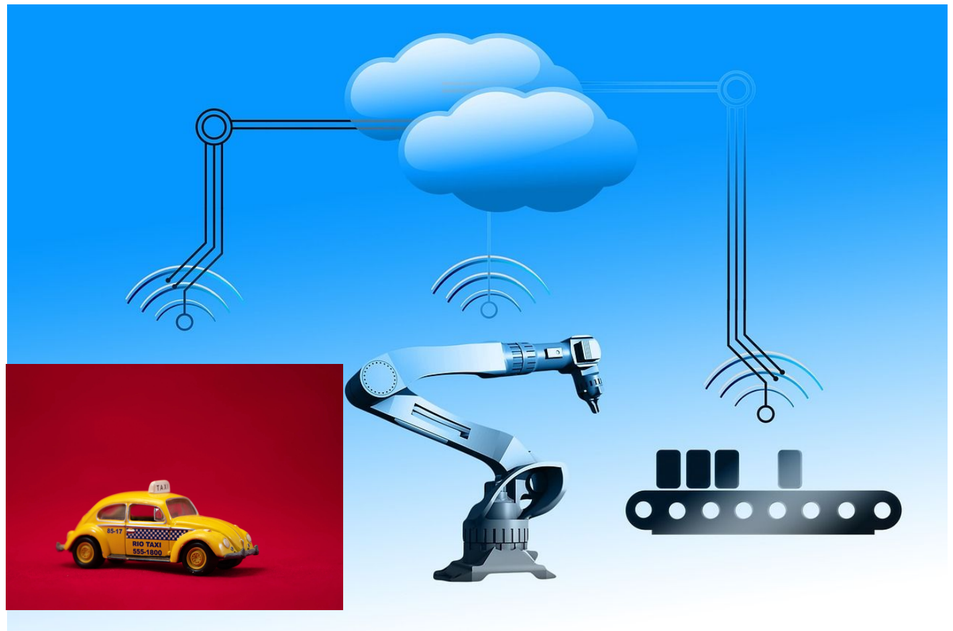
IoT devices present new challenges to data ingestion

Distributed Messages



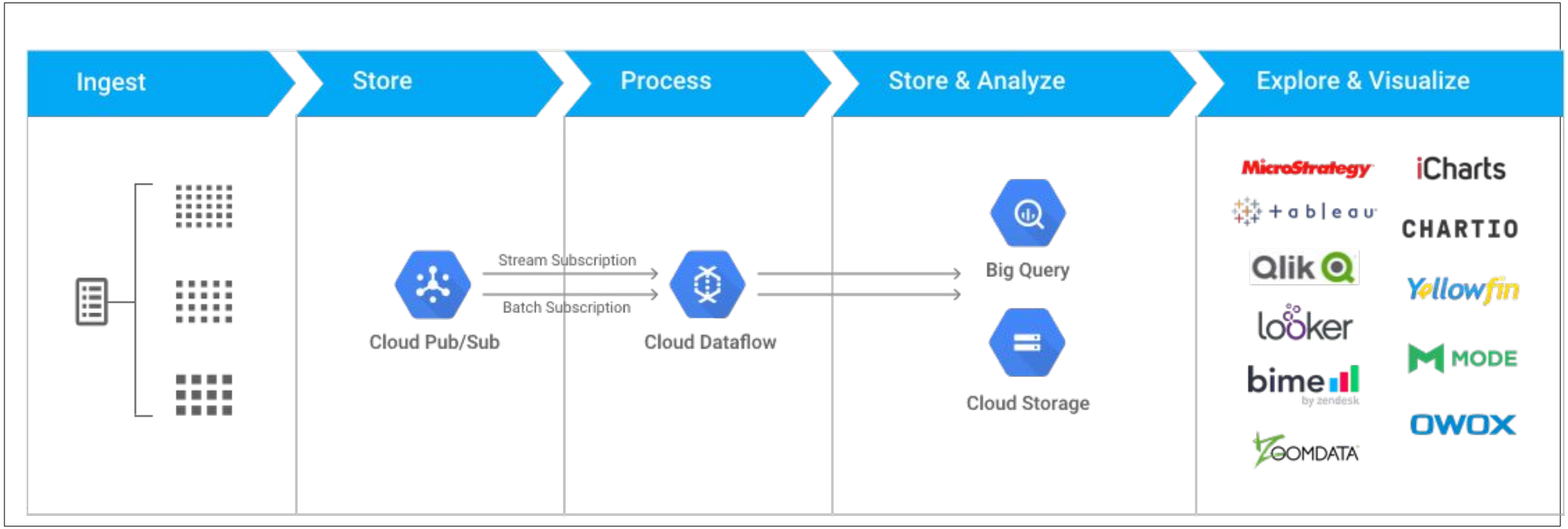
- Data streaming from various processes or devices
- Distributing event notifications (ex: new user sign up)
- Scale to handle volume
- Reliable (no duplicates)

Cloud Pub/Sub offers reliable, real-time messaging

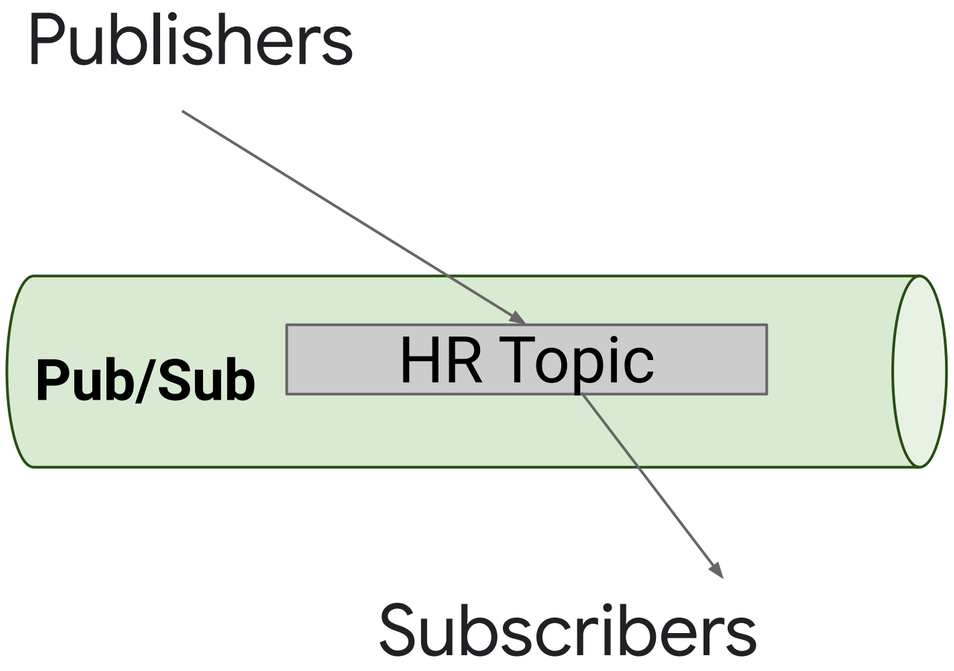
Distributed Messaging
with Cloud Pub/Sub

- At-least-once delivery
- Exactly-once processing
- No provisioning, auto-everything
- Open APIs
- Global by default
- End-to-end encryption

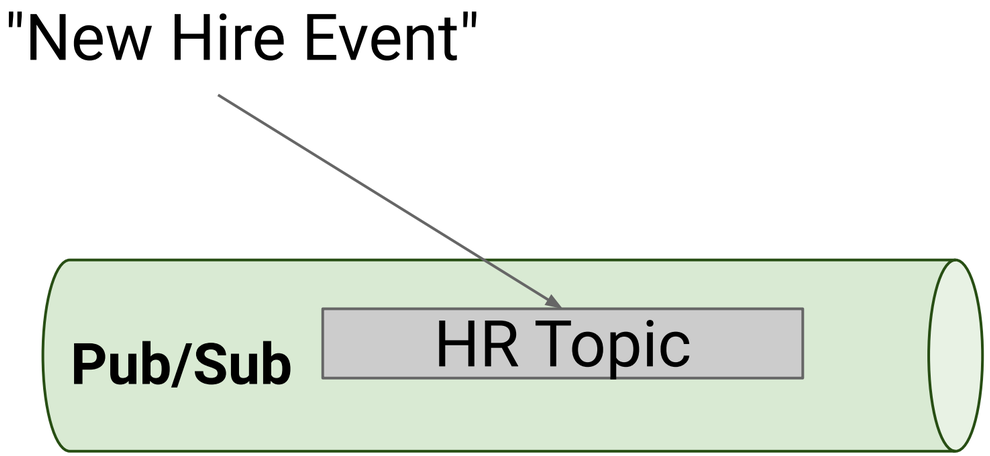
Google Cloud Serverless Big Data Pipeline



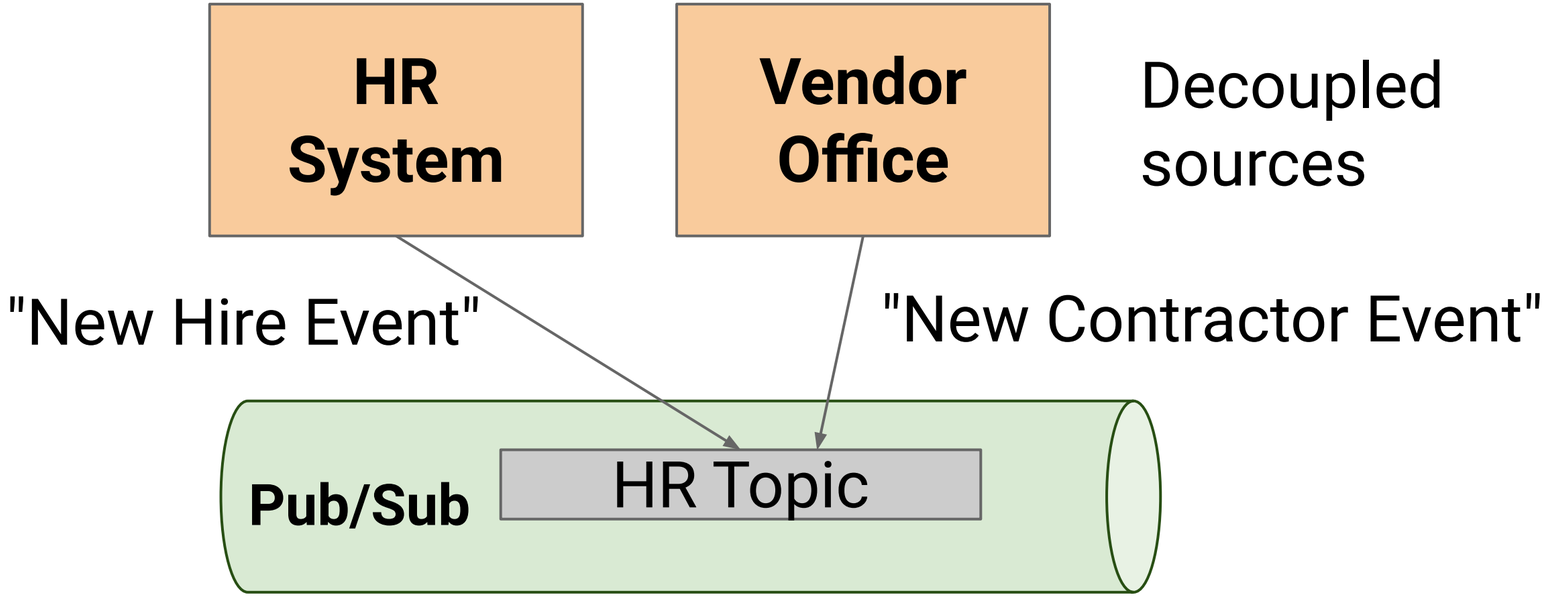
Pub/Sub topics are like radio antennas



Scenario: HR messaging system



Scenario: HR messaging system



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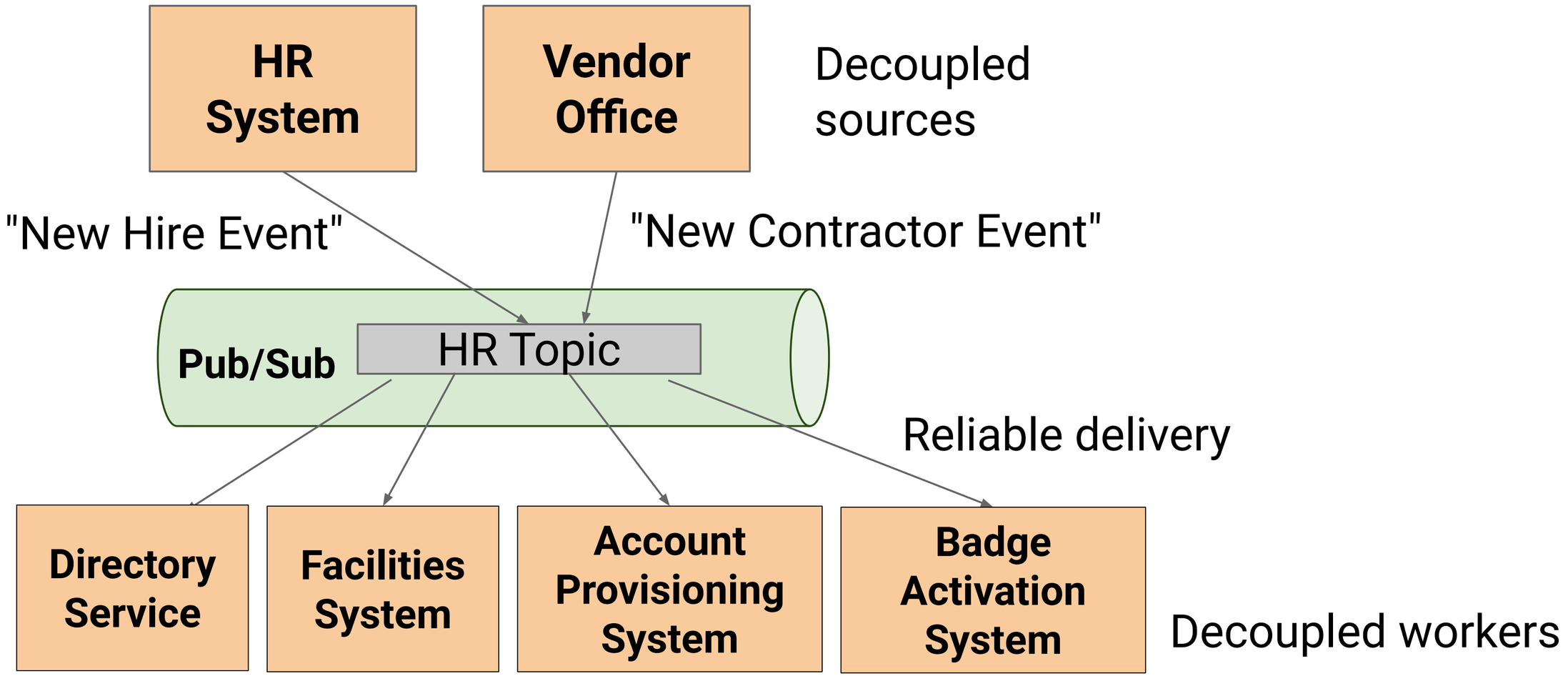

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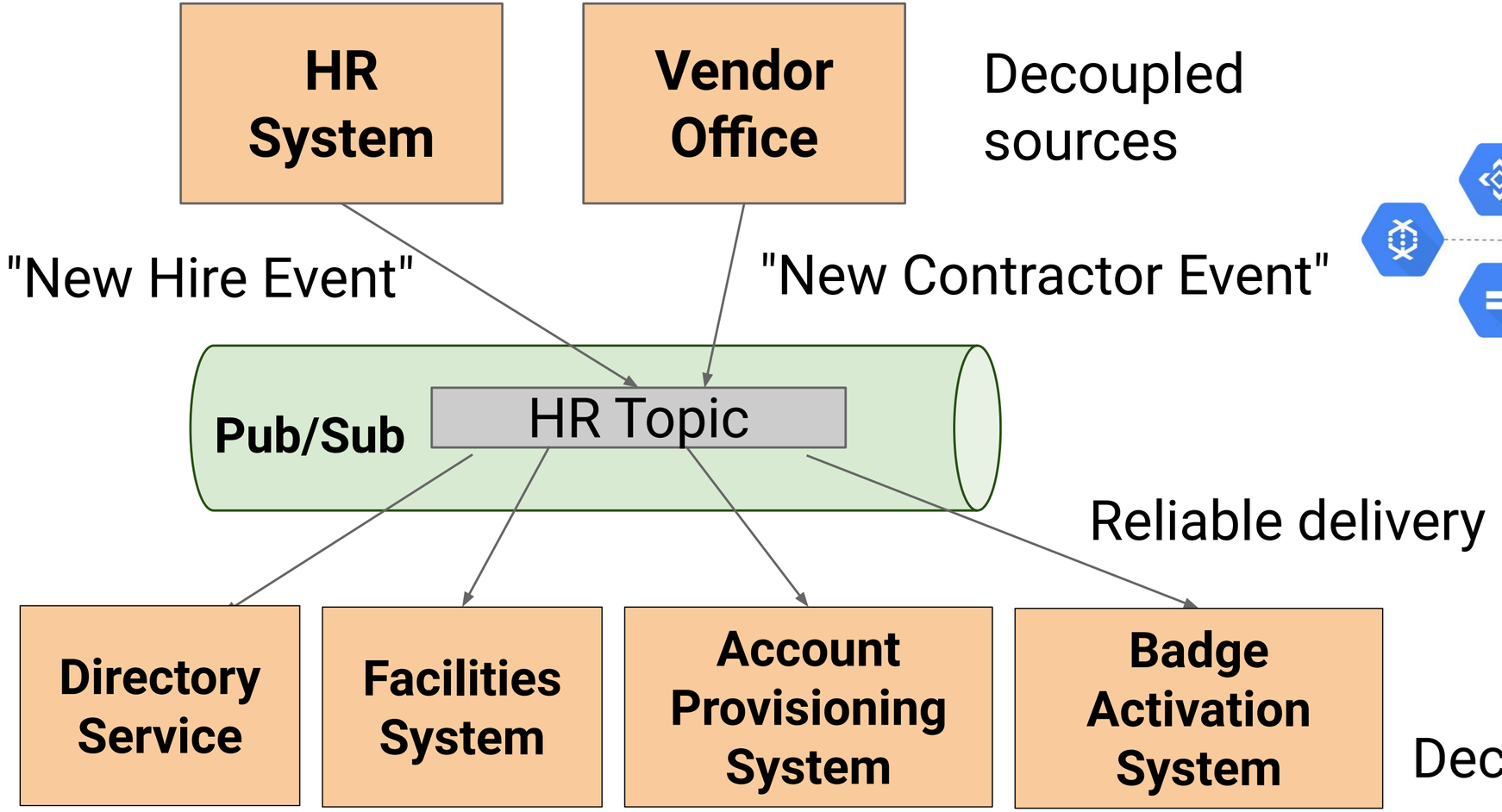

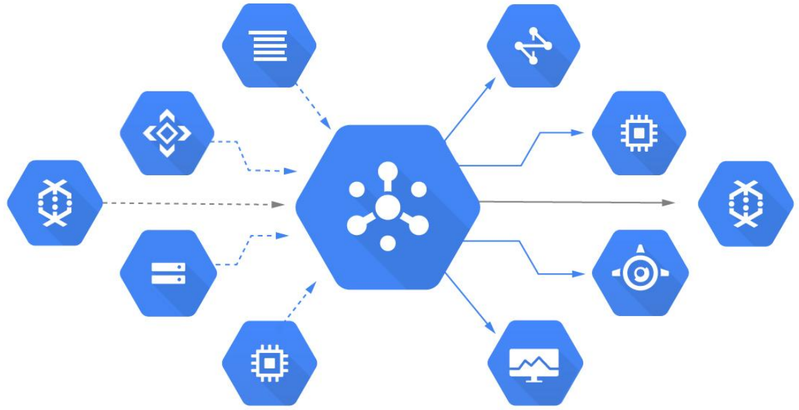

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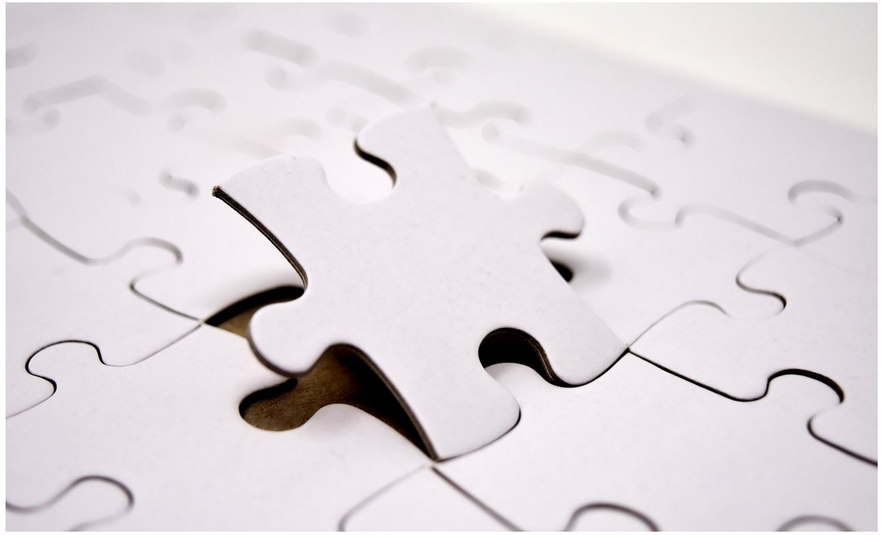
Data Engineers need to solve two distinct problems

Pipeline design



Implementation

Data Engineers need to solve two distinct problems

Pipeline design

- Will my code work with both batch and streaming data?
- Does the SDK support the transformations I need to do?
- Are there existing solutions?

Implementation

Data Engineers need to solve two distinct problems

Pipeline design with Apache Beam

- Will my code work with both batch and streaming data? ..... Yes
- Does the SDK support the transformations I need to do? ..... Likely
- Are there existing solutions? ..... Choose from templates

Start with provided templates and build from there:

github.com/GoogleCloudPlatform/DataflowTemplates

- BigQuery to Datastore
- Bigtable to GCS Avro
- Bulk Compressor
- Bulk Decompressor
- Datastore Bulk Delete *
- Datastore to BigQuery
- Datastore to GCS Text *
- Datastore to Pub/Sub *
- Datastore Unique Schema Count
- GCS Avro to Bigtable
- GCS Avro to Spanner
- GCS Text to BigQuery *
- GCS Text to Datastore
- GCS Text to Pub/Sub (Batch)
- GCS Text to Pub/Sub (Streaming)
- Jdbc to BigQuery
- Pub/Sub to BigQuery *
- Pub/Sub to Datastore *
- Pub/Sub to GCS Avro
- Pub/Sub to GCS Text
- Pub/Sub to Pub/Sub
- Spanner to GCS Avro
- Spanner to GCS Text
- Word Count

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What is Apache Beam?

Beam is an advanced unified & portable data processing programming model

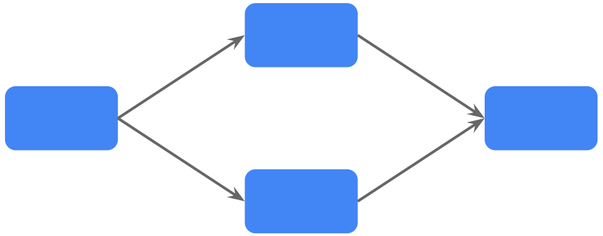
- Programming model
- SDKs for writing data pipelines
- Runners to run distributed processing

beam

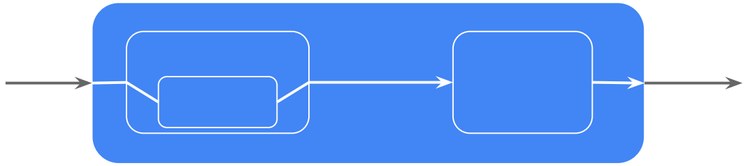
Why Apache Beam?

- **Unified** - Use a single programming model for both batch and streaming use cases
- **Portable** - Execute pipelines on multiple execution environments
- **Extensible** - Write and share new SDKs, IO connectors, and transformation libraries

User code



Libraries of PTransforms, IO



Language SDK

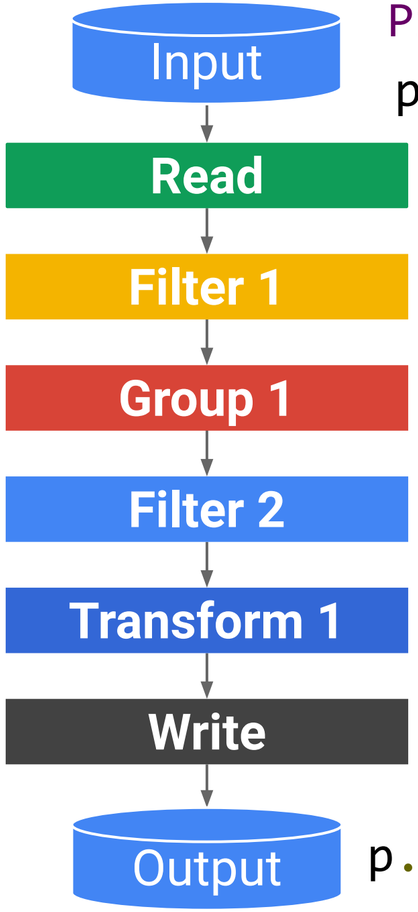
Java

Beam Model representation

Runner

Spark

Dataflow offers NoOps data pipelines



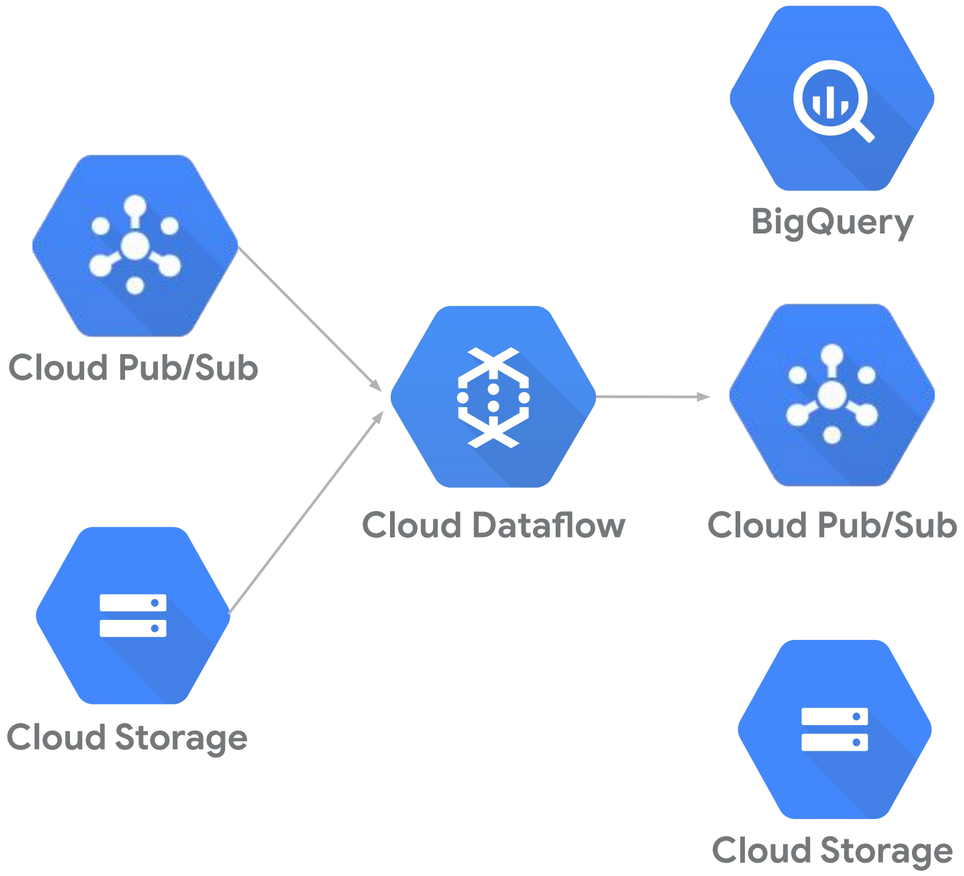

```
Pipeline p = Pipeline.create();
p
  .apply(TextIO.Read.from("gs://...
  "))
  .apply(ParDo.of(new Filter1()))
  .apply(new Group1())
  .apply(ParDo.of(new Filter2())
  .apply(new Transform1())
  .apply(TextIO.Write.to("gs://...")
  );
p.run();
```

Open-source API (Apache Beam) can be executed on Flink, Spark, etc. also

Parallel task (autoscaled by execution framework)

```
class Filter1 extends DoFn<...> {
  public void
  processElement(ProcessContext c) {
      ... = c.element();
      ...
      c.output(...);
  }
```

Same code does real-time and batch




```
Pipeline p = Pipeline.create();
    p.begin()
        .apply(PubsubIO.Read.from("input_topic"))
        .apply(SlidingWindows.of(60, MINUTES))
        .apply(ParDo.of(new Filter1()))
        .apply(new Group1())
        .apply(ParDo.of(new Filter2())
        .apply(new Transform1())
        .apply(PubsubIO.Write.to("output_topic"));
    p.run();
```

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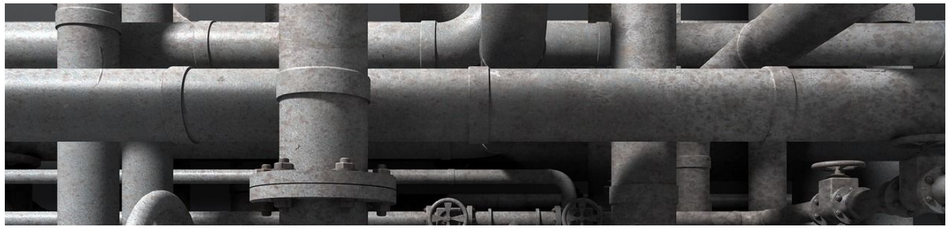
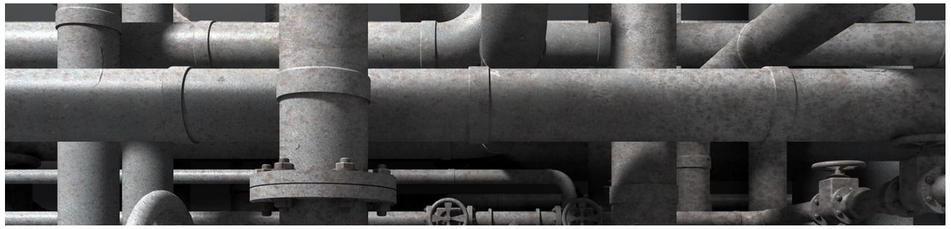
Implementation



- How much maintenance overhead is involved?
- Is the infrastructure reliable?
- How is scaling handled?
- How can I monitor and alert?
- Am I locked in to a vendor?

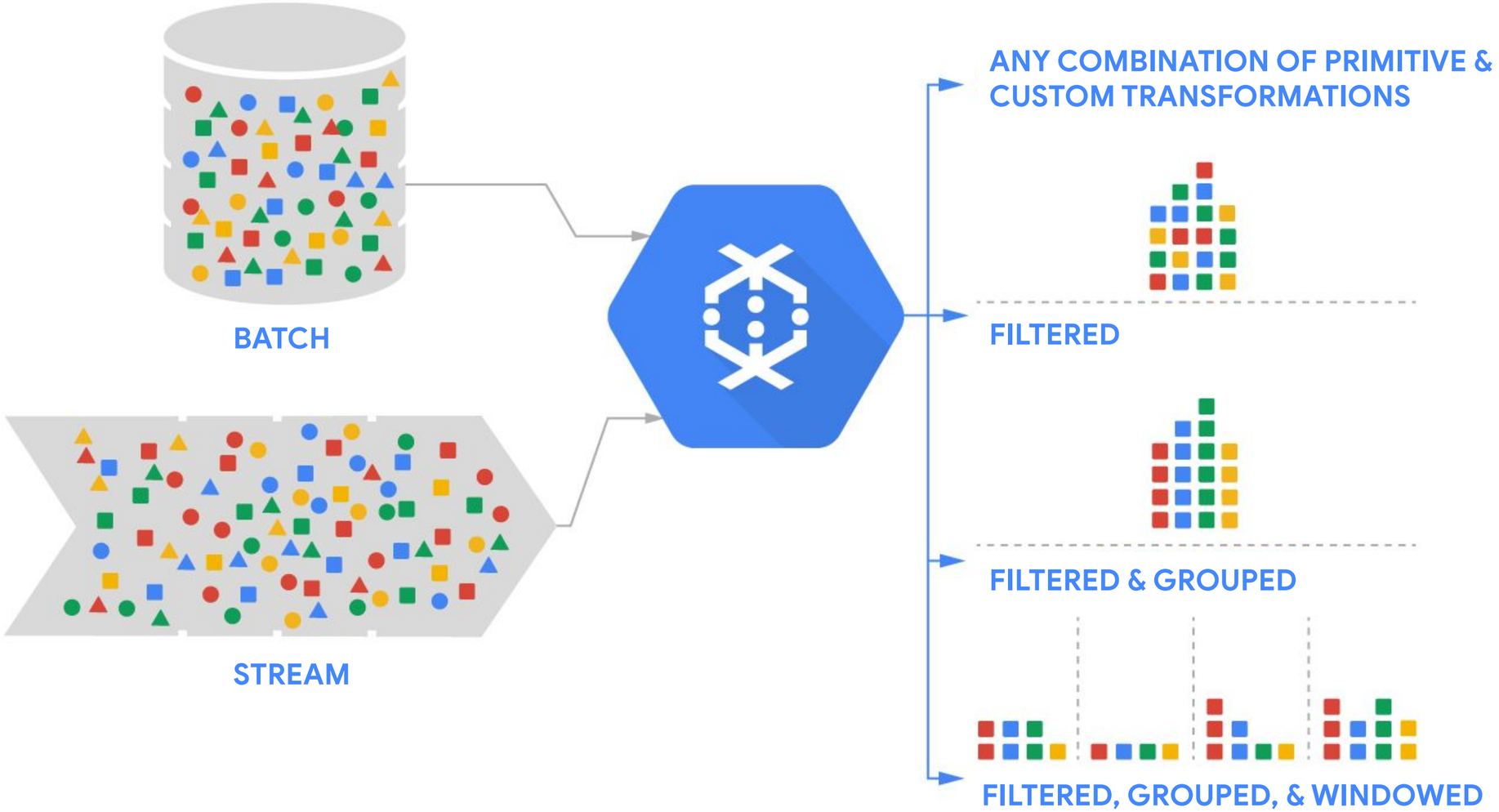
Data Engineers need to solve two distinct problems

Implementation with Google Cloud Dataflow

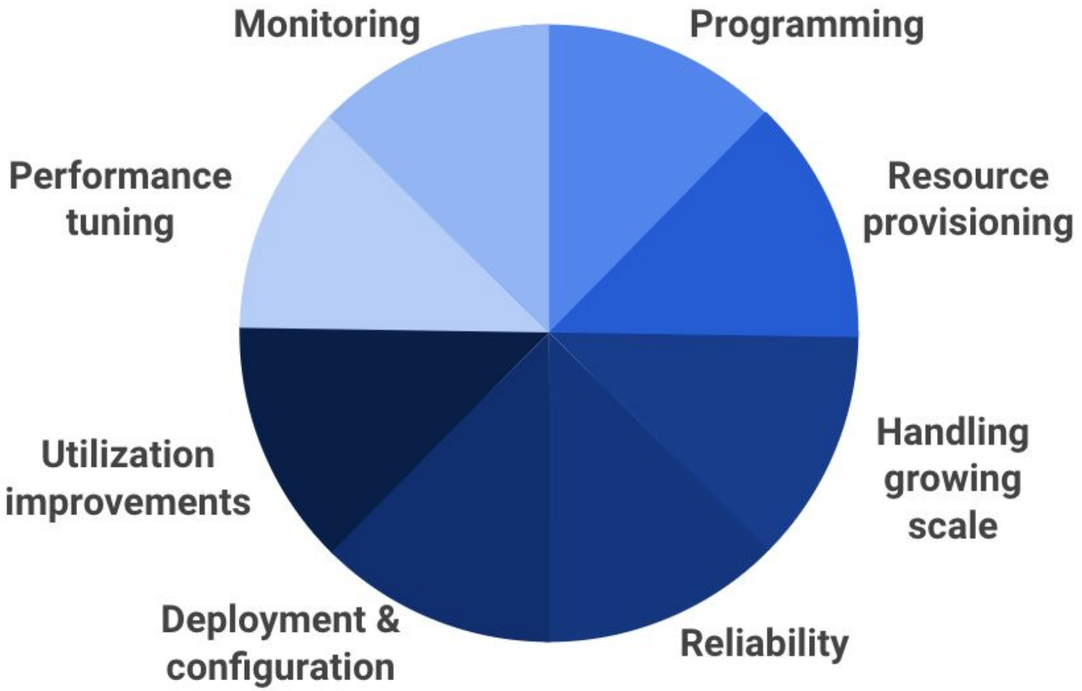


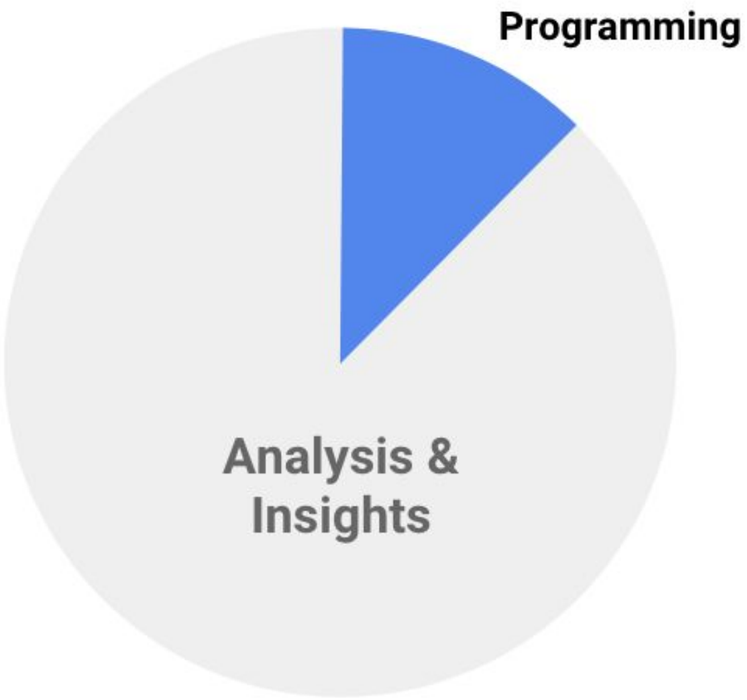
- How much maintenance overhead is involved? ····· Little
- Is the infrastructure reliable? ····· Built on Google infrastructure
- How is scaling handled? ····· Autoscale workers
- How can I monitor and alert? ····· Integrated with Stackdriver
- Am I locked in to a vendor? ····· Run Apache Beam elsewhere

Dataflow does ingest, transform, and load

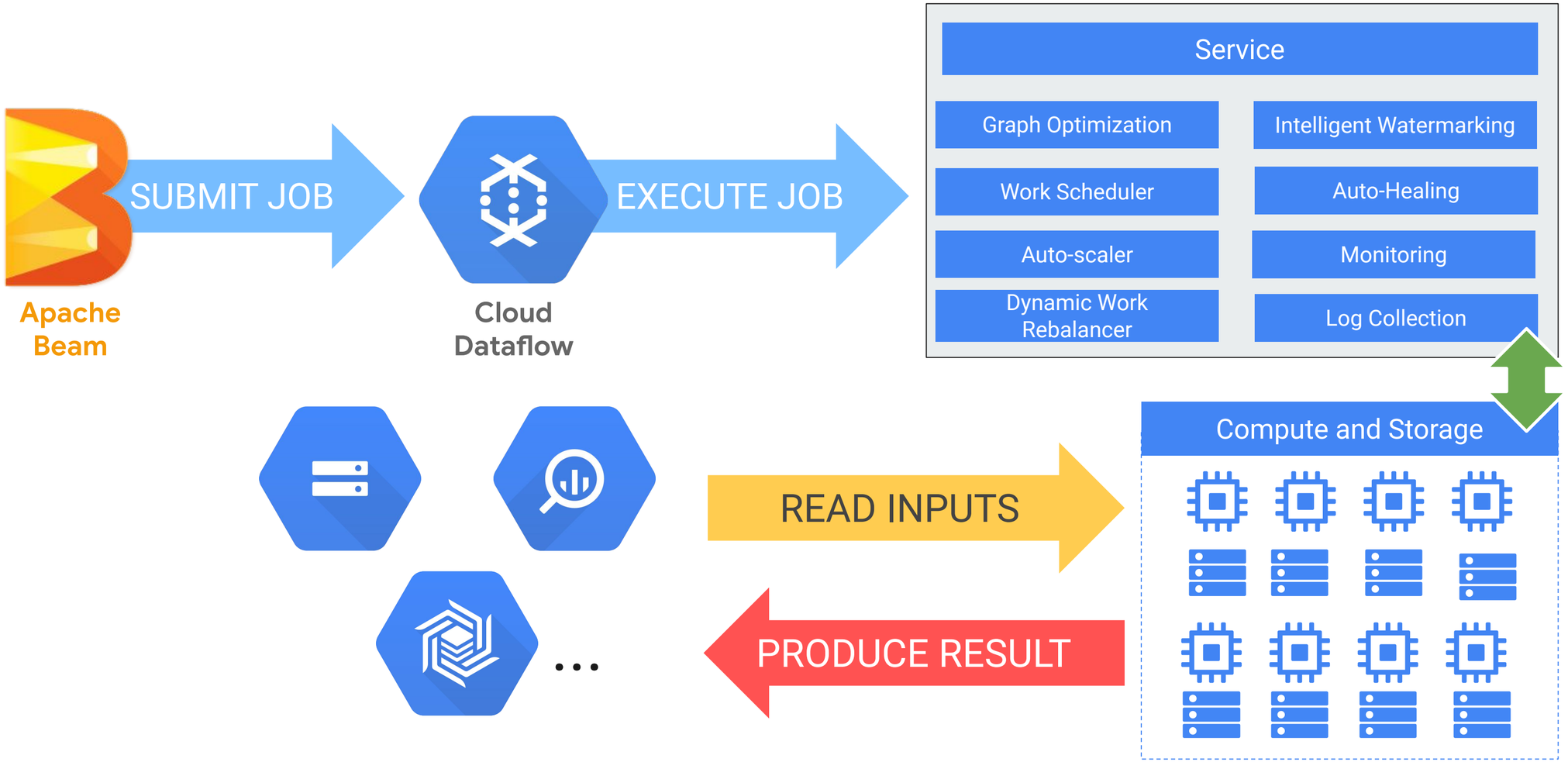


Why Serverless?





Workflow with Dataflow



Cloud Dataflow

- Serverless, fully managed data processing
- Unified batch and streaming processing + autoscale
- Open source programming model using beam
- Intelligently scales to millions of QPS

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Explore Data Studio insights right from within BigQuery

Query editor

```
# which days did it rain in SF?
WITH rainy_sf AS (
SELECT
wban,
stn,
rain_drizzle,
fog,
PARSE_DATE("%F",CONCAT(year,'-',mo,'-',da)) AS date
FROM `bigquery-public-data.noaa_gsod.gsod2018`
WHERE wban = '93816'
ORDER BY rain_drizzle DESC, date
)
```

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

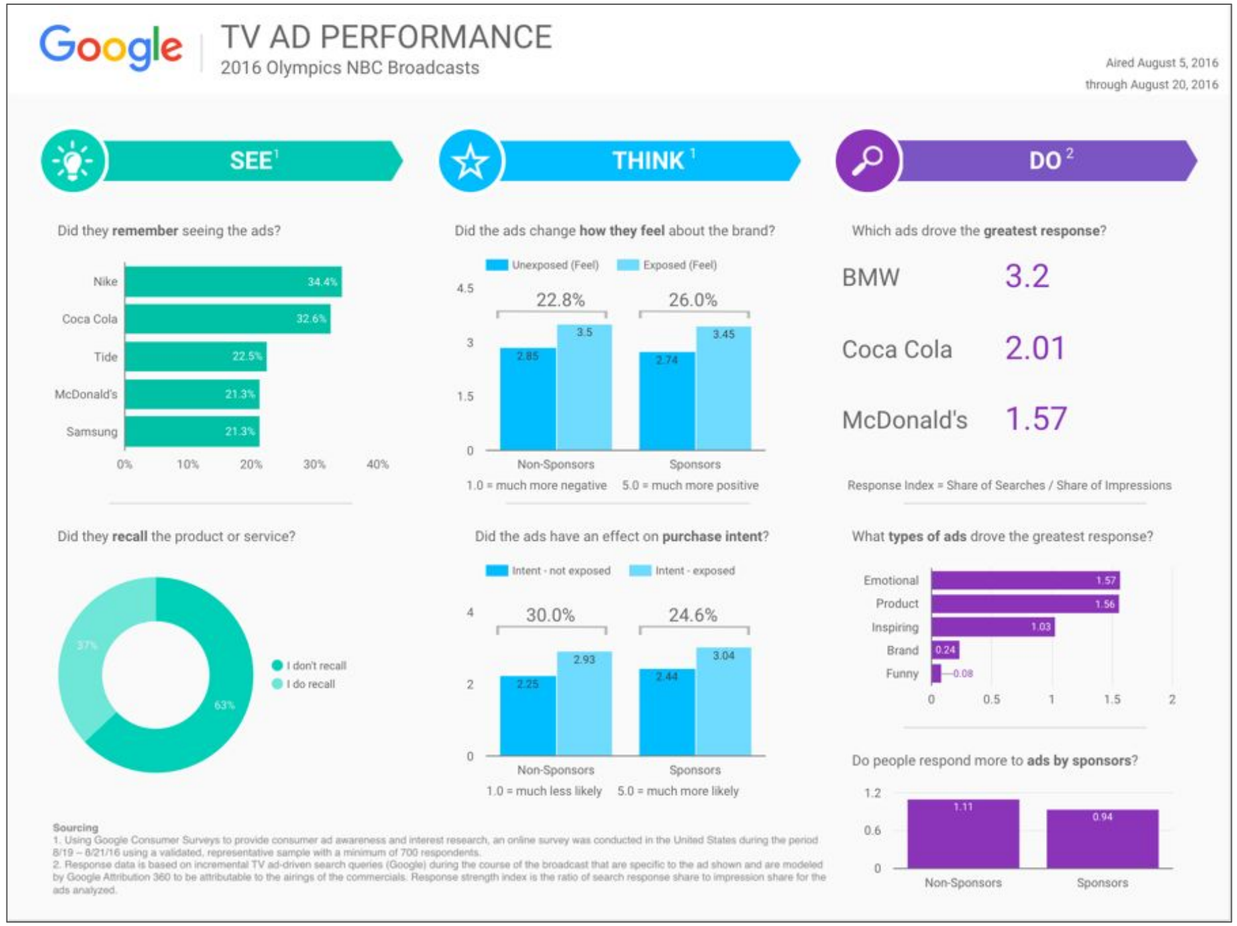
Query results | SAVE RESULTS | EXPLORE IN DATA STUDIO

Query complete (2.5 sec elapsed, 118.1 MB processed)

Job information | Results | JSON | Execution details

Row	date	total_trips	rain_drizzle	fog
1	2018-01-07	1382	1	0
2	2018-01-08	805	1	0
3	2018-01-10	3459	1	1

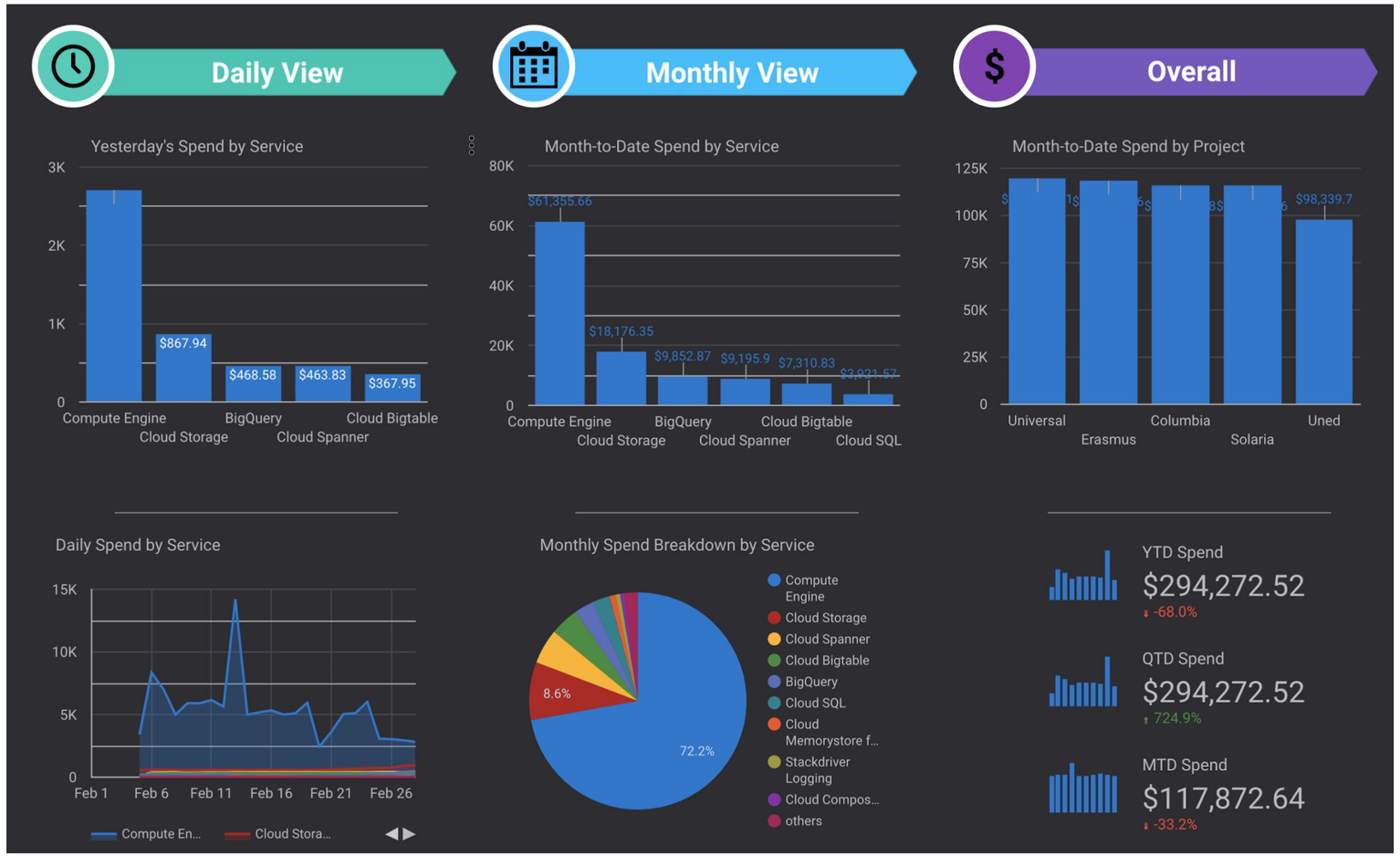
Build, collaborate, and share your dashboards



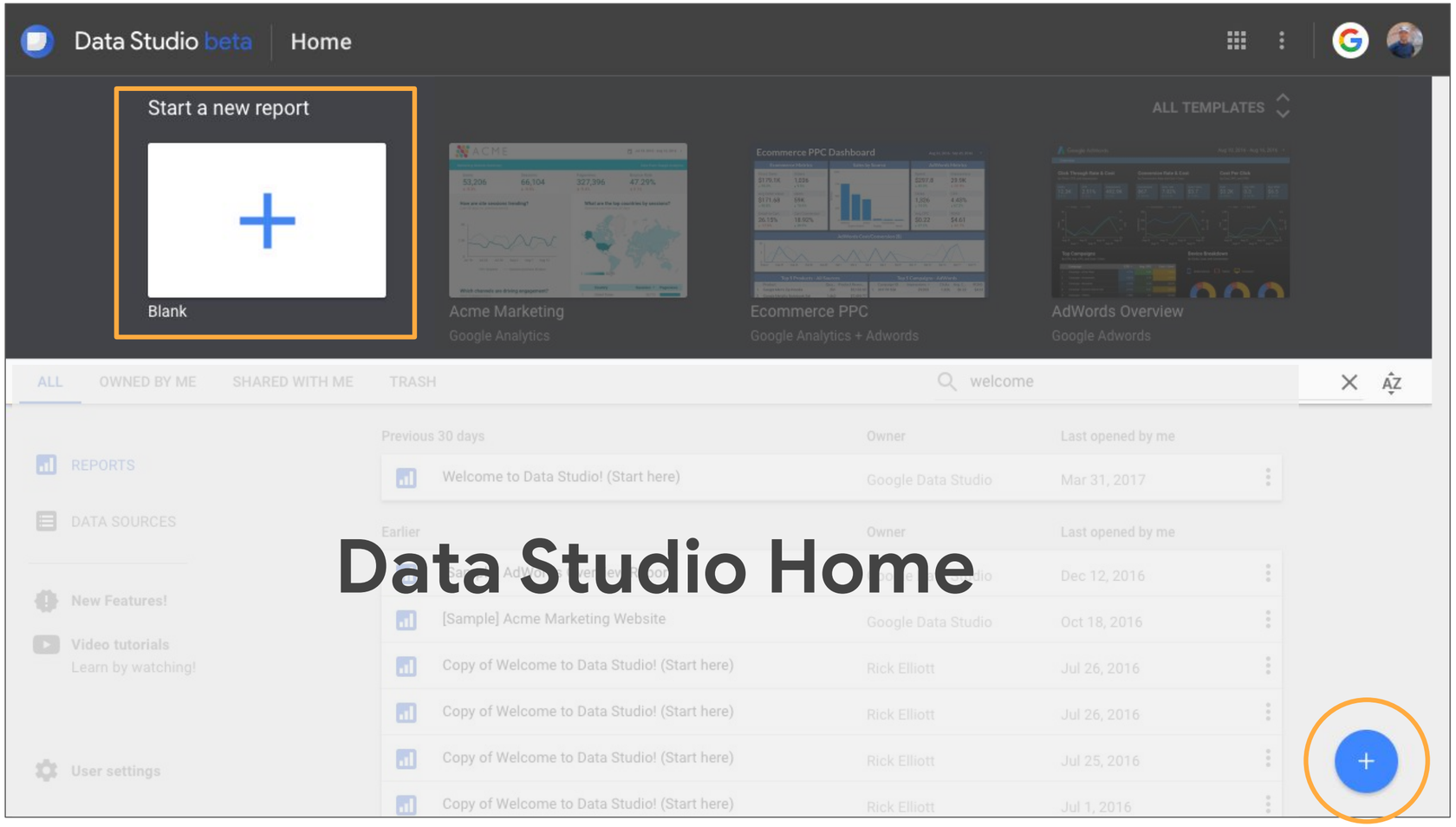
Tell a clear story with your data

Share and collaborate on reports with others

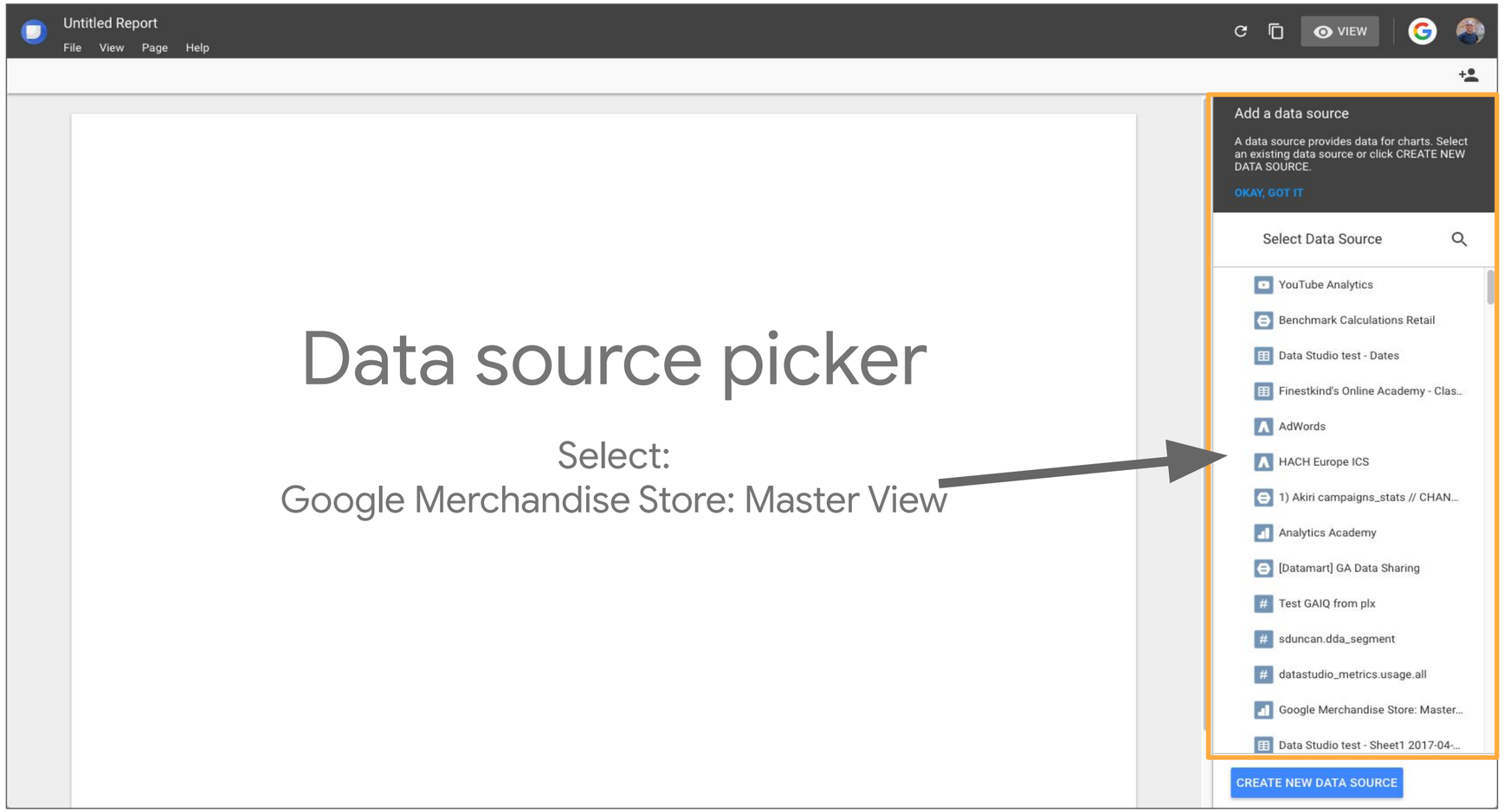
Access templates like this GCP Billing Dashboard



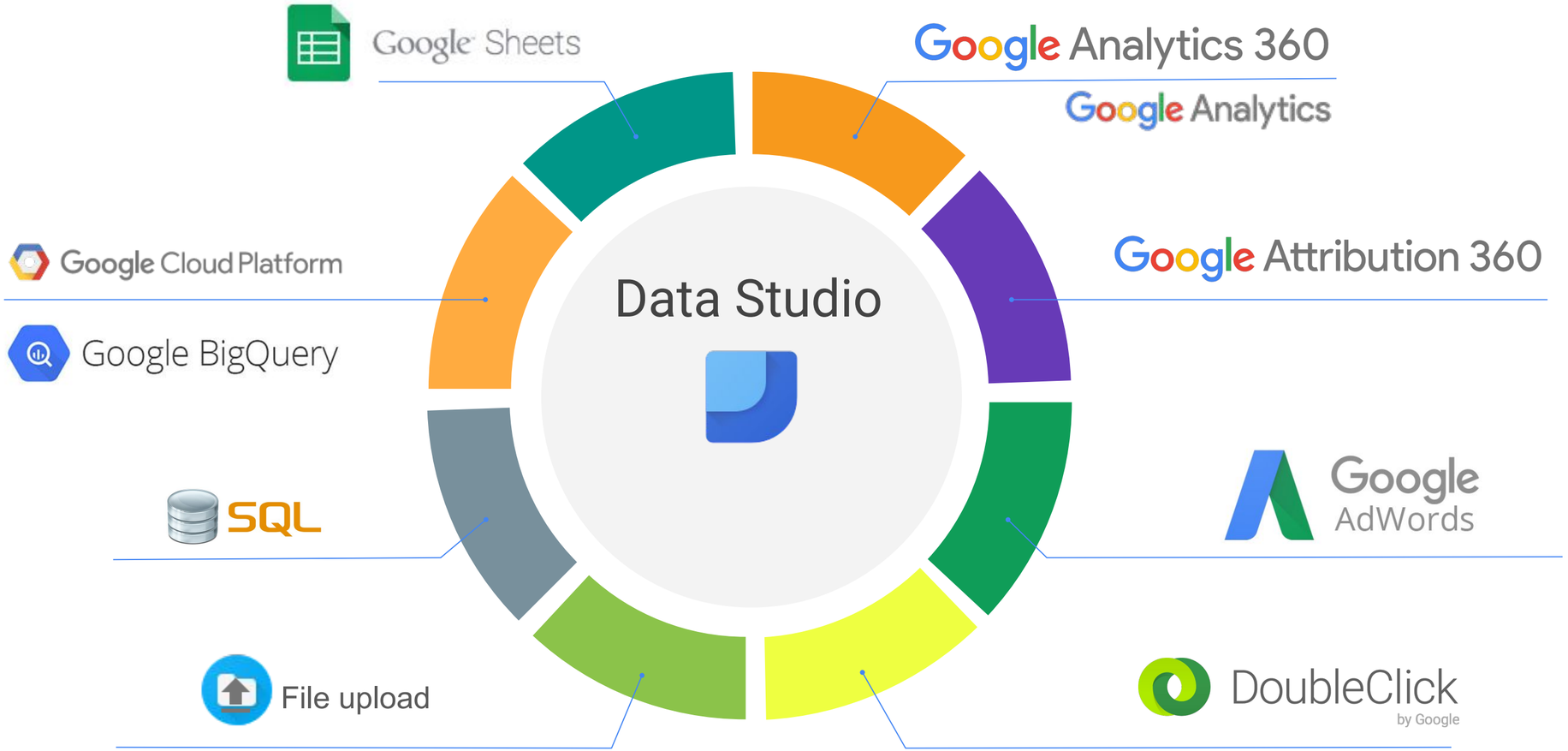
Create new reports in the Data Studio UI



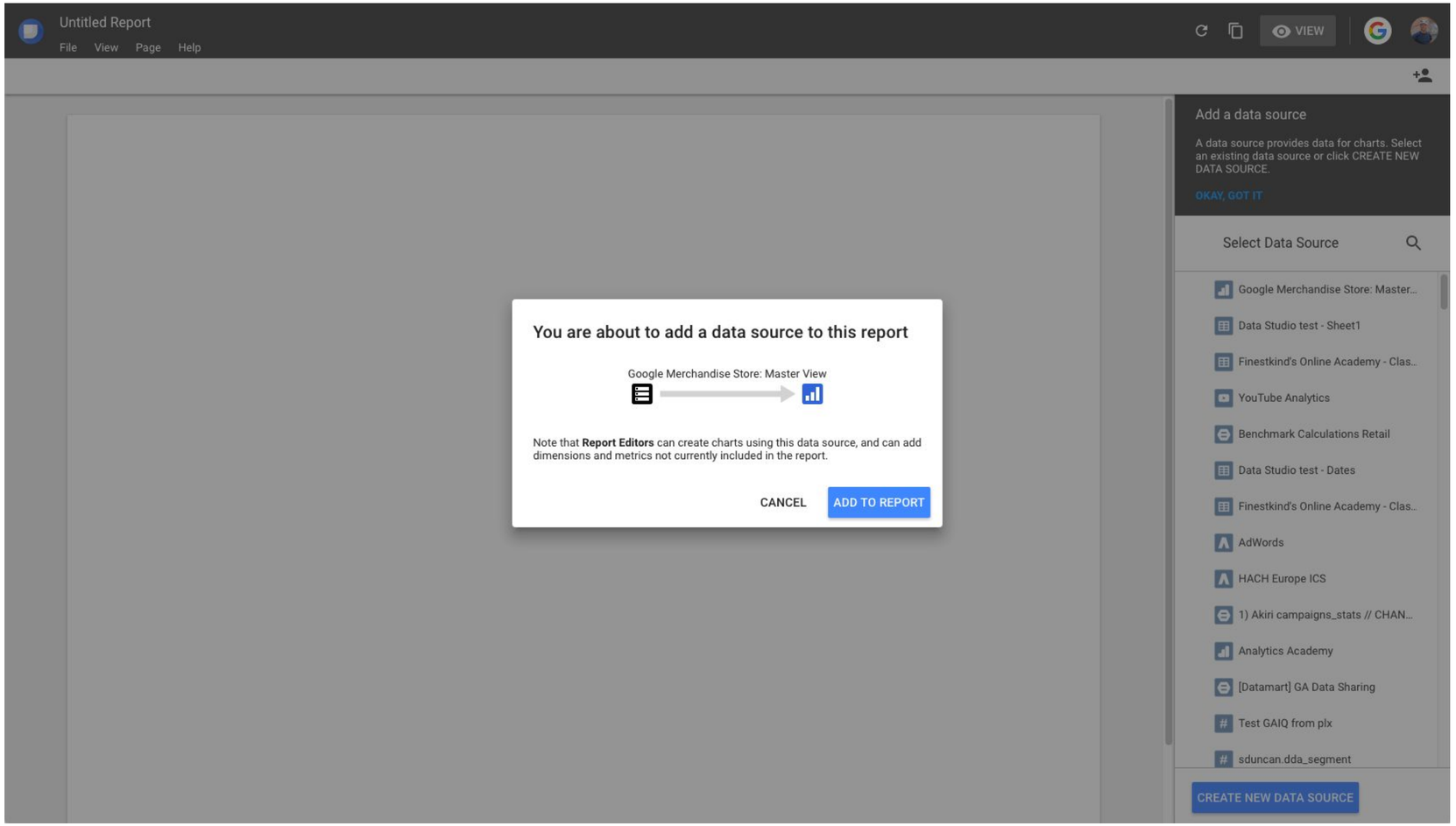
Select data sources to build your visualizations



Connect to multiple different types of data sources



Add the data source to your report



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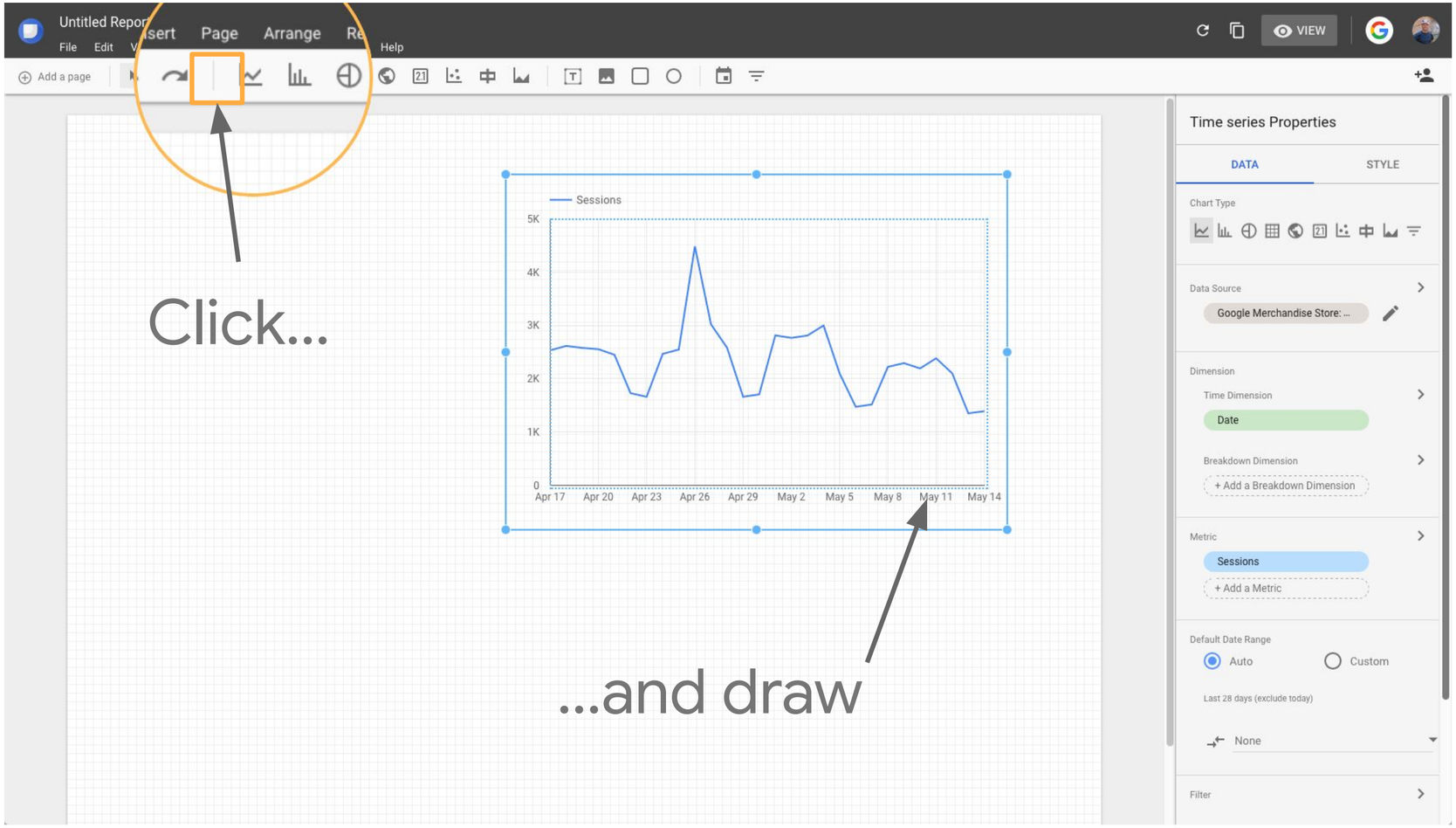
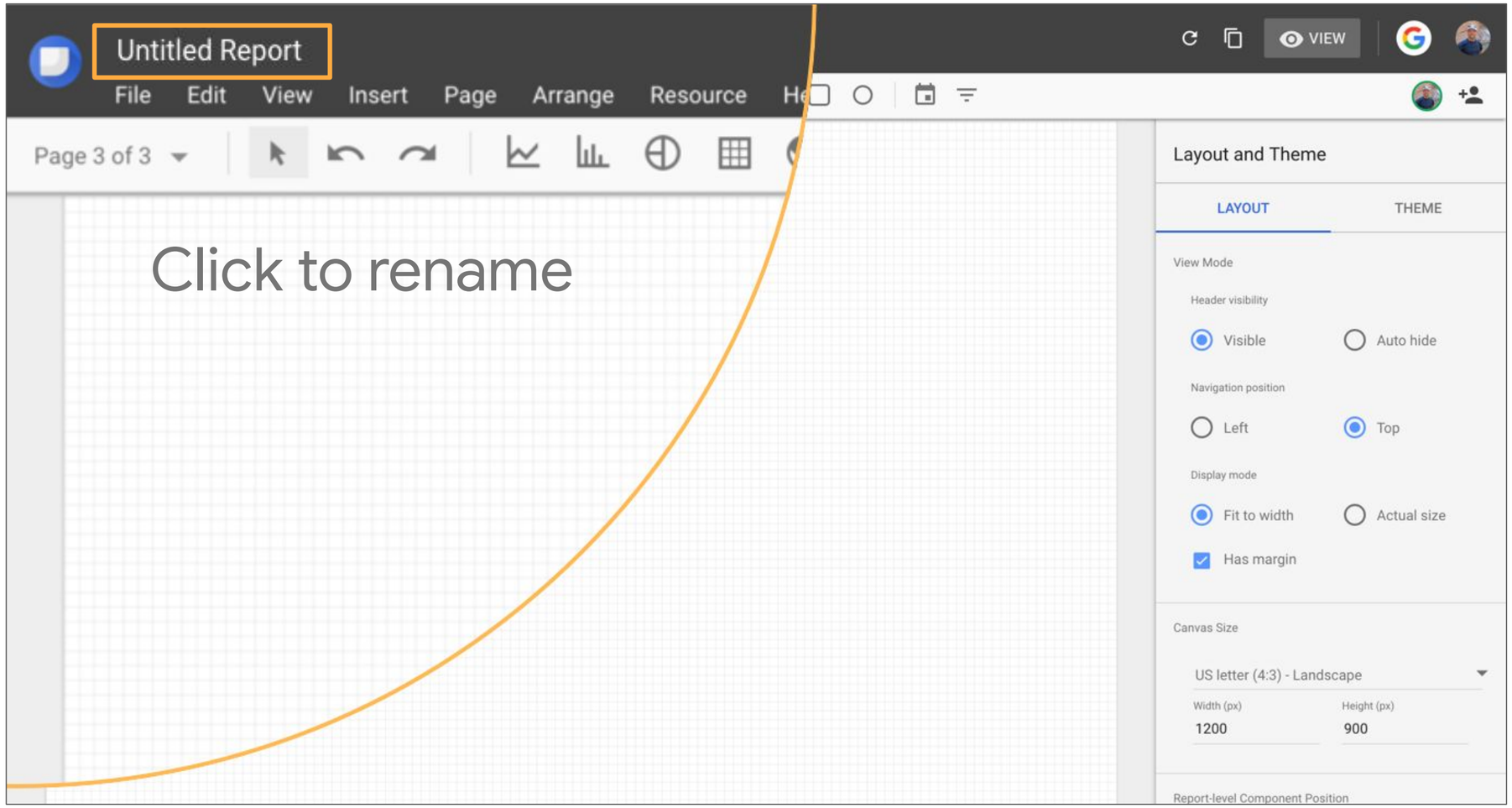
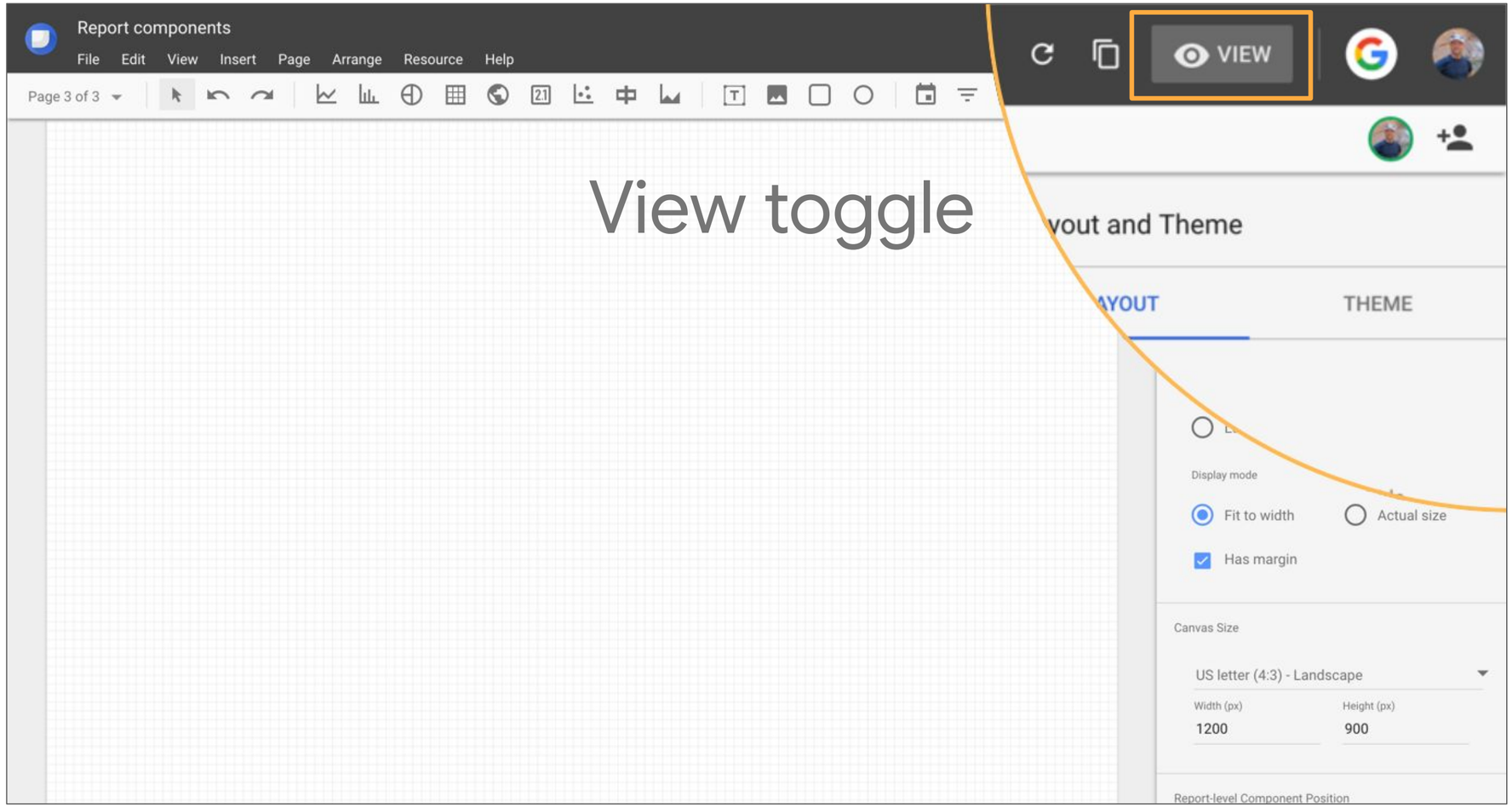
Create charts to visualize data relationships



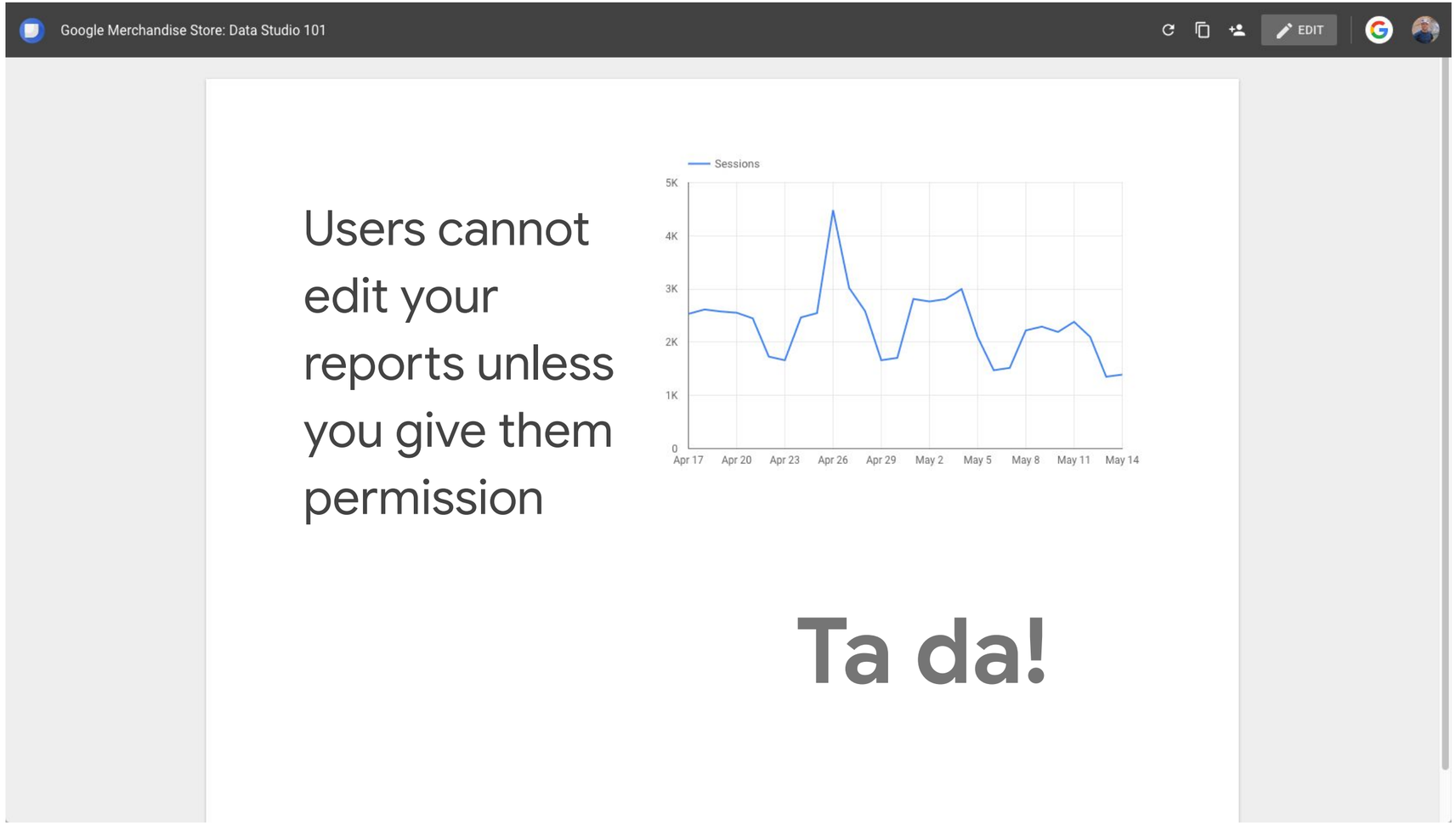
Add a descriptive name to your report



View the end-user version of the report



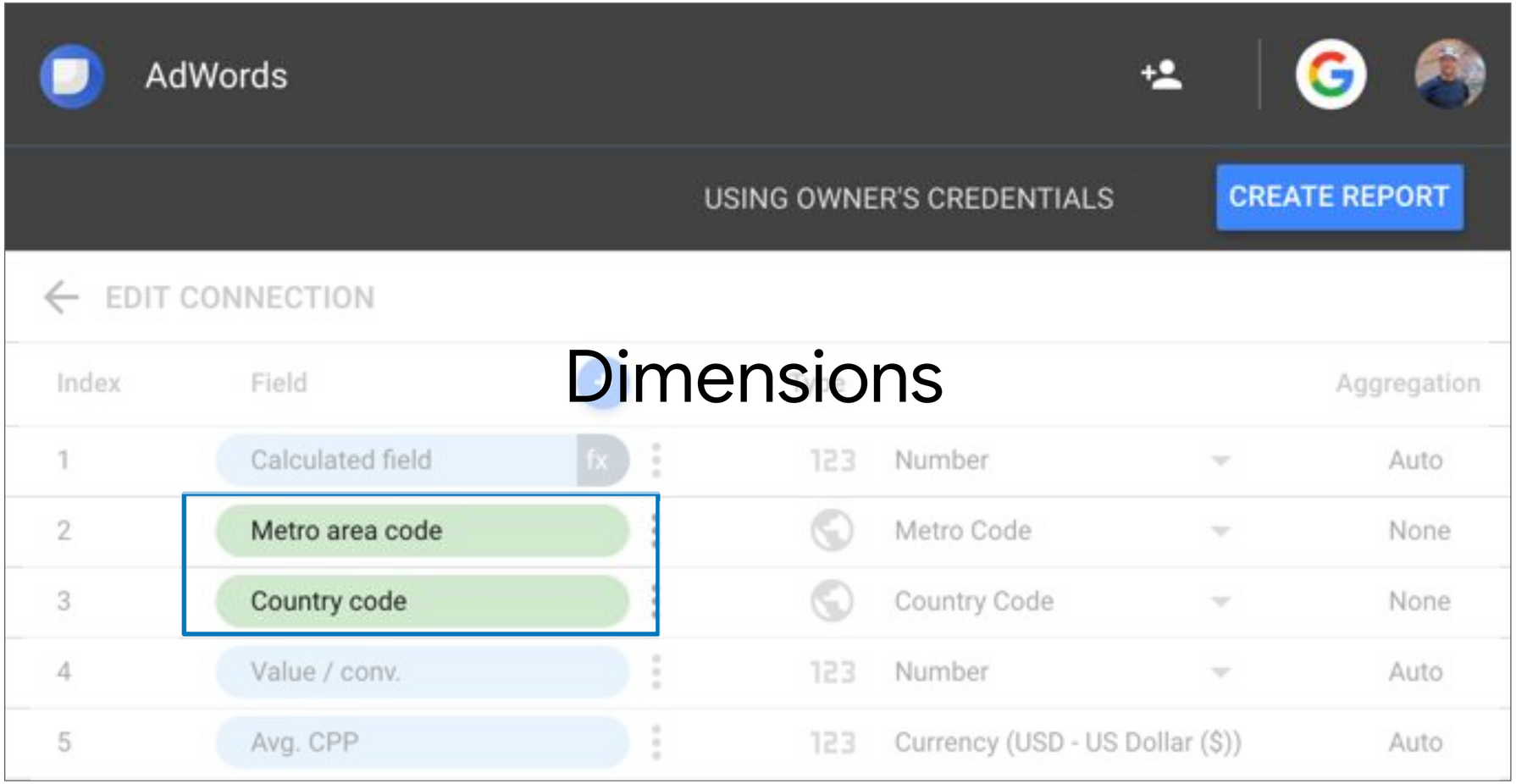
View your report as an end-user



Users cannot edit your reports unless you give them permission

Ta da!

Understand the date source shade



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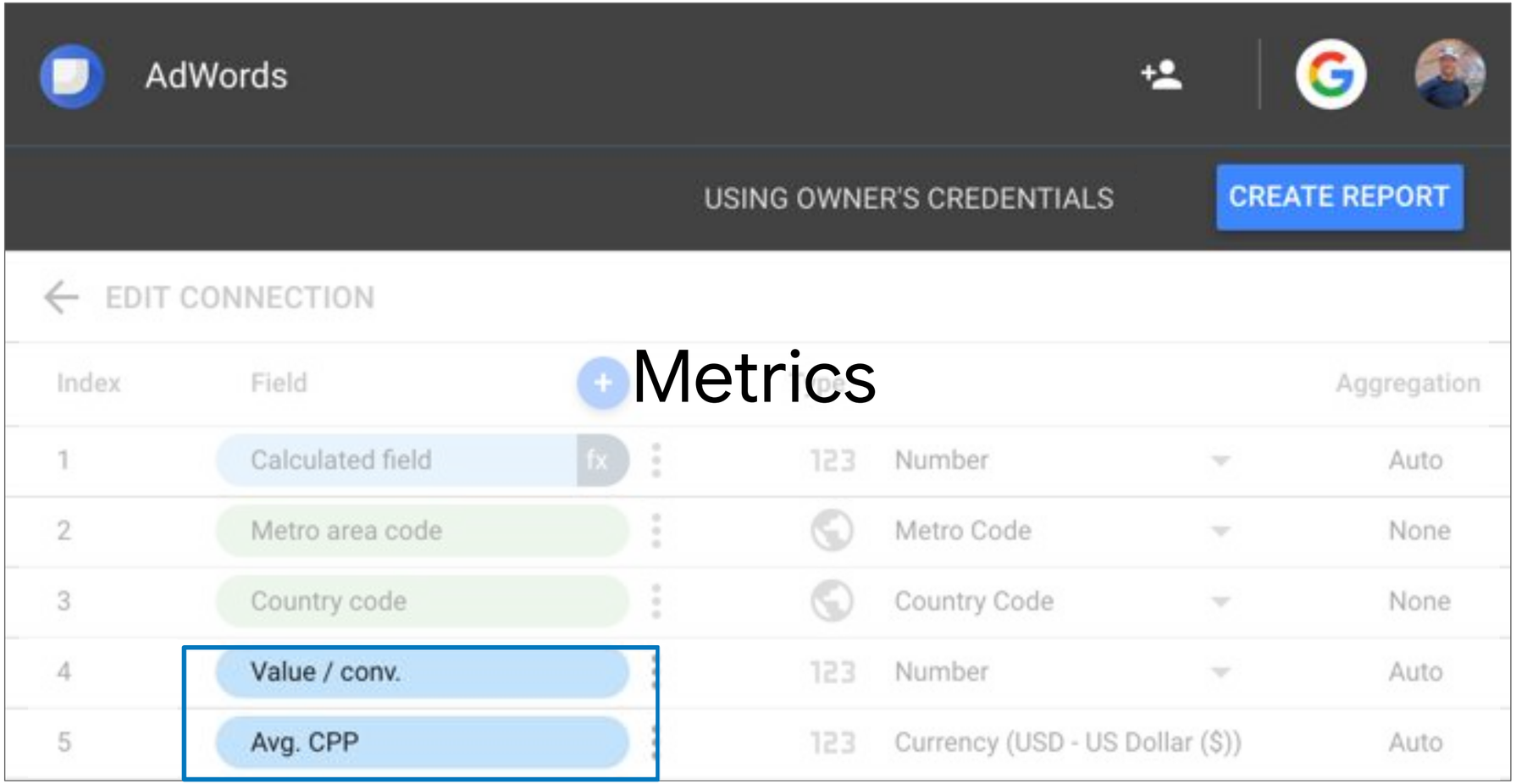
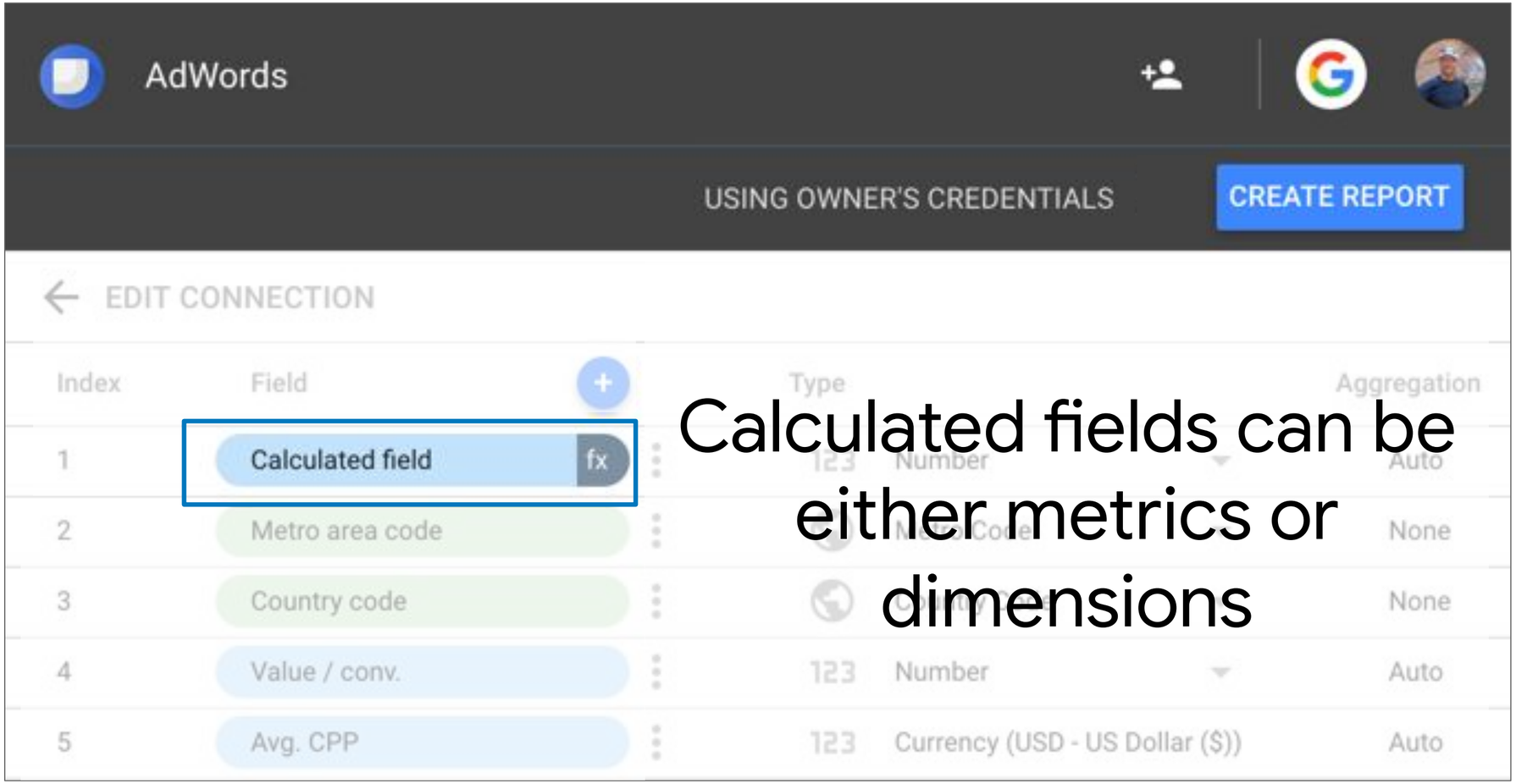


Understand the date source shade



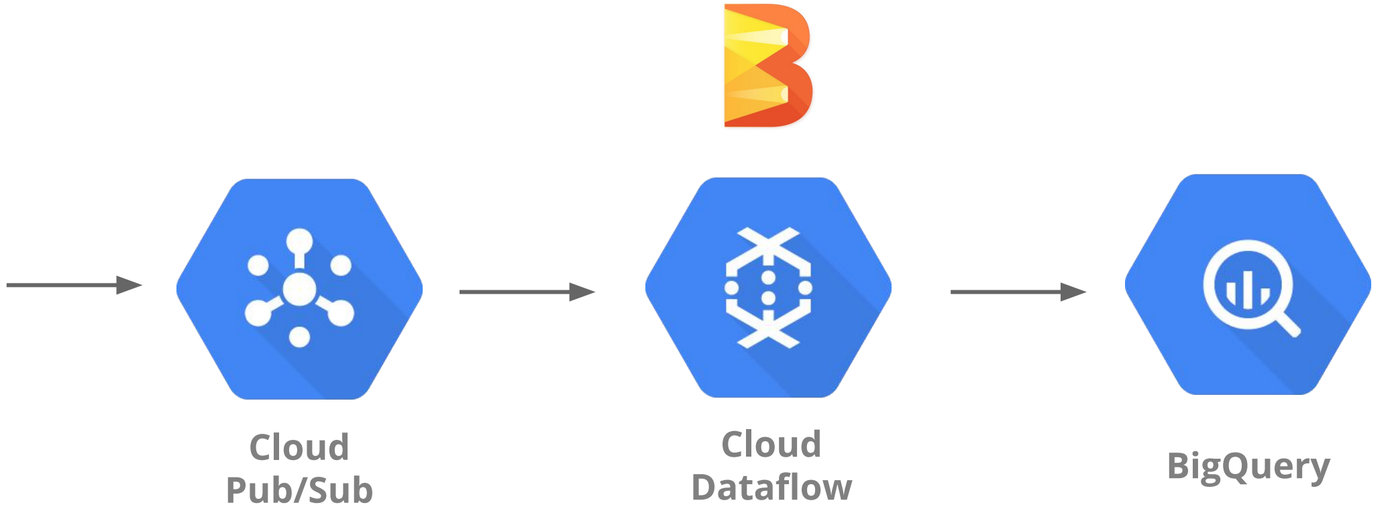
Calculated fields can be either metrics or dimensions

Sharing and Collaborating on Dashboards

- Data Studio uses Google Drive for sharing and storing files.
- When you share a report with view permission, no login is required to view the report. A Google login is required to edit a report.
- Sharing a report does NOT share direct access to any added data sources.
- Data sources must be shared separately from reports.

Lab: Real-time dashboards with Pub/Sub, Dataflow, and Data Studio

How can I monitor streaming insights for my business?



Lab

Streaming Data into BigQuery with Pub/Sub and DataFlow

- Setup streaming taxi cab topic in Pub/Sub
- Create Dataflow job from template
- Stream and monitor pipeline in BigQuery
- Analyze results and create views
- Visualize key metrics in Data Studio