Scalable Cloud-Native

How to Build a Streaming Database
(in Three Challenging Steps)

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What is a
Streaming Database?

Streaming Database

The user is able to trade off **when** their work is done, at <u>data ingestion</u> or <u>query time</u>, through their use of

CREATE VIEW   and   SELECT

Same SQL, same scale-out dataflow infrastructure.

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Demo (Streaming)

```
mcsherry@gallustrate ~ % psql "postgres://mcsherry%40materi
alize.com@51q8veosv9gow5ly1nwc488db.us-east-1.aws.staging.m
aterialize.cloud:6875/materialize?sslmode=require"
```

datacouncil.sql ✕

```sql
1   -- Auction data as `auctions` and `bids`.
2   CREATE SOURCE auction_house
3   FROM LOAD GENERATOR AUCTION (TICK INTERVAL '1ms')
4   FOR ALL TABLES
5   WITH (SIZE = '3xsmall');
6
7   -- Brief data exploration.
8   SELECT COUNT(*) FROM auctions;
9   SELECT COUNT(*) FROM auctions WHERE end_time > mz_now();
10
11  -- Collect bids that are for currently active auctions
12  CREATE VIEW active_bids AS
13  SELECT
14      bids.id,
15      bids.buyer,
16      bids.auction_id,
17      bids.amount,
18      bids.bid_time
19  FROM bids
20  JOIN auctions ON bids.auction_id = auctions.id
21  WHERE auctions.end_time > mz_now()
22    AND bids.bid_time + INTERVAL '10 seconds' > mz_now();
23
24  -- Bids that are beating an active bid.
25  CREATE VIEW out_bids AS
26  SELECT
27      a1.id,
28      a1.buyer,
29      a1.auction_id,
30      a1.amount,
31      a1.bid_time,
32      a2.buyer AS other_buyer,
33      a2.amount AS other_amount
34  FROM active_bids a1, active_bids a2
```
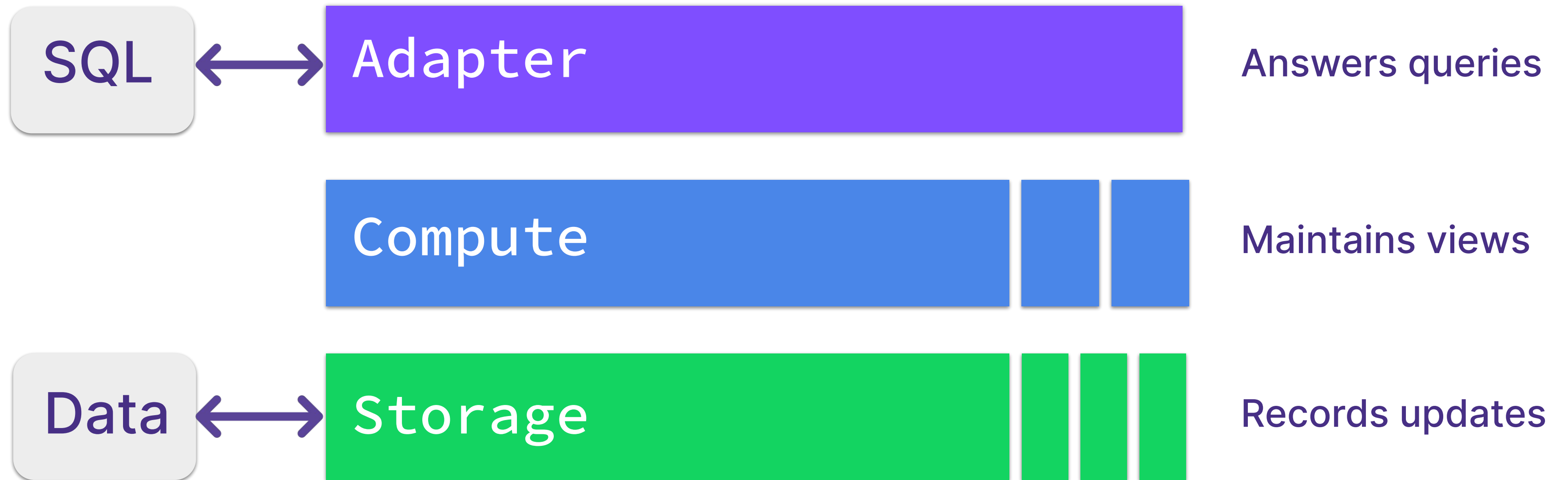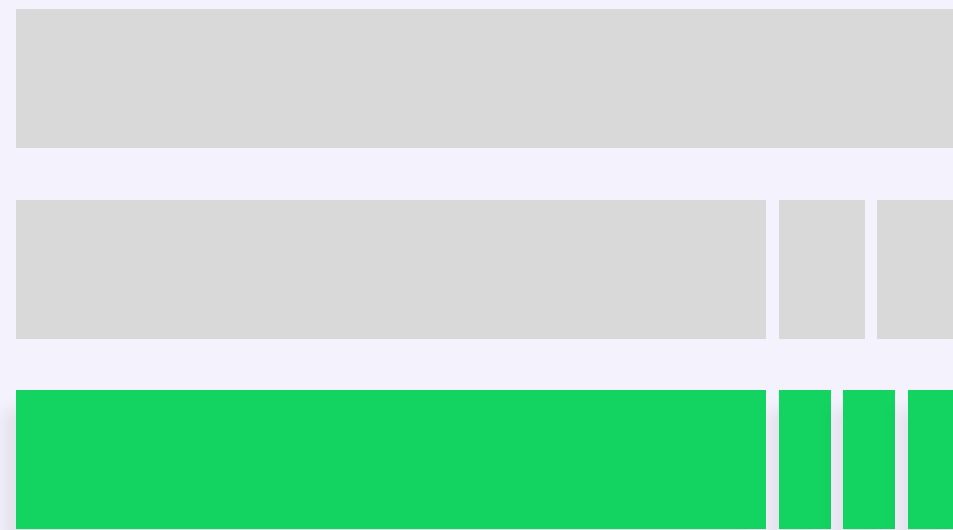
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What is a

Scalable Cloud-Native

Streaming Database?

A Scalable Cloud-Native Streaming Database

SQL	⟷	**Adapter**	Answers queries
		Compute	Maintains views
Data	⟷	**Storage**	Records updates

A Scalable Cloud-Native Streaming Database

SQL ⟷ **Adapter**

Answers queries
at virtual times

Compute

Maintains views
at virtual times

Data ⟷ **Storage**

Records updates
at virtual times

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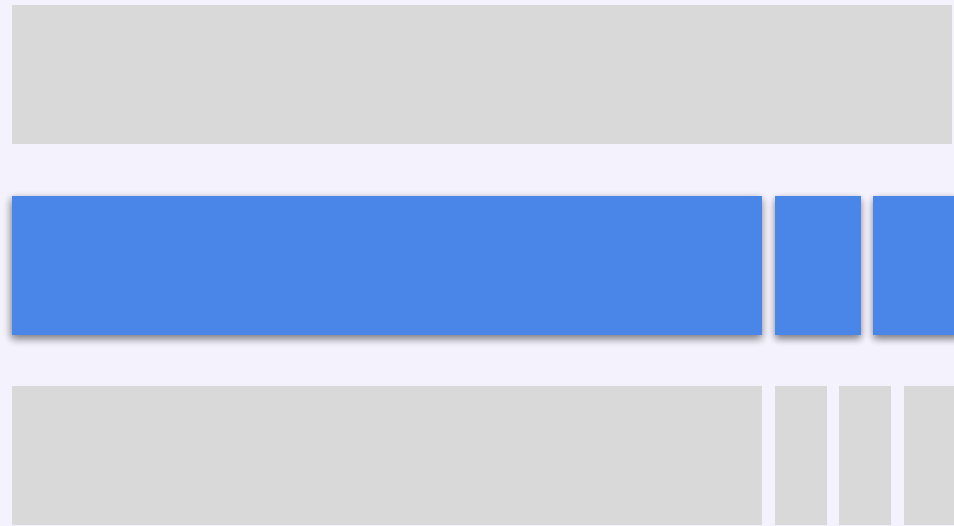
Storage Layer

Records updates

Challenge: durability

Data arrive as Change Data Capture (CDC) streams: PostgreSQL, Debezium, Kafka Upsert, ...

... and are then written in CRDB/S3 as *"time varying collections"*
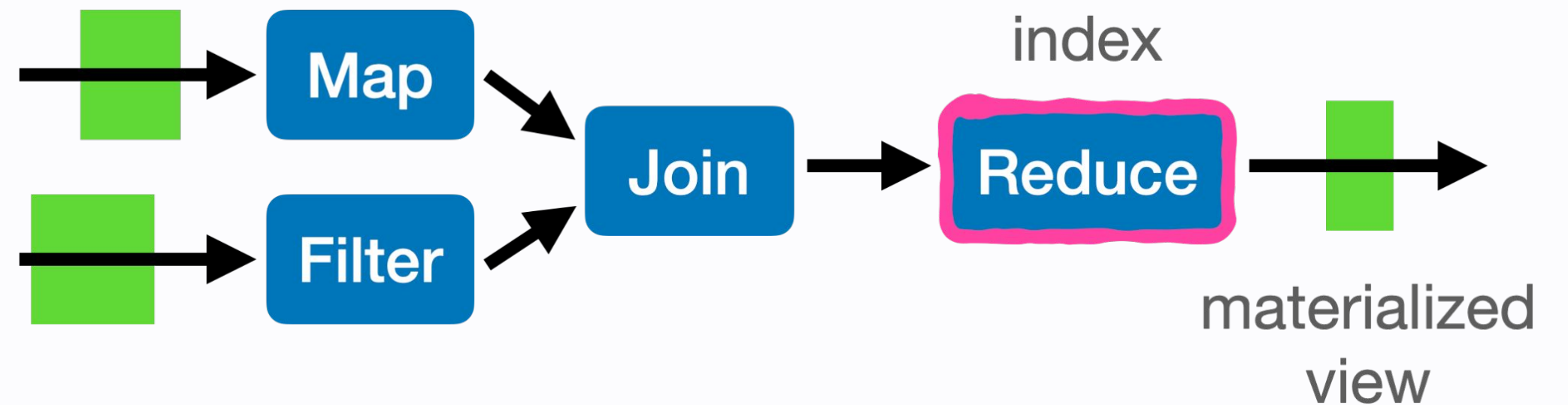
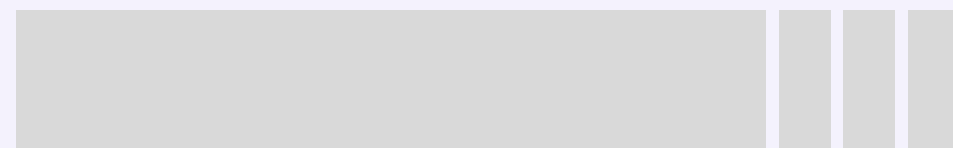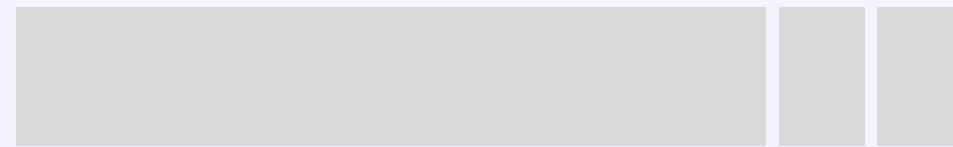# Compute Layer

Maintains views

Challenge:
performance

SQL queries translate to data-parallel dataflow: from CDC input to CDC output.

Output updates correspond exactly to inputs.

index

Map

Filter

Join

Reduce

materialized view
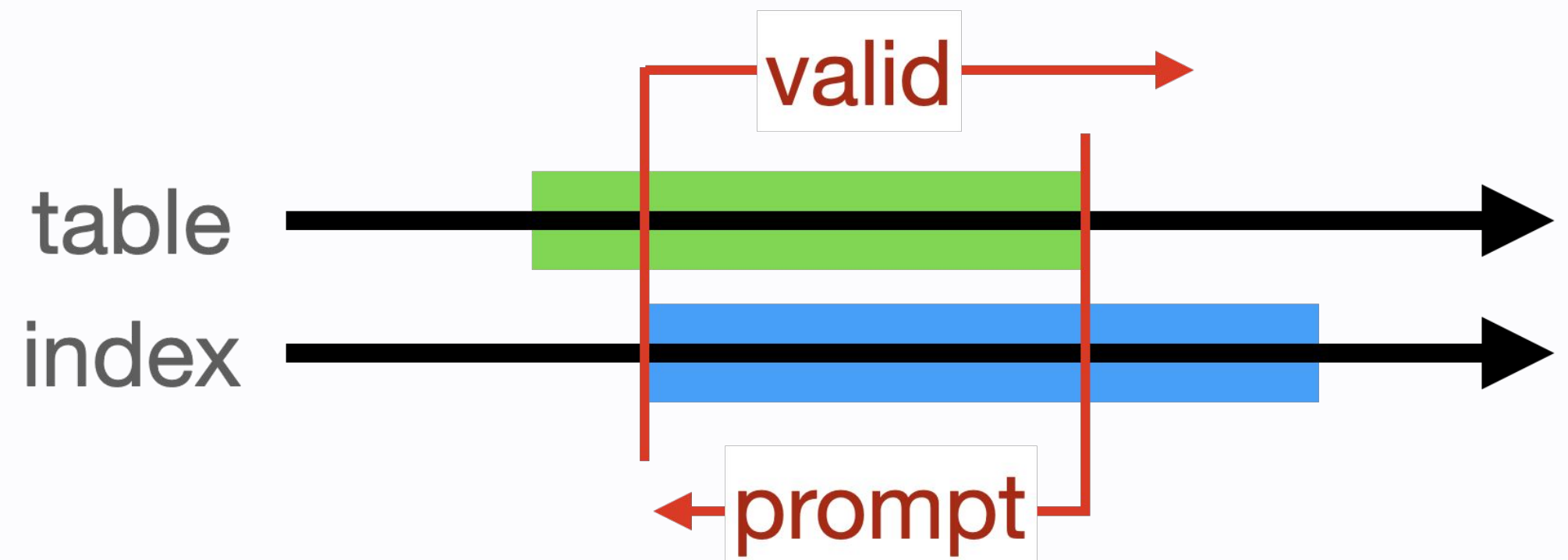
Adapter Layer

Answers queries

Challenge:
consistency

SQL commands need timestamps.

For strict serializability:
        timestamps must increase.

A Scalable Cloud-Native Streaming Database

SQL ←→ **Adapter**

Answers queries
at virtual times

Compute

Maintains views
at virtual times

Data ←→ **Storage**

Records updates
at virtual times

Demo (Scaling)

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```
1679843574001    t    \N        \N        \N       \N
1679843575001    t    \N        \N        \N       \N
1679843575395    f    -1        548298    3612     88
1679843575395    f    -1        548298    2089     95
1679843575395    f    -1        548298    2468     65
1679843575395    f    -1        548298    3831     49
1679843576001    t    \N        \N        \N       \N
1679843577001    t    \N        \N        \N       \N
1679843577399    f    -1        548623    382      35
1679843577399    f    -1        548623    134      54
1679843577399    f    -1        548623    668      63
1679843577399    f    -1        548623    724      55
1679843577399    f    -1        548623    3563     56
1679843577399    f    -1        548623    1012     85
1679843578001    t    \N        \N        \N       \N
1679843579001    t    \N        \N        \N       \N
1679843580001    t    \N        \N        \N       \N
1679843581001    t    \N        \N        \N       \N
1679843582001    t    \N        \N        \N       \N
1679843583001    t    \N        \N        \N       \N
1679843584000    f    1         550953    1083     86
1679843584001    t    \N        \N        \N       \N
1679843585001    t    \N        \N        \N       \N
1679843586001    t    \N        \N        \N       \N
1679843587001    t    \N        \N        \N       \N
1679843588001    t    \N        \N        \N       \N
1679843589001    t    \N        \N        \N       \N
1679843590001    t    \N        \N        \N       \N
1679843591001    t    \N        \N        \N       \N
1679843592001    t    \N        \N        \N       \N
1679843592432    f    -1        550953    1083     86
1679843593001    t    \N        \N        \N       \N
1679843594000    f    1         552514    794      37
1679843594001    t    \N        \N        \N       \N
1679843595001    t    \N        \N        \N       \N
```

```
materialize=>
```

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A Scalable Cloud-Native Streaming Database

SQL ⟷ **Adapter**

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Thank you!

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