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LAB SESSION 04 - Time Series DB

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Why use time series DB?

- Optimized for time-stamped or time series data
- Support for dropping / archiving older data (retention policies)
- You care about ingesting speed and throughput as much as possible.
- Typical use cases: IoT, monitoring, sensor, data which is immutable

Time series DB: High cardinality issues

Cardinality often refers to the number of distinct elements in a single column.

Cardinality of the dataset = calculate the total number of unique combinations, the cardinality of each of the columns is multiplied.

Time series datasets tend to have high cardinality

Time series DB: High cardinality issues

	DIMENSIONS			MEASURES		
Timestamp	Source IP	Source Port	Protocol	Duration	Forward Packets	Backward Packets
06/12/2022 23:00:15	192.168.20.19	33118	6	36728	5	3
06/12/2022 23:00:51	192.168.20.48	53948	6	890408	17	16
06/12/2022 23:01:19	192.168.20.43	58752	6	3777984	13	13
06/12/2022 23:01:25	192.168.20.43	46084	6	8672390	17	16
06/12/2022 23:00:02	192.168.20.15	49156	17	116995737	40	0
06/12/2022 23:00:03	8.6.0.1	0	0	118298750	51	0
06/12/2022 23:00:04	192.168.20.13	49154	17	114999347	24	0
06/12/2022 23:00:04	192.168.20.12	49154	17	115000492	24	0
06/12/2022 23:00:04	192.168.20.42	37322	6	106719497	10	6
06/12/2022 23:00:03	54.217.52.155	443	6	119570085	12	13
06/12/2022 23:00:08	192.168.20.19	0	0	430015	2	0
06/12/2022 23:00:06	192.168.20.48	35582	6	112851237	25	13
06/12/2022 23:00:09	192.168.20.19	46048	6	90245130	4	4
06/12/2022 23:00:11	18.203.57.224	443	6	119999378	9	4
06/12/2022 23:00:13	192.168.20.42	35056	6	90254035	4	3
06/12/2022 23:00:03	192.168.20.10	47863	6	119997319	17	17

This network analytics table has high cardinality because the combination of unique values for Source IP, Source Port, and Protocol is very large.

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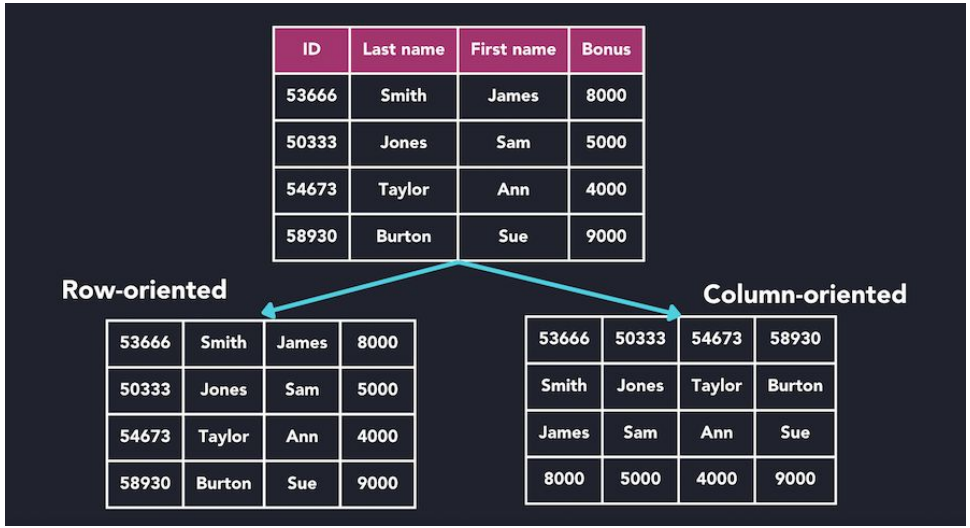
QuestDB

- Open source TSDB
- Columnar storage model
- Supports time partitions

QuestDB: Columnar storage model



- Only retrieve the columns needed to solve the query
- Great for analytical queries: ““Calculate the average and total price for an order in the last month…”

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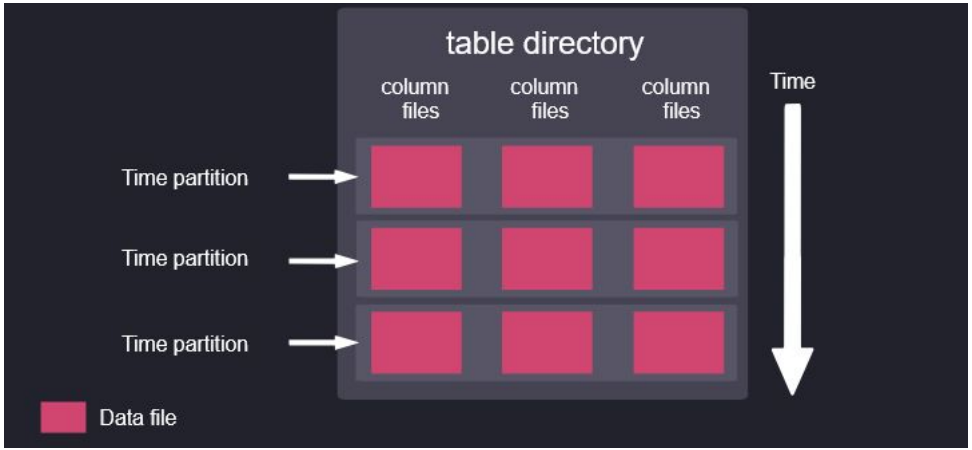
QuestDB: time partitions



- Technique that splits data in a large database into smaller chunks in order to improve the performance and scalability of the database system.
- QuestDB offers the option to partition tables by intervals of time. Data for each interval is stored in separate sets of files.

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Lab Session Structure

1. Store movie ratings and tags in QuestDB
   - Design table schema
   - Create a materialized view
   - Use Kafka Connect to ingest data
2. Work on project

Lab Session Structure: design table schema

- Time partitioning
- Symbols
- Deduplication

```
CREATE TABLE x AS (
  SELECT
    cast(x as int) i,
    - x j,
    rnd_str(5, 16, 2) as str,
    timestamp_sequence('2023-02-04T00', 60 * 1000L) ts
  FROM
    long_sequence(60 * 23 * 2 * 1000)
) timestamp (ts) PARTITION BY DAY WAL;
```

```
SHOW PARTITIONS FROM x;
```

index	partitionBy	name	minTimestamp	maxTimestamp	numRows
0	DAY	2023-02-04	2023-02-04T00:00:00.000000Z	2023-02-04T23:59:59.940000Z	1440000
1	DAY	2023-02-05	2023-02-05T00:00:00.000000Z	2023-02-05T21:59:59.940000Z	1320000

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Lab Session Structure: materialized view

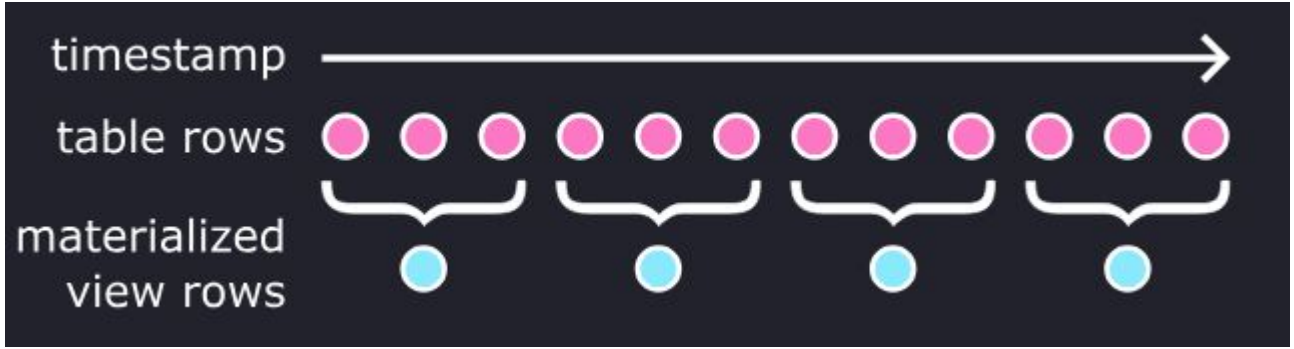
- Stores the pre-computed results of a query.
- Persist their data to disk.
- Efficient for expensive aggregate queries that are run frequently.

```
SELECT
  timestamp,
  symbol,
  side,
  sum(price * amount) AS notional
FROM trades
SAMPLE BY 1m;
```

Scans the entire dataset -> slower as the dataset grows

Lab Session Structure: materialized view

As you add new data to the base table, the materialized view will efficiently update itself. You can then query the materialized view as a regular table without the impact of a full table scan of the base table.



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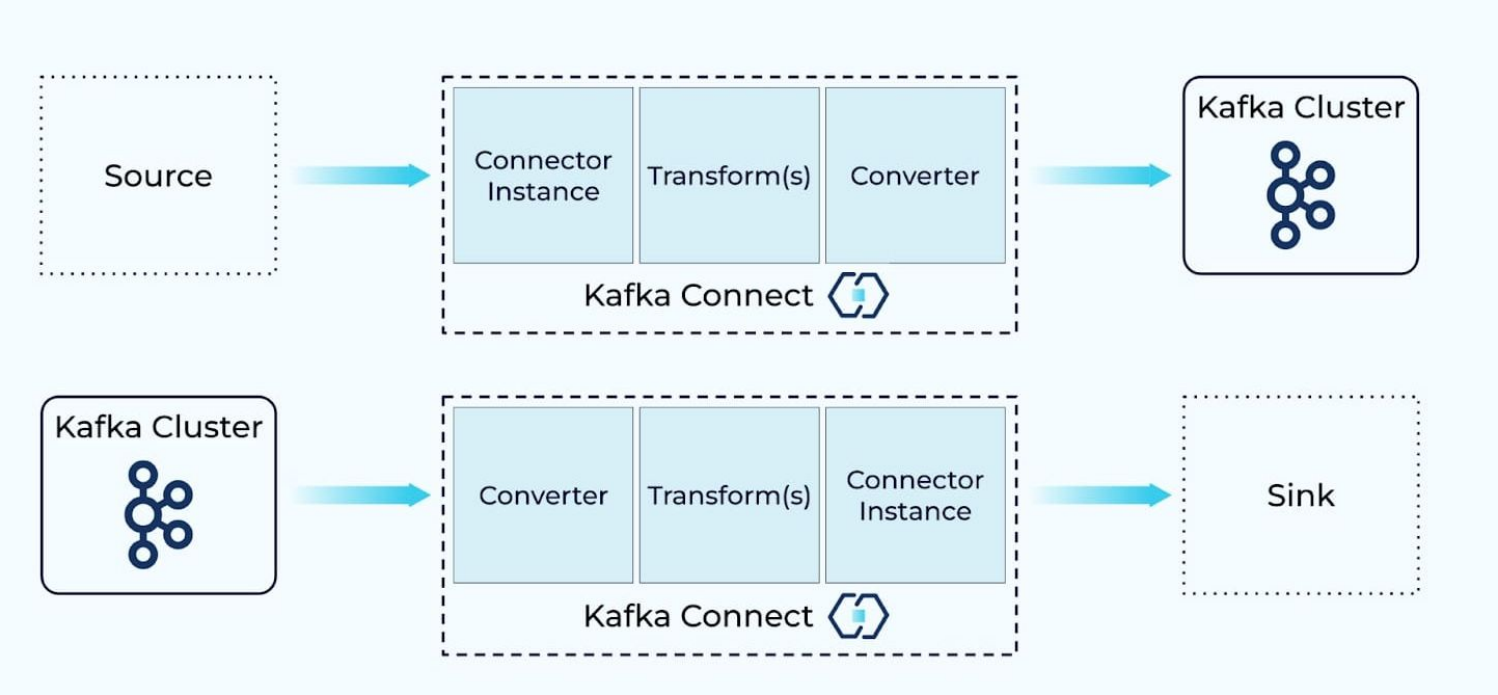
Lab Session Structure: Kafka Connect



Lab Session Structure: Kafka Connect

Use the REST API to submit connector config, start, stop and monitor workers / tasks.

```
name=questdb-sink
client.conf.string=http::addr=localhost:9000;
topics=example-topic
table=example_table

connector.class=io.questdb.kafka.QuestDBSinkConnector

# message format configuration
value.converter=org.apache.kafka.connect.json.JsonConverter
include.key=false
key.converter=org.apache.kafka.connect.storage.StringConverter
value.converter.schemas.enable=false
```

Tips: use json for the connector config

https://github.ugent.be/GDV/lab-time-series-db