دوره آموزشی
مهندسی داده [Data Engineer]

مدرس: مجتبی بنائی

nikamooz;
آموزش برنامه نویسی و اجرای پروژه

جلسه: بیست و یکم

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جلسه بیست و یکم

آپاچی درویید

دیتابیس‌های تحلیلی - بخش دوم

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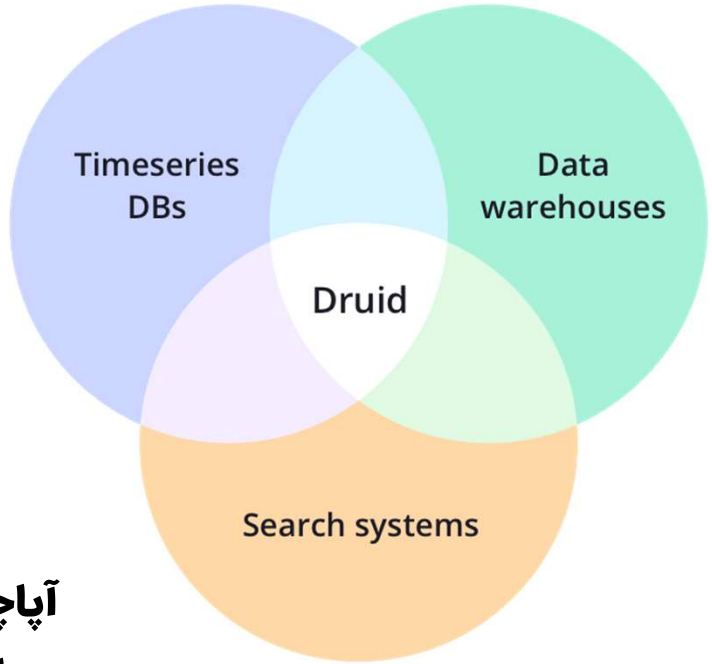
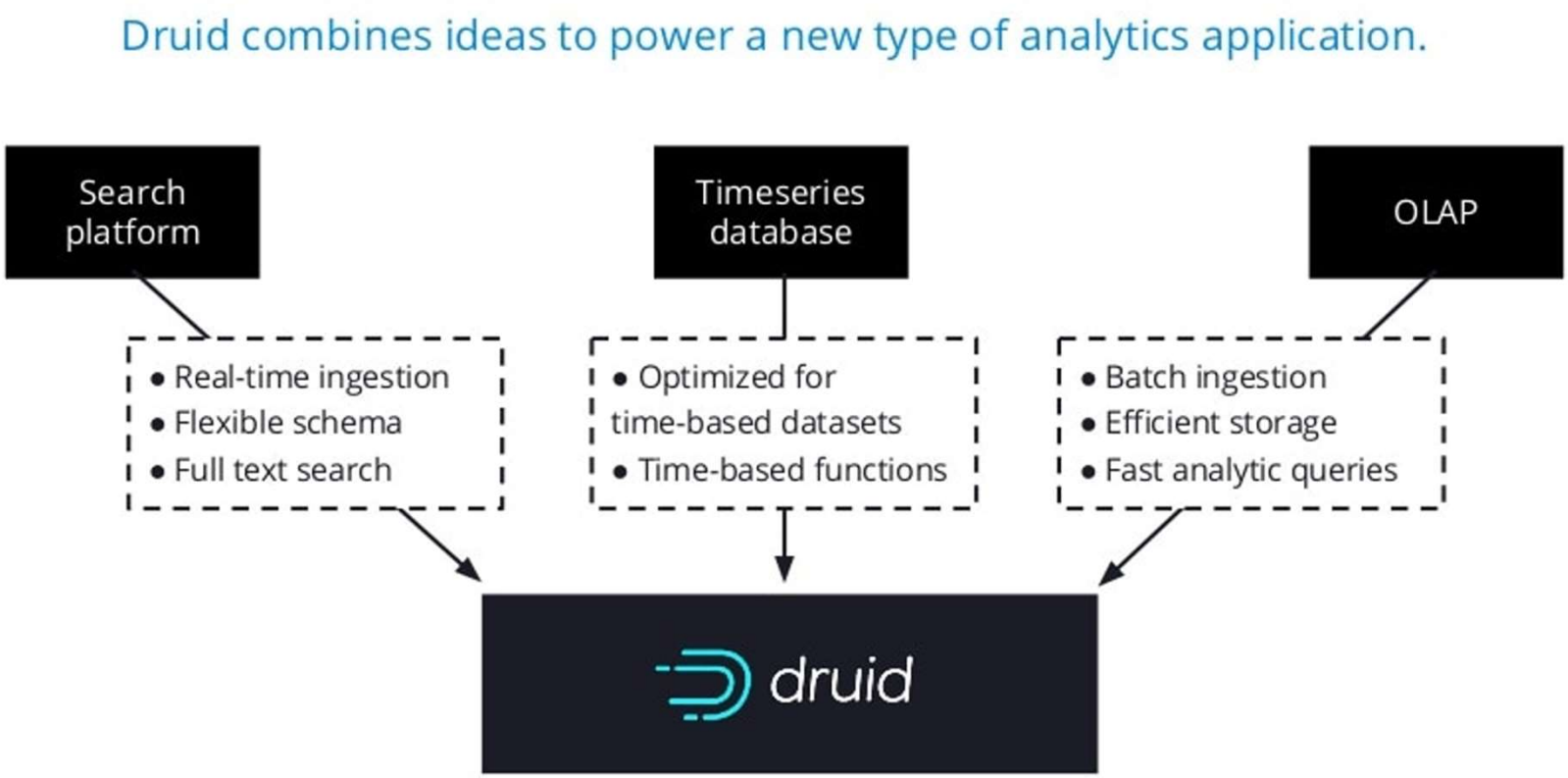
درویید - تعریف رسمی سایت آپاچی

- Apache Druid is an open source distributed data store.
- Druid's core design combines ideas from **data warehouses**, **timeseries databases**, and **search systems** to create a high performance real-time analytics database for a broad range of **use cases**.
- Druid merges key characteristics of each of the 3 systems into **its ingestion layer**, **storage format**, **querying layer**, and **core architecture**.



آپاچی درویید یک دیتابیس تحلیلی توزیع شده برای ذخیره و پردازش بلادرنگ حجم عظیم جریان‌های ورودی داده است.

درواید - در یک نگاه



قابلیت‌های کلیدی

Column-oriented storage

Druid stores and compresses each column individually, and only needs to read the ones needed for a particular query, which supports fast scans, rankings, and groupBys.

Native search indexes

Druid creates inverted indexes for string values for fast search and filter.

Streaming and batch ingest

Out-of-the-box connectors for Apache Kafka, HDFS, AWS S3, stream processors, and more.

Flexible schemas

Druid gracefully handles evolving schemas and nested data.

قابلیت‌های کلیدی

Time-optimized partitioning
Druid intelligently partitions data based on time and time-based queries are significantly faster than traditional databases.

SQL support
In addition to its native JSON based language, Druid speaks SQL over either HTTP or JDBC.

Horizontal scalability
Druid has been used in production to ingest millions of events/sec, retain years of data, and provide sub-second queries.

Easy operation
Scale up or down by just adding or removing servers, and Druid automatically rebalances. Fault-tolerant architecture routes around server failures.

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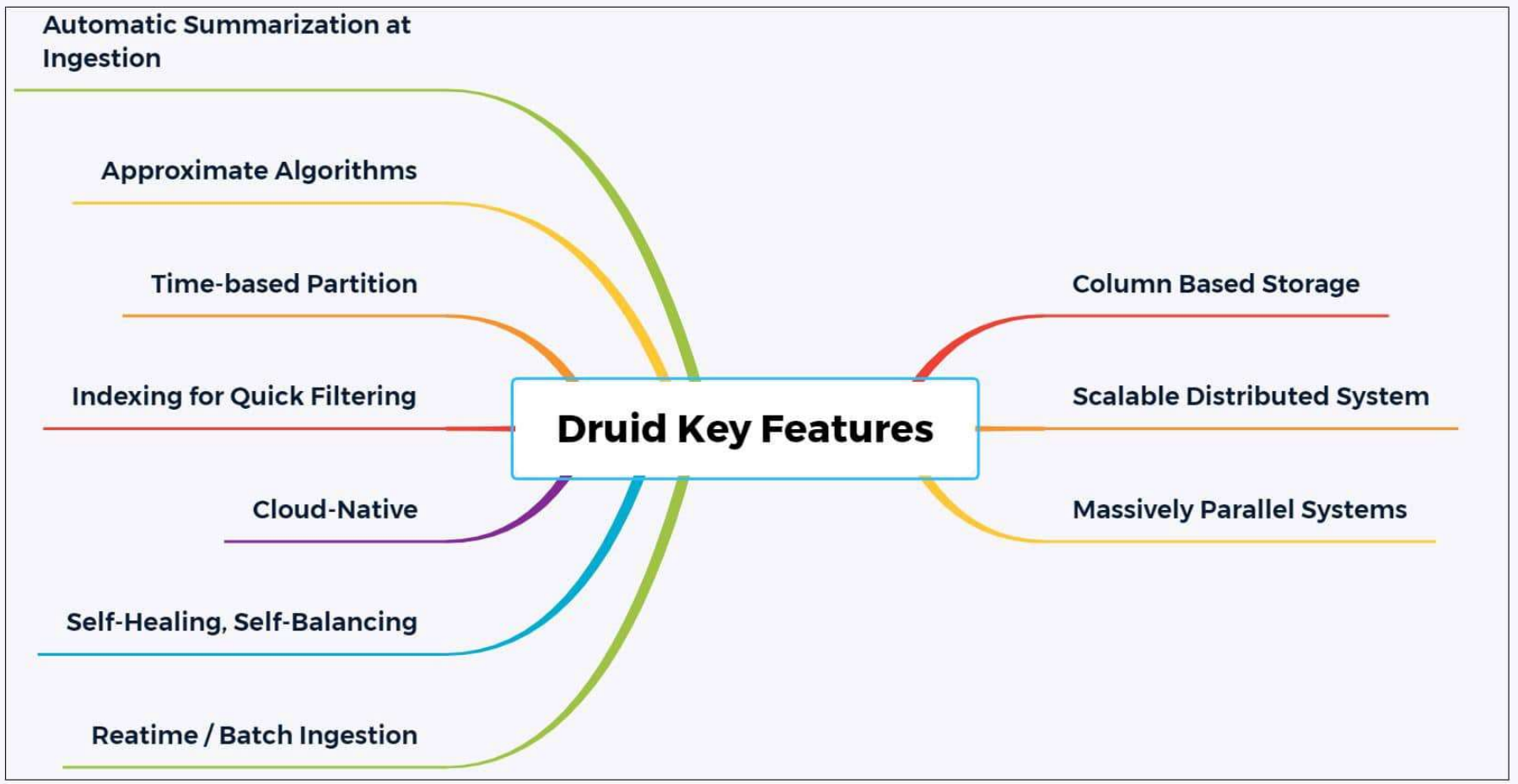
قابلیت‌های کلیدی



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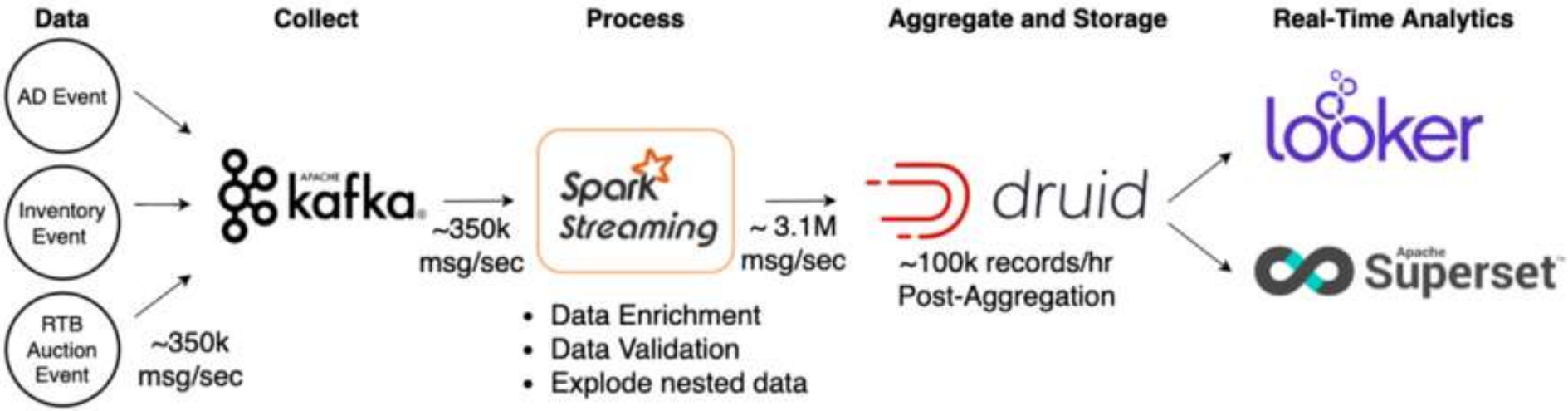
درواید در عمل - GumGum



Optimized Real-time Analytics using Spark Streaming and Apache Druid **Jun 2, 2020**

gumgum

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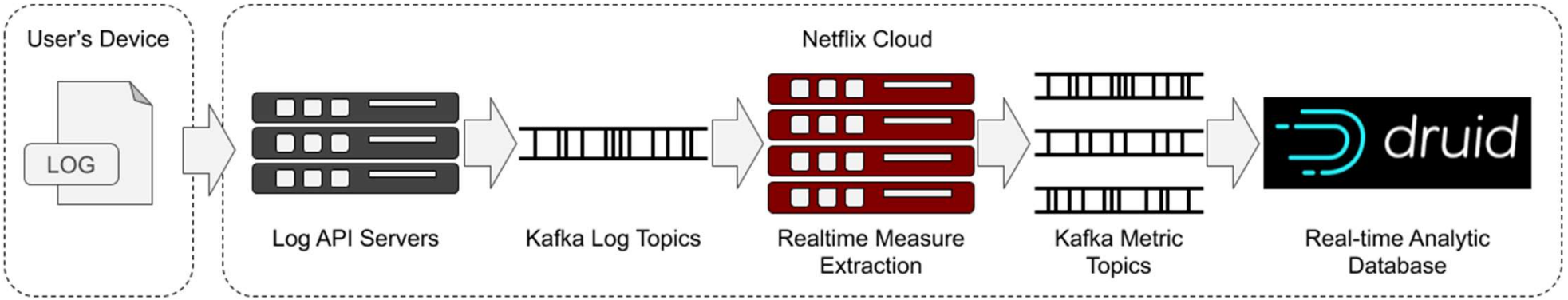
درواید در عمل - Netflix



How Netflix uses Druid for Real-time Insights to Ensure a High-Quality Experience - **Mar 3,2020**

NETFLIX

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تولد درويد - 2011

metamarkets.com/2011/druid-part-i-real-time-analytics-at-a-billion-rows-per-second/

METAMARKETS PRODUCTS SOLUTIONS RESOURCES COMPANY LOG IN

Technology Corporate Druid

Introducing Druid: Real-Time Analytics at a Billion Rows Per Second

APRIL 30TH, 2011 ERIC TSCHETTER

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تولد درواید - 2011

Here at Metamarkets we have developed a web-based analytics console that supports drill-downs and roll-ups of high dimensional data sets – comprising billions of events – in real-time. This is the first of two blog posts introducing Druid, the data store that powers our console. Over the last twelve months, we tried and failed to achieve scale and speed with relational databases (Greenplum, InfoBright, MySQL) and NoSQL offerings (HBase). So instead we did something crazy: we rolled our own database. Druid is the distributed, in-memory OLAP data store that resulted.

The Challenge: Fast Roll-Ups Over Big Data

To frame our discussion, let's begin with an illustration of what our raw impression event logs look like, containing many dimensions and two metrics (click and price).

timestamp	publisher	advertiser	gender	country	dimensions	click	price
2011-01-01T01:01:35Z	bieberfever.com	google.com	Male	USA		0	0.65
2011-01-01T01:03:63Z	bieberfever.com	google.com	Male	USA		0	0.62
2011-01-01T01:04:51Z	bieberfever.com	google.com	Male	USA		1	0.45
...							
2011-01-01							
2011-01-01							
2011-01-01							
...							

Roll-Ups

timestamp	publisher	advertiser	gender	country	impressions	clicks	revenue
2011-01-01T01:00:00Z	ultratrimfast.com	google.com	Male	USA	1800	25	15.70
2011-01-01T01:00:00Z	bieberfever.com	google.com	Male	USA	2912	42	29.18
2011-01-01T02:00:00Z	ultratrimfast.com	google.com	Male	UK	1953	17	17.31
2011-01-01T02:00:00Z	bieberfever.com	google.com	Male	UK	3194	170	34.01

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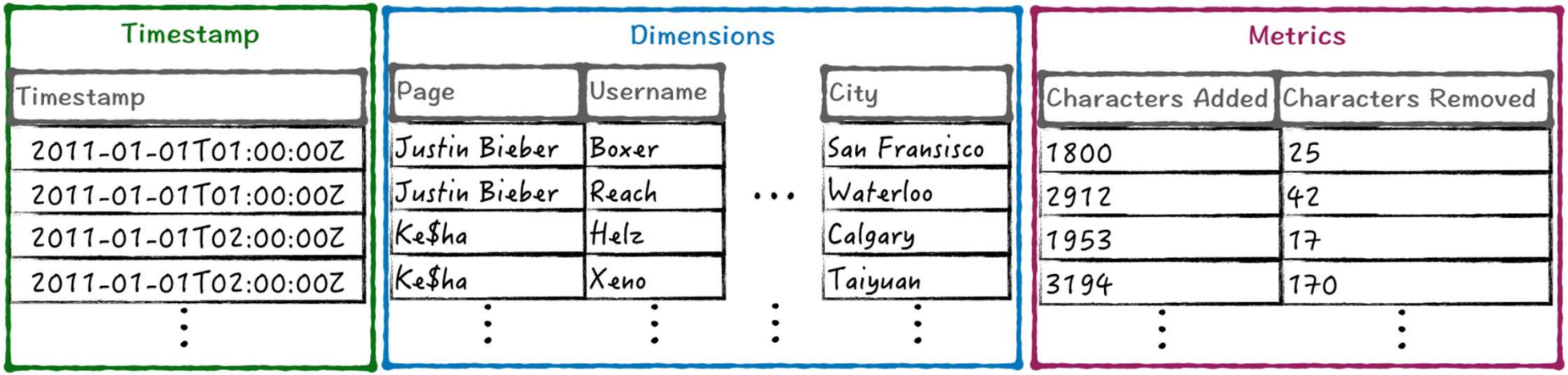
ساختار داده‌ها در دروید



- Every dataset is stored in **datasources** (similar to tables in relational DB)
- **Timestamp** serves as primary partition column
- **Dimensions** are used to filter, query/groupBy
- **Metrics** are values that can be aggregated and must be numeric

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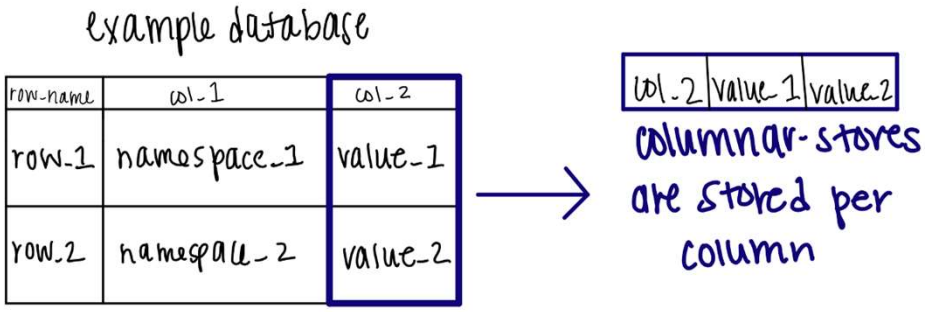
چرا دروید این‌قدر سریع است؟

For storage efficiency and fast filtering over dimensions of data, Druid **stores data in a column-oriented compressed format .**Therefore, it can deal with data redundancy and at the same time it uses an efficient format for performing queries over multi-dimensional aggregations and groupings.

- To answer a query, it **only loads the exact columns that are required.**
- Each column **is stored optimized for its particular data type**.
- To provide **fast filtering and searching across multiple columns**, Druid uses state-of-the-art compressed bitmap indexes (for details see CONCISE and Roaring).

The data are **being partitioned based on time**, thus timeseries queries are significantly faster than traditional databases.
Druid provides out-of-the-box **algorithms for approximate count-distinct, approximate ranking, and computation of approximate histograms and quantiles**.



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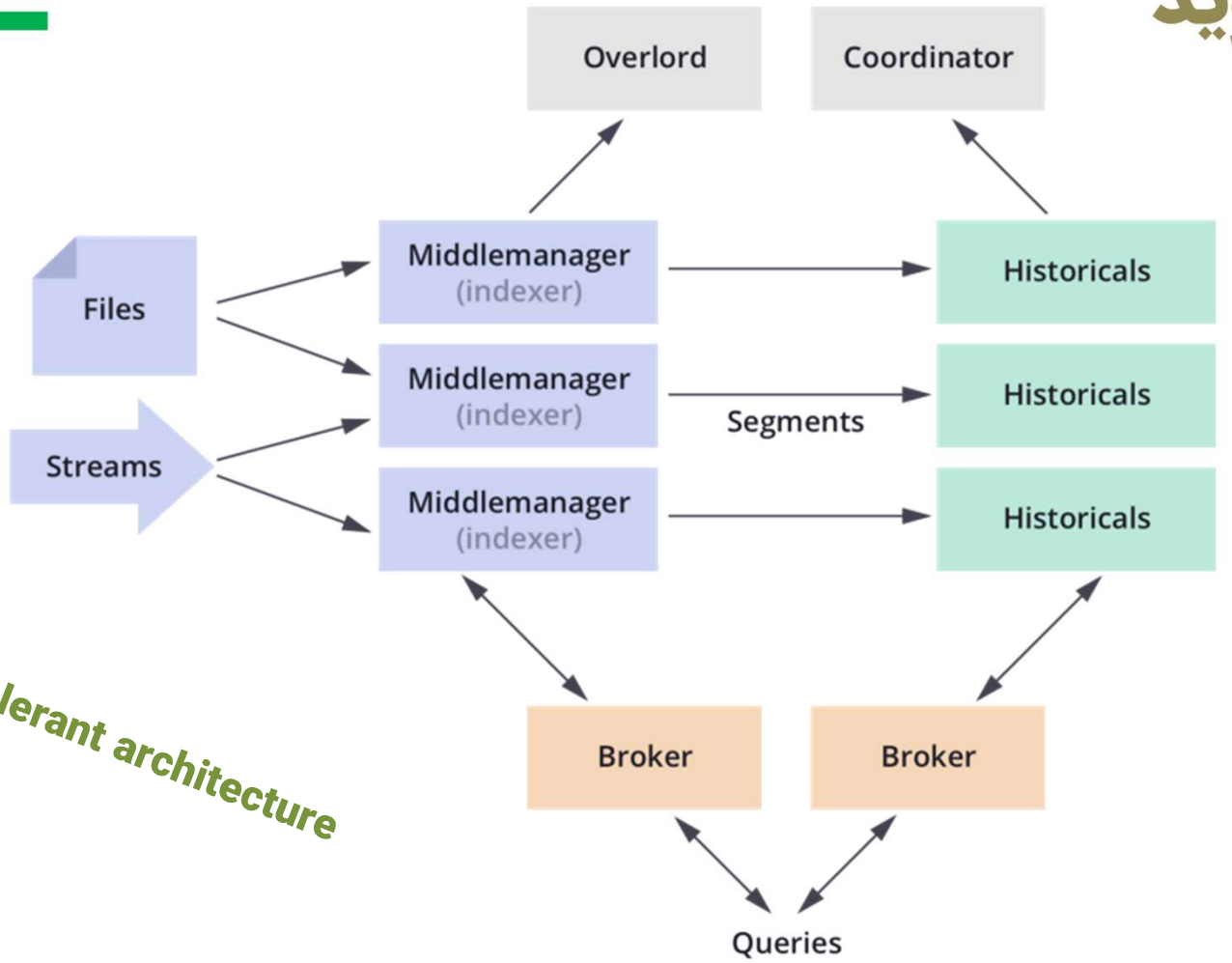
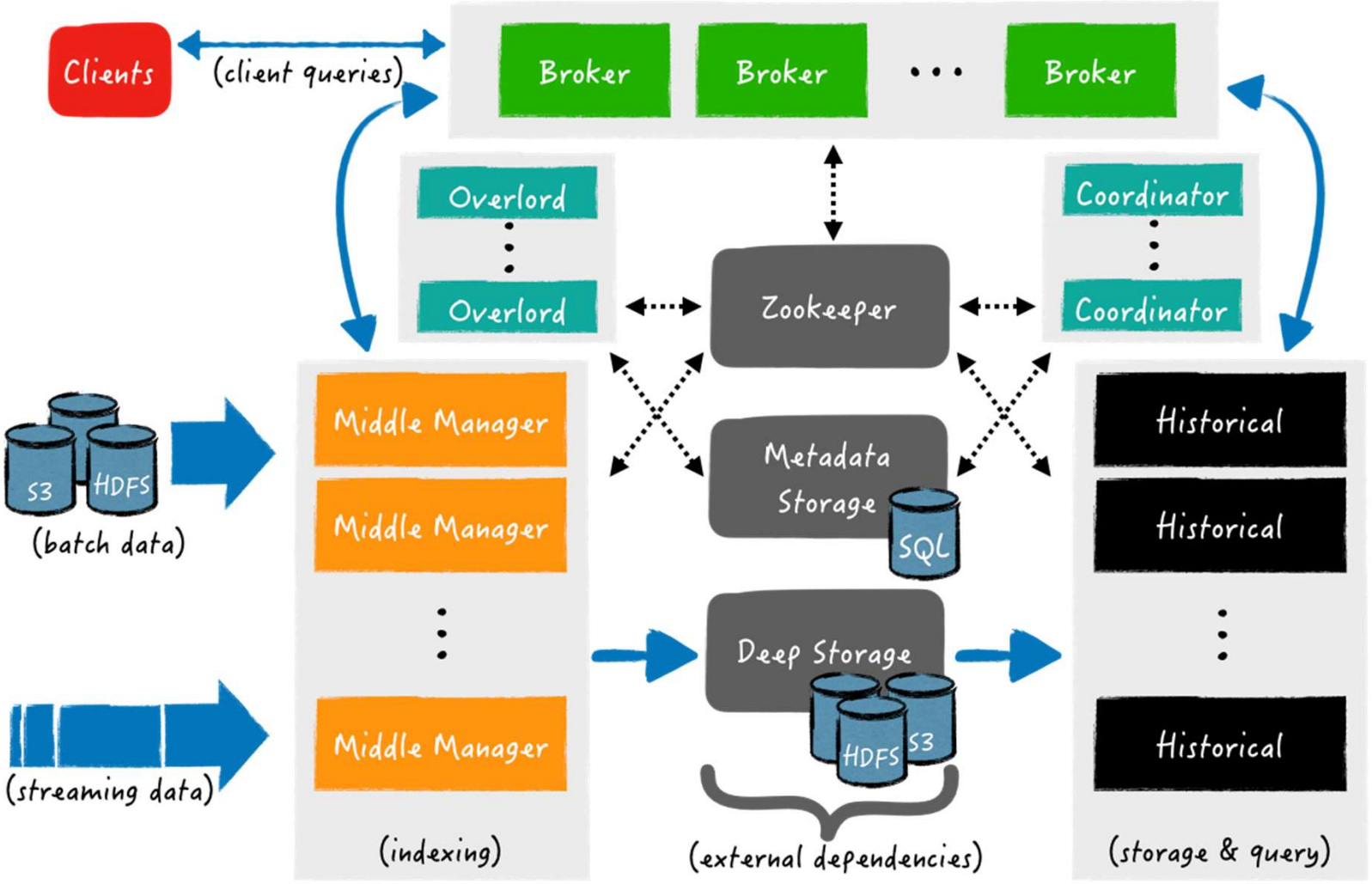
معماری درواید



Fault-tolerant architecture

معماری درواید- نگاهی دقیق‌تر



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معماری درویید- وابستگی‌های خارجی

•**Deep Storage**: it can be **any distributed file system or object storage**, like Amazon S3, Azure Blob Storage, Apache HDFS (or any HDFS compatible system), or a network mounted file system. The purpose of the deep storage is to persist all data ingested by Druid, as a backup solution and at the same time to be available to all Druid components and clusters, when it is needed.

•**Metadata Storage**: **is backed by a traditional relational database system**, e.g., PostgreSQL or MySQL. All metadata are available to any Druid component. There are various types of metadata in Druid, some are related to the persisted segments in deep storage, for example paths of segment files, their timestamp, their version, etc., other may related to external systems like the ingested partition offsets from a Apache Kafka topic and the rest are related to metadata of various internal processes (e.g., in which segments are being created now).

•**ZooKeeper**: is used for **internal service discovery, coordination, and leader election.**

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معماری درواید- مولفه‌های اصلی

- **Coordinator:** Manages data availability on the clusters
- **Overlord:** For controlling the assignment of data ingestion workloads
- **Broker:** This is for handling queries from external clients
- **Router:** Used to route requests to brokers, coordinators and overlords
- **Historical:** For storing the data that can be queried
- **Middle manager:** This is responsible for ingesting data There are three types of servers.

Master: This is for running the **coordinator** and **overlord** processes. It also manages data availability and ingestion.

Query: This runs **broker** and **router** processes (optional). It is used for handling queries from external clients.

Data: This runs the **historical** and **middle manager** processes. It is used to execute ingestion workloads.

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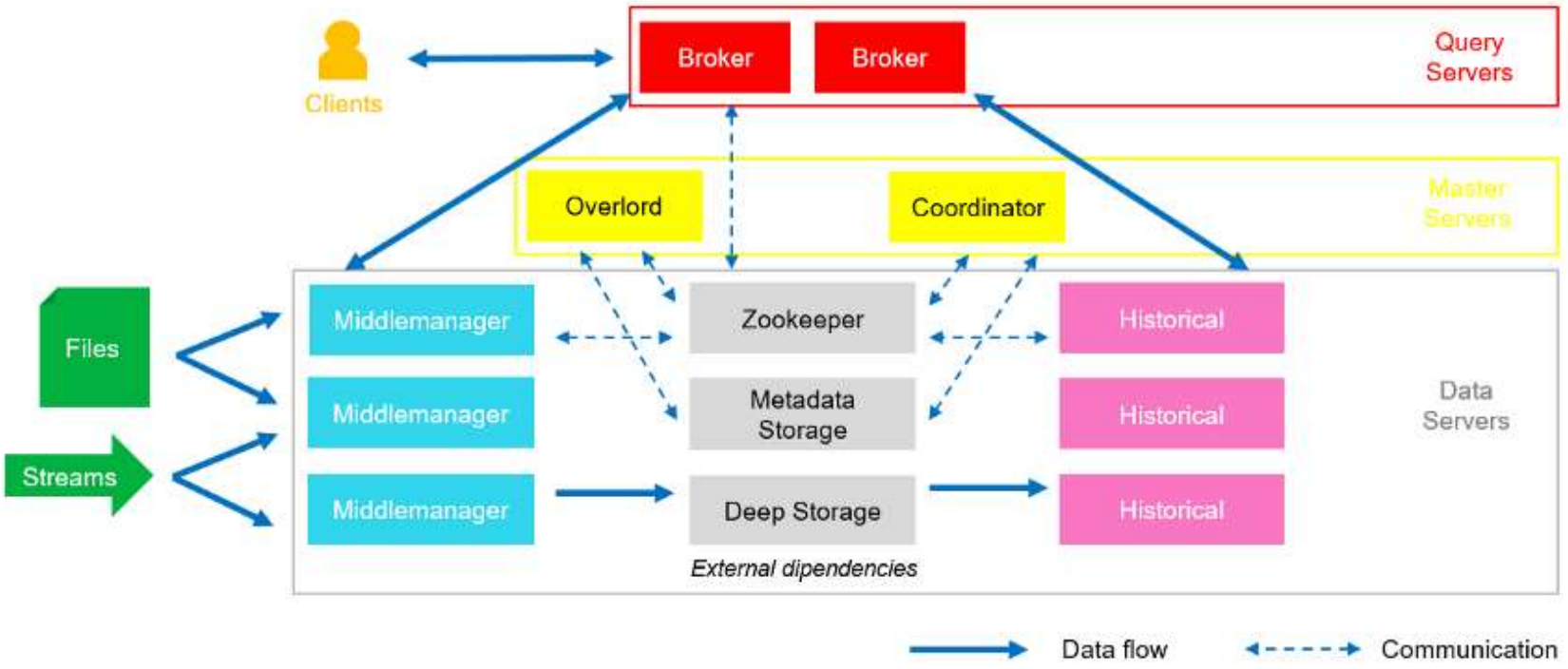
معماری درواید- مولفه‌های اصلی



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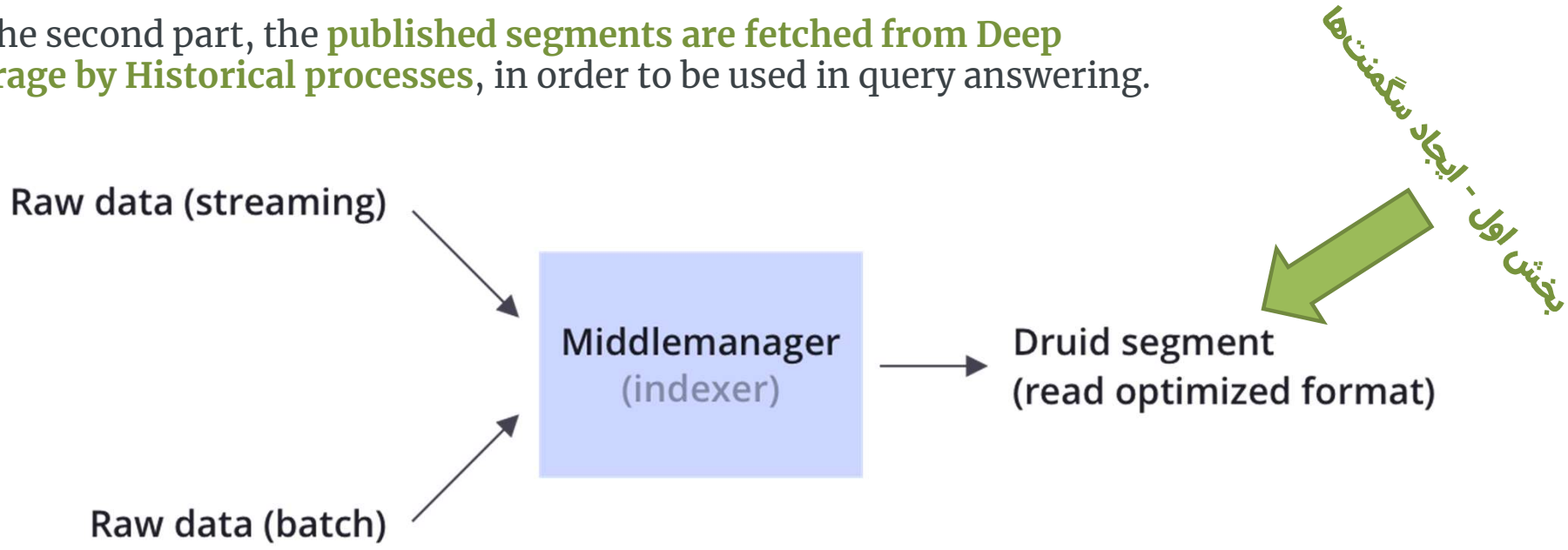
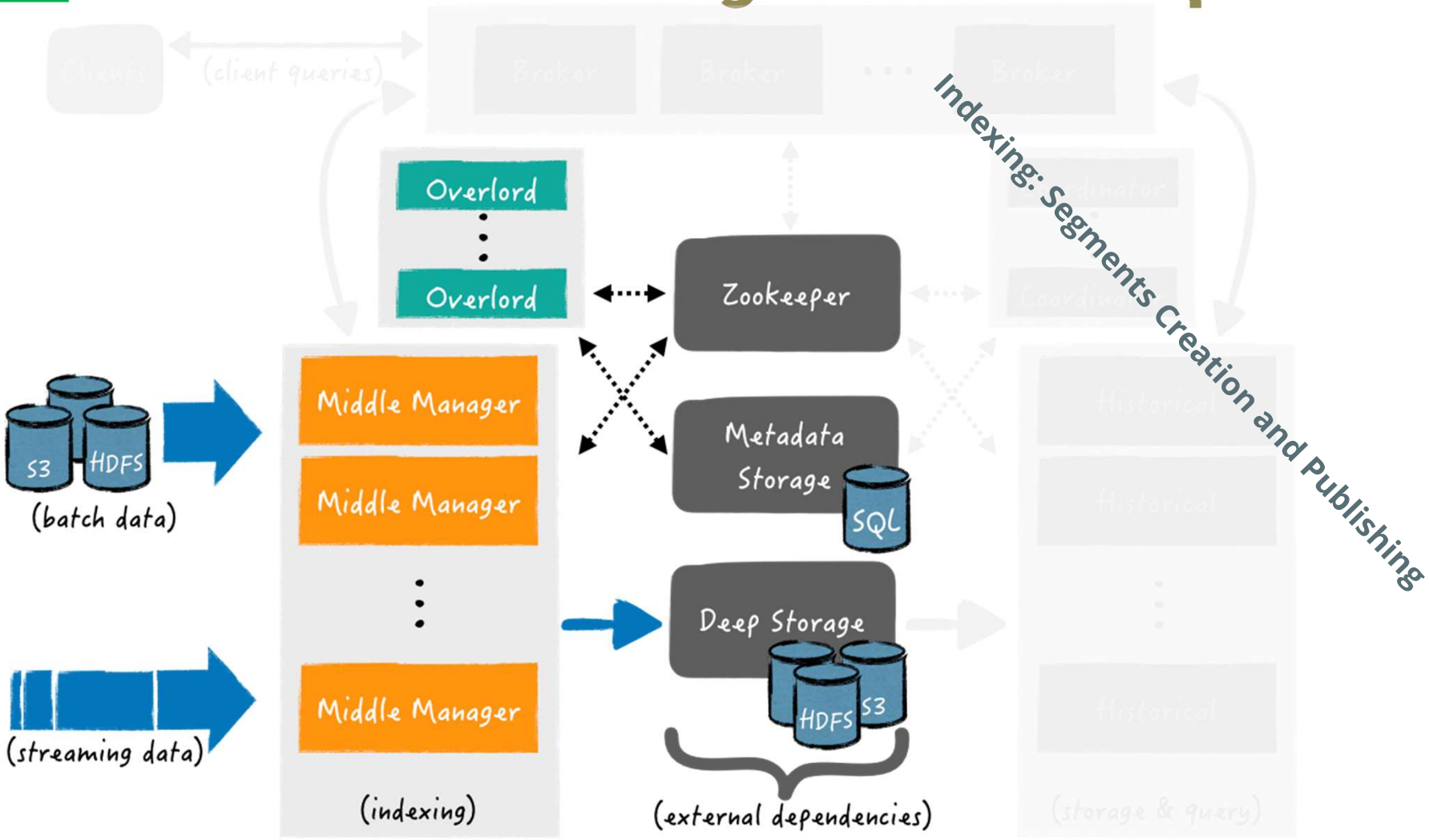
Data ingestion flow

Data ingestion flow is **a two part process**.

- In the first part, *Middle Managers* are running indexing tasks that **create and publish segments to *Deep storage***.
- In the second part, the **published segments are fetched from Deep storage by Historical processes**, in order to be used in query answering.



Data ingestion flow - part 1



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Data ingestion flow - part 1

Indexing: Segments Creation and Publishing

At the beginning of an indexing task, **a new segment is created**. The input data of a segment may originate by a real-time stream (e.g., a Kafka topic) or by a batch of files (e.g., CSV files in HDFS)

the currently creating segments from tasks that are real-time are immediately queryable

A task is completed either when it has indexed **the maximum number of records per segment** (e.g., five million records) or **reached the desired rollup interval of time** (e.g., hourly aggregates).

At this point, the segment is published by persisting its data to the Deep storage and its metadata to the Metadata store

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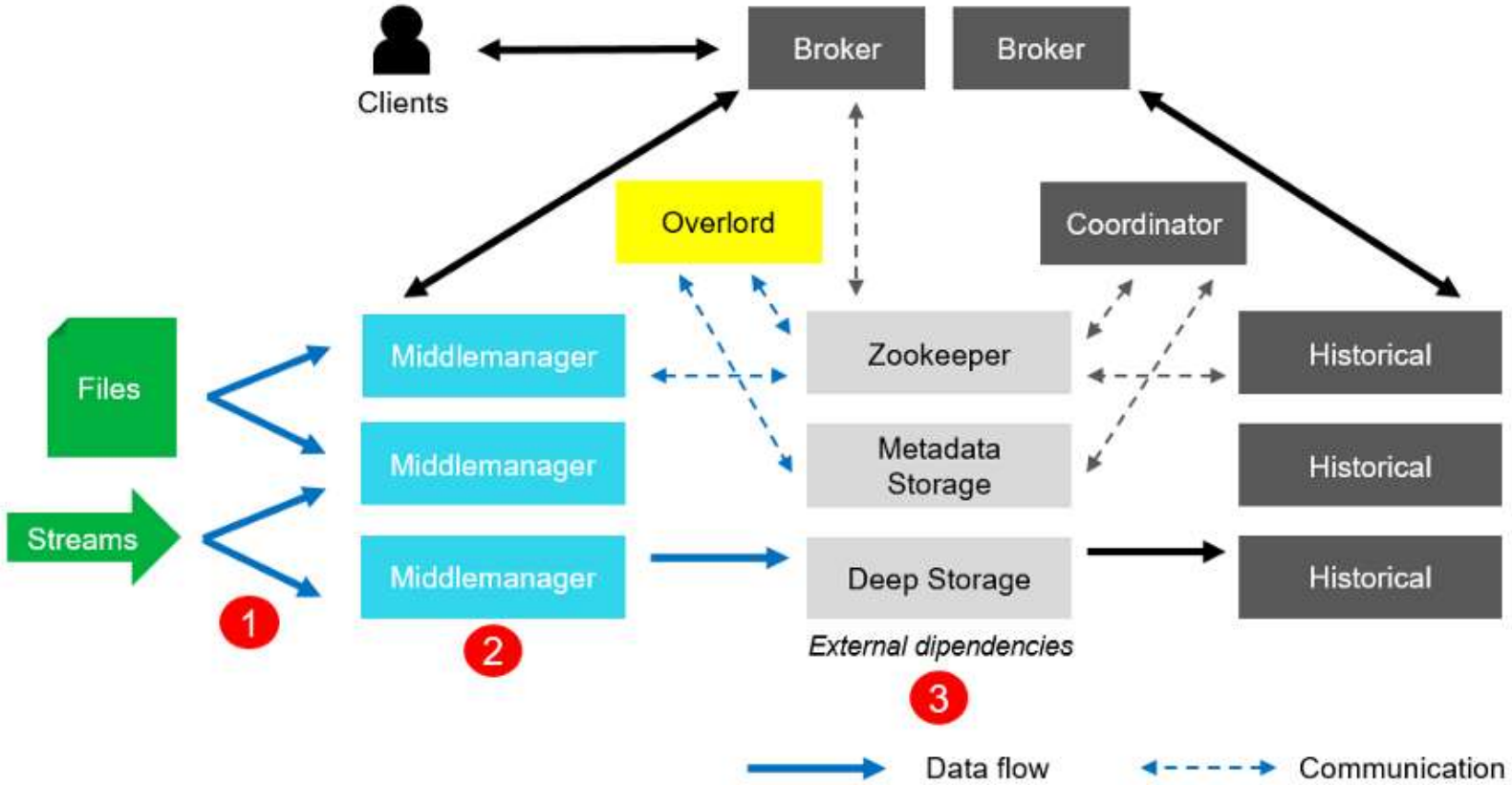
Data ingestion flow - part 1



In the indexing phase, at first data are gathered from the sources (1), then they are indexed and pre-aggregated (2) in order to create new segments and published (3) into the Deep Storage.

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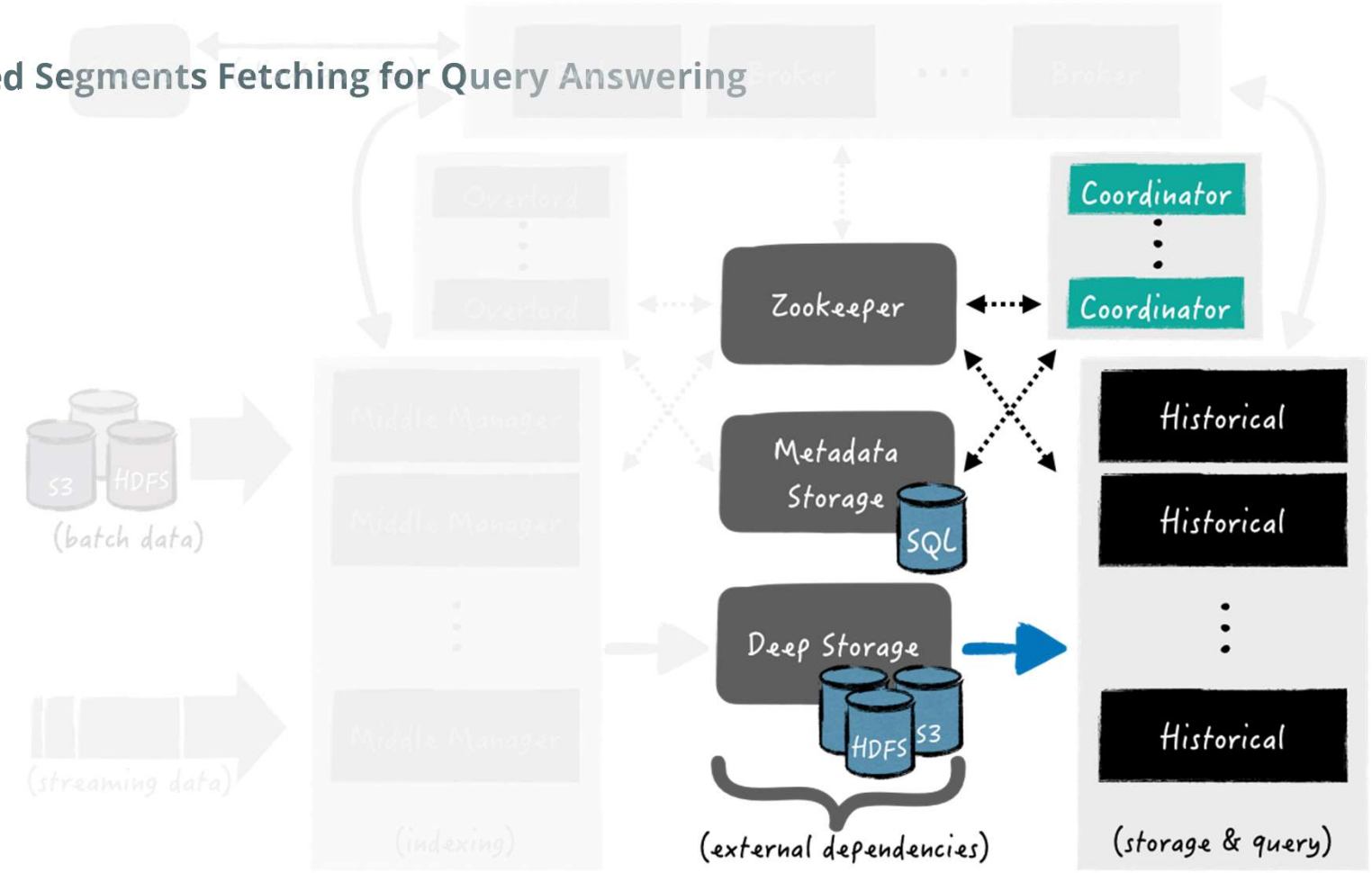
Data ingestion flow - part 2

Handoff: Published Segments Fetching for Query Answering



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Data ingestion flow - part 2

The **Coordinator** processes are periodically polling the Metadata store in order to find any newly published segments from data ingestion tasks.

Once a newly created segment is being discovered by a Coordinator process, it chooses which Historical process should fetch the segment from Deep storage

When the segment has been successfully loaded, the *Historical process* is ready to serve it for querying

Handoff: Published Segments Fetching for Query Answering

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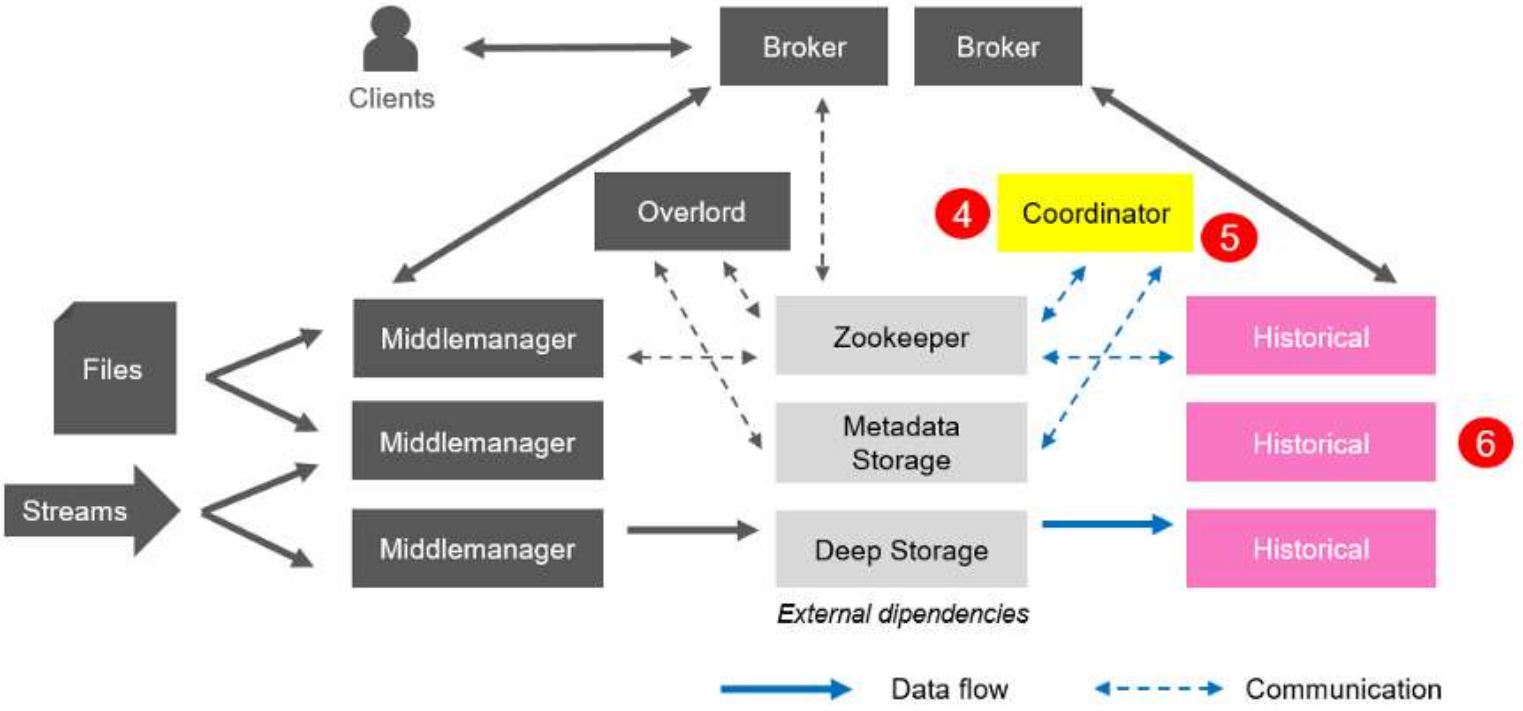
Data ingestion flow - part 2



In the fetching phase, since Coordinators are listening to Metadata Storage periodically for newly published segments (4), when one of them finds a segment that is published and used but unavailable, it chooses a Historical process to load that segment in memory and instructs that Historical to do so (5). At the end, the Historical performs its task and begins serving the data(6).

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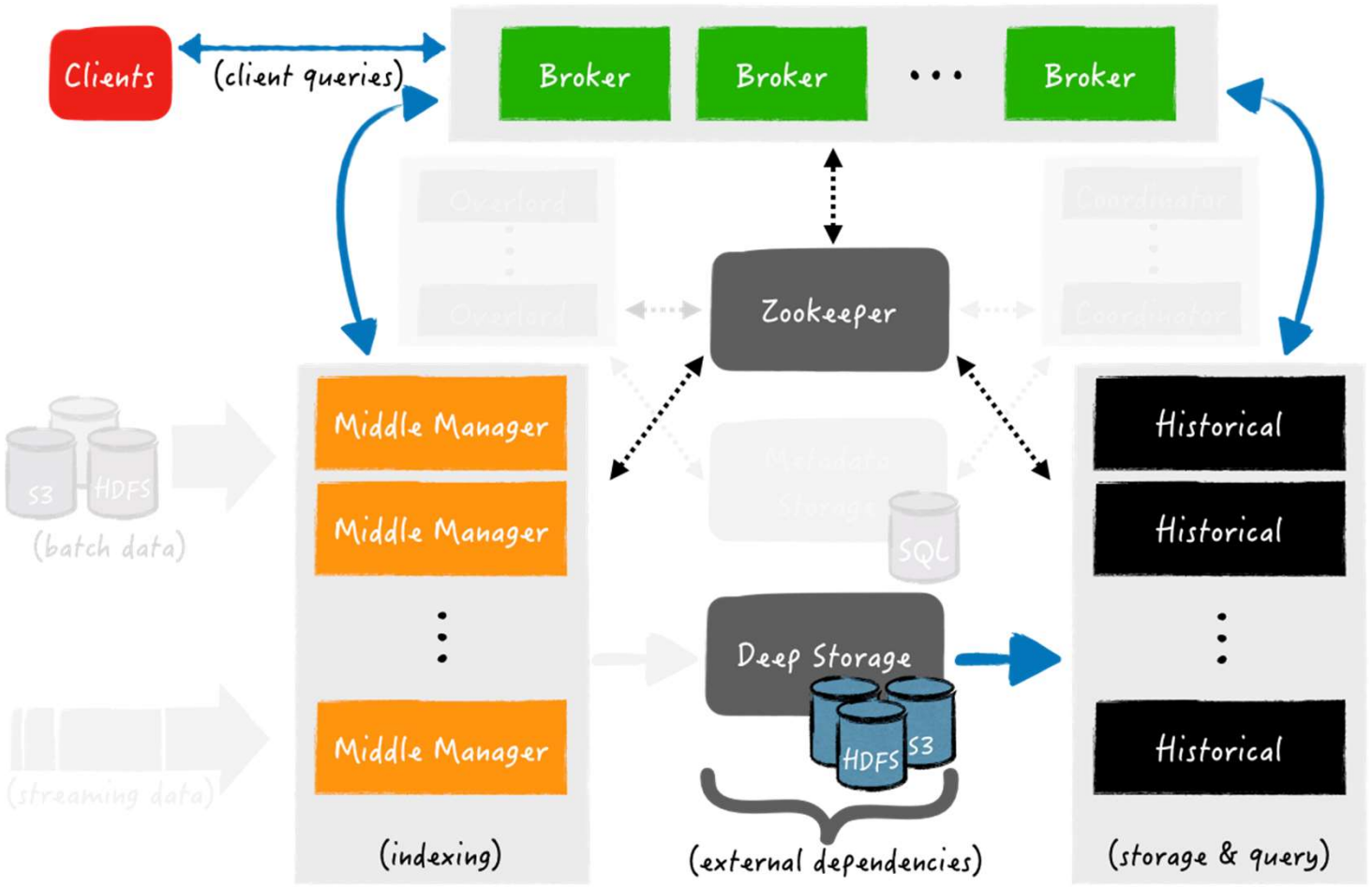
Query Answering



https://anskarl.github.io/post/2019/druid-part-1/

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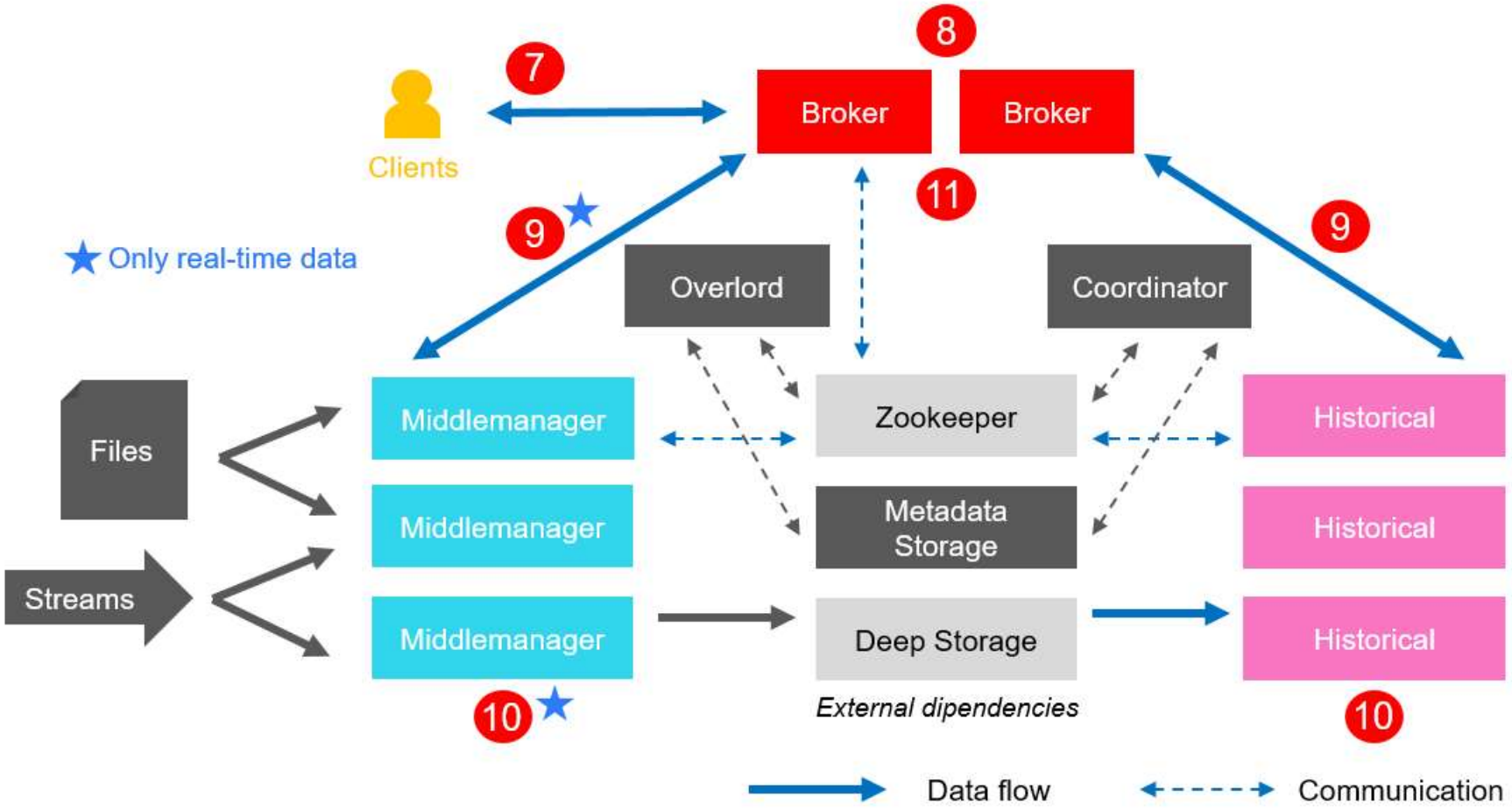
Query Answering



https://medium.com/data-reply-it-datatech/what-is-apache-druid-ad67bb8cd7f7

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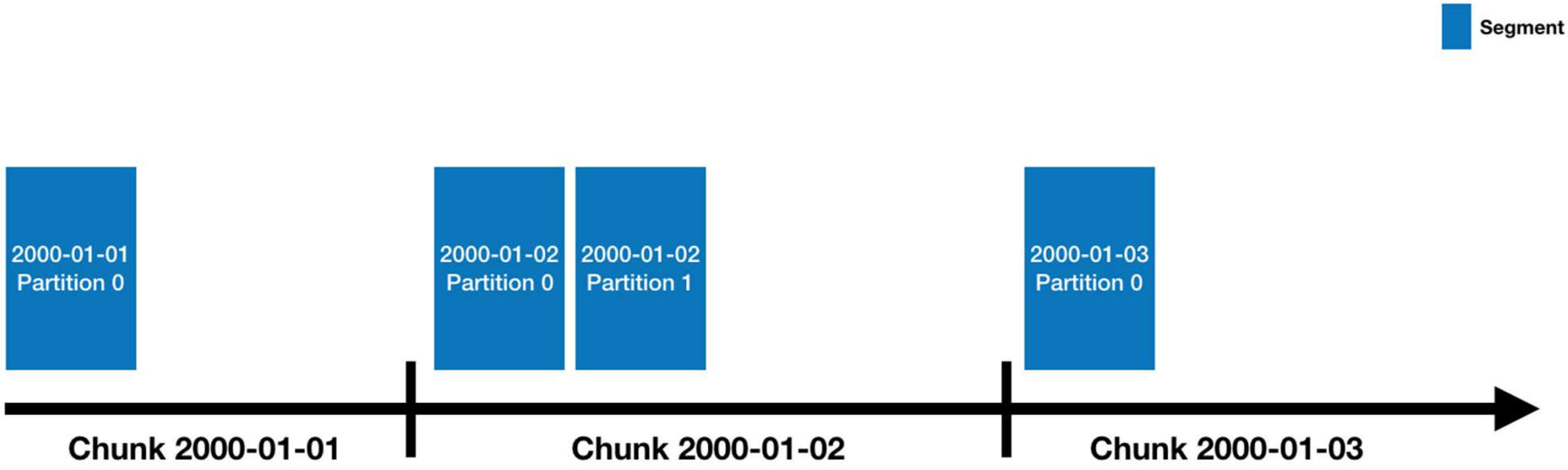
نگاهی دقیق‌تر به ساختار داخلی داده‌ها

- هنگام تعریف یک دیتاسورس، نحوه **پارتیشنینگ داده‌ها** را تعیین می‌کنیم.
- پارتیشن **بر اساس زمان** انجام میشود. (بازه روزانه در مثال زیر)
- بسته به ریزدانگی پارتیشن، بازه‌های زمانی به **مجموعه‌ای از چانک‌ها** تقسیم می شوند
- هر چانک، به **مجموعه‌ای از سگمنت‌ها** تقسیم می‌شود



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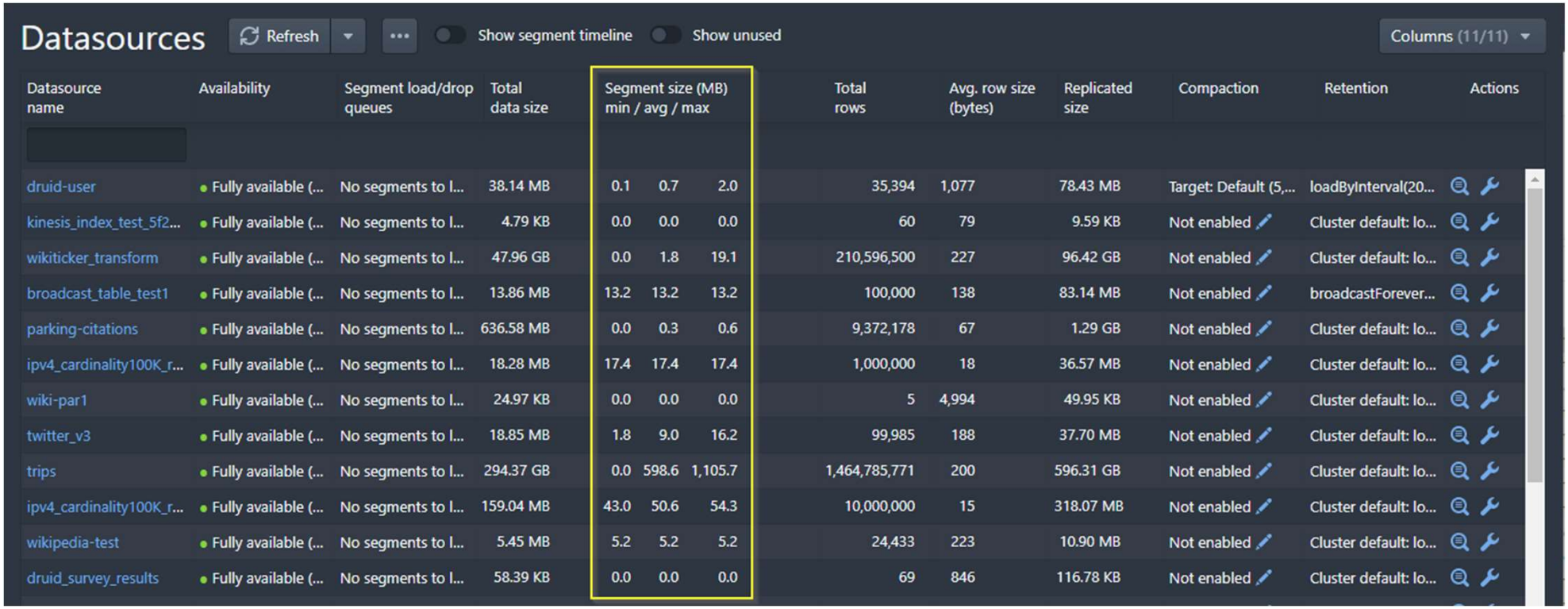
مشاهده آماره‌های مرتبط با سگمنت‌ها در واسط کاربری درواید



Datasource name	Availability	Segment load/drop queues	Total data size	Segment size (MB) min / avg / max			Total rows	Avg. row size (bytes)	Replicated size	Compaction	Retention	Actions
druid-user	Fully available (...	No segments to l...	38.14 MB	0.1	0.7	2.0	35,394	1,077	78.43 MB	Target: Default (5,...	loadByInterval(20...	
kinesis_index_test_5f2...	Fully available (...	No segments to l...	4.79 KB	0.0	0.0	0.0	60	79	9.59 KB	Not enabled	Cluster default: lo...	
wikiticker_transform	Fully available (...	No segments to l...	47.96 GB	0.0	1.8	19.1	210,596,500	227	96.42 GB	Not enabled	Cluster default: lo...	
broadcast_table_test1	Fully available (...	No segments to l...	13.86 MB	13.2	13.2	13.2	100,000	138	83.14 MB	Not enabled	broadcastForever...	
parking-citations	Fully available (...	No segments to l...	636.58 MB	0.0	0.3	0.6	9,372,178	67	1.29 GB	Not enabled	Cluster default: lo...	
ipv4_cardinality100K_r...	Fully available (...	No segments to l...	18.28 MB	17.4	17.4	17.4	1,000,000	18	36.57 MB	Not enabled	Cluster default: lo...	
wiki-par1	Fully available (...	No segments to l...	24.97 KB	0.0	0.0	0.0	5	4,994	49.95 KB	Not enabled	Cluster default: lo...	
twitter_v3	Fully available (...	No segments to l...	18.85 MB	1.8	9.0	16.2	99,985	188	37.70 MB	Not enabled	Cluster default: lo...	
trips	Fully available (...	No segments to l...	294.37 GB	0.0	598.6	1,105.7	1,464,785,771	200	596.31 GB	Not enabled	Cluster default: lo...	
ipv4_cardinality100K_r...	Fully available (...	No segments to l...	159.04 MB	43.0	50.6	54.3	10,000,000	15	318.07 MB	Not enabled	Cluster default: lo...	
wikipedia-test	Fully available (...	No segments to l...	5.45 MB	5.2	5.2	5.2	24,433	223	10.90 MB	Not enabled	Cluster default: lo...	
druid_survey_results	Fully available (...	No segments to l...	58.39 KB	0.0	0.0	0.0	69	846	116.78 KB	Not enabled	Cluster default: lo...	

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نامگذاری سگمنت‌ها

Segments all have a four-part identifier with the following components (_ *is the separator*):

- **Datasource name**
- **Time interval** (for the time chunk containing the segment; this corresponds to the segmentGranularity specified at ingestion time).
- **Version number** (generally an ISO۸۶۰۱ timestamp corresponding to when the segment set was first started).
- **Partition number** (an integer, unique within a datasource+interval+version; may not necessarily be contiguous).

```
clarity-cloud0_2018-05-21T16:00:00.000Z_2018-05-21T17:00:00.000Z_2018-05-21T15:56:09.909Z_1
```

Segments with partition number ۰ (the first partition in a chunk) omit the partition number

```
clarity-cloud0_2018-05-21T16:00:00.000Z_2018-05-21T17:00:00.000Z_2018-05-21T15:56:09.909Z
```

داده‌های موجود در هر سگمنت

- Within a Segment:
  - Timestamp Column Group.
  - Dimensions Column Group.
  - Metrics Column Group.
  - Indexes that facilitate fast lookup and aggregation.

Timestamp | Dimensions | Metrics

Timestamp	Page	Username	Gender	City	Characters Added	Characters Removed
2011-01-01T01:00:00Z	Justin Bieber	Boxer	Male	San Francisco	1800	25
2011-01-01T01:00:00Z	Justin Bieber	Reach	Male	Waterloo	2912	42
2011-01-01T02:00:00Z	Ke$ha	Helz	Male	Calgary	1953	17
2011-01-01T02:00:00Z	Ke$ha	Xeno	Male	Taiyuan	3194	170

انتخاب نوع ستون‌ها

String column

- ✓ indexed
- ✗ fast aggregation
- ✓ fast grouping

Numeric column

- ✗ indexed
- ✓ fast aggregation
- ✓ fast grouping

مروری بر نحوه ایندکسینگ و فشرده‌سازی داده‌ها

COLUMN COMPRESSION - DICTIONARIES

timestamp	publisher	advertiser	gender	country	...	click	price
2011-01-01T00:01:35Z	bieberfever.com	google.com	Male	USA		0	0.65
2011-01-01T00:03:63Z	bieberfever.com	google.com	Male	USA		0	0.62
2011-01-01T00:04:51Z	bieberfever.com	google.com	Male	USA		1	0.45
2011-01-01T01:00:00Z	ultratrimfast.com	google.com	Female	UK		0	0.87
2011-01-01T02:00:00Z	ultratrimfast.com	google.com	Female	UK		0	0.99
2011-01-01T02:00:00Z	ultratrimfast.com	google.com	Female	UK		1	1.53
...							

- Create ids
  - bieberfever.com -> 0, ultratrimfast.com -> 1
- Store
  - publisher -> [0, 0, 0, 1, 1, 1]
  - advertiser -> [0, 0, 0, 0, 0, 0]

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BITMAP INDEXES

timestamp	publisher	advertiser	gender	country	...	click	price
2011-01-01T00:01:35Z	bieberfever.com	google.com	Male	USA		0	0.65
2011-01-01T00:03:63Z	bieberfever.com	google.com	Male	USA		0	0.62
2011-01-01T00:04:51Z	bieberfever.com	google.com	Male	USA		1	0.45
2011-01-01T01:00:00Z	ultratrimfast.com	google.com	Female	UK		0	0.87
2011-01-01T02:00:00Z	ultratrimfast.com	google.com	Female	UK		0	0.99
2011-01-01T02:00:00Z	ultratrimfast.com	google.com	Female	UK		1	1.53
...							

- bieberfever.com -> [0, 1, 2] -> [111000]
- ultratrimfast.com -> [3, 4, 5] -> [000111]
- Compress using Concice or Roaring (take advantage of dimension sparsity)

مروری بر نحوه ایندکسینگ و فشرده‌سازی داده‌ها

FAST AND FLEXIBLE QUERIES

Rows	POETS
0	JUSTIN BIEBER
1	JUSTIN BIEBER
2	KE$HA
3	KE$HA

JUSTIN BIEBER
[1, 1, 0, 0]

KE$HA
[0, 0, 1, 1]

JUSTIN BIEBER
OR
KE$HA
[1, 1, 1, 1]

Queries that solely aggregate metrics based on filters do not need to touch the list of dimension values !

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لوکاپ‌ها : راهی برای جلوگیری از جوین‌های غیرضروری

Think back to lookups.

timestamp	product_id	country	city	gender	age	revenue
2030-01-01	212	US	New York	F	34	180.00
2030-01-01	998	FR	Paris	M	28	24.95

Lookup: “products”

id	name
212	Office chair
998	Coffee mug, 2-pacl

```
SELECT
  LOOKUP(id, 'products') AS product_name
  SUM(sales.revenue)
FROM sales
GROUP BY product_name
```

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Rollup - تجمیع داده‌ها هنگام ورود

timestamp	page	city	added	deleted
2011-01-01T00:01:35Z	Justin Bieber	SF	10	5
2011-01-01T00:03:45Z	Justin Bieber	SF	25	37
2011-01-01T00:05:62Z	Justin Bieber	SF	15	19
2011-01-01T00:06:33Z	Ke$ha	LA	30	45
2011-01-01T00:08:51Z	Ke$ha	LA	16	8
2011-01-01T00:09:17Z	Miley Cyrus	DC	75	10
2011-01-01T00:11:25Z	Miley Cyrus	DC	11	25
2011-01-01T00:23:30Z	Miley Cyrus	DC	22	12
2011-01-01T00:49:33Z	Miley Cyrus	DC	90	41

timestamp	page	city	count	sum_added	sum_deleted
2011-01-01T00:00:00Z	Justin Bieber	SF	3	50	61
2011-01-01T00:00:00Z	Ke$ha	LA	2	46	53
2011-01-01T00:00:00Z	Miley Cyrus	DC	4	198	88

الگوریتم‌های تقریبی - بنیاد آپاچی

datasketches.apache.org/docs/Background/TheChallenge.html

Apache DataSketches™ DOCUMENTATION DOWNLOAD RESEARCH COMMUNITY APACHE

API Snapshots: Java Core, Memory, Pig, Hive,

The Challenge: Fast, Approximate Analysis of Big Data[1]

Suppose you have a new Internet company that sells Mobile Apps and Music. Your internal reporting system collects log data from two main sources: your web servers and your Financial Transactions System that records purchases and handles credit cards and authentication. The data logs from these two systems might look something like this:

Web Site Logs

Time	User ID	Site	Time Spent Sec	Items Viewed
9:00 AM	U1	Apps	59	5
9:30 AM	U2	Apps	179	15
10:00 AM	U3	Music	29	3
1:00 PM	U1	Music	89	10
Billions of rows ...				

Financial Transactions System Log

Time	User ID	Site	Purchased	Revenue
9:00 AM	U1	Apps	FaceTune	$3.99
9:30 AM	U2	Apps	Minecraft	$6.99
10:00 AM	U3	Music	Purple Rain	$1.29
Billions of rows ...				

The web server logs contain information such as a time-stamp, a user identifier (obfuscated, of course), the site visited, a time-spent metric, and a number of items viewed metric. The financial logs contain information such as a time-stamp, a user identifier, the site visited, the purchased item and revenue received for the item.

From these two simple sets of data there are many queries that we would like to make, and among those, some very natural queries might include the following:

الگوریتم‌های تقریبی

- Data sketches are lossy data structures
- Tradeoff accuracy for reduced storage and improved performance.
- Summarize data at ingestion time using sketches
- Improves roll-up, reduce memory footprint

الگوریتم‌های تقریبی

timestamp	page	userid	city	added	deleted
2011-01-01T00:01:35Z	Justin Bieber	user11	SF	10	5
2011-01-01T00:03:45Z	Justin Bieber	user22	SF	25	37
2011-01-01T00:05:62Z	Justin Bieber	user11	SF	15	19
2011-01-01T00:06:33Z	Ke$ha	user33	LA	30	45
2011-01-01T00:08:51Z	Ke$ha	user33	LA	16	8
2011-01-01T00:09:17Z	Miley Cyrus	user11	DC	75	10
2011-01-01T00:11:25Z	Miley Cyrus	user44	DC	11	25
2011-01-01T00:23:30Z	Miley Cyrus	user44	DC	22	12
2011-01-01T00:49:33Z	Miley Cyrus	user55	DC	90	41

→

timestamp	page	city	count	sum_added	sum_deleted	userid_sketch
2011-01-01T00:00:00Z	Justin Bieber	SF	3	50	61	sketch_obj
2011-01-01T00:00:00Z	Ke$ha	LA	2	46	53	sketch_obj
2011-01-01T00:00:00Z	Miley Cyrus	DC	4	198	88	sketch_obj

الگوریتم‌های تقریبی

Approximate queries can provide up to 99% accuracy while greatly improving performance

- Bloom Filters
  - Self Joins
- Theta Sketches
  - Union/Intersection/Difference
- HLL Sketches
  - Count Distinct
- Quantile Sketches
  - Median, percentiles

کوئری - SQL

```sql
SELECT channel, SUM(added)
FROM "wikipedia"
WHERE
    "__time" >= CURRENT_TIMESTAMP - INTERVAL '1' DAY
    and commentLength >= 50
GROUP BY channel
ORDER BY SUM(added) desc
LIMIT 3
```

کوئری - Native Json

```
[
  {
    "queryType": "topN",
    "dataSource": {
      "type": "table",
      "name": "wikipedia"
    },
    "virtualColumns": [],
    "dimension": {
      "type": "default",
      "dimension": "channel",
      "outputName": "d0",
      "outputType": "STRING"
    },
    "metric": {
      "type": "numeric",
      "metric": "a0"
    },
    "threshold": 3,
    "intervals": {
      "type": "intervals",
      "intervals": [
        "2019-04-25T14:56:20.000Z/146140482-04-24T15:36:27.903Z"
      ]
    },
    "filter": {
      "type": "bound",
      "dimension": "commentLength",
      "lower": "50",
      "upper": null,
      "lowerStrict": false,
      "upperStrict": false,
      "extractionFn": null,
      "ordering": {
        "type": "numeric"
      }
    },
    "granularity": {
      "type": "all"
    },
    "aggregations": [
      {
        "type": "doubleSum",
        "name": "a0",
        "fieldName": "added",
        "expression": null
      }
    ],
    "postAggregations": [],
    "context": {
      "sqlQueryId": "b0112645-e231-47b1-95a6-6154deca8a7a",
      "timeout": 300000
    },
    "descending": false
  }
]
```

کوئری - Native Json

```
[
  {
    "queryType": "topN",
    "dataSource": {
      "type": "table",
      "name": "wikipedia"
    },
    "virtualColumns": [],
    "dimension": {
      "type": "default",
      "dimension": "channel",
      "outputName": "d0",
      "outputType": "STRING"
    },
    "metric": {
      "type": "numeric",
      "metric": "a0"
    },
    "threshold": 3,
    "intervals": {
      "type": "intervals",
      "intervals": [
        "2019-04-25T14:56:20.000Z/146140482-04-24T15:36:27.903Z"
      ]
    },
    "filter": {
      "type": "bound",
      "dimension": "commentLength",
      "lower": "50",
      "upper": null,
      "lowerStrict": false,
      "upperStrict": false,
      "extractionFn": null,
      "ordering": {
        "type": "numeric"
      }
    },
    "granularity": {
      "type": "all"
    },
    "aggregations": [
      {
        "type": "doubleSum",
        "name": "a0",
        "fieldName": "added",
        "expression": null
      }
    ],
    "postAggregations": [],
    "context": {
      "sqlQueryId": "b0112645-e231-47b1-95a6-6154deca8a7a",
      "timeout": 300000
    },
    "descending": false
  }
]
```

انواع کوئری در درویید

- **TimeBoundary** - Returns min/max timestamp for given interval.
- **Timeseries** - When you don’t want to group by dimension
- **TopN** - When you want to group by a single dimension
  - Approximate if > 1000 dimension values
- **GroupBy** - Least performant/most flexible
- **Scan** - For returning streaming raw data
  - Perfect ordering not preserved
- **Select** - For returning paginated raw data
- **Search** - Returns dimensions that match text search

انواع فیلترها در دروید

- Interval
  - Matches time range, can be used on __time or any column with millisecond timestamp
- Selector
  - Matches a single dimension to a value
- Column Comparison
  - Compares two columns. Example ColA == ColB
- Search
  - Filter on partial string matches
- In
  - Matches to list of values

انواع فیلتر در درویید

- Like Filter
  - Equivalent of SQL LIKE
  - Can perform better than Search Filter for prefix only searching

A note about Extraction Functions....

Most filters also support extraction functions. Performance of functions varies greatly, and if possible using functions on ingest instead of query time can improve performance

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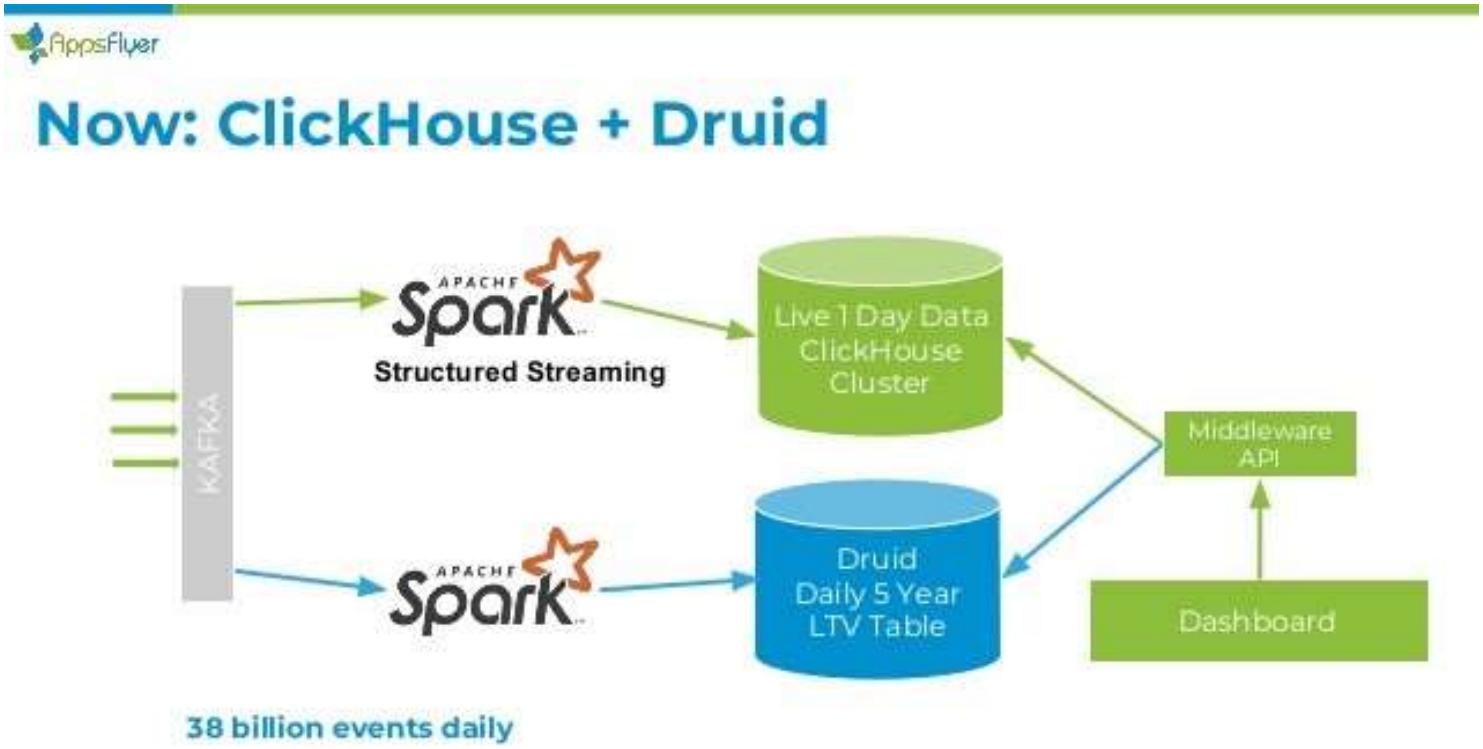
When NOT to use Apache Druid

Despite Druid's ability to process large amounts of data, there are situations where you would NOT want to use it:

- **Low-latency updates of existing records** using a primary key. Druid supports streaming inserts, but not streaming updates (i.e., updates are done using background batch jobs).
- **Storing all the historical data in a raw format**, without any aggregation or transformation.
- **Building an offline reporting system** where query latency is not very important.
- **Queries that have "big" joins (joining one big fact table to another big fact table)**, where you're comfortable with these queries taking a long time to complete.

آخرین سخن


AppsFlyer
Now: ClickHouse + Druid
KAFKA
APACHE Spark
Structured Streaming
APACHE Spark
Live 1 Day Data
ClickHouse
Cluster
Druid
Daily 5 Year
LTV Table
Middleware
API
Dashboard
38 billion events daily

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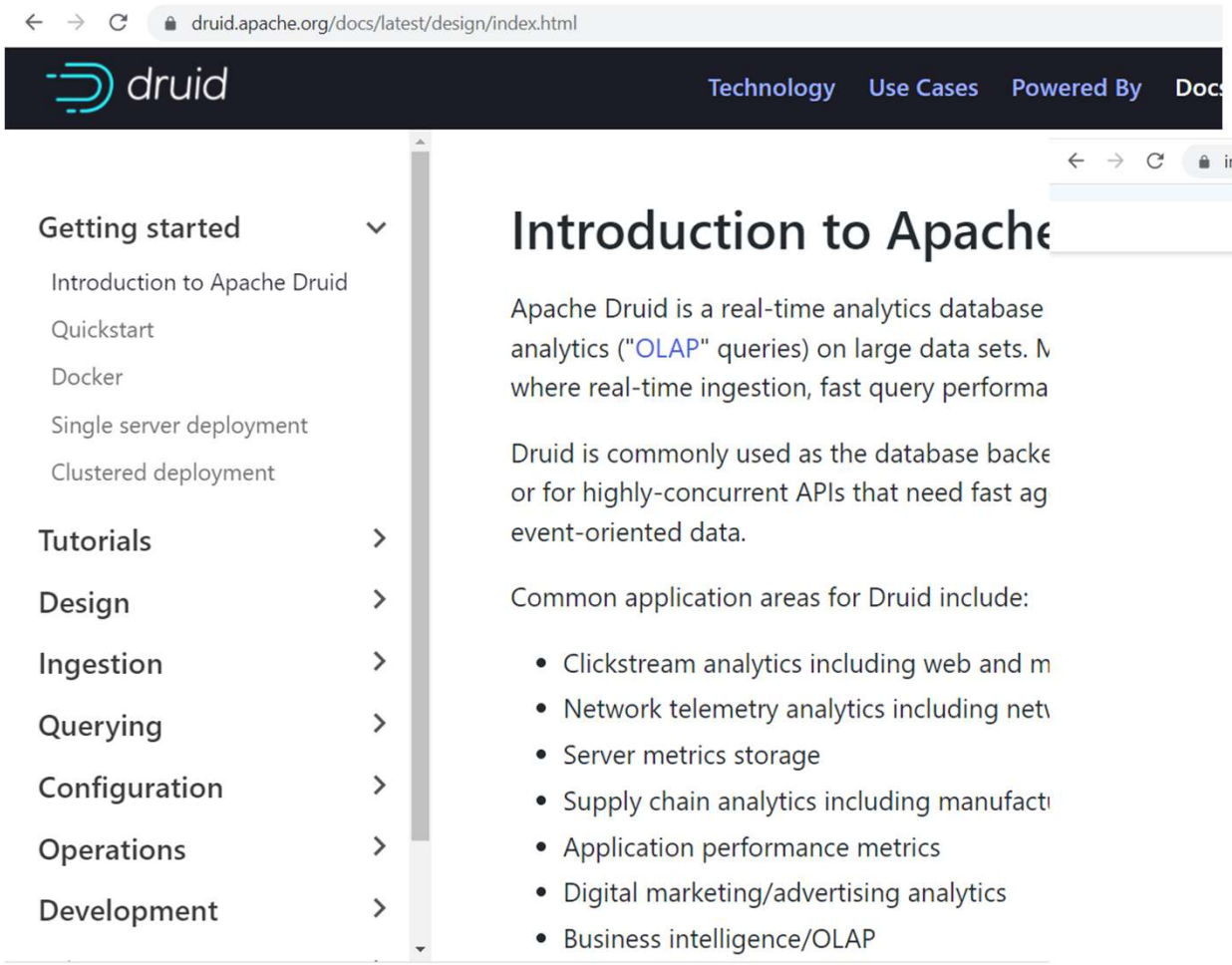
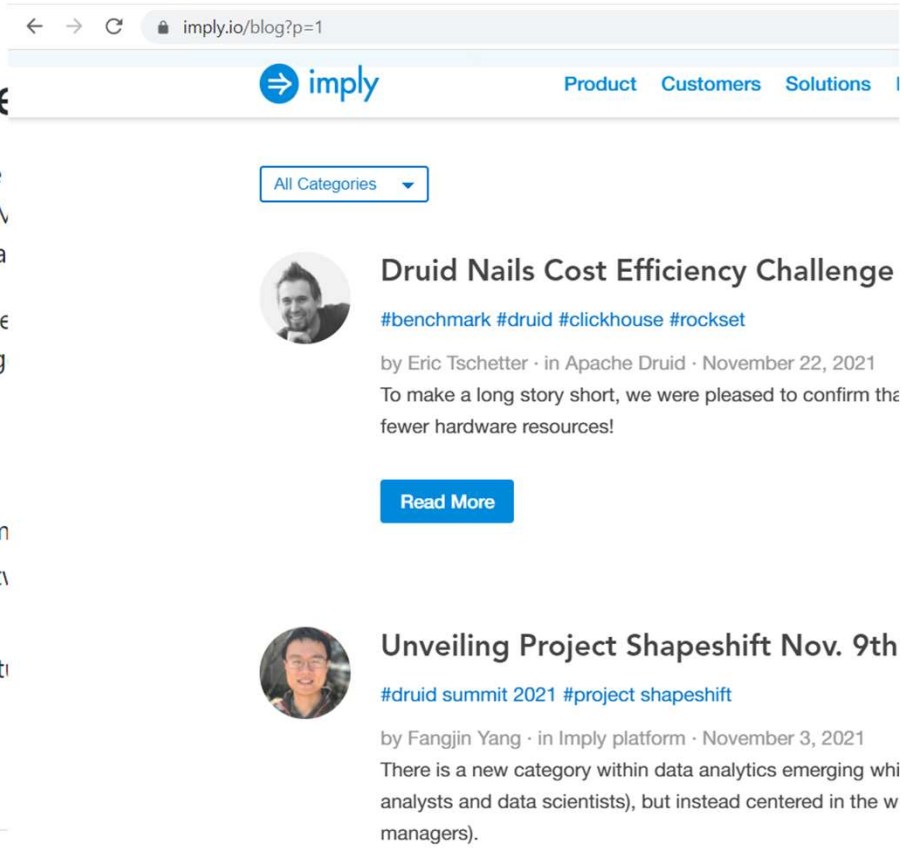
منابع آموزشی





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کارگاه عملی

- دانلود مخزن کد درس

https://gitlab.com/nikamooz_bigdata/de

- دستورات این بخش در پوشه Section 21 قرار گرفته‌اند
- نرم افزار Typora را نصب کنید
- در این کارگاه نیاز به اینترنت و داکر برای دانلود و ساخت ایمیج‌های پایه درواید خواهید داشت.