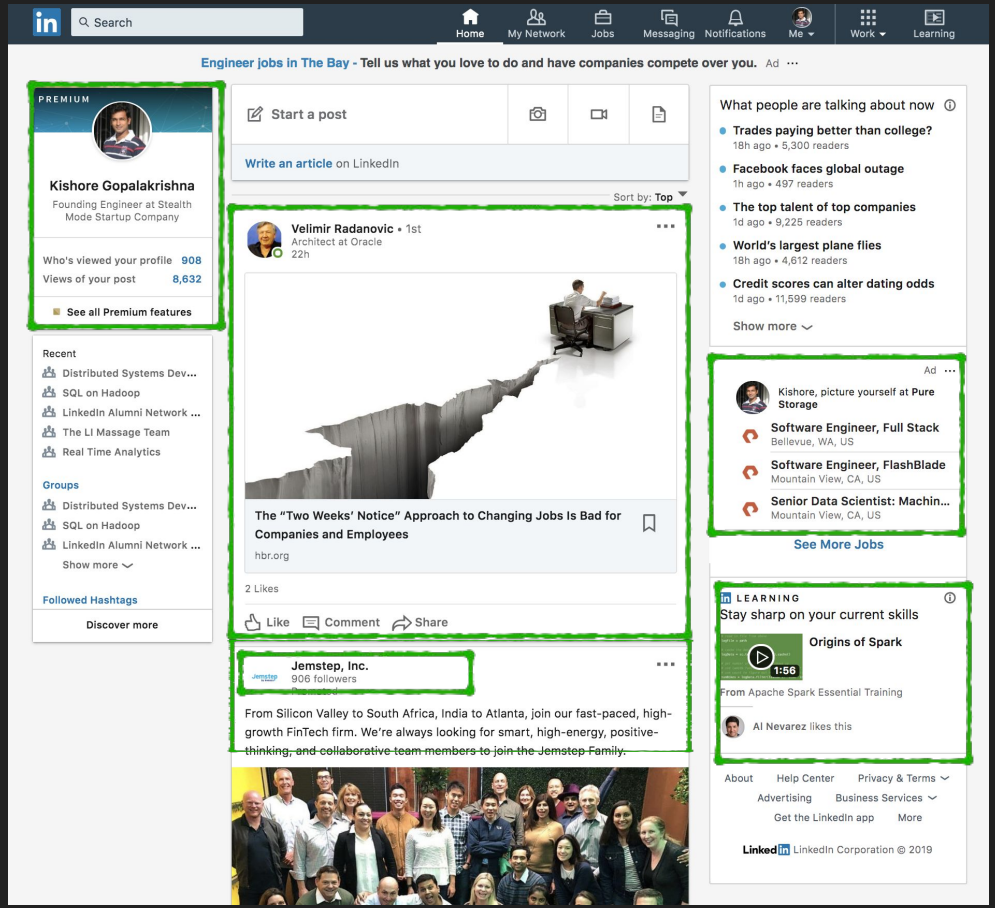
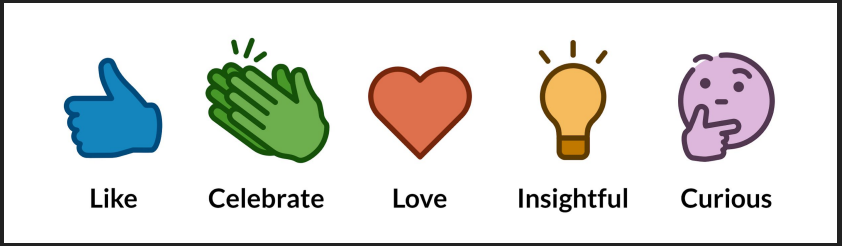
Building real-time analytics applications using

A LinkedIn case study



Member
Job
Ad
Post
Company
Course

LinkedIn Activity Data Model



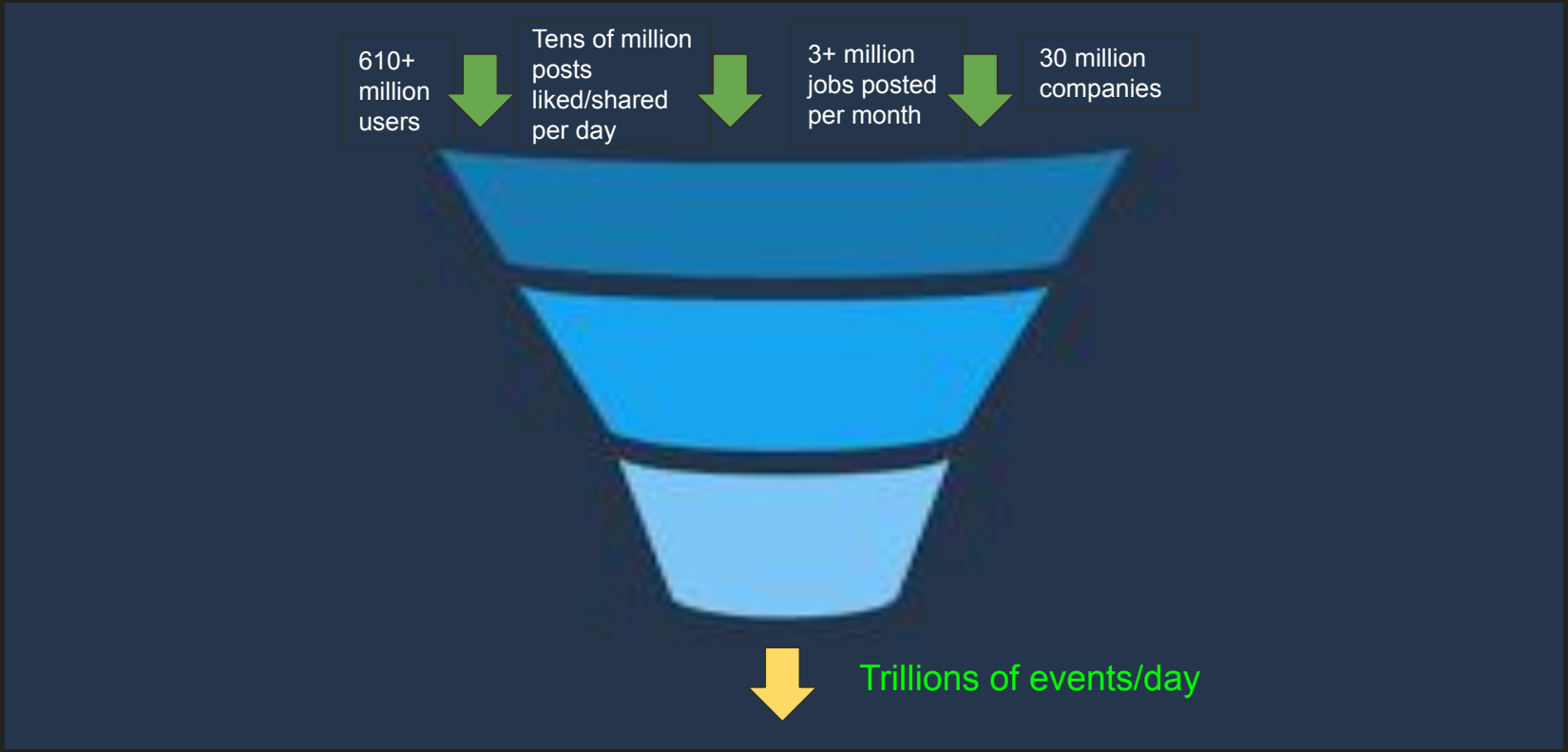
Member
Job
Ad
Post
Company
Course

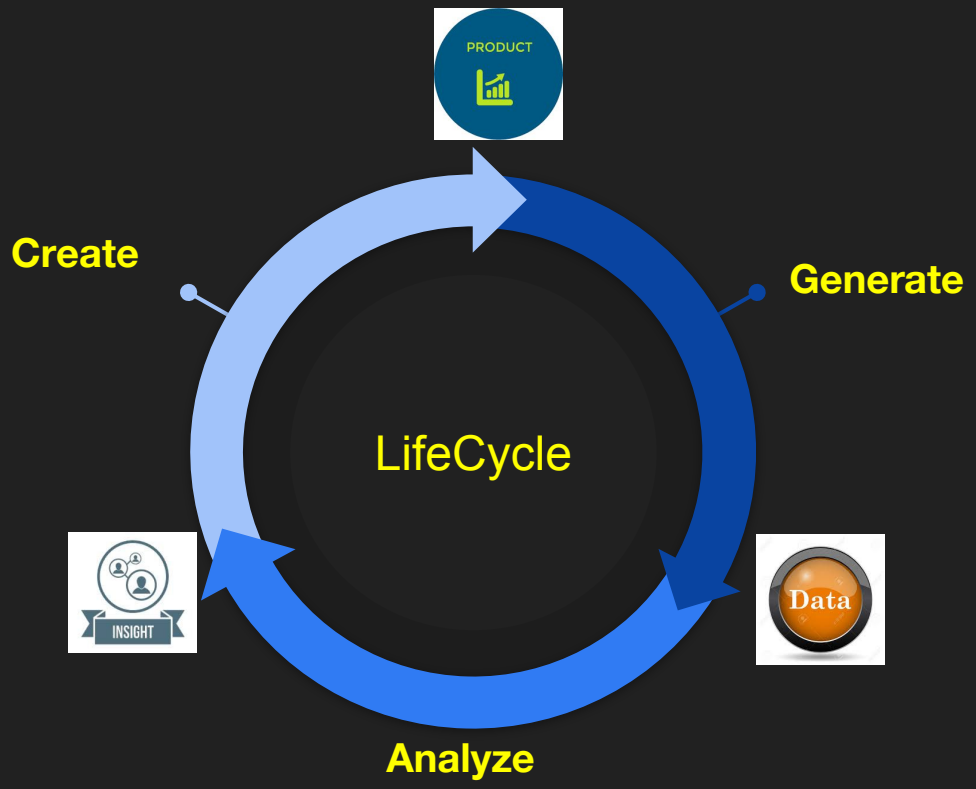
Actor

Verb

Object

Activity Data Scale





What can we do with all the activity data?

Pinot @ LinkedIn

50+ site facing use cases

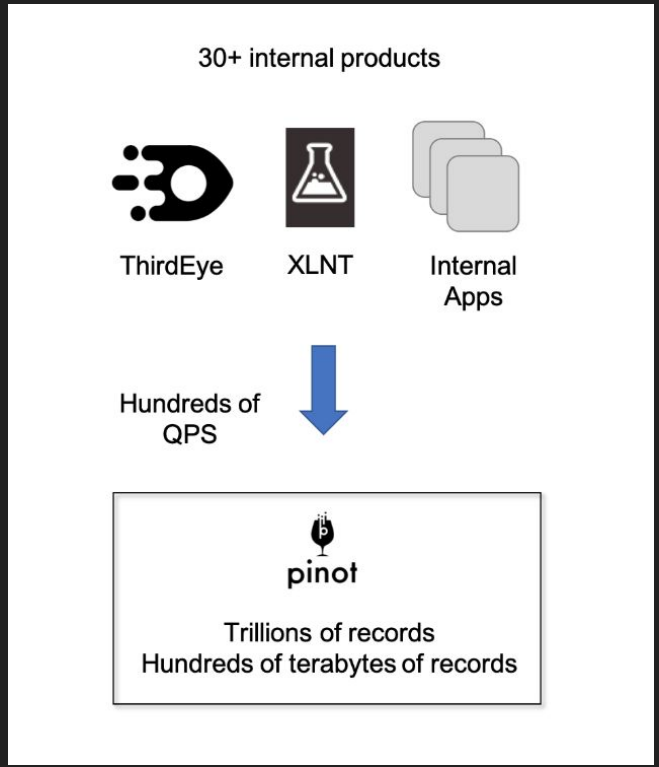
Hundreds of thousands of QPS at peak

10s to 100s of milliseconds query time

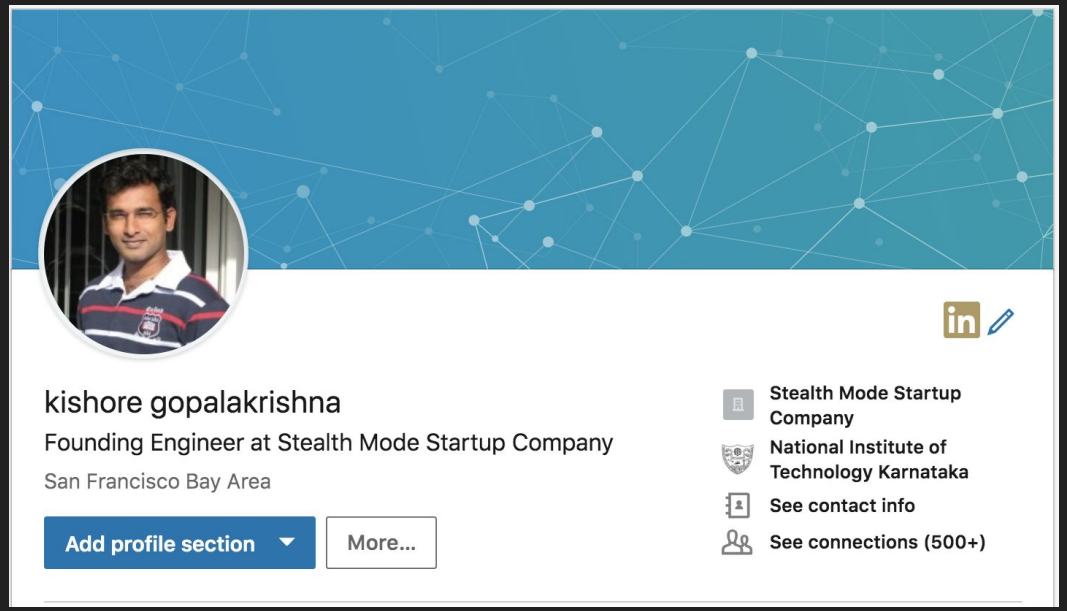
pinot

Hundreds of billions of records
Tens of terabytes of data

Pinot @ LinkedIn



Who Am I



HELIX

pinot

ESPRESSO

ThirdEye

Why am I finding it so painful ....

Published on December 18, 2018 | Edit article | View stats

Kishore Gopalakrishna
Founding Engineer at Stealth Mode Startup Company
1 article

6,809 446 57 0

Why am I finding it so painful .... 57 comments

6,809 article views | 5 reshares

1,376 views from people at LinkedIn

Google	263
Microsoft	186
Facebook	169
Uber	126

1,889 have the job title Software Developer

Technology Manager	785
Product Manager	227
Engineer	223
Product Development Engineer	155

3,704 views from San Francisco Bay Area

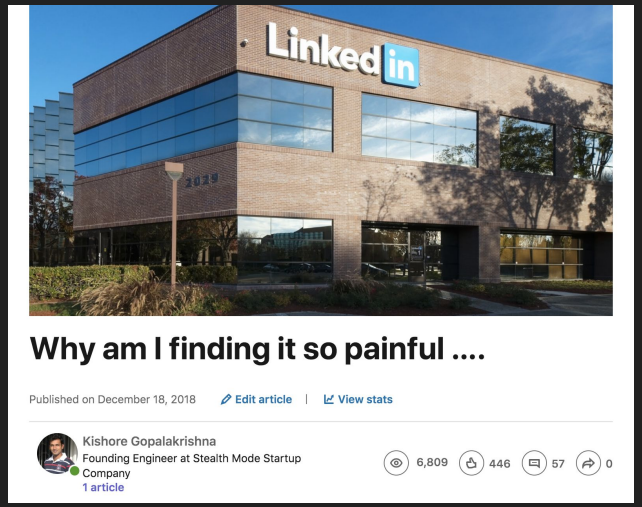
Greater Seattle Area	382
Bengaluru Area, India	368
Greater New York City Area	242
Greater Los Angeles Area	86

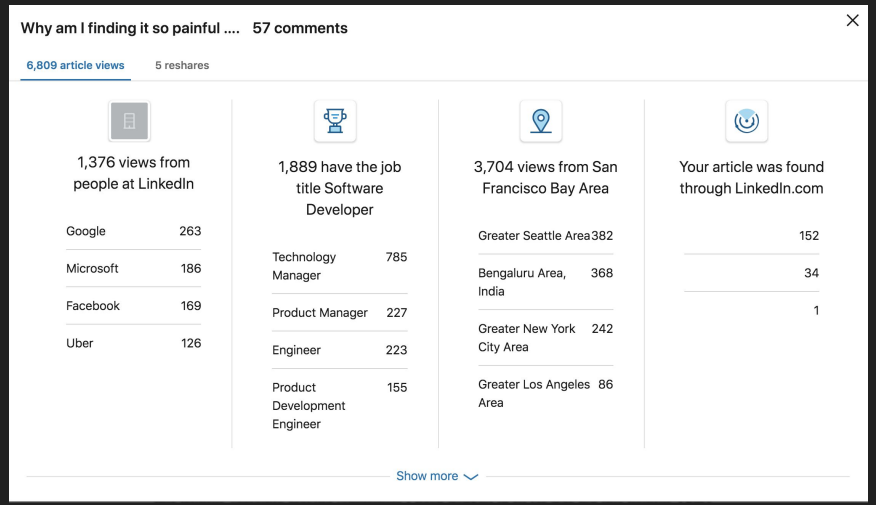
Your article was found through LinkedIn.com

152
34
1

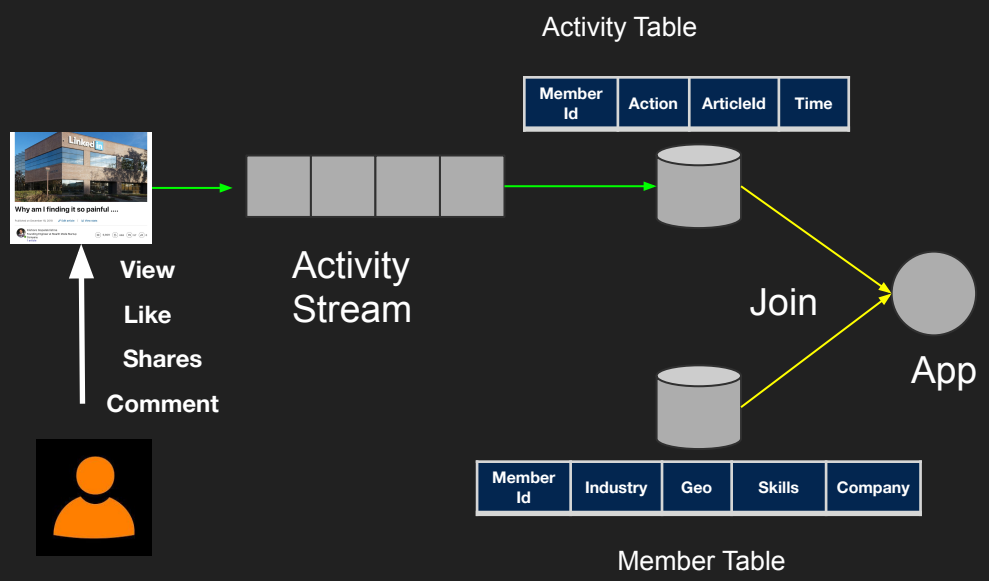
Show more

Use case 1: Article Analytics





Option 1: Join on the Fly




```
SELECT M.industry, count(*)
FROM Activity as A
INNER join Member as M
ON A.memberId = M.memberId
WHERE A.articleId=<111>
GROUP BY M.industry
```

- REALTIME (Depending on storage)
- High Latency

Option 2: Pre Join + Pre Aggregate

View

Like

Shares

Comment

Activity Stream

Stream Processing Framework

Look Up

Member Id	Industry	Geo	Skills	Company

Member Table

Pre Join + Pre Agg

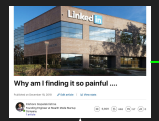
Article Id	Industry	...	Action	Time	Count

App

```
SELECT industry, sum(count)
FROM PreJoined_Activity_Member
WHERE A.articleId=<111>
GROUP BY M.industry
```

- Near real-time ingestion
- Low latency (unpredictable*)

Option 3: Pre Join + Pre Cube + Pre Agg



View

Like

Shares

Comment

Activity Stream

Stream Processing Framework

Look Up

Member Id	Industry	Geo	Skills	Company

Member Table

Pre Cube

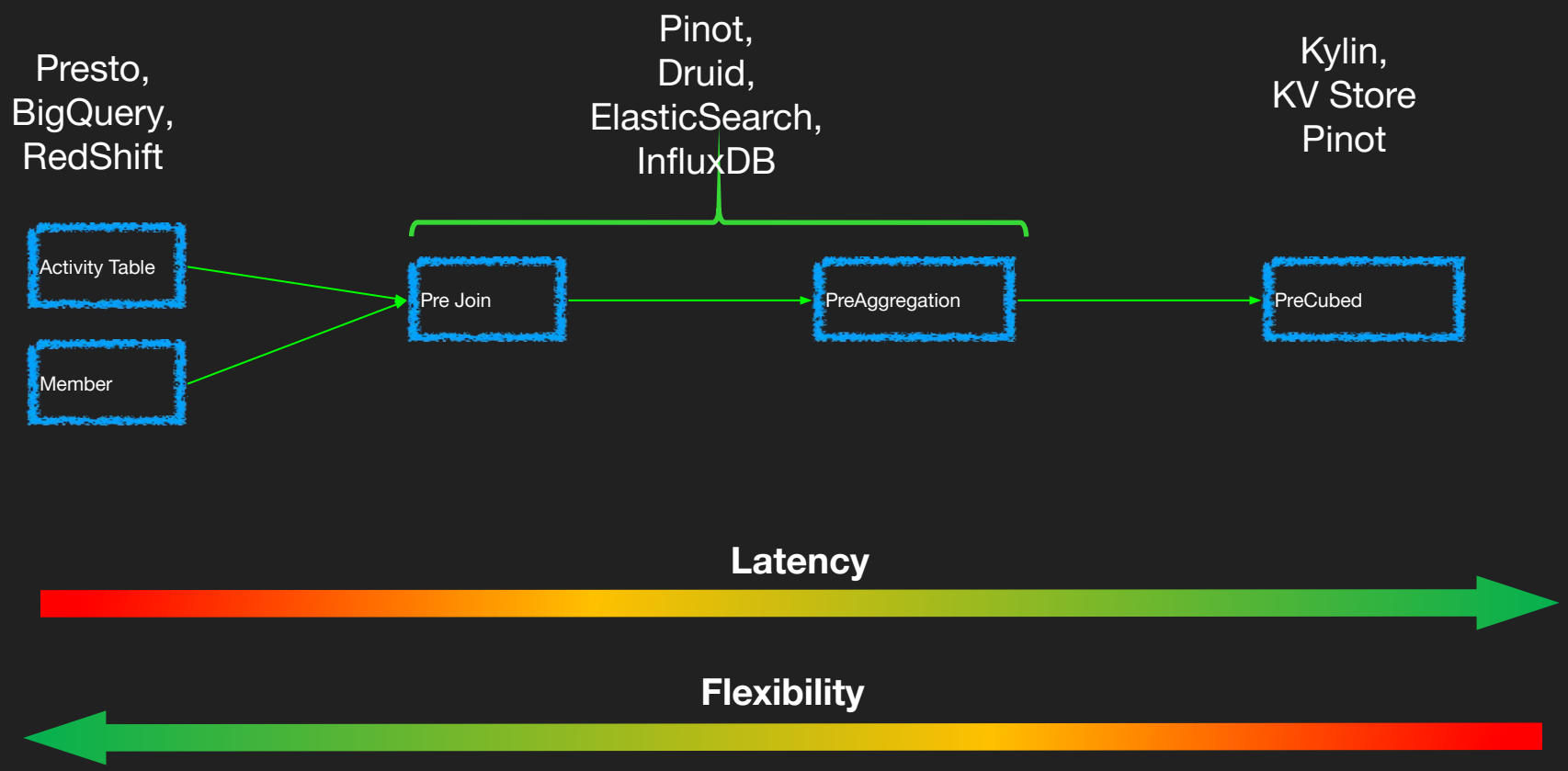
Article Id	Industry	...	Action	Time	Count

App

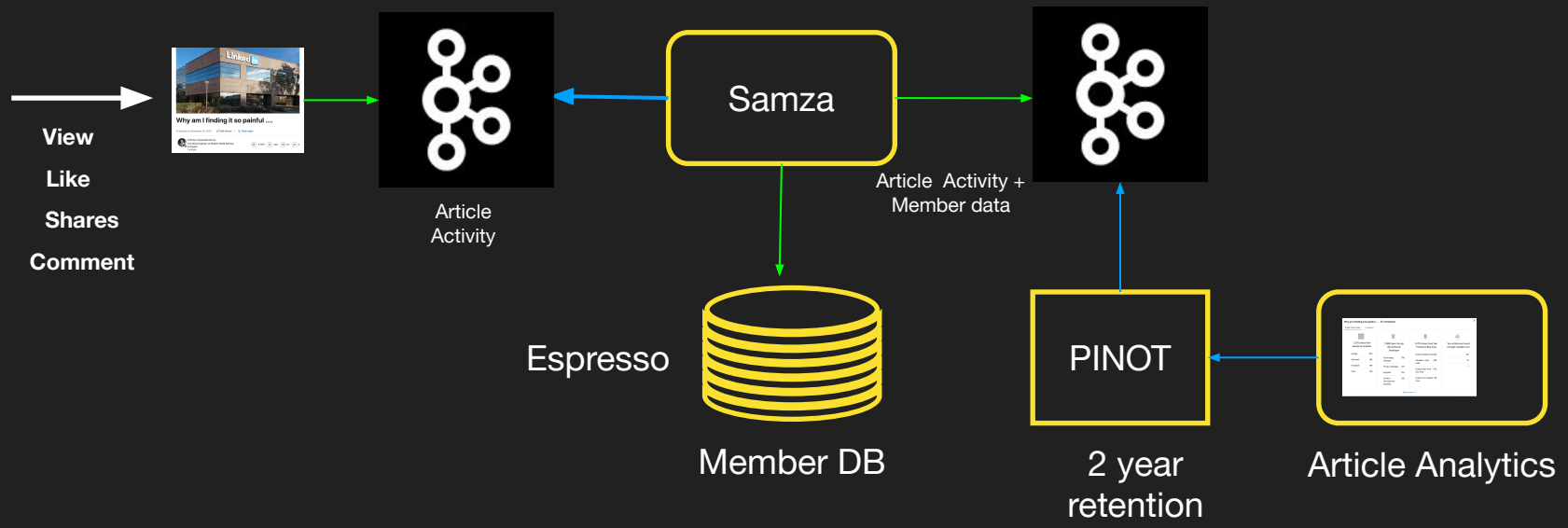
```
SELECT industry, sum(count)
FROM PreCubed_Activity_Member
WHERE A.articleId=<111>
        AND company = '*'
        AND … = '*'
GROUP BY M.industry
```

- Very fast (mostly lookup)
- Batch (Hourly/Daily)
- Extra storage (Curse of dimensionality)
- Re-bootstrap on schema changes
- Limited query capability

Comparison


Presto,
BigQuery,
RedShift
Pinot,
Druid,
ElasticSearch,
InfluxDB
Kylin,
KV Store
Pinot
Activity Table
Member
Pre Join
PreAggregation
PreCubed
Latency
Flexibility

Publisher Analytics Architecture



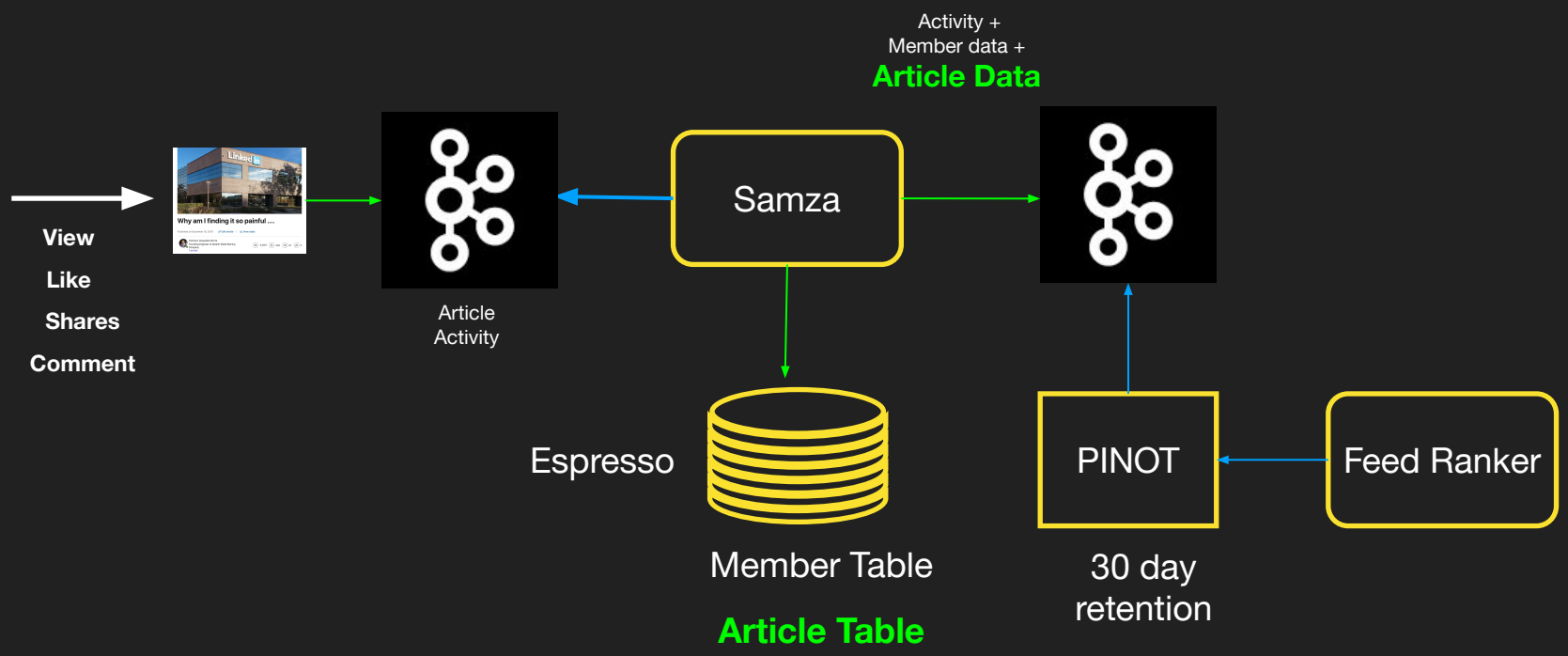
Can we use the activities data to improve the feed?

Feed Relevance

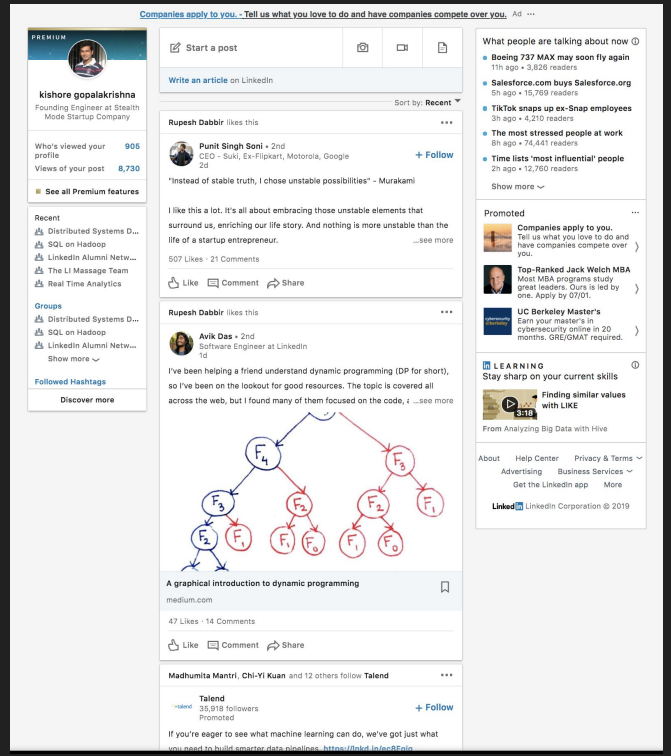
Rank the feed based on relevance

01	**Identity**	• Company • Geography • Skills
02	**Content**	• Views, Likes, Comments • Age • Category
03	**Behaviour**	• Prior interactions • Interests • Engagement

Feed Ranking Architecture



Feed Ranking Perf Numbers

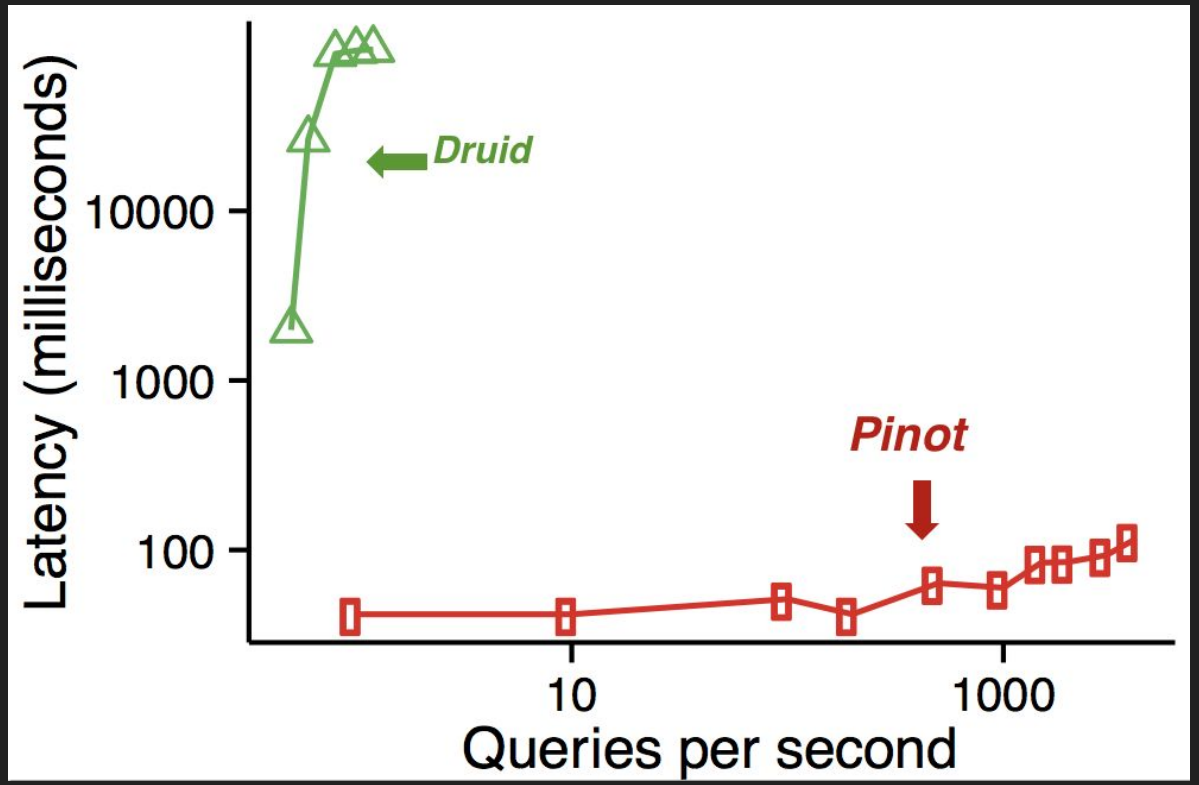


SELECT sum(count) from T
WHERE memberId = <>
AND article in (list of 1500 items)
AND time >= (now - 14 days)
GROUP BY action, item, position, time

QPS	p50	p90	p99	p99.9
6400	5ms	25ms	45ms	100ms

Significant increase in engagement

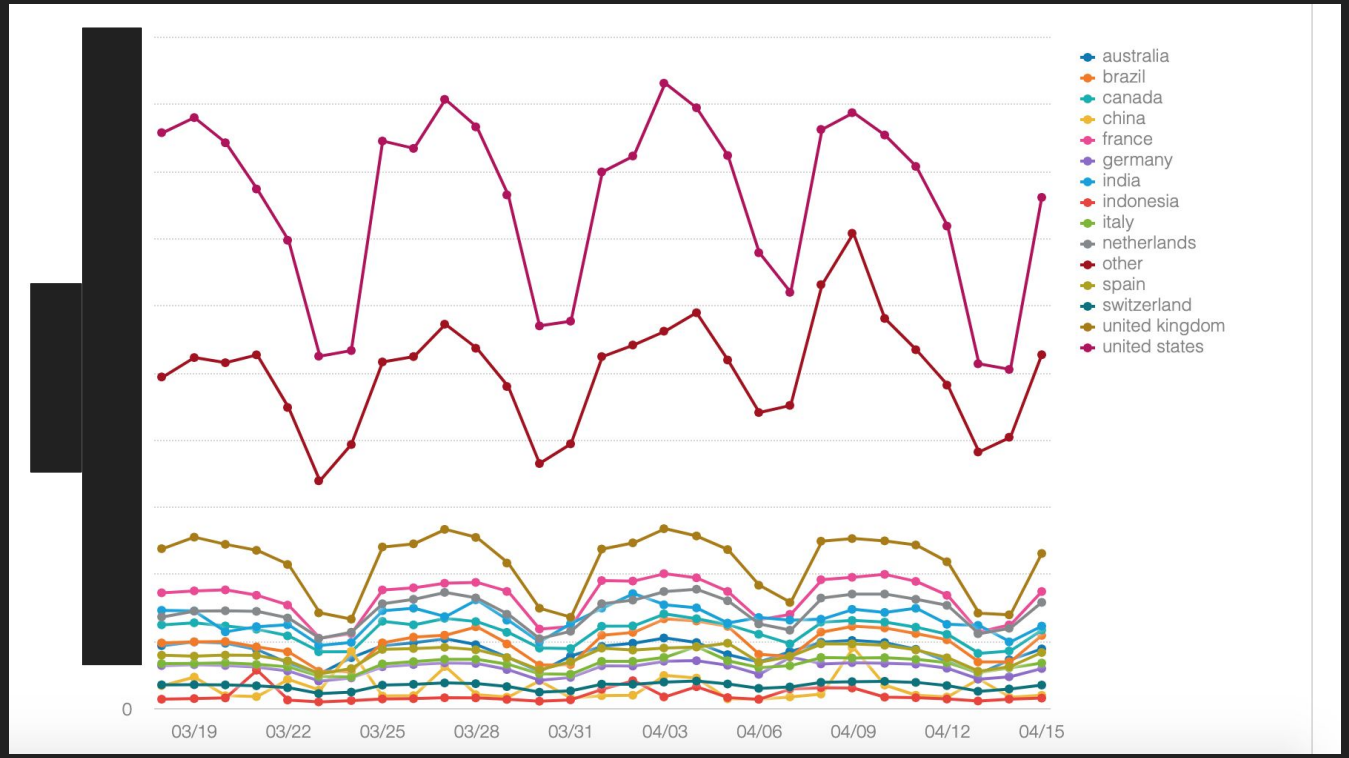
Site Facing use case: Pinot vs Druid



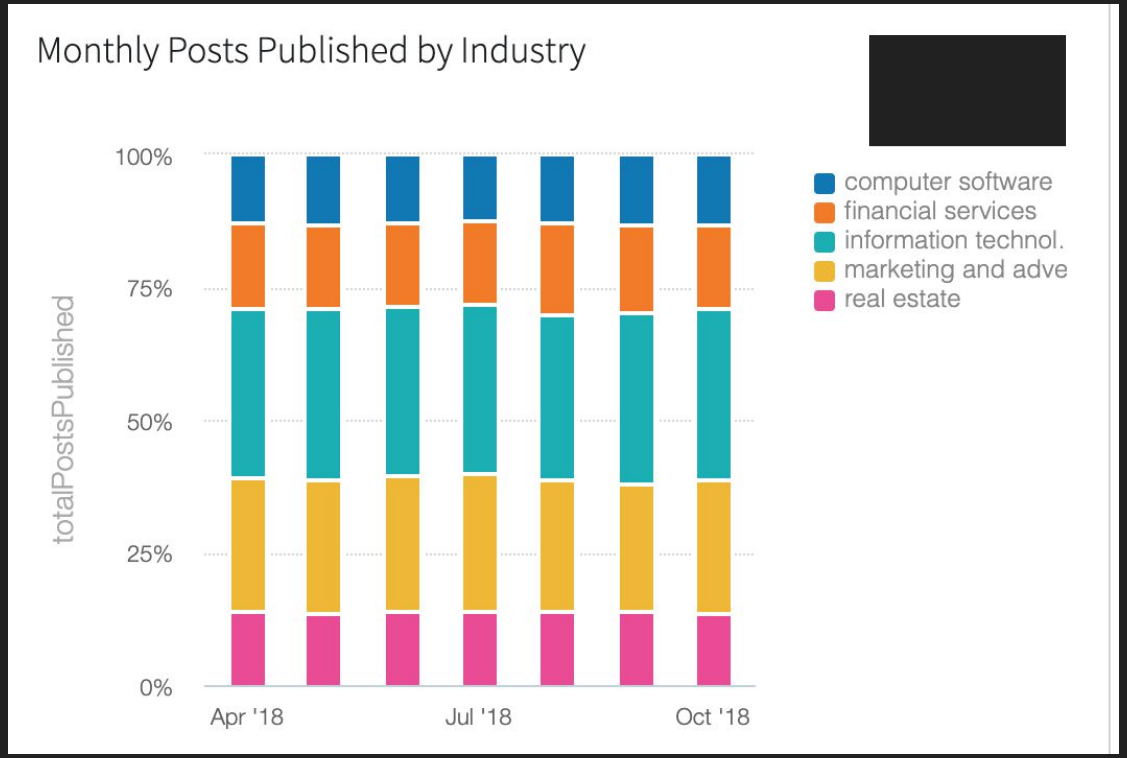
- Sorted Index
- Per query optimizer
- Optional indexing

What Business Insights can we generate from this data?

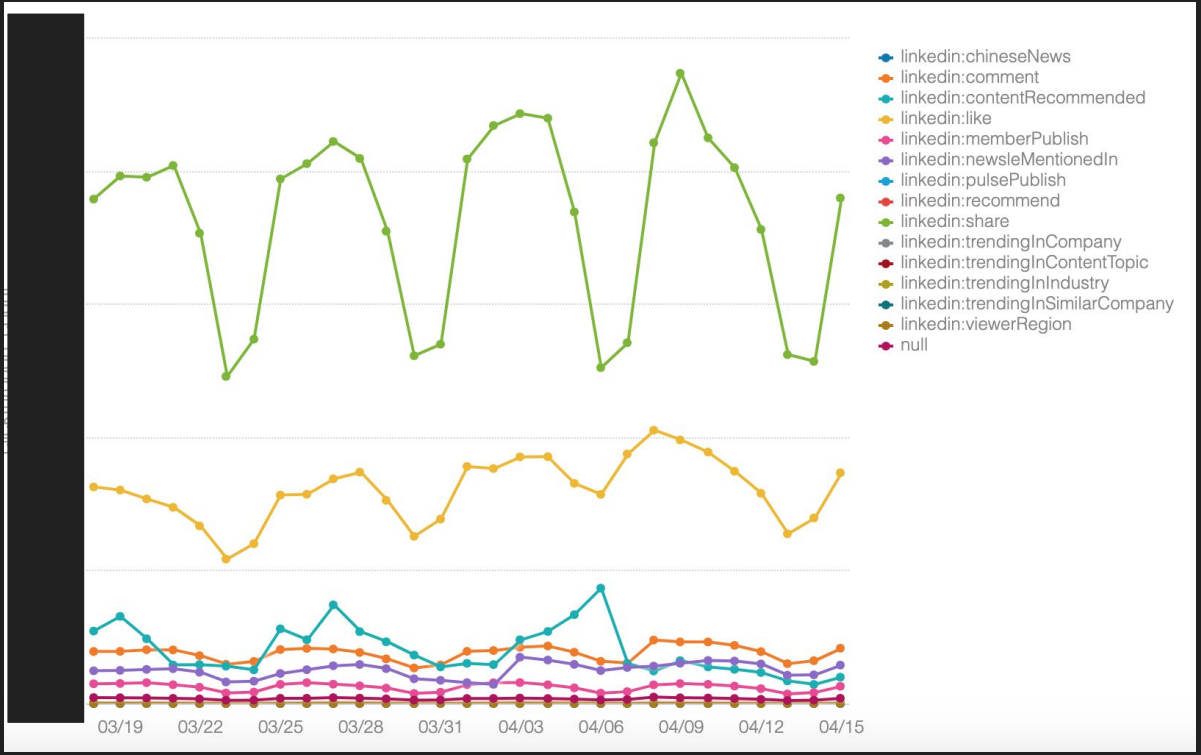
Posts Published: Breakdown By Country



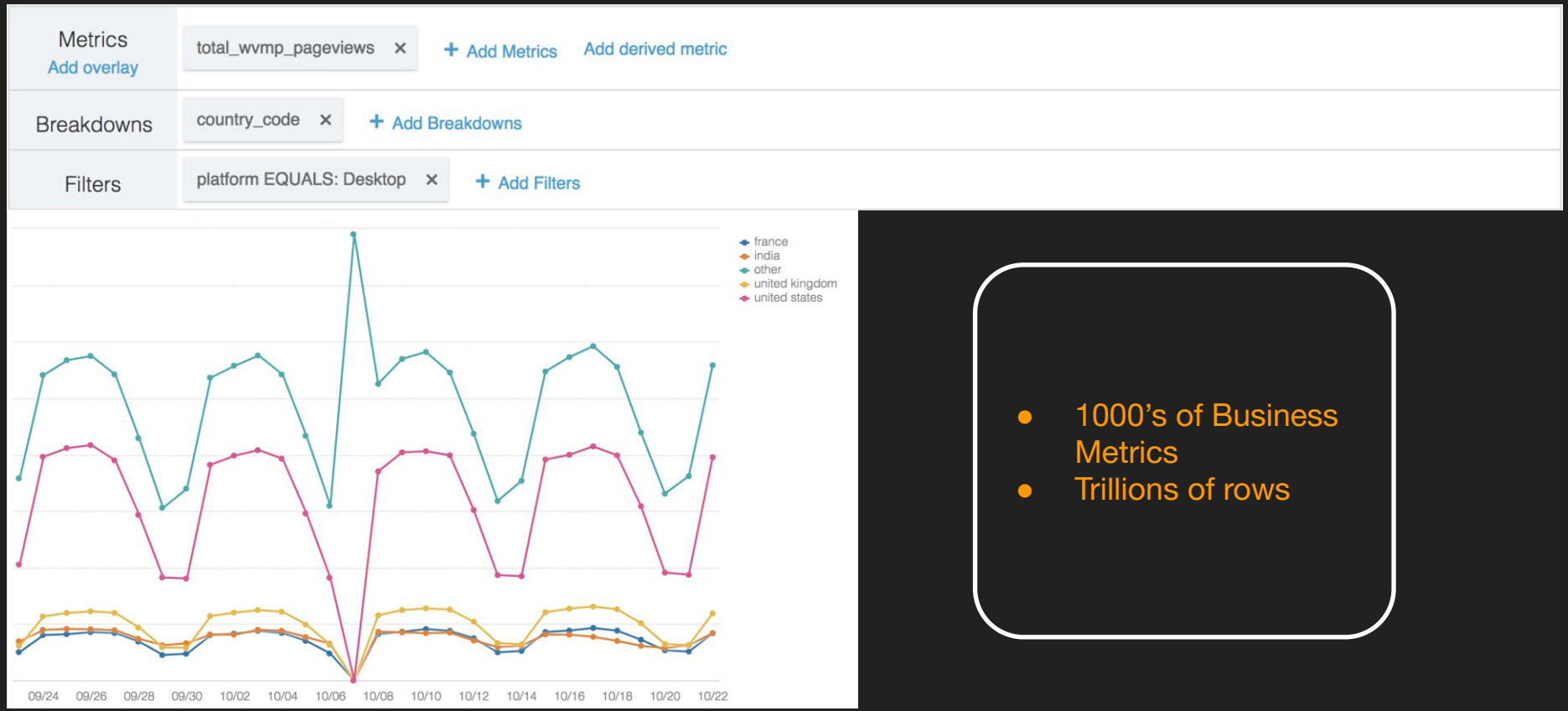
Distribution: By Industry



Views: Breakdown by Referrer

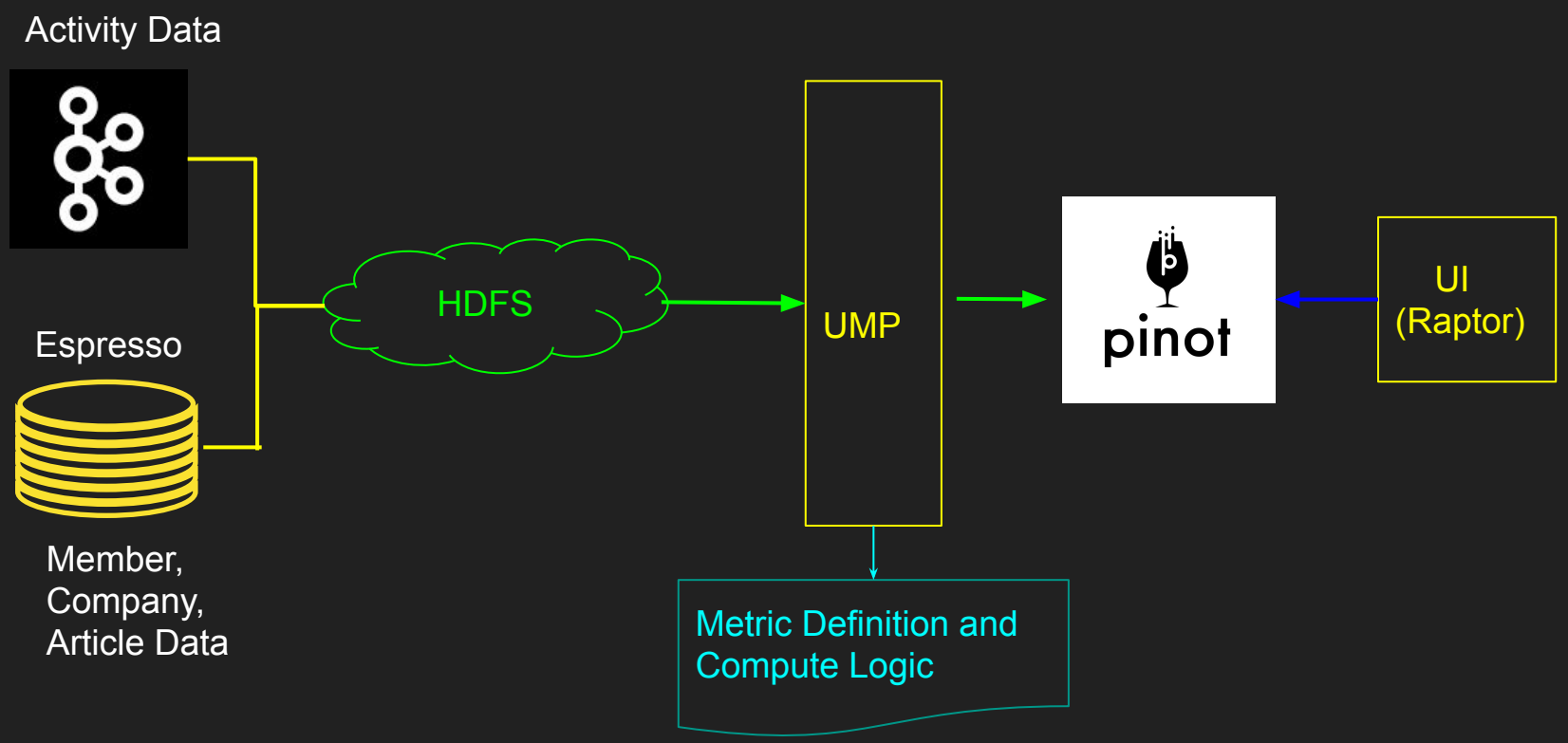


Slice and Dice UI

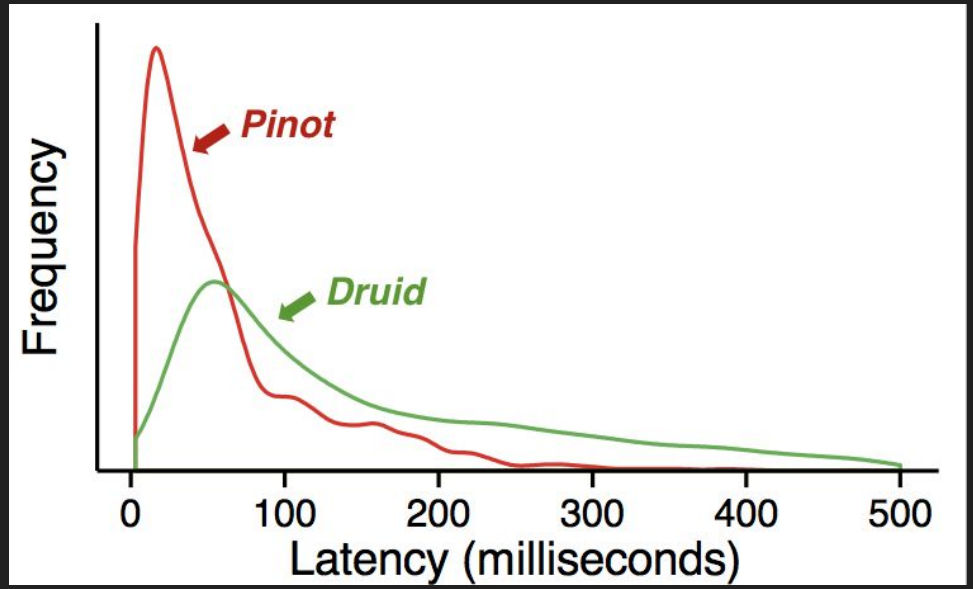


- 1000's of Business Metrics
- Trillions of rows

Dashboard Pipeline Architecture



Dashboard use case: Pinot vs Druid



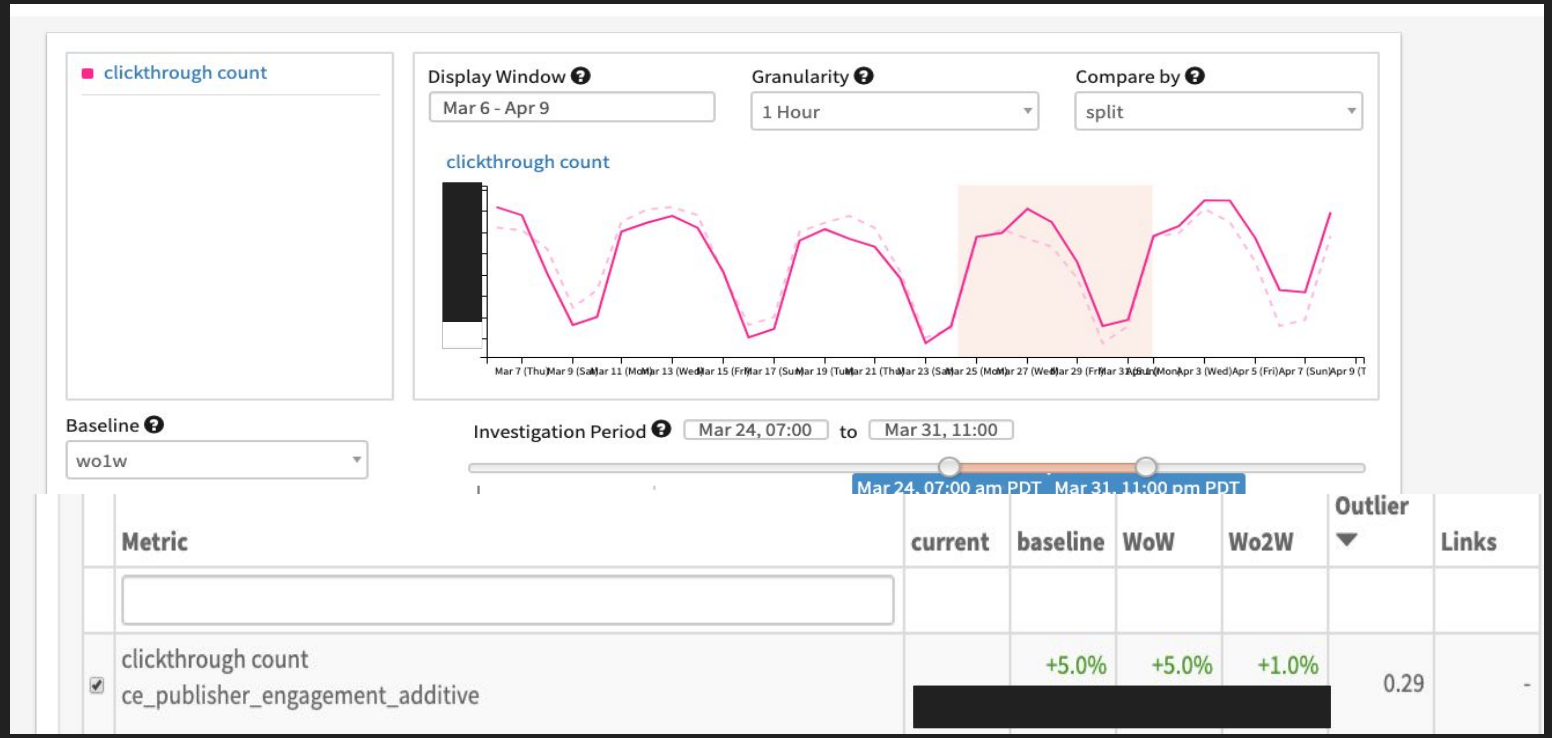
- ~ 5000 random queries of the form
  - **select sum(views), time from T where country = us, browser = chrome,… group by Date**
- run sequentially one after the other

	Pinot	Druid
Total time	11 minutes	24 minutes
p50	84 ms	136 ms
p90	206 ms	667 ms

Anomaly Detection

Why don’t we monitor these metric and alert?

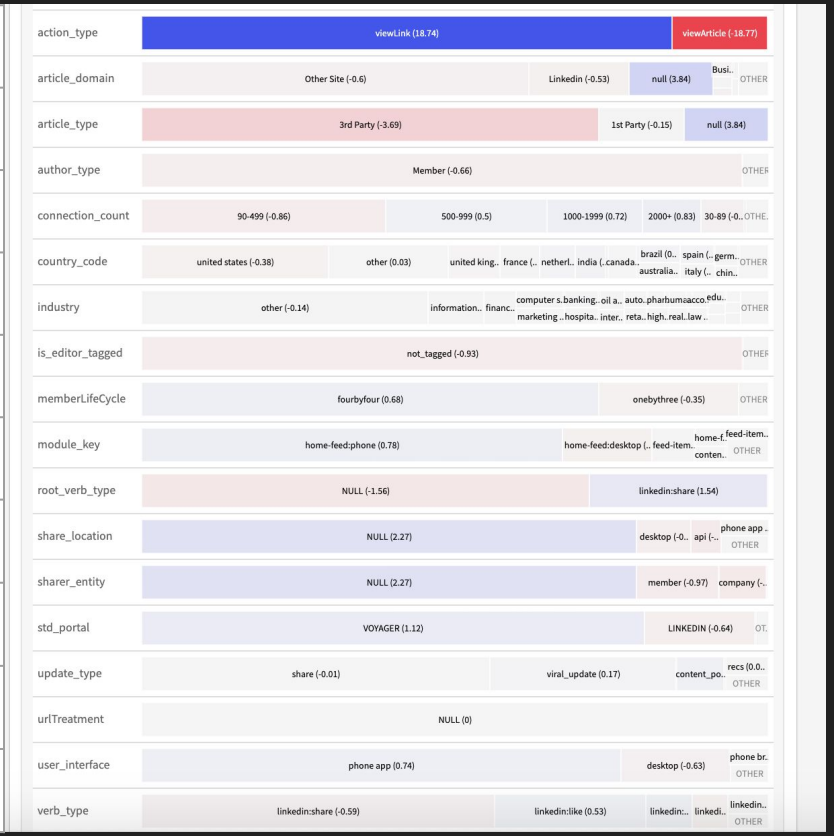
ThirdEye: Anomaly Detection



ThirdEye:Root Cause Analysis

18 Dimensions

- action_type
- Domain
- article_type
- author_type
- #connections
- industry
- ....
- location
- verb_type



- Interactive
- break down
- sub-second
- Multiple queries

Anomaly Detection

```
SELECT sum(view), time
 FROM PostView
 GROUP BY time
```

TOP LEVEL

```
for d1 in [us, ca, … ]
   for d2 in [chrome, ie, … ]
     …
     SELECT sum(view), time
      FROM PostView
      WHERE
           country = d1
           AND  browser = d2
           AND ...
     GROUP BY time
```

MULTI DIMENSIONAL

Multi-dimensional anomaly detection challenges

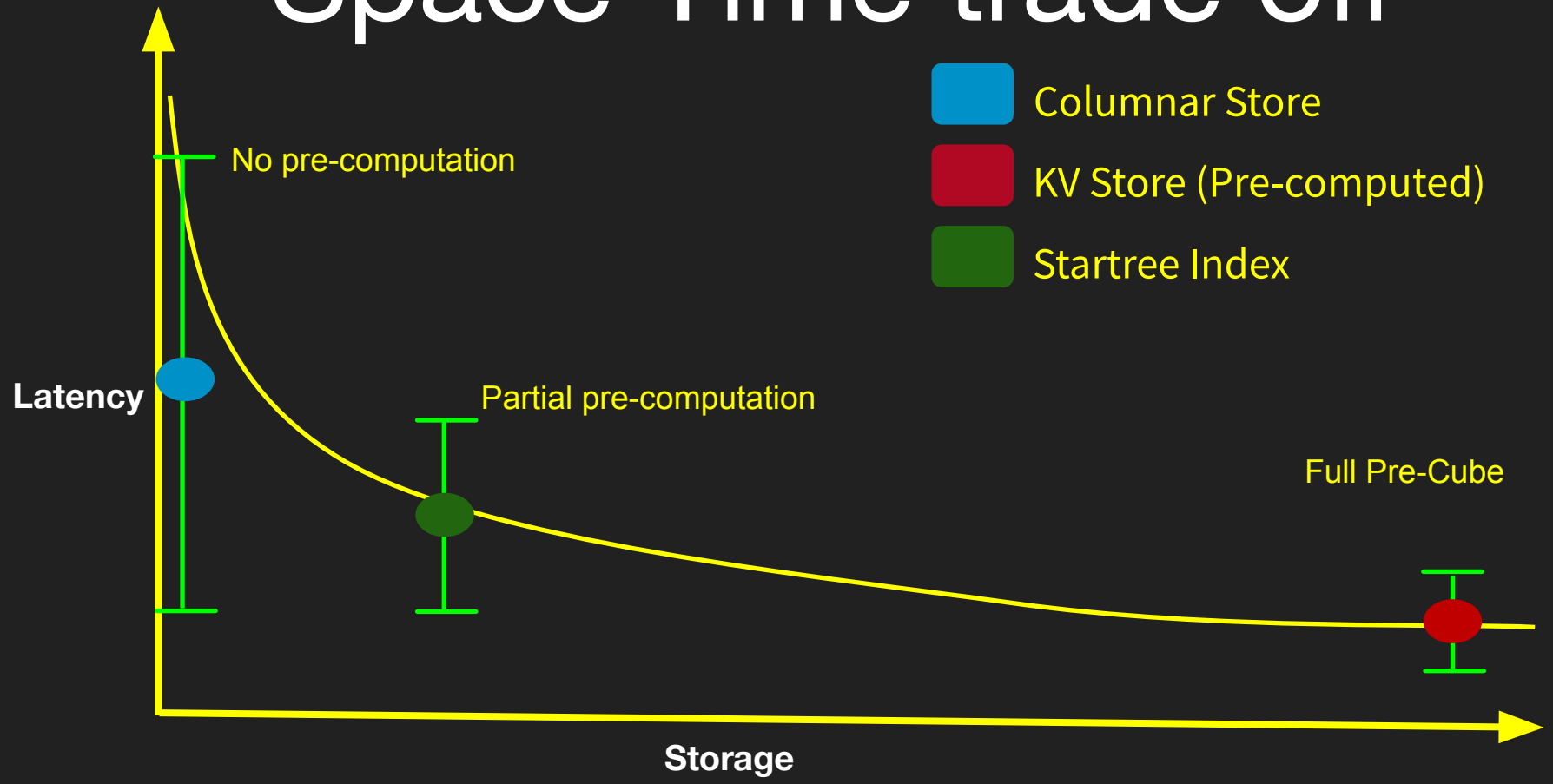
```
for d1 in [us, ca, … ]
  for d2 in [chrome, ie, … ]
    …
    SELECT sum(view), time
     FROM PostView
     WHERE
          country = d1
          AND  browser = d2
          AND ...
    GROUP BY time
```

MULTI DIMENSIONAL

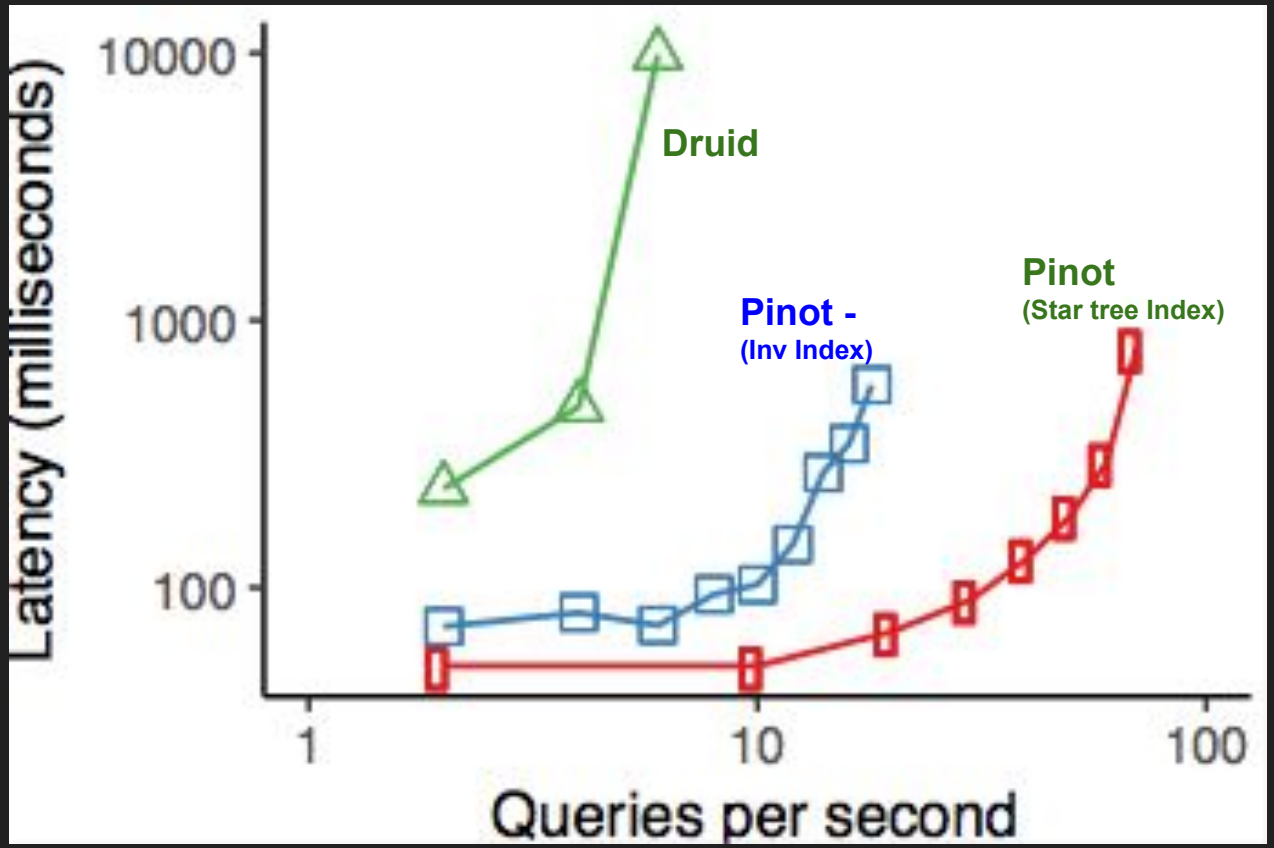
1. ***Identifying issues requires monitoring all possible combinations***
2. ***No Id column (ArticleId, Member Id)***
3. ***Latency is unpredictable even with Inverted Index***

select sum(view) where country=”us’	scan 60-70% of the rows	Slow
country=”ireland’	scan <1% of the rows	Fast

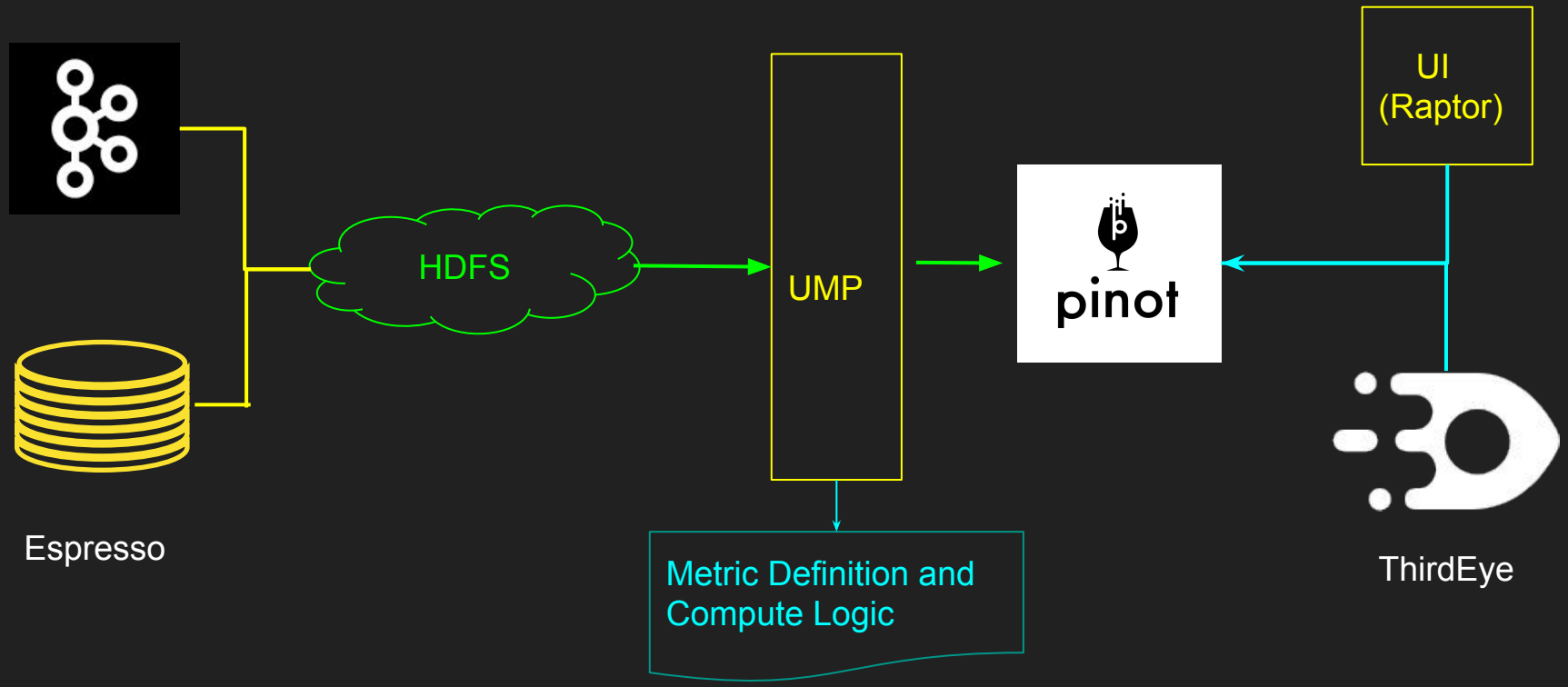
Space-Time trade off



Anomaly Detection: Druid vs Pinot

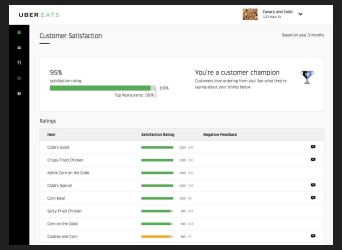


Anomaly Detection Architecture



Pinot usage

50TB
1000 qps

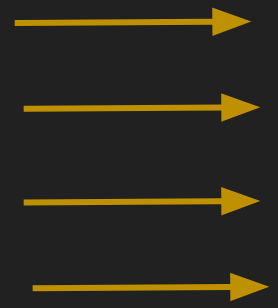


✓ UberEATS

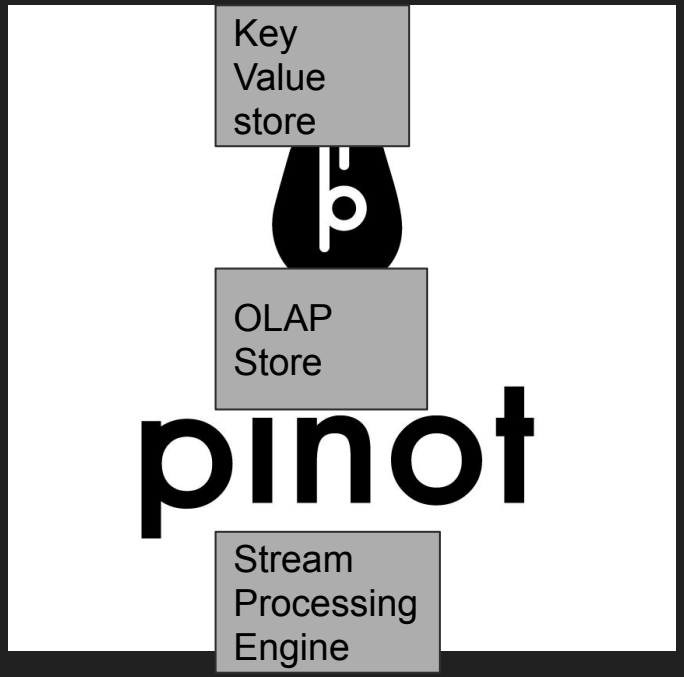
✓ MarketPlace
✓ UberPool
✓ UberFreight
✓ Jump

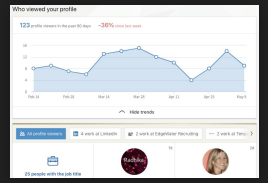
Hi Just want to let you know the power of Pinot, the same data & usecase I have to use 45 node each 256gb ram machines to index it in druid. I'm using 18 node 122gb machine now for Pinot, but that itself is over provisioned!!

Conclusion

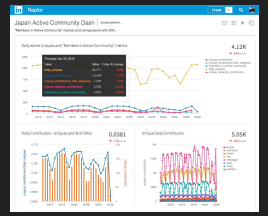


Activity Data

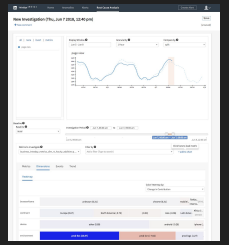




Site Facing Applications



Dashboard: Business Analytics



Anomaly Detection

Questions

Website	http://pinot.apache.org
Slack	apache-pinot.slack.com
Twitter Handle	@apachepinot, @kishoreBytes