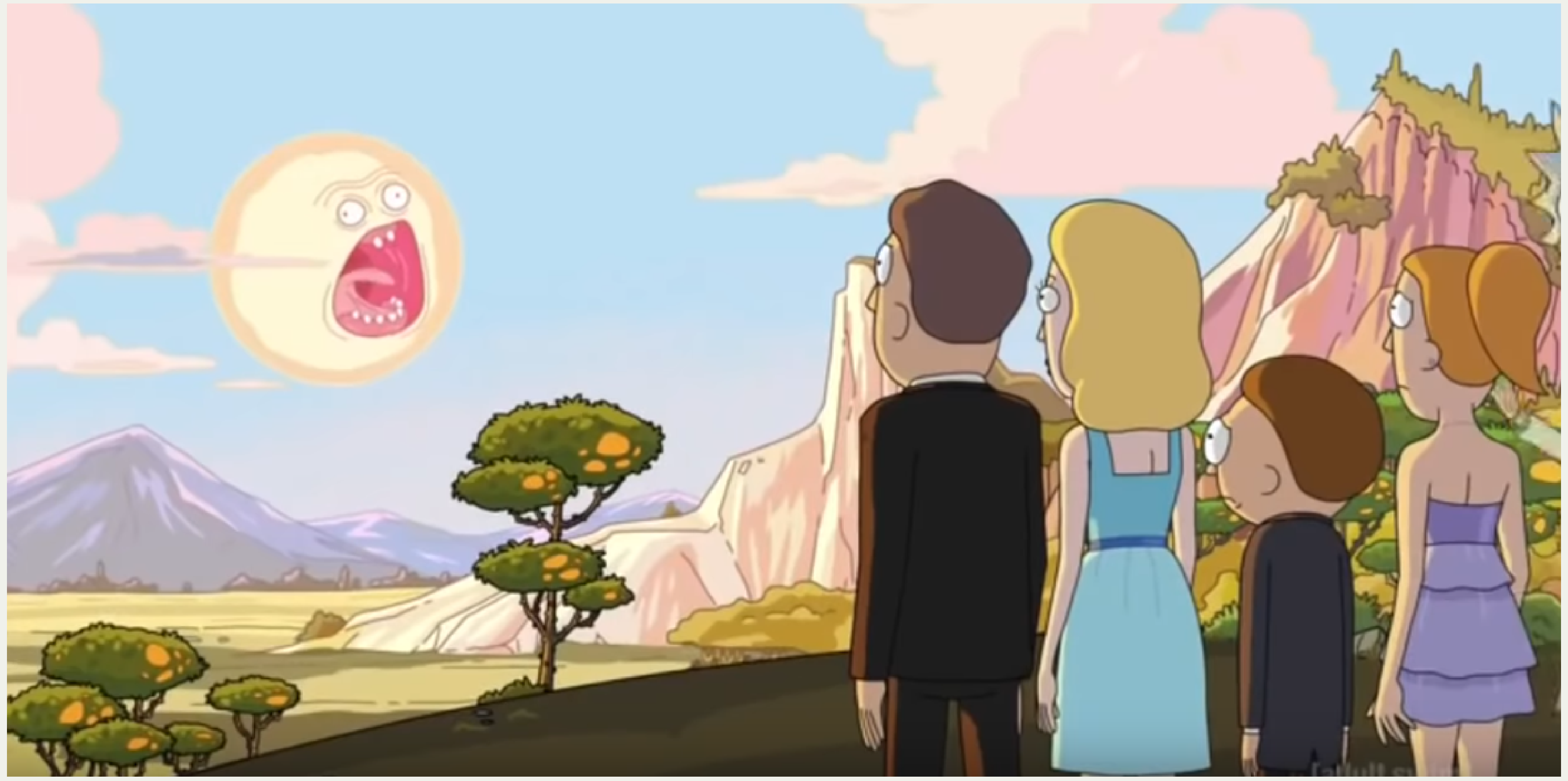
Metarank:

Building an open-source online LTR engine

Haystack EU, 2022

This is me

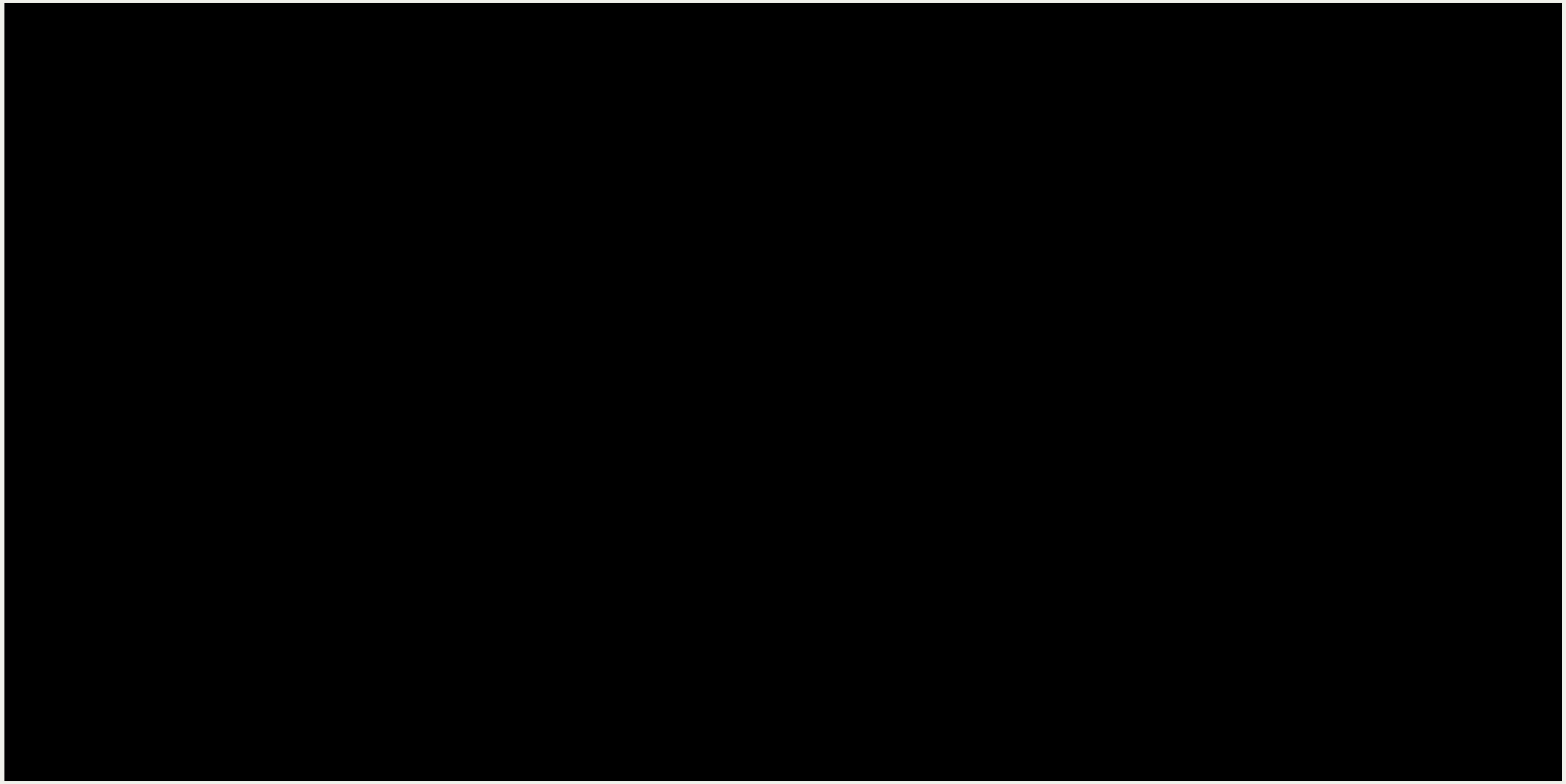


- Long ago: PhD in CS, quant trading, credit scoring
- Past: Search & personalization for ~7 years
- Now: ~~Unemployed~~ Full-time open-source contributor

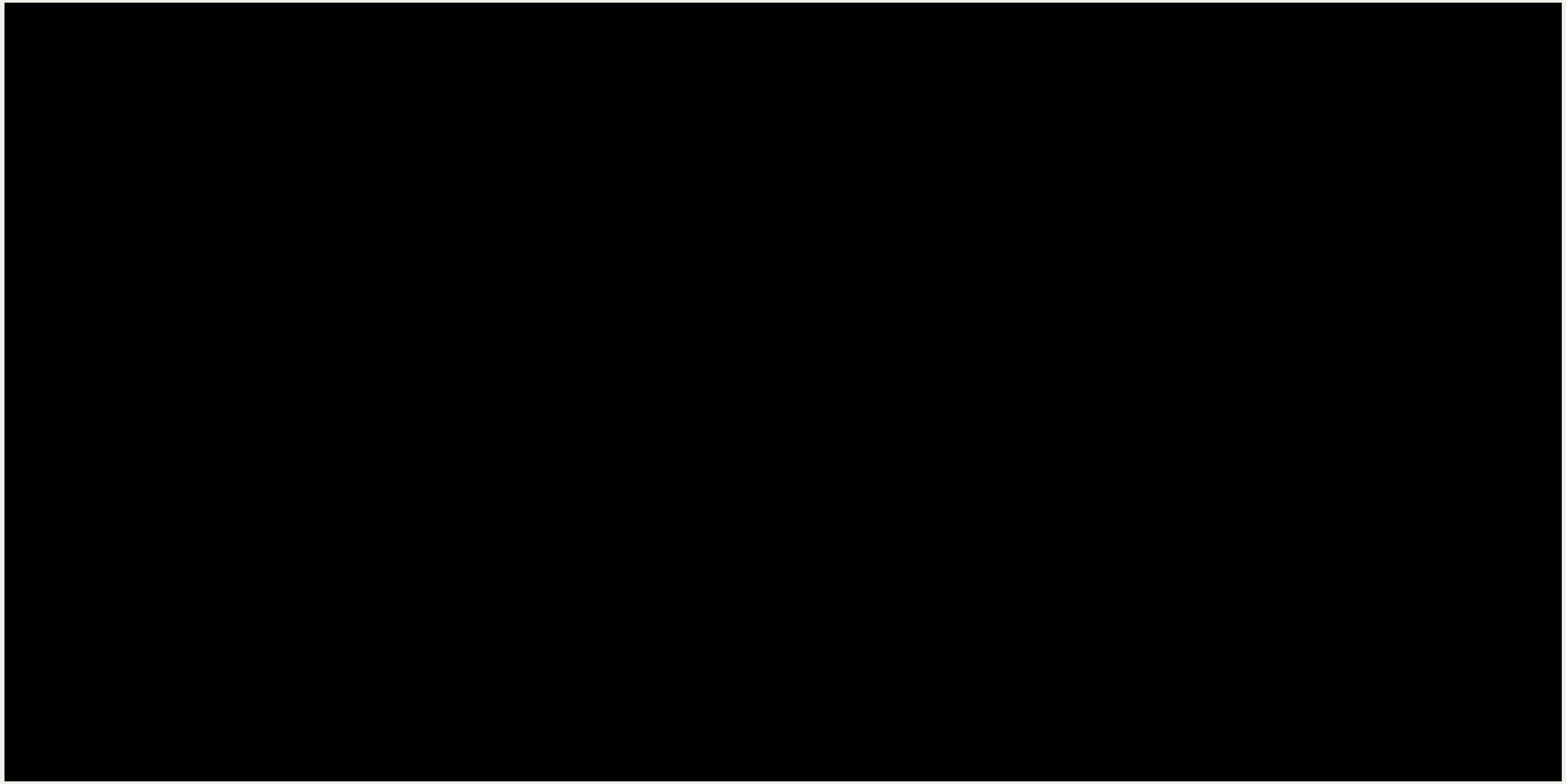
RANKING

Not [only] about search

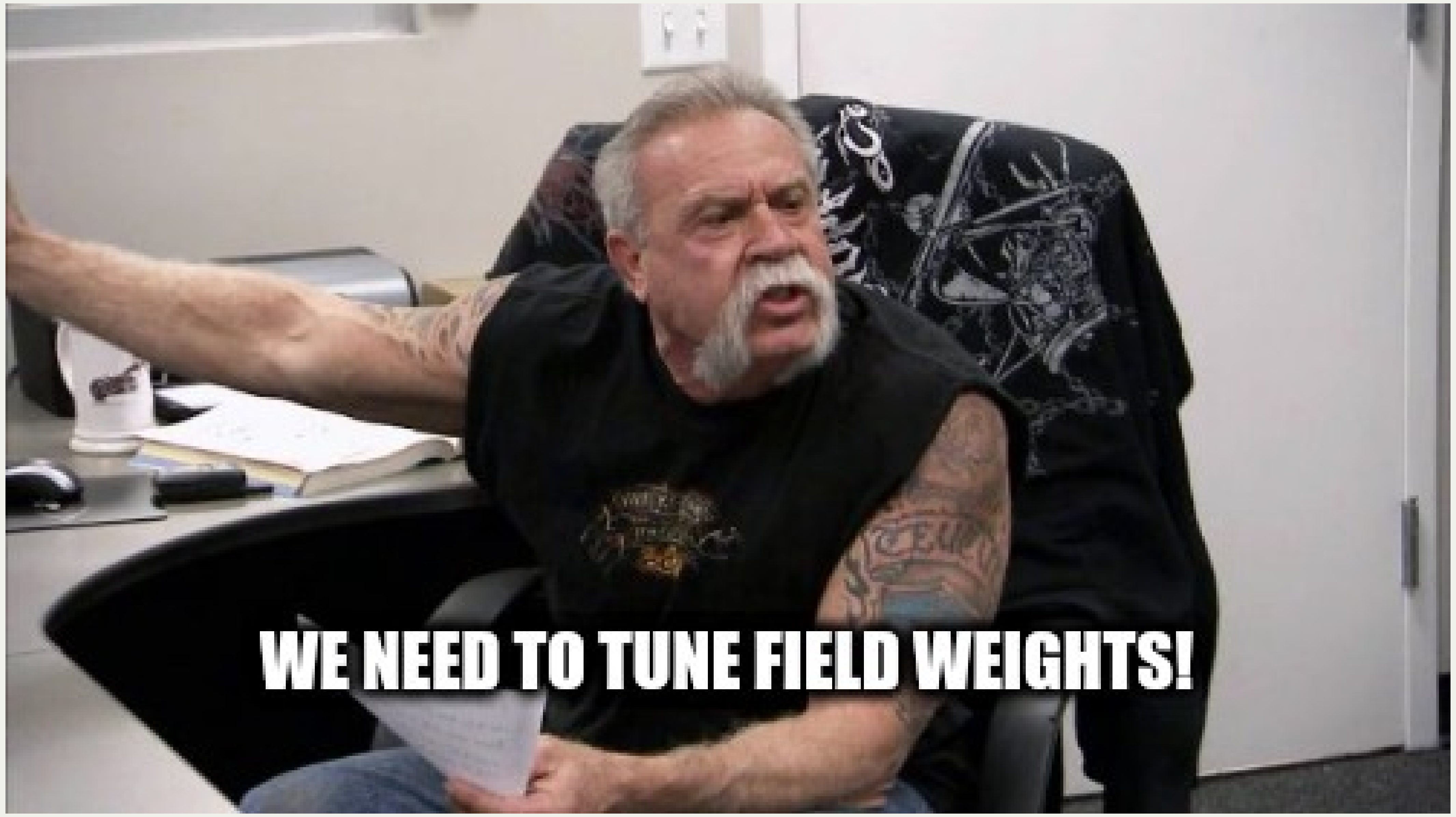
Not [only] about e-commerce



Not [only] static



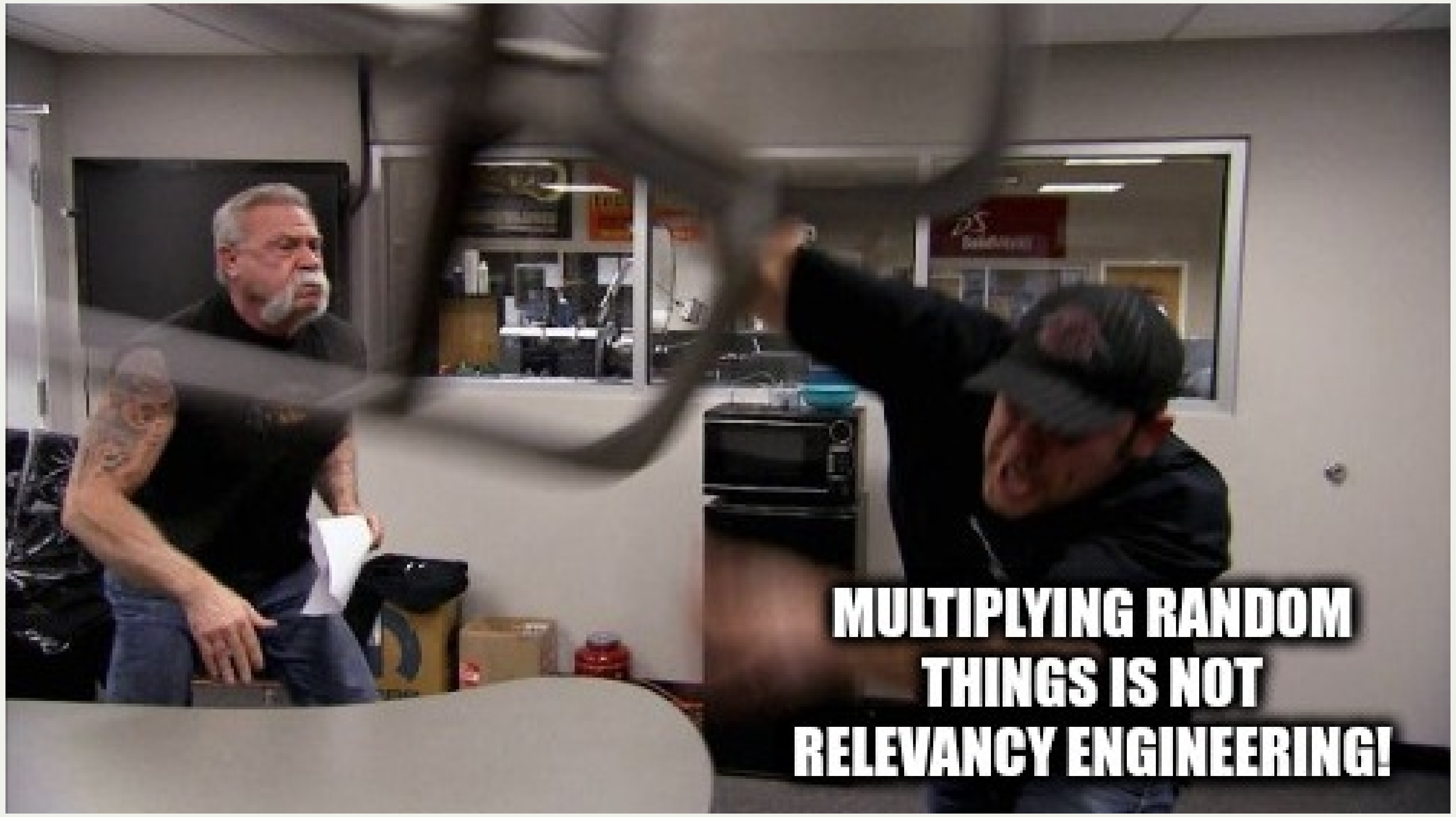
Learn-to-rank, again?



- A low-hanging fruit, existing tooling
- poke - a/b test - poke - a/b test

- Iterative a/b tests take a lot of time
- More weights = more problems

- Learn-to-rank needs a myriad of MLops things
- Long project, no experience, no tooling = high risk



- BM25 * CTR = quick feedback
- LTR = 🤔

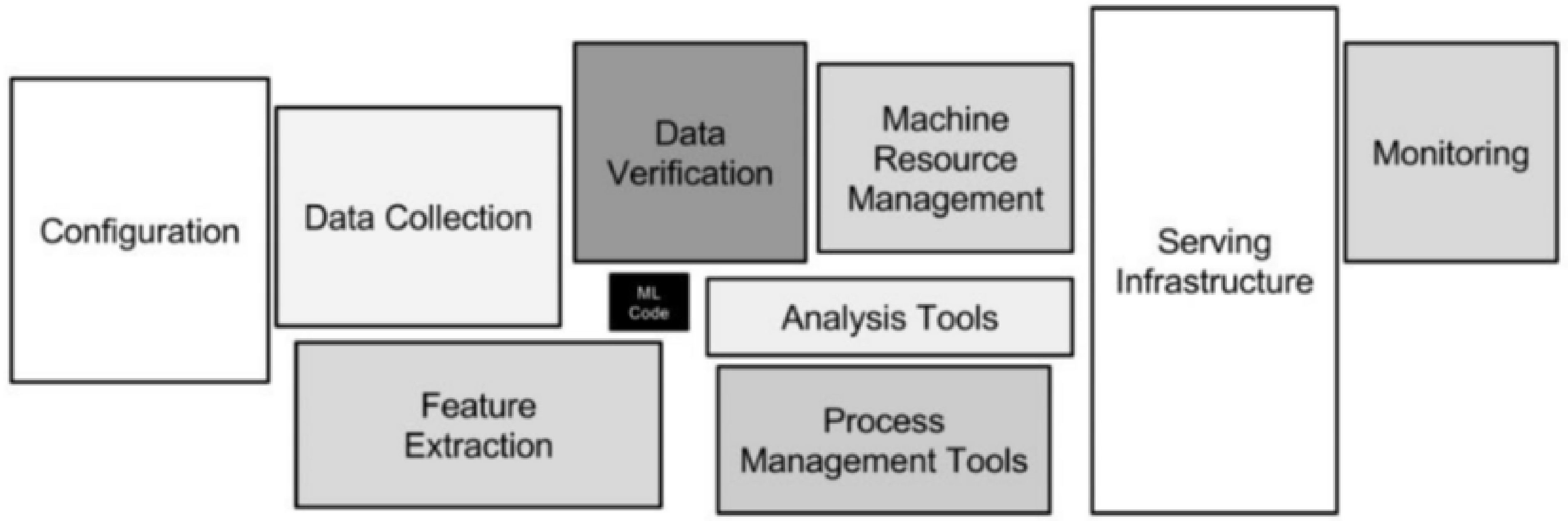
- BERT, HNSWlib & FAISS are 2018
- Existing tooling made it approachable

LTR: a high risk investment

- team: ML/MLops experience
- time: 6+ months, not guaranteed to succeed
- tooling: custom, in-house

Hidden Technical Debt in Machine Learning Systems

D. Sculley, Gary Holt, Daniel Golovin, Eugene Davydov, Todd Phillips
{dsculley,gholt,dgg,edavydov,toddphillips}@google.com
Google, Inc.



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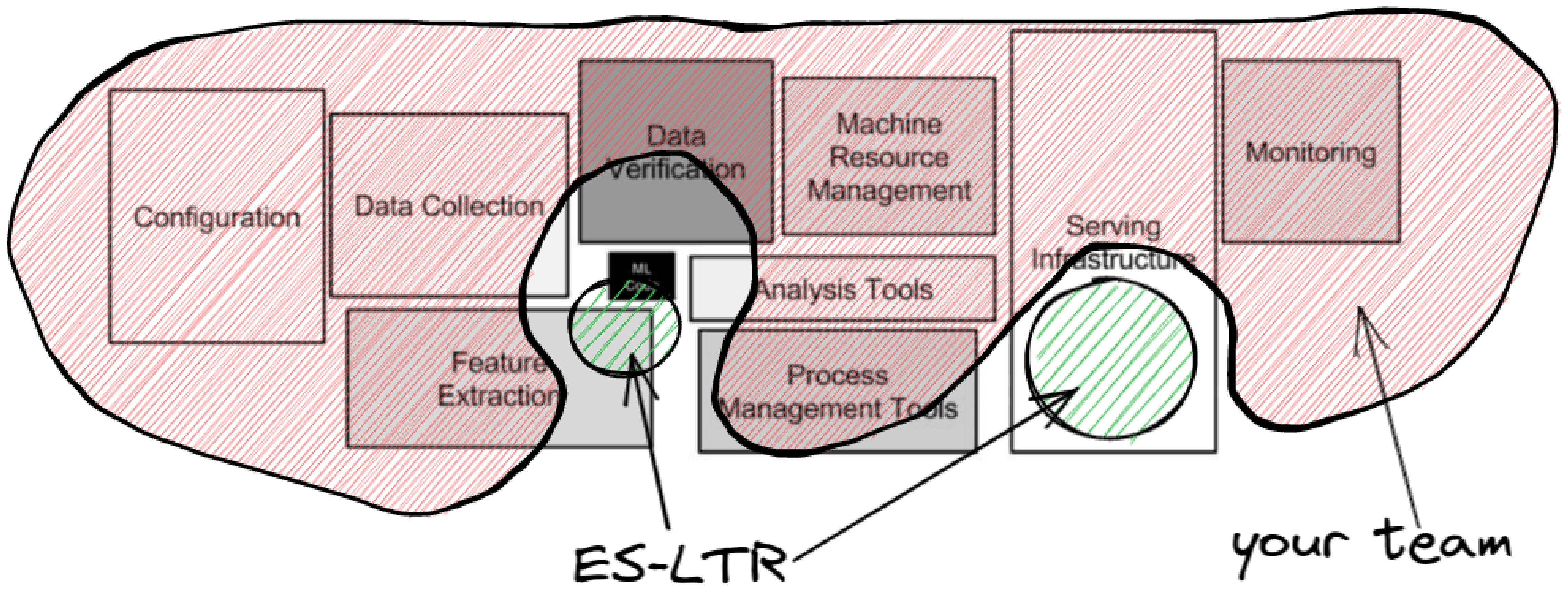
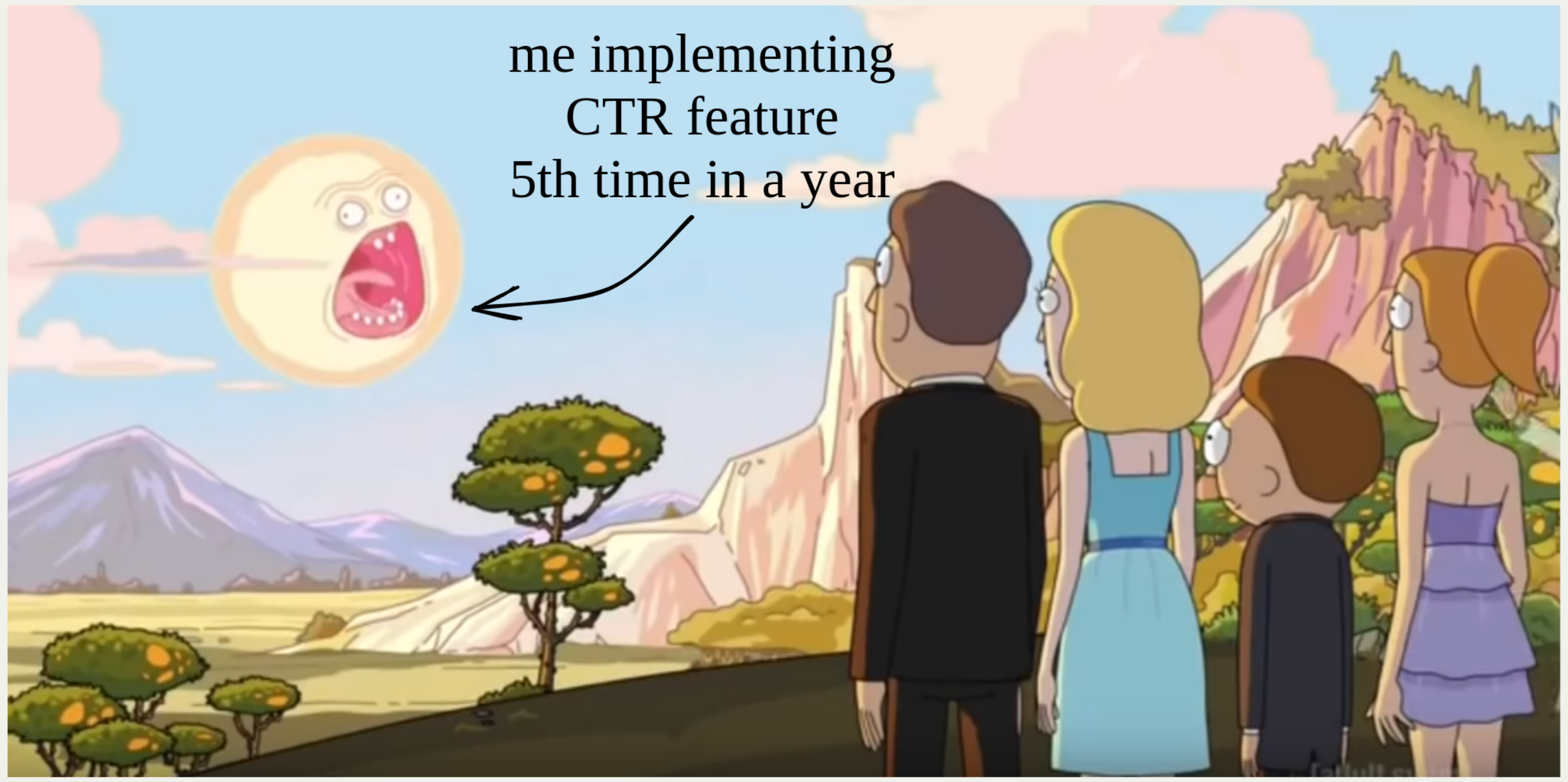


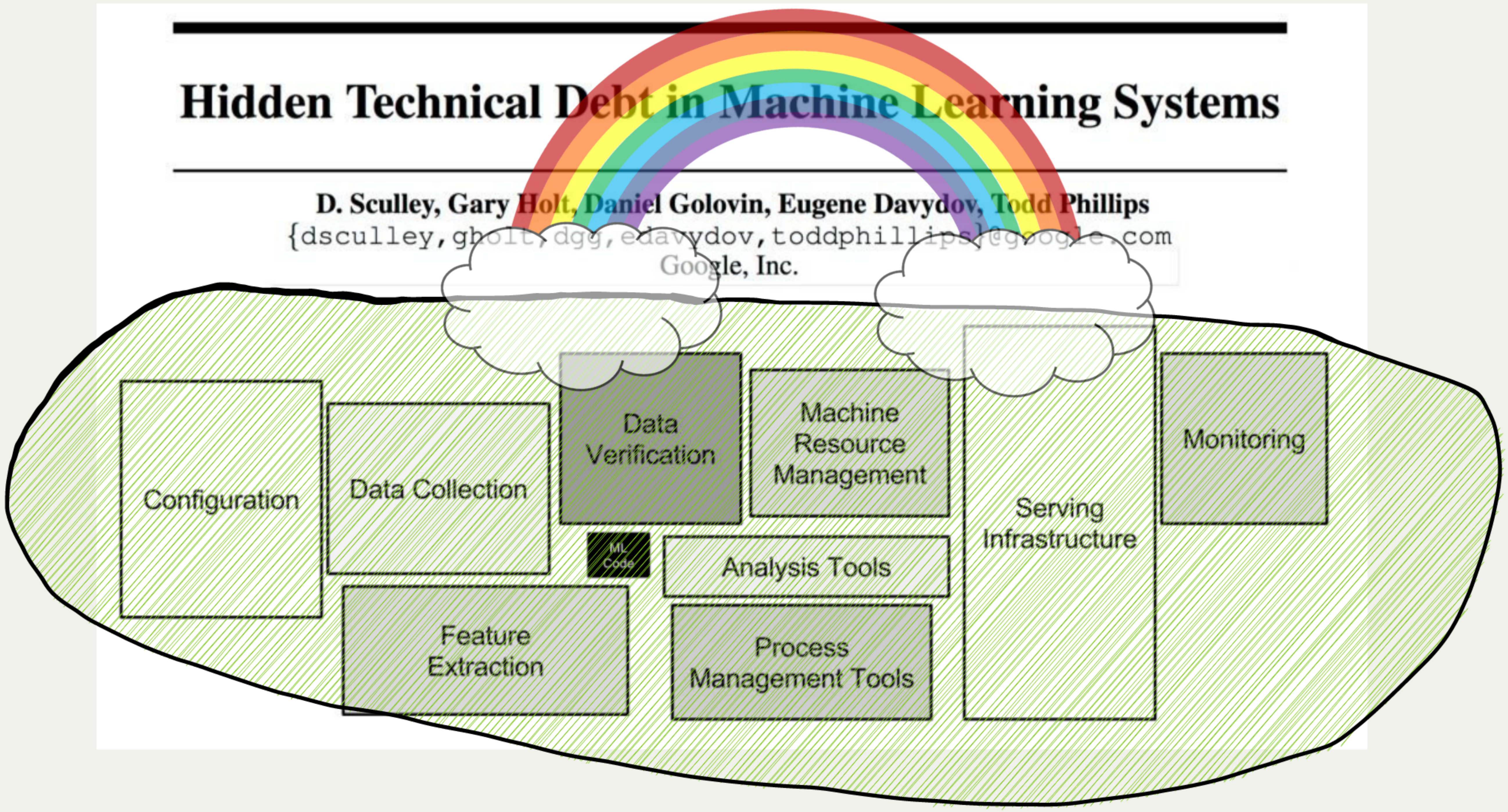
Are my ranking factors unique?



- UA, Referer, GeoIP
- query-field matching, item metadata
- counters, CTR, visitor profile

Is my data setup unique?

- data model: clicks, impressions, metadata
- feature engineering: compute and logging
- feature store: judgement lists, history replay, bootstrap
- typical LTR ML models: LambdaMART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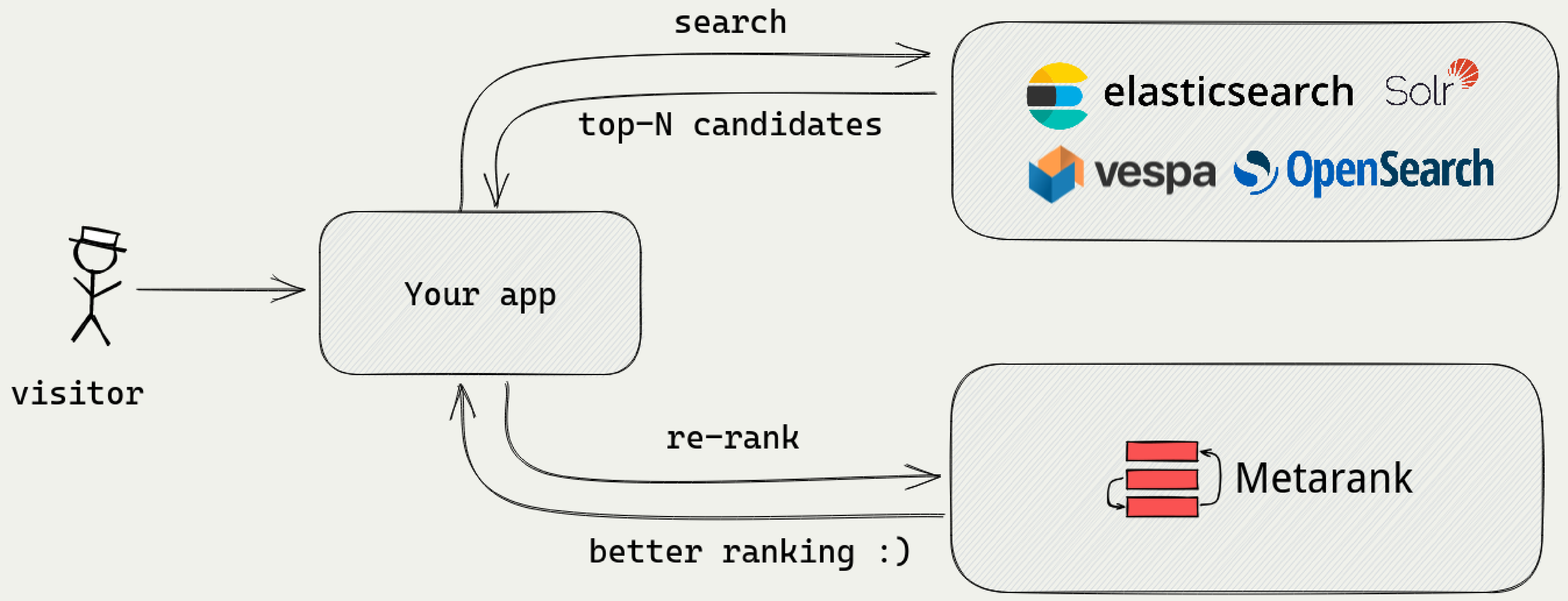
- cover 90% typical tasks in 10% time?

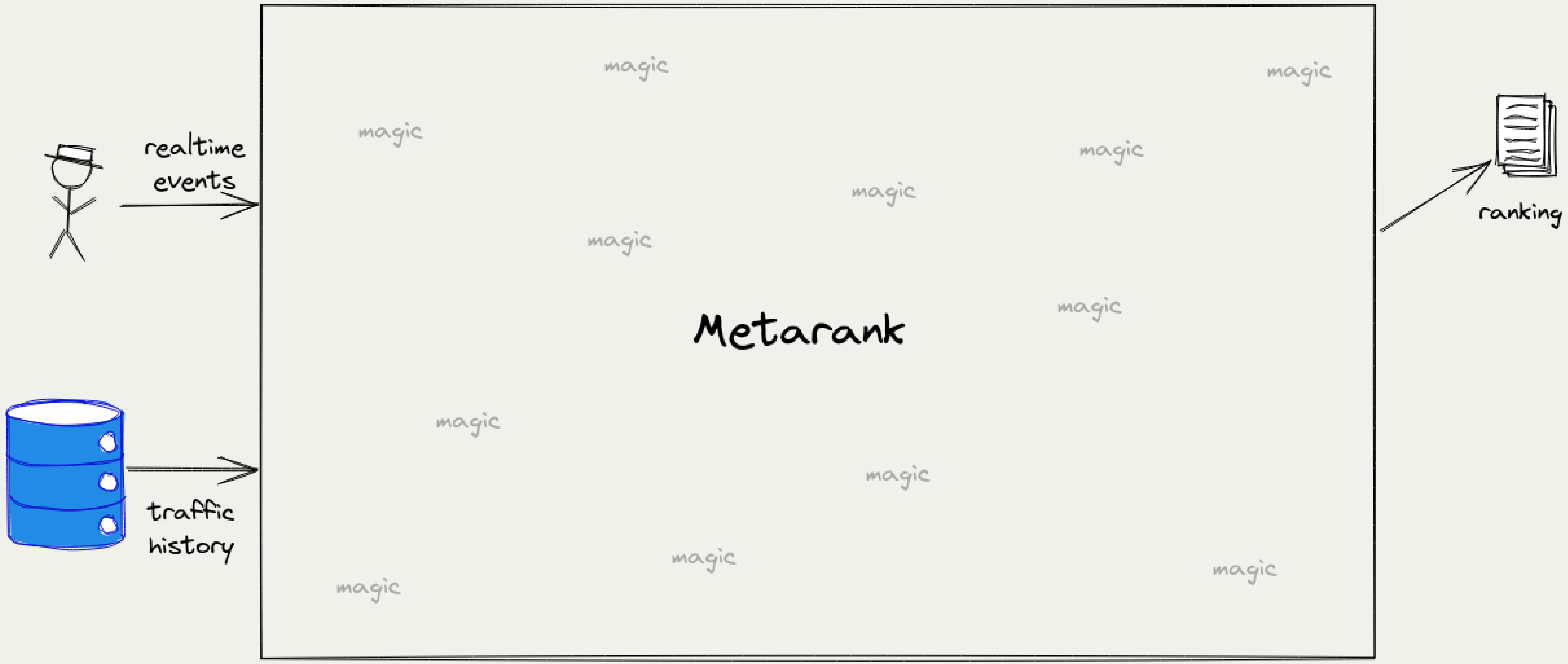
Metarank

a swiss army knife of re-ranking

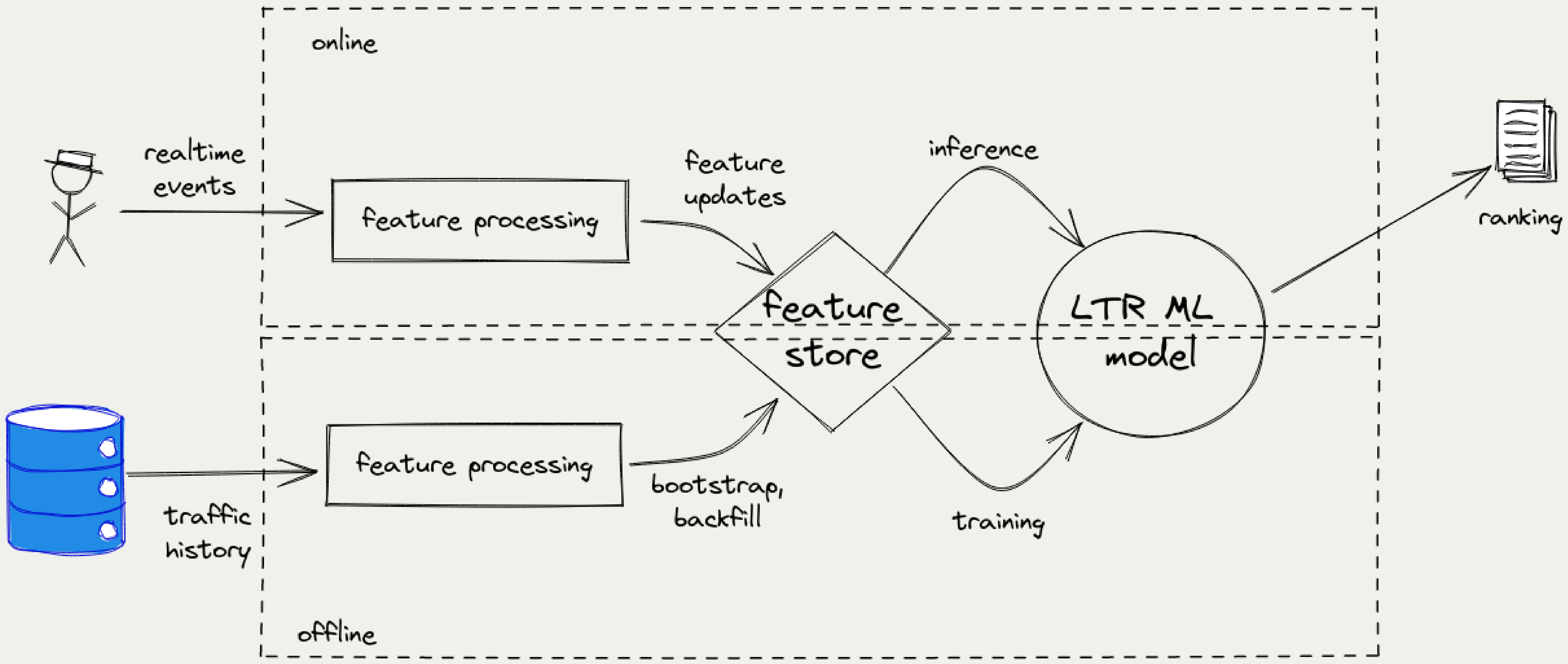
A secondary re-ranker



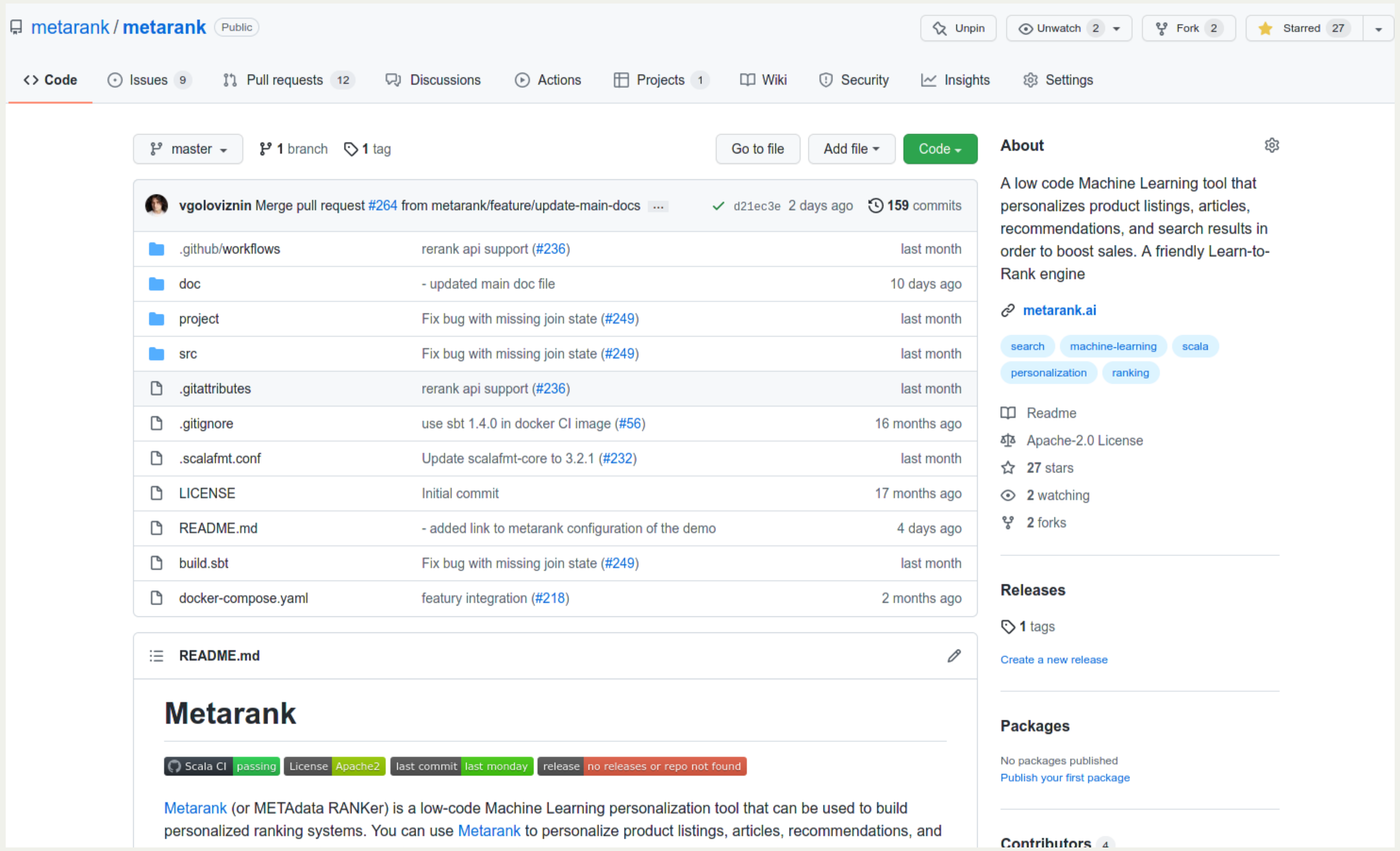
Inside Metarank



Inside Metarank



Open Source



vgoloviznin Merge pull request #264 from metarank/feature/update-main-docs … d21ec3e 2 days ago 159 commits

.github/workflows	rerank api support (#236)	last month
doc	- updated main doc file	10 days ago
project	Fix bug with missing join state (#249)	last month
src	Fix bug with missing join state (#249)	last month
.gitattributes	rerank api support (#236)	last month
.gitignore	use sbt 1.4.0 in docker CI image (#56)	16 months ago
.scalafmt.conf	Update scalafmt-core to 3.2.1 (#232)	last month
LICENSE	Initial commit	17 months ago
README.md	- added link to metarank configuration of the demo	4 days ago
build.sbt	Fix bug with missing join state (#249)	last month
docker-compose.yaml	featury integration (#218)	2 months ago

README.md

Metarank

Scala CI passing | License Apache2 | last commit last monday | release no releases or repo not found

Metarank (or METAdata RANKer) is a low-code Machine Learning personalization tool that can be used to build personalized ranking systems. You can use Metarank to personalize product listings, articles, recommendations, and

About

A low code Machine Learning tool that personalizes product listings, articles, recommendations, and search results in order to boost sales. A friendly Learn-to-Rank engine

metarank.ai

search machine-learning scala personalization ranking

Readme
Apache-2.0 License
27 stars
2 watching
2 forks

Releases

1 tags

Create a new release

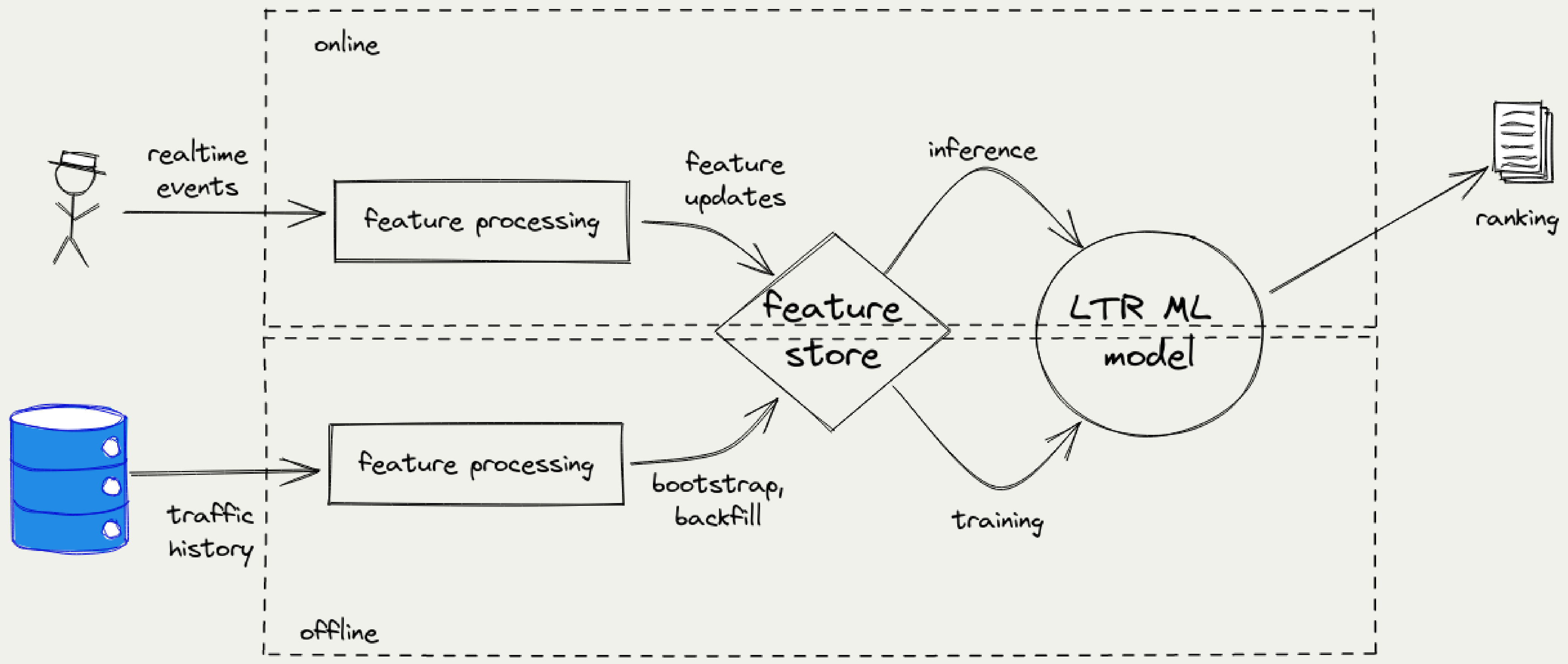
Packages

No packages published
Publish your first package

Contributors 4

- Apache2 licensed, no strings attached
- Single jar file, can run locally

Taking off



1. Import historical events: S3, HTTP, files
2. Train: LambdaMART @ XGBoost & LightGBM
3. Inference: API, Redis as backend

Data model

Inspired by GCP Retail Events, Segment.io Ecom Spec:

- **Metadata**: visitor/item specific info
  - item price, tags, visitor profile
- **Impression**: visitor viewed an item list
  - search results, collection, rec widget
- **Interaction**: visitor acted on an item from the list
  - click, add-to-cart, mouse hover

Document metadata example

```
{
  "event": "item",
  "id": "81f46c34-a4bb-469c-8708-f8127cd67d27",
  "item": "product1",
  "timestamp": "1599391467000",
  "fields": [
    {"name": "title", "value": "Nice jeans"},
    {"name": "price", "value": 25.0},
    {"name": "color", "value": ["blue", "black"]},
    {"name": "availability", "value": true}
  ]
}
```

- Unique event id, item id and timestamp
- Optional document fields
- Partial updates are OK

Ranking event example

```
{
  "event": "ranking",
  "id": "81f46c34-a4bb-469c-8708-f8127cd67d27",
  "timestamp": "1599391467000",
  "user": "user1",
  "session": "session1",
  "fields": [
      {"name": "query", "value": "socks"}
  ],
  "items": [
    {"id": "item3", "relevancy":  2.0},
    {"id": "item1", "relevancy":  1.0},
    {"id": "item2", "relevancy":  0.5}
  ]
}
```

- User & session fields
- Which items were displayed, BM25 score

Interaction event example

```json
{
  "event": "interaction",
  "id": "0f4c0036-04fb-4409-b2c6-7163a59f6b7d",
  "impression": "81f46c34-a4bb-469c-8708-f8127cd67d27",
  "timestamp": "1599391467000",
  "user": "user1",
  "session": "session1",
  "type": "purchase",
  "item": "item1",
  "fields": [
    {"name": "count", "value": 1},
    {"name": "shipping", "value": "DHL"}
  ],
}
```

- Multiple interaction types: clicks/carts/purchases
- Must include reference to a parent ranking event

Demo: ranklens dataset

~~No-code~~ YAML feature setup

Goal: cover 90% most common ML features

- **feature extractors**: compute ML feature value
- **feature store**: add to changelog if changed
- **online serving**: cache latest value for inference

Feature extractors: basic

```
// take a value from item metadata
- name: price
  type: number
  scope: item
  source: item.budget
  ttl: 60 days
```

Feature extractors: basic

```
// one-hot/label encode a string
- name: color
  type: string
  scope: item
  source: item.genre
  values:
  - comedy
  - drama
  - action
```

Special transformations

```
// index encode mobile/desktop/tablet category
// from User-Agent field

- name: platform
  type: ua
  field: platform
  source: ranking.ua
```

- There should be a User-Agent field present in ranking event

Counters

```
// count how many clicks were done on a product

- name: click_count
  type: interaction_count
  scope: item
  interaction: click
```

- Uh-oh, there shouldn't be a global counter!

More counters!

```
// A sliding window count of interaction events
// for a particular item

- name: item_click_count
  type: window_count
  interaction: click
  scope: item
  bucket_size: 24h          // make a counter for each 24h rolling window
  windows: [7, 14, 30, 60] // on each refresh, aggregate to 1-2-4-8 week counts
  refresh: 1h
```

Per-field matching

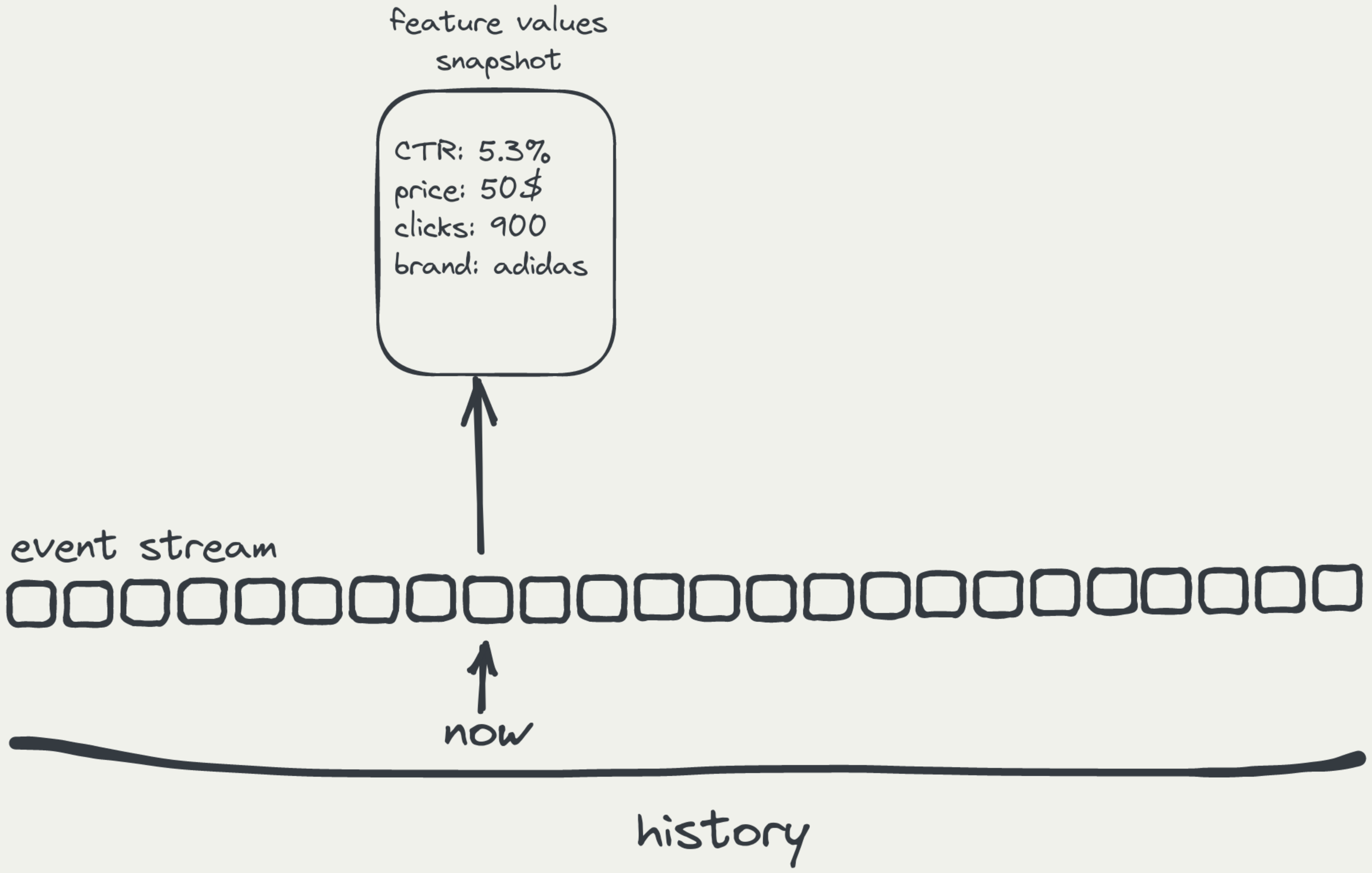
```yaml
- name: title_match
  type: field_match
  itemField: item.title
  rankingField: ranking.query
  method:
    type: ngram
    n: 3
```

- Lucene language-specific tokenization is supported

Demo: ranklens config

Demo: import and training the model

What has just happened?



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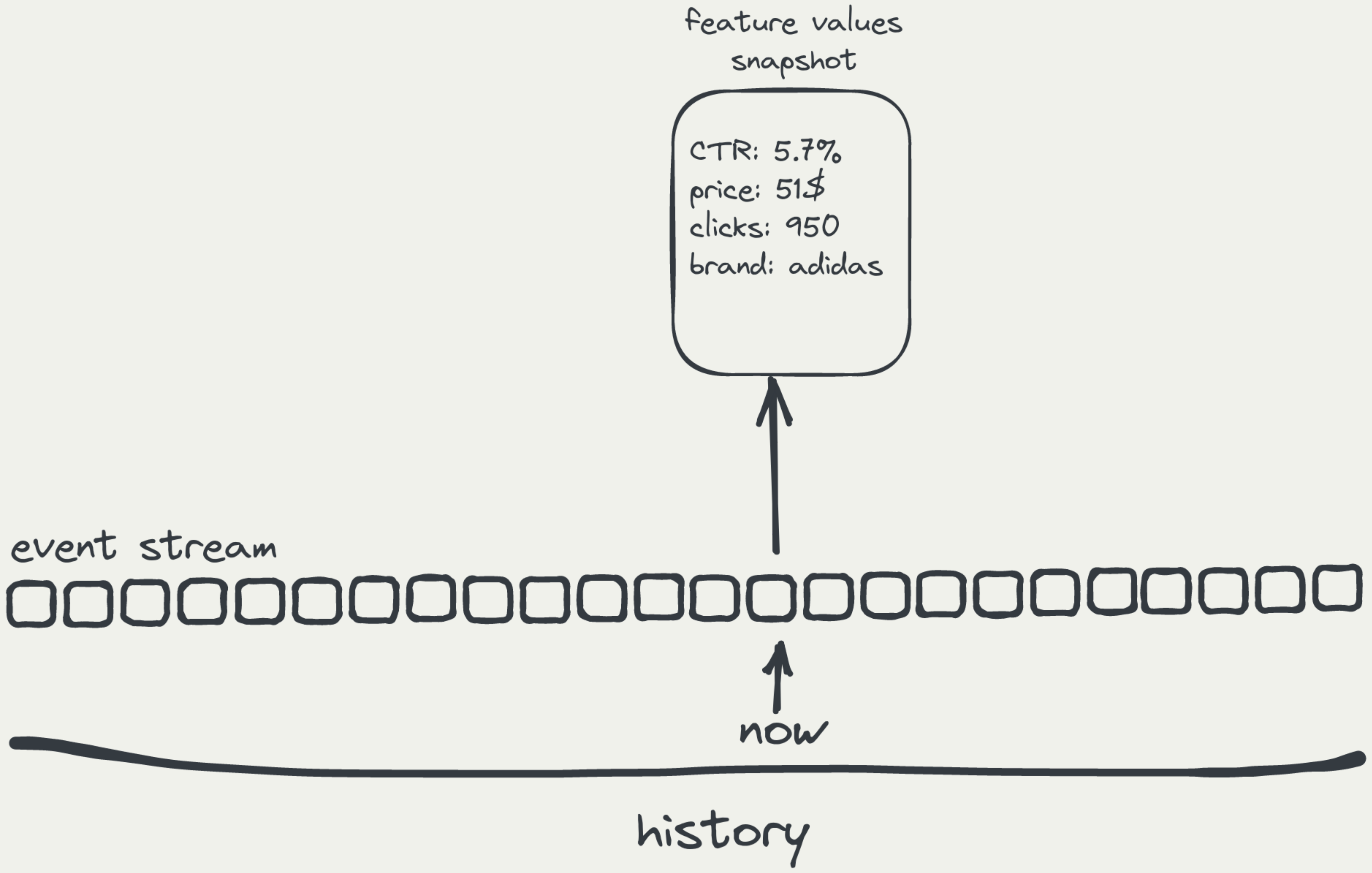

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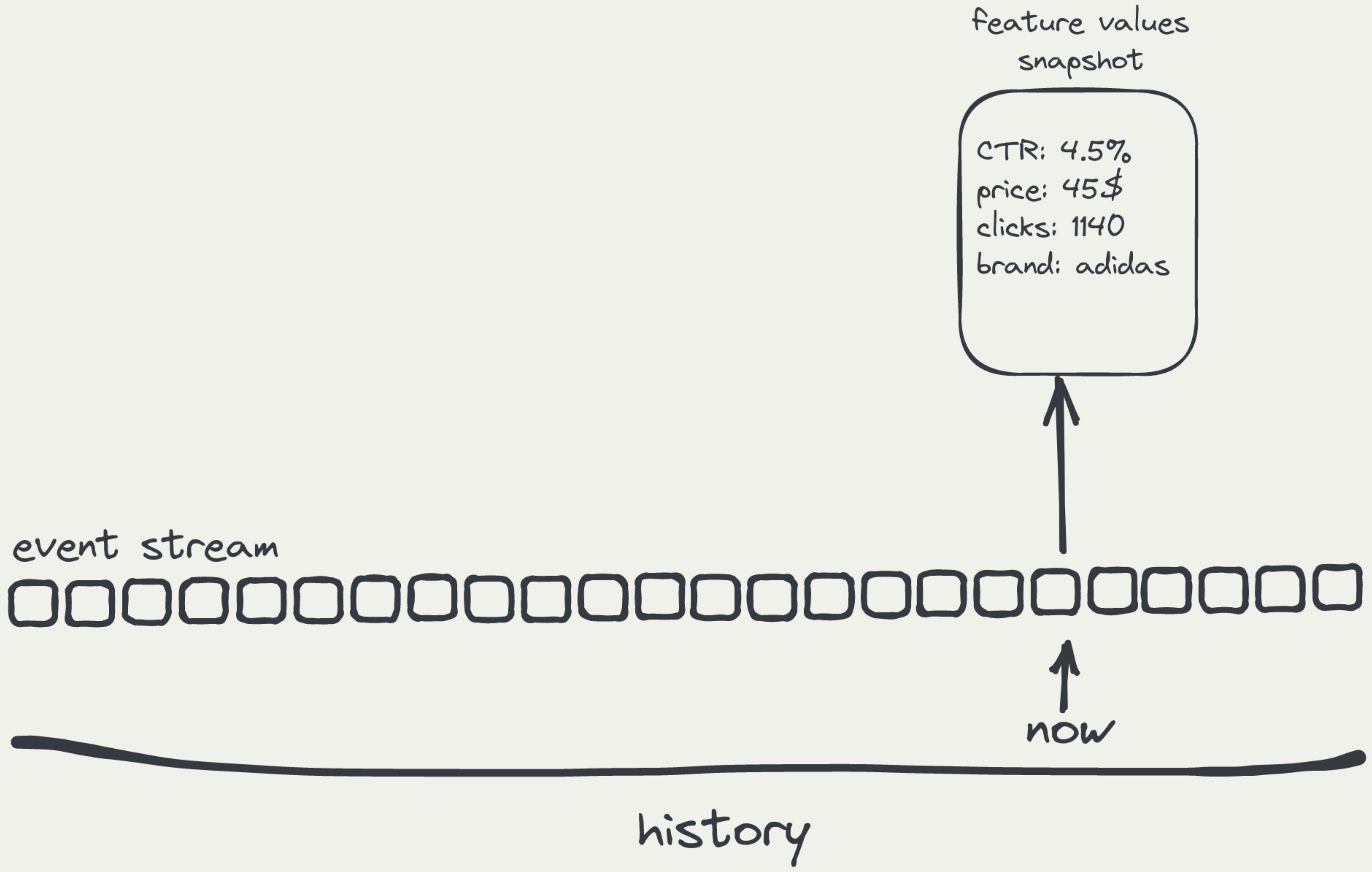

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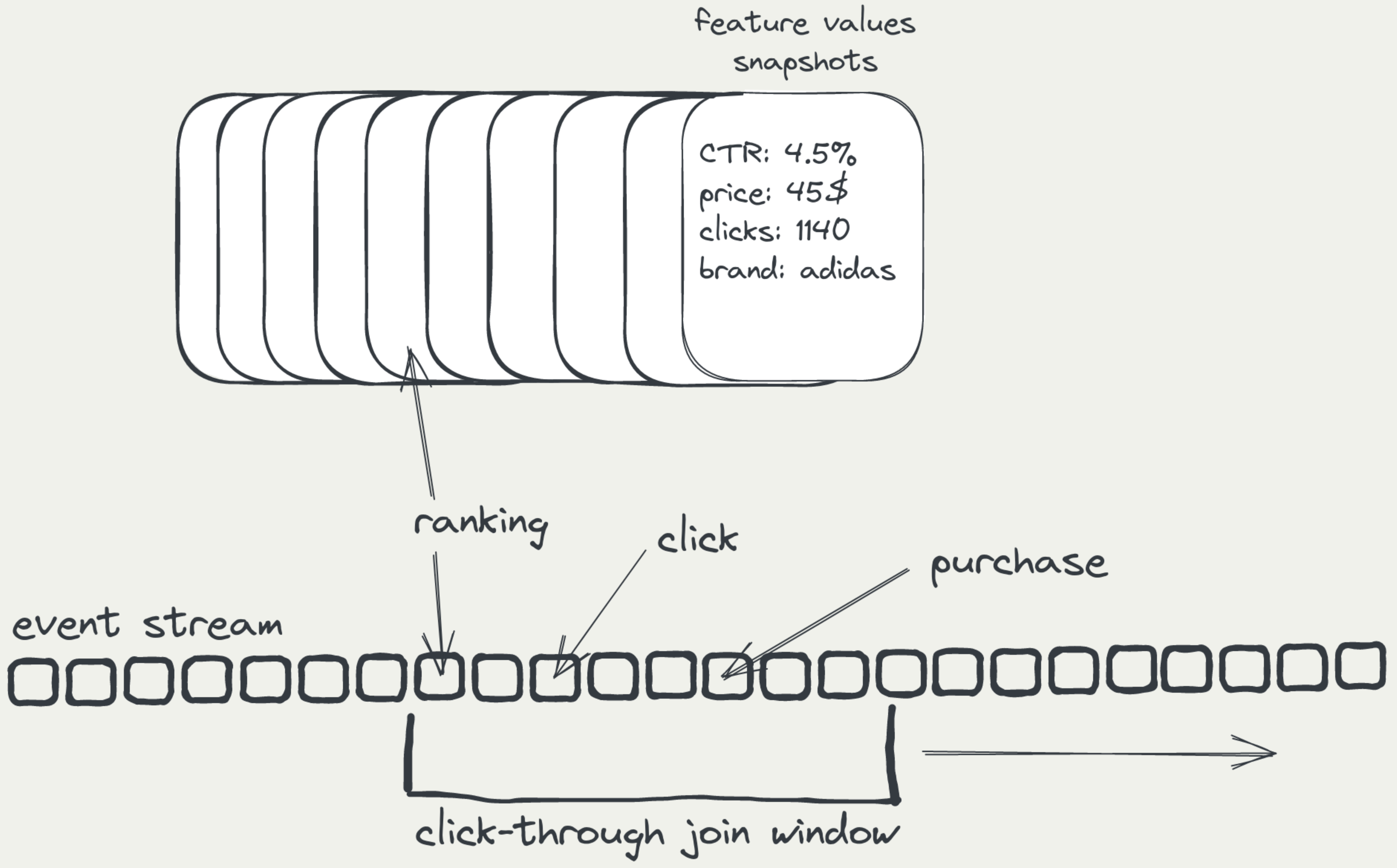
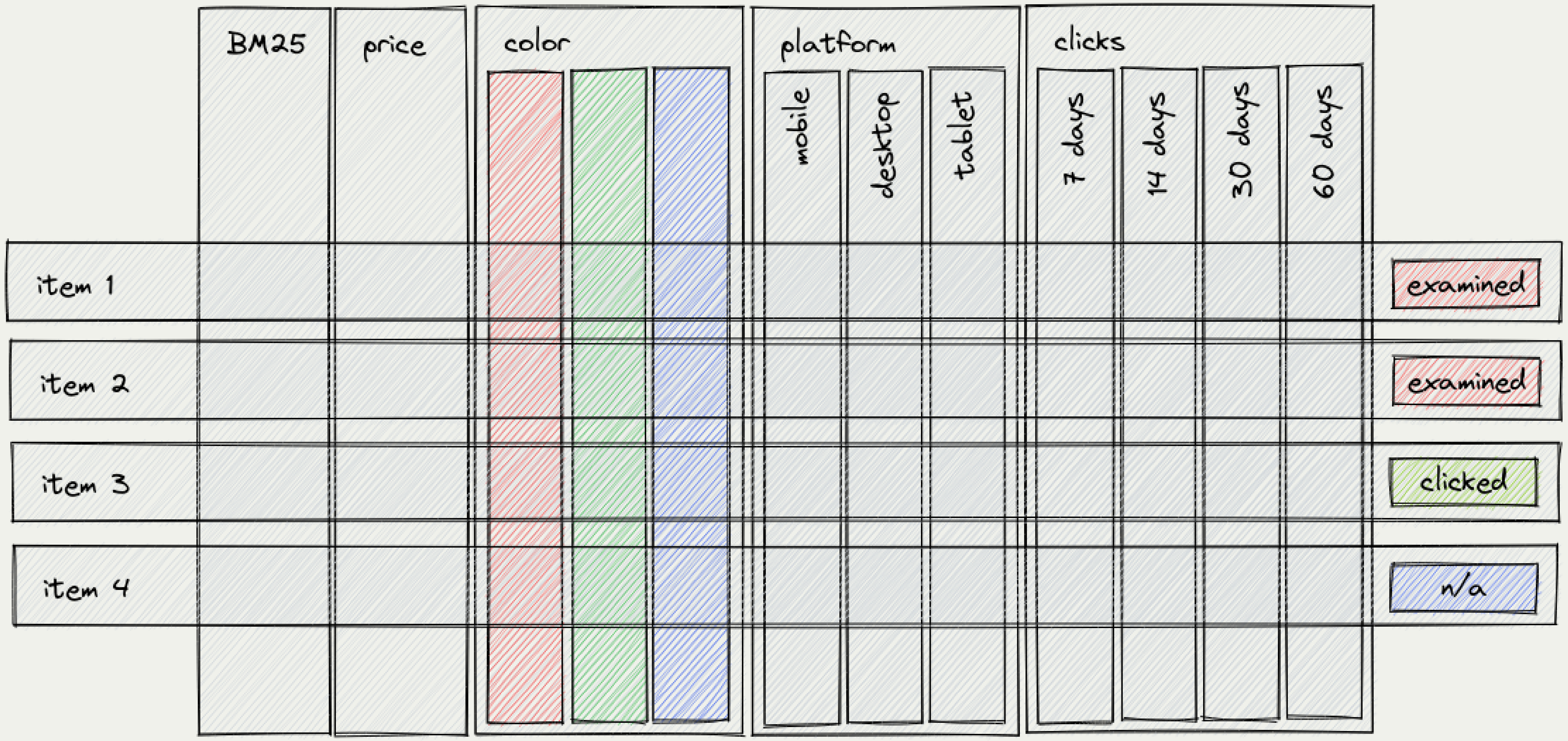


Implicit judgements



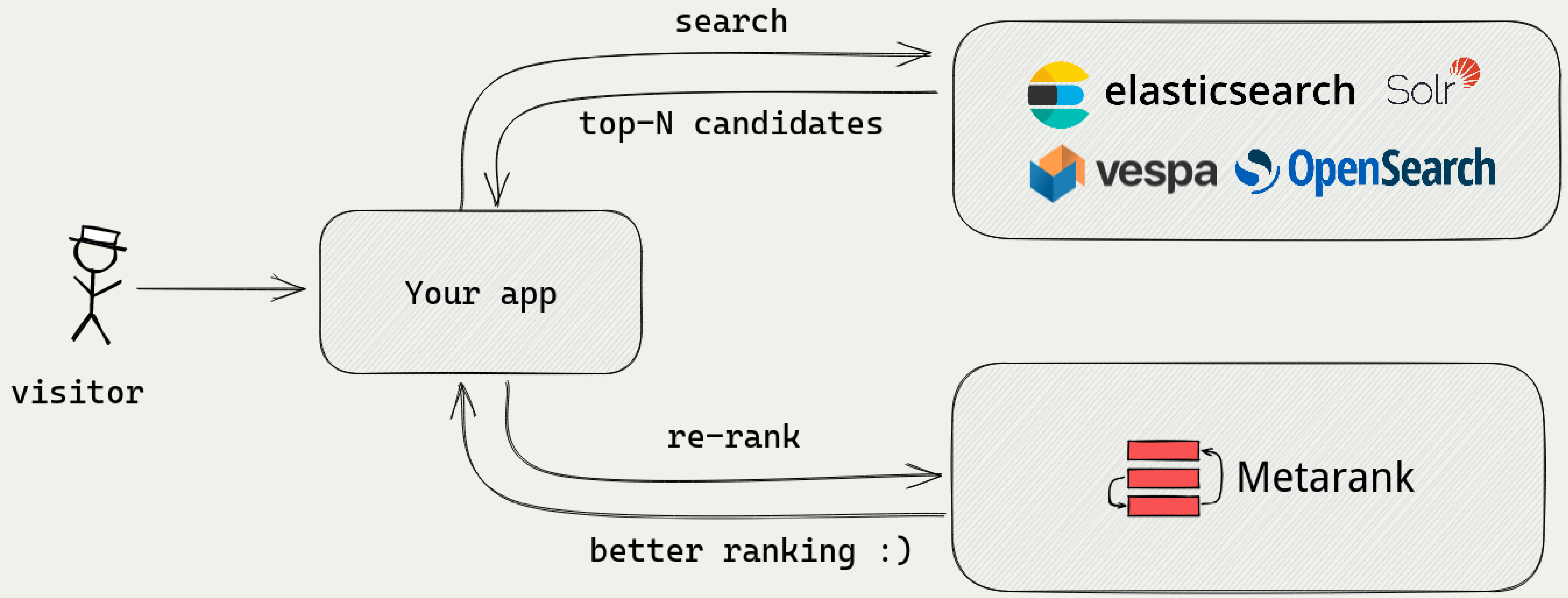
- Feed all of them into LambdaMART

Demo: sending requests

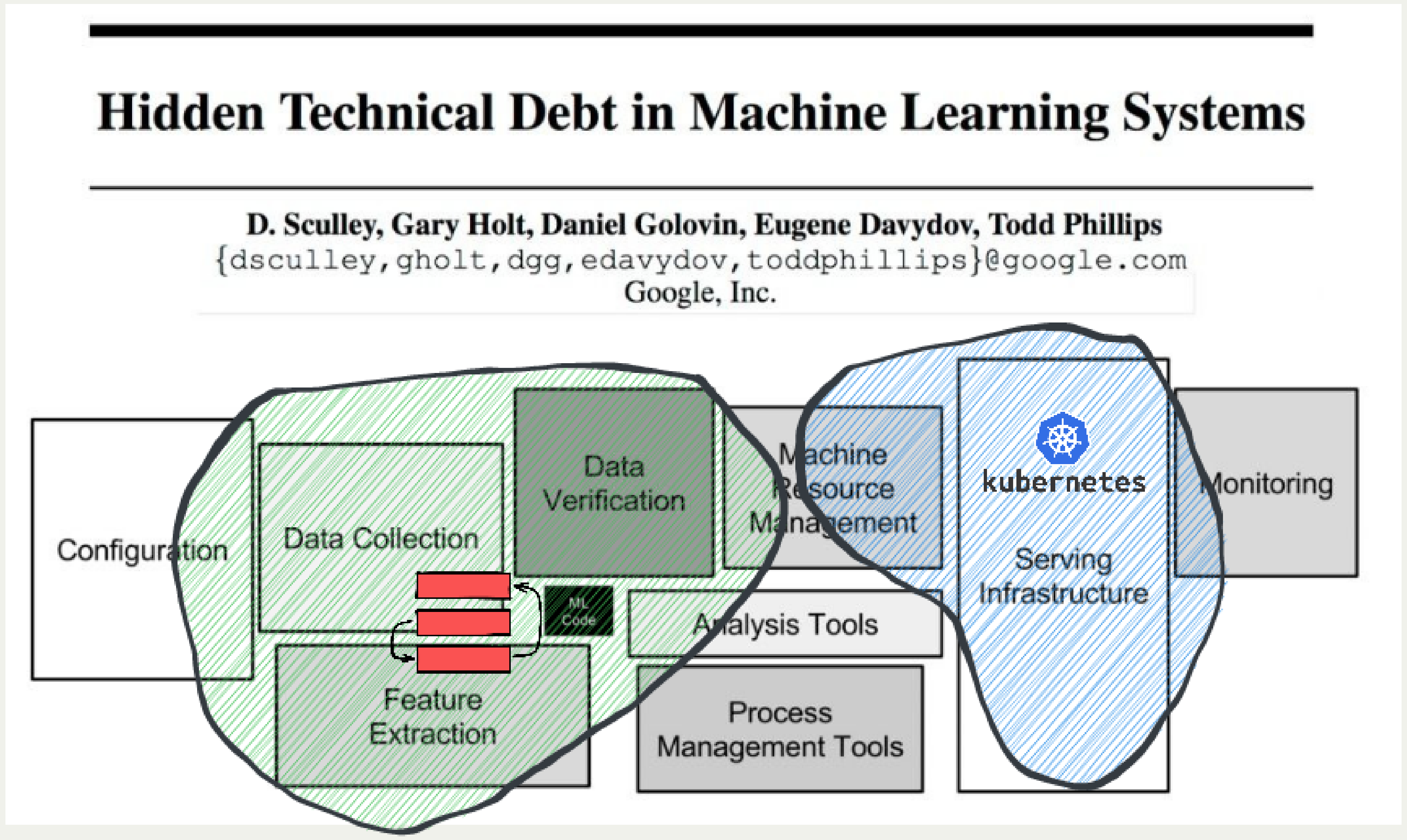
[not only] personalization

- Demo: **interacted_with** dynamic features ⇒ dynamic ranking
- Pilot: static features ⇒ precomputed ranking

[not only] reranking



- **soon:** recommendations retrieval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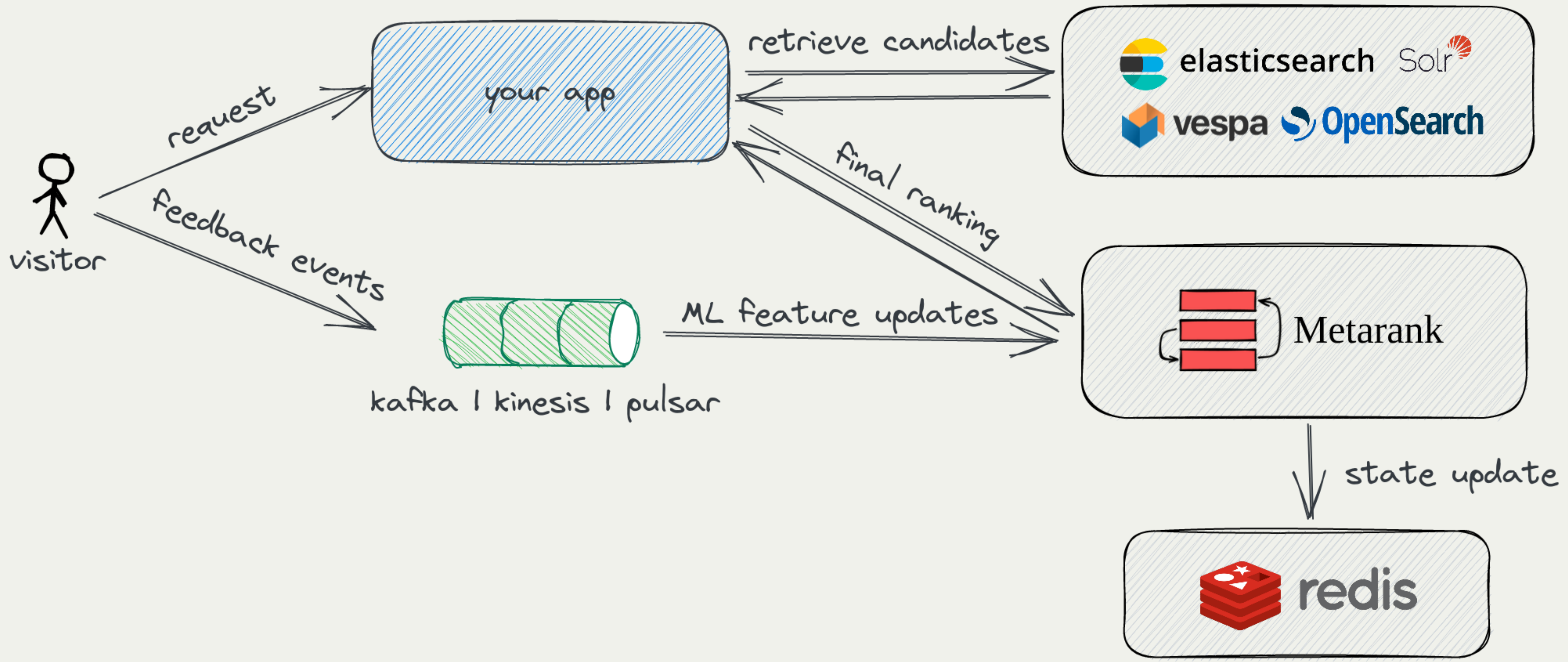
- **Data collection**: event schema, kafka/kinesis/pulsar connectors
- **Verification**: validation heuristics
- **ML Code**: LambdaMART now, more later
- **Feature extraction**: manual & automatic f. engineering

Cloud-native by design



- **ops**: k8s stateless deployment, up/down scaling
- **mlops**: ML model retraining, A/B testing

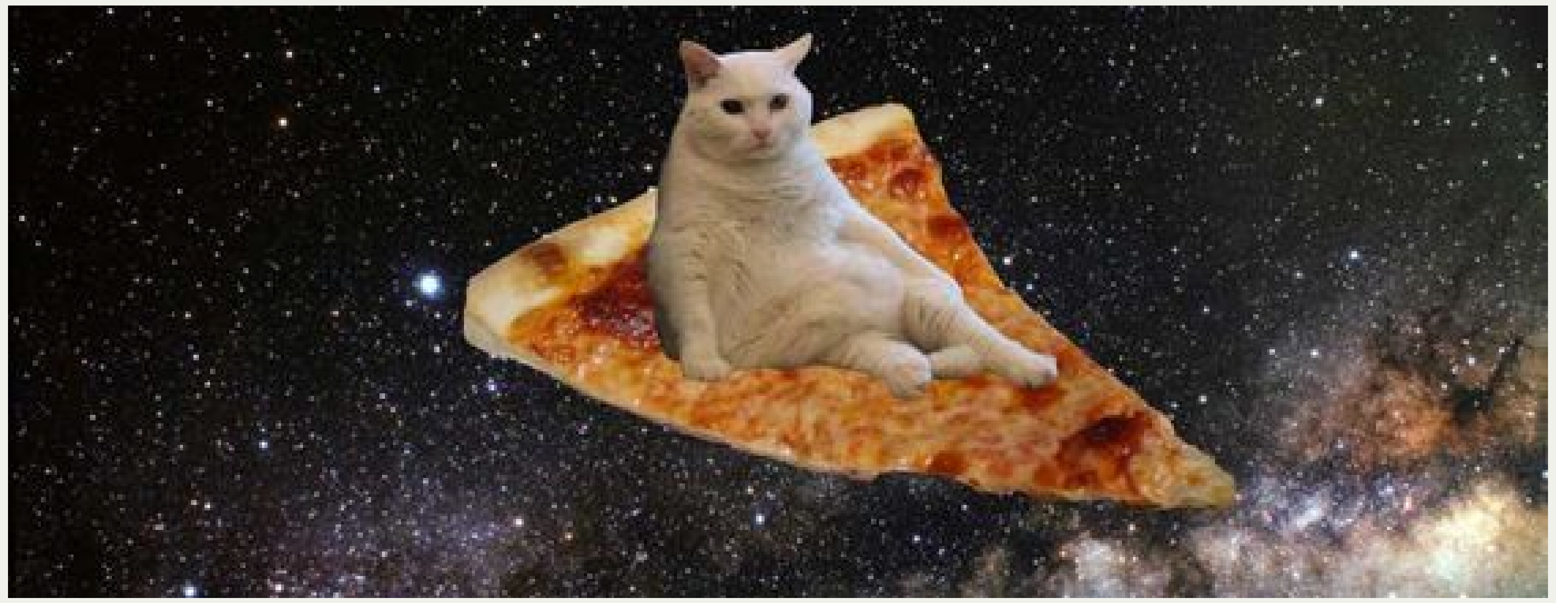
Current status

https://demo.metarank.ai

- Not MVP: running in prod in pilot projects
- k8s distributed mode, snowplow integration
- A long backlog of ML tasks: click models, LTR, de-biasing

We built Metarank to solve our problem.

But it may be also useful for you



- **Looking for feedback**: what should we do next?
- **Your unique use-case**: what are we doing wrong?

Metarank

- github.com/metarank/metarank
- metarank.ai/slack
- linkedin.com/in/romangrebennikov/
  linkedin.com/in/vgoloviznin/