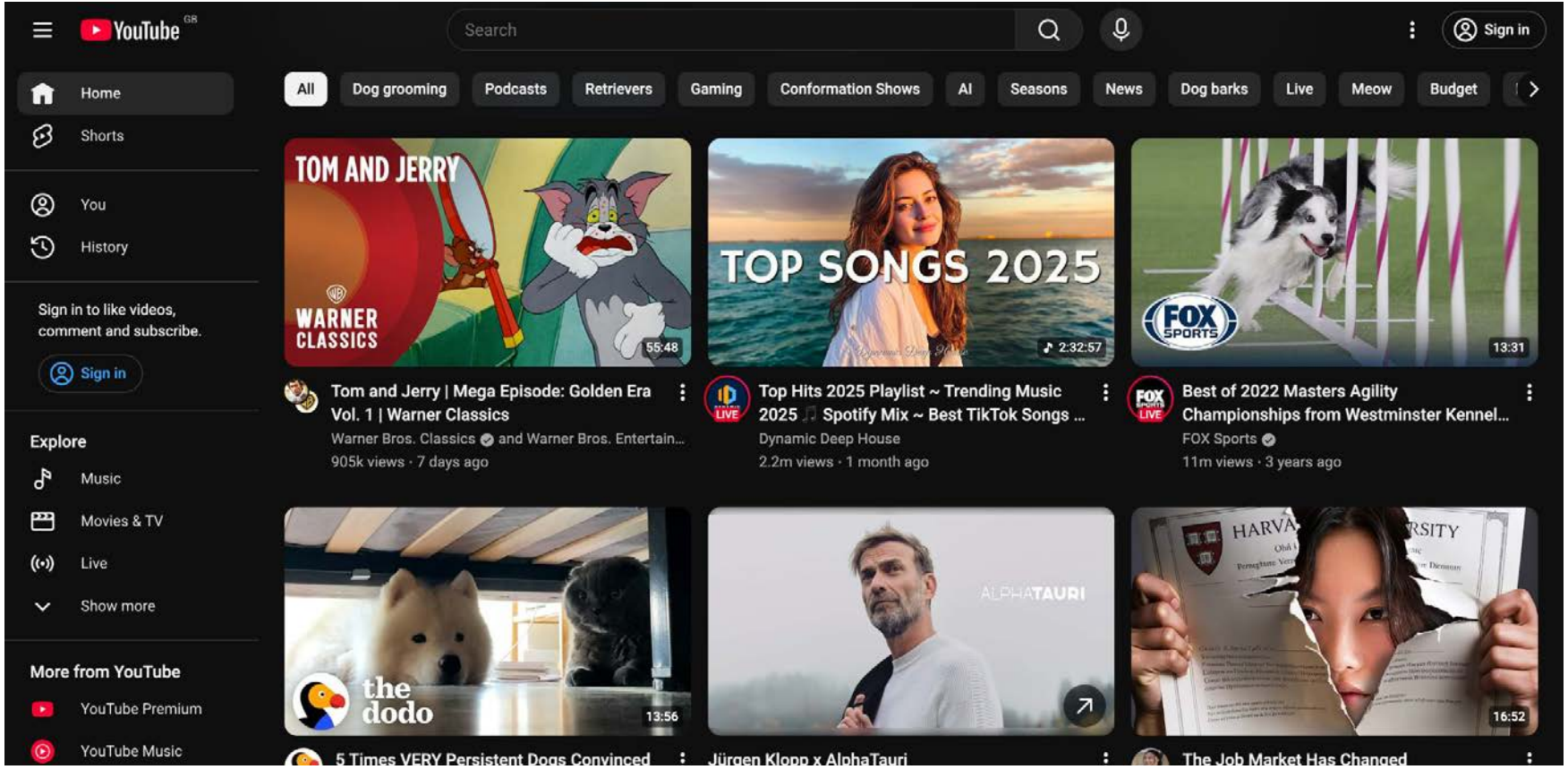
Making recommendations explainable

Lev Fedorov

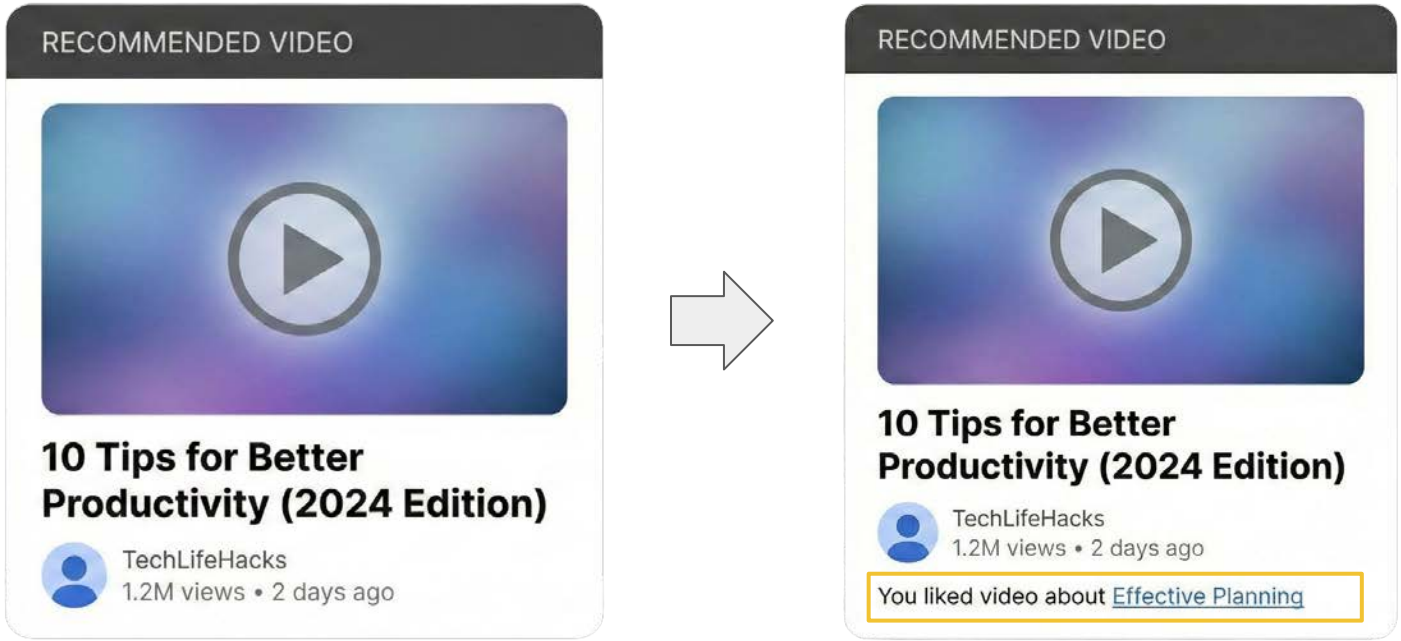
Introduction

Recommendation system

Recommendation feed



Explanation



Motivation

Problems

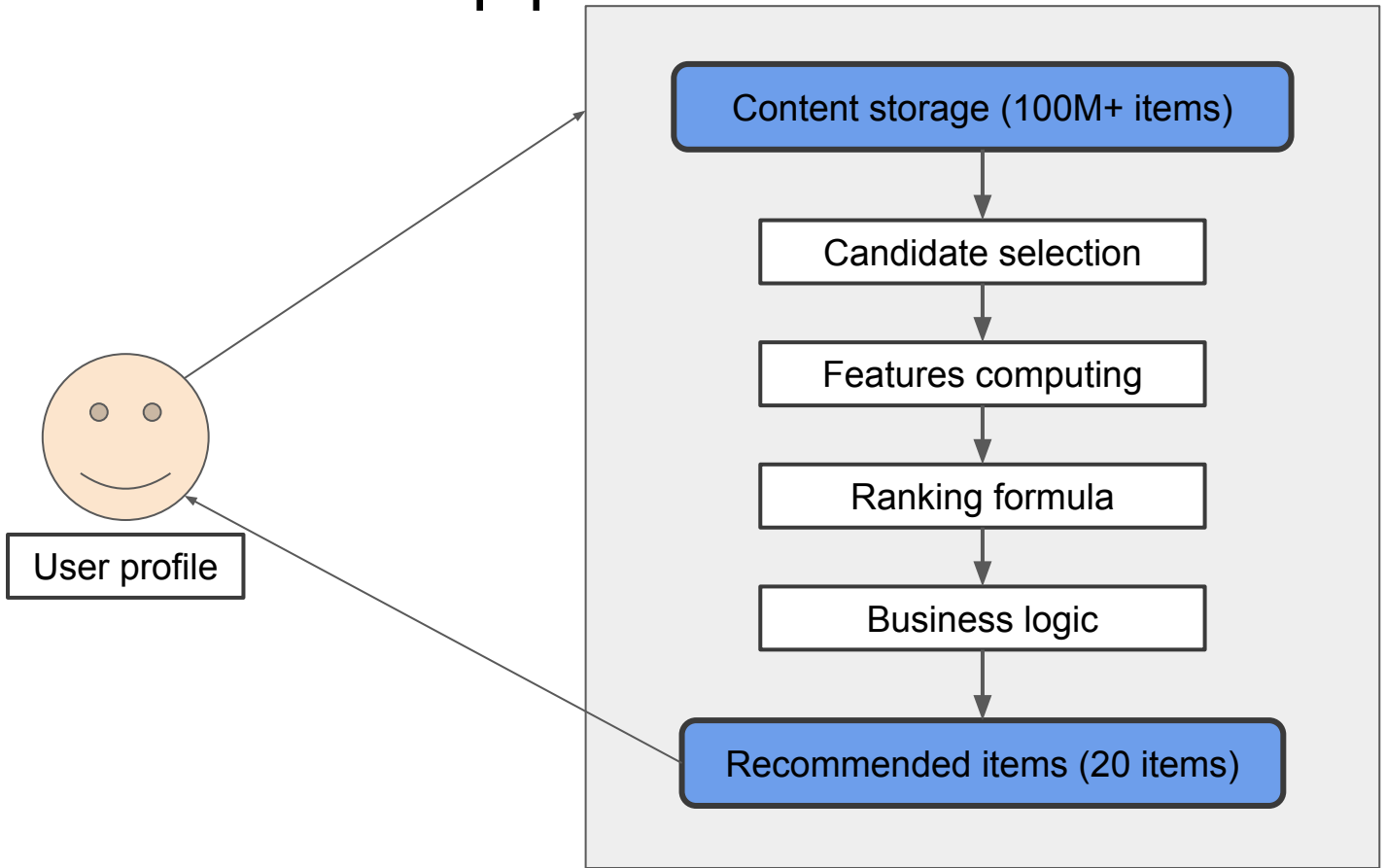
Users

- Reports about feed irrelevancy

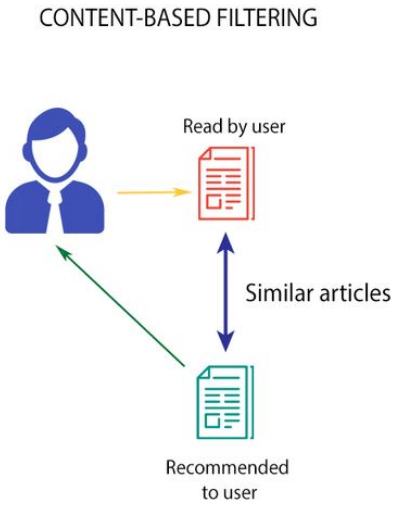
Developers

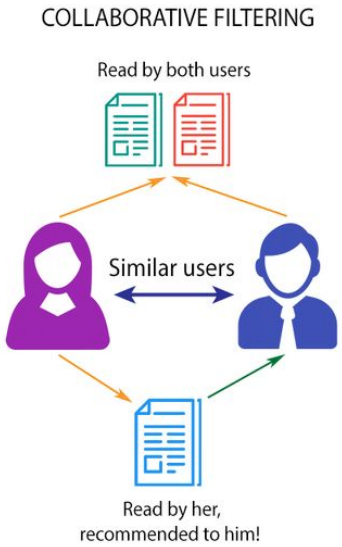
- No traceability/debugging tools

Recommendations pipeline



Recommendation systems





Embedding

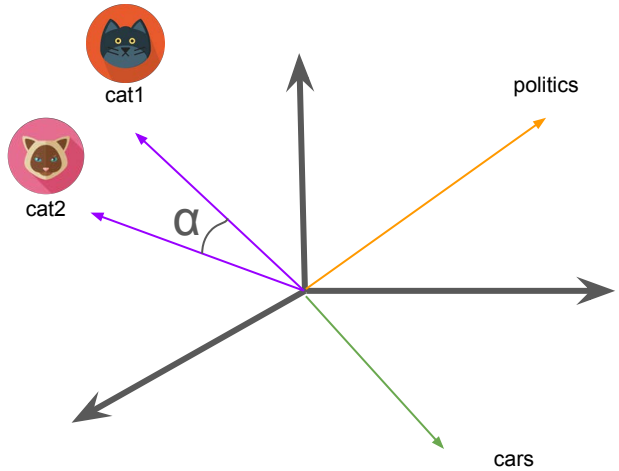
embedding = float[] array = vector

1	2	...	N - 1	N
0.98	0.22	...	0.45	0.78

=

$\angle\alpha \rightarrow 0°$

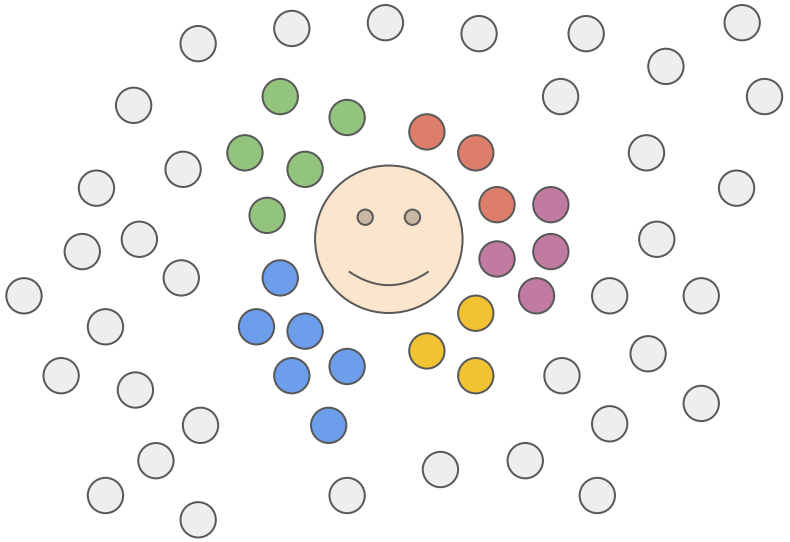
$\cos(\alpha) \rightarrow 1$



expectations

User profile / One embedding

- cats
- dogs
- cars
- it
- fashion
- other
- user



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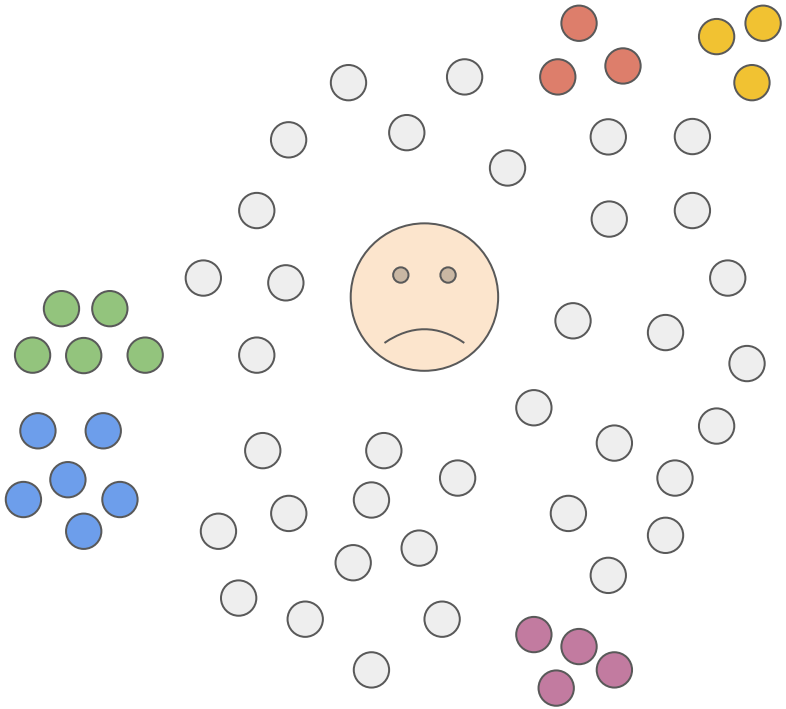
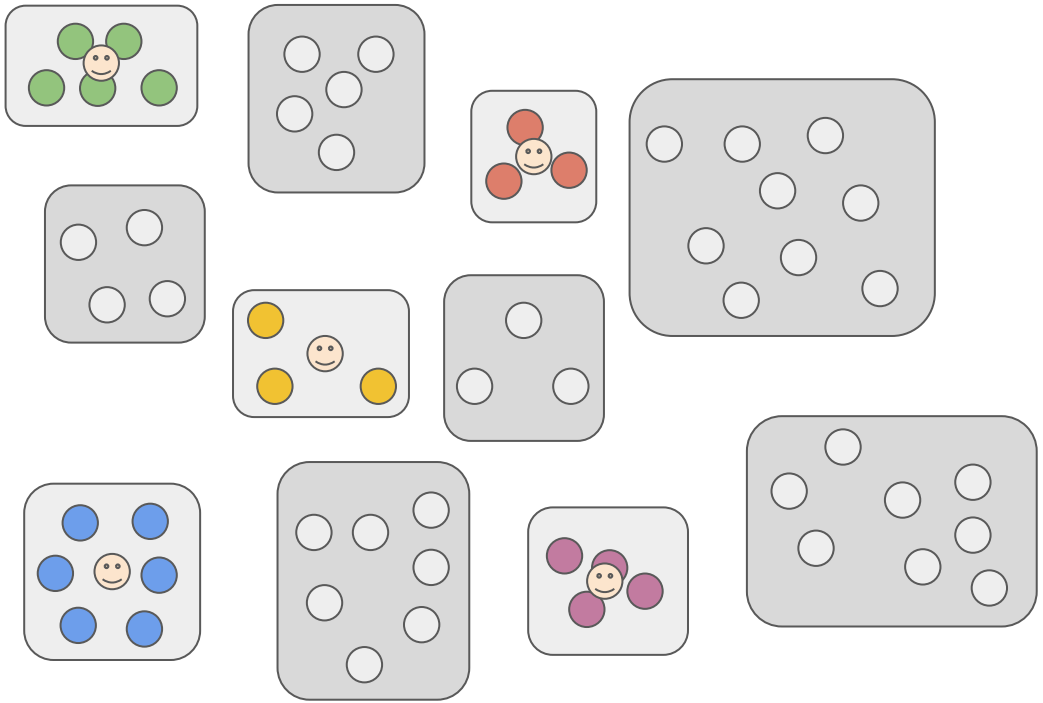


reality

expectations

User profile / K-Means (Centroids)

- cats
- dogs
- cars
- it
- fashion
- other
- user



User profile / K-Means (Centroids)

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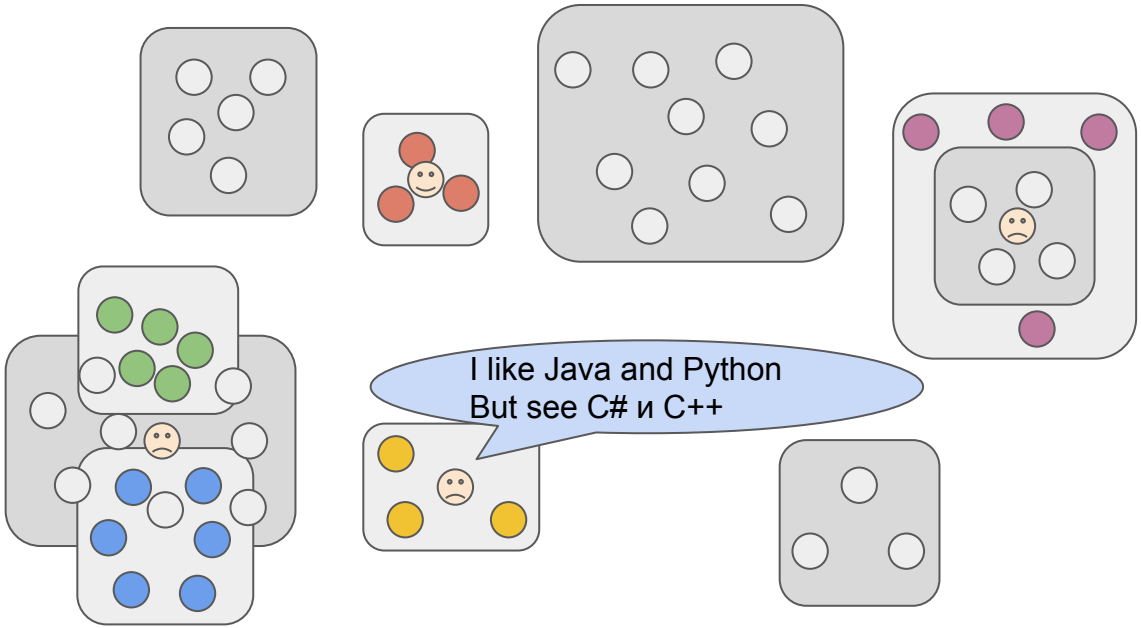
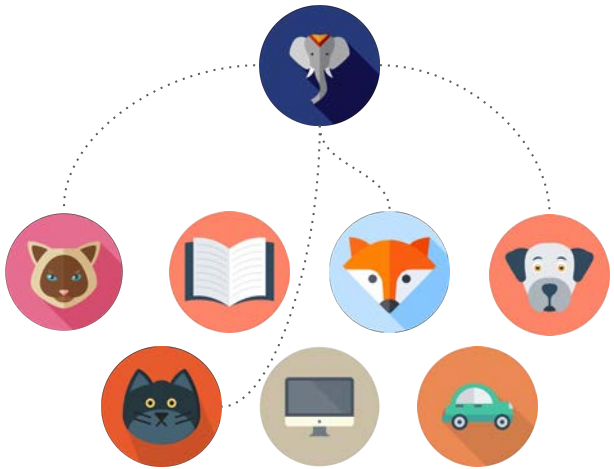
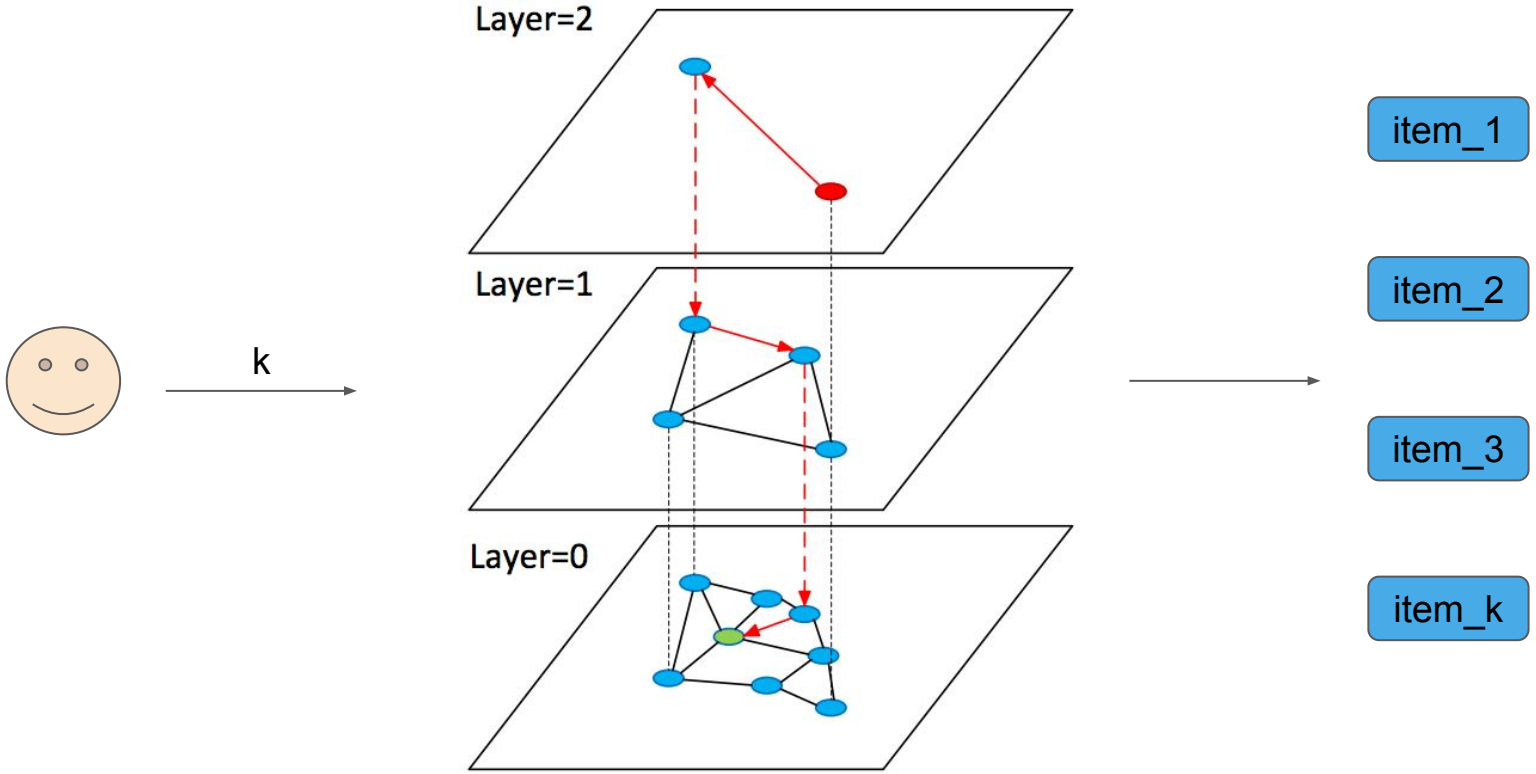


Candidate selection / KNN

KNN (K-Nearest Neighbors) — return the K nearest neighbors to a given embedding

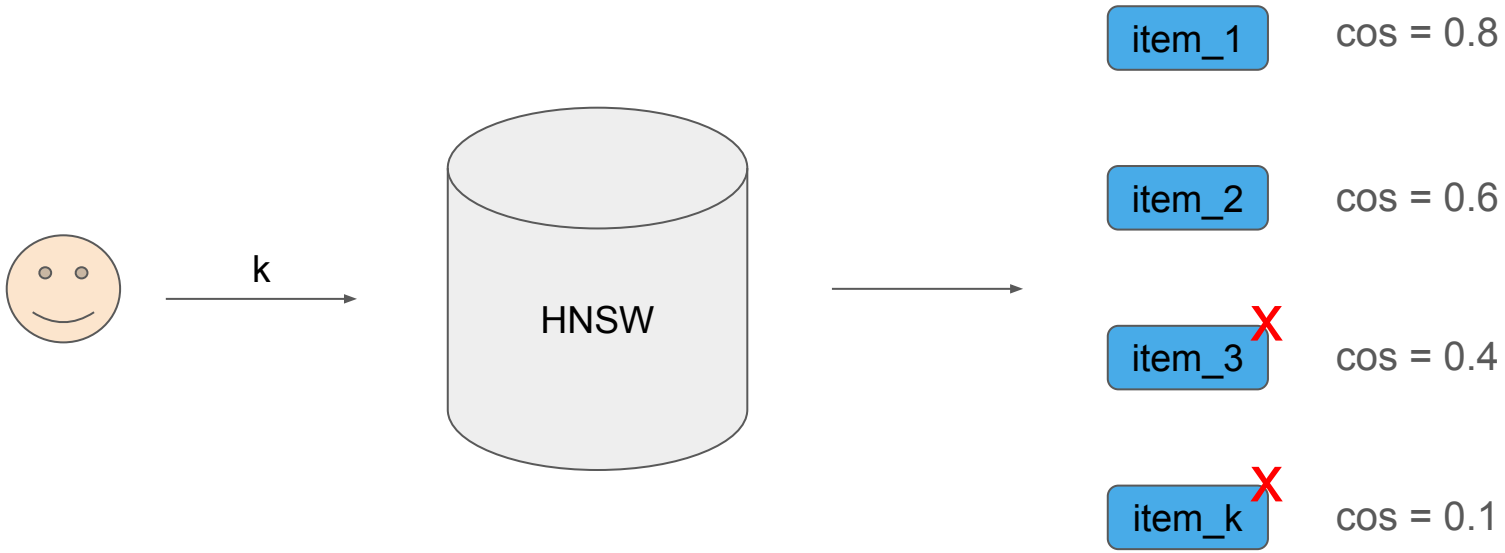


KNN (HNSW)



https://arxiv.org/pdf/1603.09320

KNN (HNSW)



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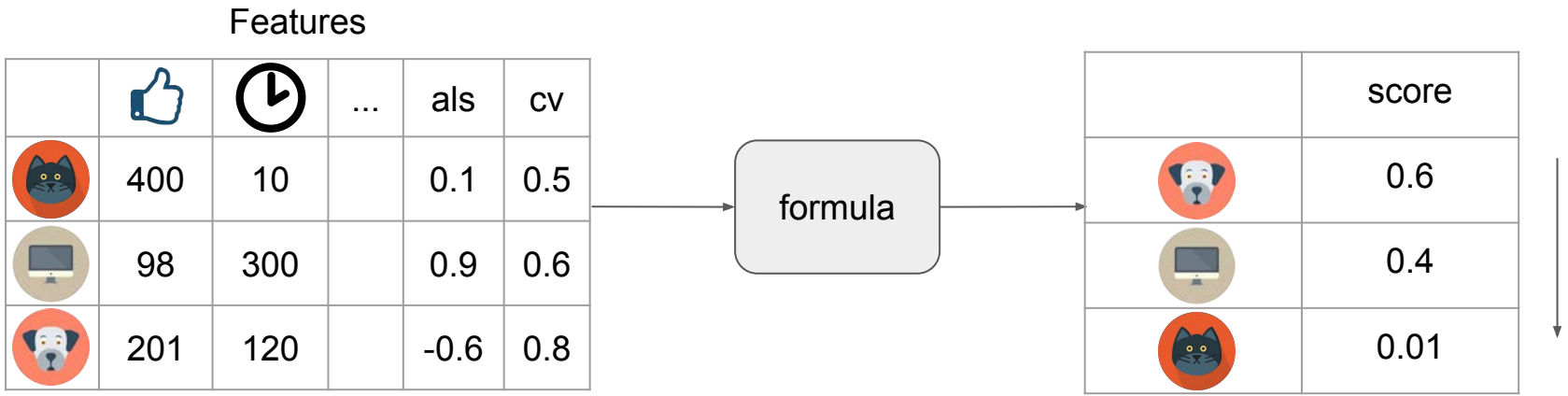
Ranking formula

Model (CatBoost) – predicts the publication relevance for user



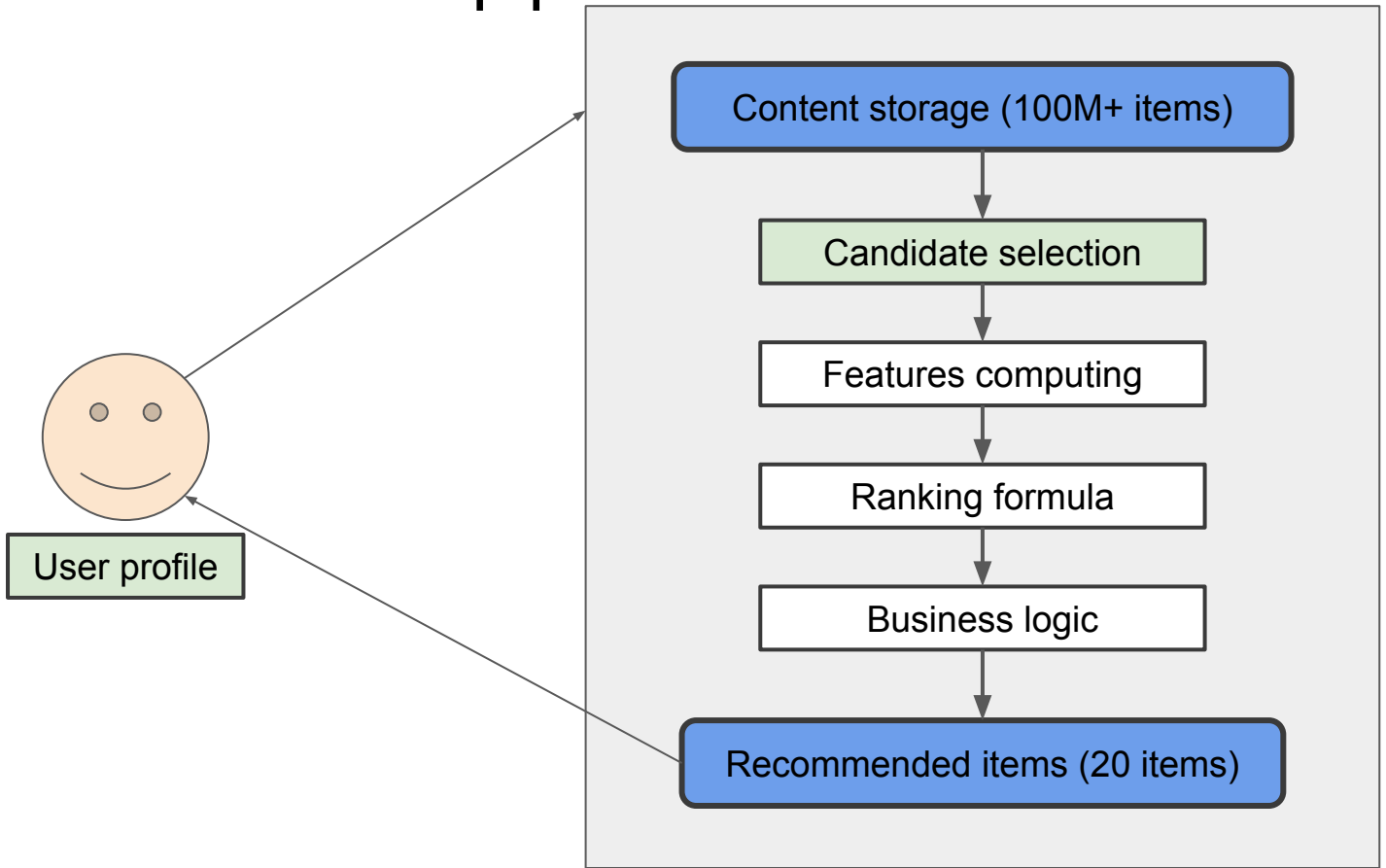
Business logic

Diversity

- Don’t allow all posts to come from a single author
- Don’t allow the entire feed to be only one topic/theme

Approach

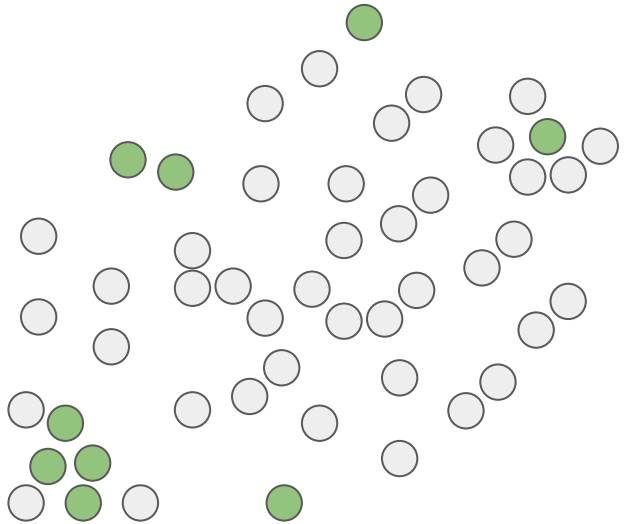
Recommendations pipeline



User profile

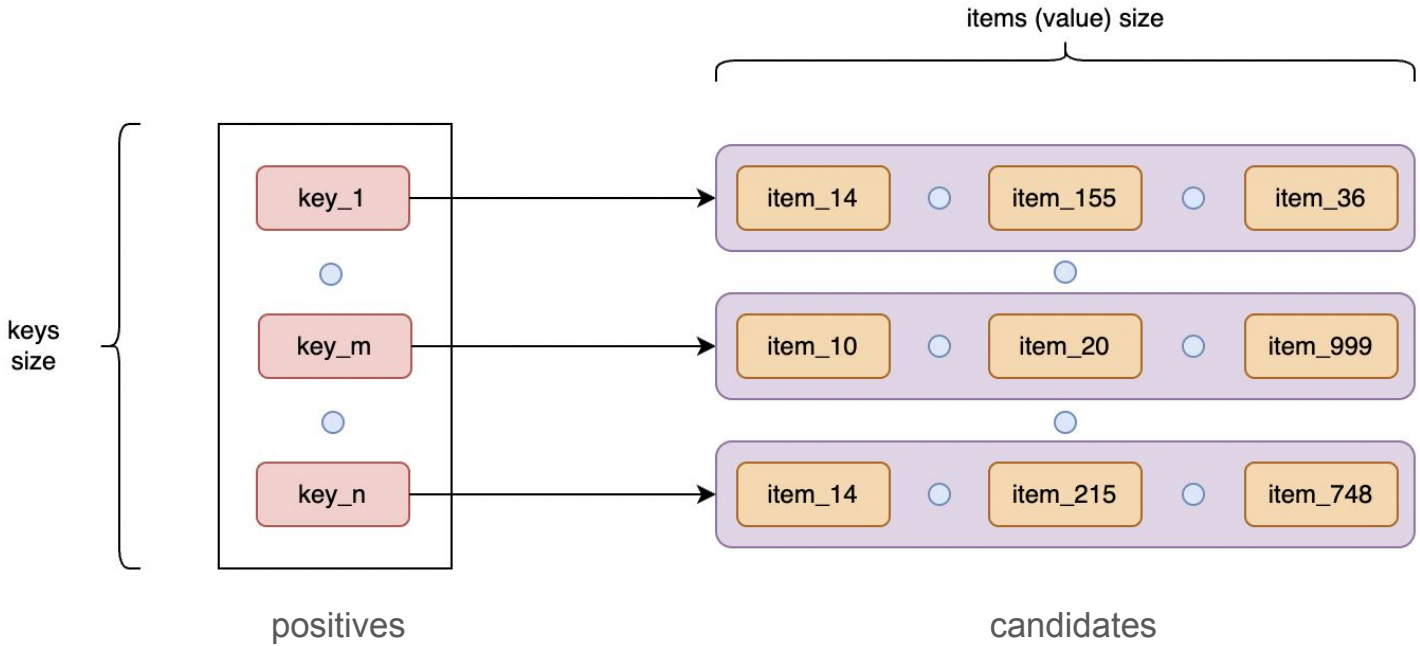
Instead of embedding, storing publication id

- positive interaction
- impression
- user



= [publication_1, publication_5, …]

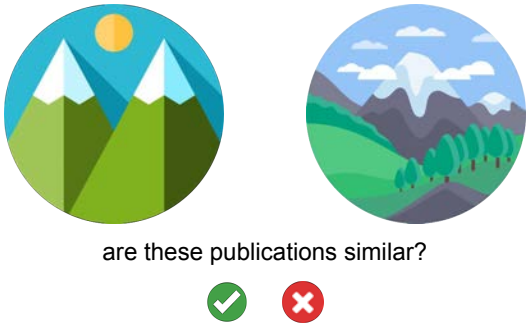
Candidate Selection



Relevance

Filter non-similar publications

- Annotate pairs of publications as “relevant” and “irrelevant”



- V0: Define cosine threshold for content-based model
- V1: Train relevance formula

Attractiveness

Order list of candidates

- V1: Conditional CTR

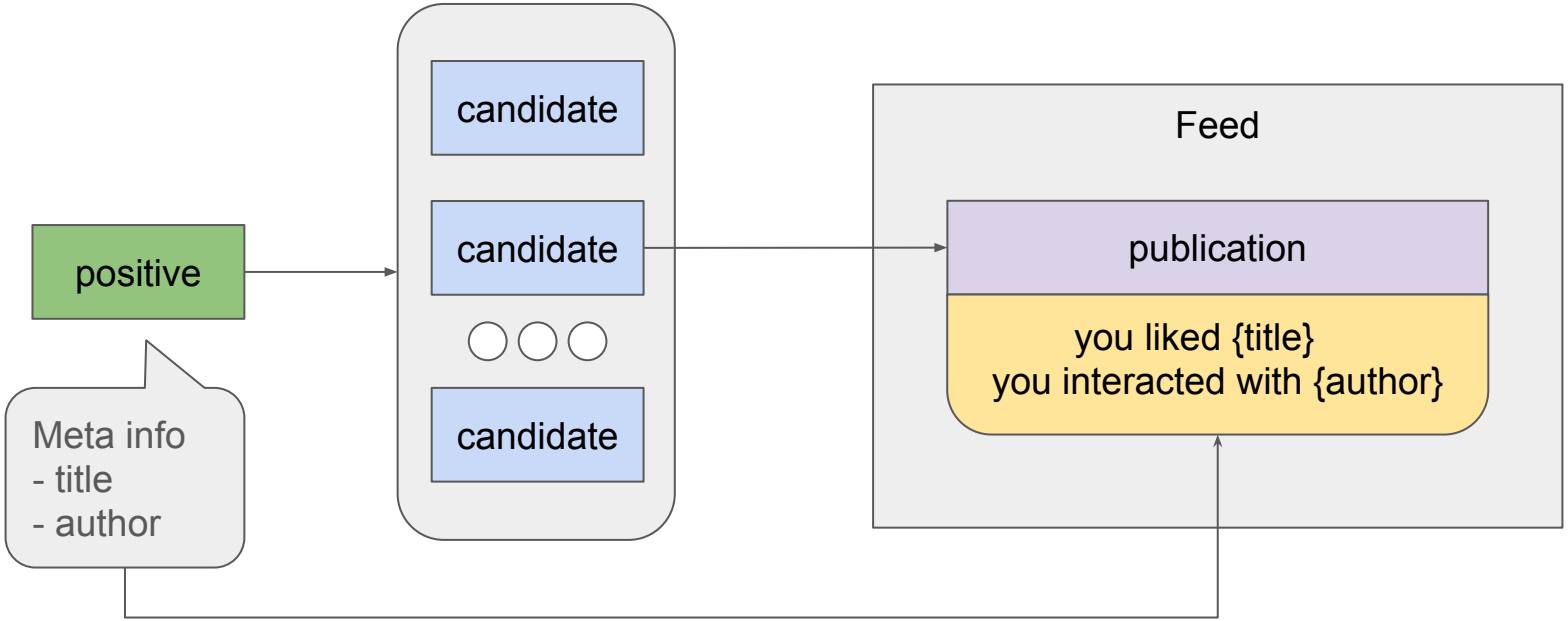
  $$CTR(A|B) = CTR_A|click_B$$

  Conditional CTR is the click-through rate of publication A given that the user had a positive interaction with publication B

- V2: Attractiveness formula

  Predict positive interaction with publication A given that the user had a positive interaction with publication B

Recommendations Pipeline

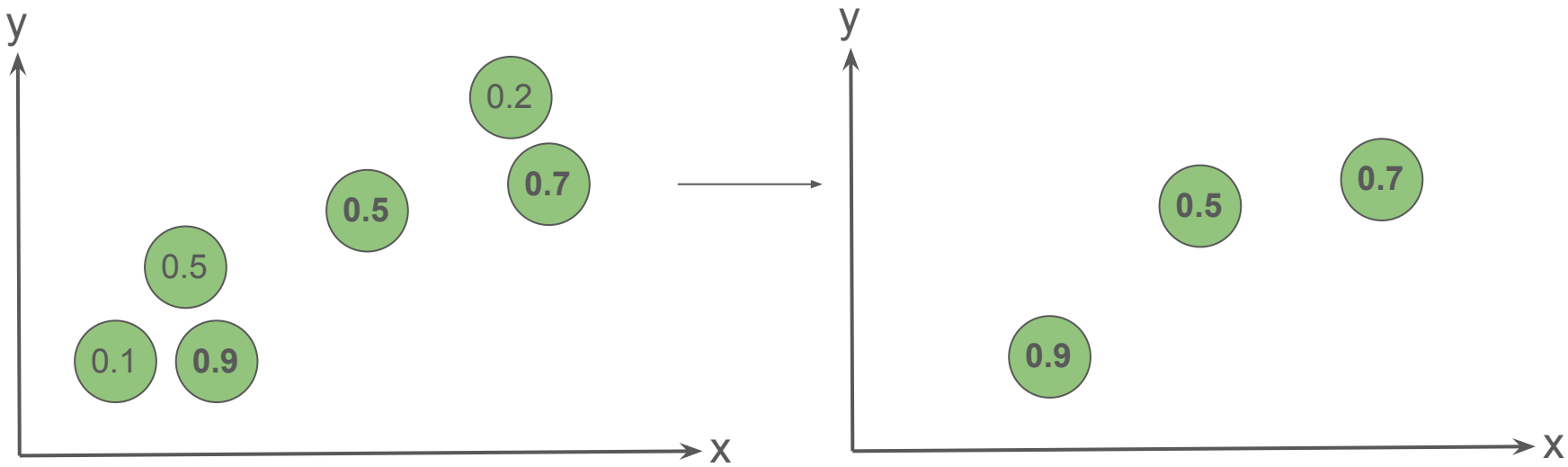


Positives selection / DPP

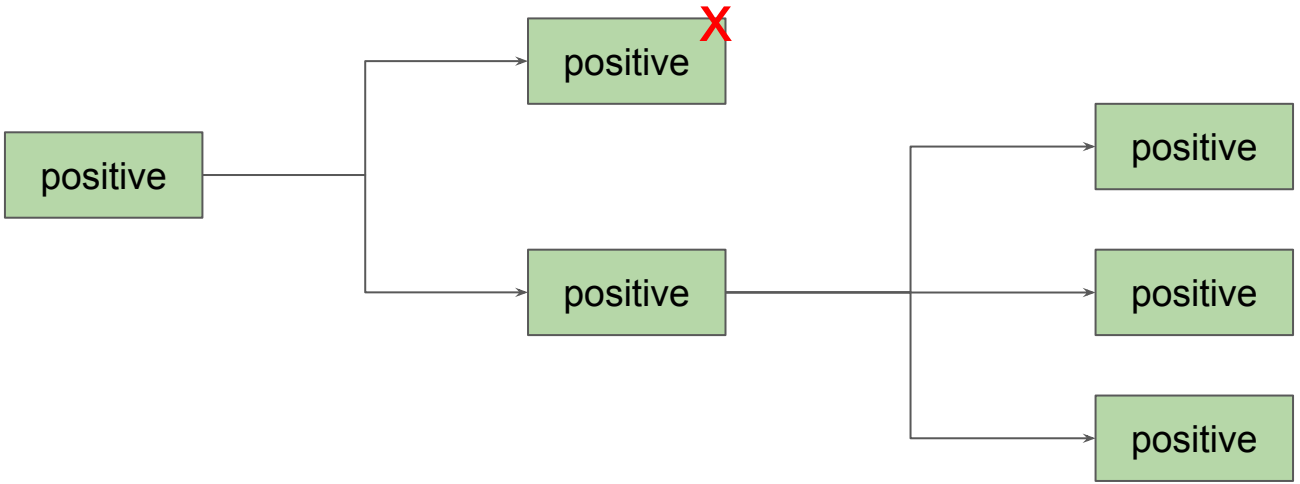
Determinantal Point Process

Select K points

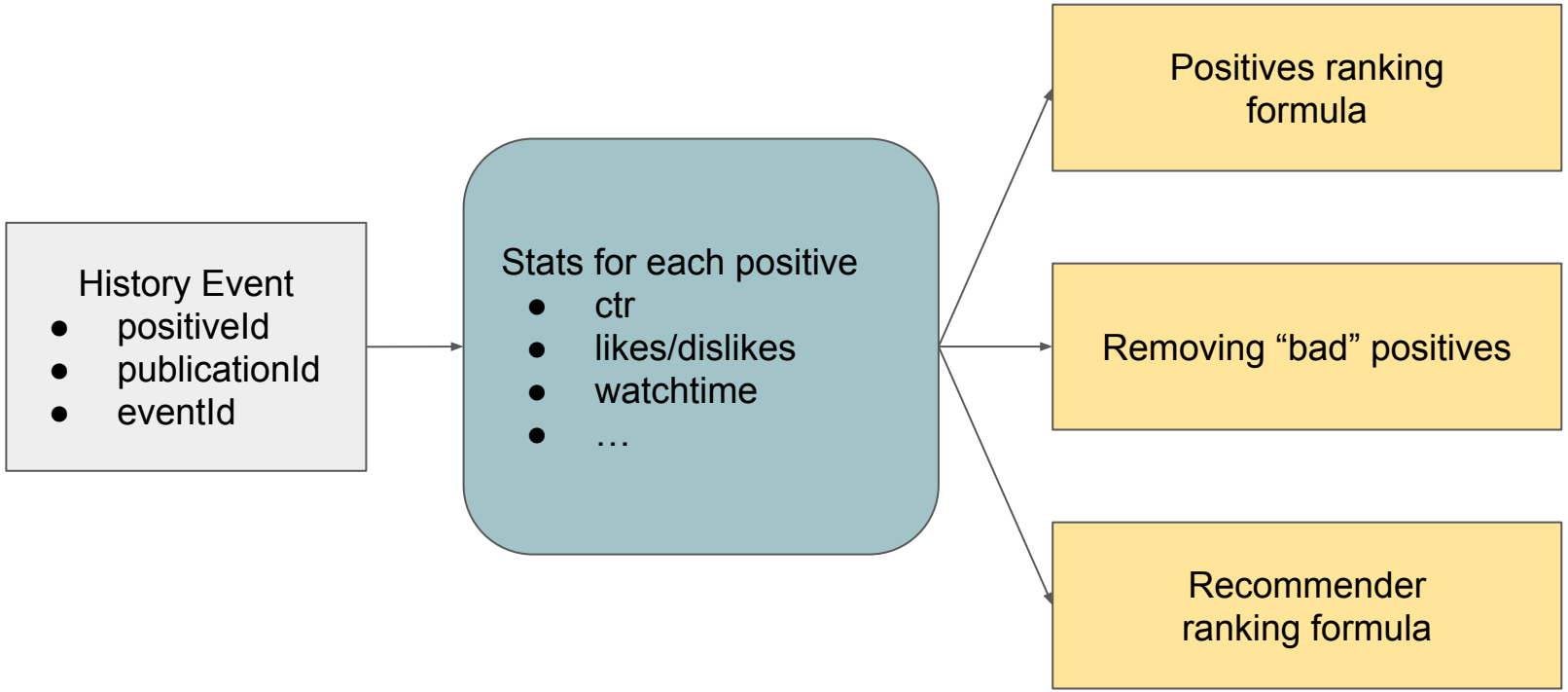
- prefer high weight points
- keep diversity in set



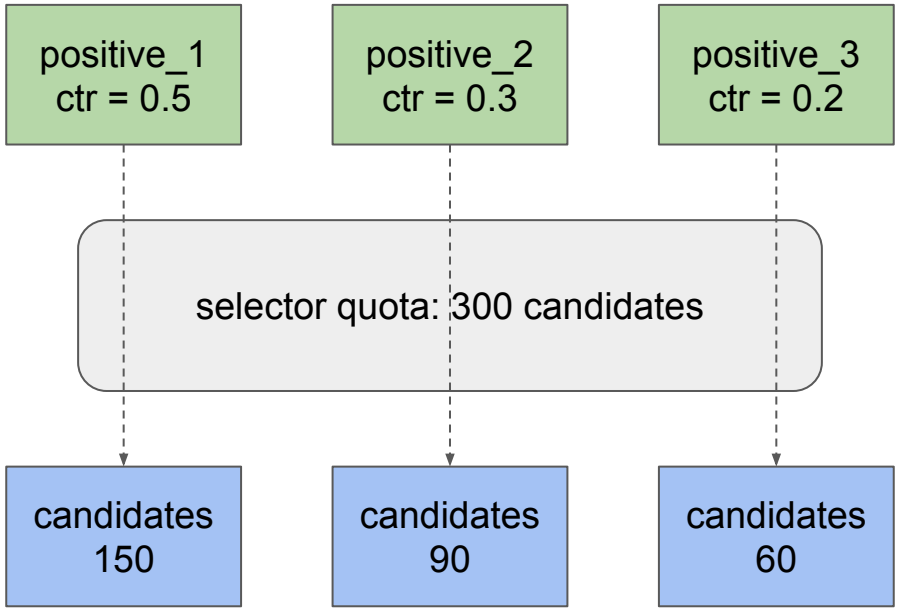
Positives selection / Tree



Positives selection / Formula



Candidate selection / Bandits



Conclusion

Summary

1. Transparent recommendations pipeline
2. User has recommendation explanation
3. Feed relevance increase
4. Developers can trace, debug and improve system

Thank you!