TWO-STAGE RECOMMENDER SYSTEM

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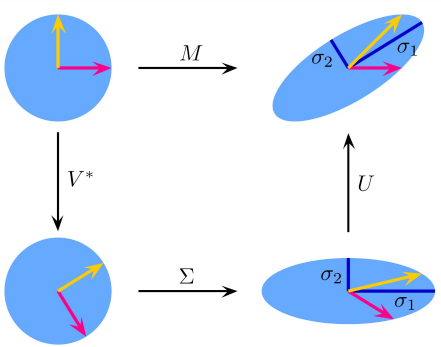
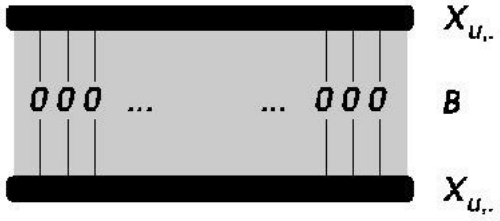
First-stage models

SVD

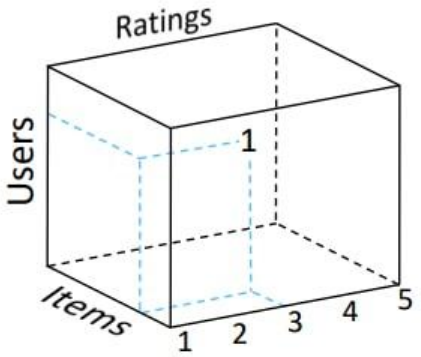


$$M = U \cdot \Sigma \cdot V^*$$

EASEr



Tensor Model



$$||\mathcal{A}_0 - \mathcal{R}||_F^2 \rightarrow \min$$

$$\mathcal{R} = \mathcal{G} \times_1 U \times_2 V \times_3 W$$

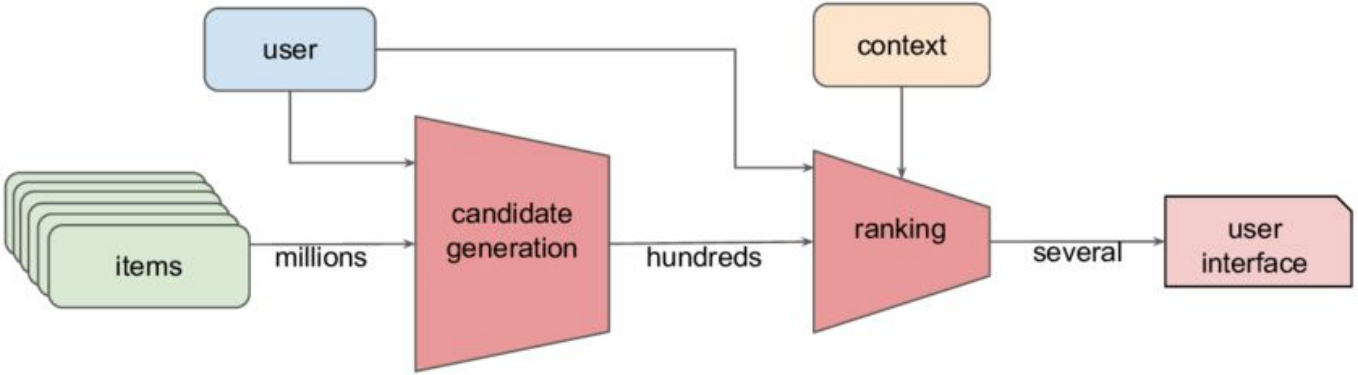
Options

- Directly generate top-10 candidates for scoring
- Generate candidates for second-stage

Why Two-stage Recommender system?

Many real-world recommender systems need to be highly scalable: matching millions of items with billions of users, with milliseconds latency. The scalability requirement has led to widely used two-stage recommender systems, consisting of efficient candidate generation model(s) in the first stage and a more powerful ranking model in the second stage.

What is this?



This is Problems, Always

Big data

No open-source

evfro - exception

Low metrics

Validation leakage

Our plan

1. Honestly split the data
2. Train and test 1st stage models
3. Make some feature generation
4. Train and test 2nd stage models
5. Tune hyperparameters
   for combined model

YouTube

"была ли у вас какая-то тактика с самого начала , которой вы придерживались" ?

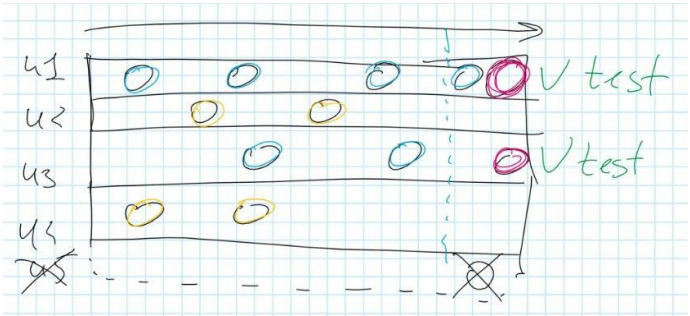
"была ли у вас какая-то тактика с самого начала , которой вы придерживались" ?

Data preprocessing

1. First split: train - 95% and test - 5%
2. Remove test users from train
3. Split train on stage1_train, stage2_predict, stage2_train, stage2_holdout
4. Add generated features to stage2_train
5. Finally, split test on test_predict and test_holdout

Data by time: stage1_train, stage2_predict, stage2_train, stage2_holdout, final_test, final_train

train



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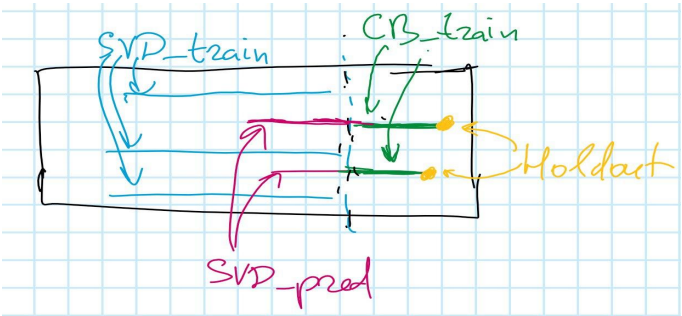

to this

Feature Engineering

Main concept - Sequential features

Your browser history?

Interactions with objects

SVD-embeddings

Metadata of items

BERT-embeddings

Second-stage model

How to fit?

1. Get candidates from the first-level model
2. Merge with stage2_train to generate labels
3. Add generated features
4. Train model

How to predict?

1. Repeat 1, 2, 3 steps from fit for final_test, but without labels
2. Score candidates and choose top-10
3. Calculate metrics on final_holdout

Results

Baseline models results

model	hit rate	mrr	cov
SVD	0.0841	0.0325	0.2670
EASEr	0.0912	0.0365	0.1861

Two-stage model results

model	hit rate	mrr	cov
SVD + CB	0.0859	0.0332	0.2459

Качественные результаты

Разработана схема валидации двухуровневой модели

Проверены следующие гипотезы:

1. Двухуровневая модель лучше одноуровневой

2. Динамические признаки лучше статических

3. Тензорная модель уточняет предсказания

Sources

- Блоги про двухуровневый подход:

https://habr.com/ru/company/okko/blog/454224/

https://habr.com/ru/company/tinkoff/blog/454818/

https://habr.com/ru/company/avito/blog/439206/

- Литература по моделям:

https://dl.acm.org/doi/10.1145/1864708.1864721

https://arxiv.org/abs/1607.04228

- Генерация фичей:

https://habr.com/ru/post/447376/

https://github.com/aprotopopov/retailhero_recommender

https://github.com/mike-chesnokov/x5_retailhero_2020_recs

https://arxiv.org/abs/1610.04850

- Примеры:

https://github.com/evfro/recsys19_hybridsvd/tree/master/data

https://github.com/skoltech-ai/Recommender-Systems-Intro-Sber-2022/blob/main/Evaluation.ipynb

https://github.com/sharthZ23/your-second-recsys/blob/master/lecture_5/tutorial_hybrid_model.ipynb/