



POLITECNICO
MILANO 1863

RecSys Challenge

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Roadmap

- Data Exploration

- Single Recommenders Hyperparameters Tuning

- SLIM Elastic, P3 alpha, RP3 beta, ...



Best MAP@10:
0.1380 (public),
0.13689 (private)

- Hybrid Recommenders

- Linear Combination
- Pipelines
- List Combination



Best MAP@10:
0.13920 (public),
0.13874 (private)

- XGBoost/Catboost/LightGBM Ranker

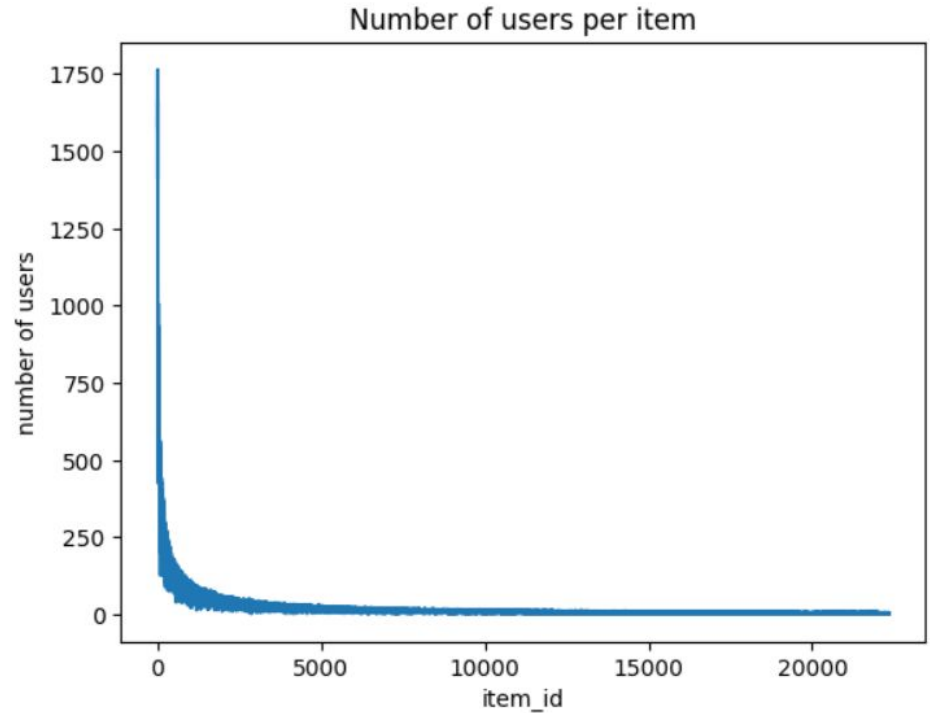


Final Submission MAP@10:
0.14396 (public),
0.14431 (private)



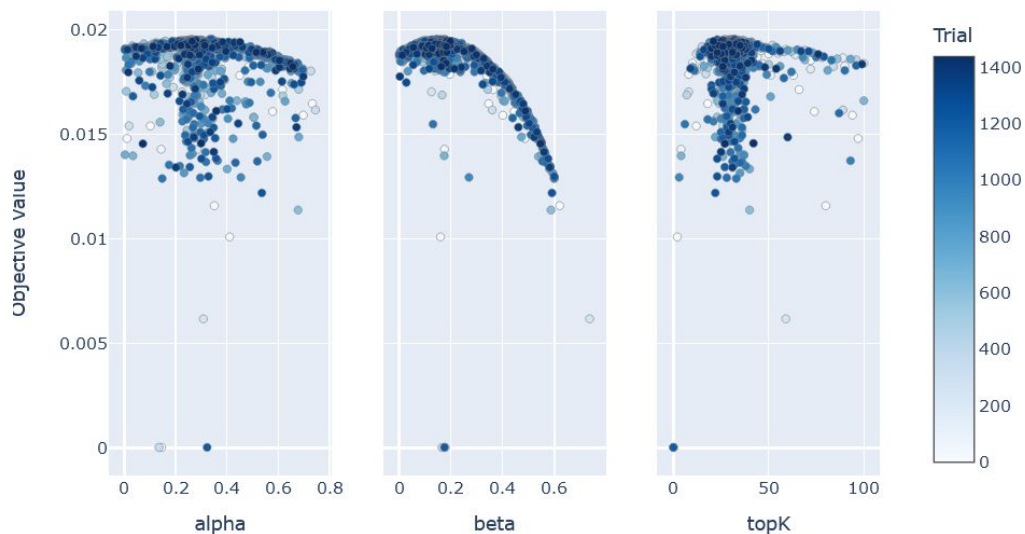
Data Exploration

- Implicit Ratings URM-Pure Collaborative
- 22.347 items
- 13.024 users



Single Recommenders Hyperparameter Tuning

- Optuna
- Intense hyperparameter tuning



Top Recommenders:

- Slim Elasticnet
- RP3Beta
- ItemKNN

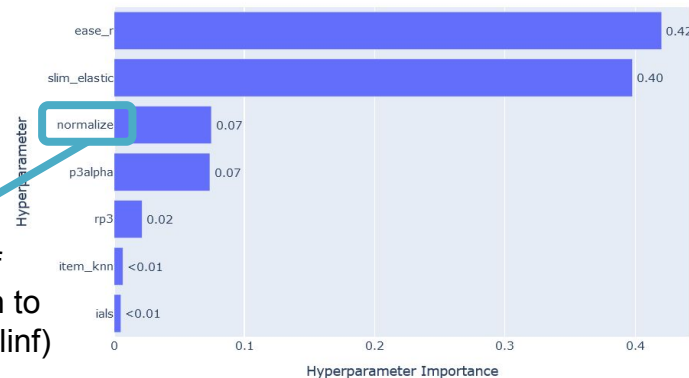
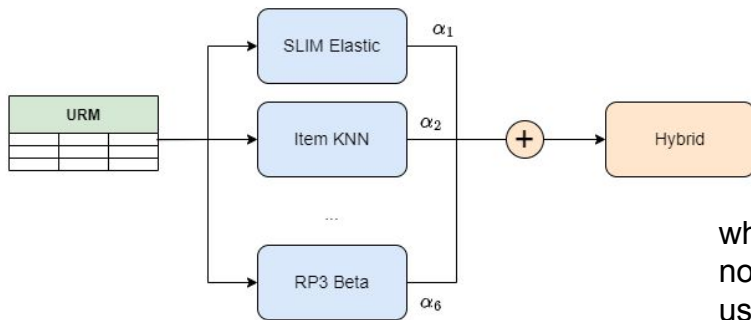
Worse Recommenders:

- NMF
- SlimBPR
- LightFM

Hybrid Recommenders

- (Normalized) Linear Combination:

- Best public MAP@10: 0.1392 (SLIM Elastic + RP3 Beta + P3 alpha + Item KNN + IALS + EASE R)



which type of
normalization to
use (l1, l2 or linf)

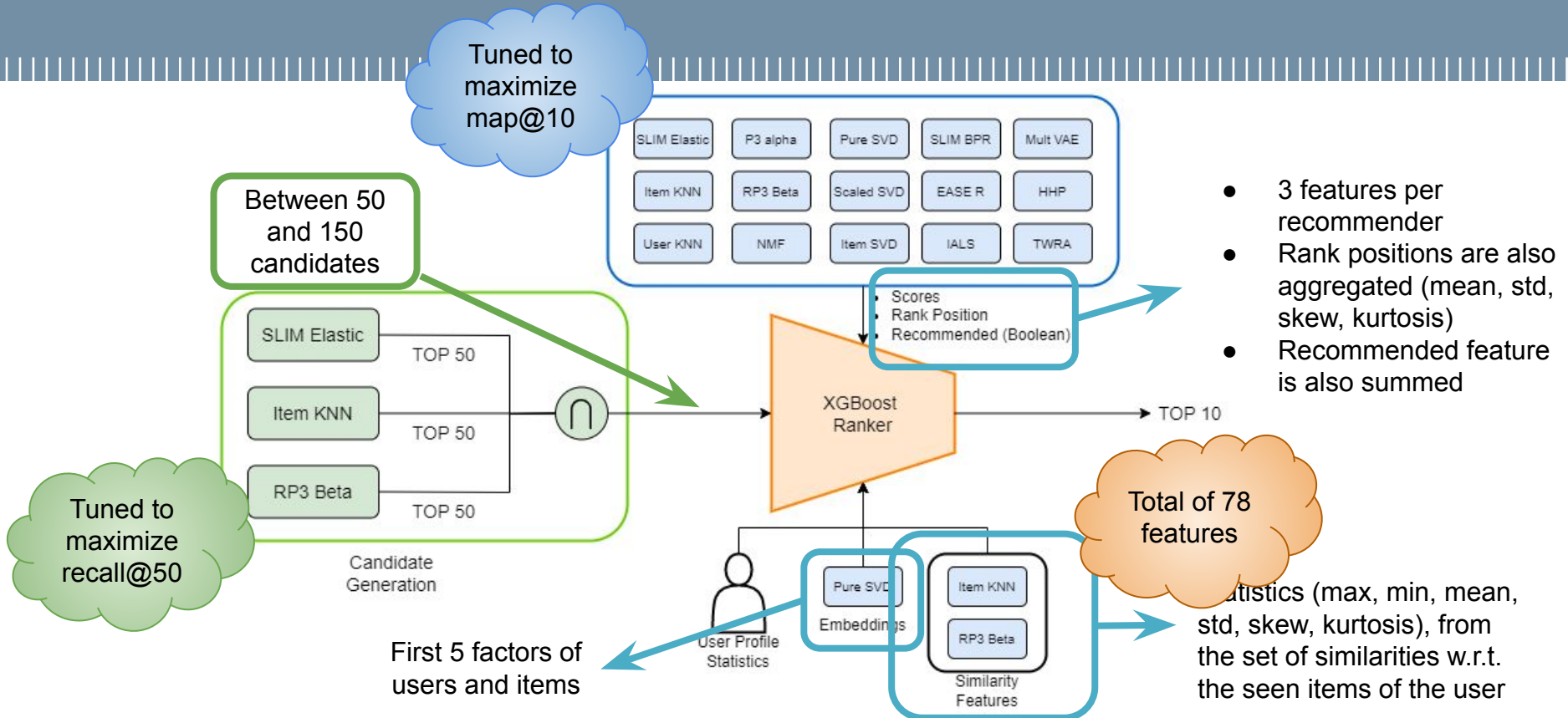
- Pipelines:

- Best public MAP@10: 0.1384 (RP3 Beta + SLIM Elastic)

- List combination (Round Robin, Ranking)

- Best public MAP@10: 0.13868 (Ranking of RP3 Beta + SLIM Elastic)

Final solution - The architecture

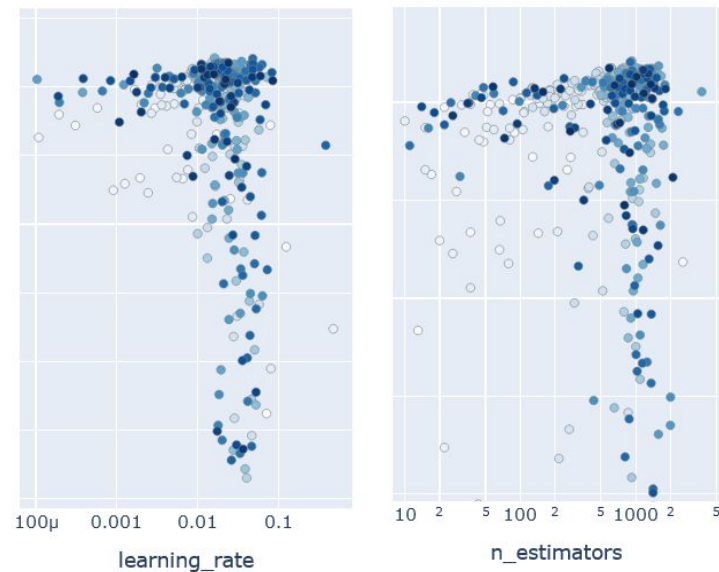
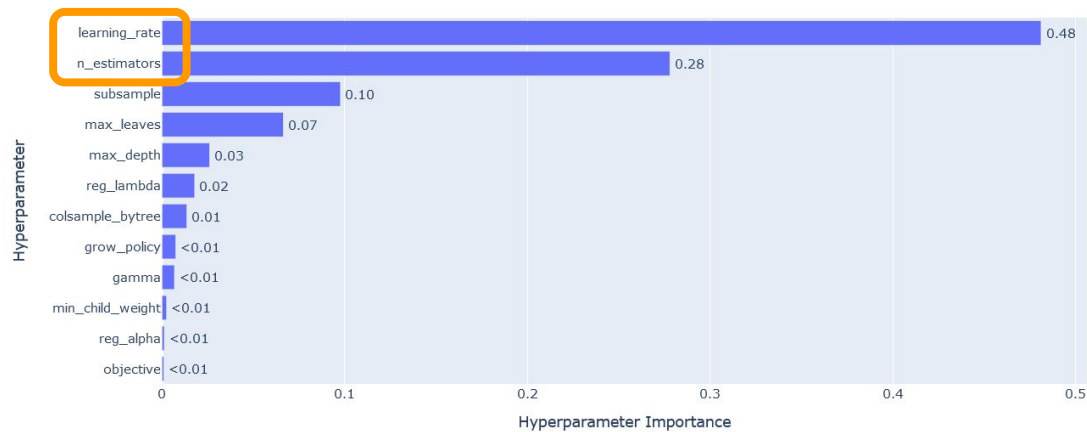


Final solution - Pipeline Implementation

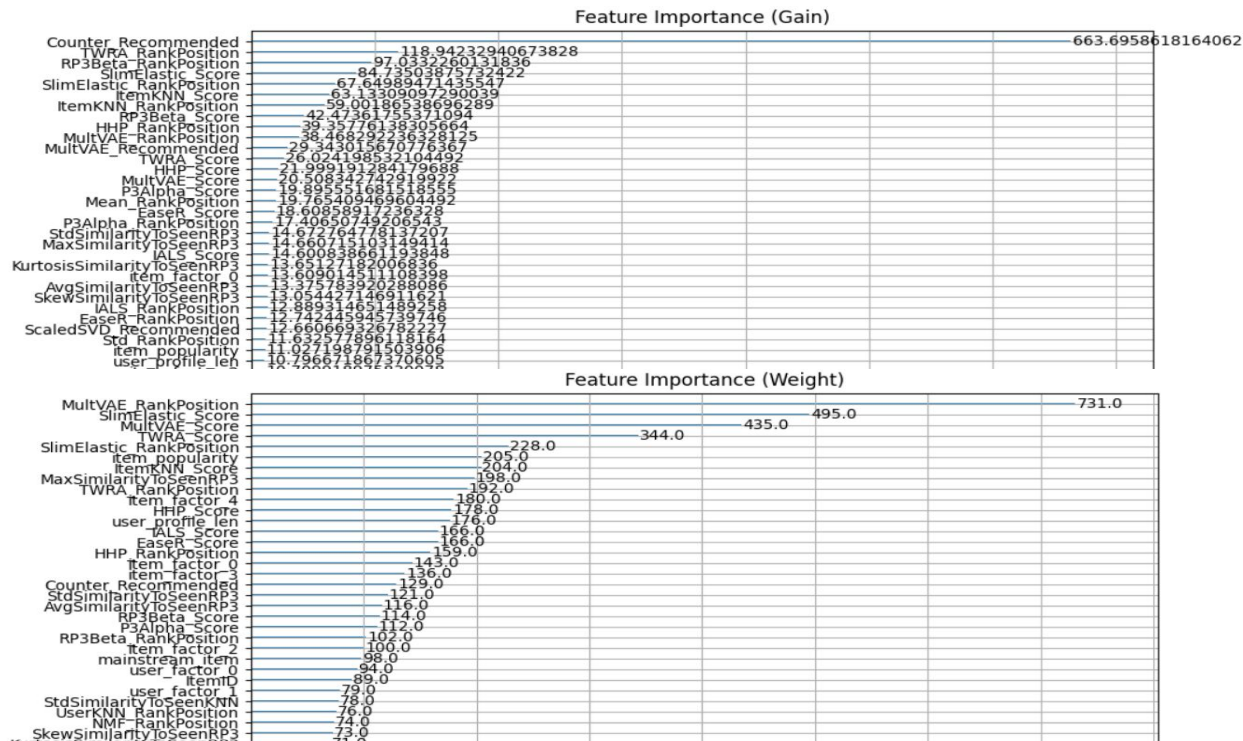
URM splitted in 3: URM_train, URM_label, URM_val (64% - 16% - 20%)

- Hyperparameters Tuning:
 - Single Recommenders trained on URM_train produce features for training
 - URM_label produce the labels for XGBoost
 - Single Recommenders trained on URM_train + URM_labels produce features for predictions
 - URM_val evaluate the final recommendations of XGBoost
- Final Training:
 - Single Recommenders trained on URM_train + URM_label produce features for training
 - URM_val used to produce the labels for XGBoost
 - Single Recommenders trained on the complete URM produce features for predictions

Final solution - Hyperparameters Tuning



Final solution - Feature Importance



Implemented Recommenders

- HHP (Hybrid HeatS ProbS):

$$\left. \begin{array}{l} \text{ProbS (P3): } W_{\alpha\beta} = \frac{1}{k_{\beta}} \sum_{j=1}^U \frac{a_{j\alpha} a_{j\beta}}{k_j} \\ \text{HeatS: } W_{\alpha\beta} = \frac{1}{k_{\alpha}} \sum_{j=1}^U \frac{a_{j\alpha} a_{j\beta}}{k_j} \end{array} \right\} W_{\alpha\beta}^H = \frac{1}{k_{\alpha}^{1-\lambda} k_{\beta}^{\lambda}} \sum_{j=1}^U \frac{a_{j\alpha} a_{j\beta}}{k_j}.$$

- TWRA (Two-Way Rank Aggregation):
 - Forward ranking: computes the score of the items for a user
 - Backward ranking: computes the score of the users for a item

$$\text{ag-rank}^{\pi}(u, i) = (1 - \lambda) * \text{f-rank}^{\pi}(u, i) + \lambda * \text{b-rank}^{\pi}(u, i)$$