

# Recommender Systems Challenge 2023

Lorenzo Campana

Politecnico di Milano

February 21, 2024

Personal Code: 10605775

- $\approx 600k$  user-book interactions ( $\approx 13k$  users,  $\approx 22k$  books)
- Implicit ratings
- Provided slides results consider 80% training, 20% test
- Evaluation metric: MAP@10

$$\text{MAP@}K = \frac{1}{K} \sum_{u=1}^N \frac{1}{\min(K, m)} \sum_{k=1}^K P(k) * \text{rel}(k)$$

## Top Popular algorithm

Identify the most frequently occurring books

- Non Personalized
- $\text{MAP@10} = 0.011742$
- How was it used?
  - To provide recommendation to new users

# Hyperparameter tuning

- Optuna
- 5 Folds Cross Validation
- AWS free tier  $\approx$  €2.25

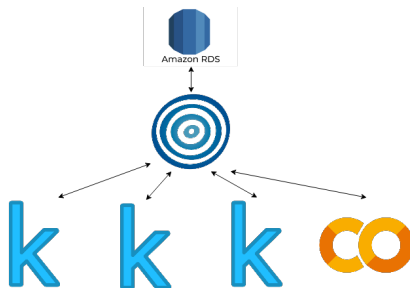


Figure: Optuna easy parallelization

# Directory tree structure

```
...
├── Recommenders
│   │   ...
│   ├── XGboostRecommender.py
│   ├── best_models.ipynb
│   ├── best_models_info.pickle
│   ├── Builder.py
│   ├── dataset
│   │   └── book_dataset
│   │       ├── data_target_users_test.csv
│   │       └── data_train.csv
│   ├── saved_models
│   │   ├── URM.npz
│   │   ├── URM_test.npz
│   │   ├── URM_train.npz
│   │   ├── URM_train_val.npz
│   │   ├── URM_val.npz
│   │   ├── cross_val
│   │   └── train
│   │   ...
│   ├── submissions
│   │   └── xgboost_final.csv
│   └── tuners
│       ├── KNN
│       │   ├── graph_tuners.py
│       │   ├── knn_ml.py
│       │   └── knn_tuners.py
│       ├── MF
│       │   └── mf_tuners.py
│       ├── hybrid
│       │   ├── hybrid_tuner.py
│       │   └── xgboost_tuner.py
│       ├── neural
│       │   └── neural_tuner.py
│       └── tuner.py
├── xgboost.ipynb
└── xgboost_tuner_run.py
```

Figure: Directory tree structure

# Recommendation Algorithms Comparison

## KNN Collaborative Filtering

- Item-Based
  - BM-25
  - $\text{MAP@10} = 0.03493$
- User-Based
  - TF-IDF
  - $\text{MAP@10} = 0.03493$

## Graph-based

- P3alpha
  - $k = 40$
  - $\text{MAP@10} = 0.04793$
- RP3beta
  - $k = 28$
  - $\text{MAP@10} = 0.04899$

# Recommendation Algorithms Comparison

## Matrix Factorization

- IALS
  - $k = 80$  latent factors
  - $\text{MAP@10} = 0.03230$

## Neural

- MultVAERecommender
  - $\text{MAP@10} = 0.037868$

## Item-Based CF

- SLIMElasticNet
  - $k = 570$
  - $\text{MAP@10} = 0.05003$
- SLIMBRP
  - $\text{MAP@10} = 0.03893$

## ScoresHybrid

- SLIMElasticNet, RP3beta
- $\alpha = 0.50282$
- $\text{MAP@10} = 0.05104$

$$\tilde{R} = \alpha \cdot \tilde{R}_A + (1 - \alpha) \cdot \tilde{R}_B$$



# XGBoost (Preprocessing)

- Candidate generation selection
- Candidate generation cut-off selection
- Feature engineering
- Categorical features encoding

# XGBoost (Candidate Generation)

- **ScoresHybrid**

- SLIMElasticNet, RP3beta
- Metric: Recall
- Cut-off = 35
- $\alpha = 0.36771$
- $\text{RECALL@35} = 0.24885$

- SLIMElasticNet

- Metric: Recall
- Cut-off = 35
- $\text{RECALL@35} = 0.24221$

- RP3beta

- Metric: Recall
- Cut-off = 35
- $\text{RECALL@35} = 0.24156$


# XGBoost (Feature Engineering)

- Chosen scores:
  - SLIMElasticNet
  - RP3beta
  - ItemKNNCF
  - TopPopular
  - IALS
  - MultVAE
- Metric: NDCG
- Cut-off = 10
- $k=[3, 10, 20]$ 
  - `is_in_top_k()`
  - `count_agreement()`
- `score_stats()`
  - `mean`
  - `...`
  - `iqr`
- `normalize_scores()`
- `disagreement()`
- $n_{groups} = 20$ 
  - `user_profile()`
  - `item_profile()`
  - `MAP@10 = 0.051485`

# XGBoost (Categorical Features)

- naive `enable_categorical = True` (Used approach)
- Truncated SVD ( $k = 100 \approx 10\%$  explained variance)
- What I did not tried:
  - Target encoding
  - Matrix Factorization
  - One-hot encoding
  - Embeddings

# Conclusion

- Thank you for your attention!
- Feel free to check out the project on GitHub:  
 <https://github.com/loreccampa/RecSysChallenge2023>