

# HYBRID MUSIC RECOMMENDER USING CONTENT-BASED AND SOCIAL INFORMATION

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## 1 Introduction

Recommender systems are software facilities for providing items suggestions or predicting customer behavior by using prior user information. These systems play an important role in commercial applications to increase sales and improve user satisfaction.

We introduce a hybrid music recommender to mitigate the *cold-start* problem. Our approach is inspired on the results in [1] and [2] using convolutional neural networks (CNN) for music genre classification and estimation of distribution algorithms (EDA) for user modeling. Our findings support the idea that a combination of techniques might improve the recommendation performance.

## 2 Hybrid Music Recommender

The hybrid music recommender approach is an implementation of feature augmentation and meta-level methods. One advantage of the meta-level method is the use of compressed users and songs information instead of sparse raw data.

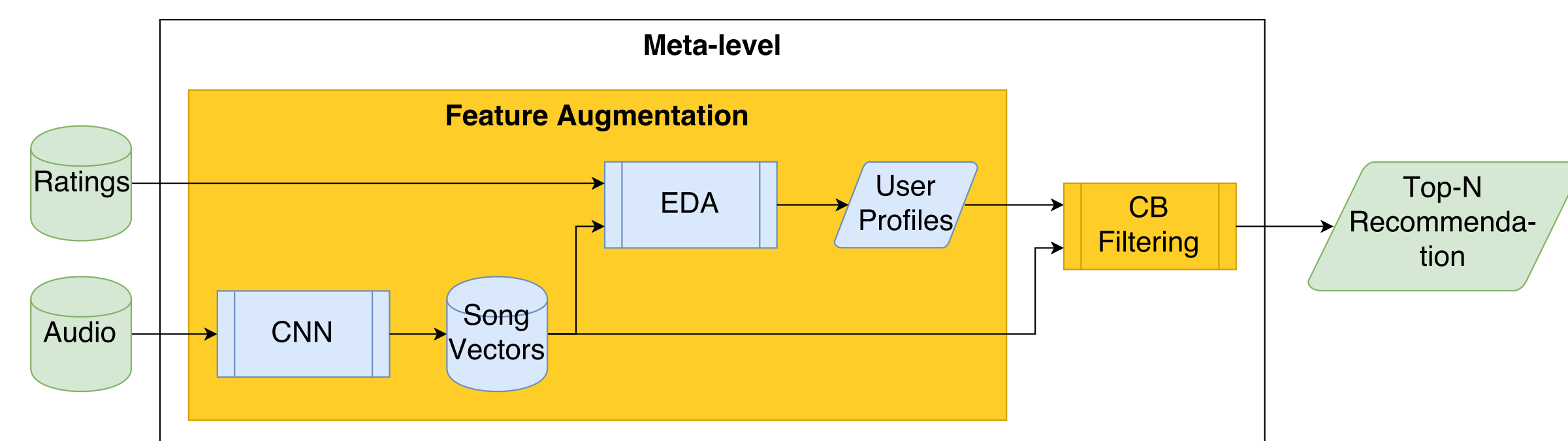


Fig. 1. Diagram of our hybrid music recommender approach

## 3 Data Representation

- The CNN produces a vector representation of the spectrograms for each audio file.
- The EDA [3] estimates a probabilistic model from a sample to model the user profiles from the user ratings dataset and vector representation.

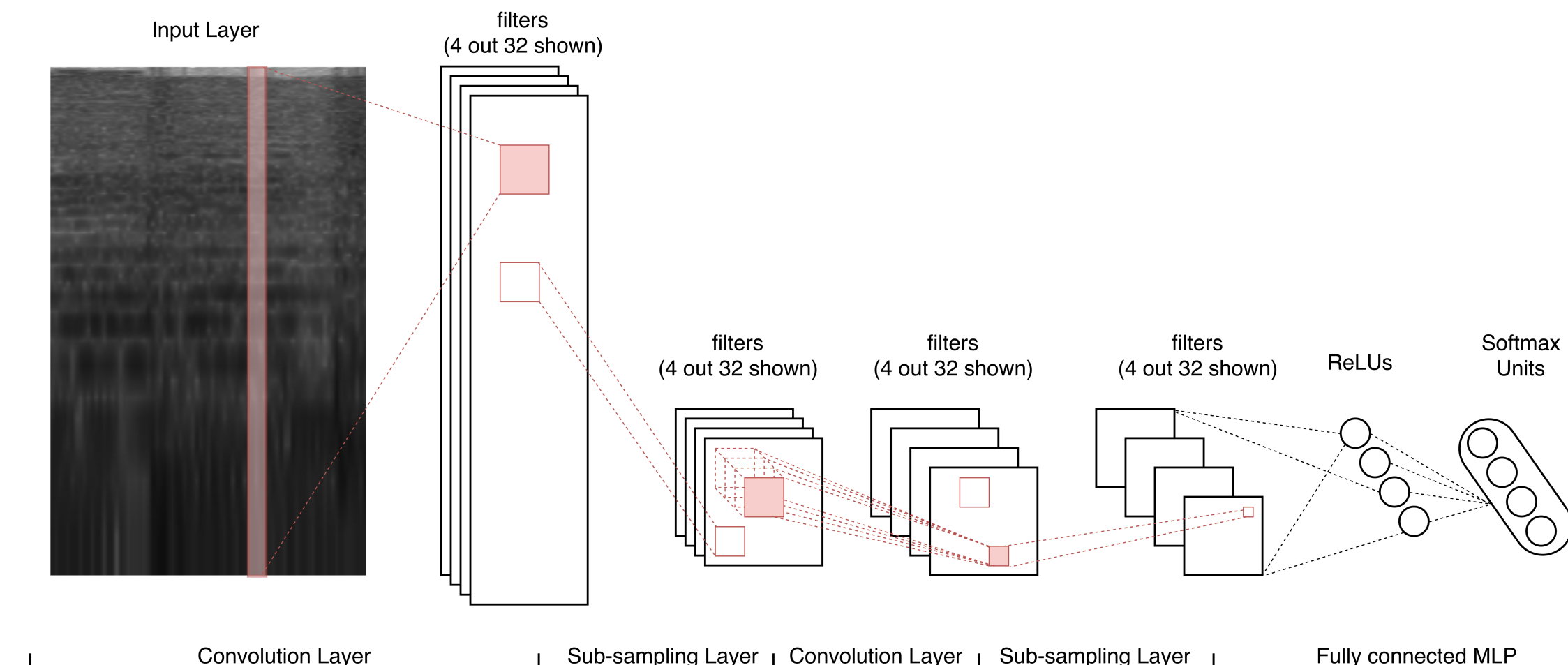


Fig. 2. Architecture of a CNN for music genre representation

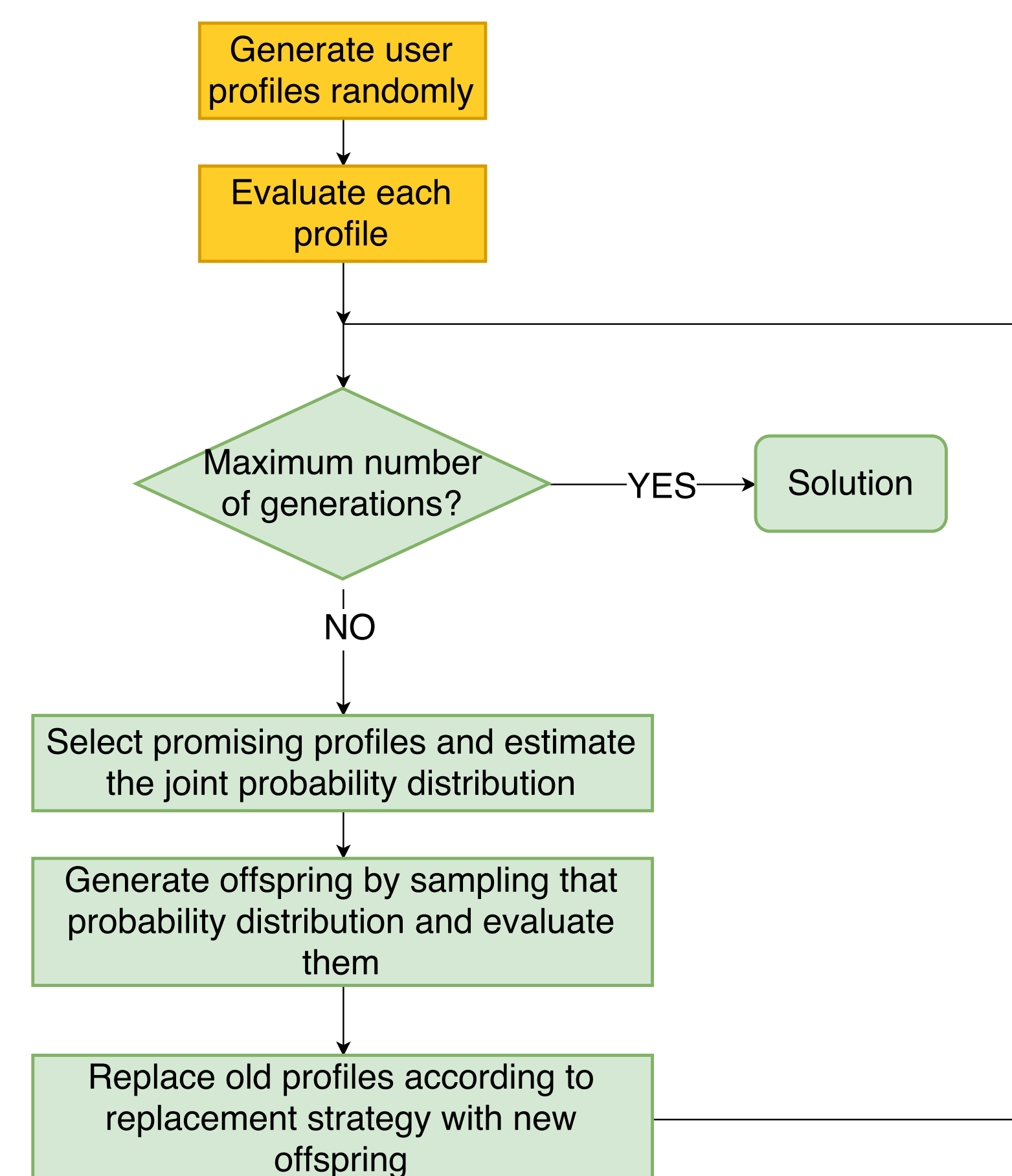


Fig. 3. General flowchart for an EDA

## 4 Results

- 20% of song ratings is the test set, the other 80% is the training set, for each user. The number of users evaluated is 53.
- For each song in the test set, we look up if the song is included or not in the produced top-N recommendations.

Recommender	Precision	Recall	F1	Accuracy
Content-based (baseline)	0.275 ± 0.087	0.010 ± 0.003	0.020 ± 0.007	0.681 ± 0.008
Hybrid (discrete EDA)	<b>0.391 ± 0.182</b>	<b>0.013 ± 0.007</b>	<b>0.025 ± 0.013</b>	<b>0.685 ± 0.009</b>
Hybrid (continuous UMDA)	0.318 ± 0.142	0.011 ± 0.005	0.021 ± 0.011	0.683 ± 0.009

## 5 Conclusions

- We investigated and considered EDA for modelling users' listening behaviour in terms of probabilities of music genres from the songs in they have listened.
- We found the CNN achieve similar results to long-established music genre classifier approaches in music information retrieval field.
- The results show that using a discrete values in EDA can outperform a single content-based recommender.
- We aim to build on this work by implementing unsupervised deep learning networks and an online evaluation interface.

## References

- [1] Corey Kereliuk, Bob L. Sturm, and Jan Larsen, "Deep learning and music adversaries," *CoRR*, vol. abs/1507.04761, 2015.
- [2] T. Liang, Y. Liang, J. Fan, and J. Zhao, "A hybrid recommendation model based on estimation of distribution algorithms," *Journal of Computational Information Systems*, vol. 10, no. 2, pp. 781–788, 2014.
- [3] C. Ding, L. Ding, and W. Peng, "Comparison of effects of different learning methods on estimation of distribution algorithms," *Journal of Software Engineering*, vol. 9, no. 3, pp. 451–468, 2015.