Collaborative Filtering
Improvements on Deep Matrix Factorization

Research focus : How to add external data to a deep MF model ?

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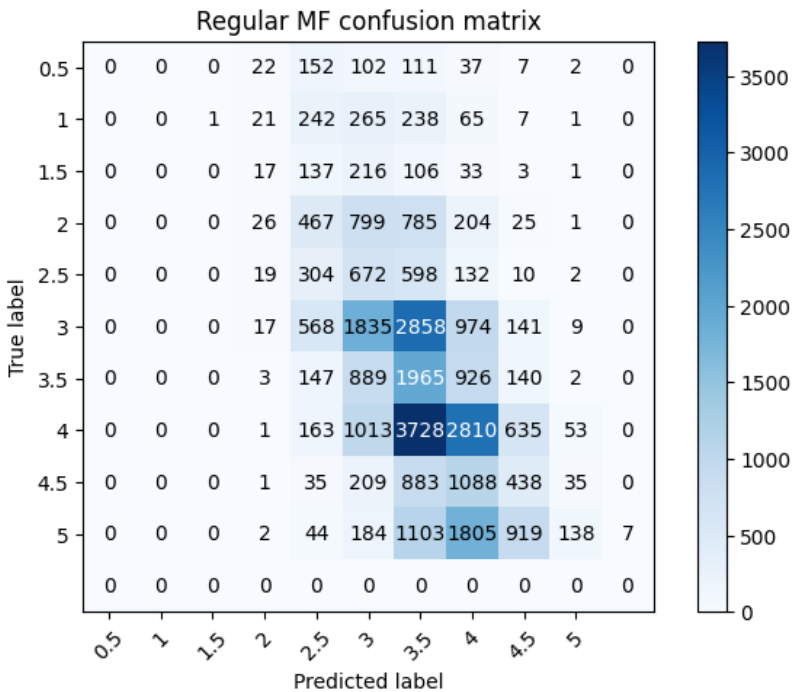
Roadmap

- Matrix Factorization (baseline)
- Deep MF
  - Paper implementation (hyperparameters)
  - Paper limits (*nan* values, loss function)
- Improvements
  - Model improvements
  - Data augmentation

Matrix Factorization

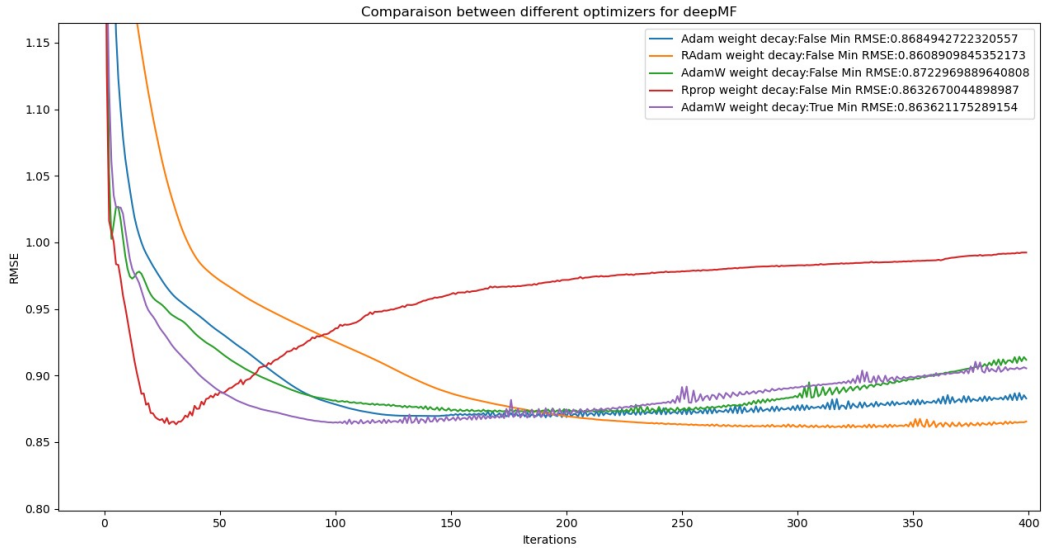


Metric	Value
Train RMSE	0.811
Test RMSE	0.882
Plateforme RMSE	0.930
Accuracy	23.79 %

MF to Deep MF

$\rightarrow$ *Non linear model, use of Binary Cross Entropy loss*

Hyperparameters



Paper limit : ponderation of *nan* values

Metric	Value
Train RMSE	0.814
Test RMSE	0.865
Plateforme RMSE	0.852
Accuracy	24.93 %

Model improvements

Reformulations of the method:

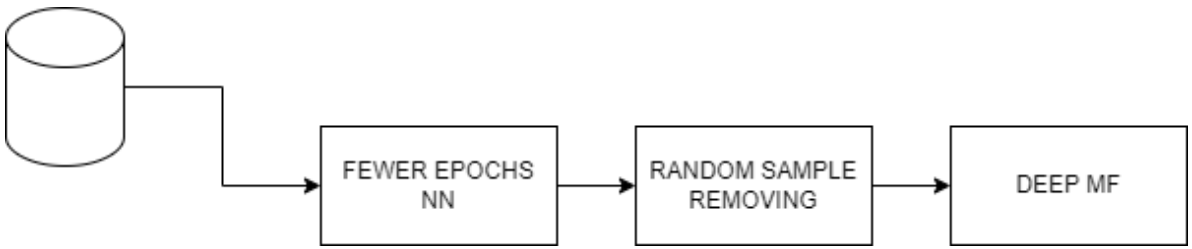
$\rightarrow$ Under-representation of lowest grades

- Regularization terms in the loss function

$$\ell(Y, \hat{Y}) = \text{BCE}(Y, \hat{Y}) + \lambda \cdot \|p\|_F + \mu \cdot \|q\|_F$$

$\rightarrow$ *Slower and more unstable convergency of the optimizer.*

- Chained NN



Data augmentation

First attempt :

Adding new ratings to the metrics.

- Distance between movies :

$$d(M_1, M_2) = 1 - I/U$$

With I the common genres between M_1 and M_2, and U the union.

- Rate *nan* values with mean of ratings in neighborhood of M_1.

→ *Overfitting, we added a biais in the model.*

Second attempt :

Adding rows of genres.

- One hot encoding of genres for each movie.

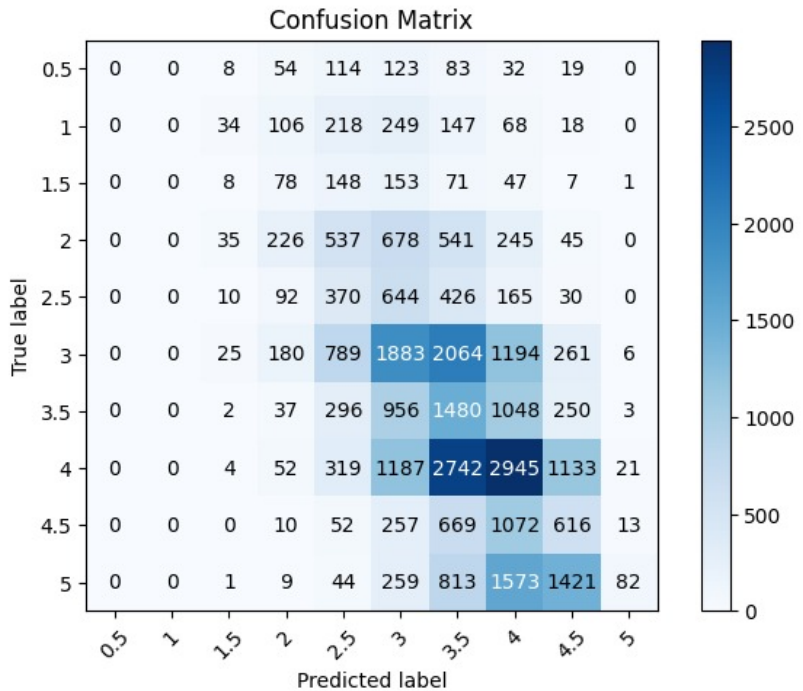
→ *No biais added, but no improvement either.*

	Train	Test	Plateforme	Accuracy
DeepMF	0.814	0.865	0.852	24.93%
First attempt	0.719	0.955	-	-%
Second attempt	0.814	0.865	-	-%

Conclusion

	Train	Test	Plateforme	Accuracy
MF	0.811	0.882	0.930	23.79%
DeepMF	0.814	0.865	0.852	24.93%
DeepMF regularized	0.748	0.889	-	-%
Data augmentation - 1	0.719	0.955	-	-%
Data augmentation - 2	0.814	0.865	-	-%

Confusion matrix for DeepMF



References

Hong-Jian Xue, Xin-Yu Dai, Jianbing Zhang, Shujian Huang, Jiajun Chen, *Deep Matrix Factorization Models for Recommender Systems*, Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence (IJCAI-17)