Dauphine | PSL
UNIVERSITÉ PARIS

Recommendation System using Optimal Trasport

ESIOT

Data Science Project
IASD

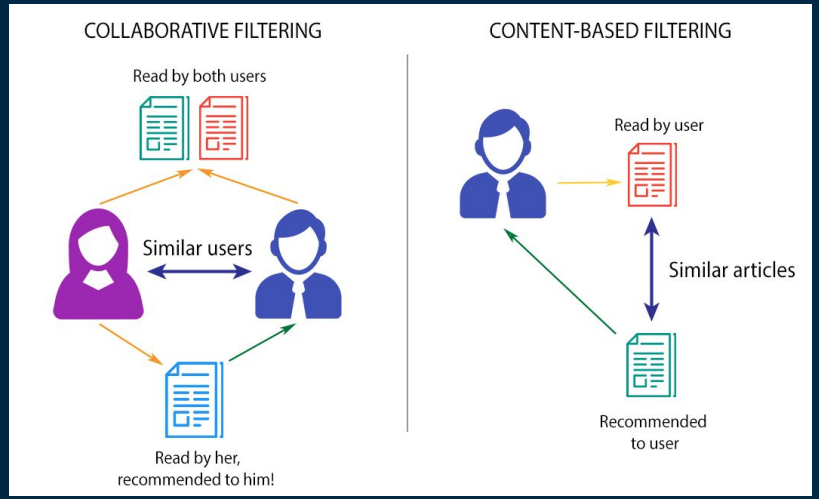
2022/2023

Presentation Of the problem and the approch

01

Dauphine | PSL
UNIVERSITÉ PARIS

Recommendation system



Collaborating filtering

Optimal transport

Optimal Transport

$\boldsymbol{\mu} \in \Sigma_m$ and $\boldsymbol{\nu} \in \Sigma_n$

$$d(C, \boldsymbol{\mu}, \boldsymbol{\nu}) := \min_{\pi \in U(\boldsymbol{\mu}, \boldsymbol{\nu})} \langle \pi, C \rangle$$

Regularized Optimal Transport (ROT)

$$d_\lambda(C, \boldsymbol{\mu}, \boldsymbol{\nu}) := \min_{\pi \in U(\boldsymbol{\mu}, \boldsymbol{\nu})} \{\langle \pi, C \rangle - H(\pi)/\lambda\}$$

$$\pi^\lambda = \mathrm{diag}(a) K \, \mathrm{diag}(b)$$

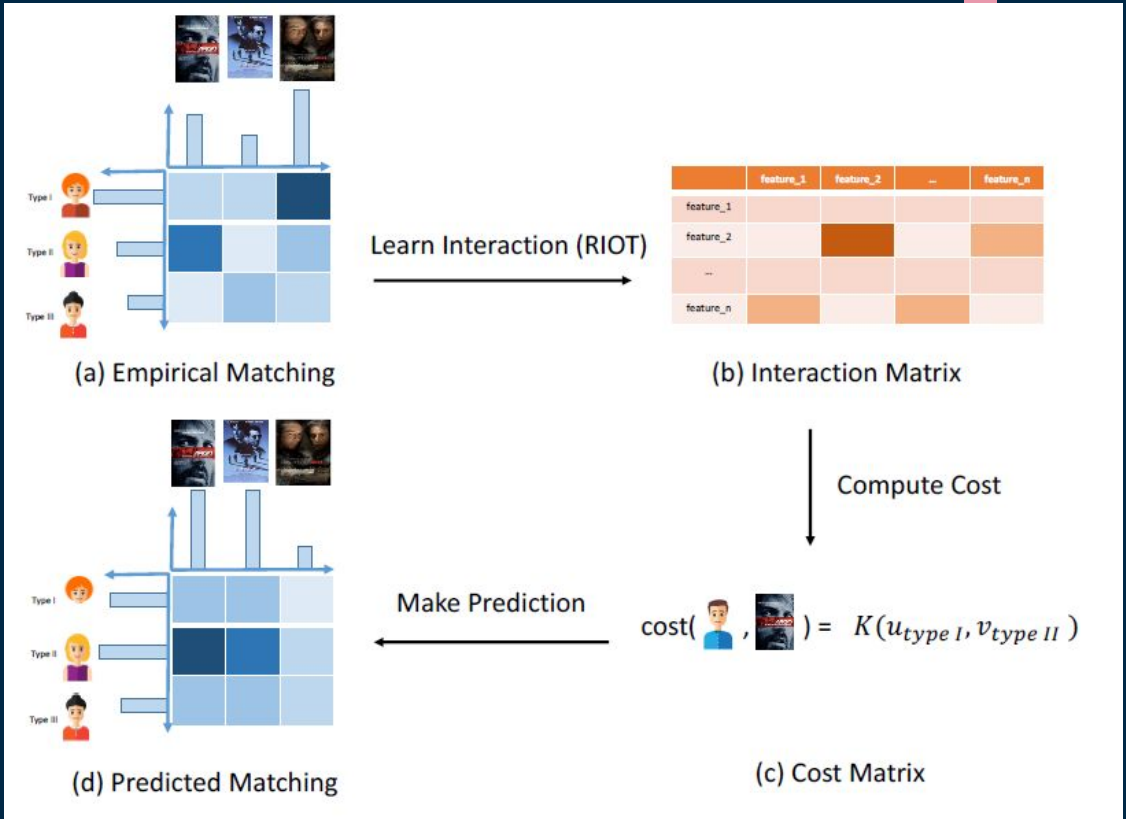
Sinkhorn-Knopp Algorithm

Inverse Optimal Transport (IOT)

$$C(A) = f(U^T A V)$$

$$\min_A \mathrm{KL}(\hat{\pi} \| \pi)$$

Optimal transport



LI, Ruilin, YE, Xiaojing, ZHOU, Haomin, et al. Learning to match via inverse optimal transport. Journal of machine learning research, 2019, vol. 20.

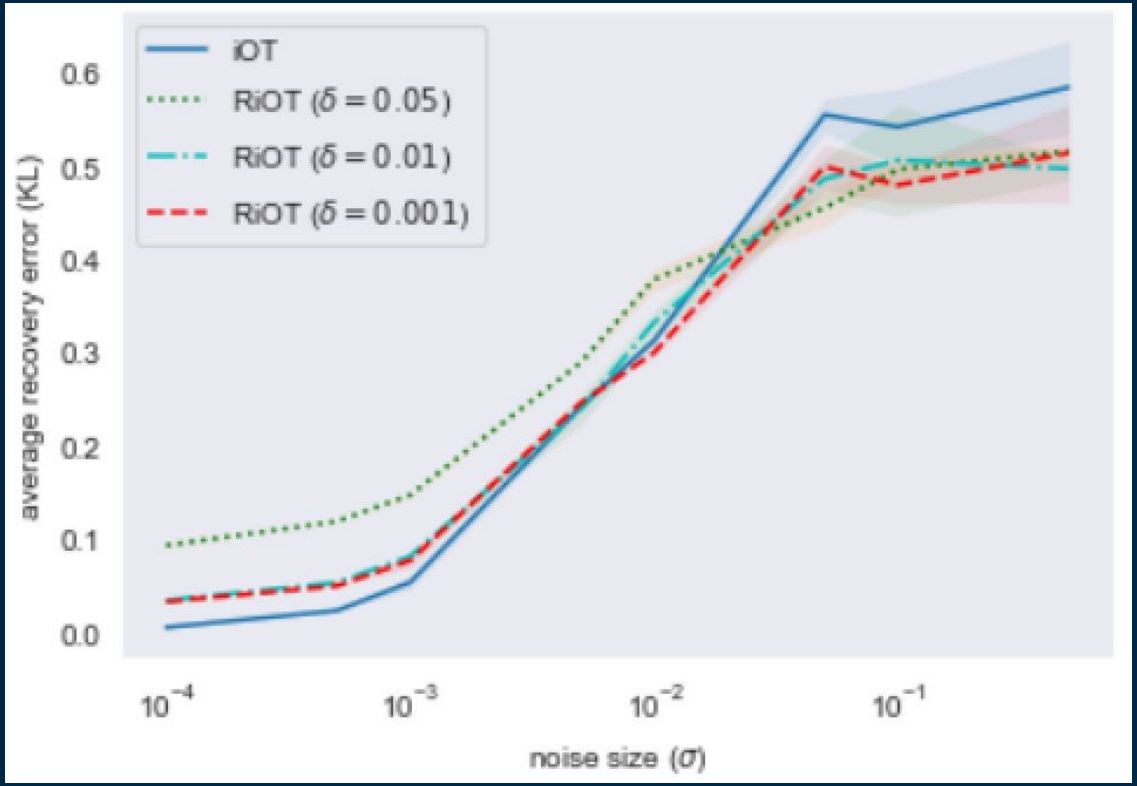
Test And Results

Dataset1

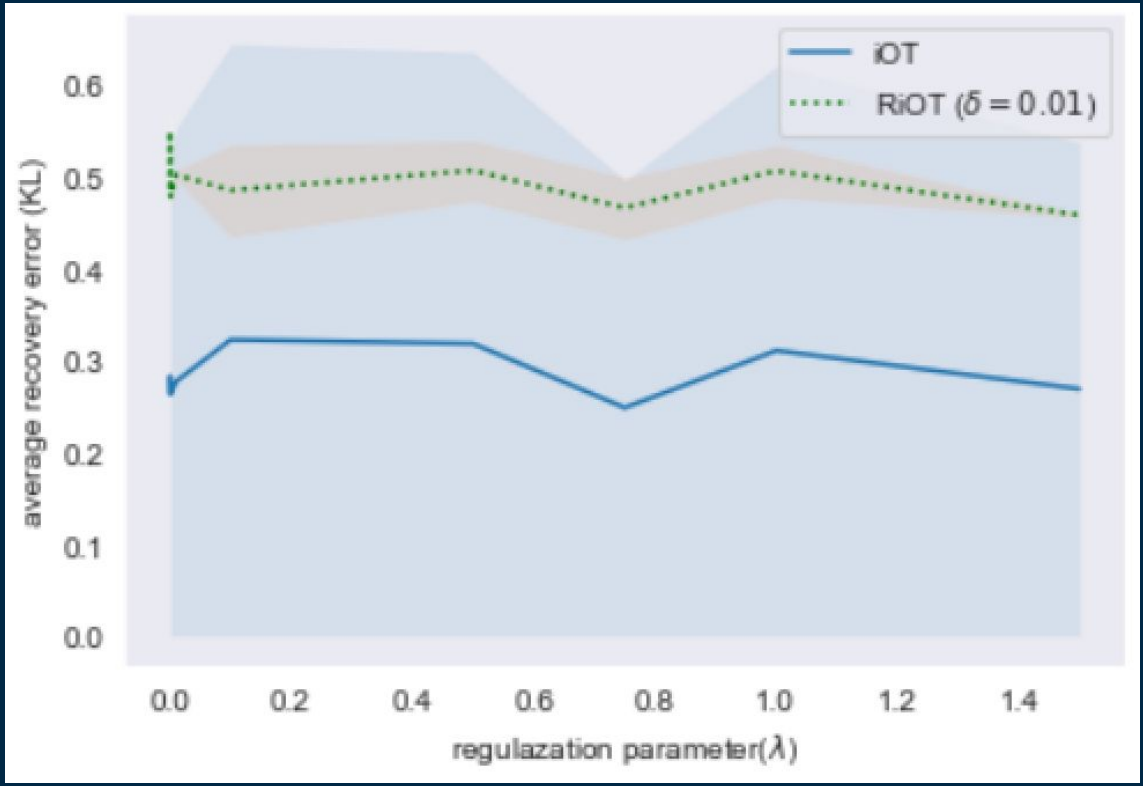
02

Dauphine | PSL
UNIVERSITÉ PARIS

RESULTS (1)(Comparison of recovery performance)

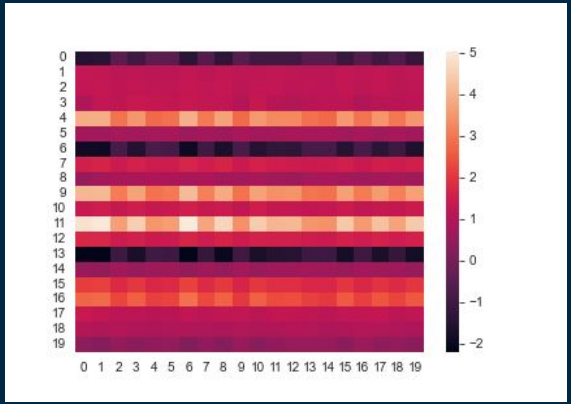


RESULTS (2)(Regulization Parameter Effect)



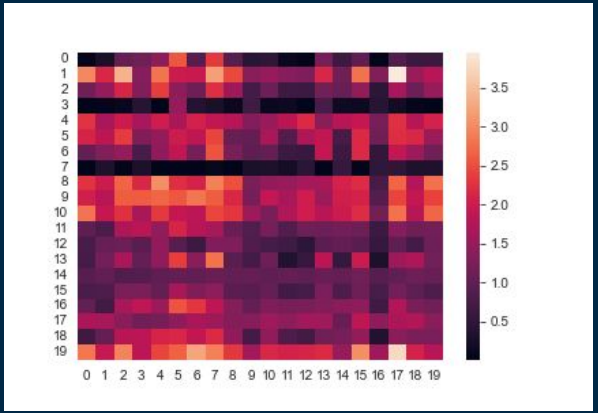
RESULTS (3)

C_0



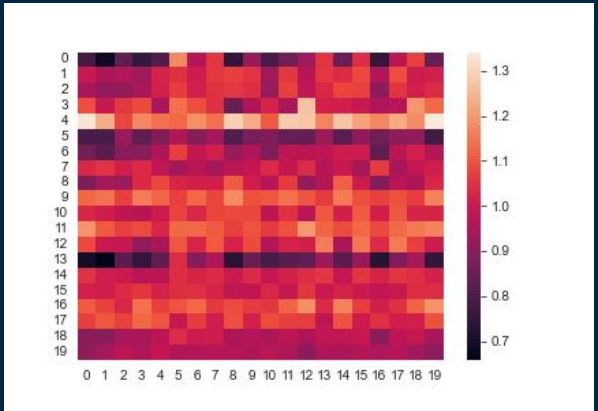
Initial Cost Matrix

IOT



Cost Matrix
calculated using IOT

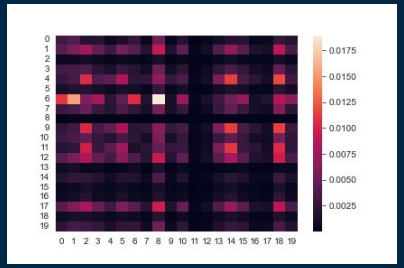
RIOT



Cost Matrix
Calculated using RIOT

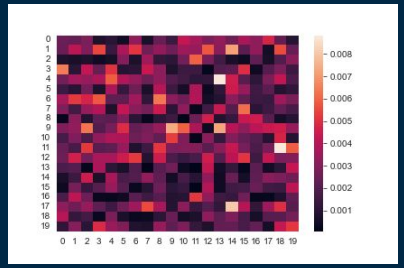
RESULTS (4)

π



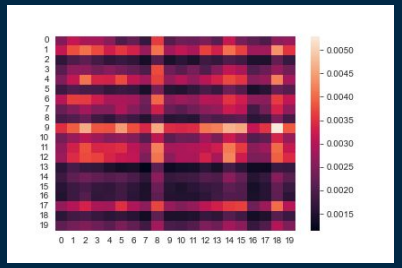
Initial

π_{opt}



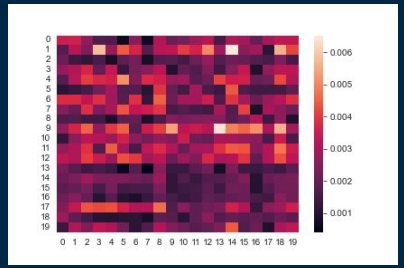
Optimal

π_{IOT}



Generated using IOT

π_{RIOT}



Generated using RIOT

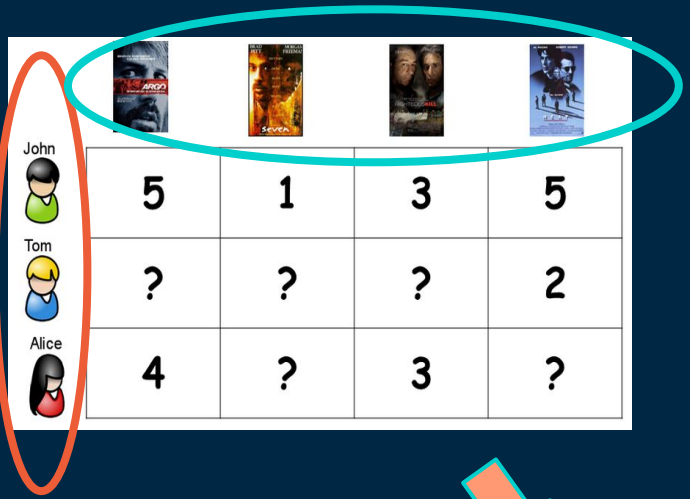
Test And Results
Dataset 2

03

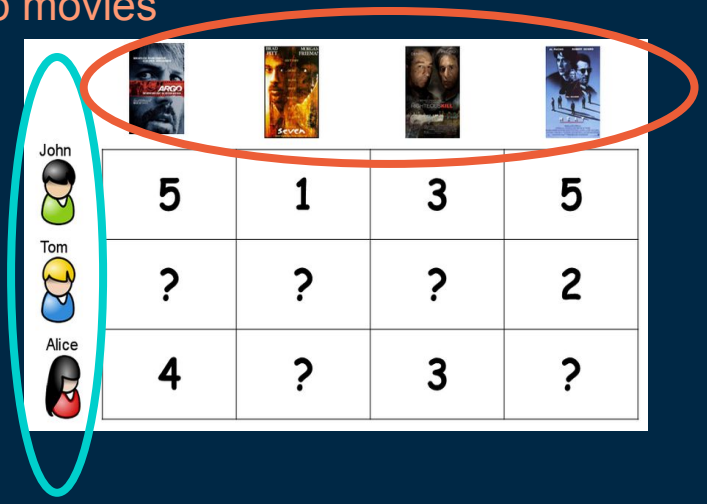
Dauphine | PSL
UNIVERSITÉ PARIS

RESULTS (1)

Features = movies



Group movies



Group users

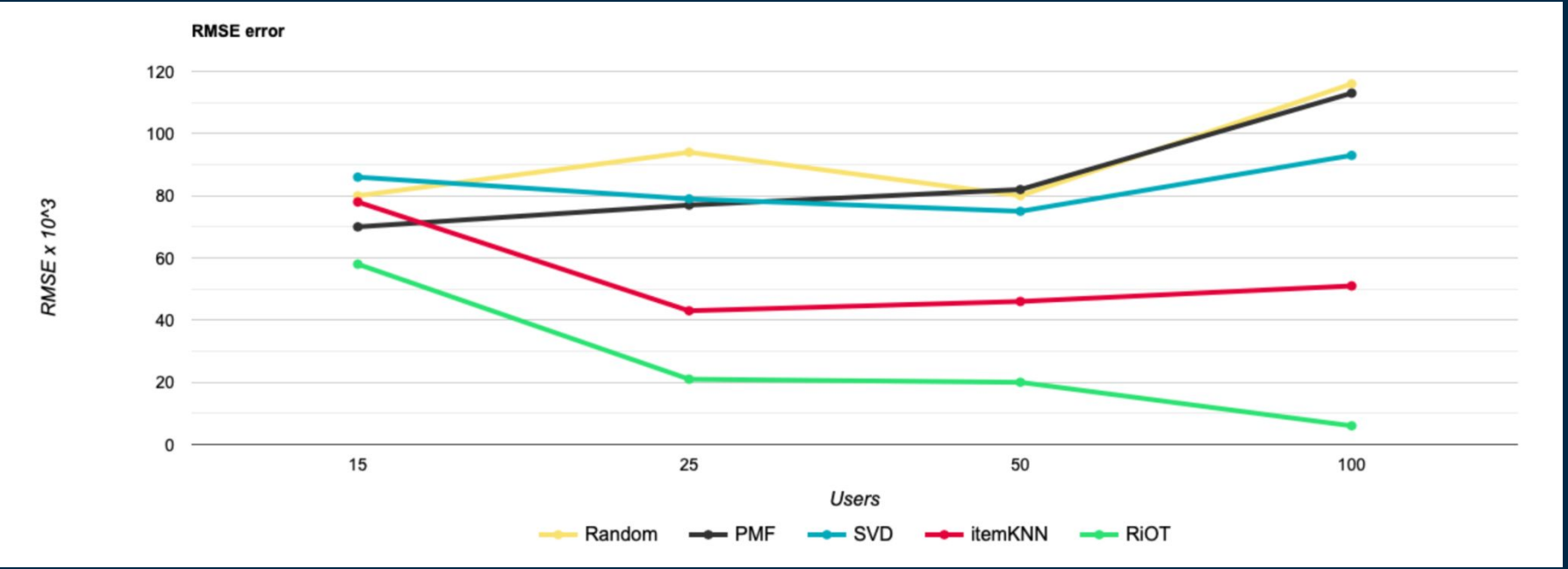
Movie groups

Features = users

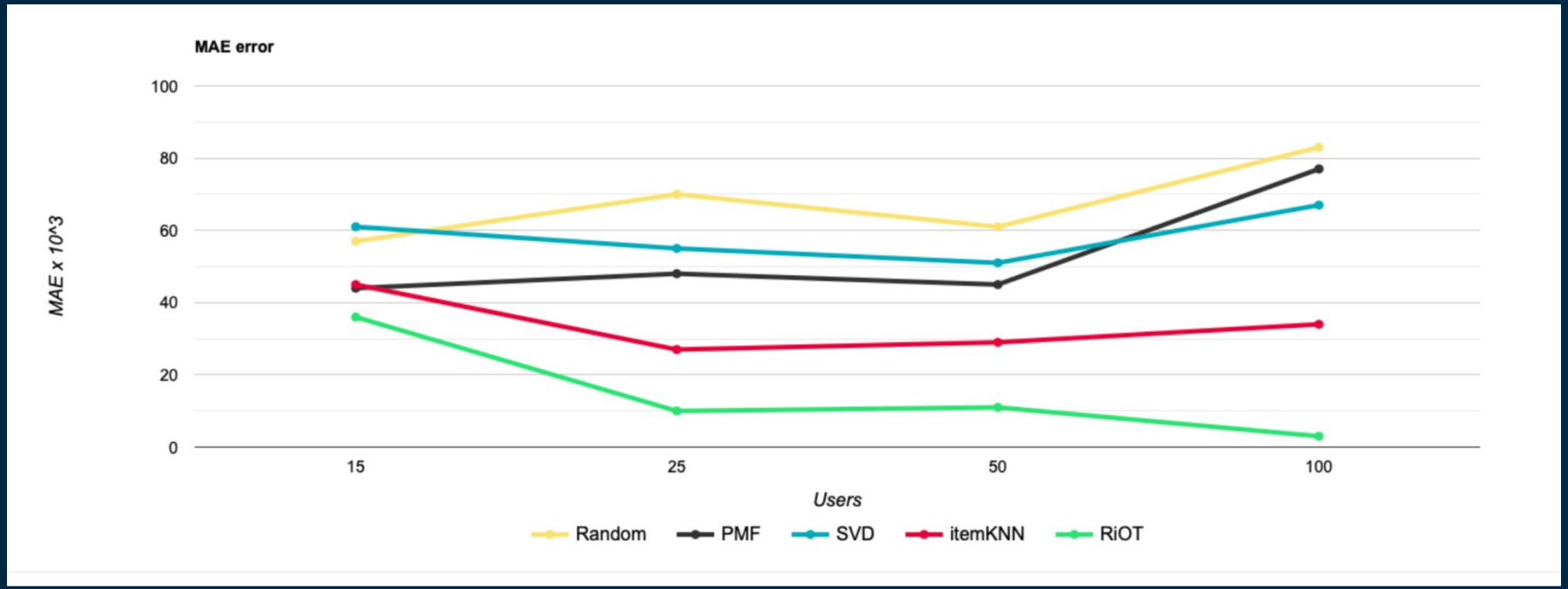
User groups

	4.5	2.0	
4.0		3.5	
	5.0		2.0
	3.5	4.0	1.0

RESULTS (2)


RMSE error
RMSE x 10^3
120
100
80
60
40
20
0
15
25
50
100
Users
Random
PMF
SVD
itemKNN
RiOT

RESULTS (3)


MAE error
100
80
60
40
20
0
MAE x 10^3
15
25
50
100
Users
Random
PMF
SVD
itemKNN
RiOT

Thanks !

Dauphine | PSL
UNIVERSITÉ PARIS

Références

- LI, Ruilin, YE, Xiaojing, ZHOU, Haomin, et al. Learning to match via inverse optimal transport. Journal of machine learning research, 2019, vol. 20.
- STUART, Andrew M. et WOLFRAM, Marie-Therese. Inverse optimal transport. SIAM Journal on Applied Mathematics, 2020, vol. 80, no 1, p. 599-619.