Measuring Individual User Fairness with User Similarity and Effectiveness Disparity

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ADD algorithms data & democracy

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Individual fairness for users

=

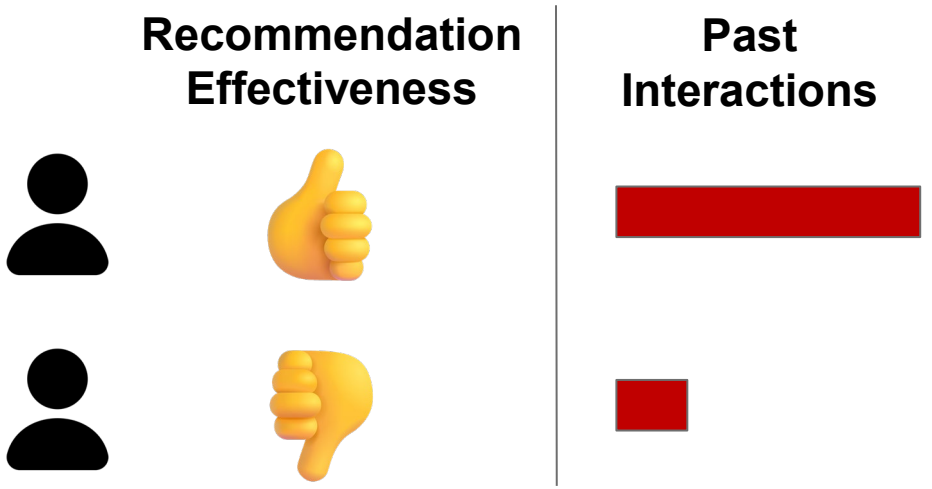
similar treatment for (similar) individual users

Cynthia Dwork, Moritz Hardt, Toniann Pitassi, Omer Reingold, and Richard Zemel. 2012. Fairness through awareness. In ITCS 2012 - Innovations in Theoretical Computer Science Conference. 214–226. https://doi.org/10.1145/2090236.2090255

User-side Individual Fairness in Recommender System: Definition #1

Different Effectiveness = Unfair

User-side Individual Fairness in Recommender System: Definition #1



Different amount of data →
Different performance

Different Effectiveness = Unfair

Problem #1: no consideration for **user similarity** (based on past interactions)

User-side Individual Fairness in Recommender System: Definition #2

Similar Recommendations for **Similar Users = Fair**

User-side Individual Fairness in Recommender System: Definition #2

similar recommendations
≠ equal satisfaction

Similar Recommendations for **Similar Users = Fair**

Problem #2: no consideration for **effectiveness disparity**

New Evaluation Measure for User-side Individual Fairness in Recommender Systems

Fairness Measure	Effectiveness Disparity	User Similarity
Standard deviation	✓	-
Gini index	✓	-
Envy-based measures	✓	-
UF	-	✓
PUF (our measure)	✓	✓

Similar Effectiveness for **Similar Users = Fair**

Our contribution: Pairwise User unFairness (PUF)

$$\text{PUF} = \frac{2}{m(m-1)} \sum_{u \in U} \sum_{u' \in U \setminus \{u\}} sim(u, u') \times |S(u) - S(u')|$$

average across all user pairs

User Similarity

Effectiveness Disparity

Lower PUF score is fairer

HIGH	×	**LOW**	➡	**LOW (FAIR)**
LOW	×	**HIGH**	➡	**LOW (FAIR)**
LOW	×	**LOW**	➡	**LOW (FAIR)**
HIGH	×	**HIGH**	➡	**HIGH (UNFAIR)**

Key Findings from Experimental Results

1. Existing fairness measures **cannot be used as a proxy** for PUF

2. PUF **captures** varying levels of effectiveness and user similarities

3. PUF **correctly** scores close to the fairest for the most fair case

Paper

Thank you!