
Fair Ranking Metrics

Amifa Raj



16th ACM Conference on Recommender Systems
Seattle, WA, USA, 18th-23rd September 2022



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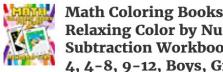
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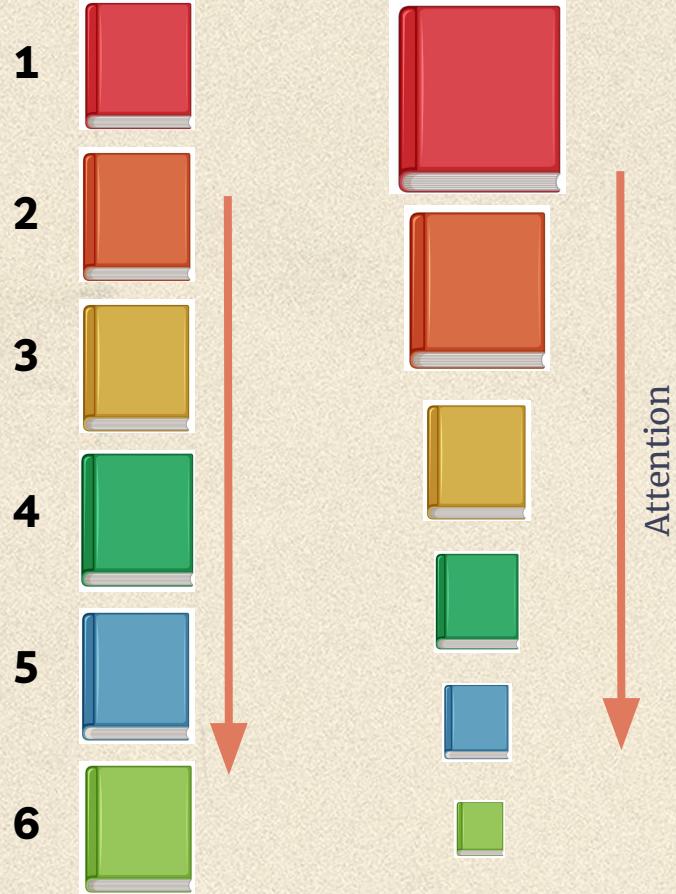
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2



High-Level Research Question

How to measure fairness in ranking of information access systems (IAS)?



Fairness Positioning

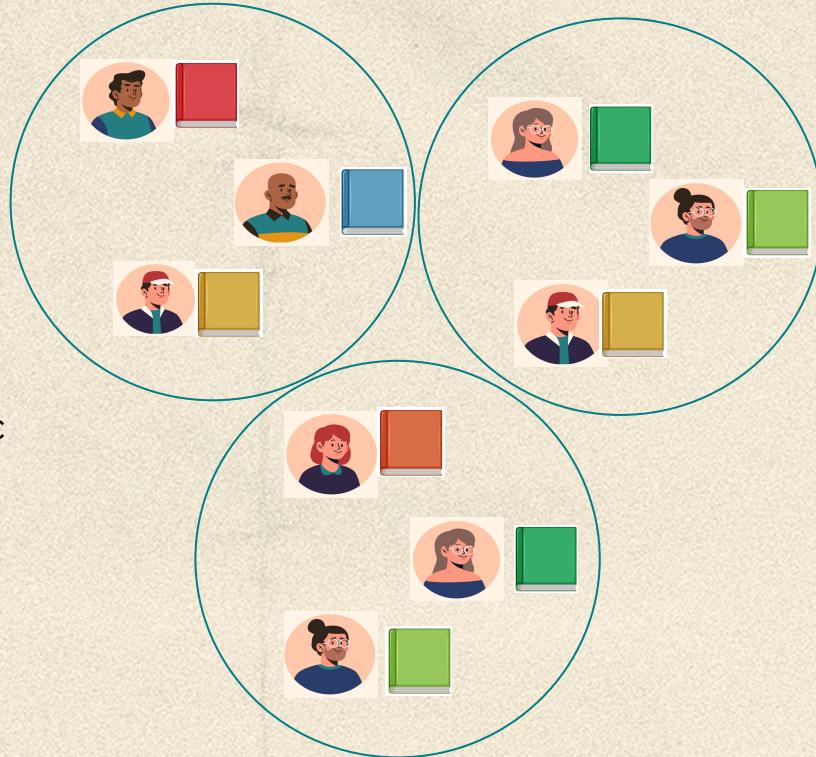


Age
Gender



Geography

Race
Economic status



Provider Fairness

Group Fairness

Research Goal



Provide comprehensive and comparative analysis of fair ranking metrics research



Contribute to the advancement of fair ranking metrics

Expanding applicability of fair ranking metric

Bias in relevance

Fair Ranking Metrics Resources

PreF Δ

(Yang et. al.; SSDBM '17):

EEL, EED, EER

Diaz et.al.; CIKM'20)

IAA

(Biega et. al.; SIGIR'18)

AWRF

(Sapienzynski et. al.; WWW'19)

FAIR

(Zehlike et.al.; CIKM'17)

DP, EUR, RUR

(Singh et.al.; KDD'18)





Fairness Goal

What does it mean to be fair?

Browsing Model

How to measure position weight?

Browsing Models

patience parameter

visiting probability exponentially decreases with position
RBP

stopping probability

visiting probability exponentially decreases with position
Geometric

patience parameter
stopping probability

visiting probability depends on relevance of visited items
Cascade

visiting probability logarithmically decreases with position
Logarithmic



Fairness Goal

What does it mean to be fair?

Browsing Model

How to measure position weight?

Target Exposure

Compare system exposure
with what?

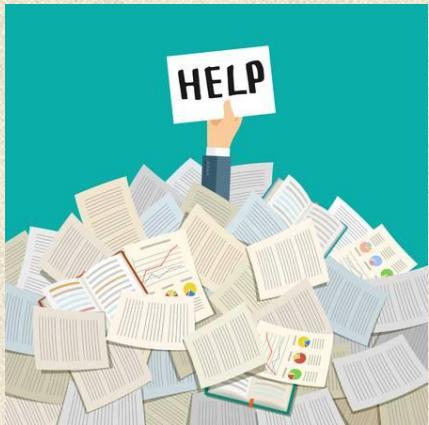
Relevance

How to incorporate relevance?

Group Membership

Does it allow multinomial
and soft group association?

What is the Problem?



Several fair ranking metrics



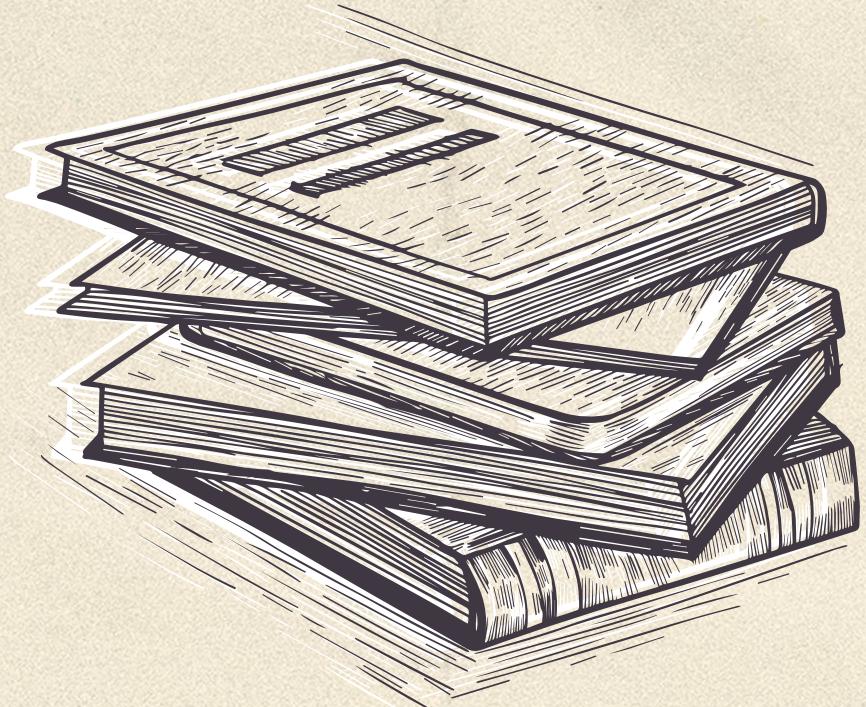
Finding suitable metrics



Comparison among the metrics

01

Analyzing Fair Ranking Metrics



Current Stage

2019

Raj, A., Wood, C., Montoly, A., & Ekstrand, M. D. (2020). Comparing fair ranking metrics. 3rd FAccTRec Workshop: Responsible Recommendation at RecSys 2019 arXiv:2009.01311



2022

Raj, A., & Ekstrand, M. D. (2022, July). Measuring Fairness in Ranked Results: An Analytical and Empirical Comparison. In *Proceedings of the 45th International ACM SIGIR Conference on Research and Development in Information Retrieval* (pp. 726-736) DOI 10.1145/3477495.3532018



Contribution

01

Describe and compare rank-fairness metrics in unified framework

02

Identify gaps between their original presentation and the practicalities of applying them to IAS

03

Direct comparison of their outcomes with same data and experimental setting

04

Sensitivity analysis to assess the impact of design choices and external factors on these metrics

Fairness Definition

Item position should not be affected by group membership

Exposure/attention should be proportional to relevance



Key Findings

Defining metrics in unified framework

- Metrics are conceptually similar with common components like **relevance, browsing model, aggregation, target exposure**

Implement the metrics in same experimental setup

- Missing data, missing relevance information, ranked list size are crucial/delicate factors in implementing metrics.

Sensitivity Analysis

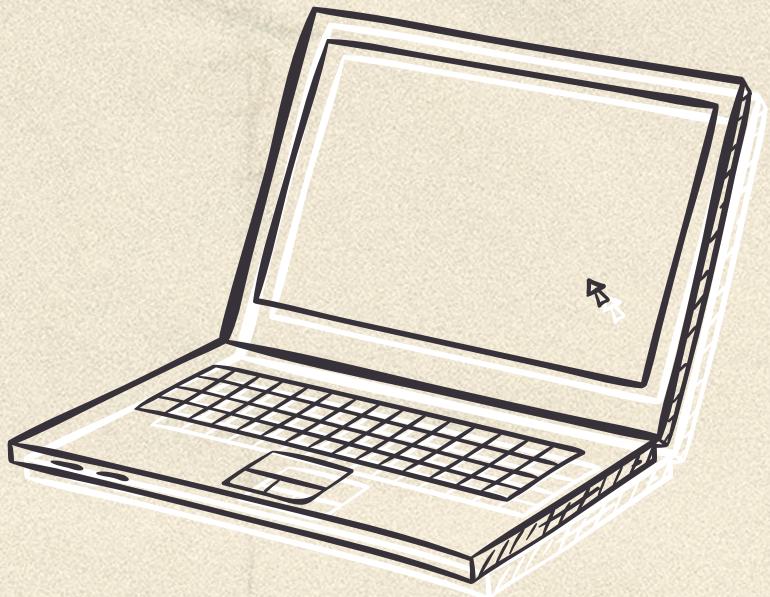
- Metrics differ in their sensitivity towards external factors.
- High sensitivity towards design choices add complexity in the usability of metrics

Simulation Study (in-progress)

Better understand the impact of these factor like

- relevance-set size
- group distribution, and
- missing relevance information

on metric implementation and outputs



Advancement of fair ranking metrics



Browsing
Models

Expanding Applicability of
Fair Ranking Metric

Expand beyond linear ranking

Relevance

Bias in Relevance

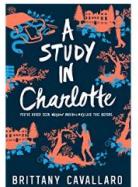
Incorporate existing social
bias in relevance



02

Expanding Applicability of Fair Ranking Metric

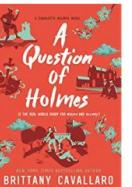
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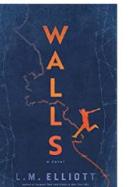
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Why Grid-Browsing Model?



Fair Ranking Metrics for
Linear Ranking Models



Research on user behavior
analysis in grid-based UI is
focused on image search



No comprehensive analysis
on types of grid-based
browsing model in IAS



Research Agenda



Identify suitable relevance and attention model for grid-based item recommendation and search results

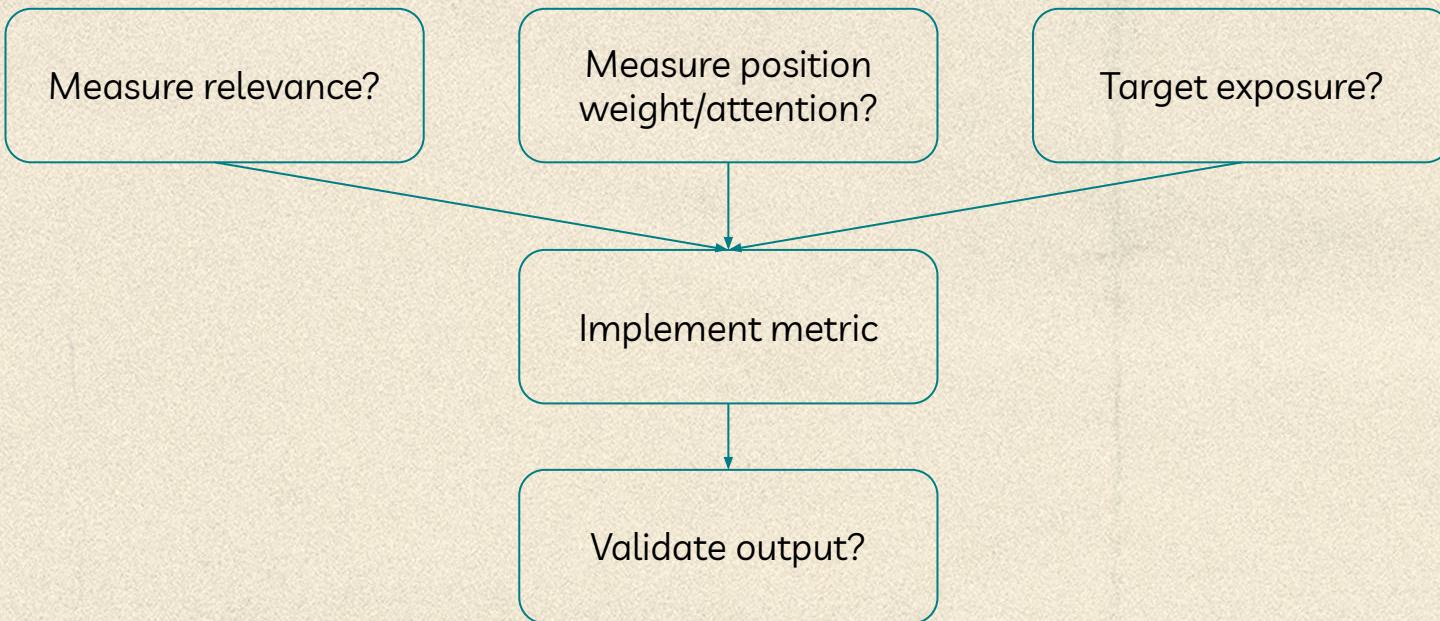


Design a metric to measure fairness in grid-based ranking



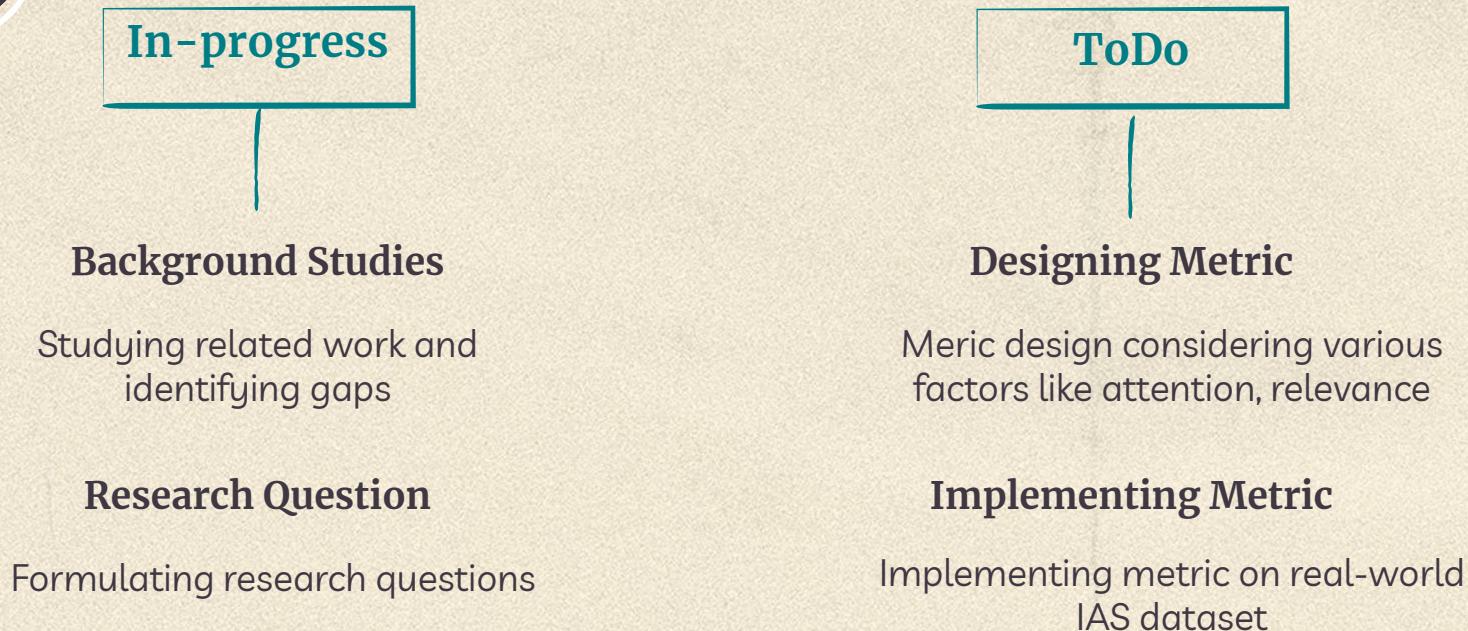
Potential Metric Design

Fairness Goal: Exposure should be proportional to relevance





Current Stage

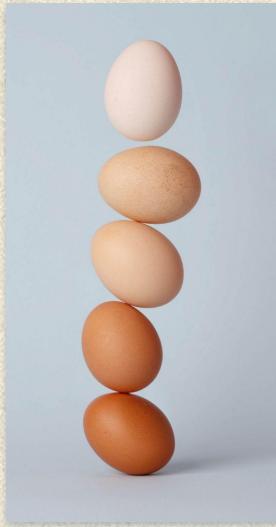


03

Bias in Relevance



Metrics Reliability

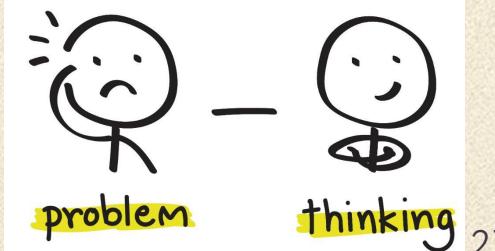


QUESTION?
Is the ranking
actually fair?

Social bias in relevance

Research Goal

Better understand how to measure fairness
when there exists bias in relevance



Research Contribution

The comprehensive and comparative analysis of existing fair ranking metrics

- Provide insights on the fairness goal, assumptions, and applicability of fair ranking metrics
- Provide potential research direction to improve the metrics by considering the limitations
- Aid researchers and practitioners finding suitable metrics

Incorporating different browsing models in metrics design

Broaden the usability of fair ranking metrics and identify the potential challenges

Acknowledging social bias in relevance

Help to consider historical bias while measure fairness in ranking

Feedback?

- Research design
 - Browsing model
 - Simulation Study

Thank You!

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Thanks

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