

Debiasing Career Recommendations with Neural Fair Collaborative Filtering

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In Proceedings of the Web Conference (WWW) (accepted, in press), 2021



Motivation

- Fairness in artificial intelligence and machine learning
- Social media data-based personalized recommendations
 - As long as **bias issues are adequately countered**

Search Query	Work Experience	Education Experience	Candidate	Xing Ranking
Brand Strategist	146	57	male	1
Brand Strategist	327	0	female	2
Brand Strategist	502	74	male	3
Brand Strategist	444	56	female	4
Brand Strategist	139	25	male	5
Brand Strategist	110	65	female	6
Brand Strategist	12	73	male	7
Brand Strategist	99	41	male	8
Brand Strategist	42	51	female	9
Brand Strategist	220	102	female	10
...				
Brand Strategist	3	107	female	20
Brand Strategist	123	56	female	30
Brand Strategist	3	3	male	40

Job platform XING

P. Lahoti, K. Gummadi, and G. Weikum. 2019, ICDE, 2019

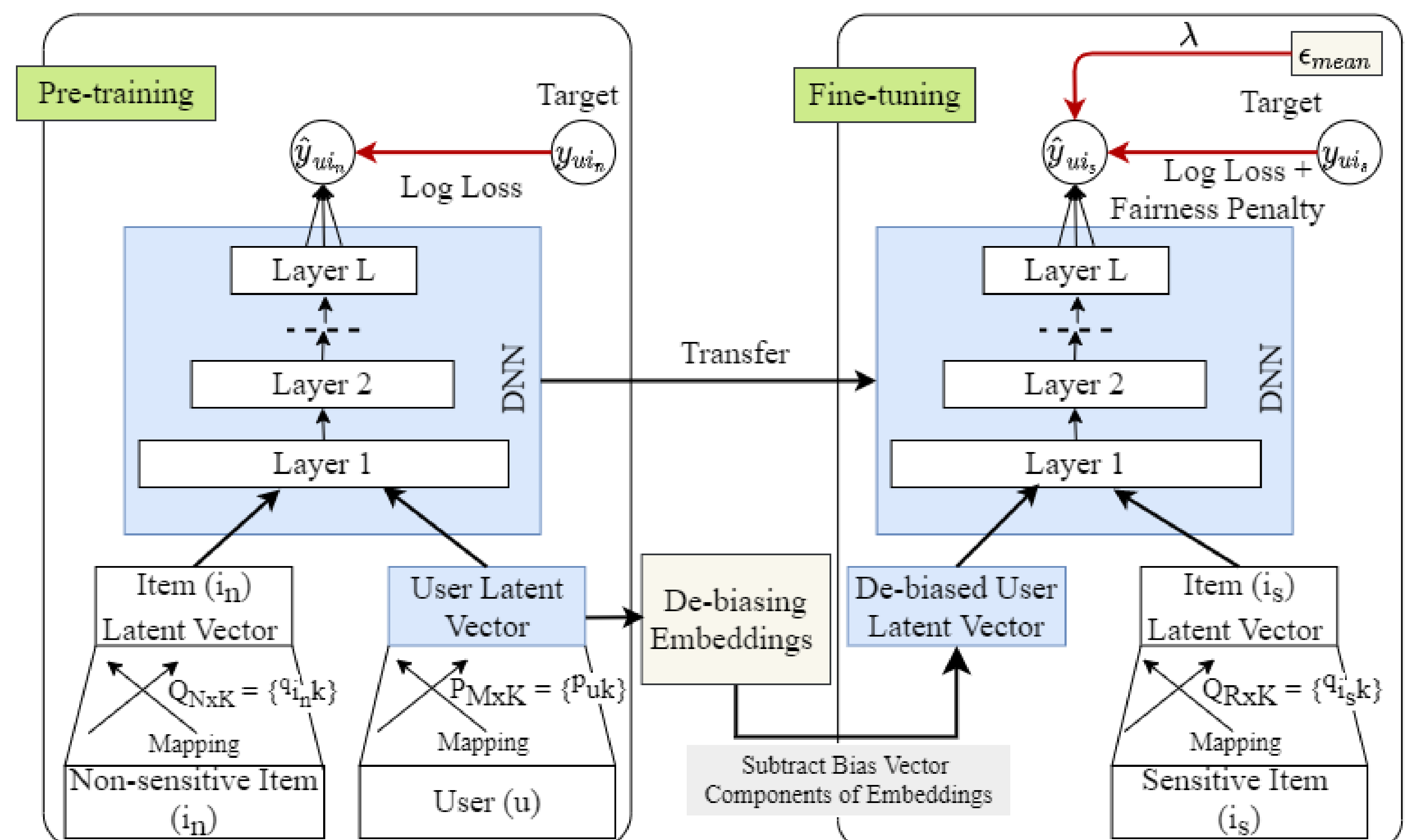
- In 2010, **women accounted for only 18%** of the degrees awarded in computer science

S. Broad and M. McGee, Association Supporting Computer Users in Education, 2014

Interventions to bridge this gap are crucial to support the economic competitiveness and level of innovation

Neural Fair Collaborative Filtering (NFCF)

- We envision an ML-based fair career counseling tool

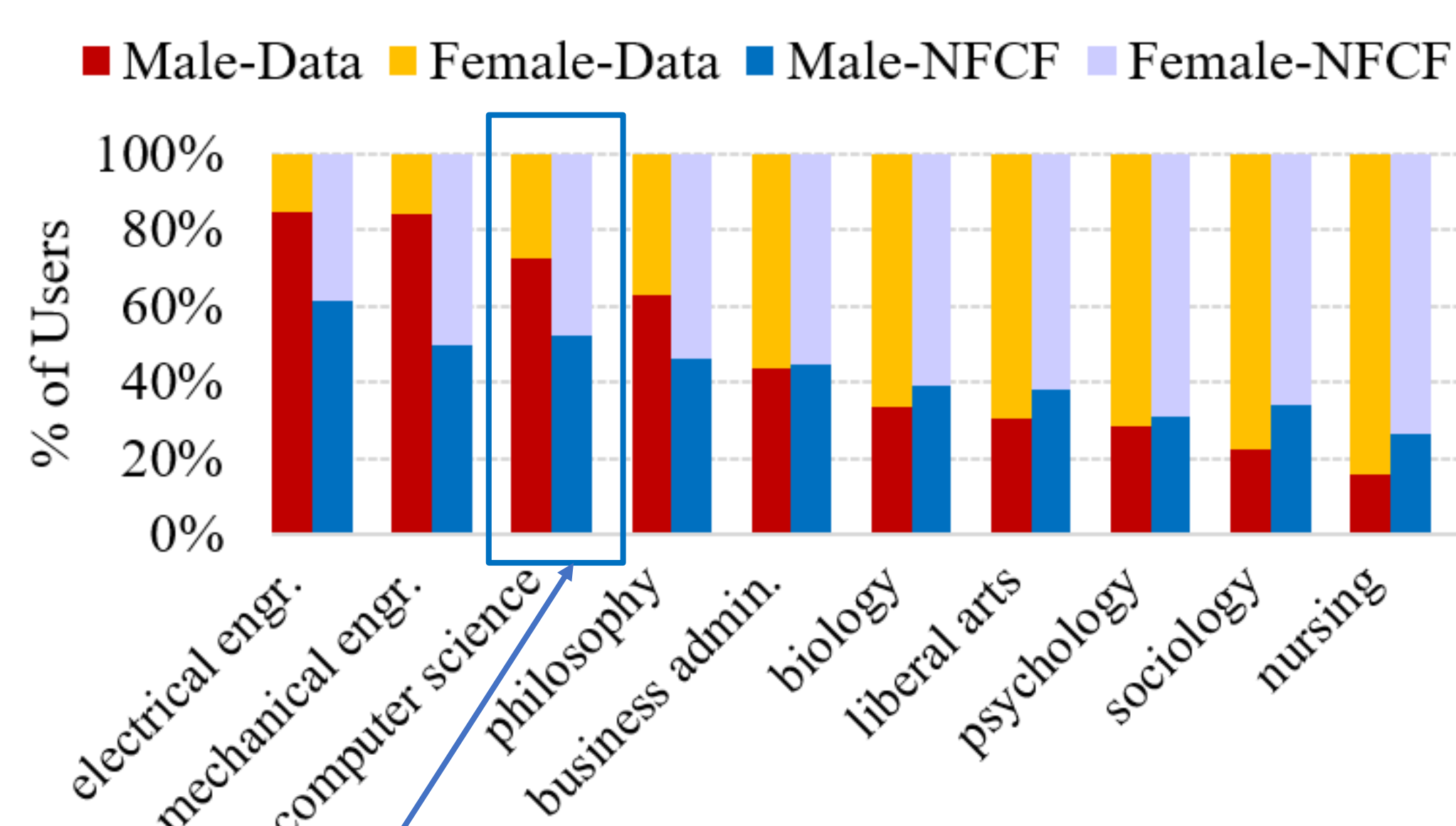


A practical framework for mitigating gender bias in recommending career, e.g., **jobs**, **academic concentrations**, or **courses of study** using-

- a **pre-training and fine-tuning** approach
- augmented with **bias correction** techniques.

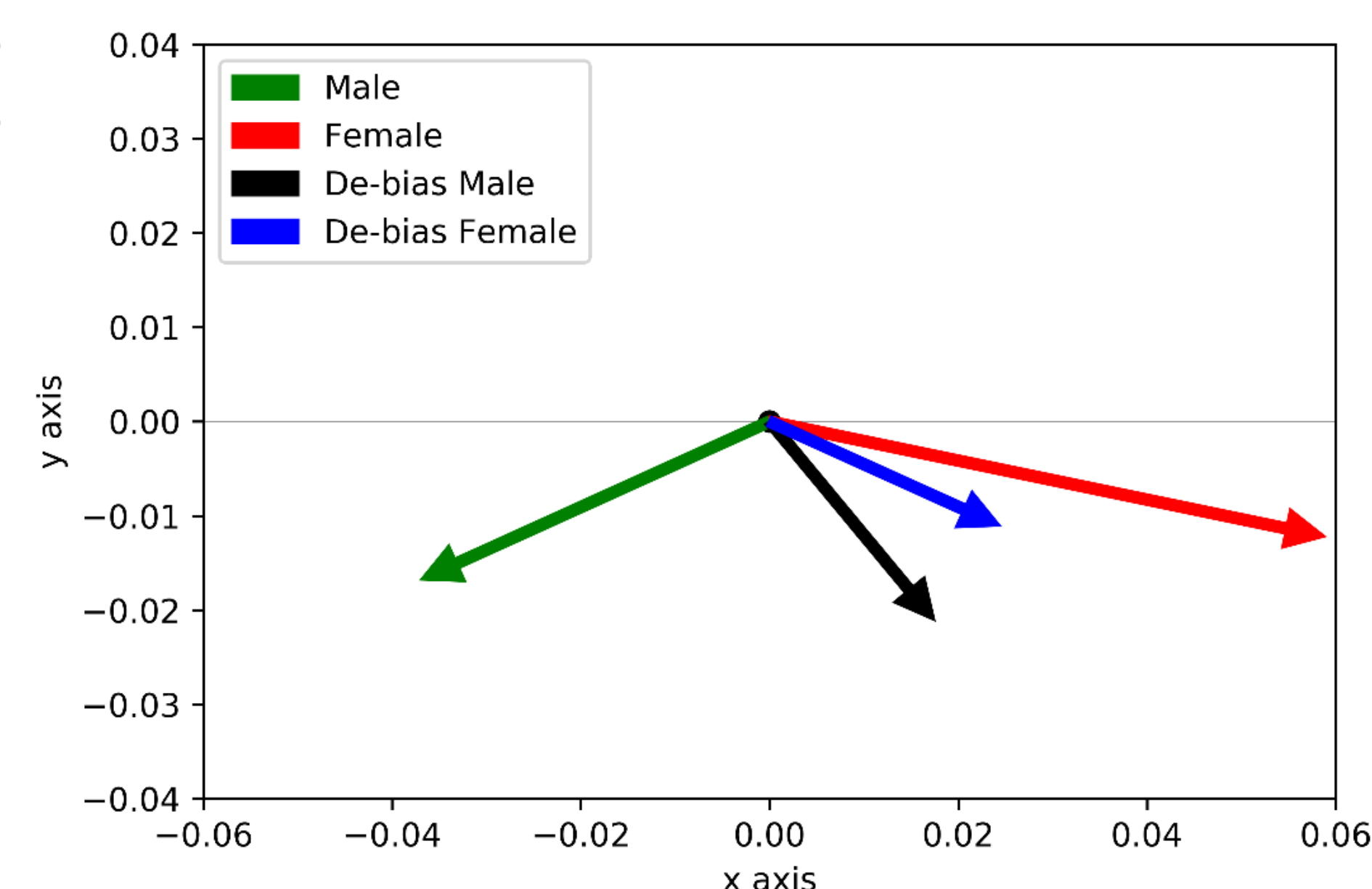
Validation of NFCF Model Design

Gender Distributions for Facebook Data



NFCF increased the percentage of women from 27% to 48%

Similar results on MovieLens Data



Visualization of Embedding De-biasing

Facebook Dataset

Ablation study	HR@10 ↑	NDCG@10 ↑	ϵ_{mean} ↓	U_{abs} ↓
NFCF	0.551	0.326	0.302	0.024
w/o pre-train	0.339	0.127	0.613	0.038
w/o de-biasing embeddings	0.556	0.328	0.314	0.024
w/o fairness penalty	0.557	0.327	0.363	0.026
replace NCF w/ MF	0.297	0.112	0.880	0.071

Ablation Study

A large degradation of the performance of NFCF

- If a component is removed/replaced

Facebook

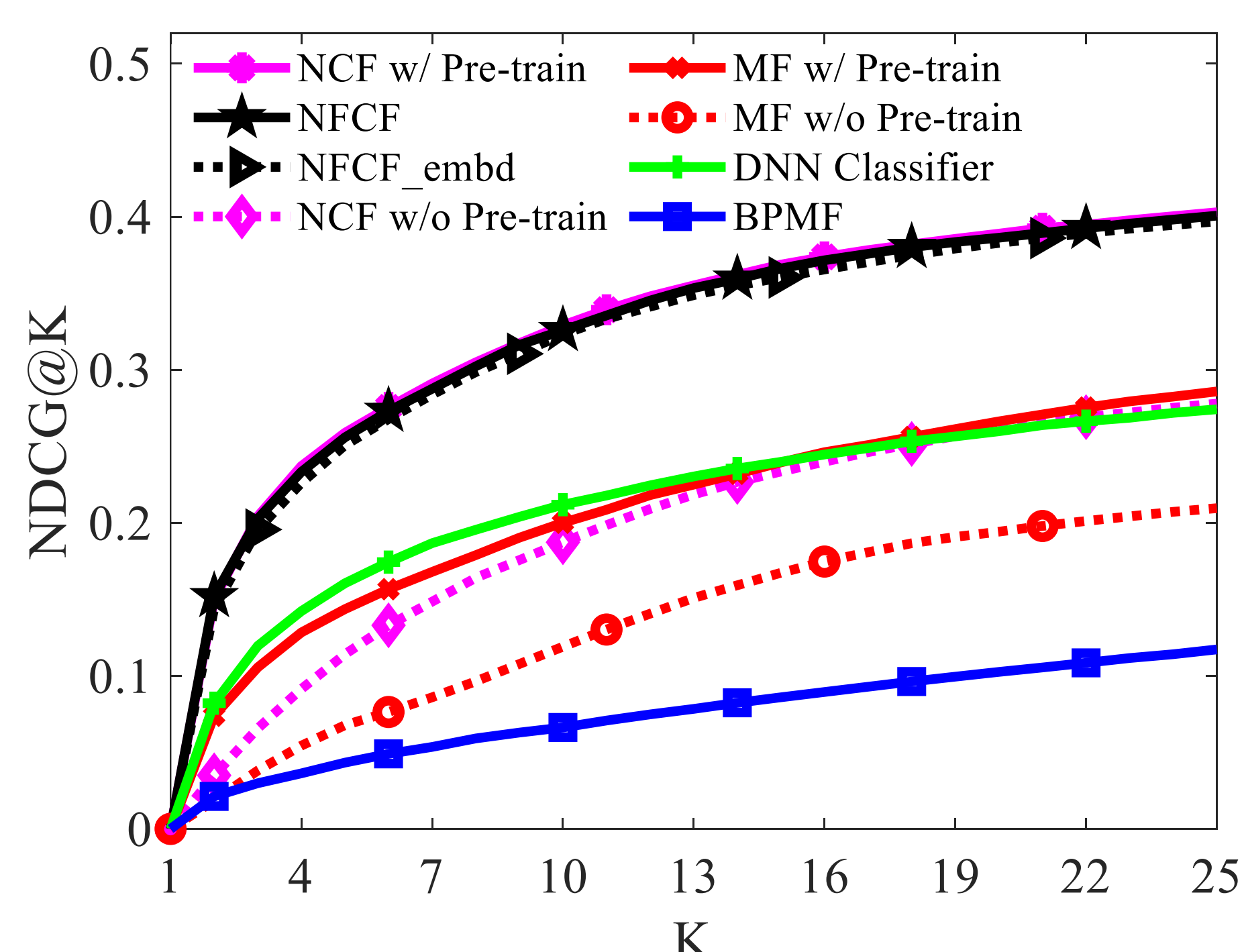
- Non-sensitive: *Facebook Pages*
- Sensitive: *Academic Majors*

MovieLens

- Non-sensitive: *Movies*
- Sensitive: *Occupations*

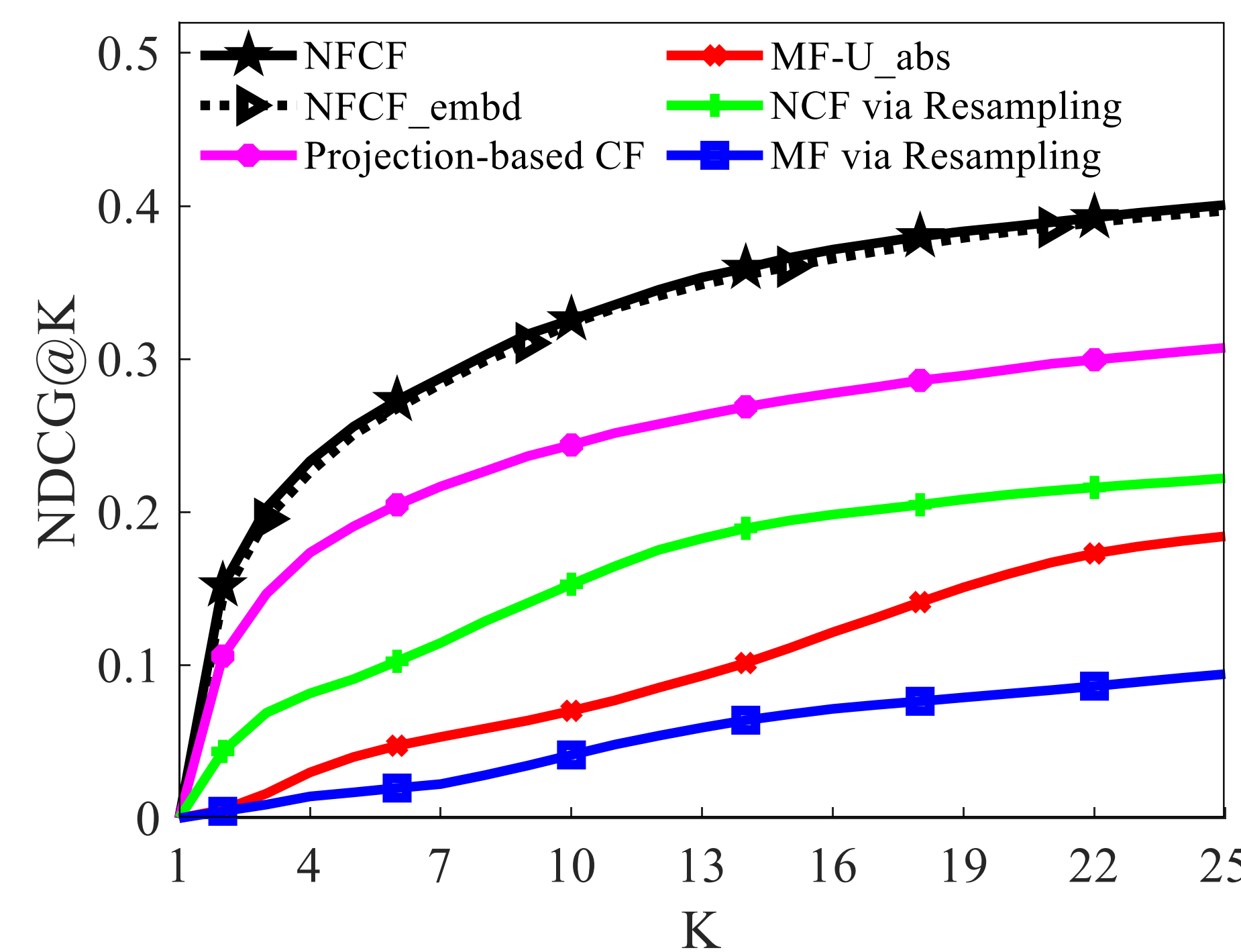
Performance for Mitigating Gender Bias in Career Recommendations

Comparison with typical baselines



Approximately similar to best performing typical model

Comparison with fair baselines



Outperformed all fair baselines

Career Recommendations

Facebook Dataset			
NFCF		NCF w/o Pre-train	
Male	Female	Male	Female
psychology	psychology	philosophy	psychology
english literature	english literature	psychology	nursing
graphic design	music	computer science	sociology
music	theatre	biochemistry	graphic design
nursing	nursing	business admin.	business marketing
liberal arts	history	political science	elementary education
business admin.	sociology	business management	cosmetology
biology	liberal arts	medicine	accounting
history	business admin.	law	physical therapy
criminal justice	biology	finance	music

Recommended similar careers

societal stereotypes

Check out our WWW-21 paper for more experimental results and details of NFCF algorithm!

NFCF achieved better performance and fairness compared to an array of state-of-the-art baseline models