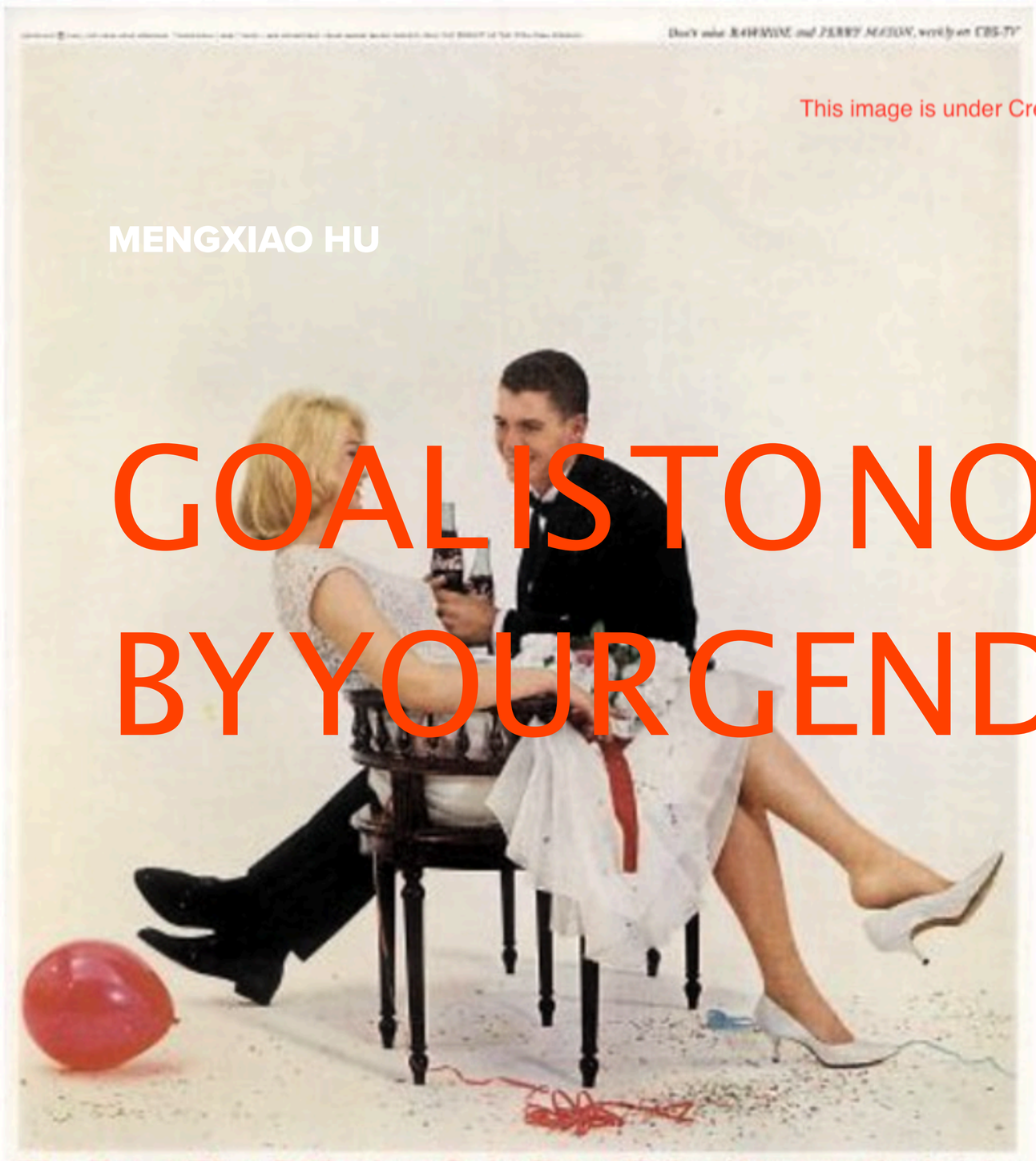
MENGXIAO HU

GOAL IS TO NOT RATE YOU BY YOUR GENDER OR RACE

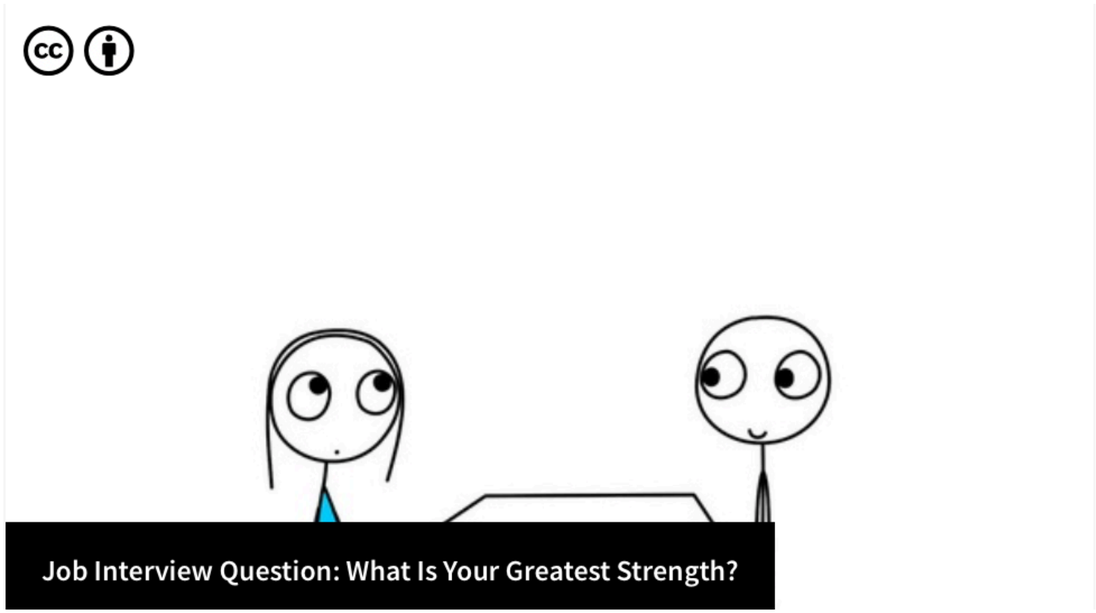


HAVE YOU EVER BEEN ANNOYED BY:

BEING ALLOCATED A DIFFERENT LIMIT OF A CREDIT CARD OR
FINDING YOUR COLLEAGUES GOT HIGHER PAID OR
BEING AVOIDED TO SEAT BY IN A BUS.

Mostly because you are a female or black?

THE BAD THING IS THAT EVEN AI LEARNS TO JUDGE PEOPLE BY THEIR APPEARANCE



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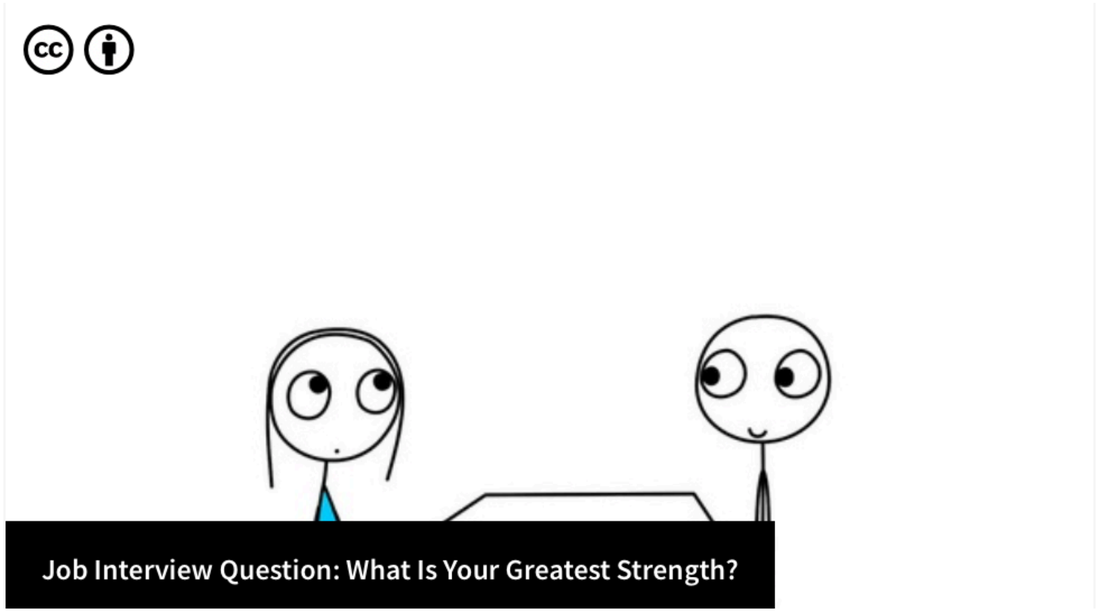
Jeffrey Dastin

8 MIN READ

SAN FRANCISCO (Reuters) - Amazon.com Inc's (AMZN.O) machine-learning



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Healthcare IT News

AI bias may worsen COVID-19 health disparities for people of ...

"If not properly addressed, propagating these biases under the mantle of AI has the potential to exaggerate the health disparities faced by ...

3 weeks ago

THE GOOD THING IS THAT WE ARE SOLVING IT

Axios

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Identity-verification startup Onfido is training its machine-learning system to reduce the bias that leads AI to make more facial recognition errors ...

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For example, in Zhao's work:

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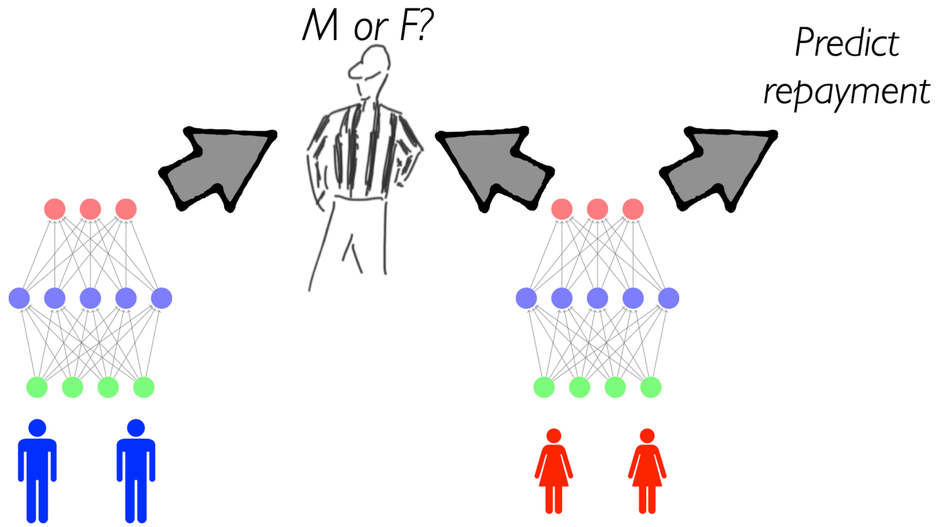
https://hanzhaoml.github.io/papers/ICLR2020/cfair_slides.pdf



They gave many forms of fairness...

https://hanzhaoml.github.io/papers/ICLR2020/cfair_slides.pdf

Definition	Paper	Citation #
Group fairness or statistical parity	[12]	208
Conditional statistical parity	[11]	29
Predictive parity	[10]	57
False positive error rate balance	[10]	57
False negative error rate balance	[10]	57
Equalised odds	[14]	106
Conditional use accuracy equality	[8]	18
Overall accuracy equality	[8]	18
Treatment equality	[8]	18
Test-fairness or calibration	[10]	57
Well calibration	[16]	81
Balance for positive class	[16]	81
Balance for negative class	[16]	81

[Verma et al. 18]

We have many works to do:

- When do we use them?
- Can we generalize them into fewer ones?
- How to design algorithms with them?

In Zhao's work:

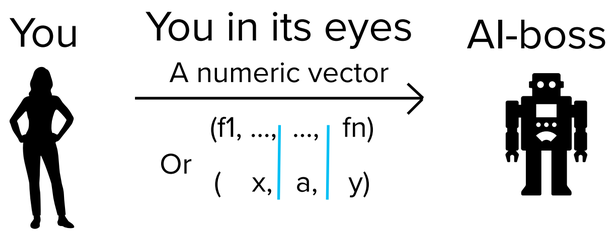
- Are they consistent?
- At least some of them?

IN REPRESENTATION LEARNING CONTEXT,

- **He found two definitions of fairness are not inconsistent;**

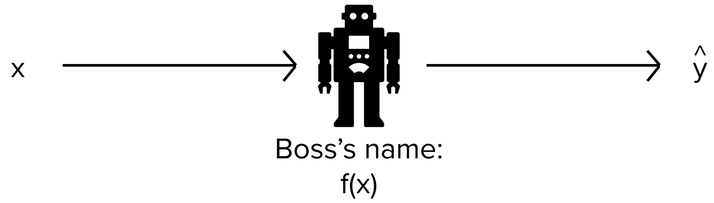
Because the objective function he proposed simultaneously ensured them.

IT CAN REDUCE THE BIAS OF AN AI-BOSS'S DECISIONS ON YOUR WAGES, BUT HOW...



a: gender
y: biased wage
x: other features

For fairness, 'a' is hidden for decisions



Suppose: $(X, A, Y) \sim \mathcal{D}$

- **Equalized odds:** $\hat{Y} \perp A \mid Y$
- **Accuracy parity:** $\mathrm{err}(\hat{Y}) \perp A$

- He found these two definitions of fairness are not inconsistent;

SO, WE CAN NOT TRADE FAIRNESS FOR ACCURACY!

IT IS IMPOSSIBLE IF WE USE ANOTHER FORM OF FAIRNESS

- Demographic parity*: $\hat{Y} \perp A$

BECAUSE DP IS NOT CONSISTENT WITH AP

$\varepsilon_{A=0}(h) + \varepsilon_{A=1}(h) \geq \Delta_{\mathrm{BR}}$ [Zhao and Gordon, NeurIPS 19]

$\Delta_{\mathrm{BR}} := |\Pr(Y = 1 \mid A = 0) - \Pr(Y = 1 \mid A = 1)|$

*Also called statistical parity.

HE PROPOSED A NEW METRIC TO SIMULTANEOUSLY ENSURE EO AND AP!

$$\mathrm{BER}_{\mathcal{D}}(\widehat{Y} \mid\mid Y) := \mathcal{D}(\widehat{Y} = 0 \mid Y = 1) + \mathcal{D}(\widehat{Y} = 1 \mid Y = 0)$$

He showed that in some cases, EO is satisfied, the BER is the upper bound of Type-I and Type-II errors:

$$\mathrm{Err}_{\mathcal{D}_0}(\widehat{Y}) + \mathrm{Err}_{\mathcal{D}_1}(\widehat{Y}) \leq 2\mathrm{BER}_{\mathcal{D}}(\widehat{Y} \mid\mid Y)$$

That means we can minimize the BER to ensure the accuracy!

WHAT'S THE CASE?

$$\Pr_{A=0}(\widehat{Y} = 1 \mid Y = 0) \approx \Pr_{A=1}(\widehat{Y} = 1 \mid Y = 0)$$

And,

$$\Pr_{A=0}(\widehat{Y} = 0 \mid Y = 1) \approx \Pr_{A=1}(\widehat{Y} = 0 \mid Y = 1)$$

THE SECOND TERM IS ENCOURAGING THIS CASE:

$$\min_{h,g} \max_{h',h''} \quad \mathrm{BER}_{\mathcal{D}}(h(g(X)) \mid\mid Y) - \lambda \left(\mathrm{BER}_{\mathcal{D}^0}(h'(g(X)) \mid\mid A) + \mathrm{BER}_{\mathcal{D}^1}(h''(g(X)) \mid\mid A)\right)$$


THAT MEANS IT ENCOURAGES TO
SIMULTANEOUSLY MINIMIZE THE ERROR RATE
AND EO!

FAIR AND RIGHT WAGES ARE ENSURED