

# I 202: INFORMATION ORGANIZATION & RETRIEVAL FALL 2025

---

Class 26: Fairness and Bias in Automated Systems

# FINAL PROJECTS

- Updated Rubric Posted
- Pushed back the due date from Wed Dec 10 to Sat Dec 13!

# Today's Outline

What is Fairness / Bias?

Focus: Dataset Creation

Focus: ML Algorithms

Fairness / Bias in Search Ranking

# Two Readings

The screenshot shows a web page from the Communications of the ACM. At the top left is the logo 'COMMUNICATIONS OF THE ACM'. To the right is a navigation bar with 'Explore Topics ▾'. Below the header, there's a dark button labeled 'PRACTICE' and a link 'Artificial Intelligence and Machine Learning Practice'. The main title 'Biases in AI Systems' is displayed in large, bold, black font. Below it, the subtitle 'A survey for practitioners.' is shown in a smaller, bold, black font. The authors 'By Ramya Srinivasan and Ajay Chander' are listed, along with the date 'Posted Aug 1 2021'.

**COMMUNICATIONS  
OF THE  
ACM**

Explore Topics ▾

PRACTICE Artificial Intelligence and Machine Learning Practice

**Biases in AI Systems**

A survey for practitioners.

By Ramya Srinivasan and Ajay Chander

Posted Aug 1 2021

Fairness  
and  
Machine  
Learning

Limitations and Opportunities

Solon Barocas, Moritz Hardt, and Arvind Narayanan

# WHAT IS FAIRNESS?

What does it mean for an algorithm/system to be “fair” or “unfair”?

# MANY CLOSELY RELATED TOPICS

- Fairness in **ranking**
  - *(job applicants, political search results)*
- Search results **representativeness**
  - *(exposure of diverse information)*
- Fairness in **automated classification**
  - *(recognizing demographics of people in images)*
- Fairness in application of algorithms to **real-world tasks**
  - *(recidivism risk assessments, assessing teachers, recommending advertisements)*
- Bias in **generative** language models
  - *(story generation, image generation)*

# SOME LEGAL DEFINITIONS

- **Protected groups:** Groups that are protected from discrimination by law, e.g., based on sex, race, age, disability, color, creed, national origin, or religion.
- **Disparate Treatment:** Intentional discrimination, where people in a protected class are deliberately treated differently.
- **Disparate Impact:** Unintentional discrimination, where the procedures are the same for everyone, but people in a protected class are negatively affected.

# WHAT IS BIAS?

What does it mean for an algorithm/system to be “biased” or “unbiased”?

## Bias in Computer Systems

BATYA FRIEDMAN  
Colby College and The Mina Institute  
and  
HELEN NISSENBAUM  
Princeton University

# WHAT IS BIAS?

**Bias:** “computer systems that systematically and unfairly discriminate against certain individuals or groups of individuals in favor of others.”

- **Preexisting bias** (arising from biases present in individuals or society),
- **Technical bias** (arising from technical constraints), and
- **Emergent bias** (unforeseen discriminatory outcomes arising in real use, often arises when an algorithm is used by an audience or in a context for which it was not designed)

They argue: “freedom from bias should be counted among the select set of criteria – including reliability, accuracy, and efficiency -- according to which the quality of systems in use in society should be judged.”

# TECHNICAL BIAS

- **Computer tools:**
  - e.g., in a database for matching organ donors with potential transplant recipients, certain individuals retrieved and displayed on initial screens are favored systematically for a match over individuals displayed on later screens
- **Decontextualized Algorithms Bias** that originates from the use of an algorithm that fails to treat all groups fairly under all significant conditions
  - e.g., a scheduling algorithm that schedules airplanes for take-off relies on the alphabetic listing of the airlines to rank order flights ready within a given period of time
- **Random Number Generation:**
  - e.g., an imperfection in a random-number generator used to select recipients for a scarce drug leads systematically to favoring individuals toward the end of the database.
- **Formalization of Human Constructs Bias** that originates from attempts to make human constructs such as discourse, judgments, or intuitions amenable to computers:
  - e.g., a legal expert system advises defendants on whether or not to plea bargain by assuming that law can be spelled out in an unambiguous manner that is not subject to human and humane interpretations in context

# FAIRNESS AND MACHINE LEARNING

## BOOK BY BAROCAS, HARDT, AND NARAYANAN

“Something … is lost in moving to automated, predictive decision making. Human decision makers rarely try to maximize predictive accuracy at all costs; frequently, they might consider factors such as whether the attributes used for prediction are morally relevant.”

“For example, although younger defendants are statistically more likely to re-offend, judges are loath to take this into account in deciding sentence lengths, viewing younger defendants as less morally culpable.”

# ADDRESSING BIAS IN REAL-WORLD APPLICATIONS

NEW YORK TIMES BESTSELLER



# WEAPONS OF MATH DESTRUCTION



HOW BIG DATA INCREASES INEQUALITY  
AND THREATENS DEMOCRACY

CATHY O'NEIL

A NEW YORK TIMES NOTABLE BOOK

Sept 2016

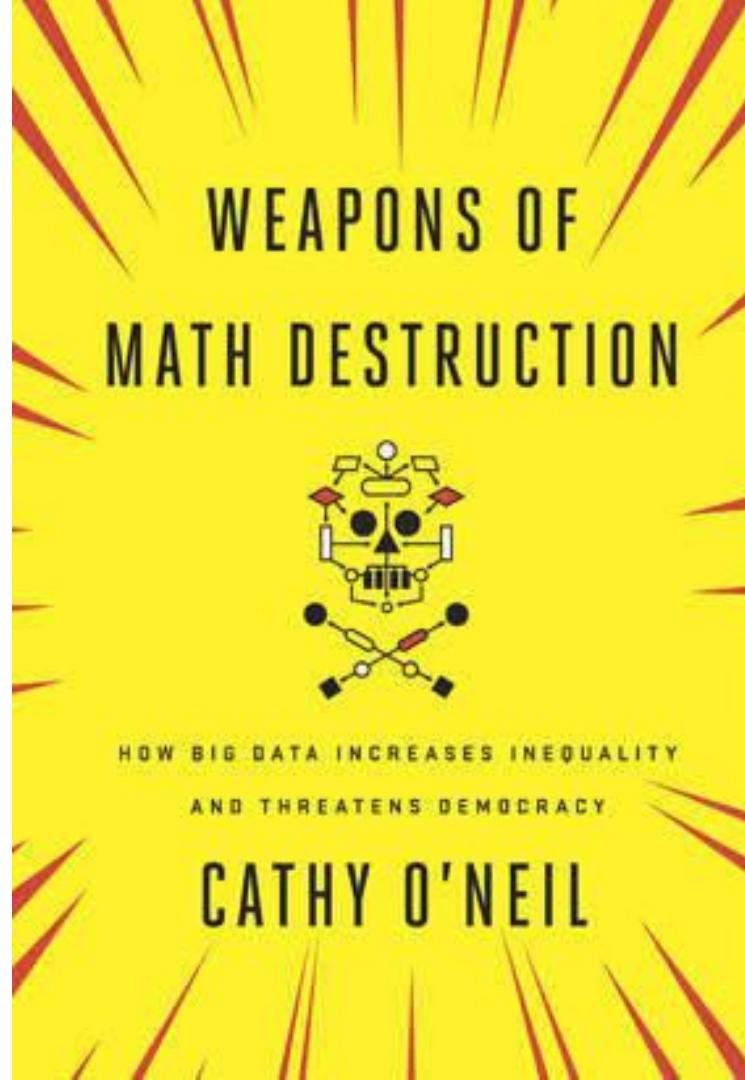
WMDs:

Measure what they can, not  
what they should

Do not adjust agilely to  
error

Not answerable, secret  
formula

Create their own reality



"Good" Model:  
baseball stats

WMD: US News College  
Rankings

# BIAS IN AUTOMATED CLASSIFICATION

Facial recognition algorithms trained on biased datasets led to under-recognition of protected

C

Proceedings of Machine Learning Research 81:1–15, 2018

Conference on Fairness, Accountability, and Transparency

## Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification\*

Joy Buolamwini

*MIT Media Lab 75 Amherst St. Cambridge, MA 02139*

JOYAB@MIT.EDU

Timnit Gebru

*Microsoft Research 641 Avenue of the Americas, New York, NY 10011*

TIMNIT.GEBRU@MICROSOFT.COM

2018



Joy Buolamwini | TEDxBeaconStreet

## How I'm fighting bias in algorithms



8:35



### Details

About the talk

### Transcript

22 languages

### Reading List

Further learning

### Footnotes

Notes + references

MIT grad student Joy Buolamwini was working with facial analysis software when she noticed a problem: the software didn't detect her face -- because the people who coded the algorithm hadn't taught it to identify a broad range of skin tones and facial structures. Now she's on a mission to fight bias in machine learning, a phenomenon she calls the "coded gaze." It's an eye-opening talk about the need for accountability in coding ... as algorithms take over more and more aspects of our lives.

*This talk was presented to a local audience at TEDxBeaconStreet, an independent event. TED's editors chose to feature it for you.*

**1,475,724** views

TEDxBeaconStreet | November  
2016

### Related tags

Activism

Algorithmic bias

Nov 2016

# Biased, Differential Ad Delivery

Ads related to Jill Schneider ⓘ

[Jill Schneider Art](#)

[www.posters2prints.com/](http://www.posters2prints.com/)

Custom Frame Prints and Canvas. Shop Now, SAVE Big + Free Shipping!

[We Found Jill Schneider](#)

[www.intelius.com/](http://www.intelius.com/)

Current Phone, Address, Age & More. Instant & Accurate Jill Schneider

10,256 people +1'd this page

[Reverse Lookup - Reverse Cell Phone Directory - Date Check - Property Records](#)

[Located: Jill Schneider](#)

[www.instantcheckmate.com/](http://www.instantcheckmate.com/)

Information found on Jill Schneider Jill Schneider found in database.

Ads related to latanya farrell ⓘ

[Latanya Farrell, Arrested?](#)

[www.instantcheckmate.com/](http://www.instantcheckmate.com/)

1) Enter Name and State. 2) Access Full Background Checks Instantly.

[Latanya Farrell](#)

[www.publicrecords.com/](http://www.publicrecords.com/)

Public Records Found For: Latanya Farrell. View Now.

# **FOCUS POINT: DATASET COLLECTION**

What kinds of biases can enter at this phase of machine learning?

# DATASET BIASES

- Sampling Bias
  - *Ex: More images of homes with lawns than without*
- Measurement Bias
  - *Ex: Camera settings for creating images*
- Label Bias
  - *Ex: Cultural differences in naming (e.g., grass vs lawn)*
- Negative Set Bias
  - *Ex: Missing images from non-dominant culture*

# Idea: Fix Bias in the Data Stage of the Pipeline

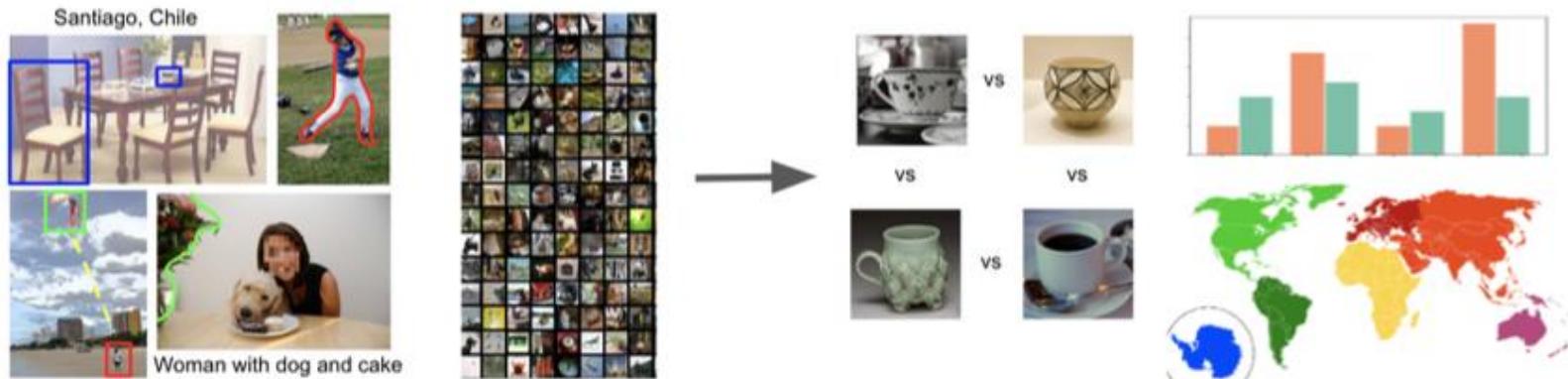


Fig. 1: Our tool takes in as input a visual dataset and its annotations, and outputs metrics, seeking to produce insights and possible actions.

Table 2: Gender-based summary: investigating representation of different genders

Metric	Example insight	Example action
Contextual representation	Males occur in more outdoors scenes and with <b>sports</b> objects. Females occur in more indoors scenes and with <b>kitchen</b> objects.	Collect more images of females in outdoors scenes with <b>sports</b> objects, and vice versa for males.
Interactions	In images with musical instrument <b>organ</b> , males are more likely to be actually playing the <b>organ</b> .	Collect more images of females playing <b>organs</b> .
Appearance differences	Males in <b>sports uniforms</b> tend to be playing outdoor sports, while females in <b>sports uniforms</b> are often indoors or in swimsuits.	Collect more images of each gender with <b>sports uniform</b> in their underrepresented scenes.
Gender label inference	When gender is unlikely to be identifiable, people in images are by default labeled as male.	Prune these gender labels from the dataset so as not to reinforce societal stereotypes.

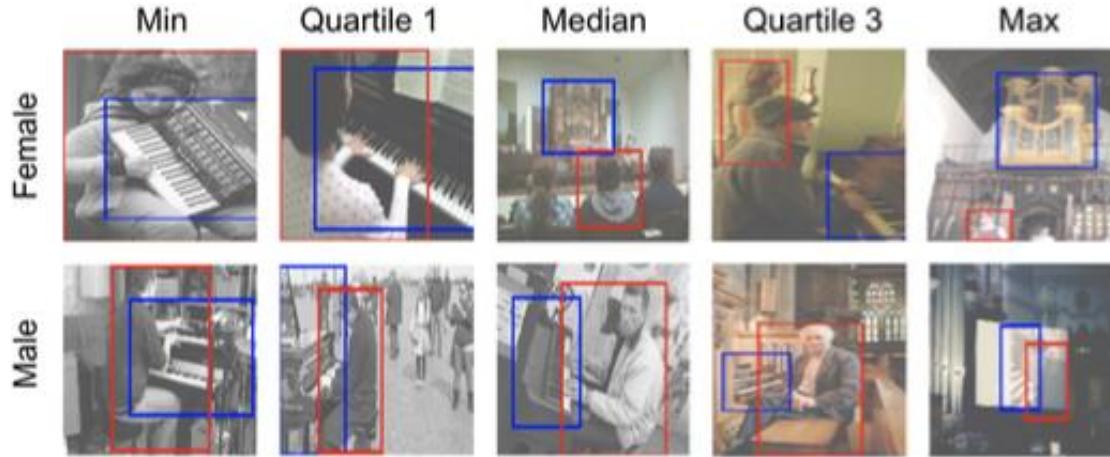


Fig. 4: 5 images from OpenImages for a person (red bounding box) of each gender pictured with an organ (blue bounding box) along the gradient of inferred 3D distances. Males tend to be featured as actually playing the instrument, whereas females are oftentimes merely in the same space as the instrument.

Table 3: Geography-based summary: looking into the geo-representation of a dataset, and how that differs between countries and subregions

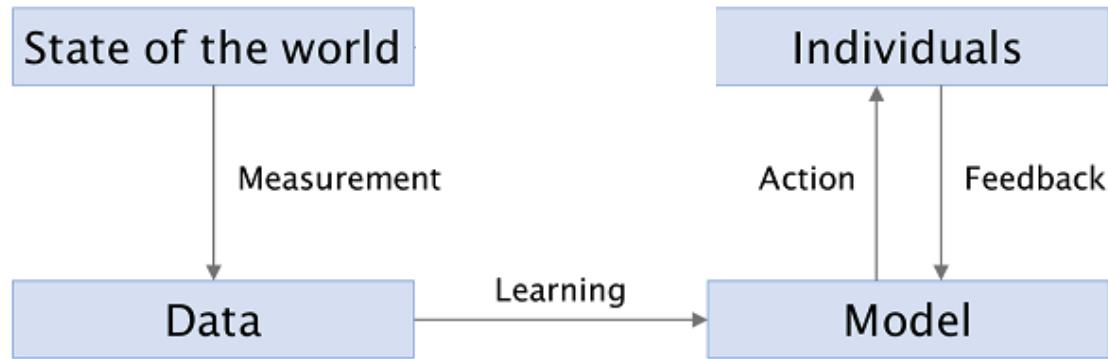
Metric	Example insight	Example action
Country distribution	Most images are from the USA, with very few from the countries of Africa	Collect more images from the countries of Africa
Local language analysis	Countries in Africa and Asia that are already underrepresented are frequently represented by non-locals rather than locals	Collect more images taken by locals rather than visitors in underrepresented countries
Tag counts, appearances	<b>Wildlife</b> is overrepresented in Kiribati, and <b>mosque</b> in Iran	Collect other kinds of images representing these countries

# FAIRNESS AND MACHINE LEARNING

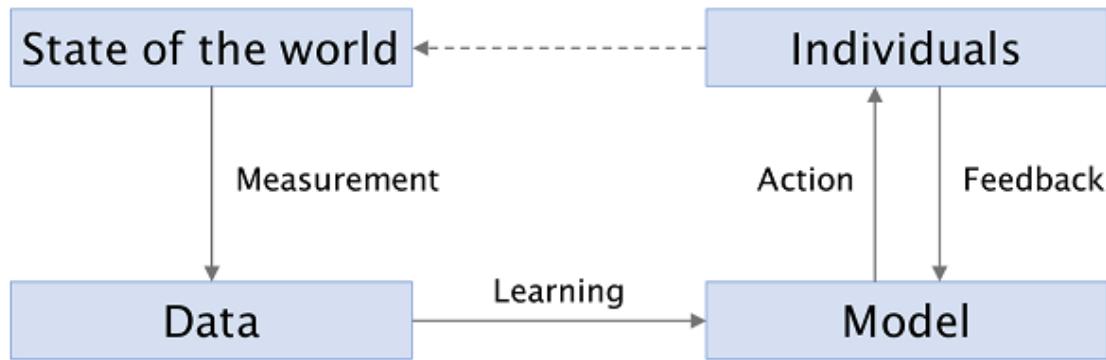
## BAROCAS ET AL.

“Is our goal to **faithfully reflect the data**? Or do we have an obligation to **question the data**, and to design our systems to conform to some notion of **equitable behavior, regardless of whether or not that’s supported by the data** currently available to us?”

# Machine Learning Feedback Loop



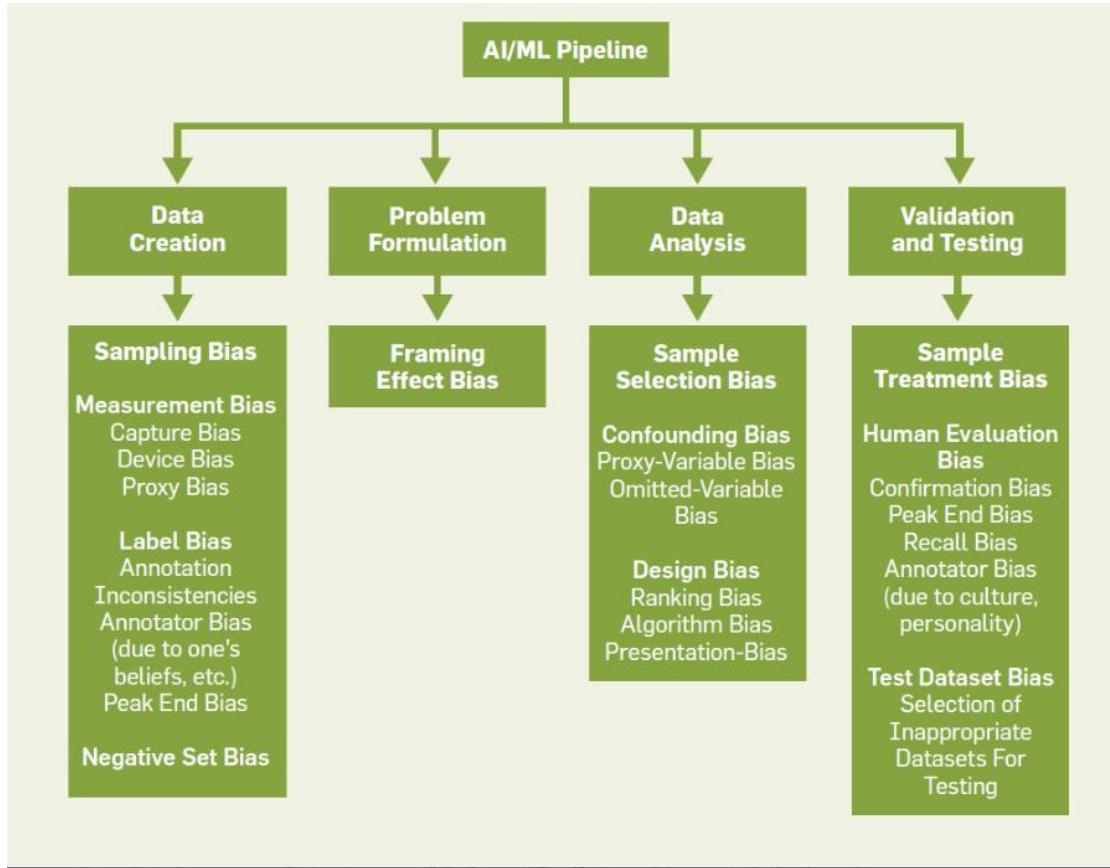
# Machine Learning Feedback Loop



Do we have to learn from data? Why do we?

Do we have to learn from human's reactions to models?  
Why do we?

# Taxonomy of Bias Types in AI Pipeline



## DEBIASING (BORACAS ET AL.)

“Most attempts to “debias” machine learning in the current research literature assume simplistic mathematical systems, often ignoring the effect of algorithmic interventions on individuals and on the long-term state of society.”

# Failed Diversification Attempt

## ***Google Chatbot's A.I. Images Put People of Color in Nazi-Era Uniforms***

The company has suspended Gemini's ability to generate human images while it vowed to fix the issue.



By [Nico Grant](#)

Nico Grant writes about Google and its related companies from San Francisco.

Published Feb. 22, 2024 Updated Feb. 26, 2024

“The company spent years assembling teams that tried to reduce any outputs from its technology that users might find offensive. Google also worked to improve representation, including showing more diverse pictures of professionals like doctors and businesspeople in Google Image search results. But now, social media users have blasted the company for going too far in its effort to showcase racial diversity.”

# 'We definitely messed up': why did Google AI tool make offensive historical images?



"Prabhakar Raghavan, Google's head of search, said in a [blog post last month](#): "So what went wrong? In short, two things. First, our tuning to ensure that Gemini showed a range of people failed to account for cases that should clearly *not* show a range. And second, over time, the model became way more cautious than we intended and refused to answer certain prompts entirely ... These two things led the model to overcompensate in some cases and be over-conservative in others, leading to images that were embarrassing and wrong."

## A REASON FOR OPTIMISM (BORACAS ET AL.)

“A reason for optimism is that the turn to automated decision-making and machine learning offers an opportunity to reconnect with the moral foundations of fairness. Algorithms force us to be explicit about what we want to achieve with decision-making.”

# SOME ADVANCES

- Datasheets and Factsheets
- Intentional data collection
- Algorithms as aids, but not decision makers
- Transparency in algorithms
- Methods for appeal outside of algorithms

# **FAIRNESS IN SEARCH RANKING**

# KEYWORDS IN TITLES OF ACCEPTED PAPERS

(SIGIR IS A TRADITIONAL TECHNICAL CONFERENCE, CORE IR RESEARCH)

- SIGIR'17: Fairness: 0 Bias: 0
- SIGIR'18: Fairness: 1 Bias: 2
- SIGIR'19: Fairness: 0 Bias: 1
- SIGIR'20: Fairness: 4 Bias: 1
- SIGIR'21: Fairness: 7 Bias: 4
- ...
- SIGIR'24: Fairness: 13 Bias: 9
- SIGIR'25: Fairness: 17 Bias: 13

# **TREC 2019 Fair Ranking Track**

The TREC Fair Ranking track evaluates systems according to how well they *fairly* rank documents. The 2019 task focuses on re-ranking academic abstracts given a query. The objective is to fairly represent relevant authors from several, undisclosed group definitions. These groups can be defined in a variety of ways and the track emphasizes the development of systems which have robust performance across a variety of group definitions.

# **TREC 2020 Fair Ranking Track**

The TREC Fair Ranking track evaluates systems according to how well they *fairly* rank documents. The 2020 focuses on scholarly search and fairly ranking academic abstracts and papers from authors belonging to different groups.

# **TREC 2021 Fair Ranking Track**

The TREC Fair Ranking track evaluates systems according to how well they *fairly* rank documents. The 2021 track focuses on fairly prioritising Wikimedia articles for editing to provide a fair exposure to articles from different groups.

# **TREC 2022 Fair Ranking Track**

The TREC Fair Ranking track evaluates systems according to how well they *fairly* rank documents.

# DIVERSITY AND NOVELTY IN IR

(CLARKE ET AL.'08)

- “For a given query, an information retrieval system should respond with a ranked list that respects both the breadth of available information and any ambiguity inherent in the query.”
- “Ideally, the document ordering for this query would properly account for the interests of the overall user population.”
- Example: for “jaguar”, if cars are more popular than cats, it might make sense to have the first few result be the jaguar car, and the next few be the felines.
- Differentiate:
  - **Novelty:** the need to avoid redundancy
    - (near duplicates; find more deeper info on same topic)
  - **Diversity:** the need to resolve ambiguity



jaguar



All

Images

News

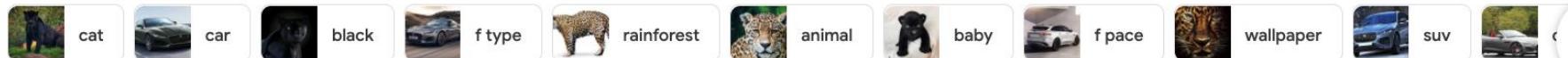
Shopping

Maps

More

Tools

Collections SafeSearch



Jaguar - Wikipedia  
[en.wikipedia.org](https://en.wikipedia.org)



Jaguar, facts and photos  
[nationalgeographic.com](https://nationalgeographic.com)



2021 Jaguar XF Prices, Reviews ...  
[cars.usnews.com](https://cars.usnews.com)



Jaguar, facts and photos  
[nationalgeographic.com](https://nationalgeographic.com)



Jaguar | Species | WWF  
[worldwildlife.org](https://worldwildlife.org)



Rebuild the U.S. Jaguar Population ...  
[scientificamerican.com](https://scientificamerican.com)



Habitat Area for Jaguars in Arizona ...  
[biologicaldiversity.org](https://biologicaldiversity.org)



How the Jaguar, King of the Forest ...  
[wired.com](https://wired.com)



Sports Cars | Jaguar  
[jaguar.com](https://jaguar.com)



The Jaguar King  
[thejaguarking.org](https://thejaguarking.org)



Jaguar New Boss Explains Why The XJ ...  
[motor1.com](https://motor1.com)



Shop jaguar Ads 



jaguar



Privacy, simplified.

All Images

Videos

News

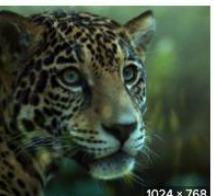
Maps

Shopping

Meanings | Settings

NEW! Android App Tracking Protection

All regions ▾ Safe search: moderate ▾ Any time ▾ All sizes ▾ All colors ▾ All types ▾ All layouts ▾ All Licenses ▾

Jaguar Society | Brevard Zoo  
brevardzoo.orgjaguar, Wild, Cat, Carnivore, Language, W...  
wallup.netTrump's Wall Threatens Last Jaguars in th...  
thedailybeast.comjaguar, Wild, Cat Wallpapers HD / Desktop...  
wallup.netjaguar, Wild, Cat, Carnivore Wallpapers ...  
wallup.netJaguar cub with burned legs rescued from...  
theanimalreader.comTwo wild cubs mig...  
revitalization.orgAdaptations - THE JAGUAR  
themajesticjaguar.weebly.comJaguar Facts - Interesting Information ...  
bigcatrescue.orgJaguar Vs Leopard, Who Will Win? - Animals ...  
animalscomparison.comjaguar, Panther, Wildcat, Predator Wallpaper...  
wallup.netMale jaguar walkin...  
flickr.comJaguar Animal Facts  
buzzle.comWild Cat Jaguar HD Wallpapers | HD Wa...  
hdwallpaperslife.com17 Things You Sho...  
buzzfeed.comMale jaguar appro...  
flickr.comNew Female Jaguar 1 | Woodla...  
flickr.comJaguar HD Animals Wall...  
hdwallpapers.inBrazil | One Very C...  
dailywildlifephoto.n...  
sciencephoto.comWhy Should A Jaguar Be Displayed As A Mascot To ...  
huffingtonpost.com

Share Feedback



jaguar



All

Images

News

Shopping

Maps

More

Tools

About 494,000,000 results (1.19 seconds)

<https://www.jaguarusa.com> :

## Jaguar USA: Jaguar Sedans, SUVs and Sports Cars - Official ...

The official home of Jaguar USA. Explore our luxury sedans, SUVs and sports cars. Build Your Own, Book a Test Drive or Find a Retailer near you.

### All Models

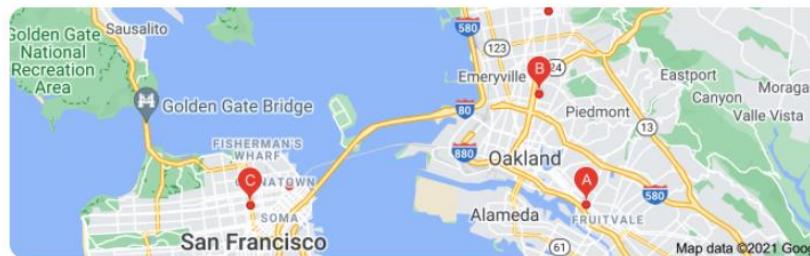
F-TYPE. Pulse-quenching, pure Jaguar sports car. COUPE ...

### Build & Price

Please contact your local authorized Jaguar Retailer for ...

[More results from jaguarusa.com »](#)

## Jaguar :



Hours ▾

A Continental Imports

2215 International Blvd · (510) 532-6603

Closed · Opens 8AM Tue



Directions

## Jaguar Cars



Luxury vehicles company

Jaguar is the luxury vehicle brand of Jaguar Land Rover, a British multinational car manufacturer with its headquarters in Whitley, Coventry, England.

[Wikipedia](#)

**Owner:** Jaguar Land Rover

**Founded:** September 4, 1922, Blackpool, United Kingdom

**Customer service:** 1 (800) 452-4827

**Headquarters:** Coventry, United Kingdom

**Parent organizations:** Tata Motors, British Motor Holdings

**Founders:** William Lyons, William Walmsley

Fastest cars

Motto

Price range

Modes



web



All

Books

News

Images

Videos

More

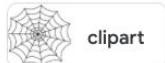
Tools

Collections

SafeSearch



spider



clipart



logo



design



icon



background



internet



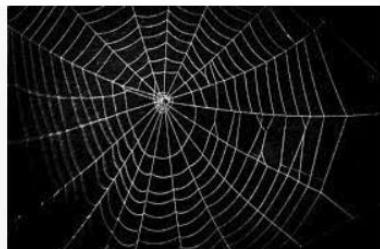
vector



word



transparent



Illuminating the 'dark web'  
phys.org



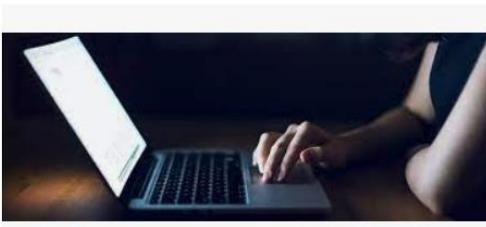
Deciphering the dark web: What it is ...  
siliconrepublic.com



What is web design, how to do it right ...  
rockcontent.com



Why Spiders Decorate Their Webs  
thoughtco.com



What is the dark web? The dark web ...  
us.norton.com



Web Scraping with Scrapy. Build your ...  
towardsdatascience.com



Free vector graphic on Pixabay  
pixabay.com



What Are Web Services? Easy to Learn ...  
cleo.com



Web.com - Home | Facebook  
facebook.com





web



All

Books

News

Images

Videos

More

Tools

About 11,860,000,000 results (1.17 seconds)

<https://web.whatsapp.com> ::

## WhatsApp Web

Quickly send and receive WhatsApp messages right from your computer.

[Join WhatsApp](#) · [Web Whatsapp](#) · [About WhatsApp Web and...](#) · [Web and Desktop](#)

<https://www.web.com> ::

## Web.com

Establish and grow your brand online with a professional website. Web.com offers a variety of website and marketing solutions designed to help you reach ...

[Domains](#) · [Websites](#) · [Marketing](#) · [Hosting](#)

<https://chrome.google.com/webstore> ::

## Chrome Web Store

Chrome Web Store. Customize and Personalize Chrome on your desktop computer with Extensions, Themes and Apps. Power up your Chrome.

## People also ask ::

What do you mean web?

What is web example?

What is App web?

Is Google a web?

## World Wide Web



The World Wide Web, commonly known as the Web, is an information system where documents and other web resources are identified by Uniform Resource Locators, which may be interlinked by hyperlinks, and are accessible over the Internet. [Wikipedia](#)

Programming

Writer

Feedback

# WEB VS IMAGE SEARCH

- Note the way the results differ for image vs web search
- One is more commercial, the other more visual
- Is this designed or accidental?

# IMAGE DIVERSITY

People noted that querying on general terms like “CEO” on google image search returned undiverse images.



CEO



All News

Images

Books

Videos

More

Tools

Collections

SafeSearch



female



business



google



microsoft



apple



desk



amazon



uber



CEO vs. Owner: The Key Differences ...  
onlinemasters.ohio.edu



CEO doesn't believe in CX ...  
heartofthecustomer.com



CEO Job Description  
betterteam.com



as CEO to Help Your Business Grow ...  
inc.com



ceos



All News

Images

Books

Videos

More

Tools

Collections

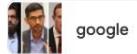
SafeSearch



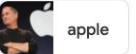
female



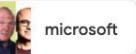
business



google



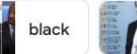
apple



microsoft



desk



black



highest paid



4 Big Tech CEOs getting heat from ...  
denverpost.com



Top C.E.O.s ...  
nytimes.com



Why CEOs Get the Really Big Bucks, And ...  
nbcnews.com



The 15 Richest CEOs of the USA - (2021)  
pakwired.com

# WHAT DOES THE QUERY MEAN?

- “CEO” alone prototype: implies famous CEO of very big company
- “CEOs” different than “CEO”
- Not the same for “custodian” or “software engineer”

# THE PROBLEM WITH VAGUE QUERIES

Let's compare some queries that are single words, and others that make use of Russell's suggestion: refine your query with more specific words



young ceos



All

News

Videos

Images

Shopping

More

Tools

Collections

SafeSearch ▾



new



business roundtable



malaysia



korean



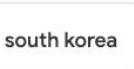
malaysian



korea



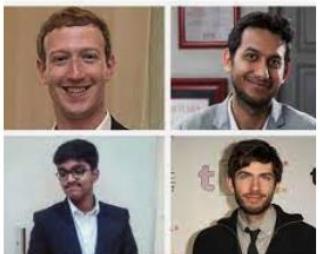
entrepreneurship



south korea



suh



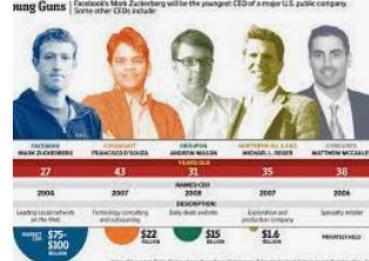
5 Self-Made Young CEOs Whose Su...  
ikateclark.medium.com



Top 10 Young CEOs To Know Abo...  
ceoworld.biz



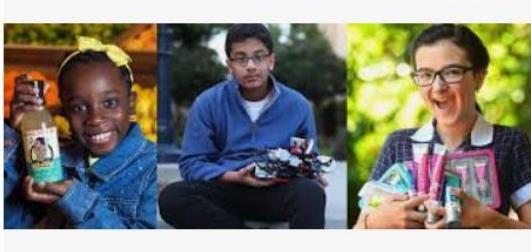
Ten Youngest CEOs of Fortune 500 Co...  
rttnews.com



Young CEOs: Are They Up to the Job? - WSJ  
wsj.com



The Youngest U.S. Public Company CEOs  
equilar.com





ceos of biotech companies



All

News

Images

Maps

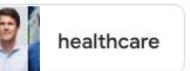
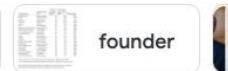
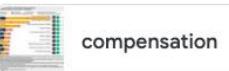
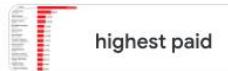
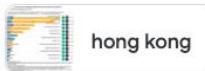
Shopping

More

Tools

Collections

SafeSearch ▾



The Top 25 Biotech CEOs of 2020 | The ...  
thehealthcaretechnologyreport.com



The Top 25 Biotech CEOs of 2021 | The ...  
thehealthcaretechnologyreport.com



The Top 25 Biotech CEOs of 2020 | The ...  
thehealthcaretechnologyreport.com



These biotech and life sciences CEOs ...  
geekwire.com



How Coronavirus Will Change Biopharma ...



Immuno-Oncology market and inspiring ...



The Top 25 Biotech CEO...



Women Leaders In Biotech of 2019 ...



10 Women Biotech CEOs Lead the Ch...



ceos of food and beverage companies



All

News

Images

Maps

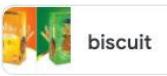
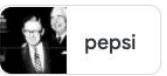
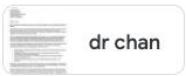
Shopping

More

Tools

Collections

SafeSearch



Seven CEOs to Watch in Food and ...  
foodprocessing.com



food industry ...  
meatpoultry.com



Seven CEOs to Watch in ...  
foodprocessing.com

Top 10 Food and Beverage Companies over the last 5 years				
#	2018	2017	2016	2015
1	Bechtel	Bechtel	Bechtel	Bechtel
2	PepsiCo Inc.	PepsiCo Inc.	PepsiCo Inc.	PepsiCo Inc.
3	Anheuser-Busch InBev	Anheuser-Busch InBev	Anheuser-Busch InBev	JBS
4	JBS	The Coca-Cola Company	The Coca-Cola Company	Anheuser-Busch InBev
5	Tyson Foods	JBS	Anheuser-Busch InBev	The Coca-Cola Company
6	Archer Daniels Midland Company	Tyson Foods	Tyson Foods	Anheuser-Busch InBev
7	Mars	Archer Daniels Midland Company	Mars	Tyson Foods
8	Anheuser-Busch InBev	Cargill	Mars	Monsanto International
9	The Coca-Cola Company	Cargill	Kraft Heinz Company	Cargill
10	Nestle	Kraft Heinz Company	Cargill	Mars

The 2019 Top 100 Food & Beverage ...  
foodengineeringmag.com



Food And Beverage Companies Play ...  
forbes.com



The 2019 Top 100 Food & Beverage ...



food & beverage companies - 2015 ...



Top 100 Food and Beverage Companies ...

FOOD & BEVERAGE STOCKS	Jan. 2017	Jan. 2018	March 1, 2019	July 30, 2020*
Anheuser-Busch InBev	\$105.95	\$114.74	\$181.96	\$57.86
Coca-Cola	41.74	46.07	45.38	47.40
General Mills	61.47	59.52	47.22	63.76
JBS S.A.	7.23	6.13	7.37	22.36
Kraft Heinz	86.31	77.84	32.40	34.88
Nestle	73.99	85.72	90.76	110.20
PepsiCo	104.56	110.67	106.18	137.30
Tyson Foods	63.22	90.88	62.19	60.58
<b>TOTAL</b>	<b>\$544.45</b>	<b>\$589.52</b>	<b>\$483.46</b>	<b>\$534.34</b>

\*Price at opening 7/30/20

Food and Beverage Companies for 2020 ...



young ceos -zuckerberg



Search All

News

Images

Videos

Shopping

More

Tools



handsome



korean



female



male



chinese



businessman



most handsome



at



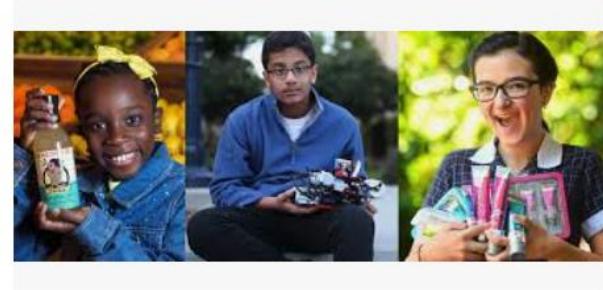
Top 10 Young CEOs To Know Abo...  
ceoworld.biz



Millionaire Fast Track: 27 CEOs Under 27  
entrepreneur.com



Young CEOs - N2Growth  
n2growth.com



These are the Three Youngest CEOs ...  
inacademy.eu



Young CEOs On How They Got to Where ...  
marieclaire.com



5 Young CEOs In Malaysia On The Perks ...  
tatlerasia.com



Young Black CEOs and Business Leaders ...  
blackbusiness.com



Young CEOs: Tips to become s...  
economictimes.indiatimes.com

# Fairness of Exposure in Rankings

Singh & Joachims, KDD'18

“[I]t is no longer just books that are being ranked, but there is **hardly anything that is not being ranked today** – products, jobs, job seekers, opinions, potential romantic partners.

Nevertheless, one of the guiding technical principles behind the optimization of ranking systems still dates back to four decades ago – namely the **Probability Ranking Principle (PRP)** [Robertson'77].

It states that the **ideal ranking should order items in the decreasing order of their probability of relevance**, since this is the ranking that **maximizes utility of the retrieval system** to the user for a **broad range of common utility measures** in Information Retrieval.

**But is this uncompromising focus on utility to the users still appropriate when we are not ranking books in a library, but people, products and opinions?”**

# FRAMING FAIRNESS IN RANKING

- There is no single definition of what constitutes a fair ranking
- Fairness depends on context and application.
- Different notions of fairness imply different trade-offs in utility, which may be acceptable in one situation but not in the other.
- For example, we may not want to convey strong rights to the books in a library when a user is trying to locate a book, but the situation is different when candidates are being ranked for a job opening.
- We are not limited to a single definition of fairness, since different application scenarios probably require different trade-offs between the rights of the items and what can be considered an acceptable loss in utility to the user

# FORMULATIONS OF FAIRNESS FOR RANKING

- Demographic Parity:
  - Enforce that average exposure from documents in all groups is equal
- Disparate Treatment:
  - Enforce that exposure of each group is **proportional to their average utility**
  - This takes relevance into account, but helps with “just-miss” cases, where the ranked values for members of groups are close to one another
- Disparate Impact:
  - Enforce that the **expected clickthrough rate of each group is proportional to its average utility**
  - Goes beyond utility to take into account the impact of the exposure

# GENDER AND IMAGE SEARCH RANKINGS STUDY

- **Introduction:** Experimentally evaluated the effects of how gender is represented in image search results for occupations. Used very general queries like:
  - “bartender”, “custodian”
- **Findings:**
  - People have quite accurate estimates of the gender proportions of occupations
  - Gender proportions in search results are close to those in actual occupations.
  - However, there are slight exaggerations of gender ratios towards gender stereotypes for many
  - People rate search results quality higher when they are consistent with stereotypes for a career
  - Images matching the gender stereotype are rated more professional and less inappropriate
  - Manipulating the representation of gender in image search results can shift people's perceptions about real-world distributions very slightly (by about 7%)
- **Conclusion:** There are tensions between desire for high-quality results and broader societal goals for equality of representation in this space.

# LINKED-IN FAIRNESS RANKING APPROACH

- “For a given search or recommendation task, our algorithms seek to achieve a desired distribution of top ranked results with respect to one or more protected attributes.”
- “We show that such a framework can be tailored to achieve fairness criteria ... depending on the choice of the desired distribution.”

# LINKED-IN FAIRNESS RANKING APPROACH

- Did A/B testing for representative ranking:
  - “For each search request, the desired gender distribution over the ranked candidate list is chosen to be the gender distribution over the set of candidates that meet (i.e., qualify for) the search criteria”
  - Hundreds of thousands of recruiters
  - Comparison was a model optimized to make a successful hire
- “Our approach resulted in tremendous improvement in the fairness metrics (nearly threefold increase in the number of search queries with representative results) without affecting the business metrics”
- “This paved the way for deployment to 100% of LinkedIn Recruiter users world-wide.”

# SUMMARY

- Fairness is a **social construct**
- There are many different definitions of fairness; it is **contextual**
- For many applications, there is a tradeoff between **fairness and accuracy/relevance**; the two often can't be simultaneously optimized
- One potential remedy is to revisit the **assumptions behind the data and the original calculation** of accuracy/relevance

# ACADEMIC WORKSHOPS AND CONFERENCES

- Workshop on Algorithmic Bias in Search and Recommendation: (BIAS, 2020-today)
- FATML.org: Fairness, Accountability, and Transparency in Machine Learning (2014-today)
- ACM Conference on Fairness, Accountability, and Transparency (FAccT, 2018-today)
- Symposium on the Foundations of Responsible Computing (math-y, 2020-today)

# More Depth on These Topics: I 203 and I 205



Prof. Morgan Ames  
UCB I School  
Social Issues of Information



Prof. Deirdre Mulligan  
UCB I School  
Information Law & Policy

# Designing Value-Based Technology: I 213: User Interface Design & Development



Prof. Niloufar Salehi  
UCB I School

# NEXT TIME

- Intellectual Property
- Course Wrap-up