Week 10: Algorithmic Bias
March 14, 2019
Term Paper Outline
Machine Learning is Everywhere
This is your machine learning system?

Yup! You pour the data into this big pile of linear algebra, then collect the answers on the other side.

What if the answers are wrong?

Just stir the pile until they start looking right.
To make things worse ...

Algorithms are "black boxes" protected by

- Industrial secrecy
- Legal protections
- Intentional obfuscation

Discrimination becomes invisible
Mitigation becomes impossible

Proprietary algorithms are used to decide, for instance, who gets a job interview, who gets granted parole, and who gets a loan.

**Human(bias) and Algorithms**
Cathy O’Neil, a mathematician and the author of *Weapons of Math Destruction*, a book that highlights the risk of algorithmic bias in many contexts, says people are often too willing to trust in mathematical models because they believe it will remove human bias.
Two areas of concern: data and algorithms

Data inputs:

- Poorly selected (e.g., observe only car trips, not bicycle trips)
- Incomplete, incorrect, or outdated
- Selected with bias (e.g., smartphone users)
- Perpetuating and promoting historical biases (e.g., hiring people that "fit the culture")

Algorithmic processing:

- Poorly designed matching systems
- Personalization and recommendation services that narrow instead of expand user options
- Decision making systems that assume correlation implies causation
- Algorithms that do not compensate for datasets that disproportionately represent populations
- Output models that are hard to understand or explain hinder detection and mitigation of bias

Judiciary use of COMPAS scores

COMPAS (Correctional Offender Management Profiling for Alternative Sanctions): 137-questions questionnaire and predictive model for "risk of recidivism"

Prediction accuracy of recidivism for blacks and whites is about 60%, but ...

- Blacks that did not reoffend were classified as high risk twice as much as whites that did not reoffend
- Whites who did reoffend were classified as low risk twice as much as blacks who did reoffend

The northern half of Atlanta, home to 96% of the city’s white residents, has same-day delivery. The southern half, where 90% of the residents are black, is excluded.

White residents

Black residents

Percentage of residents living in ZIP codes with same-day delivery

- All: 65%
- White: 96%
- Black: 41%
- Hispanic: 74%
- Asian: 95%
- Other: 75%

Population percentages are based on American Community Survey estimates and have a 90% confidence interval.
The ethical challenges

• Algorithmic bias is shaping up to be a major societal issue at a critical moment in the evolution of machine learning and AI.

• If the bias lurking inside the algorithms that make ever-more-important decisions goes unrecognized and unchecked, it could have serious negative consequences, especially for marginalized communities and minorities.
Some case studies of algorithmic bias
Semantics derived automatically from language corpora contain human-like biases

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Machines learn what people know implicitly

AlphaGo has demonstrated that a machine can learn to do things that people spend many years of concentrated study learning, and it can rapidly learn how to do them better than any human can. Caliskan et al. now show that machines can learn word associations from written texts and that these associations mirror those learned by humans, as measured by the Implicit Association Test (IAT) (see the Perspective by Greenwald). Why does this matter? Because the IAT has predictive value in uncovering the association between concepts, such as pleasantness and flowers or unpleasantness and insects. It can also tease out attitudes and beliefs—for example, associations between female names and family or male names and career. Such biases may not be expressed explicitly, yet they can prove influential in behavior.

Science, this issue p. 183; see also p. 133
• Word embedding models

• The paper shows that some more troubling implicit biases seen in human psychology experiments are also readily acquired by algorithms. The words “female” and “woman” were more closely associated with arts and humanities occupations and with the home, while “male” and “man” were closer to math and engineering professions.

• And the AI system was more likely to associate European American names with pleasant words such as “gift” or “happy”, while African American names were more commonly associated with unpleasant words.
Unequal Representation and Gender Stereotypes in Image Search Results for Occupations

- Algorithms can be biased in how they represent the world.
- The information people access affects their understanding of the world around them and the decisions they make: biased information can affect both how people treat others and how they evaluate their own choices or opportunities.
- The paper experimentally evaluates the effects of bias in image search results on the images people choose to represent those careers and on people’s perceptions of the prevalence of men and women in each occupation.
Findings

• Stereotype exaggeration: Results for many occupations exhibit a slight exaggeration of gender ratios according to stereotype: e.g., male-dominated professions tend to have even more men in their results.

• Systematic over-/under-representation: Search results also exhibit a slight under-representation of women in images, such that an occupation with 50% women would be expected to have about 45% women in the results on average.
Findings

• Qualitative differential representation: Image search results also exhibit biases in how genders are depicted: **those matching the gender stereotype of a profession tend to be portrayed as more professional-looking** and less inappropriate-looking.

• Perceptions of occupations in search results: We find that people’s existing perceptions of gender ratios in occupations are quite accurate, but that manipulated search results can have a small but significant effect on perceptions, shifting estimations on average ~7%.
On the web: race and gender stereotypes reinforced

- Results for "CEO" in Google Images: 11% female, US 27% female CEOs
  - Also in Google Images, "doctors" are mostly male, "nurses" are mostly female
- Google search results for professional vs. unprofessional hairstyles for work

Class Activity 1
Racial Discrimination in the Sharing Economy: Evidence from a Field Experiment

- Experimental study on Airbnb showing that applications from guests with distinctively African-American names are 16% less likely to be accepted relative to identical guests with distinctively White names.

- Discrimination occurs among landlords of all sizes, including small landlords sharing the property and larger landlords with multiple properties.

- Both African-American and White hosts discriminate against African-American guests; both male and female hosts discriminate; both male and female African-American guests are discriminated against.

- Airbnb’s current design choices facilitate discrimination and raise the possibility of erasing some of these civil rights gains.
Class Activity 2
Deep neural networks are more accurate than humans at detecting sexual orientation from facial images

- Authors used deep neural networks to extract features from 35,326 facial images.
  - Images scraped from public profiles posted on a U.S. dating website

- These features were entered into a logistic regression aimed at classifying sexual orientation.

- Given a single facial image, a classifier could correctly distinguish between gay and heterosexual men in 81% of cases, and in 74% of cases for women.

- The authors claimed that their findings therefore provided “strong support” for the idea that sexual orientation stems from hormone exposure in the womb
A recent Stanford University study published in the *Journal of Personality and Social Psychology* claimed artificial intelligence can figure out if a person is gay or straight by analyzing pictures of their faces. However, the Outline reports the study was met with “immediate backlash” from the AI community, academics, and LGBTQ advocates alike — and the paper is now under ethical review.
Some argued that the study is just the latest example of a disturbing technology-fueled revival of physiognomy, the long discredited notion that personality traits can be revealed by measuring the size and shape of a person’s eyes, nose and face.
Class Activity 3
DeepMind's new AI ethics unit is the company's next big move

Google-owned DeepMind has announced the formation of a major new AI research unit comprised of full-time staff and external advisors.

By JAMES TEMPERTON

Wednesday 4 October 2017
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In 2017, a group of researchers, together with the American Civil Liberties Union, launched an effort to identify and highlight algorithmic bias, called AI Now.
Last Class
Scholarly criticism of bias due to a lack of algorithmic transparency

• Joanna Bryson, a computer scientist at the University of Bath and a co-author, said: “A lot of people are saying this is showing that AI is prejudiced. No. This is showing we’re prejudiced and that AI is learning it.”

• But Bryson warned that AI has the potential to reinforce existing biases because, unlike humans, algorithms may be unequipped to consciously counteract learned biases. “A danger would be if you had an AI system that didn’t have an explicit part that was driven by moral ideas, that would be bad,” she said.
Right to be Forgotten
Right to Explanation