

CompSci 190: Lecture 15: Bias

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Decisions Under Uncertainty

Interpretation by Physicians of Clinical Laboratory Results (1978)

"We asked 20 house officers, 20 fourth-year medical students and 20 attending physicians, selected in 67 consecutive hallway encounters at four Harvard Medical School teaching hospitals, the following question:

"If a test to detect a disease whose prevalence is 1/1000 has a false positive rate of 5%, what is the chance that a person found to have a positive result actually has the disease, assuming that you know nothing about the person's symptoms or signs?"

Decisions Under Uncertainty

Interpretation by Physicians of Clinical Laboratory Results (1978)

"Eleven of 60 participants, or 18%, gave the correct answer. These participants included four of 20 fourth-year students, three of 20 residents in internal medicine and four of 20 attending physicians. The most common answer, given by 27, was that [the chance that a person found to have a positive result actually has the disease] was 95%.

Round One

- Scenario:
 - Class consists of second years (60%) and third years (40%)
 - 50% of the second years have declared their major
 - 80% of the third years have declared their major
 - I pick one student at random.
- Which is more likely: Second year or third year?
 - Second year, because they are 60% of the class

Round Two

- Slightly different scenario:
 - Class consists of second years (60%) and third years (40%)
 - 50% of the second years have declared their major
 - 80% of the third years have declared their major
 - I pick one student at random...
- Second Year or Third Year?

(Demo)

Terminology

Prior probability

0.6

0.4

Prior probability

Second
Year

0.5

0.5

Declared

Likelihood

Undeclared

Third
Year

0.8

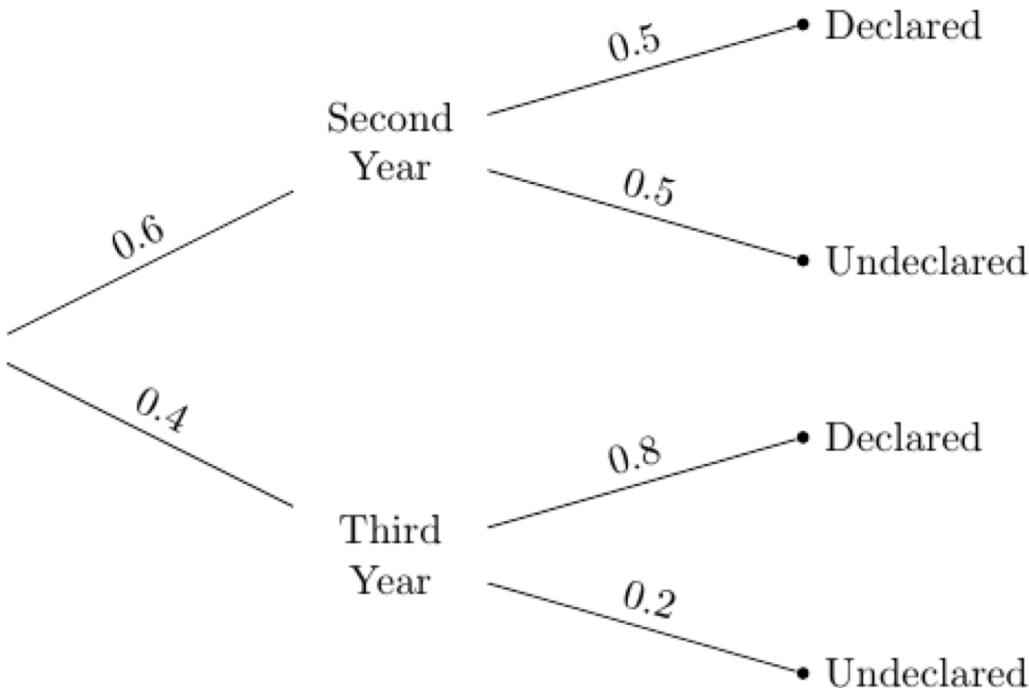
0.2

Declared

Likelihood

Undeclared

Bayes' Rule



Pick a student at random.

Posterior probability:

$$P(\text{Third Year} \mid \text{Declared})$$

$$0.4 \times 0.8$$

$$= \frac{\dots}{\dots}$$

$$(0.6 \times 0.5) + (0.4 \times 0.8)$$

$$= 0.5161\dots$$

Purpose of Bayes' Rule

- Update your prediction based on new information
- In a multi-stage experiment, find the chance of an event at an earlier stage, given the result of a later stage

(Demo)

Example: Doctors & Clinical Tests

- Out of 1000 patients:

	Positive test result	Negative test result
Has disease	1	0
Doesn't have disease	49.95	949.05

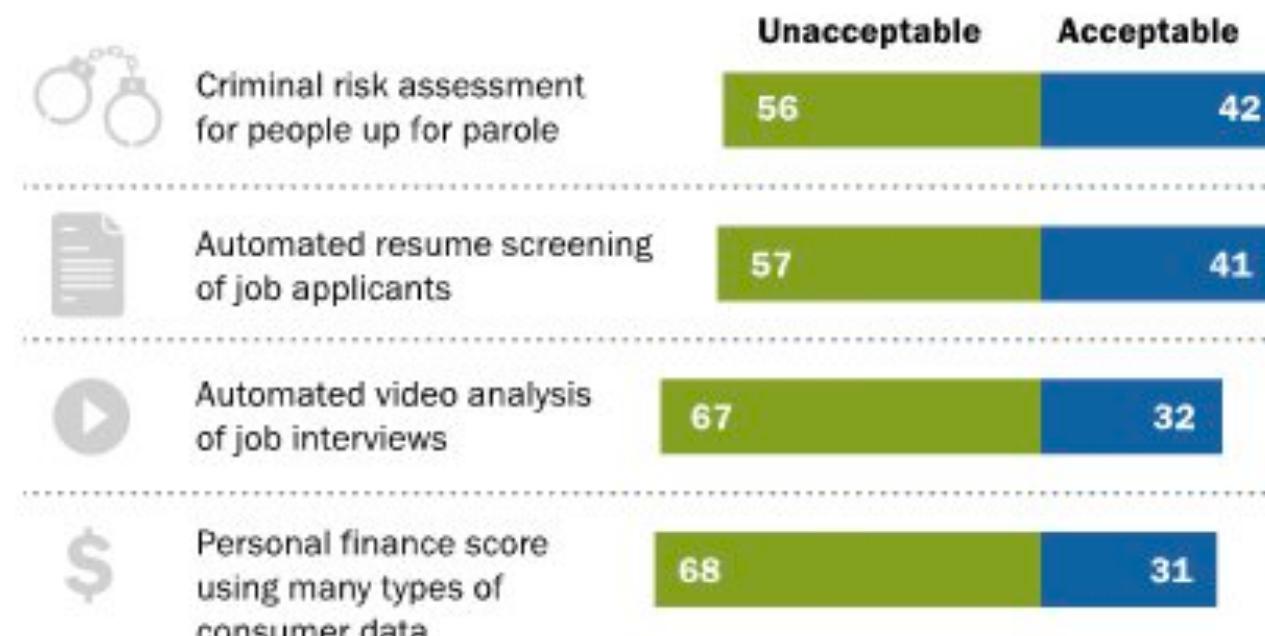
- So only $1 / 50.95$ of patients with positive test results have the disease.

Using Data Science

- What's an algorithm?
- What are the advantages?
 - Efficient
 - Objective
 - Expanding access
- What are the risks?
 1. Data used as input
 2. The algorithm itself

Majorities of Americans find it unacceptable to use algorithms to make decisions with real-world consequences for humans

% of U.S. adults who say the following examples of algorithmic decision-making are ...



Note: Respondents who did not give an answer are not shown.

Source: Survey of U.S. adults conducted May 29-June 11, 2018.

"Public Attitudes Toward Computer Algorithms"

Challenge 1: Inputs to an Algorithm

- Consider trying to generate fastest route to a destination (e.g., Google Maps). Problems include:
- Poorly selected data
- Incomplete, incorrect, or outdated data
- Selection Bias
- Unintentional perpetuation and *promotion* of historical biases

Resumé screening

Amazon scraps secret AI recruiting tool that showed bias against women

Jeffrey Dastin

8 MIN READ



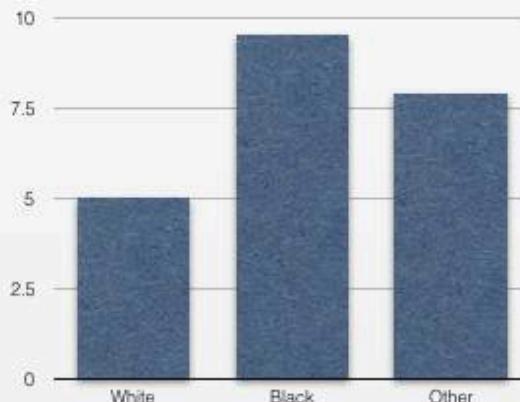
SAN FRANCISCO (Reuters) - Amazon.com Inc's ([AMZN.O](#)) machine-learning specialists uncovered a big problem: their new recruiting engine did not like women.

Predictive policing

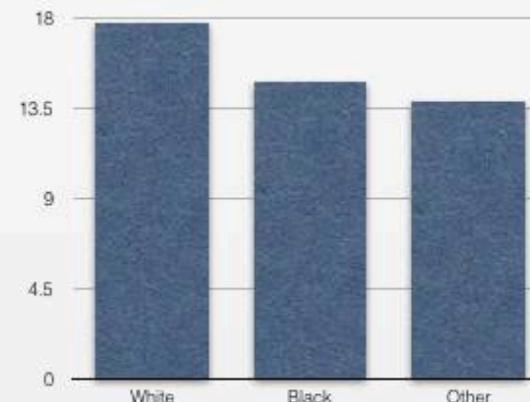
Predictive policing in Oakland vs. actual drug use

The chart on the left shows the demographic breakdown of people targeted for policing based on a simulation of PredPol in Oakland. The chart on the right shows actual estimated use of illicit drugs.

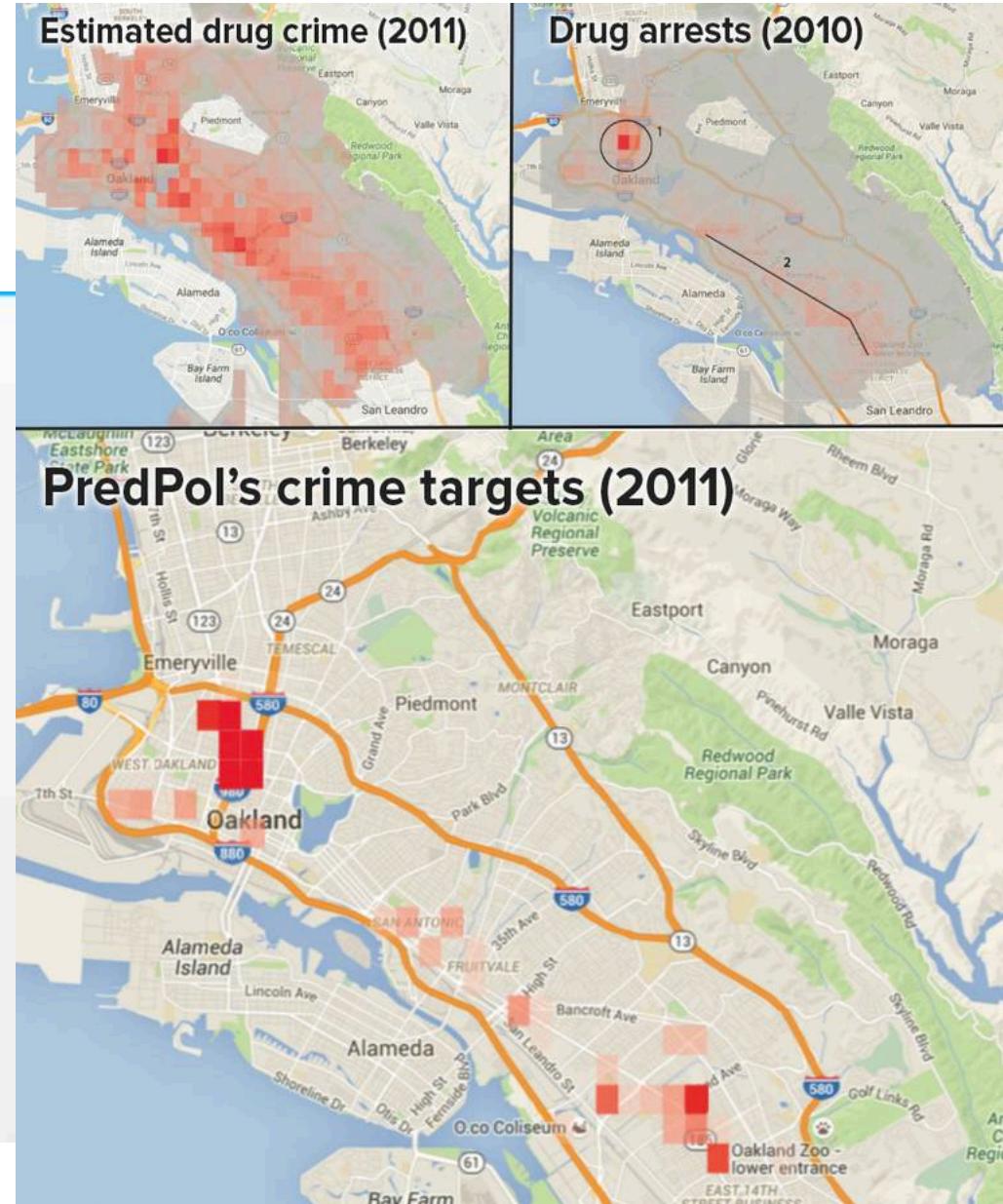
PredPol Targets



Estimated drug use



source: National Survey on Drug Use and Health , Human Rights Data Analysis Group . **Mic**



Challenge 2: The algorithm itself

- Poorly designed matching systems
- Personalization that narrow rather than expand user options
- Correlation does not imply causation!
- Beware of black boxes!

Sentencing software

- Correctional Offender Management Profiling for Alternative Sanctions
- Predict the likelihood of recidivism



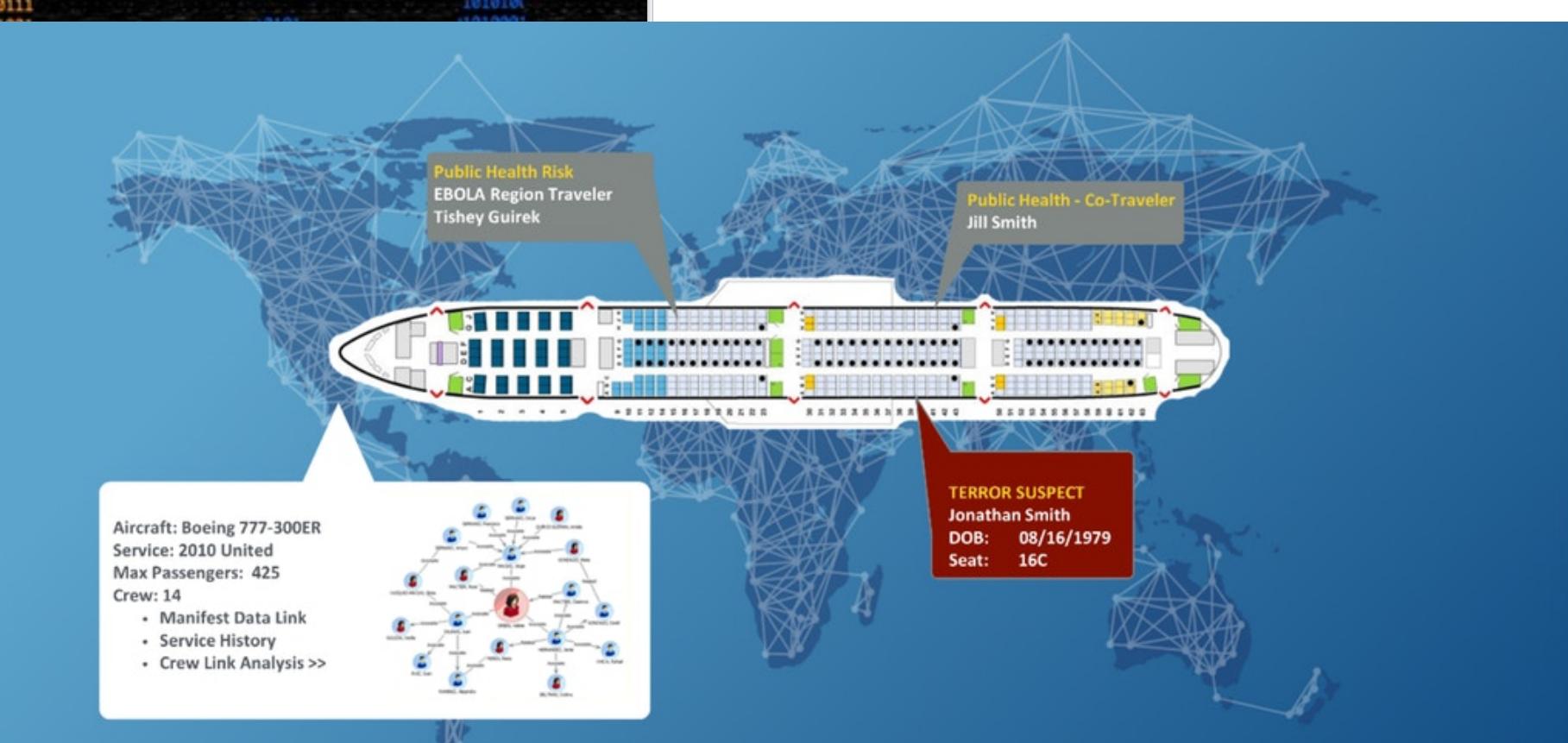
"People are getting different prison sentences because some completely opaque algorithm is predicting that they will be a criminal in the future," says Cynthia Rudin, associate professor of computer science and electrical and computer engineering at Duke University.

Homeland Security?



THEINTERCEPT.COM

Homeland Security Will Let ~~C~~ a Terrorist on Your Plane — Just



What's left?

- Grades
 - Labs & HW graded primarily by completion
 - Projects graded for correctness
 - Summary posted by end of the day on December 15
- Final Project
 - Submit notebook, presentation, and documents by **noon, December 16**
 - Presentations (< 10 minutes) – **2pm on December 16**
 - Motivating questions
 - Methods to answer those questions
 - Visualizations of key results
 - Conclusions

Thank you!

1. Please complete course evaluation on DukeHub
2. Complete teammate evaluation (link will be posted on Sakai)