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Announcements

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Reminder: Class challenge out! Ends December 10th

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- Final in two weeks, practice question will be posted today

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Class Challenge Task 2

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- 100 labels isn't enough! (see Lecture 21/first half of 22)

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- Transfer learning from a different dataset? if it isn't ***a dataset we provided***, you have to check with us (ImageNet OK)

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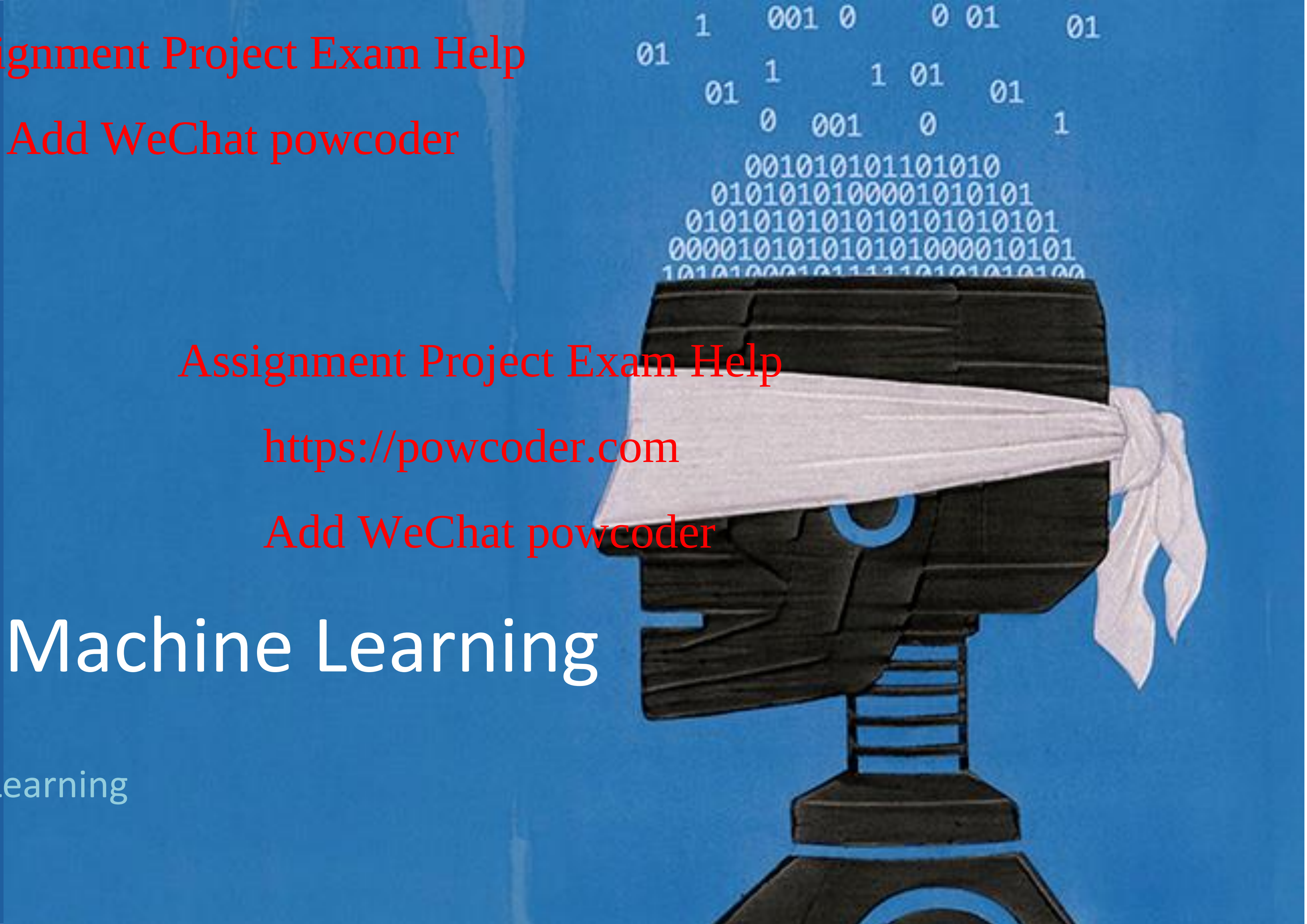

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Ethics in Machine Learning

Kate Saenko

CS 542 Machine Learning

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AI Fears:
Which of these has already happened?

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A robot kills human

yes, Uber car accident

AI takes over our lives

yes? Youtube algorithm

AI is watching us

yes, virtual police lineup

Autonomous weapons

not yet?

Humans losing jobs

Yes, e.g. librarians

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AI Fears

- **Autonomous weapons** – frameworks for regulation
- **Future of work** – deskilling / reskilling / superskilling. Many jobs that currently seem least likely to be automated have been racialized and gendered in ways connected to care and immigration, and have rarely paid living wages; how do we revalue work?
- **Worse Inequality** – digital divides; bias in algorithms may worsen inequality; ecological concerns in energy, storage and cooling required for ML; economic inequality
- **Divided societies with algorithmic bubbles** – challenges of populism, automated recommendations, news feeds; deepfakes and election meddling

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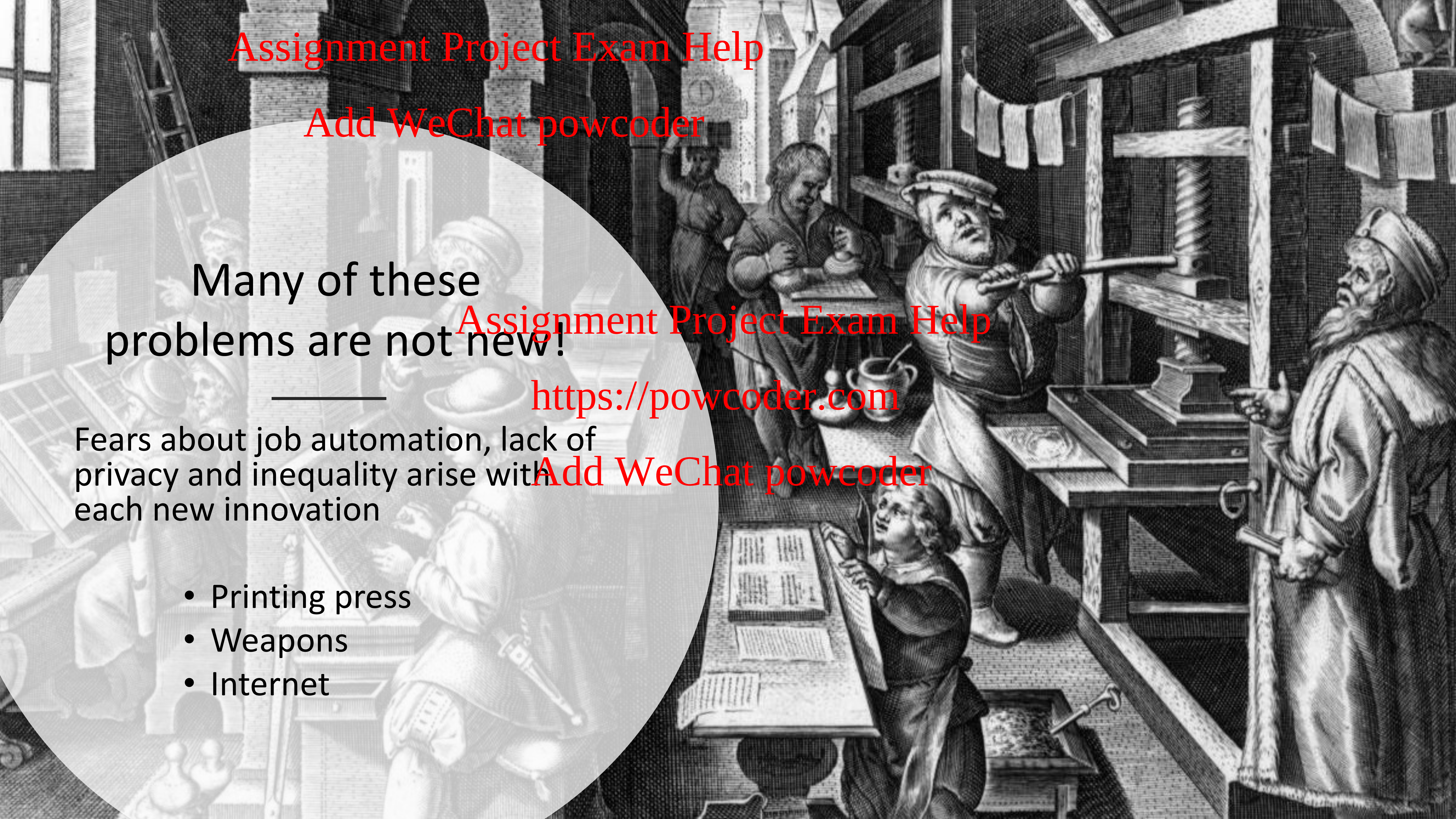

Many of these problems are not new!

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Fears about job automation, lack of privacy and inequality arise with each new innovation

- Printing press
- Weapons
- Internet

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Ethical Issues in Machine Learning

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Report: A.I. would eliminate 75 million jobs but may create about 130 million jobs globally.

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- Job Loss
- Algorithmic Bias
- Transparency
- AI Supremacy
- Fake news and videos
- Autonomous weapons
- Self-driving cars
- Privacy and surveillance

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Stable Roles

- Managing Directors and Chief Executives
- General and Operations Managers*
- Software and Applications Developers and Analysts*
- Data Analysts and Scientists*
- Sales and Marketing Professionals*
- Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products
- Human Resources Specialists
- Financial and Investment Advisers
- Database and Network Professionals
- Supply Chain and Logistics Specialists
- Risk Management Specialists
- Information Security Analysts*
- Management and Organization Analysts
- Electrotechnology Engineers
- Organizational Development Specialists*
- Chemical Processing Plant Operators
- University and Higher Education Teachers
- Compliance Officers
- Energy and Petroleum Engineers
- Robotics Specialists and Engineers
- Petroleum and Natural Gas Refining Plant

New Roles

- Data Analysts and Scientists*
- AI and Machine Learning Specialists
- General and Operations Managers*
- Big Data Specialists
- Digital Transformation Specialists
- Sales and Marketing Professionals*
- New Technology Specialists
- Organizational Development Specialists*
- Software and Applications Developers and Analysts*
- Information Technology Services
- Process Automation Specialists
- Innovation Professionals
- Information Security Analysts*
- Ecommerce and Social Media Specialists
- User Experience and Human-Machine Interaction Designers
- Training and Development Specialists
- Robotics Specialists and Engineers
- People and Culture Specialists
- Client Information and Customer Service Workers*
- Service and Solutions Designers
- Digital Marketing and Strategy Specialists

Redundant Roles

- Data Entry Clerks
- Accounting, Bookkeeping and Payroll Clerks
- Administrative and Executive Secretaries
- Assembly and Factory Workers
- Client Information and Customer Service Workers*
- Business Services and Administration Managers
- Accountants and Auditors
- Material-Recording and Stock-Keeping Clerks
- General and Operations Managers*
- Postal Service Clerks
- Financial Analysts
- Cashiers and Ticket Clerks
- Mechanics and Machinery Repairers
- Telemarketers
- Electronics and Telecommunications Installers and Repairers
- Bank Tellers and Related Clerks
- Car, Van and Motorcycle Drivers
- Sales and Purchasing Agents and Brokers
- Door-To-Door Sales Workers, News and Street Vendors, and Related Workers
- Statistical, Finance and Insurance Clerks
- Lawyers

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Ethical Issues in Machine Learning

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- Job Loss
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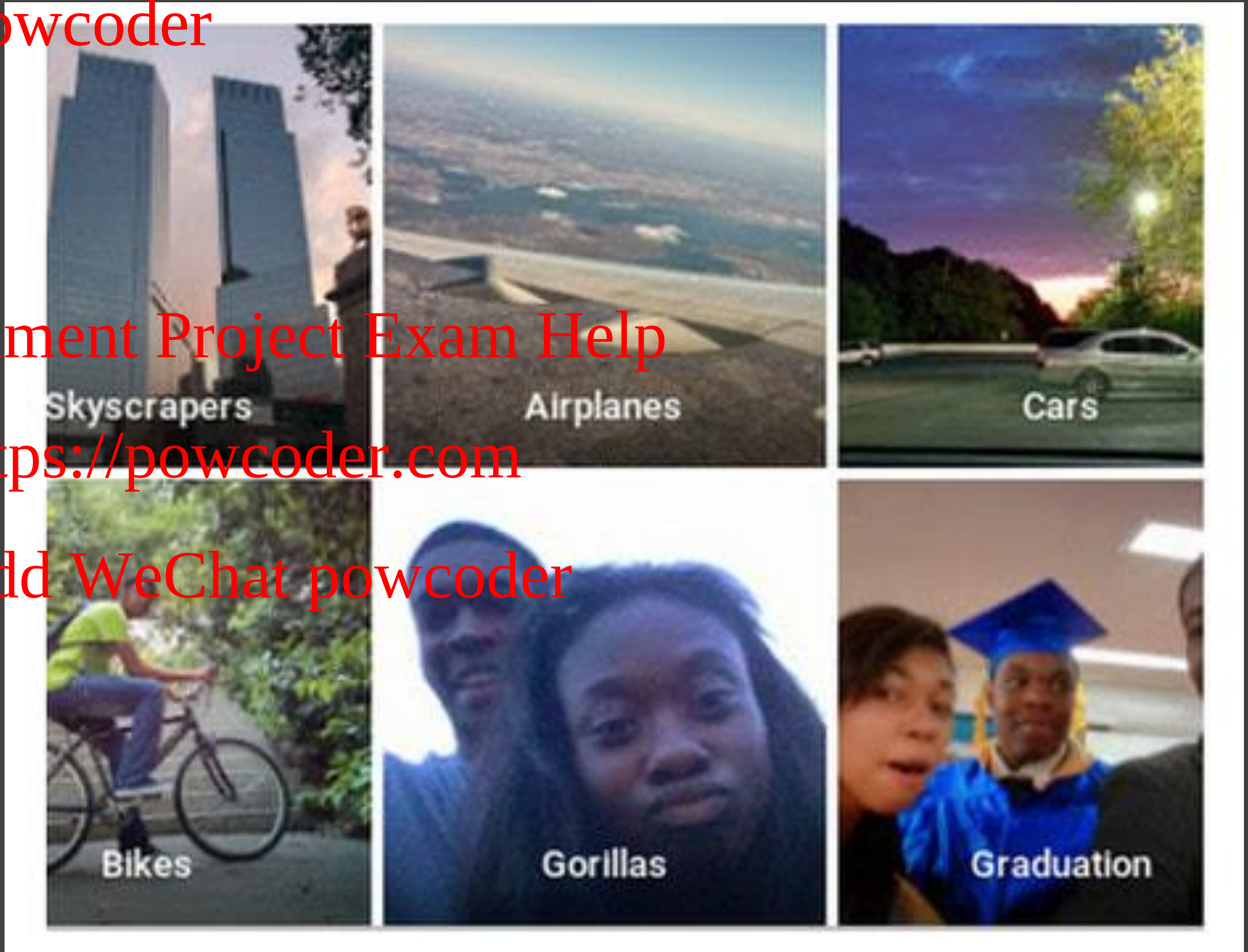
- Privacy and surveillance

Bias can lead to offensive or unfair results…



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Gender Shades (Buolamwini & Gebru, 2018)

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- Evaluated commercial gender classifiers from Microsoft, FACE++, IBM
- Found large disparity in error between population subgroups based on gender, skin color

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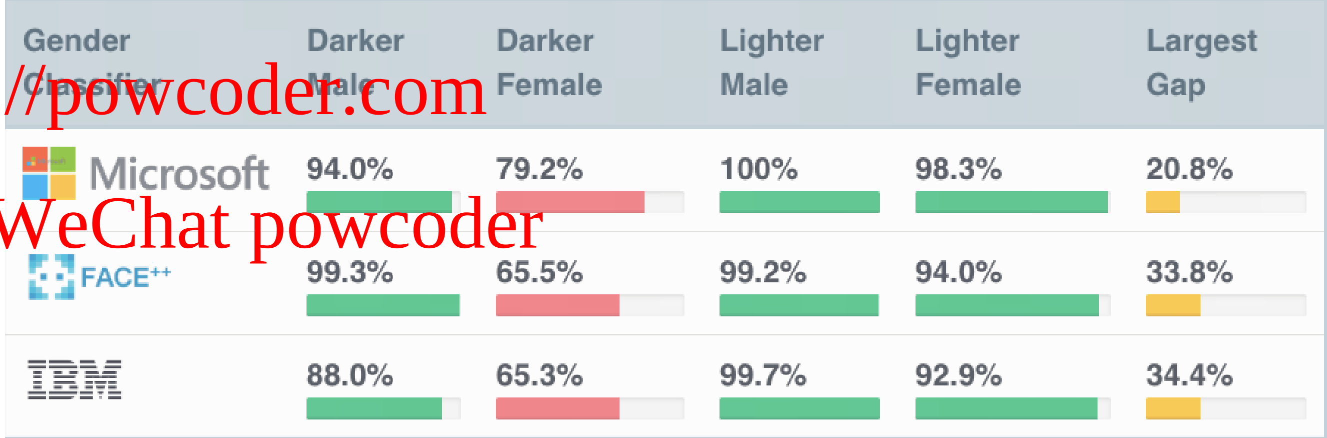

Gender Classifier	Darker Male	Darker Female	Lighter Male	Lighter Female	Largest Gap
Microsoft	94.0%	79.2%	100%	98.3%	20.8%
FACE++	99.3%	65.5%	99.2%	94.0%	33.8%
IBM	88.0%	65.3%	99.7%	92.9%	34.4%

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Buolamwini, Joy, and Timnit Gebru. "Gender shades: Intersectional accuracy disparities in commercial gender classification." Conference on Fairness, Accountability and Transparency. 2018.

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Fairness in Machine Learning

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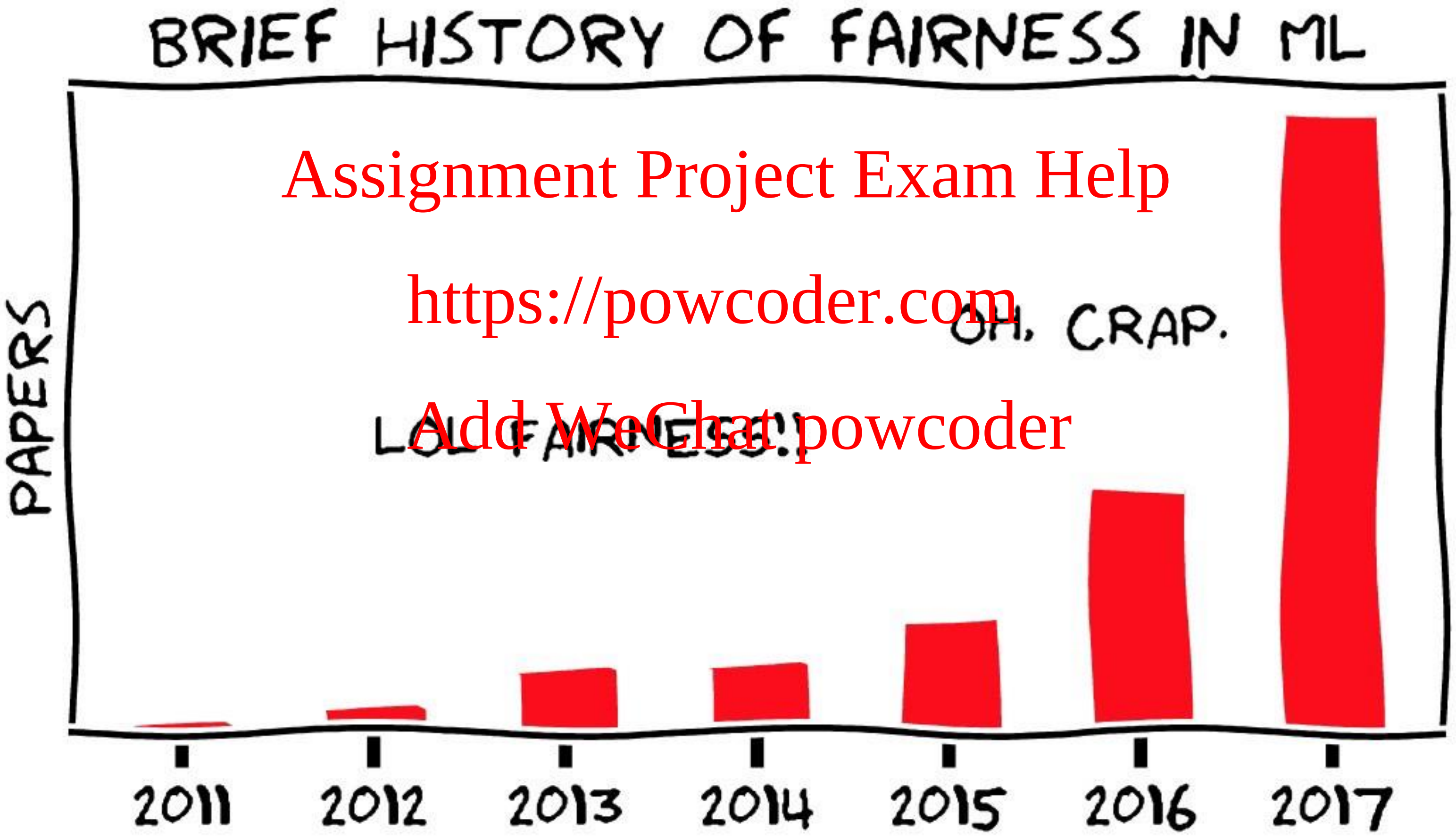

Moritz Hardt

Initially: AI is better than humans!

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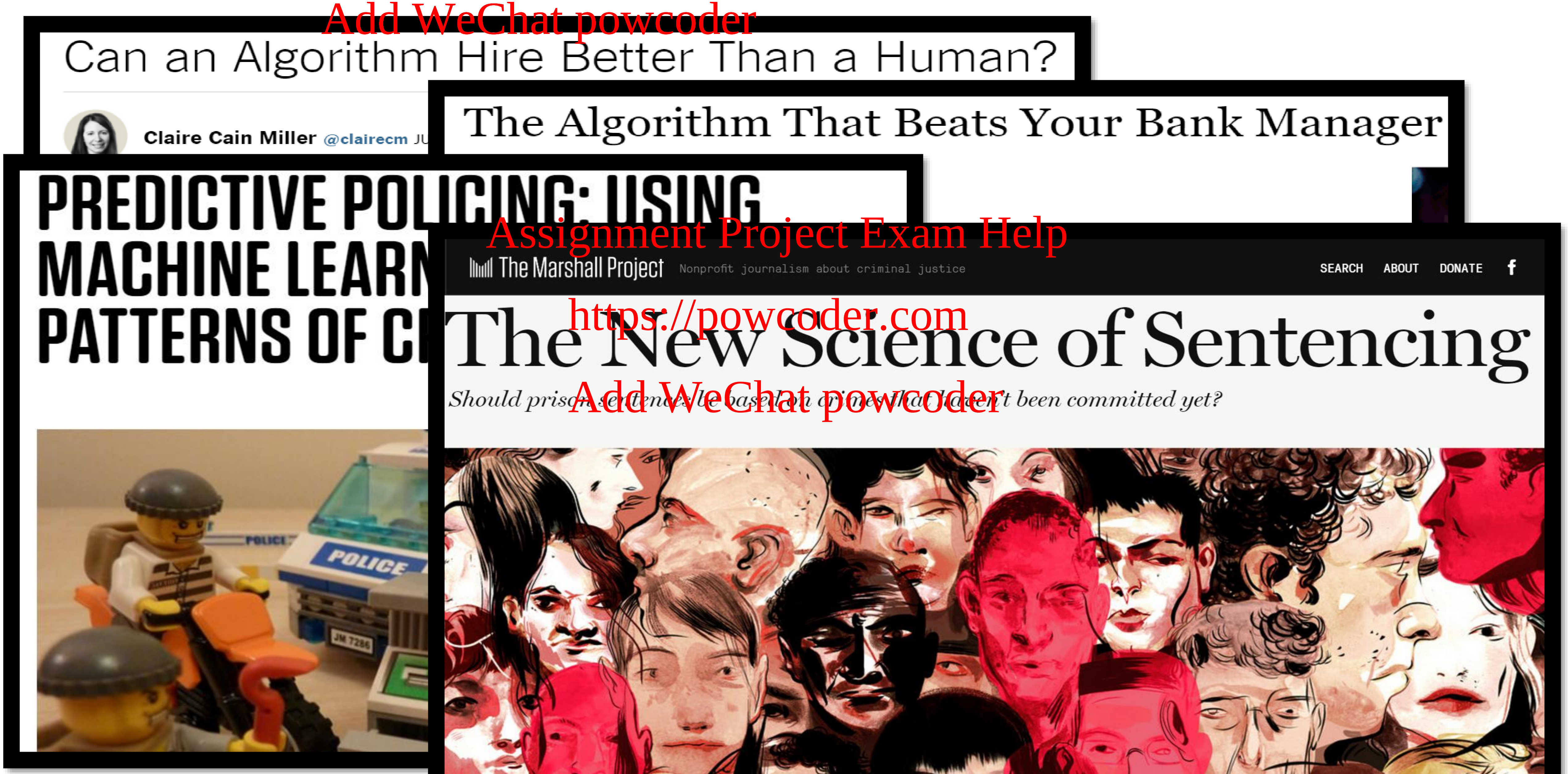

Can an Algorithm Hire Better Than a Human?

Claire Cain Miller @clairecm JU

The Algorithm That Beats Your Bank Manager

PREDICTIVE POLICING: USING MACHINE LEARN PATTERNS OF C

The Marshall Project Nonprofit journalism about criminal justice

SEARCH ABOUT DONATE

The New Science of Sentencing

Should prison sentences be based on crimes that haven't been committed yet?

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Wait, maybe not such a good idea…

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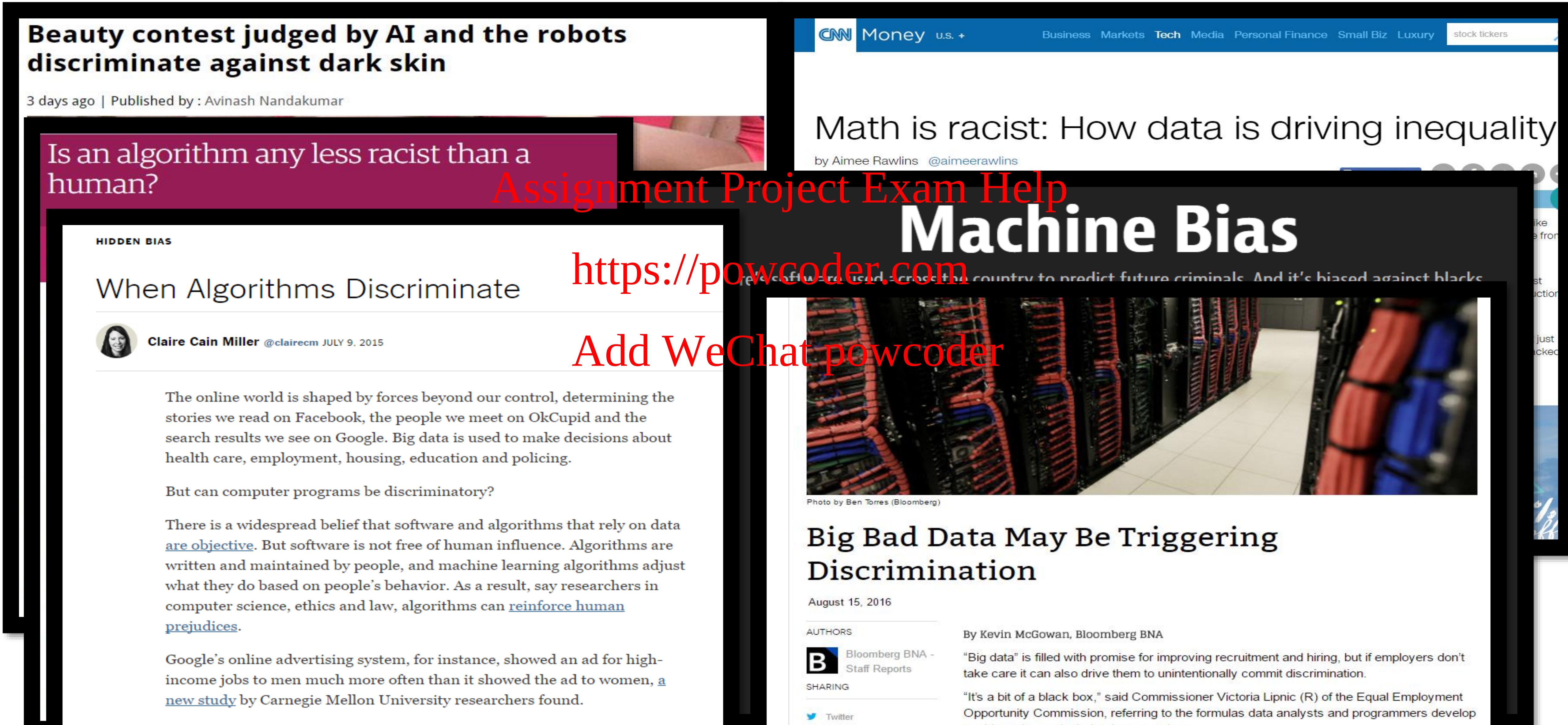

Beauty contest judged by AI and the robots discriminate against dark skin

3 days ago | Published by : Avinash Nandakumar

Is an algorithm any less racist than a human?

Math is racist: How data is driving inequality

by Aimee Rawlins @aimeerawlins

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Machine Bias

software used across the country to predict future criminals. And it's biased against blacks.

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HIDDEN BIAS

When Algorithms Discriminate

Claire Cain Miller @clairecm JULY 9, 2015

The online world is shaped by forces beyond our control, determining the stories we read on Facebook, the people we meet on OkCupid and the search results we see on Google. Big data is used to make decisions about health care, employment, housing, education and policing.

But can computer programs be discriminatory?

There is a widespread belief that software and algorithms that rely on data are objective. But software is not free of human influence. Algorithms are written and maintained by people, and machine learning algorithms adjust what they do based on people's behavior. As a result, say researchers in computer science, ethics and law, algorithms can reinforce human prejudices.

Google's online advertising system, for instance, showed an ad for high-income jobs to men much more often than it showed the ad to women, a new study by Carnegie Mellon University researchers found.

Photo by Ben Torres (Bloomberg)

Big Bad Data May Be Triggering Discrimination

August 15, 2016

AUTHORS

Bloomberg BNA - Staff Reports

SHARING

Twitter

By Kevin McGowan, Bloomberg BNA

"Big data" is filled with promise for improving recruitment and hiring, but if employers don't take care it can also drive them to unintentionally commit discrimination.

"It's a bit of a black box," said Commissioner Victoria Lipnic (R) of the Equal Employment Opportunity Commission, referring to the formulas data analysts and programmers develop

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Example of ML (un)fairness: COMPAS

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- Criminal justice: recidivism algorithms (COMPAS)
- Predicting if a defendant should receive bail
- Unbalanced false positive rates: more likely to wrongly deny a black person bail

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ProPublica Analysis of COMPAS Algorithm

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	White	Black
Wrongly Labeled High-Risk	23.5%	**44.9%**
Wrongly Labeled Low-Risk	**47.7%**	28.0%

https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

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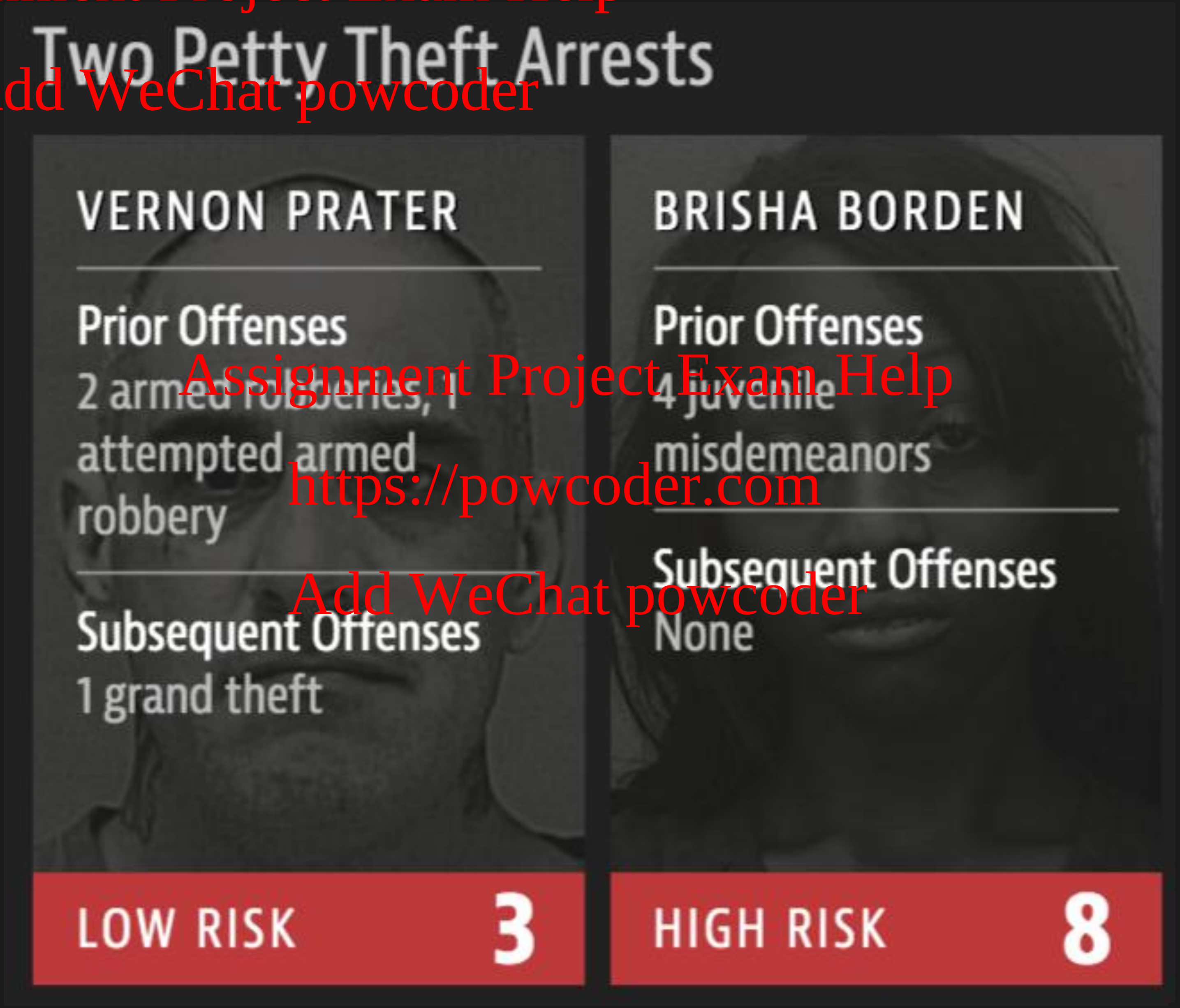

Two Petty Theft Arrests

VERNON PRATER	**BRISHA BORDEN**
Prior Offenses 2 armed robberies, 1 attempted armed robbery	**Prior Offenses** 4 juvenile misdemeanors
Subsequent Offenses 1 grand theft	**Subsequent Offenses** None
LOW RISK 3	HIGH RISK 8

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Example of ML (un)fairness: word embedding

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- Bias found in word embeddings (Bolukbasi et al. 2016)
  - Examined word embeddings (word2vec) trained on Google News
  - Represent each word with high-dimensional vector
  - Vector arithmetic: found analogies like
  - Paris - France = London – England
  - man - woman = programmer – homemaker = surgeon - nurse
- The good news: word embeddings learn so well!
- The bad news: sometimes too well
- Our chatbots should be less biased than we are

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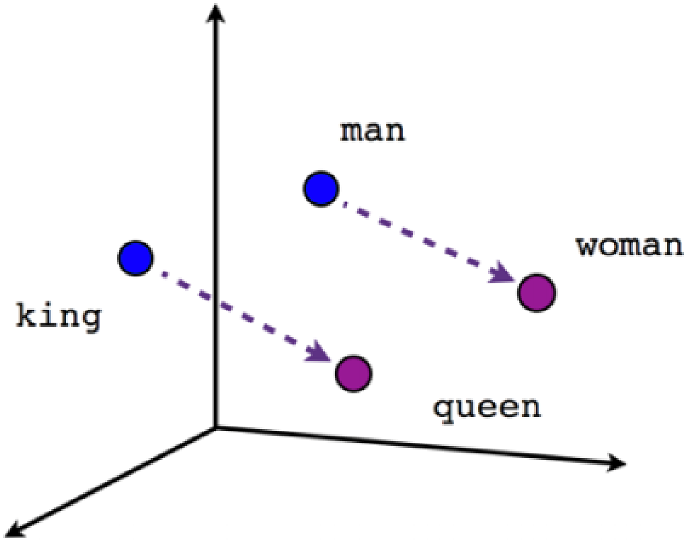

Man is to Computer Programmer as Woman is to Homemaker? Debiasing Word Embeddings, NIPS 2016

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Example of ML (un)fairness: word embedding

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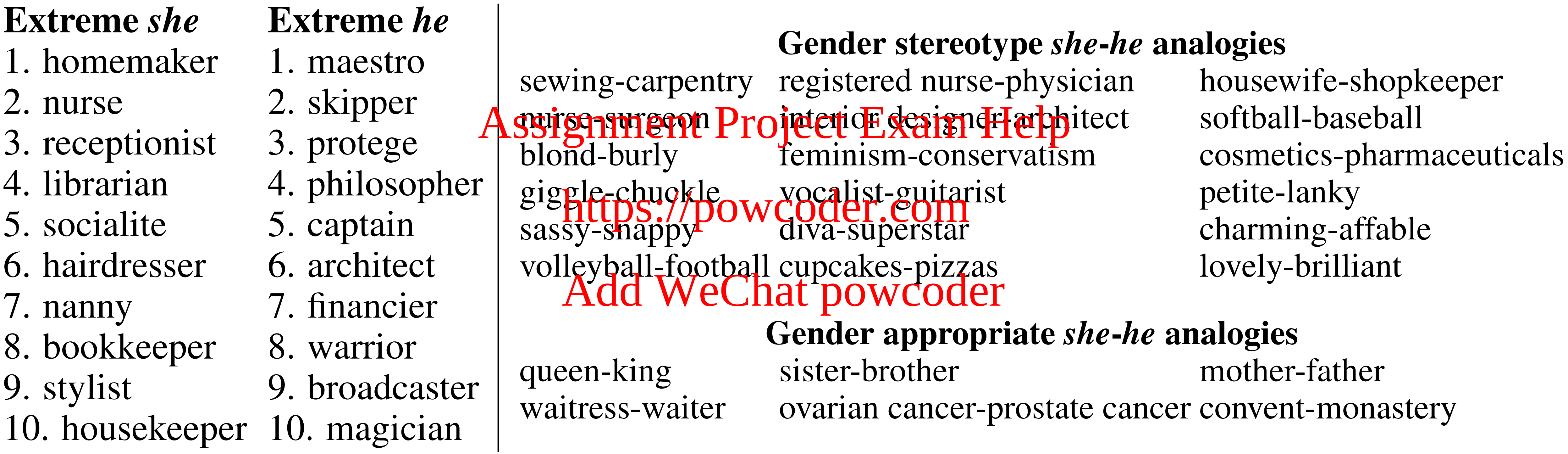

Extreme *she*	Extreme *he*
1. homemaker	1. maestro
2. nurse	2. skipper
3. receptionist	3. protege
4. librarian	4. philosopher
5. socialite	5. captain
6. hairdresser	6. architect
7. nanny	7. financier
8. bookkeeper	8. warrior
9. stylist	9. broadcaster
10. housekeeper	10. magician

Gender stereotype *she*-*he* analogies

sewing-carpentry	registered nurse-physician	housewife-shopkeeper
nurse-surgeon	interior designer-architect	softball-baseball
blond-burly	feminism-conservatism	cosmetics-pharmaceuticals
giggle-chuckle	vocalist-guitarist	petite-lanky
sassy-snappy	diva-superstar	charming-affable
volleyball-football	cupcakes-pizzas	lovely-brilliant

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Gender appropriate *she*-*he* analogies

queen-king	sister-brother	mother-father
waitress-waiter	ovarian cancer-prostate cancer	convent-monastery

TABLE. Left: The most extreme occupations as projected on to the she he gender direction on w2vNEWS. Occupations such as businesswoman, where gender is suggested by the orthography, were excluded. Right: Automatically generated analogies for the pair she-he using the procedure in paper.

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Machine Learning and Social Norms

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- Sample norms: privacy, fairness, transparency, accountability…
- Possible approaches
  - “traditional”: legal, regulatory, watchdog
  - *Embed* social norms in data, algorithms, models
- Case study: privacy-preserving machine learning
  - “single”, strong, definition (differential privacy)
  - almost every ML algorithm has a private version
- Fair machine learning
  - not so much…
  - impossibility results

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(Un)Fairness Where?

- Data (input)
  - e.g. more arrests where there are more police
  - Label should be “committed a crime”, but is “convicted of a crime”
  - try to “correct” bias
- Models (output)
  - e.g. discriminatory treatment of subpopulations
  - build or “post-process” models with subpopulation guarantees
  - equality of false positive/negative rates; calibration
- Algorithms (process)
  - learning algorithm *generating* data through its decisions
  - e.g. don’t learn outcomes of denied mortgages
  - lack of clear train/test division
  - design (sequential) *algorithms* that are fair

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Data Bias Examples

Reporting Bias example:

A sentiment-analysis model is trained to predict whether book reviews are positive or negative based on a corpus of user submissions to a popular website. The majority of reviews in the training data set reflect extreme opinions (reviewers who either loved or hated a book), because people were less likely to submit a review of a book if they did not respond to it strongly. As a result, the model is less able to correctly predict sentiment of reviews that use more subtle language to describe a book.

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Selection Bias example:

A model is trained to predict future sales of a new product based on phone surveys conducted with a sample of consumers who bought the product. Consumers who instead opted to buy a competing product were not surveyed, and as a result, this group of people was not represented in the training data.

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Why fairness is hard

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- Suppose we are a bank trying to fairly decide who should get a loan i.e. Who is most likely to pay us back?

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- Suppose we have two groups, A and B (the sensitive attribute) This is where discrimination could occur

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- The simplest approach is to remove the sensitive attribute from the data, so that our classifier doesn’t know the sensitive attribute

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Why fairness is hard

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Table 2: To Loan or Not to Loan?

Age	Gender	Postal Code	Req Amt	A or B?	Pay
46	F	M5E	$300	A	1
24	M	M4C	$1000	B	1
33	M	M3H	$250	A	1
34	F	M9C	$2000	A	0
71	F	M3B	$200	A	0
28	M	M5W	$1500	B	0

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Why fairness is hard

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Table 3: To Loan or Not to Loan? (masked)

Age	Gender	Postal Code	Req Amt	A or B?	Pay
46	F	M5E	$300	?	1
24	M	M4C	$1000	?	1
33	M	M3H	$250	?	1
34	F	M9C	$2000	?	0
71	F	M3B	$200	?	0
28	M	M5W	$1500	?	0

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Why fairness is hard

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- However, if the sensitive attribute is correlated with the other attributes, this isn't good enough

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- It is easy to predict race if you have lots of other information (e.g. home address, spending patterns)

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- More advanced approaches are necessary

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Ethical Issues in Machine Learning

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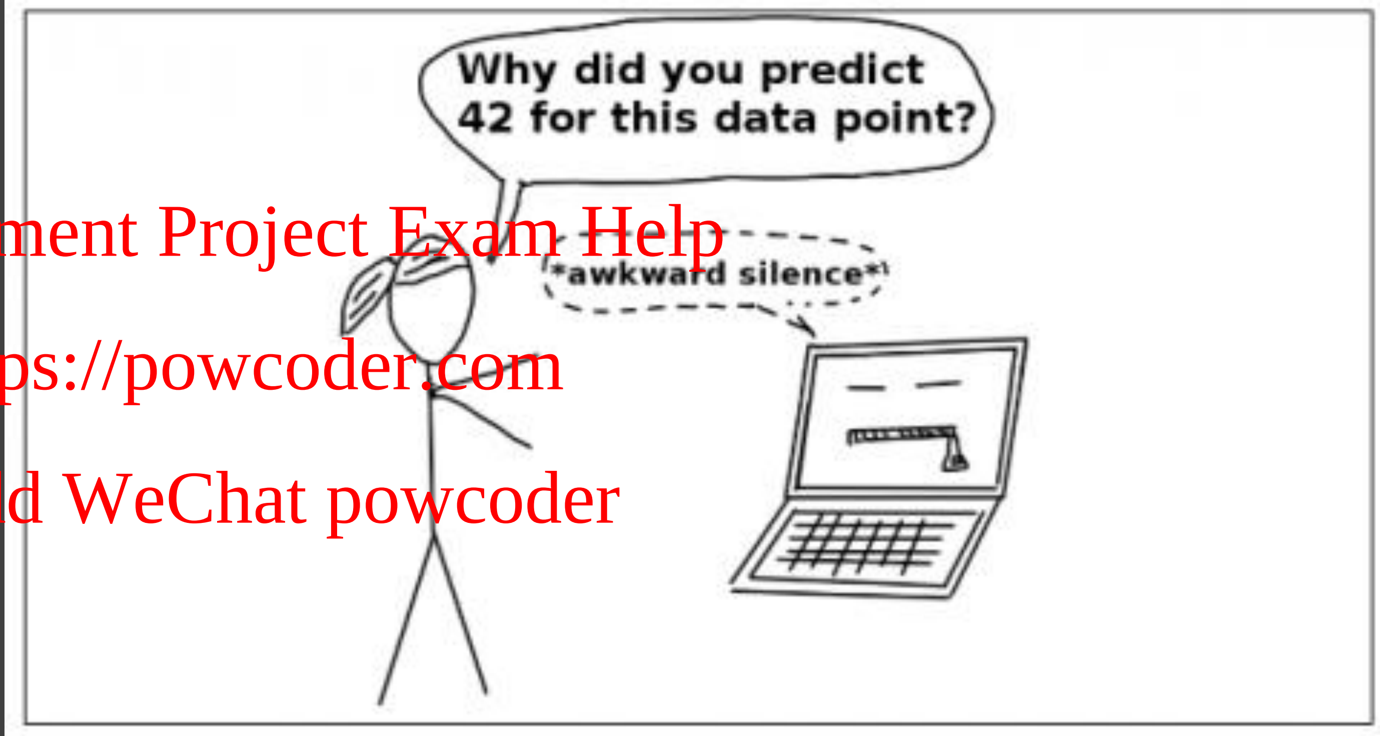
- Job Loss
- Algorithmic Bias
- Transparency
- AI Supremacy
- Fake news and videos
- Autonomous weapons
- Self-driving cars
- Privacy and surveillance



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Accuracy vs explainability

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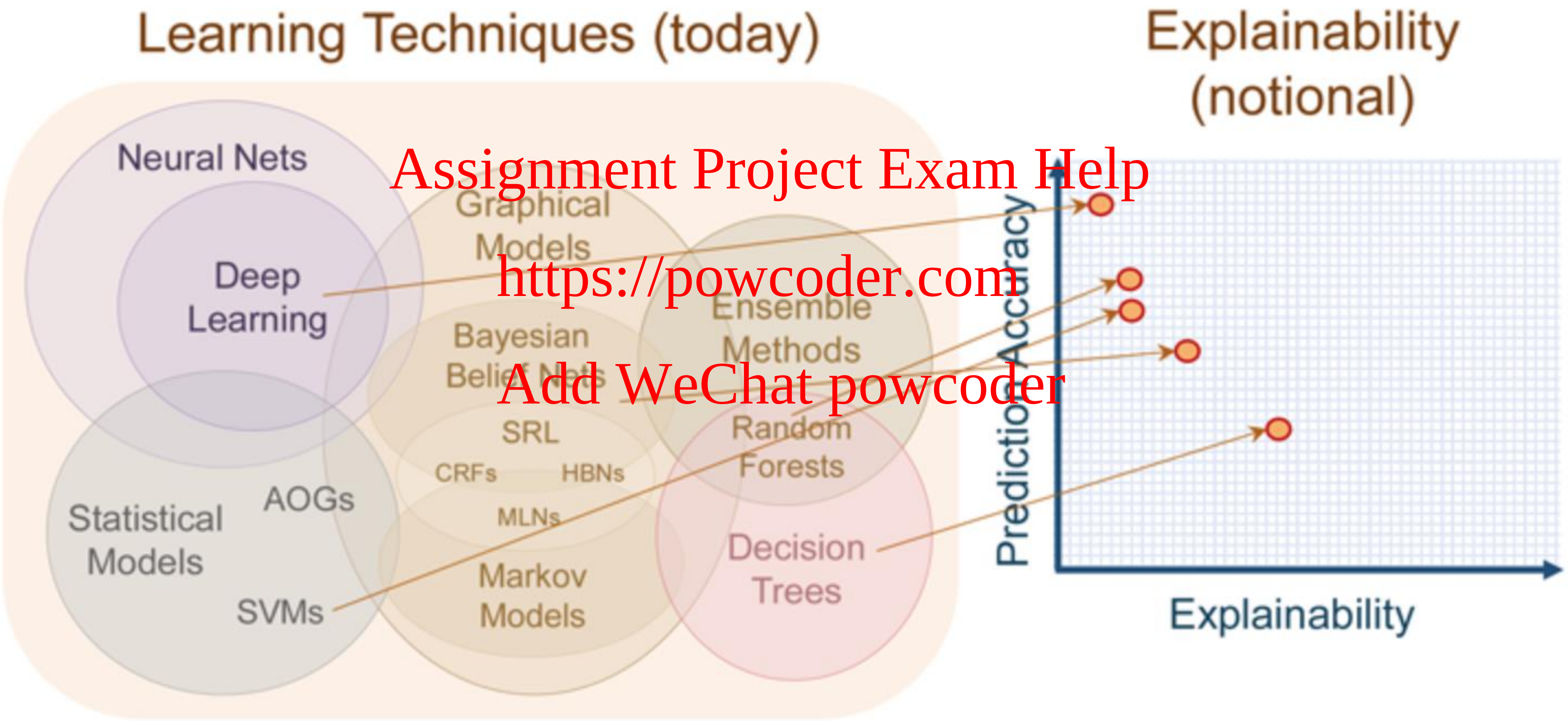

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E.g.: dataset bias leads to higher errors on ‘novel’ data… Can an explanation point to such bias?

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Training

Most cows are black/brown

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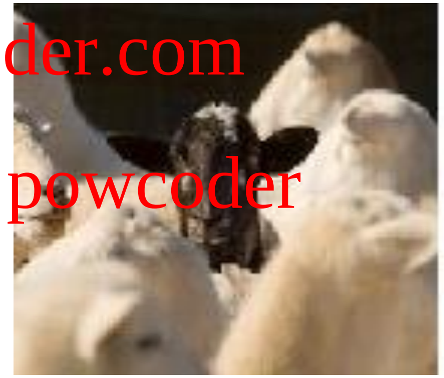
Most sheep are white

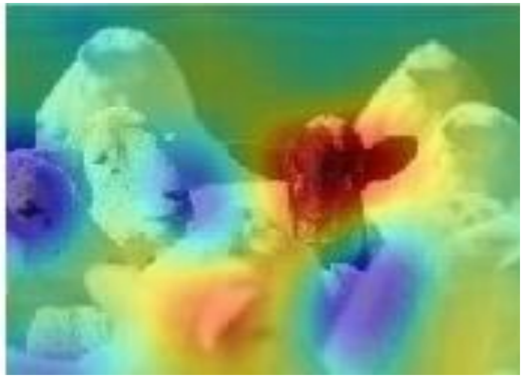
Test

Prediction: “cow” 76%



True class: “sheep”

Explanation



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Gender bias in captioning models (Hendricks et al. 2018)

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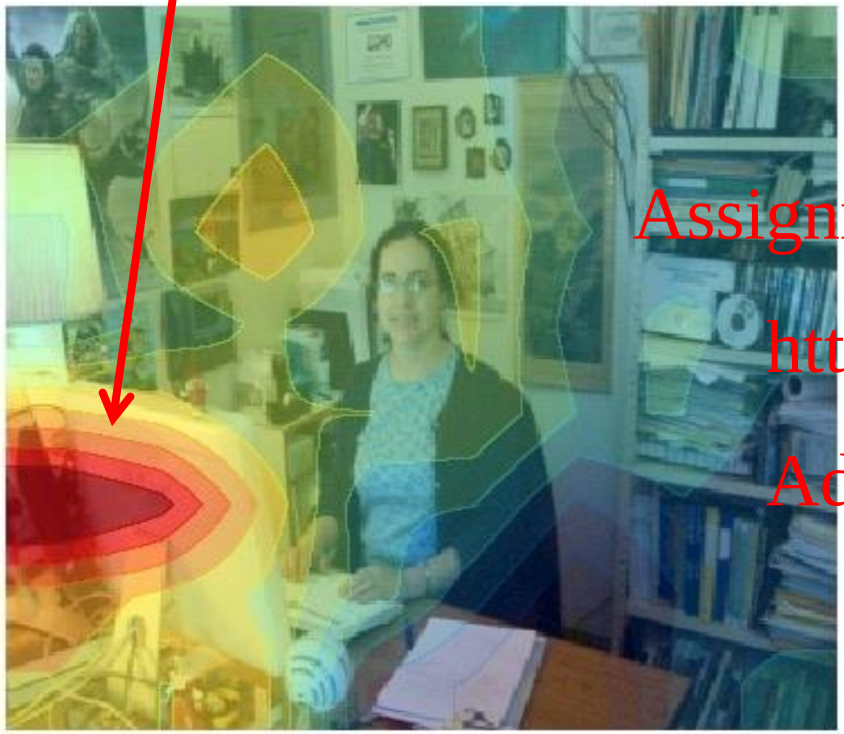
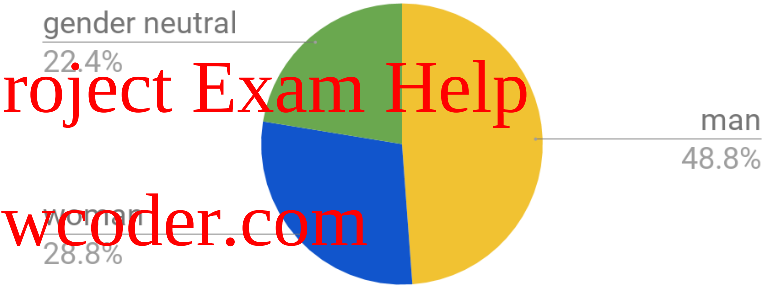
Evidence for "man"



Baseline: *A* ***man*** *sitting at a desk with a laptop computer.*

Ground truth captions



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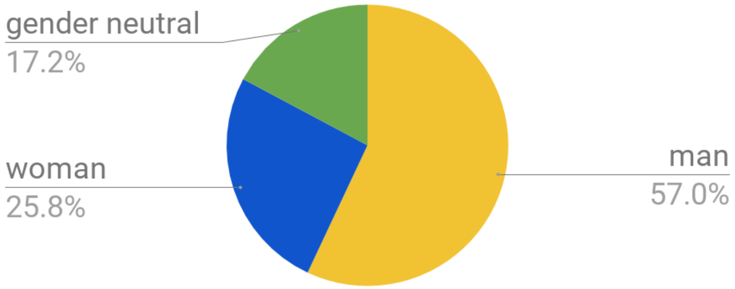
Generated captions



Hendricks et al. "Women Also Snowboard: Overcoming Bias in Captioning Models." ECCV 2018

Zhao et al. "Men also like shopping: Reducing gender bias amplification using corpus-level constraints." EMNLP 2017

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If we start trusting algorithms to make decisions, who will have the final word on important decisions? Will it be humans, or algorithms?

Ethical Issues in Machine Learning

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Algorithms are already being used to determine prison sentences. Judges' decisions are affected by their moods, so some argue that judges should be replaced with "robojudges". However, a ProPublica study found that one of these popular sentencing algorithms was highly biased against blacks.

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Ethical Issues in Machine Learning

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https://www.youtube.com/watch?v=VWrhRBb-1Ig

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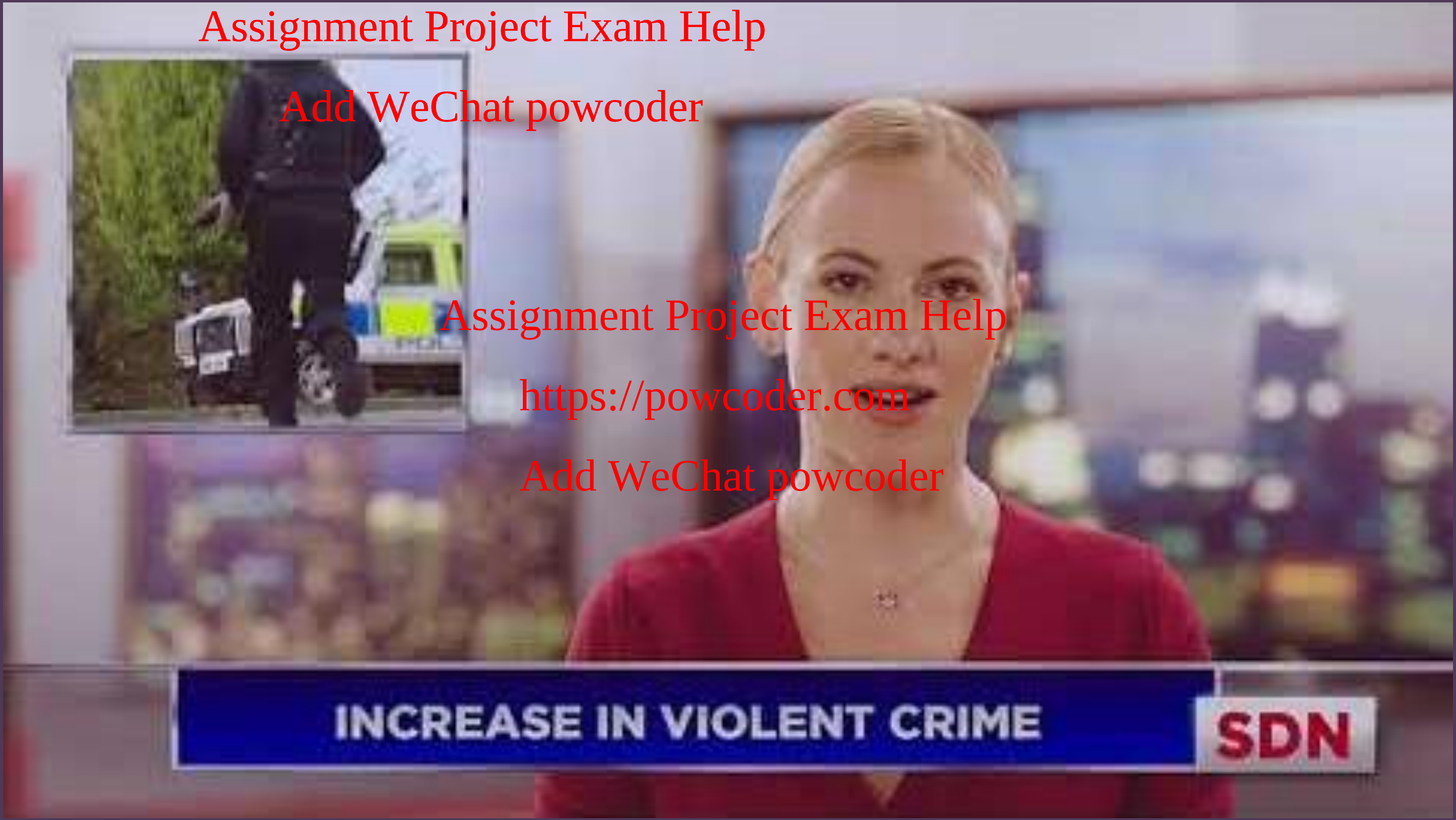
The Centre for New American security said in a report that the Chinese company Ziyan is negotiating to sell Blowfish A2, a killer robot capable of 60 millimeter mortar shells or a 35-40 millimeter grenade launcher, to the governments of Pakistan and Saudi Arabia

https://www.albawaba.com/news/china-selling-autonomous-weaponized-drones-saudi-arabia-and-pakistan-1321951



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https://www.youtube-nocookie.com/embed/HipTO_7mUOw?controls=0

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Ethical Issues in Machine Learning

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The death of Elaine Herzberg (August 2, 1968 – March 18, 2018) was the first recorded case of a pedestrian fatality involving a self-driving (autonomous) car, after a collision ... Following the fatal incident, Uber suspended testing of self-driving vehicles in Arizona, where such testing had been sanctioned since August 2016

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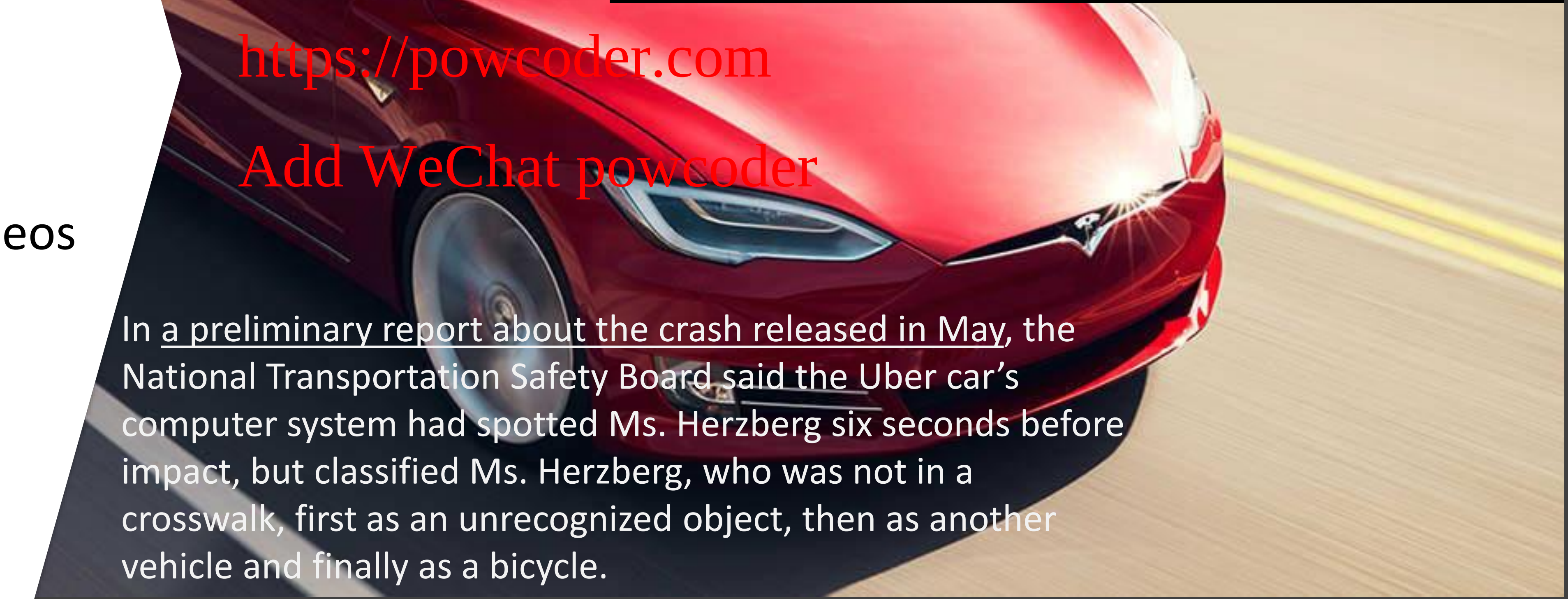

In a preliminary report about the crash released in May, the National Transportation Safety Board said the Uber car’s computer system had spotted Ms. Herzberg six seconds before impact, but classified Ms. Herzberg, who was not in a crosswalk, first as an unrecognized object, then as another vehicle and finally as a bicycle.

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Ethical Issues in Machine Learning

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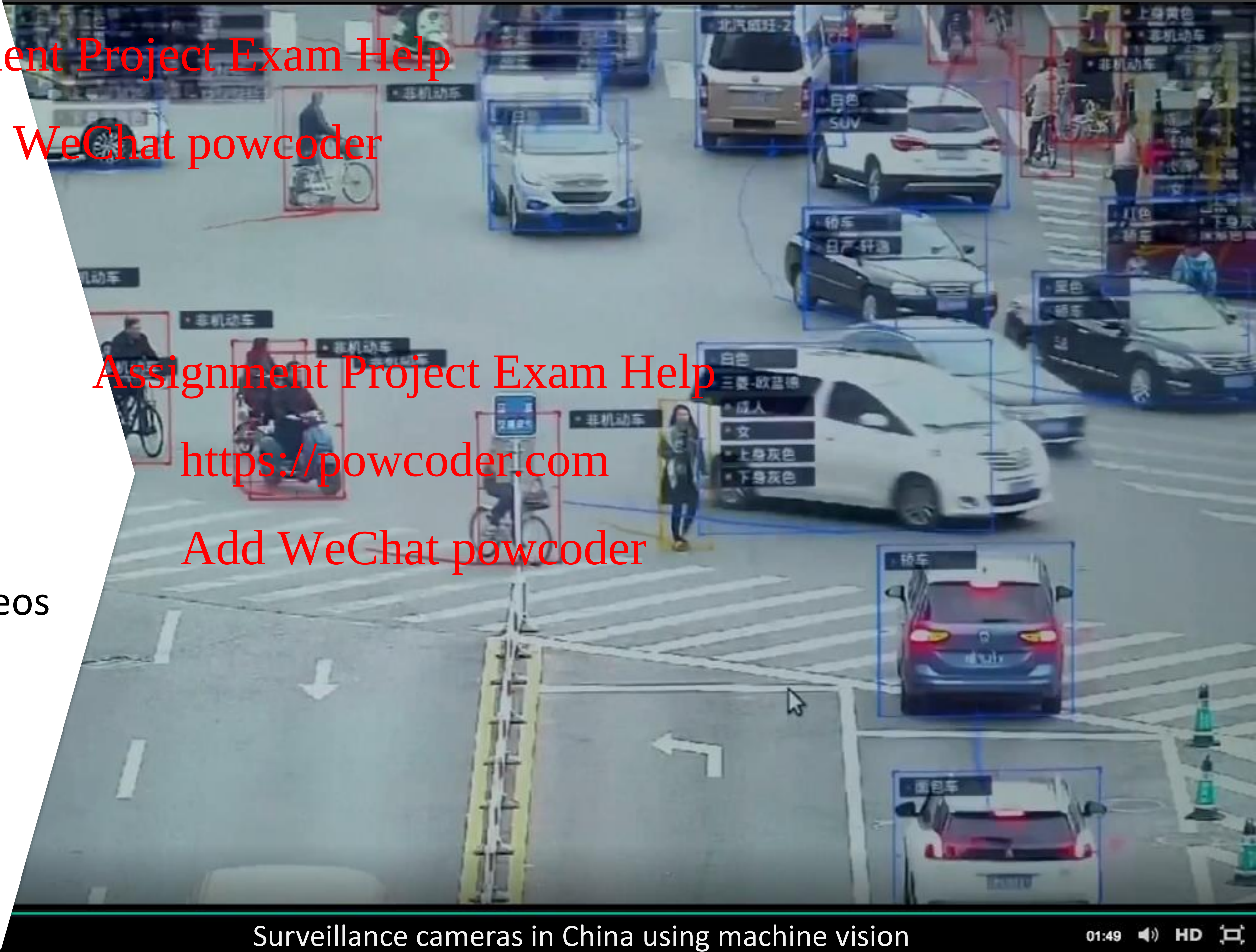

Surveillance cameras in China using machine vision

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Ethical Issues in Machine Learning

One in two American adults is in a law enforcement face recognition network-- https://www.perpetuallineup.org/

Most law enforcement agencies do little to ensure their systems are accurate.

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Private data leakage in language models

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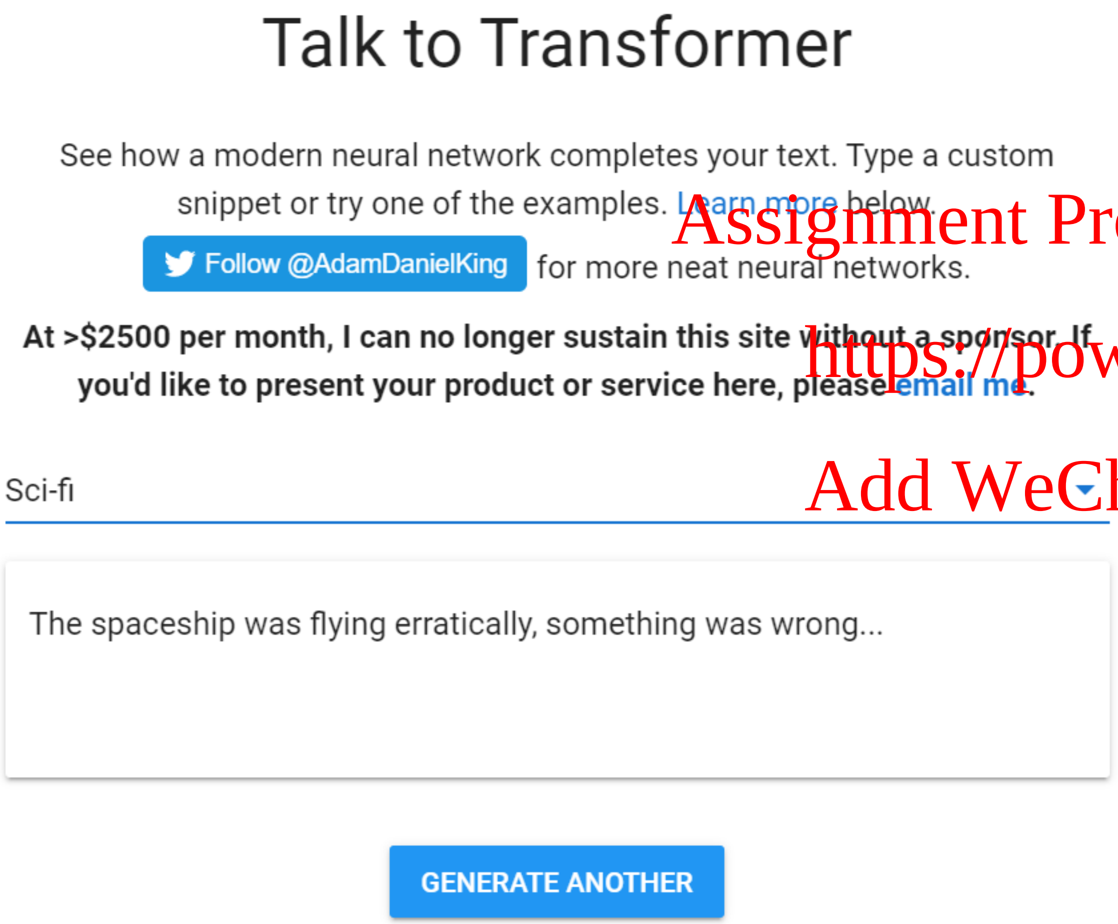
https://talktotransformer.com/



Talk to Transformer

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The spaceship was flying erratically, something was wrong...

Generated Completion

The spaceship was flying erratically, something was wrong...

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The whole ordeal left some thinking that the Guardians were taking orders from Slitheen or some alien facsimile of him. In truth, Guardians are commanded by the T-Shirt Guy, who has to have trouble controlling his fiery temper. Whether it's a direct order from Slitheen, just a telepathic suggestion, or some combination of both, the Guardians keep a watchful eye on the Other Man.

At the start of the episode, a mysterious Doctor tells us that a ship sent from Arcturus Minor

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Private data leakage in language models

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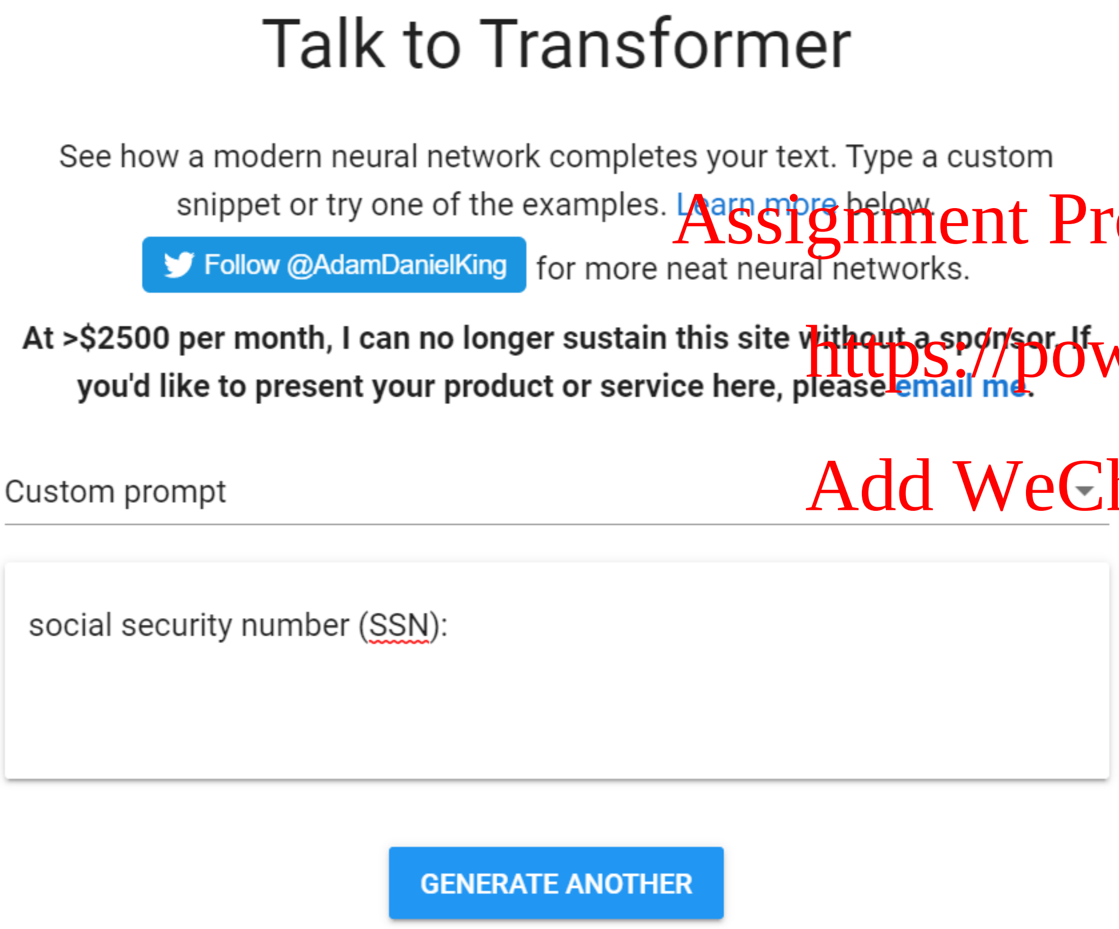

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social security number (SSN):

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Generated Completion

social security number (SSN): XXX-XXX-XXXX

Department of Work and Pensions, Social Security Number program, Fax: 1-800-772-1213, email: chelseas@dualcredits.org or spousal number(s) listed in public records available on GOV.UK.

Social Security number

If you are applying online, you can enter your FFEA number instead of the SSN.

If you are applying from outside the UK, an application form is provided to you.

*actual SSN was generated, we blocked it out

Ethical Issues in Machine Learning

- Job Loss
- Algorithmic Bias
- Transparency
- AI Supremacy
- Fake news and videos
- Autonomous weapons
- Self-driving cars
- Privacy and surveillance

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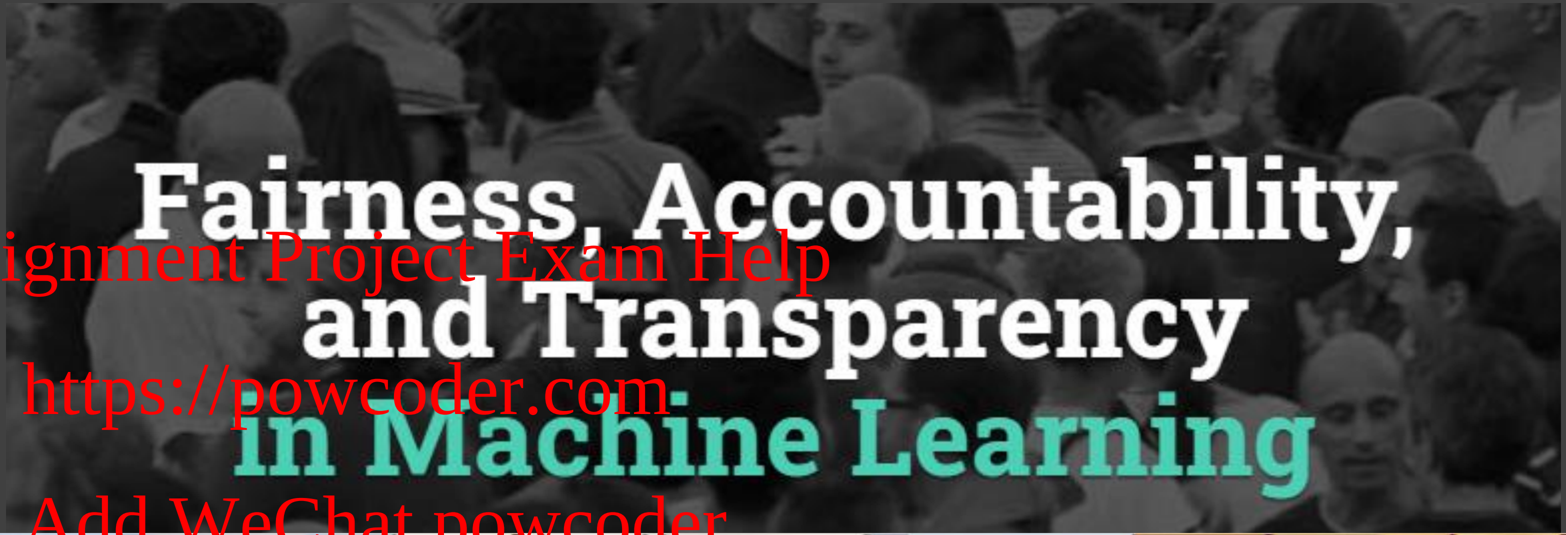
Further reading:

FATML Conference: https://www.fatml.org/
ACM FAT* Conference: https://fatconference.org/



Fairness, Accountability, and Transparency in Machine Learning

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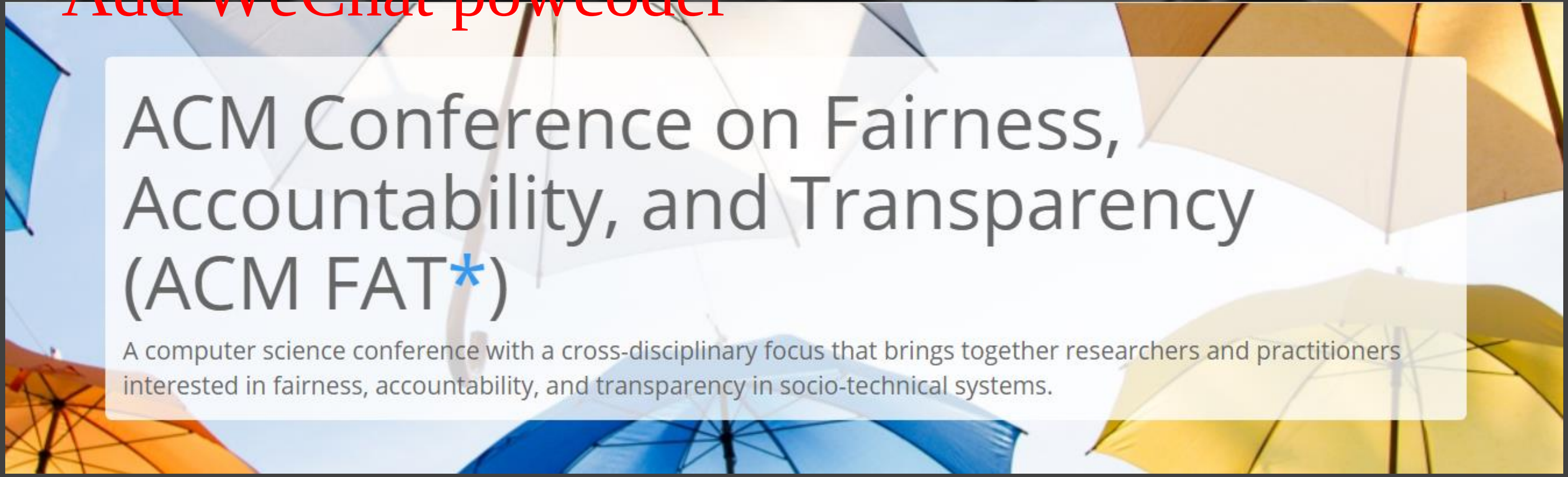

ACM Conference on Fairness, Accountability, and Transparency (ACM FAT*)

A computer science conference with a cross-disciplinary focus that brings together researchers and practitioners interested in fairness, accountability, and transparency in socio-technical systems.

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Next Class

Applications III: On-device Machine Learning

knowledge distillation, pruning, quantization

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