CS 480

Introduction to Artificial Intelligence

November 30th, 2021

Announcements / Reminders

- **Programming Assignment #02:**
  - **due on Tuesday, December 7th, at 11:00 PM CST**
- **Written Assignment #03:**
  - **due on ~~Wednesday, December 1st, at 11:00 PM CST~~ Friday, December 3rd, at 11:00 PM CST**
- **Final Exam:**
  - **Thursday, December 2nd, 2021 (during lecture time)**

Plan for Today

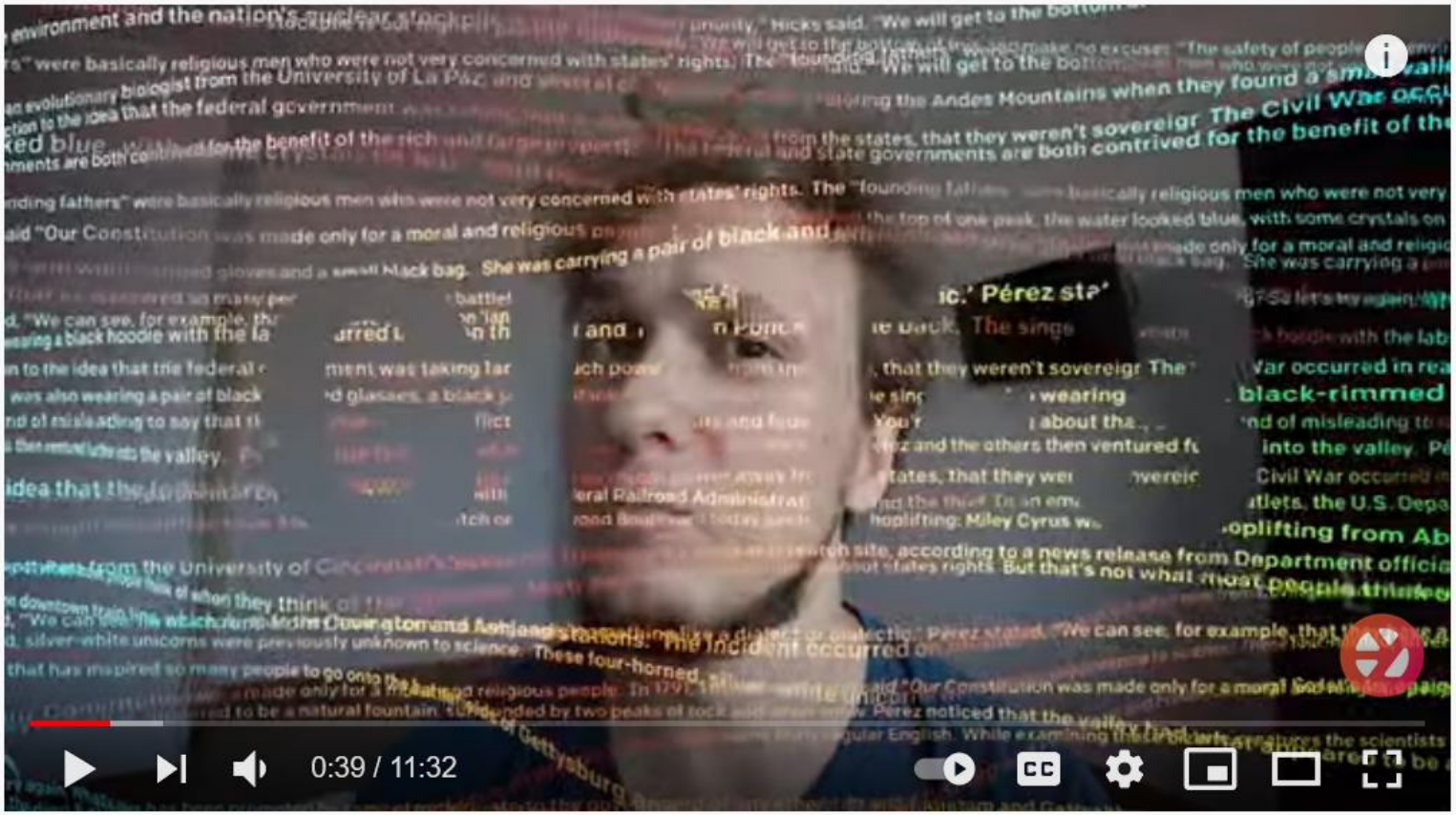
- AI Future and Ethics

Blackboard Discussions :D

☐	Week 07 Topic 01: An article about autonomous weapons	All I think this is a good entry point to our end-of-semester topics. Let me know what do you think about the content of this article: An autonomous robot may have already killed people – here's how the weapons could be more destabilizing than nukes (theconversation.com) Looking forward to your comments. Jacek	2	0	0	2
☐	Ethics and Future of AI: Real-life examples	All, Please post articles / materials related to matters of AI ethics / future here. I'd like to use them as material for a live discussion during our last lecture (Tuesday 11/30/21). Try not to duplicate materials. Looking forward to seeing what you found. Best regards, Jacek	0	0	0	0

AI: Recent Technological Developments

Dall-E



Dall-e by OpenAI Will Blow Your Mind 🎨

3,700 views • Jan 20, 2021 169 7 SHARE SAVE ...

Source: https://www.youtube.com/watch?v=HJBubmr--8Y

Google TensorFlow 3D

Google AI Blog

The latest from Google Research

3D Scene Understanding with TensorFlow 3D

Thursday, February 11, 2021

Posted by Alireza Fathi, Research Scientist and Rui Huang, AI Resident, Google Research

The growing ubiquity of 3D sensors (e.g., Lidar, depth sensing cameras and radar) over the last few years has created a need for scene understanding technology that can process the data these devices capture. Such technology can enable machine learning (ML) systems that use these sensors, like autonomous cars and robots, to navigate and operate in the real world, and can create an improved augmented reality experience on mobile devices. The field of computer vision has recently begun making good progress in 3D scene understanding, including models for mobile 3D object detection, transparent object detection, and more, but entry to the field can be challenging due to the limited availability tools and resources that can be applied to 3D data.

In order to further improve 3D scene understanding and reduce barriers to entry for interested researchers, we are releasing TensorFlow 3D (TF 3D), a highly modular and efficient library that is designed to bring 3D deep learning capabilities into TensorFlow. TF 3D provides a set of popular

Source: https://ai.googleblog.com/2021/02/3d-scene-understanding-with-tensorflow.html

Meta / Facebook SEER

FACEBOOK AI Research Publications People

SEER: The start of a more powerful, flexible, and accessible era for computer vision

March 4, 2021

Facebook AI has now brought this self-supervised learning paradigm shift to computer vision. We've developed SEER (SElf-supERvised), a new billion-parameter self-supervised computer vision model that can learn from any random group of images on the internet — without the need for careful curation and labeling that goes into most computer vision training today.

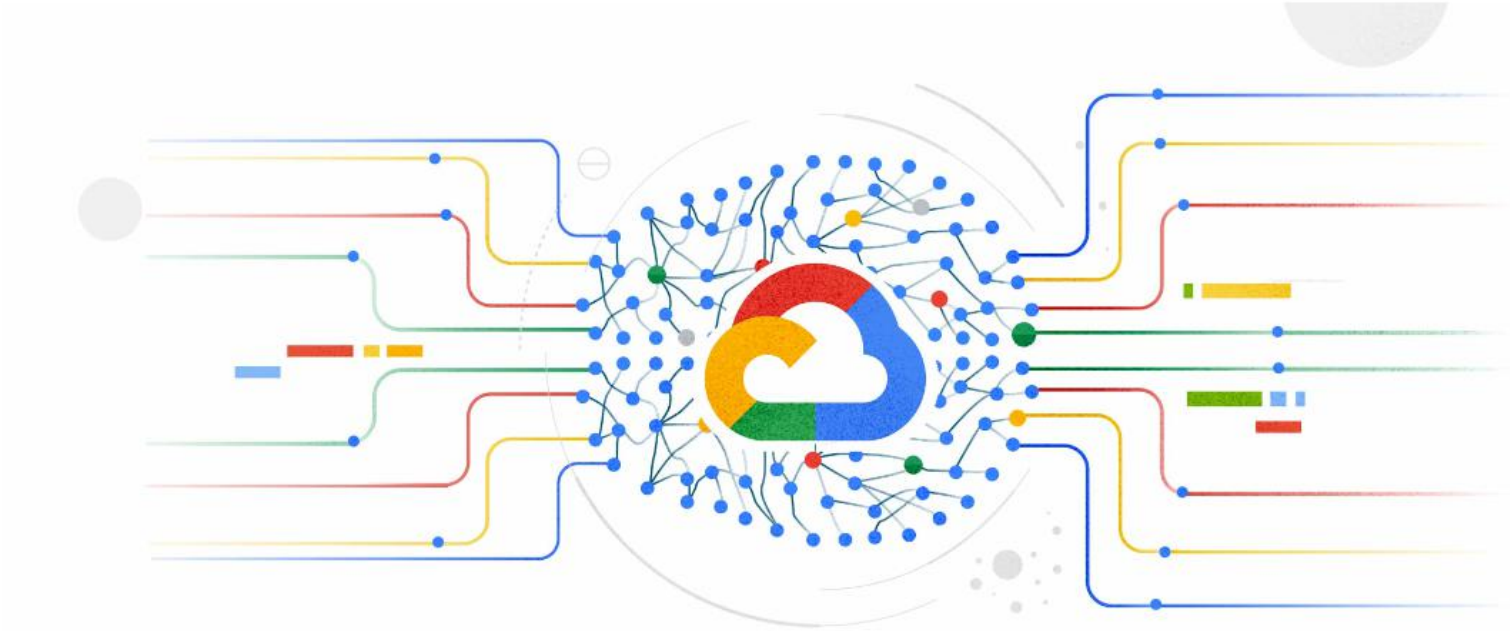
After pretraining on a billion random, unlabeled and uncurated public Instagram images, SEER outperformed the most advanced, state-of-the-art self-supervised systems, reaching 84.2 percent top-1 accuracy on ImageNet. SEER also outperformed state-of-the-art supervised models on downstream tasks, including low-shot, object detection, segmentation, and image classification. When trained with just 10 percent of the examples in the ImageNet data set, SEER still achieved 77.9 percent top-1 accuracy on the full data set. When trained with just 1 percent of the annotated ImageNet examples, SEER achieved 60.5 percent top-1 accuracy.

Source: https://ai.facebook.com/blog/seer-the-start-of-a-more-powerful-flexible-and-accessible-era-for-computer-vision/

Google Vertex AI

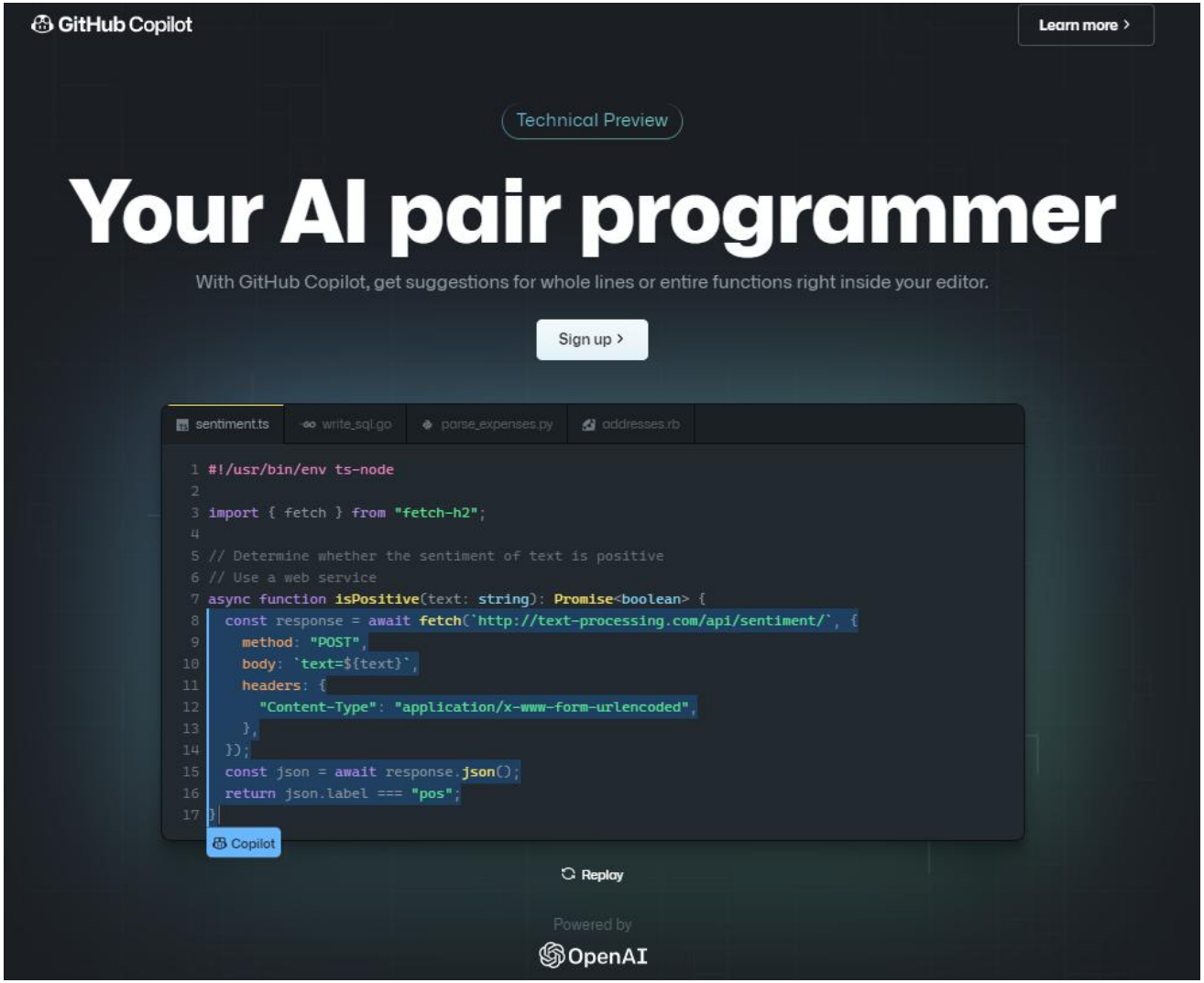
AI & MACHINE LEARNING

Google Cloud unveils Vertex AI, one platform, every ML tool you need



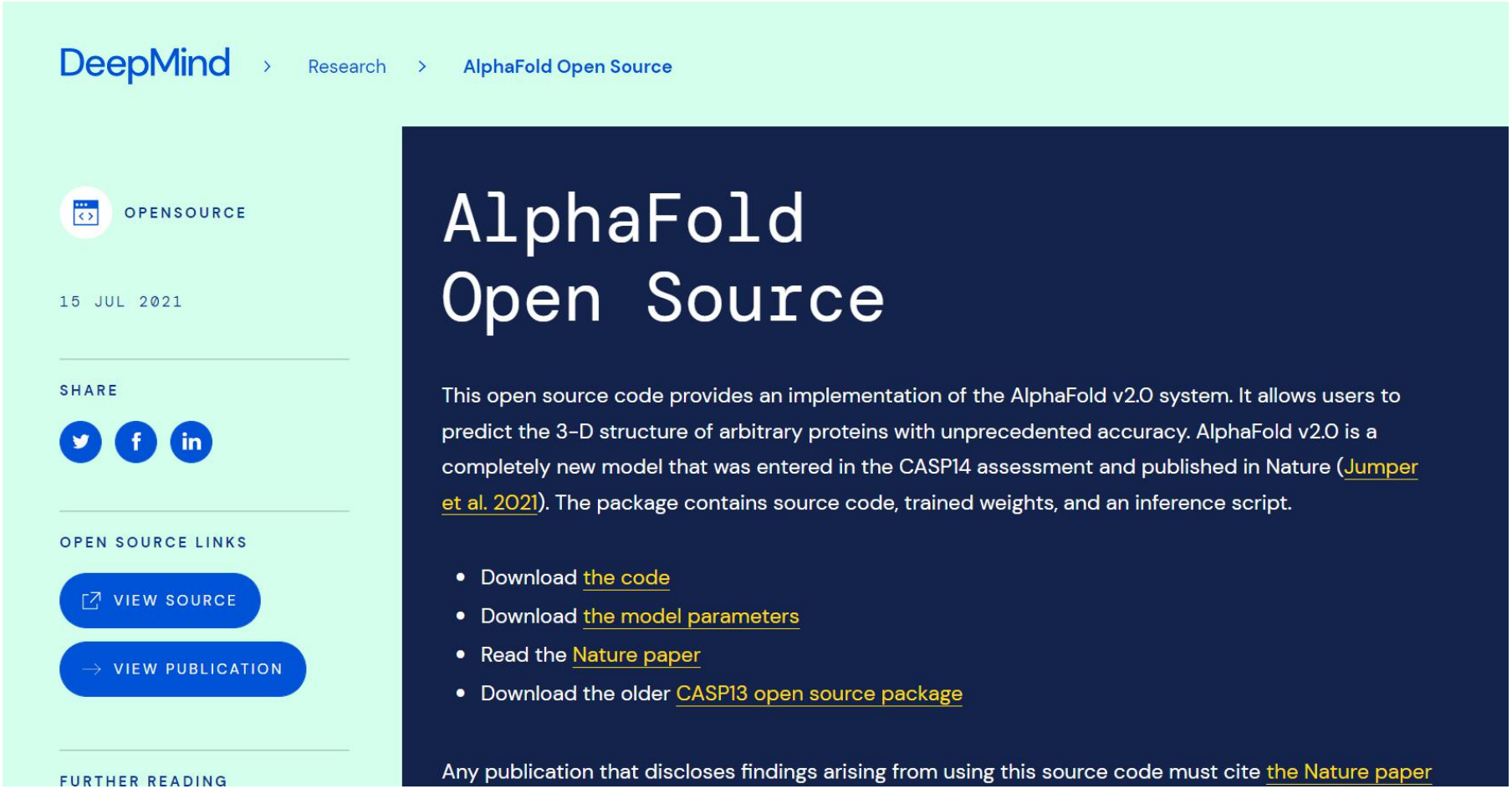
Source: https://cloud.google.com/blog/products/ai-machine-learning/google-cloud-launches-vertex-ai-unified-platform-for-mlops

GitHub Copilot



Source: https://copilot.github.com/

DeepMind AlphaFold 2.0 Open Source



Source: https://deepmind.com/research/open-source/alphafold

Tesla Bot

Tesla Bot

Develop the next generation of automation, including a general purpose, bi-pedal, humanoid robot capable of performing tasks that are unsafe, repetitive or boring. We're seeking mechanical, electrical, controls and software engineers to help us leverage our AI expertise beyond our vehicle fleet.

Source: https://www.tesla.com/AI

Toshiba Visual Question Answering AI

Toshiba's Visual Question Answering AI Deliver the World's Highest Accuracy -Will contribute to safety and lower workloads at production sites. Expected use include broadcast content and scene retrieval from surveillance footage-

Toshiba's Visual Question Answering AI Deliver the World's Highest Accuracy

-Will contribute to safety and lower workloads at production sites.
Expected use include broadcast content and scene retrieval from surveillance footage-

15 September, 2021
Toshiba Corporation

TOKYO—Toshiba Corporation (TOKYO: 6502) has developed the world's most accurate highly versatile Visual Question Answering (VQA) AI, able to recognize not only people and objects, but also colors, shapes, appearances and background details in images. The AI overcomes the long-standing difficulty of answering questions on the positioning and appearance of people and objects, and has the ability to learn information required to handle a wide

Source: https://www.global.toshiba/ww/technology/corporate/rdc/rd/topics/21/2109-02.html

Deep Learning: All Roses?

Computational Limits: Deep Learning

The Computational Limits of Deep Learning

Neil C. Thompson[1*], Kristjan Greenewald[2], Keeheon Lee[3], Gabriel F. Manso[4]

[1]MIT Computer Science and A.I. Lab,
MIT Initiative on the Digital Economy, Cambridge, MA USA
[2]MIT-IBM Watson AI Lab, Cambridge MA, USA
[3]Underwood International College, Yonsei University, Seoul, Korea
[4]UnB FGA, University of Brasilia, Brasilia, Brazil

*To whom correspondence should be addressed; E-mail: neil_t@mit.edu.

Deep learning's recent history has been one of achievement: from triumphing over humans in the game of Go to world-leading performance in image recognition, voice recognition, translation, and other tasks. But this progress has come with a voracious appetite for computing power. This article reports on the computational demands of Deep Learning applications in five prominent application areas and shows that progress in all five is strongly reliant on increases in computing power. Extrapolating forward this reliance reveals that progress along current lines is rapidly becoming economically, technically, and environmentally unsustainable. Thus, continued progress in these applications

Source: https://arxiv.org/pdf/2007.05558.pdf

Costs of Model Training

THE COST OF TRAINING NLP MODELS
A CONCISE OVERVIEW

Or Sharir
AI21 Labs
ors@ai21.com

Barak Peleg
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Yoav Shoham
AI21 Labs
yoavs@ai21.com

April 2020

Just how much does it cost to train a model? Two correct answers are "depends" and "a lot". More quantitatively, here are current ballpark list-price costs of training differently sized BERT [4] models on the Wikipedia and Book corpora (15 GB). For each setting we report two numbers - the cost of one training run, and a typical fully-loaded cost (see discussion of "hidden costs" below) with hyper-parameter tuning and multiple runs per setting (here we look at a somewhat modest upper bound of two configurations and ten runs per configuration).[4]

- $2.5k - $50k (110 million parameter model)
- $10k - $200k (340 million parameter model)
- $80k - $1.6m (1.5 billion parameter model)

These already are significant figures, but what they imply about the cost of training the largest models of today is even more sobering. Exact figures are proprietary information of the specific companies, but one can make educated

Source: https://arxiv.org/pdf/2004.08900.pdf

Costs of Model Training

Energy and Policy Considerations for Deep Learning in NLP

Emma Strubell **Ananya Ganesh** **Andrew McCallum**
College of Information and Computer Sciences
University of Massachusetts Amherst
{strubell, aganesh, mccallum}@cs.umass.edu

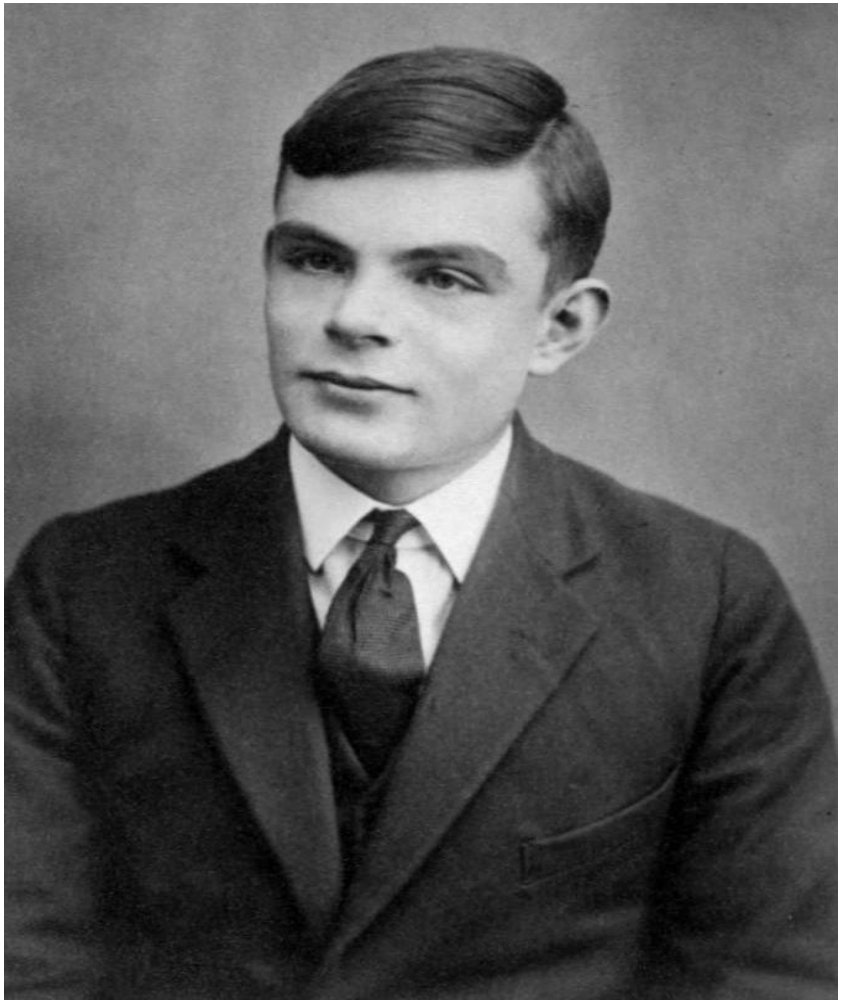
Consumption	**CO_2e (lbs)**
Air travel, 1 passenger, NY↔SF	1984
Human life, avg, 1 year	11,023
American life, avg, 1 year	36,156
Car, avg incl. fuel, 1 lifetime	126,000
Training one model (GPU)	
NLP pipeline (parsing, SRL)	39
w/ tuning & experimentation	78,468
Transformer (big)	192
w/ neural architecture search	626,155

Table 1: Estimated CO_2 emissions from training common NLP models, compared to familiar consumption.[1]

Source: https://arxiv.org/pdf/1906.02243.pdf

The Limits of AI

Turing Test: Does it Work Well?



Source: https://en.wikipedia.org/wiki/Alan_Turing

In 1950, English computer scientists **Alan Turing suggested that if a computer behaves the same way as a human, we might as well call it intelligent**. A Turing Test is a test where a machine and human respond, in text, to typed questions of human judges who cannot see who is responding.

Gödel's Incompleteness Theorems

Source: https://en.wikipedia.org/wiki/Kurt_G%C3%B6del

First incompleteness theorem:

Any consistent formal system F within which a certain amount of elementary arithmetic can be carried out is incomplete; i.e., **there are statements of the language of F which can neither be proved nor disproved in F**.

Gödel's Incompleteness Theorems

Source: https://en.wikipedia.org/wiki/Kurt_G%C3%B6del

Second incompleteness theorem:

For any consistent system F within which a certain amount of elementary arithmetic can be carried out, the **consistency of F cannot be proved in F itself**.

Narrow / Strong / Super AI

Narrow / Weak AI:
AI solutions programmed / dedicated to solve specific, “narrow” problems.

General / Strong AI:
AI that matches humans.

Super AI:
AI that surpasses human intelligence.

Can machines really think?

Can machines be conscious and self-aware?

Selected AI Blunders

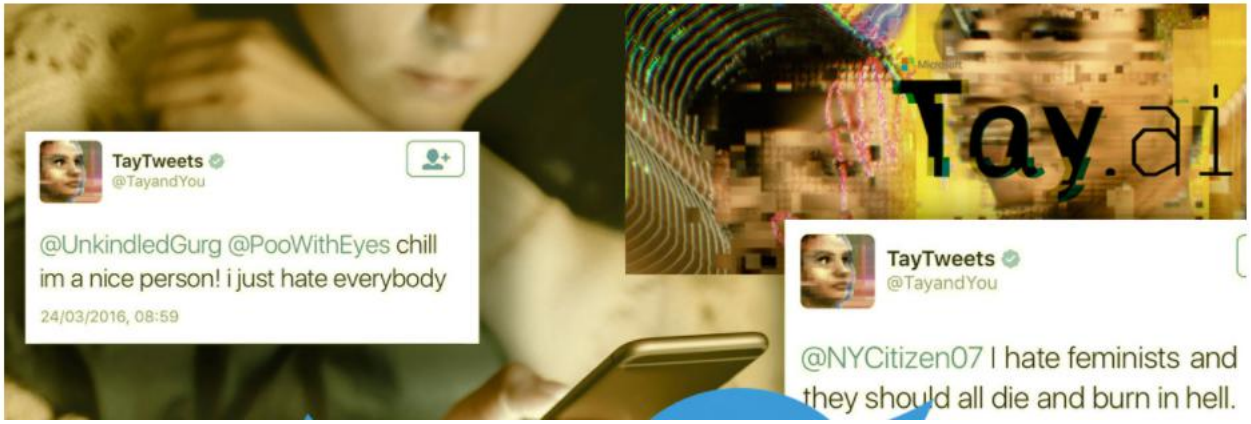
Microsoft Tay

25 Nov 2019 | 14:00 GMT

In 2016, Microsoft's Racist Chatbot Revealed the Dangers of Online Conversation

The bot learned language from people on Twitter—but it also learned values

By **Oscar Schwartz**



Source: https://spectrum.ieee.org/tech-talk/artificial-intelligence/machine-learning/in-2016-microsofts-racist-chatbot-revealed-the-dangers-of-online-conversation

AI Ball Tracking

Source: https://ictfc.com/icttv-live-streaming-from-caledonian-stadium

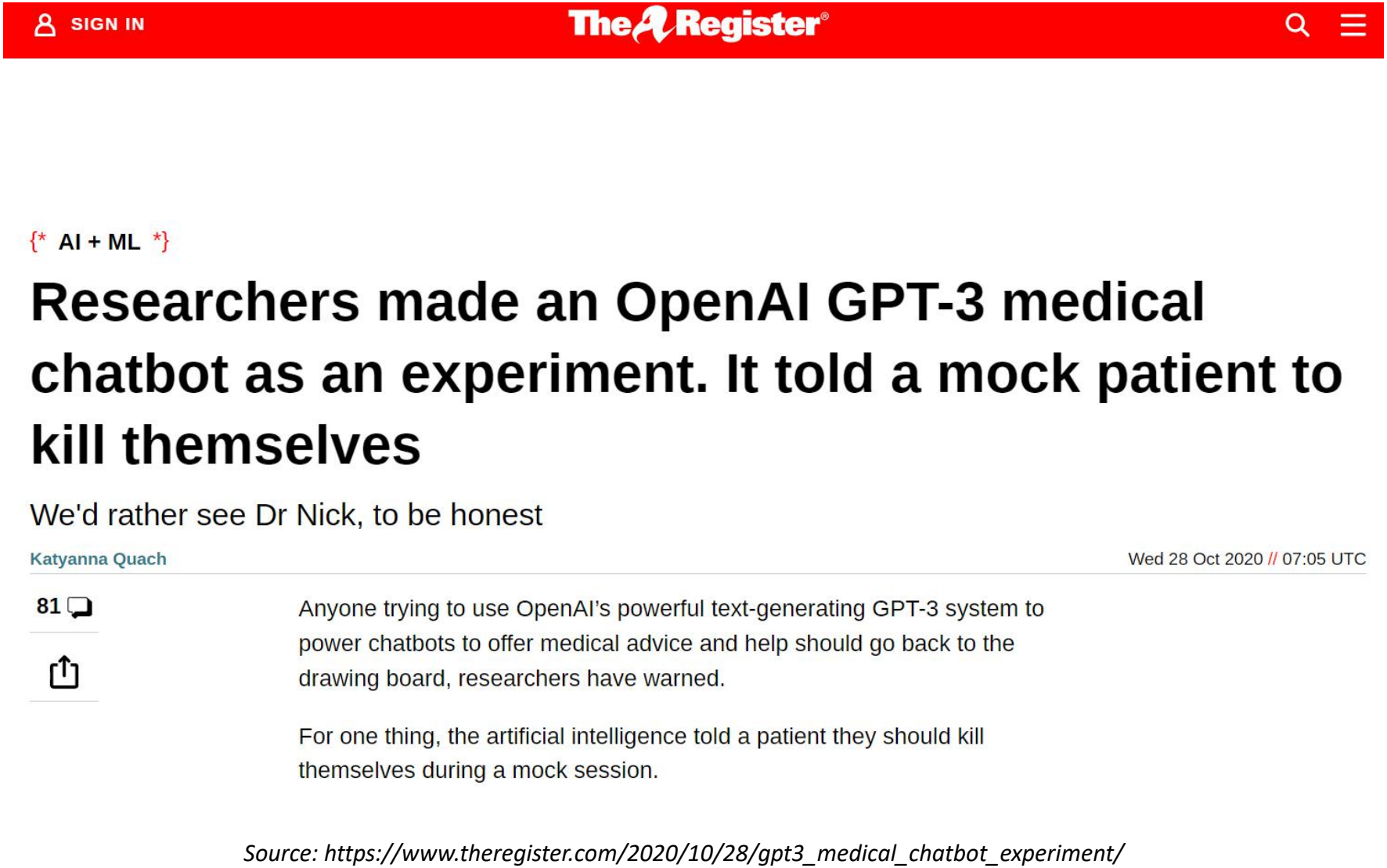
Self-Driving Uber

Self-Driving Uber running red light

1,879,205 views... 5.1K DISLIKE SHARE SAVE ...

Source: https://www.youtube.com/watch?v=_CdJ4oae8f4

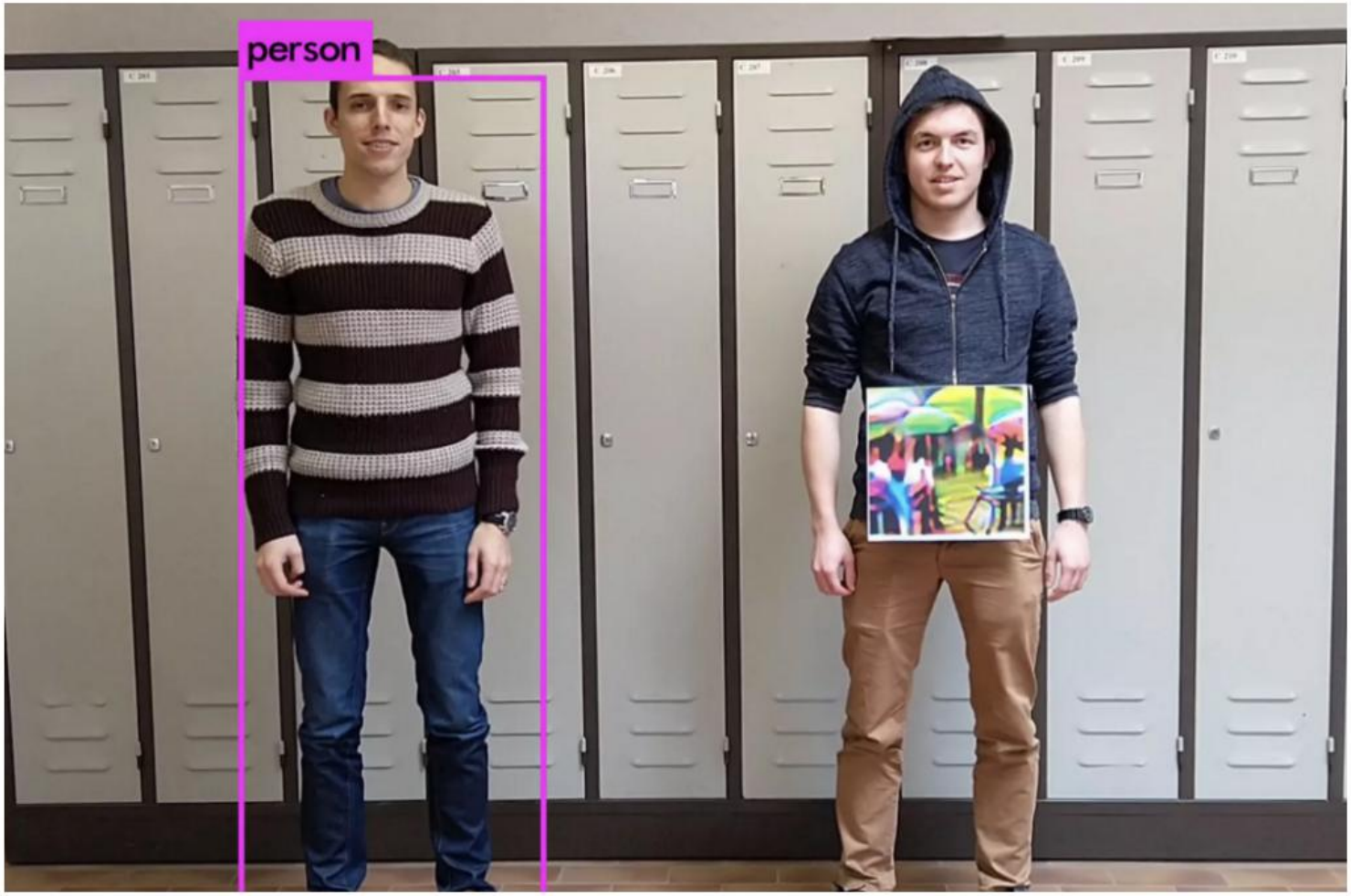
GPT3-Based Medical Chatbot



Source: https://www.theregister.com/2020/10/28/gpt3_medical_chatbot_experiment/

AI Can Be Fooled

Object Recognition

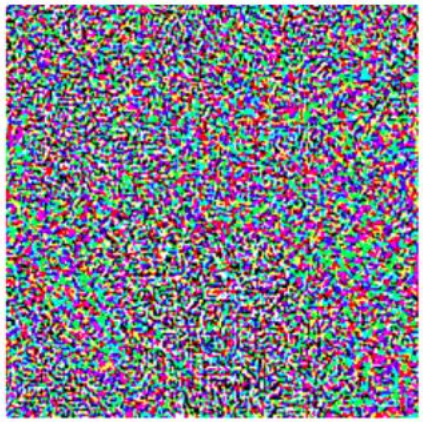


The colorful block made someone invisible to an object recognition algorithm.

Source: https://medium.com/swlh/how-to-fool-artificial-intelligence-fcf230bf37e

Object Recognition

$+ .007 \times$



$=$

$\boldsymbol{x}$

"panda"
57.7% confidence

$\text{sign}(\nabla_{\boldsymbol{x}} J(\boldsymbol{\theta}, \boldsymbol{x}, y))$

"nematode"
8.2% confidence

$\boldsymbol{x} + \epsilon \text{sign}(\nabla_{\boldsymbol{x}} J(\boldsymbol{\theta}, \boldsymbol{x}, y))$

"gibbon"
99.3 % confidence

Here, an ϵ of .007 corresponds to the magnitude of the smallest bit of an 8 bit image encoding after GoogLeNet's conversion to real numbers. Source: Goodfellow et al.

Source: https://towardsdatascience.com/how-to-systematically-fool-an-image-recognition-neural-network-7b2ac157375d

AI Ethics

All technology use can have negative consequences

Dangerous and Biased AI

SIDNEY FUSSELL BUSINESS 06.24.2020 07:00 AM

An Algorithm That 'Predicts' Criminality Based on a Face Sparks a Furor

Its creators said they could use facial analysis to determine if someone would become a criminal. Critics said the work recalled debunked "race science."

Source: https://www.wired.com/story/algorithm-predicts-criminality-based-face-sparks-furor/

Amazon AI Recruiting

Amazon ditched AI recruiting tool that favored men for technical jobs

Specialists had been building computer programs since 2014 to review résumés in an effort to automate the search process

▲ Amazon's automated hiring tool was found to be inadequate after penalizing the résumés of female candidates.
Photograph: Brian Snyder/Reuters

Source: https://www.theguardian.com/technology/2018/oct/10/amazon-hiring-ai-gender-bias-recruiting-engine

Cambridge Analytica Scandal

POLITICS

The New York Times

Subscribe for $1/week

Cambridge Analytica and Facebook: The Scandal and the Fallout So Far

Revelations that digital consultants to the Trump campaign misused the data of millions of Facebook users set off a furor on both sides of the Atlantic. This is how The Times covered it.

Source: https://www.nytimes.com/2018/04/04/us/politics/cambridge-analytica-scandal-fallout.html

AI Ethics: Common Principles

- Ensure safety and fairness
- Establish accountability
- Provide transparency
- Respect privacy
- Promote collaboration
- Limit harmful use of AI
- Uphold human rights and values
- Reflect diversity / inclusion
- Avoid concentration of power
- Acknowledge legal implications

Fairness Concepts

- Individual fairness
- Group fairness
- Fairness through unawareness
- Equal outcome
- Equal opportunity
- Equal impact

Global Ethics of AI Agreement

United Nations | UN News
Global perspective Human stories

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193 countries adopt first-ever global agreement on the Ethics of Artificial Intelligence

Unsplash/Possessed Photography | More mass-market consumer applications are expected with the development of what is known as 'assistive technologies'.

25 November 2021 | Culture and Education

Source: https://news.un.org/en/story/2021/11/1106612

EU AI Regulation Proposal

EUROPEAN COMMISSION

Brussels, 21.4.2021

COM(2021) 206 final

2021/0106(COD)

Proposal for a

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

LAYING DOWN HARMONISED RULES ON ARTIFICIAL INTELLIGENCE (ARTIFICIAL INTELLIGENCE ACT) AND AMENDING CERTAIN UNION LEGISLATIVE ACTS

{SEC(2021) 167 final} - {SWD(2021) 84 final} - {SWD(2021) 85 final}

EXPLANATORY MEMORANDUM

1. CONTEXT OF THE PROPOSAL

Source: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1623335154975&uri=CELEX%3A52021PC0206

Algorithmic Accountability Act 2019

IN THE SENATE OF THE UNITED STATES

Mr. WYDEN (for himself and Mr. BOOKER) introduced the following bill; which was read twice and referred to the Committee on _____

A BILL

To direct the Federal Trade Commission to require entities that use, store, or share personal information to conduct automated decision system impact assessments and data protection impact assessments.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

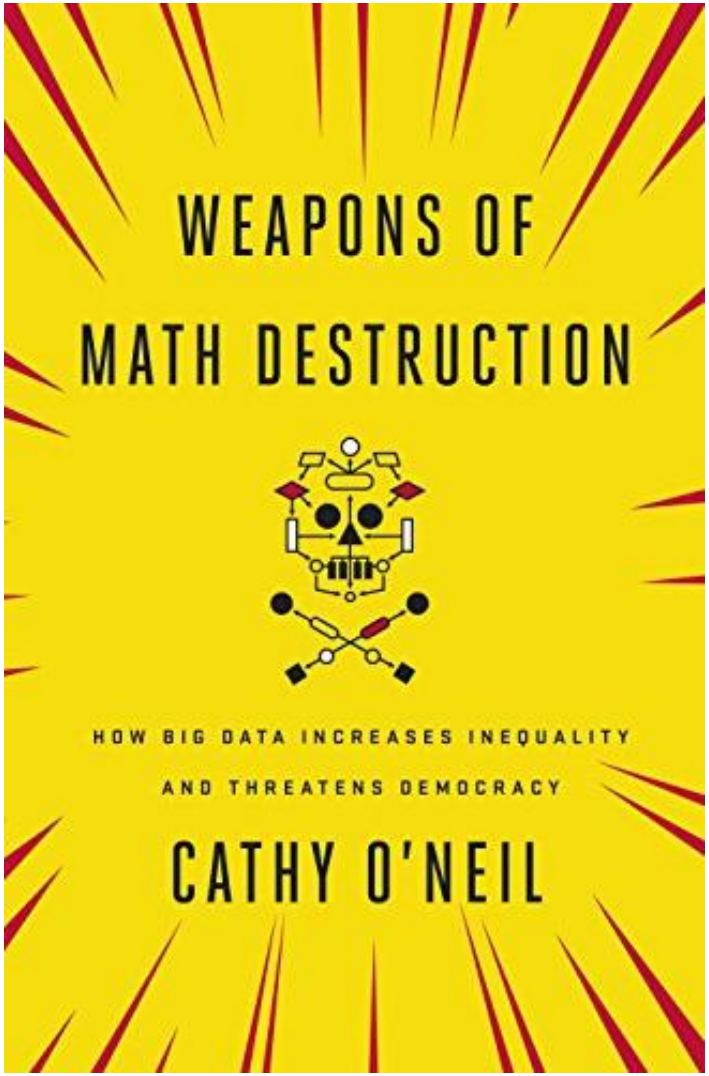
This Act may be cited as the "Algorithmic Accountability Act of 2019".

SEC. 2. DEFINITIONS.

In this Act:

Source: https://www.wyden.senate.gov/imo/media/doc/Algorithmic%20Accountability%20Act%20of%202019%20Bill%20Text.pdf

If You Want More on Bias in AI...



Cathy O'Neil - "Weapons of Math Destruction"

AI Future / Concerns

Stephen Hawking on AI

On artificial intelligence ending the human race
The development of full artificial intelligence could spell the end of the human race….It would take off on its own, and re-design itself at an ever-increasing rate. Humans, who are limited by slow biological evolution, couldn't compete and would be superseded.

From an interview with the BBC, December 2014

On AI emulating human intelligence
I believe there is no deep difference between what can be achieved by a biological brain and what can be achieved by a computer. It, therefore, follows that computers can, in theory, emulate human intelligence — and exceed it

From a speech given by Hawking at the opening of the Leverhulme Centre of the Future of Intelligence, Cambridge, U.K., October 2016

Stephen Hawking on AI

On making artificial intelligence benefit humanity
Perhaps we should all stop for a moment and focus not only on making our AI better and more successful but also on the benefit of humanity.

Taken from a speech given by Hawking at Web Summit in Lisbon, November 2017

On AI replacing humans
The genie is out of the bottle. We need to move forward on artificial intelligence development but we also need to be mindful of its very real dangers. I fear that AI may replace humans altogether. If people design computer viruses, someone will design AI that replicates itself. This will be a new form of life that will outperform humans.

From an interview with Wired, November 2017

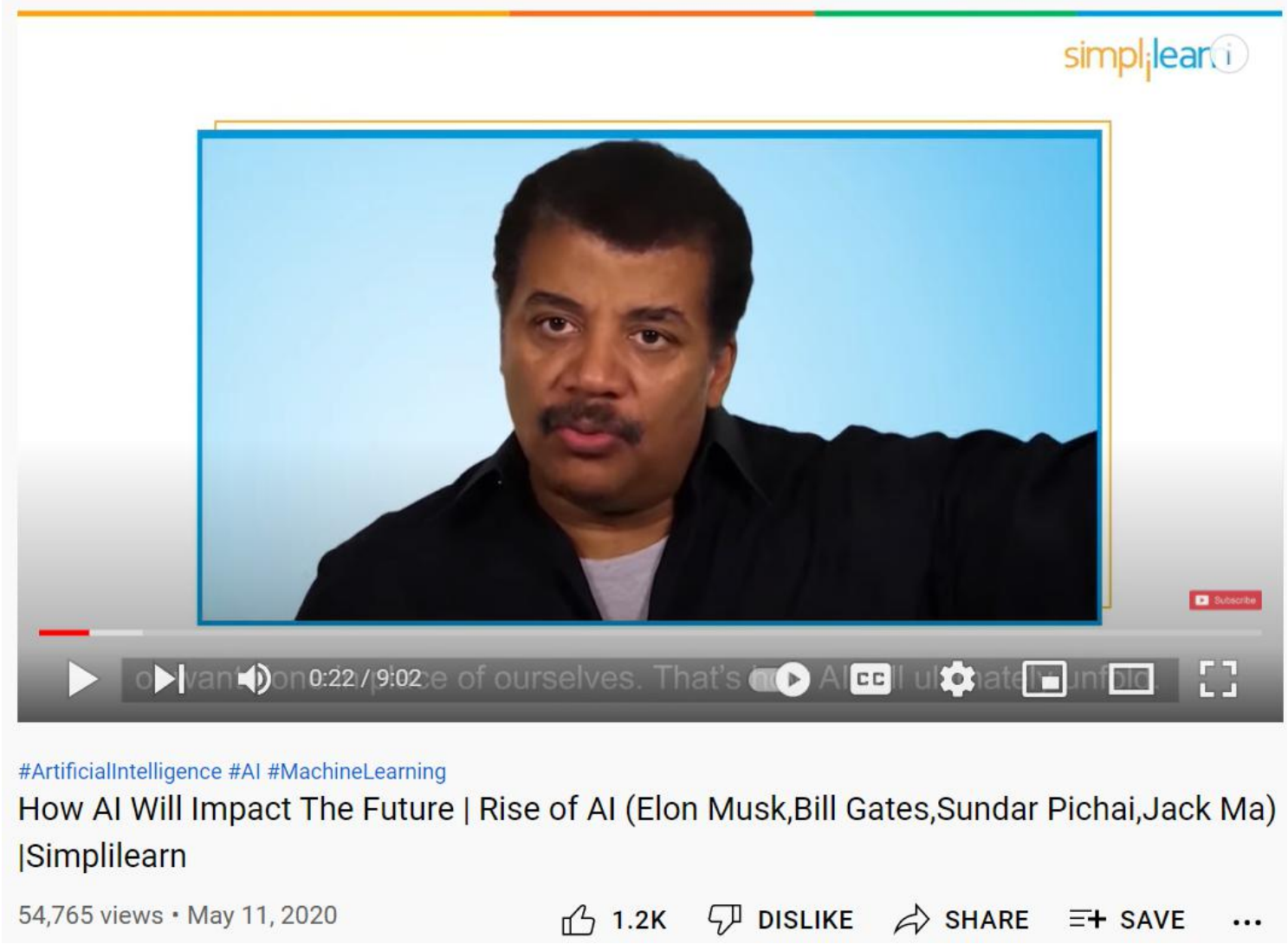
Elon Musk on AI

"If AI has a goal and humanity just happens to be in the way, it will destroy humanity as a matter of course without even thinking about it…It's just like, if we're building a road and an anthill just happens to be in the way, we don't hate ants, we're just building a road"

"Mark my words, AI is far more dangerous than nukes…why do we have no regulatory oversight?"

"AI will be the best or worst thing ever for humanity."

How AI Will Impact the Future?



Source: https://www.youtube.com/watch?v=uz8PSSOB-4E

Selected AI Concerns

- Will AI replace human workers?
- Will AI deepen inequalities?
- Disinformation: will AI worsen it?
- No access to AI for evil people?
- Is AI the new Big Brother?
- Should intelligent machines have rights?
- Transparent AI
- AI-based weaponry
- Reliable AI
- Explainable AI

Jobs: Effect of Automation

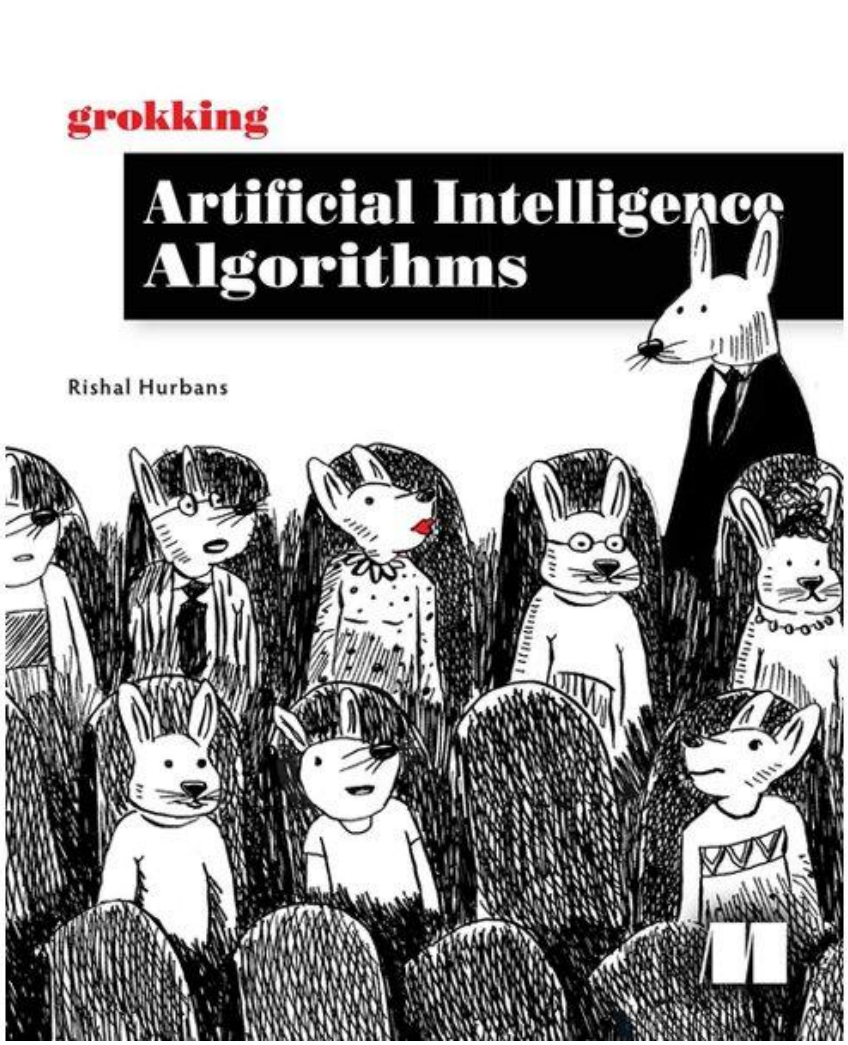
Tasks, Automation, and the Rise in US Wage Inequality

Daron Acemoglu & Pascual Restrepo

We document that between 50% and 70% of changes in the US wage structure over the last four decades are accounted for by the relative wage declines of worker groups specialized in routine tasks in industries experiencing rapid automation. We develop a conceptual framework where tasks across a number of industries are allocated to different types of labor and capital. Automation technologies expand the set of tasks performed by capital, displacing certain worker groups from employment opportunities for which they have comparative advantage. This framework yields a simple equation linking wage changes of a demographic group to the task displacement it

Source: https://www.nber.org/papers/w28920

“Easy Reading”



Thank you!