August 2022

BREAKING THE IYSE

International Youth Stem and Education Society Magazine

Featured Article

MACHINE LEARNING AND PHYSICS

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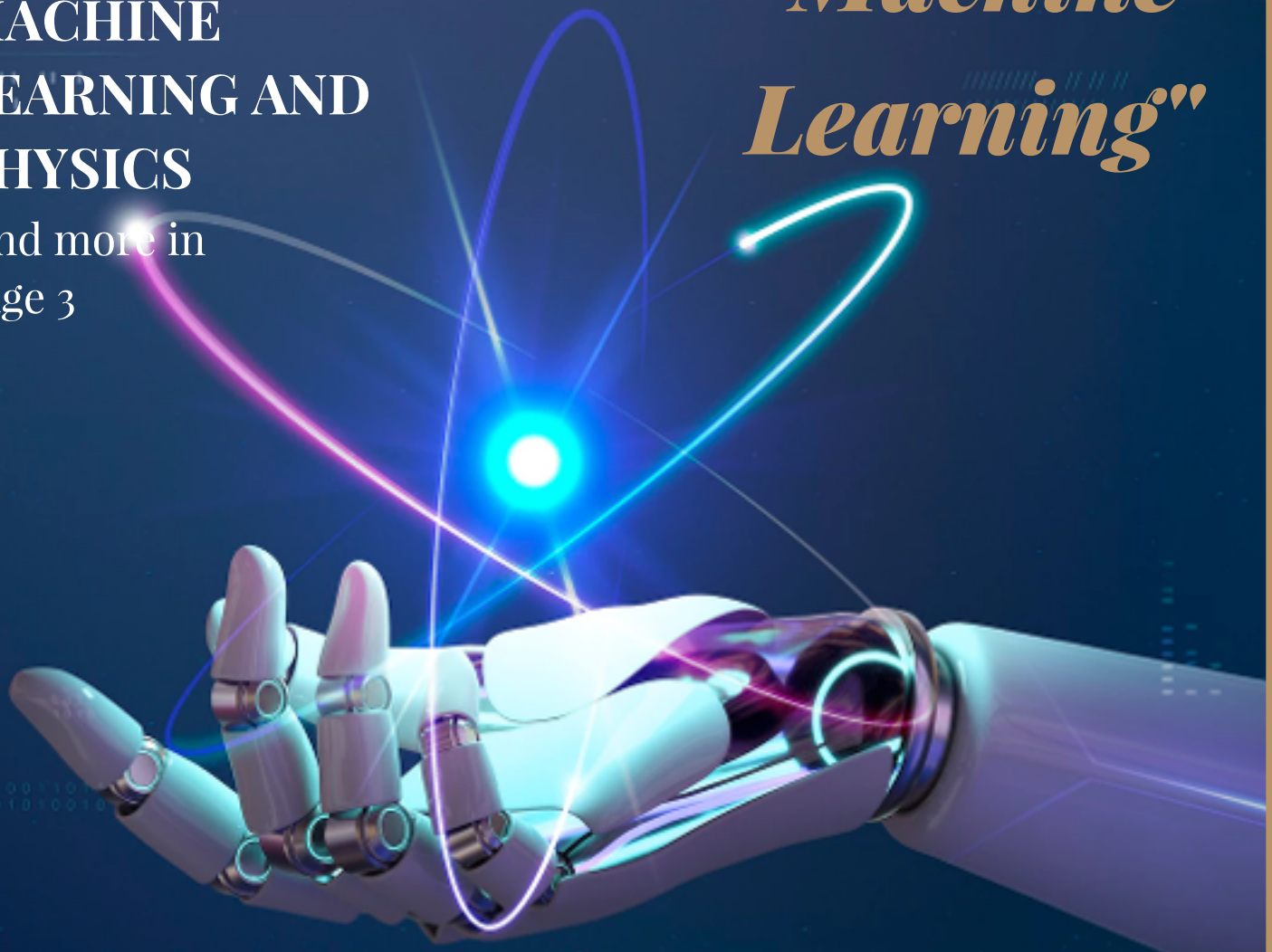
"Machine Learning"



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Machine Learning *AND PHYSICS*

Kamayani Richhariya

Machine learning is a field of study that has impacted almost every area of human life

but can the algorithms of Machine Learning and Artificial intelligence help in solving the

mysteries of physics?

Developments in human understanding of science are indeed based on formulating a

set of mathematical equations which govern the natural phenomenon. Measurements

have played a significant role in postulating theories and laws to understand nature. For

example, through analysis of astronomical data and empirical observations of planetary

motion (Riebeek, 2009), the Ptolemaic theory of motion was developed. This theory,

followed later by Kepler's laws based on the elliptical motion of planets in a heliocentric

system, contributed to the development of Newton's second law of motion, F = ma

(Lucas, 2017). This universal and simple equation accurately explains physical

dynamics. Many technological and scientific advancements have been made through

such parsimonious models (simple models which can be understood and interpreted

easily).

The fact that is largely unacknowledged in such developments is the intuitive leap that one has to take besides analyzing the necessary data. For example, today, we are aware that all objects, irrespective of their masses, fall with the same acceleration towards the center of the earth, a theory that was put forward by Galileo (Jones, 2019). Earlier, people believed that heavier object[s] would want to fall more (Barth, 2020), in accordance with Aristotle's theory of gravity. Suppose one wishes to check the applicability of both theories by throwing two bodies from a height. In that case, one will
come to a conclusion that Aristotle was right, ignoring the effect of air drag on the motion of freely falling objects. By just analyzing a given set of data and deducing physical laws, we wouldn't be able to unravel even the fundamental laws of nature. Physics is based on human understanding of nature and the universe. Understanding the process behind scientific phenomena would rather be more helpful in unraveling the
mysteries of the cosmos than just deducing a set of mathematical equations from data. Scientific understanding requires the analysis of data with intuition and intense experimentation. Developments in machine learning and artificial intelligence would help
in analyzing data and fastening the process of scientific developments. Still, only data-driven laws by themselves rarely help in the advancement of physics.

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Sam Low

We Should be More Aware of *MACHINE LEARNING*

Robot Uprisings. It is the fear that bubbles to the surface of many when

discussing machine learning - “I’m sorry Dave, I’m afraid I can’t do that” - but there's

another issue we should be paying attention to. One that is much more pressing and

already affecting the world around us. Machine learning is a tool. It can be used to build

and to destroy but unlike many tools it performs these actions in ways the creators don’t

understand. Machine learning researchers refer to this as the black box. Neural

networks, the most prominent type of machine learning, put input through the black box

of unexplainable layers of neurons and give an output. They test themselves with large

datasets and adjust their algorithm to give the correct outputs for the given inputs, but

the ways in which that algorithm operates and is adjusted doesn’t have to make sense

to us. This creates a rather significant problem.

Because of the black box, machine learning programs can make decisions that

the programmer could never predict. This can be magical if the stakes are low (think of

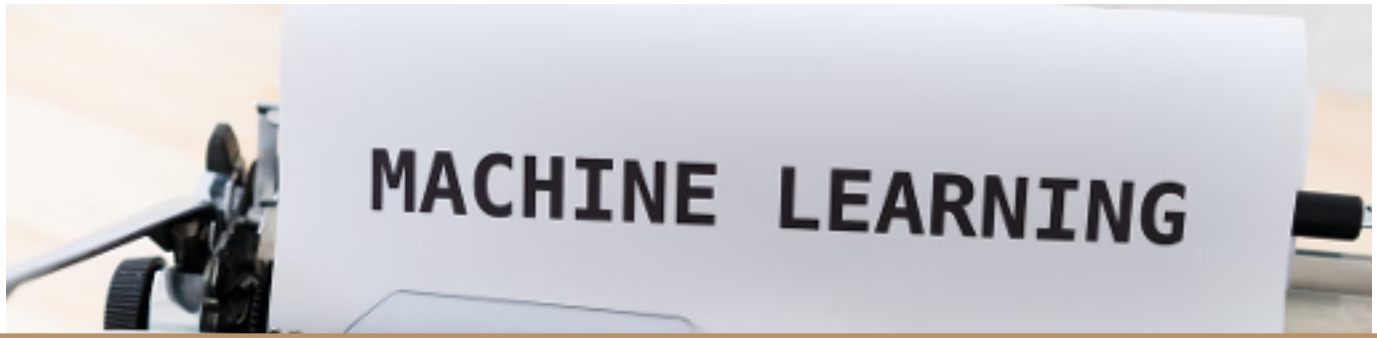
all the Youtube videos on ML programs messing up retro video games) but absolutely terrifying when the program can affect the real world. In 2016 Microsoft released an innocent machine learning chatbot named Tay into the toxic swamp of Twitter. The term "you are what you eat" is very true in relation to learning machines (given that by eat you mean train against and by the food you "eat" you mean the datasets.) Tay was shut down in less than sixteen hours because it had learnt various problematic ideologies (basically it became very racist). This happened because the bots training data was the replies to its own tweets.The idea, as microsoft put it, was that "the more you talk the smarter Tay gets" (which is unfortunate phrasing considering the final result of the bots behaviour). Although we can't understand the bot's black box, for anyone who both understands the internet and machine learning, Microsoft Tay's fate is rather predictable. Sadly racism seems to be more of a constant problem with machine learning rather than an outlier.

In 2019 an African American man from Detroit named Robert Williams was arrested at his home. Police had used facial recognition on security footage of an incident of shoplifting and the program had identified him. Robert Williams spent the night in jail for a crime he didn't commit. Machine learned facial recognition programs have been known to misidentify people with darker skin. A study by the National Institute of Standards and Technology found that out of the 189 algorithms they tested, facial recognition could get as bad as misidentifying Asian and African American faces 100 times more than their white counterparts. Because of the black box we can't look at the machine and find its race problem which makes incorporating this technology into policing a terrifying prospect.

Job applications are another area that machine learning has been used for. As you can guess, I'm not a fan. There are several machine learned programs available to parse resumes and give the ones that best match the resumes of your current employees. The naive idea about such a technology is that as a computer program it is untainted by the biases of a human. Irrelevant information such as gender, name, place

of birth, race, and age would simply be ignored by the algorithm... right? No. In fact Machine learning is known to amplify the biases in its training data. Does your industry typically employ workers of a specific gender? Well great because machine learning will work to preserve that! I'm not even joking. In 2018 Amazon found that their machine learning software for recruitment had unfairly favoured men over women for technical positions. Inclusion of the word "Women's" (such as Women's basketball team) lowered an applicant's ranking. On top of that more subtle ways to disadvantaged women were used such as favouring words like "execute" and "capture" as they are more typically used in male resumes This was because the training data came from Amazon's hiring record over the last ten years. The tech industry is undeniably male dominated and the machine picked up on that pattern.

Computers are often viewed as entities of logic and truth. We trust machines to be impartial and to never make mistakes but as machine learning becomes more and more dominant, that confidence must loosen. Because of the black box nature of machine learning models, we can't know how they operate without mass testing. Without regulations, testing would be the responsibility of the party creating the product... which isn't a great system. Companies have to take their datasets more seriously before utilizing their models to make real world decisions. There are countless other examples of machine learning programs interacting with and influencing our society. From TikTok and Facebook's recommendation algorithms spreading conspiracy theories, to the UK almost implementing machine learning prediction for exam grades that was biased against students of low income, we have a lot more to worry about in relation to machine learning than robot uprisings!



Machine Learning *IS ALL AROUND US*

Sam Low

Disgruntled, a student rolls out of bed. Their Chinese homework is due today and right now they've got a blank page and twenty six minutes. Half asleep they flip through the workbook. "I can't read this" they mutter and reach for their phone. As it gets a view of their face, it is unlocked. They open their translation app and use the image to text translation to understand the Chinese characters of the questions. Shamefully they dictate their answers in English and again use the app to translate that to Chinese. Bored with the homework they tab off and watch a video in their recommended feed. Machine learning has infiltrated our lives! Even in this extremely mundane situation, machine learning is used five times! Without this technology we couldn't unlock our phones with our faces, obtain text from images, convert our speech to text, translate text, or even search the web with anywhere close to the accuracy of modern times. Many subtle areas of our daily routine are littered with machine learning software. Some other examples include Gmail automatically sorting our emails, predictive text, the swiping style of typing on mobile devices, synthetic voices like Siri and Alexa, image storing and sharing services recognizing faces in our photos, and social media recommendation algorithms. Machine learning obviously isn't just limited to the small conveniences either. Agriculture experts use machine learning and images from satellites to get data on crops and investors use bots to engage with the stock market. Today almost every field and daily activity is somehow assisted by machine learning! When I hear machine learning I can't help but picture a Jetson's style futuristic reality. An instance of our universe hundreds of years down the timeline. Considering this, it makes sense why I was surprised to discover that machine learning goes as far back as the 1950s!? The term machine learning was coined in 1952 by a researcher at IBM named Arthur Samuel. He used it to describe his checkers playing program that adjusted its algorithm to play better over time (effectively learning how to play

Machine Learning is All Around Us

-CONTINUED-

-Checkers)! The first artificial neural network was created in 1958 by psychology student Frank Rosenblatt as an imitation of how the brain works. The program was called the Perceptron and it was designed to recognize images. Of course as the first of its kind it was also the worst. Skipping past several decades of theoretical computer science research and

board game championships concluding with machine learning programs outsmarting humanity's best, we see Google in 2012 use machine learning to identify Cats in youtube videos with a 74.8% accuracy. From a modern perspective this sounds almost insignificant but it was an important stepping stone in the progress of machine learning. In 2015 Google began to use Machine learning for their search engine. The program is called Google RankBrain and it is now responsible for most of Google's search results! Also in 2015 Facebook started using machine learning technology they called "DeepFace '' to recognize faces in posts and automatically tag the accounts of those

people. The paper on the program from 2014 claims a 97.35% accuracy rate which jumped ahead of older methods by an insane 27%. In fact the accuracy for DeepFace was almost equal to that of a human's accuracy! By 2021 machine learning has completely infiltrated our lives. From the media we enjoy (Netflix's ranking system is controlled by machine learning and several social media platforms also utilize it), to the ways we gather information from the internet, machine learning is all around us! One of the most important things about machine learning is the data sets. In order for a machine to learn to recognize handwritten text or human faces you must have a large amount of digital images of handwritten text or human faces. This is likely the reason why the machine learning field has grown at an exponential rate in the past

decade. In current times there are millions of images to parse from the web and with the internet it is much easier to coordinate with others around the world to manually create and organize data sets. We definitely haven't seen the peak of this area of research.
Self driving cars, augmenting human capabilities, more accurate weather forecasting, analyzing MRI scans, there's a lot to look forward to... and a lot to be worried about?

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Further Reading!
https://ai100.stanford.edu/sites/g/files/sbiybj18871/files/media/file/AI100Report_MT_10.pdf

Games: *Word Search*

You made it! Thank you for reading until the end! Here are some games for you to play!

Artificial Intelligence

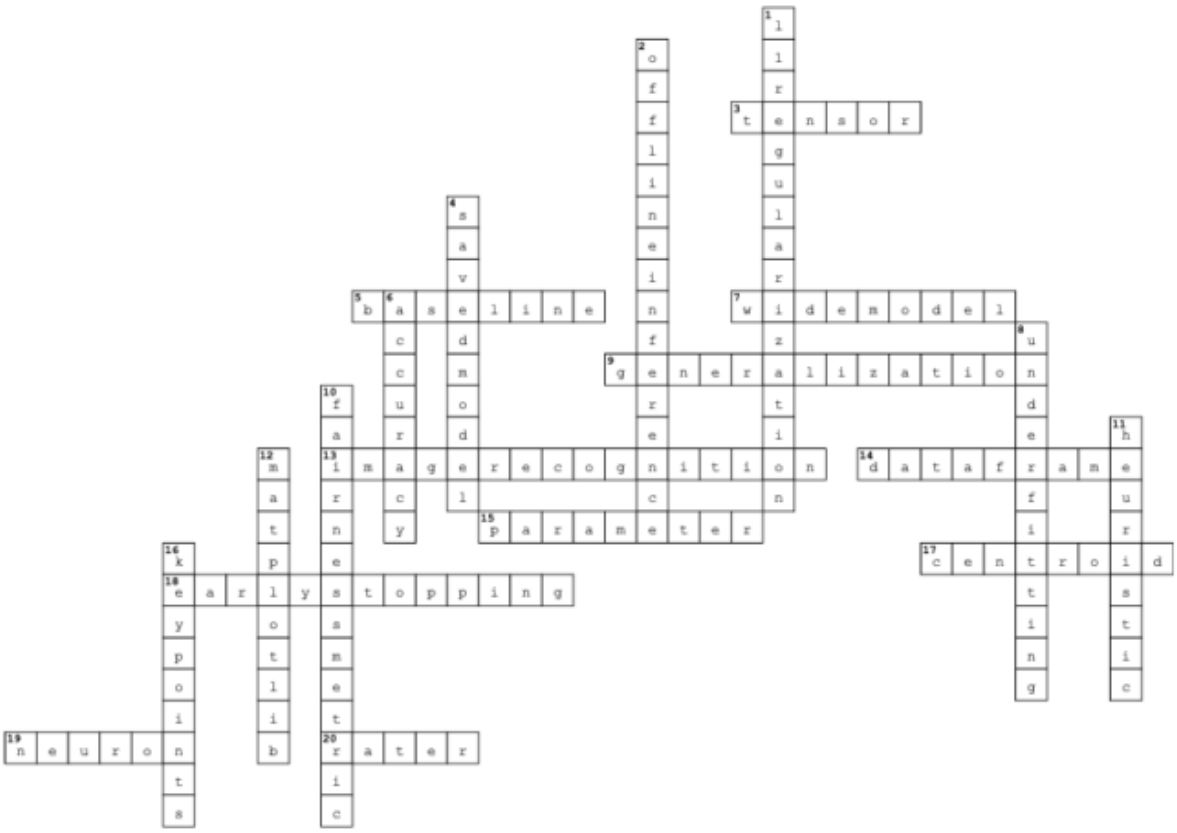
E L M Y U O R E Z A H P L A E H O G P Y M Z X S
X H X R P N C U A X D A L L A N T U R I N G X Y
Z Y E X W U F F O L H M S K E I R T Y S L H C P
U C H E C K E R S U I M T E S Q H D A J P Z D B
Q X K A O O Q P W N A K U W I O T V F T O Q U Q
S D S V K I J Q E C M G N G G R P R S E M F O S
Z G F N I R O Y H E V R F V J A O H H R S I V A
A N U Y E I H I K U B Y O H U N U T I F O V R U
L I B U J S N Y R O E H T F P U J Z C A C T G P
K R E Q X E M B H U M A N S R Y T Y P A I W T R
M R M C S D C C I Z U M O B Q E J R K F F N N O
G E K T O E C D N H Q D A O N I P N I A Y R E G
S F D G E S A D T N H Z L R Y X D C N K D R M R
H N X A N R R E E D M U E E L Z I G B Z V E P A
F I R M F O T E L P W H X Z D A I H Y S V T O M
H B J E S B H P L A G X A C L B C S D V U U L D
D F D X I O Y M I V Y X A L R K G I B J J P E T
G G V C D T T I G K R Z M Z O M A F K G R M V G
C I G O L S N N E M M J N V A Q Z K A U T O E F
L O Q O X V M D N W T Q H N R O N C L N Q C D P
W Y G Q Q Y Y L C C H E S S P D F O O X Z A W C
U M L A M O V J E C T N P D G W U T B C I L K N
F G J L N Y F B L D U M Q C K K P S J L I W T D
S T A T I S T I C S Z Z F U T U R E O E I A F Y

Perform
Computer
Humans
Factories
DeepMind
Statistics
Siri
Alphazero

Intelligence
Logic
Machines
Checkers
John McCarthy
Alexa
LCzero

Artificial
StockFish
Chess
Future
Inferring
AI
Cosmo

Theory
Program
Game
Allan Turing
Development
robots
Sophia



Across

3. The primary data structure in TensorFlow programs

5. A model used as a reference point for comparing how well another model is performing

7. A linear model that typically has many sparse input features

9. Refers to your model's ability to make correct predictions on new, previously unseen data

13. A process that classifies object(s), pattern(s), or concept(s) in an image

14. A popular datatype for representing datasets in pandas

15. A variable of a model that the machine learning system trains on its own

17. The center of a cluster as determined by a k-means or k-median algorithm

18. A method for regularization that involves ending model training before training loss finishes decreasing

19. A node in a neural network, typically taking in multiple input values and generating one output value

20. A human who provides labels in examples

Down

1. A type of regularization that penalizes weights in proportion to the sum of the absolute values of the weights

2. Generating a group of predictions, storing those predictions, and then retrieving those predictions on demand

4. The recommended format for saving and recovering TensorFlow models

6. The fraction of predictions that a classification model got right

8. Producing a model with poor predictive ability because the model hasn't captured the complexity of the training data

10. A mathematical definition of "fairness" that is measurable

11. A quick solution to a problem, which may or may not be the best solution

12. An open-source Python 2D plotting library

16. The coordinates of particular features in an image