

EVOLUTION OF AI BRANCHES AND MAIN PLAYERS

(MSC1114H) AI IN MEDICINE

MAY 2023



ERNEST (KHASHAYAR) NAMDAR

PASCAL N. TYRRELL

The oldest paper in IEEE Xplore with the artificial intelligence keyword

Large electric hoisting plants

Wilfred Sykes

Proceedings of the American Institute of Electrical Engineers

Year: 1910 | Volume: 29, Issue: 3 | Journal Article | Publisher: IEEE

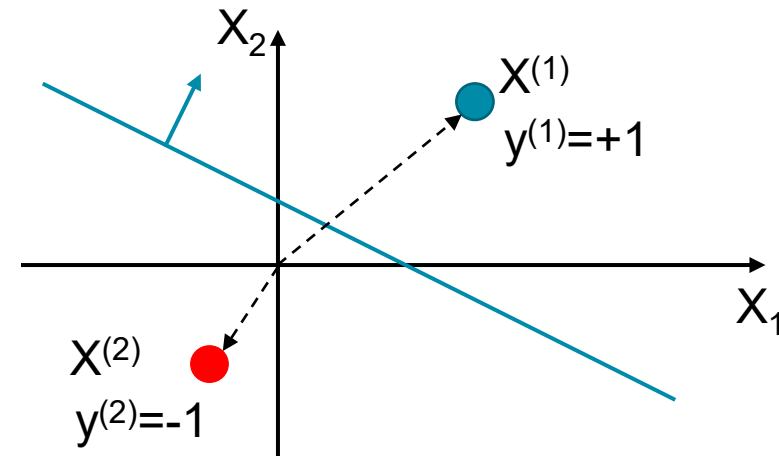
✓ Abstract



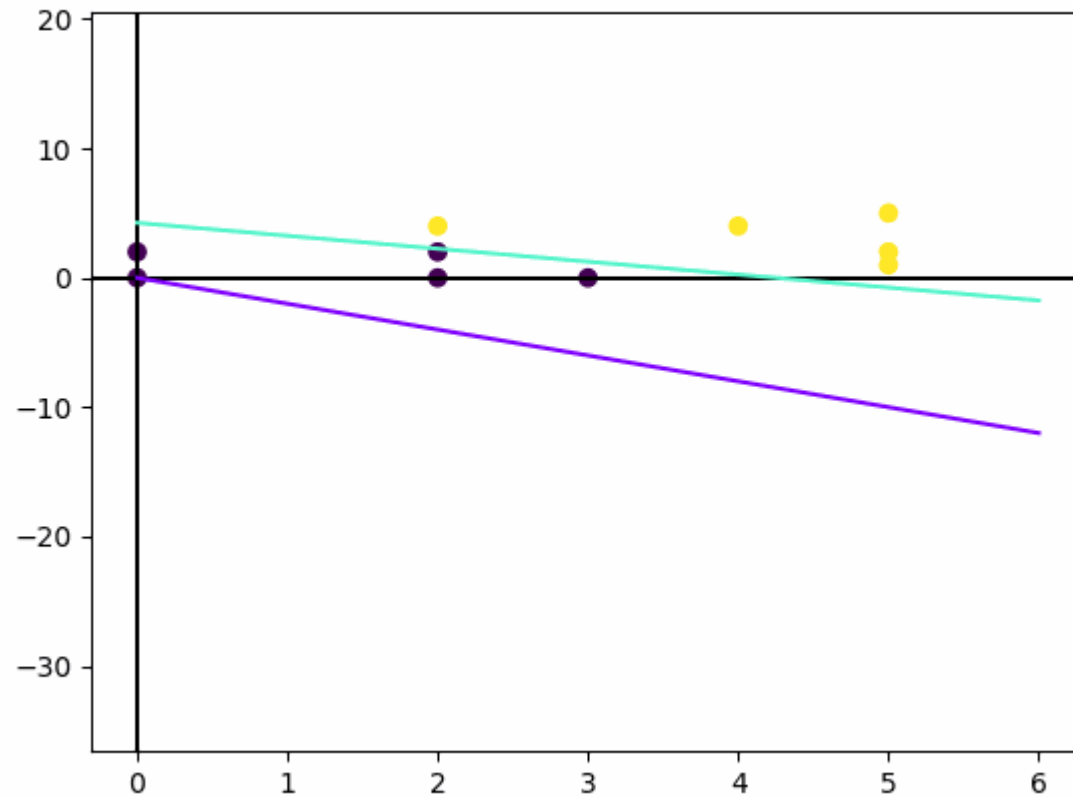
Perceptron, The Ancestor of Neural Network

- Linear Classifiers
- Simple idea with an efficient implementation approach

$$y(\theta \cdot X) \geq 0$$



Perceptron, The Ancestor of Neural Network



When was it?

- 1962
- A. Novikoff

ON CONVERGENCE PROOFS FOR PERCEPTRONS

A. Novikoff
Stanford Research Institute
Menlo Park, California

One of the basic and most proved theorems of perceptron theory is the convergence, in a finite number of steps, of an error correction procedure for an α -perceptron to a classification or dichotomy of the stimulus world, providing such a dichotomy is within the combinatorial capacities of the perceptron. In other words, if a solution exists, error correction will find one in a finite time. A proof is presented which is substantially shorter and more transparent than those now available, and which isolates out the principle on which the theorem depends. We believe this principle will find further use in other theorems of a similar nature.

- I -

The purpose of this paper is to exhibit an extremely short, and more notably, transparent proof of a theorem concerning perceptrons. The theorem itself must now be considered one of the most basic theorems concerning perceptrons, and indeed, is among the first theorems proved by Rosenblatt and his collaborators. It also enjoys the peculiar distinction of being one of the most often re-proved results in the field (see "References" at the end of this paper). The succession of proofs now available progresses from somewhat cloudy statements (which at one time caused doubt among "reasonable men" that the theorem was, in fact, true), to comparatively crisp statements of a purely mathematical nature which nonetheless use more print than is strictly necessary. 1-6

More to the point, latter-day proofs fail to enunciate a simple principle involved. This principle permits one to modify the hypotheses in a variety of ways and still secure the results; and it may well be useful in establishing genuinely new theorems of like character. I therefore present this proof in its entirety, in part to verify my claim that it is as short a line as can be drawn from hypotheses to conclusion, and also with the hope of terminating an already lengthy process of successive refinements.

Whereas previous proofs of the present theorem appealed to a structure, called by Rosenblatt and his co-workers an α -perceptron, the present proof and ensuing discussion apply without modification to a structure consisting of a single threshold element acting on a weighted set of inputs.

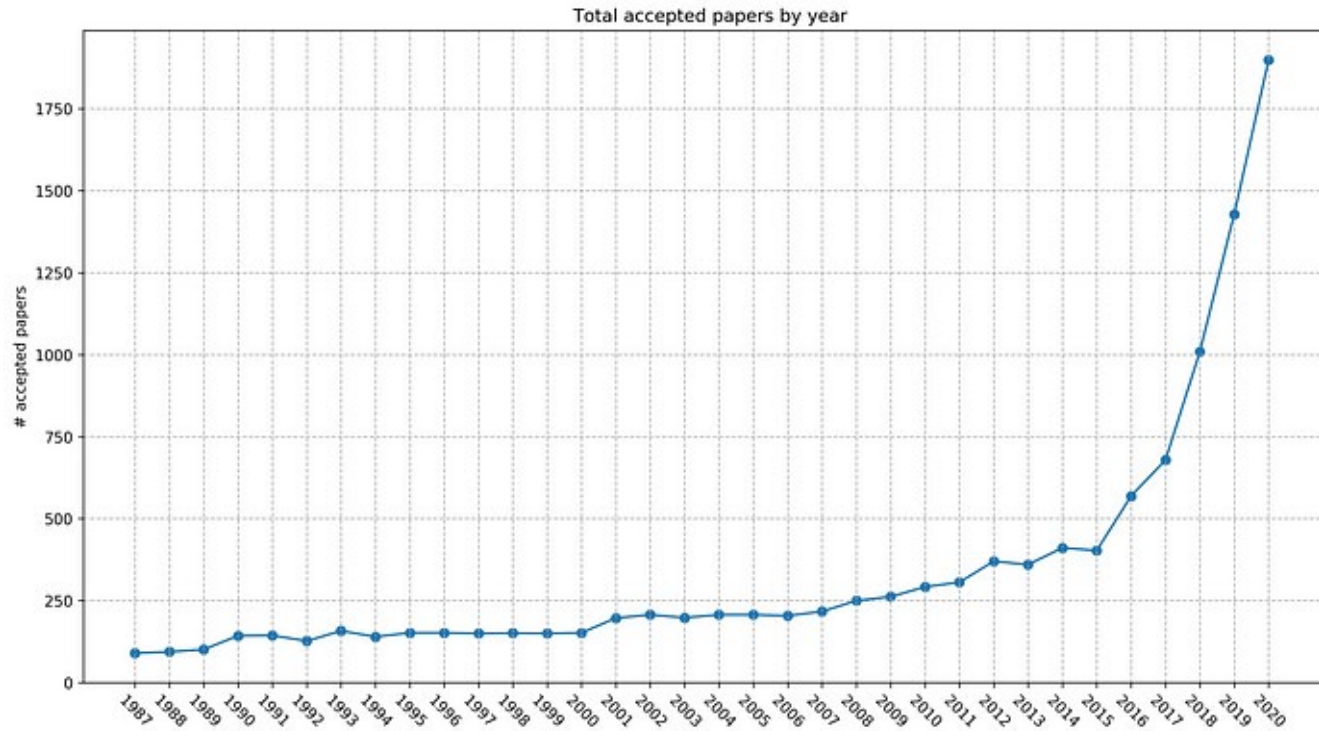
Presented at the *Symposium on Mathematical Theory of Automata*,
Polytechnic Institute of Brooklyn, April 24, 25, 26, 1962

-615-

How was it?



I'm fine with learning history, but at least make it contemporary!



Neural
Information
Processing
Systems
Up to 2017: **NIPS**
Since 2018: **NeurIPS**

Ref: NeurIPS Conference: Historical Data Analysis by Nemanja Rakicevic
<https://towardsdatascience.com/neurips-conference-historical-data-analysis-e45f7641d232>

How much has it been attractive in academia?



Geoffrey Hinton

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Emeritus Prof. Comp Sci, U.Toronto & Engineering Fellow, Google
 Verified email at cs.toronto.edu - [Homepage](#)

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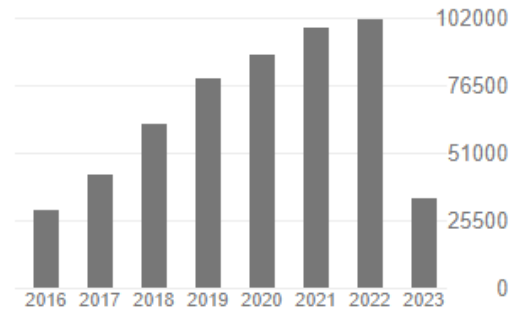
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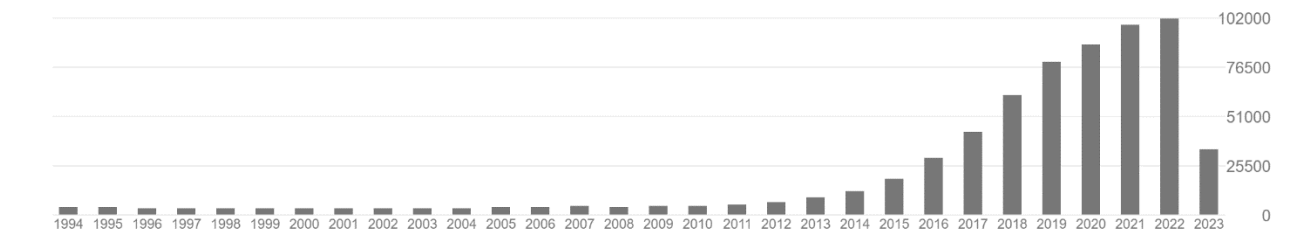
Looking for big names?



TITLE	CITED BY	YEAR
Imagenet classification with deep convolutional neural networks A Krizhevsky, I Sutskever, GE Hinton Communications of the ACM 60 (6), 84-90	132369	2017
Deep learning Y LeCun, Y Bengio, G Hinton Nature 521 (7553), 436-44	64324	2015
Dropout: a simple way to prevent neural networks from overfitting N Srivastava, G Hinton, A Krizhevsky, I Sutskever, R Salakhutdinov The journal of machine learning research 15 (1), 1929-1958	42876	2014
Visualizing data using t-SNE L van der Maaten, G Hinton Journal of Machine Learning Research 9 (Nov), 2579-2605	36080	2008



× Citations per year



How much has it been attractive outside academia?

There are 567 Artificial Intelligence startups in Toronto (**Last Updated:** March 16, 2023)



AlayaCare

Provider of cloud-based platform for home healthcare practitioners

Since: 2014

Funding: USD 274M



Deep Genomics

Machine/deep learning technologies for precision medicine, genetic testing, diagnostics

Since: 2015

Funding: USD 240M



Xanadu

Manufacturer of cloud and AI-based application-specific ICs for quantum computing applications

Since: 2016

Funding: USD 250M



Cohere

Provider of an NLP-based platform to classify and custom language generation models

Since: 2019

Funding: USD 170M

AI Evolution

ImageNet

- Golden years of computer vision
- Introduction of ALEXNet in 2012 and focus on CNNs
- 2010: Kaggle is here!
- 2010: DeepMind
- 2014: Google acquires DeepMind

Industry takes over

- Finally promising and leading young companies
- OpenAI
 - HuggingFace
 - Cohere



There is no cohesion

- Researchers are still exploring the algorithms
- Linear and tree-based models are widely used
- Image segmentation with Random Forest!
- Classic image and language analysis
- Relying on memory for game bots

The momentum was formed in 2014

- Self-driving cars
- Super-human models for different games
- Drug discovery and genomics



Nobody knows but domain knowledge for sure

Is There a Cisco in AI?

YES!



{ AI Hardware = (Specific) GPU
(Specific) GPU = NVIDIA



Biggest Moves of the Biggest Entities



2018: acquired GitHub

2019: \$1 billion investment in OpenAI

2020: Partnership with OpenAI



2013: LeCun joined Facebook

2016: PyTorch first release



2011: Google Brain was founded

2013: Hinton joined Google

2014: acquired DeepMind

2017: TensorFlow first release

2017: acquired Kaggle

2017: Google Colab was released

A Game-changer in Pure AI Research is Harder Than Before

WHY?

“The supercomputer developed for OpenAI is a single system with more than 285,000 CPU cores, 10,000 GPUs and 400 gigabits per second of network connectivity for each GPU server,”

Ref: <https://developer.nvidia.com/blog/openai-presents-gpt-3-a-175-billion-parameters-language-model/#:~:text=%E2%80%9CThe%20supercomputer%20developed%20for%20OpenAI,companies%20stated%20in%20a%20blog>

SickKids' HPC:

8 x GPU Nodes

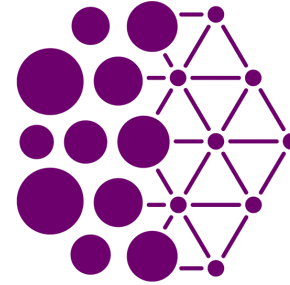
Ref: <https://ccm.sickkids.ca/hardware-specifications/>

“But I am still interested in research and academia”

Leading AI-oriented Canadian Research Institutes



VECTOR INSTITUTE



Mila



Alberta Machine Intelligence Institute

FUTURE?

“The stupid speak of the past, the wise of the present, and fools of the future”

Napoleon Bonaparte

DON'T GIVE ME CATCHY QUOTES, JUST SAY “I DON'T KNOW”