



國立陽明交通大學
NATIONAL YANG MING CHIAO TUNG UNIVERSITY

Deep Learning

深度學習

Fall 2023

Introduction

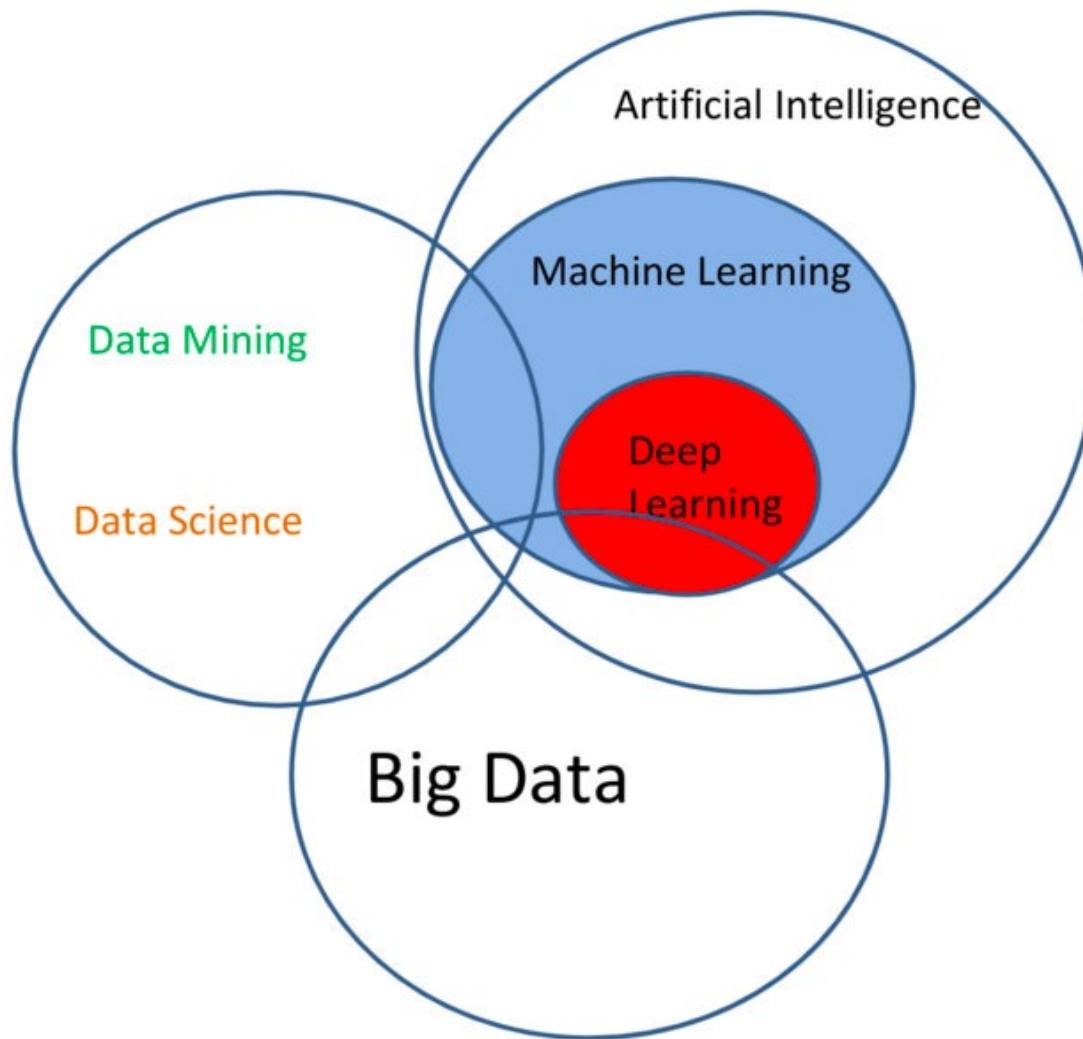
Prof. Chia-Han Lee
李佳翰 教授



-
- Figure source: Textbook and Internet
 - You are encouraged to buy the textbook.
 - Please respect the copyright of the textbook. Do not distribute the materials to other people.

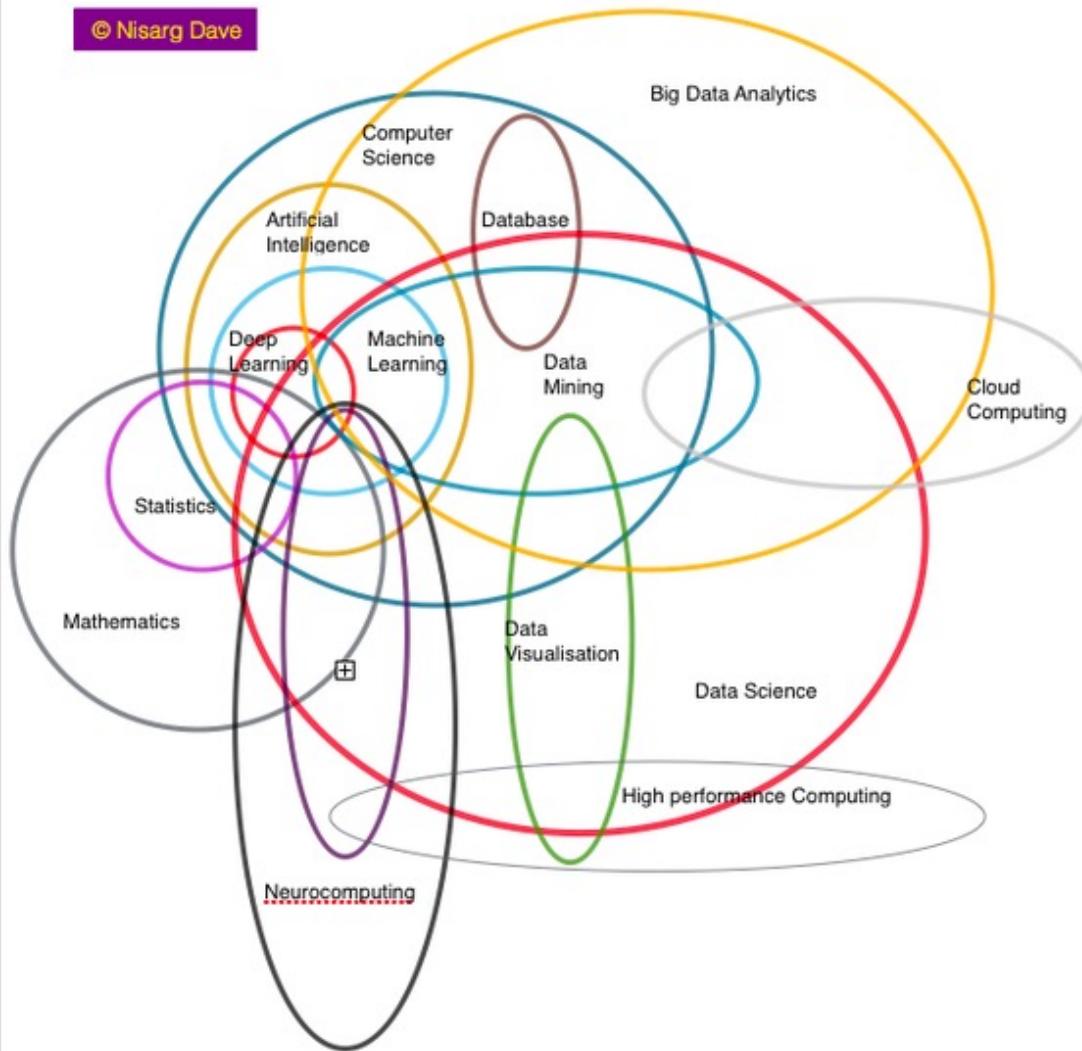


AI, ML, DL, DM, DS, BD





and more...

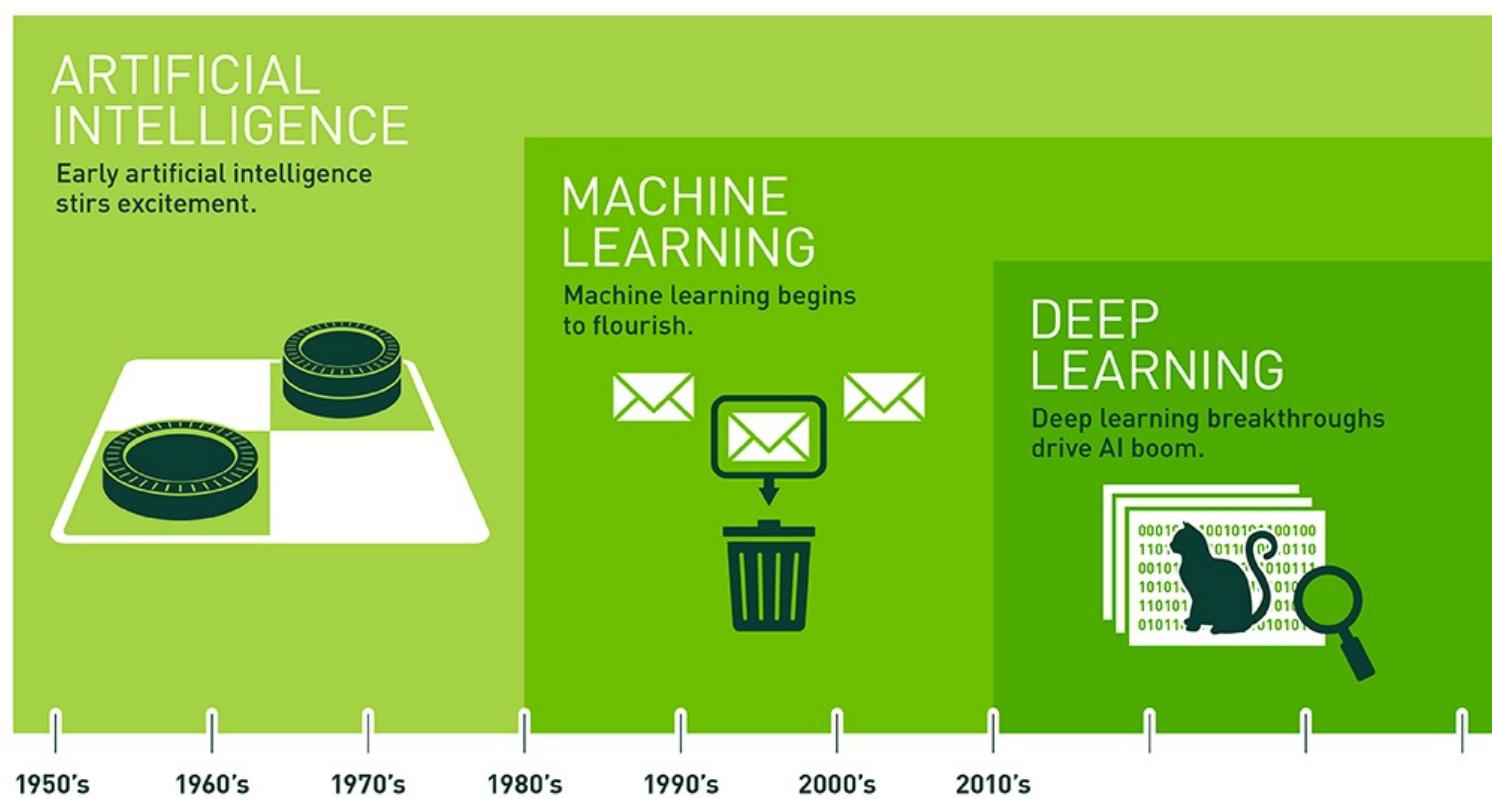




History of AI, machine learning, and deep learning



AI → ML → DL



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.



History of AI

A BRIEF HISTORY OF AI



1952

Dartmouth Conference 1956: the birth of AI. The proposal for the conference included this assertion: "every aspect of learning or any other feature of intelligence can be so precisely described that a machine can be made to simulate it"



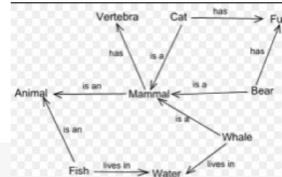
1974-1980

The first AI winter 1974–1980. AI was subject to critiques and financial setbacks. AI researchers had failed to appreciate the difficulty of the problems they faced. Their tremendous optimism had raised expectations impossibly high, and when the promised results failed to materialize, funding for AI disappeared



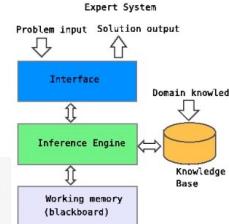
1987-1993

The second AI winter 1987–1993. The business community's fascination with AI rose and fell in the 80s in the classic pattern of an economic bubble. The collapse was in the perception of AI by government agencies and investors – the field continued to make advances despite the criticism



1956-1974

The golden years, There were many successful programs and new directions: Natural language Understanding (first AI program to use a semantic net), Micro-worlds, Neural Networks



1980-1987

Boom: In the 1980s a form of AI program called "expert systems" was adopted by corporations around the world and knowledge became the focus of mainstream AI research. In those same years, the Japanese government aggressively funded AI with its fifth generation computer project.



1993-2001

It began to be used successfully throughout the technology industry. Milestones and Moore's Law: On 11 May 1997, Deep Blue became the first computer chess-playing system to beat a reigning world chess champion, Garry Kasparov. Intelligent agents, Algorithms originally developed by AI researchers began to appear as parts of larger systems. AI had solved a lot of very difficult problems and their solutions proved to be useful throughout the technology industry, such as data mining, industrial robotics, logistics, speech recognition, banking software, medical diagnosis and Google's search engine



History of AI



1952

Dartmouth Conference 1956: the birth of AI. The proposal for the conference included this assertion: "every aspect of learning or any other feature of intelligence can be so precisely described that a machine can be made to simulate it"





History of AI

1956 Dartmouth Conference: The Founding Fathers of AI



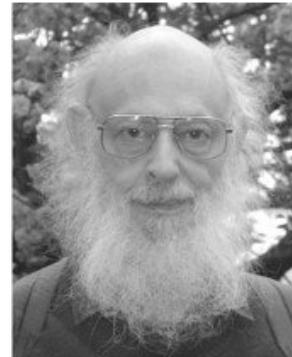
John MacCarthy



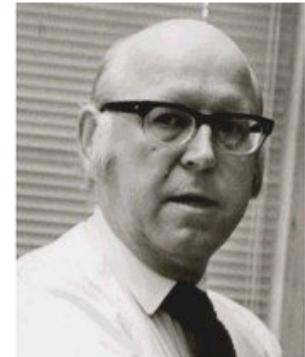
Marvin Minsky



Claude Shannon



Ray Solomonoff



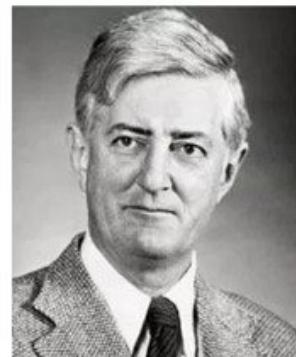
Alan Newell



Herbert Simon



Arthur Samuel



Oliver Selfridge



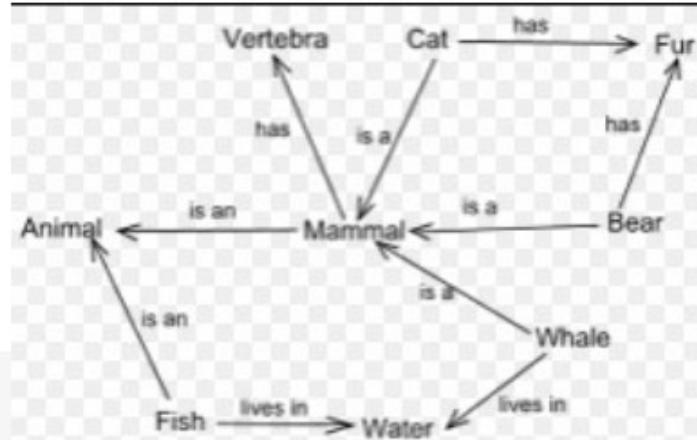
Nathaniel Rochester



Trenchard More



History of AI



1956-1974

The golden years, There were many successful programs and new directions: Natural language Understanding (first AI program to use a semantic net), Micro-worlds, Neural Networks



History of AI



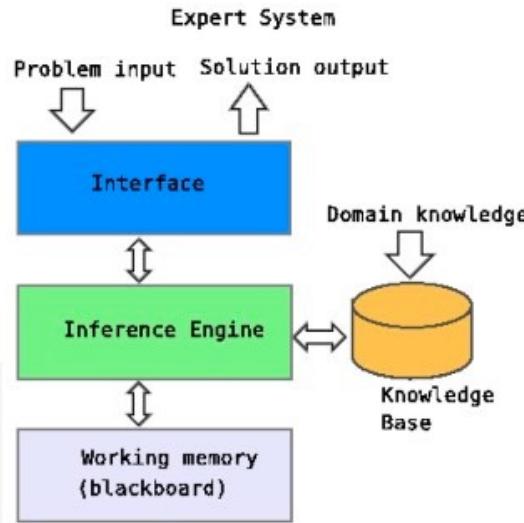
1974-1980

The first AI winter 1974–1980. AI was subject to critiques and financial setbacks. AI researchers had failed to appreciate the difficulty of the problems they faced. Their tremendous optimism had raised expectations impossibly high, and when the promised results failed to materialize, funding for AI disappeared



History of AI

1980-1987



Boom: In the 1980s a form of AI program called "expert systems" was adopted by corporations around the world and knowledge became the focus of mainstream AI research. In those same years, the Japanese government aggressively funded AI with its fifth generation computer project.



History of AI



1987-1993

The second AI winter 1987-1993. The business community's fascination with AI rose and fell in the 80s in the classic pattern of an economic bubble. The collapse was in the perception of AI by government agencies and investors – the field continued to make advances despite the criticism



History of AI



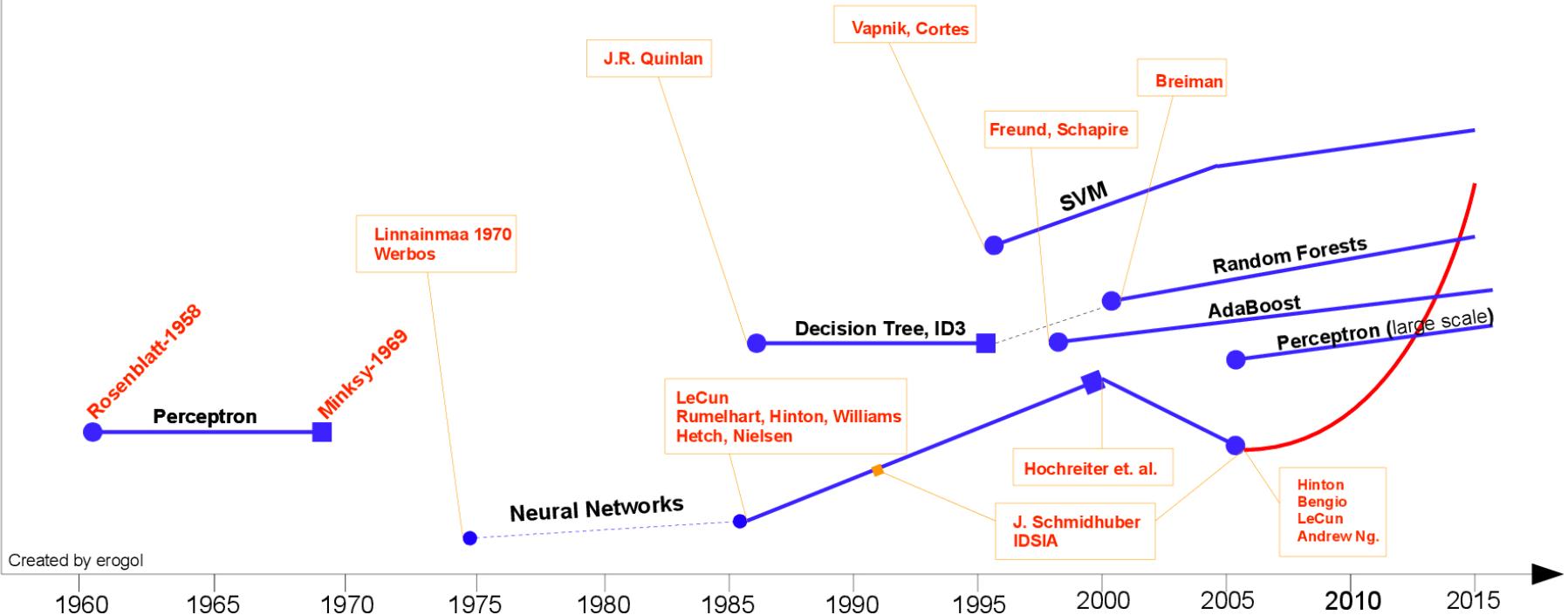
1993-2001

It began to be used successfully throughout the technology industry. Milestones and Moore's Law: On 11 May 1997, Deep Blue became the first computer chess-playing system to beat a reigning world chess champion, Garry Kasparov. Intelligent agent originally developed by AI began to appear as parts systems. AI had solved a lot of difficult problems and they proved to be useful through technology industry, such as manufacturing, industrial robotics, logistics, pattern recognition, banking software, medical diagnosis and Google's search engine.



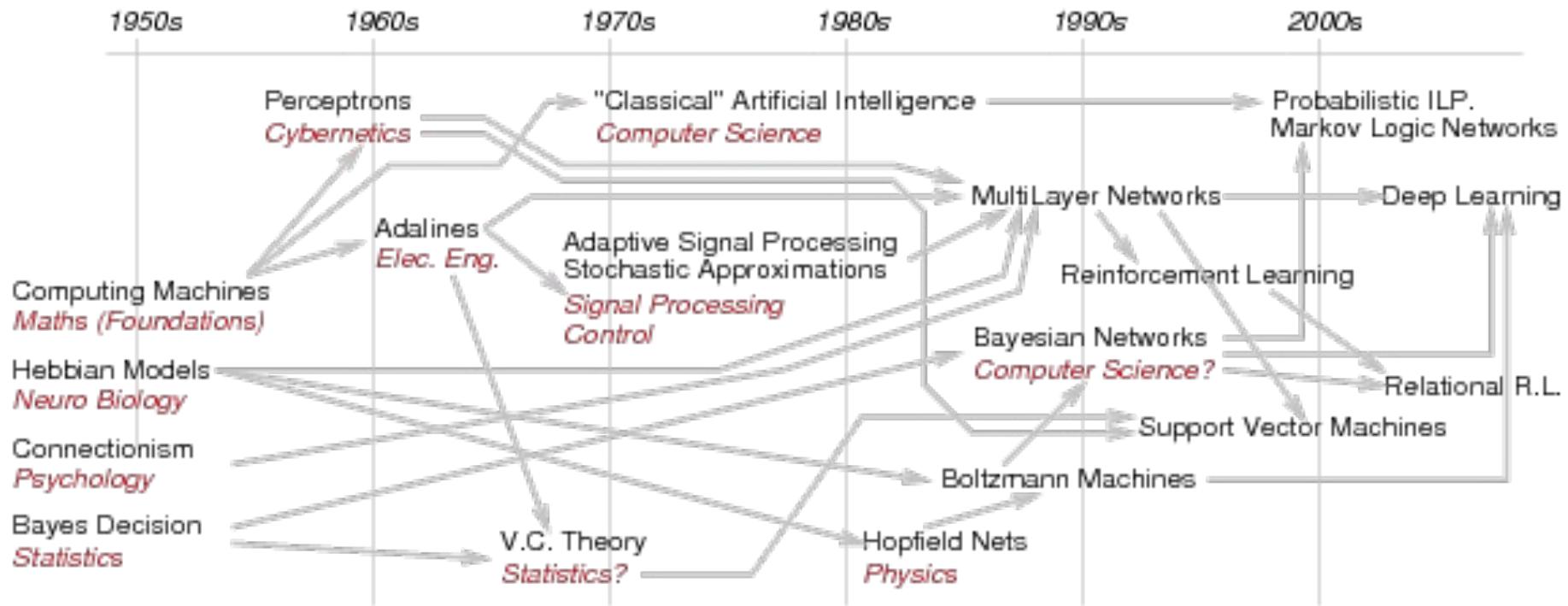
History of machine learning

Subjective Popularity



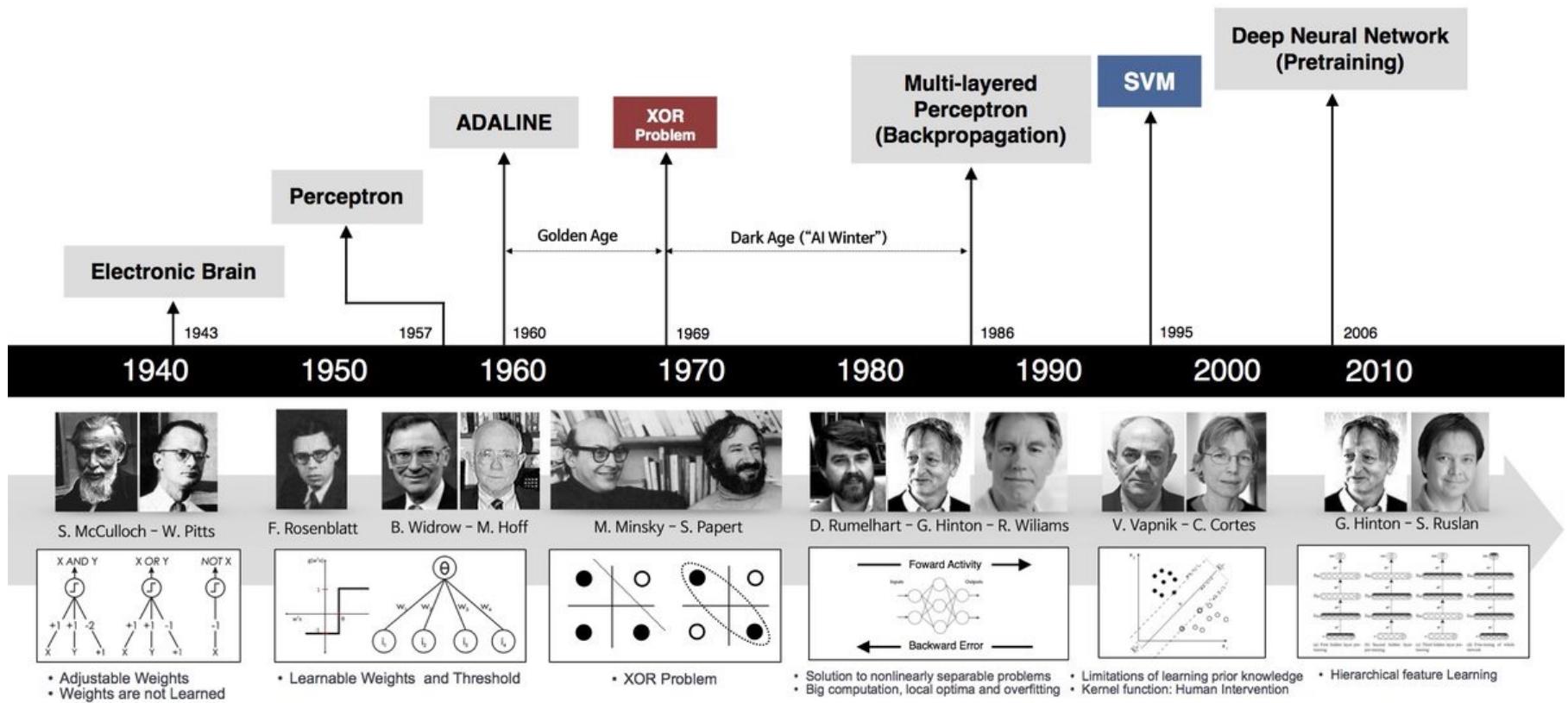


History of machine learning



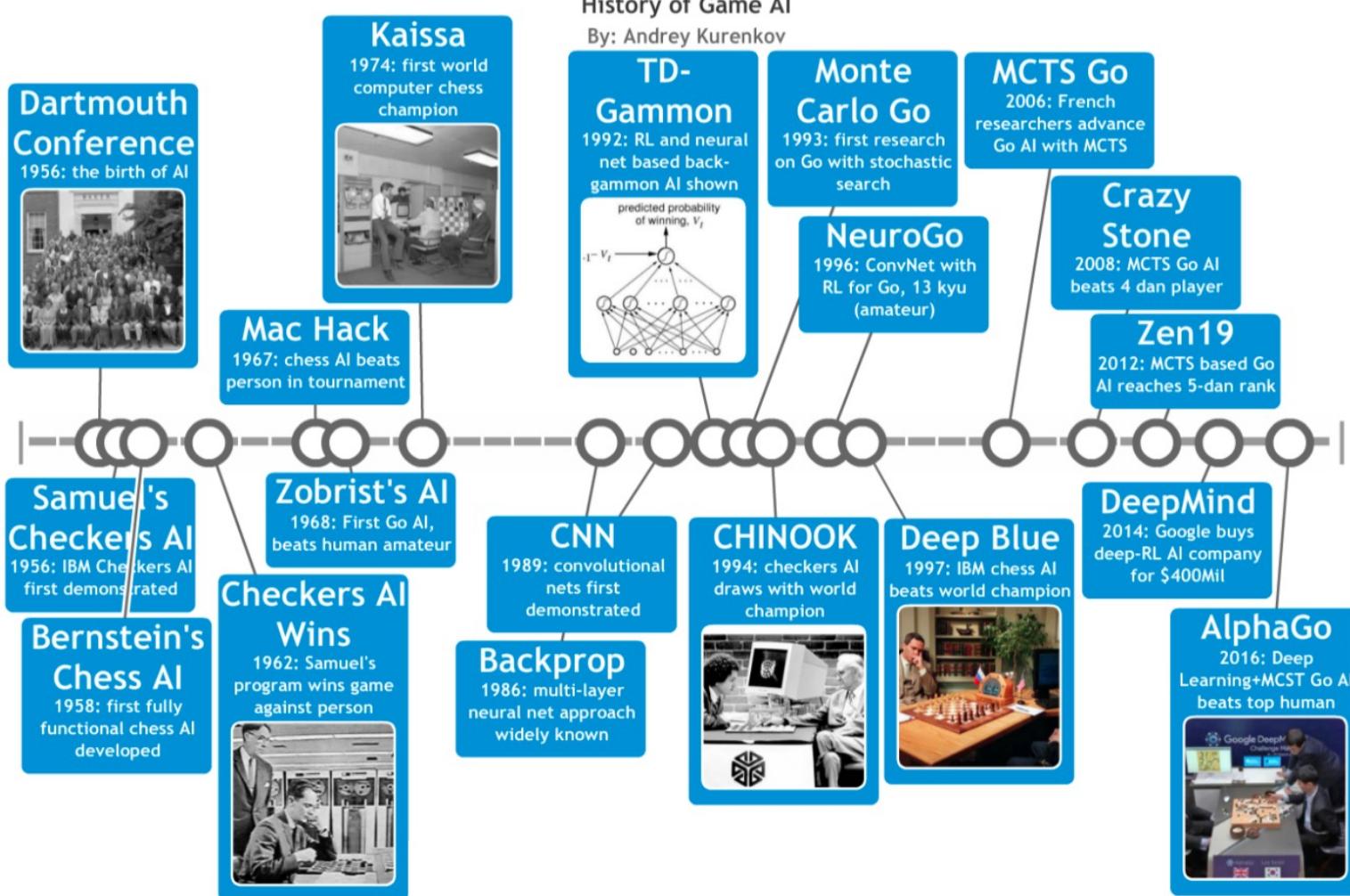


History of deep learning





History of Game AI





ARTICLE

doi:10.1038/nature16961

Mastering the game of Go with deep neural networks and tree search

David Silver^{1*}, Aja Huang^{1*}, Chris J. Maddison¹, Arthur Guez¹, Laurent Sifre¹, George van den Driessche¹, Julian Schrittwieser¹, Ioannis Antonoglou¹, Veda Panneershelvam¹, Marc Lanctot¹, Sander Dieleman¹, Dominik Grewe¹, John Nham², Nal Kalchbrenner¹, Ilya Sutskever², Timothy Lillicrap¹, Madeleine Leach¹, Koray Kavukcuoglu¹, Thore Graepel¹ & Demis Hassabis¹

The game of Go has long been viewed as the most challenging of classic games for artificial intelligence owing to its enormous search space and the difficulty of evaluating board positions and moves. Here we introduce a new approach to computer Go that uses ‘value networks’ to evaluate board positions and ‘policy networks’ to select moves. These deep neural networks are trained by a novel combination of supervised learning from human expert games, and reinforcement learning from games of self-play. Without any lookahead search, the neural networks play Go at the level of state-of-the-art Monte Carlo tree search programs that simulate thousands of random games of self-play. We also introduce a new search algorithm that combines Monte Carlo simulation with value and policy networks. Using this search algorithm, our program AlphaGo achieved a 99.8% winning rate against other Go programs, and defeated the human European Go champion by 5 games to 0. This is the first time that a computer program has defeated a human professional player in the full-sized game of Go, a feat previously thought to be at least a decade away.



AlphaGo, Master, AlphaGo Zero, AlphaZero



<https://d1c50x50snmhul.cloudfront.net/wp-content/uploads/2017/01/04171004/gettyimages-515358458.jpg>
https://cdn-images-1.medium.com/max/2000/1*do6bDqxzHog67luH77-pAA.jpeg

DL Fall 2023



DeepMind plays StarCraft II



<https://edge.slashgear.com/wp-content/uploads/2016/11/Blizzard-Releases-All-Warcraft-3-Assets-in-Starcraft-2-472003-7-980x420.jpg>
<http://team-dignitas.net/uploads/tinymce/images/scout.jpg>

DL Fall 2023



Applications of machine/deep learning



Handwriting detection





Fingerprint detection



http://biometrics.mainguet.org/types/fingerprint/algo/whorl_loop_arche.jpg
<http://biometrics.mainguet.org/types/fingerprint/algo/minutiae.jpg>

DL Fall 2023



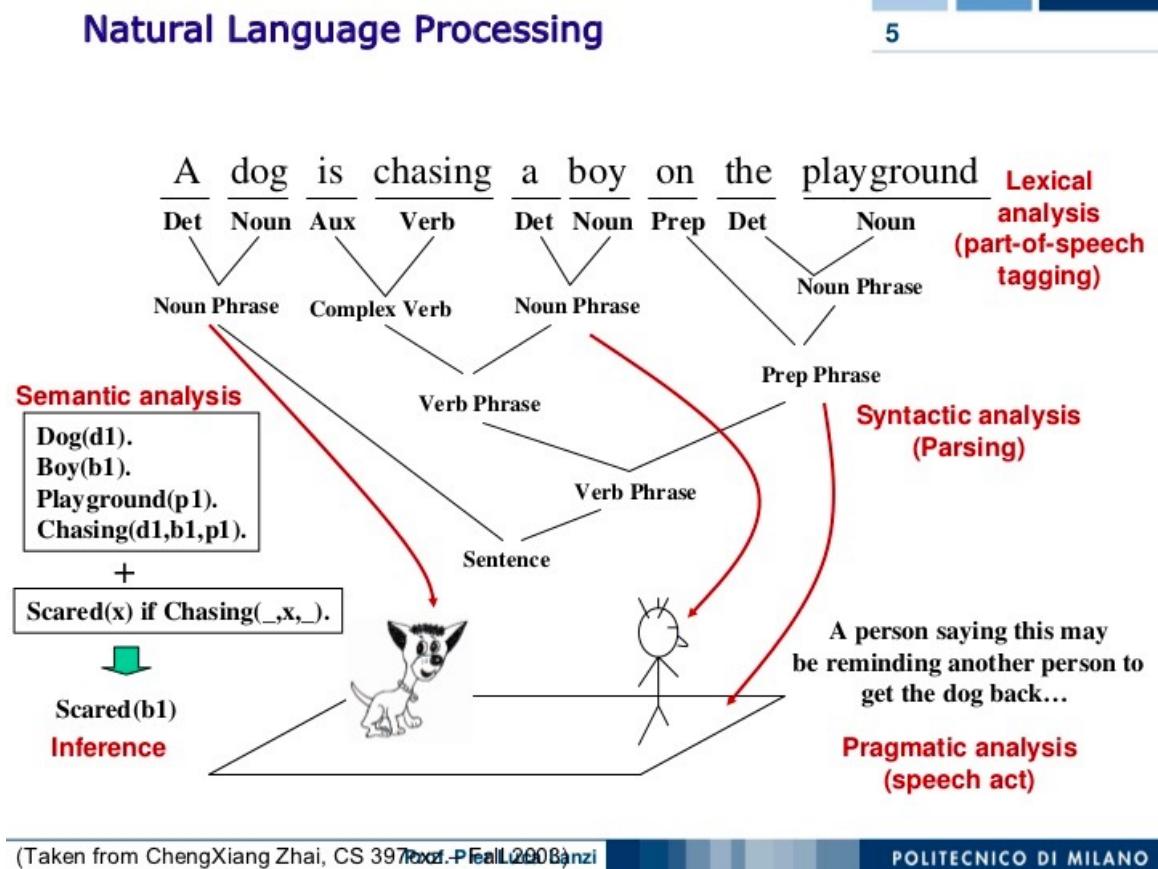
Spam email filter





Natural language processing (NLP)

- Text understanding





Natural language processing (NLP)

- Translation: Which is by Hemingway? (Which is by Google Translate?)

Kilimanjaro is a snow-covered mountain 19,710 feet high, and is said to be the highest mountain in Africa. Its western summit is called the Masai “Ngaje Ngai,” the House of God. Close to the western summit there is the dried and frozen carcass of a leopard. No one has explained what the leopard was seeking at that altitude.

Kilimanjaro is a mountain of 19,710 feet covered with snow and is said to be the highest mountain in Africa. The summit of the west is called “Ngaje Ngai” in Masai, the house of God. Near the top of the west there is a dry and frozen dead body of leopard. No one has ever explained what leopard wanted at that altitude.

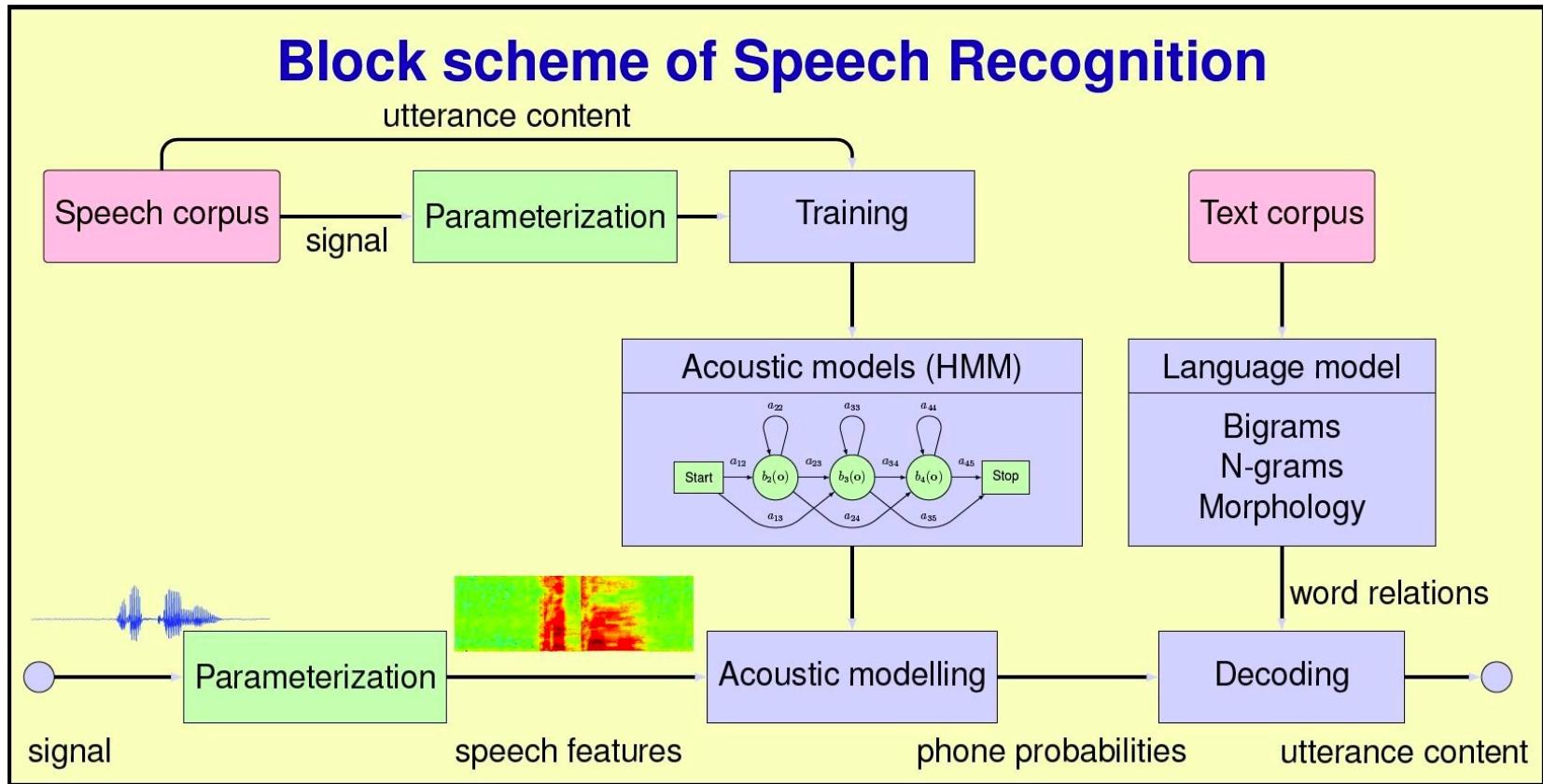


Speech recognition





Speech recognition



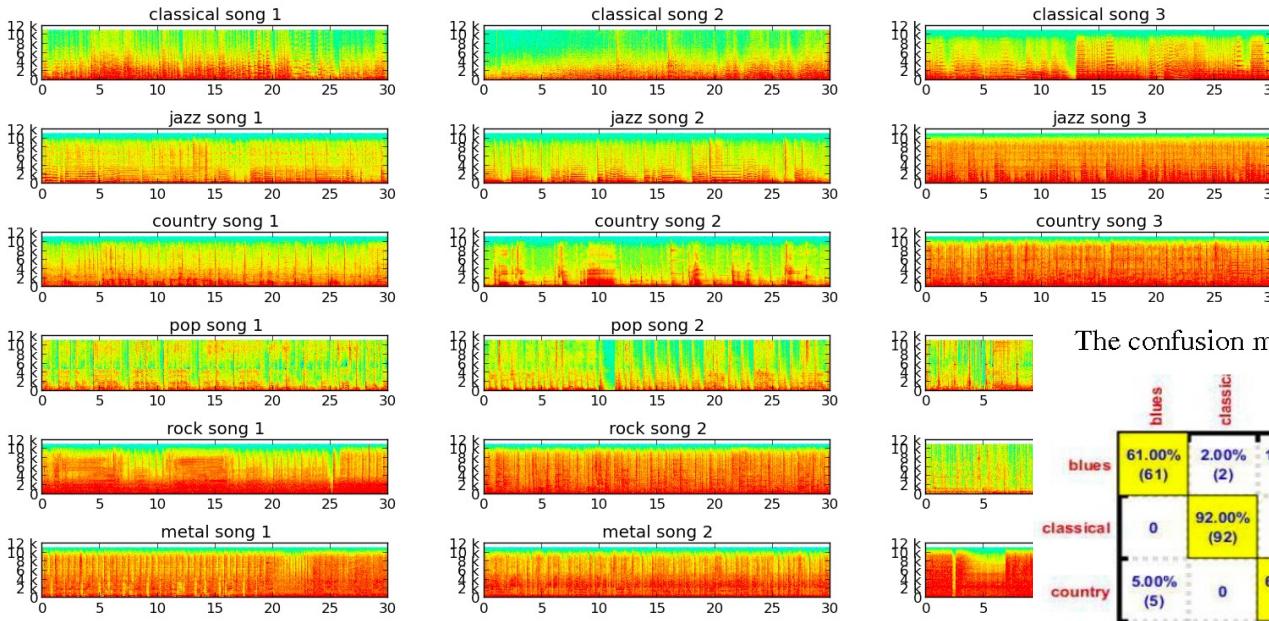


Music genre classification





Music genre classification



The confusion matrix was plotted for this in Fig. 6.

	blues	classic	country	disco	hiphop	jazz	metal	pop	reggae	rock
blues	61.00% (61)	2.00% (2)	12.00% (12)	0	2.00% (2)	3.00% (3)	8.00% (8)	0	2.00% (2)	10.00% (10)
classic	0	92.00% (92)	0	0	1.00% (1)	6.00% (6)	0	0	0	1.00% (1)
country	5.00% (5)	0	61.00% (61)	9.00% (9)	2.00% (2)	2.00% (2)	1.00% (1)	3.00% (3)	6.00% (6)	11.00% (11)
disco	1.00% (1)	0	5.00% (5)	56.00% (56)	3.00% (3)	2.00% (2)	4.00% (4)	8.00% (8)	8.00% (8)	13.00% (13)
hiphop	2.00% (2)	3.00% (3)	4.00% (4)	5.00% (5)	58.00% (58)	0	7.00% (7)	5.00% (5)	13.00% (13)	3.00% (3)
jazz	3.00% (3)	9.00% (9)	7.00% (7)	1.00% (1)	0	72.00% (72)	1.00% (1)	0	2.00% (2)	5.00% (5)
metal	3.00% (3)	0	0	2.00% (2)	4.00% (4)	2.00% (2)	80.00% (80)	0	1.00% (1)	8.00% (8)
pop	0	2.00% (2)	10.00% (10)	9.00% (9)	6.00% (6)	0	0	70.00% (70)	3.00% (3)	0
reggae	5.00% (5)	3.00% (3)	10.00% (10)	7.00% (7)	12.00% (12)	1.00% (1)	1.00% (1)	3.00% (3)	55.00% (55)	3.00% (3)
rock	9.00% (9)	1.00% (1)	10.00% (10)	19.00% (19)	1.00% (1)	6.00% (6)	11.00% (11)	1.00% (1)	5.00% (5)	37.00% (37)

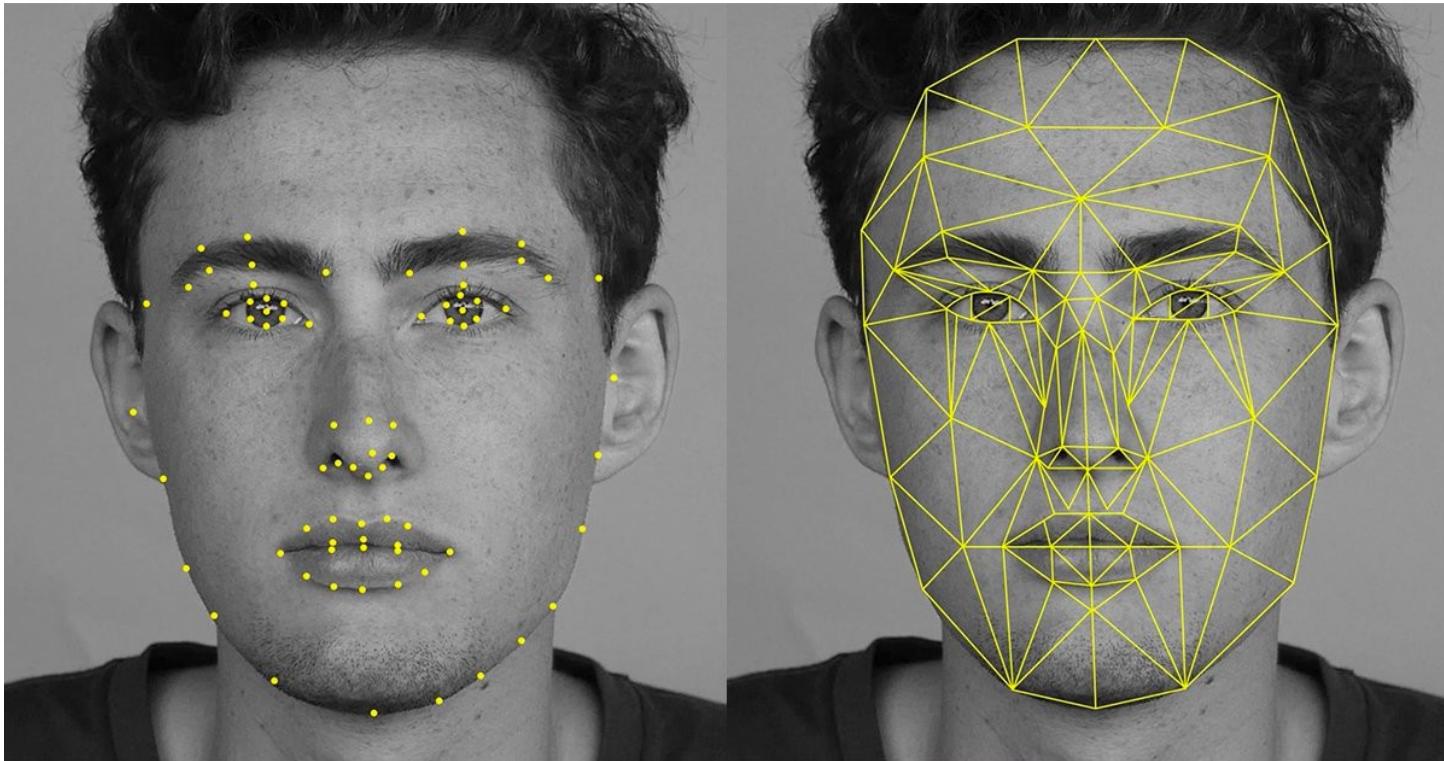
https://raw.githubusercontent.com/jazdev/genreXpose/master/genreXpose/graphs/Spectrogram_Genres_clean.png

<https://ai2-s2-public.s3.amazonaws.com/figures/2017-08-08/e272ce9dd8c7adec73817135d053f5819d968082/6-Figure7-1.png>

Fig. 7. SVM with reduced dimensions.



Face recognition





Emotion detection





Object recognition

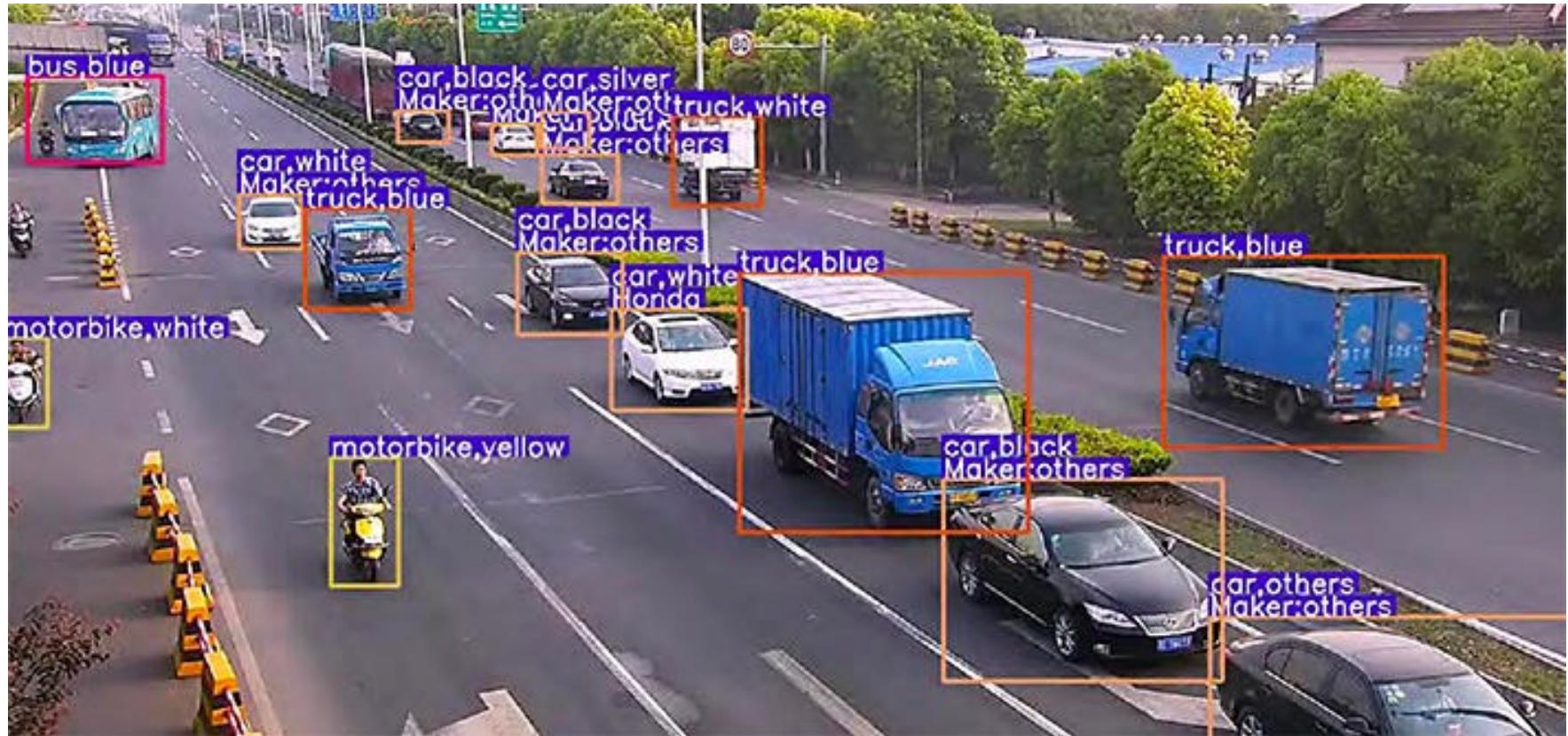


https://d26pej6xf128et.cloudfront.net/wp-content/uploads/2017/08/AI_Object_Recognition_Feature_Img.jpg?x89106

DL Fall 2023



Surveillance camera





Surveillance camera



1. Detection
Real-time categorization
and search of external appearance
and movement features



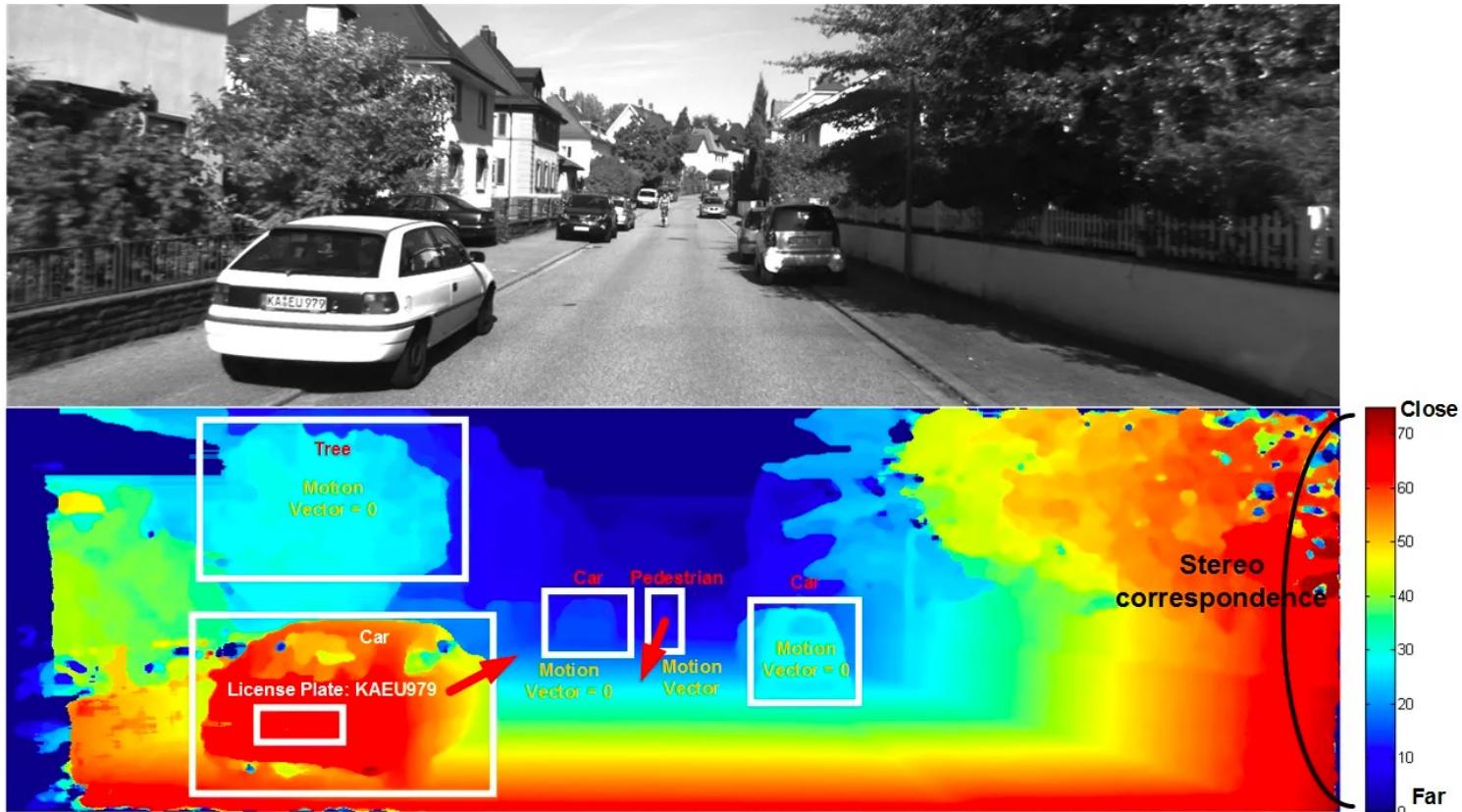
<https://www.asmag.com/upload/pic/article/54438.217875.png>

DL Fall 2023



Self-driving cars

- Road detection, pedestrian detection





Recommendation system

- Music/movie/video/shopping recommendation

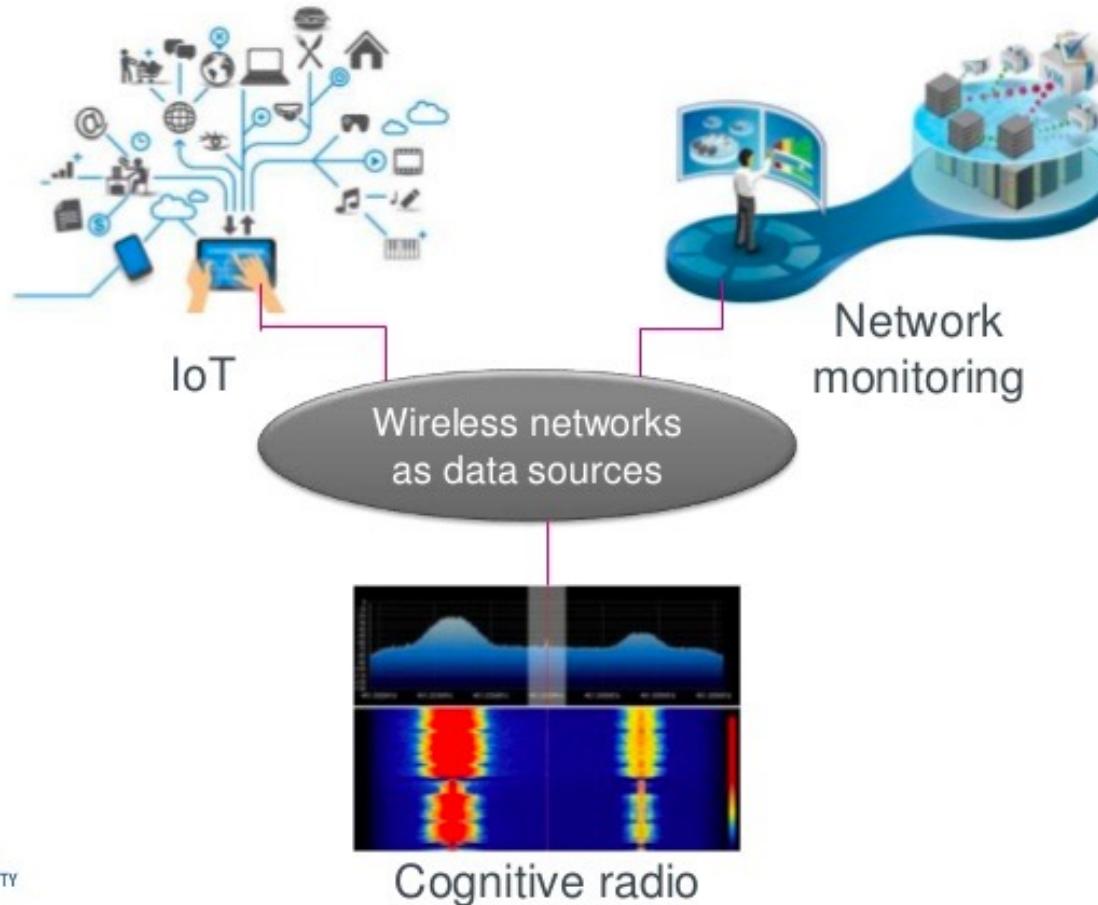


https://o.aolcdn.com/images/dims?quality=100&image_uri=http%3A%2F%2Fwww.blogcdn.com%2Fwww.engadget.com%2Fmedia%2F2012%2F02%2Fappletv2.020312.jpg&client=cbc79c14efcebee57402&signature=8eeeeec4130169746e4a35a1cf0793fce75f196f



Wireless communications/network

What kind of data are generating wireless networks?



<https://image.slidesharecdn.com/ttjg6jg4qdcl9sawvdvg-signature-78f69696f964c9cc253b4acd4ecb196acc4a51da7692bbe4ca18825f7aca38c4-pol-161128140921/95/machine-learning-for-wireless-networks-bestcom2016-5-638.jpg?cb=1485252301>



Fintech

- Precision marketing



Understanding your Shopper's Purchase Graph & Cycles



ARF AUDIENCE 2015
MEASUREMENT

@The_ARF #ARFAM2015

<https://image.slidesharecdn.com/084b8551-2a96-46de-bdd2-251183d1cd72-150624164355-lva1-app6892/95/precisionmarketingplaybook-8-638.jpg?cb=1435164448>

<http://slideplayer.com/6915664/23/images/2/PRECISION+MARKETING+MEETS+BRAND+ADVERTISING.jpg>

DL Fall 2023



- Automatic trading

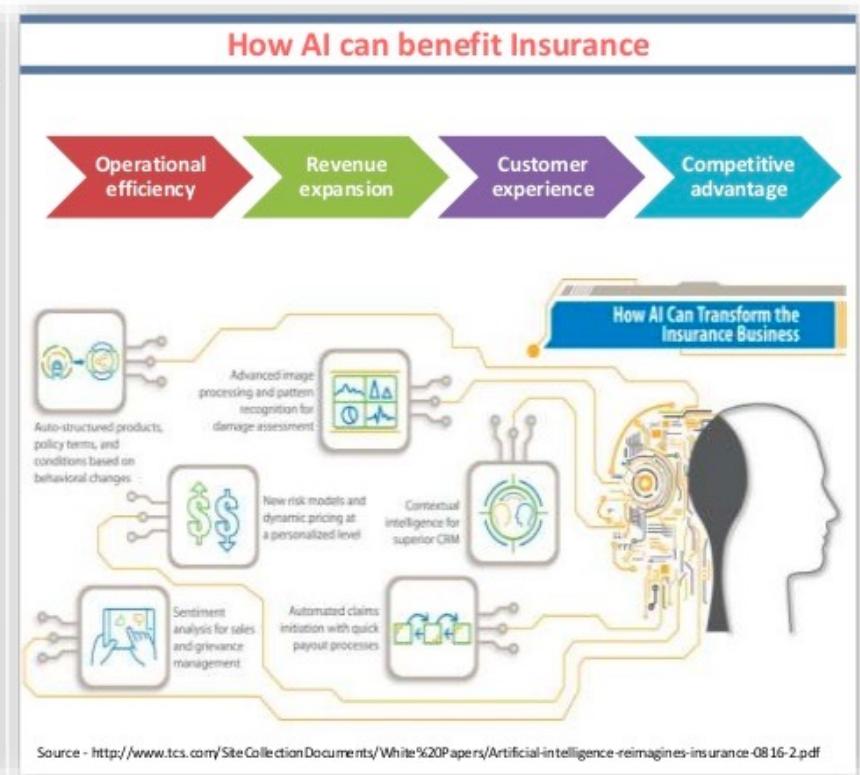




Fintech



Disrupting (& Improving) Insurance



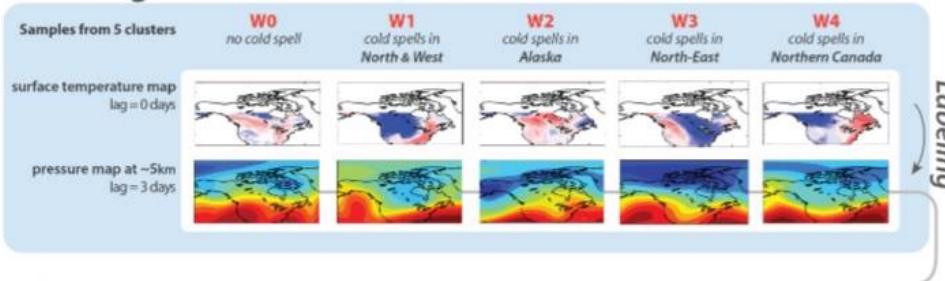
<https://image.slidesharecdn.com/aiininsurance-primer-draft-version2-170327114347/95/ai-in-insurance-inview-primer-5-1024.jpg?cb=1490615256>



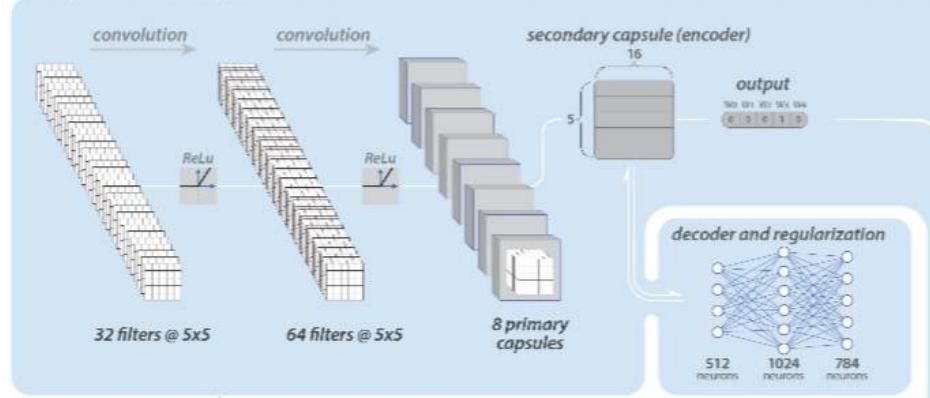
Earth science

- Weather prediction

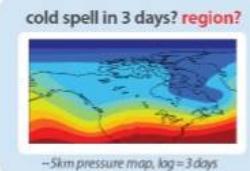
Training



CapsNet



Test

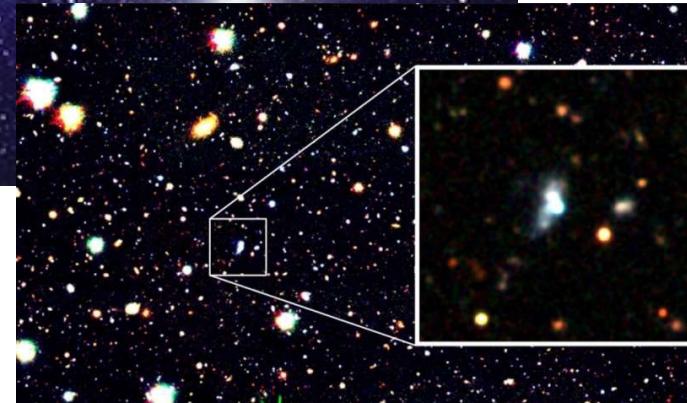


Prediction result





Astronomy



<https://www.illinoistimes.com/springfield/astronomy/Content?oid=11493849>

<https://phys.org/news/2020-08-machine-early-galaxy.html>



Art creation



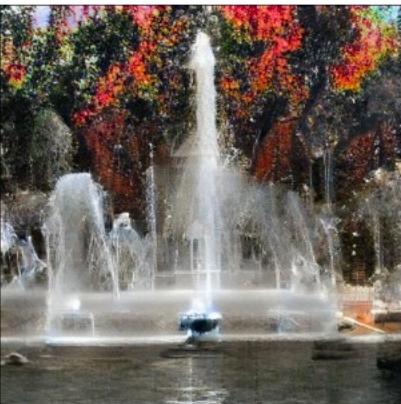
Yating
(雅婷)

<https://www.electronicproducts.com/uploadedImages/Programming/Software/aipainter.jpg>
https://s.mxmcdn.net/images-storage/albums4/4/5/1/7/6/9/37967154_350_350.jpg

DL Fall 2023



Image/video generation





Image/video generation

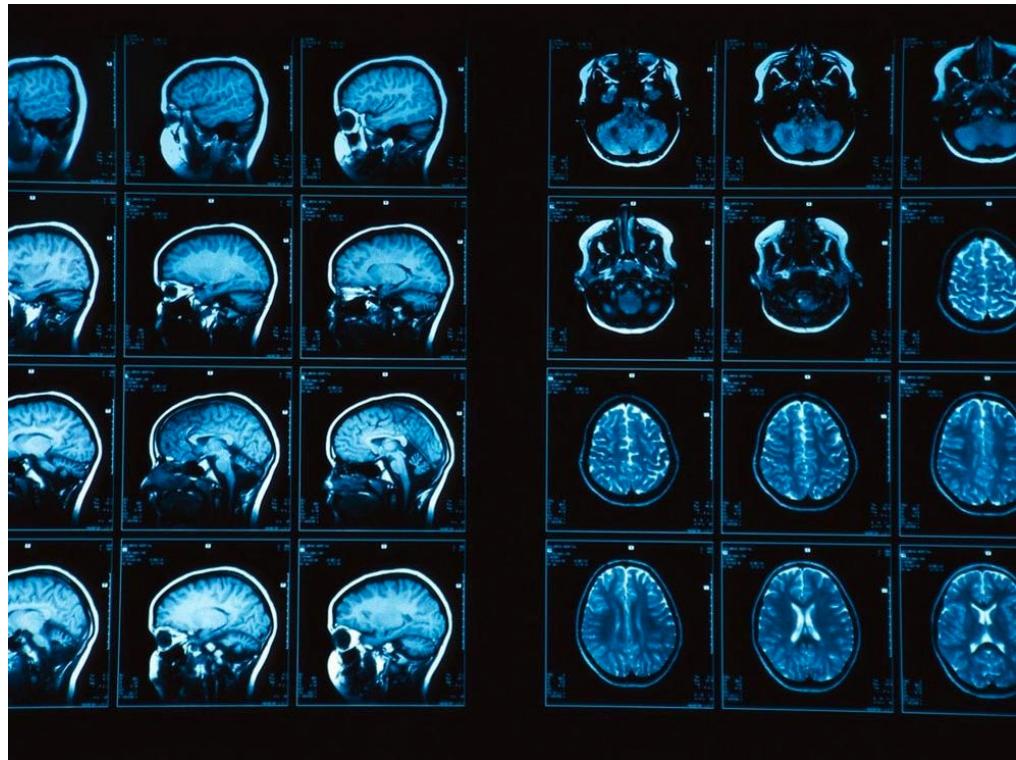
Deepfake

<https://www.abc.net.au/news/2018-09-27/fake-news-part-one/10308638?nw=0>



Medical imaging

- MRI



- Precision medicine

http://images.nationalgeographic.com/wpf/media-live/photos/000/008/cache/brain-mri_848_990x742.jpg

DL Fall 2023