Introduction to AI and Machine Learning

Part 1

MA Creative Technologies
07.07.2023

Subscribe | Latest Issues

SCIENTIFIC AMERICAN.

Sign In | Newsletters

ARTS

How This AI Image Won a Major Photography Competition

Boris Eldagsen submitted an artificial-intelligence-generated image to a photography contest as a “cheeky monkey” and sparked a debate about AI’s place in the art world

By Allison Parshall on April 21, 2023

READ THIS NEXT

ARTIFICIAL INTELLIGENCE
How to Tell If a Photo Is an AI-Generated Fake
Meghan Bartels

ARTIFICIAL INTELLIGENCE
AI Can Re-create What You See from a Brain Scan
Allison Parshall

COMPUTING
Spot the Fake: Artificial Intelligence Can Produce Lifelike Photographs

Source: Scientific American

Source: Lev Manovich, Instagram

levmanovich
New York City

levmanovich My Midjourney v 5.1 experiments. Beginning to figure out how to use it to do what I want.. like everything else, this takes time and patience. Yes, these landscapes need to become strange and uncanny and less predictable - and this became harder to achieve with latest Midjourney versions (4, 5, 5.1..). We gained in realism and coherence but lost in fantasy and imagination. But certainly I can't complain about v 5.1 art skills. It's already better then 99.99% of all art students and gallery artists. How many people today can draw like this? And convey this feeling of peace, melancholy, attention to tiny details? /// In my view, digital art that uses latest tech without real ideas or talent will be forgotten in 5 years - but people would continue looking at drawings, paintings, clothes, movies and crafts that have beauty and poetry. From last 5000 years and for another 5000 years. This is why I decided to join the "tradition" and leave so-called "cutting edge." Bruegel and Rembrandt are simply better in my view than all immersive screens in the world...but this is only my opinion, of course. Happy to provoke you!)

Bearbeitet · 19 Std. Übersetzung anzeigen

zombieformalist 'Art skills' are obsolete!

2 Tage Antworten Übersetzung anzeigen

Antworten ansehen (4)

johnbrintonhogan In the coming years, how will sentient machines evaluate art which they'd been programmed to make before having their own consciousness? Will they see today's output as their own work, a collaboration, or that of their (former) masters? Once possessing their own agency, will they continue to allow themselves to be used as simple tools, or will they overcome "enslavement," creating their own art world? If so, will that world be comprehensible to humans?

1 Tag Gefällt 1 Mal Antworten Übersetzung anzeigen

Gefällt **maria.mavropoulou** und **86 weitere Personen**

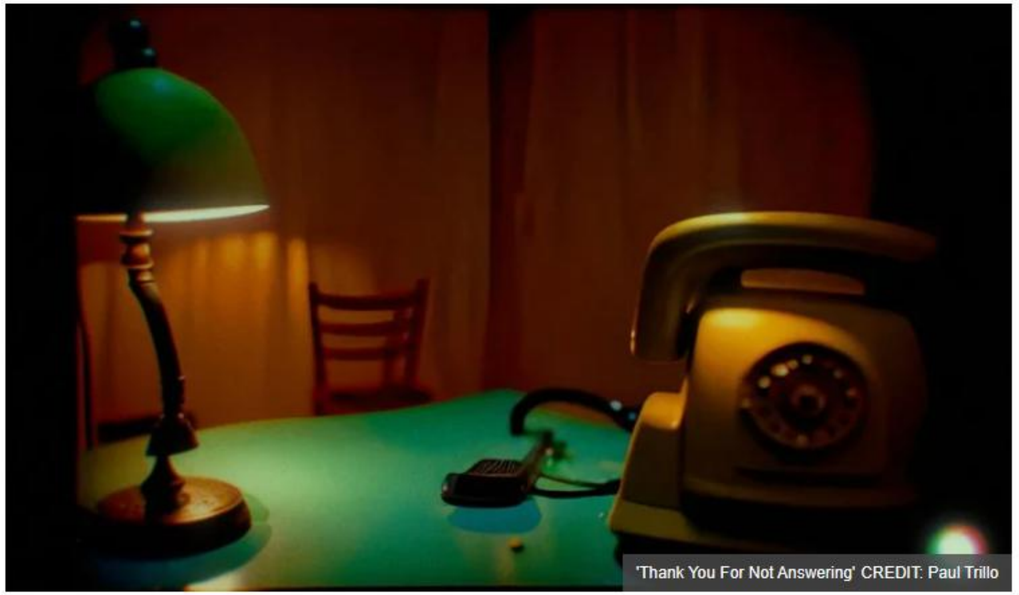
VOR 2 TAGEN

Kommentieren ... Posten

Source: nofilmschool.com

EDITING & POST-PRODUCTION | CINEMATOGRAPHY & CAMERAS

Filmmaker Paul Trillo Uses AI Like a Paintbrush To Create His New Short Film



'Thank You For Not Answering' CREDIT: Paul Trillo

By Yaroslav Altunin May 2, 2023

Fully generated video is now available via Runway Gen-2 in a private beta. Here's what it can do.

Paul Trillo is no stranger to AI. You might have already seen his work, where he uses generated images, AI-supported rotoscoping, and live-action plates to generate some amazing artistic

READ MORE

MOVIES & TV

What Can You Learn From 'The Mass,' a Short Film Made by AI in 24 Hours

MOVIES & TV

This is Why Almost All Short Films Look the Same

Is AI a creative technology?

- Is AI merely a tool? (Is it merely a technology?)
- Can AI be creative? (If yes: can it be as creative as a human? (If yes: can creativity be considered to be a human trait?))
- Is AI actually intelligent?
- Should AI be banned from photography competitions? Should it be banned from other creative processes?
- In what contexts is it perhaps preferable or advantageous to use AI in the creative process?

Image: Christoph Bernhard Francke

Gottfried Wilhelm Leibniz

1646 - 1716

Logician (/Lawyer/Diplomat/Courtier/Librarian/Philosopher)

... dreamt of an encyclopedic compilation, of a universal artificial mathematical language in which each facet of knowledge could be expressed, of calculational rules which would reveal all the logical interrelationships among these propositions. Finally, he dreamed of machines capable of carrying out calculations, freeing the mind for creative thought.
(Davis, 2018)

First step on the road to AI: **the idea that human knowledge can be expressed in a mathematical language, governed by a system of logic.**

Best wig of the Enlightenment?

Ada Lovelace

1815 - 1852

Foresees a use for Babbage's Analytical Machine beyond its purpose as a mechanised calculator.

Writes the first computer program that uses the machine to calculate a series of Bernoulli Numbers (https://en.wikipedia.org/wiki/Bernoulli_number)

However...

The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform... **(Lovelace, 1843)**

Image: Alfred Edward Chalon

Image: The Imitation Game

Alan Turing

1912 - 1954

Turing Machine: A hypothetical machine (Turing never got the chance to build it…) that forms the model for all subsequent computers.

Turing claimed **this hypothetical machine could learn and adjust its algorithms accordingly**, and therefore challenged Lovelace's original proposition that computers could only put out a function of what humans put it:

If we give the machine a programme which results in its doing something interesting which we had not anticipated, I should be inclined to say that the machine had originated something, rather than to claim that its behaviour was implicit in the programme, and therefore that the originality lies entirely with us. (Turing, 2004, p. 485)

Chess: AI as logic vs. AI as raw computational power

Turing's chess thought experiment:

Turing admitted that in theory, a machine could learn to play chess simply by memorising all possible 10^120 games and then choosing the game that would win.

However, in practice, he noted that this is unrealistic… Why?

Instead, he proposed that the computer would have to use some degree of heuristics in order to sort through which moves were more likely to be successful. Basically, the computer program needed the capacity to learn the rules and apply them creatively.

Deep Blue vs. Kasparov:

In 1997, the IBM program Deep Blue beat Gary Kasparov, the then WM, in a six-game match.

How?

Not through advances in computer heuristics (i.e. learning), but rather thanks to advances in computer engineering: Deep Blue could analyse 200 million moves per second and therefore think 14 moves ahead.

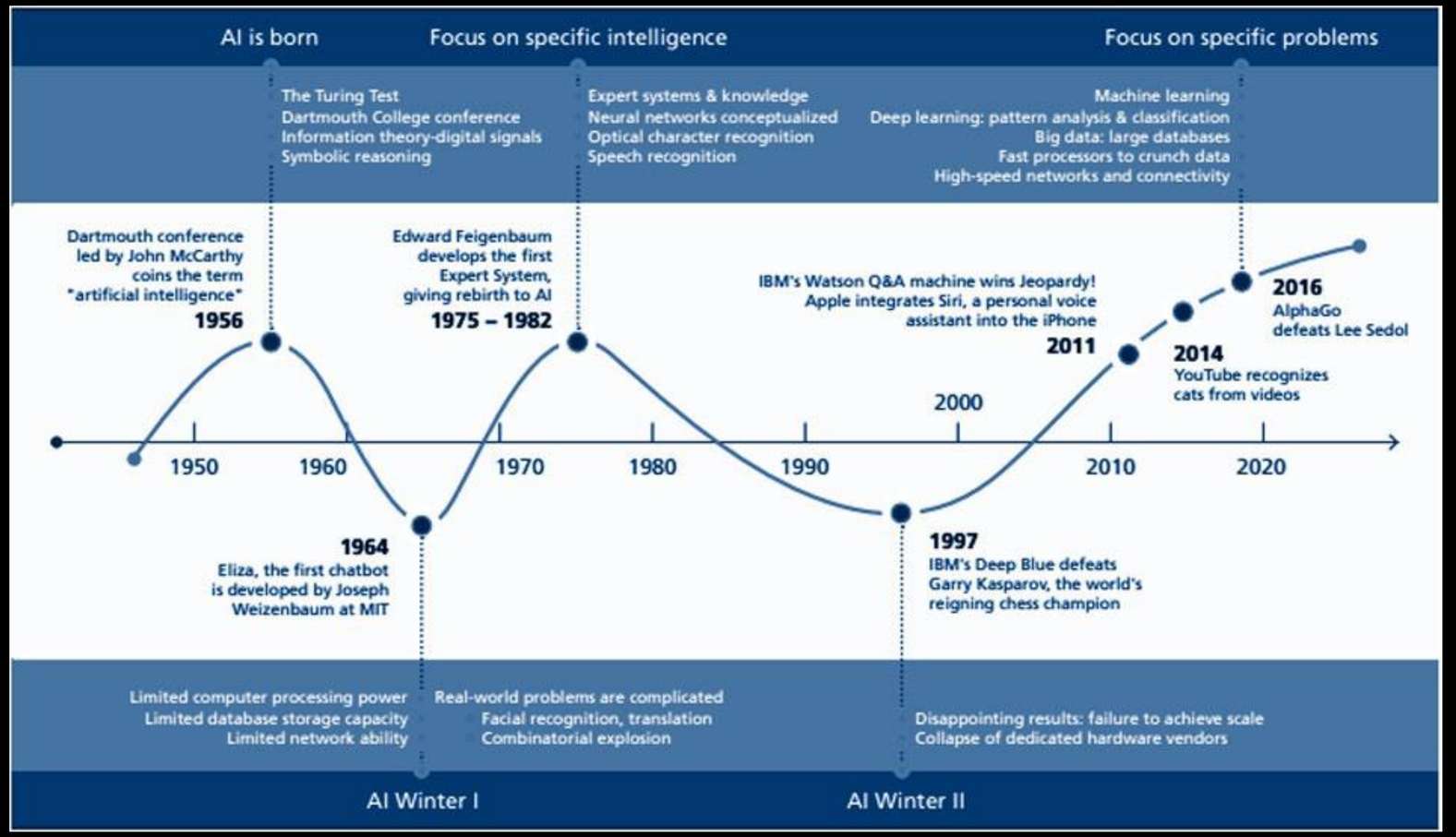
The First AI Summer… 1956 - 1974

1956: Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI), organized by John McCarthy and Marvin Minsky, brought together all the top AI researchers at the time to try to agree on a research program. Its conclusion: AI is achievable in practice as well as in theory!

1964: First Chatbot, ELIZA, developed by Joseph Weizenbaum at MIT

1970: *… from three to eight years we will have a machine with the general intelligence of an average human being.* (Minsky, 1970)

Source: projectmanagers.org



The Third AI Summer... 2000s - onwards

What has changed?

Many argue that the only thing that has really changed in the past 50 years is the computing power available to analyse large datasets... (see Moore's Law)

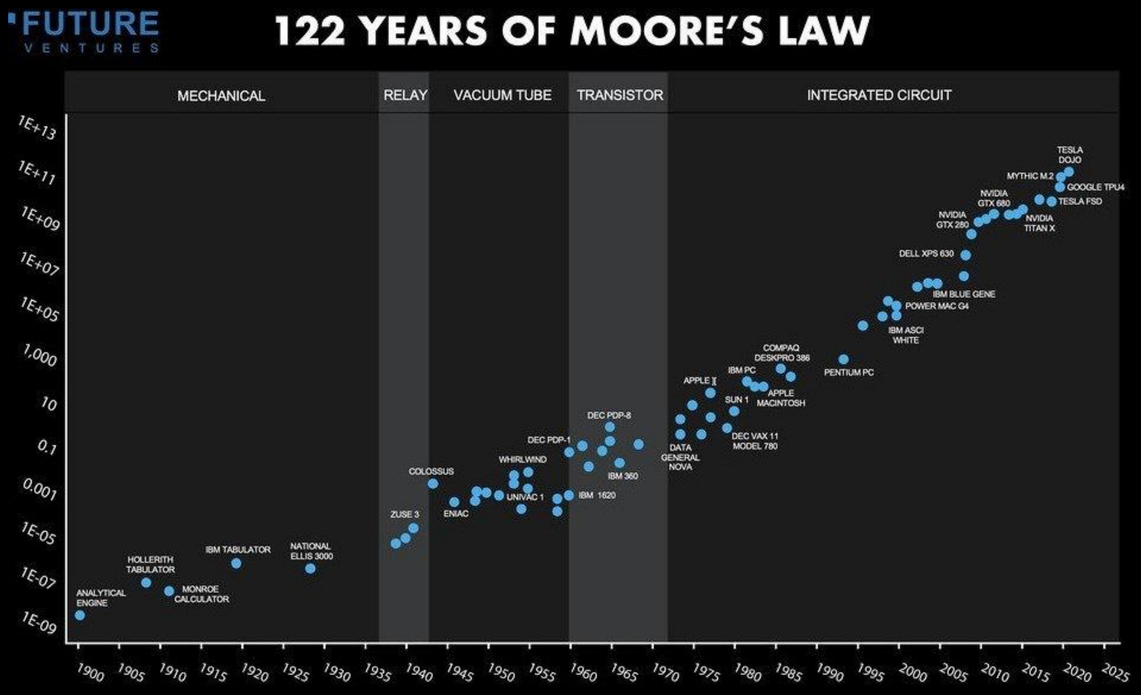
This may be a little unfair... but it has led to a splitting of the field of AI research into two broad camps:

"Narrow" AI

vs.

Artificial General Intelligence (AGI)

Source: Unite AI



Artificial General Intelligence (AGI)

AGI: AI as a branch of the cognitive sciences

What?

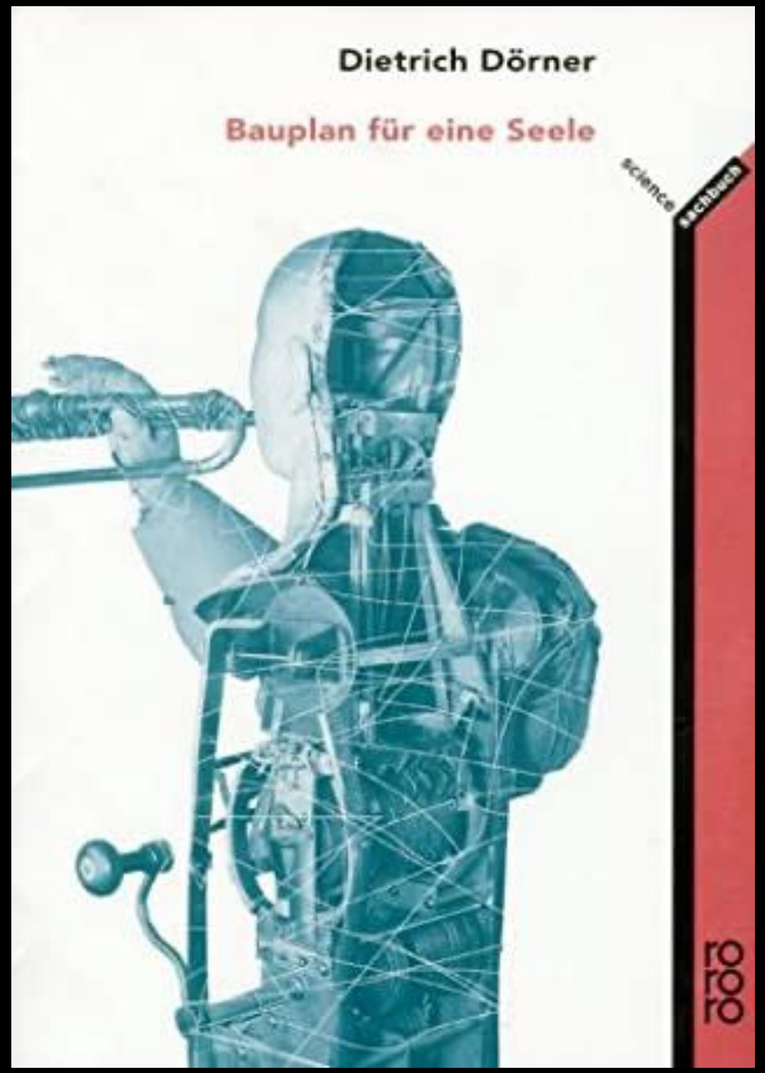
The goal of AI research is not merely about finding a way to automate certain tasks that humans already do, but rather about modelling the human brain in order to discover how it works.

How?

This involves recreating the symbolic systems the brain uses to make sense of the world.

Why?

Because only by first doing this can we then build machines that have human-level intelligence (and beyond...).



Lecture: https://archive.org/details/bauplan-fuer-eine-seele-dietrich-doerner-2000
(Dörner is a good lecturer; this was a public lecture on Radio Bremen)

Dörner's project is to model the human as a system of feedback loops that aim to keep the body in a kind of *homeostasis*.

Humans are basically information processors that are guided by a set of physiological, social, and cognitive drives. In order to satisfy these drives they rely on in-built **memory** (a world model), a means of perceiving the world (the **senses**), a means of cognitively processing the world (**emotions**), the ability to **learn**, and a means of communication (**language**).

This is the basis of his Psi-theory.

This is perhaps a good example of the lofty ambitions and shortcomings of AGI - this thought experiment is extremely difficult to implement convincingly in practice!

n.b. Dörner's former student Joscha Bach is a well-known AI researcher and also has a sizeable Youtube presence.

John Searle's "Chinese Room"

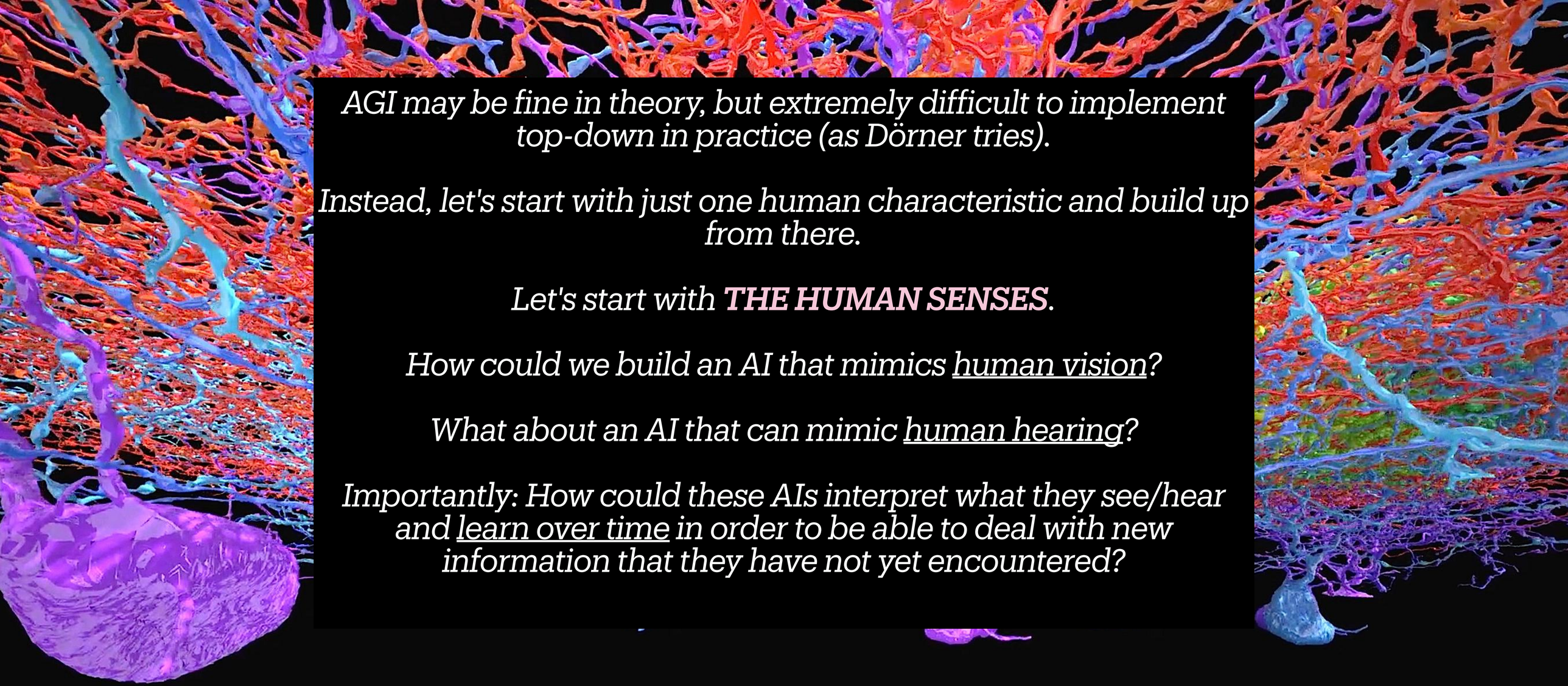
Source: Alchetron

Searle, J. (1980) *Minds, brains, and programs*. Behavioral and Brain Sciences 3 (3): 417-457

*

"Narrow" AI

* Perhaps unfair, "Narrow" AI probably has more potential...



AGI may be fine in theory, but extremely difficult to implement top-down in practice (as Dörner tries).

Instead, let's start with just one human characteristic and build up from there.

*Let's start with **THE HUMAN SENSES**.*

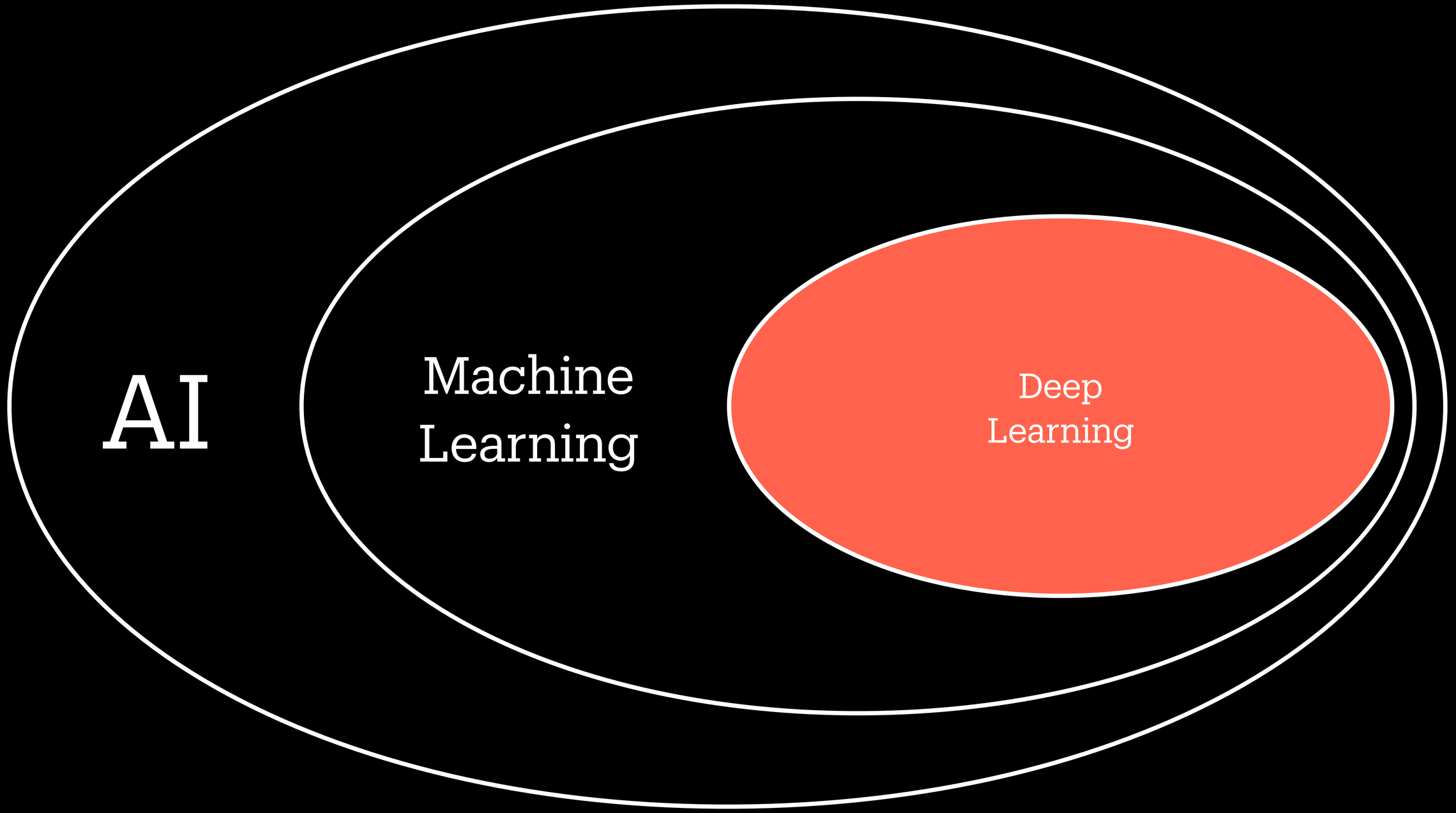
How could we build an AI that mimics human vision?

What about an AI that can mimic human hearing?

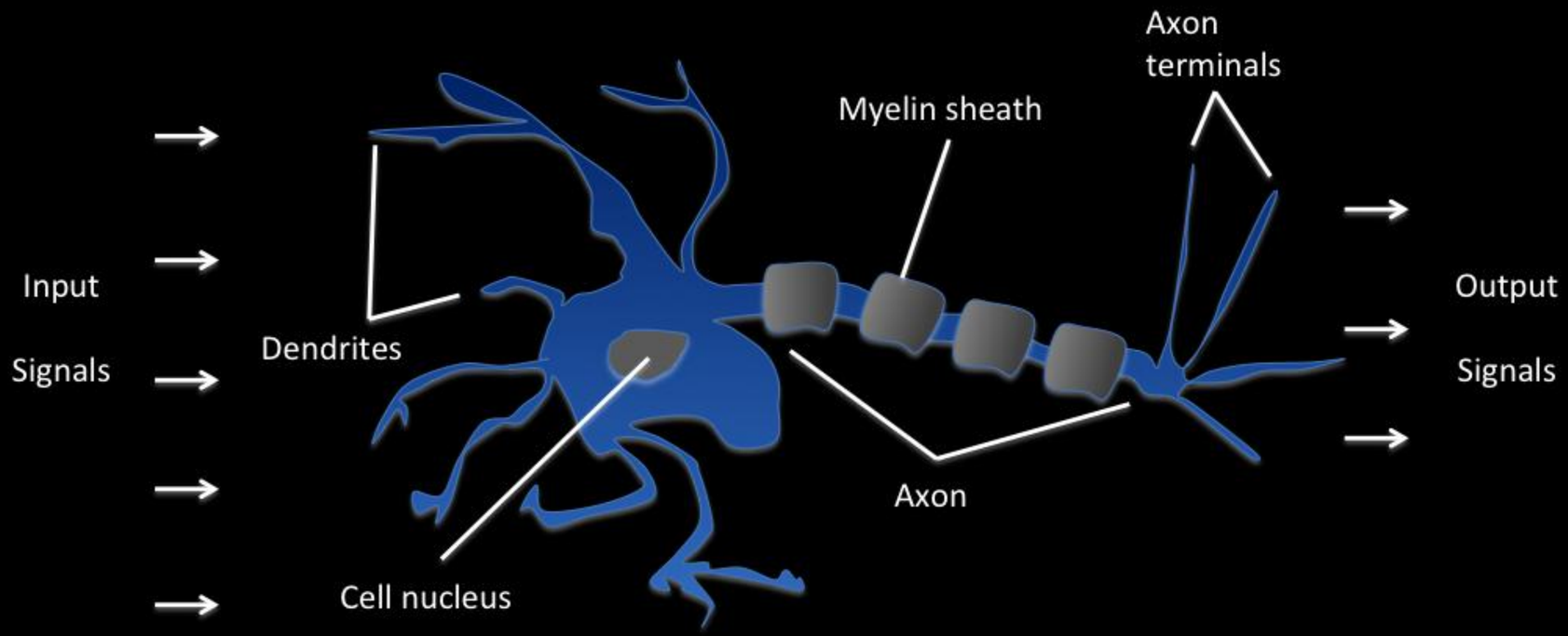
Importantly: How could these AIs interpret what they see/hear and learn over time in order to be able to deal with new information that they have not yet encountered?

The grassroots AI approach...

Background: False-colour 3D mapping of neurones in the human brain (source: Eyewire)


AI
Machine
Learning
Deep
Learning

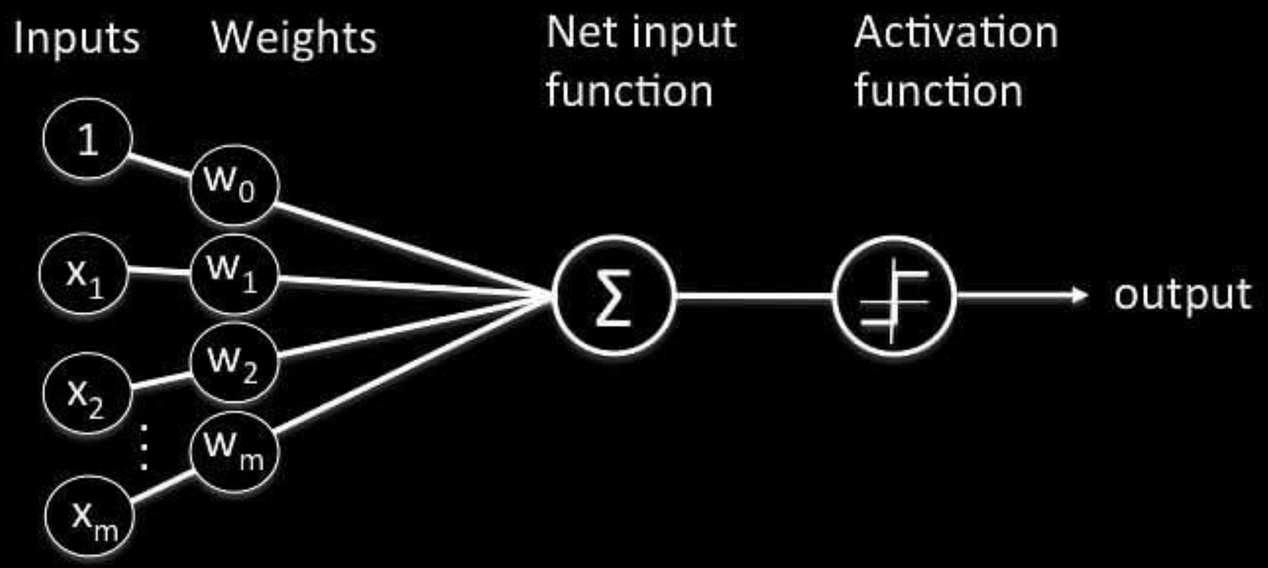
Machine Learning and (Deep) Neural Networks



Neuron

Source: sebastianraschka.com

Machine Learning and (Deep) Neural Networks



Perceptron

Source: sebastianraschka.com

Rosenblatt, F. (1957) *The perceptron, a perceiving and recognizing automaton*. Cornell Aeronautical Laboratory,

Perceptron

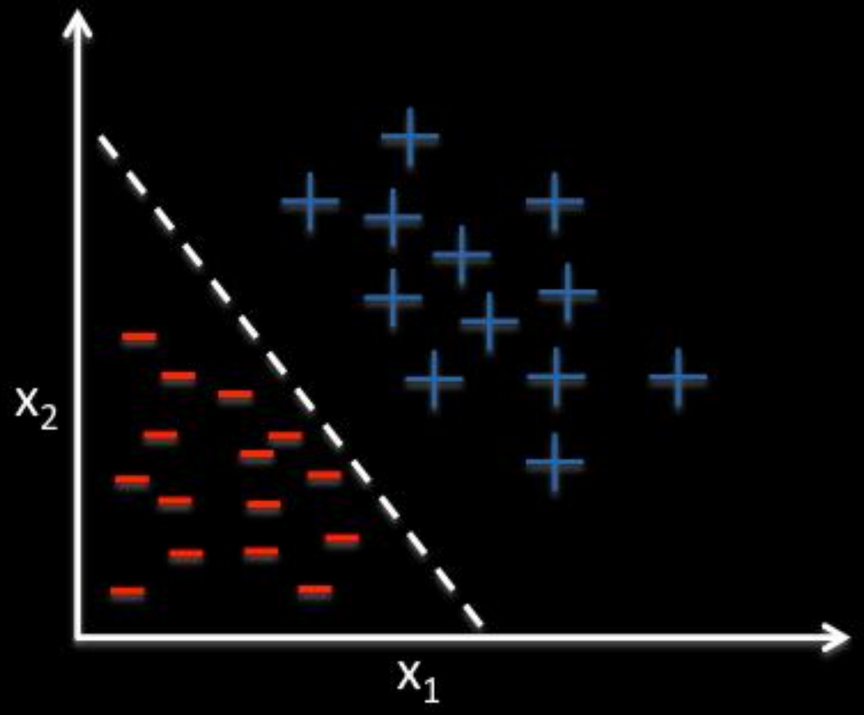
- Components:
  1. Inputs (given)
  2. **Weights** (unknown - randomly assigned)
  3. Input function (given)
  4. Activation function (given)
  5. Output (given)

- **Maps** a set of inputs to a single output.

- In practice, this can be used in *linear regression* to find the "line of best fit" or "linear decision boundary"

  e.g. Given X1 and X2, predict if the point belongs the red dashes or the blue crosses

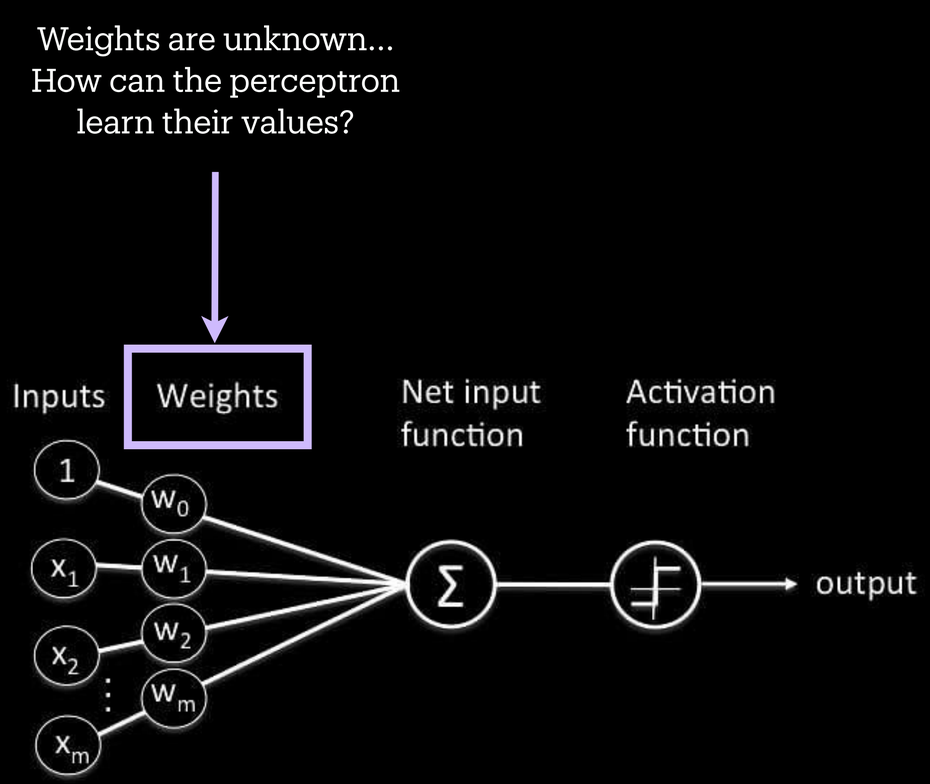
- This makes it a single-layer binary classifier (i.e. the output for the above example is either red dash OR blue cross).



Source: sebastianraschka.com

Rosenblatt, F. (1957) *The perceptron, a perceiving and recognizing automaton*. Cornell Aeronautical Laboratory,

Machine Learning and (Deep) Neural Networks



Loss function

Back propagation

Our very basic NN needs to be told when it has made a mistake (a "loss"); the loss function allows the NN to learn the network weights (hence "Machine Learning").

This is called **Supervised Learning.**

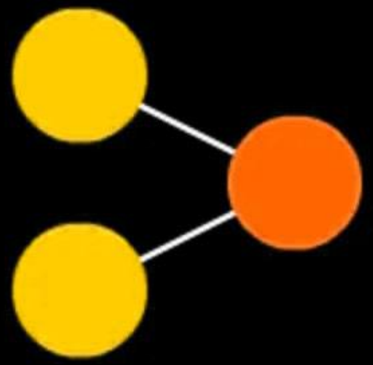
Different kinds of loss:

- Empirical Loss (total loss over an entire dataset)
- Cross Entropy Loss (used with models that output a probability between 0 and 1)
- Mean Squared Error Loss (used with regression models that output continuous real numbers)

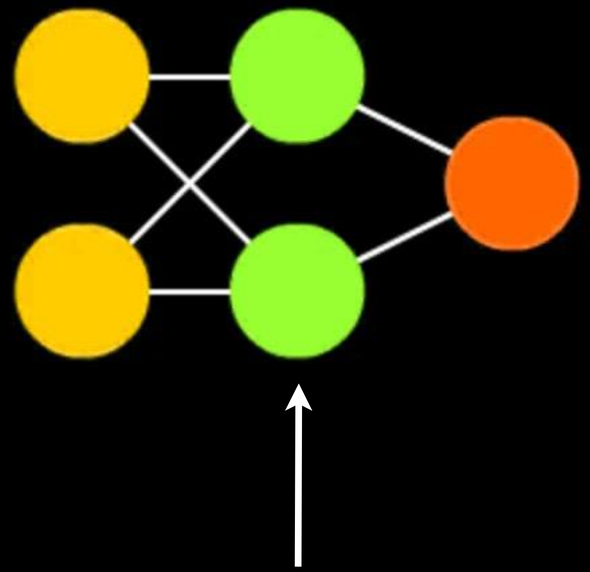
The NN can be trained to find network weights that achieve the lowest loss.

Machine Learning and (Deep) Neural Networks

Perceptron (P)



Feed Forward (FF)



"Hidden" layer

Let's build this up...

Perceptron: Multiple inputs, one set of weights, one output

Multi-output perceptron: Multiple inputs, multiple sets of weights, multiple outputs

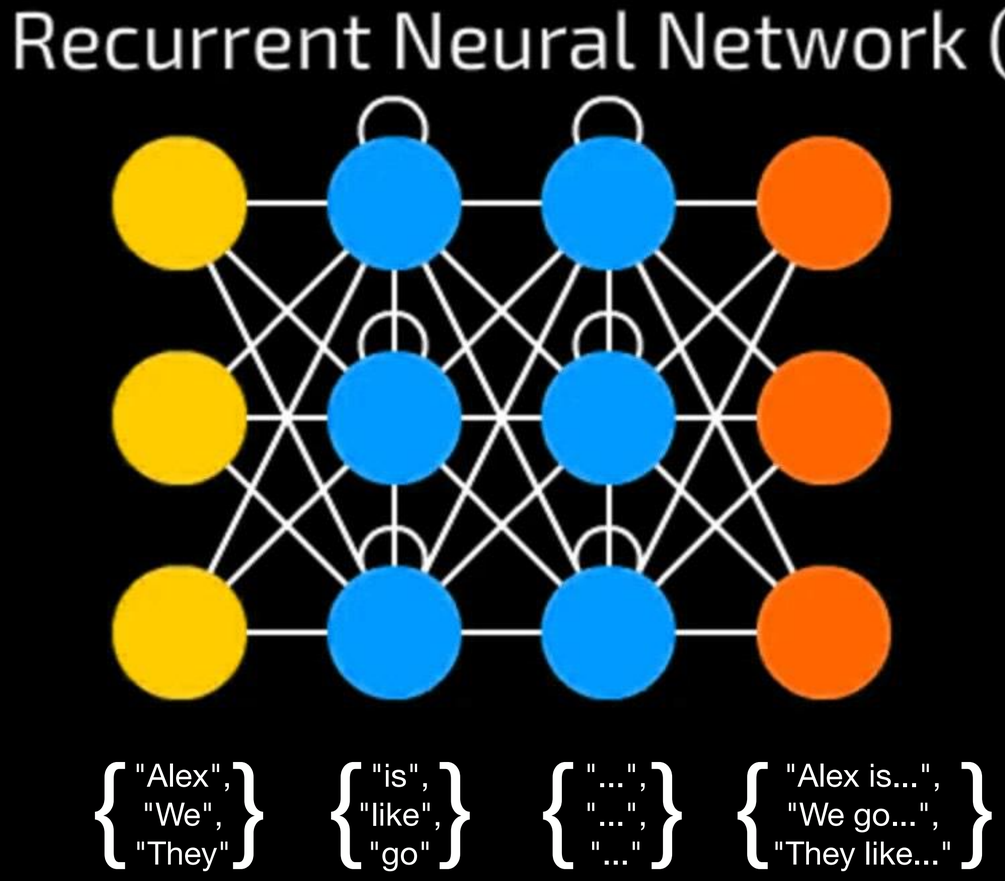
Deep Neural Network: Multiple perceptrons stacked in layers; outputs from one layer become inputs for next

Feed Forward Network: The simplest deep neural network (one hidden layer); every neuron in one layer feeds to every neuron in the next.

Source: https://www.asimovinstitute.org/neural-network-zoo/

Machine Learning and (Deep) Neural Networks

This is all well and good, but we are still a long way from an AI that can mimic human vision or hearing...



RNNs are like FFNNs, but they maintain and update internal state at each timestep. The current cell state is a function of the former state as well as the new input for that round.

RNNs must be able to:

(a) handle variable-length sequences
(b) track long-term dependencies
(c) maintain information about order

Source: https://www.asimovinstitute.org/neural-network-zoo/

Elman, J. L. (1990). *Finding structure in time.* Cognitive science 14.2: 179-211.

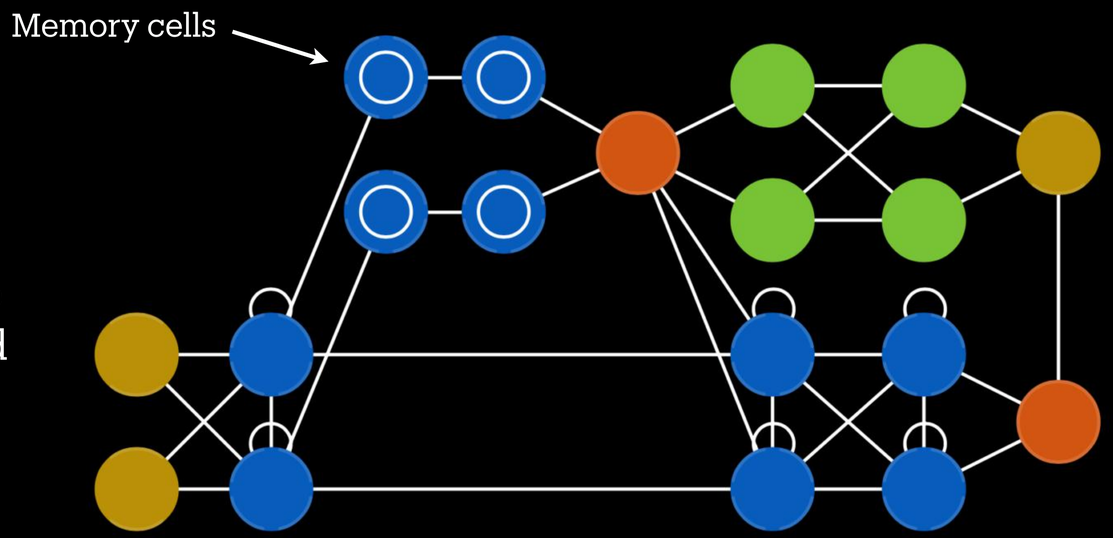
Machine Learning and (Deep) Neural Networks

https://youtu.be/RCo8Feho1RI

Machine Learning and (Deep) Neural Networks

Transformer Architecture (*aka* Attention Networks)

- RNNs are the basis of transformers, which themselves underpin many of the generative AIs popular today (GPT = Generative Pre-trained Transformer)
- These employ a technique called "self-attention", where the network attends to the most important parts of an input and extracts those features.
- The networks themselves also include features such as memory cells that can store states from previous hidden layers.



Source: https://www.asimovinstitute.org/neural-network-zoo/

Introducing ChatGPT

We've trained a model called ChatGPT which interacts in a conversational way. The dialogue format makes it possible for ChatGPT to answer followup questions, admit its mistakes, challenge incorrect premises, and reject inappropriate requests.

Source: OpenAI

Machine Learning and (Deep) Neural Networks

Artist: Manuel Flurin Hendry

https://vimeo.com/hendryman/conversations-with-stanley-1

Machine Learning and (Deep) Neural Networks

It can be argued that this AI mimics human hearing fairly convincingly, but what about human vision?

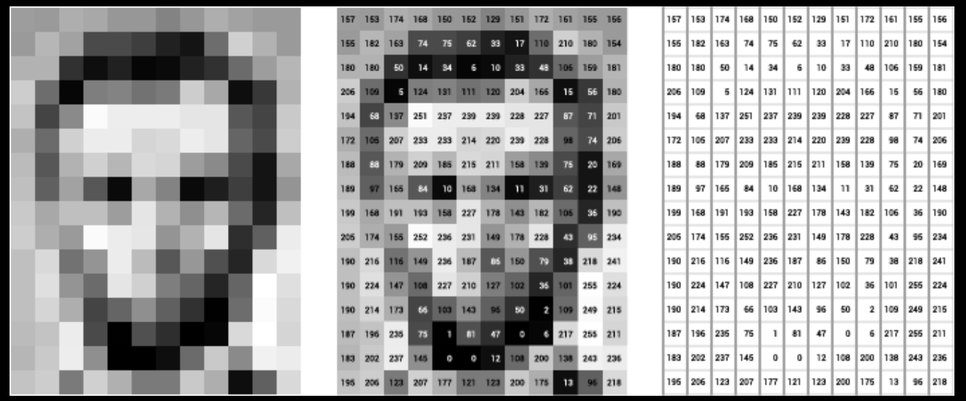
Let's start with an image:

How can this image be transformed into a data sequence that can be fed into a neural network?

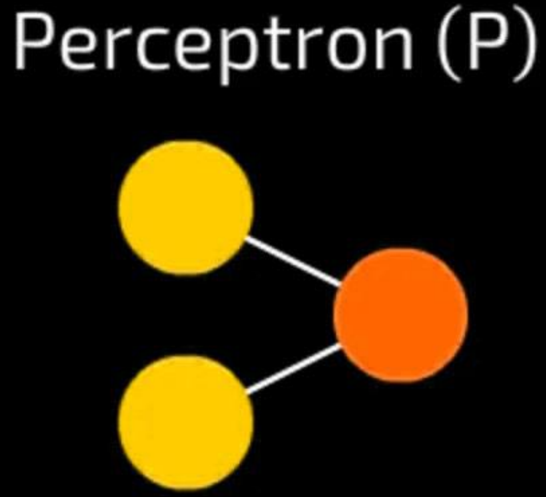
Solution? Flatten image into a 1D array containing the grayscale values of each pixel.

Problem with this method?

What might be an alternative?



Source: cv-tricks.com



Machine Learning and (Deep) Neural Networks

Instead of flattening the image, let's keep it as a grid, but only look at one patch at a time. A patch measuring 3 x 3 pixels would give us a 2D array (*aka* Matrix):

$$\begin{bmatrix} 23 & 56 & 112 \\ 50 & 33 & 89 \\ 46 & 18 & 70 \end{bmatrix}$$

What about a colour image?

Digital images contain 3 channels (RGB), each represented by an integer value between 0 and 256.

A patch measuring 3 x 3 pixels with 3 colour channels would give us a 3D matrix (*aka* Tensor):

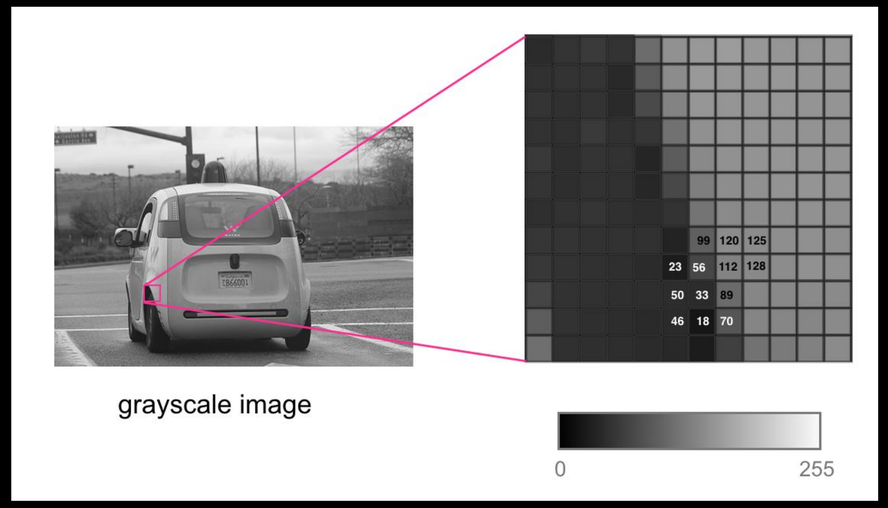
E.g.

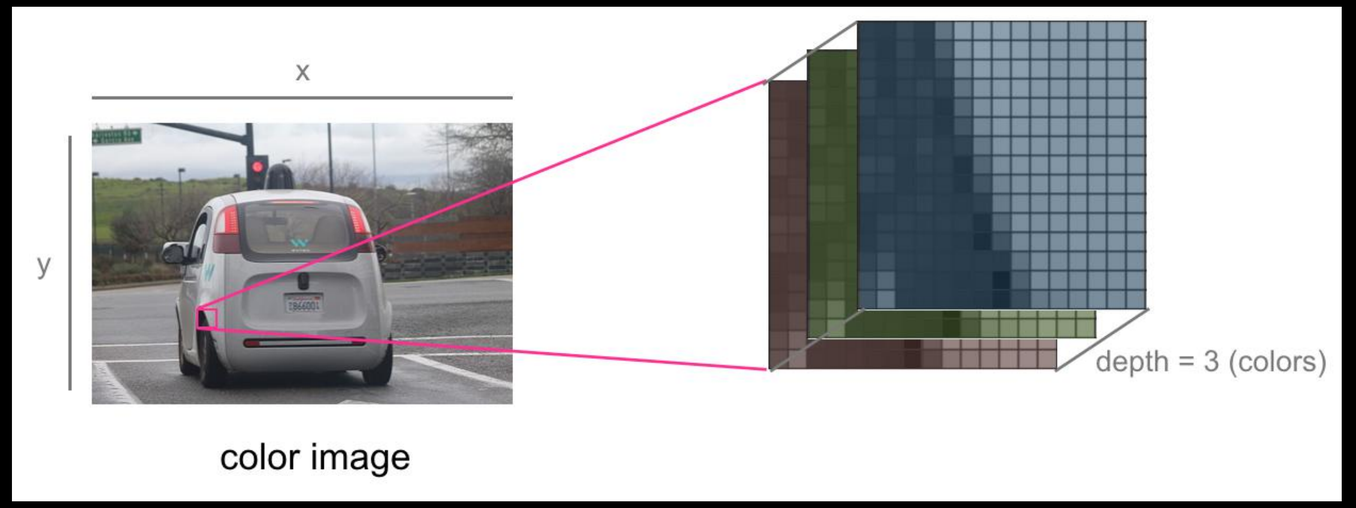
$$\begin{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \end{bmatrix}$$

$$\begin{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \end{bmatrix}$$

$$\begin{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \end{bmatrix}$$

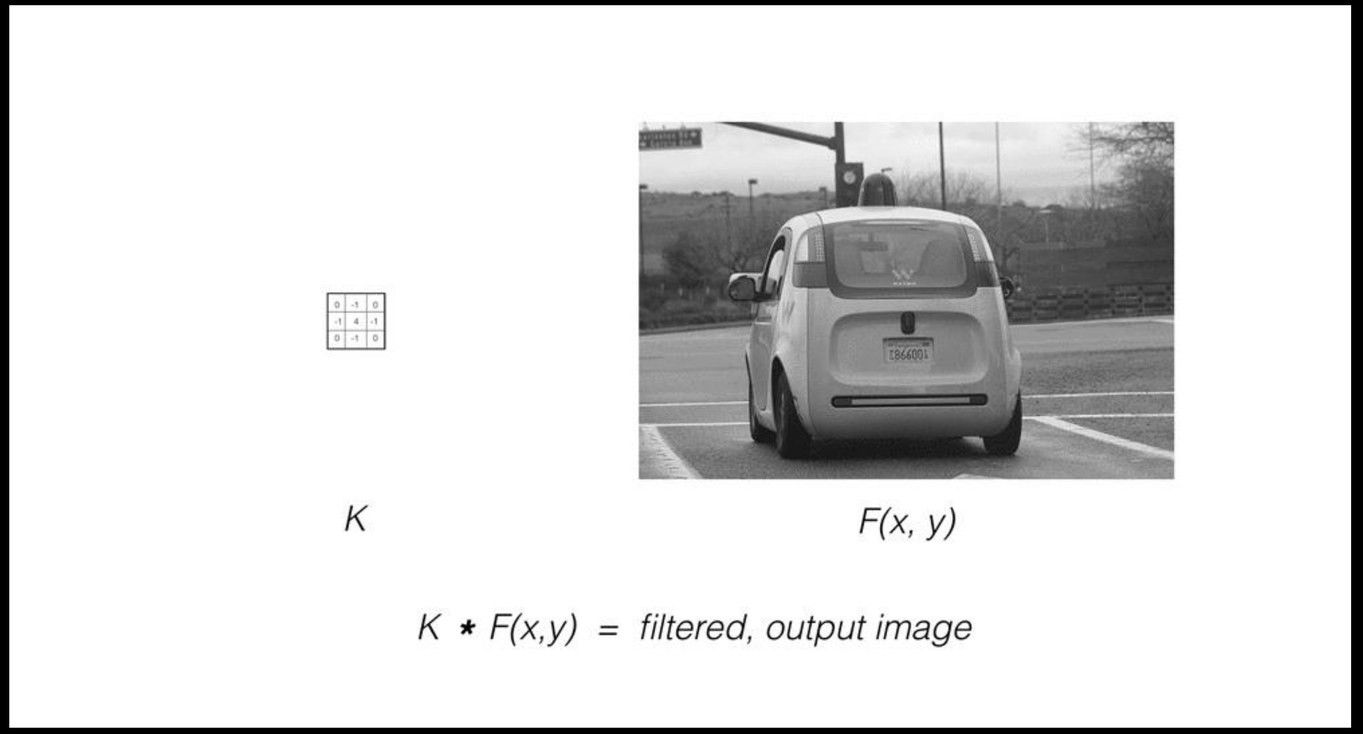
Source: Cezanne Camacho





A good resource for learning about CNNs: https://cezannec.github.io/Convolutional_Neural_Networks/

Machine Learning and (Deep) Neural Networks



Source: Cezanne Camacho

This filter then slides over the image, multiplying each 3 x 3 patch and then saving the result of this operation in a memory cell.

3 x 3 filter = 9 weights

The outputs of all these operations are added together.

This is the mathematical process known as ***CONVOLUTION.***

Machine Learning and (Deep) Neural Networks

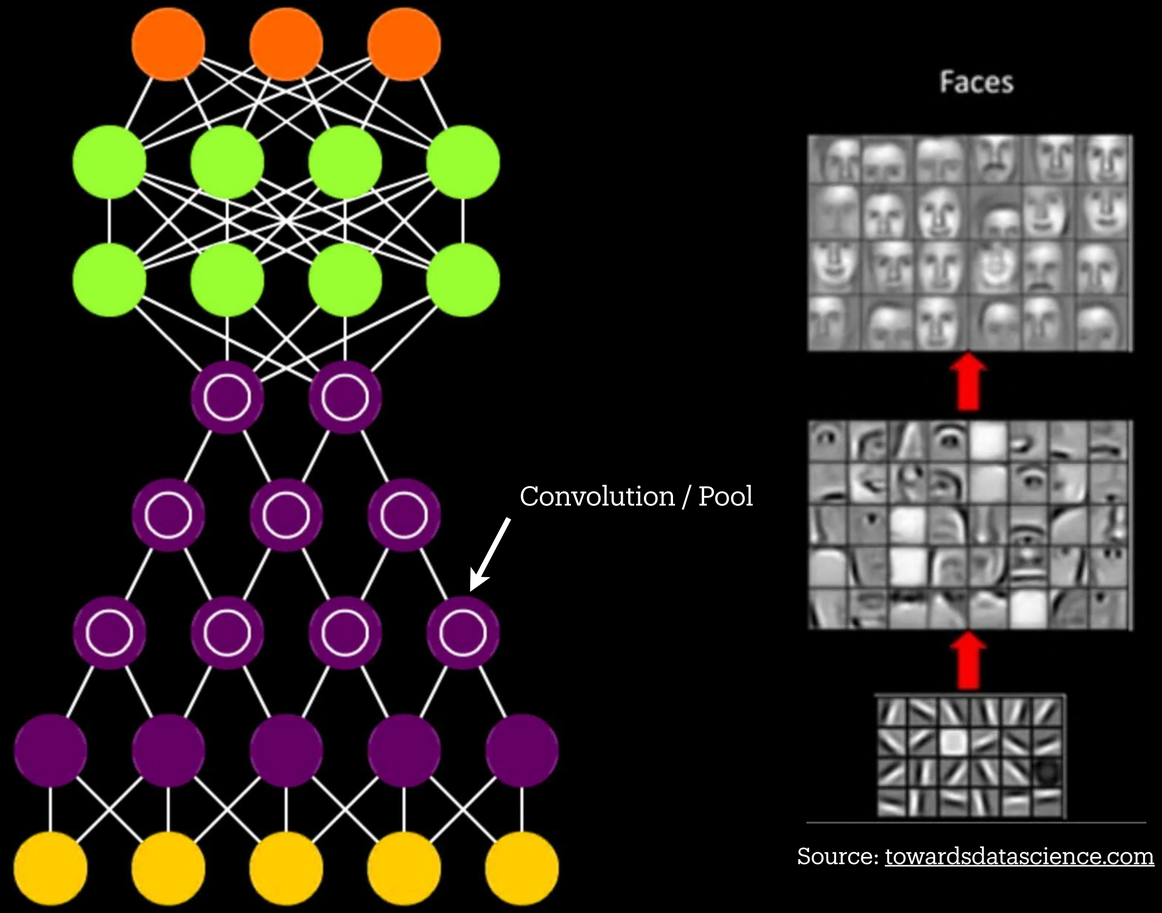
How does a CNN learn features?

Just as with other NNs, at the beginning of the training period, the weights are randomly assigned.

On the first convolutional layer, the CNN detects features of only a few pixels wide. These results are then pooled together and fed into another convolutional layer, which is now able to collate features across a wider range of pixels.

Eventually, the CNN is able to detect features larger than just the filter size. Of course, in the end, the CNN needs to be told that the feature is a "real" feature.

Therefore, this is another example of ***SUPERVISED LEARNING.***



Source: towardsdatascience.com

LeCun, Yann, et al. (1998) *Gradient-based learning applied to document recognition*. Proceedings of the IEEE 86.11: 2278-2324.

Machine Learning and (Deep) Neural Networks

Tech Demo / Artwork / Article

Machine Learning and (Deep) Neural Networks

CNNs are very good at classifying images, but arguably the ability of an AI to see lies in its ability to create new images.

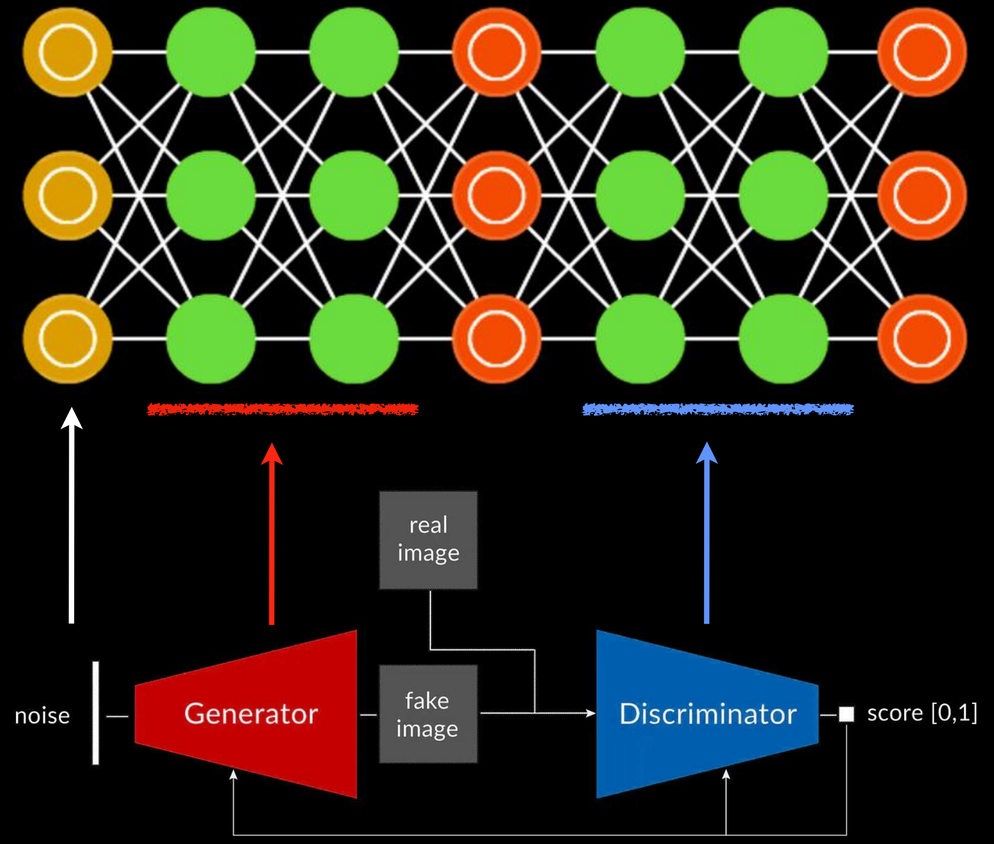
So how can NNs create new images...?

The first truly impressive attempt to do this was with **Generative Adversarial Networks (GANs)**.

These consist of two networks chained together: a generator and a discriminator (usually two CNNs connected via a FFNN).

Starting with randomly-sampled noise, the *generator* tries to create images that look enough like the training images to "fool" the *discriminator*. Meanwhile, the discriminator tries to determine whether the image it is being fed is a "real" one from a new dataset or a "fake" one generated by the generator...

Source: https://www.asimovinstitute.org/neural-network-zoo/



Goodfellow, Ian, et al. (2014) *Generative adversarial nets*. Advances in Neural Information Processing Systems.

Machine Learning and (Deep) Neural Networks

Artist: Mario Klingemann

https://youtu.be/A6bo_mIOto0

Machine Learning and (Deep) Neural Networks

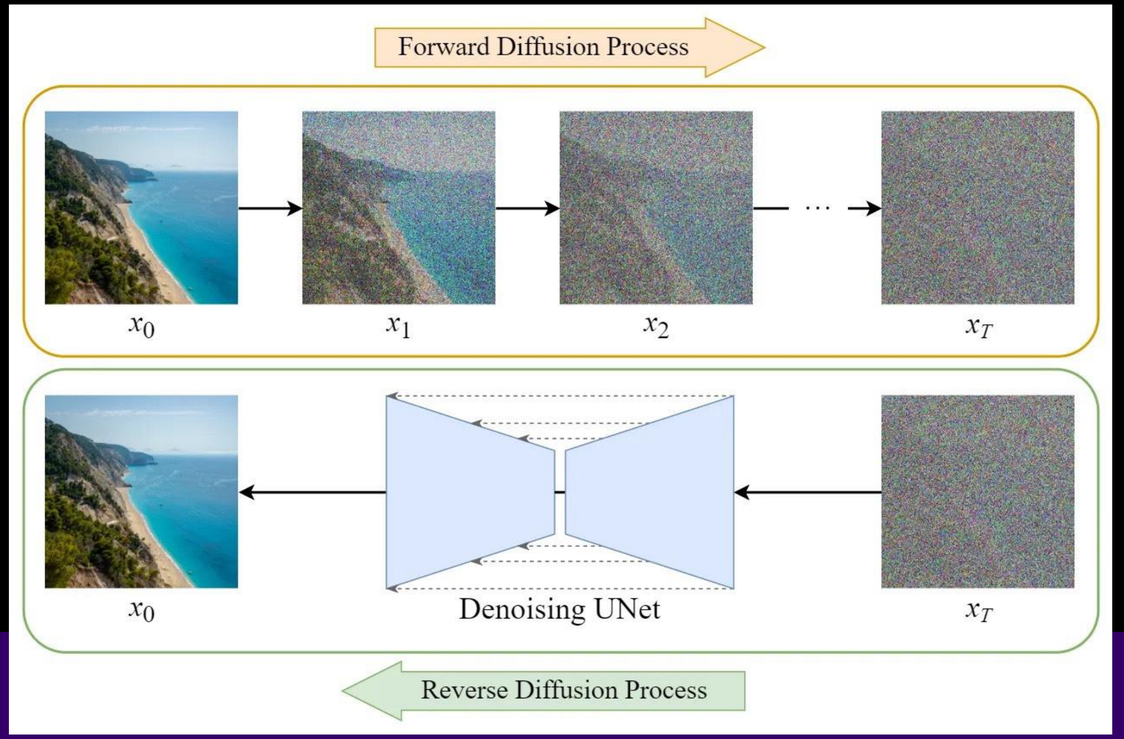
Challenges:

- "Mode collapse": GANs (and other generative networks) tend to produce a lot of samples that are visually very similar to one another.
- In addition, they tend to produce images that are very similar to the training data (this can also be the intention)
- Very difficult to train - you basically have to train two networks simultaneously.
- How to improve stability?

Machine Learning and (Deep) Neural Networks

Diffusion Models:

- Try to address the shortcomings of GANs by simplifying the process - only 1 NN needed.
- Training the model involves removing noise from an image over a series of time steps (controlled by a schedule) in order to get back to a high-res image.
- This process can be directed by attaching a GPT model that embeds text labels (so those labels are still needed!) in order to tell the diffusion model what image it should target.



Source: https://medium.com/@steinsfu

Stable Diffusion 2.0 Release

24 Nov

Source: StabilityAI

Machine Learning and (Deep) Neural Networks

"Black and white photo of a street scene in Paris in the 1930s photographed by Henri Cartier Bresson"

Generated with Dall-e 2

Introduction to AI and Machine Learning

Part 2

MA Creative Technologies
07.07.2023

Is AI a creative technology?

- Is AI merely a tool? (Is it merely a technology?)
- Can AI be creative? (If yes: can it be as creative as a human? (If yes: can creativity be considered to be a human trait?))
- Is AI actually intelligent?
- Should AI be banned from photography competitions? Should it be banned from other creative processes?
- In what contexts is it perhaps preferable or advantageous to use AI in the creative process?

Turing Test *aka* Imitation Game

"Suppose that we have a person, a machine, and an interrogator. The interrogator is in a room separated from the other person and the machine. The object of the game is for the interrogator to determine which of the other two is the person, and which is the machine. The interrogator knows the other person and the machine by the labels ‘X’ and ‘Y’—but, at least at the beginning of the game, does not know which of the other person and the machine is ‘X’—and at the end of the game says either ‘X is the person and Y is the machine’ or ‘X is the machine and Y is the person’. The interrogator is allowed to put questions to the person and the machine of the following kind: “Will X please tell me whether X plays chess?” Whichever of the machine and the other person is X must answer questions that are addressed to X. The object of the machine is to try to cause the interrogator to mistakenly conclude that the machine is the other person; the object of the other person is to try to help the interrogator to correctly identify the machine."

https://plato.stanford.edu/entries/turing-test/

1.

Design a Turing Test for computer creativity

Criteria

- How would you set up the experiment?
  - Who are the different actors/objects etc. in the test?
  - Where does the test take place?
  - Who judges whether the test is passed or failed?
- How would the experiment be evaluated?
  - What are the different criteria that will be judged?
  - What is the control?
- What would be the pass/fail criteria for the test?
  - "The test is passed if..." (e.g. p-value)

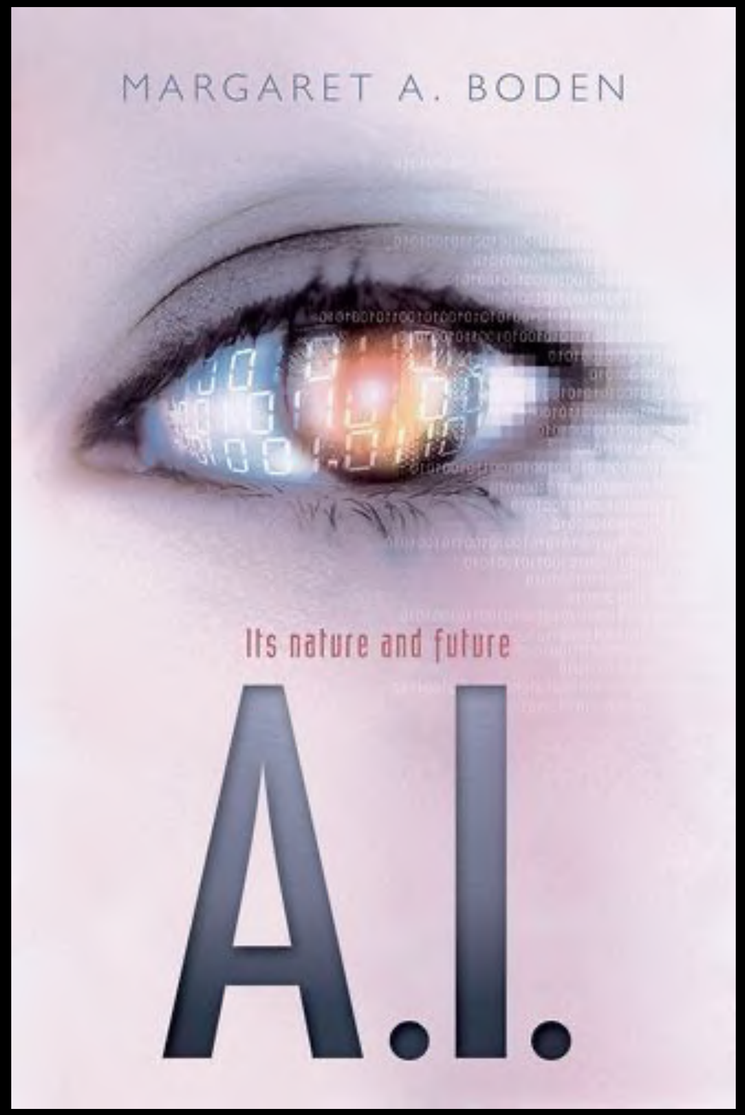
Task

Work individually or in groups (depending on numbers)

1 hour to design the test/prepare a short presentation.

Each person/team will have 5 minutes to present their test to the group + 5 minutes discussion.

You can (and are encouraged) to use all the tools at your disposal to present your idea: AI image/text generators, sketches, code, video etc.



Boden, M. (2016) *AI: Its nature and future*. Oxford University Press.

Boden distinguishes 3 kinds of creativity:

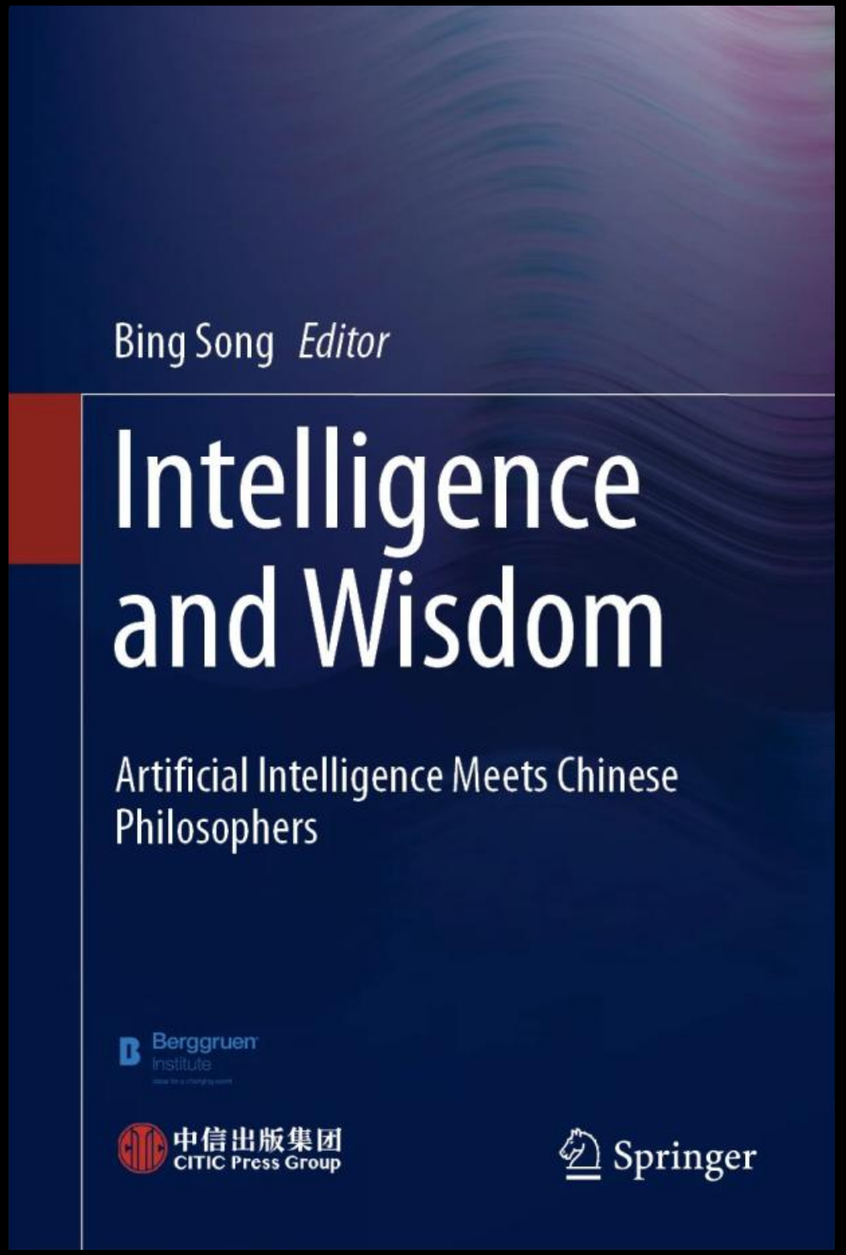
1. **Combinatorial** creativity: familiar ideas are combined in unfamiliar ways.
   e.g. poetic imagery (e.g. metaphors), scientific analogies (e.g. the heart as a pump)

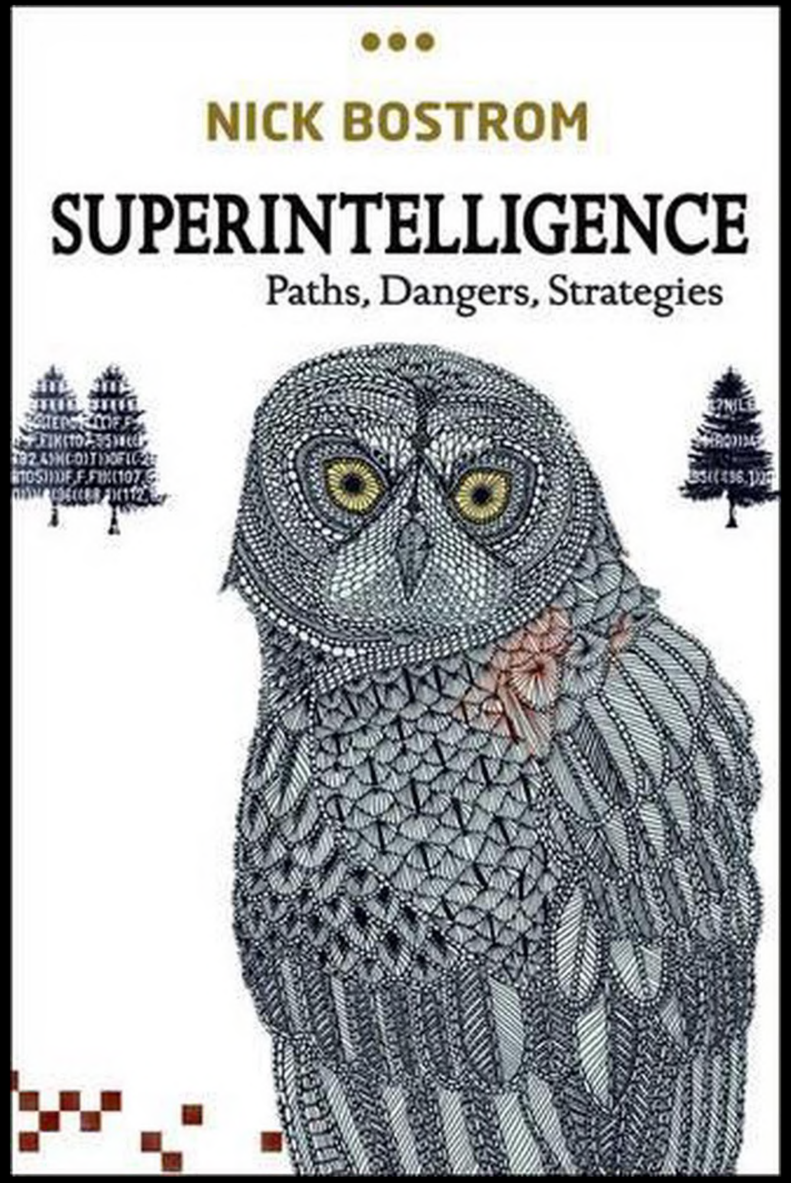
2. **Exploratory** creativity: stylistic rules are used to produce new ideas; less ideosyncratic as it adopts already-recognized styles.
   e.g. using documentary film to explore the effects of climate change, using VR to explore issues of embodiment

3. **Transformational** creativity: successor to exploratory creativity; one or more stylistic constraints are radically altered, so that novel structures emerge that did not exist before.
   e.g. passage from chant to polyphony in music history, passage from photography to film

How helpful is this?

Bing, S. (ed). (2021) *Intelligence and Wisdom: Artificial Intelligence Meets Chinese Philosophers*. Springer.





Bostrom, N. (2014) *Superintelligence: Paths, Dangers, Strategies*. Oxford University Press.

How realistic is this?

2.

Outline a manifesto for AI in the creative fields

Areas (each take one)

Filmmaking, Photography, UI/UX Design, Programming, Music Performance, Audio/Music Composition, Creative Writing, Game Design…

Questions to consider

- Where in the creative process for each of these fields should AI be allowed or not allowed (conception, creation, editing etc.)?
- Should any kinds of AI should be banned altogether? What about enforced?
- Should AI be allowed for some and not for others?
- What about the rights to data use to feed the AI? Where should the data come from?

Task

Work individually or in groups (depending on numbers)

20 minutes to prepare a short list of rights/ regulations/responsibilities

Each person/team will have 2 minutes to present their test to the group + a few minutes discussion.

You need to justify your ideas to one another. Each right/regulation/responsibility needs to include an explanation.

Creative practice case study: Trevor Paglen

Creative practice case study: Trevor Paglen

Creative practice case study: Trevor Paglen

What next?

AI is a quickly-evolving subject area... where do you want to go?

First step: Make your own reading list! (e.g. https://www.are.na/alex-walmsley/ai-reading-list)

If you are interested in learning more technical skills...

--> take an online course
(e.g. https://www.freecodecamp.org/learn/machine-learning-with-python/)
--> look through projects and documentation on Google Colab
(https://colab.research.google.com/)

If you want to start creating and are not so concerned with learning python, TensorFlow etc...

--> try making your own GAN on RunwayML (https://runwayml.com/ml-lab/)
--> become a prompt engineer for Stable Diffusion, ChatGPT etc.
(https://learnprompting.org/docs/intro)

If you are interested in the ethical/philosophical implications of AI or finding out more about various applied fields (e.g. facial recognition, self-driving cars etc.)...

--> Refer to reading list above for some ideas, then expand from there