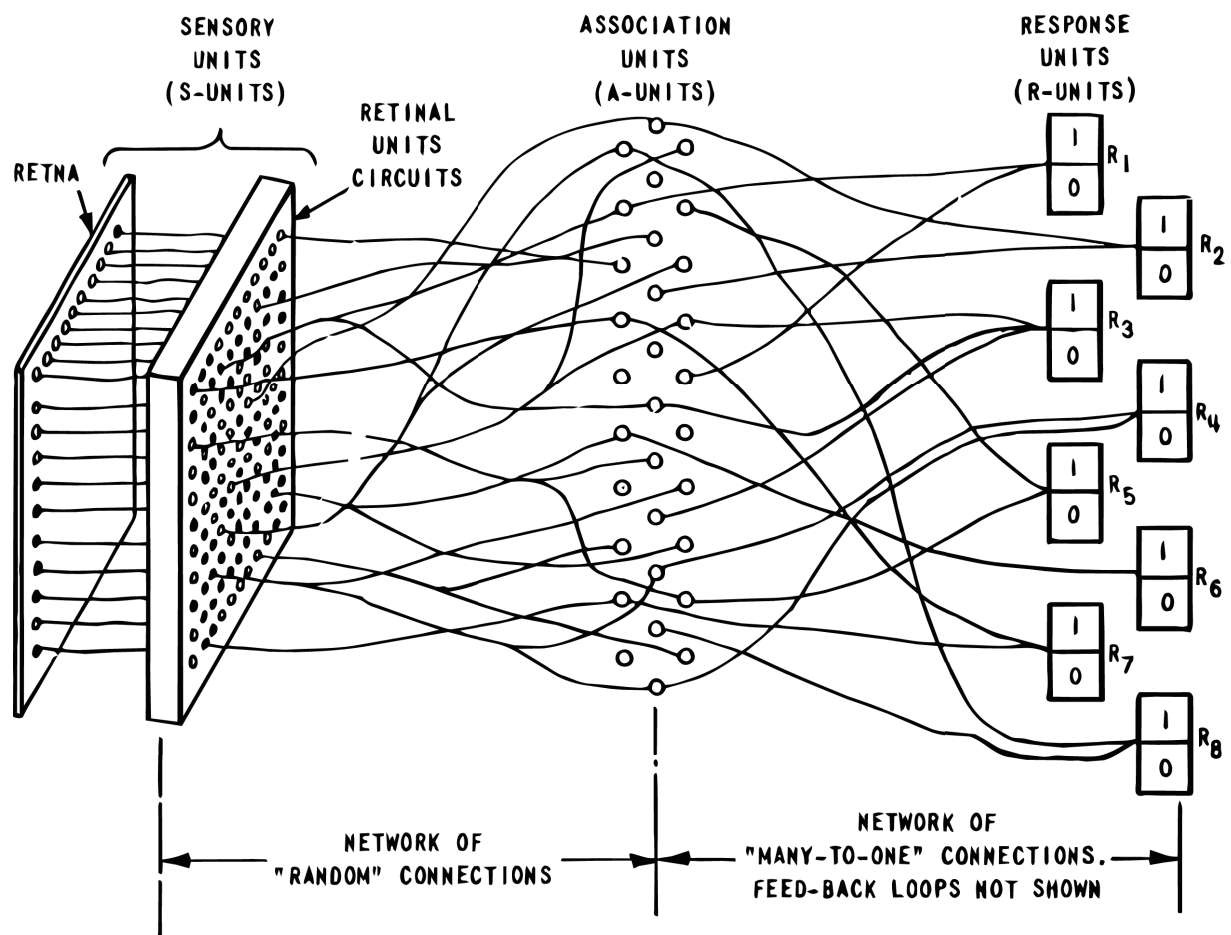


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Theory and History of Artificial Intelligence

Sebastian Gießmann
University of Siegen



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Cover image: Schematic structure of the Mark 1 Perceptron from *Mark I Perceptron Operators' Manual*, <https://apps.dtic.mil/sti/tr/pdf/AD0236965.pdf>, 4–5
Layout: Karina Kirsten

Universität Siegen
SFB 1187 Medien der Kooperation
Herrengarten 3
57072 Siegen, Germany
mediacoop.uni-siegen.de
info@sfb1187.uni-siegen.de

The Multiple Returns of Connectionism: Theory and History of Artificial Intelligence¹

Sebastian Gießmann
University of Siegen

Abstract In light of the recent boom in artificial intelligence, what future and what new environments should research in media and cultural techniques focus on? This article returns to a fundamental question posed by Marcel Mauss regarding the constitution of techniques between specific and general purposes. First, it offers a brief description of the current state of machine learning and recent AI developments between specialization and universalization. Second, I propose a genealogy of artificial intelligence between nature and cultural techniques. It inquires into the historical recurrence of connectionist practices, algorithms, and styles of thinking and acting as a condition of current AI technologies. How could biological neurons become artificial neural networks that work as the infrastructural foundation of artificial intelligence? Third, what is at stake here are the notions of media and mediation themselves. Due to the naturalization and habitualization of connectionist AI, they are becoming statistically operationalized, data-intensive networks.

Keywords Artificial Intelligence, Media Theory, Media History, Connectionism, Cybernetics, Sensor Media, Machine Learning, Image Analysis, History of Technology, Cultural Techniques

¹ My thanks go to all colleagues with whom this text was discussed, and to the students of the seminar “Media and Knowledge History of Artificial Intelligence,” University of Siegen, winter term 2024/25.

“Geh, wir haben grobe Sinne. Einander kennen? Wir müssten uns die Schädeldecken aufbrechen und die Gedanken einander aus den Hirnfasern zerren.”

Georg Büchner, *Dantons Tod*²

In 2008, artificial intelligence was as dead as any technology could be. Almost all the promises of thinking machines had turned into their opposite. Only very attentive observers could have noticed how statistical techniques were in regular use in certain fields such as speech recognition and financial systems. If one were to follow a popular self-description of the field that distinguishes between AI “summers” and AI “winters,” 2008 would have been very cold.

At first glance, Hamit Ekbia’s book *Artificial Dreams: The Quest for Non-Biological Intelligence*, published in the same year, sealed the decline of major AI booms. At the same time, Ekbia’s historicization has an undeniable advantage from today’s perspective. It eludes the pressure to be up-to-date, which has so far determined almost all attempts to classify recent developments beyond the present day.³ One can also find in his book the statistical formation of (later) ‘machine learning,’ since a detailed chapter deals with “language learning” as a central field of artificial intelligence.⁴ Even more valuable, however, is the clear differentiation between research paradigms presented here.

Ekbia’s account encompasses the repeatedly emphasized difference between connectionist and symbolic methods of building AI, which is also decisive for my historical reconstruction. Plus, Ekbia emphasizes a third approach that explores situated—and thus interactionist—artificial intelligence. In contrast to the other two paradigms, situational AI emerged in the 1980s from long-standing criticism of computer science’s claims to rationality and operability. Media and cultural studies would do well to return to this theoretical tradition, which is both critically precise and creative in its interventions. It has left a deep mark on human-computer interaction (HCI), computer-supported cooperative work (CSCW), and science and technology studies (STS). In the following, I will draw on this body of knowledge, which includes not only Ekbia, but also Lucy Suchman, Phil Agre, Geoffrey C. Bowker, Susan Leigh Star, and others.

But how did we arrive at our current passage into the (post-)digital age, driven by connectionist AI? In what follows, I show how the recent boom in artificial intelligence can be explained by the historical formation of its nature-cultures. For research in media and cultural

techniques, AI poses a challenge to its fundamental epistemic principles, as generative processes are set to become the infrastructural and epistemological basis of all digitally networked media, including older media industries. At the same time, it is important to remain impartial in terms of media theory despite all the current quick escalations of generative and agentic artificial intelligence.

First, I return to a fundamental question posed by French anthropologist Marcel Mauss regarding the constitution of technologies between special and general purposes. This is followed by a brief description of the rapid development of machine learning and generative AI between specialization, generalization and universalization. Second, my account offers a cultural-technical genealogy characterized by the multiple returns of connectionism. By connectionism, I mean a paradigm of artificial intelligence that, in contrast to deductive, rule-based symbolic AI, relies on inductive computation with neural networks. How could biological neurons (i.e., natural entities or *Techniken der Natur* in a Kantian sense) become artificial neural networks that provide the infrastructural basis of artificial intelligence? What specific role do neural network algorithms play in this? Third, what is at stake here is nothing less than the media, mediation and their environmental character itself. Due to the naturalization and habitualization of connectionist AI, media are becoming statistically operationalized, data-intensive networks that rely on stochastic operations. In turn, our most elementary semiotic resources are being questioned anthropologically, especially when it comes to image-making, speaking, reading, and writing.

1 Artificial Intelligence Between Specialization and Universalization

Marcel Mauss’s attempts to systematically define the concept of technology have received surprisingly few attention. They can be found in his *Manuel d’Ethnographie*, which was posthumously published. Mauss’ condensed lecture notes were explicitly devoted to teaching, thereby putting the program of his great essay on ‘techniques of the body’ into practical ethnographic research.⁵ For Mauss, technology is always constituted by the entire ensemble of techniques. He describes his method of researching them as follows: “Absolute precision is indispensable in the observation of techniques. The most insignificant tool should be named and located: by whom is it used, where was it found, how is it used and for what purpose, does it

² Georg Büchner, *Werke und Briefe: Münchner Ausgabe*, 9. Aufl. (München: dtv, 2002), Act 1, Scene 1, 69. “Go, we have coarse senses. Know each other? We would have to crack open our skulls and drag each other’s thoughts out of our brain fibers.”

³ Hamit R. Ekbia, *Artificial Dreams: The Quest for Non-Biological Intelligence* (Cambridge University Press, 2008).

⁴ Ekbia, *Artificial Dreams: The Quest for Non-Biological Intelligence*, chapter 6.

⁵ Marcel Mauss, *Manual of Ethnography* (Durkheim Press/Berghahn Books, 2007). Orig. Marcel Mauss, *Manuel d’Ethnographie*, 2nd ed., Petite Bibliothèque Payot 13 (Éditions Payot, 1967).

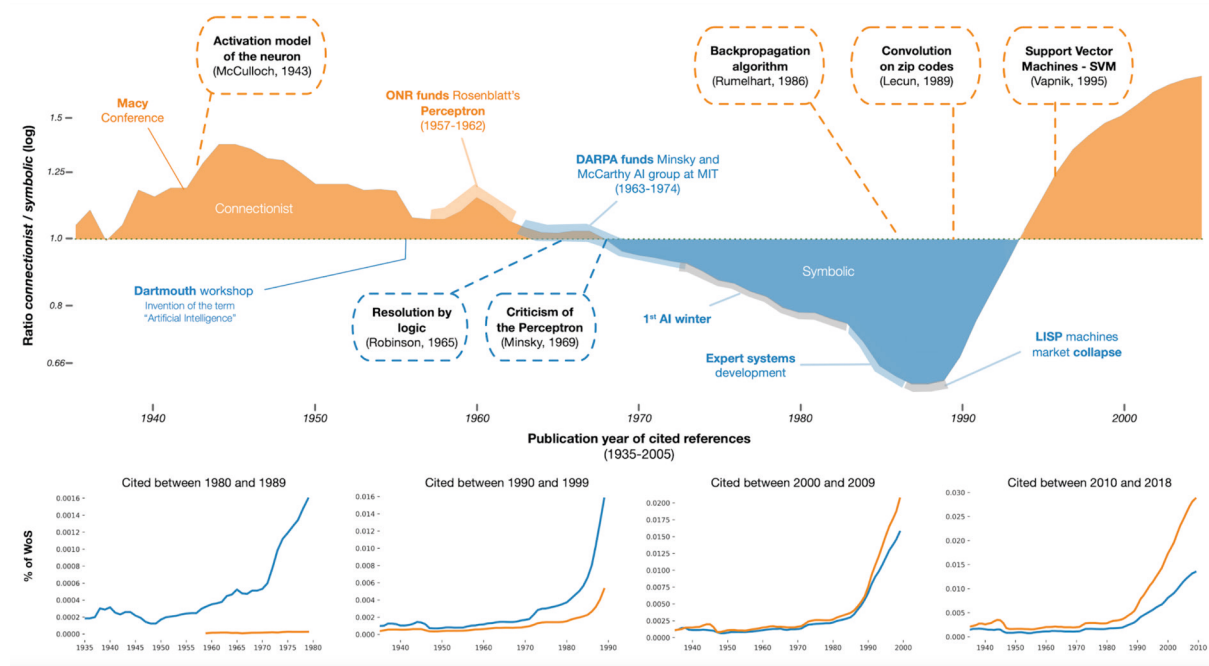


Figure 1: Overview of AI trends between connectionism and symbolic artificial intelligence, 2018.

have a general purpose or a special one?”⁶ On this basis, Mauss distinguishes between tools, instruments, and machines. He thus sets out—in the tradition of Durkheim’s category project⁷—to create a three-part classification of techniques between specialization and generalization. It distinguishes between ‘general techniques with a general use’, ‘special techniques with a general use or general industries for special use’ and ‘specialized industries with special use’.⁸

Like so many of his writings, Mauss’s classification is productive both for and against current media technological developments. For starters, the development of machine learning and large language models should be understood, as Mauss does, as a new formation between specialized digital applications and the search for general or even ‘universal’ AI. In this, the multiple returns of connectionist network models intertwine with new data economies and geopolitical interests, which pursue artificial intelligence as a business model and environmental condition of mobile media practice.

The promise of ‘generativity’ and transformation of the datafied source material into something new obscures the fact that language models and image generators also work with big data, but do so in variations of a digital cultural memory. Yet, it might be more adequate to speak of new cultural *memories* that depend heavily

on their training data and its embedded classifications. But there is still no causal reason for the interactional effects of AI in use, even if “reasoning” features have been integrated in large language models, while research for a better “explainable AI” goes on. What can be explained though is the invisible data and classification work of those who train “AI” after its pretraining to eliminate unwanted biases.

A team of French sociologists—Dominique Cardon, Jean-Philippe Cointet, and Antoine Mazières—took this shift as the starting point for a historical investigation in a scientific study aptly titled “La revanche des neurones” or “Neurons spike back” (Figure 1). In their reconstruction, the connectionism of current AI does not come as a complete surprise. Rather, the interplay between symbolic and connectionist AI follows the cycles of (internal) scientific and (external) political and economic investments.⁹ However, situated AI does not even play a marginal role here, which speaks to its dissident status in computer science.

On the contrary, this reconstruction of AI cycles clearly shows how the current “summer” has been updating cybernetic concepts into a neo-cybernetics. Connectionist modes of operation, modeled along the biological circuits of the human brain (and not along “mind” or “consciousness”), date back at least to

⁶ Mauss, *Manual of Ethnography*, 24. Mauss wanted his students to use photographs to document technical practice.

⁷ Émile Durkheim and Marcel Mauss, *Primitive Classification*, Routledge Revivals (Routledge, 2009). See also Johannes F.M. Schick et al., eds., *The Social Origins of Thought: Durkheim, Mauss, and the Category Project*, Methodology and History in Anthropology 43 (Berghahn Books, 2022).

⁸ Mauss, *Manual of Ethnography*, 27.

⁹ Dominique Cardon et al., “La revanche des neurones: L’invention des machines inductives et la controverse de l’intelligence artificielle,” *Réseaux* (Paris) 211, no. 5 (2018): 173–220, cairn.info, <https://doi.org/10.3917/res.211.0173>; Dominique Cardon et al., “Neurons Spike Back: The Invention of Inductive Machines and the Artificial Intelligence Controversy,” trans. Liz Carey-Libbrecht, *Réseaux* (Paris) 211, no. 5 (2018): 173–220, cairn.info.

early cybernetics.¹⁰ However, in contrast to a booming neo-cybernetics, STS practices of historical and critical analysis must be renewed. Geoffrey C. Bowker, for example, was able to show early on how the cybernetic project strategically aimed at epistemological universalization—and, in contrast, asked how this claim to universality was actually made plausible or enforced, and whether it was. Bowker's plea for "infrastructural inversion" remains a valuable methodological guideline.¹¹ *How to be practically universal?* In my opinion, this crucial question is already inherent in Mauss's classification of techniques, while at the same time demanding a new mode of infrastructural inversion and critique.¹²

While Silicon Valley and China are aiming at Artificial General Intelligence (AGI)¹³ using large language models, this means, conversely, that it does not yet exist. What exists in abundance though are specialized applications that run on specialized hardware with algorithms that are sometimes very specific. Their practical generalization and universalization is a laborious process that proceeds in small steps. This is particularly evident in the case of autonomous driving, which remains stubbornly semi-autonomous, as every road test of the technology shows. The development of Generative Pre-Trained Transformers (GPTs), which has been accelerating since 2017, has now reached a stage where chatbots have become normalized as interfaces and apps of LLMs. Their updates are incremental, data-based biases regarding gender, race, and class are taken care of after pre-training, and the industrialization of applications is taking place, again, step by step—including data colonialism and unfair ways of distribution on a worldwide scale.¹⁴ These slower rhythms, however, get way less recognition than the frenzied pace of AI's frontier labs.

As a cultural technique, neo-connectionist AI provides for agentic media that continually challenge our anthropological constitution. Their naturalization and habitualization in the name of general artificial intelligence is happening ever so rapidly. There is hardly

any time left to pause and reflect, which is necessary for media and cultural studies. "We hardly know what we've built," as Geoffrey C. Bowker and Susan Leigh Star put it in their history of classification systems.¹⁵ But what have we built, and how?

2 The Multiple Returns of Connectionism¹⁶

In 1988, French philosopher Paul Virilio was already very certain. There would be no new super software to solve detailed problems, and no more computers that would *not* be able to grasp and perceive the environment. At the end of the Cold War, Virilio's diagnosis of an upcoming *Perceptron* revealed a longing for sensory technology that models and surpasses human perception and thinking. The automation of perception led to the question of "artificial intelligence."¹⁷ For a long time, it remained unclear whether this AI should be deductive and rule-based, i.e., symbolic, or whether its medium should be inductive computation with neural networks. The latter was based on a history of knowledge that had already begun in the 19th century with a fundamental neurophysiological question.

It first culminated on the evening of the 1906 Nobel Prize for Medicine award ceremony in Stockholm, where two fundamentally different attitudes toward the functioning of the brain collided. Santiago Ramón y Cajal's microscopical techniques had shown the neuron to be a functionally and structurally independent unit. Camillo Golgi, however, continued to emphasize in his Nobel Prize speech that neurons cannot be separated from each other and should not be viewed only individually. Is the brain characterized by neural networks in which individual neurons are the central switching unit (Ramón y Cajal), or is it a diffuse network of nerves (Golgi)? While this controversy remained unresolved for contemporary witnesses, Ramón y Cajal's point of view became increasingly accepted within the scientific community during the 1920s.¹⁸ By the middle of the 20th century, neurophysiological single-neuron research had become properly established as a field of research.¹⁹

10 Orit Halpern, *Beautiful Data: A History of Vision and Reason since 1945*, Experimental Futures (Duke University Press, 2015). See in particular chapter 3.

11 Geoffrey C. Bowker, "How to Be Universal: Some Cybernetic Strategies 1943–70", *Social Studies of Science* 23, Nr. 1 (1993): 107–127. On methodological aspects of infrastructural inversion see Geoffrey C. Bowker, "Information Mythology: The World of/as Information," in *Information Acumen: The Understanding and Use of Knowledge in Modern Business*, ed. Lisa Bud-Frierman, Comparative and International Business Series: Modern Histories (London; New York: Routledge, 1994), 231–247, 235.

12 My esteemed colleague Jörg Potthast has called this approach "Bowker 2.0"—which is a stellar goal to aspire to.

13 Julian Togelius, *Artificial General Intelligence*, MIT Press Essential Knowledge Series (MIT Press, 2024). For the imaginaries driving AI's development cf. Karen Hao, *Empire of AI: Dreams and Nightmares in Sam Altman's OpenAI* (New York: Penguin Press, 2025), for example 47, 76, 129, 232, 388.

14 Ulises A. Mejias and Nick Couldry, *Data Grab: The New Colonialism of Big Tech and How to Fight Back* (The University of Chicago Press, 2024).

15 Geoffrey Bowker und Susan Leigh Star, *Sorting Things Out: Classification and its Consequences* (Cambridge, MA; London: MIT Press, 1999), 319.

16 The following section was first published on October 2, 2024, in *Frankfurter Allgemeine Zeitung*. It has been revised and expanded for this translation.

17 Paul Virilio, *The Vision Machine* (British Film Institute; Indiana University Press, 1994), 50, 76.

18 Lorraine Daston and Peter Galison, *Objectivity*, 2nd ed. (New York: Zone Books, 2008), 115–120.

19 For the brain, only the latest media technology is apparently good enough. This is why, historically, both the practice of telephone switching and tinkering with radio circuits were popular references in physiological theory. See Douwe Draaisma, *Die Metaphernmaschine: Eine Geschichte des Gedächtnisses* (Darmstadt: Primus Verlag, 1999). On single neuron research cf. Max Stadler, "Assembling Life: Models, the Cell, and the Reformations of Biological Science, 1920–1960" (PhD dissertation,

Biological and socio-technical circuits of neurons were decisively intertwined in the development of cybernetic and information-theoretical concepts. Warren McCulloch's and Walter Pitts's "Logical Calculus of Nerve Activity," published in 1943, is the turning point at which this analogy is formally established with calculative and diagrammatic methods. For a long time, less attention was paid to their follow-up article, "How We Recognize Universals: The Perception of Visual and Auditory Forms" from 1947. The significance of both works for the connectionism that founded AI can hardly be overestimated. Since the controversy between Golgi and Ramón y Cajal unfolded, the decisive question of synaptic connections has been significantly intertwined with the question of digitality itself—0 or 1, current or no current—in cybernetics. McCulloch himself referred to a corresponding thesis by computer pioneer John von Neumann in the interdisciplinary discussion at the 6th Macy Conference in 1949. Von Neumann had insisted that neurons should be understood as "mere all-or-nothing devices" that were "quantized or digital or logical" in their structure.²⁰

At the same conference, Walter Pitts argued with Norbert Wiener that the brain itself "must be digital," whereupon Wiener described the analog/digital difference as "not sharp."²¹ Although neurophysiologist Ralph W. Gerard took up this cautious conceptualization at the 7th Macy Conference in 1950, his own warning went largely unheeded. Gerard clearly articulated his skepticism about equating the nervous system with digital mechanisms that rely on all-or-nothing behavior.²² Nevertheless, equating neural activity with digital circuits proved to be enormously influential. Although its critics established a distinction between biological and artificial neurons within the scientific community, this distinction was repeatedly undermined by equating the biological circuits of the brain with socio-technical algorithms. The widespread perception of computers as "giant brains" in the 1950s transferred this relation of media and anatomy into popular knowledge.²³

Imperial College, 2010), https://www.ultrabeige.de/pdf/2010_assembling_life.pdf.

²⁰ "Von Neumann is very insistent that whatever the items are, lying beyond the property of neurons as mere all or none devices, they must still be quantized, or digital or logical in their structure." Claus Pias, ed., *Cybernetics – Kybernetik: The Macy Conferences 1946–1953. Transactions/Protokolle*, vol. 1 (Zürich; Berlin: diaphanes, 2003), 31.

²¹ Pitts: "The brain must be digital." Wiener: "Every digital device is really an analogical device which distinguishes region of attraction rather than by a direct measurement." Pias, *Cybernetics*, 158.

²² "Although it remains true that nerve impulses are atomic in character and that they move or don't move, I think it dangerous to go on from there and conclude that the functioning of the nervous system can be expressed essentially in terms of digital mechanisms of the all-or-none behavior of the units in the system and, particularly, of their connections." Pias, *Cybernetics*, 175.

²³ Ronald R. Kline, "Inventing an Analog Past and a Digital Future in Computing," in *Exploring the Early Digital*, ed. Thomas Haigh, *History of Computing | Media of Cooperation* (Springer, 2019), 19–39, 33.

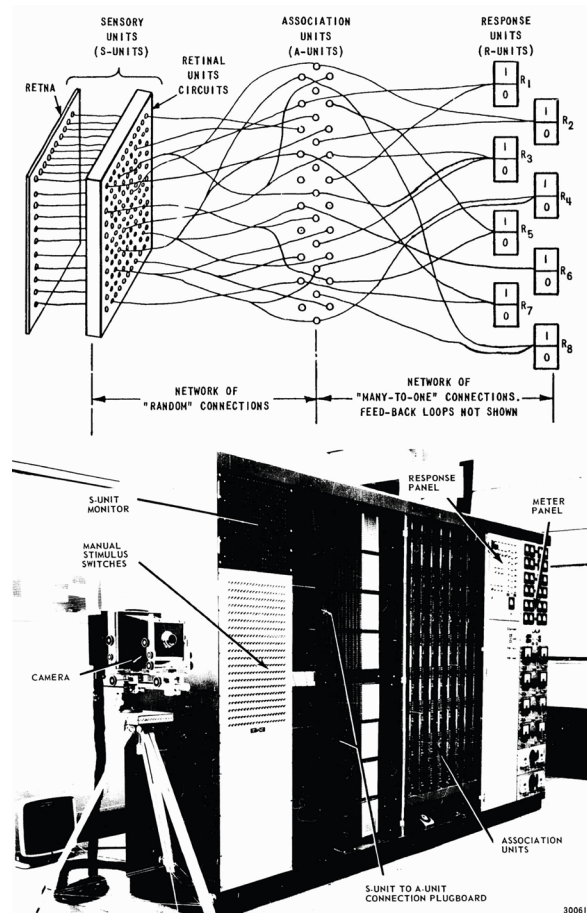


Figure 2: Schematic structure of the Mark 1 Perceptron and spatial computing setup with camera, 1960.

One could even say that cybernetics relied on a decisive 'imitation game' in itself. The cybernetic debates led to the strategic definition of an explicit concept of connectionism. It got differentiated into three variants—an economically motivated one by Friedrich Hayek, a logical one by McCulloch/Pitts, and a statistical connectionism.²⁴ The latter contributed to psychologist Frank Rosenblatt's experimental attempt to build the so-called Mark 1 Perceptron at Cornell's Aeronautical Laboratory from 1957 to 1962 as an image pattern recognition machine.²⁵ The Perceptron functioned as a sensor medium with a grid of 400 photocells arranged more or less like the cells of the retina, which were connected to a layer of 512 neuron-like elements. It is now considered the first computer for digital pattern recognition (Figure 2). In addition to Rosenblatt's psychological research, the computer served the image

²⁴ Matteo Pasquinelli, *The Eye of the Master: A Social History of Artificial Intelligence* (New York: Verso, 2023), chap. 8.

²⁵ Cornell Aeronautical Laboratory, "Mark I Perceptron Operators' Manual (Project PARA). Report No. VG-1196-G-5," February 15, 1960, <https://apps.dtic.mil/sti/tr/pdf/AD0236965.pdf>; Frank Rosenblatt, *Principles of Neurodynamics: Perceptrons and the Theory of Brain Mechanisms* (Cornell Aeronautical Laboratory, 1962).

Handwritten Digit Recognition with a Back-Propagation Network

Y. Le Cun, B. Boser, J. S. Denker, D. Henderson,
R. E. Howard, W. Hubbard, and L. D. Jackel
AT&T Bell Laboratories, Holmdel, N. J. 07733

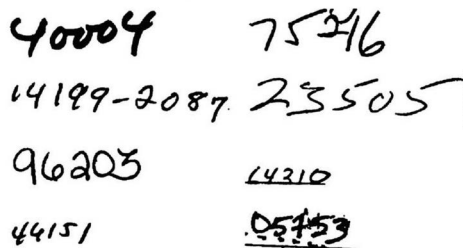


Figure 1: Examples of original zipcodes from the testing set.

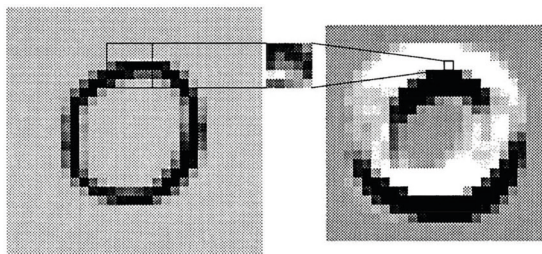


Figure 3: Input image (left), weight vector (center), and resulting feature map (right). The feature map is obtained by scanning the input image with a single neuron that has a local receptive field, as indicated. White represents -1, black represents +1.

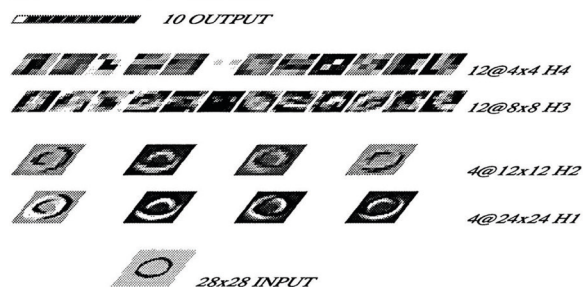


Figure 4: Network Architecture with 5 layers of fully-adaptive connections.

Figure 3: Handwriting sample, image processing, and layered network architecture for recognizing postal codes, AT&T Bell Laboratories, 1989.

recognition needs of the US Navy.²⁶ The mathematical and epistemological criticism of the perceptron, published in 1969 by Marvin Minsky and Seymour Papert under the title *Perceptrons*, in turn motivated the successful financing of symbolic AI in an ongoing battle for research funding.²⁷

²⁶ Albert Murray, "Perceptron Applications in Photo Interpretation," *Photogrammetric Engineering* 27, no. 4 (1961): 627–33.

²⁷ Marvin Minsky und Seymour Papert, *Perceptrons: An Introduction to Computational Geometry*. Expanded Edition (Cambridge, MA; London: MIT Press, 1988 [1969]). The expanded edition from 1988 cited here features a historical prologue (vii–xv) and an epilogue (247–280) on the "New Connectionism"

In contrast, the founding documents of 'neconnectionism' were the volumes on *Parallel Distributed Processing: Explorations in the Microstructure of Cognition*, which were edited by David Rumelhart and James McClelland, and published in 1986 and 1987. They included a rarely mentioned 1988 hands-on handbook that came with a floppy disk.²⁸ Neural networks consisting of several layers were prototypical for the 1980s, whereas the perceptron had had only one. With the use of the so-called 'backpropagation' algorithm proposed by Paul Werbos in 1982, the weights in multi-layer networks could be dynamically adjusted.²⁹

Significantly, a specialized application became suitable for everyday use in 1989 with the machine recognition of handwritten postal codes. A team led by Yann LeCun at AT&T's Bell Labs had made reliable optical character recognition of postal codes possible.³⁰ Within the contract research that LeCun et al. carried out for the US Postal Service, *convolutional neural networks* were used not to simulate perception, but to automate co-operative postal addressing already in 1989 (Figure 3). It was not universal AI that prevailed, but an everyday application for socio-technical cooperation. Bell Labs did not work on this alone though. Comparable automations of computer-based pattern recognition of postal codes had already been in place since the 1970s, initiated by the respective national postal administrations in Western Europe and North America.³¹

of the 1980s. Interestingly, Minsky also thought and built in a connectionist style in the early 1950s. His Stochastic Neural Analog Reinforcement Calculator, or SNARC, developed with Dean S. Edmonds, calculated using specially built electronic neurons. ²⁸ Jay M. McClelland et al., *Parallel Distributed Processing: Explorations in the Microstructure of Cognition*. Volume 1: Foundations, Computational Models of Cognition and Perception (MIT Press, 1986); James L. McClelland et al., *Parallel Distributed Processing: Explorations in the Microstructure of Cognition*. Volume 2: Psychological and Biological Models (Cambridge; London: MIT Press, 1986); James L. McClelland and David E. Rumelhart, *Explorations in Parallel Distributed Processing: A Handbook of Models, Programs, and Exercises*, 2nd ed., Computational Models of Cognition and Perception (MIT Press, 1988).

²⁹ Paul J. Werbos, "Applications of Advances in Nonlinear Sensitivity Analysis," in *System Modeling and Optimization*, ed. R. F. Drenick and F. Kozin (Springer Berlin Heidelberg, 1982), 762–770. However, Werbos still writes about "backwards methods" here, which in turn date back to his Harvard dissertation from 1974.

³⁰ Yann LeCun et al., "Handwritten Digit Recognition with a Back-Propagation Network," in *Advances in Neural Information Processing Systems*, ed. D. Touretzky, vol. 2 (Morgan-Kaufmann, 1989), 396–404, https://proceedings.neurips.cc/paper_files/paper/1989/file/53c3bce66e43be4f209556518c2fcb54-Paper.pdf; Yann LeCun et al., "Backpropagation Applied to Handwritten Zip Code Recognition," *Neural Computation* 1, no. 4 (1989): 541–51, <https://doi.org/10.1162/neco.1989.1.4.541>. Cf. Harry Law, "Bell Labs and the 'Neural' Network, 1986–1996," *BJHS Themes* 8 (2023): 143–54, Cambridge Core, <https://doi.org/10.1017/bjt.2023.1>; Chris Wiggins and Matthew Jones. *How Data Happened. A History from the Age of Reason to the Age of Algorithms*. W. W. Norton & Company, 2023, chap. 9.

³¹ In West Germany, for example, they were technically implemented from 1978 onwards by AEG-Telefunken, among others, based on mathematical research by Jürgen Schürmann at their Ulm research institute. Thanks to Bruce Mayo for this information.

Despite such developments, the years between 1985 and 2010 were long considered an “AI winter.” Only a small community of connectionist researchers such as LeCun continued to conduct in-depth research into algorithms that promoted computing with artificial neurons. As mentioned before, a French team of sociologists led by Dominique Cardon has succinctly reconstructed the recent shift to an “AI summer” that began in 2012.³² In their account, the current revival of neural networks started with the ECCV computer vision conference in Florence in October 2012. In the third competition for the best image recognition rates based on the ImageNet database, Alex Krizhevsky, Ilya Sutskever, and Geoffrey Hinton used a new deep learning algorithm. It had a ten percent lower error rate than all other competitors. Their algorithm became known as ALEXnet.³³ The image collection analyzed by Fei Fei Li’s ImageNet database is now considered a typical example of cultural bias being reproduced by a dataset. New forms of technical image analysis used training data as simply “given,” i.e., raw material available in databases or captured online. At the same time, every attempt to compensate for the social and cultural biases of the data has led to new biases.³⁴

AlexNET also had a decisive techno-economic effect. Since 2012, Google, its Chinese search engine competitor Baidu, Facebook, and Microsoft specifically recruited scientists to set up machine learning laboratories. Among those who dared to switch sides, taking their employees with them, were Geoffrey Hinton (Google), Andrew Ng (Baidu), Yann LeCun (Facebook), and Yoshua Bengio (Microsoft). The founding of OpenAI in 2014 was also part of this exodus of people and skills to new, excellently funded industrial research laboratories.³⁵

The return of connectionist network models in deep learning between 2009 and 2012 coincided with an Internet that had become data-intensive (not just) by social media. In 2009, Google began integrating natural language processing—more specifically, the automatic transcription of speech into text—into its Android mobile operating system.³⁶ The widespread availability

of graphics cards for parallel computing enabled the training of algorithms with ever-larger amounts of data. Economic and geopolitical interests once again pursued artificial intelligence as a business model and environmental condition for mobile media practice. Since then, newer AI has certainly operated artificially, but not intelligently. Its artificial operation is characterized by its statistical and probabilistical means.

Biological analogies continue to be invoked, however, as if the aim were to completely naturalize a neocybernetics of artificial intelligence. Turing Award winner Geoffrey Hinton confessed to *Wired* in 2019 that he had always designed the neural networks of machine learning to work like the brain.³⁷ Lucy Suchman has subjected this universalist claim to an impressive, resituating feminist critique.³⁸ But while cybernetics has been historicized well, writing up new critical histories of the small, initially predominantly white, male, and North America-centric neoconnectionist community of practice takes time. Right now, YouTube videos entitled “ChatGPT: 30 Year History,” in which series of scientifically innovative papers visualize astonishing improvements in network algorithms, are reaching a larger audience than in-depth histories of science and technology.³⁹ YouTube tends to be a preferred platform for male AI actors to historicize themselves, too. However, a well-researched popular non-fiction book such as Cade Metz’s *Genius Makers* has shown the central social role played by the annual conference series dedicated to Neural Information Processing Systems (NIPS; the conference now operates under the title NeurIPS), which has been held since 1987.⁴⁰

Given the current boom in data-intensive artificial intelligence, we are faced with a real problem of preserving evidence, as is the case with all cultural techniques and digital media. Big data and AI are changing the infrastructural conditions of media history. With the recent shift to generative and agentic AI via large language models, their use has increased once again. *For to the extent that the analysis and generation of language, texts, numbers, images, and sounds is based on layers of neural networks, all media—including film and computer code—potentially become statistically operationalized, data-intensive networks.* We will have to be

32 Cardon et al., “La revanche des neurones”; Cardon et al., “Neurons Spike Back.”

33 Alex Krizhevsky et al., “ImageNet Classification With Deep Convolutional Neural Networks,” in *Advances in Neural Information Processing Systems*, vol. 25, ed. F. Pereira et al. (Curran Associates, Inc., 2012), https://proceedings.neurips.cc/paper_files/paper/2012/file/c399862d3b9d6b76c8436e924a68c45b-Paper.pdf. The highly informative presentation slides from the conference are available online under the same title. Plus, they come with pictures of cats. See Wayback Machine: <https://web.archive.org/web/20140701051812/> and <http://image-net.org/challenges/LSVRC/2012/supervision.pdf>.

34 Cf. Kate Crawford, *Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence* (New Haven, CT; London: Yale University Press, 2021), in particular chapters 3–4.

35 Cf. Hao, *Empire of AI: Dreams and Nightmares in Sam Altman’s OpenAI*.

36 Cade Metz, *Genius Makers: The Mavericks Who Brought AI to Google, Facebook, and the World* (New York: Dutton, 2022), chapter 6 onwards.

37 Nicholas Thompson, “An AI Pioneer Explains the Evolution of Neural Networks,” Tags, *Wired*, June 13, 2019, <https://www.wired.com/story/ai-pioneer-explains-evolution-neural-networks>.

38 Ranjodh Singh Dhaliwal et al., *Neural Networks*, In Search of Media (University of Minnesota Press; Meson, 2023), <https://meson.press/wp-content/uploads/2024/07/978-3-95796-083-2-Neural-Networks.pdf>, 87–112.

39 ChatGPT: 30 Year History | How AI Learned to Talk, directed by Brit Cruise, Art of the Problem, 2023, <https://www.youtube.com/watch?v=OFS90-FX6pg>.

40 Cade Metz, *Genius Makers: The Mavericks Who Brought AI to Google, Facebook, and the World* (New York: Dutton, 2022), See, among others, 2 et seq., 64 et seq. (on Geoffrey Hinton’s strategic renaming of “neural networks” to “deep learning” at the 2007 NIPS conference), 126 et seq., 145 et seq.

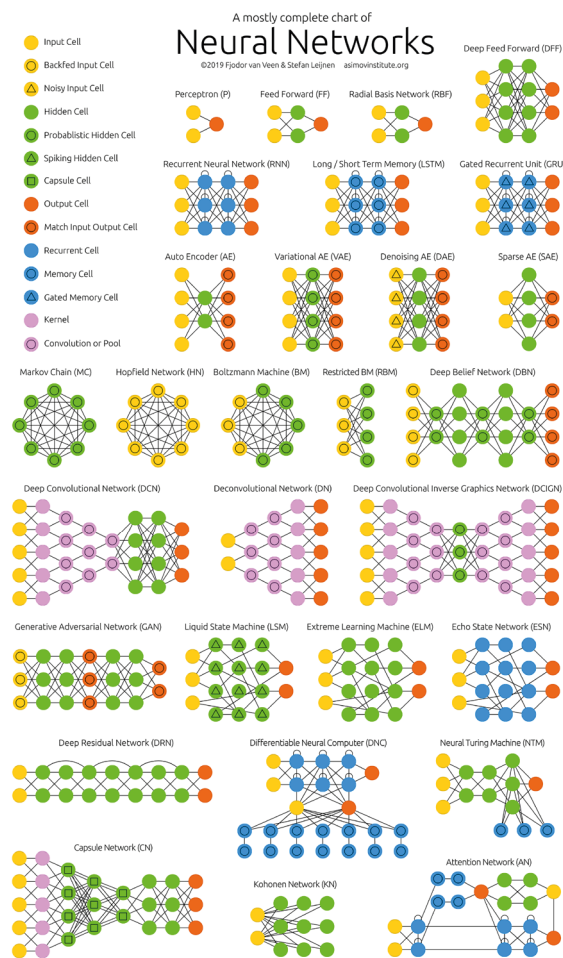


Figure 4: Fjodor van Veen and Stefan Lejnen. "A mostly complete chart of Neural Networks," 2019.

both patient and quick to write their history. It will require new archives and methods.

In contrast to Paul Virilio, American sociologist Susan Leigh Star was not so sure in 1988. Star had ethnographically researched the scientific work of AI researchers at MIT. As a result, she invited computer science to move away from the Turing test as the basis of its human-machine thinking.⁴¹ AI technologies, according to Star, require a "Durkheim test" instead. For this test, it is not the closed world of humans and machines, mind and consciousness that counts. Rather, artificial intelligence creates social facts as part of distributed open systems that form new media environments. While Star wanted to shape this process in advance through a test that would enable the real time design, acceptance, use, and modification of the system by its users, the contours of testing have shifted due to

41 Susan Leigh Star, "The Structure of Ill-Structured Solutions: Boundary Objects and Heterogeneous Distributed Problem Solving," in *Distributed Artificial Intelligence*, ed. Les Gasser and Michael N. Huhns, Research Notes in Artificial Intelligence II (London: Pitman; San Mateo, CA: Morgan Kaufmann, 1989), 37–54.

generative AI. Everyone is currently testing AI, modifying it with their data, while being themselves tested by Big Tech.⁴² A critical Durkheim test, which decisively brings the unsettled media history of artificial intelligence into play, is still pending.

3 A Short List of Arguments to Resituate Artificial Intelligence

In view of the accelerating development of digital media, media theoretician Hartmut Winkler noted early on: "The history of media appears to be a series of large-scale experiments that test, evaluate, and reject competing designs one after the other with remarkable speed; completely different media concepts supplant each other or coexist for a certain period of time, media landscapes emerge, can assert themselves as the status quo, then erode or suddenly break down into new constellations."⁴³

Winkler has linked this to the theoretical question of what drives media history. He answers it at the beginning of his 1997 book *Docuverse* with a linguistic theory that shifts between Ferdinand de Saussure and Marshall McLuhan. To Winkler, it is the metaphor of "the network" that drives media history.⁴⁴ His approach is just as relevant today as Hamit Ekbis's impartial account of former AI paradigms mentioned at the beginning. Winkler's linguistic and semiotic thesis that the internet externalizes the networked structures of linguistic grammar—de Saussure's *langue*—deserves renewed attention in light of the current popularity of large language models.⁴⁵ At the same time, my material approach to describing network cultures differs from Winkler's. My long-standing interest lies in a network history of media, which is also a media history of networks. I am therefore interested in when and why artificial intelligence resorts to artificial neural networks and how these networks instrument the unexpected media upheavals and discontinuities described by Winkler. Connectionist AI has indeed given rise to a diverse new network grammar that operates algorithmically (Figure 4) and can therefore even be conceived of as a seventh layer of network history.⁴⁶

A linguistic-theoretical explanation alone will not suffice to explain these dynamics. But without doubt, the question of memory and externalization posed by

42 Noortje Marres and David Stark, "Put to the Test: For a New Sociology of Testing," *The British Journal of Sociology* 71, no. 3 (2020): 423–43, <https://doi.org/10.1111/1468-4446.12746>.

43 Hartmut Winkler, *Docuverse. Zur Medientheorie der Computer* (München: Boer, 1997), 14.

44 Winkler, *Docuverse: Zur Medientheorie der Computer*, chap. 1.

45 It was way ahead of current diagnostics regarding large language models as "language machines." Cf. Leif Weatherby, *Language Machines: Cultural AI and the End of Remainder Humanism*, Posthumanities 74 (University of Minnesota Press, 2025).

46 Cf. Sebastian Gießmann, *The Connectivity of Things: Network Cultures since 1832*, Infrastructures (MIT Press, 2024), <https://doi.org/10.7551/mitpress/12547.001.0001>, in particular chapter 2.

classical media theory is back on the agenda, especially in the multiple practices of digital delegation to generative artificial intelligence. Marcel Mauss's best student, André Leroi-Gourhan, already anticipated this in 1965 based on the development of the early digital computer:

"The artificial brain of course is still in its infancy, but we can already be sure that it will be more than just a nine days' wonder with limited applications. To refuse to see that machines will soon overtake the human brain in operations involving memory and rational judgment is to be like the Pithecanthropus who would have denied the possibility of the biface, the archer who would have laughed at the mere suggestion of the crossbow, most of all like the Homeric bard who would have dismissed writing as a mnemonic trick without any future. We must get used to being less clever than the artificial brain that we have produced, just as our teeth are less strong than a millstone and our ability to fly negligible compared with that of a jet aircraft."⁴⁷

The anthropological offense caused by statistical AI and its connectionist promises has not yet been widely recognized as such—and when it is, it is addressed in the context of debates on the division of labor and automation. What phenomena would a future resituated and resituating media theory of artificial intelligence need to address? What would be the elementary passages of a new Durkheim test that locates the practices and infrastructures of machine learning and the generativity and agency of large language models not only, but also within the history of classification systems?

- A first passage problematizes the *naturalization* of biological computation as socio-technical digitization, which has turned neurons into artificial neurons (life or thought itself is always universal, as shown by the continuing orientation toward the human brain—which brain research itself does not follow lightly—on the supposed path to general artificial intelligence).
- A second passage addresses the enduring *neo-cybernetic impulse* that leads to the emergence and recurrence of cognitivist and behaviorist connectionism (as with cybernetics itself, this primarily affects the human sciences, including cognitive science, psychology, statistics, economics, anthropology, Bildwissenschaft, and linguistics).
- A third passage traces the enormous amount of *public research funding* (20th century) and *private investment* (21st century) that is used to finance AI (thus making "follow the money" a methodological imperative).
- A fourth passage resulting from this *takes into account connectionist formations of practices, media, and data* that contribute to the practical generalization of (initially mostly specialized) AI applications in certain constellations—and in others rather not;

- A fifth passage theorizes the plural *practices of testing* that make AI publicly available, i.e., marketable, and at the same time habitualize its use.
- A sixth passage reveals *neocolonial data economies and geopolitics* that extract, automate, and industrialize human semiotic resources and—crucially for the future of media and cultural studies—
- The seventh passage considers the transformation of all media through their digitization as statistical/stochastic AI.

Let me repeat: for to the extent that the analysis and generation of language, texts, numbers, images, and sounds is based on layers of neural networks, all media—including film and computer code—potentially become statistically operationalized, stochastically-driven data-intensive networks.

The current industrial phantasm of Artificial General Intelligence (AGI) leads to the expenditure of ever more natural, technical, aesthetic, and financial resources. Connectionist AI places nearly all media under its own conditions by installing itself as the naturalized environment of all possible media, data, and sensor practices. The ecological and anthropological consequences of this development, which is unfolding as a data geo-economic race for more "scale" and "compute," remain unforeseeable.⁴⁸ Yet, this race to the bottom is already creating our new distribution of the sensible, making and remaking our semiotic resources anew. It also installs generative AI as a classification system that is remediating all other classification systems, and thus: the infrastructures of culture. But perhaps we could, in the meantime, make a more humble bet with Marcel Mauss: In its chatbot interaction, AI has currently become not only a cultural technique of agentic media, but also a general industry with special uses.⁴⁹

⁴⁷ André Leroi-Gourhan, *Gesture and Speech*, (MIT Press, 1993), 265.

⁴⁸ Cf. on "scale" and "compute" as obsession and method of the US-based AI industry Hao, *Empire of AI: Dreams and Nightmares in Sam Altman's OpenAI*.

⁴⁹ Mauss, *Manual of Ethnography*, 27.

Figures

Figure 1: Overview of AI trends between connectionism and symbolic artificial intelligence, 2018.

Cardon, Dominique, Jean-Philippe Cointet, and Antoine Mazières. "Neurons Spike Back. The Invention of Inductive Machines and the Artificial Intelligence Controversy." Translated by Liz Carey-Libbrecht. *Réseaux* (Paris) 211, No. 5 (2018): 173–220. [Cairn.info](https:// Cairn.info), p. IX of the PDF file.

Figure 2: Schematic structure of the Mark 1 Perceptron and spatial structure with camera, 1960.

Mark I Perceptron Operators' Manual, <https://apps.dtic.mil/sti/tr/pdf/AD0236965.pdf>, 4–5.

Figure 3: Handwriting sample, image processing, and layered network architecture for recognizing postal codes, AT&T Bell Laboratories, 1989.

LeCun, Yann, Bernhard Boser, John Denker, Donnie Henderson, R. Howard, Wayne Hubbard, and Lawrence Jackel. 1989. "Handwritten Digit Recognition with a Back-Propagation Network." In *Advances in Neural Information Processing Systems 2*, edited by D. Touretzky, 396–404. San Francisco, CA: Morgan-Kaufmann.

Figure 4: Fjodor van Veen and Stefan Lejnen. "A mostly complete chart of Neural Networks," 2019. <https://www.asimovinstitute.org/neural-network-zoo>.

Author

Sebastian Gießmann is Reader in Media Theory at the University of Siegen. He serves as principal investigator of the research project "Digital network technologies between specialization and generalization" at the collaborative research center Media of Cooperation. Gießmann has been a visiting professor of cultural techniques and history of knowledge at Humboldt-Universität zu Berlin, and holds a Privatdozentur in media and cultural studies at the University of Cologne. Recent publications: *The Connectivity of Things: Network Cultures since 1832*, Cambridge, MA; London (MIT Press), 2024; *Das Kreditkarten-Buch. Geschichte und Theorie des digitalen Bezahlens*, Berlin (Kadmos), 2026.