Artificial intelligence - the great revolution also in the financial sector?

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Abstract

Artificial intelligence is one of the buzzwords when innovations in business and society are discussed. The financial sector is no exception. But what is the fuss about algorithms and data, and what is actually so novel? This is an attempt to take stock.

Zusammenfassung

Künstliche Intelligenz ist eines der Schlagwörter, wenn über Innovationen in Wirtschaft und Gesellschaft diskutiert wird. Die Finanzbranche bildet keine Ausnahme. Aber was ist dran am Wirbel um Algorithmen und Daten und was ist eigentlich das Neuartige? Dies ist der Versuch einer ersten Bestandsaufnahme.

Artificial intelligence - what is it exactly?

The attempt by humans to formalize problems, to process them in a standardized manner and thus to arrive at more efficient results is already very old. Formal rules for solving defined problems have been around for around twelve centuries. The associated term algorithm is named after the Iranian polymath Al-Chwarizmi, who wrote about arithmetic around 830 AD. It was formalized in the first half of the 20th century with the participation of Alan Turing and the concept of the Turing machine he devised, a mathematical concept in theoretical computer science:

"A computational rule for solving a problem is called an algorithm if and only if there exists a Turing machine equivalent to that computational rule that stops for any input that has a solution."[1]

A prominent example of the recent history of an algorithm including implementation is the coding machine "Enigma", with which secret messages were encrypted according to fixed rules during the Second World War. It is no coincidence that Alan Turing played a key role in uncovering the calculation rules behind it.[2]

Computers have been used since the 1950s to support people in solving complex problems and to relieve them of standardized tasks.

With the advent of the computer in the period after the Second World War, the computational rules, which were then still implemented mechanically by means of rollers and plug connections, were increasingly replaced by digital computational rules, which we now commonly describe as programs or software. Mainframe computers increasingly took over standard tasks in companies such as payroll and accounting.[3] The goal was to increase efficiency and save costs. If you look back at the 50-year history of the Walldorf-based software company SAP, you can see the enormous upheavals this process brought. Founded by five former IBM employees, SAP today serves more than 400,000 customers worldwide with standard business software, including a host of algorithms for handling business processes.

In recent history, growing computing power has made it possible to map ever more complex business transactions from software. Amazon's Internet presence can be interpreted as an algorithm that maps the essential activities of a (book) retailer, including advice and new book introductions. At the same time, humans and machines have access to more data every day on every conceivable aspect of life. Algorithms can therefore be "trained" with a multitude of historical experiences. This way of "learning" is not unlike human

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[1] Algorithmus – Wikipedia
[2] Enigma (Maschine) – Wikipedia
[3] Geschichte des Computers: Großrechner - Computer und Roboter - Technik - Planet Wissen (planet-wissen.de)

behavior and ultimately leads us to a possible definition of artificial intelligence (AI), which states as one goal teaching machines to mimic human behavior:

„Artificial Intelligence (AI), broadly (and somewhat circularly) defined, is concerned with intelligent behavior in artifacts. Intelligent behavior in turn, involves perception, reasoning, learning communicating, and acting in complex environments. AI has as one of its long-term goals the development of machines that can do these things as well as humans can, or possibly event better. Another goal of AI is to understand this kind of behavior whether it occurs in machines or in humans or other animals."[4]

It should be noted that AI is not limited to copying human decision-making processes. Rather, it is about doing tasks better than humans could do themselves. An alternative definition clearly highlights this difference:

„It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable."

Here intelligence is defined as follows:

"Intelligence is the computational part of the ability to achieve goals in the world. Varying kinds and degrees of intelligence occur in people, many animals and some machines." [5]

The example of the chess computer Deep Blue, which defeated world chess champion Garri Kasparov in 1997, makes this essential nuance clear. While Kasparov used intuition and experience in addition to predicting moves, Deep Blue simply calculated 200 million positions per second and selected the "best" next move. Therefore, one can only speak of imitating human behavior to a limited extent, but one can speak of achieving the goal of winning a chess game by perceiving facts (the opponent's move) and logical conclusions (the rules of the game).

Current methods in AI

Following author Kai-Fu Lee, we are in a phase of "industrialization" of AI.[6] That is, the main focus of business is on monetizing existing concepts. It is difficult to predict when the next technological quantum leap will come

Artificial intelligence is not limited to mimicking human behavior.

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[4] Artificial Intelligence: A New Synthesis, Nils J. Nilsson.
[5] whatisai.pdf (stanford.edu)
[6] AI Superpowers, Kai-Fu Lee, Houghton Mifflin Harcourt, 2018.

through the invention of a new class of algorithms. We therefore focus on presenting some existing concepts in more detail:

The Chat GPT-3 program is currently the talk of the town. This is a software which gives answers of astonishingly high quality to arbitrary questions - at universities it is already discussed which effects the software could have on the preparation of homeworks. The technology behind it is known as Natural Language Processing. Algorithms predict the next word in a sentence using statistical methods. The software thus belongs to the field of "Generative AI", as it independently generates new content. Chat GPT-3 is not connected to the Internet, but uses only the data with which the algorithm was trained, i.e. the parameters calibrated. One of the developers' achievements was to train the algorithm with extraordinarily large amounts of data.[7]

In contrast, search algorithms such as PageRank, developed by Google, are permanently connected to the Internet and do not produce new content themselves. Their goal is to find the most relevant existing information. One of the great achievements of the developers at the turn of the millennium was to sort the list of search results not only on the basis of frequencies of the search word in web pages, but also to take into account the number and quality of links of the found web pages.[8]

Chatbots, search algorithms and pattern recognition are applications of artificial intelligence (AI).

When it comes to classifying objects, for example in medicine to find out whether a birthmark is malignant or not, neural networks are often used. The term is based on the functioning of the human brain as we understand it today. The mathematical underpinnings date back to the 1940s.[9] Based on inputs, neurons send impulses to other neurons, which may themselves trigger further neurons. The inputs of its predecessors are first multiplied by weights in the neuron. By applying an activation function, the output of the neuron is then calculated from the sum of the weighted inputs. The network is populated with initial inputs and the result is output to neurons that no longer have successors.

Using cancer detection as an example, we can think of it as follows: At the beginning, parameters like size, shape and color are given to the algorithm. At the end there is the decision whether the birthmark is benign or not. Already classified birthmarks are needed to build up the network. The machine chooses weights, order and interconnectedness of the neurons using

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[7] ChatGPT: How Does It Work Internally? | by Patrick Meyer | Dec, 2022 | Towards AI and ChatGPT-what is it and how does it work exactly? | by Eeman Majumder | Geek Culture | Dec, 2022 | Medium

[8] Artificial Intelligence: A Modern Approach (yale.edu), Seite 871

[9] Künstliches neuronales Netz – Wikipedia

mathematical optimization, such that the network correctly classifies as many known moles as possible.

Underlying all three of the described applications of AI is an essential resource without which the methods would not work: Data. Unlike programming laws of nature or simple procedures, it is central for AI algorithms to have real-world data for (machine) learning, so that they can later extract the desired information from unknown data sets or generate their own content. Data is therefore already being referred to as the new oil. Because of its large population, Kai Fu Lee refers to China as the Saudi Arabia of data.[10]

The availability of big data is central to the applicability of AI algorithms.

The interaction of data with algorithmic structures reflects the attempt to formalize human decision-making processes and the term artificial intelligence is set apart from "classical" algorithms: Based on empirical knowledge and certain rational laws, solutions for concrete problems are developed. The ability to abstract more or less meaningfully from the known to the new can be described as (artificial) intelligence.

Where is the financial industry using AI?

In the financial industry, the familiar AI applications have reached all parts of the value chain. In contact with the end customer, for example, chatbots are used. In the so-called "middle office", AI is used to automate money laundering controls and in the "back office", algorithms are used to create credit ratings.[11]

Algorithms probably have the longest history in the area of securities trading and the development of trading strategies. The pioneering work in this field in the 1980s is closely linked to the American mathematician James Simons. The investment company he founded, Renaissance Technologies, became known for trading algorithms based on returning commodity prices to their historical averages and tracking trend movements. The holding period of individual positions was usually only a few days. Nowadays, hedge funds in particular try to discover, test and execute new trading strategies based on tons of data from the capital market using machine learning. In particular, a subspecies of Natural Language Processing called "text mining" is used here. Here, documents such as annual reports are automatically combed through in an attempt to extract information.[12] The number of documents a machine

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[10] AI Superpowers, Kapitel: „The Saudi Arabia of data".
[11] OECD Business and Finance Outlook 2021: AI in Business and Finance | READ online (oecd-ilibrary.org)
[12] Artificial Intelligence and Machine Learning in Asset Management (blackrock.com)

can read exceeds the capabilities of any human. However, analysts (still) evaluate for themselves whether the extracts contain valuable information.

We are currently still a long way from the target vision of an algorithm that independently develops trading strategies, adapts itself on the basis of current information and efficiently executes buy and sell orders without humans intervening at least temporarily in the process. If such a system were ever created, the question of the traceability of decisions would immediately arise. Or to put it another way: Would you entrust your assets to a machine that does not provide an explanation for the profit or loss generated at the end of the year? However, systems to support experts are already in use today.[13]

Artificial intelligence in retirement provision

Let's concretize possible applications even more by looking at a specific area of the financial industry. What does the transformation of processes through the use of AI in retirement provision look like?

Applications of AI exist in all areas of the financial industry's value chain. In most cases, AI expert systems support the users.

In direct customer contact, chatbots are already taking over the tasks of advisors. Particularly in the case of standard questions, these give customers answers without a human intervening. The "Finnish Center for Pensions (ETK)", for example, has been working with the chatbot Tyyne since 2019. 54.1% of customer inquiries there are completely taken over by the algorithm, saving almost 40 hours of work per month in a team of five. In addition, there is now round-the-clock accessibility compared to only four and a half hours of consulting time daily without the chatbot. In addition, ETK employees are able to train the bot themselves, which they did not program themselves. The additional efficiency gains are obvious.[14]

In order to set up products for retirement planning that are as precisely tailored as possible, it is of interest to identify factors that predict the risk preference, i.e. the investment strategy desired by the customer, as appropriately as possible. However, traditional questionnaires, such as those used in consulting sessions, sometimes produce risk profiles that do not match the subsequent investment decisions. Using machine learning, a study based on data from a Turkish pension fund was able to identify the main factors for determining the risk propensity of savers. For this, the risk propensity questionnaire prescribed by the regulator, along with socioeconomic factors, was compared to actual investment decisions by approximately 80,000

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[13] Artificial Intelligence and Machine Learning in Asset Management (blackrock.com)
[14] Pensions Chatbot Saves Time and Money (getjenny.com)

individuals. The authors showed that models based on machine learning provide better predictions of actual risk propensity than the regulator's questionnaire, which converts individual questions into a risk score using a fixed weight function.[15] Age was identified as the main influencing factor. In addition, direct and comprehensible questions have more explanatory power than more comprehensive formulations.

The Japanese Government Pension Investment Fund (GPIF) is the world's largest manager of retirement savings. Compared to funds in other countries, it stands out for its high outsourcing rate of investment.[16] Traditionally, GPIF has had a small group of experts in charge of selecting external funds and fund managers - but investment results have been considered disappointing. To improve returns and debunk the argument of arbitrariness and lack of objectivity in the selection process, GPIF has been experimenting with AI since 2018.

First, a method was developed that detects how similar a fund is to itself over time. The investment behavior of the funds is monitored and the AI reports when there are changes in investment behavior. In one specific case, the machine reported a change in the investment behavior of a fund and it turned out that this coincided with a change in the portfolio manager's position. Secondly, a model was created that compares different funds with each other. As a result, for example, the preference for stocks in a certain sector in fund A compared to fund B can be reported.

So AI is assisting the experts here. If we take a look at the methods used, this will probably remain the case for the time being. So-called Explainable AI has been developed. In contrast to "black box" models, such an AI model allows conclusions to be drawn about the causes of the results.

GPIF's research now focuses on methods that can predict how individual funds will behave in different market environments. Specifically, the model aims to predict how weights of individual assets in a fund portfolio will evolve as economic fundamentals change. Thus, the model would be superior to static risk analyses and could ensure that broad diversification is provided in a wide range of market environments.

Conclusion

AI is the logical further development of a working world that aims to reduce

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[15] 2-9-2023-Saltoglu.pdf (ucr.edu)
[16] research_2017_1_en.pdf (gpif.go.jp)

AI - a further development of algorithmics, but it is not limitless.

costs and increase efficiency through automation and algorithms. The availability of more and more (real-time) data and computing power has led to the development of applications, some of which have been known conceptually for some time, but which have only begun to develop their practical impact with this technological change. The existing systems presumably cannot (yet) solve cognitively complex tasks on their own. Rather, they support humans in solving problems, as we have also seen in the example of old-age provision. To break through the existing limits of cognition, AI would not only have to match given theoretical hypotheses with empirical data but would also have to be able to intuit new hypotheses. So far, it is not seen to be able to achieve this capability.

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