

Artificial intelligence: A review of the 2018 seminar of the Amicale du Corps des Mines

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Abstract:

Artificial intelligence offers our economy powerful scientific tools for analyzing and processing a growing volume of data. There are many promising applications, whether for productivity gains or assisted decision-making. They provide us a glimpse at the start of a structural transformation in our society. However this fascinating trend raises questions and arouses apprehensions having to do with society (Should we worry about massive job destruction?), ethics (Who is responsible for an algorithm's decisions?) and sovereignty (What role for the public administration and Europe?). A review of these issues and prospects, which were discussed during the 2018 seminar of the Amicale du Corps des Mines...

On 12 October 2018, the annual Corps des Mines seminar was held on École Polytechnique's former campus. Presentations, lectures and roundtables centered on the topic of artificial intelligence (AI). Let us look at the major points made, questions raised and conclusions drawn.¹

After PIERRE PRINGUET, president of our alumni association, Amicale du Corps des Mines, opened the seminar, STÉPHAN CLÉMENÇON (chair of Machine Learning for Big Data at Télécom ParisTech) described AI's scientific context. Four roundtables were then organized on themes related to: applications in cybersecurity and defense; AI's sociological and ethical aspects; driverless vehicles; and the role of public authorities. Two firms (Safety Data and Shift Technology) offering AI-based services presented demonstrations. Among the lectures during this seminar, ÉRIC LABAYE, president of École Polytechnique, talked about AI's economic impact; MARTINE GOURIET, director of EDF's information systems, presented applications in the field of energy; and Prof. GUY VALLANCIEN of the National Academy of Medicine, discussed how AI will disrupt medicine. BENOÎT POTIER, chairman of the board and managing director of Air Liquide, concluded the day by sharing his firm's AI strategy.

¹This article, including quotations from French sources, has been translated from French by Noal Mellott (Omaha Beach, France). The translation into English has, with the editor's approval, completed a few bibliographical references.

AI for digitizing the economy

The idea underlying artificial intelligence is to reproduce a learning process by using information and models. Scientists have, since the invention of computers, wondered whether machines can be made to learn. In 1956, John McCarthy, a young professor, proposed the phrase “artificial intelligence” during a summer workshop that he organized on this topic at Dartmouth College. The forerunner of neural networks, the “perceptron”, was invented in 1957; but AI would not become a major theme again till the start of the 21st. century. Given the limitations on computational power and, even more, the need of very large quantities of data, AI was forced to “hibernate” till the end of the 1990s. This hibernation was interrupted for a short spell by the speculative Dot-Com bubble, which the industry’s unfulfilled promises burst.

Besides advances in big data and computing power, the progress made in theory-building and algorithms opened the way toward the revival of AI (neural networks and so forth). The power of AI tools for optimizing and processing masses of data soon spawned applications in fields ranging from advertising to autonomous vehicles, not to mention logistics and medicine. Major issues — scientific, economic and ethical — are still to be addressed. The scientific community continues advancing, explaining AI’s findings, making them more reliable and reducing the computing power needed so as to integrate AI in distributed systems. A very promising activity is “reinforcement learning” for using algorithms to explore situations while rewarding the algorithms for the choices made.

Artificial intelligence would not have echoed so strongly in the business world had the latter not been digitized. Michel Serres compared our times with its switch toward digital technology to the period of changes that followed the invention of writing and to the Renaissance during the passage from writing to printing. Apart from the digitization of operations and processes, this new technology has revealed the value of the data in a firm’s possession not only for better targeting advertising but also, and above all, for improving its knowledge of its customers and their behaviors.

The proliferation of digital data calls for new methods to process them. To extract value from big data (the accumulated masses of data), specific tools are needed for visualization, analytics and predictions. AI is increasingly considered to be a solution to the problems related to the volume of data, the velocity of data flows, and the variety of data (formats, structure, etc.). At EDF, the data stored amount to nearly 40,000 TB; 800 million e-mails are exchanged per month; and the information system comprises more than 11,000 servers. To cope with this volume of data, EDF is developing tools that incorporate AI, in particular to process the reports of incidents on the grid. Beyond the increasing quantity of data being generated, it is always necessary to go faster. Banking transactions must be treated instantaneously, whereas banks used to have a few days to process a transaction. Likewise, the General Directorate for External Security (DGSE) has to detect, in the shortest possible time, signals immersed in lakes of data. In both cases, AI offers a solution to the challenges arising out of the digitization of the economy.

AI, a vector of economic growth

AI, when properly implemented, is a promising vector of growth with prospects for applications throughout society. Based on its simulations of the economic impact of various forms of AI technology, the McKinsey Global Institute has predicted that 70% of firms are likely to adopt at least one form by 2030. The economic spinoffs will potentially amount to an accumulated total of \$13,000 billion by 2030 — 16% of the world's current GDP. AI's impact by sector is estimated between +1% and +9% with the largest increases in marketing, sales and logistics, where problems of optimization seem simpler to formulate.

These spinoffs for the economy will be gradual, taking off slowly (due to the substantial investments required, both in money and time) and then accelerating (owing to considerable competition and new applications). The economic impact predicted for 2030 is thrice as high as the impact estimated for the next five years.

Adopting AI might, it should be pointed out, widen the gap between the winners and losers of the digital transition. What appears to be essential for firms is to maintain long-term investments in order to test and adapt various models of this technology. This apparently represents a significant limit on the involvement of small firms. Focusing on short-term problems would skew choices in favor of a given form of this technology, which, due to our shortsightedness, risks becoming obsolete.

AI's real potential is, at present, hard to estimate; but we are able to distinguish two categories of multifaceted applications.

The first, for making human perception granular, seeks to more efficiently detect certain signals in a huge volume of data, whether images (computer vision) or texts. Text- and image-recognition tools are being used in medicine (prior to a practitioner's diagnosis), transportation (autonomous vehicles), energy (automation of EDF's hydroelectric dams), security (so that the DGSE can find "*four needles in thousands of haystacks*"), insurance (to automatically detect scams) or the translation of languages.

Next, once results are registered in making perception more granular, algorithms will be able to provide real assistance to decision-making by automating certain tasks. The general objective will be to save human time spent on recurrent tasks and to assist in situations where human errors are not wanted. Algorithms will automatically adjust the itineraries of autonomous vehicles as a function of the perceived environment. Many chatbots have been installed. These conversational agents answer users' questions in natural language. EDF uses a chatbot to respond to recurrent legal questions. Nonetheless, the boundary between automation and human intervention will have to be defined case by case so as to check whether AI's answers are adapted to cases beyond the scope of machine learning.

Sensitive ethical issues and AI's consequences

Given the progress AI is making in various sectors and its growing influence, its consequences should be examined. They have aroused fear but, too, fascination since they raise questions about our society's current model.

It is widely feared that jobs will be destroyed as machines replace workers. This major technological shift will modify many an occupation and organization. As this happens, protecting those who are least capable of preparing for the changeover seems necessary. The McKinsey Global Institute has estimated that nearly 50% of our activities can be automated, in particular those requiring the lowest skills. Several occupations are going to be created or evolve as AI increasingly comes into use, for example jobs in developing algorithms or training chatbots. Nonetheless, this will not suffice to make up for the jobs destroyed. Upgrading the aptitudes and qualifications specific to human beings, such as relational intelligence and creativity, thus seems indispensable for making human activities complementary to the activities performed by machines. Changes in work should "*free neural space for creativity*" according to GUY VALLANCIEN. Should we see in AI a chance for freeing people from the toil of working?

Beyond the technical difficulties of rolling out AI, let us not underestimate the organizational, structural and cultural consequences on our societies. Implementing AI in firms entails many adaptations, from the phase of development (access to computing power, algorithms and, of course, data) to the phases for diffusing and selling solutions. In big firms, several steps can be imagined. The first is collaboration with new players outside the firm (usually startups), whose agility, skills and delocalized access to data are conditions for inventing solutions, which can then be efficiently applied on the scale of a big firm so as to facilitate the digital transformation. The next step is internal development, which might take the form of "intrapreneurs". Firms will become a driving force behind research in AI. This research will define new standards for R&D, and publish them as now happens in the automobile industry and cybersecurity, and even at Google and Facebook. The last step, indispensable for durable success, is to change a firm's culture and value chains by adapting them to this new model.

Finally, AI raises new ethical questions. Who is responsible for the decisions made by an algorithm? The answer is very complicated when it concerns the security of persons. Driverless vehicles are a litmus test. Identifying the person (ranging from an algorithm's developer to the automaker) to hold liable in case of an accident is far from easy. The learning phase is crucial since the choice of the criteria for algorithms or data can produce biases with repercussions on all results. The boundary between AI's opacity (due to intellectual property rights justified by the high costs of development) and the legitimate need for transparency (to guarantee the equality of individuals in relation to data) is thin and fuzzy. Adopting a position means politicizing AI-related issues and calls for thought about government interventions.

The latitude of public authorities

Given the ethical and societal issues related to AI, what position should state authorities adopt? This question has several dimensions: economic (how to support AI in France and Europe?), the protection of individuals, and the sort of society where we live. As BERTRAND PAILHÈS, in charge of France's national strategy in artificial intelligence, pointed out, "*Even if authorities do nothing, something will be done.*" The Villani report made authorities aware of the importance of AI for our country's future.² Measures have been taken for developing AI: a simplification of the visa procedures for recruiting talent from abroad and incentives for researchers to move between academic research and firms (the Pact Act). However, the sensitive question of AI's raw material — data — has not been settled. In the field of health, patients' "anonymized" data could be made available to researchers and firms under conditions providing a high level of privacy protection.

It is of utmost importance that citizens be involved in giving thought to these questions. Their input must be reflected in the decisions made about AI. This is one of the points made by the CNIL in a report on this topic.³ To thwart certain tendencies, the CNIL formulated a set of principles to which AI developers should be subject: the superiority of users' interests, the principle of precaution, the verification of algorithms, and the possibility of human interventions. However specialists in this domain have argued against requiring AI to have a regulation, since this is not required of classical software programs (which are not, for example, required to provide formal proofs of operations). Technological innovation, social acceptance and the legal framework must be thought out together.

Besides ethical issues, AI raises questions of sovereignty. Despite its many advantages, France cannot be considered a leader in this field. Opposite it are powers who do not abide by the same rules of competition law or of privacy. Do we want China's social credit system in Europe? Under it, individuals receive, depending on their behavior, points that allow them to accomplish usual formalities (apply for a visa, enroll children in school, and so forth). The development of AI cannot be separated from use cases and the data to be processed. To stay in the race, are we ready for AI to be put to use in any way soever?

Owing to its cultures and the values it advocates, Europe has a special conception of AI. To not fall subject to the choices made by other powers, the issues related to developing AI must be discussed on the European scale. The General Data Protection Regulation (GDPR) provides an example of the European Union asserting its values through a regulation that is coming to be an international norm.⁴ The European strategy for high performance computing is intended to build an architecture for enabling the scientific community to pursue research.

The annual seminar of the Corps des Mines has, once again, focused on AI's potential in our societies. This major current topic has emerged out of scientific developments, as AI is increasingly applied in many a field — applications that fascinate as much as they strike fear. Beyond the industrial and ethical issues, AI calls for Europe to stake out a position on the issue of sovereignty.

² VILLANI C., (2018) *Donner un sens à l'intelligence artificielle. Pour une stratégie nationale et européenne* (Paris: Prime Minister's Office), 235p., available via: https://fichiers.acteurspublics.com/redac/pdf/2018/2018-03-28_Rapport-Villani.pdf.

³ CNIL [Commission Nationale de l'Informatique et des Libertés] (2017) *Comment permettre à l'homme de garder la main? Les enjeux éthiques des algorithmes et de l'intelligence artificielle*, December, 80p., available via https://www.cnil.fr/sites/default/files/atoms/files/cnil_rapport_garder_la_main_web.pdf.

⁴ The GDPR (General Data Protection Regulation): "Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data" available via: <http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1478961410763&uri=CELEX:32016R0679>.

