



HANDBOOK OF ARTIFICIAL INTELLIGENCE AND ROBOTIC PROCESS AUTOMATION

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Applications

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Chapter 4

GOVERNMENT 4.0 AND EVIDENCE-BASED POLICIES: AI AND DATA ANALYTICS TO THE RESCUE

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Introduction

Since its origin as a specific field of research in the mid-twentieth century, artificial intelligence (AI) has rapidly evolved (Villani et al., 2018). Designated as a cutting-edge technology, AI can be used in most sectors of our economy, whether manufacturing, finance, transportation, health, or the public sector. In recent years, the discipline has entered a new era, thanks in particular to the development of machine learning (ML), which “includes any information technology that learns and improves from examples, data, and experience, rather than following pre-programmed rules” (Treasury Board of Canada Secretariat, 2019). The digitalization of public administration, the automation of public sector workflows, and policy issues related to this revolution are part of the government transformation toward “Government 4.0.”

In this new digital world, the role of governments must be reaffirmed. Within this new technological environment, Government 4.0 has several roles: a facilitator, a user, and a legislator. As a facilitator, the government must support the development and adoption of AI through funding and the creation of entities. It should also help create or promote AI ecosystems. The government must also be a user of AI, using data science and ML techniques in its daily activities, in order to design new public policies. Finally, the government must have a legislative role in several areas, namely ethics, standardization, and privacy.

In this chapter, we will focus on opportunities for governments in the digital age. AI can help them not only in their daily operations but also to solve

complex public sector problems. We will present several AI research projects that could help governments in designing or assessing public policies. At the same time, rapid technological changes raise concerns regarding risks and social impacts. We will identify emerging issues and the role of a government as a legislator. It is critical that the use of AI be governed with clear values, ethics, and rules.

Opportunities of AI and ML for Governments

AI and ML can be used to help the government improve public services and make the best use of its resources. They can also help identify issues in real time that can lead to faster reactions or better decisions. In addition, access to big data—both structured and unstructured data—can help to refine analyses and provide new evidence to build or adapt public policies in this new environment.

Improving the government's operational efficiency

Around governmental agencies, some issues seem to be recurrent, for instance, resource constraints, paperwork burdens, and backlogs. With the application of AI and ML, processing times can be reduced while offering personalized services to citizens and businesses (Benay, 2018).

In several countries, AI technologies are already having an impact on the government's work. The government of Singapore has developed chatbots that can deliver a set of customer services, taking away the need for customers to scroll through numerous pages on the government's websites (Singapore Economic Development Board, 2017). The US Department of Homeland Security's Citizenship and Immigration Services has created a virtual assistant, EMMA, that can respond accurately to human language and answer questions. The Department receives more than 500,000 questions per month. Learning from her own experiences, EMMA gets smarter as she answers more questions. Customers said that its answers have helped (Eggers et al., 2017).

The rise of sophisticated cognitive technologies is aiding advances in several other departments. For instance, speech recognition and machine translation have implications for international relations and the Department of defense. Moreover, computer vision can help to identify thieves by video surveillance. Soon, safety departments will be able to scan license plate numbers of vehicles stopped at red lights, identifying suspects' cars in real time (Eisenberg, 2018). This may also apply for disease surveillance, illustrating a potentially life-saving capability (Eggers et al., 2017). Big data analysis also allows more accurate predictions to be made. The Research Data Archive

at the US National Center for Atmospheric Research (NCRA) contains a large and diverse collection of data (meteorological data, oceanographic observations, remote sensing datasets to support atmospheric research, etc.). These multiple sources of big data provide more accurate weather forecasts and, consequently, determine energy production and needs (National Center for Atmospheric Research, 2019).

Revenue and tax agencies also have large volumes of data. Applications based on data science include algorithms that could detect tax evasion. By cross-referencing several data sources, the government can detect whether the reported income actually appears to be what was earned.

Algorithms could also sort through data related to infrastructures to target bridge inspections by cross-referencing with weather data or images taken by drones. Another example is to sift through health and social service data to prioritize cases for child welfare and youth protection (Dhasarathy et al., 2019). These new evidences enable governments to perform more efficiently and generate benefits for the government and citizens.

Using data visualization and predictive inference for evidence-based public policies

All these examples show that governments can effectively use these new technologies to improve public services and save costs. Data science and ML techniques can also be used to help the government in designing new public policies or assess the impact of public policies in place. For some complex issues, there are often large datasets of structured data and unstructured data with hundreds of variables from different sources that are sometimes difficult to compare or use effectively. Data visualization with embedded real-time statistics could help provide a more in-depth analysis of societal issues. Moreover, several policy problems may use predictive modeling. New developments in the field of ML are particularly useful for addressing these prediction problems (Kleinberg et al., 2015). We will present two research projects to illustrate data visualization and the use of ML for public policy.

Data visualization and the “FrackMap”

For some complex issues, several data sources are available, and it is sometimes difficult to use all of them to make an informed decision. Exploration for shale gas in the United States is an example of a complex subject. Whether we look at economic impacts or environmental or human health impacts, it is often difficult to draw an obvious conclusion. To identify and link research on these topics to individual wells and shale plays in the United States, we developed

the “FrackMap” (Backus et al., 2019). This map, built on a public domain platform, as a collaboration among the Harvard Chan-NIEHS Center for Environmental Health, the UPENN Center of Excellence in Environmental Toxicology, the Harvard Center for Geographic Analysis, and the data science platform nuance-R, shows the geospatial association of *research articles to individual wells, shales, or regions of unconventional drilling* as well as *geolocated Tweets* talking about shale gas and fracking.

Based on the latest developments in data science, we coded algorithms to perform some text analysis of tweets related to fracking. The FrackMap is truly a unique and useful tool for the public health policymakers. They can infer correlations between various layers of the map (for instance, the number of wells and the number of publications related to health impacts in the same area). The temporal and spatial information embedded in tweets can also be used to contextualize the layer dedicated to the scientific research analysis, which helps improve public understanding of environmental and human health impacts, inform public policy, and support health policies and environmental justice. This tool can also contribute to the formulation of energy policies with low impact on health, the environment, and the climate.

ML to predict the migration flow process in China

Advances in computer science combined with a recognition of its applicability to economic and public policy questions make it a new tool for economists. Usually, econometric models cull the immense proliferation of explanatory variables into a tractable and parsimonious list. However, there are several problems with this approach that in turn hint at fundamental gaps in our understanding of societal changes. An ML framework can precisely fill these kinds of gaps in evidence and improve prediction for public policies.

Bengoa and Warin (2019) have developed an ML framework to predict health issues for internal migrants in China (Hukou system). In such a framework, different algorithms are trained to identify an internally validated set of correlates. ML helps to find causality instead of correlations. Why does it matter for public policies? Causality means one variable is identified prior to other significant factors. This matters a lot for public policies since officials can now target the first indicator instead of looking at a portfolio of potential indicators. Public policies may gain in terms of efficiency as well as costs.

There are not many studies that have addressed this link between migration with limited access to healthcare and health outcomes in developing economies. Other studies suggest that migrants are reasonably healthy at the point of migration but more likely to experience adverse effects than nonmigrants. As they get injured and do not have access to health some return home while

others remain in urban areas. The existing Hukou household registration system imposes restrictions and limits on where to live, which is determined mainly by birth. Hukou card is an internal passport that gives access to education and health services. Bengoa and Warin (2019) have showed that China's Hukou reform is a move in the right direction. Pilot programs in 29 provinces are helping to raise awareness about the necessity to eliminate barriers to health access, which are now linked to geography. In 2015, Shanghai had approximately 9.8 million migrant workers holding a rural Hukou.

Challenges for Governments in Implementing AI

However, the government must overcome some obstacles if it wants to benefit from AI solutions. First, the public sector continues to be plagued by an aging information technology (IT) infrastructure. Another difficulty faced in transforming the government to use AI and ML is the lack of statistical awareness and tool experience throughout the ranks of analysts (Eisenberg, 2018). In addition to these issues, similar to those of large nontechnology companies, structural issues must be addressed if the government is to legitimately position itself as a user of AI solutions (Gouvernement du Québec, 2018). The essential condition for the use of AI by governments is the accessibility of public data and at the same time the protection of personal data and their ethical use.

The difficulty of accessing (good-quality) data

The *Open Data Barometer* assesses the openness of government data in key sectors, including education, health, the environment, and public expenditure. The latest edition suggests that most government datasets are still not open (World Wide Web Foundation, 2018). Moreover, agency-specific IT and data governance protocols are often misaligned. This lack of interoperability limits how agencies can integrate multiple databases that ML algorithms can then analyze and use to provide richer insights (Desouza, 2018).

This question is indeed decisive, since application development in this field requires massive amounts of data. Many countries are considering in their AI strategies making better use of the government's asset to support business access to the data required to build successful applications. Finland makes the openness and use of data collected by Finnish ministries and agencies a priority (Gouvernement du Québec, 2018). Government agencies would sometimes wish to make public data available to research centers, start-ups, and companies to develop products and services that can benefit society as a whole, but this cannot be done without adequate consideration of citizens' rights (Gouvernement du Québec, 2018).

Data can be incomplete, biased, and of poor quality. AI techniques require high-quality data, otherwise they may lead to discriminatory outcomes or have other undesired effects. Governments should value more of their data as well as improve their data quality. To go further, governments that use algorithms and AI systems for public policies may want to open up the data used in the policy-making process (World Wide Web Foundation, 2018). The management and circulation of these data require certain conditions (e.g., anonymization and exclusive use for training new models), which would be established not only by the participating organizations but also by the people to whom the data relate (e.g., public transportation or taxi users, hospital or clinic patients). There are ways to overcome this major obstacle. For example, countries such as the United Kingdom have considered creating data trusts to ensure a better dissemination and exploitation of data (Gouvernement du Québec, 2018).

The government must adopt best practices in its ability to open up its data to promote their best use for the benefit of the community, which will be beneficial for the development of new AI applications by and for the country. This access to data in no way constitutes a disempowerment of the government with regard to the need to protect privacy. However, this responsibility must now be balanced with the responsibility to deploy and enhance data for the common good (Gouvernement du Québec, 2018). At the European level, several ongoing reforms are expected to improve access and data flows. Villani et al. (2018) suggested that the public authorities must initiate new modes of production, collaboration, and governance of data, through the creation of “data commons.” The government can play a role as a trusted third party.

Ethics, standardization, and privacy

The government must have the role of legislator in several areas of ethics, standardization, and privacy. Governments need to also ensure that their policies and regulations are coherent with AI evolution (Bharadwaj, 2019).

Indeed, open data come with the modernization of the regulations surrounding the use of public data. For instance, in Quebec (Canada), the government needs to modernize the *Act respecting access to documents held by public bodies and the protection of personal information (chapter A-2.1)*. This is not only to enable the adoption of AI within government but also to give the ecosystem the opportunity to value anonymized public data in their own application development. Obviously, a rigorous but agile mechanism will have to be put in place to avoid slippage and leakage of sensitive information.

According to the CIRANO Barometer 2018, an annual survey of the Quebec population on the level of risk perception related to 47 social issues,

47 percent of Quebecers are concerned with the protection of personal data collected by connected objects and AI and 34 percent of Quebecers want the government to provide an ethical framework for the development of AI (De Marcellis-Warin and Peignier, 2018).

Transparency and ethical uses of data become critical issues with the move toward AI, increasing the need to develop new ethical frameworks around algorithms that support decision-making. Public agencies need to educate people about these systems, be transparent in their design, and make clear how to deduce and report errors. The development of predictive algorithms can also result in biases based on gender or race, not because they are designed with biases in mind but because they may learn from data that are not representative of the population.

It will be important to have frameworks in place to review and check cognitive systems, to safeguard against these issues (Desouza, 2018). “It will become increasingly important to develop AI algorithms that are not just powerful and scalable, but also transparent to inspection, predictable, robust against manipulation and able to find the person responsible” (Bostrom and Yudkowsky, 2014).

Several initiatives have been launched around the world, in particular the *Montreal Declaration for Responsible AI* in 2017 (Montreal Declaration for Responsible AI, 2018). The Declaration has three main objectives: develop an ethical framework for the development and deployment of AI, guide the digital transition so that everyone benefits from this technological revolution, and open a national and international forum for discussion to collectively achieve equitable, inclusive, and ecologically sustainable AI development. The *Montreal Declaration* concerns any person or organization willing to promote the responsible development of AI, “whether it is to contribute scientifically or technologically, to develop social projects, to elaborate rules (regulations, codes) that apply to it, to be able to contest bad or unwise approaches, or to be able to alert public opinion when necessary” (Montreal Declaration for Responsible AI, 2018). It is also useful for political representatives, whether elected or named, whose citizens expect them to take stock of developing social changes, quickly establish a framework allowing a digital transition that serves the greater good, and anticipate the serious risks presented by the development of AI applications.

Public agencies, and especially agencies that have specific audit and inspection mandates, need to develop capabilities to audit and inspect AI systems. Given that these systems do not have agreed-upon models and step-by-step functions that can be audited, innovations in auditing are required (Desouza, 2018). The creation of specific norms and standards for AI has intensified in recent years. In 2017, ISO set up Subcommittee 42 to centralize and initiate the

activities of the IT standardization program in the field of AI (Gouvernement du Québec, 2018). Governments can seek out academic institutions in their communities to work on AI development initiatives. Academic partners are often a rich source of specialized knowledge in a domain and can bring the necessary computational and analytical knowledge to bear (Desouza, 2018).

Conclusion

AI-based programs can help governments cut costs and save labor hours, which can be then used for more complex tasks and deliver faster services. AI systems can also play a role in increasing objectivity for decision-making. To the extent that biases may play a role in deciding court sentencing for instance, AI systems can be deployed jointly with humans so as to analyze the results of decisions and use this data to identify any anomalies (Desouza, 2018). Government 4.0 should be an “AI-augmented government” (Eggers et al., 2017). This means that governments should build and increase their capacity to use as well as govern AI (Brundage and Bryson, 2016). For that, governments must enhance their expertise through policy changes that will support multidisciplinary talent development.

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