World Federation of Engineering Organizations
Fédération Mondiale des Organisations d'Ingénieurs

Big Data and AI Principles in Engineering

-Promoting responsible conduct of Big Data and AI innovation and application in Engineering

Big Data and Artificial Intelligence (AI) are rapidly expanding their application in engineering projects with growing in capability and influences, which are expected to progress dramatically in the future. They hold great promise for empowering people, raising the quality of people's lives, fostering economic and social development, addressing critical global challenges such as climate change, food, inequality, health, and education, and promoting the achievement of United Nations Sustainable Development Goals. In engineering, Big Data and AI, as crucial driving force of the 4th Industrial Revolution are transforming every aspect of engineering such as R&D, plan, design, manufacture/implementation, testing, operation, and maintenance, with incredible potential to improve the productivity, quality, safety and efficiency in various engineering projects while decreasing related carbon emission, energy and matter consumption, and the costs. Moreover, they may contribute to fighting against corruption and others to keep engineering integrity.

While offering unprecedented opportunities, Big Data and AI also bring many technical and ethical challenges that must be addressed precisely, thoughtfully, and affirmatively. While considerable progress has been made in recent years, many knotty technical problems remain that will require more innovation: Data usability still needs improving. Data capture, storage, search, transfer, analysis, and visualization techniques need to be improved or even renovated. While significant progress of AI, it is not perfect. For example, machine learning requires large amounts of human effort to label the data necessary for supervised learning. Moreover, ethical challenges, including, but not limited to, privacy violations, inexplicability, bias, malicious use, and the possibility of exacerbating digital divide and inequality are confronting us and drawing increasing public concerns.

Engineering societies, as practitioners of Big Data and AI innovation and application, have the responsibility to promote innovation and ensure their development and application to maximize their benefit to people and our living environment while minimizing their negative impact. To promote responsible conduct of Big Data and AI innovation and application, engineers and engineering community should comply with the following principles, adopting sustainable development of humanity and the planet as primary success criterion, in engineering practices:

Good for Humanity and Its Environment

Respect, promote, and protect human dignity and autonomy, maximally serve human rights; follow cultural, social, and legal norms; serve the global social and environmental good, especially cultural continuity and ecological diversity; foster application beneficial to human of Big Data and AI technologies to augment human perception, cognition, and problem-solving abilities to realize sustainable development.

Inclusiveness, Fairness, Public Awareness and Empowerment

Pay attention to inclusiveness so that all parts of society participate and get the social and economic benefits of data and AI, especially involving vulnerable groups such as children, persons with disabilities and others that are easily at risk of exclusion; mitigate the bias in datasets and seek to develop methods that detect and correct existing and potential biases; take up the responsibility of improving public awareness of the development and influence of Big Data and AI; make efforts to empower all people to take benefit of Big Data and AI and to deal with potential disruptions such as job loss.

Opening and Sharing while Respecting Privacy and Data Integrity

Open and share the data, metadata, data products, and information timely and comprehensively to responsibly make the most use of them; respect people's right to access, share, and benefit from the data and the insights it provides; safeguard users' privacy during data collection, disclosure, and utilization; empower individuals with the abilities to access and securely share their data to maintain people's capacity to have control over their identity; utilize private data with notice and informed consent; take measures to record and protect first-hand engineering data and to ensure data integrity and quality while avoiding data theft, misuse, and corruption.

Transparency

Maximize the traceability of data from the point of data-generating to the end of its application; pay attention to the verifiability of inputs/outputs of AI systems and the explicability of their judgments and decisions; endeavor to provide understandable explanations and information to all stakeholders about the possible impact of using these AI products and services; understand and provide the capabilities and limitations of AI systems being developed and deployed.

Accountability

Adhere to laws, regulations and technical standards; ensure responsibility, accountability, and liability for Big Data and AI applications and their outcomes in their whole life cycle, both before and after their development, deployment, and utilization to be traceable; make efforts to fulfill their accountability to the stakeholders including consumer users, indirect users and third parties affected by the use of Big Data and AI applications, to gain enough trust in them from people and society.

Peace, Safety and Security

Keep it firmly in mind at the first beginning that Big Data and AI applications contribute to world peace; take measures to identify and address risks, including harm to the life, body, property of users or third parties through actuators or other devices; ensure that they are safe and secure; consider such risks of AI systems throughout their operational lifetime, and verifiably where applicable and feasible; undertake thorough testing under real-world scenarios to firmly validate they are fit for purpose and meet product specifications; work closely with all stakeholders to uphold and further improve the applications' quality, safety, reliability, and security.

Collaboration

Understand the interconnectivity and interoperability of sustainable development goals and the critical importance of partnership to achieve these goals; promote inter-disciplinary, inter-industrial, and international cooperation with all stakeholders to accelerate the implementation of sustainable development goals, through responsible innovation and application of Big Data and AI.

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