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Liability for Damage Caused by AI Entities

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Abstract. The age of big data and machine learning technologies brought the new flourishing of artificial intelligence research along with profound innovation in digital services. A global AI race is underway, and the EU seeks to play a determining role in it, by exploiting its scientific abilities and strengths. Beyond the commercial and technological interests, the EU is intent on preventing the damages and harms that can be caused by devices and systems using AI, which could undermine users' trust in this new and promising technology. The protection of users from AI-caused damage will consequently constitute a crucial factor of the global AI contest. European integration is about to elaborate a regulatory framework on civil liability related to AI applications.

Keywords: artificial intelligence, big data, regulation, European Union, risks

1. Introduction

Humanity's way of life has been profoundly transformed by the innovations of the information age and the technology giants that have made them massively available. While in the physical world climatic conditions are changing dramatically, devastating wars are breaking out, and a virus has swept across the globe, virtuality is infiltrating everyday life. People spend their time stuck to their screens, constantly refreshing endless streams of personalized content.

This is just one of the many applications of artificial intelligence (AI) and its impact on our lives. The sophisticated psychological trap of social networking is largely based on advanced profiling capabilities that harness AI. Over the past decades, AI has evolved into one of the most progressive, far-reaching, and challenging areas of computer science. A broad and enriching range of applications is emerging and, in parallel, we are facing more and more problems with the ethical, legal, and governance issues surrounding the use of AI.

Before the substantive discussion on legal liability issues of this technology, the attributes, capabilities, and functions of AI must be described. Consequently,

for the purpose of this legal survey, a definition and taxonomy of the AI systems will be inevitable.

2. Definition and Taxonomy

The recent proliferating technology-related literature offers a plethora of definitions and approaches on artificial intelligence per se and on functional AI systems. For the sake of the legal tract, only some – maybe arbitrary – approaches will be considered.

2.1. Scientific Definitions of AI

As no ultimate definition on AI can be found, one may consider certain elements of several interpretations. The concept of intelligence can be identified and measured by several attributes. The touchstone of intelligence can be human-like cognitive performance or an abstract, ideal rationality, that is, 'rightful thinking'. According to other definitions, intelligence would be the ability to conduct sophisticated thought processes and reasoning or engage in intelligent behaviour. These vectors, as described by Russell and Norvig,[1] delineate four main interpretations of AI as follows:

– thinking like a human being, that is, cognitive modelling;
– acting like a human being, that is, the ability for passing the Turing Test;
– thinking rationally, that is, the logic-based model;
– acting rationally, that is, the rational agent model.

Russel and Norvig, however, emphasize that the notion of intelligent agent[2] is the central concept of the aforementioned categories of artificial intelligence. The intelligent agent is designed to receive percepts from the environment and to perform actions. The famous 'Turing test', which Alan Turing himself called the 'Imitation Game',[3] constitutes a kind of touchstone of intelligent machine behaviour. Conducted according to some relevant criteria, the test basically implies a 'conversation' between a human party and a human or computer interlocutor in such conditions as to leave the human party unaware of whether s/he is interacting with a fellow human or a computer. At the end of the test, the human party is asked whether s/he thinks s/he has just communicated with another human or a computer. An AI system would be considered to have passed the Turing test if it would be indistinguishable from a human interlocutor by the human party. According to certain opinions, an AI chatbot called Eugene

1 Russell–Norvig 2021. 2.
2 Id. VII.
3 Bernhardt 2016. 157.

Goostman actually succeeded in passing the Turing test in 2014, though this information remains heavily controversial.[4] The intelligent agent that can have any chance of passing the Turing test shall require at least the following capabilities: natural language processing, knowledge representation, automated reasoning, and machine learning.

Considering the requirement for a rational – non-human – AI, which would not operate within the confines of a simple conversation, more abstract and exact approaches need to be implemented in the development process such as: mathematics, statistics, and several branches of formal logic as Boolean (propositional) logic, first-order logic, deontic logic, and fuzzy logic.

These are considered by now, among others, as the main disciplines of AI research and development. For the purposes of robotics[5] ('embodied AI'), however, even further disciplines and technologies need to be (and are being) developed such as: computer vision and face recognition, speech recognition, and affective computing for expressing (or more likely imitating or emulating) emotions.

It is evident that for the purpose of creating a practical AI system, several technologies must be developed and employed in conjunction, a problem that is sometimes overlooked.

2.1.1. Indeterministic Behaviour: A Crucial Challenge

A usual computer program is designed to operate – to behave – in a deterministic way. Every user expects a word processor, for example, to carry out its functions in a proper order without any 'creative' actions. In fact, such actions may even be considered as perturbing normal use. The unpredicted reaction of a program to input usually indicates a 'bug' in the code, an unforeseen error.

An AI application, however, is not a usual form of software. Some AI systems are based on deterministic algorithms, but most newly developed systems employ deep learning and related technologies that implement non-deterministic algorithms and require a good deal of arbitrary datasets to be educated (trained) on. Probabilistic functioning is an inherent attribute of these systems. This means that an AI system works in a non-deterministic way, and this crucial property imposes high security risks in the course of implementation and use of AI systems. These systems may produce answers in a less transparent and explicable way than a user would expect. In many cases, even the AI experts and developers cannot predict correctly and explain the conduct of the AI. An AI system can also be interpreted as a black box;[6] by giving the system an input,

4 Masnick 2014.
5 Häuselmann 2022. 47.
6 Tan 2022. 92.

the user will receive an output without any obvious reasoning or explanation. The mode of substantive operation of the system can be approached at a certain level only by inference engineering.

This is collateral, and rather undesirable side-effect of the highly sophisticated autonomous technologies used in creating AI systems. The lack of direct control over our machinery is an entirely new phenomenon in the history of technological civilization, and still we have no proper answers and policies for disentangling ourselves from this situation. The most threatening and alerting scenario in the evolution of AI and robotics would be the rise of self-aware AI and perchance superhuman intellect displayed by such systems. Academic discussions and papers[7] also warn of this opportunity beyond the realm of overabundant science fiction works. The security risk requires special care from developers and regulators when implementing this new technology.

There is a strong motivation and inevitable need to create proper controls and security provisions for the development and use of AI systems. As to the regulatory framework, this surely must soon be elaborated, in the form of new doctrines and norms beyond the habitual toolkit of today's law. The need to regulate the roles and liabilities of the providers and operators of the AI is becoming more evident, along with the technological evolution of these autonomous and intelligent systems.[8]

2.1.2. The Fields of Application of AI

The Dartmouth Conference[9] (Hanover, New Hampshire) of 1956 is claimed to be the founding event of AI research. Since that time, AI technologies and methods have grown very sophisticated, gave rise to many genuine fields of application, and percolated into several segments of social, economic, and personal activities. Some sectors that have implemented AI extensively include:[10] astronomy and other sciences, climatology, data- and cybersecurity, e-commerce, education, finance and banking (stock market management and forecast), gaming and entertainment, healthcare (diagnosing), household and personal assistance, manufacturing, robotics, social media platforms, and transport (navigation, traffic optimization, autonomous vehicles, etc.).

Most of the listed domains are closely related to personal activities and permit human involvement, so direct legal and liability issues may be concerned in respect of fundamental rights and freedoms of natural persons or the business interests of companies.

7 Totschnig 2020.
8 Custers–Fosch-Villaronga 2022. 10.
9 McCarthy et al. 1955.
10 JavaTpoint.AAI 2022a.

2.2. Definition of AI in the EU law

The Artificial Intelligence Act (hereinafter referred to as AIA) of the EU – technically a draft bill of a forthcoming EU Regulation – also attempts to define artificial intelligence for the purpose of constructing a regulatory framework. Article 3(1) of the AIA describes the notion of an artificial intelligence system – and not the abstract concept of AI – as follows (original emphasis): 'For the purpose[s] of the Regulation[,] *artificial intelligence system* (AI system) means software that is developed with one or more of the techniques and approaches listed in *Annex I* and can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with.'

The definition can be interpreted using the content of Annex I, which enumerates the relevant technologies as being:

– Machine learning approaches, including:
  - supervised,
  - unsupervised,
  - reinforcement learning, using a wide variety of methods, including
  - deep learning.

– Logic- and knowledge-based approaches, including:
  - knowledge representation,
  - inductive (logic) programming,
  - knowledge bases,
  - inference and deductive engines,
  - symbolic reasoning and expert systems.

– Statistical approaches:
  - Bayesian estimation,
  - search and optimization methods.

This interpretation tends to be as neutral as possible, that is, the legal concepts omit any appearance of the legislator taking sides in the scientific discussion on whether the technical criteria and quality of AI should be compared to the average human skills and capabilities or an abstract – mathematical and/or logical – rationality. The list of relevant technologies is also a substantive part of the definition. This agenda reflects the widely acknowledged scientific definition and taxonomy of AI.

3. Typology of AI

Speaking about AI, it is obvious to see that several levels of intelligence can be observed in this domain. Some systems work only within very limited abilities, while other ones may compete with skills of human experts – for instance, in

medical imaging, mostly implemented in diagnostics such as cancer diagnostics, pregnancy tests, electroencephalography, etc.

Considering the state of the art in AI development and having regard to some foresight, one may identify certain categories of AI applications. This taxonomy is necessary also for legal thinking, as the nature and abilities of the AI system shall determine the legal title, factors, and level of liability. The categories can be identified either on the basis of the functionalities of the AI system or according to their abilities.

3.1. AI Typology According to Functionalities

3.1.1. Reactive AI

Reactive AI is programmed to provide a deterministic output based on the input it receives. The applications based on reactive AI 'engines' (software and hardware used to implement an AI model) respond to identical situations in the same way every time, and they are not able to learn actions or conceive of past or future. These types of AI services cannot function beyond the tasks they were initially designed for. That makes them inherently limited and ripe for improvement. As to operable examples, we may consider some well-known applications as follows: Deep Blue – the chess-playing supercomputer by the IBM; spam-filtering utilities embedded into email servers; Google/YouTube/Spotify/Netflix recommendation engines; etc.

3.1.2. Limited-Memory AI

Artificial intelligence with limited memory learns from past experience and builds up empirical knowledge by observing the results of actions or newly generated data. This type of AI uses past observational information combined with pre-programmed information to make predictions and perform complex tasks. Obviously, machine learning capabilities are two steps up from the reactive AI mentioned in the previous point. Today, these systems are also extremely widespread. It may be noted that AI systems controlling autonomous vehicles are also a specific application of this type.

Limited-memory AI, as the name suggests, is still quite limited. The information that autonomous vehicles work with is ephemeral and not stored in the car's long-term memory, for example.

3.1.3. Theory of Mind AI

No industrial examples can be presented for the AI system included in this category – as yet. There are only a few scientific and technological experiments with some rudimentary elements of the decision-making capabilities equal – or uncannily similar – to humans. Machines with this cognitive AI will be able to understand and remember emotions and then adjust their behaviour based on these emotions when interacting with humans. An intelligent conversation with an emotionally intelligent robot that looks and sounds like a real human will be feasible with these machines. There are still many obstacles to the realization of consciousness-based AI, as the process of changing behaviour based on rapidly changing emotions in human communication is very elastic. This is difficult to imitate as we try to create more and more emotionally intelligent machines. Some humanoid robots, such as Sophia developed by Hanson Robotics in Hong Kong, can demonstrate some abilities of social interactions with human users. 'She' can recognize faces and respond to interactions with her own facial expressions.

3.1.4. Self-Aware AI

This category currently exists only in the world of science fiction, and there is no telling when this highly advanced form of artificial intelligence might emerge. At present, we do not have the necessary hardware, nor do we know the algorithms that could make such a machine work. This artificial intelligence is a machine that is self-aware and has its own emotions, not only having the ability to react – more or less – adequately to the actions and emotions of the people connected with it. This type of artificial intelligence, if and when it emerges, will not only be self-aware but will also have desires, needs, and emotions.

3.1.5. Superhuman AI

This category looks even beyond the realms of sci-fi, but in a particular way it is already a matter of scientific discussion. We can only have conjectures and surmises about such an entity and quite obscure premonitions regarding the implications of its emergence. It is predicted that the development of the superhuman AI is physically possible, and no reasons for its implausibility (at least in some distant future) are known. Joseph Carlsmith devoted a hefty paper to this scenario and predicts superhuman AI emerging with some likelihood by 2070.[11] In the same 'prophecy', he concludes that the permanent and unintentional disempowerment of all humans in such a scenario would be an existential catastrophe.[12]

11 Carlsmith 2021. 13.
12 Ibid.

3.2. Typology of AI Based on Capabilities

Another habitual and widely implemented taxonomy of AI is based on the capabilities of these systems. According to this approach, the following types of AI can be identified.

3.2.1. Weak AI, or Narrow AI

The weak (a.k.a. narrow) AI is a type of artificial intelligence that can perform a given task intelligently. Currently, these are the most common and available AI-supported or -operated systems. Weak AI cannot perform beyond its own domain or limitations, as it is only designed and trained for a specific task. Beyond a particular domain, the operation of the weak AI is unreliable and unpredictable.

Consider some operable examples as follows:

– Apple Siri is a narrow AI. Siri operates with a limited pre-defined range of functions.
– IBM Watson online soft-computing facilities also run under narrow AI. Watson's abilities include:
  • the expert system approach (logical structures called 'trees' designed to guide the user to a certain result),
  • machine learning,
  • natural language processing.
– Other narrow AI applications include:
  • chess – and other board game – player programs,
  • purchasing recommendation engines on e-commerce sites,
  • autonomous cars,
  • speech recognition and translation applications,
  • image recognition.

3.2.2. General AI a.k.a. AGI (Artificial General Intelligence)

General AI is a highly developed type of intelligent agent that could solve and carry out any intellectual task with human-like performance. An AGI system would think like a human on its own, likely even far exceeding human cognitive abilities. Currently, no such system exists, but this is a primary target of AI research and development. The timespan of this research effort is unpredictable. AI experts and knowledge engineers mostly agree that the AGI should have the capacities to represent knowledge, reason, develop strategy, decide under uncertainty (able to solve Bayesian problems), plan, learn (machine learning), communicate in natural language, and, finally, to integrate all these above-mentioned skills.

3.2.3. Strong, or Super AI

The strong, or super AI is a hypothetical concept referring to the level of machine intelligence that could surpass human skills and cognitive abilities. This would be an outcome of AGI. Pessimistic – or realistic – forecasts stipulate that this would impose a disastrous future for the mankind.

4. The Legal Risks of AI

After such a – partly futuristic – overview, we can now see what challenges and risks we can actually expect to face today in the context of the use of AI. What are the realistic risks, harms, and damage that AI systems can cause to individuals, groups of individuals, and society as a whole? What types of AI systems do we have any practical experience with?

Only the following categories of AI can be seen as extant systems and services: reactive AI, limited-memory AI, and weak/narrow AI. The other mentioned categories belong to the world of fantasy, and we must clarify that science fiction is not the genuine operational area of law. Legal thinking consequently shall concentrate on the challenges imposed by currently and or foreseeably operational AI systems. These are the lower class of intelligent agents but are also worth considering as sources of legal risks. Without the ambition to make a comprehensive list of legal interests jeopardized by AI systems, we may easily identify some fundamental categories. These are personality rights and property rights.

4.1. Personality Rights in Danger. Profiling and Web Scraping

Data protection law is a significant legal innovation of European legal culture. Within a few decades, this became a forefront of personality rights. National data protection authorities, NGOs, and civilian activists are combating the thirst for information of the modern state and Internet-related companies trading in personal and behavioural data such as social media platforms.

Digital technology – strengthened by AI capabilities – provides the data controllers with sophisticated tools and methods for monitoring and profiling society and private individuals alike. Never before in history has any state benefited from such an effective tool for controlling and manipulating society as the AI implementations we see in daily use even now. The profiling capabilities of social media providers, web stores, and government agencies are mostly based on AI algorithms. Alarming news on massive data breach incidents are regularly broadcast in the media. The Facebook–Cambridge Analytica data scandal illustrates the social and political

risks[13] of massive algorithmic profiling. GDPR and other related laws provide lawful treatment for these abuses and delicts. However, beyond these incidents, there is also the risk that the data processed and profiled by AI algorithms may lead to erroneous conclusions and thus to uninformed decisions. The law must provide an answer as to who and how is liable for the damage caused by such errors and misuse. Web scraping (mass gathering of online information for various purposes) by intelligent software agents is an increasingly widespread practice, also imposing special privacy risks.

4.2. Property Rights in Danger

Intelligent systems are used in several other fields of business – beyond data trading and social media. The modern financial system is also based on digital services. Banks and stock markets use intelligent agents to carry out financial operations. The banking business is regulated and protected by subtle, elaborate legal provisions.

Algorithmic trading – a.k.a. high-frequency trading – in stocks, however, is a relatively new phenomenon, and new challenges are imposed by AI-based algorithms employed in its course. Financial losses in this line of business can erode the livelihoods of families and undermine the prosperity of companies, causing huge damage. One of the most famous stock market incidents, probably caused by artificial intelligence algorithms, is the 2010 Flash Crash[14] on the Chicago Mercantile Exchange (CME). The investigation and interpretation of the causes is still ongoing.

Apart from AI-supported financial systems, one may meet with AI on the roads as well. The risk of autonomous vehicles has grown into a classical dispute topic of ethics and law. The harm caused by an erroneous, disoriented – or unethical – car can be significant and may cause personal harm, injury, or even death.

These are also challenging legal problems. Mainly, the question arises as to who will be held liable in cases like this. This is a new area where ethical considerations need to be taken into account before a legal framework can be established.

5. Ethical and Legal Doctrines on Liability for Damages Caused by AI

A robot is not a person and will not be one for a long time. When the age of self-aware AI, or strong AI, even superhuman AI comes – if ever –, we must reconsider this statement, but now is not the time. Therefore, the type of weak AI currently

13 Chan 2019.

14 Brush–Schoenberg–Ring 2015.

in existence obviously cannot be subject to any legal relationship since it has no legal capacity. Both the ethical and legal requirements for artificial intelligence are therefore imposed on the legally competent persons associated with the intelligent agent, namely: the developer, the service provider, and the user.

5.1. Ethical Framework of AI Liability

Transparency is the first and foremost among the ethical criteria concerning the development and operation of artificial intelligence. This means that it is inevitable that software developers are about to harmonize the algorithms they use, and – despite the fact that these are the most enshrined and confidential secrets of many businesses – they must stop using uncontrolled AI. In the scientific, philosophical, and legal disputes on the demanded framework regulation on AI, many further expectations are on the floor. Most of them are principles so abstract that extensive reasoning and interpretation will be needed to determine their exact meaning. The upper chamber of the British Parliament – the House of Lords – drafted an ethical standard[15] for the AI law of the UK. Five governing principles were laid down as the cornerstones of the forthcoming regulation as follows:

1. Artificial intelligence should be developed for the common good and benefit of humanity.
2. Artificial intelligence should operate on principles of intelligibility and fairness.
3. Artificial intelligence should not be used to diminish the data rights or privacy of individuals, families, or communities.
4. All citizens should have the right to be educated to enable them to flourish mentally, emotionally, and economically alongside artificial intelligence.
5. The autonomous power to hurt, destroy, or deceive human beings should never be vested in artificial intelligence.

Translating moral standards into legal institutions is a non-trivial process with no clear outcome. EU law has replaced the notion of moral AI with the notion of 'trustworthy AI' and has assigned to it criteria that are now legally interpretable.

5.2. Trustworthy AI

Trustworthy AI[16] has three principles, which should be met throughout the system's entire life cycle: (1) lawfulness, (2) displaying of ethical behaviours, and (3) robustness. That is, trustworthy AI should be lawful, complying with all applicable laws and regulations, should be ethical, ensuring adherence to ethical principles and values,

15 House of Lords 2018.

16 European Commission High-Level Expert Group on AI (AI HLEG) 2019. 5.

and should be robust, both from a technical and social perspective since, even with good intentions, AI systems can cause unintentional harm. These basic principles are transposed into seven further particular requirements to achieve trustworthy AI: (1) human agency and oversight; (2) technical robustness and safety; (3) privacy and data governance; (4) transparency; (5) diversity, non-discrimination, and fairness; (6) societal and environmental well-being; (7) accountability.

The articulated concept of trustworthy AI is based on the European doctrine of fundamental rights and a corresponding set of ethical principles that are crucial in an AI context. The Ethics Guidelines developed at the behest of the European Commission emphasized the principles[17] of (1) respect for human autonomy, (2) prevention of harm, (3) fairness, and (4) explicability.

Explicability is probably the most problematic expectation for the AI developers though this is a crucial factor to set up and maintain users' trust in AI systems. The development and training processes of AI should be transparent, the capabilities and purpose of AI systems need to be openly communicated, and decisions need to be explained as far as possible to those directly and indirectly affected. The relevant fundamental rights in relationship with basic ethical principles should guarantee respect for human dignity, individual freedom, rule of law, democracy, equality, solidarity and freedom from discrimination and the fullest scale of citizens' right. AI developers and service providers granting products and services fuelled with AI capabilities must refrain from any practice and technological measure that could breach these fundamental values of law and ethics.

6. Conclusions

The development of AI still looks a long process, and we are just at the beginning of this long road. The legal and ethical issues concerning AI are still in the embryonic stage. The game is not over, and the stakes are very high. AI can be the gold standard of the future or can be a bane for mankind. The legal framework, the regulatory principles shall determine which scenario will be fulfilled. This is why the discussion and collaboration of software developers, knowledge engineers, and legal counsels will be inevitable in the development of artificial intelligence.

17 AI HLEG 2019. 12.

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