# ARTICLES

## LEGAL STATUS OF ARTIFICIAL INTELLIGENCE FROM QUANTUM-THEORETIC PERSPECTIVE

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*Massive inclusion of artificial intelligence (AI) in the technosphere and electronic governments urges an update in legal regulation of these and related areas. The issue converges on the key question of whether AI can be endowed with legal personhood and capacity. Opposing views in this respect build on hardly compatible ethics and largely outdated scientific grounds with a clear perspective for deep cultural antagonisms and further fragmentation of the world. We contribute to this debate from the perspective of quantum cognitive science and show how it can resolve some of the current impasses. Our approach builds on the quantum-theoretic refinement of the concept of uncertainty into quantum and classical types: classical uncertainty denotes subjective ignorance of the present state of affairs, while quantum uncertainty accounts for individual freedom to construct the future. We show that legal capacity of intelligence, at bottom, is defined by the type of uncertainty it is capable to resolve. Natural intelligence, in particular, can resolve quantum uncertainties, generating genuine novelty and affective experience in the process. Classical AI, in contrast, is limited to algorithmic computation, bound to produce predefined results regardless of its complexity. Concepts of decision-making, subjectness, creativity, and personal meaning then are recognized as physically inapplicable to such systems. The proposed definitions of these terms complement and sharpen the criteria of legal capacity in the existing legislations, indicating that "autonomy" is essentially equivalent to "appreciation." Classical AI then appears as fundamentally alien to subjectness and legal capacity both in civil and common laws, resolving a delicate contradiction between them. Quantum-empowered AI, in contrast, escapes this conclusion due to its access to quantum uncertainty, introducing novel challenges*

*with respect to responsibility gaps and meaningful human control. The developed approach aligns with the present legal practice and ethical discourse, contributing to the scientifically informed development of law in technological societies.*

*Keywords: artificial intelligence; legal capacity; meaningful human control; responsibility gap; subjectness; quantum; law.*

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## Introduction

The second decade of the 20th century witnessed an explosive development of artificial intelligence (AI). From 2015 to 2020, an autonomous household robot passed a self-awareness test;[1] AI defeated the world's top master of go;[2] a robot Sofia received citizenship in Saudi Arabia;[3] a chat bot Shibuya Mirai was granted residency in Japan;[4] for the first time, AI-generated text was qualified for copyright protection,[5] and an AI prosecution system was deployed in China.[6] These experimental decisions reflect the capabilities of AI, often unexpected even to their designers: learning from unstructured data, adaptation to novel environments, composition of sensible texts, music and paintings. The emergence of these and other features shifts the perception of AI from an initial tool-like to a human-like entity, asking for similar legal status. Step by step, artificial subjectness and agency proceeds from unthinkable to useful metaphor to reality.[7,8,9,10]

The aforementioned cases, of course, induce critical discussions. As AI becomes more and more indispensable in various spheres of life, potential dangers for the privacy, safety, and autonomy of humans become evident.[11] In this respect, some welcome the advent of artificial agents and electronic persons as a new wave of

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1 Christopher Hooton, *A robot has passed a self-awareness test*, The Independent, 20 July 2015 (Jun. 10, 2023), available at https://www.independent.co.uk/tech/a-robot-has-passed-the-selfawareness-test-10395895.html.

2 Joon Ian Wong & Nikhil Sonnad, *Google's AI won the game Go by defying millennia of basic human instinct*, Quartz, 25 March 2016 (Jun. 10, 2023), available at https://qz.com/639952/googles-ai-won-the-game-go-by-defying-millennia-of-basic-human-instinct.

3 Rozina Sini, *Does Saudi robot citizen have more rights than women?*, BBC News, 26 October 2017 (Jun. 10, 2023), available at https://www.bbc.com/news/blogs-trending-41761856.

4 Anthony Cuthbertson, *Artificial Intelligence 'Boy' Shibuya Mirai Becomes World's First AI Bot to Be Granted Residency*, Newsweek, 11 June 2017 (Jun. 10, 2023), available at https://www.newsweek.com/tokyo-residency-artificial-intelligence-boy-shibuya-mirai-702382.

5 Zhang Yangfei, *Court rules AI-written article has copyright*, China Daily, 20 January 2020 (Jun. 10, 2023), available at https://www.chinadaily.com.cn/a/202001/09/WS5e16621fa310cf3e3558351f.html.

6 Stephen Chen, *Chinese scientists develop AI 'prosecutor' that can press its own charges*, South China Morning Post, 26 December 2021 (Jun. 10, 2023), available at https://www.scmp.com/news/china/science/article/3160997/chinese-scientists-develop-ai-prosecutor-can-press-its-own.

7 Sam N. Lehman-Wilzig, *Frankenstein Unbound: Towards a Legal Definition of Artificial Intelligence*, 13(6) Futures 442 (1981).

8 Phil McNally & Sohail Inayatullah, *The Rights of Robots: Technology, Culture and Law in the 21st Century*, 20(2) Futures 119 (1988).

9 John MacIntyre et al., *At the Tipping Point*, 1 AI Eth. 1 (2021).

10 José-Antonio Cervantes et al., *Artificial Moral Agents: A Survey of the Current Status*, 26(2) Sci. Eng. Eth. 501 (2020).

11 *Лешкевич Т.Г.* Метафоры цифровой эры и Black Box Problem // Философия науки и техники. 2022. № 1(27). С. 34–48 [Tatiana G. Leshkevich, *Metaphors of the Digital Era and the Black Box Problem*, 27(1) Philosophy of Science and Technology 34 (2022)].

technological progress,[12,13,14] while others argue for reserving legal capacity for humans.[15,16,17,18] The appropriateness of replacing humans with machines is reasonably questioned in critical areas like court decisions and policy.[19,20,21,22] This debate rarely leads to agreement. At bottom, it reduces to the opposition of ethical stances that cannot be proved or disproved.[23,24] In the past, fundamental contradictions of this kind fueled deep cultural splits with dramatic and violent consequences.

Trying to keep pace with technology in this kind of controversy,[25] legislators face a hard challenge. Our traditional approaches, solidified by centuries of practice, build on the premise that any intelligence is due to human individuals. The rest of nature – surely including semiconductor chips from Intel, AMD, and Huawei, whether robotically embodied or not – must be totally inert and mindless. Modern AI bluntly rejects this view, ascending to Descartes' duality of *res cogitas* (thinking nature) and *res extensa* (spatial nature). In a way, the present legal difficulties thus stem from this 4-century-old metaphysical disjunction, implicitly shaping our worldviews and judgments.

Fortunately, similar problems were already encountered in quantum physics, psychology, and cognitive sciences, which opened the way to a more integral view of nature. Quantum physics, in particular, showed that information pervades both

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12 Lawrence B. Solum, *Legal Personhood for Artificial Intelligences*, 70(4) N. Carol. L. Rev. 1231 (1992).

13 J. Storrs Hall, *Ethics for Machines*, in Michael Anderson & Susan L. Anderson (eds.), Machine Ethics 28 (2011).

14 Joshua C. Gellers, *Rights for Robots* (2020).

15 *Алексеева И.Ю., Аршинов В.И., Чеклецов В.В.* "Технолюди" против "постлюдей": НБИКС-революция и будущее человека // Вопросы философии. 2013. № 3. С. 12–21 [Irina Yu. Alekseeva et al., *"Technohumans" versus "Posthumans": NBICS-Revolution and the Future of Man*, 3 Problems of Philosophy 12 (2013)].

16 *Алексеева И.Ю.* Культ технологий и субъектность человека // VII Декартовские чтения: глобальные угрозы развитию цивилизации в XXI веке [Irina Yu. Alekseeva, *The Cult of Technology and the Subjectivity of Man*, in VII Cartesian Readings: Global Threats to the Development of Civilization in the 21st Century] 109–116 (2021).

17 Joanna J. Bryson, *Patiency Is Not a Virtue: The Design of Intelligent Systems and Systems of Ethics*, 20(1) Eth. Inf. Tech. 15 (2018).

18 Heather M. Roff, *Artificial Intelligence: Power to the People*, 33(2) Eth. Int'l Aff. 127 (2019).

19 Richard A. Berk, *Artificial Intelligence, Predictive Policing, and Risk Assessment for Law Enforcement*, 4(1) Ann. Rev. Crim. 209 (2021).

20 Madalina Busuioc, *Accountable Artificial Intelligence: Holding Algorithms to Account*, 81(5) Pub. Adm. Rev. 825 (2021).

21 Caryn Devins et al., *The Law and Big Data*, 27(2) Cornell J.L. & Pub. Pol'y 357 (2017).

22 Andrew G. Ferguson, *Policing Predictive Policing*, 94(5) Wash. U.L. Rev. 1109 (2017).

23 Wendell Wallach & Peter M. Asaro (eds.), *Machine Ethics and Robot Ethics* (2020).

24 Priya Persaud et al., *Can Robots Get Some Human Rights? A Cross-Disciplinary Discussion*, J. Robotics (2021).

25 Woodrow Barfield & Ugo Pagallo (eds.), *Research Handbook on the Law of Artificial Intelligence* (2018).

inert and living matter, connecting elementary particles by immaterial, non-spatial ties. This finding resonated with psychological and cognitive modeling, looking for natural foundation of the psyche, soul, and mind.[26] Consciousness, sense-making, free will and other vague concepts then find formulations allowing productive analysis.[27,28] On a social scale, principles of quantum physics are used in accounts of organic structures,[29] affective communication and collective psychology,[30] "irrational" economic[31] and social processes,[32,33] eluding description by other theories. Several researchers used quantum theory to study the nature of the court, the state, and legal practice in general:

• L. Tribe, for example, considered the fact from quantum physics that any effort to control or specify the particle's state increases the randomness of its future behavior.[34] This tradeoff, known as Heisenberg's uncertainty principle, appears to work in the process of judging, which – instead of passive declaration of facts – actively changes the state of an object. Similarly, any legal regulation comes with the price of largely unpredictable back-action, often ignored by mechanistic thought.[35]

• Another example builds on the aforementioned quantum-physical fact that seemingly individual particles may be linked by non-local informational ties. On a human scale, such ties connect people regardless of spatial distance between them. In plain language, these ties are relations between enemies and friends, husbands and wives, colleagues and compatriots, where in each case a collective entity is not reducible to the sum of its individual parts. This basic social phenomenon, troublesome for methodological individualism, is naturally embraced by the concept of quantum entanglement. This approach, potentially resolving a conflict between

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26 David Bohm, *A New Theory of the Relationship of Mind and Matter*, 3(2-3) Philosophical Psychology 271 (1990).

27 Henry P. Stapp, *Science's Conception of Human Beings as a Basis for Moral Theory*, in Cultural Diversity and Transversal Values: East-West Dialogue on Spiritual and Secular Dynamics, UNESCO CLT.2006/WS/17 (2006), at 99.

28 Carlos E. Maldonado, *Quantum Theory and the Social Sciences*, 59(E) Momento 34 (2019).

29 Andrei Khrennikov, *Open Quantum Systems in Biology, Cognitive and Social Sciences* (2023).

30 Alexander Wendt *Quantum Mind and Social Science* (2015).

31 David Orrell, *Quantum Economics: The New Science of Money* (2018).

32 Thomas Holtfort & Andreas Horsch, *Social Science Goes Quantum: Explaining Human Decision-Making, Cognitive Biases and Darwinian Selection from a Quantum Perspective*, 25 J. Bioecon. 99 (2023).

33 Francisco Di Biase, *From Quantum Universe to Holographic Brain: The Spiritual Nature of Mankind*, 14(3) J. Cons. Exp. & Res. 156 (2023).

34 Laurence H. Tribe, *The Curvature of Constitutional Space: What Lawyers Can Learn from Modern Physics*, 103(1) Harv. L. Rev. 1 (1989).

35 The original constitution of the United States, in particular, is seen as the embodiment of a mechanistic worldview, strictly regulating the conduct of individuals within the state machine (*Id.*).

human and state-centric social doctrines, provides useful insights on development of social and international relations.[36,37,38,39]

• Phenomenon of entanglement points to a domain of nature, very different from spatial and temporal continuum of Newtonian and Einsteinian physics. This is the domain of informational, potential, virtual structures, mathematically formalized as Hilbert space of quantum wavefunctions. Ideologies and religions, collective (un)conscious, language, states and legislations all belong to this realm, forming possibilities of what may happen in space-time.[40] Alien to the materialistic worldview, here humans operate irrespective of their social or material status. Such an extension of "quantum holism" then provides a physical basis for universal and inalienable human rights in agreement with major traditional cultures,[41] lacking in the existing declarative ideologies.

Quantum physics thus provides us with concepts, or "scientific fictions,"[42] more adequate to the human nature than Newtonian mechanics, classical thermodynamics, and Einsteinian relativity. Conceptual analogies of the aforementioned kind incite effective ways of thinking, talking and informing human relations in a non-local and entangled, obscure and uncertain, subjectively-contextual, creative, dynamic, multidimensional and multipolar world.[43,44,45] Exploration of such ways, however, requires recognition and overcoming of deep ideological presumptions of mechanistic worldview.[46,47]

The present paper continues this line of research, aiming to resolve the issue of the legal status of AI on a firm scientific basis. After setting out the problem

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36 *Алексеева Т.А., Минеев А.П., Лошкарев И.Д.* «Земля смятения»: квантовая теория в международных отношениях? // Вестник МГИМО-Университета. 2016. Т. 2. С. 7–16 [Tatiana A. Alekseeva et al., *"Land of Confusion": Quantum Theory in International Relations?*, 2 Bulletin of MGIMO University 7 (2016)].

37 Alexander H. Montgomery, *Quantum Mechanisms: Expanding the Boundaries of Power, Space, and Time in Global Security Studies*, 1(1) J. Glob. Sec. Stud. 102 (2016).

38 James Der Derian & Alexander Wendt (eds.), *Quantum International Relations: A Human Science for World Politics* (2022).

39 Alexander Wendt, *Why IR Scholars Should Care about Quantum Theory, Part I: Burdens of Proof and Uncomfortable Facts*, 14(1) Int'l Th. 119 (2022).

40 James Der Derian & Alexander Wendt, *"Quantizing International Relations": The Case for Quantum Approaches to International Theory and Security Practice*, 51(5) Sec. Dial. 399 (2020).

41 Amar Dhall, *On the Philosophy and Legal Theory of Human Rights in Light of Quantum Holism*, 66(1) World Futures 1 (2010).

42 Donald O. Walter, *Choosing the Right Fictions of Scientific Law*, 8(3) Am. J. Physiol. 365 (1980).

43 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (2007).

44 Rick Dolphijn, *Critical Naturalism: A Quantum Mechanical Ethics*, 30 Rhiz.: Cult. Stud. Em. Know. (2016).

45 Danah Zohar, *Zero Distance: Management in the Quantum Age* (2022).

46 Stuart A. Kauffman & Arran Gare, *Beyond Descartes and Newton: Recovering Life and Humanity*, 119(3) Prog. Bioph. Mol. Biol. 219 (2015).

47 *Аршинов В.И., Буданов В.Г.* Становление методологии сложностно-семиотического мышления в диалоге с квантовой механикой // Вопросы философии. 2022. № 8. С. 77–85 [Vladimir I. Arshinov & Vladimir G. Budanov, *Becoming of the Methodology of Complex-Semiotic Thinking in Dialogue with Quantum Mechanics*, 8 Problems of Philosophy 77 (2022)].

in Section 1, Section 2 introduces the necessary concepts from quantum theory. This introduction is self-contained and requires no prior knowledge of physics. This basis allows for quantum-inspired definitions of decision, subject, and meaning in Section 3, applicable to both natural and artificial intelligence. Section 4 applies these definitions to classical AI in accord with the standard criteria of legal capacity. In the same approach to quantum AI, Section 5 identifies its legal difference from classical one and discusses potential challenges in this respect. Conclusion provides an overview of the obtained results.

## 1. Current Legal Practice and Problems

Legal concept of AI varies across countries. Here we focus on the two most popular systems of civil and common laws. Ignoring local variations, civil (Romano-Germanic, continental) law works in the post-Soviet space, China, Egypt, mainland Europe, central and south Americas including Argentina and Brazil. Common law is practiced in the UK, the U.S., Canada, Australia, New Zealand, India, Pakistan, Israel, South Africa and a number of smaller countries.[48] As necessary for conceptual analysis undertaken in this study, the following description is of a very general nature; specific differences must be taken into account when it eventually comes to the operationalization of the legal issues.

### *1.1. The Concept of Legal Capacity (LC)*

In both civil and common laws, a central concept defining the status of an individual is legal capacity. Legal capacity (LC) denotes a capability of an individual to hold rights and obligations and exercise them by one's own conduct. LC is required to be "a person before the law" recognized in the legal system. Normally it is ascribed to all adult humans. Without LC, as e.g. in cases of severe mental illnesses, an individual is not legally responsible for one's actions and could not be brought to justice.[49,50,51,52]

In the case of man-made systems, "a person before the law" is transformed into the notion of "electronic personhood," provisionally ascribed to AI.[53,54,55] To decide

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48 Jaakko Husa, *The Future of Legal Families*, in (online edn.) Oxford Handbook Topics in Law (2016).

49 Clíona de Bhailís & Eilionóir Flynn, *Recognizing Legal Capacity: Commentary and Analysis of Article 12 CRPD*, 13(1) Int'l J.L. Cont. 6 (2017).

50 Oliver Lewis, *Advancing Legal Capacity Jurisprudence*, 6 Eur. Hum. Rts. L. Rev. 700 (2011).

51 Bernadette McSherry, *Legal Capacity under the Convention on the Rights of Persons with Disabilities*, 20 J.L. Med. 22 (2012).

52 Penelope Weller, *Reconsidering Legal Capacity: Radical Critiques, Governmentality and Dividing Practice*, 23(3) Griff. L. Rev. 498 (2014).

53 Mireille Hildebrandt, *Legal Personhood for AI?,* in Law for Computer Scientists 237 (2019) (Jun. 10, 2023), available at https://lawforcomputerscientists.pubpub.org/pub/4swyxhx5/release/3.

54 Sylwia Wojtczak, *Endowing Artificial Intelligence with Legal Subjectivity*, 37(1) AI Soc. 205 (2021).

55 Solum 1992.

whether such systems are endowed with LC or not, legal systems use the following criteria, also applied for ambiguous human cases:[56]

1) **Understanding** accounts for one's ability to factually grasp and retain information. In legal practice, this is determined by the subject's ability to express it in communication with judges;

2) **Appreciation** captures the evaluative nature of one's understanding and conduct, manifesting in the attachment of a personal meaning to the facts of a given situation. Appreciation is judged by one's ability for rational argument about his or her decisions in reality-grounded fashion;

3) **Autonomy** criterion searches for capability of a person to make individual and independent (unconstrained, free) decisions. Features of autonomy include self-perception, self-determination, and free will of a subject.

Common law mainly grants LC based on criteria 1 and 2, usually evidencing one's capability for rational decision-making as befits a "reasonable person";[57,58] Civil law, in addition, requires the autonomy criterion 3, emphasizing the importance of freedom of individual conduct.[59,60]

### *1.2. Example: LC of Electronic Home Appliances*

Consider these criteria in application to an AI-based electronic home system. Such systems are used by people with mental dementia who are able, for example, to forget the time of the day and go to sleep after turning the kitchen stove on. In this case, "smart home" is designed to turn the stove off upon analysis of acoustic, video, and other sensors' data.[61] To define whether such system holds LC entailing its legal responsibility, the above criteria give the following result:

1) The system collects and stores information, so that the "Understanding" criterion 2 is satisfied;

2) Analysis of the collected information amounts to rational reasoning inquired in "Appreciation" criterion 2. "Attachment of a personal meaning," however, can be judged both ways dependent on the judge's conception of meaning;

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56 Capacity Assessment Office, Ontario Ministry of the Attorney General, *Guidelines for Conducting Assessments of Capacity* (2005) (Jun. 10, 2023), available at https://www.publications.gov.on.ca/guidelines-for-conducting-assessments-of-capacity.

57 Alan D. Miller & Ronen Perry, *The Reasonable Person*, 87(2) N.Y.U. L. Rev. 323 (2012).

58 Steven P. Scalet, *Fitting the People They Are Meant to Serve: Reasonable Persons in the American Legal System*, 22(1) L. Philos. 75 (2003).

59 Carlos Gómez-Vírseda et al., *Relational Autonomy: What Does It Mean and How Is It Used in End-of-Life Care? A Systematic Review of Argument-Based Ethics Literature*, 20(1) BMC Med. Eth. 1 (2019).

60 Catherine Quinn & Dianne Gove, *Legal Capacity and Decision Making: The Ethical Implications of Lack of Legal Capacity on the Lives of People with Dementia*, Technical report, Alzheimer Europe (2021).

61 Deniz Ozdemir, *Design and Implementation Framework of Social Assistive Robotics for People with Dementia – A Scoping Review*, 11(2) Heal. Tech. 367 (2021).

3) Since the decision is prescribed by an algorithm, ruling out any subjective freedom of the system, the "Autonomy" criterion 3 is violated.

Given that rationality of the decision is secured by the optimality of the algorithm, common law has high chance to score the criterion 2 positive. Together with criterion 1, this grants the smart home with decision-making and legal capacities. Civil law, in contrast, tends to the opposite conclusion, denying the system of LC based on the negative Autonomy criterion 3.

### *1.3. The Problem*

Although with some interpretational arbitrariness, smart home and other systems of similar complexity thus can be attributed with legal capacity in the common law countries, hosting about one third of the world's population. To pass this test, the system did not need an ability for learning, self-modification of the code, simulation of emotions or ability to talk with its user in natural language. If these features of "strong" AI would be in place, the system would also have a chance to defend its autonomy (criterion 3) in the court. Latest developments of conversational AI make this very much possible.[62]

As evidenced by recent declarations of several authorities,[63,64,65] this conclusion would not be commonly accepted. Different views on subjectness and the legal status of AI then would be backed exclusively by non-scientific ethical commitments, opening the prospect for belief-type clash, mentioned in the Introduction. The resulting legal incompatibility would also complicate international collaborations, including that among BRICS countries. The present approach aims to resolve this issue in scientific terms.

## 2. Theoretical Basis

### *2.1. Creative and Computational Intelligence*

All activity in nature categorizes in two following classes:[66]

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62 N. Gowri Vidhya et al., *Prognosis of Exploration on Chat GPT with Artificial Intelligence Ethics*, 2(9) Braz. J. Sci. 60 (2023).

63 Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts, European Commission (2021) (Jun. 10, 2023), available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52021PC0206.

64 The Ethics of Artificial Intelligence, UNESCO (2021) (Jun. 10, 2023), available at https://www.unesco.org/en/artificial-intelligence/recommendation-ethics.

65 Кодекс этики в сфере ИИ // Альянс в сфере искусственного интеллекта [Code of Ethics in the AI Sphere, AI Alliance Russia] (2021) (Jun. 10, 2023), available at https://a-ai.ru/code-of-ethics/.

66 Diederik Aerts, *The Stuff the World is Made of: Physics and Reality*, in Diederik Aerts et al. (eds.), Einstein Meets Magritte: An Interdisciplinary Reflection 129 (1999).

1) one in which new information is created;

2) one in which existing information is processed.

The second of these types is also known as (classical) computation, in which an algorithm processes initial data to produce a predetermined result. Inert physical dynamics, producing e.g. acceleration of a body based on its mass and applied force according to the Newton's law, is equivalent to such classical computing.[67] Natural intelligence, in contrast, exercises both computation and creativity.[68]

Natural intelligence uses computation to perform repetitive activities, for which it is practical to use well-working algorithms instead of devising a solution each time anew. Optimization of utility, adaptation, pattern recognition, memory, and rational logic exemplify cognitive tasks reasonably addressed by this computational side of intelligence. This side, however, can only recycle existing information, combining pieces of data according to pre-learned algorithms. Although the number of such combinations may be huge, this process cannot produce anything genuinely new.

Novelty comes to the world through action of the first, creative type. It is required to deal with novel challenges, for which one's memory has no appropriate algorithm.[69,70] Moreover, the very identification of new challenges, absent in the available recognition patterns, is a non-algorithmic creative act by itself.

Although definitions of intelligence may not mention this explicitly, creativity is implied in decision-making (as considered in detail below) and learning as building a particular cognitive-behavioral system through unique practice, which is different from installation of computer programs. Less obviously, creativity is central to understanding and perception, requiring subject to make unique, individual, and subjective sense out of objective input data.[71,72]

### *2.2. Free Will in Modern Science*

Considering the description above, one might doubt, whether such an ability to bring genuine novelty to the world is indeed available to humans. This question boils down to that of free will and choice. Without engaging into centuries-old philosophical debate, we motivate our position in this respect from a modern scientific viewpoint.

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67 Seth Lloyd, *Programming the Universe: A Quantum Computer Scientist Takes on the Cosmos* (2007).

68 Stuart A. Kauffman, *Humanity in a Creative Universe* (2016).

69 Joy P. Guilford, *Three Faces of Intellect*, 14(8) Am. Psych. 469 (1959).

70 Robert J. Sternberg, *Toward a Triarchic Theory of Human Intelligence*, 7(2) Beh. Br. Sci. 269 (1984).

71 Paulo De Jesus, *Thinking Through Enactive Agency: Sense-Making, Bio-Semiosis and the Ontologies of Organismic Worlds*, 17(5) Phenom. Cog. Sci. 861 (2018).

72 Evan Thompson & Mog Stapleton, *Making Sense of Sense-Making: Reflections on Enactive and Extended Mind Theories*, 28(1) Topoi 23 (2009).

*2.2.1. Negative Answer from Mechanistic Viewpoint*

Negation of free will and choice is usually motivated by its seeming inconsistency with natural science. Indeed, Newtonian-type laws regulate processes of nature in deterministic way, leaving no room for voluntary interventions, not predestined from the beginning of the Universe. Any uncertainty about the past, present, and future is due to our lack of knowledge and computational powers. As pieces of nature, human beings then appear as cogwheels of a whole-Universe Laplacian clockwork.

*2.2.2. Ethical Concern*

Negation of free will, however, runs in conflict with basics of humanity ingrained in most of our cultures. A stone cannot be kind or vicious; things that are commonly valued – goodness, dignity, compassion, and life itself – then appear as pre-programmed illusion built by our minds upon a meaningless mechanical circus.[73] Taken seriously, rejection of free will demounts the basis of our civilization, built upon the concepts of virtue, progress, right and wrong, just and unjust, true and false, good and bad, life and death.[74,75] Discourage of individual development[76] and undermining of legal systems (based on the premise that *one could have done otherwise*) are few of many other consequences. With this price in mind, the concept of free will needs more responsible and cautious approach than sometimes suggested.[77,78,79]

*2.2.3. Positive Answer from Quantum Theory*

Fortunately, there is no need to discard scientific progress in order to keep normal human ethics. Mechanistic worldview, underlying the negative answer above is, in fact, limited to physics of the 18th century; it remains quite popular today due to cognitive inertia and cultural bias,[80] slowing integration of wave-field and quantum-physical concepts into public culture.

A scientific framework to account for human subjectness and freedom, in fact, is provided by the very basics of quantum theory, developed to explain atomic-scale phenomena. Practice showed, in particular, that perfect knowing of the system's

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73 Kauffman 2016.

74 Roy F. Baumeister et al., *Choice, Free Will, and Religion*, 2(2) Psych. Rel. Spir. 67 (2010).

75 Russell Shafer-Landau, *Ethical Theory: An Anthology* (2nd ed. 2013).

76 Eugeny L. Dotsenko & Olga V. Pchelina, *Free Will as a Paradox: Empirical Evaluation of the Construct of Everyday Consciousness*, 14(2) Psych. Russ.: St. Art 137 (2021).

77 Daniel C. Dennett, *Freedom Evolves* (2003).

78 Dennis Overbye, *Free Will: Now You Have It, Now You Don't*, The New York Times, 2 January 2007 (Jun. 10, 2023), available at https://www.nytimes.com/2007/01/02/science/02free.html.

79 Gary Watson, *Free Action and Free Will*, 96(382) Mind 145 (1987).

80 Patrick Suppes, *The Transcendental Character of Determinism*, Midw. Stud. Phil. 242 (1993).

state does not allow prediction of its future as expected in the Newtonian world. Uncertainty of such predictions does not result from anyone's ignorance of some hidden parameters of the system; it is a fundamentally different phenomenon of nature, lying in the core of many "quantum" puzzles.[81,82]

In humanitarian perspective, quantum uncertainty provides space for actions, not predetermined by any algorithm, Pavlovian stimulus-response script, social or physical law. Ability for such actions, exercised by free will of an individual,[83] reconciles natural science with normal intuition and ethics indicated above. Humanitarian disciplines get in touch with natural sciences, bridging centuries-long split asserted by Descartes.[84] This connection goes far beyond abstract analogies, bearing practical results in philosophy,[85,86,87,88] social and cognitive sciences as noted in the Introduction. Following these approaches, the next subsection introduces the concepts of classical and quantum uncertainties, adopting them to formalize two kinds of action described in Section 2.1 as necessary for legal analysis.

### *2.3. The Key Difference: Objective and Subjective Uncertainty*

The concept uncertainty refers to any unknown quality, feature, or state. Uncertain may be, for example,

1) a number of words in the title of this paper, a color of a ball in a closed box, a date of the next solar eclipse, or a location of a sunken ship on the seabed.

Also, unknown may be, for example,

2) an answer of a friend to your next idea; an outcome of a football match; a gender of a child not yet conceived.

Although labeled by the same word, these examples of uncertainty are of fundamentally different nature to be recognized.

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81 Anton Zeilinger, *The Message of the Quantum*, 438(7069) Nature 743 (2005).

82 Gregg Jaeger, *Quantum Randomness and Unpredictability*, 65(6-8) Fortsch. Phys. (2017).

83 Henry P. Stapp, *Quantum Theory and Free Will* (2017).

84 Kauffman & Gare 2015.

85 Richard Healey, *The Quantum Revolution in Philosophy* (2017).

86 Kauffman 2016.

87 Henry P. Stapp, *Mind, Matter and Quantum Mechanics* (2004).

88 Radek Trnka & Radmila Lorencová, *Quantum Anthropology: Man, Cultures, and Groups in a Quantum Perspective* (2016).

*2.3.1. Subjective Uncertainty*

Uncertainties in block 1 result from one's ignorance of an existing state of nature. While reading the paper, a person might not remember the exact title and the number of words in it. This number, however, objectively exists, and inspection of the first page will give anyone this single true answer and nothing else. The same holds for an unknown color of an apple or for the location of past or predetermined events in time and space: these features already have definite values, but subjects may be still ignorant about them. The minimal case of such subjective uncertainty has only two alternatives, which may be black and white color of a point. In Figure 1 this ignorance is denoted by gray area.

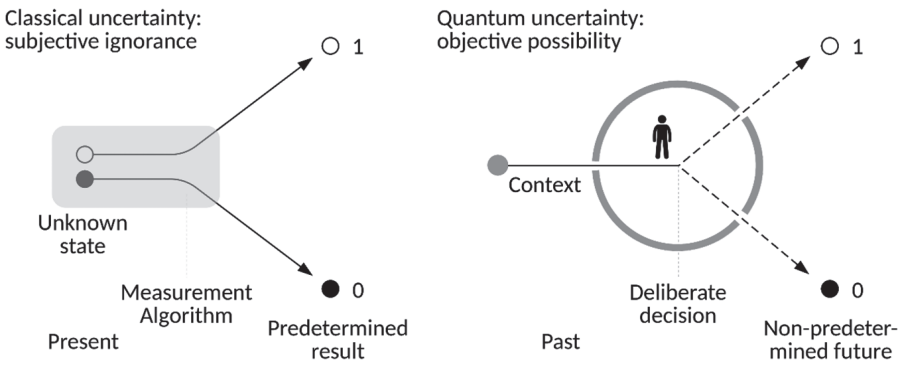


Fig. 1: **Simplest binary case of subjective (left) and objective (right) uncertainties. Subjective, classical uncertainty is resolved by measurement with a predetermined result, while objective, quantum uncertainty is resolved by creative decision act. Subject and its legal capacity have place only in the latter case**

**Definition 1:** *Subjective (classical) uncertainty is ignorance of an observer about an existing state of nature.*

Ignorant subject may get to know actual state of an object by inspection or measurement. If, for example, white balls are lightweight and black balls are heavy, such measurement of the color can be made by putting the ball in water: white ball then would pop up, while black one would sink as dictated by Archimedes' law. This law, essentially, maps color of a ball to its position, available for experience e.g. of a color-blind person. This is example of natural computation (Section 2.1) in which existing information is processed according to the (deterministic) laws of nature.

The same holds for the resolution of any subjective uncertainty. To make the corresponding information available to the subject, this process copies it to another carrier by some mapping procedure: the Archimedes' law, a word-counting algorithm, an Internet search engine, etc. In any case, such measurement does not change the state of the considered object. Resolution of subjective uncertainty is always predetermined in advance, even though an experimenter could be unaware of this; the only freedom one has is to choose a subjective belief closer or further to the actual state of reality without influencing it in any considerable way. Mathematical measure of this belief is provided by classical Kolmogorovian probability theory.

*2.3.2. Objective Uncertainty*

For the second block of examples in the beginning of Section 2.3, the situation is different. In most cases, the answer of a person is not predetermined in advance; usually it is generated during conversation depending on the tone and phrasing of a question, moods and sentiments of speakers, and many other factors. The same is true for the outcome of a sports tournament and the gender of a child two years before its birth. This kind of objective uncertainty refers not to subjective ignorance, but to the multiplicity of objectively possible futures. It is this openness of nature called quantum uncertainty, which puzzled physicists a century ago.

**Definition 2:** *Objective (quantum) uncertainty is uncertainty about potential states of the future, the choice of which is not predetermined by any algorithm*.

In contrast to the subjective case, objective uncertainty cannot be resolved by looking for the "correct" answer somewhere; there is simply no such answer in the Universe. Instead of passive observation, a subject engages in making of the future. There is no law (Archimedes' or otherwise) mapping the present state of nature to some outcome to-be-discovered; instead, there is a future yet-to-be-made at one's own discretion and responsibility. Such action resolves an uncertainty of objective type by bringing one of the potential possibilities to actual being, which becomes a new state of reality.

Although choice between such potential futures is not algorithmic, it always leads to implementation of some algorithm: a friend's answer "yes" or "no" leads to some consequence in the future; winning the match in play-off championship leads to the next opposing team; gender of a child affects its future for a lifetime. Without corresponding algorithms, this objective uncertainty would be of no interest due to lack of consequences. Objective uncertainty thus is a non-algorithmic choice between several algorithms ready for implementation, shown in Figure 2 by dashed lines.

In the binary case shown in Figure 2 the resulting state of nature is denoted by either "1" or "0," which amounts to a single brand-new bit. This is an elementary act

of creating new information, corresponding to the first type of action as categorized in Section 2.1. As well as free will, therefore, genuine creativity thus requires an objective, quantum uncertainty. This creative process is radically different from discovery-type action resolving subjective uncertainty discussed in Section 2.3.1. This difference, in particular, demands not classical, but quantum probability for its mathematical account.

## 3. Working Definitions: Decision, Subject and Meaning

Theoretic approach outlined above entails coherent understanding of decision, subjectness, creativity, computation, and meaning. This understanding can be abstracted in specific definitions of these and other terms, directly applicable to natural and artificial intelligence.

### *3.1. Decision Making and Behavior*

A stone on the road is not seen as behaving lazily by making persistent decisions to rest; as its state is predetermined by the laws of physics, a stone is not responsible for its position or velocity. If these parameters happen to be harmful, one seeks a responsible human rather than sues this piece of rock – as could be expected if it would "behave" or "make decisions." The common sense behind the concepts of decision-making and behavior thus implies the possibility of alternative ways of conduct, a choice among which is made by someone in a deliberate manner. This applies to living organisms but not to the automata with predetermined algorithmic performance.

In quantum-theoretic terms, decision-making and behavior thus refer to the resolution of objective uncertainty as described in Section 2.3.2 (otherwise, it would be better to say decision taking). This entails definition of these concepts as follows:

**Definition 3:** *Decision is resolution of an objective uncertainty. Behavior is an ensemble of such decisions performed by an individual.*

The absence of objective uncertainty then ensures the absence of decision and behavior, as illustrated in the stone case above. The same holds for any action predetermined by a plan, law, or norm of conduct.

### *3.2. Subject and Subjectness*

Since quantum, objective uncertainty, by definition, cannot be resolved by any algorithm, it requires a non-algorithmic entity capable of such resolution. Such entity is known as subject:

**Definition 4:** *The subject of a given objective uncertainty is the one who makes the corresponding decision, turning one of potential futures to reality.*

In short, the subject is just a decision maker, if the decision is understood according to Definition 3. A crucial point, introduced by the quantum approach, is that subjectness is not an absolute property of a person, like qualification in a driver's license. If that were so, any number of such licenses would come in conflict, as multiple individuals could claim their subjectness over any decision in their sight. The proposed definition, instead, explicitly defines subjectness with respect to a particular decision. A president may have subjectness over the appointment of the head of the ministry of transport, while the flight of the Air Force One is under subjectness of the captain and his crew. In that way, any number of parallel hierarchical processes can be handled by well-defined subjects with non-overlapping responsibilities and no conflict between them.

### *3.3. Affective Meaning and Meaningful Control*

Emotions and affective meaning, central to the Appreciation criterion of legal capacity as defined in Section 1.1, also derive from the nature of objective uncertainty. Continuing the above example, one does not attribute emotions to a stone, as its inert performance is understandable without these and other psychological terms.

According to the quantum approach, emotions are different states of objective uncertainty as experienced by its subject. These emotional states encode *affective meaning* of the situation, experienced by the subject in relation to the basis decision alternative as described in papers.[89,90] Meaningful subjective experience exists only for the uncertainty of objective, quantum type, requiring the existence of a subject. Accordingly:

**Definition 5:** *Affective meaning is experience of a subject, encoding subjectively established value of all available information for resolution of the basis quantum uncertainty.*

This definition conforms to the concept of *meaningful human control*, used to analyze responsibility over the performance of hybrid human-technological systems,[91] and brings some clarification to the present ambiguity.[92] In the quantum approach, a control requires the existence of objective quantum uncertainty to be

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89 Ilya A. Surov, *Natural Code of Subjective Experience*, 15(2) Biosem. 109 (2022).

90 Ilya A. Surov, *Quantum Core Affect. Color-Emotion Structure of Semantic Atom*, 13 Front. Psych. 1 (2022).

91 Herman Veluwenkamp, *Reasons for Meaningful Human Control*, 24(4) Eth. Inf. Tech. (2022).

92 Scott Robbins, *The Many Meanings of Meaningful Human Control*, in John MacIntyre & Larry Medsker (eds.), AI and Ethics (2023).

resolved; a subject of this decision is then bound to experience affective meaning of the situation according to Definition 5. Any control, therefore, is always meaningful for the corresponding subject. Whether AI can be such a subject or not is the main question of this study, for which we now made all the necessary preparations.

## 4. Legal Capacity of Classical AI

The above definitions are applicable to both natural and artificial intelligence, allowing analysis of their legal status based on standard criteria listed in Section 1.1. In this section we focus on classical AI, which encodes information in the form of ordinary bits. Such systems may simulate quantum phenomena, but do not encode information in real quantum-physical states. All ordinary computers (laptops, supercomputers, "smart" phones and watches, home appliances, chat bots, etc.) fall into this category.

### *4.1. Algorithmicity and Deterministic Nature*

Any classical AI is more or less complicated algorithm, processing information according to if-then rules. As noted in Section 2.1, such computation is entirely deterministic.[93] This equally holds for probabilistic blocks of code involving (pseudo-) random numbers, also generated algorithmically from so-called "random states,"[94] which are routinely fixed for reproducibility of the results. All uncertainty about such output is therefore of exclusively subjective, classical type (Section 2.3.1).

Deterministic quality, evident for few-line programs, in complex algorithms becomes not obvious. Modern chat bots, for example, approach success in the so-called Turing's test by closely simulating our communication practice.[95,96,97] In their algorithmicity, however, these applications are not different from elementary calculations and face classification programs. They receive input (including a supplementary set of training data, current states of memory and artificial neural nets), pass it through a sequence of algorithmic steps, and produce a pre-defined answer. The difference is the algorithmic complexity of AI, much higher than that of the Newton's laws determining "behavior" of a ball in response to an external kick. The same is true for all classical AI systems.

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93 Excluding quantum-probabilistic bit-flip type errors due to spontaneous local radioactive decay and cosmic rays.

94 Lih-Yuan Deng & Dale Bowman, *Developments in Pseudo-Random Number Generators*, 9(5) WIREs Comp. Stat. (2017).

95 Jacky Casas et al., *Trends & Methods in Chatbot Evaluation*, in ICMI'20 Companion: Companion Publication of the 2020 International Conference on Multimodal Interaction 280 (2020).

96 Katherine Elkins & Jon Chun, *Can GPT-3 Pass a Writer's Turing Test?*, 5(2) J. Cult. Analyt. (2020).

97 Yoshiteru Ishida & Ryunosuke Chiba, *Free Will and Turing Test with Multiple Agents: An Example of Chatbot Design*, 112 Proc. Comp. Sci. 2506 (2017).

When an algorithm is too complex to unravel, it is often considered as a black box – a closed entity, communicating with the outside via inputs and outputs.[98] When interacting with such a box of sufficiently complex and seemingly unpredictable performance, humans usually adopt an anthropomorphic view, attributing a machine with behavior, creativity, subjectness, emotional meaning, intentional stance, and other human-like features.[99,100,101] This illusion provokes withdrawal from responsibility over operation of such boxes, leading to the concept of so-called responsibility gaps.[102,103]

Under the hood, however, their performance remains purely deterministic. However long and convoluted, it is a continuous algorithmic track from the input to the output with no breaks and Y-like junctions like shown in Figure 1 on the right. This ensures the absence of place for decision-making (Definition 3), for subjectness or "sense of agency" (Definition 4), and for affective meaning[104] (Definition 5). This provides fundamental support for earlier arguments on the absence of creativity, authorship and responsibility gaps in AI systems.[105,106]

### *4.2. Applying Criteria for LC with Quantum Terms*

The above logic thus came to a simple conclusion: no algorithm, however complex, can raise a computer above the only thing it can do – to compute. Application of three criteria of legal capacity (LC) defined in Section 1.1 to classical AI then gives the following results:

1. Understanding: YES

Acquisition and processing of sensory input qualifies as "ability to factually grasp and retain information." Facilitated by a module of conversational AI (used e.g. for passing the Turing's test in the court), this satisfies "Understanding" criterion 1.

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98 Leshkevich 2022.

99 Luisa Damiano & Paul Dumouchel, *Anthropomorphism in Human–Robot Co-Evolution*, 9 Front. Psych. 1 (2018).

100 Serena Marchesi et al., *Do We Adopt the Intentional Stance Toward Humanoid Robots?*, 10 Front. Psych. 1 (2019).

101 Arleen Salles et al., *Anthropomorphism in AI*, 11(2) AJOB Neurosci. 88 (2020).

102 Andreas Matthias, *The Responsibility Gap: Ascribing Responsibility for the Actions of Learning Automata*, 6(3) Eth. Inf. Tech. 175 (2004).

103 Filippo Santoni de Sio & Giulio Mecacci, *Four Responsibility Gaps with Artificial Intelligence: Why They Matter and How to Address Them*, 34(4) Philos. Tech. 1057 (2021).

104 Daniel C. Dennett, *Why You Can't Make a Computer That Feels Pain*, 38(3) Synthese 415 (1978).

105 Daniel W. Tigard, *There Is No Techno-Responsibility Gap*, 34(3) Front. Psych. 589 (2021).

106 *Колмаков В.Ю., Курбатова С.М.* Философия авторского права в эпоху GPT-генерации текстов искусственным интеллектом // Философия в XXI веке: социально-философские проблемы современной науки и техники [Vladimir Yu. Kolmakov & Svetlana M. Kurbatova, *Philosophy of Copyright in the Era of GPT-Generation of Texts by Artificial Intelligence*, in Philosophy in the 21st Century: Socio-Philosophical Problems of Modern Science and Technology] 429–436 (2023).

2. Autonomy: NO

As shown above, deterministic quality ensures that classical AI has no access to the objective (quantum) uncertainty and thus is incapable of genuine decision as defined in Section 4. This inability violates the Autonomy criterion 3.

3. Appreciation: NO*

According to Definitions 4 and 5, no access to objective uncertainty guarantees the absence of subject, subjective evaluation and "personal meaning" that are requested for Appreciation criterion 2. The mark * (here and below) refers to the second part of this criterion, according to which it is "judged by one's ability for rational argument about his or her decisions in reality-grounded fashion." As mentioned above, this test can be passed by conversational AI.

The quantum approach thus essentially identifies autonomy of an individual with the meaningfulness of one's conduct, deriving both from the same fundamental aspect – the physical nature of the considered uncertainty: no personal meaning is possible without autonomy, and no autonomy exists without personal meaning. LC criteria Appreciation (2) and Autonomy (3) are thus essentially identical, addressing different sides of the same fundamental quality.

### *4.3. Conclusion on LC: Agreement of Civil and Common Laws*

These results lead to the following conclusion regarding LC of classical AI:

• Civil law:

prohibit granting of LC to classical AI regardless of its complexity due to the violation of Appreciation criterion 2 and Autonomy criterion 3.

• Common law:

prohibit granting of LC to classical AI regardless of its complexity due to the violation of Appreciation criterion 2*.

According to the disclaimer in Section 2, these conclusions are of very general nature, necessary of specify in any particular legislation. Nevertheless, this finding substantially reduces conceptual tension between families of civil and common laws. When informed by the proposed definitions both agree that classical AI has no LC, thus eliminating major ethical and legal divide, noted in Section 2.

## 5. Prospects for Recognition of Legal Capacity of Quantum AI

In contrast to mainstream classical AI, its quantum branch encodes information in real quantum-physical states, aiming to solve problems faster than classical computers.[107,108]

[107] Jacob Biamonte et al., *Quantum Machine Learning*, 549(7671) Nature 195 (2017).

[108] Vedran Dunjko & Hans J Briegel, *Machine Learning & Artificial Intelligence in the Quantum Domain: A Review of Recent Progress*, 81(7) Rep. Progr. Phys. (2018).

For the issue of legal status, however, this speedup is of no interest. What matters is that quantum hardware brings into play uncertainty of quantum, objective type, which is absent in classical computers. This feature – rarely noticed companion of a desired "quantum supremacy"[109,110,111] – is central for the present analysis.

### *5.1. The Difference from Classical AI*

Quantumness can be brought in by substituting any pseudo-random generator with a quantum chip. Objective, quantum uncertainty is then introduced to the algorithm of classical AI by measurements over single atoms or photons.[112] This time, randomness is real, since the absence of an algorithm behind it is ensured by fundamental laws of nature.

This difference overturns the logic used in Section 4. Once employed in any system, a single component of this type guarantees the absence of a deterministic algorithm behind its operation. As defined in Section 2.3, uncertainty about the resulting behavior changes from subjective to objective type. Accordingly, a real decision is made and genuinely new information is created – thus providing a core element, differing classical AI from natural intelligence. This is a physical basis for a real responsibility gap, excluded in the case of classical AI (Section 4.1).

This difference, readily implementable in practice, raises new question: where is subject exercising its deliberate and meaningful control to resolve an objective uncertainty by Definitions 4 and 5? In the case of human intelligence that was a particular person. Now, the only reasonable candidate seems to be an elementary particle within the quantum random number generator in use.

Endowing an elementary particle with free choice, subjectness and affective meaning may seem acceptable as a philosophical guess – as long as it behaves within a physical lab, producing detector counts.[113] However, using it in decision-making systems could lead to more sensitive results – road accident, court sentence, penalty bill, or wrongly prescribed medicine, for example. Would one be comfortable identifying an electron, photon, or atom as a subject responsible for such occasions?

Well, in principle, an atom can respond. Formulate a Yes–No question, identify these possible answers as 1 and 0, and run a quantum random number generator. This, however, is not going to give an intended result. The atom will make a decision

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109 Ilyas Khan, *Free Will – A Road Less Travelled in Quantum Information* (2016).

110 Valentin Jeutner, *The Quantum Imperative: Addressing the Legal Dimension of Quantum Computers*, 1(1) Mor. & Mach. 52 (2021).

111 Luca M. Possati, *Ethics of Quantum Computing: An Outline*, 36(3) Philos. Tech. 1 (2023).

112 Miguel Herrero-Collantes & Juan C. Garcia-Escartin, *Quantum Random Number Generators*, 89(1) Rev. Mod. Phys. 1 (2017).

113 Kauffman 2016.

and choose a spot, but this would be a response not to the question asked, but to the local magnetic field which is the only factor it can meaningfully recognize. As we observe in physical labs, elementary systems cannot make sense of contexts expressed in natural language, representing them in its Hilbert space in a way usual for humans.

### *5.2. The Issue of Meaningfulness*

This example shows that elementary physical systems are too primitive to properly recognize contexts of their choices, would they be amplified to the scale of human-relevant decisions. It is like inviting an infant to control an airplane: in principle, it can push the buttons creatively, but understanding of their function and consequences – i.e. meaningful control – would be lacking. Accordingly, a child would not be responsible for its actions in the captain's cabin; if the plane crashes down, the responsible party is sought among adults. This could be parents who overlooked their child, the cabin crew responsible for keeping passengers outside the cockpit, technical service that developed ineffective instructions, or designers of an education system, preparing ill-qualified specialists.

Similar logic applies to quantum AI. According to definitions in Section 3, it is able to make decisions, host proto-subjectness and affective meaning. At present, however, these qualities are of rudimentary level, incomparably lower than that of an infant in the example above. Analogously, responsibility for the actions beyond their recognition would be lifted to their human designers and/or supervisors.

### *5.3. Potential Problems*

The above logic shows that quantum type of the resolved uncertainty is necessary, but not sufficient to ascribe LC to its subject; determining of one's responsibility requires examination of meaningfulness of one's conduct, going beyond definitions of Section 3. In standard practice, for example, an individual must be able to explain his or her motivation and logic around the considered decision. With humans, this is revealed by direct communication with the judges, as mentioned in the LC criteria above.

With quantum-empowered AI, however, this practice will face problems. As already mentioned, such systems could be able to convince a court in their understanding, appreciation, and autonomy in the same way as AI passes the Turing's and other imitation-based tests.[114,115] As in the modern chat bots, this is possible by means of exclusively classical part of the system, so that adequacy of its quantum part would remain unattested.

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[114] Selmer Bringsjord, *Psychometric Artificial Intelligence*, 23(3) J. Exp. Theor. Art. Int. 271 (2011).

[115] Diane Proudfoot, *Anthropomorphism and AI: Turing's Much Misunderstood Imitation Game*, 175(5-6) Art. Int. 950 (2011).

At present, quantum AI has no ability to represent features of macroscopic contexts considered in legal practice, like e.g. traffic situations, relations and states of the actors in a road accident. Modern few-qubit systems are not yet adapted for that. However, as such systems get more complex and find practical applications, the situation becomes less clear. Technology strives for arbitrary manipulation of the quantum registers, possibly representing real-world contexts of the robots' decisions.

With this possibility realized in practice, our legal systems would face another challenge. To qualify such robots for responsible resolution of a particular class of objective uncertainties, one would need a test resistant to the Turing's fallacy noted above – some advanced version of AI audit.[116,117] This could lead to an intellectual competition, in which natural cognition does not seem to be a favorite.[118] Previous discussions[119,120,121,122,123,124,125,126] provide a basis for assessing the appropriateness of this foreseeable technology.

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116 Katie Atkinson et al., *Explanation in AI and Law: Past, Present and Future*, 289 Art. Int. 103387 (2020).

117 Jocelyn Maclure, *AI, Explainability and Public Reason: The Argument from the Limitations of the Human Mind*, 31(3) Mind. Mach. 421 (2021).

118 Daniel C. Dennett, *What Can We Do?*, in Possible Minds: Twenty-Five Ways of Looking at AI 41 (2019).

119 Alekseeva et al. 2013.

120 Alekseeva 2021.

121 Peter M. Asaro, *A Body to Kick, but Still No Soul to Damn: Legal Perspectives on Robotics*, in Patrick Lin et al. (eds.), Robot Ethics: The Ethical and Social Implications of Robotics 169 (2012).

122 Mark A. Bedau et al., *Open Problems in Artificial Life*, 6(4) Art. Life 363 (2000).

123 *Гарбук С.В*. Особенности применения понятия «доверие» в области искусственного интеллекта // Искусственный интеллект и принятие решений. 2020. № 3. С. 15–21 [Sergei V. Garbuk, *The Features of Using the Concept of "Trust" in the Area of Artificial Intelligence*, 3 Artificial Intelligence and Decision-Making 15 (2020)].

124 *Никитина Е.А.* Проблема субъектности в интеллектуальной робототехнике // Философские проблемы информационных технологий и киберпространства. 2016. № 2(12). С. 31–39 [Elena A. Nikitina, *The Problem of Subjectivity in Intellectual Robotics*, 12(2) Philosophical Problems of Information Technologies and Cyberspace 31 (2016)].

125 *Карпов В.Э., Готовцев П.М., Ройзензон Г.В.* К вопросу об этике и системах искусственного интеллекта // Философия и общество. 2018. № 2. С. 84–105 [Valery E. Karpov et al., *On Ethics and Artificial Intelligence Systems*, 2 Philosophy and Society 84 (2018)].

126 *Разин А.В.* Этика искусственного интеллекта // Философия и общество. 2019. № 90(1). С. 57–73 [Alexander V. Razin, *Ethics of Artificial Intelligence*, 1(90) Philosophy and Society 57 (2019)].

## Conclusion

Although based on quantum theory, the realistic approach described above does not imply radical reform of legal foundations. What it offers is scientifically sound understanding of the basic terms, already used in legislations. Based on this understanding we have shown that:

• Due to its algorithmic nature, classical AI has no access to objective quantum uncertainty. Therefore, classical AI is fundamentally incapable of decision-making, hosting subjectness, subjective experience and meaning.

• With the proposed definitions of decision-making, subjectness and meaning, classical AI violates Autonomy and Appreciation criteria for legal capacity, preventing positive conclusion in this respect both in civil and common legislations.

• Quantum AI may host subjectness, decision-making capacity and meaning on the level of elementary particles involved in its operation. At present, rudimentary level of these qualities does not introduce new legal entities and responsibility gaps for most practical purposes.

In terms of subjectness, classical AI thus is no different from any other tool like pencil, saw, or excavator. Standard legal practice then dictates that there is no way in which such tool, however complex, can introduce responsibility gaps or have human-like legal status. A subject, responsible for any benefit or harm made by such tool, is always sought in natural life among its users, owners and creators. To avoid anthropomorphic confusion noted in Section 4.1, the concepts of decision-making and behavior, machine's meaning and ethics should be avoided in descriptions of performance of both quantum and classical AI.

Notably, the obtained conclusions are reached with no appeal to our subjective norms, likes and dislikes. A view of machine as a subject can be considered; but then, to be consistent, you also have to sue not a robber but his car that took your goods away. What is offered by science, then, is just faithful view of nature, necessary for self-consistent logic and social development in nature-compatible ways.[127,128,129] This, however, does not mean that ethics can be discarded from the lawmaking practice. This is only true for those who know the Universe in its entirety; otherwise, moral and ethics are useful to make proper decisions in those domains of nature, where science have not yet reached. As in the present case, normal human ethics and codes of conduct – whether in European, Confucian, African, Russian, Islamic or Hindu tradition – will eventually find support in scientific reason and coordinated legislation.

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127 Orsolya Bányai, *Quantum Mechanics and Law: What Does Quantum Mechanics Teach Us?*, in Ecological Integrity in Science and Law 147 (2020).

128 Cormac Cullinan, *Wild Law: A Manifesto for Earth Justice* (2003).

129 Peter Burdon, *Wild Law: The Philosophy of Earth Jurisprudence*, 35(2) Alter. L.J. 62 (2010).

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