

## Conflicting opinions in connection with digital superintelligence

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### ABSTRACT

In 1964, Nikolai Kardashev proposed the Kardashev scale, a system for measuring the extent of technological advancement of a civilization based on the magnitude of energy consumption. We are approaching an inevitable type-1 civilization, and artificial superintelligence superior to that of humans can concur with a higher-hierarchy Kardashev civilization. We aim to survey public opinions, specifically video gamers, worldwide compared to those in Poland, concerning artificial general intelligence and superintelligence. We implemented an amalgam of cross-sectional and longitudinal analyses of the database of literature and Google search engine. The geographic mapping of surface web users who are interested in artificial superintelligence revealed the top ten contributing countries: Iran, Mexico, Colombia, Brazil, India, Peru, South Africa, Romania, Switzerland, and Chile. Developing countries accounted for 54.84% of the total map. Polish people were less enthusiastic about artificial general intelligence and superintelligence compared with the rest of the world. Futuristic technological innovations imply an acceleration in artificial intelligence and superintelligence. This scenario can be pessimistic, as superintelligence can render human-based activities obsolete. However, integrating artificial intelligence with humans, via brain-computer interface technologies, can be protective. Nonetheless, legislation in connection with information technologies is mandatory to regulate upcoming digital knowledge and superintelligence.

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## 1. INTRODUCTION

There have been several technological advancements in modern history, including the agricultural revolution in the 17th and 18th centuries that has its radix since 10,000 BC, the industrial revolution in the 18th and 19th centuries, the second industrial revolution in the 19th and 20th centuries, the scientific-technical revolution in the late 20th century, and the digital revolution in the second half of the 20th century [1-2]. Similarly, military progress has witnessed a collateral booming of technologies, the latest of which is fifth-generation warfare, also known as non-contact warfare [3-4]. Technological progress would not have been possible without the innovation of silicon-based entities known as computers [5-6], and there is much debate over who invented the first calculating machine [6-7]. It is possible that the two-millennia old mechanism from ancient Greece, around the time of the great Archimedes, known as the Antikythera, represents the oldest computing mechanism [8-10]. In Renaissance Italy, the Italian polymath Leonardo da

Vinci invented a mechanical calculator, an invention that IBM company replicated in the 20th century [11-12]. Later, in the early 17th century, the prodigy Blaise Pascal developed a more sophisticated mechanical calculator [11, 13]. Before the second world war, Alan Turing created the Turing machine in 1936, a mathematical model of computation that defines an abstract machine [14]. Almost three decades later, the United States Department of Defense parented the development of a decentralized computer network that formed the archetype of what later became the internet, including infamous deep web [5, 15].

Artificial intelligence, abbreviated as AI, is the simulation of human intelligence by a computer system [16-17]. Artificial neural networks are non-biologic mimics of the neural networks of the brain, and these systems can learn to carry out analyses without being pre-programmed to be task-specific [18]. These tasks are not limited to pattern recognition, computer vision, and real-time processing, as well as forecasting analytics for big data [19-22]. In [23], Warren McCulloch and Walter Pitts proposed a basic computer model mimicking, to some degree, the neural networks of the human brain. Currently, artificial intelligence includes a spectrum of three overlapping categories: narrow artificial intelligence (narrow AI), artificial general intelligence (AGI), and artificial superintelligence [24]. Researchers also defined four main categories of AI machines: reactive machines, those with limited memory, theory-of-mind compliant AI machines, and the anticipated self-aware machines [25-26]. However, albeit the advances in neurological sciences, there is no unanimous agreement on the definition of human consciousness [27]. Perhaps it can be “simply” defined as “the quality or state of being aware, especially of something within oneself” [28].

Nonetheless, Alan Turing espoused the renowned Turing test, which is a test of a machine's ability to exhibit intelligent behavior indistinguishable from that of a human, including the characteristics of self-awareness [29]. The exponential growth of technologies in the digital epoch, backed by substantiating evidence of Moore's law and the recent emergence of quantum computers, indicate that a human-level machine intelligence (HLMI), as well as a subsequent superintelligence, could be imminent, as Elon Musk disclosed recently [30-32]. Musk predicts that AI will take over most of, if not all, human activities, including advanced research [32]. Others argue that humanity is marching towards an inevitable technological singularity [33-35]. Thanks to the pioneering efforts of Werner Heisenberg and Richard Feynman pioneering efforts in quantum mechanics, it appears that the invention of quantum computing will further accelerate, augmenting AI potentials, as reported by Google in 2019 [36-38].

In [39], the Soviet astronomer Nikolai Kardashev proposed the Kardashev scale, a system for measuring the level of technological advancement based on the magnitude and modalities of energy consumption. The current human civilization still does not qualify as type-1, despite the tremendous progress in connection with energy exploitation since the era of the prolific electromagnetic innovations of Nicola Tesla [39-40]. Kardashev introduced five types of civilizations, four of which mandate the concept of a technological singularity, encompassing an artificial superintelligence [33, 39]. There is much evidence that we are approaching a Kardashev type-1 civilization, at which we can harness all the energy resources on earth in addition to utilizing all the solar energy with the highest possible efficiency [39]. According to Carl Sagan, humanity is currently going through a transitional phase that is “typical of a civilization about to integrate the type I Kardashev scale.” [41]. Signs of an imminent type-1 civilization are not limited to the innovations in artificial intelligence, as well as realistic plans for colonizing Mars and seeking alternative resources to fossil-based fuel on Earth, including nuclear fusion reactors and renewable energy resources [41-45]. Potential evidence of a more advanced Kardashev civilization is the puzzling Boötes void, which may represent a near-omnipotent type-3 extraterrestrial Kardashev civilization [46-47].

The creation of the universe took place at 14 billion years ago, while the earliest sign of a carbon-based biological life form on earth existed at around four billion years ago [48-49]. During the Miocene epoch, Hominins transmogrified over no less than seven million years [50-51]. In comparison, it took homo sapiens four hundred thousand years to emerge in Africa, while it is plausible that superintelligent silicon-based entities will coexist with humans within the next few centuries [50, 52]. It is remarkable, given that even if a digital superintelligence emerges over the next ten millennia, it will still represent less than one-millionth of the age of our universe.

Our primary objective is to survey the opinions, specifically video gamers, concerning the artificial general intelligence and superintelligence. We, based on our areas of expertise, shall discuss the literature on the implementation of artificial intelligence in medicine and sociology. We chose video gamers because we opine that they are motivated to complete surveys in connection with modern technology. Additionally, video games nowadays include a lot of technological innovations, including those on artificial intelligence. We reason that readers should care about video gamers' opinions as they represent a substantial segment of the youth, including those from the developing world. Besides, we opine that they may have different opinions because they possess distinct demographics, including age, distribution of gender, and ethnographic parameters. To the best of our knowledge, our study is the first to explore public opinions, using survey tools and big data, in connection with digital superintelligence, and within the context of the Kardashev scale.

## 2. RESEARCH METHOD

### 2.1. The systematic review of the literature

During September and October 2019, we conducted a pragmatic review of the databases of the peer-reviewed published literature in an aim to assess the extent of artificial intelligence and machine learning-based research. We searched Embase [Elsevier Database | Scopus], PubMed [the United States National Library of Medicine], and the Cochrane Library [the Cochrane Database of Systematic Reviews | the Cochrane Collaboration]. We deployed an exhaustive combination of generic terms and MeSH-based keywords, as well as truncations, shuffled with Boolean operators.

### 2.2. The survey

Quantic Dream, a videogame developer, created the title “Detroit: Become Human”, in which they incorporated an electronic poll [53]. The worldwide sales of the videogame reached approximately three million copies, most of which are in Asian countries, which indicates that the poll is valid and inferential, as thousands of video gaming enthusiasts completed the survey [54]. The survey had ten items as multiple-choice questions [55]. Based on thematic analysis, seven articles of the poll associate with artificial intelligence and the neurology concept of consciousness [56]. In August 2019, we communicated with Quantic Dream to replicate their survey for distribution among the youth and videogamers in Poland. During the 4th quarter of 2019, we developed and distributed the survey electronically via Google Forms. For external validity, the survey included a replica of the original ten items, translated into the Polish language, to map opinions on artificial general intelligence and human-level machine intelligence. The survey included a question concerning the belief in God (Question 4), and we argue that religious backgrounds and convictions can provide a good hint on the potential correlation with opinions on artificial intelligence and exponential technological advances. Religious individuals may oppose or be less liberal concerning a digital superintelligence that can be self-aware and superior to humans.

We chose to distribute our survey in Poland for four main reasons: 1) Poland is a formerly occupied nation by the Union of Soviet Socialist Republics (USSR) [invaded by the Soviets in 1939], and the demographics of the Polish population shares similarities with Eastern European countries. 2) Besides, the astrophysicist Nikolai Kardashev who pioneered the Kardashev scale was a Soviet national. 3) We had reliable access to survey the Polish population as the 2nd, and the third author of this study are Polish nationals and academics who work at tertiary educational institutes in Poland [the University of Rzeszow and the University of Radom]. 4) Our survey of the Polish population can be a good representative of Eastern Europe and the vast Asiatic territories previously occupied by the former Soviet Union, thereby providing some inference when comparing with the rest of the world. 4) Our preliminary data analysis, based on Google Trends analyses, confirmed that the Kardashev scale is most popular among nationals of the Ukraine, Russia, and Poland, as well as several other countries of the former USSR.

### 2.3. Google-based analytics

To map the geographic distribution of the videogamers who responded to the survey, we used Google Trends for a retrospective longitudinal analysis of data [57]. A snapshot was taken on the 26th of August 2019, using the keyword “Detroit: Become Human”, to map the search volume over the surface web for the period from the beginning of 2017 to the current date. We also implemented keywords to assess the geographic mapping of surface web users who searched for artificial general intelligence and related topics since 2004. The keywords included “Artificial general intelligence”, “Existential risk from artificial general intelligence”, “Superintelligence”, “Technological singularity”, and “Kardashev scale”. We explored the search volume on the surface web for the same keywords by using the Keywords Everywhere Add-on for the Google Chrome web browser [version 77.0.3865.90 (Official Build) (64-bit)] [58]. Keywords Everywhere provided data on the monthly search volume as well as the cost per click (CPC) in United States dollars. CPC represents the amount that advertisers are paying for a single click for a keyword in Google AdWords [58]. The search term volume can provide an estimate of the interest of individuals in specific topics. CPC metrics also reflect the interest of the population in specific themes. The higher the CPC, the higher the interest.

### 2.4. Statistical analysis, ethics, and the level-of-evidence

We implemented the Statistical Package for the Social Sciences [IBM-SPSS version 24] and Excel [Microsoft Office 2016] with integrated Data Analysis ToolPak add-in. We followed the Code of Ethics of the World Medical Association (Declaration of Helsinki) on medical research involving human subjects, EU Directive (210/63/EU) on the protection of animals used for scientific purposes, Uniform Requirements for manuscripts submitted to biomedical journals and the ethical principles defined in the Farmington Consensus of 1997. We evaluated the level-of-evidence according to the Oxford Centre for Evidence-based Medicine [University of Oxford, 2016].

### 3. RESULTS

#### 3.1. The literature

We conducted a systematic review of the literature via Cochrane Library, PubMed, and Embase. We searched for indexed publications in connection with machine learning and artificial intelligence in medical and paramedical research Figure 1. The review strategy generated an impressive total count of 1,360,737 papers distributed to the Cochrane Library of Systematic Reviews [6,382(0.47%)], the United States National Library of Medicine [1,193,042(87.68%)], and Embase [161,313(11.86%)]. Based on the combination of MeSH and generic terms of interest, the total number of publications was 209,950 allocated to the United States NLM [153,760 (73.24%)], and Embase [56,190 (26.76%)] Figure 1. We retrieved a vast number of publications. Hence, we anticipated a large percentage of false-positive data signals, i.e., publications that were not relevant to our keywords-based literature search strategy. Accordingly, we filtered through the first two hundred publications indexed in the NLM Pubmed databases.

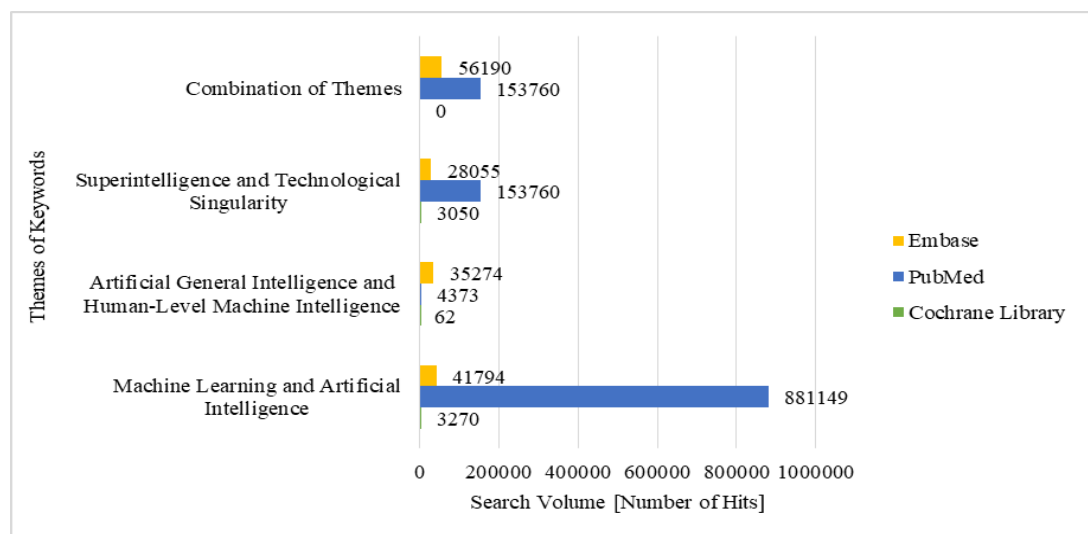


Figure 1. Exploration of medical databases of literature

Following a full-text retrieval of papers of interest, only fifteen publications (7.5%), indexed in PubMed, implemented AI and machine learning. More than three quarters (86.67%) of the research output were original studies, while the rest included a review article and an editorial paper. Each original study deployed regression models. Almost half of the research output was in connection with cardiovascular diseases (46.67%), in addition to prevalent risky medical conditions and agriculture-related research, including cancerous conditions (20%) and veterinary applications in the industry (13.33%). Other studies were related to epidemiological studies and chronic infections, including tuberculosis (20%). The publications included prospective cohorts (60%), anecdotal reports (13.33%), retrospective studies (13.33%), cross-sectional (6.67%) and real-time analyses (6.67%). The researchers published most of these papers in 2018 (26.67%), and the majority of the research originated from the United States (46.67%), China (20%), and Spain (13.33%), in addition to Germany, the United Kingdom, and the Netherlands.

#### 3.2. The survey

Worldwide (n=3,571), 68% of individuals would consider having a relationship with an android that looks like a human, 62% think that technology could become a threat to humanity, 70% find themselves dependent on technology, 41% believed in God, 49% would let an android take care of their children, 72% would agree to be operated on by a machine in case of urgent surgery, and 68% think that computers could become self-aware and conscious as shown in Table 1. Participants who responded to the survey were from 139 countries. The top ten contributing countries were mainly from the far east Australasia, including Brunei, Japan, Guam, South Korea, Hong Kong, Guernsey, Czechia, Macao, China, and Australia. Countries from the Middle East accounted for 6.80%, and those from the north of Africa and the Middle East summed to 7.92% of the holistic map. Countries from the Middle East and the North of Africa included Bahrain, Kuwait, the United Arab Emirates, Qatar, Saudi Arabia, Turkey, Lebanon, Israel, Egypt, Libya, Iran, Tunisia, Jordan, Libya, Oman, Iraq, Palestine, Morocco, and Syria.

Table 1. The global survey

Table 1: The global survey				Yes	No	Do not Know
1. Would you consider having a relationship with an android that looks like a human?				68	16	16
2. Do you think that technology could become a threat to mankind?				62	18	20
3. Do you consider yourself dependent on technology?				70	19	11
4. Do you believe in God?				41	41	18
5. Would you let an android take care of your children?				49	24	27
6. If you needed emergency surgery, would you agree to be operated on by a machine?				72	12	16
7. Do you think one day machines could develop consciousness?				68	16	16
	Androids	Flying Cars	Space Tourism	Brain Connected Devices		
8. What technology do you most anticipate?	35	13	21	31		
	1 Hour	2 Hours	4 Hours	More		Do not Know
9. How much time per day would you say you spend on an electronic device?	1	9	22	61		7
	A Book	A Cellphone	Pen and Paper	A Console		An Instrument
10. If you had to live on a deserted island and could only bring one object, what would it be?	15	23	21	11		30

Timestamp: August 26<sup>th</sup>, 2019.

Numerical values are in percentiles.

In Poland (n=455), 15% of individuals would consider having a relationship with an android that looks like a human, 71% think that technology could become a threat to humankind, 55% feel technology-dependent, almost two-thirds believed in God (68%), 21% would allow an android take care of their children, 62% would agree to be operated on by a machine in case of urgent surgery, and 52% think that machines could develop consciousness as shown in Table 2. There was a statistically significant difference between the international survey and the Polish survey for five items out of ten as shown in Table 3, including having a relationship with an android ( $X^2=23.03$ ;  $df=2$ ;  $p\text{-value}<0.001$ ), belief in God ( $X^2= 18.42$ ;  $df= 2$ ;  $p<0.001$ ), allowing an android take care of children ( $X^2= 17.03$ ;  $df=2$ ;  $p<0.001$ ), and the most anticipated technology ( $X^2= 12.84$ ;  $df=3$ ;  $p=0.005$ ). It appears that Polish people are less pro-AI compared to others worldwide. Religious, ethnographic, and sociocultural aspects of Polish society may contribute to these discrepancies, that researchers can explore in future studies using multivariate analytic models.

Table 2. The polish survey

Table 2: The polish survey				Yes	No	Do not Know
1. Would you consider having a relationship with an android that looks like a human?				15	72	13
2. Do you think that technology could become a threat to mankind?				71	14	15
3. Do you consider yourself dependent on technology?				55	31	14
4. Do you believe in God?				68	16	16
5. Would you let an android take care of your children?				21	59	20
6. If you needed emergency surgery, would you agree to be operated on by a machine?				62	16	22
7. Do you think one day machines could develop consciousness?				52	25	23
	Androids	Flying Cars	Space Tourism	Brain Connected Devices		
8. What technology do you most anticipate?	14	20	32	34		
	1 Hour	2 Hours	4 Hours	More		
9. How much time per day would you say you spend on an electronic device?	3	11	26	54		
	A Book	A Cellphone	Pen and Paper	A Console		
				An Instrument		
10. If you had to live on a deserted island and could only bring one object, what would it be?	16	45	15	6		
				18		

Date of Survey Distribution: from 25<sup>th</sup> September 2019 to November 6<sup>th</sup>, 2019.

Numerical values are in percentiles.

Table 3. Global versus polish survey: inferential analysis

Item of the Survey	X <sup>2</sup>	df	p-value
1. Would you consider having a relationship with an android that looks like a human?	23.03	2	< <b>0.001</b>
2. Do you think that technology could become a threat to mankind?	1.82	2	0.402
3. Do you consider yourself dependent on technology?	5.05	2	0.080
4. Do you believe in God?	18.42	2	< <b>0.001</b>
5. Would you let an android take care of your children?	17.03	2	< <b>0.001</b>
6. If you needed emergency surgery, would you agree to be operated on by a machine?	2.27	2	0.322
7. Do you think one day machines could develop consciousness?	5.38	2	0.068
8. What technology do you most anticipate?	12.84	3	<b>0.005</b>
9. How much time per day would you say you spend on an electronic device?	2.04	4	0.729
10 If you had to live on a deserted island and could only bring one object, what would it be?	12.67	4	<b>0.013</b>

Significant *p-values* are in bold.

### 3.3. Google-based analytics

We explored the surface web via Keywords Everywhere using nine keywords. The cumulative monthly search volume was 1,492,770, allocated to artificial general intelligence [8,100 (0.54%)], artificial intelligence [550,000 (36.84%)], consciousness [550,000 (36.84%)], existential risk from artificial general intelligence [40 (0.00%)], human-level machine intelligence [20 (0.00%)], Kardashev scale [110 (0.01%)], machine learning [368,000 (24.65%)], superintelligence [9,900 (0.66%)], and technological singularity [6,600 (0.44%)]. Surface web users searched mostly for artificial intelligence, consciousness, and machine learning. The highest cost per click (CPC) was for artificial general intelligence, machine learning, and artificial intelligence.

We also took a snapshot of Google Trends to assess the spatial and temporal mapping of surface web users who are interested in the concepts of artificial superintelligence and the Kardashev scale Figures 2 and 3. Concerning artificial superintelligence, the top contributing countries were Iran, Mexico, Colombia, Brazil, India, Peru, South Africa, Romania, Switzerland, Chile, Argentina, the United Kingdom, Finland, Germany, Spain, the United States, Canada, Australia, Philippines, Malaysia, Czechia, Denmark, Vietnam, Norway, Sweden, the Netherlands, South Korea, Poland, France, Italy, and Turkey. Developing countries accounted for 54.84% of the geographic map. Surprisingly, Iran ranked first, while other countries from the Middle East and North Africa were absent, reflecting a lack of awareness on artificial super intelligence Figure 2. Regarding the Kardashev scale, the top contributors included fifty-four countries. The first twenty of which included Ukraine, Russia, Poland, Bulgaria, Czechia, Mexico, Colombia, Peru, Romania, Chile, Spain, China, France, Italy, Turkey, Greece, Venezuela, Brazil, Switzerland, and Argentina. Developing nations accounted for 59.26% of the map, while Iran was absent, as well as other Middle Eastern and North African countries except the United Arab Emirates. The Kardashev scale, espoused by the Soviet astronomer Nikolai Kardashev, appears to be most popular among nationals of the Ukraine and Russia, as well as other countries of the former USSR.

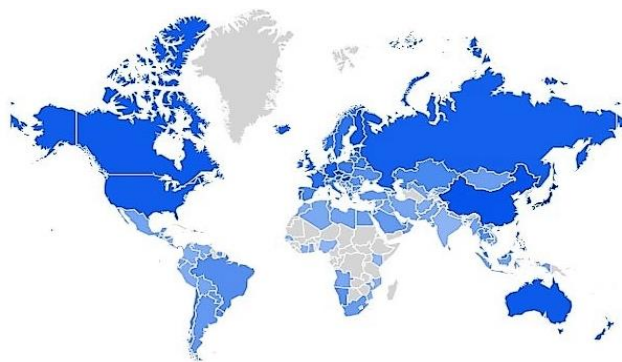


Figure 2. Geo-Mapping via Google Trends [Timestamp: October 12<sup>th</sup>, 2019] (*continue*)



Figure 2. Geo-Mapping via Google Trends [Timestamp: October 12<sup>th</sup>, 2019]

Upper Map: Keyword “Detroit: Become Human” [Timestamp: August 26<sup>th</sup>, 2019].

Lower Map: Keywords “Artificial general intelligence”, “Existential risk from artificial general intelligence”, “Superintelligence”, “Technological singularity”, and “Kardashev scale”

Lower Map Color-coding: Green [Technological singularity], Orange [Superintelligence], and Blue [Artificial general intelligence].

Google Trends generated retrospective data on five topics, including artificial general intelligence, the existential risk from artificial general intelligence, superintelligence, technological singularity, and the Kardashev scale. The most popular was the technological singularity, the signal of which peaked in July 2010, originating principally from Iran Figure 3. Interestingly, in June 2010, several researchers informed that a cyber worm nicknamed “Stuxnet” struck the Iranian nuclear facility [59-60]. A blog website, by the journalist Brian Krebs, reported the incident on the 15<sup>th</sup> of July 2010, which was a possible joint operation between the United States and the Israeli intelligence services [61]. Kaspersky Laboratory experts estimated that Stuxnet propagated over electronic devices as early as March 2010, while the first variant of it appeared in June 2009 [62-63]. This typology of cyber attack best fits the category of non-contact fifth-generation warfare [3-4].

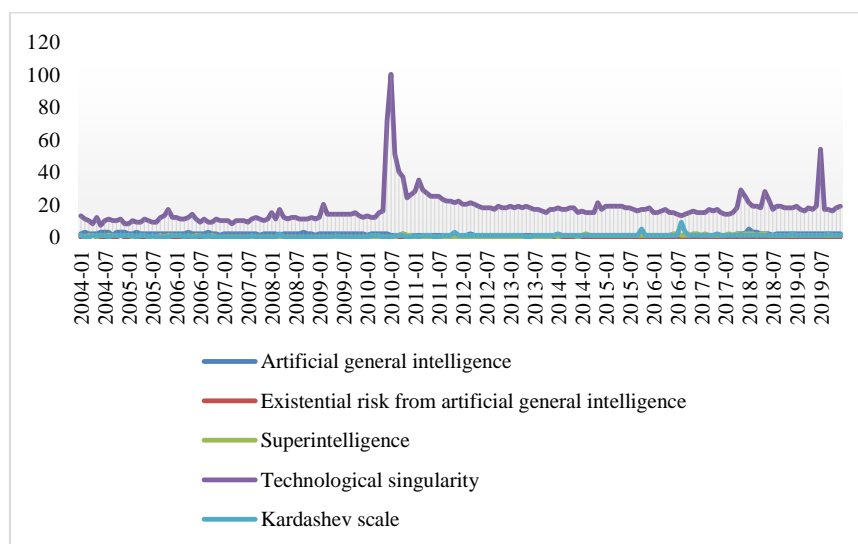


Figure 3. The interest of surface web users [Google Trends: 01.01.2004 - 25.09.2019]

### 3.4. The level-of-evidence

According to the Oxford Centre for Evidence-based Medicine (OCEBM), our study represents an amalgam of observational cross-sectional analysis and internet snapshots (Grade C), as well as longitudinal analyses via the database of literature, trends databases, and the Google search engine



(Grade D) [64]. Accordingly, the level-of-evidence for this study does not apply to the existing scheme imposed by the OCEBM in 2016.

#### 4. DISCUSSION AND CONCLUSION

Artificial intelligence, an exponentially growing interdisciplinary branch of computer science and information technologies, relies on the analyses of big data using a multitude of established mathematical models, including neural networks, regression analysis, and classification trees [65]. Artificial intelligence attempts to maneuver towards the lowest error of predictions by implementing gradient descent algorithms and other principles of machine learning [65-68]. AI is mandatory for applications related to the spatio-temporal description and prediction of phenomena of interest, including epidemiological and digital epidemiological investigations in medicine [21, 66-71]. The infrastructure of big data upon which AI algorithms operate is the same as those designated for classical epidemiology and digital epidemiological research [72]. Researchers can retrieve data using survey tools and internet snapshots, longitudinal and cross-sectional studies, analyses of web-based social networks, and electronic commerce websites analytics of the surface as well as the deep web, including the infamous Darknet hypermarket [72-75].

More than sixty years ago, John McCarthy, a pioneer of the concept of creating intelligent computer programs, initiated research on his project and presented the process of implementing his idea in the following way: "For the present purpose the artificial intelligence problem is taken to be that of making a machine behave in ways that would be called intelligent if a human were so behaving." [76]. According to Toby Walsh (2017), McCarthy and his colleagues in the famous Dartmouth Summer Research Project dreamed of describing the process of learning and other aspects of human intelligence with enough precision to be simulated by a computer, explicitly, translating thinking into computing [34-35]. Six decades later, researchers have made significant progress in this field of science. These include, among others, the construction of the intelligent robot Shakey [77], the Dendral project, which aimed to encode expert knowledge in computer systems, and the creation of the chess-playing computer program Deep Blue by IBM, which defeated Garry Kasparov in 1997 [78-79]. The dynamic development of the science of artificial intelligence gave rise to several concerns that point out the risks associated with its exponential progress [80-82]. The indicated AI levels of development for the increasing capabilities of thinking machines are as follows: weak AI (i.e., artificial intelligence that is inferior to a human); general artificial intelligence (i.e., i.e., artificial intelligence that is equivalent to a human); the strong AI and superintelligence (i.e., machines with self-awareness and superior intelligence to a human) [35, 83]. The reason for these dangers is precisely the fear of intelligent and conscious machines, which, by achieving the potential of superintelligence, will be able to improve themselves without any human intervention [35].

Nevertheless, according to Kaplan [83], only engineering errors or poorly designed projects related to the development of AI can lead to unintended or unknown consequences. Machines may have the ability to set and modify planned objectives, but the scope of this ability will always be limited to the main goals of the design phase [83]. The mistake that Kaplan pointed out would be to design a machine whose program would consist of maintaining its existence at all costs, for example, including the annihilation of humankind. He considers such a scenario possible, but as he points out, it will not be an unforeseen evolution resulting from the self-development of thinking machines, but only a human-made error [83]. According to Wang and Goertzel (2007), the term "artificial general intelligence" does not have a precise definition. However, it emphasizes the generic nature of the desired capabilities of the systems under study, compared to narrow AI, which focuses on systems with highly specialized intelligence and skills [84-85]. The idea is to construct machines that are capable of working on any problem at a human-level or even a supreme level of intelligence. However, AGI does not assume that thinking machines will be self-aware and become a threat to people [35]. AGI is a foreseen project that involves the creation of a machine that has a virtual personality, autonomy, and the ability to maintain and improve itself, above all, to learn and integrate knowledge from all the forms of data they analyze [86]. Currently, programmers use narrow AI in the creation of chatbots and other tools for communicating with people, where they analyze thousands of texts to learn about human emotions and behaviors, which they are then able to replicate, adjusting the answers to specific situations [87].

The current rate of development of artificial intelligence systems is so dynamic that any attempt to summarize progress in this field is out of date after a few months. In their viewpoint article, Katja Grace et al. [88] believe that there is a 50% chance that AI will inevitably outperform humans in all tasks within 45 years, and it will automate all human jobs within 120 years from now. In July 2019, Microsoft announced that, together with OpenAI, it intends to work on the development of AI, investing more than one billion dollars in this project. According to the CEO of OpenAI, Sam Altman, the creation of AGI could be the most pivotal event in human history [89]. Other indicators of a transition towards a general



form of artificial intelligence, include the emergence of “automatic machine learning” (auto-ML), an example of which is the Google’s AI successfully coding its own “AI Child” via a reinforcement learning modality [90-91]. Other attempts are those of Boston Dynamics, acquired by Google X in 2013, to build robots, including a plethora of advanced humanoid robotics [92].

By the end of the last Millenium and in connection with the application of AI in medical and paramedical research, Fabian et al. [93] developed a prediction model for breast cancer using random periareolar fine-needle aspiration cytology and the Gail risk model. In 2002, Moons and colleagues were able to predict stroke in the general European population according to specific parameters, including the fibrinogen level and ECG characteristics [94]. Luquero et al. [95] were able to analyze the trends and seasonality of tuberculosis in Spain for the period 1996-2004 by using data from the national surveillance network. In 2011, Ito and associates pioneered a cardiovascular risk model for asymptomatic individuals with atherosclerosis in connection with cystatin-C and creatinine [96]. Xu et al. [97] created an epidemiological-molecular system for analyzing the relationship between smoking, Epstein-Barr virus activation, and the risk of nasopharyngeal carcinoma. In 2015, the Spanish workgroup lead by Torres managed to generate a syndromic surveillance system based on near real-time cattle mortality monitoring [98]. In the same year in China, Hou and colleagues explored the predictive value of high-sensitivity C-reactive protein in middle-aged individuals with peripheral arteriosclerosis [99]. One year later, Hwang and colleagues investigated the effect of increased visceral adipose tissue as an independent predictor for the atherogenesis [100]. Dong et al. [101] were successful in extrapolating a risk prediction model for Barrett's esophagus and esophageal adenocarcinoma based on genetic, clinical, and demographics, as well as lifestyle factors. In the same year, Steele and et al. [102] concluded that machine learning models deployed for electronic health records could outperform conventional survival models for predicting patient mortality in coronary artery diseases. Later that year, a research team led by Yang developed a risk prediction model of dyslipidemia [103]. In 2019, Tremblay and collaborators succeeded in optimizing a prediction model by utilizing regression trees in connection with the bovine-related industry [104].

To conclude, humanity is marching towards a fated Kardashev type-1 civilization. The exponential growth of technologies in the digital epoch, backed by substantiating evidence of Moore's law and the rise of the quantum computing era, indicates that human-level machine intelligence and a subsequent superintelligence are forthcoming [32-35]. Elon Musk, a technology entrepreneur and co-founder of Neuralink and SpaceX, predicts that AI will take over most of the human-based activities, replacing humans literally [32-35]. Many argue that humanity is marching towards an inevitable technological singularity. However, integrating artificial intelligence with humans, via brain-computer interface technologies, can be protective. Nonetheless, legislation in connection with information technologies is mandatory to regulate the upcoming superintelligence of the digital epoch [105-107].

## ACKNOWLEDGMENTS

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## AVAILABILITY OF DATA

Our data are available upon request from the corresponding author

## CONTRIBUTION OF AUTHORS:

Conceptualization, Ahmed Al-Imam, and Marek Motyka; Formal analysis, Ahmed Al-Imam; Investigation, Ahmed Al-Imam, and Marek Motyka; Methodology, Ahmed Al-Imam; Project administration, Ahmed Al-Imam; Writing – original draft, Ahmed Al-Imam, Marek Motyka and Mariusz Jędrzejko; Writing – review & editing, Mariusz Jędrzejko.

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