# High Tech Advances in Artificial Intelligence (AI) and Intelligence Augmentation (IA) and Cyprus

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## Abstract

*In the last several years, technological progress has accelerated rapidly. Artificial intelligence (AI) has brought self-driving cars to our streets, super-automation to our factories, deep learning algorithms that beat world champions, image recognition programs that diagnose cancer more accurately than experienced oncologists can, voice recognition machines that understand speech on a par with humans and a host of other achievements which would have been hard to imagine even a decade ago. The critical interest, however, is not in what has been accomplished, but rather where technology is going and what will be the implications of forthcoming advances in all aspects of our lives, work and societies, including the possibility, some argue, of mass unemployment and huge income inequalities, as machines and robots powered by AI replace human labor. It is the purpose of this paper to discuss AI and related technological advancements and consider their implications for humanity in general and for a small country like Cyprus in particular. The paper is organized into three parts. It first looks at AI and its achievements and considers four scenarios of how it could affect us. In the second part, the paper presents a complementary to AI technology, that of intelligence augmentation (IA) that provides a different perspective to where technology is leading us and the implications involved. The final, third part considers the consequences of AI and IA for Cyprus and what would need to be done to exploit their advantages whilst minimizing their drawbacks.*

**Keyword:** artificial intelligence (AI), intelligence augmentation (IA), blockchain, societal implications, singularity, unemployment, income inequalities, AI/IA impact on Cyprus

## Artificial Intelligence, Its Achievements and the Four Possible Scenarios

Artificial Intelligence (AI), as its name implies, is a different form of intelligence to our own. As AI advances at an accelerating speed, its proponents declare that there will be a time when it will reach and then surpass human intelligence, reaching what is popularly known as singularity. At such time, machines and robots would be capable of performing all manual and mental tasks being presently performed by humans, presenting for the first time, a formidable competitor to our own dominance of the world. The implications, hard to predict, are summarized by the late Stephen Hawking:[2]

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2 A. Kharpal, 'Stephen Hawking says A.I. could be "worst event in the history of our civilization"',

'AI has the potential to be the best or worst thing humanity has ever seen and the scary reality is we just don't know which yet.' The uncertainty about the implications of AI has given rise to four groups of thought we call the Optimists, the Pessimists, the Pragmatists, and the Doubters,[3] each arguing about what they predict to be the impact of AI on our future.

### *The Optimists*

Ray Kurzweil[4] and other optimists predict a utopian 'science fiction' future, with genetics, nanotechnology, and robotics (GNR) revolutionizing everything and allowing humans to harness the speed, memory capacities, and knowledge-sharing ability of computers. Robots would be doing all the actual work, leaving humans with the choice of spending their time performing activities they simply enjoy and working (when they want to) at jobs that interest them. Furthermore, improvements in medicine will reduce or even eliminate disease and double or triple life expectancy. In other words, a utopian world of plenty with practically unlimited freedom to pursue one's own interest.

### *The Pessimists*

In a much-quoted article from *Wired* magazine in 2000, Bill Joy wrote: 'Our most powerful 21st-century technologies – robotics, genetic engineering, and nanotech – are threatening to make humans an endangered species.'[5] Joy pointed out that as machines become more and more intelligent and as societal problems become increasingly complex, the situation will eventually and inevitably end in a reality where machines are in control of all important decisions. Joy and other scientists and philosophers[6] believe that the optimist camp vastly underestimates the magnitude of the challenge and the potential dangers that can arise from thinking machines and intelligent robots. They point out that in a world of abundance, where all work will be done by machines and robots, humans may be reduced to second-rate status – even the equivalent of 'computer pets', losing their interest in doing meaningful work and becoming lazy and apathetic in the process.

*CNBC* (2017, November 6), available at https://www.cnbc.com/2017/11/06/stephen-hawking-ai-could-be-worst-event-in-civilization.html.

3 See S. Makridakis, 'The forthcoming Artificial Intelligence (AI) revolution: Its impact on society and firms, *Futures*, Vol. 90, (2017): 46–60.

4 R. Kurzweil, *The Singularity Is Near: When Humans Transcend Biology* (New York: Viking Press, 2005).

5 B. Joy, 'Why the Future Doesn't Need Us', *Wired.com* (2000, April 1), available at https://www.wired.com/2000/04/ joy-2/.

6 For example, N. Bostrom, *Superintelligence: Paths, Dangers, Strategies* (Oxford: Oxford University Press. 2014).

### *The Pragmatists*

At present, the majority of views about the future implications of AI are negative, as people are concerned with its potential dystopian consequences. Elon Musk, the CEO of Tesla, says it is like 'summoning the demon' and calls the consequences worse than what nuclear weapons are capable of. There are few optimists in the rank of thoughtful people. However, there is a small contingent of experts that can be thought of as being pragmatic about how AI will change and evolve in the future. Two of these include Sam Altman and Michio Kaku,[7] who believe that AI technologies can be controlled through 'OpenAI' and effective regulation and that people will always be able to stay ahead of machines and robots (see next section about the rise of IA).

### *The Doubters*

The doubters do not believe that General AI will ever be possible or that it will ever become a threat to humanity. Hubert Dreyfus,[8] this scenario's major proponent, argued that human intelligence and expertise cannot be replicated and captured by machines using formal rules. He believed that AI is a fad promoted by the computer industry. Dreyfus pointed to the many AI predictions that did not materialize, such as those made by Herbert A. Simon, another optimist, in 1958 that 'a computer would be the world's chess champion within 10 years' and those made in 1965 that 'machines will be capable within 20 years of doing any work a man can do'.[9] Dreyfus claimed that Simon's optimism was totally unwarranted, as it was founded on the false assumption that our intelligence works like an information-processing machine while in reality our brain works in a completely different way than a computer. There is an increasing number of recent doubters, including Pearl and Mackenzie and Larson.[10]

## Intelligence Augmentation (IA)

AI has proven to be excellent in games, easily beating world champions, as well as in image, speech and text recognition where it is on a par with and often surpasses humans. However, it underperforms compared to humans in practically all other tasks.

7 M. Peckham, 'What 7 of the World's Smartest People Think about Artificial Intelligence', *Time.com* (2016, May 5), available at http://time.com/4278790/smart-people-ai/.

8 H. Dreyfus, *What Computers Still Can't Do: A Critique of Artificial Reason* (Cambridge, MA: MIT Press 1972).

9 D. Crevier, *AI: The Tumultuous History of the Search for Artificial Intelligence* (New York: Basic Books, 1993).

10 J. Pearl and D. Mackenzie, (2018) *The Book of Why: The New Science of Cause and Effect* (New York: Basic Books, 2018); E. Larson, 'Questioning the Hype About Artificial Intelligence', *The Atlantic* (2015, May 14), available at https://www.theatlantic.com/technology/archive/2015/05/the-humanists-paradox/391622/Larson 2015.

It cannot make causal connections, does not understand meaning and cannot acquire common sense. Additionally, it cannot match the competences of a one-year-old and it will probably take decades before it will be able to do so. People on the other hand are creative, capable of strategic thinking and having entrepreneurial ideas, while they are not good with computations, remembering many facts, while getting easily bored from performing repetitive tasks, which is an area where computers excel. There is, therefore, a complementarity between humans and computers/AI. Equally as important, we humans possess a tremendous ability to adapt to environmental changes and AI is another challenge we face. We will therefore need to exploit it successfully to our own benefit. It is naïve then to believe that in the face of a great danger, we humans will do nothing to overcome such a challenge and we will allow this technology to reach our own intelligence and eventually dominate us. There is no reason that our own intelligence cannot also improve to keep up and eventually surpass that of machines, through a process that has been labeled Intelligence Augmentation (IA).

'Instead of just fretting about how robots and AI will eliminate jobs, we should explore new ways for humans and machines to collaborate,' says Daniela Rus,[11] the director of MIT's Computer Science and Artificial Intelligence Lab. The value of IA is easily seen in games like chess where the 'centaur' concept – half human, half computer – is being advanced. In a recent chess game, a group of four Englishmen managed to draw with mighty AlphaZero for the first time.[12] In such play, the complementarity between humans and computer is exploited with humans being in charge of strategy and the computer responsible for the tactics as well as verifying the correctness of possible moves. By harnessing the speed and memory of computers, there is nothing to prevent us from being able to compete with the most advanced chess/Go program, and my prediction is that this will happen in the not too distant future. The centaur idea is supported by Moravec's Paradox, which states that it is comparatively easy to make computers exhibit adult-level performance on intelligence tests or playing checkers, and difficult or impossible to give them the skills of a one-year-old when it comes to perception and mobility. The same is true for tactics, where computers possess a great advantage and strategy, where humans excel. IA can naturally amplify human intelligence by exploiting AI's considerable tactical benefits and people's superior strategic capabilities.

Future developments would focus on finding innovative ways to turn AI into

11 W. Knight, 'More Evidence That Humans and Machines Are Better When They Team Up', *MIT Technology Review* (2017, November 8), 1, available at https://www. technologyreview.com/s/609331/more-evidence-that-humans-and-machines-are-better-when-they-team-up/.

12 L. Watson, 'Englishmen held mighty AlphaZero to draw', *Chessable* (2018, December 10), available at https://www.chessable.com/blog/2018/12/10/alphazero-google-david-howell-draw/.

IA, working toward a symbiosis of humans and machines rather than an adversarial face-off in a lose/lose competition. This symbiosis will reduce the perceived danger that one day AI will end human supremacy, degrading our roles and importance to second-rate citizens. There is little reason to doubt that humans will learn to tap into the power of computers to augment their own intelligence and in doing so, keep up with the increasing capabilities of computers. The chances are that they will achieve much more, exceeding AI and always remaining a step ahead of it. There are endless possibilities to augment human intelligence.[13] Initially voice commands will make the keyboard obsolete while computer projection to any surface will do the same to computer screens. This would mean that computer interactions would be possible without bulky equipment, even using a digital watch to communicate with computers. The next step would be direct brain-to-computer links allowing us unlimited computer power and to search for data. Such power will provide us with the ability to become smarter than any human without a brain-computer interface (BCI). Some say that voice commands are already being used by blind people to use computers, while brain to computer links are being used by paraplegics to allow them to move their hands and walk. So the future may already be here, and what would be required is to be able to implement it in a wide, affordable way. Futurists envisioned three required steps for this to become a reality available to everyone:[14]

- Create a direct neural link to all available information stored in the computer – the equivalent of a 'telepathic' Google – that would tell us whatever we would want to know but would also process this information at lightning speed.
- Build a brain-computer interface (BCI) that would augment our visual cortex, the best-understood part of our brain.
- Genuinely augment our prefrontal cortex, enhancing the way we combine perceptual data into concepts, thus achieving hitherto impossible intellectual feats.

This vision of intelligence augmentation may seem difficult at present but could become a reality in the next 20 to 50 years, drastically amplifying our intelligence, as we will be able to interact directly with computers, exploiting their huge memory capacities and their lighting speed processing power. If such an advancement seems like science fiction, consider to have told someone in the middle of the nineteenth century, a time when someone holding a red flag had to run before cars to warn pedestrians of their arrival, that 170 years later there would be self-driving cars. There would have

13 S. Makridakis, 'Forecasting the Impact of Artificial Intelligence, Part 5: The Emerging and Long-Term Future', *Foresight: the International Journal of Applied Forecasting,* No. 51 (2018).

14 See G. Dvorsky, 'Humans with Amplified Intelligence could be More Powerful than AI', *Futurism* (2013, May 22). Available at https://io9.gizmodo.com/humans-with-amplified-intelligence-could-be-more-powerf-509309984.

been no way for anyone to believe you. Cars driving on their own in the middle of a busy city around other cars, pedestrians, bicycles and other obstacles were beyond the imagination of even the most wildly imaginative person. What is clear is that we always underestimate long-term technological progress by our tendency to extrapolate in a linear fashion. The three most disruptive technologies of our century, computers, the Internet and email, as well as mobile phones, were not predicted even 30 years before their widespread adoption, while now everyone wonders how it had been possible to live without, say, email or smartphones. Thus, BCI on a grand scale may indeed seem like science fiction today, but so were the most disruptive innovations of the past. The interesting thing we cannot predict is the timing and the speed that BCI will become a mainstream application and its specific implications for our lives, work environment, education and our societies in general. Will BCI provide an advantage to developed countries that would be able to exploit its advantages sooner than to poorer ones? Will the rich obtain an advantage over the middle class and the poor? These issues are covered in the next section.

## Cyprus: In the Age of Artificial Intelligence (AI) and Intelligence Augmentation (IA)

There is a global competition among large countries like the USA, China, Russia, UK and France to win the AI race.[15] The stakes are high, both in the economic sphere and in the military domain. 'Whoever becomes the leader in AI will become the ruler of the world', Russian President Vladimir Putin told a group of students last fall.[16] However, becoming an AI leader requires substantial investments and a scientific infrastructure capable of successful research and turning it into successful applications. Clearly, sufficient funding, adequately trained scientists and appropriate infrastructures will become critical components for succeeding in the global AI race. For the time being, China is getting ahead in the game, having established the goal of becoming the world's AI frontrunner by 2030 and probably leaving other countries behind. Its great size and lack of restrictions for using personal, confidential data to advance AI will be a positive factor, as will be its willingness to finance AI research both through state funds and with government-controlled companies. But, other countries are not willing to be left behind, with the USA unwilling to lose its technological advantage and Russia spending huge sums to gain superiority in military AI applications. In addition to AI, there is less talk about IA, but still, the implications of useful applications in this area can be equally important, providing a niche market for smaller countries to develop an expertise and to not be left out of the AI/IA race.

Cyprus' economic model is based almost exclusively on services, much less on

15 Radu, 2018.

16 Ibid.

light manufacturing and practically nil on agriculture. As such, it will not be affected as much as some other countries in losing significant amounts of manufacturing/agricultural jobs to AI automation. The challenge would be to upgrade its service sector to keep ahead of new AI developments and to improve its competitiveness through specialized, niche AI/IA applications. Doing so would not require huge funding as Cyprus would need to concentrate on tourism and a few other sectors, like auditing, education and perhaps medicine, where it can specialize and be able to stay competitive. This would not mean that a good number of service jobs (bookkeepers, professional service firms, bank tellers, hotel clerks and travel agents) will not be commoditized by specialized AI applications in the next two to ten years, but, hopefully, new jobs will be created to replace most of the ones that are lost.[17]

Below, some more specific suggestions are discussed in the two areas that Cyprus could concentrate its AI/IA efforts.

**Research Spending on AI/IA**

The EU, fully aware of the need to stay ahead in AI, has already announced a great number of AI projects to be funded, while more are being planned. It would therefore be possible for Cyprus to stay ahead by applying for funds to develop such projects in collaboration with scientists in other EU countries and, therefore, achieving expertise without having to spend huge amounts of internal funds to do so. Critical for pursuing EU funds would be political support and a concerted effort to disseminate information about the importance of AI and the need for Cyprus not to be left behind. Maybe one or two of the several, excellent, publically available reports[18] about the future of AI and its importance/implications could be adopted and disseminated to interested parties in Cyprus, providing background information and making decision- and policy-makers aware of the situation and its importance for the future wellbeing of Cyprus. A second step could be to start a discussion of what would need to be done and how to start formulating an AI strategy on how Cyprus can achieve excellence, or at least not be left behind in this area. Part of the strategy could be choosing some niche areas to concentrate its efforts where, as was mentioned, there is a lesser need for huge funding in order to be developed. What is clear, however, is that in addition to many jobs being replaced by AI, there will be new, highly paid ones created to fill AI and IA positions to implement the new technologies.

17 K. Coats, 'Let The Robots Take Over: How The Future Of AI Will Create More Jobs', *Forbes* (2018, December 28), available at https://www.forbes.com/sites/forbestechcouncil/2018/12/28/let-the-robots-take-over-how-the-future-of-ai-will-create-more-jobs/#524d72ba3c6d.

18 See for example World Economic Forum, *The Future of Jobs Report* (2018), available at https://www.weforum.org/reports/the-future-of-jobs-report-2018; Coats, 'Let the Robots Take Over'.

**Dedicated Academic Institutions or Specialized Academic Departments**

More important than money would be the need for an adequate number of specialized scientists to be involved conducting AI/IA research, as well as open-minded managers to apply the new AI/IA developments to their firms and non-profit organizations, including government departments. In addition, it would require visionary and motivated entrepreneurs to found new startups capable of offering the needed, dedicated AI/IA services. All tasks would require education and training, as well as an expansion of the role of Cypriot universities. The challenge involved would be threefold. First, the Ministry of Education, or some other government body, must be involved in providing strategic directions and, most importantly, incentives to universities to develop expertise and courses in high-tech areas and, more specifically, in AI and IA. Second, the universities themselves must realize the need for change and adapt their curricula to include new high tech, degree programs in such areas, as well as executive courses covering new technologies and their applications. Today there is a great need for deep learning experts, AI learning and development specialties, data scientists, software engineers and specialized programmers. There is a great need to educate and train students/personnel in these areas as well as related ones like blockchain, the Internet of Things, virtual and augmented reality, and related areas. In addition, universities must also become involved with applied research to further advance AI and IA in Cyprus, specializing as was previously mentioned, in some niche areas. Finally, in addition to the state universities, private ones need to be included in the Cyprus strategy to advance AI/IA and related high techs, as they are often ahead in these fields compared to state universities.

**Conclusions**

Disruptive technologies are affecting firms, economies and our societies in general, and AI/IA are at the heart of this disruption. Some big countries have realized their great potential and are racing to become the leaders of such technologies, while most others understand that they must adapt so as not to be left behind. The aim of this short article was to present the challenge of AI and IA and some ideas of what Cyprus can do to be able to stay ahead of the new developments in these disruptive technologies that would greatly affect it, along with the rest of the world.

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