From Artificial Intelligence to Augmented Age An Overview

dr Duško Lukač
IEEE Germany Section
Siegburg, Deutschland
e-mail: dlukac@aol.com

dr Miljana Milić and dr Jelena Nikolić
University of Niš, Faculty of Electronic Engineering,
Niš, Serbia
e-mail: miljana.milic/jelena.nikolic@elfak.ni.ac.rs

***Abstract*— In this work the overview about the development of artificial intelligence to augmented age is presented. In the last 20 years the terminology "Artificial Intelligence", also known as A.I., has been gaining credibility from the common population because of its growing presence and utility in our day to day activities by solving problems. In this paper we define and summarize the history of the A.I. to provide a better understanding the present and future of the same. We engage the terms Machine Learning and Deep Learning which represent our actual technological/knowledge state of the A.I. And finally, we will give a short insight into the terminology and example Augmented Age in the present A.I. technology.**

Keywords*— *Artificial Intelligence; Machine Learning, Deep Learning; Artificial Neural Networks

I. INTRODUCTION

There are many approaches trying to define A.I.; this term has been dynamically evolving and being used by scientist since 1955. Because we must summarize almost 60 years of scientist "philosophy", we will take definitions that the common population can relate to in the present time. The general definition of A.I. is the automation of an intelligent behavior, which also means to program a machine in such a way that it can solve problems on its own. The level or intelligence of the A.I. is proportional to the complexity of the problem. If the problem is simple, then the A.I. is simple too. Looking from the philosophical meaning, "Human Intelligence can be so precisely described that a machine can be made to simulate it" [1]. This definition gave birth to many different meanings, but always putting human intelligence or the human mind as the example or model to compare to. To sum up, all the definitions of A.I. with the human aspect [2] can be organized into four categories. They are as follows:

- Systems that think like humans;
- Systems that act like humans;
- Systems that think rationally;
- Systems that act rationally.

This is only important for the simulation of human intelligence. That's why this will not be the focus of this paper. Instead, the "solve a problem" direction will be the focus of this paper.

II. HISTORICAL PERSPECTIVE

The idea and folklore of being able to create a "being" that can represent human behavior or intelligence begins with Greek mythology [3]. Prometheus (a Titan) made the humans out of clay and shaped them after the image of the Gods and gave them fire (technology). Knowing this, to build or make something after "our" image and bestow it with technology would never be an irrational idea. The only thing that kept us from accomplishing this, is that we didn't know how. In 1931., Kurt Gödel built the foundations of Theoretical Computer Science and A.I., by publishing the first universal formal language to create general computational theorem provers, and discovered the fundamental limitations of mathematics, computers and A.I. The technology to create intelligent machines became available with the first electronic computer in 1941. (Zuse, Konrad). Although the computer provided the technology necessary for A.I., it was not until the early 1950's that the link between human intelligence and machines was really observed. The term "Artificial Intelligence" was firstly introduced in 1956. by computer scientist, John McCarthy describing "the science and engineering of making intelligent machines", at the Dartmouth conference, and since then Artificial Intelligence has expanded because of the theories and principles developed by its dedicated researchers. In 1961., the first industrial robot-UNIMATE, was born. This robot went to work at GM replacing humans on the assembly line. One of the most controversial Epic-science fiction films is released in 1968., "2001: A Space Odyssey". This movie showed the world how unprepared we could be if keep developing A.I. This movie was pure imagination from Stanley Kubrick, and still today, the idea of A.I. going on is one of the most controversial topics parallel to Global Warming [4]. In the 1990´s, A.I. research and its applications revived. Scientist forgot about A.I. with a human intelligence and started a greater emphasis on solving specific problems, real problems. It started in areas like logistic and medical diagnosis with the help of data mining. Moore's Law took a big role in this boom. This law explained how computational power and capacity (computer technology in general) would double every 2 years/ 18 months. This would allow A.I. development possible. Coming to newer times, in 2011. the recommendation technology gives birth to SIRI, an intelligent virtual assistant with a voice interface, integrated by APPLE into the iPhone

978-1-5386-4927-5/18/$31.00 ©2018 IEEE

4S. Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human in 2014. In 2016. the market for A.I. related products, hardware and software reached more than 8 Billion Dollars.

III. A.I. IN THE GAMING WORLD

It may be difficult to believe, but the gaming world had a big influence on the development of A.I. One may ask how is this possible? Games can be easy or complex, fun and have various rules, have specific goals and they are closed systems. This enables A.I. to be easily studied and tested in many ways. Throughout the history of A.I. professional players of many games have been challenged and beaten in their own environment by A.I. Something very important to notice in many of this moments showed A.I. breakthroughs that were first experienced live in a match [5].

The first working A.I. programs were written in 1951. to run on the Ferranti Mark 1 machine of the University of Manchester: a chess-playing program written by Christopher Strachey and a chess-playing program written by Dietrich Prinz. In 1952. a huge computer was built to play Tic-Tac-Toe. In 1968. Richard Greenblatt (programmer) at MIT built a knowledge-based chess-playing program, MacHack, that was good enough to achieve a class-C rating in tournament play. Coming to newer times, in 1997., Deep Blue, a chess-playing computer from IBM defeats world chess champion, Garry Kasparov. In 2011., Watson, IBM's question answering computer wins first place on popular $1M prize television quiz show Jeopardy. Which is much harder for a computer to play then chess is. In fact, rather from working from predefined recipes, Watson had to use reasoning to overcome his opponents. In 2017., ALPHAGO, Google's A.I. beats world champion Lee Sedol in the complex board game of Go, notable for its vast number (2^{170}) of possible positions. This is the most difficult board game that we-humans have. In fact, in Go there are more possible moves then there are atoms in the universe. So, in order to win, AlphaGo had to develop intuition. AlphaGo programmers didn't understand why AlphaGo was doing what it was doing. In 2017., an OpenAI learned bot played at "The International 2017." Dota 2 tournament in August. It won during a 1v1 demonstration game against professional Dota 2 player Dendi.

IV. TYPES OF A.I.

Artificial Intelligence has always been the same, but the way we program it, has been changing. When we change the way we program it, it changes its behavior when its confronting the problem. In the Fig. 1 we can clearly see how A.I. has been evolving through time [6].

A. Machine Learning

The basics of Machine Learning lie in a procedure of using algorithms to parse data, learn from them, and use the knowledge to make a decision or forecast about a certain variable or appearance from world [6]. Machine Learning does not require coding of software procedures using a special limited set of instructions to realize a particular task. With such a learning, the machine is "trained" to use huge amounts of

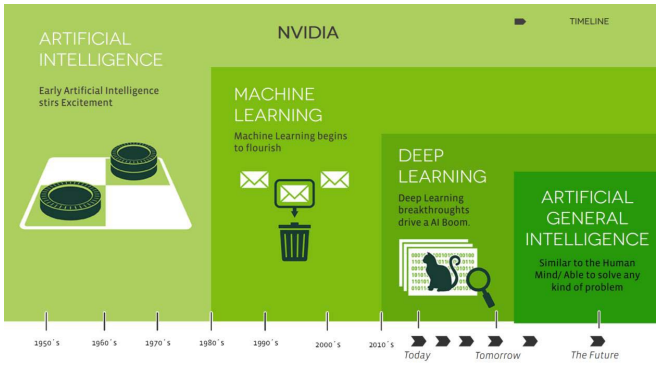

Fig. 1. Types of A.I, following M. Manwar (2017.)

data and algorithms that enables and facilitates them to learn how to complete the task. The early Machine Learning approaches and algorithms developed over the years and latter incorporated: decision tree learning, inductive logic programming, clustering, reinforcement learning, and Bayesian networks among others [7].

B. Deep Learning

Since 1949., thanks to Donald Hebb, we had an idea how the human brain worked. Neurons are connected through links called Synapses. The Neurons send signals or charges from Neurons to Neurons and scientists discovered that the Neurons decide where to send the signals depending on how strong and thick (Synaptic plasticity) the Synapses between Neurons are. The density of the Synapse in the human brain over time is shown in Figure 2.

Neural Networks are inspired by our understanding of the biology of our brains. But, unlike a biological brain where any neuron can connect to any other neuron within a certain physical distance, these artificial neural networks have discrete layers, connections, and directions of data propagation.

A weight function is assigned to every input of the neuron – how important or important it is relative to the performed task, as shown in Figure 3. The final output of the neuron is obtained by summarizing those weights. Let us analyze an example with a STOP sign. Features of a STOP sign image are decomposed and "assessed" by the neurons — its octagonal shape, its fire-engine red color, its unique letters, its size, and its movements or lack thereof. The neural network's job is to make a decision

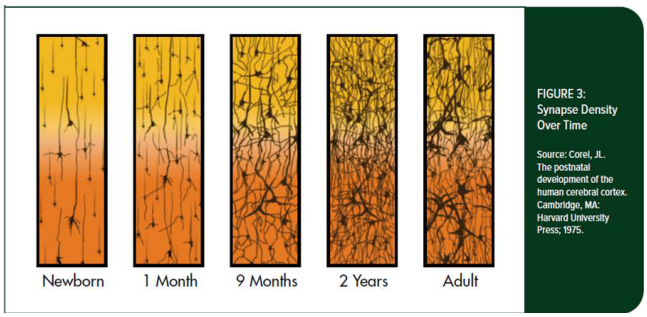

Fig. 2. Synapse Density

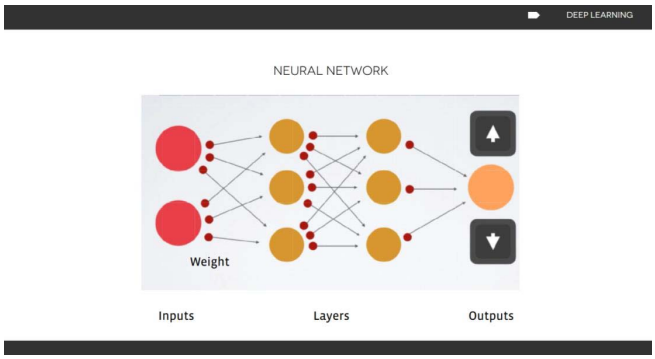

Fig. 3. Forward Artificial Neuronal Network

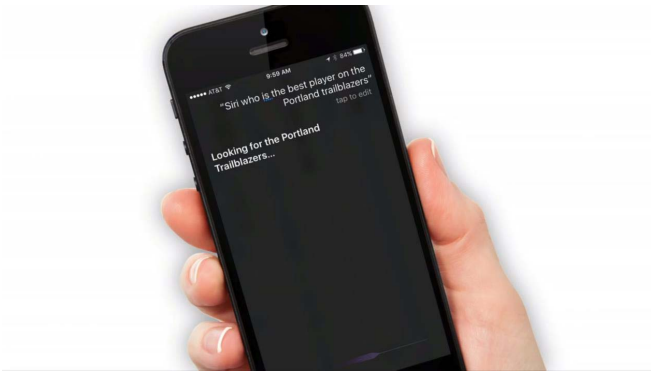

Fig. 4. Siri, answering a question

whether it is or it is not a STOP sign. According to its weighs, it defines a "probability vector," which is a highly educated guess. In this example the system might be 86% confident the image is a STOP sign, 7% confident it's a speed limit sign, and 5% it's a kite stuck in a tree, and so on - and the network architecture then tells the neural network whether it is right or not [8]. This technology was discovered in 2016. and scientist are just recently coming up with new ideas on how to use this breakthrough.

C. *Artificial General Intelligence*

British psychologist Charles Spearman defined the term of general intelligence in 1904., as the ability to learn and apply the common sense. Many psychologists of that time measured the intelligence by analyzing specific skills independently, such as the ability to solve mathematical problems or to navigate social situations. Spearman claimed that if one really needs to assess a human's intelligence, he must analyses his or her abilities to combine. Applying this definition to Deep Blue and other computer programs that are limited to only one skill (e.g. playing chess or guessing passwords using brute force), those programs could not be considered as the intelligent ones. This is the further step in improving A.I., but it still hasn't been discovered.

A hypothetical machine that would show the skillful and flexible behavior similar to humans would do. Artificial general intelligence is also referred to as "Strong A.I." [9], "Full A.I." or as the ability of a machine to perform "general intelligent action". AGI is a machine with the flexibility and ingenuity of a human brain [10].

V. The Augmented Age

Thanks to recent discoveries and developments in A.I. we have entered a new age - The Augmented Age. The hunter-gatherer age lasted several millions of years, the agricultural age lasted several thousands of years, the industrial age lasted a couple of centuries and the information age lasted a few decades [11]. We have entered the augmented age. Whether we are talking of Self-Driving Cars, Generative Design Programs, High-Tec Robotics, or Object Recognition Software at the end we are enhancing our human capabilities with computational systems that help us think, robotics systems that help us make and digital nervous systems that connect us with the world beyond our natural senses. Some of these inventions are already in our lives enhancing our capabilities. The example of this is an intelligent personal assistant called *Siri* [12]. Siri mobile application in shown in Figure 4. It is able to detect voice commands and a natural language user interface to answer questions, make recommendations, and perform actions by delegating requests to a set of Internet services. Another example of the current development in the area of the augmented age are autonomous vehicles. Autonomous vehicles depend on a range of sensors to interrelate with the world around them. There are, in-between many producers of the technology, as for instance, Google car, Lexus, BMW, Mercedes or Tesla. Autonomous vehicles merely substitute the "human sensors" like eyes, which are substituted by camera systems. In addition, by using such technology, vehicles become on the other side susceptible to extreme daylight, meteorological conditions or even faulty traffic lights [13]. One of the most problems form implementation of the autonomous vehicles behind the legal problems is a human behavior. Human error, and unexpected human behavior present problems for autonomous vehicles, as both car users and pedestrians, and dealing with human unpredictability represents an important challenge for the new technology and its final implementation [14].

VI. Conclusion

Just about few decades years ago, A.I. was a "kid" playing chess. In about a human lifetime, A.I. has become a professional player of GO, it has developed recommendation traits such as Siri, it can analyses pictures of human retina to define illnesses, it can gather big data and generate imaginable designs and it can help people with their tax problems.

Slowly but steady A.I. is becoming the new electricity. We will find it and have it everywhere. Most importantly is that it enhances us, so we can solve our smallest and biggest problems. Maybe A.I. is the solution to global warming, because currently we are not doing a good job at it. We don't know very much about A.I., we are just getting to know understand the basics behind such a huge "Monster". A.I. still doesn't know either, and we hope it stays like that for the next decades.

ACKNOWLEDGMENT

This paper is partially funded by The Ministry of Education and Science of Republic of Serbia under contract no. TR32004.

REFERENCES

[1] J. McCarthy, The Dartmouth Proposal, New Hampshire, 1955.

[2] N. Rajakishore, Philosophy of Artificial Intelligence: A Critique of the Mechanistic Theory of Mind, Florida: Universal Publishers, 2009.

[3] -, Creation of Men by Prometheus, Retrieved from www.greekmythology.com, March 2018.

[4] E. Musk, at all, (M. Tegmark, Interviewer), Superintelligence: Science or Fiction?, January 6.-8., 2017.

[5] P. Marsden, Digital Intelligence Today, Retrieved from: https://digitalintelligencetoday.com, August 2017.

[6] M. Manwar, "Learning Machine Learning" DEV IT Journal, 2017., available at <http://blog.devitpl.com/learning-machine-learning/>, accessed 26.03.2018,14:40h.

[7] -, NVIDIA, Retrieved from https://blogs.nvidia.com, July 2016.

[8] https://blogs.nvidia.com/blog:https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificialintelligence-machine-learning-deep-learning-ai/

[9] R. Kurzweil, The Singularity is Near, Viking Press, 2005.

[10] -, Chemical Heritage Foundation, Retrieved from https://www.chemheritage.org, November 2016.

[11] M. Conti, The incredible inventions of intuitive AI, (Performer: TED Talks), California, USA, 2017.

[12] -, "Hey Siri, wake me up at 7 AM tomorrow", Retrieved from https://www.apple.com/ios/siri/, March 2018.

[13] C. Moldrich, and V. Wollaston, "Driverless cars of the future: How far away are we from autonomous cars?", available form <http://www.alphr.com/cars/1001329/driverless-cars-of-the-future-how-far-away-are-we-from-autonomous-cars>, accessed on 15.05.2018, 09:01h.

[14] S. Levin, and J.C. Wong, "Self-driving Uber kills Arizona woman in first fatal crash involving pedestrian", available from <https://www.theguardian.com/technology/2018/mar/19/uber-self-driving-car-kills-woman-arizona-tempe>, accessed on 15.05.2018, 10.20h.