CHAPTER 2

"Havruta:" Synergetic Learning between Humans and Machines (Super-cognition)

We cannot imagine the future of AI in 2040 or beyond. [52] Therefore, today we are discussing the practical concept of "team." The Human-Machine Team refers to the synergetic learning between humans and machines that creates "super-cognition."[53] A machine can use big data to generate information better than humans can. Humans can understand context, and have feelings and ethics. A machine can take the information we have (often called "data") and use it to generate information we don't have, and humans can think "out of the box." Therefore, we are talking about the collaboration between human intelligence and artificial intelligence, and about The Human-Machine Team.[54]

Synergetic learning is the new, systematic, mutual process of a human and a machine as a learning team. For many years, humans and machines have acted as a team to achieve goals that people could not achieve by themselves. An example is a pilot and a plane that act together as a team to fulfill a mission. Synergetic learning is a new potential for The Human-Machine Team in the period of artificial intelligence. It is a concept that puts the focus on the new potential in which the period of AI enables us to learn together,[55] and it allows for the understanding of issues that the human brain cannot understand or cannot address before machines had the ability to perform human cognitive activities.[56]

Learning is idea concept with a broad meaning. It is the process by which we acquire new knowledge or modify existing knowledge, behaviors, skills, values, and preferences. The "Pavlovian Response" is a well-known example of the fact that animals can also learn. However, when we discuss the deep, unique meaning of "human learning," we mean *conscious* learning – learning as a process that leads to change. These changes occur as a result of new understandings of the environment, ourselves, other entities, and the way that all these factors interact and influence each other. In this book, the concept of learning refers to a journey for the development of new knowledge. Learning is a mental and conceptual journey of exploring new territories of understanding and characteristics of reality. Learning, here, is the ability to start a journey in which we do not know exactly where we will find ourselves at the end of the road. Furthermore, this journey also has the potential to change a few of the aspects of who we are after the experience.[57]

The ideas of "machine-learning" and "Deep Learning" both also use the word and the meaning of "learning." These ideas

refer to using a machine to acquire new knowledge and new understandings. They are concepts of new capabilities for understanding issues that were not possible to understand before the creation of these new types of artificial learning. In addition, some of these new understandings were also not achievable by humans alone. Choosing to represent these concepts with the word "learning" is not accidental; "machine-learning" and "Deep Learning" are concepts that describe the ability to attain new knowledge and new understandings as a result of the DE. "Intelligence" and "learning" are ideas from the same family; therefore, Deep Learning is a basis that enables artificial intelligence. AI is a unique ability under the umbrella of machine-learning.[58]

Deep Learning

Deep Learning is using technology to perform activities that trace parts of the capabilities of the human brain. It is when machines can simulate some of the functions of the human mind by using algorithms to connect unrelated details in order to create a congruent picture. The new technology that helped achieve this concept is the artificial neural network. The human brain works through billions of neurons and their networks of connections; Deep Learning builds similar capabilities with an artificial neural network.[59] In fact, Deep Learning is an artificial neural network that brings new potential to trace part of the human brain.[60]

The last 10 years represent the "spring" of Deep Learning.

The concept of an artificial neural network plus infinite data, along with the ability to deal with billions of details with a strong machine made it possible to trace numerous activities of the human brain.[61] A well-known example of Deep Learning is facial recognition. This is the ability of a machine to learn, through a neural network, and recognize a human face. A machine learns the picture and chooses to represent it by using millions of data points through an artificial neural network. A computer can then learn this neural network and compare it to other neural networks; the end result is facial recognition. The ability to take a picture and replace it with digital data by using a neural network enables the machine to identify the person.[62]

Synergetic Learning

Synergetic learning is a new process of mutual learning combining human intelligence and artificial intelligence.[63] Synergetic learning represents new potentials for dealing with complex, complicated issues that were unsolved until machines began to be able to "think."[64] Imagine that soon after a machine beat Kasparov in chess, he was asked to build a human-machine team composed of himself and the computer that beat him. He could surmise that such a human-machine team would never again lose to a computer, to a human, or to another human-machine team. And do you know what? If he had suggested this idea, he would have been totally right![65] Synergetic learning is a new potential that is based on the possibility of a machine and a human "bouncing" data, ideas, and insights off each other,

and "passing" the concepts to each other to create common insights.[66]

In order to understand the power of The Human-Machine Team, we can use the metaphor of "*havruta*." Just before delving into the idea behind havruta, let's stop and a take a look at two other examples. The first is the development of flight. Watching birds fly was a metaphor for humans to discover the idea that flight was possible. Humans saw birds flying and dreamed of the ability to fly. Technology enabled humans to invent a plane that could fly. In addition, from several aspects, planes fly better than birds. However, without the initial metaphor of birds flying in the sky, the idea of human flight would never have come up – and the plane would never have been invented. (This is also one of the reasons that a plane is structured like a bird.)[67]

The second example is the brain as a metaphor for "thinking." Having a brain, and understanding how the brain works, helped humans ask, "Can machines think?" The understanding of the brain's neural network was a metaphor for coming up with the idea of artificial neural networks. These networks do not work like the human brain, but they help perform the capabilities of human cognition.[68]

> There is a fable from the Talmud about an event that took place almost 2,000 years ago between two men, Rabbi Yohanan and Reish Lakish, which describes the idea of "havruta." Rabbi Yohanan was the head of a yeshiva (a Jewish Talmudic college) and Reish Lakish was the head of the mafia. One day, Rabbi

Yohanan saw Reish Lakish transporting big logs from one side of the river to the other. Rabbi Yohanan was amazed and told him, "Your strength should be used for learning Torah (the Jewish bible)." Reish Lakish answered, "You are too handsome, and your good looks should be for a woman." They decided to make a deal. Reish Lakish would come to study in the yeshiva, and Rabbi Yohanan's sister, who was even better-looking than he was, would become Reish Lakish's wife. The two men became a havruta, thinking together and studying together all the time. After a few years, Reish Lakish died and the smartest student in the yeshiva became the new havruta for Rabbi Yohanan. The two began thinking and learning together, but after a while Rabbi Yohanan declared to his new havruta, "I want to die!" In shock, the smart student turned to Rabbi Yohanan and asked, "Why? What happened?" Rabbi Yohanan explained, "For every new idea that I had and then discussed with Reish Lakish, he gave me 24 reasons that I was wrong, and then we had to think together to improve our thoughts and create new knowledge together. In your case, I give you an idea and you give me 24 reasons that I am correct, so there is no new knowledge." This fable is also the reason behind another powerful sentence from the Talmud: "Havruta or death!"

"Havruta" is a metaphor to explain this new mutual learning team comprised of a human and a machine. It is an Aramaic word meaning "friendship" or "companionship," and it is a process of synergetic learning between humans who learn together as a team. Havruta is synergetic learning and a major way that Jewish knowledge developed over thousands of years of studying Jewish texts in groups. It is a mutual learning process that enables humans to create new knowledge and discover new understandings. There is a famous Jewish saying that a knife can only be made sharper by another knife, and this is the concept of learning together in havruta. It is all about the knowledge that is created in the interaction between the various points of view. Havruta can also be a good metaphor to explain the idea of synergetic learning between a human and a machine. "I think; therefore I am" is a well-known statement by the philosopher Descartes.[69] The ability to think is one of the "magic secrets" of humankind, an ability that is a base for creating our reality. Human cognition enables the discovery of new innovations.[70] Today, humanity has the potential to achieve "super-cognition" with the havruta between humans and machines.

The bottom line is that the Spring of AI brings with it a new potential for merging human intelligence and artificial intelligence. Synergetic learning enables us to address national challenges in novel, atypical ways that years ago we could not have even imagined. It also enables us to discover new national security challenges, new risks, and new opportunities. With these "lenses of synergetic learning" we can dream of these

new discoveries,[71] which is why the future of national security belongs to security establishments that fulfill the conditions to bring to fruition the opportunity for synergetic learning. The unique challenge of our time is the situation of being in between paradigms. This unique reality requires us to build our nations and organizations to lead the revolution when a human and a machine can think and learn together in havruta.[72]