## The Artificial Intelligence Revolution

Max Tegmark, President of the Future of Life Institute recently said:

"Everything we love about civilization is a product of intelligence, so amplifying our human intelligence with artificial intelligence (AI) has the potential of helping civilization flourish like never before – as long as we manage to keep the technology beneficial."

Tegmark's warning, "as long as we manage to keep the technology beneficial," evokes the often deeply felt fear that perhaps the machines can or will replace us.

An example of this appeared in the science fiction movie *The Terminator*, where an autonomous AI called SkyNet tried to eliminate humans.

Recently, this potential has re-emerged in a very public debate between two popular businessmen of our time, Elon Musk, CEO of Tesla, and Mark Zuckerberg, CEO of Facebook. Musk is highlighting the dangers of AI and Zuckerberg its benefits.

This month we will address what AI is and how recent improvements in our understanding have triggered a fresh look at its potential. Successes in creating more powerful and semi-intelligent machines are accelerating the rate of technological progress and are forcing change in both business structures and in our personal lives. In order to explain what we see going on in AI, we need to begin with some definitions.

### AI, ML and Deep Learning

Artificial Intelligence is a phrase coined by the pioneering computer scientist John McCarthy in the 1950s. It is an umbrella term for all the methods and disciplines that result in any form of intelligence exhibited by machines. This includes anything from the 1980s expert systems (basically datasets of hard-coded knowledge), up to


Source: http://www.crmbuyer.com

most advanced forms of AI in the 2010s. Today nearly all software in every industry uses at least some form of AI, even if it is limited to basic manually-coded procedures.

Machine Learning (ML) is currently the leading sub-field within AI. It allows computers to learn without being explicitly programmed. Machine learning-based methods completely dominated AI in the 2000s, and have outperformed all non-machine, learning-based results. Despite its success, one of the major limitations of traditional machine learning is its reliance on feature extraction, a process through which human experts dictate what the important features or properties of each problem are.

For example, when applying machine learning to face recognition, the raw pixels in the image cannot be fed into the machine learning module, but instead they must first be converted into features such as distance between pupils, proportions of the face, texture, color, etc.

This feature extraction phase basically results in most of the raw data being ignored, and the selected features, as good as they may be, miss the rich nonlinearities in the data.

Deep Learning, aka "deep neural networks", is a sub-field of machine learning, and takes inspiration from how our brains work. The big conceptual difference between deep learning and traditional machine learning is that deep learning is the first, and currently the only, learning method that is capable of training directly on the raw data (e.g., the pixels in our face recognition example), without any need for feature extraction. Additionally, deep learning scales well to hundreds of millions of training samples, and continuously improves as the training dataset becomes larger and larger.

Examples of the kind of results achieved via the deep learning methods are:

1) Google's AlphaGo AI robot developed by the Deep-Mind program was able to beat the best Go player in the world. The result is similar to IBM's "Deep Blue" success in beating world chess grandmaster Garry Kasparov in 1997 except, most experts would agree that the Chinese Go game is magnitudes of difficulty greater than chess. Also notable was the method the program used to play involved learning "on the fly."

2) Google also directed the DeepMind program to solve how to lower energy costs at their data centers. DeepMind discovered how to save Google 15% of their overall energy costs, which included a 40% reduction in electricity use. DeepMind co-founder Demis Hassabis said that the specially designed neural networks control roughly 120 variables in the data centers, including fans, cooling systems and windows. The AI worked out the most efficient methods of cooling by analyzing data from sensors among the server racks, including information temperatures and pump speeds.

Combined with the use of neural networks and deep learning programming structures, computer scientists have been increasingly successful in teaching computers to recognize natural language, and we are now seeing the fruits of this effort in telephone call centers, and "chat-bot" products like Siri™ or Cortana™. With this new capability, the industry will enable the creation of intelligent personal assistants for virtually any business or endeavor. We expect to see interactively intelligent assistants soon for a broad array of solutions in medicine, engineering, finance, etc.

A large company with their business strategy oriented most strongly toward creating these products is IBM. Their engineers are currently collaborating with domain experts across many business sectors in order to embed expert knowledge (such as an oncologist) into a machine they still call "Watson." Remember Watson's success on Jeopardy? IBM calls their endeavor "cognitive computing" and is advertising its capabilities with statements like:

*"With Watson, you can build chatbots and virtual agents that answer your customers' questions, responding to their needs quickly and efficiently."*

During the past few years, deep learning has revolutionized nearly every field it has been applied to, resulting in the greatest leap in performance in the history of computer science. As with many problems, we used to see small, gradual improvements every year. But now, we are witnessing 20% – 30% improvements within months, due to the application of deep learning.

**The Fourth Industrial Revolution**

Because the pace of technological innovation is accelerating, we maintain that we are on the brink of an economic and business revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, this transformation ahead will be unlike anything humankind has experienced before. It can be appropriately called, the Fourth Industrial Revolution.

The First Industrial Revolution used water and steam power to mechanize production. The Second used electric power to create mass production. The Third (the digital revolution) used electronics and information technology to automate production. Now, a Fourth Industrial Revolution is building upon the digital revolution that has been occurring since the middle of the last century. This fourth segment can be characterized by a fusion of technologies as the communication and information process is blurring the lines between the physical, digital, and biological spheres. The resulting structures will produce significant disruption of almost all existing businesses and ways of life. Let's look at a few ways in which artificial intelligence tools are creating new products and offering new ways of doing things.

**Examples of How AI Is Being Applied**

We see innovative applications in:

1) **Precision Farming.** By using drones, farmers are now able to fly over their croplands, assess the dryness of the soil in different regions, and then apply that information to automatic seeding machines. Different seeds are then planted depending on soil conditions. Additionally, varying amounts of fertilizer can be applied concurrently, depending on the information supplied by the flyovers. This combination can result in greater crop yields.

2) **Improved Cybersecurity.** Intelligent agents can continuously monitor Internet or data traffic, reacting much faster than a human can to suspicious traffic or intrusions.

3) **Improving Health Care Outcomes.** As diagnostic information is processed into intelligent domain systems which can include specific patient information as well as general population information, a more

targeted diagnosis becomes possible. In addition, rural doctors gain access to diagnostic treatments that are working elsewhere and with their patient specific information can improve outcomes.

4) **Lower Business Costs and Improve the Customer Experience.** AI tools allow businesses to analyze their data faster than ever before, to identify the most profitable customers, to improve the interaction and experience of customers with the company, and rationalize repetitive functions in order to free up time for human employees to add value to the customer experience.

5) **Enabling better Forecasting.** Forecasting more accurately in weather, business sales, logistical timing, or consumer preferences adds significantly to improved outcomes.

## Will Technology and AI Replace Humans?

This is a controversial subject. As we examine the issue, we note that new technology has always removed the need for some types of jobs, as it historically has also created new ones. Technology is a set of tools that we use in different ways to increase efficiency. The Industrial Revolution destroyed some jobs but created many more. It also increased the aggregate wealth of society and began to create a middle class who could enjoy health, education and other benefits that previously had been available only to the wealthiest. It can be challenging to predict the kinds of jobs that this new revolution will create and in what quantities. Data from the World Economic Forum highlights that nine of the top ten most in-demand jobs of 2012 did not exist in 2003, suggesting that the current revolution in jobs is also creating new employment opportunities.

But, for many, this picture of an ever expanding job pool is overly optimistic. The new jobs almost always require a completely different skill set. You can't turn an assembly plant worker into a data scientist. The Industrial Revolution played out over two centuries and yet still caused massive social upheaval, unrest and widespread problems for many. The accelerating digital revolution is happening faster, across larger areas of a complex, interconnected set of economies that have very tightly built feedback loops (for example, the global logistics and supply chains).

This characteristic sometimes means that disruption can influence many countries at once. A good example is China. The last twenty years of China's hyper-growth were heavily based on the export of products that were assembled by a vast manual labor force. As manufacturing in China moves increasingly toward robotics and automation, large numbers of workers are being quickly displaced. This effect on the global supply and logistics chain is having ripple effects around the world. Just as in China,

and according to a 2014 Oxford study, 47% of jobs in the US could also be replaced by automated processes in the next two decades.

Future job losses are not confined to "blue collar" workers. In fact, many "white collar" jobs are also routine and thereby automatable.

If we are indeed facing the potential for significant job losses in the short run, a question being asked is: how should we handle the potentially growing displacement of existing workers? Should it be slowed down? Does the corporation, government, or the individual have the responsibility to retrain workers? Or should market forces be allowed to reign?

### Rometty's Prescription

One answer to this problem is being offered by Ginni Rometty, CEO of IBM. She suggests that we invent a new category of worker for the future. She calls these workers, "new collar" workers. She is directing IBM to create and provide "intelligent assistants" that can relieve a worker of the routine portion of their job and then add enhanced capabilities to their toolkit, such as extra service capability.

We can see the effects of such tools applied in the Human Resources industry where intelligent chat-bot software can be used to improve the on-boarding of new hires. For example, Talla$^{TM,}$ a chat-bot, can provide a set of interview questions based upon the role, and can even conduct a Net Promoter Score survey following the recruiting process. Rob May, CEO of Talla$^{TM}$, sees, "an intelligent assistant as being able to augment a mid-level HR professionals' job so he/she can focus on more strategic HR issues." The vision behind launching Talla$^{TM}$ is to ultimately become a real time advisor to HR professionals in how they source and on-board new hires.

The same 'intelligent assistant' process can be applied in the health care industry where doctors, nurses, and nurse practitioners will become enabled by an AI assistant that can draw on vast informational resources and help the medical professional interact on a higher level with the patient, and perhaps perform triage decisions that are cost effective, timely, and preventative.

### The Need for Educational Change

In addition to augmenting the capabilities of the existing workforce, IBM and others are suggesting that we revamp our educational system starting in the high schools. This will involve corporations increasing their mentoring programs and getting involved with local school systems to insure that skills that businesses need are being taught in the high schools. Some are also suggesting that we extend the vocational training process into the community college level.

As the job market has evolved, the educational system has not. Today's jobs are vastly different than they were a generation ago, yet the curriculum at most high schools isn't. The entire workforce is facing a world that is more changeable and unpredictable than ever.

The days of working for 40 years at one job and retiring with a good pension are gone. Now the average time in a single job is 4.2 years, according to the US. Bureau of Labor Statistics. 35% of the skills that workers need, regardless of industry, will have changed by 2020. That rapid pace of change in jobs and skills means there's a growing demand to update skills as well. According to a new report on workforce re-skilling by the World Economic Forum, one in four adults reported a mismatch between the skills they have and the skills they need for their current job.

Continuous learning lies at the heart of thriving in the Fourth Industrial Revolution. The skills required for most jobs are evolving rapidly but our adult education and training systems are lagging behind. Thus, enabling and empowering workers to transform and update their skills is a key concern for businesses and societies across the globe.

### How Do We Retool the Workforce?
In order to create a robust and inclusive adult education and training system, leaders from across business, government and civil society will need to start laying a common foundation through strategic and coordinated action. In a white paper produced by the World Economic Forum this year, they layout the pathways for change. The paper illustrates successful examples of implementation in order to inspire broad-based transformation. The paper is the outcome of the World Economic Forum's System Initiative on "Shaping the Future of Education, Gender and Work[1]."

### Is It Really Different This Time?
Many are concerned that this time it really is different, that we are facing a permanent reduction in the need for human labor. While many economists, including former Treasury Secretary Larry Summers, initially viewed this assessment as economically naïve, now Summers and many other experts are not so sure. Coincidentally, and perhaps fortunately, aging demographics are already slowing the growth rate of labor supply.

Neither our social norms nor our economic systems are ready for the upcoming speed of change. Today, self-worth is inherently tied up with jobs, professions, careers and trades. And in a global economy still based on neo-classical models of capitalism, mass unemployment spells depression of sorts, not utopia.

A recent *Atlantic* magazine article explored possible futures that may play out in a world without work[2]. It painted a mixed picture. On the one hand, we might have the time and freedom to explore our creativity and passions. On the other, we might be heading for a "gig economy" where smaller parcels of work replace the security of full-time jobs.

The extent to which we replace or transform jobs, or the extent to which this is just a transitional shift or a permanent change, is not well understood. Nor is the outcome inevitable.

We have a choices for how we want to use technology, which path we take, and to a certain extent, which scenario emerges. Perhaps the question is not a theoretical one, nor an empirical one, but one of intent and principle: what kind of society do we want to have?

The answer to the debate between Elon Musk and Mark Zuckerberg does not have a simple answer. The answer is: "It depends." The outcome will depend on how we approach the emerging new environment and its conditions. Since intelligence, as Max Tegmark stated, really is the source of almost all of what we value in our civilization and culture, it would be a shame to "put out the fire" just because we might get burned. This approach seems overly fearful. But insightful planning and cooperative effort in anticipation of this emerging future could result in a positive outcome.

Note1: http://www3.weforum.org/docs/ WEF_Shaping_the_Future_of_Education_Gender_and_Work_2P_031116.pdf

Note2: https://www.theatlantic.com/magazine/archive/2015/07/world-without-work/395294/

### MARKET STATS

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| S&P 500 | 2470 |
| DOW JONES | 21891 |
| 10 YR T-BOND | 2.31% |

As of 07/31/2017

Source: Bloomberg