Available online at www.aucjc.ro

Annals of the University of Craiova for

Journalism, Communication and Management

Volume 5, 172-194, 2019 *ISSN 2501-3513*

THE VALUE OF DATA FROM AN ARTIFICIAL INTELLIGENCE PERSPECTIVE

Andrei-Dragoş POPESCU
SCX Holdings Pte. Ltd., Singapore

Abstract

Go is arguably the most complex board game in existence. Its goal is simple, to surround more territory on the board than your opponent. This game has been played by humans for the past 2,500 years and is thought to be the oldest board game still being played today.

In 2016, Google DeepMind's AlphaGo beat 18-time world champion Lee Sedol in four out of five games. Now, normally a computer beating a human at a game like chess or checkers, wouldn't be that impressive, but Go is different. Go cannot be solved by brute force, Go cannot be predicted, there are over 10^{170} moves possible in Go. To put that into perspective, there are only 10^{80} atoms in the observable universe. AlphaGo was trained using data from real human Go games. It ran through millions of games and learned the techniques used and even made up new ones that no one had ever seen and this is very impressive alone.

However, what many people don't know is that only a year after AlphaGo's victory over Lee Sedol, a brand-new AI called AlphaGo Zero, beat the original AlphaGo, not in four out of five games, but beat it 100 to 0, all games in a row.

The most impressive part is that it learned how to play with zero human interaction. There was no data that needed to be input and this technique is more powerful than any previous version. It isn't restricted to human knowledge as no data was given. No historical figures were given and with just the bare-bones rules AlphaGo Zero surpassed the previous AlphaGo in only 40 days of learning.

In only 40 days, it surpassed over 2,500 years of strategy and knowledge and it only played against itself. Now, is regarded as the best Go player in the world, even though it isn't human (Silver D., Hassabis D., 2017).

This article will analyses several studies and researches on Artificial Intelligence (AI) and its other subsets, from a perspective of Data Input, focusing on a synthesis of several framework attributes, necessary to sustain trust.

Keywords: Artificial Intelligence (AI), Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI), Artificial Super Intelligence (ASI), Machine Learning (ML), Deep Learning (DL), Data Science, Data Capital.

Introduction

We’re overwhelmed with information, articles and opinions on AI. Experts and non-experts alike, are attempting to envision a future driven by the rise of this exponential technology. Because of the constant flow of information on AI, it’s becoming increasingly difficult to pinpoint what exactly AI is. Few

of us are able to actually define Artificial Intelligence. Many of us make the mistake of using it synonymously with other buzzwords, like “robots”.

As we know, the world is changing at an alarming pace, so thinking critically about these changes is crucial, if we want to thrive in the future. To adapt in a world driven by change, understand the implications of AI on society, and clarify where we stand today, we need to first distinguish between the various types of AI.

The definition of AI as per the Cambridge Dictionary is the use of computer programs that have some of the qualities of the human mind, such as the ability to understand language, recognize pictures, and learn from experience (Cambridge Dictionary,2019).

AI is not a single technology, but a diverse set of methods and tools continuously evolving in tandem with advances in Data Science, Chip Design, Cloud Services and End-User Adoption. The most common examples of AI methods and tools include Natural Language Processing (NLP), Machine Learning (ML), Deep Learning (DL), Computer Vision, Conversational Intelligence and Neural Networks (Ernst & Young, 2018).

You can think of Deep Learning (DL), Machine Learning (ML) and Artificial Intelligence (AI) as a set of Russian dolls nested within each other, beginning with the smallest and working out. DL is a subset of ML, and ML is a subset of AI, which is an umbrella term for any computer program that does something smart. In other words, all ML is AI, but not all AI is ML, and so forth (Nicholson C., 2019).

Artificial Narrow Intelligence (ANI)

The “broad” definition of AI is vague and can cause a misrepresentation of the type of AI that we interact with today.

Artificial Narrow Intelligence (ANI) also known as “Weak” AI is the AI that exists in our world today. Narrow AI is programmed to perform a single task - whether it’s checking the weather, being able to play chess, or analyzing raw data to write journalistic reports.

ANI systems can attend to a task in real-time, but they pull information from a specific data-set. As a result, these systems don’t perform outside of the single task that they are designed to perform.

Every sort of machine intelligence that surrounds us today is Narrow AI. Google Assistant, Google Translate, Microsoft’s Cortana, Siri and other natural language processing tools are examples of Narrow AI. Some might assume that these tools aren’t “weak” because of their ability to interact with us and process human language, but the reason that we call it “Weak” AI is because these machines are nowhere close to having human-like intelligence.

ANI systems are able to process data and complete tasks at a significantly quicker pace than any human being, which has enabled us to improve our overall productivity, efficiency, and quality of life. ANI systems like IBM’s Watson, for example, is able to harness the power of AI to assist doctors to make data-driven decisions, making healthcare better, quicker, and safer (Jajal T.D., 2018).

Artificial General Intelligence (AGI)

Artificial General intelligence or “Strong” AI refers to machines that exhibit human intelligence. In other words, AGI can successfully perform any intellectual task that a human being can.

AGI is expected to be able to reason, solve problems, make judgements under uncertainty, plan, learn, integrate prior knowledge in decision-making, and be innovative, imaginative and creative.

But for machines to achieve true human-like intelligence, they will need to be capable of experiencing consciousness.

Artificial Super Intelligence (ASI)

Oxford philosopher Nick Bostrom defines Superintelligence as any intellect that greatly exceeds the cognitive performance of humans in virtually all domains of interest (Bostrom N., Superintelligence, 2015).

Artificial Super Intelligence (ASI) will surpass human intelligence in all aspects - from creativity, to general wisdom and problem-solving. Machines will be capable of exhibiting intelligence that we haven't seen in the brightest amongst us. This is the type of AI that many people are worried about, and the type of AI that people like Elon Musk think will lead to the extinction of the human race.

Data as an Asset

Over the past decade, almost all aspects of how we work and how we live – from retail to manufacturing to healthcare – have become increasingly digitized. The internet and mobile technologies drove the first wave of digital, known as the Internet of People. However, analysis carried out by PwC's AI specialists anticipates that the data generated from the Internet of Things (IoT) will outstrip the data generated by the Internet of People many times over. This increased data is already resulting in standardization, which naturally leads to automation, and the personalization of products and services, which is setting off the next wave of digital. AI will exploit the digital data from people and things to automate and assist in what we do today, as well as find new ways of doing things that we've not imagined before (Dr. Rao A.S., Verweij G., 2017).

7 of the 10 most valuable public companies in the world are using Deep Learning and AI at the heart of their operations. Most of them are in the process of reimagining every aspect of their operations, their business, their products,

their services to deepen customer relationships, to grow new capabilities, or design better products (Dell M., 2018).

And nothing can help make a product or a service better, than data. That allows a company to attract more customers, more users, and better outcomes; Of course, that results in more data, and the cycle just repeats. Now companies are starting to use AI, ML, IoT, Neural Networks, Quantum Computing to crunch all that data more effectively.

That's going to mean just another step function change, in how all this works. Exponentially more data, at exponentially faster speeds, so the cycle just keeps getting faster, and the faster we do it, the more progress we all make.

So bottom line, if AI is our rocket ship, data is the fuel for this rocket. The more data we have, the more accurate AI, better learning, inference and better outcomes.

When we get this right, it turns into what we call, Data Capital, and it becomes one of the most valuable assets. In fact, all Multi-National Corporations (MNCs) have numerous buildings, hire a bunch of people and sit on a lot of capital, but now they own and have access to Data. That's like an incredibly valuable asset inside each company, even more valuable than some of their applications.

Biased Data

But not all data is good data. Data can be messy, it can be duplicated, it can be incomplete, it requires data engineering, so we need to simplify the acquisition of data, the management, the access and the protection of data.

As more corporations and governments embrace the use of AI, there's the potential for us to reach new efficiency frontiers, for us to see new markets and to create new products, but there is also the ability for us to exacerbate inequality and further bias.

Let's take a look at an example of a theoretical hiring algorithm, used by a company to identify the most promising managers employees.

If the existing management team is homogeneous and we train it to identify more people like the existing management team, the hiring and promotion expectations for this particular case is that you're only going to get more of the same caliber. Now it's tempting here to say that we've built this biased algorithm and that's why your hiring practices continue to be biased, but that's not the case, the case is you trained an algorithm unbiased data and therefore you get biased results.

The design of any AI systems starts with the choice of training data, which is the first place where unfairness can arise. Training data should sufficiently represent the world in which we live, or at least the part of the world where the AI system will operate. Consider an AI system that enables facial recognition or emotion detection. If it is trained solely on images of adult faces, it may not accurately identify the features or expressions of children due to differences in facial structure.

But ensuring the "representativeness" of data is not enough. Racism and sexism can also creep into societal data. Training an AI system on such data may inadvertently lead to results that perpetuate these harmful biases. One example might be an AI system designed to help employers screen job applicants. When trained on data from public employment records, this system might "learn" that most software developers are male. As a result, it may favor men over women when selecting candidates for software developer positions, even though the company deploying the system is seeking to promote diversity through its hiring practices (Microsoft, 2018).

Data Driven Architecture

AI & Data is emerging as one of the most potentially disruptive themes in the digital world. As the world's data grows exponentially, AI capabilities are tracking close behind, the far-reaching implications of which are becoming clearer every day.

Big Data is AI's fuel, it is both what trains AI to become increasingly powerful and what AI systems are ultimately applied to in order to generate real-world insights. The more data AI systems can tap, the greater their intelligence and disruptive potential (Jacobs J., 2018).

While AI as a concept has been around for more than 50 years, a shortage of structured data for much of that span and computational limits stunted AI's growth. For example, good speech-recognition technology requires about 150,000 hours (i.e., 10 years) of audio data; Facial recognition applications require roughly 15 million images (Watermark, 2018).

Only until recently, these amounts of image and audio data, was readily available. In fact, 90% of the world's data has been generated since 2015 (Watermark, 2018). That year, the digital universe, the reservoir of data created and copied, totaled less than 10 zettabytes - that would be 10, followed by 21 zeros. By 2020, it is expected to grow more than four times to 44 zettabytes. Just five years after that, it could reach 180 zettabytes (Forbes, 2017).

Much of this growth can be attributed to the increased adoption of the Internet of Things and advancements in Deep Learning. With more connected devices recording videos, measuring heart rates, or tracking deliveries, the world's information is becoming increasingly digitized. Combining this data creation with advancements in Deep Learning for image and speech recognition, more and more information is not just saved and stored now, it is structured and analyzed by AI systems.

Data Science for AI Impact

AI is set to be the key source of transformation, disruption and competitive advantage in most business sectors:

Healthcare

Areas with the biggest AI potential:

- Supporting diagnosis in areas such as detecting small variations from the baseline in patients' health data or comparison with similar patients.
- Early identification of potential pandemics and tracking incidence of the disease to help prevent and contain its spread.
- Imaging diagnostics (radiology, pathology).

Barriers to overcome

It would be necessary to address concerns over the privacy and protection of sensitive health data. The complexity of human biology and the need for further technological development also mean than some of the more advanced applications may take time to reach their potential and gain acceptance from patients, healthcare providers and regulators.

High potential use case: Data-based diagnostic support

AI-powered diagnostics use the patient's unique history as a baseline against which small deviations flag a possible health condition in need of further investigation and treatment. AI is initially likely to be adopted as an aid, rather than replacement, for human physicians. It will augment physicians' diagnoses, but in the process also provide valuable insights for the AI to learn continuously and improve. This continuous interaction between human physicians and the AI-powered diagnostics will enhance the accuracy of the systems and, over time, provide enough confidence for humans to delegate the task entirely to the AI system to operate autonomously (Dr. Rao A.S., Verweij G., 2017).

Financial Services

Areas with the biggest AI potential:

- Personalized financial planning.
- Fraud detection and anti-money laundering.
- Process automation – not just back office functions, but customer facing operations as well.

Barriers to overcome

Consumer trust and regulatory acceptance.

High potential use case: Personalized financial planning

While human financial advice is costly and time-consuming, AI developments such as robo-advice have made it possible to develop customized investment solutions for mass market consumers in ways that would, until recently, only have been available to high net worth clients. Finances are managed dynamically to match goals (e.g. saving for a mortgage) and optimize client's available funds, as asset managers become augmented and, in some cases, replaced by AI. The technology and data is in place, though customer acceptance would still need to increase to realize the full potential (Dr. Rao A.S., Verweij G., 2017).

Retail

Areas with the biggest AI potential:

- Personalized design and production.
- Anticipating customer demand – for example, retailers are beginning to use Deep Learning to predict customers' orders in advance.
- Inventory and delivery management.

Barriers to overcome

Adapting design and production to this more agile and tailored approach. Businesses also need to strengthen trust over data usage and protection.

High potential use case: Personalized design and production

Instead of being produced uniformly, apparels and consumables can be tailored on demand. If we look at fashion and clothing as an example, we could eventually move to fully interactive and customized design and supply in which AI created mock-ups of garments are sold online, made in small batches using automated production, and subsequent changes are made to design based on user feedback (Dr. Rao A.S., Verweij G., 2017).

Technology, Communications and Entertainment

Areas with the biggest AI potential

- Media archiving and search – bringing together diffuse content for recommendation.
- Customized content creation (marketing, film, music, etc.).
- Personalized marketing and advertising.

Barriers to overcome

Cutting through the noise when there is so much data, much of it unstructured.

High potential use case: Media Archiving and Search

We already have personalized content recommendation within the entertainment sector. Yet there is now so much existing and newly generated (e.g. online video) content that it can be difficult to tag, recommend and monetize. AI offers more efficient options for classification and archiving of this huge vault of assets, paving the way for more precise targeting and increased revenue generation (Dr. Rao A.S., Verweij G., 2017).

Energy

Areas with the biggest AI potential

- Smart metering – real-time information on energy usage, helping to reduce bills.

- More efficient grid operation and storage.
- Predictive infrastructure maintenance.

Barriers to overcome

Technological development and high investment requirements in some of the more advanced areas.

High potential use case: Smart meters

Smart meters help customers tailor their energy consumption and reduce costs. Greater usage would also open up a massive source of data, which could pave the way for more customized tariffs and more efficient supply (Dr. Rao A.S., Verweij G., 2017).

Transport and Logistics

Areas with the biggest AI potential

- Autonomous trucking and delivery.
- Traffic control and reduced congestion.
- Enhanced security.

Barriers to overcome

Technology for autonomous fleets is still in development and testing.

High potential use case: Traffic Control and Reduced Congestion

Autonomous trucking reduces costs by allowing for increased asset utilization as 24/7 runtimes are possible. Moreover, the whole business model of Transport & Logistics (T&L) might be disrupted by new market entrants such as truck manufacturers offering T&L and large online retailers vertically integrating their T&L (Dr. Rao A.S., Verweij G., 2017).

Economic Potential of AI

The majority of studies emphasize that AI will have a significant economic impact. Research launched by consulting company Accenture covering 12 developed economies, which together generate more than 0.5 % of

the world's economic output, forecasts that by 2035, AI could double annual global economic growth rates. AI will drive this growth in three important ways. First, it will lead to a strong increase in labor productivity (by up to 40 %) due to innovative technologies enabling more efficient workforce-related time management. Secondly, AI will create a new virtual workforce – described as 'intelligent automation' in the report – capable of solving problems and self-learning. Third, the economy will also benefit from the diffusion of innovation, which will affect different sectors and create new revenue streams (EPRS, 2019).

In the near-term, the biggest economic potential uplift from AI is likely to come from improved productivity. This includes automation of routine tasks, augmenting employees' capabilities and freeing them up, to focus on more stimulating and higher value-adding work. Capital-intensive sectors such as manufacturing and transport are likely to see the largest productivity gains from AI, given that many of their operational processes are highly susceptible to automation.

AI technologies differ significantly on the opportunities and risks they create, and therefore it's important that organizations consider what type of AI is appropriate for their particular use case. Before starting an AI project, organizations should ensure that the following four conditions have been considered and met to the degree required for their specific use case:

Ethics - The AI system needs to comply with ethical and social norms, including corporate values. This includes the human behavior in designing, developing and operating AI, as well as the behavior of AI as a virtual agent. This condition, more than any other, introduces considerations that have historically not been mainstream for traditional technology, including: moral behavior, respect, fairness, bias and transparency.

Social Responsibility - The potential societal impact of the AI system should be carefully considered, including its impact on the financial, physical and mental well-being of humans and our natural environment. For example, potential impacts might include workforce disruption, skills retraining, discrimination and environmental effects.

Accountability and Explainability - The AI system should have a clear line of accountability to an individual; Also, the AI operator should be able to explain the AI system's decision framework and how it works. This is about demonstrating a clear grasp of how AI uses and interprets data, how it makes decisions, how it evolves as it learns and the consistency of its decisions across sub-groups.

Reliability - The AI system should be reliable and perform as intended, this involves testing the functionality and decision-framework of the AI system to detect unintended outcomes, system degradation or operational shifts - not just during the initial training or modelling but also throughout its ongoing operation.

Trusted AI framework emphasizes four attributes necessary to sustain trust:

- **Bias**: Inherent biases arising from data, the development team composition and training methods are identified, and addressed through the AI design. The AI system is designed with consideration for the need of all impacted and to promote a positive societal impact.
- **Transparency**: When interacting with an AI algorithm, an end user is given appropriate notification and an opportunity to select their level of interaction. User consent is obtained, as required for data captured and used.

- **Resiliency**: The data used by the AI system components and the algorithm itself is secured from unauthorized access, corruption and adversarial attack.
- **Governance**: Track emergent issues across social, regulatory, reputational and ethical domains to inform processes that govern data sourcing and management, the integrity of a system, its uses, architecture and embedded components, model training, and monitoring.

A.I. Responsibility - Societal Patterns and Implications

The current debate surrounding the ethical ramifications of using AI and its potential impact on society, isn't ending anytime soon. In the absence of ethical consensus on so many aspects of cognitive technologies, individual companies on AI journeys should factor ethical considerations – as well as their organization's values – into the development of their own AI solutions. Though a few organizations operating at the vanguard of cognitive exploration are using machines to write code, many still write it, by and with, large numbers of humans.

As such, all their biases, assumptions, and perceptions may find their way into the algorithms being developed (Deloitte, 2019).

Let's assume that we're able to give a super intelligent AI orders and it follows those orders; it may just take the quickest and easiest route to solve them. Just because we make a super intelligent AI, that doesn't mean that it's going to be wise.

There's a difference between intelligence and wisdom; Intelligence is more about making mistakes and acquiring knowledge and being able to solve problems through that. Wisdom, on the other hand, is about applying the correct knowledge in the most efficient way. Wisdom reflects on being able to see beyond the intelligence gained and being able to apply that to other things,

hopefully, in a productive way. If we give AI an order to solve world hunger, the easiest way to solve world hunger is just to kill all life on the planet and then nothing would ever be hungry again.

But even more importantly, AI has the potential to help society overcome some of its most daunting challenges. Think of the most complex and pressing issues that humanity faces: from reducing poverty and improving education, to delivering healthcare and eradicating diseases, addressing sustainability challenges such as growing enough food to feed our fast-growing global population through to advancing inclusion in our society. Then imagine what it would mean in lives saved, suffering alleviated and human potential unleashed if we could harness AI to help us find solutions to these challenges (Microsoft, 2018).

Job Displacements & New Opportunities

Clearly, intelligent machines will increasingly be able to do our jobs and meet our material needs, disrupting industries and displacing workers in the process.

In a world where AI looks like it's chomping it, bit by bit, to automate all of our jobs and take away everything that makes us human, how do we remain relevant in the AI economies workforce?

The adoption of ‘no-human-in-the-loop’ technologies will mean that some posts will inevitably become redundant, but others will be created by the shifts in productivity and consumer demand emanating from AI, and through the value chain of AI itself. In addition to new types of workers who will focus on thinking creatively about how AI can be developed and applied, a new set of personnel will be required to build, maintain, operate, and regulate these emerging technologies.

For example, we will need the equivalent of air traffic controllers to control the autonomous vehicles on the road. Same day delivery and robotic packaging and warehousing are also resulting in more jobs for robots and for humans. All of this will facilitate the creation of new jobs that would not have existed in a world without AI (Dr. Rao A.S., Verweij G., 2017).

Among the most prized IT skills today, are those in the areas of Data Analysis, Data Modeling and Applications Development. As AI adoption grows, companies will increasingly value expertise in Data Science, Algorithm Development and AI System Design – with special emphasis on the human-centered design skills required to develop personalized user experiences.

Retraining and acclimating legacy talent to the world of AI may present its own challenges. It's not about just learning a new skill – it requires adapting to a new culture as AI-fueled organizations work in unorthodox ways (Mittal N., Kuber D., 2019).

As we move into the AI-fueled model, workers will have to adapt to a more advanced end state in which humans and machines interact and collaborate in ways that, until recently, existed only in the realm of Science-Fiction.

Conclusion

Amazon, Google, Apple and Facebook all used very different business strategies to gain their current market dominance and global influence, but their common success is arguably their foresight in understanding the value of data and positioning themselves early. They worked from the inside out, placing continuous emphasis on capability building, alongside developing, testing and deploying the top technologies internally. They have opted for a freeware model for most of their services, for which we all pay in return with all our data. The value of our data is hard to be monetize within a personal business

model, but we hope that it’s used in such a way to fuel cognitive technologies to deliver trust and future advantages for our society.

Creating trust in AI will require both technical and cultural solutions. To be accepted by users, AI must be understandable, meaning its decision framework can be explained and validated. It must also perform as expected and be incorruptible and secure (Ernst & Young, 2018).

Although there is a growing consensus on the need for AI to be ethical and trustworthy, the development of AI functionality is outpacing developers’ ability to ensure that it is transparent, unbiased, secure, accurate and auditable. There is a need for organizations to develop an AI governance model that embeds ethical design principles into AI projects and overlays existing technology governance structures.

So, we've seen some examples where AI can revolutionize the way the world works and how it can save human lives. We have endless amounts of data to compute and power the most creative minds and with an AI presence it sounds like an absolutely glorious future, but is it?

With every promise of a breakthrough technology also comes the looming threat of widespread unemployment and job loss. In the past you could hedge against this, you could go to school, get a master's degree, PhD, you could also specialize by getting skills learn a trade, get a certification, but this time it's bit different.

Algorithms and their computers can process thousands of images and hours millions of rows, of text, and minutes, and hundreds of millions of lines of data in seconds, so in a world already out read, out processed, out memorized and out analyzed by computers and their algorithms, and their chips, how do we differentiate ourselves from our silicon counterparts?

This lies in some uniquely human attributes like curiosity, communication and empathy.

With all of the advances in ML, the truth remains that we are still nowhere near creating AI machines that feel any emotions at all. Can you imagine the elation that comes from beating a world champion at the game you've devoted your whole life to mastering? AlphaGo did just that, but it took no pleasure in its success, felt no happiness from winning, and had no desire to hug a loved one after its victory (Lee K-F.,2018).

Innovation and invention are notoriously inefficient and as we look to our role in the future, in an AI economy, humans will definitely be required to define new problems and we need to partner with AI to find the optimal outcomes.

As we have the historical data and we are constantly creating and updating it, we should focus on harnessing the power of AI and all its subsets to help people. On this note, the value of data that we own is priceless, and the main idea isn't to replace people with machines, but to supplement human capabilities with the unmatched ability of AI to analyze these huge amounts of data and find patterns that would otherwise be impossible to detect.

References

Boobier T., (2018). Advanced analytics and AI: impact, implementation, and the future of work.

Bostrom N., (2015). Superintelligence – Paths, Dangers, Strategies.

Brockman J., (2019). Possible Minds: 25 Ways of Looking at AI.

Cambridge Definition, Artificial Intelligence. Cambridge Advanced Learner's Dictionary and Thesaurus. Retrieved from https://dictionary.cambridge.org/dictionary/english/artificial-intelligence

Castelli B., Hadjarian A., Offen J., (2019). PwC – Machine Learning: What every risk and compliance professional needs to know. Retrieved from https://www.pwc.com/us/en/services/forensics/pdf/pwc-machine-learning-for-risk-and-compliance-professionals.pdf

Castrounis A., (2019). AI for People and Business: A Framework for Better Human Experiences and Business Success.

Chavez T., O'Hara C., Vaidya V., (2018). Data Driven: Harnessing Data and AI to Reinvent Customer Engagement.

Cook A.V., Berman J., Dajee J., (2019). Deloitte. Intelligent Interfaces - Reimagining the way humans, machines, and data interact. Retrieved from https://www2.deloitte.com/us/en/insights/focus/tech-trends/2019/human-interaction-technology-intelligent-interface.html

Corea F., (2019). An Introduction to Data: Everything You Need to Know About AI, Big Data and Data Science.

Dell M., (2018). Dell Technologies, Intel, AI Summit - Unlock the Power of Data. Retrieved from https://www.delltechnologies.com/en-us/events/ai-summit.htm#main=replay&secondary=dtw187449772

Deloitte, (2019). Digital Insights - Tech Trends 2019 - Beyond the digital frontier. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/br/Documents/technology/DI_TechTrends2019.pdf

Dignum V., (2019). Responsible Artificial Intelligence: How To Develop And Use AI In A Responsible Way.

Dr. Rao A.S., Verweij G., (2017). PwC's Global Artificial Intelligence Study: Exploiting the AI Revolution – Sizing the prize Retrieved from https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

EPRS, (2019). European Parliamentary Research Service – Economic Impacts of Artificial Intelligence. Retrieved from http://www.europarl.europa.eu/RegData/etudes/BRIE/2019/637967/EPRS_BRI(2019)637967_EN.pdf

Ernst&Young, (2018). How do we teach AI the value of Trust? Retrieved from https://www.ey.com/Publication/vwLUAssets/ey-how-do-you-teach-ai-the-value-of-trust/$FILE/ey-how-do-you-teach-ai-the-value-of-trust.pdf

Flach P., (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data.

Forbes, (2016). IoT Mid-Year Update From IDC And Other Research Firms. Retrieved from https://www.forbes.com/sites/gilpress/2016/08/05/iot-mid-year-update-from-idc-and-other-research-firms/#8672bfd55c59

Gentsch P., (2018). AI in Marketing, Sales and Service: How Marketers without a Data Science Degree can use AI, Big Data and Bots.

Horton R., Watson J., Wright D., Dr. Howard M., Witherick D., Coe L., Hatfield S., (2019). Deloitte Insights - Automation with intelligence. Retrieved from https://www2.deloitte.com/us/en/insights/focus/technology-and-the-future-of-work/intelligent-automation-technologies-strategies.html

Jacobs J., (2018). AI & Big Data: The Future of the Digital World. Retrieved from https://www.globalxetfs.com/ai-big-data-the-future-of-the-digital-world/

Jajal T.D., (2018). Distinguishing between Narrow AI, General AI and Super AI. Retrieved from https://medium.com/@tjajal/distinguishing-between-narrow-ai-general-ai-and-super-ai-a4bc44172e22

KPMG, (2019). KPMG – Artificial Intelligence in Control - Uncover the full potential of Artificial Intelligence. Retrieved from

https://assets.kpmg/content/dam/kpmg/gr/pdf/2019/02/gr-AI-in-control-slipsheet-en.pdf

Lee K-F., (2018). AI Superpowers – China, Silicon Valley and the New World Order.

Loucks J., Davenport T., Schatsky D., (2018). Deloitte. State of AI in the Enterprise - Early adopters combine bullish enthusiasm with strategic investments. Retrieved from https://www2.deloitte.com/us/en/insights/focus/cognitive-technologies/state-of-ai-and-intelligent-automation-in-business-survey.html

Malcolm F., Pring B., Roehrig P., (2017). What to Do When Machines Do Everything: Five Ways Your Business Can Thrive in an Economy of Bots, AI, and Data.

Microsoft, (2018). The Future Computed – Artificial Intelligence and its role in society.

Mittal N., Kuber D., (2019). Deloitte – AI-Fueled Organisations. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/technology/deloitte-uk-tech-trends-2019-chapter2-ai-fuelled.pdf

Nicholson C., (2019). Artificial Intelligence (AI) vs. Machine Learning vs. Deep Learning. Retrieved from https://skymind.ai/wiki/ai-vs-machine-learning-vs-deep-learning

Oxborough C., Ringger T., Versage M. S., (2019). PwC – Digital Pulse. Three governance considerations to unlock the potential of AI. Retrieved from https://www.digitalpulse.pwc.com.au/ai-governance-considerations/

Panesar A., (2019). Machine Learning and AI for Healthcare. Big Data for improved Health Outcomes.

Purdy M., Daugherty P., 2016. Accenture – Why Artificial Intelligence is the future growth. Retrieved from https://www.accenture.com/t20170524T055435__w__/ca-en/_acnmedia/PDF-52/Accenture-Why-AI-is-the-Future-of-Growth.pdf

Schneider S., (2019). Princeton University Press - Artificial You: AI and the Future of Your Mind.

Silver D., Hassabis D., (2017). AlphaGo Zero: Starting from scratch. Retrieved from https://deepmind.com/blog/article/alphago-zero-starting-scratch

Stix C., (2018). The European Commission. The European Artificial Intelligence landscape. Retrieved from https://ec.europa.eu/digital-single-market/en/news/european-artificial-intelligence-landscape

Voulgaris Z., Bulut Y. E., (2018). AI for Data Science: Artificial Intelligence Frameworks and Functionality for Deep Learning, Optimization, and Beyond.

Watermark, (2018). Artificial intelligence is the fourth industrial revolution.

Westermann C. B., (2019). PwC Switzerland – Research and Insights. If AI isn't responsible, it isn't truly intelligent. Retrieved from https://www.pwc.ch/en/insights/digital/if-ai-isnt-responsible-it-isnt-truly-intelligent.html

WIPO (2019). WIPO Technology Trends 2019: Artificial Intelligence. Geneva: World Intellectual Property Organization. Retrieved from https://www.wipo.int/edocs/pubdocs/en/wipo_pub_1055.pdf

Yang S., Abbasi A., (2019). EY - Five key trends illuminating AI's impact for financial services. Retrieved from https://www.ey.com/en_gl/innovation-financial-services/five-key-trends-illuminating-ai-s-impact-for-financial-services