**End of Year Final Integrated Exam**

**Reading Articles**

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Pre-reading 1

**Which Industries Benefit from Machine Learning?**

(By Virginia Green, Jacqueline McCarthy, 2020)

**What is machine learning?**

Machine learning is an essential component of artificial intelligence which refers to an algorithm written to stimulate an artificial neural network to perform a function. An artificial neural network, which is modeled after the biological neural networks in a brain, uses training data to learn to perform the function. Users might think of a machine learning system as a statistical modeling algorithm with the sophistication and nuance of a neural network. While artificial neural networks are not nearly as complex or creative as human brains, they have computational capabilities that no human can match.

Unlike algorithms that have fixed and unchanging parameters, machine learning algorithms are able to use information from within the dataset to do predictive analytics and data mining. An unsupervised learning algorithm can develop the capacity to make decisions without explicit programming. However, machine learning algorithms do not design themselves. The process to develop a machine learning algorithm takes a trained data scientist who is knowledgeable about machine learning techniques and neural networks, as well as data mining and natural language processing.

Machine learning technologies provide more sophisticated data analysis that can, for example, target a marketing initiative in a fine-grained way that would not be possible without AI. Machine learning makes predictive analytics more accurate – to the point where a company like Amazon might know what product its customers will order before they hit “purchase.”

**Popular applications for machine learning techniques**

Machine learning technologies have brought great benefits through their broad applications [across many industries](https://medium.com/datadriveninvestor/5-industries-that-heavily-rely-on-artificial-intelligence-and-machine-learning-53610b6c1525) which rely on neural networks that run learning algorithms and support natural language processing to support their operations.

One popular application is that machine learning is the foundation upon which many of the [innovations of modern life](https://medium.com/app-affairs/9-applications-of-machine-learning-from-day-to-day-life-112a47a429d0) are built. For example, the chatbots that pop up on many websites would not be possible without learning algorithms. The bots use machine learning and data mining techniques to find answers to questions you might ask. This reduces the need for companies to hire customer service personnel. It also allows small companies that cannot afford round-the-clock, personalized customer service to provide an AI-powered approximation. In addition, site visitors can often get their questions answered in real time without waiting for an email response or staying on hold on the phone.

Another major application is in e-commerce. E-commerce giants like Amazon are using machine learning and AI to improve customer experience data and increase sales. Data mining allows machine learning engineers to create learning algorithms that provide insights into customer behavior. For example, if customers have shopped on Amazon, they have probably benefited from machine learning algorithms. The feeds that pop up with other products they might like are created with machine learning. Using data about their shopping preferences and the choices of others with similar preferences, the learning algorithm is able to predict what additional products they might be interested in buying. Amazon uses machine learning and predictive analytics for more than recommending products for its customers to buy. Its neural networks use machine learning techniques to [predict their next purchase](https://www.npr.org/2018/11/21/660168325/optimized-prime-how-ai-and-anticipation-power-amazons-1-hour-deliveries) so Amazon can have it in a warehouse close to them even before they place their order. The company has also turned this machine learning technology into a product that it sells to other retailers, [Amazon Forecast](https://aws.amazon.com/forecast/). There are some other benefits machine learning has brought to e-commerce. For instance, natural language processing can provide faster and more responsive customer service, and insights from AI and machine learning algorithms can help retailers streamline all aspects of their supply chain.

AI used in financial service and fraud detection is just one of the many ways that machine learning techniques benefit the financial services industry. Machine learning helps protect consumers against the growing threat of financial fraud. Financial institutions use machine learning techniques to spot patterns that do not fit their purchase pattern, as learning algorithms scan millions of online purchases and withdrawals. That is why consumers’ bank may call them to report a suspicious transaction before they even know anything was wrong. Additionally, now that almost all transactions are online, artificial neural networks can use learning algorithms to help investment managers make better decisions.

Machine learning also adds flavor to food service. For example, [McCormick and Company have partnered with IBM](https://newsroom.ibm.com/2019-02-04-McCormick-Company-and-IBM-Announce-Collaboration-Pioneering-the-Use-of-Artificial-Intelligence-in-Flavor-and-Food-Product-Development) to develop an AI system that will change food science. Famous for their ubiquitous red-capped spices in grocery stores, McCormick’s product developers use the AI-enabled product platform called “ONE” to “learn and predict new flavor combinations from hundreds of millions of data points across the areas of sensory science, consumer preference and flavor palettes.”

The sector where machine learning may have the largest impact on society is in the healthcare field. Artificial neural networks can be used to process and analyze medical data to give medical researchers and doctors better insights, quicker than ever before. Learning algorithms can help scientists home in on the most effective treatments, based on data rather than hunches and anecdotal evidence. In the subfield of computer vision—the technical pursuit to allow computers to mimic the human capacity to see and make inferences from an image—applications for the health industry include [the ability for a computer to scan a medical image and make a diagnosis](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5857319/). Moreover, the corporations and nonprofits that run hospitals and health centers value machine learning technologies because data science can lower healthcare costs while improving patient outcomes. Learning algorithms can allow healthcare systems to provide optimal treatments for their members while reducing the number of ineffective or unnecessary procedures.

Machine learning technologies are also widely applied in some other areas. For example, machine learning has played a big role in maintaining email as a viable form of communication. Without learning algorithms that detect spam and filter users’ emails, their inbox would be overrun by an unworkable volume of junk mail. Over time, algorithms to filter spam have become exponentially more accurate, thanks to machine learning. Search engines like Google use machine learning to refine the search results presented to users. This personalization can have a downside, though. In its attempt to cater to users’ every wish, the search engine can create a [filter bubble](https://qz.com/1194566/google-is-finally-admitting-it-has-a-filter-bubble-problem/) that shows them only information that reinforces the perceptions with which they started their search. This can cut users off from differing viewpoints and starve them of information that might be valuable to them. Google has been working on correcting this problem – yet another task for machine learning. For users of a virtual assistant such as Alexa or Siri, natural language processing allows the assistant to understand their requests and formulate responses in human language with the proper syntax. Machine learning helps the assistant learn their preferences and predict what they will want.

As discussed above, machine learning technologies have been widely applied in many areas and have brought great benefits although these examples barely scratch the surface of the applications of machine learning techniques and data mining in use today.

Pre-reading 2

**The limitations of machine learning**

(By Matthew Stewart,Dorian Martin, Matthew Lynch, Daniel Faggella, 2018)

**Background information on machine learning**

Astounding technological breakthroughs in the field of Artificial Intelligence (AI) and its sub-field Machine Learning (ML) have been made in the last couple of years. Machine learning is focused on teaching computers to learn from data and to improve with experience – instead of being explicitly programmed to do so. In machine learning, algorithms are trained to find patterns and correlations in large datasets and to make the best decisions and predictions based on that analysis. For the first time in history, machine learning is letting data scientists and robotic engineers approach the threshold of true autonomous intelligence in almost every field- in schools, shopping carts, healthcare and restaurants.

Machines can now be trained to behave like humans and are able to mimic complex cognitive functions such as informed decision-making, deductive reasoning, and inferences. However, while the technology may be beneficial, it is not perfect. This article will present some limitations of applying machine learning in different industries including education, e-commerce, healthcare, and food service.

**Problems machine learning have in different industries**

ML is becoming more prevalent in modern classrooms as teachers make the shift to blended learning. Students can often enjoy the more modernized version of lessons that allow them to learn at their own pace and teachers can enjoy the more personalized aspect of machine learning. This year researchers even launched a trend of creating the algorithm based on ML that will help students determine their future career paths and college education options. However, many are beginning to wonder if everything about these machines is truly beneficial for students and teachers since not all the implementations of ML in education are about benefits and advantages.

The major downside to machine learning is the problem with data collection and transparency. In the report by WSJ, a few parents voiced their concern over how the data is collected by the AI-powered headbands, where it is stored, and who has access to it. The issue of [non-protected digital privacy](https://notbusinessasususal.com/2019/08/general-risks-of-non-protected-digital-privacy/) still remains a topical one in education, as the data is collected from millions of students. Therefore, a seemingly useful technology aimed at helping students do better at school can turn out to be a time bomb. That is why more research should be conducted to secure the private data of both students and teachers, who use devices powered by ML.

In addition, since machine learning systems today cannot carry out all the tasks that require intelligence effectively and efficiently, educators still need to plan to grade essays and other items in the old-fashioned way. Computers can easily grade multiple choices but may struggle with the more time-consuming essay assignments as they lack the ability to assess items that do not have a specific technical requirement associated with them. As machines cannot explain why they do or what they do, students cannot receive constructive feedback or suggestions when machine learning is applied in grading.

Machine learning can also cause other problems in e-commerce. As ML has the potential to take out the guesswork and manual labor related to most online marketing and sales processes, dirty data is an even bigger problem. As it is easy to automate processes using machine learning, it sometimes does happen that data in between is improper. This might cause incorrect results or errors. For example, customers might witness a situation where they may be classified as defaulters or customers are recommended products not related to their search history or patterns. According to a 2015 Experian [data quality survey](https://www.edq.com/globalassets/white-papers/data-quality-benchmark-report.pdf), 83% of respondents believed their company revenue was negatively affected by inaccurate and incomplete data. The issue of dirty data is becoming significant.

Therefore, ‘Garbage In Garbage Out’ is the point that always needs to be remembered in this technology. The data pushed in the models as training data must be clean and accurate for the problem people are solving. [The New York Times reports](https://www.nytimes.com/2014/08/18/technology/for-big-data-scientists-hurdle-to-insights-is-janitor-work.html) that due to dirty data, data scientists are spending 30-50% of their time doing what is known asdata cleansing*.* On average, the global companies surveyed estimated that 26% of their data was inaccurate and this number increased to 32% when looking at U.S. companies only. Researchers can only guess whether U.S. companies have poorer data than others, are more pessimistic, more realistic, or any combination of the above. Moreover, dirty data brings huge financial losses. For example, [IBM](https://www.ibmbigdatahub.com/sites/default/files/infographic_file/4-Vs-of-big-data.jpg) states that poor data quality costs the U.S. economy a whopping $3.1 trillion a year, which sounds incredible.

The advanced technologies supporting these breakthrough capabilities are also finding a home in healthcare, and physicians are starting to be concerned that AI and ML are about to evict them from their offices and clinics. One point regarding the technology itself is that artificial intelligence and machine learning present a whole new set of challenges around data privacy and security-challenges that are compounded by the fact that most algorithms need access to massive datasets for training and validation. Shuffling gigabytes of data between disparate systems is uncharted territory for most healthcare organizations, and stakeholders are no longer underestimating the financial and reputational perils of a high-profile data breach. It would be also possible to cause data leakage especially when dealing with all the complexities associated with healthcare data.

Finally, among the barriers in food services, some are formidable. Some restaurants use chatbot, a technological machine-learned program, as a tool to enhance customer interaction and improve the overall user experience. However, due to fixed programs, chatbots can be stuck if an unsaved query is presented in front of them. This can lead to customer dissatisfaction and result in loss. Additionally, chatbots are often seen to be complicated and require much time to understand users’ requirements. It is also the poor processing which is not able to filter results in time that can annoy customers. As ML needs a great deal of data to provide appropriate results, and ML system needs to get training from the initial data and then start working on future data, users may expect a slower pace of innovation and adoption in the food industry.

To conclude, machine learning technology is transforming industries and impacting daily lives. It is believed to play a major and influential role in the future of mankind. However, its disadvantages or limitations in different areas cannot be ignored. It is important to keep in mind that machine learning technology today is just getting started. There will be more advancement in future and the advancement in machine learning technology will bring more excitement and also challenges.