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Concept of Artificial Intelligence, its Impact and Emerging Trends

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Abstract -*Whilst there is plenty of new hype around artificial intelligence (AI) as we move into the third decade of the 21st century, the history books would tell you that it has been around for several years. It is best to start with a brief history of AI before digging deeper into the current principles.*

Application of machine learning came into existence for the first time during Second World War when a Computer Scientist named Alan Turning tried to crack a piece of called known as the 'Enigma code' which was used by the German forces for secure communication. According to Turing, a machine which can communicate with humans without the humans knowing it could be defined as an "intelligent" machine.

Keywords – Artificial Intelligence, Machine Learning, Deep Learning

1.INTRODUCTION

Whilst the term 'artificial intelligence' wasn't coined until 1956, Turing prompted an accelerated amount of research into computer science with a vision on transforming the world. Despite some early promise such as the first neurocomputer built by Marvin Minsky (known as Ferranti Mark 1) and exploration in robotics like the Unimate robot from GM, research of artificial intelligence (AI) in 1970sheaded into an "AI Winter."

Scientists found it hard to create intelligence without more data and computing power. In turn, this led to a slump in funding and investment across all areas of AI. It wasn't until the dawn of the new Millennium that there was a real upturn as improvements in computer hardware meant companies had more data leading to opportunities for generating machine learning propositions.

As the Big 4 (Google, Apple, Facebook and Amazon) started to get heavily involved in AI technology, investment grew exponentially from the start of autonomous cars in 2005, IBM Watson in 2006 (a famous case where it defeated a Jeopardy champion), Netflix streaming and Google street view in 2010 and Alexa in 2015.

We now have countless other applications founded on evolving technologies like augmented reality (AR), virtual reality (VR), computer vision, natural language processing (NLP) and others. Terms like machine learning and deep learning have become synonymous with the field but there tends to be clouds as to exactly what they mean.

The state of AI has changed drastically in the last ten years and it is important to separate the buzz from reality. In this paper, we will clarify what AI is and the applications of machine learning and deep learning that fall within its realm. We will finish by reviewing the impact AI is having on modern day society and what the future might look at.

2.WHAT IS AI?

AI is a field of computer science that studies how machines can imitate the intelligence of their human counterparts. Over the last decade, definitions of the term have become quite loose and refer to just about any computerized or automated function. However, the difference between an AI system and traditional software packages is the ability to make informed judgments and decisions by responding to patterns in data.

Many of us use movies as a guide to the current state of artificial intelligence. In November 2019, the latest release in the "Terminator" movie series sparked some debate on the subject as did previous films in the series. The reason is that movies tend to offer up AI on the basis that it will cause doomsday type scenarios rather than facing up to the reality of what it is genuinely doing in the world. University of Washington law professor Ryan Calo stated one example where the movie talks about a neural net which is a trained model. It would be rather incomprehensible from somebody to be building a trained model that turns itself into a Terminator.

The takeaway here is that the AI of today is not yet about machines that can understand human concepts like evil, love, creativity and strategy. The applications are in fact far narrower right now in that they tend to be brilliant at solving one specific task and that is about it. AI is usually split into three categories, each being an evolution of the next.

2.1 Artificial Narrow Intelligence (ANI)

Commonly known as machine learning, ANI solutions specialize in one area and one problem at a time. This is the form of AI that we see in the market today and complete tasks like recommending a product or predicting the weather forecast. ANI comes very close to replicating and sometimes surpassing how humans carry out tasks and is the only form of AI that truly exists today (some reports might challenge that, but it is certainly the only monetized form).

2.2 Artificial General Intelligence (AGI)

AGI is the next level up from ANI and refers to AI which has a "human level of cognitive function." To be successful, an AGI system would need to connect potentially thousands of ANI systems together to imitate human behavior. To put it into context, the market leading IBM Watson system took 40 minutes to simulate just one second of neuro-activity. Big companies are striving to achieve AGI and we will get there but just not quite yet.

2.3 Artificial Super Intelligence (ASI)

This is the point where we start thinking of science fiction. An ASI system is one that can completely surpass any sort of human intelligence. It can be creative, make rational decisions, build relationships and decide whether it wanted to be good or evil. It is thought that the progression from AGI to ASI wouldn't necessarily be that huge. If machines can start coming up with their own concepts with AGI, a super intelligent system would be the next logical step.

To better understand its current state, the two main applications that fall under the umbrella of ANI are machine learning and deep learning. Before looking at how AI impacts society, we are going to take a deeper look at both techniques.

3. WHAT IS MACHINE LEARNING?

Machine learning is the most common form of AI in the world today and how most use cases for ANI are realized. The reason we have been able to develop AI solutions at a rapid rate in the last few years is due to vast volumes of data being generated in the world. Machine learning is the process where computer systems become capable of gaining intelligence through data.

Devices and Systems which are built with machine learning algorithms can learn from experience in the form of historical data. When we talk about algorithms, these are programming codes, a bit like how a developer would build a website or some other online functionality. In the data science, the two codes that tend to be used are Python and R. When you hear these names banded about, it refers to the language in which an algorithm has been created in for it to function. Both Python and R have pros and cons. See the references section of this paper for details on where you can find more information on Python and R.

A recent example of machine learning would be Amazon Alexa. Everyone will be familiar with the voice activated device which sits in the living room and responds to commands but may not have considered the AI system which sits as its foundation.

To put this into a machine learning context. A user will make a request by talking to Alexa. Alexa will recognize what the user is asking using a text to speech algorithm. This is essentially a way of turning unstructured information like spoken words into data. The converted speech is sent to the cloud and matched against a vast pool of existing data to ascertain the best possible response. Alexa then sends the reply and converts it to audio for the user to hear.

The process Alexa goes through is machine learning (ANI), a system trained for a specific task that it does incredibly well. There are plenty of other similar examples that we'll discuss later in this paper.

There are four common types of machine learning which are summarized below.

3.1 Supervised Learning

This method takes existing data and trains a model to work out how to classify a new piece of data. For example, it could hold data on the symptoms of diabetes and when it receives blood test results of a new patient, it is able to make a diagnosis prediction.

Initially a human would train the machine how to classify symptoms into "Has Diabetes" or "Does Not Have Diabetes." Over time, with enough data, an AI system will be able to take a new set of information and create its own prediction as to which classification the new patient falls into.

3.2 Unsupervised Learning

Unlike, supervised learning, these models will attempt to classify data without any prior knowledge. The algorithms look to find patterns themselves and put data into groups. A common example is something like customer purchasing behaviors. The algorithm won't have existing labels and will decide on its own how to classify the data, often known as clustering. Imagine going to a party where everybody is a stranger. Your mind will probably classify people based on age, gender or clothing. You don't know them but have still worked out the classifications.

3.3 Semi-Supervised Learning

Semi-Supervised Learning is a mix between supervised and unsupervised learning. In a large volume of data, it is common that some items are labelled, and some are not. A semi-supervised model would have some labelled data to know that classification does exist. It is then trained on unsupervised data to define the boundaries of what it is looking at and potentially specify new classifications that the human did not specify when labelling.

For example, machine learning is being used to detect fraud in banking by identifying patterns in the data. However, initially you can only classify the fraudulent activity that you know about. The entire criminal mindset of fraud is about undertaking activity that nobody can detect meaning classifying it is impossible. A semi-supervised algorithm will take new data and retrain the

model each time to add to its classification methods. Whilst a computer being left to do this on its own might not be 100% accurate, it is better than having no labels at all.

3.4 Reinforcement Learning

This application is about positive and negative rewards for certain behaviors and is a common method in robotics. Machines can learn to optimize behavior from experiencing positive or negative results. For example, if a robot found an iPhone and decided to throw it, it would break and be a negative result. However, pressing a button opens an App, producing a positive result so it continues the activity. The robot will continue this process until finding the best optimal result.

The image below shows how the flow works for Alexa.

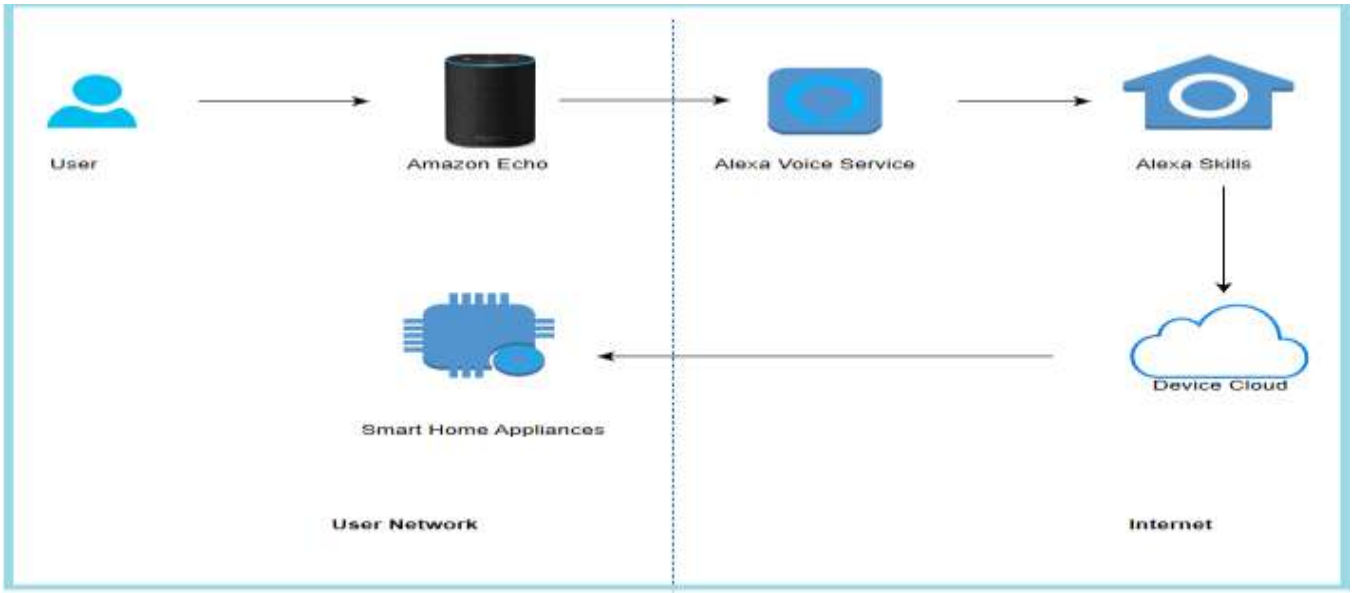

Fig -1: How Alexa Works

4. WHAT IS DEEP LEARNING?

Deep learning is another subset of AI and the term is often used interchangeably with machine learning, but the two applications are different. In the simplest form, deep learning algorithms have numerous layers, each providing a separate interpretation of the data it is based on. This multi-layer approach is often referred to as an artificial neural network as their function is designed to (at least attempt) replicate that of a human brain.

One of the key differentiators of machine and deep learning lies in classification. Earlier in this paper, we spoke about how supervised learning techniques rely on labelling images to classify predictions accurately. A common cited example is that of distinguishing between pictures of cats and dogs. In machine learning, there would be batches of labelled images for the machine to learn from and work off to decide if future pictures can be classified as a dog or cat.

Solving the same problem with deep learning would not use labelled cat and dog data. Instead, a new picture is distributed through the multiple layers of our neural network to define the different features and come up with a reasoned decision. The human brain works in the same way to find the appropriate identifiers. Even children play the board game "Guess Who" which is all about feature recognition to help the brain on its way towards logical predictions.

Deep learning is being used in places where there is too much data for classic machine learning algorithms to derive conclusions from or problems that are highly complex. Autonomous vehicles are one technology that are reliant on deep learning to succeed. For them to think like a human, there needs to be a network of models working simultaneously. For example, one needs to know how to drive, another needs to perceive the environment, one needs to understand road signs and so on. Until the AI can do all these tasks at the same time, we won't see full commercialized examples of completely driverless cars.

Advancements in deep learning will ultimately be the key to AGI.

5. IMPACT ON SOCIETY

Machine learning and deep learning are already having an impact on society across many industries and applications. Some of the key cases are outlined below. The AI sector is by no means limited to these, but they represent the primary uses in the market.

5.1 Customer Service

One of the most common forms of AI is the conversational chatbot. These are messaging apps, speech-based assistants or voice activated devices that are used to automate communication and create a very personalized customer experience. These applications (often known as

the Internet of Things or IoT) can process vast amounts of data instantly meaning they can make faster and more accurate responses than a human would ever be able to.

Similar personalization that makes best use of data can be used in marketing. This is where we get emails that are relevant to us and social media ads that just happen to be something, we are interested in. In some cases, each customer can even see different website homepages depending on their likely preferences and what will interest them the most.

Utilizing AI in these ways is a great way to ensure customer loyalty through a personalized experience.

5.2 Data Security and Fraud

AI can be used to help identify fraudulent transactions and prevent unauthorized access to data. In a rapidly growing digital world, Artificial Intelligence play a crucial role in defending cyber-attacks. Powerful algorithms can find malware and combat spam for example. Machine learning will detect irregular patterns in the data and inform businesses when there is a potential threat.

As well as this we are seeing the increased utilization of identity checks other than passwords such as facial recognition and fingerprint technology. These unique identifiers based on unstructured data are far more difficult to hack and offer a great layer of protection for businesses.

5.3 Business Process Automation

Businesses that have been established for a long time tend to have several manual processes. AI is a natural partner to optimize these efforts given its efficiency at handling routine tasks, improving interfaces, willingness and speed to do monotonous tasks and ability to handle massive amounts of data.

There are some obvious processes like using robotics in factories, managing conditions in product storage, processing payments and registering customer requests but these only touch the surface of the possibilities. Doctors can use AI devices to dictate clinical notes which automatically fills in the relevant forms and orders a prescription. Lawyers will use AI to process contracts and agreements in a split second that may have taken them days or weeks.

5.4 Predictive Analytics

Machine learning is being used in prediction-based systems. For example, consider a person applying for a loan. As they enter their data, machine learning algorithms can predict in real-time whether they are likely to be a good or bad future risk i.e. will they ultimately default on payments. The model could then decide on the interest rates or term of the loan instantly.

Predictive applications are becoming very common across several industries now. One such way is via recommender systems. For example, Netflix predict what shows we want to stream, Spotify tell us the music we want to hear, and Amazon know the products we want to buy. Even a Google search is predicting what we want to know after typing or saying a few words.

5.5 Staff Training

AI is being used in businesses to create personalized training plans. Some companies could have huge knowledge bases that take staff weeks or even months to learn. AI has been shown to cut this in half by presenting content to the learner in the way that best suits them. This could include the order they learn items in, the length of time between when learners are presented with repeat information or the type of material such as written, visual and audio. Training is both more useful and enjoyable.

6. EMERGING TRENDS

Many emerging AI trends are focused on machine and deep learning techniques. A clear priority moving into 2020 is autonomous AI. We have already spoken about vehicles but whilst they are not ready to be commercialized yet, innovations like drones and robots that move on their own are likely to have a bigger impact.

Google and Amazon are already in the testing phase of drone technology but other applications such as in agriculture, construction and logistics and making accelerated headway. In each of these, drones are removing immense amounts of manual labor and driving better efficiency and productivity.

Beyond that, cybersecurity needs to be at the top of AI strategy lists. Gartner say that as much as 30% of AI cyberattacks leverage data poisoning or AI model theft to compromise systems. Organizations need to start doing all they can to prevent innovative systems from being penetrated. Whilst machine learning and deep learning are critical to innovation, they are also a keen way for hackers to develop techniques that can carry out new kinds of cyberattacks.

The world of search and conversation is also changing. We have already spoken about chatbots in this paper, but further Gartner research has said it expects as much as 70% of workers will work with conversational platforms every day. This could be in the form of mobile, voice activated or service devices but in whichever form, conversational AI is becoming big business.

5G networks will provide super-fast download and upload speeds which leads to greater access to data. These networks are available now but are still expensive and confined to quite specific regions. Going into 2020, the increased bandwidth will allow machines to collect and transfer more data than ever before, creating natural advancements in AI technology.

Whilst it isn't an emerging trend as such, connectivity enhancements like 5G will likely bring technologies such as augmented and virtual reality back to the forefront of AI systems. This technology has already shown to have practical applications in healthcare, construction and education but is still yet to reach full potential.

All these emerging trends incrementally move us from ANI towards an AGI world. Slow and steady wins the AI race.

7. CONCLUSION

AI has been around us for many years but as we move towards 2020, more is anticipated from the technology than ever before. With the way in which it has changed everyday life via machine and deep learning, AI has become embedded as part of what we do. In fact, much of the time we don't even recognize something as AI because it is so familiar, just like how we take using the Internet for granted.

AI has always been considered as futuristic if we go by films and TV but as the examples in the paper show, it I very much in the here and now.

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