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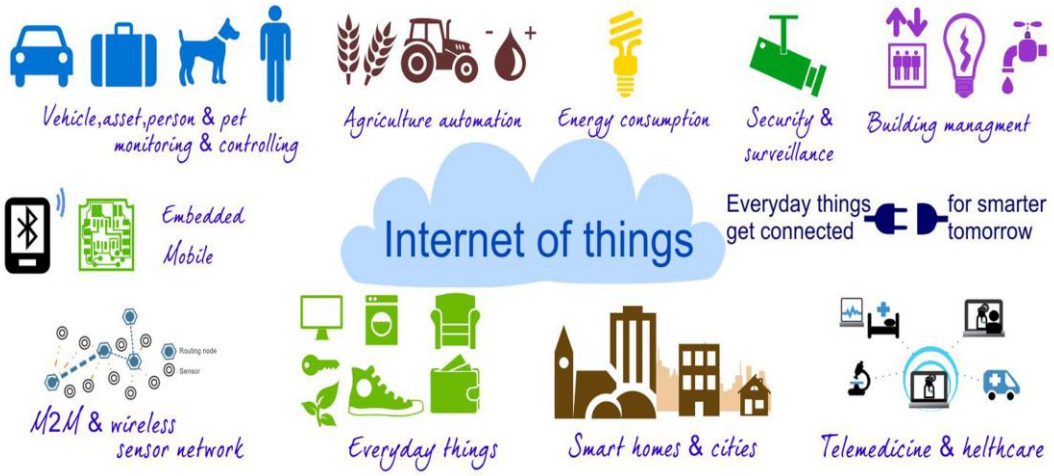
INTRODUCTION TO INTERNET OF THINGS

N NAGA PRANATHI, II-EIE

We have all heard about the Internet of Things (IoT). It‘s either great or terrible, depending on who you ask. But what is it, exactly?

The Internet of Things, or IoT, is emerging as the next technology mega-trend, with repercussions across the business spectrum. By connecting to the Internet billions of everyday devices–ranging from fitness bracelets to industrial equipment–the IoT bridge the physical and online worlds, opening up a host of new opportunities and challenges for companies, governments, and consumers. The Internet of Things is the internet-able nature of mod-ern physical devices, vehicles, and buildings. You may also have heard of IoT products as connected devices or smart devices.



How does the Internet of Things work?

Typically, Internet of Things devices have sensors and software that enable the collection and exchange of data via the internet. IoT objects can be controlled remotely to allow direct integration with computer systems, which, it‘s argued, results in economic benefit and improved efficiency for users.

Trends in IoT

The trends witnessed in 2019 will get spilled into 2020 and even better, we‘ll see a greater impact of IoT. Internet of Things has also helped companies make and value data-driven decisions not to mention that they can now fill the gap between the vast amount of data they are getting and extracting beneficial insight from it through top draw analytics. In the following section, we will analyse some of the top IOT trends that are driving our lives into a completely new world.

Security of things

Connections made over the Internet can be prone to hacking and data breaches. There is a rise in concern about the security of IoT especially in a bid to ensure such data security breaches are mitigated. Cyber Security experts have been looking for a solution to this and most of them recommend solution providers who ensure that security is guaranteed to the devices and machines, which leverage their services for connection.

Automated smart vehicles

You have probably heard about vehicles that can self-park or self-drive themselves while you sit and do very little in it. Well, you can afford to enjoy this thanks to IoT. Therefore, you might be wondering how this is possible. Depending on the technology deployed, such a vehicle might be connected to a Google map that lays down the available routes to your destination and smart algorithms for the distance estimation. Of course, it is not that simple as there is a need for some control engineering to get the whole thing working but you can judge that IOT is part of the core framework of the system. This was a major trend in 2020. In fact, 2019 saw more smart cars manufactured as the demand for them escalated. For example, IoT has made driving extremely easy as all you have to do is input your destination to a smart car and you are good to go. Car manufacturing industries in 2019- especially those in the US, are expected to ship their cars embedded with 4G-LTE capability to ensure that there are all connected any-where in across the world. This will guarantee more sales for the company and another happy generation whose life has just become a little easier.

Automated smart factories

Smart factories and manufactures are on the rise thanks to IoT. On the other hand, a massive number of workers might end up losing their jobs since they are no longer needed to do tasks such as packaging or sealing the finished products. These days, machines are programmed to do automatically what humans used to do, albeit with better performance, that work is done faster and more efficiently. IoT has helped in the improvement of productivity and profits as well as labor efficiencies hence contributed to the growth of many industrial companies.

Digitalised health sector

Don‘t you think that having a device that wirelessly monitors your glucose level is quite amazing? The year 2019 saw the development of wearable devices that could monitor health and fitness. Devices such as wearable watches that go hand in hand with phone applications, are booming in the market today. Most of the wearable devices that are prevalent revolve around fitness and health trackers enabled by wireless connectivity. This feature best enables individuals keep track of various aspects of their health whilst also forwarding the vital data to health professionals.

New business models

New business models are now taking shape courtesy of IOT. Take an example of the farming sector where there are traditionally huge challenges facing farmers. Of course, pests and sowing times are considered two most common challenges in this sector. In addition, once the plants are fully-grown and ready for harvesting, it some-times takes the farmers a longer time to do it, which leads to lower income.

On a positive note, the development of technology has seen these challenges reduced and even eliminated. A good example is the internet-based pest management systems composed of smart hard-ware and software that have helped farmers save on labour, costs and most important of all they are now getting the better income.

IMPORTANCE OF MACHINE LEARNING AND DEEP LEARNING

A S Aiswarya Vallika, II-EIE

What is machine learning?

Machine learning (ML) is a type of artificial intelligence (AI) that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so. Machine learning algorithms use historical data as input to predict new output values.

Recommendation engines are a common use case for machine learning. Other popular uses include fraud detection, spam filtering, malware threat detection, business process automation (BPA) and predictive maintenance.

Why is machine learning important?

Machine learning is important because it gives enterprises a view of trends in customer behaviour and business operational patterns, as well as supports the development of new products. Many of today's leading companies, such as Facebook, Google and Uber, make machine learning a central part of their operations. Machine learning has become a significant competitive differentiator for many companies.

What are the different types of machine learning?

Classical machine learning is often categorized by how an algorithm learns to become more accurate in its predictions. There are four basic approaches: supervised learning, unsupervised learning, semi-supervised learning and reinforcement learning. The type of algorithm data scientists choose to use depends on what type of data they want to predict.

- **Supervised learning:** In this type of machine learning, data scientists supply algorithms with labeled training data and define the variables they want the algorithm to assess for correlations. Both the input and the output of the algorithm is specified.
- **Unsupervised learning:** This type of machine learning involves algorithms that train on unlabelled data. The algorithm scans through data sets looking for any meaningful connection. The data that algorithms train on as well as the predictions or recommendations they output are predetermined.
- **Semi-supervised learning:** This approach to machine learning involves a mix of the two preceding types. Data scientists may feed an algorithm mostly labeled training data, but the model is free to explore the data on its own and develop its own understanding of the data set.
- **Reinforcement learning:** Data scientists typically use reinforcement learning to teach a machine to complete a multi-step process for which there are clearly defined rules. Data scientists program an algorithm to complete a task and give it positive or negative cues as it works out how to complete a task. But for the most part, the algorithm decides on its own what steps to take along the way.

How does supervised machine learning work?

Supervised machine learning requires the data scientist to train the algorithm with both labeled inputs and desired outputs. Supervised learning algorithms are good for the following tasks:

- **Binary classification:** Dividing data into two categories.
- **Multi-class classification:** Choosing between more than two types of answers.
- **Regression modeling:** Predicting continuous values.
- **Ensembling:** Combining the predictions of multiple machine learning models to produce an accurate prediction.

How does unsupervised machine learning work?

Unsupervised machine learning algorithms do not require data to be labeled. They sift through unlabelled data to look for patterns that can be used to group data points into subsets. Most types of deep learning, including neural networks, are unsupervised algorithms. Unsupervised learning algorithms are good for the following tasks:

- **Clustering:** Splitting the dataset into groups based on similarity.
- **Anomaly detection:** Identifying unusual data points in a data set.
- **Association mining:** Identifying sets of items in a data set that frequently occur together.
- **Dimensionality reduction:** Reducing the number of variables in a data set.

How does semi-supervised learning work?

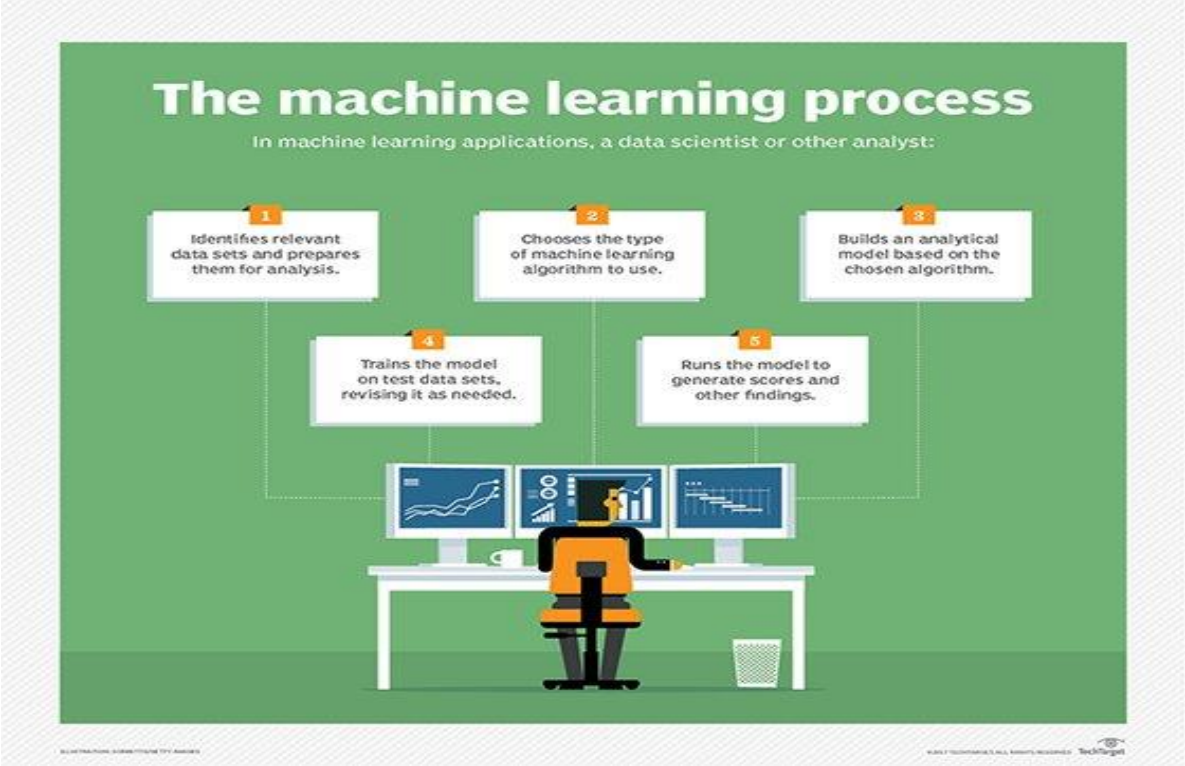
Semi-supervised learning works by data scientists feeding a small amount of labeled training data to an algorithm. From this, the algorithm learns the dimensions of the data set, which it can then apply to new, unlabelled data. The performance of algorithms typically improves when they train on labeled data sets. But labelling data can be time consuming and expensive. Semi-supervised learning strikes a middle ground between the performance of supervised learning and the efficiency of unsupervised learning. Some areas where semi-supervised learning is used include:

- **Machine translation:** Teaching algorithms to translate language based on less than a full dictionary of words.
- **Fraud detection:** Identifying cases of fraud when you only have a few positive examples.
- **Labelling data:** Algorithms trained on small data sets can learn to apply data labels to larger sets automatically.

How does reinforcement learning work?

Reinforcement learning works by programming an algorithm with a distinct goal and a prescribed set of rules for accomplishing that goal. Data scientists also program the algorithm to seek positive rewards -- which it receives when it performs an action that is beneficial toward the ultimate goal -- and avoid punishments -- which it receives when it performs an action that gets it farther away from its ultimate goal. Reinforcement learning is often used in areas such as:

- **Robotics:** Robots can learn to perform tasks the physical world using this technique.
- **Video gameplay:** Reinforcement learning has been used to teach bots to play a number of video games.
- **Resource management:** Given finite resources and a defined goal, reinforcement learning can help enterprises plan out how to allocate resources.



Who's using machine learning and what's it used for?

Today, machine learning is used in a wide range of applications. Perhaps one of the most well-known examples of machine learning in action is the recommendation engine that powers Facebook's news feed. Facebook uses machine learning to personalize how each member's feed is delivered. If a member frequently stops to read a particular group's posts, the recommendation engine will start to show more of that group's activity earlier in the feed. Behind the scenes, the engine is attempting to reinforce known patterns in the member's online behaviour. Should the member change patterns and fail to read posts from that group in the coming weeks, the news feed will adjust accordingly.

In addition to recommendation engines, other uses for machine learning include the following:

- **Customer relationship management.** CRM software can use machine learning models to analyze email and prompt sales team members to respond to the most important messages first. More advanced systems can even recommend potentially effective responses.

- **Business intelligence.** BI and analytics vendors use machine learning in their software to identify potentially important data points, patterns of data points and anomalies.
- **Human resource information systems.** HRIS systems can use machine learning models to filter through applications and identify the best candidates for an open position.
- **Self-driving cars.** Machine learning algorithms can even make it possible for a semi-autonomous car to recognize a partially visible object and alert the driver.
- **Virtual assistants.** Smart assistants typically combine supervised and unsupervised machine learning models to interpret natural speech and supply context.

What are the advantages and disadvantages of machine learning?

Machine learning has seen use cases ranging from predicting customer behaviour to forming the operating system for self-driving cars. When it comes to advantages, machine learning can help enterprises understand their customers at a deeper level. By collecting customer data and correlating it with behaviours over time, machine learning algorithms can learn associations and help teams tailor product development and marketing initiatives to customer demand.

Some companies use machine learning as a primary driver in their business models. Uber, for example, uses algorithms to match drivers with riders. Google uses machine learning to surface the ride advertisements in searches. But machine learning comes with disadvantages. First and foremost, it can be expensive. Machine learning projects are typically driven by data scientists, who command high salaries. These projects also require software infrastructure that can be expensive.

There is also the problem of machine learning bias. Algorithms trained on data sets that exclude certain populations or contain errors can lead to inaccurate models of the world that, at best, fail and, at worst, are discriminatory. When an enterprise bases core business processes on biased models it can run into regulatory and reputational harm.

How to choose the right machine learning model

The process of choosing the right machine learning model to solve a problem can be time consuming if not approached strategically.

Step 1: Align the problem with potential data inputs that should be considered for the solution. This step requires help from data scientists and experts who have a deep understanding of the problem.

Step 2: Collect data, format it and label the data if necessary. This step is typically led by data scientists, with help from data wranglers.

Step 3: Chose which algorithm(s) to use and test to see how well they perform. This step is usually carried out by data scientists.

Step 4: Continue to fine tune outputs until they reach an acceptable level of accuracy. This step is usually carried out by data scientists with feedback from experts who have a deep understanding of the problem.

Importance of human interpretable machine learning

Explaining how a specific ML model works can be challenging when the model is complex. There are some vertical industries where data scientists have to use simple machine learning models because it's important for the business to explain how every decision was made. This is especially true in industries with heavy compliance burdens such as banking and insurance.

Complex models can produce accurate predictions, but explaining to a lay person how an output was determined can be difficult.

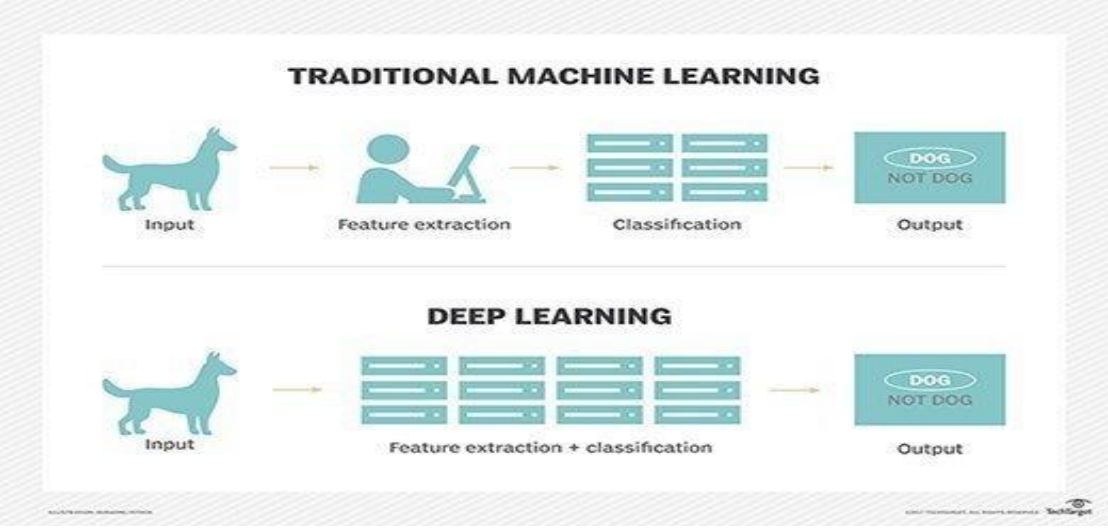
What is the future of machine learning?

While machine learning algorithms have been around for decades, they've attained new popularity as artificial intelligence has grown in prominence. Deep learning models, in particular, power today's most advanced AI applications.

Machine learning platforms are among enterprise technology's most competitive realms, with most major vendors, including Amazon, Google, Microsoft, IBM and others, racing to sign customers up for platform services that cover the spectrum of machine learning activities, including data collection, data preparation, data classification, model building, training and application deployment.

As machine learning continues to increase in importance to business operations and AI becomes more practical in enterprise settings, the machine learning platform wars will only intensify.

Continued research into deep learning and AI is increasingly focused on developing more general applications. Today's AI models require extensive training in order to produce an algorithm that is highly optimized to perform one task. But some researchers are exploring ways to make models more flexible and are seeking techniques that allow a machine to apply context learned from one task to future, different tasks.



How has machine learning evolved?

1642 - Blaise Pascal invents a mechanical machine that can add, subtract, multiply and divide.

1679 - Gottfried Wilhelm Leibniz devises the system of binary code.

1834 - Charles Babbage conceives the idea for a general all-purpose device that could be programmed with punched cards.

1842 - Ada Lovelace describes a sequence of operations for solving mathematical problems using Charles Babbage's theoretical punch-card machine and becomes the first programmer.

1847 - George Boole creates Boolean logic, a form of algebra in which all values can be reduced to the binary values of true or false.

1936 - English logician and cryptanalyst Alan Turing proposes a universal machine that could decipher and execute a set of instructions. His published proof is considered the basis of computer science.

1952 - Arthur Samuel creates a program to help an IBM computer get better at checkers the more it plays.

1959 - MADALINE becomes the first artificial neural network applied to a real-world problem: removing echoes from phone lines.

1985 - Terry Sejnowski's and Charles Rosenberg's artificial neural network taught itself how to correctly pronounce 20,000 words in one week.

1997 - IBM's Deep Blue beat chess grandmaster Garry Kasparov.

1999 - A CAD prototype intelligent workstation reviewed 22,000 mammograms and detected cancer 52% more accurately than radiologists did.

2006 - Computer scientist Geoffrey Hinton invents the term deep learning to describe neural net research.

2012 - An unsupervised neural network created by Google learned to recognize cats in YouTube videos with 74.8% accuracy.

2014 - A chatbot passes the Turing Test by convincing 33% of human judges that it was a Ukrainian teen named Eugene Goostman.

2014 - Google's AlphaGo defeats the human champion in Go, the most difficult board game in the world.

2016 - LipNet, DeepMind's artificial intelligence system, identifies lip-read words in video with an accuracy of 93.4%.

2019 - Amazon controls 70% of the market share for virtual assistants in the U.S.

WHY 5G?

K Sabarish, II-EIE

The first-generation network (1G) kicked off an era of wireless telecommunication technology. Although revolutionary during its time, it did not ensure security and was less efficient as it dealt with analog signals. Later came the 2G which was similar to the first generation. However, 2G utilized digital signals which meant better encoding, better efficiency and also had a comparatively longer spectrum allowing many more users in the network. With technology improving day by day and increasing connectivity, next generation network, 3G became a reality which offered speeds up to 200kbps followed by 3.5G which offered about 3 Megabits per second.

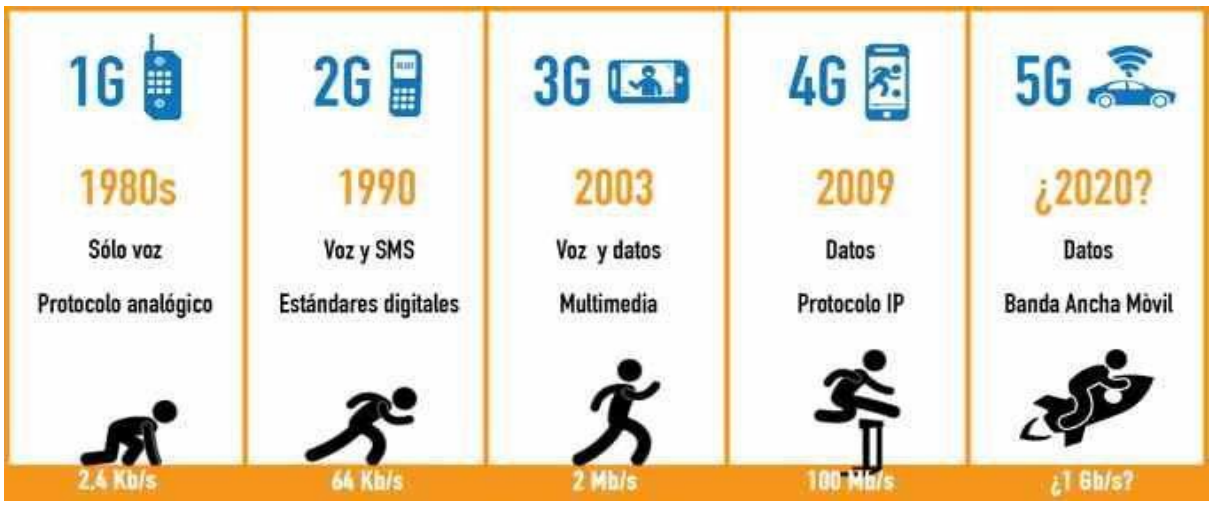
We currently live in the age 4G network. Providing speeds up to 100Mbps, 4G proved to be a breakthrough in communication technology enabling faster downloads along with high-definition video streaming and voice call.

With such great speeds in 4G, people may ask why 5G? The answer lies in: (i) connectivity, (ii) latency and (iii) capacity. Connectivity has been increasing at high rates with rise in population and newer technologies. Autonomous vehicles and artificial intelligence (AI) are said to reach its peak by 2030 and this could lead to very high traffic in the spectrum. In the year 2015, the traffic was about 1 Zettabytes (a trillion Gigabytes) per year and this is expected to increase to 4 Zettabytes per year according to the CEO of NOKIA, Rajeev Suri. Here's where 5G comes into play.

The 5G network uses 'millimetre wave' technology. This provides a much better spectrum and a much wide channel bandwidth of about 1-2GHz. However, this poses great challenges in terms of circuit design as current handsets work at 10-20 MHz and these waves can be almost completely absorbed by obstacles.

5G can be extremely helpful in the industrial sector and health sector. While the latency of 4G networks is about a 100ms, latency of 5G is less than 1ms! This proves extremely useful in the automation industry where very low response times are desirable. People can control machines for mining and other life endangering activities remotely more efficiently with this technology. Doctors in cities can communicate with those in rural areas by exchanging health records of patients and having live interactions with them especially at times of sur-gery and other emergency situations hence increasing life expectancy.

This technology is not expected to be developed overnight. The next phases include 4.5G pro, 4.7G, 4.9G and then comes the 5G which can deliver speeds greater than 1GBps. They are currently under research and testing by NOKIA and ERICSSON.



IoT Attack Trends and Mitigation:

D Teja Priyanka, I-EIE

Two years ago, IoT attacks were considered exotic, an aberration of interest mainly to those in the industry and conspiracy theorists. The recent ―teddy bear‖ data breach, which exposed more than 2 million children‘s and parent‘s voice recordings along with emails and pass-words, forcing IoT cyber security dangers to become a mainstream household concern. And the few who were still unaware certainly got the message earlier this month, with the WikiLeaks revelation of the CIA hacking tool that can turn Samsung TVs into eavesdropping de-vices.
The evolution of IoT malware mirrors that of PC-based malware, but at lightning speed. The first attacks were essentially pranks, tricksters seeing what they could do, like the 2012 ―Internet Census‖ powered by a botnet of 400,000+ embedded devices. Bad actors were quick to see the possibilities, leading to the Mirai botnet-based DDoS attacks on Dyn, Deutsche Telekom and others. The latest transition is the monetization of IoT malware by hiring out these botnets, ransomware or ad-click fraud providers such as the Linux/Moose botnet operators selling Instagram followers.

IoT attack trends

While these attacks may be minor compared to the mega-record, mega-expensive breaches we‘ve seen, the potential is huge. Gartner predicts IoT devices will reach an installed base of 21 billion units by 2020. And we‘re not just talking toasters, teddy bears and TVs — by 2020, there will be 250 million ―connected‖ cars on the road. This brings the problem to an entirely new level. Given the sheer variety of IoT devices and opportunities to exploit them, IoT attacks will develop in several directions.

DDoS attacks

As IoT expands so will IoT botnets — and their capacity to launch large-scale DDoS attacks. The Mirai DDoS attacks on the Dyn net-work were the most massive in history, with reported attack strength of 1.2 Tbps and taking down more than 80 major websites. Dyn‘s pre-liminary analysis found that tens of millions of discrete IP addresses associated with the Mirai botnet were part of the attack.

With the public release of the Mirai source code by its creator, hackers have already begun developing more virulent and broader reaching strains. Mirai is not a simple attack tool but a development framework. Additional capabilities such as new credential stealing, IP anonymization, persistency and traffic hiding will expand its attack potential. New Mirai strains will also likely include obfuscation techniques that make it difficult to track activity and expanded infection capabilities to target more types of devices.

IoT ransomware attacks

Until recently, IoT ransomware was all theory. At the 2016 DEF CON conference, researchers demonstrated they could infect smart thermostats with ransomware. And in a Bloomberg interview, GM of Intel Security Chris Young sketched a future where hackers demand a ransom before allowing a car owner to drive to work. That future has come sooner than anticipated. In January, attackers locked the electronic key system and computers of a four-star Austrian hotel, de-manding $1,800 in bitcoins to restore functionality. They paid up. One can easily imagine cybercriminals making similar ransom de-mands to unlock hacked medical devices such as insulin pumps or pacemakers. Ironically, one reason that IoT ransomware is not yet a bigger

problem is what makes IoT so difficult to secure — the variety of IoT de-vices and operating systems means hackers can‘t write ransomware that spreads superfast or easily.

IoT as attack vectors to enter an organization

As edge devices proliferate, so do the opportunities to gain entry into the wider network to which they are connected. Unfortunately, in the rush to get to market, many IoT device manufacturers neglect security aspects. Even manufacturers that are conscious of security issues might unknowingly embed insecure third-party components into their products. Many of the webcams enlisted by the Mirai botnet utilized electronic components from the same manufacturer

IoT for spying and surveillance

One of the most concerning IoT security issues is the ability to in-vade and expose our most private moments. First reported in 2014, tens of thousands of home security cameras are being hacked and streamed live online. In most cases, changing the default password blocks the feed. However, Senrio researchers discovered a security flaw in D-Link cameras that lets attackers overwrite administrator passwords, exposing thou-sands of users to hacks not only of their cameras, but the network it connects to.

Even more disturbing are the types of attacks revealed this month by the WikiLeaks CIA dump. Ac-cording to the documents, Britain‘s MI5 and the American CIA worked together to develop a smart TV app, Weeping Angel, that can turn televisions into spying tools. Targeting Samsung TVs specifically, the malware records audio from surrounding areas, including when the user has turned the set off. While it‘s unclear at what stage of development this particular project is in, the potential for hacks of this type, when used by malicious hackers, are enormous.

Vendors need to step up

Vendors have been slow to respond to the push for better IoT security, particularly more advanced penetration testing. However, they soon may find the financial consequences persuade them. In 2015, Fiat Chrysler recalled 1.4 million vehicles to install a security patch to prevent hackers from gaining remote control of the engine, steering and other systems. And the FTC recently filed a lawsuit against D-Link for ―failing to protect its customers against well-known and easily preventable software security flaws in its routers and IoT cameras.

IoT antimalware

Nascent IoT antimalware holds some promise, how-ever approaches that work for PC-based attacks will not work in the IoT world. The high level of device diversity and operating systems versioning pose a barrier for security vendors. Currently, most IoT security products focus on the network side, trying to detect and block attacks by analysing the traffic. How-ever, these techniques be-come less relevant when encrypted traffic is involved.

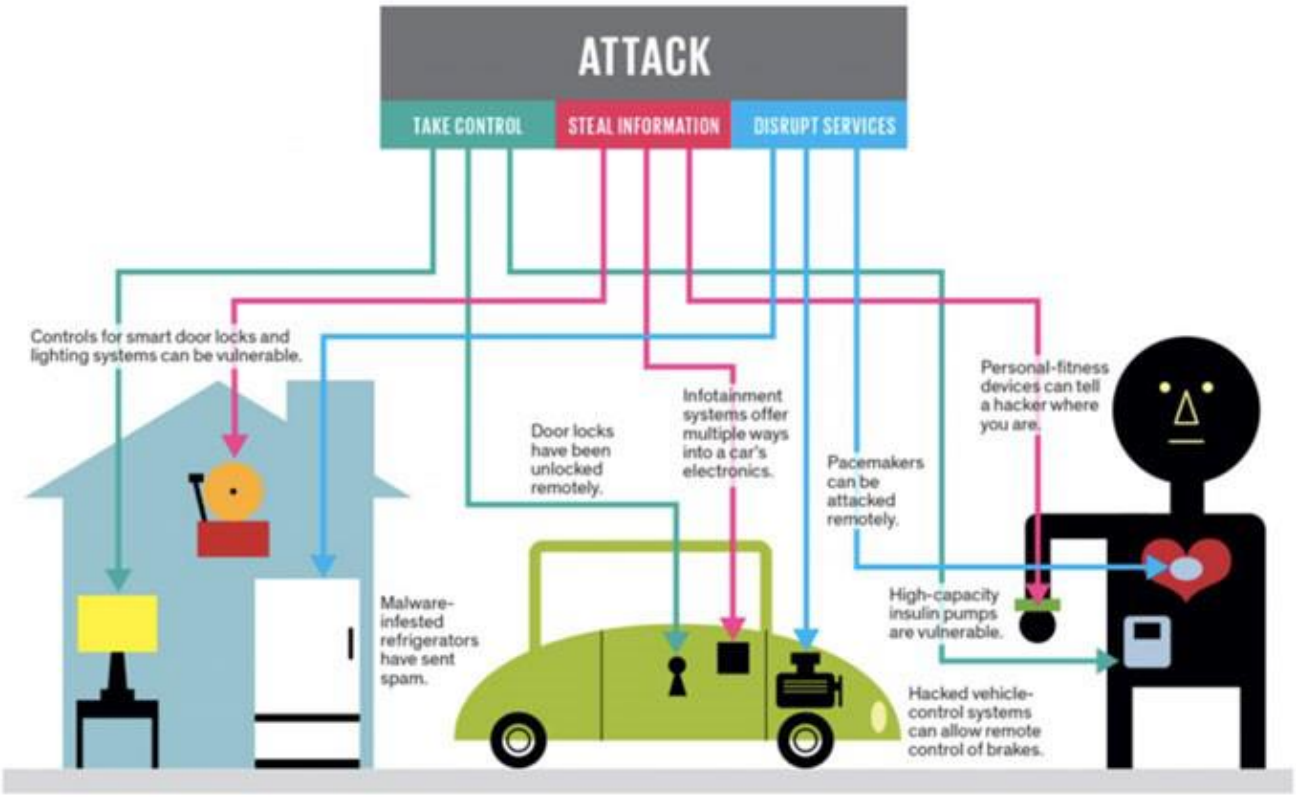


Illustration: J. D. King

WHAT IS BIG DATA

P Akhil Sai, I-EIE

The data lying in the servers of your company was just data until yesterday – sorted and filed. Suddenly, the slang Big Data got popular and now the data in your company is Big Data. The term covers each and every piece of data your organization has stored till now. It includes data stored in clouds and even the URLs that you book-marked. Your company might not have digitized all the data. You may not have structured all the data already. But then, all the digital, papers, structured and non-structured data with your company is now Big Data.

In short, all the data – whether or not categorized – present in your servers is collectively called BIG DATA. All this data can be used to get different results using different types of analysis. It is not necessary that that all analysis use all the data. Different analysis uses different parts of the BIG DATA to produce the results and predictions necessary.

Big Data is essentially the data that you analyze for results that you can use for predictions and for other uses. When using the term Big Data, suddenly your company or organization is working with top level Information technology to deduce different types of results using the same data that you stored intentionally or unintentionally over years.

How big is Big Data?

Essentially, all the data combined is Big Data but many researchers agree that Big Data – as such – cannot be manipulated using normal spreadsheets and regular tools of database management. Normally, for analysing data, people used to create different data sets based on one or more common fields so that analysis becomes easy. In case of Big Data, there is no need to create subsets for analysing it. We now have tools that can analyze data irrespective of how huge it is. Prob-ably, these tools themselves categorize the data even as they are analysing it.

Big Data Example – How NetFlix used it to fix its problems

Towards 2008, there was an outage at NetFlix due to which many customers were left in the dark. While some could still access the streaming services, most of them could not. Some customers man-aged to get their rented DVDs whereas others failed. A blog post on Wall Street Journal says Netflix had just started on-demand-streaming.

The outage made the management think about the possible future problems and the hence, it turned to Big Data. It analyzed high traffic areas, susceptible points, and network throughput etc. using that data and worked on it to lower the downtime if a future problem arises as it went global.

The above summarizes what is Big Data in a layman‘s language.

Big data is about the processing and analysis of large data repositories, so disproportionately large that it is impossible to treat them with the conventional tools of analytical databases. Some statements suggest that we are entering the ―Industrial Revolution of Data, where the majority of data will be stamped out by machines. These machines generate data a lot faster than people can, and their production rates will grow exponentially with Moore‘s Law. Storing this data is cheap, and it can be mined for valuable in-formation. Examples of this tendency Include, Web logs; RFID, Sensor networks; Social networks, Social data (due to the Social data revolution), Internet text and documents, Internet search indexing; Call detail records; astronomy, atmospheric science, genomics, bio-geochemical, biological, and other complex and/or interdisciplinary scientific research, Military surveillance, Medical records, Photography archives, Video archives, Large scale e-commerce

The trend is part of an environment quite popular lately: the proliferation of web pages, image and video applications, social networks, mobile devices, apps, sensors, and so on, able to generate, according to IBM, more than 2.5 quintillion bytes per day, to the extent that 90% of the world‘s data have been created over the past two years.

Big data requires exceptional technologies to efficiently process large quantities of data within a tolerable amount of time. Technologies being applied to big data include massively parallel processing (MPP) databases, data-mining grids, distributed file systems, distributed databases, cloud computing platforms, the Internet, and scalable storage systems. These technologies are linked with many aspects derived from the analysis of natural phenomena such as climate and seismic data to environments such as health, safety or, of course, the business environment. The biggest challenge of the Petabyte Age will not be storing all that data, it will be figuring out how to make sense of it. Big data deals with unconventional, unstructured databases, which can reach petabytes, exabytes or zettabytes, and require specific treatments for their needs, either in terms of storage or processing/display.

Companies focused on the big data topic, such as Google, Yahoo!, Facebook or some specialised start-ups, currently do not use Oracle tools to process their big data repositories, and they opt instead for an approach based on distributed, cloud and open-source systems. An extremely popular example is Hadoop, an Open-Source framework in this field that allows applications to work with huge repositories of data and thousands of nodes. These have been inspired by Google tools such as the MapReduce and Google File system, or NoSQL systems, which in many cases do not comply with the ACID (atomicity, consistency, isolation, durability) characteristics of conventional databases.

In future, a huge increase is expected in adoption, and many, many questions that must be addressed. Among the imminent research targets in this field are:

• **Privacy.** Big data systems must avoid any suggestion that users and citizens in general perceive that their privacy is being invaded.

• Integration of both relational and NoSQL systems.

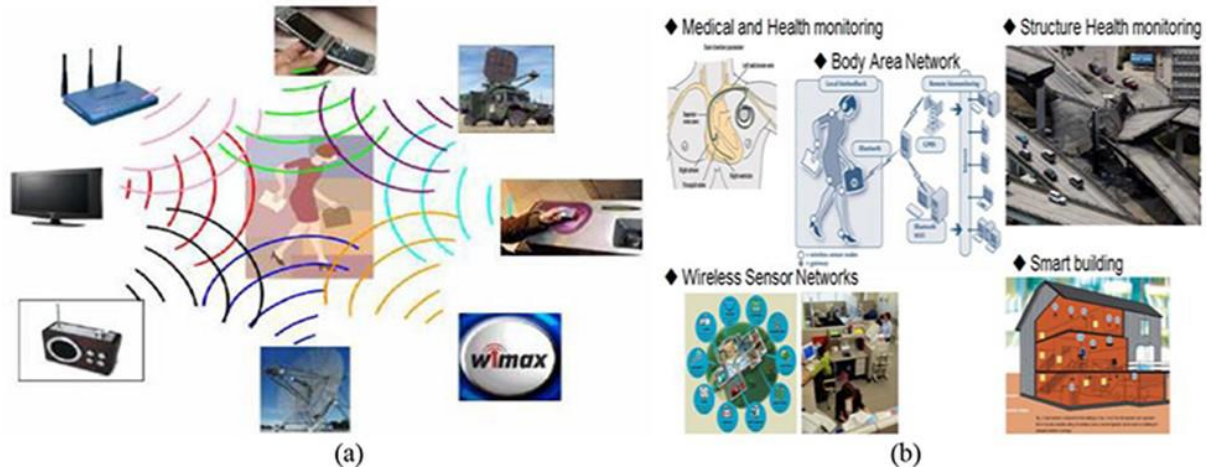
• More efficient indexing, search and processing algorithms, allowing the extraction of results in reduced time and, ideally, near to ―real time‖ scenarios.

• **Optimised storage of data**. Given the amount of information that the new IoT world may generate, it is essential to avoid that the storage requirements and costs increase exponentially.

RF ENERGY HARVESTING

A SNEHAJA, II-EIE

In the recent communication scenario, Internet of Things (IoT), Wearable Technologies, 5G Wireless Systems are the technologies for advanced research and applications. There is demand for devices/sensors, positioned at places beyond physical reach, capable of communicating wirelessly with each other. Such devices are equipped with processors, sensors, wireless transceivers, and power source (battery, super capacitor) to send or receive data and its applications span a wide range of fields including home automation, surveillance, transportation, healthcare, etc.



One of the main challenges of implementing such a device, which is connected anywhere anytime and could as well be wearable, is to supply adequate power for its operation. Replacing wires with batteries would lead to the tedious task of large number of batteries to be purchased, maintained, and disposed further causing pollution. So it is imperative to improve longevity and energy efficiency of such devices. Energy harvesting presents the most promising solution for the development of such wireless systems with limited battery usage.

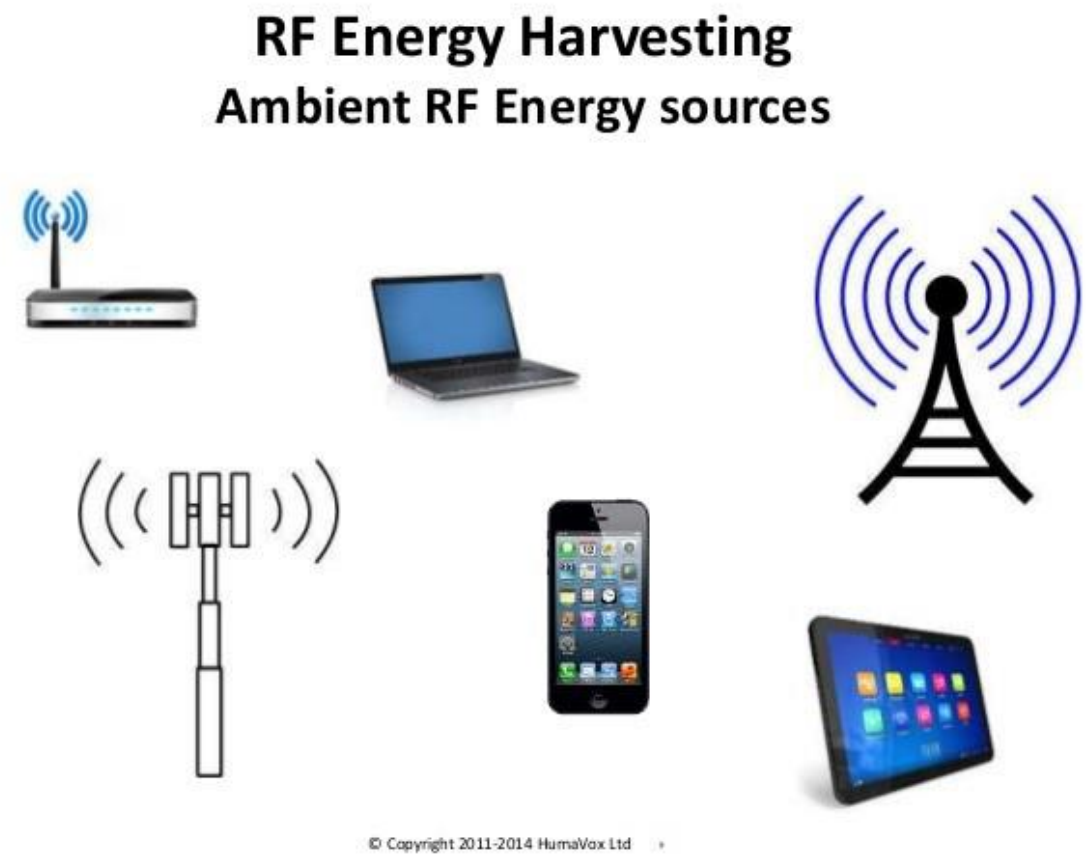
Energy harvesting means gather ambient energy and converting this into electricity to power various devices. Various sources of ambient energy are solar energy, wind energy, tidal energy, electro-magnetic energy, thermal energy, mechanical energy etc. Solar energy is the most abundant source available in nature, but it has a disadvantage that it is not available continuously. So for directed communication, RF is the widely accepted alternative to light due to the implied hazards on the human eye. It also provides 24 hour continuous supplies when compared to solar but its main limitation is its low power levels. The power density from various RF sources ranges from 0.1 (ambient RF) to 1000 (dedicated RF) μW/cm2. Various sources of RF energy are Wi-Fi, WLAN, Digital TV, AM, FM, Bluetooth etc. RF energy harvesting is the process of harvesting energy from RF signals. RF-EH is used for powering wireless sensor nodes, wireless charging systems and wireless body networks.

Devices distributed in wide area can be powered by RF energy. According to Friis transmission formula RF energy is attenuated according to the reciprocal of distance between transmitter and receiver. Even though effective energy transfer distance has increased, it suffers from low conversion efficiency for low input power.

Antenna is used for collecting the available ambient energy. Matching circuit is used for matching antenna to the rest of the circuit. Rectifier as the name suggests is used for converting RF signal into DC. However, the amplitude of the output signals is lower than the received signal amplitude. Antenna along with the rectifier circuit is known as _Rectenna. They are widely used for wireless power transmission systems. It determines the overall RF to DC power conversion efficiency (PCE). Harmonic suppression filters are used for removing unwanted signals generated by the rectifier.

RF signals from the environment, though act as source for energy harvesting, the output powers are so low that it cannot power even low energy devices. Improvements on power conversion efficiency is important as it will enable more current to be recycled so that it can even charge mobile phones and laptops. The possibility of using this harvester in energizing sensor networks appears to be the most practical use at the moment. RF energy harvesting provides optimum solution for powering low energy devices. Hence, it brings about trans-formative changes to 5G deployments by enabling autonomously powered devices without high cost. RF energy can be used as a re-placement for electricity enabling reduced use of this conventional energy. Thus, this type of energy harvesting is renewable and most feasible. It also enables the user‘s freedom of mobility by discarding the use of wires for charging.

The main challenge associated with the implementation of RF energy harvester is its low conversion efficiency. The requirement on rectenna is compact designs so that they can be embedded into any circuit.



Some of the challenges possessed by RF energy harvester is listed below

Antenna – It should be circularly polarized with wide bandwidth and high gain to provide a high output voltage.

Matching network- Matching network should be able to match the antenna and the rectifier circuit for input power, frequency, and load variations.

Rectifier – It should be able to provide high conversion efficiency for wide range of frequencies, for input power variations and should have low loss.

Low pass filter – It is used for rejecting the unwanted harmonics generated by the nonlinear device used in rectifier circuit. A low pass filter must be able to filter efficiently the unwanted harmonics even under frequency variations in wireless sensor nodes, wearable devices as well as implantable devices.

Formula for the success in GATE

P Venkata Sushma, II-EIE

GATE (Graduate Aptitude Test in Engineering) is a competitive exam conducted jointly by IISc Bangalore & 7 premier IITs and is considered one of the toughest exams in the country. The GATE Score can be used for admission to various postgraduate programs in Indian higher education institutes and by several Indian public sector undertakings for recruitment into entry-level positions.

This article briefly outlines my preparation for GATE 2021 Electronics & Instrumentation Paper. First of all this is one of the exams that should be not taken lightly. Appear for the exam only if you have genuine interest. I had plans for appearing for GATE as early as 4th semester though my preparation began only from the 5th semester. As a day scholar, there was no possibility for regular preparation and my studies for the same were limited to the semester breaks. According to our VRSEC syllabus core electronics subjects were mainly during the 2nd year. All the remaining subjects heavily depend on the knowledge of these subjects. So during the semester breaks, I tried to strengthen my basic concepts in electronics. This was relatively easy as we had an amazing faculty who ensured that we got our basics right. I did not go for any coaching classes as such. Instead, I relied upon the coaching material from different leading coaching institutes which were available online for free. I cleared my doubts with the faculty.

The most important part of the preparation is about 3 to 4 months before the exam. The exam is most likely to fall on the first week of February. The last stage preparation was strictly restricted to previous year question papers which helped me to familiarise with the basic pattern. The GATE paper is on 100 marks and 15% of the paper is general aptitude related questions and the rest are from technical section. We had our placement training sessions during the S7 sem break which mainly focused on GA (General Aptitude) questions. This was more than enough and I didn‘t have to specially prepare for the GA questions.

As indicated by the mark division a good percentage of the paper is dedicated for core subject related questions. These questions hold the key to improving the score. But the catch is that there is a negative marking scheme for wrong answers. Therefore, the first rule is to only answer if you are sure of the answer. Blind guessing will only serve to reduce your score and in turn affect you rank. Recently the examination model was limited only to the computer-Based model and it is important to attempt the mock test provided by the IIT hosting the exam. Else there is a chance that you will spend some time figuring out the rules of the test.

The final and most important thing is not to lose your cool during the exams. Speaking from my own experience with GATE 2021, I was shocked to find that the question paper was a lot tougher than I expected. I became a little nervous at first but fortunately I was able to calm down and focus on the paper. Actually, the questions were not really that tough. But it took me some time to realise it.

Good luck to all those who are planning to attempt the GATE exam.

ARTIFICIAL INTELLIGENCE AND DEVELOPMENTS

M CHANDANA, III-EIE

Artificial Intelligence (AI) is one of the major developments of our time. In particular, Machine Learning, and the implications that go with it, is shaking up many aspects of how we do things, allowing us to deploy AI software where we previously used a human or a more inefficient process. Sometimes this is to the consternation of people, particularly those who worry about AI systems and machine intelligence taking over human jobs, or perhaps the sci-fi scenario of AI being intelligent and organized enough to overrule humans. One thing we do know is that we've probably only scratched the surface in terms of what is possible. As Oracle EVP and head of applications, Steve Miranda said at a recent event, "Two years from now, we'll probably be talking about a whole new set of things in this category that probably none of us is even thinking about today." In other words, AI and its methods like Machine Learning are moving pretty fast. What we discuss today may not be what we will discuss in just a few years.

AI Robots Learning Through Observation

The mechanism through which AI "learns" is generally through training by humans or Machine Learning, where the bot learns by processing data by itself. For example, a bot might observe that you seem to go to the same place at the same time every day, and it may start to automatically look for traffic and weather conditions to provide you with an estimated driving time. A ground-breaking development in AI has been the development of robots' abilities to learn through observing the actions of humans. Nvidia demonstrated a robot that performs tasks in a real-world setting by watching how the tasks are done, a different and more hands-off mechanism from how robots are usually trained. If robots can learn through observing demonstrations, this has implications, particularly for the workplace and for carrying out physical tasks. Perhaps robots of the future will be in homes, observing how household tasks are performed and taking care of those? In another development along similar lines, a bot program called AlphaGo taught itself advanced strategies for playing the game Go, with no training from humans. This is further highlighting a growing trend of AI that is able to be independent from human knowledge.

AI Robot Caregivers Are Filling a Shortfall

How would you feel about being cared for by a robot nurse, or your elderly relatives being cared for by robot caregivers? Many countries throughout the world are heading towards a crisis in terms of having enough carers for aging populations. Particularly, as the large baby boomer generation reaches their elderly years, the shortage is predicted to be more pronounced. Artificial Intelligence is being developed to step in and make up for the shortfall. The Japanese government, in particular, is working on increasing acceptance of technology filling in for human nursing and caregiving roles. Japan is facing a predicted shortfall of 370,000 caregivers by 2025, and developers are focusing their attention on simple applications of AI technology. For example, a robot might help a person to get out of bed, or it might predict when a patient is going to need to use the restroom. Potential resistance to help from a robot is one of the issues researchers are working on. The next research priorities include wearable mobility aid devices and technology that guides people to the restroom at what it predicts is the right time.

AI Diagnostics for X-Rays

Medical technology is a field that's ripe for innovation from AI. Areas such as diagnostics traditionally rely on human intelligence and capabilities being able to read and interpret tests or imaging results. This naturally creates some kind of lag in processing and leaves open the possibility for human error. There are major challenges in the area of AI adoption for diagnostics. For example, the AI must be taught to correctly interpret results under human supervision, and it is difficult to teach the identification of rare pathologies, due to a shortage of images. A recent development has essentially "used Machine Learning, to do Machine Learning," by using computer-generated x-rays to augment AI training. As Shahrokh Valaee, a Google scholar stated, "we are creating simulated x-rays that reflect certain rare conditions so that we can combine them with real x-rays to have a sufficiently large database to train the neural networks to identify these conditions in other x-rays." This development brings the idea of AI actually taking the diagnostics role even closer.

Artificial Intelligence Trends in App Development

App development is not exempt from the most recent developments in Artificial Intelligence. Developers are using new and powerful AI tools to enhance the app development process as well as the User Experience. These are some of the most important ways in which Artificial Intelligence is impacting app development:

AI in Smartphone Apps

AI is making an appearance in a broad range of smartphone apps that are designed for everyday consumers. Gartner predicts that by 2022, 80% of smartphones will be equipped with on-device AI capabilities (compared to the 10% that have these capabilities right now). This makes Artificial Intelligence a key opportunity for developers of all types of apps. Here are just a few that are currently in use:

- **Google Assistant** – You can access your assistant by holding down the home button on your Android phone, or saying aloud, "Okay Google." From there you can send messages, check appointments, play music, and a host of other things hands-free.
- **Socratic** – Math help is here! Socratic is a smart tutoring app that can explain how to solve problems by analyzing a picture of the math problem.
- **Microsoft Pix** – Everyone wants to be able to take and share the perfect photo. Microsoft Pix helps by capturing ten frames per shutter click, using AI to select the best three, then deleting the rest, saving you storage space.

AI Advancements in the Healthcare Industry

The Healthcare industry is under the radar for providing accurate disease diagnosis, improved clinical decision making, and patient care. With innovative AI advancements, telemedicine is being openly adopted by more healthcare institutions for all-time patient care. Not just in the form of front-desk availability, telemedicine has also been incorporated into wearable devices for real-time information about patient data and telemedicine apps with useful features like text, video chat, screen sharing, and file transfer to book appointments, follow-ups, and prescriptions.

Another major advancement of AI has been COVID-19 vaccine production. According to the Brookings Institution, a non-profit American public policy organization, the aim is to add strongly immunogenic viral components that caused the immune system to respond and machine learning has helped a lot. According to experts, AI has the ability to identify viral components that have the necessary properties to stimulate the immune system. SYGFQPTNGVGYQPY is a fragment of the COVID-19 strain which the above-mentioned properties and this insightful discovery would not have been possible without machine learning developments.

AI Advancements in the Automobile Industry

Every discussion about purchasing new cars stops at self-driving cars. The growing popularity of autonomous vehicles, powered by AI is a topic under the spotlight. According to the prediction by PwX, 40% of mileage in Europe can be covered by autonomous vehicles by 2030. The US Department of Transportation also has the opinion that road freight, which is one of the largest carbon emissions producers in the world, can be controlled by self-driving trucks and cars. It can help optimize fuel usage and improve energy and time management.

MODERN ELECTRONICS WORLD

M PARTHIVE, II-EIE

'Electronics' is one of the most commonly used word in the world nowadays. Wherever we look now we will be able to see how electronics has revolutionized the world. Every task ls in our life can now be done in a simple and efficient way due to the evolution of the electronic world. Everything can now be made automatic be-cause of the innovation in electronics.

The different technological things such as mobile phones, television, computers etc which started as small innovations but now has become an important part in our daily life. There are people who depend very much on the electronic devices made but actually doesn't realise how it was achieved. If these inventions where not there it would have totally changed the world and things wouldn't have been running smoothly as it is now.

If we look closely we can see that the growth of the world is directly proportional to the growth of electronics and other technologies. Now we all prefer everything as small as possible that is when we take the case of mobiles we prefer maximum facilities with light weight features. This is one of the case where electronics plays it's vital role.

If we look back through the history of electronics we will be able to recognise it's marvelousness. Something very small like the transistor has played an important role in our life. It is one of the main invention which took over the world and made everyone realise how vast electronics is and how much more it can provide.

Now take the case of computers. The first computers where very large and would take up the space of two rooms. But now due to the evolution in electronics world we were able to make computers in a size very small that now it can be carried any-where easily. Now every electronic product is marketed on its size.

Day by day due to the new innovations in electronics we are able to reduce every-thing to size in the range of nanometres and make different things which were thought as impossible once. So electronics has really proved that nothing in the world is impossible.

Even if we take a look at the recent events, we can see a high-tech artificial robot named Sophia was given citizenship in Saudi Arabia. It is something that was thought impossible but due to the development of nanotechnology and electronics we were able to achieve a different level of application and make everything possible in one-word electronics can now simply be called as the 'FUTURE' because everything that is yet to come and surprise all of us will be from electronics that's for sure. The only thing we have to do is expect the unexpectable.

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