DEPARTMENT OF COMPUTER SCIENCE
UNIVERSITY OF DELHI

SRIJAN

‹ INTELLIGENT EXPRESSIONS /›

VOLUME 10

ABOUT SRIJAN

Srijan is the annual magazine of the Department of Computer Science, University of Delhi. It is launched every year at Sankalan.

Srijan literally translates to 'creation'. In the context of this magazine, it is the creation of new ideas, advancements and technologies in computer science and its allied disciplines.

Begun with the aim of presenting the latest developments in technology in a concise manner, Srijan has since evolved to provide not only a complete roundup of the emerging tech and research, but also examine their consequential social and psychological effects. With the intent to create a comprehensive journal unraveling the mysteries behind mind-boggling innovations, we present the most exciting inventions of 2020.

And since all work and no play makes Jack a dull boy, we also showcase the key co-curricular activities at DUCS, highlighting glimpses of annual events held on campus.

This year, Srijan showcases novel technologies being developed around the world, while also elucidating advances made in existing ones. Innovations gaining rapid integration in society are examined, and the magazine speaks of all the current development in computer science around the world.

FROM THE HEAD'S DESK

Prof. Neelima Gupta

Head of Department

The developments in computer science seem to be ceaseless as evident by the phenomenon of our lives being integrated with innovation swiftly. The products or the ideas that we have today seemed like a distant future not long ago. And the ones that may fill some people with scepticism today might be the ones creating a revolution in research and technology tomor-

From Google's push towards Quantum Supremacy to the much-hyped Blockchain and "Ethical AI", last year has once-again been mired with buzzwords revolving around new and technologically impactful innovation. Other than elaborating on the above mentioned buzzwords, this issue of Srijan covers a diverse range of topics. It talks about the real-world impact AI is making on Healthcare, along with fundamental innovations and practical deployments such as the IPFS and SpaceX's Starlink, which are slated to revolutionalise the internet experience for billions of users around the globe.

As a person devoted to the furtherance of the dynamicity of this field, it gives me immense pleasure to see the students not just be involved and engrossed in computer science as an academic discipline but to be actively interested in putting their thoughts, understanding, and knowledge of the latest research into words. As responsible members of the society, it is also important to analyse and scrutinize details of every break-through that we come about. It is heartening to see the students have an independent perspective as they share their constructs.

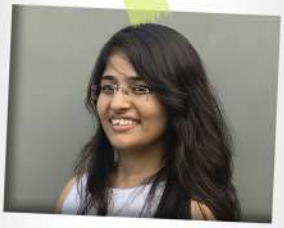
Kudos to the authors,the editorial and the desigining team for compiling this issue. I sincerely hope that Srijan will cover contemporary topics for its readers as we move forward in this next decade.

Team SRIJAN 2020

Swati Gautam
Chief Editor

Nitin Kumar
Chief Designer

Ronak Aggarwal
Senior Editor



Shruti Katyal
Senior Editor

Arpita Saggar
Editor

Diksha Gupta
Editor

Kajal Gupta
Editor

Kritika Singh
Designer

Shoaib Asgar
Designer

Vasu Sehgal
Designer

TEAM

FOREWORD

The Editorial team of DUCS takes immense pleasure to announce the 10th volume of Srijan successfully, with all new enthusiasm and zeal towards a new era of computer science.

Keeping the ever-expanding sphere of technology in mind, we've tried to keep the content boundless, imaginative and inquisitive. A variety of topics like Blockchain, Edge Computing, Cyber Security, Quantum Computing and many more will keep you intrigued.

We profusely thank all the authors for their contribution to this magazine. Your willingness to share and spread knowledge has made this magazine possible.

We hope you enjoy reading this year’s magazine.

INDEX

Ethics & AI

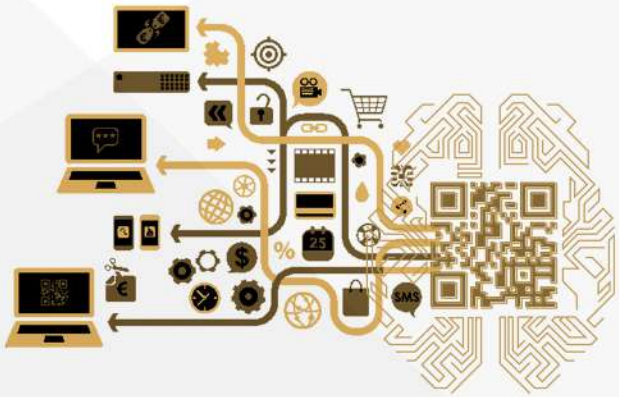
Arpita Saggar
MCA 1st Year

The pursuit of building machines that can replicate true human behaviour has been a relentless and unfruitful one for the past few decades, yet there is evidence to suggest that this dream may become a reality far sooner than one might imagine. While the task of successfully passing a Turing test remains the hardest challenge for building such a system, the more pressing matter is how we control and regulate it. If indeed the ambition of an independent, self-conscious AI is realized, what ethics should govern its operations? Which morals apply to the machine – those of its designer or those of its consumer? The 2012 film 'Robot and Frank' offers some insight (Spoiler Alert!). The film tells the story of retired cat burglar Frank, who suffers from dementia, and is given a robot butler to help him around the house. Eventually, Frank trains his robot to pick locks and help him commit robberies. The robot agrees to be an accessory to theft, simply because planning the robberies helps stimulate his owner's otherwise deteriorating brain, even helping him get rid of evidence in order to avoid prosecution. Would such a situation be considered 'good judgement'? The robot did act in the best interests of its owner. But perhaps various law enforcement agencies would disagree.

Teaching morals to a machine is an arduous task, because humans themselves stand on shaky ground when it comes to describing what constitutes a 'sound' moral character. Our decisions are often governed by our worldliness and emotions, as opposed to machines which use cost-benefit analysis. How then, does one combine the best of both worlds to build an AI that can integrate itself seamlessly into our society? The difficulty lies in the approach that should be adopted to replicate human morality. Researchers at MIT have developed 'Moral Machine', a platform that crowdsources human perspectives pertaining to moral dilemmas, while developers of the 'Quixote' AI at the Georgia Institute of Technology have turned to literary works to teach machines socially acceptable behaviour.

Can either of these approaches be deemed ideal? We've already established that human morality is fickle. But what about fiction? Is the protagonist of every story perched on the moral high ground? A quick look at Macbeth or The Picture of Dorian Gray will prove that untrue. Such approaches are sensible but are not without flaw. Indeed there is no foolproof technique (yet) that can master the impartment of ethics. Yet, the situation isn't entirely hopeless. Treating an AI as an autonomous, self-thinking agent rather than a program might prove beneficial. This would mean not just maintaining and troubleshooting a machine, but also nurturing it like a fellow human.

The question remains if there will ever be a perfectly moral AI, especially since there isn't a human with perfect morals. If the creator isn't perfect, does that imply that neither will be the creation? Perhaps some questions are best left unanswered. As machines become increasingly ubiquitous in our daily lives, the price of absent morals could negatively affect the lives of billions. Forging true artificial intelligence will by no means be an easy task, but nonetheless one worth pursuing



Computing at the Edge

Bharat Sardana
M.Sc. 1st Year

Rather than delving straight into the wonders of futuristic technology, let us commence with a mythic tale.

An ancient story set during the reign of King Robert recounts the wisdom of one of his courtiers, Lord Varys. Renowned for his astuteness, Lord Varys was responsible for the preservation of peace in the kingdom. With help from his 'little birds', he would gather information on all the events occurring in the realm, then filter out the critical matters and only present those to the palace council. However, as the king expanded his territory, Varys found himself incapable of sifting through and resolving every trivial affair. Exasperated, Varys decided to upgrade his helpers, by replacing his 'little birds' with people. By delegating responsibility to them for resolving minor scuffles, and only presiding over crucial situations, Varys helped restore order and harmony in the kingdom.

The above story provides an intuition into the principle behind the paradigm known as 'Edge Computing'. On replacing the council, the 'little birds' and Varys' employees with a server, dumb terminals and smart devices respectively, the connotation becomes apparent.

Edge computing is a distributed programming paradigm, which aims to shift intelligence towards the data generating edge of the network. By exploiting network gateways and smart devices to perform computations on behalf of the cloud, it helps a network improve response time and save bandwidth.

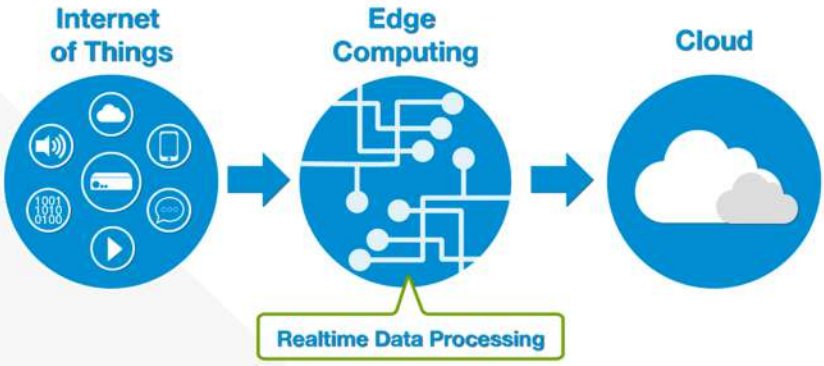
Prior to the adoption of edge computing, devices would collect data and upload it on the cloud, which would then perform all required computations and send back the results. However, as computational capabilities improve, most modern devices can afford to spare adequate resources to perform the requisite computations by themselves. For instance, driverless vehicles have more than 50 CPUs, which can implement the most essential tasks without any assistance from the cloud. In this particular example, latency cannot be tolerated, making edge computing a necessity. With the growing omnipresence of IoT devices and the ever-increasing production of data, network bandwidth is reaching its limit, making it difficult for the server to respond quickly.

Consider this scenario. Suppose there are ten surveillance cameras in a building, that record and send live footage to a cloud server. The cloud detects motion in the video, checks for intruders and then executes necessary action. However, in a housing society, thousands of such cameras would be required, which may cause the network capabilities to fail and the traffic to cause latency. In such a situation, replacing regular surveillance cameras with smart cameras could prove to be much more efficient. These cameras monitor the environment and only connect to the server when motion is detected, drastically reducing traffic on the network and consequently improving network speed.

Innovations such as driverless cars, IoT devices or AI-enabled applications, which demand low latency, high resilience, and proximity to users, cannot work efficiently with the existing cloud computing paradigm. IoT systems operate differently as compared to existing data center workloads since they create massive datasets which are not suitable for transmission over the cloud. With 5G ready to infiltrate the network industry, in-house edge servers could radicalize communication. Addition of an intelligent layer (mini datacenter) to control all local equipment would significantly reduce the burden on the central server.

Edge Computing allows decentralization of intelligence and resources, which increases the security and privacy of the system, and reduces load on the server. While this approach is beneficial in many cases, it is not without flaw. Multiple intelligent nodes imply multiple configurations, which pave the way for erroneous configurations. This may result in significant financial loss. Additionally, replacing an outdated, unintelligent device with a smart one may increase vulnerability, since the new device is a computer itself and can be compromised.

Nevertheless, edge computing is an essential constituent of many industries today and is helping shape upcoming technology as well. It has gained wide acceptance in the industry and it is here to stay until better solutions are found.



Introduction to IPFS

Kajal Gupta
M.Sc. 1st Year

Imagine a world where streaming a high-quality video on YouTube suffers no buffering, disrupted internet connection doesn't refrain you from working and where governments can't block sites on their whims or shut internet services down.

What are the issues with the current Web?

1. **Enormous Data** — With the advent of the internet, humanity has collected nearly 130 exabytes of data. This data is exponentially growing with the growing number of internet users. This means that we will have more people streaming a significant amount of data on channels that are not scaling at the same pace. This would create congestion. Even addition of hardware would not be able to solve this problem at one point in time.

2. **Centralized** — The current web is centralized. There is a single point of failure. This can lead to internet censorship by an organization. Such an organization would be able to take advantage of the monopoly granted to it by having control of this centralised resource. Services could be controlled or even shut down.

Clearly, problems exist. A solution to these problems is the use of a brand new internet protocol, the Interplanetary File System.

IPFS

Juan Benet in 2014 designed an Internet Protocol commonly known as IPFS or Interplanetary File System with the objective of removing duplications across the network, keeping data indefinitely and acquire addresses to the information stored on computers in the network. The HTTP is location-oriented as it fetches information by pointing to locations. But IPFS is resource-oriented i.e. it points to the resource and fetches information in parts from different machines over the network making it decentralized.

Consider a situation where you are sitting in a classroom with 100 students and everyone is asked to stream the same 4k video on YouTube. The video will be retrieved from the closest YouTube server to each of the 100 machines. Everyone would end up requesting and receiving a large amount of data over long distances, congesting the network.

Using IPFS in the above scenario, the students would fetch the video from one another, thereby, making a 4k video stream bufferless using fewer resources than the inefficient method used by HTTP above.

But how is IPFS different from the BitTorrent protocol? BitTorrent has a separate group of users who share a single file or torrent. If a video exists in two different languages then there would be two swarms(peers sharing a torrent). They would not be able to share anything although both the swarms are carrying the content that is 99% identical. With IPFS, the entire World Wide Web can be contemplated as a huge torrent file that is shared by everyone. Also, BitTorrent does not support all data types and it contains duplicate data which adds up to the data congestion problems.

IPFS generates a unique cryptographic hash for every file submitted to it that depends on the content and hence achieves deduplication of data. It tracks version history that pre-empts information from being easily removed.

Misconceptions about IPFS

1. **Data stored on IPFS is persistent** — Using cryptography, IPFS stores data on the network as long as the network believes that it is beneficial to do so. IPFS encourages data storage using cryptocurrencies like Filecoin.

2. **IPFS is built on Blockchain** — IPFS uses architectural elements similar to Merkle Trees but they are meant to work together with prevailing Blockchain protocols and not build on top of them. Blockchain provides public verifiability of data whereas IPFS provides public accessibility of data.

Are there any applications with IPFS and Blockchain?

1. **Intellectual Property** — Arts, music, programs, source code, etc face the problem of plagiarism. IPFS and blockchain can encourage content creators by providing a comprehensive ecosystem for them to work on. Revenue channels, in this case, can be driven by smart contracts, identity protection, a reputation-based collaboration network and more.

2. **Social Networks** — Blockchain and IPFS can provide users with an absolute decentralized social networking experience where content creation can be awarded cryptocurrencies. Example, Akasha and Steemit.

3. **Free E-commerce** — Unlike traditional e-commerce sites like Amazon and e-Bay that charge fees for registering or selling items, an online marketplace can be created using IPFS that would not be centrally controlled and hence would not charge merchants. The trade would be peer-to-peer without any middleman. OpenBazaar being an example.

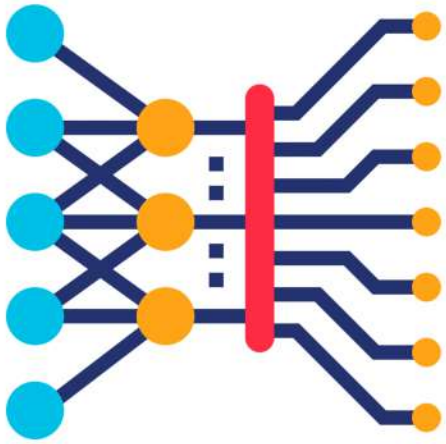
4. **Cryptocurrencies** — Since a massive amount of data storage around the world sits unused, one could use it to store data for IPFS and gain credits in the form of FileCoin or other such cryptocurrencies. These transactions are stored in blockchains.

IPFS is a conceptually and technically complex protocol that has soaring ambitions to revolutionize the way data is exchanged across the Internet. There is no doubt that HTTP helped the internet become what we know it as today. But, with emerging technology and the need for a distributed infrastructure, IPFS will certainly work better.

Molecular Machine Learning

SAACHI
M.Sc. 1st Year

In the era of rapidly advancing frontiers of science and technology, the interaction of machine learning with various domains and fields is not at all surprising. Significant improvements and developments are being made not only in the mainstream research concerned with machine learning and artificial intelligence, but also in the fields of computational chemistry and molecular biology. In recent years, the advent of sophisticated deep learning and machine learning methods in molecular studies has grabbed the interest of various researchers and scientists. Their perspective and creativity garnished with a spoonful of knowledge and learning has paved its way to molecular machine learning.



What is Molecular Machine Learning?

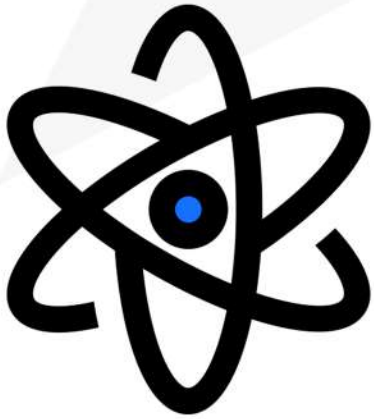
The profound use of machine learning and deep learning methods integrated with statistical analysis in chemical modelling and predicting the composition of the structures in molecular studies defines molecular machine learning. It defines a whole new approach to construct and reshape the properties of molecules. It's going to revolutionize the way molecules are studied, much more than one could ever describe.

Data is the primary resource for all the learning algorithms. Thus, molecular machine learning methods are capable enough to predict a range of properties of a chemical structure based on the available data. The data for the molecule-based learning is highly heterogeneous and extremely expensive to gather in large amounts. Moreover, the imprecision and unstructured format requires enormous pre-processing to be performed along with a mastery in that domain.

For example, the inorganic crystal structure database (ICSD) currently contains 188,000 entries, which have been checked for technical mistakes, but are still prone to human and measurement errors. The removal and identification of such algorithms is necessary for relevant conclusions. The pre-processing component should be able to represent this data in a form from which a machine could understand and learn.

Molecules are a bunch of atoms chemically bonded together. Generally, a computer would not be able to understand it this way. Thus, the molecules are fed into the datasets in the form of SMILES (Simplified Molecular-Input Line-Entry System) strings and occasionally 3D coordinates are also used to represent the molecule features. SMILES have five syntax rules and predefined notations which can be incorporated using ASCII characters.

The length sequence of ASCII characters for different molecules need to be the same to ease out further computations. For this, the ASCII characters (particularly the chemical formula) are represented as a stream of vectors to the training or testing set, this technique is known as molecular featurization. After the pre-processing of data is performed, the data is fed to different machine learning algorithms for distinct tasks. To name a few - Regression and Classification algorithms like Decision trees, Naïve Bayes, Random forest and Reinforcement learning algorithms. The choice of the learner is important based upon the domain knowledge and independent and target variables. Thus, by constructing a hypothesis, it can meet the demands in medical sciences.



Applications

Exploring the field of molecular studies using machine learning algorithms has many applications, some of which are listed below:

- **Discovering materials and their features:** Machine learning has made it feasible to discover new drugs and the crystal structure of broader range of solids. The developments have led to remarkable improvements in medical sciences and research. Also, it has tremendous application in predicting the properties of a large number of elements in order to examine their behaviour.

- **Decreased development time:** The slow progression in the field of medicinal science has caused many failures. On an average, it takes about 10 years to formulate a raw chemical structure to its final composition. On the other hand, their formulation can be accelerated with the help of knowledge captured by machine learning algorithms saving a lot of time and money.

Explainable
ARTIFICIAL INTELLIGENCE

Anurag Joshi
MCA 1st Year

Introduction

We have seen how powerful and accurate an AI system can be, but it is so, at the cost of them being black box models as they lack the virtue of explainability. Explainability in AI has become a hot topic for researchers these days. Development in explainable AI is certainly very important for us to understand and become more trustful of the decisions a machine took for us.

Explainable AI (a.k.a. XAI) is a field that is rapidly emerging nowadays. It aims to explain how "black box" AI and machine learning models are actually able to make complicated decisions for us. It is inspecting and trying to understand all the steps and models that involve decision making. And thus, it is expected of XAI to answer questions like - Why a specific AI or machine learning model makes a certain prediction? When would it fail or succeed and with what probability would it do so? Or when can we really have enough confidence in the decisions made by a machine for us?. These questions are still a few of many.

Explainability Vs Interpretability in AI

Before we go on any further we need to understand the difference between explainability and interpretability in AI. In the machine learning context, explainability and interpretability are generally used interchangeably. But there exist subtle differences between them that might be worth knowing about. Interpretability can be defined as the extent to which one can predict a model's result without trying to understand the reasons behind the predictions. So it can be said that it is easier to know the reason behind certain predictions or decisions if a model has higher interpretability.

On the other hand, explainability is the extent to which the internal working of a machine learning or deep learning system can be explained to humans. To understand the difference better, think of it like this - interpretability is about being able to know the mechanics of a model without being explicitly told and explainability is the ability to clearly explain what is happening in a model and how does it work.

How to achieve explainability in AI models?

Explainability in AI, in a way, can be gained by using machine learning algorithms that are inherently explainable. Algorithms like decision trees and bayesian classifiers have both traceability and transparency upto a certain level in their decision making. This could readily provide the visibility needed for AI systems without sacrificing much of accuracy or performance.

But these days we have more complicated and potentially more powerful models such as neural networks, ensemble methods (e.g. random forests), that in general, sacrifice transparency and explainability for better accuracy, power and performance. Therefore, for explaining such complicated models we go for other more complex algorithmic approaches, some of which we will see below.

In order to develop explainable machine learning and deep learning systems we can use any of the two main sets of techniques; ante-hoc and post-hoc. Ante-hoc are the set of techniques which introduce explainability into a model from the very beginning. Post-hoc techniques are just the opposite of ante-hoc, that is, they allow models to be created and trained normally and only at the testing time the explainability is introduced in the models.

Ante-Hoc Methods :

1) Reversed Time Attention Model (RETAIN):
This model was created at Georgia-Tech to help doctors understand an AI software's predictions.
The data of patients' hospital visits was fed to 2 RNNs equipped with attention mechanism. This exercise was conducted to understand and explain the focus points of the neural network and the features that influenced those choices.

2) Bayesian Deep Learning (BDL):
We could measure the uncertainty of a neural network's prediction using BDL. BDL forms uncertainty estimates by either learning a direct mapping to probabilistic outputs or by placing distributions over model weights. We can figure out the path that led to the decisions taken by the model by employing weight distributions of various predictions and classes.

Post-Hoc Methods:

1) Local Interpretable Model-Agnostic Explanations (LIME): LIME is not confined to a single domain. This ability gives it an edge over RETAIN. LIME provides the explanation after a decision has been made, and thus can not be called a purely transparent model. For instance, in an Image classification problem (using CNN), LIME obscures different areas of the original image and feeds the result into the model to see what part of the input deviated the algorithm and derive reasoning behind such deviations.

2) BETA: BETA is considered to be closely related to interpretable decision sets. To explain the part of the model behaviour unambiguously, BETA learns a compact 2-level decision set. BETA uses an objective function which helps the learning process in having high fidelity (agreement between explanation and model), high interpretability and low unambiguity. All these aspects are combined into one objective function which is optimized.

It has been witnessed that the success of AI models is mostly due to their complex internal representation of features, which also leads to their inexplicable nature. There are various kinds of on-going researches, even by leading companies like Google and DeepMind to make AI more answerable. But a tradeoff between accuracy and explainability will always exist. Factors like the field of application, kind of end-user and legal liabilities would weigh in. Blindly following AI systems without trying to understand the reasoning behind them is not beneficial. Interpretable and flexible AI models should be built that work well in collaboration with experts and their domain knowledge.It has been witnessed that the success of AI models is mostly due to their complex internal representation of features, which also leads to their inexplicable nature. There are various kinds of on-going researches, even by leading companies like Google and DeepMind to make AI more answerable. But a tradeoff between accuracy and explainability will always exist. Factors like the field of application, kind of end-user and legal liabilities would weigh in. Blindly following AI systems without trying to understand the reasoning behind them is not beneficial. Interpretable and flexible AI models should be built that work well in collaboration with experts and their domain knowledge.

3D STACKING

ABHINAV KUMAR
M.Sc. 2nd Year

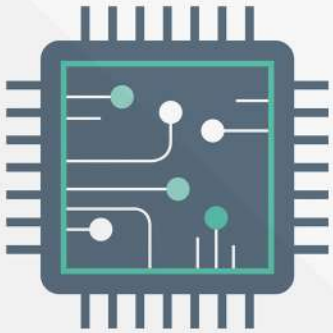
Microprocessor companies are investing billions of dollars in R&D to create innovative and revolutionary technologies that could bring Moore's law to its saturation point. As more and more devices are going handheld, companies have to decide whether to provide mobile phones with a slightly bigger headphone jack at the cost of miniaturizing internal components of the battery.

To tackle this problem of blockage, major microprocessor giants are coming up with a new form of circuit fabrication packaging which does not require discrete removable auxiliary components such as RAM. For instance, in 2019, AMD and Intel unveiled chipsets based on this paradigm. AMD called it their chipset design and Intel named it FOVEROS, with the code name 'LakeField'. These kinds of CPUs are more likely to come in HPC(High Performance Computing) and server parts than in the mainstream consumer market.

Last year, Microsoft confirmed that their revolutionary two screen folding android smart-phone - 'Surface Duos' would come equipped with chipsets of the same design. It probably was more of a marketing move to lower the market share that Qualcomm has with their ARM based chips(like 8cx) which are specifically designed for these devices. Intel's implementation had one flaw. Instead of having a direct interaction between the processors and memory, stacked like floors of a building, the memory addresses and content had to be passed by lift like pillars in the 3D packaging. This was being achieved with one logic box layer storing content from memory in a manner similar to buffer cache in UNIX systems. But, it hardly differed from Intel's previously announced 2.5D technology which had video memory instead of main memory.

Nevertheless, they managed to motivate others in the industry to come up with their own implementation, the kind of research that would eventually help the consumer. We should be excited for the day that would bring an ecosystem where we can have a set processor from different vendors that we would be able to stack on to one another. This stack would have better combined performance instead of getting bottle-necked by the caches provided by a single processor which is fixed for its lifecycle. This would probably seem to be a bit limiting to a company since they might lose monopoly on their product. But, as past is evident, this was the main selling point for ARM processors because manufacturers had the flexibility in creation. This is why you can never spot anybody holding a phone that has Intel CPU. It might have Intel's modem (iPhones for instance) but not Intel's CPU. Intel has remembered the lesson that this mistake taught indeed. They have played a great gamble on foldable devices to perhaps create the next gen that people could switch to after phones.

In conclusion, System on chip(SOC) design needs to have different subsystems for encryption, modems, and so on. A space efficient technique is required to contain cost that would otherwise blow the roof. 3D stacking could minimize the cost and help Intel gain a much-needed market share in portable devices which would help the consumer get a better product!



Cellular Technology

Mansi Saxena
M.Sc. 1st Year

Generation Gaps You might know what a 4G or 3G supported mobile phone is and you might own one as well. But, have you ever wondered what exactly is this number followed by the letter 'G'? Between the conversations around the lines "My mobile is better because it supports 4G and yours doesn't"this single-digit gap is what we can probably call a generation gap. The designation of a number followed by a 'G' represents generations of evolution of the wireless networks. It can be considered similar to what we have as 1st generation heir, 2nd generation heir and so on.

G starts with 0, not 1 !! Now that we know that these generations differ, let us dive in a little deeper. A lot of people do not know that wireless generation starts with a 0G and not 1G. Strange, right? The reason is actually quite simple. During the onset, 0G was a pre-cell phone mobile telephony tech, say radios and does not exactly relate to cell phones in today's terminology, this pretty little fact is lesser-known. Progress in technology and endless curiosity later gave birth to a better version of 0G, known as 1G. This generation included only voice calling signals, worked on analog cell phones and supported NMT (Nordic Mobile Telephone) and AMPS (Advanced Mobile Phone System). With this aeon, we were able to do basic voice-over call. But we needed more, hence we came up with 2G and 2.5G. They brought us the world of data signals and CDMA, EDGE, TDMA, GSM, and GPRS. Boom! Now you can use the internet. Satisfied? Not yet. 3G brought us a better internet usage version and video calling services with WCDMA, and UMTS. Later on, enhancements in protocols, IP based services, and VoLTE brought to what we have now, the 4G.

Into 5G Think we are done yet? Of course not. This brings us back to the topic- 5G. To say that 5G is a mere extension of 4G would be an understatement. But, at the same time, it is not an entirely new technology that is just coming to the surface. An organization known as the 3GPP (3rd Generation Partnership Project) is responsible for construing guidelines which govern generation standards for wireless systems. It was established to help delineate global benchmarks for 3G cellular networks 20 years ago. The 3GPP presents, what are termed Release Documents, every few years that outline the various core capabilities of wireless networks of subsequent generations. The latest release document, Release 15, was published in June 2019 with several fresh, noteworthy enhancements, including a comprehensive illustration of the 5G NR (New Radio) standard, which constitutes the groundwork of 5G capability. The next 3GPP document is underway and the new edition is anticipated in June this year. Therefore, it is not exactly an extension to 4G but a catalyst in the economic growth where AI and IoT will play a huge part.

The world today is moving towards digitisation faster than ever. Owing to easier accessibility to technology we're witnessing an escalation in consumer size everyday, which inevitably results in an incredible amount of data being generated. 5G would make connection,interaction, and aggregation of data between millions of devices possible.

Security In the Modern World

HITESH YADAV
M.Sc.1st Year

In recent years, the telecommunication industry has witnessed significant growth with the increasing omnipresence of communication devices, and inception and development of new technologies such as IoT (Internet of Things), which have led to a substantial augmentation in interconnectivity. However, these developments have also exposed a glaring concern – the security risks and vulnerabilities which accompany them.

Security risk management is a continual procedure used to identify and manage these risks, followed by the implementation of plans to mitigate them. It assigns relative priorities to these plans. Thus, a risk assessment framework is essential for classifying and disbursing knowledge about the security risk IT infrastructure.

Vulnerabilities and the Security Framework

Assessing vulnerabilities is a major task in any organization. Vulnerability analysis is a component of the risk evaluation method. It centralizes on processes for pinpointing vulnerabilities and executing suitable protection plans to maintain a certain standard of network security.

In order to regulate the risk assessment process, a uniform and unanimous configuration is requisite. A security framework is a holistic structure for risk assessment. It is used to evaluate security adequacies across industry specifications by utilizing tools to identify shortcomings in controls, rate the severity of IT risk and prioritize rectification and repair. Even natural calamities like earthquakes, floods and fire are included in the list of risks, as these can impact the organization's assets and its physical structure.

Security Risk Assessment

Security Risk Assessment is the systematization of processes used to gauge the security risks of an organization, to ascertain the required countermeasures. In order to be effectual, risk assessment ought to be a continuous process. The motive is to identify the threats and vulnerabilities that could perturb the privacy, stability and accessibility of the system. The assessment is done at the initial stages of product conception and is later modified as changes occur in the information asset and its ecosystem. The process involves the assessment and interpretation of every asset and process linked to the system.

It can be divided into three categories:

1. High-Level Assessment, which is administered to systems at design phase in order to diagnose prospective liabilities prior to implementation.

2. Comprehensive Assessment, which is used to assess a particular constituent system and to gather feedback for amelioration.

3. Pre-Production Assessment, performed on novel information systems before they are deployed.

An Insight into Modern Risk Assessment Tools - LUCIDEUS SAFE

SAFE (Security Assessment Framework for Enterprise) is an AI and ML-based platform which performs enterprise-wide cyber risk assessment and quantifies organizational security. It is a dynamic cyber risk assessment platform which integrates with the existing IT infrastructure and security tools deployed within an organization. It performs real-time assessment both at a macro (enterprise-wide) and a micro (asset-wise) level to allow an organization to visualize, track and enhance their cyber risk posture.

Key features of the platform include:

- **Macro-Level Assessment**: Using 2500+ controls encompassing over 15+ global compliances, SAFE assesses the entire IT stack and provides a comprehensive security score from 0 to 5

- **Micro-Level Assessment**: Provides a 360 degree view of technology-wise security posture, which is then further funnelled down to an individual asset's level.

- **Real-Time Assessment**: Enables the organization to receive a synchronous, live assessment of their assets.

- **Hack Simulation**: Virtually simulates attacks to evaluate the organization's cyber-defence system against known hacks.

- **Auto Patching**: Allows easy remediation of vulnerability and configuration controls following changes in a control process..

- **Compliance Management**: Provides real-time analysis of the system in comparison to the global compliance framework.

On the evaluation of security risk assessment frameworks, we see that at each level, the process is dependent on the results of its predecessors. The risk assessment process depends on the result of vulnerability identification, while the monitoring process derives its foundation from established risks, with reports indicating all possible threats. Therefore, such frameworks not only provide a comprehensive cyber shield to organizations, but also promote strategic development in the cybersecurity industry, helping us move towards a more cyber secure future.

BIG DATA
& its relation to well-being

SHRUTI KATYAL
MCA 2nd Year

Let's talk about big data in the context of digital media. Although we have been in the big data era for some time now, there has been a certain hike in digital media usage over the past decade. People, especially teenagers spend a big portion of their time on the internet primarily; for social media and texting.

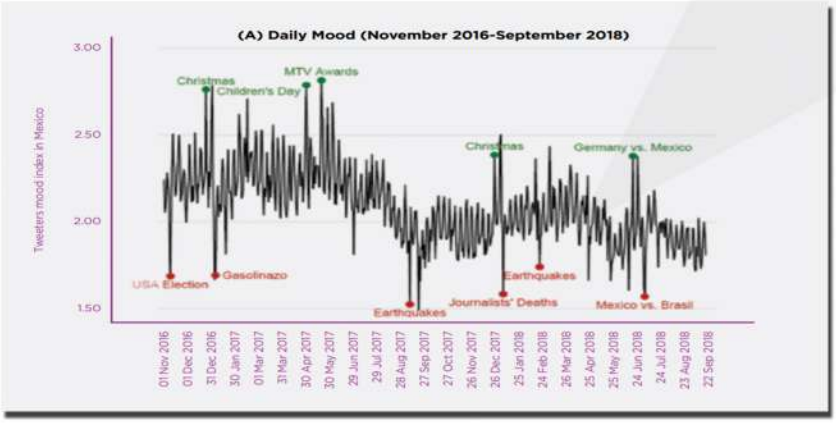
According to a World Happiness Report released by the United Nations, adolescents in 2017 spent an average of 5-6 hours a day online and spent less time on activities that do not involve a screen. If we compare this finding to any data from a few decades ago, we can establish that this has created a 180-degree shift in the fundamentals of socializing and yet it is still not conducive to the increase of the measure of happiness in an individual.

According to another finding in the same report, the measure of happiness of the American people has improved somewhat since 2010, yet it still cannot catch up with that of the people who were born between 1980 and 1992. People who are more willing to spend leisure time in family gatherings or prefer to do exercise, or any other sort of outdoor activities, tend to grasp a better sense of emotional satisfaction.

However, despite the rapid development of IT being the biggest factor of change, it is possible for the existence of reverse causation between happiness and digital media. That is, it is reasonable to believe that people's happiness is decreasing with the increasing use of digital media or it could also be the case that unhappy people turn to digital media to find some sort of comfort. Several organizations like governments, hospitals, and supermarkets take advantage of this concept of reverse causation. Organizations gather big data about their customers and then use it to strategize their revenue opportunities better.

Most of this data is gathered in exchange for rewards, loyalty programs, premium access, gift cards, surveys, etc. Consumers naively give access to such information by signing privacy agreements without giving it a once-over. Another source of gathering such data is through considered consent. That is, companies gather data that are open to the public eye, usually in the form of visual information, basic demographic or behavioral characteristics.

By analyzing such data, they can analyze and monitor people's consumption habits correlating to individual happiness, such as the health pattern of hospital customers or the pattern of product consumption amongst alcoholics. Many organizations can also analyze people's mental health from big data. For example, they can ascertain & collect people's daily emotions from an individual's social media presence/activities.



Organizations use such data to extract advantageous information that can be used to serve specific purposes. This might be good for companies, but it does have some negative implications for people. The worst-case scenario to this is that some of the databases are also used by people operating the 'Dark Web' part of the world wide web. Every identity or every user on the internet is susceptible to analysis like this. Even in incognito mode, a user cannot hide most of the browsing session. Only a very small percentage of highly skilled internet users know how to hide their presence on the internet.

In a build-up, people tend to become addicted to the virtual world for various reasons such as socioeconomic inequality, social contagion, mental health disorders, etc., but in another reality, it is scary to think that your every move on the internet is being monitored by someone and for reasons, you might never find out. To conclude, let's just hope that we the people can keep up with the rapidly changing digital world so that it doesn't make our worst dreams come true.

Blockchain
Beyond the Buzzword

Aryan Sindwani
MCA 1st Year

You may have heard of "blockchain," the record-keeping system behind bitcoin. And while trying to learn about it, you must have read definitions like: "blockchain is a decentralized, distributed, public ledger". These are some difficult words. The good news is, understanding blockchain is a whole lot easier than what this definition makes it look like.

What is blockchain?

As one can guess from the name itself, a blockchain is simply a chain of blocks, precisely said, ledgers, containing information. The idea was originally thought of in 1991 to secure digital documents by time-stamping them to protect them from getting backdated or tampered with. It went mostly unused through the decades until 2009 when Satoshi Nakamoto (presumed pseudonymous) used the idea to create a digital currency – "Bitcoin".

How does blockchain work?

A blockchain can be thought of as a distributed ledger with each block containing : 1. Data 2. Hash of its own 3. Hash of the previous block

The data stored in a single block is subject to the type of the blockchain. In the case of a cryptocurrency blockchain, the block stores the transactional data such as the bank details of the beneficiary, the amount of credit etc. For facilitating encryption, each block consists of a hash which acts like the fingerprint of any block as it is unique for each block in the blockchain. Once created, the hash of the block is calculated. If the contents of the block changes, it changes the hash of the block also.

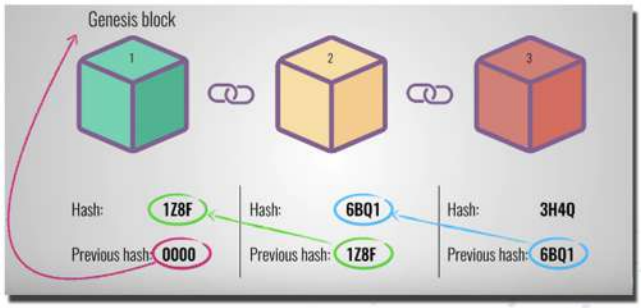
Why is a blockchain so secure?

Every block stores the hash of the preceding block, thus making it secure.
Let's understand this with the picture above. Suppose the second block here is tampered causing its hash to change. This action will make block 3 invalid as it contains invalid hash of the preceding block. To maintain consistency the hash of the third block would need to be updated. And so on. Therefore, to change a single block, every single block after it would require an update as well.

A hash is easy to calculate with a ton of powerful machines available in the market and hence can be cracked. To save the blockchain from such systems, proof-of-work(POW) technique is used. It's a technique that decelerates the creation of each block so that the tampering becomes more difficult. In the proof of work system, computers that want to add a block to a network must "prove" that they have earned the right to do so. They prove their eligibility by solving a compound computational maths problem. Thus, the security of a blockchain drives from its innovative use of hashing and POW.

A blockchain also provides security by being distributed on a decentralized network or in other words, a peer-to-peer network instead of a central database. Every peer on the network is provided with a duplicate of the blockchain. When a new block is produced, every blockchain copy on the network is updated. All the nodes establish a consensus to acknowledge which block is valid and which is not. This ensures that the tampered blocks are rejected from the network.

Consider a network of 100,000 nodes. To tamper with a block on the blockchain, one needs to calculate the hashes of all the blocks and their POW which takes a huge amount of time. This has to be done for more than 50% of the nodes on the P2P network. This is almost impossible to accomplish, making blockchain the safest way to transact.



Potential uses of blockchain

1. Banking: It is often a slow and complex system due to multiple intermediaries. With the banks removed from the process and validation on going 24 hours, using blockchain, a transaction can be settled within seconds.

2. Real Estate: Often recording property rights on paper are confusing and prone to human errors. Using blockchain, all of this work can be made verifiable and transparent. Property owners and officials must agree to their title deeds recorded on the blockchain.

3. Online Voting: Recording votes using blockchain can eliminate fraud as it is nearly impossible to tamper with a block. This makes the entire process transparent and reduces human effort by giving instant results.

4. Stock Trading: Currently it takes about 2-3 days for the settlement of stocks and bonds making it a slow and inefficient process. Blockchain can be used in buying and selling of stocks as it validates and processes transactions quickly. Intercontinental Exchange, the parent company of NYSE has launched its own bitcoin futures contracts.

Blockchain is an emerging technology and brings with itself seeming enormous and unmeasurable possibilities. The value of a bitcoin from 0.08 USD/coin in 2010 to 8000 USD/coin in 2019 showcases its lightning rise and hence is the technology to look out for the next few decades.

How Torrent Works?

Abhinav Kumar
M.Sc. 2nd Year

At one point or another, we have shared software or everyone's favourite these days, web series, with someone. Most of these, we download using "torrents". Uncountable files readily available for free download. But, where does this data come from and how do the services that we use torrent have it all?

The story of torrent is based on the robustness of the peer to peer(P2P) networks. In P2P networks there is no concept of server and client. No node on the network is entirely designated to serve and no node just downloads. Both of these functionalities are performed by each node that exists on the network. Files on the network are broken down into pieces which are then hosted by multiple nodes. These nodes have downloaded file pieces already with no regards to their point of origin. One might come from a node that exists on your own LAN or even from a different continent. Torent Client, a software/ application which can upload, download and locate pieces, then compiless the downloaded pieces natively on the device that you are downloading to. BitTorrent and µ torrent are two famous torrent clients.

Creating nodes is not a major task in itself, the problem lies in finding ways to keep track of files or as we now know, pieces of files. During the infancy of P2P systems, the reliance was on a tracking server which had only one purpose - to keep track of nodes on the network and the files that they hosted using their public IP address. Unfortunately, such systems are bound to fail. The dependency on the tracking server gradually becomes costly. Individual nodes can come and go without affecting the network throughput but if the tracking server goes down, the whole system goes down. To remedy the deficiencies caused by this design, BitTorrent architecture and protocol got introduced. It consists of an application layer protocol which provides an efficient algorithm for decision-making. Both the elements - the peers to upload to, and the pieces of a file that should be downloaded first are decided by this algorithm. It works on a hybrid network using both client server and peer to peer network. The tracking server here is based on distributed computing. Choke algorithm is used which distinctly maintains state of uploaders and downloaders. This is determined in different intervals of time to keep record on their contribution, so that new nodes will be able to locate the resources on the network in an effective manner. It also penalizes the nodes that rarely host resources on the network, thus keeping the functioning of the network streamlined.

Torrent is one of the most robust and largest peer to peer network on this planet, and it is estimated that half of the world's internet traffic is torrent!

Ambient Voice Technology in Healthcare

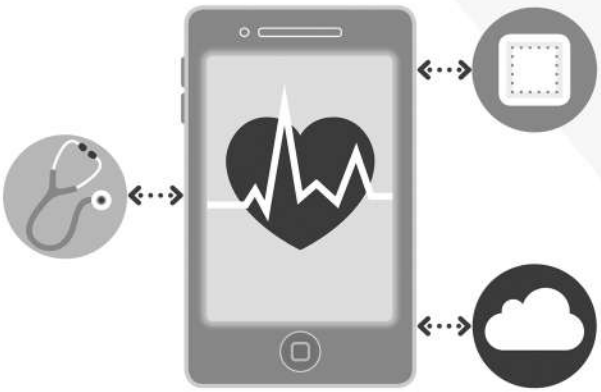
Aditya Aggarwal
MCA 2nd Year

The crux of the healthcare industry is the doctor-patient relationship, patient satisfaction and, care. On average, doctors are capable of examining 40 or more patients in a day if they don't have to spend time on making digital records entry during or after patient interaction. Digital records regulation has put doctors under great pressure.

Imagine yourself standing in a queue for a check-up with a doctor. Since the doctor can only handle one patient at a time, there's a long queue. After a while, you enter the room and the doctor asks you questions. He listens to your answer and writes things down notes, prescription and advice, spending time. Even after the patient exits, the doctor needs to complete the entry of the patient's details on a system. Most of their time on an office day is spent on maintaining electronic health records(EHR) and desk work. Abient Voice technology could help get all of this work get automated.

Ambient Intelligence is an electronic environment that can sense and response to the movement and actions of people around it. The ambient intelligence model builds upon pervasive computing, context awareness and human-centric computer interaction design. For this, we need technologies and computers that are context-sensitive, customizable, embedded and flexible.

Devices enabled with ambient voice technology listen to human conversation, transcribe communication and save all this information. A virtual assistant on a PC or smartphone can be set up which records the communication between a patient and a doctor, generates a prescription and saves it with the digital signature of the doctor in the EHR format. Thus, the entire interaction is completed without engaging with a system, reducing the tasks at hand for the doctor.



To build such virtual assistants, we need a combination of advanced speech recognition, natural language processing and machine learning. We require a medical vocabulary that accurately captures the doctor's natural verbal interaction with the patient and parses it to the EHR format. Word cloud technology can be used to give priority to words that have relevance to medicine. To train these virtual assistants and achieve to higher accuracy, human feedback can also be used.

The virtual assistants' ambient mode could bring their use to healthcare specialities like internal medicine, pediatrics and orthopedics to name a few. With ambient mode, the device is not needed to be invoked with specific commands. They could also be used during surgery to record communication in the surgery room.

Ambient voice technology is going to make it easier to record and access health data. Many industry experts see it as an important area for continued development to provide a hassle-free experience to clinicians and patients.

Reshaping Internet Access

Swati Gautam
M.Sc. 2nd Year

The Internet, from its very basic stages, to what it is today has been around for more than 35 years. Its potent is ubiquitous, from interactive education to speech enabled AI, most of the resources we use rely on the Internet. One might think, with such a huge dependence on connectivity, most people must have access to the Internet. At a price, perhaps costly in some cases, but nevertheless accessible. Yet, it is not so. About half of the population worldwide remains offline. Owing to scarce population, geological conditions or a dawdling economy, many places in India and worldwide are not acclimatized with the Internet.

The Internet, in essence, is a network of connected computers. Data is sent in parts of certain sizes along with other information in the form of packets. Specialised computers called 'routers' move these packets from source to destination systems. We pay ISPs to be connected with this network. We pay for the bandwidth and indirectly for the material that goes into maintaining the network.

The fastest method available today for connecting to the Internet is fiber-optic cables, which transmit data in the in the form of light pulses. These signals tend to be stronger than electrical signals that can be sent via metallic wires, and the speed that they provide is more than enough for purposes such as browsing and streaming. They fall short only when long distances are concerned, bringing in considerable delay in response. Also, laying these cables over long distances is no small feat. There is though, a comparatively cheaper method available, from which isolated places could especially benefit which is satellite-based internet. The speed that it offers comes close to that of metallic cable but is lesser than fiber-optic cables. In contrast to laying cables, for satellite-based internet the location in question need only have a dish installed to transmit signals to the satellites orbiting the Earth.

All things considered, there seems to be a demand for a cost-effective, more reliable and pervasive mode of connection. Urged to capture the market of internet connectivity even in places of isolation, many potential companies have set forth to deploy constellations consisting of thousands of satellites. SpaceX's Starlink is the first to begin launching their satellite models.

Starlink

The project was announced by **SpaceX**'s CEO, **Elon Musk**, back in 2015. He quoted that there was significant unmet demand for low-cost global broadband capabilities. The company aims to create a dense satellite constellation orbiting the earth at a lower altitude to provide satellite internet access. Their goal is to provide high-quality broadband internet to the most isolated places on the planet and to improve latency in previously connected cities. On May 24, 2019, the first 60 satellites were successfully launched. The target is to send more than 12000 satellites by the end of this decade. Initially, satellites would be launched into an orbit of 280 km, and afterwards, each would raise its altitude to about 350 km using ion engines. Functioning satellites would then continue moving up to an altitude of 550 km.

Let's see how the proposed network will work.

The satellites have been designed meticulously. Equipped with laser beams, each Starlink satellite will link to four others. These lasers will use light pulses to transmit data. Transmission between continuously in-motion satellites will be achieved using phased antenna (computer-controlled, electronically steered), which can change the direction of the signal without moving the constituent parts.

Each satellite will have a 81 degree range of view and will be able to cover a circular area with a radius of 500 km. The decreased altitude does decrease the area the satellite can cover but it also decreases its latency. Owing to the area a single satellite can cover, many satellites would need to be launched to create even a minor network. Within the first phase, the network will have 24 orbital planes with 66 satellites per plane. Satellites in the same orbital plane will be relatively stationary to each other and thus communication within them will be easier. But two physical sites might not be connected by a single orbital plane. Satellites belonging to different orbital planes will come in and out of view of each other. This will require the source satellite to find the best path to relay data accurately. This task will of course incur a lag in transmission, but since it's taking place at the speed of light, it might still be significantly fast once the network size is notable.

A Comparison

Connectivity provided by Starlink would be a huge upgrade to what we have with fiber-optics. In these cables, light travels at a speed of about 180,000 to 200,000 km/s. This speed depends on the refractive index of the medium, which here depends on the kind of glass used. The speed in vacuum is around 300,000 km/s. Thus, the speed of transmission in vacuum is at least 65% faster than the speed of light in glass. Even a limited Starlink network in rural areas could present competition to the internet speed in well-networked cities. SpaceX claims to provide a terminal of the size of a pizza-box in the future that would cost around $200. This amount is still out of reach for many people but it is a start.

Data transmission beamed over current satellites is slow to respond. The transmission depends on the open downlink process - the transfer of information to/ from the earth. It takes around 240 ms for geostationary satellites orbiting at around 30,000 km to achieve this. Starlink could bring this down to 3.6 ms.

Moreover, you could be in a forest or a city and enjoy the same level of service.

The project, albeit ambitious, has come into a lot of controversies, especially from the community of astronomers. They've raised the concern that their observations of space will be affected by the bright streaks of light caused by the reflective surface of the satellites. On 6 January 2020, the 60 satellites that were launched were coated in an "experimental darkening treatment". This has still left some experts with a lot of scepticism. Giorgio Savini, director of the University College London Observatory, called out the move, saying no one would deliberately paint satellites dark as this could disturb its heat regulation capabilities. Another issue has been raised by David Clements, an astronomer at Imperial College London. He says that the satellites could mimic the phenomenon of occultation. Astronomers search for exoplanets by monitoring the light of stars. When a planet passes in front of a star, a flicker is detected. Therefore, even if SpaceX manages to launch completely dark satellites, these could mimic occultation and astronomers might not be able to tell the difference.

SpaceX has deployed 180 satellites so far and plans to send more than 1500 by the end of 2020. The future that Starlink could bring, is indeed, interesting. Worldwide internet access could become a boon for avenues of education and research. Timely communication between large distances could save lives and resources during a calamity. But this is not all. Starlink does not aim to be selfless. If successfully implemented, revenue generation could be billions of dollars yearly, which in no way is a consequence that's underserved. Despite the advantages and incentives, the people responsible need to seriously take into consideration the concerns raised by the astronomical society, as well as make them a part of conversations in the planning of future satellites. It is possible that looking at the sky with a telescope in a few years will show perhaps more satellites than stars. SpaceX aims to bring about significant transformation to internet connectivity through Starlink. Many risks and responsibilities are involved, but one can hope that the results might make up for the fair amount of mistakes they might make during the journey.

Rise of Quantum Supremacy

Anubhav Sethi
MCA 1st Year

In the past year, we saw Google's first proof of "quantum supremacy". This is when a quantum computer outperforms a conventional computer.

Before we get to quantum supremacy, let me explain what a quantum computer is. All standard computers work with quantum mechanics because their elements depend on quantum behaviour much like that of an electron. But the operations that a standard computer perform are not quantum mechanical. Standard computers store and handle information in the form of bits that can take two values - 1(up) or 0 (down). A quantum computer, on the other hand, stores information in the form of quantum-bits or q-bits that work on any combination of Zeros and Ones. Operations on a quantum computer can then entangle the q-bits, which allows a quantum computer to solve certain problems much faster than a standard computer.

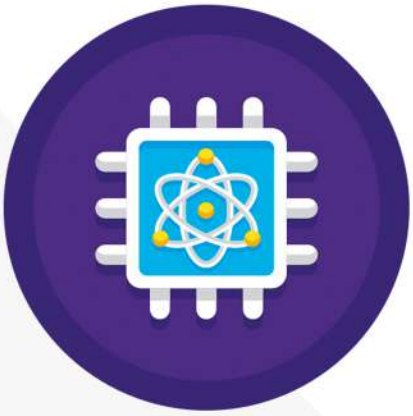
In principle, properties like conductivity, rigidity, or even colour, can be determined by looking at the atomic build-up of a molecule. But solving those equations with conventional computers would take too long. To give an idea of how much more a quantum computer can do, think about this - one can reproduce a quantum computer on a standard computer by numerically resolving equations of quantum mechanics, but, here's the catch, the computational difficulty of this exercise on a conventional computer increases exponentially with the number of q-bits that it is trying to reproduce. This could perhaps be feasible with 2 or 4 q-bits on a personal computer. But, with 50 q-bits, a group of supercomputers will be required. Anything beyond 50 or so q-bits cannot presently be determined, at least not in any reasonable amount of time.

So, what is quantum supremacy?

Quantum supremacy is the event in which a quantum computer beats the best standard computers on a specific task. It needs to be a specific task because quantum computers are special-purpose machines whose powers are realised with particular computations.

Reproducing the outcome of these computations on a standard computer would take very long. So, by letting a standard computer battle with a quantum computer on a specific task, one can show that the quantum computer does something a classical computer just can not.

The exact point at which quantum supremacy will be declared is a little ambiguous because one can always argue the alternative of using better conventional computers or better algorithms. Although, for functional purposes, this certainly doesn't matter all that much. The fact that quantum computers can perform tasks that are difficult for a standard computer would perhaps prove the point.



The Future of Quantum Supremacy

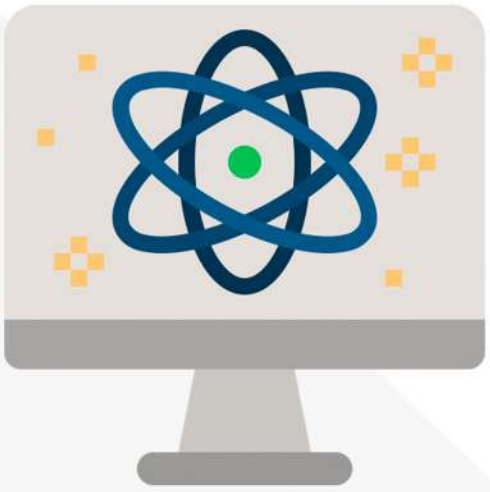
Quantum supremacy sounds very convincing until one realizes that most molecules have quantum processes that also surpass the computational limits of the present-day supercomputer. The creation of random variables that can be used to check quantum supremacy is not viable enough to give useful results.

And what would it take to estimate useful results with a quantum computer? Estimates vary between half a million and a billion, depending on just exactly what one thinks is “useful” and how optimistic they are on the prospect of improvements in algorithms for quantum computers.

When will we get to see a quantum computer with a few million q-bits? At present, no one knows. The present dominant approaches like superconducting q-bits and ion traps are unlikely to scale. In neither case is there any development on how to get beyond a few hundred. This is both an engineering problem and a cost-problem.

Precisely why, in recent years, there has been a lot of discussion in the community about NISQ computers - “noisy intermediate-scale quantum computers”. A term invented to make investors believe that quantum computing will have practical applications in the next decade or so. NISQs might soon be practically feasible, but no one knows how to calculate anything useful with them.

Personally speaking, I am doubtful that quantum computers will have practical applications soon. Quantum computing will go the same way as nuclear fusion, that it will remain forever promising but never quite work. Nonetheless, quantum supremacy is surely going to be super-exciting.



MOBILE PHONE CROWDSENSING

A resource for contextualized urban smart cities

RONAK AGGARWAL
M.Sc. 2nd Year

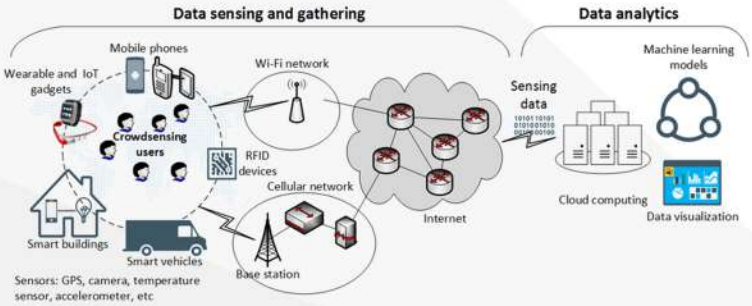
The high rise of urban population and advancements in technology demand the need for smart urban cities. Smart cities use a combination of software solutions, Internet of Things (IoT) devices and user interfaces.

IoT devices are a network of connected devices – such as vehicles, sensors or even home appliances. The way interaction between Web Pages (WWW) is the Internet of Content, the interaction between people (Social Media) is the Internet of People, similarly, the interaction between devices(or things) is the Internet of Things. The concept of a smart city uses IoT technologies to make better use of public resources and reduce the operational cost of public administrations, thus creating new opportunities and supporting better living.

In the last few years, mobile phones, appliances, vehicles, and other types of devices have come equipped with sensors. Mobile devices are used daily with a very high frequency. There can be various types of sensors installed on a mobile device - from an accelerometer to gesture recognition sensors. Mobile Phone Crowdsensing takes advantage of certain smartphone features such as camera, temperature monitoring, GPS and microphone to collect data from the environment. We first take a look at pollution sensing and social sensing.

In pollution monitoring, sensors are installed at fixed places. They continuously sense the movement of vehicles and other sources of emission of pollution around them. This is called fixed sensing. Since sensors are in place, they provide very accurate results but with a high cost.

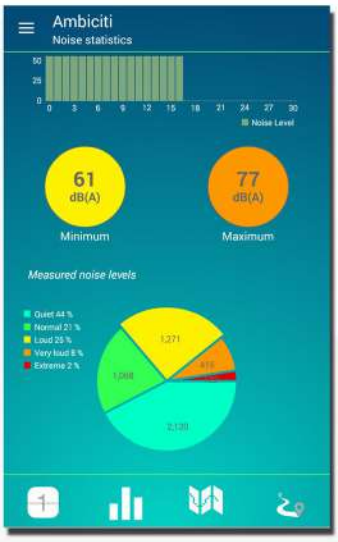
Facebook, LinkedIn and similar other social networks have led to an increment in awareness of the potential of social aspects into a variety of data-centric applications. Embedding sensors in these social networks to collect a large amount of data for prediction and monitoring of applications is a natural way to enhance their power. Social sensing is qualitative but subjective. In Mobile Phone Crowdsensing, there are a huge number of sensors whose locations are not fixed. These sensors have relatively low accuracy as compared to pollution and social monitors and are used to acquire data about the user. The acquired data can be used in several applications such as determining mental health, overall wellness monitoring and noise monitoring.



Urban Scale crowdsensing is used by a large number of individuals to extract certain phenomena of interest. An experiment was conducted in France using **Ambiciti** - an application that notifies the user of the collective exposure to urban pollution. There are certain factors that affect efficient crowdsensing solutions. Optimizing battery and memory usage, access to sensors and network interfaces and accuracy of locations are a few of the tasks involved in enhancing the approaches of crowdsensing. Users refraining from sharing their information, or sending in fake data could produce redundancy in results.

Crowd Sensing has emerged as a powerful solution to address environmental monitoring, allowing us to control air pollution levels in crowded urban areas in a distributed, collaborative, inexpensive and accurate manner. A lot of research is going on to develop it as a significant step in the context of urban smart cities.

Mobile Phone Crowdsensing represents a very promising approach for the mobilization of citizens to improve and adapt their urban mobility. Crowdsourcing dynamic geographic information has the potential to improve various aspects of urban life.



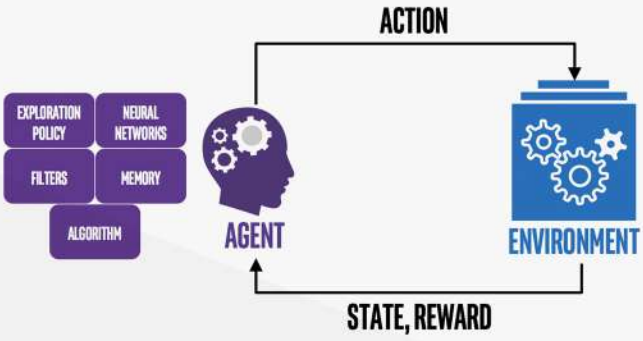
Reinforcement Learning Agents

Manish Meena
MCA 1st Year

The attainment of knowledge and wisdom is a continuous process for humanity. It commences at infancy and continues till the end of life. A child learns by observing the actions of those around him. Adults acclimatize themselves with new cultures by interaction. Such behavioral learning uses reinforcement procedures to communicate notions of 'right and 'wrong' – analogous to what might be good and bad demeanor for a child, or culturally appropriate and culturally insensitive quips for an adult. These learning techniques form the underlying theory of reinforcement learning.

With the aim to maximize some form of cumulative reward, reinforcement learning is an approach to artificial intelligence that emphasizes decision making based on past experiences. It is one of the three basic machine learning paradigms, alongside supervised learning and unsupervised learning. Its key features include trial and error, and delayed gratification, which focus on finding a balance between utilization of knowledge and assessment of raw data. Such a problem solving approach is especially useful in the world of video gaming.

Consider a classic game of Pac-Man. The titular character, Pac-Man, attempts to eat the maximum amount of Pac-Dots before being eaten by the ghosts (opponents). Near the corners of the labyrinth are four energizers that allow Pac-Man to eat the ghosts and receive bonus points. In this scenario, the enemies turn deep blue and move away from Pac-Man. So while eating a blue ghost rewards with bonus points, it increases the risk as well, since the period for which the ghost will remain blue (and harmless) is unknown. Consequently, when devising an optimal strategy to play Pac-Man, the reward earned for eating a ghost is discounted. A discount rate called gamma is defined, having a value between 0 and 1. It is inversely proportional to the reduction of reward. A large gamma implies that the learning agent is more concerned about the long term reward. On the other hand, a small gamma value means the agent has greater interest in short term rewards. Trial and error calculations, based on simulations, are then used to perfect the value of gamma.



A Closer Look at Reinforcement Learning for Video Games

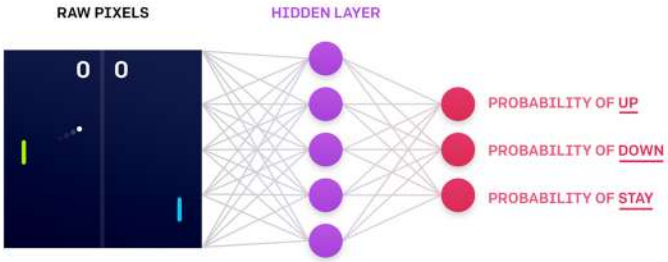
DeepMind, a UK based AI company, has designed a learning agent which can recreate human-level performance in multi-player video games based on the 'Capture the Flag' model. The game begins with a team of players on either side of a playground. Both teams must protect their flag from the enemy. The first team to steal the flag of their opponent and bring it back to their base wins the game. If a player gets tagged by the opposition, they are out of the game.

Using a digital version of the same, scientists at DeepMind have trained an entire population of agents, who learn by interacting with a three-dimensional environment via first-person perspective. There is no centralized entity and every player acts independently based on their own observations. Researchers have trained teams of up to 30 agents in parallel, all playing against each other thousands of times. Initially,all agents wander aimlessly, until one of them discovers some useful information and begins to take control of the flag and scoring points. At that point, there is an evolutionary pressure on the population. The agents continue playing till they achieve satisfactory performance. Genetic algorithms are used to ensure that the entire population evolves, and weaker agents are removed. Furthermore, the original group of trained agents is 'bred' together to produce 'child' agents, and as the number of generations increase, only the strongest traits persist. Unlike human children, AI agents inherit all knowledge that their 'parents' possess.

Getting to the subtleties of how the learning process actually takes place, consider a typical simulation. An agent plays for five minutes and in the process, performs thousands of actions. Scientists then need to devise a way to associate, the analysis done by the agent about their environment, with the rules of the game. So, internal rewards may be linked with events such as retrieving the enemy flag, or a teammate tagging an opponent. Also, agents are allowed to independently evolve the rewards assigned to each event, which helps delegate responsibility within the team.

AI agents trained in this manner can play with artificial as well as human teammates. They offer a certain advantage over human players, in that they are free from any human bias and only focus on winning the game.

While reinforcement learning is no novel innovation, it is certainly years away from reaching its full potential. A decade-long trend within artificial intelligence and machine learning, it forms the core of many computational processes which mimic the biological learning system. It has provided psychological models of animal learning that match empirical data better than traditional ones, and has helped map an influential model of the brain reward system. And if the past is any indication, future developments in this area will certainly be worth anticipating.



BIBLIOGRAPHY

Designed with Freepik
https://www.livescience.com/62656-when-will-ai-be-conscious.html
https://motherboard.vice.com/en_us/article/bj7vda/can-a-machine-be-conscious
http://52dazhew.com/download/587142052.html
https://www.1g.com/us/business/commercial-display/displays-tvs/video-walls
https://www.secunetics.com/dexisive#welcome
https://techcrunch.com/wp-content/uploads/2015/09/robotbossjpg?w=1390&crop = 1
https://www.flaticon.com/free-icon/quantum-computing_1998708
https://www.flaticon.com/search?word=molecule&license=selection
https://en.wikipedia.org/wiki/File:Ipfs-logo-1024-ice-text.png
https://miro.medium.com/max/1024/1*JMkw9e9X4FbuJu_V5wn4fg.png
https://securebox.comodo.com/theme/images/ddos-attack.png https://www.globaldots.com/wordpress/wp-content/up-loads/2016/05/Attacks_w_signatures-04-768x549.png http://www.robinmarkphillips.com/wp-content/uploads/2014/10/
robot-love2lpg
https://media.wired.com/photos/5aecf815efa7377a337590ee/mas-ter/w_799,c_limit/FINALGettylmages-950416996-.jpg
https://dee.ie/it-blog/hidden-figures-jobs-that-will-be-killed-by-automation/ https://apex.aero/2018/01/04/artificial-intelligence-change-airline-
passenger-experience

For any queries, contact Swati Gautam (Chief Editor)

life at DUCS

FAREWELL 2019

SANKALAN 2019

FRESHERS 2019

SKIT & DIWALI NIGHT

OUR SPONSORS

IBM

nagarro
THINKING BREAKTHROUGHS

GitHub

Microsoft
Student
Partners

BUGSEE

CODECHEF
A Directi Educational Initiative

DU beat
An Independent Student Newspaper

DU Updates
www.duupdates.in

DE|DU EXPRESS

MAGIC

MIRRORS OF BLUE

https://cs.du.ac.in

e-SRIJAN

DEPARTMENT OF COMPUTER SCIENCE
UNIVERSITY OF DELHI

SRIJAN

2020