



CIS ComSpective

Enlightening perspectives on computing today and tomorrow

The ICT Magazine by the Department of
Computing and Information Systems

- Technologies & Trends
- Research & Applications
- Professional & Personal Development
- Perspectives on Computing
- Software Development Projects
- Interdisciplinary Topics
- Industry Perspectives
- Alumni Views
- News & Achievements



With the aim of exploring today's world-changing sciences and technologies in the domain of computing, the Department of Computing and Information Systems at the Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka takes a step forward to unite with industry professionals and researchers through ComSpective the ICT Technical Magazine.

The magazine provides a brilliant opportunity for individuals who wish to contribute to the knowledge-base through submitting articles on technology insights, research investigations and experiences in the domain of computing.

Call for Articles Volume 02 Issue 01

Important dates

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We seek original submissions on the following topics of interest:

1. *Information Systems*
2. *Software Engineering*
3. *Pattern Analysis and Machine Intelligence*
4. *Security and Privacy*
5. *Signal Processing*
6. *Networking and Telecommunications*
7. *Human Informatics*
8. *Internet Computing*
9. *Pervasive Computing*
10. *Affective Computing*
11. *Knowledge and Data Engineering*
12. *Industrial Informatics*
13. *Robotics and Automation*
14. *Image processing and Computer Vision*
15. *Services Computing*
16. *Multimedia Technologies*
17. *Cloud Computing*
18. *Visualization and Computer Graphics*

The magazine also welcomes articles and contributions on various emerging and interdisciplinary topics

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| c. Features | f. Alumni Views |
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EDITOR'S NOTE



Dear Reader,

Sri Lanka is now at the top of the few countries that have fully vaccinated the vast majority of their population and have even proceeded to administer the booster vaccine too. Although writing about Covid-19 feels like harping on the same strings, admittedly, the pandemic has brought about a sea change in the world. And Sri Lanka too has seen her fair share of change and continues to see some more too. Now that all the travel restrictions within the country have been lifted, Sri Lanka is slowly but steadily returning to normal. But, it is wiser to stay cautious and resist the temptation to be blindly optimistic.

The dark cloud of COVID-19 has been not without some notable silver lines. The outbreak of COVID-19 served to magnify and crystallise the redemptive power of computing and information systems to keep life as normal as possible in the face of an unprecedented challenge. It reinforced and accelerated the drive for digital transformation, remote working, remote learning, virtual meetings, e-Commerce & online shopping, online payments, and so on bringing to the fore the pivotal role played by the Department of Computing and Information Systems and its local and international counterparts in producing highly competent computing graduates and also in carrying out breakthrough research that has the potential to change the world for better. Many of those Covid-driven changes are here to stay.

With the second issue of the first volume of ComSpective, we are proud to note that we have striven to fulfil our vision of making this a respected, trusted and authoritative academic voice in the field of computing. And here we are confident we have taken another big step forward and we leave it to our esteemed readers to evaluate its strengths and merits.

Thank you.

Dr. Sugeeswari Lekamge

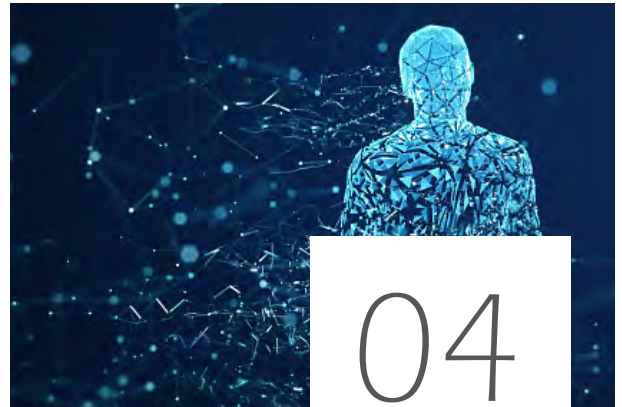
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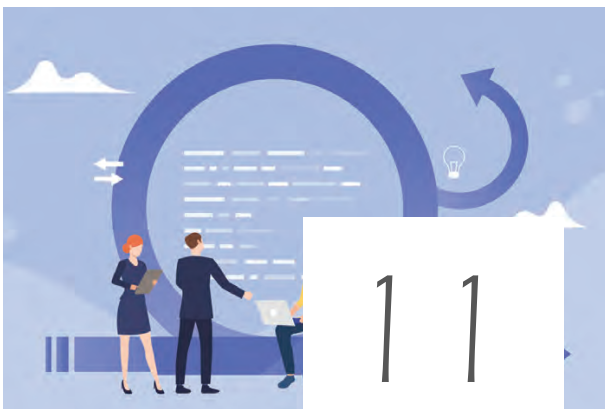
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- Professor Pradeep Abeygunawardana



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Growing With A Lean-Agile Mindset

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We dedicate ourselves to making the world smarter, with each and every Issue of the Magazine, spanning a broad range of computing disciplines.



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Empowering the Digital Economy through Technology Diffusion

Professor Pradeep Abeygunawardhna explains how technology diffusion can be used to boost Sri Lanka's economic success while also improving its global competitiveness.

After 04th generation of computers, advanced semiconductor technologies paved the way to develop many advanced technologies across the globe. High computational power, high-speed connectivity, and high storage capabilities were key factors for these rapid developments of technologies. The real value to the world will come when these technologies are used for the benefit of people and the society at large. This calls for collective efforts from all stakeholders including technology developers, end users, investors, and regulatory bodies like Information Communication Technology Agency (ICTA), Sri Lanka. The solution here is technology diffusion.

Theoretically, Technology Diffusion is adopting technologies in different verticals in an innovative way with the motive of generating the expected outcomes in an effective way. In the process of technology diffusion, leadership is very important and the ICTA has taken the leading role with the vision of transforming Sri Lanka into a technology-driven nation.

Why Technology Diffusion? - United Nations Technology and Innovation Report 2021 has identified emerging technologies in the next decade and they have predicted billion dollar income through these sectors for most countries. However, they have identified that most countries are not ready including South Asian countries. Figure 1 shows how slow the developing countries are including Sri Lanka.



Figure 1: Average GDP per capita in developing and developed economies, 1970-2018

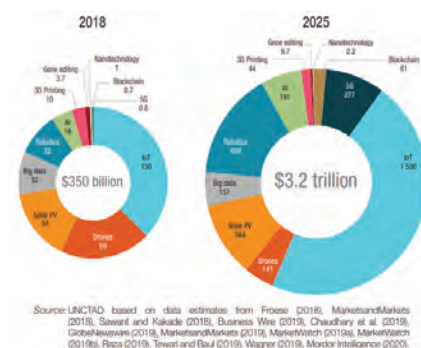


Figure 2: Market size estimates of frontier technologies, \$billions

In the same report, it has highlighted some of the key technologies that will contribute to the world economy.

With the aim of achieving development goals, Sri Lankan government is attempting to economically uplift the nation through carrying out digital transformation across all the sectors. One of the key objectives is providing strategic directions to formulate national level plans for encouraging research and innovations which can address emerging social challenges. Even though many technologies are around, adoption of emerging technologies as well as using existing technologies by the local industries are not up to the expected level of standard.

In the meantime, Sri Lanka is ranked 87 in the global competitiveness index published by the World Economic Forum (WEF). This ranking is done using 103 indicators distributed among 12 pillars, which comprise ICT adoption, stabilizing micro-economies, improving infrastructure expanding market size, and innovation eco-system. Development of innovation eco-system, technology a-

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doption and expanding market size will help to increase Sri Lanka's country position in the ranking of the global competitive index.

In harnessing the benefits of new technologies, technology diffusion plays a key role. There is a definite gap between transferring knowledge and other required information from the technology developer to the end user, one major reason being that the technology developers are subject experts with a strong background while the end user has much less knowledge. Successful adoption needs proper understanding of technologies and correct applications. Creating this awareness and adopting proper technologies are instrumental in Technology Diffusion. The other key factor in technology diffusion is adopting technologies within new domains where the potential of knowledge and innovative thinking are yet to be discovered.

Technology diffusion will solve the following issues and help to create a digital economy in Sri Lanka.

1. Lack of innovative products, digitalized services and new technologies
2. Barriers in commercializing developed products and services.
3. Low rate of technology diffusion in the industry.
4. Lack of knowledge in and accessibility to advance technologies.

Main objective of ICTA Technology Diffusion Roadmap is to increase the revenue and number of jobs through the development of new technologies and through the diffusion

of existing and new technologies for successful businesses transformation by effective technology adoption.

Specific Objectives of Technology Diffusion

1. To increase the contribution from the IT-BPM industry for GDP via improved efficiency in output and effective technology adoption for all industries across the country by the end of 2024.
2. To increase revenue and jobs through setting up of 500 technology start-ups by the end of 2024.
3. To increase the efficiency and productivity of 750 SME's through successful technology adoption by 2024.
4. To create effective and sustainable innovation eco system and research environment .
5. To increase competitiveness ranking of Sri Lanka by the end of 2024. (the country position of the Global Competitiveness Report of the World Economic Forum)

Technology Diffusion Roadmap has been set up with two key areas in mind: Technology Innovation and Technology Diffusion. The university innovation labs for research development activities, Prototype centers, Govtech laboratories solving social problems, satellite universities and company sponsored research laboratories are planned activities for technology

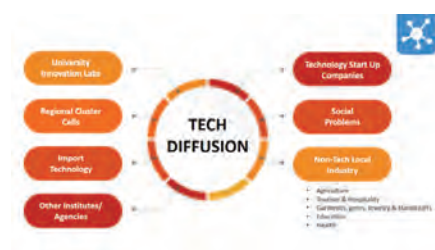
technology innovations. Figure 2 demonstrates the scope of ICTA Technology Diffusion Program.

Technology diffusion is expected to be achieved through conducting technology forums for different verticals such as Agriculture, Tourism, Education, and healthcare in regionally located diffusion cells. In addition, adopting technologies for small and medium enterprises, creating non-tech startups, importing technologies and providing required support in terms of knowledge and financial support would expedite the nationwide technology diffusion.

What is GovTech? - Concept of GovTech lab is to use the technology tools and citizen power to solve social and governmental problems. In any society, there are many issues/problems to be solved and it could be social issues, or government issues or sometimes community issues. Solutions for problems in the society, whether complex or simple, will elevate the society to the new heights. Start-ups and SMEs provide technology products and services, using new and emerging technologies, to the public sector clients.

New ideas are coming from people's interaction and constructive debates on particular issues or problems. Further, it is also observed that idea generation happens when people think with an open mind. The primary objectives of GovTech labs can be indicated as:

1. Identify people's problems by empowering the citizens of the country.
2. Enhance people's involvement on solving their own issues.



3. Find solutions for complex problems in the society through collaboration
4. Enhance community involvement for solving their own issues
5. Enhance knowledge and disseminate it across communities

What is ICTA Innovation Labs? - The purpose of the ICTA innovation labs is to enhance the research culture of Sri Lanka together with university business linkage cells. Most of the research outputs are not being commercialized in Sri Lankan universities or they are not ready to commercialize. Innovation labs is going to address the above gap. In the meantime, it is necessary to develop an innovative mind sets among students and potential researchers to identify the correct research problems and create effective solutions.

AgTech Forum - Currently, in Sri Lanka, the farmers use traditional methods for cultivation and they work hard using hand-held equipment. Even in some remote areas in the country, the harvesting was also done using hand-held equipment. Despite this fact, they work hard whilst confronting a lot of problems and suffer great financial hardships. Another major issue they face is that they are unable to harvest without wasting.

“In order to fulfil the requirements of farmers within the country, the ICTA along with universities and other co-operative industries has conducted several studies to find ways to fulfil them with the help of artificial intelligence (AI) and mobile computing. Accordingly, farm machinery is an important need for fa-

rmer to cultivate. However, currently, the farmers have no such facilities except one or two. When this was discussed with the farmers it became clear that they are in a need of machines in smaller size with low cost and machines which can be used for Sri Lankan varieties”

The technological landscape for Ag-Tech Innovation includes many advanced and recent technologies. Key technologies that we have identified are Internet of Things, artificial intelligence, robotics, drones, biotechnology, nanotechnology, hydroponics, aquaponics, cloud-based systems, mobile applications, web-based systems, precision agriculture and vertical farming.

The agriculture sector is very broad and is connected to many other areas as well. Agrobusiness is the business of many agricultural businesses which includes precision agriculture, use of technologies such as AI/ML, IoT, agrichemicals, breeding, crop production, distribution, farm machinery, processing, and seed supply as well as marketing and retail sales. In terms of technology solutions, agrobusiness stakeholders have a lot of demands. On the other hand, many solution suppliers lack sufficient access to those who are experiencing difficulties. This inaccessibility stifles business growth, and this matching space serves as a platform that brings both parties together to accelerate growth by supporting a greater number of technical solutions in the market.

Sri Lankan Roadmap of Ag-Tech - Under the Sri Lankan Roadmap of Ag-Tech Innovation, the following k-

ey activities are planned to be completed during the process. Ag-Tech School, Ag-Tech Summit, Ag-thon-Hackathon Competition, Matching space, Ag-Tech Consultancy Network, Research and Development (R&D) Arm, Ag-Tech knowledge base, Data Room, Technology Adoption funding, Product and Service Marketplace and Ag-Tech forum. Ag-Tech forum is a sustainable development strategy that needs to be considered by all stakeholders in the ecosystems and their multiple demands and requirements. The main objective of Ag-Tech forum is to create a collaborative environment to make sure that the ideation is happening in the relevant sector. Ag-Tech forum undertakes several exciting activities such as meet-ups, technical talks, focused group discussions and product demonstrations etc.

ICTA is mainly working on creating eco-system for successful technology diffusion with tech companies, leading professional bodies and associations such as SLASSCOM, FITIS, BCS, and the universities. In addition, chambers, government institutes and ministries are key stakeholders in this journey. This is a very promising journey to empower Sri Lankan economy through digital economy and digital transformation. We would like to invite you all to join and support us.



Identity in Digital Landscape: (Re)construction or Extension of Self?

Ms. Ciara Mandulee Mendis pays heed to the need of establishing digital identity with realistic features, minimizing the inherent complexities of digital platforms.

'I am, however, a real thing and really existing; but what thing?'

– Rene Descartes

In an age where people regularly and extensively engage with digital platforms, it is important to examine an individual's manifestation of self in the digital landscape. Is it a construction or a reconstruction? Is it imagined or real? Is it an extension of self? Or is it, and has it always been, something entirely different?

Identity Play: MUDs and Avatars

Online text-based chat rooms called Multi-User Domains (MUDs) and gaming avatars were among the first platforms that allowed identity playing online. For instance, MUD LambdaMoo presented the users with 10 genders to choose from. Thus, with MUDs, one could be whoever one desired to be and redefine one's self. But, quite interestingly, studies have discovered that for the users, these avatars were mere tools to accomplish their tasks, and not representations of themselves (Chee et al., 2006). MUDs and avatars are therefore hardly connected with the real identities of individuals.

Re-centering Self: Personal Home Pages, Blogging and Social Networking

Personal home pages and blogging which have become highly popular now are equipped with more facilities that help one re-center one's self. With the rise of social networking, there was a tendency among the people to ground their online identities with their corporeal day-to-day lives. According to Zhao, Grasmuck and Martin (2008), in social media, an individual constructs a desired life as a form of visual self, a cultural life as a form of self-definition, and, a descriptive self by flaunting academic and professional qualifications in various profiles. When it comes to social networking profiles, it could be seen that it is a constant mapping of one's self with one's friends and tastes. This location and relocation of self is what J.T. Ismael calls situated self. For instance, a selfie connects a person with a multitude of places and things, and locates what is private within the public space. This public space however is comprised of demands with respect to the identity. Take, for example, the expectations demanded from the site of the female body – expectatio-

ns concerning the shape, complexion, attire and presentation. Thus, it could be seen that today, we are entangled in a social networking panopticon, which demands consistency across different, and often incompatible contexts when it comes to identity representation.

Digital Identity: (Re)construction or an Extension of Self?

Considering one's behaviour in the digital landscape, one might wonder whether it is a duplication of a real life or an extension of one's self. However, when taking an analytical approach to understand this situation, it is important to note that this digital landscape is no longer a utopia, no more a separate landscape, but, very much part and parcel of the bitter-sweet landscape of the real world.

When it comes to understanding self, Mead (1934) states about the two concepts, I and me, suggesting the non-singularity of self. According to his articulation of the two concepts, me is the social self and I is the response to this social self. What this understanding of one's self, which guides an individual in presenting her/his life on the digital landscape ultimately creates, is not-

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hing other than a response to social expectations and demands. This presentation of self is embodied and enacted; thus it is a mediated performance. As a matter of fact, this hyper-mediated self is actually a network of commitments, which are constantly changing. An unfavourable outcome of this performance is, the individual's continuous effort to increase the commodity value of self with likes, comments and views. The self is thus replaced with self-value. In a networked world thriving on "participatory culture" (Jenkins, 2009, p.5), this behaviour thereby affects the entire society.

Looking at the hodgepodge of contemporary digital landscape, it is evident that the digital identity of an individual is quite complex and indefinable. It is not only a collection of representations and relationships, but also an assemblage of profiles, images, databases, websites, apps and many more. Digital

culture itself is a fluid phenomenon. The presentation of one's self, the technologies, the platforms and also the perceptions of people, continue to evolve minute by minute. Therefore, rather than situating self within this digital landscape and attempting to discover ways to define the identity of an individual, research should be focused on investigating the direct and indirect mediations of self. These scholarly investigations should be carried out from multiple vantage points in order to add clarity to this complex terrain and aid in understanding our way around this new reality.

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Generative Adversarial Networks: The Most Interesting Idea in the Last Ten Years of Machine Learning

Dr. Siyamalan Manivannan explores the evolution of machine learning and the potential challenges in the future

Assume that I produce fake currencies, and you are a police officer trying to detect whether the currencies given by me are real or fake. Initially, as I am not an expert in producing currencies, the currencies I produce look far different from the real ones. Hence, you can easily catch me. However, as my main aim is to fool you, over time I will improve my skills in producing currencies which are indistinguishable from the real ones. Simultaneously, you also improve your skills in distinguishing fake currencies from the real ones. So over time, both our skills get better and better. This explains the basic idea of Generative Adversarial Networks (GANs).

GAN was introduced by Ian Goodfellow and his team in 2014 [1]. According to Yann LeCun (in 2016), the Chief AI Scientist of Facebook AI Research, “GAN is the most interesting idea in the last 10 years of machine learning”.

Generative vs. Discriminative Models - GAN, as the name implies, is a generative model based on deep neural nets. In machine learning, two categories of models are used,

and they are: discriminative and generative. Discriminative models focus on defining the boundary between different categories of data. When a new data is given, a discriminative model predicts its category. Examples of discriminative models include Support Vector Machines and Nearest Neighbor classifier. Generative models have the ability to generate new data and can be categorized into Explicit Density Models and Implicit Density Models. Explicit density models (e.g., Maximum Likelihood Estimation) focus on learning the underlining distribution of the input data samples by defining an explicit density function. Once this function is learned, a new data can be generated by sampling from this learned distribution. Instead, the implicit density model learns the model without explicitly specifying the density function. GAN is an implicit generative model [3]

The Adversarial Learning Process of GAN

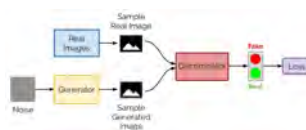


Figure 1: The structure of a GAN: The generator generates an image (fake one). The discriminator tries to identify whether the given image is a real or fake one.

Unlike other generative models, GAN contains a generator (analogous to myself in the previous story) and a discriminator (you, the police officer), and they are trained in an adversarial manner. The generator is responsible for generating new data (from a noise vector as the input), and the discriminator, on the other hand, is a classifier, and its task is to determine whether the given data is a real or fake one (Figure 1). Adversarial learning plays the most important role in GAN, and it is regarded as the min-max optimization process. Here, the generator wants to deceive the discriminator; therefore, it tries to maximize the discriminator's loss by generating data that resemble the real ones. On the other hand, the discriminator tries to minimize its loss by correctly classifying the data generated by the generator as “fake”.

Because of the idea of adversarial learning and the excellent performance of generating new data, GAN received much attention since it was proposed, and it became one of the hottest research topics in Deep Learning. Various types of GANs were proposed since its introduction. For example, Deep Convolutio-

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nal GAN (DCGAN) uses convolutional neural networks with GANs to make GANs more stable and to produce high-quality images, Conditional GAN (CGAN) uses auxiliary information such as class labels when training and generating new data.

Applications - GAN has a wide range of applications in various fields including computer vision, computer graphics, and medical imaging. The following are a subset of them.

1. Data augmentation: GAN can be used to generate new data, and therefore, can be used as a data augmentation method for training deep models.
2. Image-to-image translation: This includes generating coloured images from sketches, converting painting to photos, black and white images to colour, day-time images into night-time images, and vice versa.
3. Image inpainting: Damaged phot-

ographs can be automatically corrected with GANs without human intervention.

4. Image super-resolution: Better high-resolution images (better than using interpolation techniques) can be obtained from their low-resolution version.

5. Text-to-image synthesis: Images can also be generated from text descriptions. E.g., if the input is "A white bird with a black crown and yellow beak" GAN will generate images accordingly.

Challenges with Training a GAN - Although GANs provide lots of cool applications, training a GAN is not easy. There are mainly two problems often encountered when training GANs. The first one is the problem with vanishing gradients, particularly, when the discriminator is too good compared to the generator, the generator won't get updated as the discriminator won't give much infor-

mation (gradients will be close to zero) to the generator to update. Hence, the generator won't show much progress in learning. The second problem is mode collapsing, where the generator fails to produce diverse samples. There are possible solutions explored to overcome these problems, which includes mini-batch discrimination and one-side label smoothing ^[2].

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Congratulations Malsha Gunarathna

for winning the Student of the Year Gold Medal & Thambippillai Thambiratnam (J.P.U.M) – Attorney-at-Law Memorial Gold Medal
Awarded to the Student with the Best Performance in Computing & Information Systems
General Convocation 2021 - Sabaragamuwa University of Sri Lanka



Does Blockchain Network Allow Crypto Crimes?

Ms. Samantha Tharani Jeyakumar contemplates on the possibilities for blockchain technology to be exploited in cybercrime.

Blockchain is known as a distributed ledger technology that integrates the nodes in a peer-to-peer manner. The transactions among the nodes are decentralized and anonymous as well as available to all participants who have been permitted the access. This will generate significant benefits for businesses including greater transparency, enhance security, improved traceability, increased efficiency and speed of transactions and reduce costs. However, the crypto crimes' report [1] released by the well-known blockchain analysis organisation Chain Analysis triggered doubts among the users whether blockchain really encourages secure transactions. Why, because their analysis showed that the transactions among the blockchain network is open for vulnerabilities like scams, ransomware, money laundering, black markets, terrorism financing, etc.

This pandemic buoys the demand for the blockchain technology in the public and private sectors. Across the global supply chains, financial services, healthcare, government and many other industries, innovators are exploring ways to use blockchain technology to disrupt traditional business models. The big

challenge in front of them are the security measures adopted by the blockchain technology. This article will give you an overview about the crypto crimes over the blockchain network and how their transaction patterns look like. This will be a guide for the future investors, governments, healthcare sectors, researchers, etc. to improve the security factors during the adaptation of the traditional business model to fit the blockchain architecture.

Based on the analysis report published by the Chain analysis, in 2019 scams made up the enormous bulk of cryptocurrency-related crime as presented in Fig 1. This would account for just 0.46% of all crypto currency activity. Moreover, money laundering and the widely held notion that crypto crimes have become more like white collar crimes are the other factors behind the scene of the crypto crimes in the blockchain network.

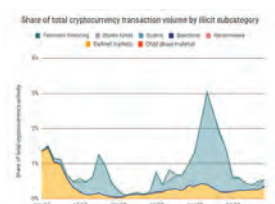


Figure 1: Share of total cryptocurrency transaction volume by illicit subcategory

Money Laundering



Figure 2: Money Laundering Cycle

Mr. Xman is a criminal who has a quantity of illicitly-gained cryptocurrency and stores it in his crypto wallet, the next question in Xman's mind is, "How am I going to turn this into cash without getting arrested?" This is where the money laundering begins in the blockchain network. In money laundering the funds start at a criminal entity, move through an intermediary wallet, and then move to OTC (Over-The-Counter) brokers. OTC brokers run a legitimate business, and have much lower KYC (Know Your Customer) requirements than the exchanges they operate on. Registered OTC brokers may participate in the market representing the client orders and acting as the market makers. Also, they may earn revenue from the commissions charged on orders or from internalising transactions. Many of the OTC brokers take advantage of it and

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help the criminals launder their ill-gotten money, cash out and go scot-free. They move the illicit funds to Binance [2] and Huobi [3]. Binance and Huobi lead all exchanges of illicit Bitcoin by a significant margin. This is the strategy used by the money launderers and other criminals to mislead the blockchain analysis software. Fig 2 illustrates the cycle of money laundering activity.

Scams - In 2019 scams were identified as the biggest crypto crime which generates USD \$4.30 billion worth of cryptocurrency from millions of victims. The highest percentage of scams come from the Ponzi schemes. In Ponzi schemes scammers promise massive, outsize returns for those who invest in their fake companies. They convince victims to invest substantial sums in the hopes of a big payout. Moreover, they promote themselves via social media, build sophisticated websites, and run aggressive marketing campaigns to attract victims. PlusToken is an example for the Ponzi schemes. It's a cryptocurrency wallet based in

China. The scammers in the PlusToken convinced millions of people to invest mostly in China, Korea, and Japan. The majority of the victims are ordinary people and they don't have much literacy in cryptocurrency. PlusToken reaches these people via the popular messaging app WeChat. In addition to that they promote themselves via education meetups, ads in supermarkets and other physical spaces and their founders participated in the charity event with the celebrities.


On the other hand, Blackmail Scams typically email victims claiming to have hacked their computers and stolen sensitive information on them, which they threaten to send to the victim's family and friends unless they pay a ransom in cryptocurrency. Scam transactions were conducted through mixers since it is more difficult to track the path of the funds. In the usual pattern, they transferred the cryptocurrency many times using many different addresses and (that's without even counting

cash outs or exchanges), this made it hard for blockchain analysis tools to trace the path of the stolen crypto currency.

In conclusion, these crypto crimes show the need of law enforcement, regulations for the players like OTC brokers at the blockchain network and effective consumer protection laws to improve the cryptocurrency's reputation as the industry seeks to work with regulators and traditional financial institutions and drive increased adoption.

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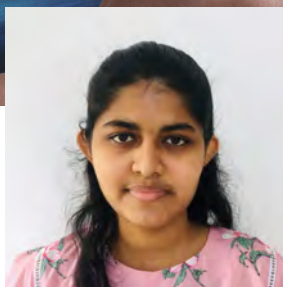




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Applications of AI in Climate Change

Ms. Gayathri Chamani elaborates how AI could be used to monitor climatic changes with accurate predictions.

Climate change is the biggest challenge the world is facing in terms of development. It includes both global warming and associated wide shifts in global weather patterns. Since 1880, the average temperature of the earth has risen more than 10C. 2020 is the hottest year recorded in earth's history even with the significant reduction of greenhouse gas (GHG) emissions due to the COVID-19 pandemic. Climate change mitigation requires massive transformations in our current transportation and energy sectors. Could AI help solve the climate change strategy?



New computational methods, including Big Data Analysis, Machine Learning (ML), and AI tools, are particularly suitable for tackling climate change. AI applies ML, Deep Learning, and other techniques to solve problems. ML is a powerful tool that

lets computers learn relationships from large training datasets, discovering new links between locations, times, and quantities in the datasets. The discovered climate connections can predict enhanced and more accurate warnings of future weather features and extreme events. Big data and AI are interdependent. Complex meteorological datasets are concerned with big data when the analysis ability is limited.

Beyond the prediction models, AI plays a major role in reducing GHG emissions. AI is poised to transform the electricity sector by developing clean energy technologies, improving electricity demand forecasts, developing system optimizations, and monitoring. Electricity systems that are composed of data have transformed into AI and ML-driven next-generation systems (smart grids) by refining the way energy is used in grids for both conservation and efficiency purposes. Neural networks, robotics, fuzzy logic, and expert systems are playing a vital role in smart grid systems.

Another quarter of GHG emissions are accounted for in the trans-

portation sector. Vehicle systems with modern control systems, board processors, and traffic management systems are primarily focused on reducing GHGs through congestion mitigation. These transportation systems use AI techniques such as Neural Networks, Genetic Algorithms, Fuzzy Logic, and Simulated Annealing to predict and track their routes.

AI is also used to monitor the effects of climate change. It can track the health of forests by collecting temperature, humidity, and carbon dioxide data. AI also recognizes shallow-water coral reefs by color to track the effects of climate change by analyzing the images of corals.

In summation, climate change is a complex global issue that can be amenable to AI. Climate change is not a debt that AI can tackle. AI is a powerful tool that can reduce emissions while predicting future extreme events and preparing for unavoidable consequences. AI-based prediction model results are more robust and reliable for sustainable policymaking. Still, the lack of interdisciplinary collaboration is a challenge we have to overcome.

The writer is a fourth year undergraduate at the Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka.



Growing with a Lean-Agile Mindset

Mr. Chathura D. Wijeratne emphasizes the timely importance of transforming an organization with a growing lean-agile mindset to cope up with unexpected corporate challenges.

A flexible mindset is what really matters for anyone's success. What is "most important" is to identify which mindset you are in and how you can adapt to grow. What most of us lack is the ability to adjust and be more flexible in how we think and react. This is not in your plan, right? We tend to lose our way when we encounter unexpected circumstances; we fail to respond positively and effectively. No matter how much we plan and execute, we find unexpected challenges, hurdles, or events daily. If we do not deal with the above effectively, it creates value killers or waste. These will slow your progress to achieving big dreams and goals.

Fail Fast and Learn Fast -The above mentioned individual goals, ideas, and visions are your grand ideas and fantastic concepts. Aside from what you learned in textbooks, real-life experience and learning will provide you with wisdom and maturity to propel you forward. For example, while you're in university, let's imagine having this great idea to create a mobile app focusing on a specific customer segment. But the real need could be different from what is

in your mind; still, it needs improvement to make it "the idea in action". Delivering a working mobile app is the ultimate milestone, and meeting customer demand is what really matters. Observation of features or functionality that is not working or not meeting customer expectations. Instead of continuing down the wrong path, apply suitable changes. Changing the direction from wrong to correct is failing fast. Identifying and adapting to failure at an earlier stage will minimize waste. Remember, financial and human resources are minimal at the initiative level, and it is not affordable to let them go to waste.

Incremental Value Delivery & Timeboxing; at school, university, work, we deliver value every day. But do we deliver it effectively and efficiently? Does it have an impact? So we talk about continuance value delivery as early as possible. Then, while providing the value, we slice the delivery into smaller, manageable pieces to deliver value faster at regular intervals. I still need a good framework and discipline—for example, planning to sit for the final exam for subject X by December 2021. How do we deliver value? We c-

ould always slice the total subject into smaller chapters and complete each chapter in a defined time frame. Then, at the end of each chapter, one can take mock exams to test whether the expected value is met. Successfully answering the maximum number of questions will allow one to move to the next step. Thus, delivering value incrementally in a timebox.

Cadence Based and Synchronizing, while delivering the incremental value mentioned above, require establishing a rhythmic routine with shorter iterations. Manageable and concise, to be precise. This allows regular planning to convert unpredictable events into predictable ones. Considering the same example of sitting for the X subject exam to produce an incremental value, we have already applied applied cadence-based approach. The approach was to take one chapter at a time in a sequenced manner. By evaluating the outcome from the first chapter, one can improve their understanding of the next chapter. This is also called a retrospective review. You are not studying X subject only for final exams; there are other subjects as well. Syncing up with pa-

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parallel activities will manage dependencies: for a university student, all the subjects must be completed with defined value to obtain the degree awarded.

At the end of the day, adopting a lean-agile mindset combines concepts from Agile Manifesto and Lean Thinking. Practices from the Scrum, Kanban, and SAFe Agile Frameworks

are explained in the body. To succeed in any framework, the adaptation of the Lean-Agile Mindset is a necessity. It is not too late to begin today.

Congratulations!

S.P. Chamith Sandagiri

for winning the Best Undergraduate Researcher of Computing Gold Medal

at the SUSL General Convocation 2021

for the Research Titled

Social Media and Online News Analytics for Identifying Crime Patterns and Crime Prediction

Supervisor: Professor B.T.G.S Kumara

Co-supervisor: Mr. K. Banujan

Crimes have affected the quality of life and economic growth of the country badly. We can identify the crime patterns and predict the crimes by detecting and analyzing the historical data. However, some crimes are unregistered and unsolved due to a lack of evidence. Thus, detecting crimes is a still challenging task. On the other hand, Social Media is becoming a great environment for sharing news. We can use social media like Twitter to detect crimes related activities. Because Twitter users sometimes convey messages related to his or her surrounding environment via Twitter. In this research, we proposed a machine learning approach to detect and predict the crimes and the location of the crimes. As the first step, we fetched the Twitter posts using predefined keywords relating to the crimes. Fetched Tweets were cleaned using general Natural Language Processing (NLP) techniques. Then, we utilized the Bidirectional Encoder Representations from Transformers (BERT) model for embedding the words. Next, we applied a Long Short-Term Memory (LSTM) neural network model to detect the crimes related posts by eliminating the noise. Then, we extracted the geolocation, crime type, crime date, and time. The Named Entity Recognizer library and Geocoding API were used for getting the geolocation. We did the same approach for news and those were fetched from News API. Then, we constructed a Multi-Data-Type Deep Neural Network model to predict the crimes. In the final stage, we compared each tweet and news datum and gave ratings for comparison data. The rating, that is, "More accurate" was obtained for 21% of the posts. 5% of the posts showed a "Moderately accurate" rating and 74% showed a "No correlation" rating. Our proposed classification and prediction models were compared with the support vector machine and other neural network-based approaches. The empirical study of our prototyping system has proved the accuracy of our proposed detection and prediction approaches 93.8% and 83.3% respectively.





Technopreneurship: The New Breed of Entrepreneurship in the Digital Era

Dr. Thilini Chathurika Gamage presents a way forward to global entrepreneurship models based on digital technology.

Entrepreneurship is a term that was first introduced in the 1730s and now has a wide range of connotations and applications in today's business landscape. It can vary from a simple description of launching a new business endeavor to more comprehensive interpretations that discuss risk, creativity, and innovation and how the combination of these factors leads to creating wealth for the individual or the society. Leaving aside all of these technical viewpoints, the most straightforward approach to comprehend entrepreneurship is to look at the successful entrepreneurs, who have created a paradigm shift. For example, innovative entrepreneurs such as Jeff Bezos, Steve Jobs, Bill Gates, and Larry Page did more than starting a new business. Without ending up as another player in the industry, they fundamentally transformed it by offering new and innovative solutions to the existing challenges.

The discovery of computers, the Internet, and subsequent advancements such as social media have transformed nearly every aspect of human life. Advances in information

and communication technology (ICT) have made life easier and brought the world closer with the blink of an eye by connecting billions of people worldwide. However, compared to other innovations, what sets ICT apart is the steep magnitude with which it affects human life. It can range from significant developments such as artificial intelligence and neural networks, to tiny improvements such as a simple app allowing a person to book a cab with a single fingertip. Another fascinating aspect of ICT is the velocity at which it evolves and becomes obsolete. For example, the floppy disks that took the world by storm in the 1990s, are now completely outdated. These unique characteristics of ICT have made it a top contender for entrepreneurial ventures.

Now that you've grasped the two sides that make up the concept of technopreneurship. Technopreneurship has taken entrepreneurship to a new height and represents a new breed of entrepreneurship, merging technology expertise with entrepreneurial traits. A technopreneur is an entrepreneur, who is tech-savvy and capable of understanding and utiliz-

ing the finest available technology to alter the current business landscape. Developing such a notion and why it should be observed by entrepreneurs moving forward are essential to focus.

Entrepreneurship is a novice and unique way of thinking. Technopreneurship takes this thinking a step further by incorporating a high-tech context into the equation. As rapid technological advances incorporate themselves into people's lives, this becomes critical, and businesses that fail to adapt themselves to these developments will be outdated in the competitive marketplace. For example, a business without a website may not have a long life in the future.

Due to the connectivity facilitated by the Internet, an online business venture will serve millions of customers every day compared to a conventional business that caters to hundreds of customers. Without limiting themselves to having a website, companies in today's competitive business landscape have advanced to own a mobile app becoming the norm across many industries. A mobile app will put the

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services at the customers' fingertips whether it's travel, food, or entertainment. Businesses that fail to adopt such technological developments will confront a serious issue of survival in such a competitive m-

arket.

Consequently, any existing or prospective entrepreneur should begin their technopreneurship journey by gaining a profound understanding of emerging technologies

and how they might be used in a business. Further, entrepreneurs should pursue divergent and innovative thought processes to integrate rapidly changing technologies into their business models to satisfy the ever-changing customer needs.

ALUMNI VIEW



The Convincing Value of a Degree

Dr. Thilini Bhagya invites prospective students to enroll in the Degree programmes offered by the Department of CIS - a premium institution that provides a great exposure to careers in both academia and industry.

It has been seven years since I received my Bachelor of Science (Honours) degree in Computing and Information Systems. My undergraduate experiences have had a significant impact on who I am today. I am extremely delighted to be an alumnus of the Department of Computing and Information Systems (CIS) and have really enjoyed learning about how much alumni have accomplished and what is going on at the Department as the years have gone by. There have undoubtedly been numerous success stories.

Personally, I was always interested in pursuing a career in academia. The department of CIS offered the right pathway for me. During my undergraduate years, in particular, I had the opportunity to get significant research experience, which allowed me to proceed straight to undertake a doctorate. I just graduated

with a PhD in Computer Science from Massey University in New Zealand and have secured a teaching position at the University of Canterbury, fulfilling my long-held professional ambition. I owe my accomplishments to the CIS for providing me with a high-quality education that gave me vast exposure and equipped me with essential skill sets that have helped me reach my career goals.

The Department has a strong focus on research. The curriculum of the degree significantly emphasises individual and original research, as well as extensive academic writing, both of which are essential for a rewarding academic career. Another massive positive side of the degree is that it provides the applied skills and knowledge needed to become a sought-after ICT professional capable of taking on a wide variety of roles in the software industry. The Department maintains close ties with the innovative and rapidly expanding software companies in Sri

Lanka, which provide chances for internships, industrial projects, and potential job offers. Another value-added aspect is the quality of the teaching staff, who are always passionate about assisting students through engaging lectures and hands-on laboratory sessions as well as mentoring them as they go through various courses. The Department also gives students great opportunities in the form of networking events and workshops, which are a useful way of improving collaboration and communication skills. The graduates are, therefore, very well qualified to take on demanding and enriching roles in a wide range of organisations in Sri Lanka and across the world.

I would highly recommend the degree programme to prospective students as the Department of CIS is a premium institution that provides students great exposure to careers in either academia or industry. If you are looking for a future where you can make a real difference come and join the CIS!

The writer is an alumnus of the Department of Computing and Information Systems who graduated in 2014. She is currently working as a Senior Tutor in Information Systems at the University of Canterbury, New Zealand. She earned her PhD Degree in Computer Science from Massey University, New Zealand.

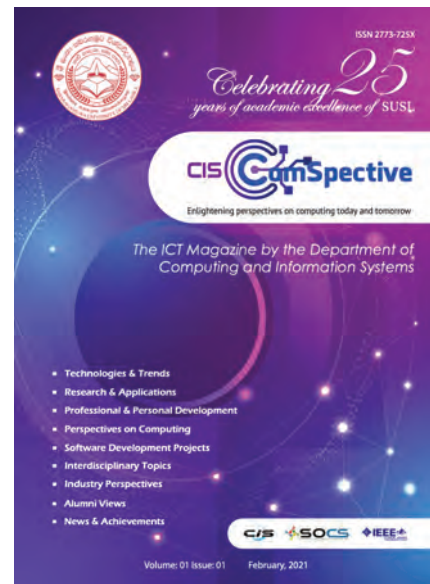
ComSpective - The ICT Technical Magazine

Launching of the Inaugural Issue

The Inaugural Issue of ComSpective the bi-annual ICT Technical Magazine published by the Department of Computing and Information Systems was successfully launched at the Book Launching Ceremony which was held in parallel to the 25th Anniversary Celebration of the Sabaragamuwa University of Sri Lanka, on 2nd February 2021. The launching of the magazine catered to a long-standing need of a technical magazine as a key publication of the Department of Computing and Information Systems.

Issue 1 of Volume 1 of ComSpective which was published in both printed and digital editions comprised 20+ articles covering the areas: Technologies and Trends, Research and Applications, Professional and Personal Development, Perspectives on Computing, Software Development Projects, Interdisciplinary Topics, Industry Perspectives, Alumni Views, and News and Achievements. 15+ writers including undergraduates, academics, researchers, and industry professionals contributed through article submissions.

The main objective of the initiative was to broaden the knowledge and understanding of the readership, within an area of changing computing landscape. ComSpective provides a platform for students, academics, researchers, and industry professionals to share their scholarly work, knowledge and expertise, experience, and insights on various computing disciplines and thereby contribute to the regional and national development through empowering the readers with up-to-date knowledge. It also allows CIS undergraduates to develop and showcase their writing and multimedia skills by actively participating in the publication process.





Shallow Learning Vs Deep Learning

Dr. Amirthalingam Ramanan reconnoiters major aspects of machine learning with profound comparison on how they are practically applied in AI.

Machine Learning (ML) is a sub-field of Artificial Intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Deep Learning (DL) is a subfield of ML concerned with algorithms inspired by the structure and function of the brain called artificial neural networks (ANNs). The term Shallow learning is generally used with those techniques of ML that are not deep. Although ML is a field within Computer Science, it differs from traditional computational approaches. In traditional computing, algorithms are sets of explicitly programmed instructions used by computers to perform calculations or problem-solving. ML algorithms instead facilitate computers in building models from sample data to automate decision-making processes based on data inputs.

The building block of ML has the ability to weigh the features of the data fed to that algorithm to make the most accurate prediction. Computing the weights of these features is a big part of what ML is. A feature is an individual measurable propert-

y or characteristic of a phenomenon being observed. The feature extraction in shallow learning is a manual process that requires domain knowledge of the data that we are learning from. In other words, it is a type of ML where we learn from the data described by the pre-defined features. On the other hand, in deep learning the feature extraction is algorithmically computed without manual human intervention, i.e., a DL algorithm automatically learns these features along with their weights from raw data with little or no preprocessing.

Shallow learning algorithms vary depending on the nature of prediction that they are trying to make. These algorithms can be grouped as follows:

1. Supervised learning (e.g., classification, regression),
2. Unsupervised learning (e.g., clustering, dimension reduction), and
3. Reinforcement learning (e.g., model-based, model-free).

In supervised learning, a predictive model is used for tasks that involve the prediction of a given output (target/concept) using other va-

riables (features/attributes) in the dataset. i.e., the learning algorithm in a predictive model attempts to discover and model the relationships among the target variable and the other variables. Classification and regression are types of supervised ML algorithms. In classification, the task is to approximate the mapping function of the predictive model from input variables to discrete output variables (e.g. labels). The main goal is to identify which class/category the new data will fall into. The different types of classification algorithms include: Nearest neighbour, Naïve Bayes, Support Vector Machine (SVM), Multilayer Perceptron (MLP), and random decision forest. In regression, algorithms predict a continuous value based on the input variables. The different types of regression algorithms include linear, logistic, and generalised regression.

In unsupervised learning, the understanding of a given data is performed without a target variable. i.e., the learning is concerned with identifying groups in the dataset. The groups may be defined by the rows (i.e., clustering) or the columns (i.e., dimension reduction). However, the

The writer is a Senior Lecturer attached to the Department of Computer Science, University of Jaffna. He earned his PhD in Computer Science from the University of Southampton, UK. His major areas of expertise include Machine Learning, Deep Learning, and Computer Vision.

motive in each case is quite different. Clustering and dimension reduction are types of unsupervised ML algorithms. In clustering, the task is to divide the data points into a number of groups such that data points in the same groups are more similar to other data points in the same group than those in other groups. The different types of clustering algorithms include K-means, mean-shift, hierarchical clustering, affinity propagation, spectral clustering, Gaussian Mixture Models (GMMs), and Latent Dirichlet Allocation (LDA). In dimension reduction, the task is to reduce the higher dimensional data by projecting it to a lower-dimensional subspace which captures the 'essence' of the data. The different types of dimension reduction algorithms include Principal Component Analysis (PCA), Independent Component Analysis (ICA), and Canonical Correlation Analysis (CCA).

In reinforcement learning (RL), an AI agent learns in an interactive environment by trial-and-error using feedback from its own actions and experiences, i.e., it refers to goal-oriented algorithms, which learn how to attain a complex goal over many steps. There are three approaches to implement a reinforcement learning algorithm: value-based, policy-based, and model-based. Generally, model-based learning attempts to model the environment then choose the optimal policy based on its learned model, whereas in model-free learning the agent relies on trial-and-error experience for setting up the optimal policy.

In addition, Semi-supervised lea-

rning (SSL) falls between supervised learning and unsupervised learning, i.e., it combines a small amount of labeled data with a large amount of unlabeled data during training which is particularly useful when extracting relevant features from the dataset is difficult, and labeling examples is a time-intensive task for experts. S3VM and Graph-based SSL are example of SSL algorithms.

Deep learning (DL) is a subfield of ML. DL has outperformed ML techniques in many domains, e.g., cybersecurity, natural language processing, bioinformatics, robotics, and medical information processing, among many others. Remarkably, DL has achieved outstanding results on several complex cognitive tasks, matching or even beating those provided by human performance. The reason is that though ML models do become progressively better at whatever their function is, they still need some guidance. With a DL model, an algorithm can determine on its own if a prediction is accurate or not through its own neural network. Since DL involves multiple levels of representation and multiple layers of non-linear processing units (or neurons), it has seemed appropriate to describe them as 'deep'. DL techniques are classified into the following major categories:

1. Deep Supervised learning (e.g., Recurrent Neural Networks [RNNs], Convolutional Neural Networks [CNNs], and Deep Neural Networks [DNNs]),
2. Deep Unsupervised learning (e.g., Generative Adversarial Networks (GANs), restricted Boltzmann machines, and auto-encoders), and

3. Deep Reinforcement learning.

Among the many implementations of DL models, CNNs are particularly suited for several domain of applications. In image classification, CNN performs by discovering low-level features (such as edges and curves) and then building up to more abstract representations through a series of convolutional layers. A commonly used type of CNN consists of numerous convolution layers preceding sub-sampling (pooling) layers, while the ending layers are fully connected layers. Some of the well-known CNN architectures are AlexNet, VGG, GoogleNet, ResNet, Xception, Residual attention neural network, DenseNet, MobileNet, CapsuleNet, and HR-NetV2.

In contrast, ML models can be trained with lesser training data which usually takes less time for training and the training can be performed using CPUs, whereas DL models take longer time for training and the proper training is performed using GPUs. DL enables a machine to efficiently analyse problems through its hidden layer architecture which are otherwise far more complex to be programmed manually. Example applications of DL includes Virtual Assistants (e.g., Amazon Alexa, Siri, and Microsoft's Cortana), Advanced driver-assistance systems (e.g., Mobileye) Chatbots, Speech-to-speech translation (e.g., Google's Translatron), Entertainment (e.g., Netflix, YouTube), and Robotics (e.g., Robo-Watch).

International Conference on Advanced Research in Computing - ICARC 2021

The Beginning of a Resounding Journey

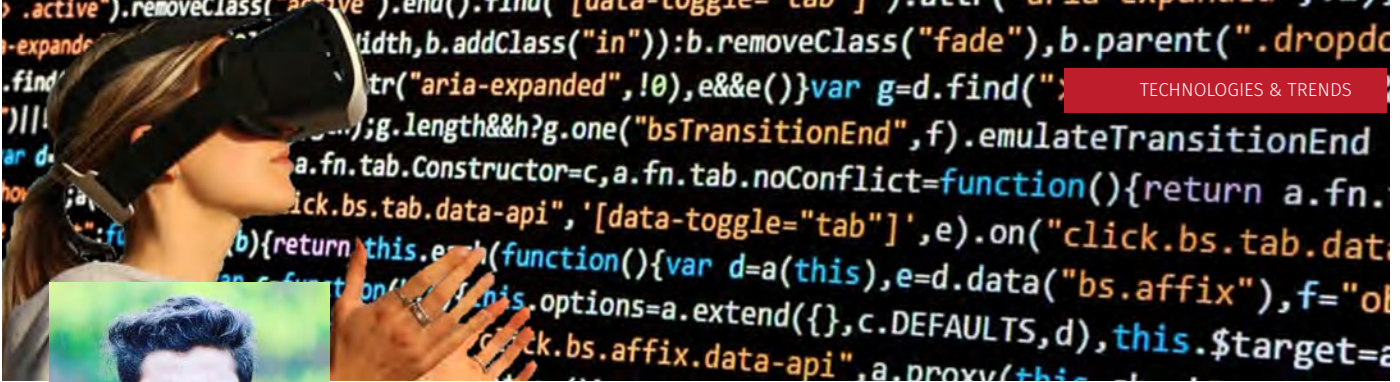
The International Conference on Advanced Research in Computing ICARC - 2021 organized by the Department of Computing and Information Systems, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka was successfully held on 23rd and 24th February 2021. In an era of accelerated digital transformation brought on by the COVID-19 pandemic where digital solutions play a critical role in enabling the continuation of economic activities and the essential services including education and healthcare, the conference was held under the theme “Towards a Digitally Empowered Society”. It was an open forum for academics, researchers, students, and industry experts to present their findings from cutting-edge computing research under seven tracks namely Data Science and Applications, Parallel and Distributed Computing, Software Engineering, Knowledge Management and Information Systems, Human-computer Interaction, Industry Research and Development, and Open Track. Due to the worldwide health concerns, the technical sessions were conducted virtually.



ICARC 2021 also included workshops, as well as stimulating talks and keynote addresses by leading figures from academia and industry, all on one platform, allowing attendees to discuss recent innovations, technologies, and trends, as well as practical issues and challenges encountered in a variety of computing disciplines.

The keynote speeches were delivered by Prof. Meikang Qiu from Department of Computer Science and Information Systems, Texas A&M University, Commerce, USA and Associate Prof. Chinthaka Premachandra from Department of Electronic Engineering, Shibaura Institute of Technology, Japan. The conference also comprised of six plenary speeches and a technical speech delivered by Mrs. Dilrukshi Gamage on improving access and participation of women in STEM.





Mixed Reality with HoloLens 2

Mr. Chirantha Jananath Kithulwatta weighs the impact of HoloLens 2 as a Mixed Reality technology on the future shape of organizations in the digital era.

In the first generation of computers, the user interface used was not as attractive as it is today. Modern needs require more dynamic user interfaces. Currently, many universities, research firms, and software companies are striving to develop more innovative and vibrant user interfaces. This article is about the mixed reality of HoloLens 2.

HoloLens 2 mixed reality combines wireless devices with applications and solutions to help organizations learn, communicate, and collaborate more effectively. Microsoft's breakthroughs in hardware design, artificial intelligence (AI) and mixed reality development can lead today's industry into the future. HoloLens 2 is an industry-leading solution that can add value through the reliability, security and scalability of Microsoft cloud and AI services within minutes, providing a highly comfortable and comprehensive mixed reality experience.

Key Features:

Immersive - With a greatly enlarged field of view, users can see more holograms at once. Read text in the industry's highest resolution, and vi-

ew complex details in 3D images more easily and conveniently.

Ergonomic - Make users' HoloLens 2 longer and more comfortable with a dial-in-fit system designed for long term use. Leave the glasses on. The headset slides straight up. When it is time to change your work, flip the visor and leave the mixed reality.

Instinctual - Touch, hold and move the hologram naturally. Very similar to a real object. Securely log in to HoloLens 2 immediately using Windows Hello. Voice microphones also work in large industrial environments thanks to intelligent microphones and natural language processing.

Untethered - There are no cables or outer packs so user can move freely. HoloLens 2 headset is a standalone computer with Wi-Fi connection. Mixed reality with HoloLens 2 is involved in different industries: education, manufacturing, logistic, health care, construction, etc. Giving remote assistance to the users, without physically walking to factories or sites, engineers can connect with workers, who are in the factory with the tools.

Researches are inventing more accurate and fast execution approaches with the edge-computing and intelligent cloud to enhance the end-user experience. Mixed reality with HoloLens2 is a giant feat in technology and engineering which brings heuristic evaluation.

The subjective platform is most effective and efficient due to the easy learnability. Users can feel the nature of the real system without any barrier. Due to the integration of usability engineering concepts, the system brings the digital innovations to end-users. The device enables the efficiency, productivity, and quality of work with real-time user collaboration and coordination.

With the engagement of new technologies and trends with user interfaces, a user can be a master of the systems. Designers are creating an increasing number of user interfaces that are based on usability engineering principles. However, improving the performance of a wide range of applications necessitates collaboration between researchers and practitioners from across multiple disciplines and industry domains.

The writer is an MPhil candidate of SUSL and a DevOps & System Administration Engineer at H&D Wireless SL PVT LTD. He has obtained BScHons Degree in Software Engineering from the University of Kelaniya.



Nanomaterials and Nanotechnologies

Dr. G. A. Sewvandi elucidates how nanotechnology is going to take the lead in the future industrial world.

Now, the terms nanomaterials and nanotechnologies are not only familiar to scientists, engineers, architects, and product designers but also to the general public. Nanomaterials and nanotechnologies have been developed as a consequence of significant advances in material science. Materials have enabled the advance of mankind from its earliest beginnings; indeed, the ages of man are named after the dominant material of the day: the Stone Age, the Copper Age, the Bronze Age, the Iron Age and so on. We are now entering a new era of nano. This article will give an overview of nanomaterials and nanotechnologies and their applications.

The term nano is used as a prefix for any unit such as a second or a meter, and it means a billionth of that unit. Hence, a nanometer (nm) is a billionth of a meter, or 10^{-9} meters. The scale bar in Figure 1 illustrates a perspective of the scale of a nanometer. From the right side to the left side of the scale bar different length scales can be found with examples in macro, micro, and nano regimes. The width of the human hair is about 80-100 μm , which is ne-

arly 10,000 times smaller than the average human height. The width of the DNA helix is about 2 nm which is about one million times smaller than the width of the human hair and about one billion times smaller than a height of a human. The comparison between a human and DNA at the nanoscale is the same as comparing the size of the sun to us. The diameter of the sun in our solar system is about one billion times larger than a human. Now you may wonder how to work in such a small length scale of the nanoworld.

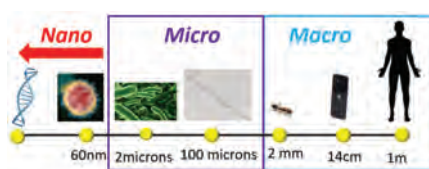


Figure 1: Illustration on the scale of a nanometer

The most important aspect of “nano-” is the appearance of interesting but often unexpected properties such as electrical conductance, chemical reactivity, magnetism, optical effects, and physical strength, which are absent in their bulk counterparts. Due to the nano size, most atoms are at the surface and their electron distributions are different than that of atoms in bulk solids. An

exact dimension for the grain size below which materials can be classified as ‘nano’ cannot be defined since it is subjective and depends on the application or the end property of interest.

Most electronic and optical properties vary when the grain size is reduced typically below 10 nm. However, their mechanical, chemical and many physical properties begin to vary significantly from bulk below 50–100 nm. Usually, the range of sizes from 1-100 nm is referred to as nanoscale materials.

Nanomaterials have been produced and used by humans for hundreds of years without knowing nano. So nano is not new but the understanding of certain materials as nanostructured materials is relatively recent, which was made possible by the advent of advanced tools that are capable of resolving information at the nanoscale.

The term “nanomaterial” refers to nanoscale materials, or materials that contain nanoscale structures internally or on their surfaces. These can include engineered (or man-made) nano meter-scale objects such as nanoparticles, nanotubes,

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and nanofilms, as well as naturally occurring nanoparticles such as volcanic ash and smoke.

Nanoscale dimensions move closer to the atomic or molecular scales. The chemistry and the geometric arrangement of atoms can influence the properties of the material, where ultimately the properties are dictated by the fundamental behavior of atoms.

Nanotechnology is a relatively new branch of science that has found a wide range of applications. The term “nanotechnology” refers to the designing and making anything whose use depends on a specific structure at the nanoscale (1-100 nm). It includes nano devices or systems and nano materials made by manipulating individual atoms or molecules. Nanomanipulation by the use of an atomic force microscope; thus manipulating atoms or moving atoms individually and arriving at predetermined arrangements, is an important first step in realizing the potential of nanotechnology. Nanotechnology range is very wide from the smallest particles that cannot be seen by naked eye to the food you eat and the clothes you wear.

The main difference between nanotechnology and conventional technologies is that the “bottom-up” approach is preferred in nanotechnology whereas conventional technologies usually use the “top-down” approach. Often, top-down technologies are described as being “subtractive,” in contrast to the “additive” technologies that describe bottom-up processes. The use of both technologies to make nanomaterials are represented in Figure 2.

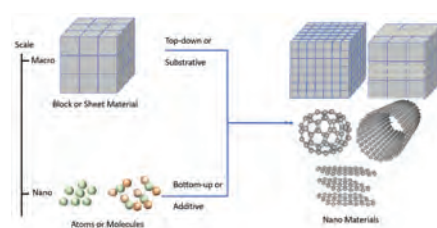
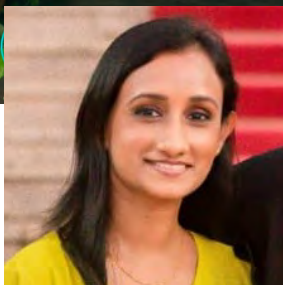


Figure 2: The top-down and bottom-up technologies for making nanomaterials

The number of products produced by nanotechnology or containing nanomaterials entering the market is steadily on the rise. For example, they include strong and lightweight materials for better fuel economy; targeted drug delivery for safer and more effective cancer treatment; regrowth of skin, bone, and nerve cells; diagnostics; self-cleaning surfaces; super fast c-

omputers, laptops and mobile phones with vast amounts of storage and facilities; more efficient solar panels; cosmetics; fabrics with stain repellent coatings; safer food through packaging and monitoring; smart windows that lighten or darken to conserve energy; and nanotechnology-enabled concrete that dries more quickly and has sensors to detect stress or corrosion at the nanoscale in roads, bridges, and buildings.

Nanotechnology and nanomaterials are vast fields that study small feature sizes with broad applications. In general, the economically most successful application of nanomaterials requires only a small amount of material when compared to the conventional technologies; hence, one is selling “knowledge” rather than “tons”. The global nanotechnology market is expected to exceed US\$ 125 Billion mark by 2024. (New York, July 15, 2020 (GLOBE NEWSWIRE). In USA, EC, Japan, Russia and other major countries, large outlays of funds have been released for nanotechnology projects.



The Emergence of MarTech in the Digital Era

Ms. Nipuni Seneviratne highlights the emerging marketing technologies to broaden the boundaries of digital business space.

Countless lives have been changed in enormous ways as we strive through the global outbreak of the Coronavirus disease. Not only the individuals, but businesses, organizations and regulatory bodies have had to transform their operations, embrace novel ways of doing business, and bid adieu to the archaic practices.

While businesses have made efforts to stay aligned with the new normal in terms of marketing, advertising and conversion, consumers on the other hand would still seek the contemporary shopping experience even with numerous hindrances in place. This is the juncture where the necessity of a more holistic and experiential buying and selling experience emerges. Enters MarTech: Marketing that synergizes with Technology came into play.

Online content consumption has soared with the massive changes in the consumers' lifestyles, and they have become more open to online advertising and purchases. Consumers claim it is convenient, it simplifies the shopping experience, and it's safe.

To cut a long story short, MarTech is evolving and so should you!

Leverage Technology - Whether you are in the retail industry, own an e-commerce site or run an online business, leveraging the available software and technology is a must. The possibilities of Chat bots, AR and VR apps, online games, CRM platforms, and novel social media channels must be closely studied and explored and then out of them what, you feel, fits your business best must be adopted. It's also noteworthy that podcasts, webinars and infographics come in handy when it comes to disseminating information to your digital consumers.

Avail yourself in the Digital World - With more time in hand, social media have become the prime source of connecting with the world and the mobile phone, the go-to-place to spend time and for entertainment. Hence, investing time and money on digital platforms will be rewarding instantly in terms of awareness building, and in the long run, it'll help your business earn leads and conversions.

Customer Experience Matter - Analyzing consumer patterns, behavior-

al changes and lifestyles upgrades can help the MarTech specialists to better understand the new requirements, empathize with the customer and disseminate timely information. In-depth analysis and correct approach to the customer will in turn reward you with a strong and loyal consumer-base

Reconsider Your Business Goal - Unlike in the past, the majority of your potential customers are online; hence, the positioning of the brand and the shopping experience need to cater to that segment. Virtual solutions are needed for a seamless business operation and the responsiveness should be one KPI at all times.

Accelerate Campaigns - One thing that shouldn't be neglected is that you are not the only one in the digital market space. More effort you put in the digital arena, so do your competitors. Agility is instrumental in planning and executing effective and efficient campaigns. Time-consuming phases in marketing can be automated via relevant MarTech practices and continuous innovation is vital.

In a nutshell, we all need to come

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to the conclusion that there is no standard solution that fits all. Covid-19 has taught us how unpredictable some events can be and how far-reaching their consequences are. To contain the damage and mit-

igate the aftereffects and recover from an unforeseen turn of circumstances, agility is absolutely vital and MarTech specialists can bring in their expertise where marketing fundamentals combine seamlessly with

the cutting-edge technology to deliver a much greater impact always.

DEPARTMENT OF COMPUTING AND INFORMATION SYSTEMS - SUSL



The Journey to Excellence for 12 Years and the Outlook for a Promising Future

The Department of Computing and Information Systems at the Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka was established in 2011, while the BSc Hons Degree Programme in Computing and Information Systems was initiated back in 2008. Embarking on software engineering education, the Department marked another milestone by introducing BSc Hons Degree Programme in Software Engineering for the academic year 2019/20.

At present, the Department is empowered with a highly qualified and competent panel of academic staff including two professors, four senior lecturers, eight probationary lecturers, and four temporary lecturers. Meanwhile, eminent senior academics and industrialists are contributing as visiting professionals in conducting lectures and practical sessions in the respective disciplines.

The Department is equipped with physical facilities including two well-established computer laboratories, a research unit, and an indus-

trial training unit. It maintains close collaborations with the industry, which has enabled the Department to secure opportunities for the undergraduates for early industrial exposure and employment upon graduation. Today, the Department is successfully progressing under the leadership and guidance of Professor S. Vasanthapriyan, the Head of the Department, by introducing numerous initiatives for research and knowledge dissemination, such as the International Conference on Advanced Research in Computing (I-CARC), the Sabaragamuwa University Journal of Computer Science (SUJCS), and the ComSpective the ICT Technical Magazine. The undergraduates are actively involved in many extra-curricular activities as the Society of Computer Sciences (SOCS), IEEE Student Branch of SUSL, and IEEE Women in Engineering (WIE) Affinity Group - the newest addition. Drawing on its collective effort and expertise, the Department also plays a pioneering role in ensuring a high-quality education at SUSL in view of the digital transformation amidst the current challenges.

The Faculty of Applied Sciences had a mandate for 238 student intake (180 for Information Systems (IS) and 58 for Software Engineering (SE)) for the academic year 2019/20. While the IS Degree Programme has reached the maximum capacity, the Department is pleased to announce that the introduction of a new BSc Hons Degree Programme in Data Science is also in progress. Accordingly, the university in its Action Plan has identified the need of establishing a Faculty of Computing at SUSL.

From its inception, throughout its journey for more than a decade, the Department of Computing and Information Systems has produced over 500 graduates, securing above 90% employability. 365 undergraduates are currently reading for the degrees, the curricula of which are designed complying with SLQF Level 6 and ACM/ IEEE guidelines, which has enabled the Department to produce competent graduates demanded by today's IT/BPM industry. The degree programmes also paves an excellent pathway for postgraduate studies.

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Lecturer (Temporary)



Augmented Reality

Dr. Barathy Mayurathan explains how augmented reality will be integrated into future technological and business elements.

Today, technology has become integral to our lives. Inventions powered by Artificial Intelligence (AI) are becoming ubiquitous in our lives. Thus, the technology known as augmented reality (AR) has taken the world to the next level. For example, suppose you are traveling in a way that you have never traveled before. What do you do when you do not know how to go ahead? Would you like it, if the travel guide appears in front of you on the road when you travel? This is what AR does. AR is the incorporation of a set of software we need in a real environment. AR was invented in 1968.

AR is the advancement of virtual reality (VR). VR is a computerized environment that can be described as close to reality. VR is the creation of an entirely imaginary world around us. By connecting smartphones with VR headsets and watching virtual reality-based videos, we can experience living it in the virtual world. The idea of VR has captured the creativity of people from a wide range of modern lifestyles. VR applications are an impressive emotional experience that digitally reveals a virtual

machine environment. VR applications cover a wide range of domains, such as education, social science, architecture, engineering, robotics, entertainment, healthcare, and clinical therapies. For haptic responses, some special resources such as the VR headset and special gloves are used in VR. It gives the digital world experience and though it has the feeling that it is real. The human brain perceives daily experience from our surrounding environment using our senses such as ears, eyes, and nerves. VR is also doing the same but in the digital environment.

AR has all the features that are in VR technology. In VR, there is no relationship between where we are and what we see on the screen. But, there is a connection to where we are and the place we see it on the screen. GPS and camera are used to gather information and these are displayed on the screen. The boogeyman game is the best example of AR. Not only for the game development but also, we can use this AR for a variety of technological improvements. For example, if you have a camera connected to the internet and GPS, you can call without a mo

bile phone. You can take pictures by using your hands without taking the camera. So computer is not important to share such a photo on social media and by using the nearby wall, you can select and share the photo.

AR is the most suitable technology for any business that wants to have facilities at a cheaper price. AR has more facilities and easier working environments than VR. AR technology is very useful for students to learn some medical applications simply and clearly. In case of emergency, treatment can be done using AR applications from anywhere. By using applications with AR technology, it is easy to find out the locations of the enemies. Even though, there is a delay to transfer data in AR technology. But, it is believed that the 5G technology will easily solve this problem.

The writer is a Senior Lecturer attached to the Department of Computer Science, University of Jaffna. Her areas of expertise include Machine Learning, Bioinformatics, and Human-Computer Interaction.



News on Covid-19: An Approach from Keyword Extraction using Python Programming Language

Chethana Nanayakkara and G.A.D.M. Thennakoon

Keywords extraction is one of the prominent techniques to extract information from text which is particularly efficient in terms of time consumption on social media platforms. It determines the importance of the communication based just on the keywords. It serves as a basis for browsing posts and comments that are enriched with keywords. Using Python programming language and natural language processing (NLP) techniques, this study aimed to extract keywords pertaining to new infectious disease caused by coronavirus (COVID-19), from five hundred new articles retrieved using News API. As we all know, there are numerous algorithms in NLP that will facilitate the extraction of keywords from text data. However, can we apprehend the frequently used algorithms? TF-IDF, RAKE, Rake-Nltk, spaCy, and Gensim are some of the most popular text processing algorithms utilized by most data scientists and machine learning engineers. Among them, in this study we used Rake-Nltk algorithm which is exceptionally efficient and operates on individual documents to enable an application to a dynamic collect-

ion.

1. Data Collection - Because the study required a sufficient quantity of articles, it was necessary to choose the best API from among the possibilities available, such as Google Trends, News API, New York Time API, and Bing API. The News API has been selected in the majority of cases owing to its developer-friendliness. News API is a simple REST API that yields JSON metadata for related headlines based on the query. It does, however, have certain limitations, such as the capacity to scrape up to 500 items and only having access for one month unless the user is willing to pay a few hundred dollars per month.

2. Installing and importing required libraries - The Rapid Automatic Keyword Extraction algorithm (rake-nltk) is a domain independent keyword extraction algorithm that attempts to identify key phrases in a body of text by analysing the frequency of word look and its co-occurrence with alternative words within the text. Notebook was generated on Jupyter Notebook. Installation of the Rake-Nltk and News API python library was facilitated by

using pip. After installation, the Rake-nltk library and all other necessary libraries were imported to facilitate the implementation of the NLP analysis.

3. Web scraping - Initially, we need to get the API key by registering on the News API online page. It is important to register as an individual. This will reward the permitted usage of the API. Next we need to set up the API key received from the website and set the parameters as per the requirement. In our case we wanted to fetch data about 'coronavirus' from articles published in English language within the period from 25th of April 2021 to 25th of May 2021, sorted by relevance.

The subsequent steps involve tokenization, stemming and lemmatization, and keyword extraction.

Ms. Chethana Nanayakkara is an Instructor of Computer Technology who is currently reading for MPhil Degree at the Faculty of Graduate Studies, SUSL.



Deep Learning (DL) is a sub field of Machine learning (ML), and they both come under Artificial Intelligence (AI). DL is a hot research topic today, and it has shown tremendous progress in a wide variety of applications in various fields including Computer Vision, Medical Imaging, and Natural Language Processing. Many tech giants such as Google, Facebook and Amazon are already using some form of DL in their projects. For example, face detection and recognition in Facebook, language translation in Google. So what is DL? How does DL differ from traditional ML and AI? Why it became so popular recently and not earlier? What are the important applications of DL? Are there any challenges with DL? This article aims to expound and answer these questions.

tion processing; it receives input from other neurons which are connected to it, processes the inputs by applying a weighted summation, applies a non-linear transformation on the weighted summation, and then sends the output to other neurons. The aim of learning an ANN is to learn the interconnection weights between the neurons by the use of an objective function. An example objective function could be Mean Squared Error (MSE), which tries to reduce the error between the desired outputs (targets or labels) and the outputs provided by the ANN for a given set of inputs.

ML, on the other hand, aims to

It is quite easy to specify what are the discriminative features to differentiate between apples and oranges. However, for many other problems, for example, classifying cats from dogs, it is often difficult to

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specify what kind of features are better suited. DL has the ability to learn almost everything (features as well as classifier) from data. As the entire model (features and the classifier) is learned in an end-to-end setting from data, the learned model is usually very robust in differentiating among object categories.

Why DL became popular now, and not earlier? - DL is a deep version of ANN. As they are deep (contain more layers and parameters), they require lots of data and clever algorithms for training, and in addition, they require high computational power such as GPUs. The unavailability of big data, high computational power and better algorithms to train deep models limited the use of DL in the past decade. However, recently DL received a significant boost due to such reasons as the availability of large, publicly available labeled datasets (e.g., ImageNet), availability of high speed GPU computing power for the acceleration of model training, and the invention of better DL models and algorithms. In addition, the appearance of public DL libraries such as PyTorch, TensorFlow, etc., also contributed to the success of DL as they help with faster prototyping.

Scalability was an issue with earlier days of ANN due to problems such as vanishing gradients, overfitting, etc., which limited the use of number of layers in an ANN. However, introduction of new activation functions such as Rectified Linear Units, introduction of Skip Connections (e.g., in ResNet) and the introduction of Batch Normalization alleviated the problems associated with vanishing gradients and therefore, provided an efficient way of training

deep models which can contain hundreds of layers. In addition, regularization techniques such as dropout, transfer learning techniques, etc., also helped to reduce the problems associated with training deep models.

Some applications of DL - Nowadays DL is widely used in various fields from agriculture to medicine. The following is a list of some important applications of DL.

1. Image analysis: Image classification, object detection and segmentation approaches are used in computer vision for several purposes including scene understanding for autonomous vehicles. Disease detection, classification and segmentation approaches were also explored in agriculture to diagnose diseases in plants; similarly medical image analysis is used to diagnose diseases in humans. Face recognition, activity recognition, pose estimation are also some of the DL applications.
2. Image Processing: Generative Adversarial Networks (GANs) are a special type of DL models which can be used for automatic image editing, image super resolution, style transfer (e.g., day-time image to night-time image, and vice versa), image inpainting (fixing damaged photographs), etc.
3. Natural Language Processing (NLP): DL is used in NLP for various purposes including language translation, text summarization, and sentiment analysis.
4. Digital Signal Processing: DL is used for analyzing signals, e.g., for voice recognition and speaker identification.

5. Gaming: DL plays a significant role in gaming, e.g., Chess.

Challenges with DL - Although DL provides the state-of-the-art results on almost all domains, still there are several challenges to be addressed.

1. The need for a large amount of annotated data: one of the main challenges with DL is the availability of a large amount of annotated/labeled data. DL models are usually data hungry, i.e., they require a large amount of labeled data for training. Obtaining such a large amount of labeled data is a tedious and expensive process.
2. Overfitting: It is a problem with the generalization ability of the DL models, where the trained model works well for the training data, but performs much poorly on the test data. Overfitting can easily occur particularly when a large model is trained with a small amount of data.
3. Class imbalance: This problem occurs when training a discriminative DL model where different classes contain different numbers of samples, which may make the training biased towards the class, which contains a large number of samples.
4. Model interpretability: It is one of the major problems associated with DL. Usually DL provides black box solutions, i.e., it is hard to interpret what the model has learned. The model interpretability is of particular interest to the clinicians; for instance, when an image is classified as cancerous, clinicians need to know which features make it cancerous.
5. Incremental learning: Most of the DL algorithms require all the training

g data before they can start training. In incremental learning we won't have all the data initially, but the data will accumulate over time.

Various solutions also have been investigated for the above problems. For example, transfer learning, semi-supervised learning, data augmentation, and data generation

approaches are widely being used to overcome the need for large amounts of labeled data for training. Techniques such as regularisation and dropout are explored to reduce overfitting.

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IEEE WIE Student Branch Affinity Group - SUSL

IEEE Women in Engineering (WIE), being one of the largest international professional organizations, is dedicated to promote and inspire women engineers and scientists around the world with the mission of facilitating the recruitment and retention of women in technical disciplines globally. IEEE WIE Affinity Groups are established worldwide in order to maintain the local level network and organize a variety of activities locally and internationally.

In June 2021, the Sabaragamuwa University of Sri Lanka succeeded in establishing the IEEE Women in Engineering Chapter in the university as one of the IEEE WIE Student Branch Affinity Groups in the Sri Lanka Section, with the aim of encouraging and facilitating the young female undergraduates in the university to achieve technical and professional eminence and enhancing women leadership and empowerment globally. This is an excellent opportunity for female undergraduates to grow and demonstrate their diverse abilities.

The first Annual General Meeting was held on the 23th of June, 2021 with the participation of Prof. Udaya Rathnayake, the Vice Chancellor of Sabaragamuwa University of Sri Lanka and Dr. Rasara Samarasinghe, the Chair of IEEE WIE Sri Lanka Section as the Guest speaker, Dr. Rasangi Sabaragamuwa, the Dean of the Faculty of Applied Sciences, Prof. S. Vasanthapriyan, the Head of the Department of Computing and Information Systems, academic staff members of the Department, and the IEEE and IEEE WIE student members of SUSL.

IEEE SUSL WIE Student Branch Affinity Group in its Action Plan has identified diverse activities including organizing technical workshops, webinars, charity work, promotional activities, mentorship programmes, and hackathons aligning with the mission of IEEE WIE focusing not only the university, but also other universities, institutes, schools etc. Affinity Group also encourages the members to collaborate with the IEEE WIE community, R10 and the worldwide WIE networks and to participate and contribute in a variety of activities and programs organized. There are plans to conduct weekly/monthly Techno Meet-ups, establishing Girls' Techno Groups and Innovation Hubs with the intention of developing a platform for the female undergraduates through which they can improve technical knowledge and present their innovative ideas.

IEEE WIE Student Branch Affinity Group of SUSL will always be a potential platform for female undergraduates to enhance themselves and pursue engineering careers while advancing in leadership roles and career advancement.



2nd International Conference on Advanced Research in Computing ICARC 2022








23rd & 24th February 2022

"Towards a Digitally Empowered Society"

2nd International Conference on Advanced Research in Computing (ICARC 2022) is organized by the Department of Computing and Information Systems, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka with the theme "Towards a Digitally Empowered Society". The ICARC 2022 will bring together researchers and practitioners to present their findings on a wide range of research.

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| TRACK 04 | Human-Computer Interaction and Computer Vision |
| TRACK 05 | Software Engineering |
| TRACK 06 | Knowledge Management and Information Systems |
| TRACK 07 | Technology-enhanced Learning, Teaching and Evaluation |
| TRACK 08 | Industry R&D |
| TRACK 09 | Open |

IMPORTANT DATES

- | | | |
|---|-------------------------|---|
|  | Paper Submission Open | 01 st September 2021 |
|  | Paper Submission Closed | 21 st November 2021 |
|  | Paper Acceptance | 01 st January 2022 |
|  | Camera Ready Submission | 15 th January 2022 |
|  | Early Bird Registration | 01 st February 2022 |
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University of Auckland,
New Zealand
Topic- Mind the gap: Engineering Usable
Security and Privacy Systems



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