Report on

2022 IEEE CIS Summer School on Deep Learning and Computational Intelligence: Theory and Applications
December 12-16, 2022
IIT Indore, India
(HYBRID MODE)

Link: http://events.iiti.ac.in/ieee-cis-summer-school-2022/

Report Prepared by

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1. Objectives

Deep learning (DL) enhances classical machine learning (ML) by adding more "depth" (complexity) to the model and modifying the data employing various functions that allow data representation in a hierarchical manner, via multiple levels of abstraction. Deep learning discovers intricate structure in enormous datasets by utilizing the backpropagation algorithm to determine how internal parameters of a machine should be changed.

Computational Intelligence (CI) is the theory, design, application and development of biologically and linguistically motivated computational paradigms. CI is set to change the world we live in through widespread application in numerous domains like medical imaging, computer vision, anomaly detection, sequence and stream processing, big data processing and so on.

The objective of this summer school is to provide a unique platform for young researchers, professionals, and students from all around the world in the recent developments and applicability of DL with CI. The school will bring people working in CI and DL domains to a common platform for generating innovative ideas. The school will also assess the state of the art on what new directions lie open for research in the areas of CI and DL. In this way, the school will generate exciting new communication across various CI, DL and ML disciplines. This summer school features a number of distinguished speakers on DL and CI which will be helpful for researchers and participants.

2. About IIT Indore

IIT Indore is one of the premier institutes under the Ministry of Human Resource Development (MHRD), Govt. of India. IIT Indore has celebrated 14 glorious years of existence this year. In this short span of time, IIT Indore has positioned itself as a vibrant center for outstanding research. Multidisciplinary research at IIT Indore has been recognized at international level with active

participation in several key international projects and several joint collaborations with academic/research institutions in Japan, Norway, USA, Germany, France, Singapore and many other countries. The institute is growing rapidly as the only center for advanced learning and knowledge dissemination in the pure and applied sciences in Central India. Read more at https://iiti.ac.in.

3. Organizers

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Juergen Schmidhuber, Director, KAUST AI Initiative

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- Puneet Gupta, IIT Indore
- Surya Prakash, IIT Indore
- Vijay Kumar Sohani, IIT Indore
- Sanjeev Singh, IIT Indore

4. Keynote Speakers and Brief profiles

- Juergen Schmidhuber, Director, KAUST AI Initiative
- PN Suganthan, Qatar University and NTU Singapore
- Johan Suykens, KU Leuven
- CV Jawahar, IIIT Hyderabad
- Kai Qin, Swinburne University of Technology, Australia
- Sansanee Auephanwiriyakul, Chiang Mai University, Thailand
- Kaizhu Huang, Duke Kunshan University, China
- Mufti Mahmud, Nottingham Trent University, UK
- M. Abulaish, South Asian University, New Delhi
- Asif Ekbal, IIT Patna
- Maryam Doborjeh, Auckland University of Technology, New Zealand
- Puneet Gupta, IIT Indore
- Reshma Rastogi, South Asian University, New Delhi
- Vinit Jakhetiya, IIT Jammu
- Sonali Agarwal, IIIT Allahabad

Brief Profile of the Speakers

Jürgen Schmidhuber, KAUST

Bio: The New York Times headlined: "When A.I. Matures, It May Call Jürgen Schmidhuber 'Dad'." Since age 15, his main goal has been to build a self-improving A.I. smarter than himself, then retire. His lab's deep learning artificial neural networks based on ideas published in the "Annus Mirabilis" 1990-1991 have revolutionized machine learning and A.I. By 2017, they were on over 3 billion smartphones, and used billions of times per day, for Facebook's automatic translation, Google's speech recognition, Google Translate, Apple's Siri & QuickType, Amazon's Alexa, etc. He also pioneered generative adversarial networks (1990), artificial curiosity, Transformers with linearized self-attention (1991), and meta-learning machines that learn to learn (since 1987). Today, the most cited neural networks all build on work done in his labs. He is recipient of numerous awards, and chief scientist of the company NNAISENSE, which aims at building the first practical general purpose A.I. He is a frequent keynote speaker at major events, and advises various governments on A.I. strategies.

Abstract: Modern Artificial Intelligence is dominated by artificial neural networks (NNs) and deep learning. I am proud that foundations of the most popular NNs originated in my labs. Here I discuss: (1) Long Short-Term Memory (LSTM), the most cited NN of the 20th century, (2) ResNet, the most cited NN of the 21st century (an open-gated version of our Highway Net: the first working really deep feedforward NN), (3) AlexNet and VGG Net, the 2nd and 3rd most frequently cited NNs of the 21st century (both building on our similar earlier DanNet: the first deep convolutional NN to win image recognition competitions), (4) Generative Adversarial Networks (an instance of my earlier Adversarial Artificial Curiosity), and (5) variants of Transformers (Transformers with linearized self-attention are formally equivalent to my earlier Fast Weight Programmers). Most of this started with our Annus Mirabilis of 1990-1991 when computers were a million times more expensive than today. In the 2010s, all of this work was feverishly built on by an outstanding community of machine learning researchers, engineers, and practitioners to create amazing things that have impacted the lives of billions of people worldwide.

Sonali Agarwal, IIIT Allahabad

Bio: Dr. Sonali Agarwal is working as an Associate Professor in the Information Technology Department of Indian Institute of Information Technology (IIIT), Allahabad, India. She received her Ph. D. Degree at IIIT Allahabad and joined as faculty at IIIT Allahabad, where she is teaching since October 2009. She holds Bachelor of Engineering (B.E.) degree in Electrical Engineering from Bhilai Institute of Technology, Bhilai, (C.G.) India and Masters of Engineering (M.E.) degree in Computer Science from Motilal Nehru National Institute of Technology (MNNIT), Allahabad, India Her main research interests are in the areas of Big Data, Big Data Mining, Complex Event Processing System, Support Vector Machines, Stream Analytics and Software Engineering. She is having hands-on experience on stream computing and complex processing platforms such as Apache Spark, and Apache Flink. She has focused in the last few years on the research issues in Data Mining applications especially in Big Data, Stream Computing and real-time analytics. She has attended many National and International Conferences/workshops and she has more than 100 research papers in national / international journals and conferences. Her recent research in Machine Learning area got accepted in many Core rank conferences such as DAWAK, PAKDD, DASFAA, ICONIP and IEA/AIE. She has also been a member of IEEE, ACM, CSI and supervised six Ph.D. Scholars and several graduate and undergraduate students in Big Data Mining and Stream Analytics domain.

Abstract: Explainable Artificial Intelligence, often known as XAI, is a relatively new area of research within the larger domain of Artificial Intelligence (AI). In addition to being able to answer different types of inquiries, XAI is also capable of explaining how AI arrived at a given solution (such as object identification or categorization). In classical AI, this kind of explainability just isn't conceivable. Explainability is needed for vital applications, such as defense, health care, law and order, and autonomous driving cars, amongst others, where knowledge is required for confidence and transparency. In this lecture, an overview of the work done so far in the area of XAI is presented. It covers state-of-the-art methods and best practices while simultaneously motivating the necessity for XAI in real-world and large-scale applications. The detailed coverage of XAI using machine learning and through the application of graph-based knowledge representation in conjunction with machine learning

has been presented. The session also explores the benefits and drawbacks of various strategies and offers future paths.

Kaizhu Huang, Duke Kunshan University, China

Bio: Kaizhu Huang works on machine learning, neural information processing, and pattern recognition. He is currently a tenured Professor of ECE at Duke Kunshan University (DKU). Before joining DKU, he was a full professor at Xi'an Jiaotong-Liverpool University (XJTLU) and Associate Dean of research in School of Advanced Technology. He also founded the Municipal Key Laboratory of Cognitive Computation and Applied Technology. Huang obtained his PhD degree from Chinese University of Hong Kong (CUHK) in 2004. He worked in Fujitsu Research Centre, CUHK, University of Bristol, National Laboratory of Pattern Recognition, Chinese Academy of Sciences from 2004 to 2012. He was the recipient of the 2011 Asia Pacific Neural Network Society Young Researcher Award. He received the best paper/book award/competition more than 10 times in major international conferences/challenges. He has published 9 books and over 220 international research papers (110+ international journals) e.g., in journals (JMLR, IEEE-TKDE, IEEE T-PAMI, IEEE T-NNLS, IEEE T-BME, IEEE T-Cybernetics) and conferences (AAAI, NeurIPS, IJCAI, SIGIR, UAI, CIKM, ICDM, ICML, ECML, CVPR). He serves as associated editors/advisory board members in 6 international journals and book series. He was invited as keynote speaker in more than 30 international conferences or workshops.

Abstract: Artificial Intelligence (AI) has achieved great success in computer vision, pattern recognition and many other areas. However, data-driven AI algorithms including deep neural networks (DNN) have been widely challenged for their weak robustness: DNN may misclassify very simple objects for which humans will never make mistakes. More particularly, recent investigations indicate that DNNs are vulnerable to small perturbations of input data, making them less trustable to be applied in security-critical scenarios. In this talk, we will start from the framework of adversarial training and introduce how it can be used for attaining efficient, robust, and trustworthy machine learning algorithms; we will then focus on introducing recent research and progress in adversarial training; finally, we will discuss connections of various robust adversarial learning methods and present possible outlook which may deserve future explorations. This talk will be mainly based on our recent research of adversarial training published at ICML, ICCV, AAAI, , ICDM, ACM MM, and ECCV.

Johan Suykens, KU Leuven

Bio: Johan A.K. Suykens was born in Willebroek Belgium, May 18 1966. He received the master degree in Electro-Mechanical Engineering and the PhD degree in Applied Sciences from the Katholieke Universiteit Leuven, in 1989 and 1995, respectively. In 1996 he was a Visiting Postdoctoral Researcher at the University of California, Berkeley. He has been a Postdoctoral Researcher with the Fund for Scientific Research FWO Flanders and is currently a full Professor with KU Leuven. He is author of the books ``Artificial Neural Networks for Modelling and Control of Nonlinear Systems'' (Kluwer Academic Publishers) and "Least Squares Support Vector Machines" (World Scientific), co-author of the book "Cellular Neural Networks, Multi-Scroll Chaos and Synchronization" (World Scientific) and editor of the books "Nonlinear Modeling: Advanced Black-Box Techniques" (Kluwer Academic Publishers), "Advances in Learning Theory: Methods, Models and Applications" (IOS Press) and "Regularization, Optimization, Kernels, and Support Vector Machines" (Chapman & Hall/CRC). In 1998 he organized an International Workshop on Nonlinear Modelling with Time-series Prediction Competition. He has served as associate editor for the IEEE Transactions on Circuits and Systems (1997-1999 and 2004-2007), the IEEE Transactions on Neural Networks (1998-2009), the IEEE Transactions on Neural Networks and Learning Systems (from 2017) and the IEEE Transactions on Artificial Intelligence (from April 2020). He received an IEEE Signal Processing Society 1999 Best Paper Award, a 2019 Entropy Best Paper Award and several Best Paper Awards at International Conferences. He is a recipient of the International Neural Networks Society INNS 2000 Young Investigator Award for significant contributions in the field of neural networks. He has served as a Director and Organizer of the NATO Advanced Study Institute on Learning Theory and Practice (Leuven 2002), as a program co-chair for the International Joint Conference on Neural Networks 2004 and the International Symposium on Nonlinear Theory and its Applications 2005, as an organizer of the International Symposium on Synchronization in Complex Networks 2007, a co-organizer of the NIPS 2010 workshop on Tensors, Kernels and Machine Learning, and chair of ROKS 2013. He has been awarded an ERC Advanced Grant 2011 and 2017, has been elevated IEEE Fellow 2015 for developing least squares support vector machines, and is ELLIS Fellow. He is currently serving as program director of Master AI at KU Leuven.

Abstract: With neural networks and deep learning several flexible and powerful architectures have been proposed, while with kernel machines solid

foundations in learning theory and optimization have been achieved. Within this talk, we outline a unifying picture and show several new synergies, for which model representations and duality principles play an important role. A recent example is restricted kernel machines (RKM), which connects least squares support vector machines (LS-SVM) to restricted Boltzmann machines (RBM). New developments on this will be shown for deep learning, generative models, multi-view and tensor based models, latent space exploration, robustness and explainability.

Maryam Doborjeh, Auckland University of Technology, New Zealand

Bio: Dr Maryam Doborjeh is a senior lecturer in the Computer Science & Software Engineer Department at Auckland University of Technology, New Zealand. Her research interest focuses on Bioinformatics and Neuroinformatics to develop advanced deep learning and AI methods for improving the accuracy of diagnosis and prognosis of neurological and mental illnesses. She is currently the AI lead and principal investigator in a number of international projects such as "Computational neuro-genetic modeling for diagnosis and prognosis in mental health". Maryam is the co-director of Centre for KEDR at AUT and co-founder of the Neuroinformatics Interest group that holds regular research seminars for knowledge decimation in the community.

Abstract: The brain is a highly interactive and deep learning network. Understanding of the spatio-temporal brain data is a complex task as the temporal features manifest complicated causal relations between the spatially distributed neural sources in the brain. To model such interactions, Spiking Neural Networks (SNNs) can be considered as suitable models that incorporate both spatial and temporal components into an operation. Therefore, their compact representation of space and time allows for learning of "hidden" spatio-temporal correlations in STBD. This talk is based on brain-inspired SNN architecture in NeuCube for modeling and analysing STBD towards improving the classification accuracy and model interpretability. This talk includes applications of SNN in modeling of Electroencephalogram (EEG) and Functional Magnetic Resonance Imaging (fMRI) datasets for detection and prediction of mental and d neurological disorders.

Puneet Gupta, IIT Indore

Bio: Dr. Puneet Gupta is currently working as an Associate Professor in the Department of Computer Science and Engineering, Indian Institute of Technology, Indore. Prior to that, he was a postdoctoral researcher at Tampere University, Finland, where he worked to make the Deep Learning architectures more secure and reliable to increase their applicability in real-world applications. Before that, he was a member of the Machine Vision group in Embedded Methods and Robotics, TCS Research and Innovation. His work in the group mainly focuses on improving the efficacy of remote heart rate estimation and exploring its application area, like human expression understanding. He received his Doctoral degree from the Department of Computer Science and Engineering, Indian Institute of Technology Kanpur, India, in 2016. Moreover, he received the B.Tech degree in Computer Science and Engineering from the Indraprastha University in First Class with Distinction in 2009. He is working to make the current technology useful for human beings by analyzing their behavior. To this end, he has worked on fusing multiple biometric traits for authentication, analyzing facial expressions using deep learning, measuring the human-vital parameters using unobtrusive and non-contact human videos, cross-modal learning, and fortifying Deep learning architectures using adversarial defenses. These play an indispensable role in security, affective computing, ambient intelligence and health care. His area of research includes affective computing, computer vision and deep learning. He has published several papers in the reputed International Journals including IEEE Transactions on Affective Computing; and International Conferences including IEEE International Conference on Computer Vision, IEEE Winter Conference on Applications of Computer Vision and Annual International Conference of the IEEE Engineering in Medicine and Biology Society.

Abstract: Deep Learning is currently the de facto approach for solving real-world data analytics problems. This talk will provide the intuition behind this powerful approach. Moreover, it will unravel the importance of an extensively explored Deep Learning paradigm, the Convolutional Neural Network (CNN). The talk will provide: i) a basic understanding of CNN; ii) possible scenarios where CNN can be applied; and iii) the limitations of CNN.

Sansanee Auephanwiriyakul, Chiang Mai University, Chiang Mai, Thailand

Bio: Sansanee Auephanwiriyakul (S'98–M'01) received the B.Eng. (Hons.) degree in electrical engineering from the Chiang Mai University, Thailand (1993), the M.S. degree in electrical and computer engineering and Ph.D. degree in computer engineering and computer science, both from the University of Missouri, Columbia, in 1996, and 2000, respectively. After receiving her Ph.D. degree, she worked as a post-doctoral fellow at the Computational Intelligence Laboratory, University of Missouri-Columbia. She is currently an Associate Professor in the Department of Computer Engineering and a deputy director of the Biomedical Engineering Institute, Chiang Mai University, Thailand. Dr. Auephanwiriyakul is a senior member of the Institute of Electrical and Electronics Engineers (IEEE).

She is an Associate Editor of the IEEE Transactions on Fuzzy System, the IEEE Transactions on Neural Networks and Learning Systems, IEEE Computational Intelligence Magazine, IEEE Transactions on Artificial Intelligence, Engineering Applications of Artificial Intelligence, and ECTI Transactions on Computer and Information Technology. She was a general chair of the IEEE International Conference on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB 2016). She will be a general chair of the IEEE World Congress on Computational Intelligence (WCCI) 2024 (IEEE International Conference on Fuzzy Systems 2024). She was a Technical Program Chair, Organizing Committee in several major conferences including the IEEE International, Conference Fuzzy Systems. She is also a member of several important IEEE CIS technical committees.

Abstract: Computational Intelligence (CI) relies on and combines several algorithms in fuzzy systems, neural networks, evolutionary computation, swarm intelligence, fractals, chaos theory, artificial immune systems, wavelets, etc., to produce an algorithm that is intelligent somehow. CI has been utilized in many applications for several years. One of the areas that CI has an impact on is the area of biomedical engineering, e.g., medical image processing, medical signal processing and biometrics. One of the CI tools used in those mentioned applications is classification or sometimes called decision making. The major area in the classification is to develop a classifier, including, feature generation and selection. The fuzzy set theory is one of the main parts in CI that has been utilized in generating features and developing a classifier. In this talk, feature generation methods and classifier methods based on the fuzzy set theory will be presented. We also show those methods

on real application, including, medical image diagnosis, medical signal diagnosis, and biometrics.

Kai Qin, Duke Kunshan University, China

Bio: Kai Qin is a Professor at Swinburne University of Technology, Melbourne, Australia. Currently, he is the Director of Swinburne Intelligent Data Analytics Lab and the Deputy Director of Swinburne Space Technology and Industry Institute. Before joining Swinburne, he worked at Nanyang Technological University (Singapore), the University of Waterloo (Canada), INRIA Grenoble Rhône-Alpes (France), and RMIT University (Australia). His major research interests include machine learning, evolutionary computation, computer vision, remote sensing, services computing, and pervasive computing. He was the recipient of the 2012 IEEE Transactions on Evolutionary Computation Outstanding Paper Award and served as the General Co-Chair of the 2022 IEEE International Joint Conference on Neural Networks (IJCNN 2022), Padua, Italy, 18-23 July 2022. Currently, he is the Associate Editor of several top-tier journals in the field of Computational Intelligence, e.g., IEEE Transactions on Neural Networks and Learning Systems, IEEE Transactions on Evolutionary Computation, IEEE Computational Intelligence Magazine, Swarm and Evolutionary Computation, and Neural Networks. Also, he is now serving as the Chair of the IEEE Computational Intelligence Society Neural Networks Technical Committee.

Abstract: Machine learning (ML) and optimization are two essential missions that Computational Intelligence (CI) aims to address. Accordingly, many CI-based ML and optimization techniques have been proposed, where deep neural networks (for ML) and evolutionary algorithms (for optimization) are the most well-known representatives. In fact, CI-based ML and optimization are closely related. On the one hand, CI-based ML consists of various model-centric or data-centric optimization tasks. On the other hand, CI-based optimization is often formulated into ML-assisted search problems. In recent years, there emerges a new research frontline in CI, namely Collaborative Learning and Optimisation (COLO), which studies synergizing CI-based ML and optimisation techniques while unleashing the unprecedented computing power (e.g., via supercomputers) to solve complex ML and optimization problems as well as real-world challenges in which ML and optimization are involved as two interwoven tasks.

This talk will give a comprehensive introduction to COLO from three aspects, i.e., how to make use of ML techniques to assist CI-based optimization (Learn4Opt), how to leverage optimization techniques to facilitate CI-based ML (Opt4Learn), and how to synergize CI-based ML and optimization techniques to deal with real-world problems which involve ML and optimization as two indispensable and interwoven tasks (LearnOpt).

M Abulaish, SAU, New Delhi

Bio: Muhammad Abulaish is a Full Professor and the Chairperson of the Department of Computer Science at South Asian University, New Delhi, India, with over twenty-four years of experience in Academics and Research. In 2007, Abulaish earned a Ph.D. in Computer Science from Indian Institute of Technology Delhi. His research focuses on the development of innovative data analytics and machine learning techniques, particularly for applications in text mining, social network analysis, biomedical informatics, and data-driven cybersecurity. He has published more than 125 research articles in international journals, books, and conference proceedings, including seven in IEEE/ACM Transactions. He serves as an Associate Editor for the Social Network Analysis and Mining journal. He has served as a member of the Program Committee for numerous prestigious international conferences, including SDM, CIKM, IJCAI-ECAI, PAKDD, Web Intelligence, and BIOKDD. He has also served as publicity co-chair for WI'19 and WI'20, as well as workshop co-chair for ASONAM'20. He is also a member of the editorial board and a reviewer for numerous prestigious journals. He holds senior memberships with IEEE, ACM, and CSI. In addition, he is a lifetime member of ISTE, IETE, and ISCA.

Abstract: Online social networks such as Twitter are experiencing sophisticated cyberattacks, which are typically carried out by means of fake or compromised profiles. Automated agents (also known as socialbots), a category of sophisticated and contemporary threat entities, are native to social media platforms and are responsible for a variety of modern weaponized information-related attacks, including astroturfing, misinformation

dissemination, and spamming. Due to their deceptive nature of mimicking human behavior, detecting socialbots is a difficult but essential task.

Starting with a brief introduction to the data deluge (mostly in the form of networks) in various fields and the convergence of data science as a pure multidisciplinary field, I will discuss the difficulties associated with analyzing connected (network) data. I will also discuss various emerging data analysis and mining challenges resulting from the deluge of diverse data over online social media, as well as some of our recent works involving the analysis of online social network data for characterizing and detecting socialbots. I will conclude with some thoughts on the direction of future research.

Reshma Rastogi, SAU, New Delhi

Bio: Reshma (nee Khemchandani) Rastogi received the Ph.D. degree in machine learning from the Indian Institute of Technology Delhi, New Delhi, India, in 2008. She is currently an Associate Professor with the Department of Computer Science, South Asian University, New Delhi. She has published over 45 papers in refereed international journals and over 16 papers in refereed international conferences in these areas. Her recent work on TWSVM has been cited over 1400 times and has been a subject of review articles in multiple highly reputed journals. She has co-authored two books including Twin Support Vector Machines: Models, Extensions and Applications (Springer) and Financial Mathematics: An Introduction. Her current research interests include machine learning, image processing, financial modeling, and optimization. She has supervised four research students so far in the field of machine learning. Dr. Rastogi has also served on the Steering and Program Committees of several international conferences and on the reviewing boards of many peer reviewed journals including IEEE TRANSACTIONS ON NEURAL NETWORKS AND LEARNING SYSTEMS, Knowledge-Based Systems, and Information Science

Abstract: Machine Learning and Deep learning have been widely applied in computer vision, natural language processing, and audio-visual recognition. The overwhelming success of deep learning models as a data processing technique has sparked the interest of the research community. However, the applications of machine learning and deep learning are not very popular among financial researchers. This talk surveys and analyzes the application of machine learning and deep learning models in finance domains to provide a

systematic evaluation of the model preprocessing, input data, and model evaluation. Thus, this talk provides academics and practitioners with insight and direction on the state-of-the-art of the application of deep learning models in the finance domain.

P. N. Suganthan, Qatar University and NTU Singapore

Bio: P. N. Suganthan received the B.A degree and M.A degree in Electrical and Information Engineering from the University of Cambridge, UK in 1990 and 1994, respectively. He received an honorary doctorate (i.e. Doctor Honoris Causa) in 2020 from University of Maribor, Slovenia. After completing his PhD research in 1995, he served as a pre-doctoral Research Assistant in the Dept of Electrical Engineering, University of Sydney in 1995−96 and a lecturer in the Dept of Computer Science and Electrical Engineering, University of Queensland in 1996−99. He moved to Singapore in 1999. He is/was an Editorial Board Member of the Evolutionary Computation Journal, MIT Press (2013-2018). He is/was an associate editor of the Applied Soft Computing (Elsevier, 2018-), Neurocomputing (Elsevier, 2018-), IEEE Trans on Cybernetics (2012 - 2018), IEEE Trans on Evolutionary Computation (2005 -), Information Sciences (Elsevier) (2009 -), Pattern Recognition (Elsevier) (2001 -) and Int. J. of Swarm Intelligence Research (2009 -) Journals. He is a founding co-editor-in-chief of Swarm and Evolutionary Computation (2010 -), an SCI Indexed Elsevier Journal. He was selected as one of the highly cited researchers by Thomson Reuters yearly from 2015 to 2020 in computer science. He served as the General Chair of the IEEE SSCI 2013. He has been a member of the IEEE (S'90, M'92, SM'00, F'15) since 1991 and an elected AdCom member of the IEEE Computational Intelligence Society (CIS) in 2014-2016. He is an IEEE CIS distinguished lecturer (DLP) in 2018-2021.

Vinit Jakhetiya, IIT Jammu

Bio: Vinit Jakhetiya received the B.Tech. degree in computer and communication engineering from the LNM Institute of Information Technology, Jaipur, India, in 2011, and a Ph.D. degree in electronics and computer engineering from the Hong Kong University of Science and Technology in 2016. From January 2015 to December 2015, he was a Visiting Student at the School of Computer Science and Engineering, Nanyang Technological University, Singapore, where he joined as a Project Officer. Currently, he is the Head of the Computer Science and Engineering Department

at IIT Jammu, India. His research interests include image/video processing, image quality assessment, and visual perceptual modeling.

Abstract: Image Quality Assessment (IQA) is the analysis of degradation in the images and the effect of these degradations on the overall perceptual quality. 3D views are a type of image which are gaining popularity these days and have applications in various domains such as Free-viewpoint Televisions (FTVs) and Virtual Reality (VR) for an immersive experience. Subsequently, their quality assessment is an important aspect of research in the computer vision domain. Recent 3D synthesis algorithms produce distortions that are not pleasant to human visual systems (HVS), such as stretching artifacts, improper alignment, and various geometric/structural distortions. In this talk, we will discuss how these distortions are different from distortions such as "black holes," which are obsolete. Building upon these observations, we will discuss recently proposed three 3D-IQA algorithms.

MUFTI MAHMUD, Nottingham Trent University, UK

Bio: MUFTI MAHMUD (Senior Member, IEEE) received his PhD degree in information engineering from the University of Padova, Italy, in 2011. He is currently serving as an Associate Professor of Cognitive Computation at Nottingham Trent University (NTU), UK. He has been listed among the top 2% cited scientists worldwide in computer science in 2020 and was the recipient of the NTU VC outstanding research award 2021 and the Marie-Curie postdoctoral fellowship. Dr Mahmud is the coordinator of the Computer Science and Informatics research excellence framework unit of assessment at NTU and the deputy group leader of the Cognitive Computing & Brain Informatics and the Interactive Systems research groups. With over 18 years of experience in the industry and academia in India, Bangladesh, Italy, Belgium, and the UK, Dr Mahmud is an expert in computational intelligence, applied data analysis, and big data technologies with a keen focus on healthcare applications. As of February 2022, he has published over 190 peer-reviewed articles and papers in leading journals and conferences and (co-)edited 6 volumes and many journal special issues on those domains. As an active researcher, Dr Mahmud has secured grants totalling > £3.3 million and supervised over 50 research students (PhD, Master and Bachelor). He is a Senior Member of IEEE and ACM, a Professional Member of the British Computer Society, and a Fellow of the Higher Education Academy, the UK. During the year 2021-2022, he has been

serving as the Vice-Chair of the Intelligent System Application and Brain Informatics Technical Committees of the IEEE Computational Intelligence Society (CIS), a member of the IEEE CIS Task Force on Intelligence Systems for Health, an advisor of the IEEE R8 Humanitarian Activities Subcommittee, the Publications Chair of the IEEE UK and Ireland Industry Applications Chapter, and the Project Liaison Officer of the IEEE UK and Ireland SIGHT Committee. He has also served as the coordinating chair of the local organization of the IEEE-WCCI2020; the General Chair of Brain Informatics conference in 2020, 2021, and 2022; the Applied Intelligence and Informatics conference in 2021 and 2022; and the Symposium Chair of IEEE-CICARE 2017, 2018, 2019, 2020, 2021 and 2022. He serves as a Section Editor (Big Data Analytics) for the Cognitive Computation journal, an Associate Editor of the Frontiers in Neuroscience, and a Regional Editor (Europe) for the Brain Informatics journal. He also serves as lead editor-in-chief of Applied Intelligence and Informatics (Springer Nature) and Smart Healthcare Systems: From Data to Knowledge (Taylor & Francis) book series.

Abstract: Artificial Intelligence (AI) is a field that has been inspired by biological intelligence. Biological intelligence, or intelligence in general, is one of the main capabilities of the mammal brain, and mimicking it to develop cutting-edge AI techniques requires a thorough understanding of the process that gives rise to intelligence. This can only be done through decoding the Brain's information processing pathways (IPPs) which are composed of neuronal networks formed by complex connectivity among neurons. This talk will showcase applied informatics techniques to decode neuronal networks at the first level of approximation, allowing us to understand some aspects of intelligence. As an example, the talk will show how neural networks can be decoded to understand high-level cognitive functions such as touch. As brain signals represent the activities of populations of neurons, their shapes serve as fingerprints of the underlying neuronal networks, which can be used in understanding how the brain generates intelligence.

Asif Ekbal, IIT Patna

Bio: Asif Ekbal is currently an Associate Professor in the Department of Computer Science and Engineering, IIT Patna. He has been pursuing research in Natural Language Processing (NLP), Information Extraction, Text Mining and Machine Learning (ML) for the last 18 years; and asuthored around 260 papers in top-tier conferences like AAAI, ACL, SIGIR, EMNLP, COLING,

HLT/NAACL, and journals like Computational Linguistics, ACM Transactions, IEEE Transactions, PlosOne, Scientific Reports etc. Asif has been involved in several sponsored research projects, funded by the different private agencies, such as Elsevier, Accenture, ezDI, LG, Skymap, Samsung Research, Wipro, Flipkart; and Govt. agencies such as MeiTY, Govt. of India, MHRD, Govt. of India, and SERB, Govt. of India etc.

He has been serving as a PC Chair, Area Chair, Senior PC member, PC member, reviewer to several well-known conferences like EACL, HLT/NAACL, AAAI, IJCAI, EMNLP, ACL etc. He is the Associate Editor of ACM TALLIP; Sadhana, Springer; Springer Nature Computer Science, Springer; Editorial board member of Computer Speech and Language, Elsevier; Plosone.

He is an awardee of "Best Innovative Project Award'' from the Indian National Academy of Engineering'', Govt. of India, "JSPS Invitation Fellowship" from Govt of Japan and "Young Faculty Research Fellowship Award" of the Govt. of India. He is listed in the top 2% scientists, published by Stanford University findings in Elsevier, and in the list of top computer scientists, published by Openrsearch.com.
Google Scholar Citations: 7206; h-index is: 44 and i-10 index: 179.

Abstract: Natural Language Processing (NLP) is one of the most promising areas that encompasses Artificial Intelligence, Linguistics, Cognition, Physics, Mathematics, logic etc. In this field, there has been phenomenal growth in terms of techniques, models and applications during the last few years, such as the RNN based models such as transformers; large language models like GPT-2, GPT-3; Alexa, Google's Search Engine, Google Machine Translation etc. This lecture focuses on the fundamentals of NLP, its applications and deep learning based models for question-answering, machine translation, sentiment analysis and conversational AI.

CV JAWAHAR, IIIT Hyderabad

Bio: Prof. C. V. Jawahar is the Dean of Research & Development and Head of Centre for Visual Information Technology (CVIT), and Machine Learning (ML) Lab at the International Institute of Information Technology, Hyderabad (IIITH), India. He leads the research group focusing on computer vision, machine learning and multimedia systems. He is also the CEO of the Centre for Innovation and Entrepreneurship (CIE-IIIT) at IIIT Hyderabad.

An Amazon Chair Professor, Prof. Jawahar is also an elected Fellow of the Indian National Academy of Engineers (INAE) and the International Association of Pattern Recognition (IAPR). His prolific research is globally recognized in the Artificial Intelligence and Computer Vision research community with more than 100 publications in top tier conferences and journals in computer vision, robotics and document image processing to his credit with over 12000 citations. He is awarded the ACM India Outstanding Contribution to Computing Education (OCCE) 2021 for fundamental, selfless service in teaching of computing, and nurturing a generation of students who now serve the larger society and have led to an impact in multiple dimensions of computing education.

Extremely conscious of the social and practical relevance and application of research, Prof. Jawahar is actively engaged with several government agencies, ministries, and leading companies around innovating at scale through research.

Abstract : Chaotic and unstructured driving environments pose several challenges. Adverse road conditions such as lack of delineated lanes, heavy traffic of smaller vehicles such as cycles, cycle-rickshaws and auto-rickshaws, presence of a large number of people and animals on the road, potholes, etc., are some of the challenges. Addressing the challenges of complex unstructured environments for bringing safety and autonomy in vehicles and traffic infrastructure is of paramount importance. India has one of the largest road networks in the world, and is emerging as one of the fastest growing networks. With more and more vehicles on the road, safety is now more crucial than ever before. The driving conditions in countries like India are quite diverse and the traffic behavior is highly unstructured compared with the rest of the world. Inspecting and assessing the quality of traffic infrastructure also poses a challenge due to the massive length of roads that countries will have and the regular frequency at which this needs to be done. These driving conditions pose unique challenges that are yet unsolved, for research in artificial intelligence (AI) and machine learning (ML) systems, and hence offer an immense opportunity for possible technical innovations.

5. Event Schedules

Mon, Dec 12, 2022

7:45 AM

Registration (For Offline Participants Only)
🕐 7:45 AM - 8:45 AM, Dec 12
📍 Maitreyi Seminar Hall, IIT Indore

9:00 AM

Opening Ceremony
🕐 9:00 AM - 9:30 AM, Dec 12
📍 Maitreyi Seminar Hall, IIT Indore (Hybrid)

📢 **General Chair**

Dr. M. Tanveer
Associate Professor and Ramanujan Fellow
IIT Indore

9:45 AM

The 5 Most Popular Artificial Neural Networks
🕐 9:45 AM - 10:30 AM, Dec 12
📍 Maitreyi Seminar Hall, IIT Indore (Hybrid)

📢 **Speaker**

Jürgen Schmidhuber
Director, KAUST AI Initiative
KAUST

10:30 AM

Explainable AI: Current Status and Future Directions
🕐 10:30 AM - 11:15 AM, Dec 12

📢 **Speaker**

Sonali Agarwal
Associate Professor
IIIT Allahabad

11:30 AM

Robust Adversarial Training: Fundamentals and Progress

🕐 11:30 AM - 1:00 PM, Dec 12

📍 Maitreyi Seminar Hall (Hybrid)

📢 **Speaker**

Kaizhu Huang
Professor
Duke Kunshan University, China

2:30 PM

Neural Networks and Kernel Machines: The Best of Both Worlds

🕐 2:30 PM - 4:00 PM, Dec 12

📍 Maitreyi Seminar Hall (Hybrid)

📢 **Speaker**

Johan Suykens
Professor
KU Leuven

Tue, Dec 13, 2022

9:30 AM

Brain Inspired Artificial Intelligence Technology for Modeling of Spatiotemporal Brain Data in Mental and Neurological Applications

🕐 9:30 AM - 11:00 AM, Dec 13

📍 Maitreyi Seminar Hall, IIT Indore (Hybrid)

📢 **Speaker**

Maryam Doborjeh
Senior Lecturer
Auckland University of Technology, New Zealand

11:15 AM

Basics of Deep Learning
🕐 11:15 AM - 12:45 PM, Dec 13
📍 Maitreyi Seminar Hall, IIT Indore (Hybrid)

📢 **Speaker**

Puneet Gupta
Assistant Professor
IIT Indore

2:00 PM

Computational Intelligence in Biomedical Engineering Application
🕐 2:00 PM - 3:30 PM, Dec 13
📍 Maitreyi Seminar Hall, IIT Indore (Hybrid)

📢 **Speaker**

Sansanee Auephanwiriyakul
Associate Professor
Chiang Mai University

Wed, Dec 14, 2022

9:30 AM

Collaborative Learning and Optimization
🕐 9:30 AM - 11:00 AM, Dec 14
📍 L-13, Lecture Hall Complex (Hybrid)

📢 **Speaker**

Kai Qin
Professor
Swinburne University of Technology, Australia

11:15 AM

Demystifying Socialbots and their Detection using Machine Learning Techniques
🕐 11:15 AM - 12:45 PM, Dec 14
📍 L-13, Lecture Hall Complex (Hybrid)

📢 **Speaker**

Muhammad Abulaish
Professor
South Asian University, New Delhi

2:00 PM

Machine/Deep Learning: Applications in Finance
🕐 2:00 PM - 3:30 PM, Dec 14
📍 L-13, Lecture Hall Complex (Hybrid)

📢 **Speaker**

Reshma Rastogi
Associate Professor
SAU, New Delhi

Thu, Dec 15, 2022

9:30 AM

Differential Evolution with Ensemble Strategies, Adaptation and Population Topologies
🕐 9:30 AM - 11:00 AM, Dec 15
📍 L-13, Lecture Hall Complex (Hybrid)

📢 **Speaker**

P.N. Suganthan
Professor
NTU Singapore and Qatar University

11:15 AM

Visual Perception and Image Quality Assessment
🕐 11:15 AM - 12:45 PM, Dec 15
📍 L-13, Lecture Hall Complex (Hybrid)

📢 **Speaker**

V

Vinit Jakhetiya
Assistant Professor
IIT Jammu

2:30 PM

Understanding "Intelligence": A Network Decoding Approach
🕐 2:30 PM - 4:00 PM, Dec 15
📍 L-13, Lecture Hall Complex (Hybrid)

📢 **Speaker**

Mufti Mahmud
Professor
Nottingham Trent University, UK

4:15 PM

Deep Learning for Natural Language Processing
🕐 4:15 PM - 5:15 PM, Dec 15
📍 L-13, Lecture Hall Complex (Hybrid)

📢 **Speaker**

(A) **Asif Ekbal**
Associate Professor
IIT Patna

Fri, Dec 16, 2022

9:00 AM

Towards Safe Driving in Unstructured Environments
🕐 9:00 AM - 10:30 AM, Dec 16
📍 Gargi Seminar Hall, IIT Indore (Hybrid)

📢 **Speaker**

CV Jawahar
Professor
IIIT Hyderabad

10:45 AM

Closing Ceremony
🕐 10:45 AM - 11:45 AM, Dec 16
📍 Gargi Seminar Hall, IIT Indore (Hybrid)

📢 **Speaker**
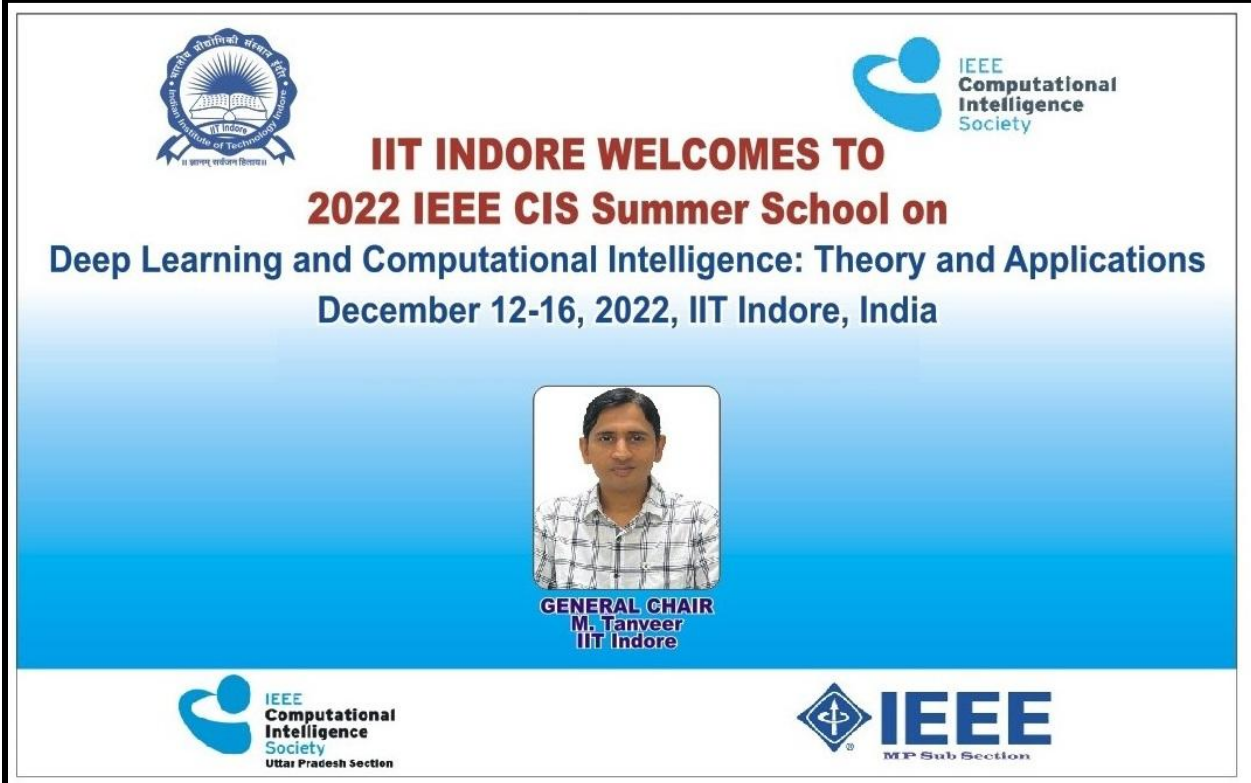
Dr. M. Tanveer
Associate Professor and Ramanujan Fellow
IIT Indore

6. Technical Sponsors
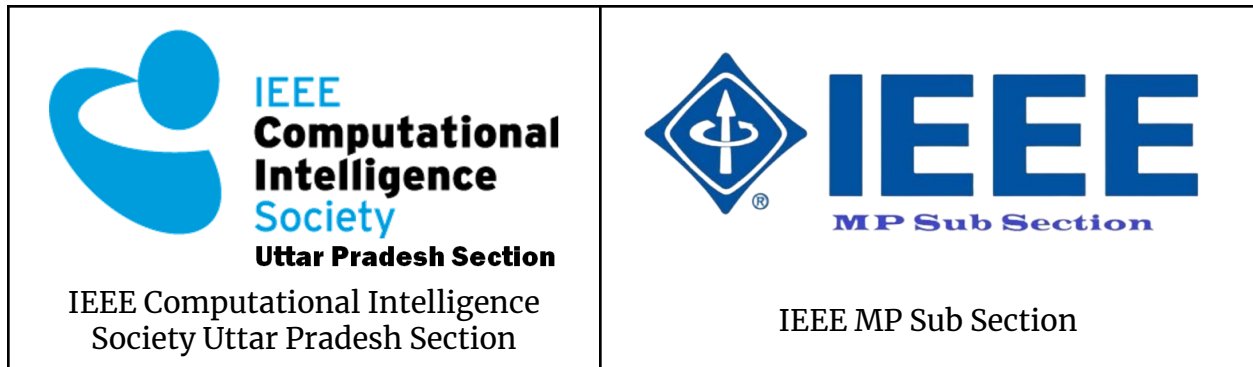
IEEE Computational Intelligence Society Uttar Pradesh Section	IEEE MP Sub Section

7. Posters and Banners

2022 IEEE CIS Summer School on
Deep Learning and Computational Intelligence:
Theory and Applications
December 12-16, 2022, IIT Indore, India
(HYBRID MODE)

IEEE Computational Intelligence Society

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Honorary Chair
Juergen Schmidhuber, Director, KAUST AI Initiative

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- Mohd Arshad, IIT Indore
- Bapan Ghosh, IIT Indore
- Chandresh Kumar Maurya, IIT Indore
- Puneet Gupta, IIT Indore
- Surya Prakash, IIT Indore
- Vijay Kumar Sohani, IIT Indore
- Sanjeev Singh, IIT Indore

Important Dates

- **Late Registration**: Dec. 06-11, 2022

- **Opening Ceremony**: Dec. 12, 2022

- **Closing Ceremony**: Dec. 16, 2022

- **Registration Link: http://events.iiti.ac.in/ieee-cis-summer-school-2022/registration**

Contact Us

M. Tanveer
Associate Professor and Ramanujan Fellow
OPTImization for MAchine Learning
(OPTIMAL) Lab
Indian Institute of Technology Indore
Email: mtanveer@iiti.ac.in
Mobile: +91-9413259268
Page: https://www.iiti.ac.in/people/~mtanveer/

About

IEEE Computational Intelligence Society (CIS) Summer School

Deep learning (DL) enhances classical machine learning (ML) by adding more "depth" (complexity) to the model and modifying the data employing various functions that allow data representation in a hierarchical manner, via multiple levels of abstraction. Deep learning discovers intricate structure in enormous datasets by utilizing the backpropagation algorithm to determine how internal parameters of machine should be changed.

Computational Intelligence (CI) is the theory, design, application and development of biologically and linguistically motivated computational paradigms. CI is set to change the world we live in through widespread application in numerous domains like medical imaging, computer vision, anomaly detection, sequence and stream processing, big data processing and so on.

The objective of this summer school is to provide a unique platform for young researchers, professionals, and students from all around the world in the recent developments and applicability of DL with CI. The school will bring people working in CI and DL domains to a common platform for generating innovative ideas. The school will also assess the state of the art on what new directions lie open for research in the areas of CI and DL. In this way, the school will generate exciting new communication across various CI, DL and ML disciplines. This summer school features a number of distinguished speakers on DL and CI which will be helpful for researchers and participants.

IIT Indore

IIT Indore is one of the premier institutes under the Ministry of Human Resource Development (MHRD), Govt. of India. IIT Indore has celebrated 12 glorious years of existence this year. In this short span of time, IIT Indore has positioned itself as a vibrant center for outstanding research. Multidisciplinary research at IIT Indore has been recognized at international level with active participation in several key international projects and several joint collaborations with academic/research institutions in Japan, Norway, USA, Germany, France, Singapore and many other countries. The institute is growing rapidly as the only center for advanced learning and knowledge-dissemination in the pure and applied sciences in Central India.
Read more at https://iiti.ac.in.

Keynote Speakers

- Juergen Schmidhuber, Director, KAUST AI Initiative
- PN Suganthan, Qatar University and NTU Singapore
- Johan Suykens, KU Leuven
- CV Jawahar, IIIT Hyderabad
- Kai Qin, Swinburne University of Technology, Australia
- Sansanee Auephanwiriyakul, Chiang Mai University, Thailand
- Kaizhu Huang, Duke Kunshan University, China
- Mufti Mahmud, Nottingham Trent University, UK
- M. Abulaish, South Asian University, New Delhi
- Asif Ekbal, IIT Patna
- Maryam Doborjeh, Auckland University of Technology, New Zealand
- Vinit Jakhetiya, IIT Jammu

- For more details, please visit:
  http://events.iiti.ac.in/ieee-cis-summer-school-2022/main
- Request for reduced registration fee under virtual mode, please contact: 2022ieee.cis.ss@gmail.com
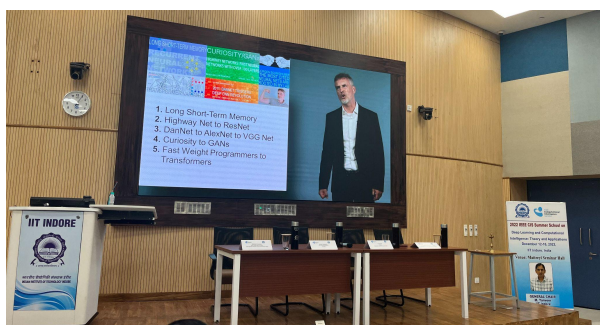
8. Activity Photos and Videos

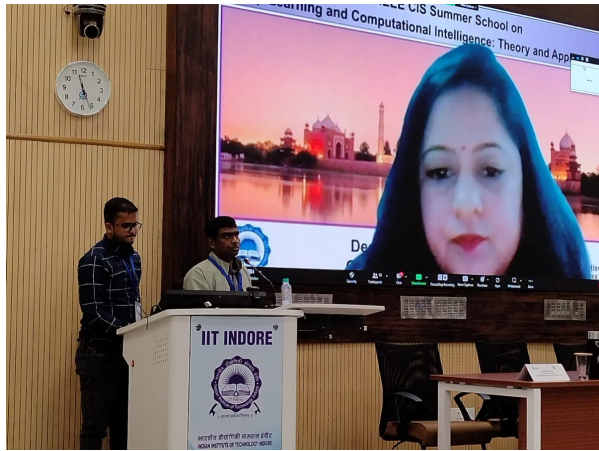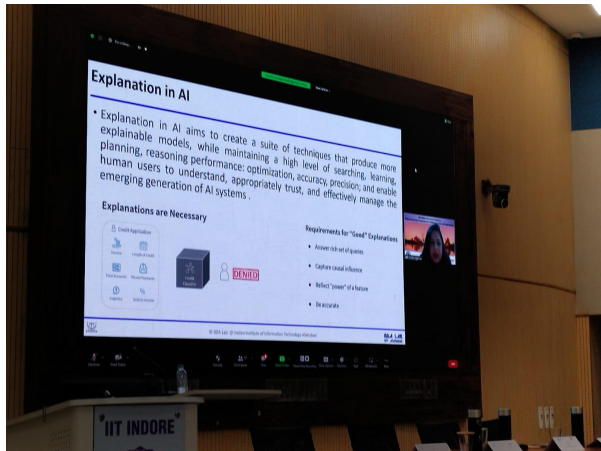Day 1: Opening Ceremony ([Video Link](#))

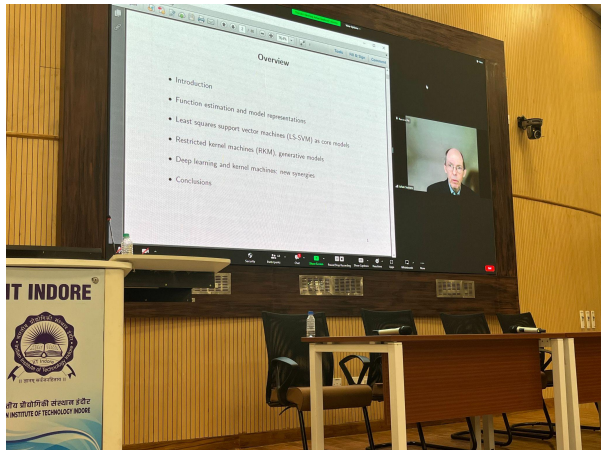# Day 1-5: Lectures
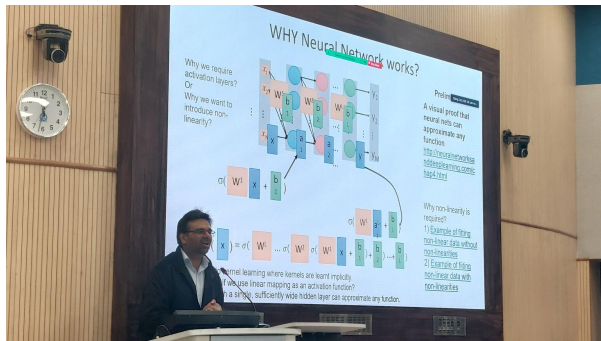

Jürgen Schmidhuber

Kaizhu Huang

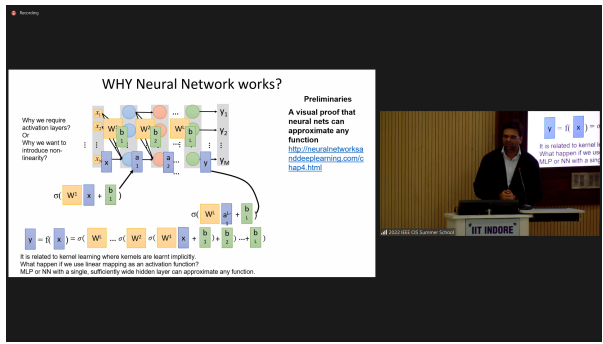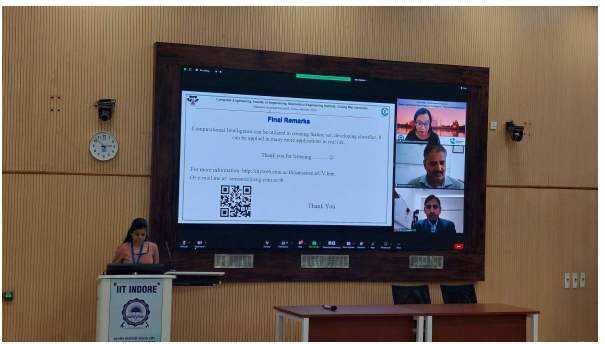Sonali Agarwal

Sonali Agarwal
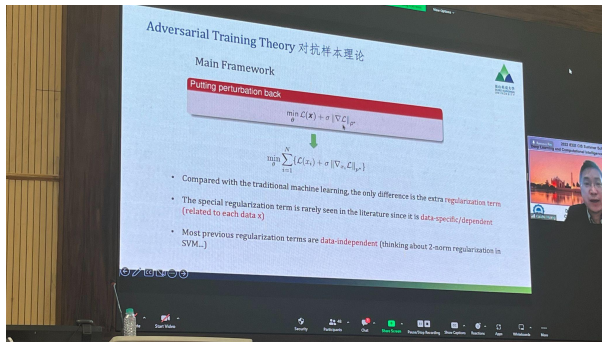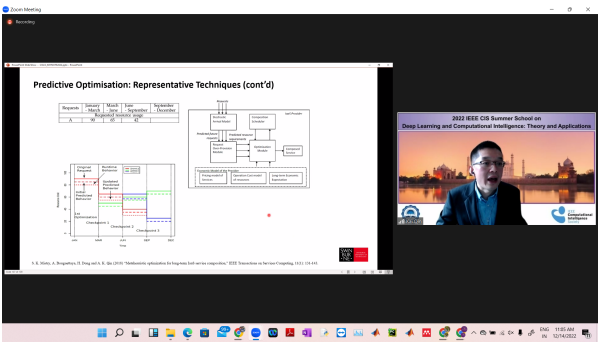

Johan Suykens

Johan Suykens

Maryam Doborjeh
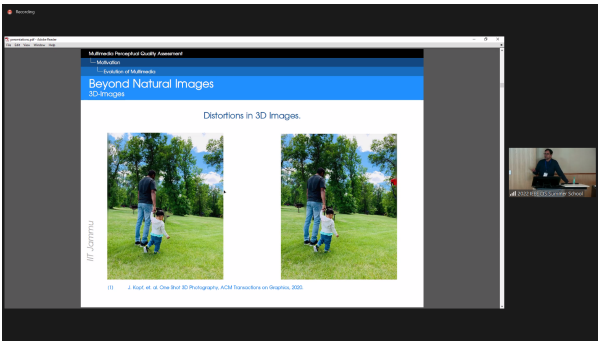

Puneet Gupta

Puneet Gupta

Sansanee Auephanwiriyakul

Kai Qin

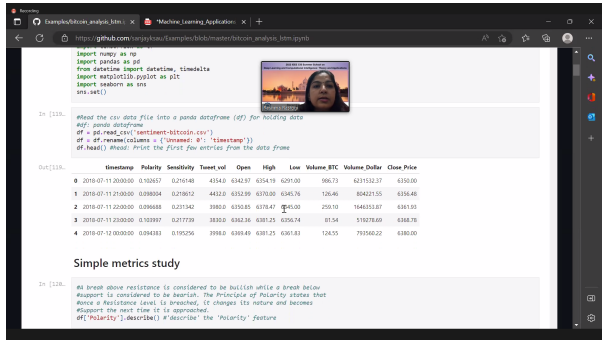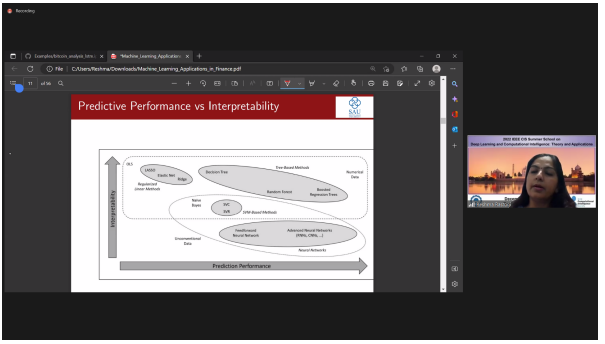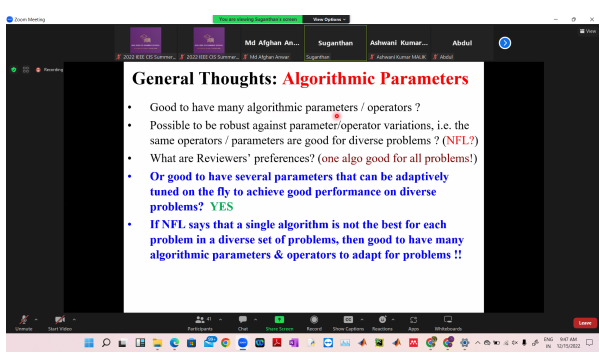Kai Qin

Asif Ekbal

Vinit Jakhetiya

Reshma Rastogi

Reshma Rastogi
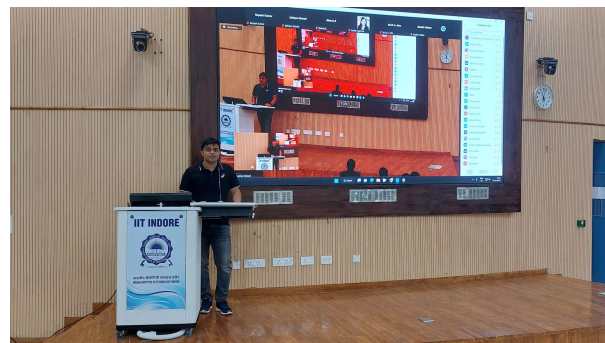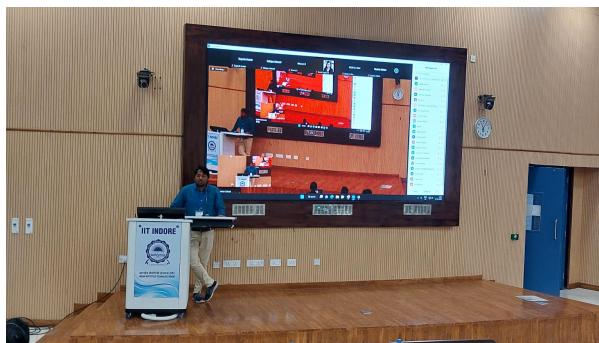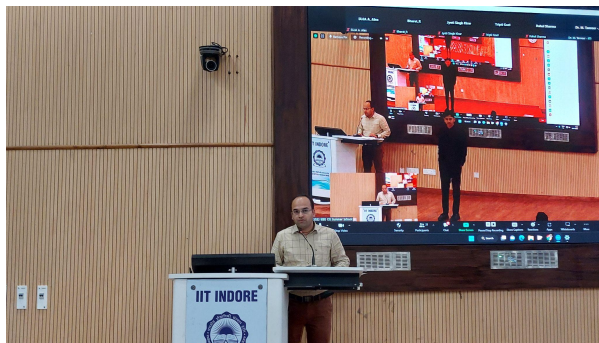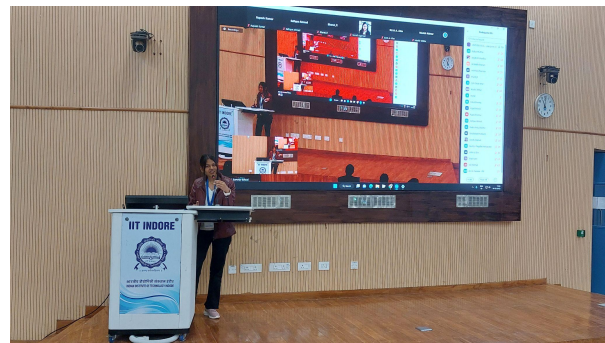
PN Suganthan

CV Jawahar

Day 5: Closing Ceremony ([Video Link](#))
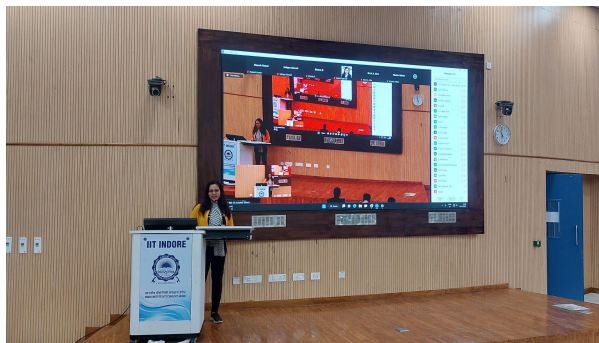
9. Short Report through Whova App

9.1. Hybrid Audience Interaction
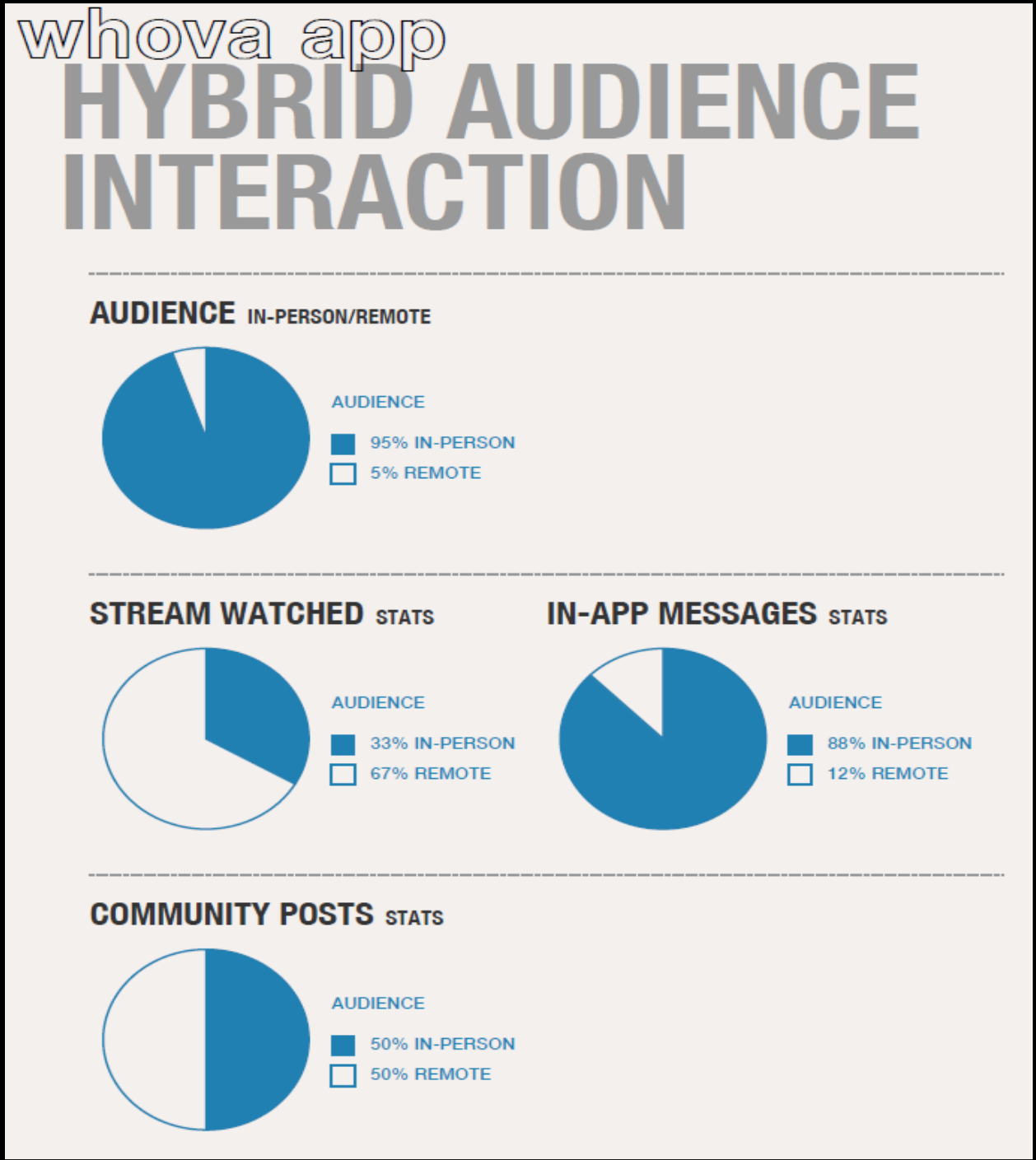
9.2. Attendance Breakdown

9.3. Networking Highlights

whova app
NETWORKING HIGHLIGHTS

PRIVATE MESSAGES 1-ON-1

212

ATTENDEE INTERACTION 1-ON-1

183

Attendees who have interacted with each other in private 1-on-1 messages

ATTENDEES INDICATED INTEREST

26

RECOMMENDED ATTENDEES

46

ATTENDEES MATCHED BASED OFF OF INTERESTS, LOCATIONS, AFFILIATION

TOP RECOMMENDATION MATCHES
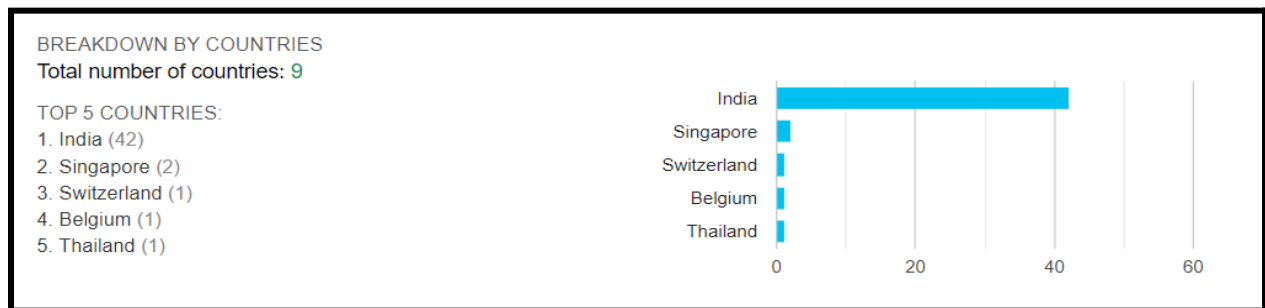deep learning, artifioial intelligenoe, maohine learning, optimization, oomputational intelligenoe, and more...
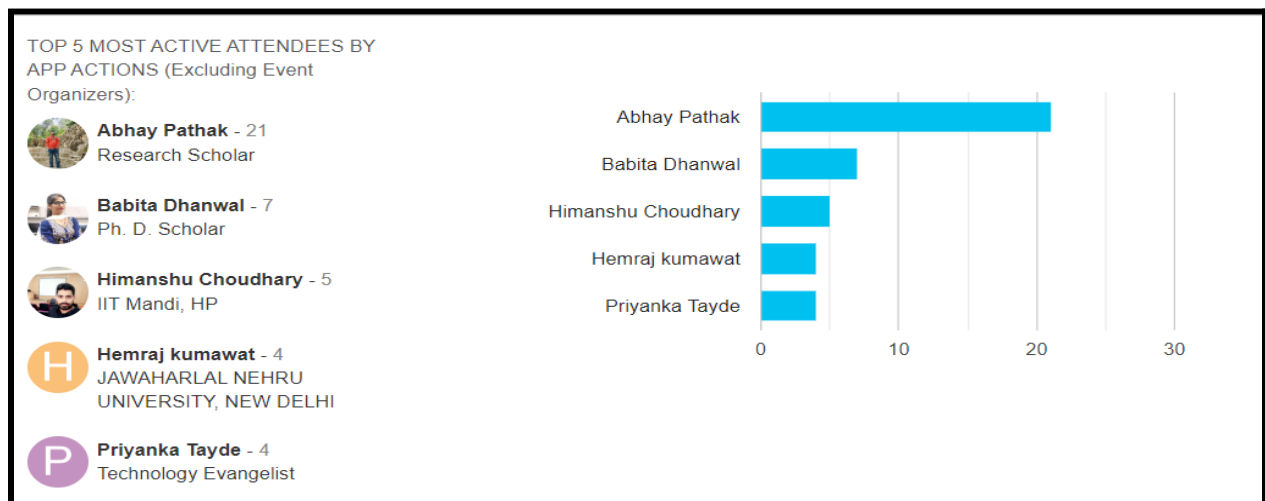
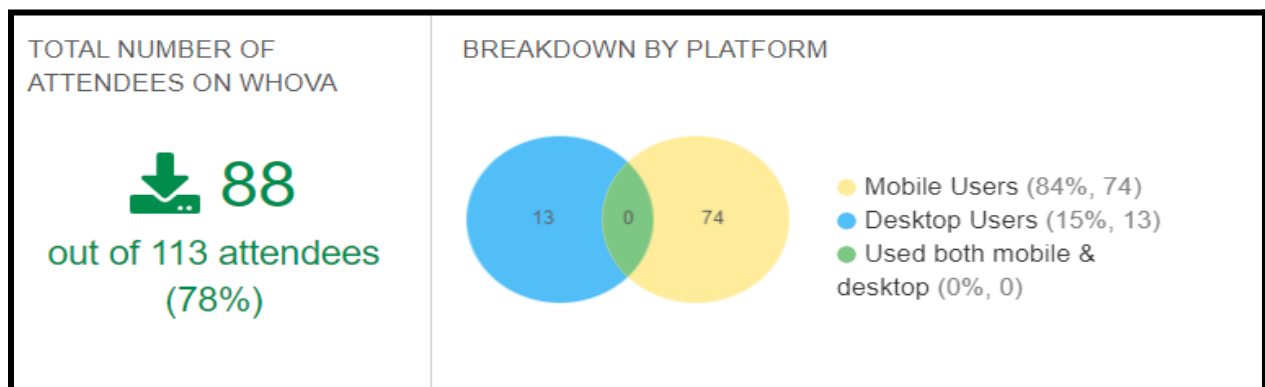**BIZ CARD** SCANNED AND EXCHANGED

25

ATTENDEES PROFILE VIEWS

473

9.4. Breakdown by Countries

BREAKDOWN BY COUNTRIES
Total number of countries: 9

TOP 5 COUNTRIES:
1. India (42)
2. Singapore (2)
3. Switzerland (1)
4. Belgium (1)
5. Thailand (1)

9.5. Five Most Active Attendees in Whova App

TOP 5 MOST ACTIVE ATTENDEES BY APP ACTIONS (Excluding Event Organizers):

Abhay Pathak - 21
Research Scholar

Babita Dhanwal - 7
Ph. D. Scholar

Himanshu Choudhary - 5
IIT Mandi, HP

Hemraj kumawat - 4
JAWAHARLAL NEHRU UNIVERSITY, NEW DELHI

Priyanka Tayde - 4
Technology Evangelist

9.6. Attendees Breakdown

TOTAL NUMBER OF ATTENDEES ON WHOVA

⬇ 88
out of 113 attendees
(78%)

BREAKDOWN BY PLATFORM

13   0   74

● Mobile Users (84%, 74)
● Desktop Users (15%, 13)
● Used both mobile & desktop (0%, 0)

10. Impacts and Discussions

Our summer school has had an impact on Deep Learning (DL) and Computational Intelligence (CI) education to young researchers, professionals, and students of Computer Science, Mathematics, Electrical Engineering, and related areas from all around the world in the recent developments and applicability of DL with CI. The purpose of the summer school is to promote CI and bring people working in DL and CI domains to a common platform for generating innovative ideas. The ***Summer School on Deep Learning and Computational Intelligence: Theory and Applications*** has promoted the CI and DL concept and knowledge from university students, professionals to researchers in India. The school has repercussions on opening the new directions for researchers in the area of CI and DL.

We summarize the ***Summer School on Deep Learning and Computational Intelligence: Theory and Applications*** as a great event to introduce DL with CI to university students, professionals, and young researchers to be involved in rapidly growing fields. We hope that after attending this summer school, students will have a strong desire and motivation to be active in global concerns and trends.

11. Acknowledgement