2018 IEEE CIS SUMMER SCHOOL ON DEEP LEARNING AND COMPUTATIONAL INTELLIGENCE

December 5th, 2018 to December 7th, 2018

Indian Institute of Technology Kanpur

India – 208016

About the School

Title: 2018 IEEE CIS Summer School on Deep Learning and Computational Intelligence

Duration: December 5th, 2018 to December 7th, 2018

Place: Indian Institute of Technology Kanpur, India – 208016

URL: http://www.iitk.ac.in/idea/IEEECISSS2018/

Coordinator:

Prof. Nishchal Kumar Verma
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Inter-disciplinary Program in Cognitive Science
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Objective:

The main idea of this school is to raise awareness and applicability about Deep Learning (DL) with Computational Intelligence (CI) among the research communities. Traditional learning and computing methods deal with vast range of applications related to reasoning, decision making, perception building etc. However, DL with CI deals with dynamical systems more efficiently by embedding and facilitating learning mechanism. Most of the data obtained in real time environment from various domains i.e. environment, industry, business, biology involves lots of imprecision and vagueness. To address these issues in various domains of algorithms, tools or techniques are required which should be adaptive and robust so that they can handle the uncertainty and dynamic nature of this system in efficient and optimized way.

"CI is a set of biological and linguistic tools and methodologies to address complex real-world problems to which traditional Artificial Intelligence (AI) approaches may not be very effective. CI comprises of concepts and implementations that ensures intelligent behaviour in complex and dynamic environment."

According to Robert J. Marks, "Neural Network, Genetic Algorithms, Fuzzy systems, evolutionary programming and artificial life are the building blocks of Computational Intelligence."

Using CI tools, we will be able to build the systems which are prone to adaption, robust across problem domains, apply extrapolated reasoning and behave intelligently in given state. Neural network techniques provide capability of computational adaption. System can improve its parameter without any intervention based on optimizing criteria same as human learning occurs. Fuzzy systems help in defining the system where we have a rough estimate of system requirements. Evolutionary algorithms are good enough to optimize parameters and to select best among given constraints. Synergistic effect of these tools may increase their individual performances and gives better adaptive and reliable system. Knowledge representation, reasoning, information mining, discovery science, web intelligence, semantic web, multi agent systems and designing of products i.e. air conditioners, automobile systems, ABS, cameras, dishwashers, pattern recognition in remote sensing, video games are the major areas where CI can be very helpful.

Advantages of DL and CI over existing deep learning algorithms: One has automatic structure optimization ability where a neural network structure (e.g., the number of layers, the number of units in each layer, the type of an activation function at each unit, etc.) is automatically optimized for a given data set and a given objective by an evolutionary structure learning technique. The other is multi-objective ability where several different neural networks are simultaneously obtained under a multi-objective scenario. Various multi-objective formulations can be considered for deep learning. A general formulation is a combination of complexity minimization and accuracy maximization. For detection problems, false positive and false negative can be handled as separate objectives.

The school will bring people working in CI and DL domain 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 area of CI and DL. In this way, the school will generate exciting new communication across various CI and machine learning disciplines.

The school has attracted around 99 participants (Annexure I) from various engineering colleges, industries and organizations across the India. In nutshell, the event was an excellent opportunity where thought-provoking lectures were conducted for fruitful interaction and several technical challenges. It helped exciting new communication across various DL and CI disciplines and helps to define an emerging international research community.

Sponsor(s): IEEE Computational Intelligence Society (CIS) - https://cis.ieee.org/

Co-Sponsor(s):

(1) CIS Chapter, IEEE UP Section (CIS11) - http://iitk.ac.in/idea/IEEECIS11/
(2) Indian Institute of Technology Kanpur, India - http://iitk.ac.in/
(3) Soft Computing Research Society (SocPros) - http://scrs.in/

Speaker(s) of the School

Prof. J. Sarangapani
Missouri University of Science and Technology, USA
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Title: Direct Error Driven Deep Learning Scheme for Bigdata Classification

Abstract: Complex systems like smart environments, fleet of vehicles, machining center, process control, smart grid and health care applications generate large quantities of data. Challenges in big data analytics are Noisy data, Noisy dimensions, Heterogeneity and Computational Cost. Big Data can be analysed using Dimension-reduction based and Learning Based Approaches Learning based approach involves deep learning techniques using deep neural networks and L1 penalized feature selection.

Prof. P. K. Kalra
Dayalbagh Educational Institute, Agra, India
Email: premkkalra@gmail.com

Title: Issues, Myths, and Best Application s of Computational Intelligence

Abstract: This lecture will be describing the three phases of Artificial Intelligence, first being the Theorem proving phase in the 1950s-1960s when there wasn't enough data and computing power, followed by the beginning of Neural Networks in 1980s and finally the third phase where there is enough data and power. We grazed through the history of the subject and neural networks, moving on to some basic, yet tricky problems such as the XOR problem. We were explained the importance of understanding the data, and how misinterpretation can lead to misleading results. Various other problems were discussed such as the blind source problem, inverse problem, PCA for complex variable, and so on. Finally, the insightful talk concluded by explaining out how important it is to integrate different concepts together in order to have an efficient and robust network.

Prof. Swagatam Das
Indian Statistical Institute, Kolkata, India
Email: swagatam.das@isical.ac.in

Title: Predictive and Generative Deep Neural Architectures of Recent Interest: Foundations, Perspectives, and Future Challenges

Abstract: Building from basics, this talk will elaborate on the advent of deep neural networks and the associated gradient-based optimization algorithms. The talk will then discuss Convolutional Neural Networks (CNNs) and Generative Adversarial Networks (GANs) with comprehensive examples. Finally, the talk will unearth some challenging future research avenues for deep learning.

Prof. Sandeep Shukla
Indian Institute of Technology Kanpur, India
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Title: Machine Learning Applications in Cyber Security

Abstract: Learning from examples and use the leaned model to classify or predict the future data points, have become the raison d'etre of machine learning. Deep Learning has been particularly useful in unsupervised machine learning. In this talk, we will discuss the various ways machine learning is used in the field of cyber security -- anomaly detection in cyber-physical systems, intrusion detection in network, malware detection for various classes of malware, malware classification etc. Unfortunately, as researchers start using machine learning for detection of various types of attacks, the attackers are responding by creating techniques for obfuscating the features so that the models cannot distinguish through regular feature sets. Such attacks on the learning algorithms and counter measures for those also will be discussed in brief. At the Interdisciplinary center for cyber security of critical infrastructure (C3I) at IIT Kanpur, several tools are being developed in this context. We will provide glimpses of some of those as well.

Prof. Nishchal K. Verma
Indian Institute of Technology Kanpur, India
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Tittle: Deep Learning and Deep Fuzzy Networks

Abstract: Deep learning has recently attracted lots of attention. In Simple Learning, one who learns faster is more intelligent. In basic structure of artificial learning mechanism, an artificial neuron contains a nonlinear activation function and has several incoming and outgoing weighted connections. Deep Learning (DL)framework comprises of multiple layers of nonlinear processing nodes which are trained over a large set of data. It works on the architecture of deep neural network (DNN) which is an artificial neural network with multiple hidden layers. However, DNN is unable to model uncertainty due to vagueness, ambiguity and impreciseness. Deep Fuzzy Network (DFN) can process uncertainty due to vagueness, ambiguity, imprecision (fuzziness) in inputs and actual output is close to the desired output.

Prof. A. R. Garg
J.N.V University Jodhpur, India
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Title: Convolutional Neural Network: the biologically inspired model of deep neural network

Abstract: Convolution neural networks (CNN) an example of deep neural networks, are hierarchical multi-layered networks and have been extensively used for many pattern recognition tasks such as facial recognition, hand written character recognition, image classification, medical image analysis, and natural language processing. Convolutional networks were inspired by the neurophysiological findings on the visual system of mammals in that the simple cells of primary visual cortex respond to stimuli only in a restricted region of visual field known as the receptive field of that cell. Further, these simple cell act as local feature detector and their output are then combined in higher layer of visual cortex to form higher order features. It has been shown that this knowledge can be easily built into a multi-layered network of neuron wherein each hidden layer consists of a set of feature detectors which are used to detect distinctive features of the object and to make a feature maps containing position information of that feature. The first layer of the CNN is used to detect local features and then these local features are combined in next layer to form higher order features, this process of combining features is continued to form next higher order features. Finally, these higher order features are used as input to multi layered perceptron (MLP) consisting of single hidden layer.

Each of these hidden layers contain a subsampling layer (pooling layer) to provide CNN's the property of translation and deformation invariance. Starting with the explanation of neurophysiological findings on the visual system of mammals which are used to construct CNN's an attempt in this talk will be made to explain the architecture, working and learning mechanisms of CNN. The talk will culminate with giving details and explanation on one of the applications of CNN.

Prof. A. K. Deb
Indian Institute of Technology Kharagpur, India
Email: alokkanti@ee.iitkgp.ac.in

Title: Support Vector Machines and Its Applications

Abstract: Support Vector Machines (SVM) that originate from Statistical Learning Theory has superior generalization capability as it not only takes care of the empirical risk but also the structural risk. This talk will deliberate on a classification architecture that is a hybrid of neural networks and SVMs. Evolution of alternate SVMs that are computationally fast and hence suitable for large datasets will be discussed. Application of SVMs in automotive modelling and in the control, framework will be demonstrated.

Prof. B. Bhattacharya
Indian Institute of Technology Kanpur, India
Email: bishakh@iitk.ac.in

Title: On some Electro-Mechanical Aspects of Neuron Model

Abstract: In this talk, I'll talk about the existing Hodgkin-Huxley model of neural impulse flow through axon system and indicate some of the anomalies related to this model. This will be further explored by introducing a new Soliton based wave model of the neural impulse transmission. The issues related to both the models will be discussed and a hybrid model based on co-propagation of electric and mechanical signal will be presented. The impact of the new

model in developing Biological Neural Network as an advanced model of ANN will be discussed.

Prof. Laxmidhar Behera
Indian Institute of Technology Kanpur, India
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Tittle: Selected Applications of Deep Networks and CI

Abstract: This talk will focus some interesting applications of CI and deep networks in Intelligent Control, Visual Perception, and EEG analysis. The primary motivation is to highlight how computing power juxtaposed with simple adaptive laws can extract meaningful information from huge data. Simultaneously it will be demonstrated that while control applications are governed by stability constraints, applications in visual grasping and EEG analysis are guided by convergence speed, accuracy and generalization.

Prof. Vrijendra Singh
Indian Institute of Information Technology Allahabad, India
Email: vrij@iiita.ac.in, vrijendra.singh@gmail.com

Tittle: Time Series Analysis: Recent Advancements & Applications

Abstract: Time series analysis has been always important for pattern recognition researchers. Time series analysis comprises methods for analysing time series data in order to extract meaningful information for the purpose of modelling, classification, clustering and forecasting etc. Parametric and non-parametric techniques have been widely used in the study of time series data. Recent advancements like time series anchored chains and deep learning model have been presented including real life applications and challenges.

Prof. J. C. Bansal
South Asian University, New Delhi, India
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Tittle: Nature Inspired Optimization Algorithms

Abstract: It become infeasible to apply classical optimization algorithms if the problem under consideration is highly nonlinear, have multiple optima and the gradient information is not available. For these optimization problems, there exist few intelligent random search algorithms. These algorithms search the solution stochastically. The intelligence in this random search is inserted by inspiration from the nature. Whether it is ants foraging behaviour or birds' swarming behaviour or human evolution process, the computational optimization algorithms have been developed based on many natural phenomena. Researchers found that these nature inspired optimization algorithms can efficiently tackle the problems, which are otherwise difficult to solve using traditional optimization algorithms. During this lecture, few popular and successful algorithms (Particle Swarm Optimization, Artificial Bee Colony Algorithm, Spider Monkey Optimization and Biogeography Based Optimization) will be introduced. Artificial Bee Colony Algorithm will be discussed in detail.

Prof. Vipul Arora
Indian Institute of Technology Kanpur, India
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Tittle: Machine Learning for Speech and Audio Applications

Abstract: Recently machine learning has been very successful for a large variety of audio applications: speech recognition, speaker identification, hearing aids and smart home devices to name a few. This talk will discuss the basics of audio signal processing and machine learning models commonly used for some of the popular audio applications like speech recognition and audio detection.

Program Schedule

2018 IEEE CIS Summer School on Deep Learning and Computational Intelligence December 5th - 7th, 2018 Indian Institute of Technology Kanpur, India		
Venue: Lecture Hall Complex (L-15)		
Day 1: December 5th, 2018		
08:00 AM Onwards	**Registration**	
08:45 AM - 09:00 AM	Welcome Speech	
09:00 AM - 10:30 AM	**Lecture 1**	Speaker: Prof. Akhil R. Garg Affiliation: J.N.V University Jodhpur, India *Title: Convolutional Neural Network: the biologically inspired model of deep neural network*
10:30 AM - 11:00 AM	Tea Break	
11:00 AM - 12:30 PM	**Lecture 2**	Speaker: Prof. A. K. Deb Affiliation: Indian Institute of Technology Kharagpur, India *Title: Support Vector Machines and Its Applications*
12:30 PM - 02:00 PM	Lunch	
02:00 PM - 03:30 PM	**Lecture 3**	Speaker: Prof. B. Bhattacharya Affiliation: Indian Institute of Technology Kanpur, India *Title: On some Electro-Mechanical Aspects of Neuron Model*
03:30 PM - 04:00 PM	Tea Break	
04:00 PM - 05:30 PM	**Lecture 4**	Speaker: Prof. J. C. Bansal Affiliation: South Asian University, New Delhi, India *Title: Nature Inspired Optimization Algorithms*
Day 2: December 6th, 2018		
09:00 AM - 10:30 AM	**Lecture 5**	Speaker: Prof. Vipul Arora Affiliation: Indian Institute of Technology Kanpur, India *Title: Machine Learning for Speech and Audio Applications*
10:30 AM - 11:00 AM	Tea Break	
11:00 AM - 12:30 PM	**Lecture 6**	Speaker: Prof. Nishchal K. Verma Affiliation: Indian Institute of Technology Kanpur, India *Title: Deep Learning and Deep Fuzzy Networks*

12:30 PM - 02:00 PM	Lunch	
02:00 PM - 03:30 PM	**Lecture 7**	Speaker: Prof. Vrijendra Singh Affiliation: Indian Institute of Information Technology Allahabad, India *Title: Time Series Analysis: Recent Advancements & Applications*
03:30 PM - 04:00 PM	Tea Break	
04:00 PM - 05:30 PM	**Lecture 8**	Speaker: Prof. L. Behera Affiliation: Indian Institute of Technology Kanpur, India *Title: Selected Applications of Deep Networks and CI*
Day 3: December 7th, 2018		
09:00 AM - 10:30 AM	**Lecture 9**	Speaker: Prof. Jagannathan Sarangapani Affiliation: Missouri University of Science and Technology, USA *Title: Direct Error Driven Deep Learning Scheme for Bigdata Classification*
10:30 AM - 11:00 AM	Tea Break	
11:00 AM - 12:30 PM	**Lecture 10**	Speaker: Prof. P. K. Kalra Affiliation: Dayalbagh Educational Institute, Agra, India *Title: Issues, Myths, and Best Applications of Computational Intelligence*
12:30 PM - 02:00 PM	Lunch	
02:00 PM - 03:30 PM	**Lecture 11**	Speaker: Prof. Sandeep Shukla Affiliation: Indian Institute of Technology Kanpur, India *Title: Machine Learning Applications in Cyber Security*
03:30 PM - 04:00 PM	Tea Break	
04:00 PM - 05:30 PM	**Lecture 12**	Speaker: Prof. Swagatam Das Affiliation: Indian Statistical Institute Kolkata, India *Title: Predictive and Generative Deep Neural Architectures of Recent Interest: Foundations, Perspectives, and Future Challenges*

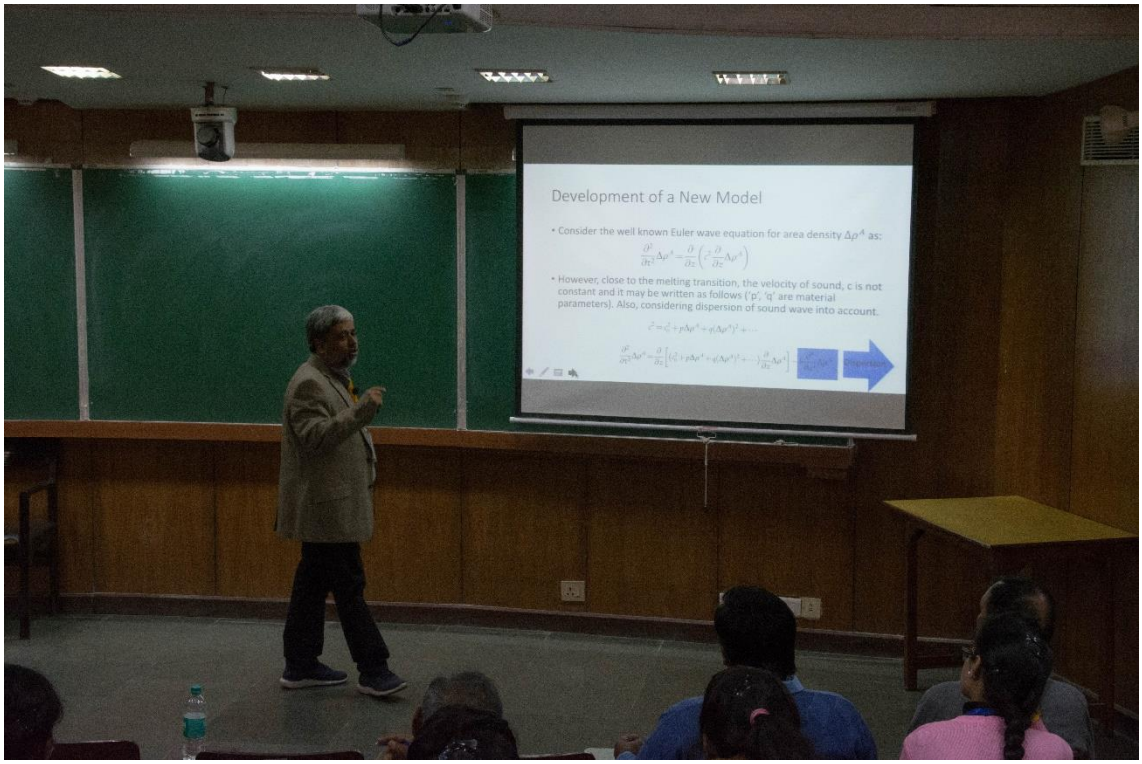
Photograph(s) of the event

Welcome address to the participants of Summer School by School Coordinator: **Prof. Nishchal K. Verma**, *Dept. of Electrical Engineering, Indian Institute of Technology Kanpur, India*

Participants of Summer School listening the welcome address by School Coordinator: **Prof. Nishchal K. Verma**, *Dept. of Electrical Engineering, Indian Institute of Technology Kanpur, India* at the venue of the event: Lecture Hall Complex – L15, Indian Institute of Technology Kanpur, India

Prof. Akhil R. Garg, *J.N.V University Jodhpur, India* delivering lecture on "Convolutional Neural Network: the biologically inspired model of deep neural network" on Day 1: December 5th, 2018

Prof. A. K. Deb, *Indian Institute of Technology Kharagpur, India* delivering lecture on "Support Vector Machines and Its Applications" on Day 1: December 5th, 2018



Prof. B. Bhattacharya, *Indian Institute of Technology Kanpur*, *India* delivering lecture on "On some Electro-Mechanical Aspects of Neuron Model" on Day 1: December 5th, 2018

Prof. J. C. Bansal, *South Asian University, New Delhi, India* delivering lecture on "Nature Inspired Optimization Algorithms" on Day 1: December 5th, 2018

Prof. Vipul Arora, *Indian Institute of Technology Kanpur*, *India* delivering lecture on "Machine Learning for Speech and Audio Applications" on Day 2: December 6th, 2018

Prof. Vrijendra Singh, *Indian Institute of Information Technology Allahabad, India* delivering lecture on "Time Series Analysis: Recent Advancements & Applications" on Day 2: December 6th, 2018

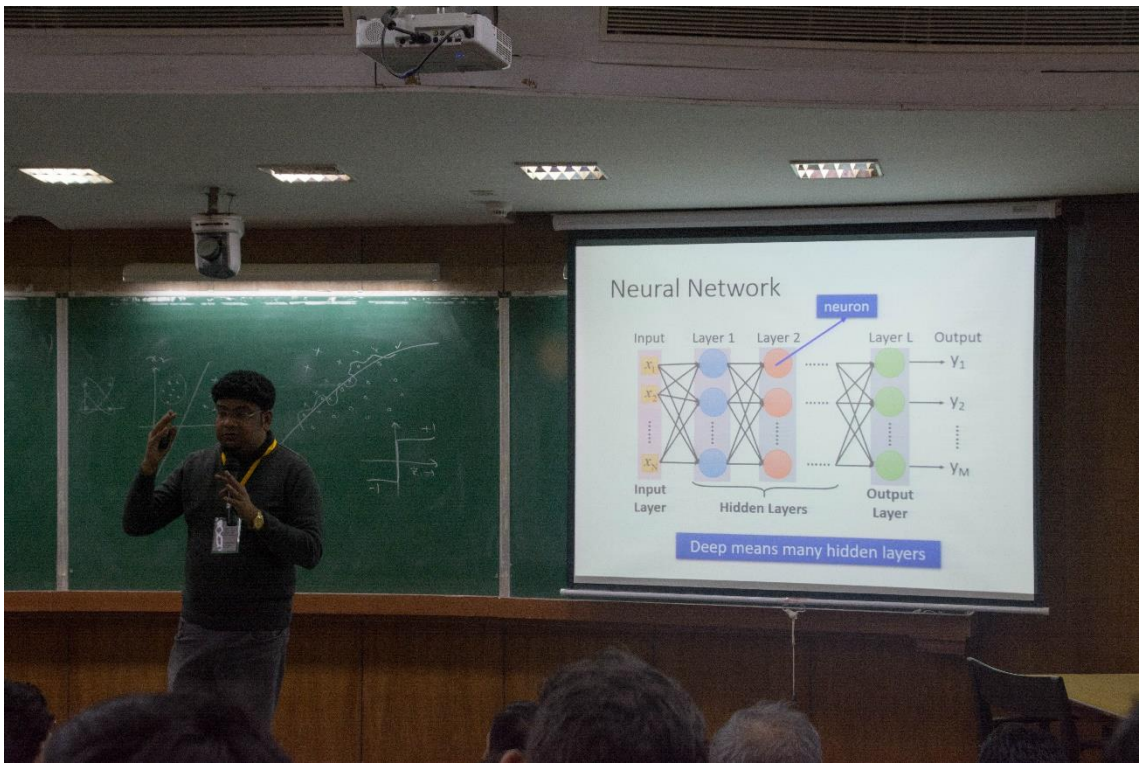
Prof. Nishchal K. Verma, *Indian Institute of Technology Kanpur, India* delivering lecture on "Deep Learning and Deep Fuzzy Networks" on Day 2: December 6th, 2018

Prof. L. Behera, *Indian Institute of Technology Kanpur, India* delivering lecture on "Selected Applications of Deep Networks and CI" on Day 2: December 6th, 2018

Prof. Jagannathan Sarangapani, *Missouri University of Science and Technology, USA* delivering lecture on "Direct Error Driven Deep Learning Scheme for Bigdata Classification" on Day 3: December 7th, 2018

Prof. P. K. Kalra, *Dayalbagh Educational Institute, Agra, India* delivering lecture on "Issues, Myths and Best Applications of Computational Intelligence" on Day 3: December 7th, 2018

Prof. Sandeep Shukla, *Indian Institute of Technology Kanpur*, *India* delivering lecture on "Machine Learning Applications in Cyber Security" on Day 3: December 7th, 2018



Prof. Swagatam Das, *Indian Statistical Institute, Kolkata, India* delivering lecture on "Predictive and Generative Deep Neural Architectures of Recent Interest: Foundations, Perspectives, and Future Challenges" on Day 3: December 7th, 2018

Group photo of participants along with delegates at Lecture Hall Foyer, Indian Institute of Technology Kanpur, India on December 7th, 2018

Group photo of participants along with delegates at Lecture Hall Foyer, Indian Institute of Technology Kanpur, India during Summer School on December 7th, 2018








Certificate distribution session during Summer School at Lecture Hall Complex – L15, Indian Institute of Technology Kanpur, India on December 7th, 2018

Organizing Team

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