



**SREE CHITRA THIRUNAL
COLLEGE OF ENGINEERING**

Pappanamcode, Thiruvananthapuram - 695018

Dept. of Electronics & Communication Engineering
Faculty Development Programme on

Research Perspectives of Machine Learning & Deep Learning for Signal Processing Applications

Sponsored by
APJ Abdul Kalam Technological University
Kerala, India



**2021
SEP
6-10**

Online
Mode

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Trivandrum



*SREE CHITRA THIRUNAL
COLLEGE OF ENGINEERING*

**A Report on
Faculty Development Programme**

**RESEARCH PERSPECTIVES OF
MACHINE LEARNING & DEEP LEARNING
FOR SIGNAL PROCESSING APPLICATIONS**

6th to 10th September, 2021

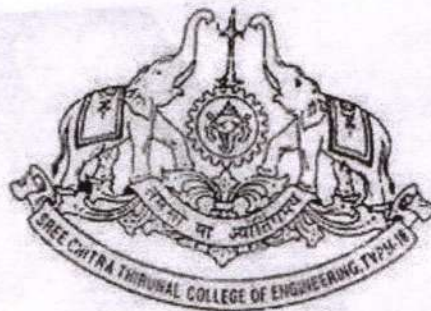
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APJ Abdul Kalam Technological University

Kerala

Organized by



Department of Electronics & Communication Engineering

Sree Chitra Thirunal College of Engineering

Pappanamcode, Thiruvananthapuram,

Kerala

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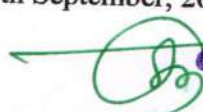


Introduction

A Faculty Development Programme (FDP) is always designed to keep pace with the changing scenario in Technical Education by providing ample opportunities to acquire knowledge about current technological developments in relevant fields and facilitate the up-gradation of new concepts, methods and tools, theory and skills development. Every academic year the APJ Abdul Kalam Technological University of Kerala (KTU) gives financial assistance to its affiliated colleges to conduct such programmes to impart training to the faculties of KTU affiliated colleges in different disciplines of Engineering & Technology. This will promote the professional practices relevant to technical education, motivates the faculty to achieve competitive teaching and learning environment and channelize developments with respect to academic qualifications and personal matters. Sree Chitra Thirunal College of Engineering (SCTCE) faculty members actively organizes and participates in various KTU sponsored FDPs in different disciplines as a part of teaching learning process. Sree Chitra Thirunal College of Engineering (SCTCE), Thiruvananthapuram was established by the Govt. of Kerala in the year 1995 in memoriam of Sree Chithira Thirunal Balarama Varma, the Great Maharaja of Travancore. It is one among the top engineering college in the state of Kerala. The institution has the broad objective of being an active agent of change by responding to the needs and challenges of the times by grooming young men and women into technocrats through the process of engineering education, training and research. Exposing the young minds to the world of technology, SCTCE instills in them plenty of confidence and fortitude to face new challenges and triumph in their chosen areas. The National Board of Accreditation has given accreditation to four branches of this college which includes the Department of Electronics & Communication Engineering. The department offers B.Tech, M.Tech and Ph. D programmes under APJ Abdul Kalam Technological University

The department of Electronics and Communication Engineering was established during the inception of the institute, in the year 1995. The department grew into a full-fledged one with two batches in the year 2001. The annual intake for undergraduate (B.Tech) programme is currently 120 students. A postgraduate programme (M.Tech) in Signal Processing, with an annual intake of 18 students, was started in the year 2011. The department is an approved research centre under APJ Abdul Kalam Kerala Technological University (KTU) from 2016 and currently there are 6 research scholars in the department. With its state of the art facility and a highly qualified faculty, this department is the best among its counterparts in Kerala. The focus of the department is to produce graduates and post graduates with strong fundamentals in electronics and communication domain and experience in the latest happenings of the industry, so that they can meet the upcoming challenges in the field.

During the academic year 2021-22 the department of Electronics & Communication Engineering (ECE) of SCTCE got approval for conducting the FDP on Research Perspectives of Machine Learning & Deep Learning for Signal Processing Applications which was conducted from 6th to 10th September, 2021.


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About the Programme

Present "Big Data Era" demand technologies that provide high value predictions which leads to better decisions and smart actions in real time without human intervention. Machine and deep learning methodologies help to perform various data analytics in order to make sense of the data for smarter actions. This faculty development programme (FDP) is intended to provide a platform for faculty, research scholars and post graduate students, to upgrade their knowledge and acquire skills in the fundamentals of machine learning and deep learning techniques and its applications in various signal processing domains.

Initially it was planned for an offline FDP program starting from the basics of Machine Learning, progressing towards the state-of-the-art of Deep Learning with hands-on sessions and exploring the domain of signal processing applications. As the pandemic still continues to disrupt normal operations, it was decided to maintain normalcy as much as possible made us to think of the course to go online. Under this context let me give a brief overview of the course.

Recent years have seen a significant widening of scope of Signal Processing research with machine learning playing an important role in the development. Since 2006, Deep learning, a new area of machine learning research, emerged resulting in the wide range of signal and information processing work within the traditional and the new, broadening the scopes.

Various workshops have been devoted exclusively to machine learning/ deep learning techniques and its applications to classical signal processing areas. With this motivation, this FDP is designed aiming to introduce the research perspectives of machine learning techniques and deep learning techniques useful for various signal processing applications.

The following topics were covered: -

1. Perspectives of Machine Learning & Deep Learning Algorithms.
2. Overview of different ML algorithms with its mathematical foundations.
3. Introduction to Gradient Descent Algorithm and its applications in Machine Learning.
4. Preference learning in socio-sensing systems.
5. Basics of CNN, U-Net, RCNN, and Faster R-CNN for object detection.
6. Deep Learning for Medical Image Analysis/Processing.
7. Deep Learning for Natural Language Processing.
8. Machine Learning Techniques in Audio Processing.
9. Deep unfolding for signal processing.
10. Deep Learning for Computer Vision.


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Course Outcomes

At the end of the program, the participants was able to


- 1) **Discuss** the fundamental theoretical and practical concepts in machine learning and deep learning algorithms
- 2) **Analyze** the mathematical foundations of machine learning and deep learning techniques
- 3) **Apply** Machine Learning and Deep Learning Algorithms in various domains of signal processing like Computer Vision, NLP, Image Analysis etc.
- 4) **Evaluate** the performance of Machine Learning and Deep Learning tools and techniques that has been applied for solving specific signal processing problems.
- 5) **Formulate** machine learning and deep learning models in various real-time practical applications.

Methodology

FDP sessions were conducted via google meet and the meet id for the entire FDP was shared through email. The attendance of each session was taken by circulating a google form. On the last day, (10th September) last session, an assessment test was conducted online. All materials were made available in Google classroom including the recordings of the classes. E-Certificates for the courses were mailed to all participants.

Audience

This faculty development programme (FDP) is intended to provide a platform for faculty, research scholars and post graduate students, to upgrade their knowledge and acquire skills in the fundamentals of machine learning and deep learning techniques and its applications in various signal processing domains. Hence the participants were invited from Faculty members from different engineering colleges under the APJ Abdul Kalam Technological University Kerala and other Universities, Research Scholars of AICTE approved institutions, Engineers and Scientists from industry with relevant background. The list of participants is attached as Annexure.



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COMMITTEE MEMBERS

Chief Patron:

Shri. Antony Raju

The hon'ble minister for Transport, Kerala (Chairman, Board of Governors, SCTCE)

Patron:

Dr. Jayasudha J. S., The Principal i/c, SCTCE

Convenor:

Dr. Sheeja M. K., Professor & Head, Dept. of ECE, SCTCE

Coordinators:

Prof. Bindu V., Associate Professor, Dept. of ECE, SCTCE

Dr. Lakshmi V. S., Assistant Professor, Dept. of ECE, SCTCE

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Copy to:-
1. The Principal concerned
2. The Finance Officer
3. VCP/VC Registrar/Dean(Academics/Dean(Research))

**APJ Abdul Kalam Technological University
Thiruvananthapuram**

Abstract

Faculty Development Programme (FDP) for the academic Year 2020-21 - Selected - reg

ACADEMIC SECTION

U.O.No. 1660/2020/KTU

Thiruvananthapuram, Dated: 25.11.2020

Read:-1. Notification dated 03/02/2020

2.U.O. No. 1600/2020/KTU dated 18.11.2020

ORDER

Proposals were invited for conducting Faculty Development Programme for the academic year 2020-21 from Institutions / professional bodies as per reference 1 cited above.

Vide reference 2, a Committee was constituted for scrutinizing the proposals. Considering the recommendations of the Committee, sanction is accorded by the Hon'ble Vice-Chancellor for conducting the Faculty Development Programme as detailed below (List attached).

The Institutions can conduct FDPs before August 2021. In the present scenario of Covid-19 pandemic, the Institutions can organize FDPs in online mode or in offline mode.

The Colleges shall engage the classes by the expert faculty listed in the proposal. There will be scrutiny regarding the conduct of FDPs by the APJKTU authorities. The respective course coordinators are required to submit the report of the program as mentioned in the guidelines, after the completion of the program. They are also directed to submit original bills of all transactions made during the program including honorarium, TA, refreshments, reading materials, etc. attested by the Head of the Institution and statement of accounts audited by a Chartered accountant.

Encl:

1. List of FDP sanctioned for the academic year 2020-21
2. Budgetary provisions and instructions for conducting offline mode
3. Budgetary provisions and instructions for conducting online mode.

Sd/-

Dr. Bijukumar R *
Dean (Academic) in Charge

Copy to:-

1. The Principals concerned
2. The Finance Officer
3. VC/PVC/Registrar/Dean(Academics)/Dean(Research)

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* This is a computer system (Digital File) generated letter. Hence there is no need for a physical signature.

Sl. No.	Name of the Host Institution	Title of the Programme	Faculty Name
1	GOVERNMENT ENGINEERING COLLEGE KOSHIKODE	Pattern Analysis Applications in Machine Vision and Learning	Dr. Shajee John, Asst. Prof.
2	NSS COLLEGE OF ENGINEERING PALAKKAD	Recent Advancements in Wireless Communication Technologies	Dr. Suman M. Asst. Prof.
3	SREE CHITRA COLLEGE OF ENGINEERING PALAKKAD	Research Perspectives of AI in Learning & Designing Applications	Dr. V. Anoop, Prof.
4	LIBS COLLEGE OF ENGINEERING KASARAGOD	IoT Based Autonomous Robot Design	Dr. Manoj Kumar, Asst. Prof.
5	ADITHYAN ENGINEERING TECHNOLOGY, RAJALADY	Power Electronics and Applications in Vehicles - Control and Strategies	Dr. Manoj Kumar, Asst. Prof.
6	VIMAL JYOTHI ENGINEERING COLLEGE, KANNUR	IoT Based Autonomous Robot Design	Dr. Manoj Kumar, Asst. Prof.
7	VIMAL JYOTHI COLLEGE OF ENGINEERING	Biomedical Instrumentation - Research Challenges	Dr. S. K. K. Asst. Prof.
8	RAGHURI SCHOOL OF ENGINEERING & TECHNOLOGY, KOTTAI	Artificial Intelligence and Machine Learning: Theory and Applications	Dr. Manoj Kumar, Asst. Prof.
9	VIMAL COLLEGE OF ENGINEERING, MANKARA, PALAKKAD	Computer Vision & Data Mining	Dr. Manoj Kumar, Asst. Prof.
10	SAHAYYA COLLEGE OF ENGINEERING & TECHNOLOGY, THIRISSUR	Deep Learning for Signal Processing - Basics to Implementation	Dr. Manoj Kumar, Asst. Prof.
11	ALHULA SCHOOL OF ENGINEERING & TECHNOLOGY, PALAKKAD	Recent Trends in Artificial Intelligence and Machine Learning	Dr. V. Anoop, Prof.
12	INSTITUTION OF ELECTRONICS & TELECOMMUNICATIONS ENGINEERS, PATTOM, MAR BASILIOS CHRISTIAN COLLEGE OF ENGINEERING AND TECHNOLOGY, PEERWADE	Chaos in Biomedical Signal Processing	Dr. R. Radhakrishnan, Asst. Prof.
13	AL AMEEN ENGINEERING COLLEGE, SHORANUR	Emerging trends and challenges in Low Power VLSI Design	Dr. Manoj Kumar, Asst. Prof.
14		Recent Trends in Application of Renewable Energy in Engineering Applications	Dr. K. George Varma, Principal & HOD

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ELECTRONICS

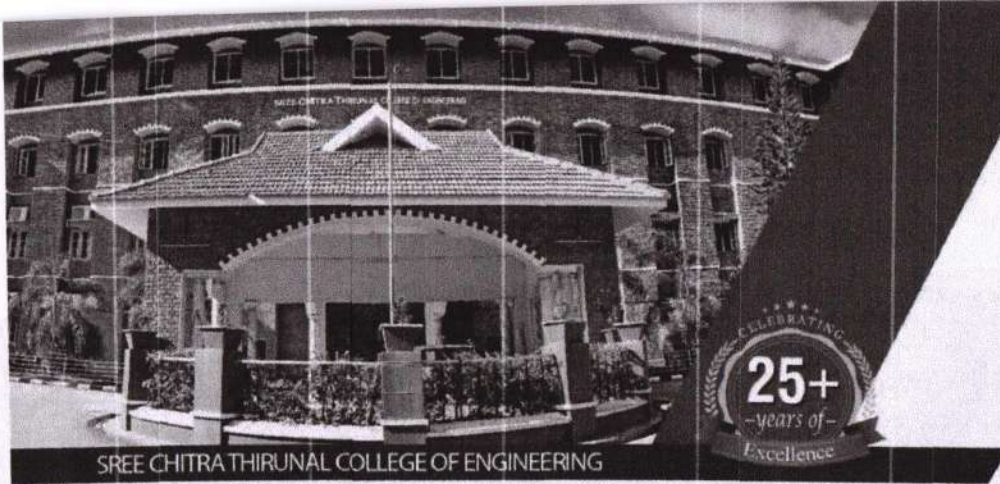
SL.NO.	NAME OF THE HOST INSTITUTION	TITLE OF THE PROGRAMME	COORDINATORS
1	GOV.ENGINEERING COLLEGE KOZHIKODE	Pattern Analysis Applications in Machine Vision and Listening	Dr. Shajee Mohan B S, Assoc. Prof Dr. Abdurahiman V, Asst. Prof
2	NSS COLLEGE OF ENGINEERING, PALAKKAD	Recent Advancements in Wireless Communication Technologies	Dr. Sumi M, Asst. Prof Ashok S Kumar, Asst. Prof
3	SREE CHITRA THIRUNAL COLLEGE OF ENGINEERING, TVM	Research Perspectives of Machine Learning & deep Learning fo signal Processing Applications	Bindu V, Assoc. Prof Lakshmi V S, Asst. Prof
4	LBS COLLEGE OF ENGINEERING, KASARAGOD	LoRaWAN and IoT Applications	Dr. Mary Reena K E, assoc. Prof Reni Sam Mathew, Asst. Prof
5	ADI SHANKARA INSTITUTE OF ENGINEERING AND TECHNOLOGY, KALADY	Power Electronics for Electric Vehicles- Control and Challenges	Dr. Jeno Paul, Professor Deepa Sankar, Assoc. Prof
6	VIMAL JYOTHI ENGINEERING COLLEGE, KANNUR	IoT Based Autonomous Robot Design	Shinu M M, Asst. Prof Dhanoj Mohan, Asst. Prof
7	AMALJYOTHI COLLEGE OF ENGINEERING	Biomedical Instrumentation-Research Challenges	Dr. S N KUMAR, Asst.Prof, EEE Dr GODWINRAJ, Asst.Prof,ECE
8	RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY, KOCHI	Artificial Intelligence and Machine Learning: Theory and Applications	Dr. Hari C V, Asst. Prof
9	AMMINI COLLEGE OF ENGINEERING, MANKARA, PALAKKAD	Computer Vision & Data Mining	Asha Arvind, Asst.Professor
10	SAHRDAYA COLLEGE OF ENGINEERING & TECHNOLOGY, THRISSUR	Deep Learning for Signal Processing- Basics to Implementation	Dr. Vishnu Rajan, Head,Dept.of ECE Binet Rose Devassy, Asst. Prof
11	AHALIA SCHOOL OF ENGINEERING & TECHNOLGY, PALAKKAD	Recent Trends in Artificial Intelligence and Machine Learning	Dr. V Balamurugan, Professor & HOD
12	INSTITUTION OF ELECTRONICS & TELECOMMUNICATION ENGINEERS, PATTOM	Chaos in Biomedical Signal Processing	N Radhakrishnan Nair, Vice Principal,SNIT Adoor
13	MAR BASELIOS CHRISTIAN COLLEGE OF ENGINEERING AND TECHNOLOGY, PEERMADE	Emerging trends and challenges in Low Power VLSI Design	Prof. Anu Mary Mathew, Dept. of ECE
14	AL AMEEN ENGINEERING COLLEGE, SHORANUR	Recent Trends in Utilization of Renewable Energy in Engineering Applications	Dr. K Geetha Varma, Principal & HOD



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SREE CHITRA THIRUNAL COLLEGE OF ENGINEERING



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Pappanamcode, Thiruvananthapuram - 695018

Dept. of Electronics & Communication Engineering
Faculty Development Programme on

Research Perspectives of Machine Learning & Deep Learning for Signal Processing Applications

Sponsored by
APJ Abdul Kalam Technological University
Kerala, India

**2021
SEP
6-10**
Online
Mode

About the Institution

Sree Chitra Thirunal College of Engineering (SCTCE), Thiruvananthapuram was established by the Govt. of Kerala in the year 1995 in memoriam of Sree Chithira Thirunal Balarama Varma, the Great Maharaja of Travancore. It is one among the top engineering college in the state of Kerala. The institution has the broad objective of being an active agent of change by responding to the needs and challenges of the times by grooming young men and women into technocrats through the process of engineering education, training and research. Exposing the young minds to the world of technology, SCTCE instills in them plenty of confidence and fortitude to face new challenges and triumph in their chosen areas. The National Board of Accreditation has given accreditation to four branches of this college which includes the Department of Electronics & Communication Engineering. The department offers B.Tech, M.Tech and Ph. D programmes under APJ Abdul Kalam Technological University.

Vision of the Institution

To become an engineering and technology institution which is renowned for producing professionally capable and socially responsible engineers.

Mission of the Institution

To create a learning process for students to acquire engineering fundamentals, in an environment that encourages analysis, team work, entrepreneurship and ethical values, thus preparing them for productive careers.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

About the Department

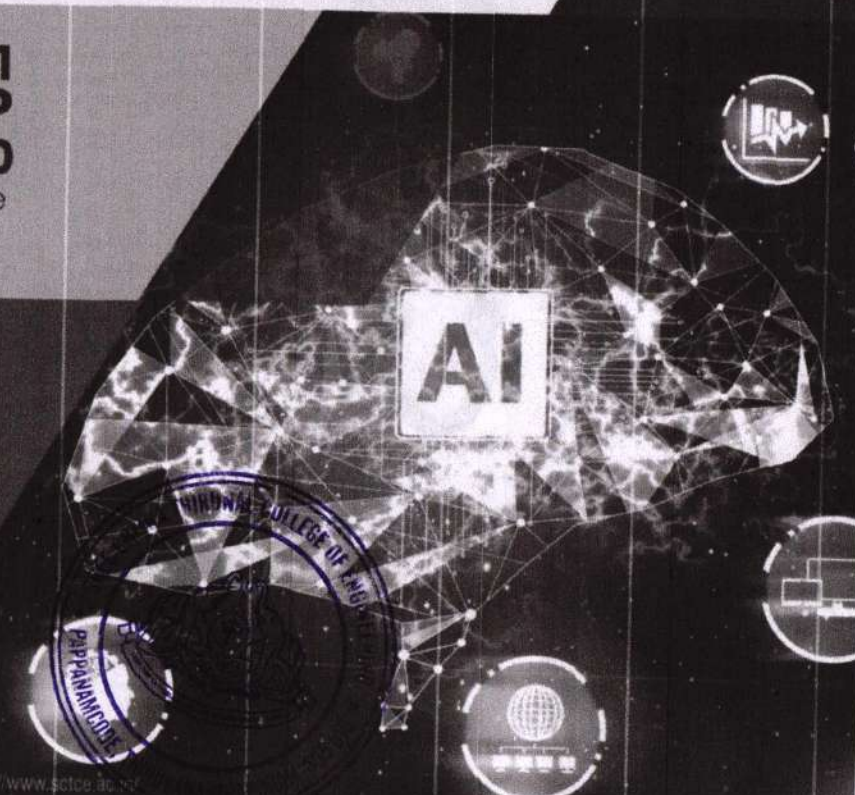
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Vision of the Department

To be a centre of quality education and research in the field of Electronics and Communication Engineering, to mould socially responsible engineering professionals.

Mission of the Department

Provide a systematic teaching-learning process, aiming quality education, in an ambience that encourages research, industry interaction and value-based education.



<http://www.sctce.ac.in>

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About the Programme

Present "Big Data Era" demand technologies that provide high value predictions which leads to better decisions and smart actions in real time without human intervention. Machine and deep learning methodologies help to perform various data analytics in order to make sense of the data for smarter actions.

This faculty development programme (FDP) is intended to provide a platform for faculty, research scholars and post graduate students, to upgrade their knowledge and acquire skills in the fundamentals of machine learning and deep learning techniques and its applications in various signal processing domains.

Important Dates

Submission of Application

03/09/2021

Date of Intimation

04/09/2021

Date of Confirmation

05/09/2021

The selected candidates will be intimated through email only

Registration Details

No registration fee for the participants

Link for registration:

<https://forms.gle/MLuWt-fqTvY2YAJ9o8>

OR

Scan

This QR Code



Address for Correspondences

Dr. Lakshmi V. S
Assistant Professor
Department of Electronics &
Communication Engineering
Sree Chitra Thirunal College of
Engineering, Trivandrum.
(m): 9895193140
Email: fdpece@sctce.ac.in

Topics to be Covered

- 1 Perspectives of Machine Learning & Deep Learning Algorithms
- 2 Overview of different ML algorithms with its mathematical foundations
- 3 Introduction to Gradient Descent Algorithm and its applications in Machine Learning
- 4 Preference learning in socio-sensing systems
- 5 Deep learning based algorithms for Image Analysis
- 6 Deep Learning for Medical Image Analysis/Processing
- 7 Deep Learning for Natural Language Processing
- 8 Machine Learning Techniques in Audio Processing
- 9 Deep unfolding for signal processing
- 10 Deep Learning for Computer Vision

Organizing Committee

Chief Patron.....
Shri. Antony Raju
The hon'ble minister for Transport, Kerala
(Chairman, Board of Governors, SCTCE)

Patron.....
Dr. Jayasudha J. S
The Principal i/c, SCTCE

Convener.....
Dr. Sheeja M. K
Professor & Head, Dept. of ECE, SCTCE

Coordinators.....
Prof. Bindu V
Associate Professor, Dept. of ECE, SCTCE
Dr. Lakshmi V. S
Assistant Professor, Dept. of ECE, SCTCE

Intended Audience

The faculty members of the AICTE/UGC approved institutions, Research Scholars, PG Scholars, participants from the Government organizations, Industry/Bureaucrats / Technicians / Participants from Industry etc.) and staff of host institutions. Number of participants for FDP are LIMITED to 60.

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Faculty Development Programme Speakers



Dr. Ram Prasad K
Shiv Nadar University
Chennai



Dr. Birenjith P S
Government Engineering College
Barton Hill, Thiruvananthapuram



Dr. Sowmya V
Amrita Center for Computational Engg
and Networking (CEN)
Coimbatore Campus



Dr. Sinih M S
Government Engineering College
Thrissur



Prof. Jeena Kleeemankandy
Amrita School of Engineering
Amrita Vishwa Vidyapeetham
University, Coimbatore



Dr. Sumitra S
IIST
Thiruvananthapuram



Dr. Anup Aprem
National Institute of Technology
Calicut



Mr. Sajith Warriar
Amrita Vishwa Vidyapeetham
Coimbatore Campus



Dr. Deepak Mishra
IIST
Thiruvananthapuram



Dr. Lakshmi Narasimhan
Indian Institute of Technology,
Palakkad



Dr. Varun P. Gopi
National Institute of Technology
Trichirappalli



SREE CHITRA THIRUNAL COLLEGE OF ENGINEERING

PAPPANAMCODE, THIRUVANANTHAPURAM – 695018

Department of Electronics and Communication Engineering

Faculty Development Programme

on

**“RESEARCH PERSPECTIVES OF MACHINE LEARNING
& DEEP LEARNING FOR SIGNAL PROCESSING APPLICATIONS”**

(6th – 10th September, 2021)

Sponsored by

APJ Abdul Kalam Technological University (KTU), Kerala

REGISTRATION FORM

Salutation : Dr./Mr./Ms.

Name :

Participant Category : Faculty/Scholar/Industry

Designation :

Department :

KTU-ID :

Institution/University/ :

Company Name :

Address for :

Communication :

E-mail :

Phone Number :

Is the Institution : Yes / No

Approved by AICTE? :

Signature of the Participant

SPONSORSHIP CERTIFICATE

This is to certify that Dr./Mr./Ms. _____ is an employee of our institution/organization/industry. He/she is sponsored & permitted to attend the programme, if SELECTED. He/she will abide by the rules and regulations of the host institute.

Signature of the Sponsoring Authority
with Date and Seal

Date:


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SREE CHITRA THIRUNAL COLLEGE OF ENGINEERING, THIRUVANANTHAPURAM- 695018

Department of Electronics & Communication Engineering

KTU Sponsored FDP on Research Perspectives of Machine Learning and Deep Learning for Signal Processing Applications

Schedule

Date/Day	9.30 A.M. - 12.30 P.M		1.30 P.M. - 4.30 P.M.	
06-09-2021 Monday	Inauguration	Perspectives of Machine Learning & Deep Learning Algorithms Dr. Ram Prasad K (Shiv Nadar University, Chennai)	Overview of different ML Algorithms with its Mathematical Foundations Dr. Sumitra S. (IIST)	
07-09-2021 Tuesday	Introduction to Gradient Descent Algorithm and its Applications in Machine Learning Dr. Birenjith P.S. (GEC Barton Hill)		Preference learning in Socio-Sensing Systems Dr. Anup Aprem (NIT Calicut)	
08-09-2021 Wednesday	Deep Learning based Algorithms for Image Analysis Dr. Sowmya V. (Amrita Vishwa Vidyapeetham, Coimbatore)		Deep Learning for Computer Vision Dr. Deepak Mishra (IIST)	
09-09-2021 Thursday	Machine Learning Techniques in Audio Processing Dr. Sinith M S. (GEC Thrissur)		Deep Learning for Natural Language Processing Dr. Jeena Kleenankandy (Amrita Vishwa Vidyapeetham, Coimbatore)	
10-09-2021 Friday	Deep Learning for Medical Image Analysis/Processing Dr. Varun P. Gopi (NIT Trichy)		Deep Unfolding for Signal Processing Dr. Lakshmi Narasimhan Theagarajan (IIT Palakkad)	Feedback & Valedictory Session

Lunch Break

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Programme Report

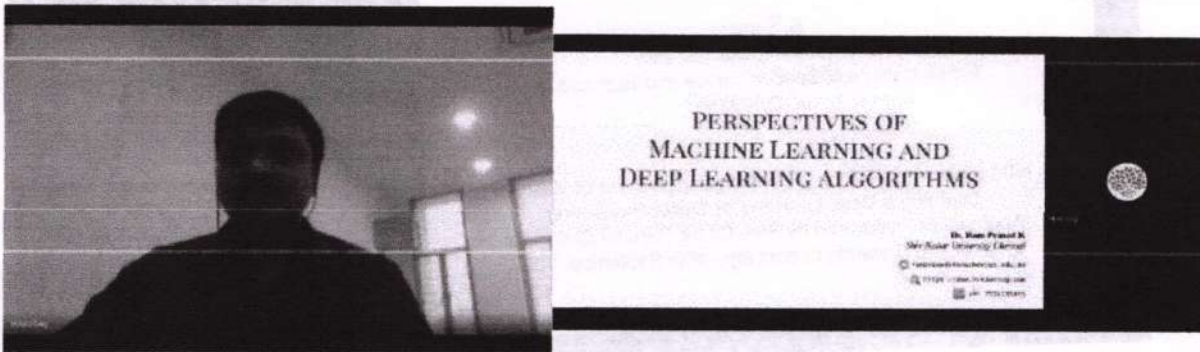
Day 1

Session 1

Time: 10: 00 am to 12:30 pm

Title of topic: Perspectives of Machine Learning & Deep Learning Algorithms

Resource person: Dr. Ram Prasad K, Assistant Professor, Department of Computer Science and Engineering, Shiv Nadar University Chennai. (Founder & Director, VisionCog Research & Development Pvt. Ltd.)



The speaker started the session by introducing artificial intelligence and the need for automation of basic tasks. He also elaborated the difference between artificial intelligence, machine learning and deep learning. The speaker introduced several real world applications of machine learning (ML) such as self-driving cars, amazon recommendation, sentiment analysis, map predictions, object localization. He then explained in detail the ML techniques such as regression, classification, clustering and dimensionality reduction with the help of suitable use cases. Furthermore, the speaker discussed about the working of deep learning (DL) as well as Bayesian deep learning starting from the fundamentals of neural networks and its possible adversarial attacks. He also stressed the need for generalization in deep learning approaches/ networks for practical adaptation. The speaker concluded the session by giving an insight into recent research areas in this domain such as self-supervised learning and geometric deep learning; and the groups/ companies which are working in this area. The audience cleared their queries by the end of the session.



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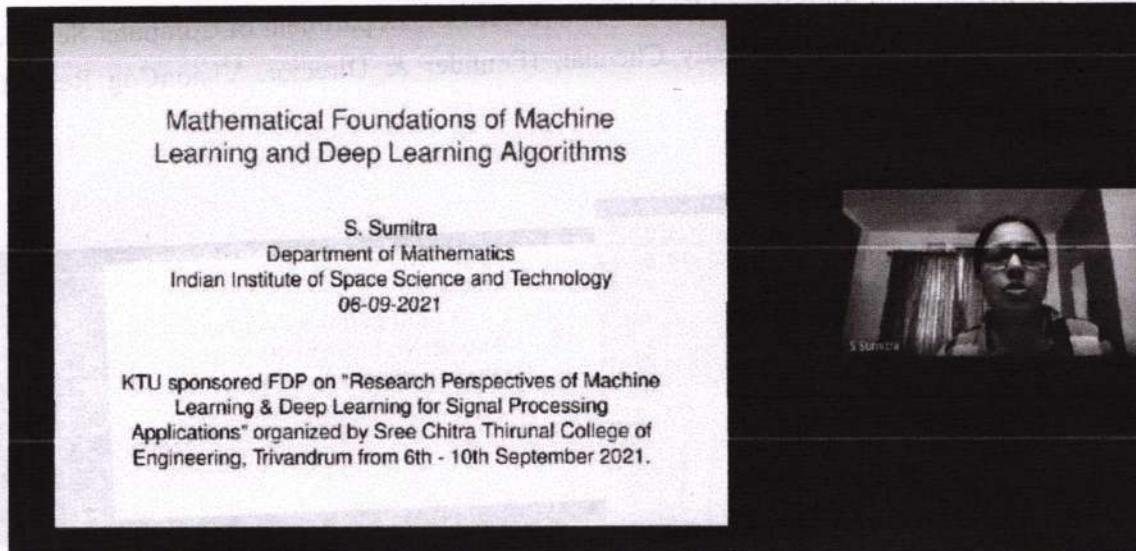


Session 2

Time: 01: 30 pm to 04:30 pm

Title of topic: Overview of different ML Algorithms with its Mathematical Foundations

Resource person: Dr. Sumitra S. , IIST



The speaker started the session by explaining the fundamentals of machine learning (ML) and the requirements of different ML algorithms for specific applications. She explained the significance of training/ learning the ML algorithm with the characteristic properties of each use case. She elaborated the mathematical concepts behind the three learning methods such as supervised learning, unsupervised learning and reinforcement learning, which are used to make the algorithm intelligent based on the data. The speaker explained that the output data are discrete for classification problem, while they are continuous for regression problems. Different types of classification problems such as binary and multi class were also introduced with the help of simple examples such as modeling/learning for detection of heart disease. The mathematical concepts such as vector space, matrices, range, hyperplane etc required for finding a function that satisfies the given data points were clearly laid in this session. The speaker explained that the regression problem can be represented as a matrix equation and solution may vary depending on the size of matrices. She concluded the session by pointing out the need for minimizing the cost function in order to reduce the error and how to find the optimized value with respect to least square cost optimization problem.

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Day 2

Session 1

Time: 9.30 pm to 12.30 p.m

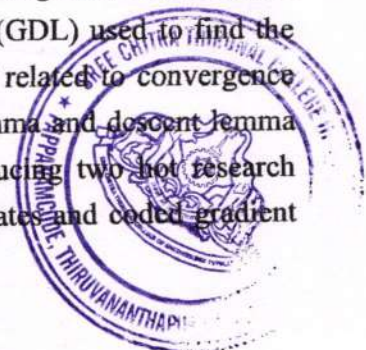
Title of topic: Introduction to Gradient Descent Algorithm and its Applications in Machine Learning

Resource Person: Dr. Birenjith P.S

The image shows a screenshot of a presentation slide on the left and a video call window on the right. The slide title is "An Introduction To Gradient Descent Algorithm From The Perspective of Learning". The speaker is identified as Birenjith Sasidharan, Government Engineering College, Barton Hill, Trivandrum. The slide also mentions a workshop sponsored by APJ Abdul Kalam Technological University, Kerala, held from Sep. 6-10, 2021. The speaker's affiliation is the Department of Electronics & Communication Engineering, Sree Chitra Thirunal College of Engineering, Thiruvananthapuram, dated Sep. 7, 2021. The video call window shows a man in a dark shirt, identified as Birenjith Sasidharan.

The speaker started the session with the binary classification problem and explained that a linear classifier can be defined using a linear discriminant function, including weight vector, data/ feature vector and bias vector. Through sufficient mathematical proofs, he justified that learning the classifier is equivalent to minimizing the loss function with respect to weight vector, by absorbing bias into weight vector. The speaker pointed out that this method has two computational issues namely, non-invertibility of matrix and finding inverse of large matrices is algorithmically expensive. He also explained that these issues can be resolved through convex optimization, which assumes the function to be convex so that it always guarantees unique global minimum. He then detailed the mathematical fundamentals behind concept of gradient, directional derivative, rate of change along gradient, relationship between gradient, tangent and local minimum for convex functions along with mathematical proofs. The speaker then introduced the gradient descent algorithm (GDL) used to find the minimum for convex optimization problem. The theorem and proof related to convergence rate of gradient descent, tangent-distance lemma, strong-tangent lemma and descent lemma were also explained. The speaker concluded the session by introducing two hot research problems related to federated learning such as quantized model updates and coded gradient aggregation.

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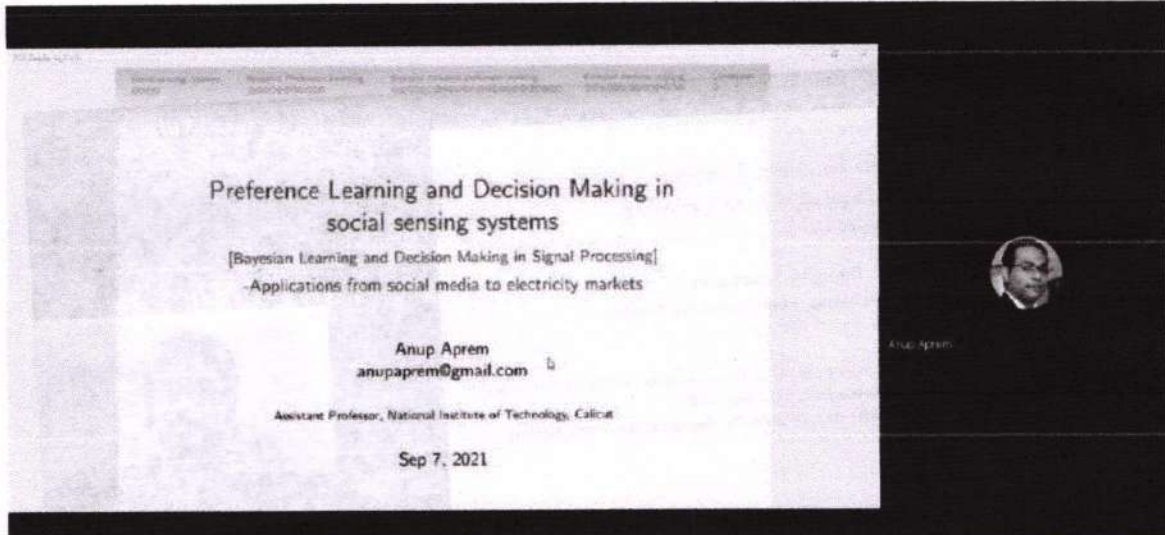
Session 2

Day 3

Time: 1: 30 am to 4:30 am

Title of topic: Preference learning in Socio-Sensing Systems

Resource Person: Dr. Anup Aprem



The speaker started the session with an overview of social sensing systems and its design challenges. He then introduced the classical framework of preference learning which includes how exactly the human sensors produce data and how it can be utilized for learning data. The speaker explained that the utility function which captures the preference based on human rational behaviour, will be a monotone, continuous and concave function. He detailed the Afriat's theorem which is widely used in this data centric leaning method and it is non-parametric in nature. The linear perturbation model used for dynamic utility maximization was also elaborated with the help of examples. The speaker then explained Bayesian preference learning by taking multi-agent problem as a motivating example. He also gave a detailed explanation of Gaussian process and its use for Bayesian optimization and algorithm. Then Bayesian decision making with human sensors was discussed with respect to the system model for interactive advertising in personalized live social media; using Markov decision process (MDP) and partially observable Markov decision process (POMDP).

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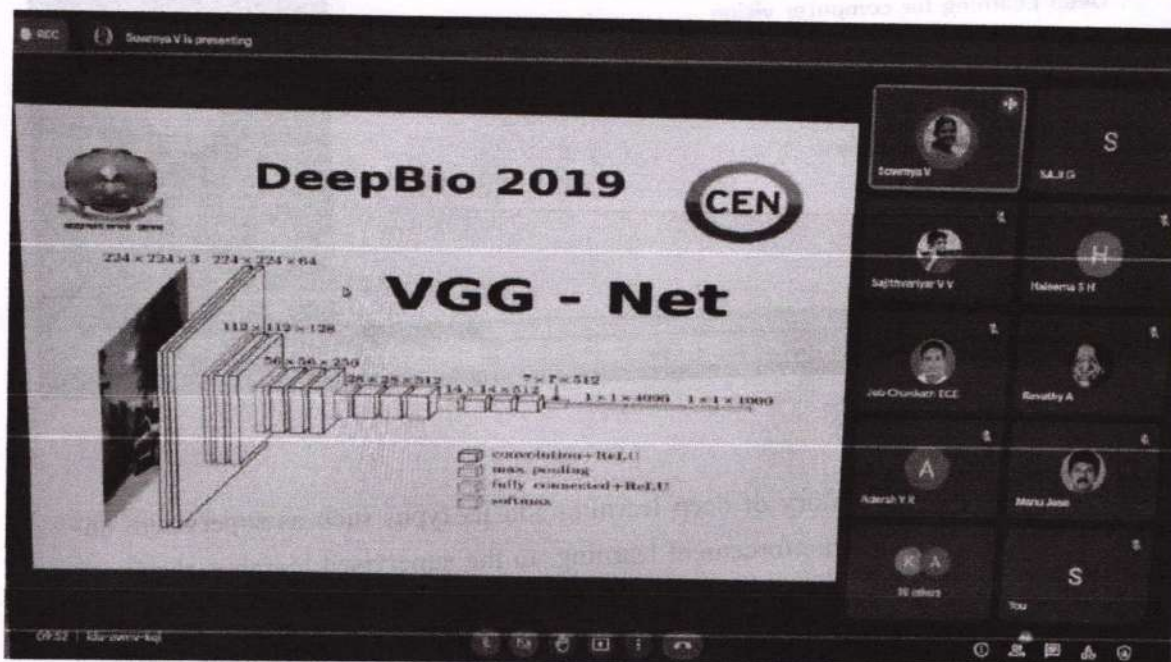
Day 3

Session 1

Time: 9: 30 am to 12:30 pm

Title of topic: Deep Learning based Algorithms for Image Analysis

Resource Person: Dr. Sowmya V.



The speaker introduced CNN, VGG architecture, followed by detailed explanation of U-Net, which is the CNN used for biomedical image segmentation. She then started with binary classification examples such as pixel level semantic segmentation, electron microscopic image segmentation and modifications done in CNN and DNN architectures to attain the required localization accuracy based on the constraints. The speaker also detailed about the mathematical computations done in each layer, number of filters and its size calculation etc. She also gave an insight into contracting path, expansive path and upsampling with transposed convolution with simple numerical examples. The modified U-Net architecture with less number of learnable parameters proposed for Nuclei segmentation was also explained in detailed with simulation results. This is followed by a hands on session on implementation of deep learning of medical image analysis. The speaker introduced the sample GPU/CPU configurations, Python virtual environment and system requirements. The familiarization of neural network front end and backend, and implementation of brain tumor segmentation was also demonstrated.

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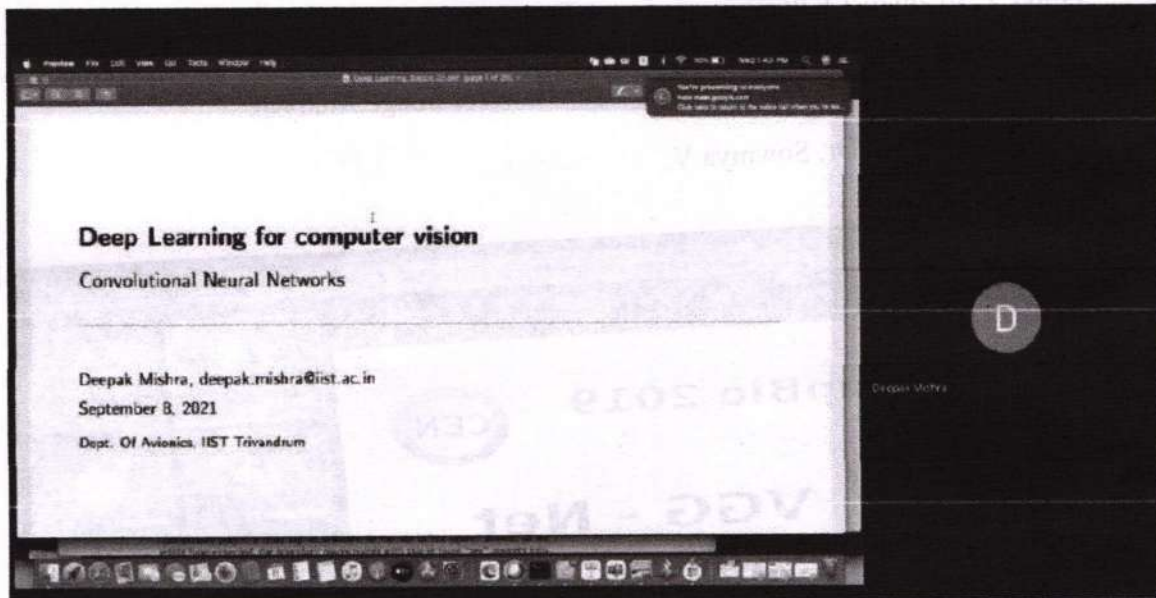


Session 2

Time: 1:30 pm to 4:30 pm

Title of topic: Deep Learning for Computer Vision

Resource Person: Dr. Deepak Mishra



The speaker started with the history of deep learning and its types such as supervised, unsupervised, self-supervised and reinforcement learning. In the supervised learning, the linear classifiers, logistic regression and softmax classifiers were detailed. The mathematical modeling of neuron in neural networks was explained from the concept of neuron, which is the brain computational unit. The idea of multiple layers is actually coming from the non-linear activation functions and he explained some of these functions such as sigmoid, tanh, ReLu. He then gave a detailed explanation about neural networks, forward propagation, and training of DNN which includes objective functions, backward propagation and how an objective function can be selected for a particular application. The speaker then extended the concept of neural network to convolutional neural network, its architecture and layers, and its applications in computer vision. He concluded the session by giving the case study of VGG, a deep neural network developed for image recognition, visualizing what CNN learns and transfer learning.

A handwritten signature in green ink, consisting of a stylized 'D' and 'M' followed by a horizontal line with an arrow pointing to the left.

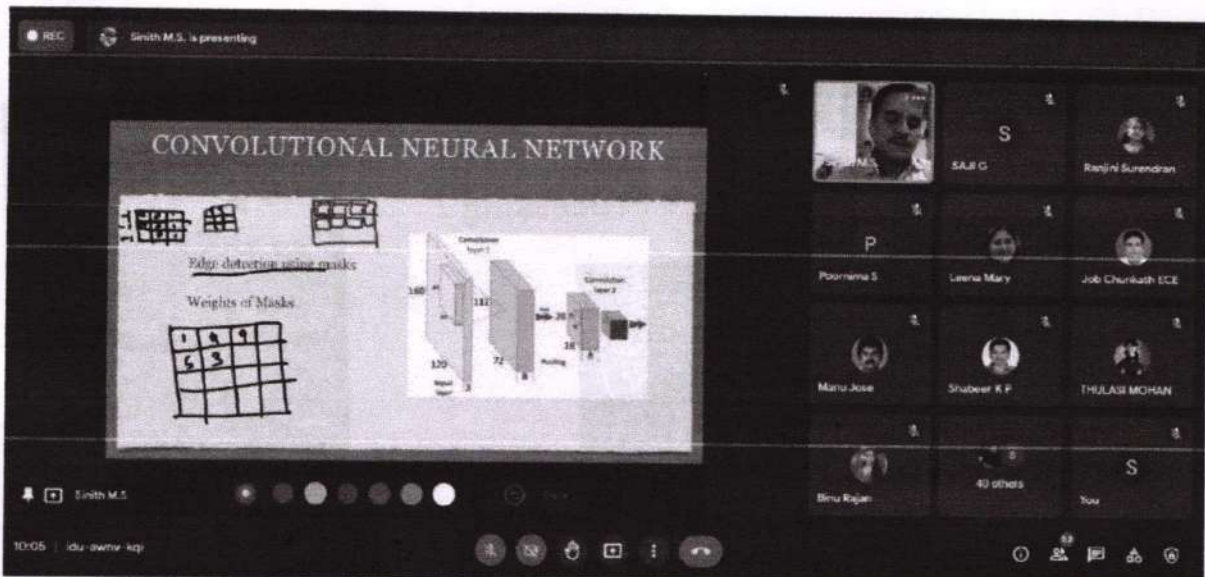
Day 4

Session 1

Time: 09: 30 am to 12:30 am

Title of topic: Machine Learning Techniques in Audio Processing

Resource Person: Dr. Sinith M S.



The speaker started the session with perceptron, stimulus and response, and explanation of logistic regression. He then explained audio analysis and convolutional neural network used for this task with the help of examples such as Spectrogram analysis. The recurrent neural network and gated recurrent unit for audio analysis were also explained, followed by the discussion on differences between GRU and LSTM network used for this application. The speaker also demonstrated the tensor implementation of audio analysis using GAN generated audio. He then moved on with the overview of machine learning specifically for musical signals, starting from the Fourier analysis of signals produced by various musical instruments such as violin, flute etc. After detailing the different terms associated with music signals and raga, he has justified the relationship between Fibonacci series and Indian classical music. The speaker concluded the session by giving an insight into the mathematical model for raga recognition and the use of wavelets and adaptive filters in this application. The audience cleared their queries by the end of the session.

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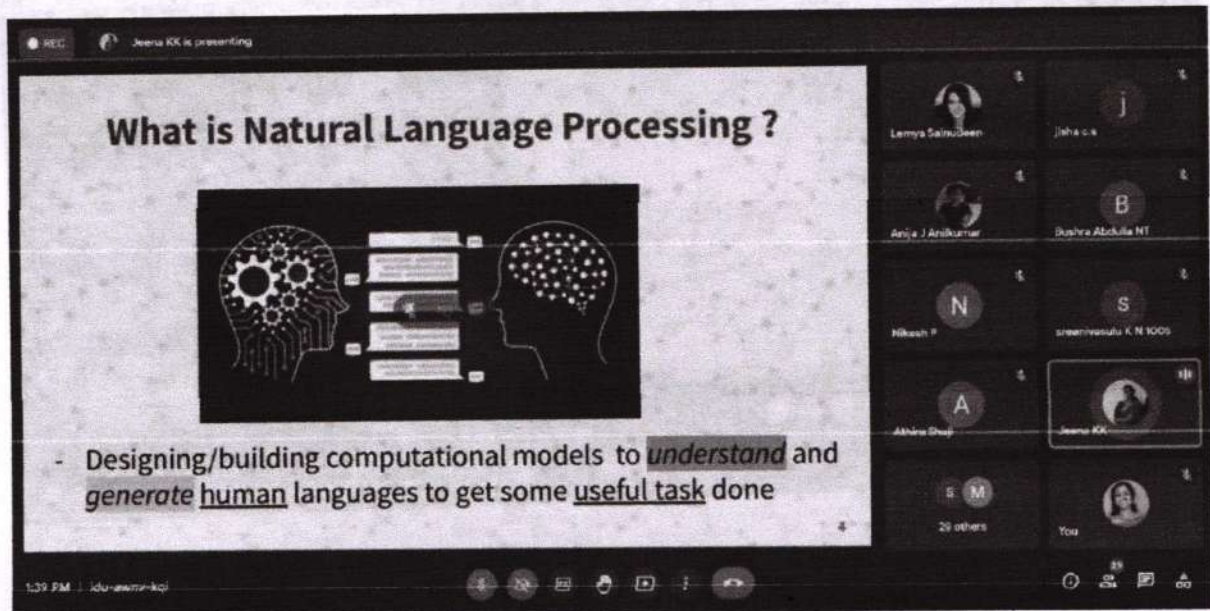


Session 2

Time: 1:30 am to 4:30 pm

Title of topic: Deep Learning for Natural Language Processing

Resource Person: Dr. Jeena Kleenankandy,



The speaker introduced the idea of natural language processing and its applications, followed by the role of machine learning in NLP, its challenges and evolution. She then talked about the neural NLP systems which consists of neurons and perceptrons; and the difference between traditional ML and deep learning in NLP applications, with respect to the basic model. The speaker also presented the word representation problem with the help of simple examples, and then introduced neural word embeddings and working of skip gram. She then extended the concept into sentential and phrase representation. She introduced the traditional deep learning network, recurrent NN and its types, followed by the detailed explanation of long term short memory (LSTM) networks. The speaker concluded the session by introducing the transformers, which is the state of the art in NLP, classic NLP problems, DL-NLP research directions etc and also shared several useful links and resources.

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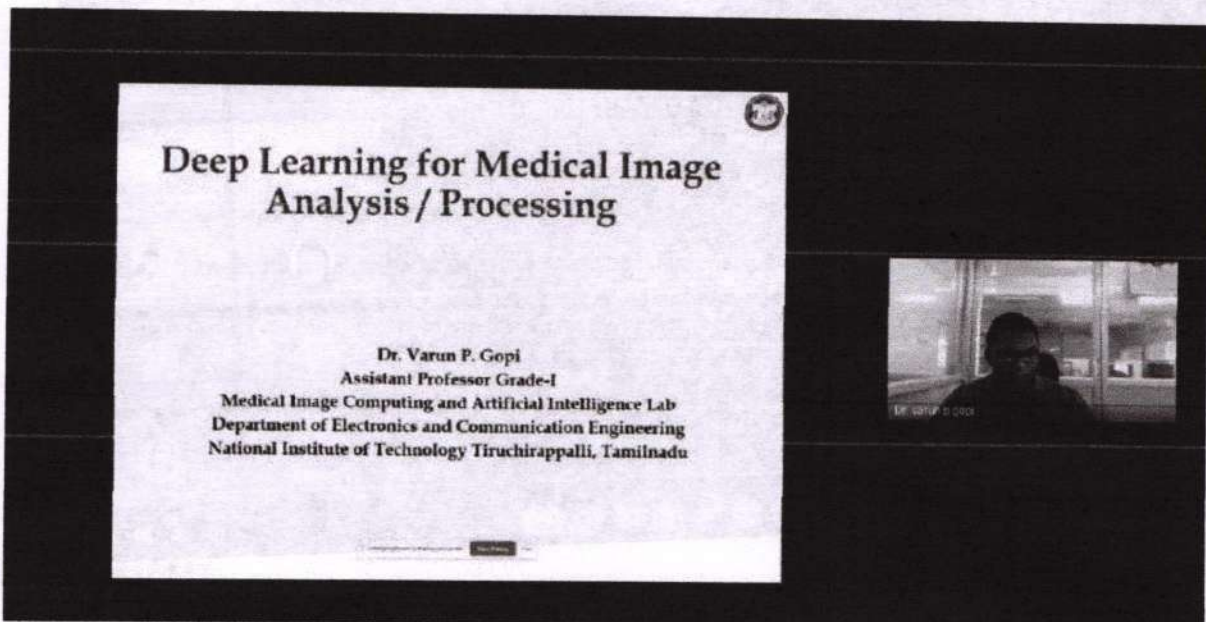
Day 5

Session-1

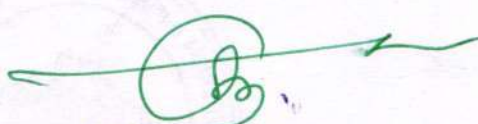
Time: 9:30 pm to 12:30 pm

Title of topic: Deep Learning for Medical Image Analysis/Processing

Resource Person: Dr. Varun P. Gopi,



The speaker in the initial portion of his presentation gave an idea of taxonomy of artificial intelligence, applications and general model of machine learning. He then explained ANN structure, different types of learning, activation function, forward and backward propagation, cost function, hyper parameters, overfitting etc. The speaker explained the importance, challenges and types of deep learning networks, followed by the detailed explanation of convolutional network architecture and difference between traditional ML and transfer learning. The object detectors used in deep learning such as RCNN, fast RCNN, single shot detector and YOLO were also covered. The speaker finally gave a detailed overview of medical image applications such as Colonal polyp detection, CNN based optic disc segmentation, CNN based age related macular degeneration classification using OCT images, RNN based 3D image segmentation, general adversarial networks (GAN), Cycle GAN for image authentication, Liver lesion classification using GAN.


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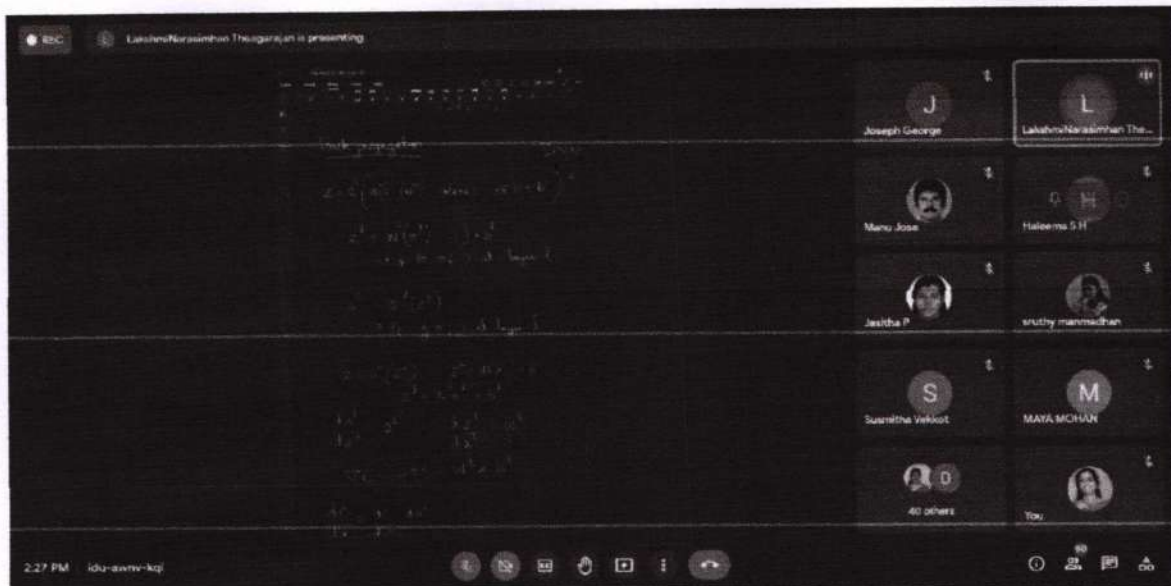
DAY 2

Session 2


Time: 1: 30 am to 3:30 am

Title of topic: Deep Unfolding for Signal Processing

Resource Person: Dr. Lakshmi Narasimhan Theagarajan, IIT Palakkad



The speaker started the session by introducing the architecture of deep neural networks along the equation connecting each layer. He detailed the importance of activation function and the different types of functions such as logistic, $\tanh(x)$, ReLU and softmax. The importance of training lies in the fact that given an input, how close do we want to be with respect to output. Therefore, the training accuracy depends on minimizing the cost function which is relating the input and target output based on weights. He also explained in detail the Gradient descent and stochastic Gradient descent algorithm used for solving the optimization problem, and also the forward pass and backward propagation methods used for finding the gradients. He also introduced universal approximation theorem which essentially tells us that any function can be deep neural networks. The speaker then explained the sparse coding problem which has applications in image restoration, denoising, compressed sensing and sparse regression, super resolution etc. He concluded the session by introducing iterative shrinkage and thresholding algorithm, alternating direct method of multipliers and robust PCA.


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