

## About IIT Kharagpur



Kharagpur - a dusty town tucked away in the eastern corner of India, famous until 1950 as home to the longest railway platform in the world - became the nursery where the seed of the IIT system was planted in 1951. IIT Kharagpur started its journey in the old Hijli Detention Camp in Eastern India, where some of the country's great freedom fighters toiled and sacrificed their lives for India's independence. Spurred by the success of IIT Kharagpur, four younger IITs sprouted around the country in the two following decades, and from these five came thousands of IITians, the brand ambassadors of modern India. It was the success of this one institution at Kharagpur that wrote India's technological odyssey.

The Institute takes pride in its relentless effort to provide the best platform for both education as well as research in the areas of science and technology, infrastructure designs, entrepreneurship, law, management, and medical science and technology. IITKGP is not just the place to study technology, it is the place where students are taught to dream about the future of technology and beam across disciplines, making differences enough to change the world.



### Program Features/ Structure

Classroom lectures – **50%**

Numerical/ Problem solving, and Activity – **25%**

Hands-on work with Python/ Deep Learning toolkits - **25%**

### Program Schedule and Venue

**5 days**, 19 – 23 February 2020 (8:30 AM – 6 PM)

IIT Kharagpur –  
Kolkata Campus  
HC Block, Sector – III  
Salt Lake City  
Kolkata – 700 106

### Program Fee

**Nil** for TEQIP-III sponsored faculty

#### For others

Students-INR 10,000(+GST)

Faculty-INR 20,000(+GST)

Industry-INR 30,000(+GST)

### Who will benefit (Eligibility)

Faculty members of Engineering and Science teaching disciplines, Industry professionals working in Deep Learning, PhD, M. Tech and B. Tech students in EECS.

### Last day of Registration

# 19

January 2020

### Accommodation

Accommodation cannot be arranged for any participants. The program is being conducted outside the main campus. Plenty of hotels available in vicinity.

## How to Apply

Use the link: <https://erp.iitkgp.ac.in/CEP/courses.htm> to apply ONLINE.



Payment if applicable is to be done **ONLINE** after getting short listed for the program.

## Contact Us

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# NPIU

# TEQIP-KIT

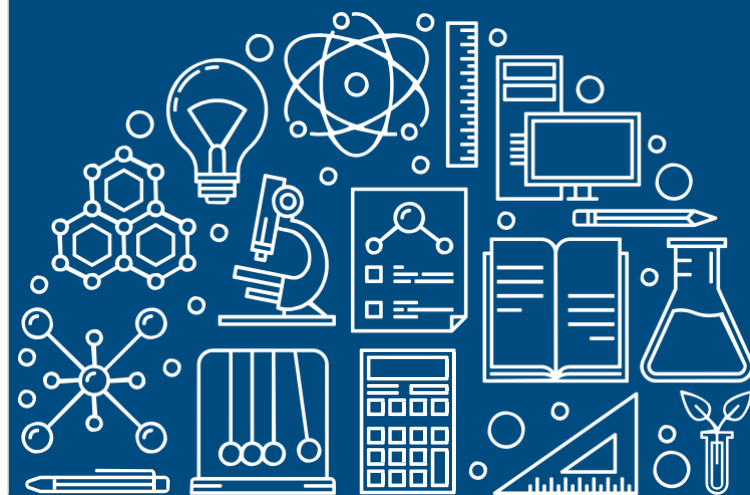
NPIU - A Unit of MHRD, Govt. of India for  
Implementation of World Bank Assisted Projects in Technical Education

Indian Institute of Technology Kharagpur

## MATHEMATICS OF DEEP LEARNING (MoDL)

5 Days

19 – 23 February 2020



## Introduction / Overview

Deep learning since the start of the 21st century has been witnessing a surge and interest similar to that witnessed by quantum mechanics at the start of the 20th century. While in its early days in the last decade, experimentalists have proven its might and we see a rise in practical deployment of deep learning based solutions across vision, language, speech, signal processing, etc. of which some include chat bots with ambient assisted intelligence like Alexa, Siri, Cortana. Although the advent of specialized toolboxes for the trade, and availability of numerous open source models has enabled rapid deployment of commercial solutions, there is a lack in the community's in-depth understanding of underlying mathematical foundations which make such technologies so powerful. This has led to the mathematical reasons for its success to remain elusive and ill-understood.

## Program Objectives

This course will initially start with a mathematical understanding of the objectives and basis of machine learning, traversing across through linear algebra and data structure associated with representing different deep neural networks, bounds of their performance, statistics and information theory required for understanding learning principles and optimization, principles behind generative models and adversarial learning, finally to conclude in the mathematical understanding of explainability for reasoning with a deep neural network.



## What you will learn

### Program Content

Mathematical perspectives and objectives of deep learning

Model complexity, hierarchical decomposition

Linear algebra, probability and statistics, information theory for deep neural networks

Optimization and solvers for deep neural networks, stochastic-/ conjugate gradient descent

Guaranteeing learnability of a deep neural network, dropouts, regularization, normalization

Adversarial learning and multitask learning within deep neural networks

Autoencoding and latent space distribution, deep generative models, perception loss modeling

Mixed precision number system representation during learning and inferencing; Concepts of dynamic range and range scalability

Floating point vs. fixed point number systems, mixed precision gradient descent and learning

Learnability vs. Communication vs. Compute efficiency in mixed precision computation

Reasoning and explainability within deep neural networks

Class activation maps, randomized input sampling for explanation of black-box models

Distributed deep learning, data privacy aspects and regulation during learning

Federated learning

Hands on sessions with Deep Learning toolkits and libraries

## About the Faculty Principal Coordinator

### Dr. Debdoot Sheet

Dr. Sheet is an Assistant Professor at the Department of Electrical Engineering and the Centre of Excellence in Artificial Intelligence. He holds a B. Tech in Electronics and Communication Engineering from the West Bengal University of Technology in 2008, M.S. and PhD in Machine Learning and Medical Imaging from the Indian Institute of Technology Kharagpur in 2010 and 2014 respectively. His research includes deep learning, high-density tensor computation, fairness-accountability-trust-explainability (FATE) of artificial intelligence (AI). He is a senior member of IEEE, editor of IEEE Pulse.

### Co-Coordinator

#### Dr. Swanand Ravindra Khare

Dr. Khare is an Assistant Professor at the Department of Mathematics and the Centre of Excellence in Artificial Intelligence. He obtained the M.Sc. and Ph.D. degrees from the Indian Institute of Technology Bombay in 2005 and 2011 respectively. He was a post-doctoral researcher in the University of Alberta, Canada from 2011 to 2014. His research interests include inverse eigenvalue problems, computational linear algebra, estimation and computational issues in applied statistics. He is a recipient of Excellent Young Teacher Award 2018 at the Indian Institute of Technology Kharagpur.

### Other faculty for the course

#### Dr. Abir Das

Dr. Das is an Assistant Professor at the Department of Computer Science and Engineering where he leads the Computer Vision and Intelligence Research (CVIR) group. He received the B.E. degree in Electrical Engineering from Jadavpur University, India, in 2007, and the MS and PhD degrees in electrical engineering from the University of California, Riverside, USA in 2013 and 2015, respectively. He was a postdoctoral researcher at the University of Massachusetts Lowell during 2015-2016, and at Boston University during 2016-2018. His research interests include computer vision, activity detection, person re-identification, explainable AI and bias in machine learning.

#### Dr. Buddhananda Banerjee

Dr. Banerjee is an Assistant Professor at the Department of Mathematics and the Centre of Excellence in Artificial Intelligence. He obtained the B. Sc. in Statistics from the University of Calcutta in 2005, M.Sc. in Statistics and Informatics from the Indian Institute of Technology Kharagpur in 2007, PhD in Statistics from the Indian Statistical Institute Kolkata in 2014. He was an Assistant Professor at IISER Kolkata during 2014-2016. His research interests include functional data analysis, change point detection, goodness of fit for censored data, surrogate endpoint analysis in clinical trials.