भारतीय प्रौद्योगिकी संस्थान दिल्ली
Indian Institute of Technology Delhi

INNOVATION IS THE ONLY WAY FORWARD

Certificate Programme in

Machine Learning and Deep Learning

06 Months | Starts 05th November, 2022 | Live Online Lectures

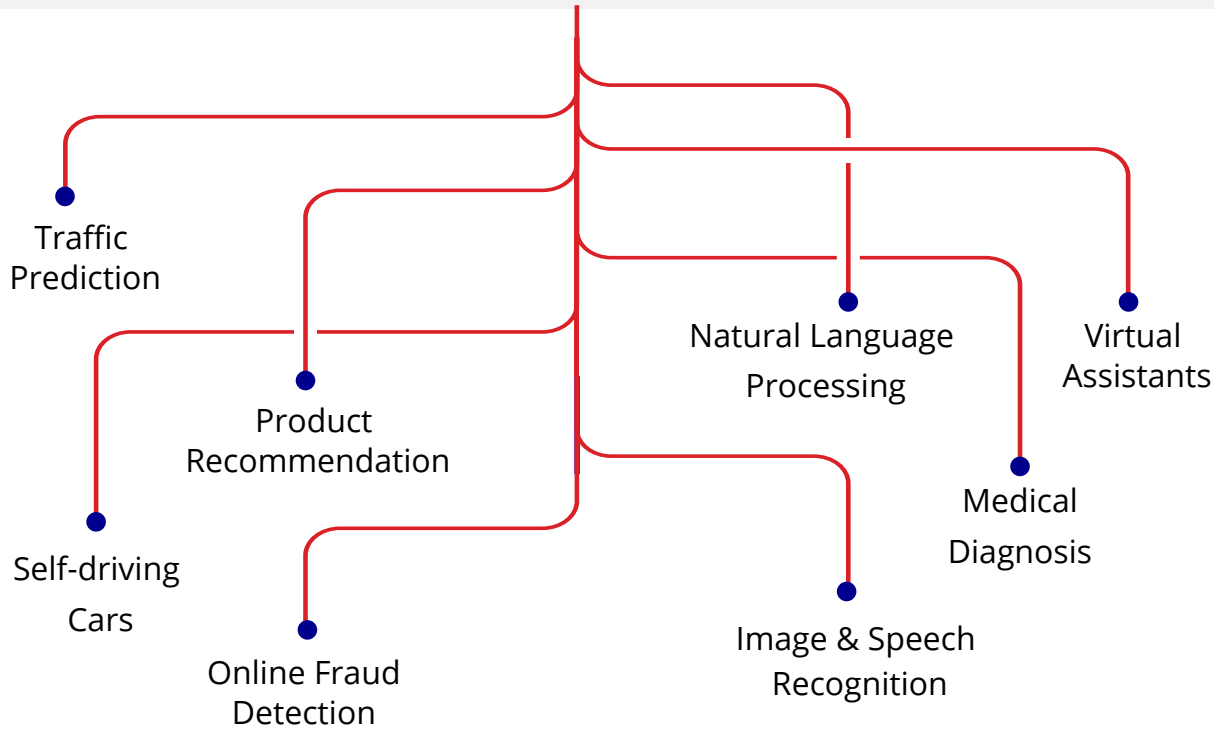
Programme offered by Continuing Education Programme (CEP), IIT Delhi

Machine Learning & Deep Learning

Machine Learning (ML) and Deep Learning (DL) are the two main pillars of Data Science and are the subsets of Artificial Intelligence. ML integrates computer science and statistics to recognise patterns and make predictions from data and perform specific tasks without being explicitly programmed. DL, a subset of ML, uses algorithms that analyse data with a logic structure, called Artificial Neural Network (ANN) that mimics the human thinking process. In general, the learning process of these algorithms can either be supervised or unsupervised, depending on the data being used to feed the algorithms.

While the global market for ML is projected to grow from $17.1 billion in 2021 to $90.1 billion by 2026, the DL market is estimated to grow from $12.3 billion in 2021 to $60.5 billion by 2025 (bccresearch.com).

Machine Learning & Deep Learning Applications



We are living in the era of big data where massive amounts of data are generated every second. Thanks to the applications of Machine Learning and Deep Learning, yesterday's sci-fi has become today's reality. Acquiring skills and competencies in these technologies of the future will go a long way in securing your own future in this exciting domain.

Certificate Programme in Machine Learning and Deep Learning

Programme Highlights

- A programme from the Department of Electrical Engineering, IIT Delhi. IIT Delhi is ranked #2 as per QS World University Rankings 2022 in India
- 6-month online training programme for working professionals
- 70 hours of live online teaching
- Certification from CEP, IIT Delhi

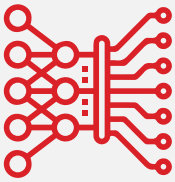
Who Should Attend?

- Fresh graduates from science or engineering background seeking a career in the ML/DL domain
- Professionals in the software and IT industry seeking to upskill with ML/DL expertise and applying this intelligent learning tool in their respective fields
- Professionals aspiring to work as data engineers, data scientists, machine learning engineers, etc.

Learning Outcomes

After completing this programme, the participants should be able to:

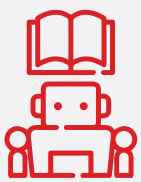
Have a good grasp of efficient Python programming including developing the skill to load and pre-process the data from online and offline databases using pandas



Have a good understanding of the fundamental aspects and challenges of ML: data, model selection, model complexity, etc.

Understanding of the strengths and weaknesses of popular ML approaches

Able to design and train your own neural networks using Keras and TensorFlow modules



Able to design and implement various ML/DL techniques in a range of real-world applications

Programme Curriculum

Module 1: Programming with Python

- Foundations of Python Programming
- Data Structures, Loops, and Control Structures
- Functional Programming in Python
- Linear Algebra using NumPy
- Data Pre-processing using Pandas
- Data Visualisation using Matplotlib
- Scikit-learn

Module 2: Data Analysis & Applied Math

- Data analysis: Data types, attribute types, general characteristics of datasets, data pre-processing, dissimilarities between data objects
- Linear Algebra: Vectors, Matrices, Norms, Subspaces, Projections, SVD, EVD, Derivatives of matrices, Vector derivative identities, least squares
- Optimization: Gradient Descent, Second derivative test, constrained optimization, KKT
- Probability Theory: Discrete and continuous random variables, conditional probability, joint probability distribution, multivariate, MAP criterion, ML criterion

Module 3: Machine Learning

- Introduction: Supervised & Unsupervised Learning, Classification & Regression Models
- Bayesian Decision Theory: Bayesian Classifier, Discriminant Functions, Minimum Error Rate Classification
- Bayesian Parameter Estimation: ML Estimation, Bayesian Estimation, Component Analysis & Discriminants, Expectation Maximisation
- Non-Parametric Techniques: k-Nearest-Neighbor Estimation, Nearest-Neighbor Rule
- Perceptron, Multilayer Perceptron, LMS, Feedforward Operation, Backpropagation Algorithm, Activation Function, Regularisation
- SVM, Decision Trees, Radial Basis Function Networks

Module 4: Deep Learning

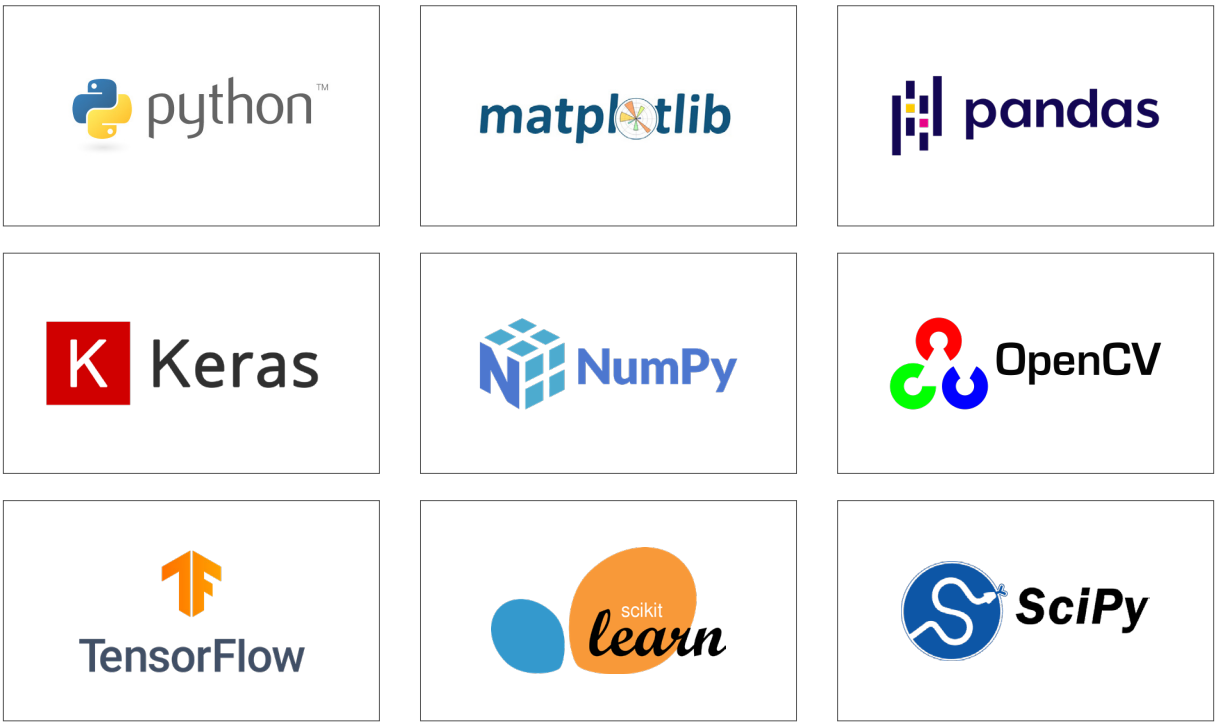
- Basics
- Regulation and Optimisation
- DNN, CNN, RNN, LSTM, Autoencoder
- Methodology and Applications

Module 5: Applications of Machine Learning

- Computer Vision
- Speech Recognition
- Wireless Communications

Module 6: Projects/Assignments

ML/DL Tools Used



Hands-on Projects and Case Studies

MNIST digit recognition using DNN, CNN, and SVM

Classification of Real news and Fake news using decision trees

Prediction of the iris flower species using Naive Bayes classification

Classify Photos of Dogs and Cats using Deep Convolutional Neural Network

To build a movie recommender model using K-means clustering

Identification of IoT devices using experimental radio spectrum dataset and deep learning

German Traffic Sign Recognition Benchmark: Develop a Feed Forward Neural Network and then a Convolutional Neural Network to classify between the different Road Signs. Test it using images from the Internet to validate the functioning of the developed model

CIFAR-10 Object Recognition: Develop a Convolutional Neural Network to classify between the different classes. Test it using images from the Internet

Programme Details

Duration
- 6 Months
- 70 Hours of Live Online Learning
- 2-Hour Sessions

Delivery
Live Online Sessions delivered Direct-to-Device (D2D)

Class Schedule
Saturday and Sunday: 10:00 a.m. to 12:00 p.m.

Eligibility
- Any science or engineering graduate with a minimum of 50% marks
- At least 1 year of experience

Admission Criteria
Selection based on application review

Evaluation
- 50%: End of programme MCQ-based exam
- 30%: Assignments & Project
- 10%: Class interaction
- 10%: Attendance
- Candidates need to secure a minimum of 50% overall marks to be eligible for the 'Certificate of Completion'

Certification*

- Candidates who score at least 50% marks overall and have minimum attendance of 50% will receive a Certificate of Completion from CEP, IIT Delhi.
- Candidates who score less than 50% marks overall and have minimum attendance of 50% will receive a Certificate of Participation from CEP, IIT Delhi.

*Only e-certificates will be issued by CEP, IIT Delhi.

Programme Faculty

Dr. Manav Bhatnagar
Professor,
Department of
Electrical Engineering,
IIT Delhi

Dr. Manav Bhatnagar is currently a Professor with the Department of Electrical Engineering, IIT Delhi, New Delhi, India, where he is also a Brigadier Bhopinder Singh Chair Professor. He holds a global rank of 517 in the area of Networking & Telecommunications among the top 2% scientists in a global list compiled by the prestigious Stanford University. He is a Fellow of IET, INAE, NASI, IETE, and OSI. He has received the prestigious NASI-Scopus Young Scientist Award, Shri Om Prakash Bhasin Award, and Dr. Vikram Sarabhai Research Award. He has been an Editor of the IEEE Transactions on Wireless Communications during 2011-2014. Currently, he is an Editor of the IEEE Transactions on Communications. He has published more than 100 high quality IEEE journal papers out of which 10 are single-authored. His research interests include signal processing for MIMO systems, free-space optical communication, satellite communications, and machine learning.

Dr. Manoj B R
Assistant Professor,
Department of
Electronics and
Electrical Engineering,
IIT Guwahati

Dr. Manoj B R is an Assistant Professor in the Department of Electronics and Electrical Engineering at the Indian Institute of Technology Guwahati, India. He received a B.E. degree in Electronics and Communication Engineering from the Visvesvaraya Technological University, India, in 2007, a M.Tech. degree in Signal Processing from the Indian Institute of Technology Guwahati, in 2011, and a Ph.D. in Wireless Communications from the Indian Institute of Technology Delhi, in 2019. He has gained a mixed exposure of academic and industrial backgrounds. Before joining IIT Guwahati, he was an Early Doctoral Research Fellow with the Indian Institute of Technology Delhi; a Postdoctoral Researcher with the Division of Communication Systems, Department of Electrical Engineering, Linköping University, Sweden; and a Senior

Researcher with the Radio Transmission Technology Lab, Huawei Technologies, Stockholm, Sweden. His research interests include wireless communication and networks, machine learning, deep learning for wireless communications and signal processing, security and robustness of deep learning-based wireless systems, large-scale sensing using radio signals, buffer-aided relaying networks, Markov chains and their applications, diversity combining, and multi-hop communications.

Dr. Anirban Dasgupta
Assistant Professor, Department of Electronics and Electrical Engineering, IIT Guwahati

Dr. Anirban Dasgupta is an Assistant Professor in the Department of Electronics and Electrical Engineering, Indian Institute of Technology (IIT) Guwahati. He has received his doctorate (Ph.D.) in Electrical Engineering from the Indian Institute of Technology Kharagpur in 2019, Master of Science (MS) by research in Electrical Engineering from the Indian Institute of Technology Kharagpur in 2014 and Bachelor of Technology (BTech) in Electrical Engineering from the National Institute of Technology, Rourkela in 2010. He was the co-founder of the start-up company 'Humosys Technologies Private Limited', and worked there as a Chief Technical Officer (CTO) from January 2019 to July 2021. He joined Boeing India Private Limited, Bengaluru, in July 2021 as a Data Scientist, and worked there till November2021. From December' 2021 onwards, he is with IIT Guwahati. He has ten publications in peer-reviewed international journals, which include five IEEE Transactions. He also has filed three Indian patents, and published 16 IEEE conferences and one book chapter. His research areas include machine learning, internet of things, digital signal and image processing for human cognition, and affective computing. He has served as a reviewer in more than 10 journals which include IEEE Transactions on Signal Processing, IEEE Transactions on Image Processing, IEEE Transactions on Pattern Recognition and Machine Learning.

Dr. Zhu Han
John and Rebecca Moores Professor, Electrical and Computer Engineering Department, and Computer Science Department, University of Houston, Texas

Dr. Zhu Han (S'01–M'04-SM'09-F'14) received the B.S. degree in Electronic Engineering from Tsinghua University, in 1997, and the M.S. and Ph.D. degrees in Electrical and Computer Engineering from the University of Maryland, College Park, in 1999 and 2003, respectively.

From 2000 to 2002, he was an R&D Engineer of JDSU, Germantown, Maryland. From 2003 to 2006, he was a Research Associate at the University of Maryland. From 2006 to 2008, he was an Assistant Professor at Boise State University, Idaho. Currently, he is a John and Rebecca Moores Professor in the Electrical and Computer Engineering Department as well as in the Computer Science Department at the University of Houston, Texas. His research interests include wireless resource allocation and management, wireless communications and networking, game theory, big data analysis, security, and smart grid. Dr. Han received an NSF Career Award in 2010, the Fred W. Ellersick Prize of the IEEE Communication Society in 2011, the EURASIP Best Paper Award for the Journal on Advances in Signal Processing in 2015, IEEE Leonard G. Abraham Prize in the field of Communications Systems (best paper award in IEEE JSAC) in 2016, and several best paper awards in IEEE conferences. Dr. Han was an IEEE Communications Society Distinguished Lecturer during 2015-2018, AAAS fellow since 2019, and an ACM distinguished Member since 2019. Dr. Han is a 1% highly cited researcher since 2017 according to Web of Science. Dr. Han is also the winner of the 2021 IEEE Kiyo Tomiyasu Award, for outstanding early to mid-career contributions to technologies holding the promise of innovative applications, with the following citation: "For contributions to game theory and distributed management of autonomous communication networks."

Dr. Carlo Fischione
Professor,
KTH Royal Institute of Technology, Sweden

Dr. Carlo Fischione is a Professor at KTH Royal Institute of Technology, Sweden. He is the Chair of the IEEE ComSoc ML for Communication Emerging Technology Initiative, and Director of the "Data Science Micro Degree Program" of KTH Royal Institute of Technology, Sweden, an advanced study programme to upskill industrial researchers worldwide on data science for telecommunication. He received a Ph.D. in Electrical and Information Engineering in 2005 and the Laurea degree in Electronic Engineering (Summa cum Laude) in 2001 from University of L'Aquila, Italy. He has held faculty positions at the University of California at Berkley, MIT Massachusetts Institute of Technology, and Harvard University. He was the recipient of numerous awards, including the Best Paper Awards from the IEEE Transactions on Communications (2018), the IEEE Transactions on Industrial Informatics (2007), and several Best Paper Awards at IEEE conferences. He has co-authored over 200 publications, including books, book chapters, journals, conferences, and patents. He has offered consultancy to numerous technology companies such as ABB Corporate Research, Berkeley Wireless Sensor Network Lab, Ericsson Research, Synopsys, and United Technology Research Center. His research interests include optimisation with applications to wireless networks, Internet of Things, and Machine Learning. He is the Editor of the IEEE Transactions on Communications (Machine Learning area) and the IEEE Journal on Selected Areas in Communications series ML in Communications and Networking.

Programme Fees

Particulars	Amount (₹)
Programme Fee	1,50,000
GST@18%	27,000
Total	**1,77,000**

Note: All fees should be submitted in the IITD CEP Account only, and the details will be shared post-selection.

Instalment Schedule

Instalment	Date	Amount (₹)*
I	To be paid within 7 days of offer rollout	37,500
II	10th December, 2022	37,500
III	10th January, 2023	37,500
IV	10th February, 2023	37,500

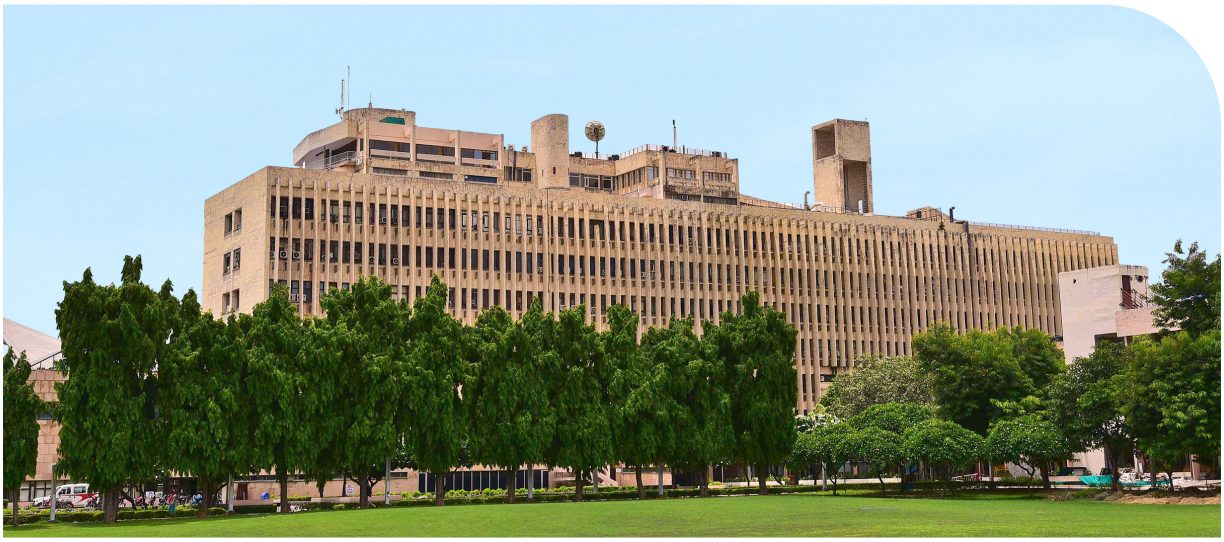
*GST @18% will be charged extra in addition to the fee

Programme Timelines

Application Closure Date	13th September, 2022
Shortlisted candidates will be informed by	18th September, 2022
Last date to submit the 1st installment	25th September, 2022
Programme Start Date	19th November, 2022
Programme End Date	April 2023

APPLY NOW

भारतीय प्रौद्योगिकी संस्थान दिल्ली
Indian Institute of Technology Delhi



The Indian Institute of Technology Delhi (IIT Delhi) is one of the 5 initial IITs established for training, research, and development in science, engineering, and technology in India. Established as the College of Engineering in 1961, the Institute was later declared an Institution of National Importance under the “Institutes of Technology (Amendment) Act, 1963” and was renamed as “Indian Institute of Technology Delhi”. It was then accorded the status of a Deemed University with powers to decide its own academic policy, conduct its own examinations, and award its own degrees. Since its inception, over 48,000 students have graduated from IIT Delhi in various disciplines including Engineering, Physical Sciences, Management, and Humanities & Social Sciences.

The Department of Electrical Engineering has been playing a vital role in producing scientists and technologists of highest calibre ever since it was established in the year 1961. The department runs three undergraduate programmes and 9 post-graduate programmes to cater to the ever challenging needs of technical excellence in all areas of electrical engineering such as Integrated Electronics and Circuits, Tele-communications, Computer Technology, Control & Automation, Power Systems & Power Electronics.

In addition to the strong undergraduate programmes, the department has been playing a pioneering role in producing world class postgraduates and research scholars. The infrastructure and lab facilities are upgraded from time to time and provide adequate opportunities for students and researchers to learn and

innovate. The department has distinguished faculty, all holding Ph.D. degrees from renowned institutes in India and abroad. There are two Fellows of IEEE in the department and many other faculty members are Fellows of several national and international scientific bodies. The faculty of the department has been constantly carrying out research on many cutting-edge technologies and regularly publishes in IEEE and other top international journals. The department also undertakes many research projects sponsored by both the government and the industry.

For more details, please visit: www.iitd.ac.in

Continuing Education Programme (CEP)

Executive education is a vital need for companies to build a culture that promotes newer technologies and solutions and builds a workforce that stays abreast of the rapidly transforming needs in the technological, business, and regulatory landscape. Committed to the cause of making quality education accessible to all, IIT Delhi has launched Online Certificate Programmes under eVIDYA@IITD (ई-विद्या @IITD), enabling Virtual and Interactive learning for Driving Youth Advancement @IITD for Indian as well as international participants.

These outreach programmes offered by the Indian Institute of Technology Delhi (IIT Delhi) are designed to cater to the training and development needs of various organisations, industries, society, and individual participants at national and international levels with a vision to empower thousands of young learners by imparting high-quality Online Certificate Programmes in cutting-edge areas for their career advancement in different domains of engineering, technology, science, humanities, and management.

For more details, please visit: http://cepqip.iitd.ac.in

2nd in NIRF Rankings 2021 (Engineering)	2nd in Outlook ICARE Rankings 2021 (Engineering)	2nd in QS World University Rankings 2022 in India

Services provided by:

TIMESPRO

TimesPro, 18th Floor, G-02 Wing,
Lotus Corporate Park,
Off Western Express Highway,
Jogeshwari (E), Mumbai – 400 063, India.

1800-270-5400
admissions@timesgroup.com
www.timespro.com

For any feedback, please write to:
Head CEP, IIT Delhi at
hodqipcep@admin.iitd.ac.in

Online Certificate Programmes are offered by the Indian Institute of Technology Delhi under the aegis of Continuing Education Programme (CEP) so that the Institute can realise its vision of serving as a valuable resource for industry and society, and fulfil its mission to develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

Programme offered by Continuing Education Programme (CEP), IIT Delhi