ABOUT THE COURSE

This comprehensive Deep Learning course equips participants with foundational theory and practical skills to master neural networks and advanced architectures. Participants explore perceptrons, MLPs, backpropagation, gradient descent variants, and cutting-edge models using Python and frameworks like PyTorch/TensorFlow. Through balanced theory sessions and hands-on coding exercises, learners gain proficiency in training deep networks, optimizing hyper-parameters, and tackling real-world applications from computer vision to sequence modeling. Ideal for beginners entering AI research or professionals—like edge computing researchers—seeking to integrate deep reinforcement learning into vehicular networks and task offloading systems. This course provides industry-essential tools for developing state-of-the-art Deep Learning solutions.

CONTENTS OF THE COURSE

1. Introduction to Perceptron/Neurons; History of Deep Learning (DL)

Biological inspiration of neurons (dendrites, axons, synapses),Perceptron algorithm and mathematical formulation, Weight initialization and learning rate concepts, Linear separability and decision boundaries, Step/Heaviside activation function, Single-layer perceptron limitations (XOR problem), Multi-Layer Perceptron (MLP) motivation, Deep Learning historical timeline (1950s-present), Key milestones: Rosenblatt perceptron, Minsky/Papert critique, Backpropagation rediscovery (1986), AI Winters and revival factors, AlexNet breakthrough (2012) and modern DL era, Evolution of activation functions (sigmoid → ReLU)

2. Introduction to Deep-Learning, MLP, ANN (Theory)

Artificial Neural Networks (ANN) Fundamentals: Network architecture, layers (input, hidden, output), neurons/nodes, Multi-Layer Perceptron (MLP) Structure: Multiple hidden layers, fully connected topology, Forward Propagation: Weighted sum computation, bias addition, activation application, Activation Functions: Sigmoid, Tanh, ReLU, Softmax (detailed math and properties), Loss Functions: MSE, Cross-Entropy, Binary Cross-Entropy for classification/regression, Universal Approximation Theorem: MLP capability to approximate any continuous function, Deep Learning vs Shallow Networks: Depth benefits, representational power, Vanishing/Exploding Gradients: Challenges in deep networks. Initialization Techniques: Xavier/Glorot, He initialization, Regularization. Introduction: Dropout, L1/L2 penalties overview.

3. Training an ANN, Backpropagation

Backpropagation Algorithm, Gradient Computation, Error Surface: Loss landscape, local/global minima visualization, Gradient Descent Variants: Batch GD, Stochastic GD, Mini-batch GD, Learning Rate: Importance, scheduling (step decay, exponential), Momentum: Accelerating convergence, escape local minima, Weight Update Rule, Epochs vs Iterations: Training terminology clarification, Convergence Criteria: Early stopping, validation monitoring, Computational Graph, Numerical Stability: Gradient clipping, double precision,

4. Variants of Gradient Descent

Batch Gradient Descent: Full dataset per update, stable but memory-intensive, Stochastic Gradient Descent (SGD): Single sample updates, noisy but fast, Mini-batch Gradient Descent: Compromise (32-256 samples), practical standard, Momentum SGD: Velocity accumulation, smoother convergence, Nesterov Accelerated Gradient (NAG): Look-ahead momentum, Adagrad: Per-parameter learning rates, adaptive for sparse data, RMSProp: Moving average of squared gradients, non-stationary objectives, Adam: Momentum + RMSProp hybrid, adaptive learning rates, AdamW: Decoupled weight decay for better regularization, Learning Rate Scheduling: Step decay, cosine annealing, warm restarts, Gradient Clipping: Exploding gradient prevention, Second-order Methods: Newton's method overview, quasi-Newton (BFGS)

5. Advanced DL architectures and applications

Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) & LSTMs, Transformers & Attention Mechanisms, Generative Adversarial Networks (GANs), Transfer Learning & Pre-trained Models, Applications: Computer Vision, NLP, Reinforcement Learning

COURSE OBJECTIVES

1. To understand perceptrons, MLPs, activation functions, and backpropagation for building deep learning models from scratch.
2. To Implement Modern Training Techniques: Gain hands-on experience with gradient descent variants (SGD, Adam) and optimization strategies for stable convergence.
3. To apply Advanced Architectures: Learn CNNs, RNNs, Transformers, and their real-world applications in computer vision, NLP, and reinforcement learning.

Anusandhan National Research Foundation
PAIR Scheme

Short Term Course
on
A Primer to Deep Learning
(DL -2026)
Hybrid Mode
(Online and Offline)
8th –12th JUNE 2026

Chairman

Prof. Bibhudutta Sahoo, HoD(CS)

Convener

Dr. Panthadeep Bhattacharjee

Department of Computer Science and Engineering

National Institute of Technology

Rourkela-769008, Odisha

https://www.nitrkl.ac.in/

ABOUT NIT ROURKELA

National Institute of Technology (NIT) Rourkela is an institution of national importance funded by the Ministry of Education. NIT Rourkela was established as Regional Engineering College (REC) on August 15, 1961. In India, it was ranked 13 among engineering colleges by the National Institutional Ranking Framework (NIRF) in 2025. For details about the institute please visit us at https://www.nitrkl.ac.in/.

ABOUT DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Department of Computer Science & Engineering, NIT, Rourkela was established in 1982. Since its inception, the Department is under dynamic progress and is able to establish the reputation for imparting quality education both at undergraduate and graduate programmes. The department also offers Ph. D. for regular as well as sponsored candidates. Please visit https://www.nitrkl.ac.in/CS/ to know more about the Department of CSE. The department has well equipped modern laboratories such as Software Engineering, Distributed Object Systems, Information Security & Data Communication, Image Processing & Cluster Computing and Advanced Database Engineering Labs for pursuing research keeping in view of the technological advancement.

TARGET PARTICIPANTS

The short-term course is of immense interest for UG/ PG students, research scholars/professionals, staff/ faculty members and industry professionals working in the area of Data Science. The participants from different Science and Engineering (Computer Science and Engineering, Electronics and Communication Engineering, Electrical Engineering, etc.) background will be benefitted with this course.

IMPORTANT DATES

Registration Starts	15th March 2026
Registration Ends	25th May 2026
Maximum Offline Participants (First Come First Serve Basis)	100
Registration Confirmation	27th May 2026
Course Schedule	8th - 12th JUNE 2026

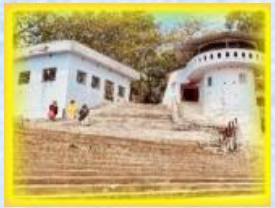
PREREQUISITES

1. The offline participants should bring their laptop.
2. Basics of machine learning will be a plus.

TOURIST PLACES NEARBY

Khandadhar Waterfall

Pitamahal Dam



Vedvyas Temple

Mandira Dam

REGISTRATION FEE PARTICULARS

Registration Fee	
Students	Rs. 1,180/- (online) Rs. 2,360/- (offline)
Faculty from Academic Institutions	Rs. 2,360/-
Employees from Industry and R&D Organizations	Rs. 3,540/-
Accommodation Charges	
Guest house (South / North block)	As Per Institute Norms
Hostel	

Registration fees include Registration Kit, Refreshment, Tea and Snacks and 18% GST. Lodging, boarding, lunch and dinner facility can be availed on separate payment basis and based on availability.

BANK ACCOUNT DETAILS FOR REGISTRATION

Account Name:	CONTINUING EDUCATION NIT ROURKELA
Account No.:	10138951784
Bank Name	State Bank of India(002109)
Branch:	NIT Rourkela Campus
IFSC Code	SBIN0002109

REGISTRATION FORM

To complete the online registration, the participants need to fill the following google form:

Click Here

Patron	Prof. K. Umamaheswar Rao, Director, NIT Rourkela
Chairperson	Prof. Bibhudatta Sahoo
Coordinator	Dr. Panthadeep Bhattacharjee

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