

Deep Learning
LEARN CERTIFY
ENGAGE COMPETE
COURSE OUTLINE

1 Introduction to Deep Learning

2 Neural Networks and Backpropagation

3 Convolutional Neural Networks (CNNs)

4 Recurrent Neural Networks (RNNs)

5 Advanced Topics in Deep Learning

6 Practical Projects and Case Studies

7 Final Project

Module 01 What is Deep Learning?

Overview of machine learning and artificial intelligence

Differences between traditional machine learning and deep learning

Historical context and key milestones in deep learning

Module 02 Building Neural Networks

Layers, weights, and biases

Forward and backward propagation

Loss functions (MSE, Cross-Entropy)

Module 03 Introduction to CNNs

Convolution operation

Pooling layers (Max Pooling, Average Pooling)

Fully connected layers and softmax

Module 04 Understanding RNNs

Sequential data and time-series prediction

Basic RNN structure and backpropagation through time
(BPTT)

**Module 05 Generative Adversarial Networks
(GANs)**

Understanding GANs and their components (Generator, Discriminator)
Training process and common challenges
Applications in image generation and data augmentation

Module 06 Project Planning and Dataset Preparation
Choosing a project topic and gathering data
Data preprocessing and feature engineering

Module 07 Project Proposal
Define a problem statement and objectives
Outline the approach and methodology

Module 8 Neural Networks Basics
Understanding neurons and the biological inspiration
Perceptron and multi-layer perceptron (MLP)
Activation functions (ReLU, Sigmoid, Tanh)

Module 9 Optimization Techniques
Gradient Descent and its variants (SGD, Mini-batch GD)
Learning rate and its importance
Advanced optimizers (Adam, RMSprop, Adagrad)

Module 10 Architectures and Applications
Famous CNN architectures (LeNet, AlexNet, YOLO, VGG, ResNet)
Applications in image recognition and computer vision

Module 11 Advanced RNNs
Long Short-Term Memory (LSTM) networks
Gated Recurrent Units (GRUs)
Applications in NLP and speech recognition

Module 12 Autoencoders and Variational Autoencoders (VAEs)
Understanding autoencoders and their applications

Variational autoencoders for generative modeling

Module 13 Model Building and Training

Building and tuning models for different applications

Performance evaluation and metrics

Module 14 Implementation

Data collection and preprocessing

Model development and training

Module 15 Key Concepts in Deep Learning

Supervised, unsupervised, and reinforcement learning

Overfitting and underfitting

Bias-variance tradeoff

Module 16 Implementing Neural Networks

Practical examples and exercises

Hands-on with Python and popular libraries (TensorFlow, Keras, PyTorch)

Building a simple neural network from scratch

Module 17 Practical Implementation

Data augmentation and transfer learning

Building and training a CNN

Hands-on projects: Image classification, object detection

Module 18 Practical Implementation

Building and training RNNs, LSTMs, and GRUs

Hands-on projects: Text generation, sentiment analysis

Module 19 Reinforcement Learning

Basics of reinforcement learning

Deep Q-Learning and policy gradients

Applications in gaming and robotics

Module 20 Deployment and Production

Deploying models using cloud services
Monitoring and maintaining models in production

Module **21** Evaluation and Presentation

Evaluate model performance

Prepare a presentation and report of the findings

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info@itsolera.com +923334471066 itsolera.com ENCE.

info@itsolera.com +923334471066 itsolera.com