Deep Learning with PyTorch Training

Duration: **10 Day**

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info@bilginc.com
bilginc.com

Overview

Deep Learning with PyTorch Training provides a comprehensive introduction to the tools and techniques available in **PyTorch** for developing, training, evaluating, and optimizing deep learning models.

PyTorch is an open-source **deep learning framework** recognized for its dynamic computation graph and flexible development environment. It supports the creation and improvement of neural network models across research projects and real-world applications.

The course begins with **tensor operations** and essential mathematical concepts before progressing to **automatic differentiation (Autograd)**, **neural network layers**, **model training**, **backpropagation**, and **optimization**.

Participants also explore deep learning architectures such as **Convolutional Neural Networks (CNNs)**, **Recurrent Neural Networks (RNNs)**, **Transformers**, **generative models**, and **Graph Neural Networks (GNNs)**.

Additional topics include **data preprocessing**, **distributed training**, **high-performance model development**, **hyperparameter optimization**, **model compression**, **acceleration**, **transfer learning**, and **production deployment**.

The training aims to provide both theoretical understanding and practical knowledge for participants who want to develop **end-to-end deep learning solutions** using PyTorch.

Prerequisites

There are **no mandatory prerequisites** for attending this training.

Who Should Attend

- Individuals interested in **Artificial Intelligence and Machine Learning**
- **University students** and those pursuing a career in deep learning
- **Data Scientists** and **Data Engineers**
- **Software Developers** who want to integrate deep learning into their applications
- **Academics** and **Researchers**
- Professionals working in **healthcare, finance, automotive, and retail**
- Technical teams and professionals interested in applying**deep learning to business processes**

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What You Will Learn

Upon completing this training, you will be able to:

- Design, train, and optimize deep learning models from scratch using **PyTorch**.
- Understand fundamental tensor operations such as **Broadcasting** and **torch.einsum**.
- Work with **Dynamic Computation Graphs**, **Autograd**, and **Memory Management**.
- Configure **neural network layers**, **Backpropagation**, and model training loops.
- Develop deep learning models using **CNN** and **RNN** architectures.
- Explore modern architectures such as **Transformers**, **Generative Models**, and **GNNs**.
- Use the PyTorch ecosystem for **large-scale data** and **distributed training** scenarios.
- Apply **Hyperparameter Optimization**, **Model Compression**, and **Acceleration** techniques.
- Understand **Transfer Learning** and **Model Deployment** workflows.
- Develop **scalable deep learning solutions** for industry and research applications.

Outline

1. Introduction to Deep Learning and PyTorch

Evolution of Deep Learning

- Historical background and fundamental concepts of **deep learning**
- Development from **Perceptron** and **Backpropagation** to **AlexNet**, **Transformers**, and **Diffusion** models
- Key differences between traditional **Machine Learning** and **Deep Learning**

PyTorch Ecosystem

- Structure and applications of the **PyTorch** framework
- **TorchScript**
- **torch-data**
- **torch-metrics**
- **torch-compile**
- **PyTorch 2.x Dynamo**

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- PyTorch community, release lifecycle, and **LTS distributions**

Mathematical Foundations of Deep Learning

- **Linear Algebra:** Eigenvalues and **Singular Value Decomposition (SVD)**
- **Calculus:** The **Chain Rule**
- **Jacobian** and **Hessian** matrices
- **Probability** and **Information Theory**
- **KL Divergence** and **Cross-Entropy**

Tensor Operations

- Understanding **tensors** in PyTorch
- **Broadcasting**
- **Einstein Summation**
- Tensor operations using **torch.einsum**

2. PyTorch Fundamentals and Advanced Mechanisms

This section explores the core building blocks of **PyTorch** and the mechanisms used to develop deep learning models.

- **Dynamic Computation Graphs**
- Automatic differentiation with **Autograd**
- **Neural network layers**
- Modular model development
- **Memory management**
- Using PyTorch mechanisms throughout model development and training

3. Data Ecosystem and Preprocessing

This section focuses on preparing datasets for deep learning workflows.

- Exploring the **PyTorch data ecosystem**
- **Data preprocessing**
- Preparing datasets for model training
- Integrating data preparation into the model development workflow

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4. Training Loops and Fundamental Neural Networks

- Building **neural network architectures**
- Structuring the **model training loop**
- **Forward Propagation**
- **Backpropagation**
- **Optimization** processes
- Model training and evaluation approaches

5. Convolutional Networks and Image Processing

- Understanding **Convolutional Neural Networks (CNNs)**
- The role of CNNs in **image processing**
- Developing **convolutional neural networks** with PyTorch
- Approaches to training models on image datasets

6. Additional Deep Learning Architectures

Other architectures identified in the course overview and learning outcomes include:

- **Recurrent Neural Networks (RNNs)**
- **Transformer** architectures
- **Generative Models**
- **Graph Neural Networks (GNNs)**
- Evaluating the application areas of different architectures

7. Model Optimization and Production Workflows

Advanced topics reflected in the stated learning outcomes include:

- **Hyperparameter Optimization**
- **Transfer Learning**
- **Distributed Training**
- Large-scale data processing and **high-performance model training**
- **Model Compression**
- **Model Acceleration**

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- **Model Deployment** to production environments
- Developing scalable and sustainable deep learning solutions