MIT xPRO

THE MIT WAY

Dive into this subset of machine learning and discover the foundations, techniques, architectures, applications, and benefits that deep learning can offer your organization in this 8-week online course.

DEEP LEARNING: MASTERING NEURAL NETWORKS

THE MIT WAY

Expand your skill set and help your organization make data-informed predictions.

The AI revolution has brought about extensive technological advances: conversational systems like Siri or Alexa, driverless cars, and even automated traders that compete with their human counterparts on Wall Street. The subset of machine learning known as deep learning is the force behind many of these incredible applications.

With the rapid rise of big data across a multitude of industries, the ability to analyze it in order to detect trends and make data-driven predictions has become a necessity for organizations. And having both a solid theoretical foundation and a practical understanding of the basic building blocks of deep learning could be a differentiating factor for professionals in nearly any sector. This online course provides such expertise, backed by the reputation of one of the world's leading research institutions in AI: MIT.

THIS COURSE IS AIMED AT

Tech enthusiasts who wish to learn more about deep learning and gain hands-on experience with the vast array of techniques and applications it offers.

IT professionals looking to expand their skill set with some of the most common and powerful machine and deep learning algorithms.

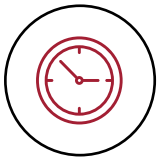
Professionals from nearly any industry (finance, logistics, biotech, manufacturing, and consulting, among others) that want to improve their data management abilities to generate valuable insights.

A basic knowledge of programming languages is a prerequisite for this program. The course will, however, explain the necessary foundational concepts of machine learning and programming, allowing those without previous experience to fully participate.

FACULTY DE MIT

Duane S. Boning
Clarence J. LeBel Professor in Electrical Engineering, and Professor of Electrical Engineering and Computer Science in the EECS Department at MIT

He is affiliated with the MIT Microsystems Technology Laboratories, and serves as MTL Associate Director for Computation and CAD. He is also the Engineering Faculty Co-Director of the MIT Leaders for Global Operations (LGO) program, serving in that role since September 2016. From 2004 to 2011, he served as Associate Head of the EECS Department at MIT. From 2011 through 2013 he was the Director/Faculty Lead of the MIT Skoltech Initiative, and from 2011 through July 2018, he was the faculty Director of the MIT/Masdar Institute Cooperative Program.



Duration

8 weeks

Commitment

6-8 hours per week

Format

Online

CEU

4.8

THROUGHOUT THIS COURSE, YOU WILL:

- √ Explore the core mathematical and conceptual ideas underlying deep neural networks.
- √ Experiment with deep learning models and algorithms using available machine learning toolkits.
- √ Examine application approaches and case studies where deep learning is being used throughout a variety of industries.

PROGRAM OUTLINE

MODULE 1 — Foundations of Deep Learning

Learning Objectives:

1. Learn about the history of deep learning, from the development of single neural networks to deep neural networks
2. Understand the basic building blocks of deep learning
3. Use gradient descent to learn how model coefficients and weights are learned

History of Machine Learning

Overview of Key Machine Learning Concepts
- Selected Machine Learning Methods
- Model Complexity

Linear and Logistic Regression Algorithms
- Linear Classifiers
- Regression Algorithms
- Iterative Algorithms
- Revisiting Classification Logistic Regression

Perceptrons and Neural Networks
- The Neuron
- Neural Network

Gradient Descent-Based Learning
- Necessary Steps in Achieving Gradient Descent-Based Learning

MODULE 2 — Basics of Python for Deep Learning

Learning Objectives:

1. Learn about Python as a programming tool and its different applications
2. Gain a better understanding of the Python language through examples and exercises
3. Learn about the fundamentals of machine learning models through the basics of Python

Introduction to Coding Tools
- Google Colab and Python

Basics of Python
- Variables, Control, and Functions

Overview of Data Science-Related Python Libraries
- What Are Python Libraries?
- Popular Data Science-Related Python Libraries

Introduction to Machine Learning using Python
- Machine Learning With Python Functions
- Tiny Implementations of Models and Methods
- Example of Regression and Classification Models
- Training Using Gradient Descent

Python Classes
- Defining and using Python Classes
- Things to Bear in Mind When Learning Python

MODULE 3

Building and Training Neural Networks

Learning Objectives:

1. Use data-science Python libraries to implement larger neural networks
2. Learn how to define and train a multilayer perceptron (MLP) neural network
3. Identify the train/validate/test split paradigm and model evaluation metrics

- Train/Test/Validate Split
- Train/Test/Validate Splitting in Code

Overfitting vs Generalization
- Regularization
- Applying Regularization in Neural Networks

Training Curves
- Confusion Matrix
- ROC Curves

Dropout
- Generalization Improvement with Dropout
- Dropout Effect on Features
- Dropout in PyTorch

Data Encoding
- Scaling.

MODULE 4

Deep Networks

Learning Objectives:

1. Gain a better understanding of complex neural networks and how to train them
2. Learn about autoencoding as an architectural method to customize neural networks and the use of convolutional neural networks in image recognition
3. Analyze basic concepts and challenges of deep neural networks

Neural Networks: Multilayer Perceptrons (MLPs)
- Activation and Loss Functions
- How Do We Train a Multilayer Perceptron

Autoencoders
- Autoencoder Example
- Variational Autoencoder

Convolutional Neural Networks (CNNs)
- Max Pooling Layers
- Multiple Filters Across Multiple Channels

Deep Neural Networks
- Challenges of DNNs
- Data Augmentation
- Hyperparameters
- Types of Neural Network Layers in PyTorch

MODULE 5

Deep Neural Network Architectures: CNNs and RNNs

Learning Objectives:

1. Learn how to adapt existing deep convolution neural networks to new applications using transfer learning
2. Understand sequence to sequence mapping as another important machine learning task
3. Gain intuition behind recurrent neural network (RNN) structures that learn from sequence data rather than from image data

Convolutional Neural Networks (CNNs)
- Transfer learning and fine-tuning, e.g. using VGG16, Resnet50 models

Sequence to Sequence Mappings
- Word completion, language translation

Recurrent Neural Networks (RNNs)
- Basic recurrent element
- LSTM and GRU

MODULE 6

Deep Neural Networks: GANs and Transformers

Learning objectives:

1. Learn how deep neural networks can generate new examples that look "like" training samples
2. Understand generative adversarial networks (GANs) and how they are trained
3. Gain exposure to attention networks and transformers as a recent advance in deep learning

Generative Adversarial Networks (GANs)
- Generative models: Variational Autoencoder to generate new examples
- GANs: Generator and Discriminator in competition

Transformers
- Attention networks

Large foundation models: GPT-3

MODULE 7

Building NN-based applications with PyTorch II *

Objetivos de aprendizaje:

1. Gain exposure to modern deep neural networks in action, including CNNs for image segmentation and classification, RNNs for text processing, and transformer models for wide-ranging applications
2. Understand the importance of ethical practices in building and using deep learning models

Three guided cases studies about Deep Neural Networks

Ethical AI

- Bias in data sets, training
- Trends in explainable models, trustworthy-AI

MODULE 8

Capstone Project

- Two week long project
- The students will have to apply a particular deep learning algorithm (or set of algorithms) of their choice to a real dataset to solve a certain challenge or business problem.
- They will elaborate a report with the results in the form of a presentation or blog post.
- They will be required to develop their project in Google Colab.
- Finally, they will be asked to upload a link to their notebook and their choice of report (uploaded in .pdf) so that it can be reviewed and corrected by their peers.
- The plan is to use PyTorch with torchvision and torchaudio datasets and pre-trained models.

MIT xPRO AND GLOBAL ALUMNI:
Continuing programs for professionals around the world

About MIT and MIT xPRO

The Massachusetts Insitute of Technology, more commonly referred to as MIT, is a private American university founded in 1861. The Institute's faculty has included 97 Nobel Prize laureates, 58 National Medal of Science winners, 58 Rhodes Scholars, and 45 MacArthur Fellows.

MIT xPRO offers online continuing education courses for professionals at all levels from the fields of science, engineering, and technology. All courses are led and supervised by MIT faculty.

Collaboration with Global Alumni

Our collaboration with Global Alumni has driven the launch of MIT xPRO in Portuguese, Spanish, and English. This EdTech is dedicated to expanding access to the knowledge of the world's top universities, helping break down both geographical and language barriers.

Their focus on innovation, technology, and user experience, along with their expensive understanding of our goals as an institution, ensure that quality of our teaching is upheld as we expand our offering to professionals around the globe.

This collaboration offers these professionals the opportunity to take advantage of the same quality teaching found on MIT's campus wherever they are and in their own language.

USA +1 617 778 2938 | Spain +34 679 492 128

globalalumni@xpro.mit.edu

More Information