

# Postgraduate Certificate

## Mathematical Basis of Deep Learning



## Postgraduate Certificate Mathematical Basis of Deep Learning

- » Modality: online
- » Duration: 12 weeks
- » Certificate: TECH Technological University
- » Dedication: 16h/week
- » Schedule: at your own pace
- » Exams: online

Website: [www.techtitute.com/us/artificial-intelligence/postgraduate-certificate/mathematical-basis-deep-learning](http://www.techtitute.com/us/artificial-intelligence/postgraduate-certificate/mathematical-basis-deep-learning)

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01

# Introduction

Deep Learning models are abruptly transforming society in all its aspects. This branch of Artificial Intelligence is an unparalleled breakthrough in scientific research, where experts continue to design more sophisticated and efficient neural networks to improve the accuracy of complex tasks such as decision-making. So much so that a recent study forecasts that the global Deep Learning market will grow to 20 billion dollars next year. This implies a great opportunity for growth for companies and disruption for industries. For this reason, TECH launches an online university program that will allow professionals to master the mathematical foundations that enable the operation of such intelligent models.







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*Thanks to this 100% online Postgraduate Certificate, you will master the fundamentals of Deep Learning and design the most efficient architectures for specific tasks such as sentiment analysis"*

Deep Learning is so versatile and offers so many applications that it has become one of the most relevant technologies today. In this sense, professionals use Deep Learning tools to better understand customer behavior and adapt their marketing strategies in order to build customer loyalty. In addition, these models are used to predict consumer preferences based on aspects such as purchase history, website navigation and even ad clicks. In this way, specialists personalize product recommendations and offers for each individual, optimizing their experience while companies increase their conversion rates.

In this scenario, TECH develops a pioneering program in Mathematical Foundations of Deep Learning. Thanks to this program, developers will gain a solid understanding of Deep Learning algorithms and implement them to neural network models. The curriculum will delve into essential concepts such as derivatives of linear functions, Backward Pass and parameter optimization. The syllabus will also focus on the use of Supervised Learning machines. Students will nurture their practice with the most innovative models to be used in procedures with labeled data. The syllabus will also emphasize the importance of model training, offering advanced techniques including Online Learning. Thanks to this, graduates will ensure that their devices learn from the data in order to perform activities accurately.

Moreover, the program features the revolutionary Relearning methodology, based on the reiteration of key content and experience, offering simulation cases for a direct approach of professionals with the current challenges in Deep Learning. Students will enjoy a variety of didactic materials in different formats such as interactive videos, complementary readings and practical exercises.

This **Postgraduate Certificate in Mathematical Basis of Deep Learning** contains the most complete and up-to-date program on the market. The most important features include:

- The development of case studies presented by experts in Mathematical Basis of Deep Learning
- The graphical, schematic and practical contents with which it is conceived gather technological and practical information on those disciplines that are essential for professional practice
- Practical exercises where the self-assessment process can be carried out to improve learning
- Its special emphasis on innovative methodologies
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Content that is accessible from any fixed or portable device with an Internet connection



*You will master the Batch Learning approach at the world's best digital university according to Forbes"*

“

*You will master Decision Tree models to effectively solve you a variety of classification problems in different areas”*

The program’s teaching staff includes professionals from the sector who contribute their work experience to this program, as well as renowned specialists from leading societies and prestigious universities.

The multimedia content, developed with the latest educational technology, will provide the professional with situated and contextual learning, i.e., a simulated environment that will provide immersive education programmed to learn in real situations.

This program is designed around Problem-Based Learning, whereby the professional must try to solve the different professional practice situations that arise during the academic year For this purpose, the students will be assisted by an innovative interactive video system created by renowned and experienced experts.

*Do you want to specialize in hyperparameter adjustment? Achieve it with this program in only 300 hours.*

*With the Relearning system you will focus on the most relevant concepts without having to invest a large amount of study hours.*



# 02

# Objectives

Upon completion of this Postgraduate Certificate, graduates will have a holistic view of the Mathematical Foundations of Deep Learning. This will enable professionals to apply the concepts of functions and their derivatives to Deep Learning algorithms for devices to automate complex tasks. Likewise, experts will master the various systems of Supervised Learning, among which Decision Trees or Neural Networks models stand out. In this way, developers will provide solutions in a wide range of applications such as natural language recognition, text generation or automatic translations.





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*You will implement in your projects the most effective Optimization Methods for training Deep Learning models”*



## General Objectives

- Fundamentalize the key concepts of mathematical functions and their derivatives
- Apply these principles to deep learning algorithms to learn automatically
- Examine the key concepts of Supervised Learning and how they apply to neural network models
- Analyze the training, evaluation and analysis of neural network models
- Fundamentals of the key concepts and main applications of deep learning
- Implement and optimize neural networks with Keras
- Develop expertise in the training of deep neural networks
- Analyze the optimization and regularization mechanisms required for deep neural network training



*Updating your knowledge of the mathematical foundations of Deep Learning will be much easier thanks to the multimedia material provided by this program"*





## Specific Objectives

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- Develop the chain rule for calculating derivatives of nested functions
- Analyze how to create new functions from existing functions and how to compute the derivatives of these functions
- Examine the concept of Backward Pass and how derivatives of vector functions are applied to automatic learning
- Learn how to use TensorFlow to build custom models
- Understand how to load and process data using TensorFlow tools
- Fundamentalize the key concepts of NLP natural language processing with RNN and attention mechanisms
- Explore the functionality of Hugging Face transformer libraries and other natural language processing tools for application to vision problems
- Learn how to build and train autoencoder models, GANs, and diffusion models
- Understand how autoencoders can be used to efficiently encode data
- Analyze how linear regression works and how it can be applied to neural network models
- Understand the rationale for optimizing hyperparameters to improve the performance of neural network models
- Determine how the performance of neural network models can be evaluated using the training set and the test set



# 03

# Course Management

True to its goal of providing teaching of high educational standards, TECH carries out a thorough selection process to choose the teachers who teach their university programs. Therefore, students have the guarantee of expanding their knowledge from the hand of experts in each discipline. For this Postgraduate Certificate, the institution offers students a teaching staff formed by references in the field of Deep Learning, who have vast experience in the area of Computer Vision and have offered innovative solutions in the construction of algorithms for neural networks.





“

*You will study from the experience of the best experts in Machine Learning to become the most competent developer”*

## Management



### Mr. Gil Contreras, Armando

- ♦ Lead Big Data Scientist at Johnson Controls
- ♦ Data Scientist-Big Data at Opensistemas S.A
- ♦ Fund Auditor at Creatividad and Tecnología (CYTSA)
- ♦ Public Sector Auditor at PricewaterhouseCoopers Auditors
- ♦ Master's Degree in Data Science from the Centro Universitario de Tecnología y Arte
- ♦ MBA in International Relations and Business from the Centro de Estudios Financieros (CEF)
- ♦ Bachelor's Degree in Economics from Instituto Tecnológico de Santo Domingo

## Professors

### Ms. Delgado Feliz, Benedit

- ♦ Administrative Assistant and Electronic Surveillance Operator for the National Drug Control Directorate (DNCD)
- ♦ Customer Service at Cáceres y Equipos
- ♦ Claims and Customer Service at Express Parcel Services (EPS)
- ♦ Microsoft Office Specialist at the National School of Informatics (Escuela Nacional de Informática)
- ♦ Social Communicator from the Catholic University of Santo Domingo

### Ms. Gil de León, María

- ♦ Co-Director of Marketing and Secretary at RAÍZ Magazine
- ♦ Copy Editor at Gauge Magazine
- ♦ Stork Magazine reader from Emerson College
- ♦ B.A. in Writing, Literature and Publishing from Emerson College





**Mr. Matos Rodríguez, Dionis**

- ◆ *Data Engineer* at Wide Agency Sodexo
- ◆ *Data Consultant* at Tokiota
- ◆ *Data Engineer* at Devoteam
- ◆ *BI Developer* at Ibermática
- ◆ *Applications Engineer* at Johnson Controls
- ◆ *Database Developer* at Suncapital España
- ◆ *Senior Web Developer* at Deadlock Solutions
- ◆ *QA Analyst* at Metaconcept
- ◆ *Master's Degree in Big Data & Analytics* by EAE Business School
- ◆ *Master's Degree in Systems Analysis and Design*
- ◆ *Bachelor's Degree in Computer Engineering* from APEC University

**Mr. Villar Valor, Javier**

- ◆ *Director and Founding Partner* of Impulsa2
- ◆ *Chief Operations Officer (COO)* at Summa Insurance Brokers
- ◆ *Director of Transformation and Operational Excellence* at Johnson Controls
- ◆ *Master in Professional Coaching*
- ◆ *Executive MBA* from Emlyon Business School, France
- ◆ *Master's Degree in Quality Management* from EOI, Spain
- ◆ *Computer Engineering* from the Universidad Acción Pro-Education and Culture (UNAPEC)

# 04

## Structure and Content

By means of 300 teaching hours, this degree will offer students a deep analysis of the Mathematical Basis of Deep Learning. After delving into key concepts ranging from functions to derivatives, the curriculum will focus on the Backward Pass. stage. This will allow students to adjust the weights of the neural network and improve the performance of the model during the program. Likewise, the syllabus will analyze the different systems of Supervised Learning taking into account factors such as linear regression or optimization methods. In this sense, the program will provide advanced regularization techniques.





“

*You will enrich your professional practice with the most cutting-edge Evaluation Metrics and you will evaluate the effectiveness of neural network models in specific tasks”*

## Module 1. Mathematical Basis of Deep Learning

- 1.1. Functions and Derivatives
  - 1.1.1. Linear Functions
  - 1.1.2. Partial Derivative
  - 1.1.3. Higher Order Derivatives
- 1.2. Multiple Nested Functions
  - 1.2.1. Compound Functions
  - 1.2.2. Inverse Functions
  - 1.2.3. Recursive Functions
- 1.3. Chain Rule
  - 1.3.1. Derivatives of Nested Functions
  - 1.3.2. Derivatives of Compound Functions
  - 1.3.3. Derivatives of Inverse Functions
- 1.4. Functions with Multiple Inputs
  - 1.4.1. Multi-variable Functions
  - 1.4.2. Vectorial Functions
  - 1.4.3. Matrix Functions
- 1.5. Derivatives of Functions with Multiple Inputs
  - 1.5.1. Partial Derivative
  - 1.5.2. Directional Derivatives
  - 1.5.3. Mixed Derivatives
- 1.6. Functions with Multiple Vector Inputs
  - 1.6.1. Linear Vector Functions
  - 1.6.2. Non-linear Vector Functions
  - 1.6.3. Matrix Vector Functions
- 1.7. Creating New Functions from Existing Functions
  - 1.7.1. Addition of Functions
  - 1.7.2. Product of Functions
  - 1.7.3. Composition of Functions



- 1.8. Derivatives of Functions with Multiple Vector Entries
  - 1.8.1. Derivatives of Linear Functions
  - 1.8.2. Derivatives of Nonlinear Functions
  - 1.8.3. Derivatives of Compound Functions
- 1.9. Vector Functions and their Derivatives: A Step Further
  - 1.9.1. Directional Derivatives
  - 1.9.2. Mixed Derivatives
  - 1.9.3. Matrix Derivatives
- 1.10. The *Backward Pass*
  - 1.10.1. Error Propagation
  - 1.10.2. Application of Update Rules
  - 1.10.3. Parameter Optimization

## Module 2. Deep Learning Principles

- 2.1. Supervised Learning
  - 2.1.1. Supervised Learning Machines
  - 2.1.2. Uses of Supervised Learning
  - 2.1.3. Differences between Supervised and Unsupervised Learning
- 2.2. Supervised Learning Models
  - 2.2.1. Linear Models
  - 2.2.2. Decision Tree Models
  - 2.2.3. Neural Network Models
- 2.3. Linear Regression
  - 2.3.1. Simple Linear Regression
  - 2.3.2. Multiple Linear Regression
  - 2.3.3. Regression Analysis
- 2.4. Model Training
  - 2.4.1. *Batch Learning*
  - 2.4.2. *Online Learning*
  - 2.4.3. Optimization Methods
- 2.5. Model Evaluation: Training Set vs. Test Set
  - 2.5.1. Evaluation Metrics
  - 2.5.2. Cross Validation
  - 2.5.3. Comparison of Data Sets
- 2.6. Model Evaluation: The Code
  - 2.6.1. Prediction Generation
  - 2.6.2. Error Analysis
  - 2.6.3. Evaluation Metrics
- 2.7. Variables Analysis
  - 2.7.1. Identification of Relevant Variables
  - 2.7.2. Correlation Analysis
  - 2.7.3. Regression Analysis
- 2.8. Explainability of Neural Network Models
  - 2.8.1. Interpretable Models
  - 2.8.2. Visualization Methods
  - 2.8.3. Evaluation Methods
- 2.9. Optimization
  - 2.9.1. Optimization Methods
  - 2.9.2. Regularization Techniques
  - 2.9.3. The Use of Graphs
- 2.10. Hyperparameters
  - 2.10.1. Selection of Hyperparameters
  - 2.10.2. Parameter Search
  - 2.10.3. Hyperparameter Tuning

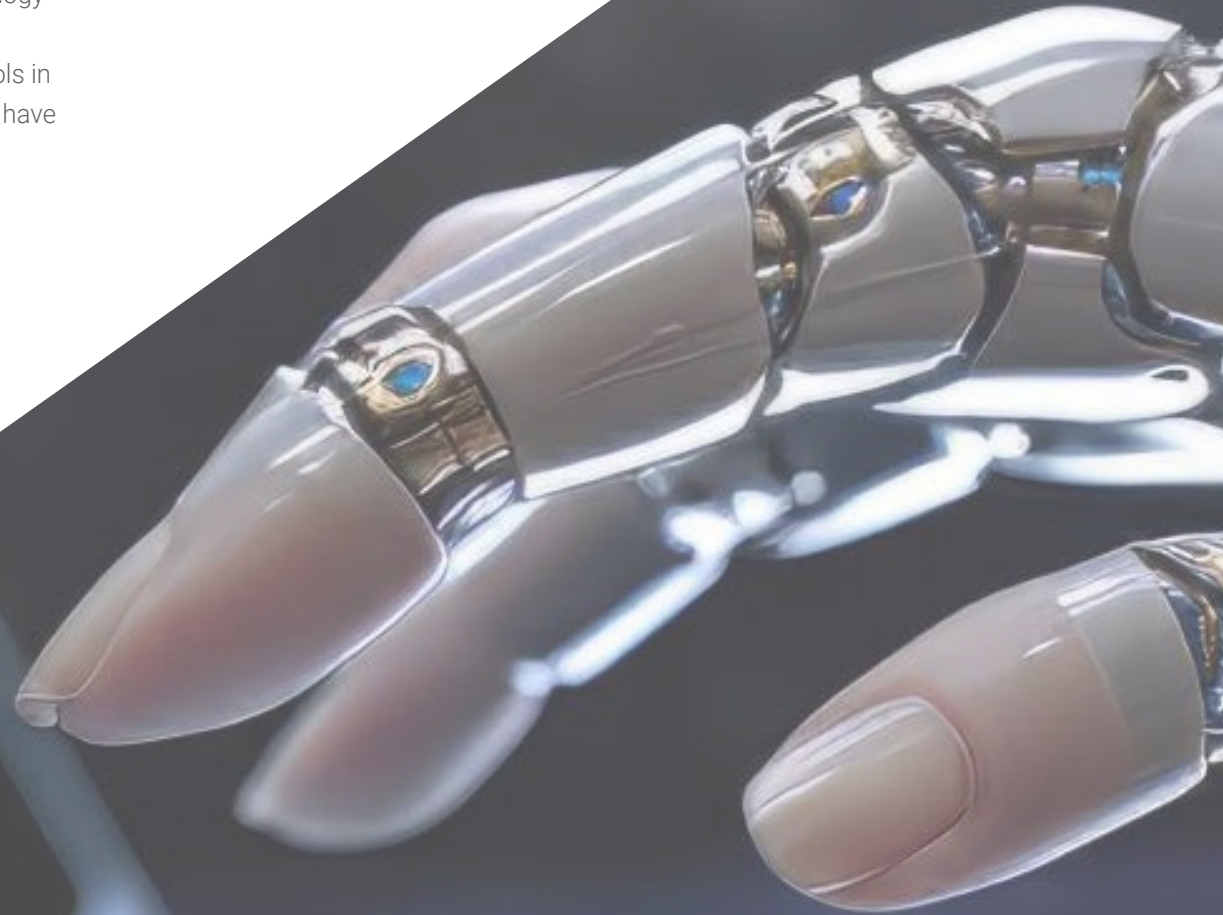


05

# Methodology

This academic program offers students a different way of learning. Our methodology uses a cyclical learning approach: **Relearning**.

This teaching system is used, for example, in the most prestigious medical schools in the world, and major publications such as the **New England Journal of Medicine** have considered it to be one of the most effective.







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*Discover Relearning, a system that abandons conventional linear learning, to take you through cyclical teaching systems: a way of learning that has proven to be extremely effective, especially in subjects that require memorization"*

## Case Study to contextualize all content

Our program offers a revolutionary approach to developing skills and knowledge. Our goal is to strengthen skills in a changing, competitive, and highly demanding environment.

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*At TECH, you will experience a learning methodology that is shaking the foundations of traditional universities around the world”*



*You will have access to a learning system based on repetition, with natural and progressive teaching throughout the entire syllabus.*



*The student will learn to solve complex situations in real business environments through collaborative activities and real cases.*

### A learning method that is different and innovative

This TECH program is an intensive educational program, created from scratch, which presents the most demanding challenges and decisions in this field, both nationally and internationally. This methodology promotes personal and professional growth, representing a significant step towards success. The case method, a technique that lays the foundation for this content, ensures that the most current economic, social and professional reality is taken into account.

“*Our program prepares you to face new challenges in uncertain environments and achieve success in your career”*

The case method has been the most widely used learning system among the world's leading Information Technology schools for as long as they have existed. The case method was developed in 1912 so that law students would not only learn the law based on theoretical content. It consisted of presenting students with real-life, complex situations for them to make informed decisions and value judgments on how to resolve them. In 1924, Harvard adopted it as a standard teaching method.

What should a professional do in a given situation? This is the question that you are presented with in the case method, an action-oriented learning method. Throughout the course, students will be presented with multiple real cases. They will have to combine all their knowledge and research, and argue and defend their ideas and decisions.

## Relearning Methodology

TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines different teaching elements in each lesson.

We enhance the Case Study with the best 100% online teaching method: Relearning.

*In 2019, we obtained the best learning results of all online universities in the world.*

At TECH you will learn using a cutting-edge methodology designed to train the executives of the future. This method, at the forefront of international teaching, is called Relearning.

Our university is the only one in the world authorized to employ this successful method. In 2019, we managed to improve our students' overall satisfaction levels (teaching quality, quality of materials, course structure, objectives...) based on the best online university indicators.





In our program, learning is not a linear process, but rather a spiral (learn, unlearn, forget, and re-learn). Therefore, we combine each of these elements concentrically.

This methodology has trained more than 650,000 university graduates with unprecedented success in fields as diverse as biochemistry, genetics, surgery, international law, management skills, sports science, philosophy, law, engineering, journalism, history, and financial markets and instruments. All this in a highly demanding environment, where the students have a strong socio-economic profile and an average age of 43.5 years.

*Relearning will allow you to learn with less effort and better performance, involving you more in your training, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation for success.*

From the latest scientific evidence in the field of neuroscience, not only do we know how to organize information, ideas, images and memories, but we know that the place and context where we have learned something is fundamental for us to be able to remember it and store it in the hippocampus, to retain it in our long-term memory.

In this way, and in what is called neurocognitive context-dependent e-learning, the different elements in our program are connected to the context where the individual carries out their professional activity.



This program offers the best educational material, prepared with professionals in mind:



### Study Material

All teaching material is produced by the specialists who teach the course, specifically for the course, so that the teaching content is highly specific and precise.

These contents are then applied to the audiovisual format, to create the TECH online working method. All this, with the latest techniques that offer high quality pieces in each and every one of the materials that are made available to the student.



### Classes

There is scientific evidence suggesting that observing third-party experts can be useful.

Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.



### Practising Skills and Abilities

They will carry out activities to develop specific skills and abilities in each subject area. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop in the context of the globalization that we are experiencing.



### Additional Reading

Recent articles, consensus documents and international guidelines, among others. In TECH's virtual library, students will have access to everything they need to complete their course.





#### Case Studies

Students will complete a selection of the best case studies chosen specifically for this program. Cases that are presented, analyzed, and supervised by the best specialists in the world.



#### Interactive Summaries

The TECH team presents the contents attractively and dynamically in multimedia lessons that include audio, videos, images, diagrams, and concept maps in order to reinforce knowledge.

This exclusive educational system for presenting multimedia content was awarded by Microsoft as a "European Success Story".



#### Testing & Retesting

We periodically evaluate and re-evaluate students' knowledge throughout the program, through assessment and self-assessment activities and exercises, so that they can see how they are achieving their goals.





06

# Certificate

The Postgraduate Certificate in Mathematical Basis of Deep Learning guarantees students, in addition to the most rigorous and up-to-date education, access to a Postgraduate Certificate issued by TECH Technological University.





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*Successfully complete this program and receive your university qualification without having to travel or fill out laborious paperwork"*

This **Postgraduate Certificate in Mathematical Basis of Deep Learning** contains the most complete and up-to-date program on the market.

After the student has passed the assessments, they will receive their corresponding **Postgraduate Certificate** issued by **TECH Technological University** via tracked delivery\*.

The diploma issued by **TECH Technological University** will reflect the qualification obtained in the Postgraduate Certificate, and meets the requirements commonly demanded by labor exchanges, competitive examinations, and professional career evaluation committees.

Title: **Postgraduate Certificate in Mathematical Basis of Deep Learning**

Official N° of Hours: **300 h.**



\*Apostille Convention. In the event that the student wishes to have their paper diploma issued with an apostille, TECH EDUCATION will make the necessary arrangements to obtain it, at an additional cost.

future  
health confidence people  
education information tutors  
guarantee accreditation teaching  
institutions technology learning  
community commitment  
personalized service innovation  
knowledge present  
online training  
development languages  
virtual classroom



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