Postgraduate Diploma

Computer Vision and Quantum Computing

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Postgraduate Diploma
Computer Vision and Quantum Computing

- Modality: **online**
- Duration: **6 months**
- Certificate: **TECH Technological University**
- Dedication: **16h/week**
- Schedule: **at your own pace**
- Exams: **online**

Website: www.techtitute.com/us/information-technology/postgraduate-diploma/postgraduate-diploma-computer-vision-quantum-computing

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01

Introduction

Training and specializing in quantum computing is a winning bet. It is today and will undoubtedly be even more so in the future. Unlike classical computing, which has the bit as its basic unit, quantum computers use *qubits*. These generate subatomic particles, making the processing power many times higher and faster than classical computers, solving problems in a novel way and performing several operations at the same time. This 100% online degree will provide the graduate with specialized knowledge in computer vision and quantum computing, to generate competitive advantages in the IT labor market.

Acquiring knowledge in quantum technologies at this time will make you a leader in programming in the near-term future"

Training a model from scratch implies having a large amount of previously catalogued information, approximately 10,000 photos of each of the types to be differentiated. This takes hours to achieve good results. In these cases, previously trained models can be used as a starting point, through the *Transfer Learning* resource. This Postgraduate Diploma examines what network models are currently available to facilitate model training using this technique.

The graduate will analyze the main use cases that exist for computer vision: classification, object detection, object identification and object tracking. For example, Google uses these algorithms to be able to search from images. Facebook, for example, uses them to automatically identify and tag people in a photo.

Quantum computing has advanced rapidly in both theory and practice in recent years and, with it, the hope of potential impact on real applications. A key area of interest and where quantum computing is proving to be most efficient is in the field of *Machine Learning* and its application in real proactive, predictive and prescriptive problems.

This program analyzes in which situations a quantum advantage, in the context of advanced analytics and artificial intelligence, could be achieved for the engineering world. The objective of this Postgraduate Diploma is to show what benefits current and future quantum technologies can provide to machine learning, focusing on algorithms that are challenging for classical digital computers, such as Kernel-based models, optimization and convolutional networks.

As it is a 100% online University Expert, the student is not conditioned by fixed schedules or the need to move to another physical location. Using a device with Internet access, you can consult the rich content that will help you acquire quantum computing techniques to reach the elite in the computer industry. All of this, at any time of the day, combining your work and personal life with your academic life at your own pace.

This **Postgraduate Diploma in Artificial Vision and Quantum Computing** is the most comprehensive and up-to-date scientific program on the market. The most important features include:

- The development of case studies presented by experts in Computer Vision and Quantum Computing
- The graphic, schematic, and eminently practical contents with which they are created, provide practical information on the 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

This training will allow you to advance in your career in a seamless way"

You are facing an emerging market where getting the right knowledge and advice is going to be paramount in order to take advantage of evolutions"

You will examine which network models are currently available to facilitate the training of your model, applying the Transfer Learning technique.

You will see the benefits that current and future quantum technologies can provide to machine learning, focusing on algorithms.

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

The multimedia content, developed with the latest educational technology, will provide professionals with situated and contextual learning, i.e., a simulated environment that will provide immersive training, designed for training oneself 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 student will be assisted by an innovative interactive video system created by renowned and experienced experts.

02

Objectives

The Postgraduate Diploma in Computer Vision and Quantum Computing is oriented to approach the subject from a practical point of view. In this way, a sense of security is generated in the student, which will allow them to be more effective in their daily practice. The direct application of the knowledge acquired in real projects is an added professional value that very few professionals specialized in Information and Communication Technologies can offer. This is precisely what makes this Postgraduate Diploma unique in the market, since the computer scientists who take it will be unique professionals in their sector.

Immerse yourself in the most relevant technologies that will play a major role in the technological advances of the coming years"

General Objectives

- Analyze how a computer is able to identify an image
- Determine how the convolution layer works and howTransfer Learning works
- Identify the different types of algorithms mainly used in computer vision
- Demonstrate the differences between quantum computing and classical computing
- Analyze the mathematical foundations of quantum computing
- Determine the main quantum operators and develop operational quantum circuits
- Analyze the advantages of quantum computation in examples of quantum "type" problem solving
- Develop and demonstrate the advantages of quantum computing in application solving examples (games, examples, programs)
- Demonstrate the different types of projects achievable with classical Machine Learning techniques and the state of the art in quantum computing
- Develop the key concepts of quantum states as a generalization of classical probability distributions, and thus be able to describe quantum systems of many states
- Analyze how to encode classical information in quantum systems
- Determine the concept of "Kernel Methods", common in classic Machine Learning algorithms
- Develop and implement learning algorithms for classical ML models in quantum models, such as PCA, SVM, neural networks, etc
- Implement DL model learning algorithms in quantum models, such as GANs

Specific Objectives

Module 1. R&D+I.A. Computer Vision. Object Identification and Tracking

- Analyze what computer vision is
- Determine typical computer vision tasks
- Analyze, step by step, how convolution works and how Transfer Learning works
- Identify what mechanisms we have available to create modified images, from our own, to have more training data
- Compile typical tasks that can be performed with computer vision
- Examine commercial computer vision use cases

Module 2. Quantum Computing A New Model of Computing

- Analyze the need for quantum computing and identify the different types of quantum computers currently available
- Specify the fundamentals of quantum computing and its characteristics
- Examine the applications of quantum computing, advantages and disadvantages
- Determine the basic fundamentals of quantum algorithms and their internal mathematics
- Examine Hilbert space of dimension 2n, *n-Qubits* states, quantum gates and their reversibility.
- Demonstrating Quantum Teleportation
- Analyze Deutsch's Algorithm, Shor's Algorithm and Grover's Algorithm
- Develop examples of applications with quantum algorithms

Module 3. Quantum Machine Learning The Artificial Intelligence (AI) of the Future

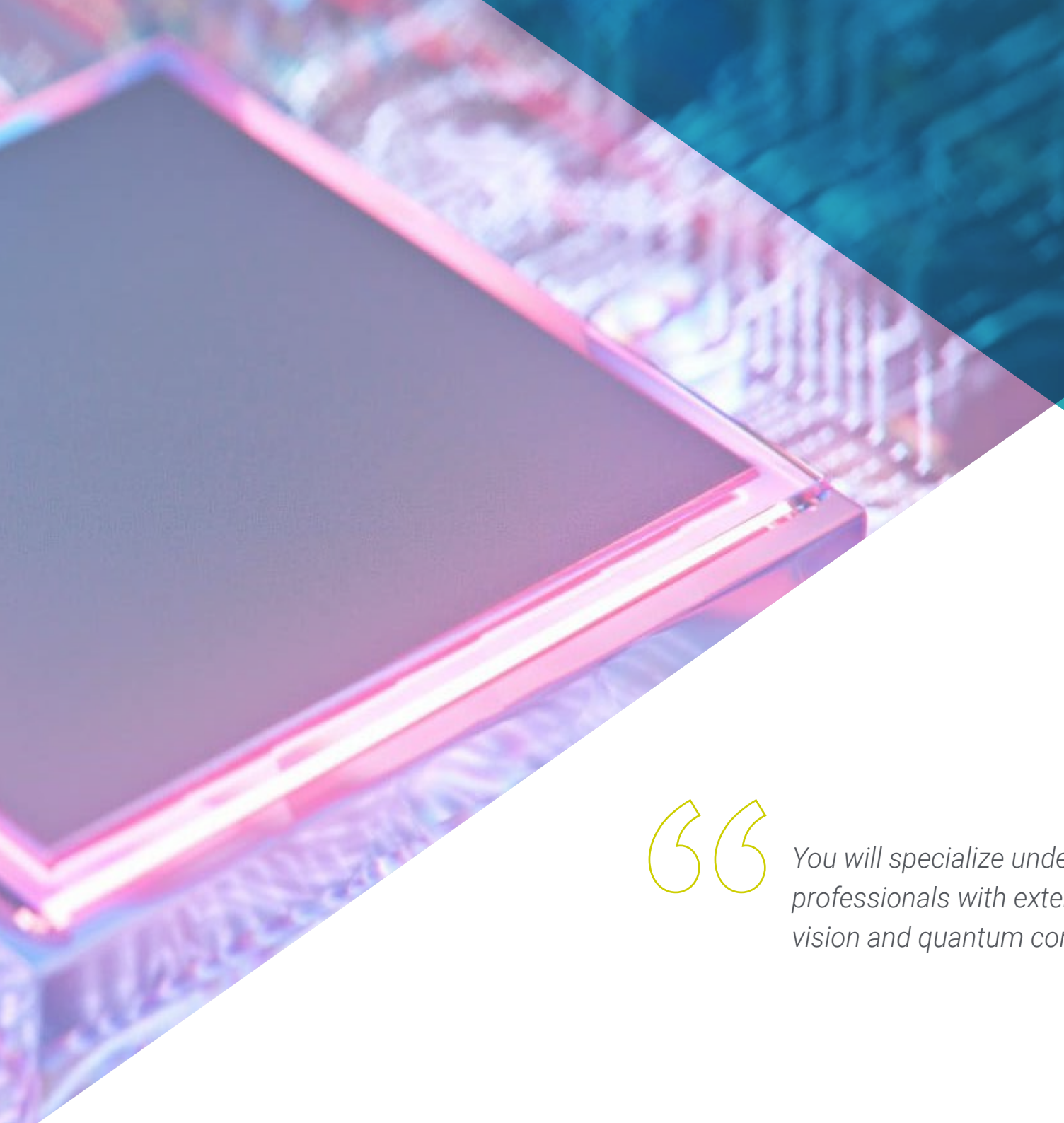
- Analyze quantum computing paradigms relevant to machine learning
- Examine the various ML algorithms available in quantum computing, both supervised and unsupervised
- Examinar los distintos algoritmos de ML disponibles en la computación cuántica, tanto supervisados como no supervisados
- Fundamentals of the use of the quantum Fourier transform in the integration of indicators for quantum ML models, as well as for feature selection
- Develop pure quantum algorithms for solving optimization problems
- Generate specialized knowledge on hybrid algorithms (quantum computation and classical computation) to solve learning problems
- Implementing learning algorithms on quantum computers
- Establish the current status of QML and its immediate future

Develop a highly specialized vision, which will allow you to focus on advanced technological projects"

03

Course Management

Renowned and highly qualified professionals with extensive experience in the sector will offer the best contents for the specialization of the graduate during their studies. The teachers of this Postgraduate Diploma will provide the keys and tools on artificial vision and quantum computing, to turn the student into an expert in the most advanced technologies and of greater application in the present and in the future.



You will specialize under the guidance of renowned professionals with extensive experience in computer vision and quantum computing"

Management

Mr. Molina Molina, Jerónimo

- He is currently leading several relevant projects in the field of Artificial Intelligence
- IA Engineer & Software Architect. NASSAT-Internet Satellite in Motion
- Sr. Consultant Hexa Ingenieros
- Expert in Artificial Intelligence based solutions
- He is currently leading several relevant projects in the field of Artificial Intelligence
- Computer Engineer (Univ. Alicante)
- University Expert in Business Creation and Development (Bancaixa-FUNDEUN Alicante)
- Computer Engineer (Univ. Alicante)
- MBA-Executive (European Business Campus Forum)
- Master's Degree in Artificial Intelligence (Universidad Católica de Ávila)

Professors

Mr. Pi Morell, Oriol

- Product Owner of Hosting and post in CDMON
- Functional Analyst and Software Engineer in different organizations such as Fihoca, Atmira, CapGemini
- Teacher of different courses such as BPM at CapGemini, ORACLE Forms CapGemini, Atmira Business Processes
- Degree in Technical Engineering in Computer Management from the Universidad Autónoma de Madrid
- Master's Degree in Artificial Intelligence
- Master's Degree in Business Administration. MBA
- Master's Degree in Information Systems Management Teaching Experience
- Postgraduate, Postgraduate Design Patterns. Open University of Catalonia

Dr. Moreno Fernández de Leceta, Aitor

- Head of the Artificial Intelligence Department at Ibermática
- Degree in Computer Engineering from the University of Deusto
- Master's Degree in Advanced Artificial Intelligence (UNED)
- Master's Degree in Advanced Artificial Intelligence (UNED)
- D. in Artificial Intelligence from the University of the Basque Country (UPV/EHU).
- Certificate in "Computational Neuroscience" (University of Washington)
- Winner Bilbao Quantum Computing Hackathon Issuing authority IBM
- Certificate in "Computational Neuroscience" (University of Washington)
- Certificate: "Quantum Computing: Theory to Simulation and Programming"


100
10
1
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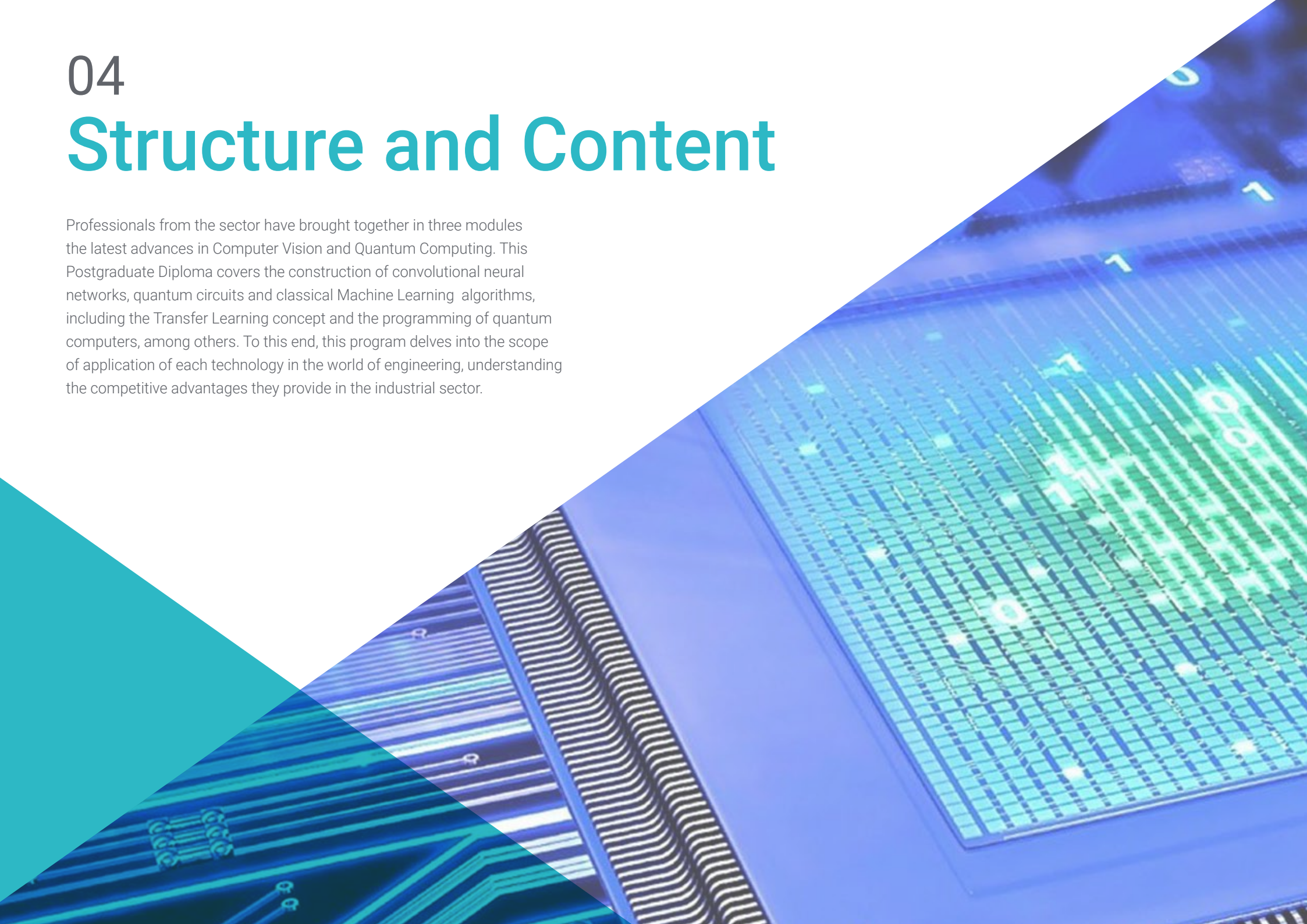
04

Structure and Content

Professionals from the sector have brought together in three modules the latest advances in Computer Vision and Quantum Computing. This Postgraduate Diploma covers the construction of convolutional neural networks, quantum circuits and classical Machine Learning algorithms, including the Transfer Learning concept and the programming of quantum computers, among others. To this end, this program delves into the scope of application of each technology in the world of engineering, understanding the competitive advantages they provide in the industrial sector.



You will have a global vision of the application of the different technologies involved in global digitalization and the ability to apply them"

Module 1. R&D+I.A. Computer Vision. Object Identification and Tracking

1.1. Computer Vision
- 1.1.1. Computer Vision
- 1.1.2. Computational Vision
- 1.1.3. Machine Interpretation of an Image

1.2. Activation Functions
- 1.2.1. Activation Functions
- 1.2.2. Sigmoid
- 1.2.3. ReLU
- 1.2.4. Hyperbolic Tangent
- 1.2.5. Softmax

1.3. Convolutional Neural Network Construction
- 1.3.1. Convolution Operation
- 1.3.2. ReLU Layer
- 1.3.3. Pooling
- 1.3.4. Flattering
- 1.3.5. Full Connection

1.4. Convolution Process
- 1.4.1. Functioning of a Convolution
- 1.4.2. Convolution Code
- 1.4.3. Convolution: Application

1.5. Transformations with Images
- 1.5.1. Transformations with Images
- 1.5.2. Advanced Transformations
- 1.5.3. Transformations with Images: Application
- 1.5.4. Transformations with Images. Use Case

1.6. Transfer Learning
- 1.6.1. Transfer Learning
- 1.6.2. Transfer Learning. Typology
- 1.6.3. Deep Networks to Apply Transfer Learning.

1.7. Computer Vision Use Case
- 1.7.1. Image Classification
- 1.7.2. Object Detection
- 1.7.3. Object Identification
- 1.7.4. Object Segmentation

1.8. Object Detection
- 1.8.1. Detection from Convolution
- 1.8.2. R-CNN, Selective Search
- 1.8.3. Fast Detection with YOLO
- 1.8.4. Other Possible Solutions

1.9. GAN Generative Adversarial Networks, or Generative Adversarial Networks
- 1.9.1. Generative Adversarial Networks
- 1.9.2. Code for a GAN
- 1.9.3. GAN Application

1.10. Computer Vision Model Application
- 1.10.1. Organization of Contents
- 1.10.2. Visual Search Engines
- 1.10.3. Facial Recognition
- 1.10.4. Augmented Reality
- 1.10.5. Autonomous Driving
- 1.10.6. Fault Identification at Each Assembly
- 1.10.7. Plague Identification
- 1.10.8. Health

Module 2. Quantum Computing A New Model of Computing

2.1. Quantum Computing
- 2.1.1. Differences with Classic Computing
- 2.1.2. Need for Quantum Computing
- 2.1.3. Quantum Computers Available: Nature and Technology

2.2. Applications of Quantum Computing
- 2.2.1. Applications of Quantum Computing vs. Classical Computing
- 2.2.2. Context of Use
- 2.2.3. Application in Real Cases

2.3. Mathematical Foundations of Quantum Computing
- 2.3.1. Computational Complexity
- 2.3.2. Double Slit Experiment Particles and Waves
- 2.3.3. Entanglement

2.4. Geometries Foundations of Quantum Computing
- 2.4.1. Qubit and Complex Two-Dimensional Hilbert Space
- 2.4.2. Dirac's General Formalism
- 2.4.3. N-Qubits States and Hilbert Space of dimension 2n

2.5. Mathematical Fundamentals Linear Algebra
- 2.5.1. The Internal Product
- 2.5.2. Hermitian Operators
- 2.5.3. Eigenvalues and Eigenvectors

2.6. Quantum Circuits
- 2.6.1. Bell States and Pauli Matrices
- 2.6.2. Quantum Logic Gates
- 2.6.3. Quantum Control Gates

2.7. Quantum Algorithms
- 2.7.1. Reversible Quantum Gates
- 2.7.2. Quantum Fourier Transform
- 2.7.3. Quantum Teleportation

2.8. Algorithms Demonstrating Quantum Supremacy
- 2.8.1. Deutsch's Algorithm
- 2.8.2. Shor's Algorithm
- 2.8.3. Grover's Algorithm

2.9. Quantum Computer Programming
- 2.9.1. My First Qiskit Program (IBM)
- 2.9.2. My First Ocean Program (Dwave)
- 2.9.3. My First Cirq Program (Google)

2.10. Application on Quantum Computers
- 2.10.1. Creating Logistic Gates
  - 2.10.1.1. Creation of a Quantum Digital Adder
- 2.10.2. Creation of Quantum Games
- 2.10.3. Secret Key Communication between Bob and Alice

Module 3. *Quantum Machine Learning* The Artificial Intelligence (AI) of the Future

3.1. Classic Machine Learning Algorithms
- 3.1.1. Descriptive, Predictive, Proactive and Prescriptive Models
- 3.1.2. Supervised and Unsupervised Models
- 3.1.3. Feature Reduction, PCA, Covariance Matrix, SVM, Neural Networks
- 3.1.4. Optimization in ML: the Gradient Descent

3.2. Classic Machine Learning Algorithms
- 3.2.1. Boltzmann Networks: The Revolution in Machine Learning
- 3.2.2. Deep Learning Models CNN, LSTM, GAN
- 3.2.3. Encoder-Decoder Models
- 3.2.4. Signal Analysis Models. Fourier Analysis.

3.3. Quantum Classifiers
- 3.3.1. Generating a Quantum Classifier
- 3.3.2. Amplitude Coding of Data in Quantum States
- 3.3.3. Encoding of Data in Quantum States by Phase/Angle
- 3.3.4. High-Level Coding

3.4. Optimization Algorithms
- 3.4.1. Quantum Approximate Optimization Algorithm (QAOA)
- 3.4.2. Variational Quantum Eigensolvers (VQE)
- 3.4.3. Quadratic Unconstrained Binary Optimization (QUBO)

3.5. Optimization Algorithms Examples:
- 3.5.1. PCA with Quantum Circuits
- 3.5.2. Optimization of Stock Packages
- 3.5.3. Optimization of Logistic Routes

3.6. Quantum Kernels Machine Learning
- 3.6.1. Variational Quantum Classifiers. QKA
- 3.6.2. Quantum Kernel Machine Learning
- 3.6.3. Classification Based on Quantum Kernel
- 3.6.4. Clustering Based on Quantum Kernel

3.7. Quantum Neural Networks
- 3.7.1. Classical Neural Networks and the Perceptron
- 3.7.2. Quantum Neural Networks and the Perceptron
- 3.7.3. Quantum Convolutional Neural Networks

3.8. Deep Learning (DL) Advanced Algorithms
- 3.8.1. Quantum Boltzmann Machines
- 3.8.2. General Adversarial Networks
- 3.8.3. Quantum Fourier Transformation, Quantum Phase Estimation and Quantum Matrix

3.9. Machine Learning Use Case
- 3.9.1. Experimentation with VQC (Variational Quantum Classifier)
- 3.9.2. Experimentation with Quantum Neural Networks
- 3.9.3. Experimentation with qGANS

3.10. Quantum Computing and Artificial Intelligence
- 3.10.1. Quantum Capacity in ML Models
- 3.10.2. Quantum Knowledge Graphs
- 3.10.3. The Future of Quantum Artificial Intelligence

You are in front of the best degree to learn about the latest advances in Computer Vision and Quantum Computing"

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.

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.

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

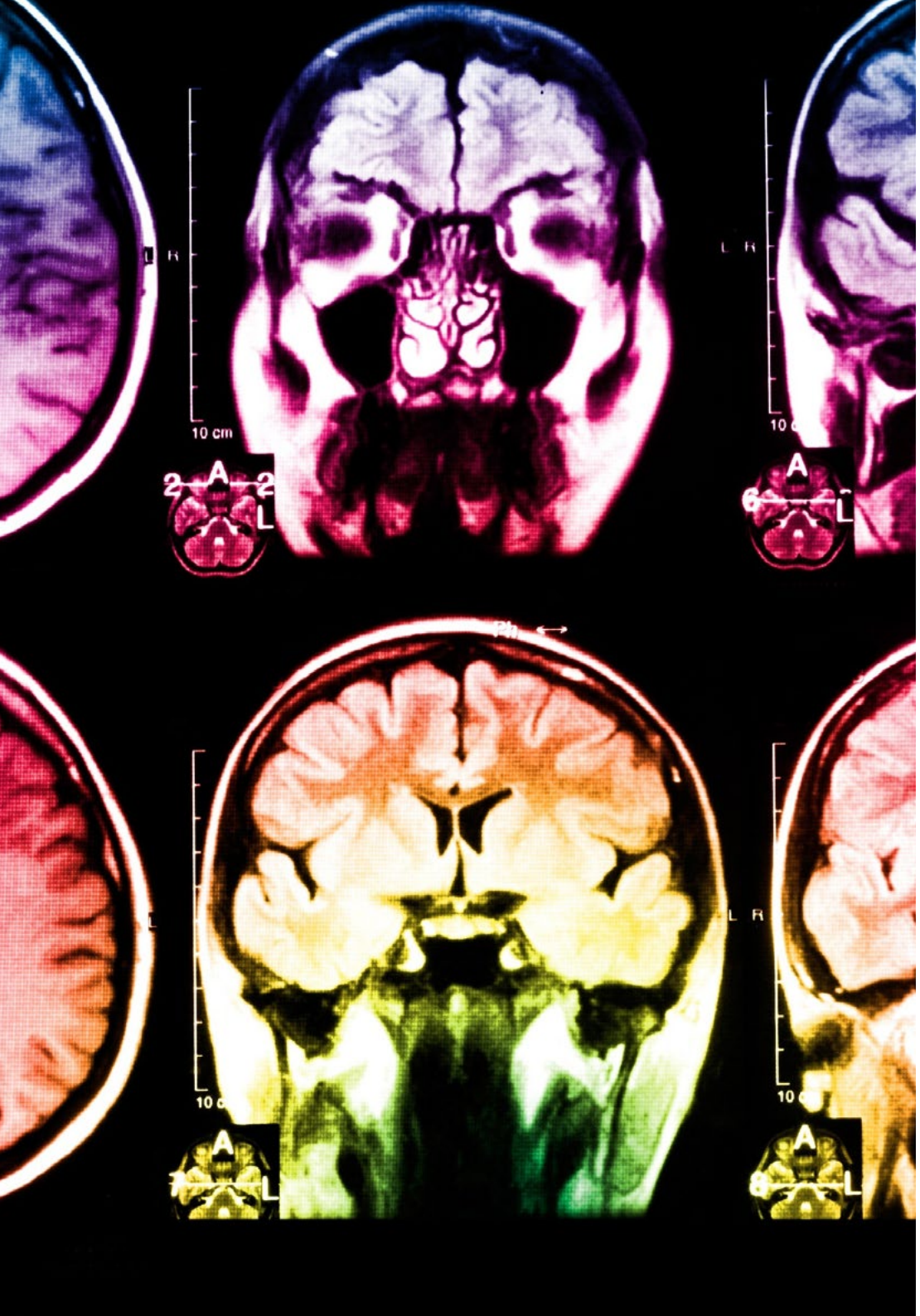
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines different teaching elements in each lesson.

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.

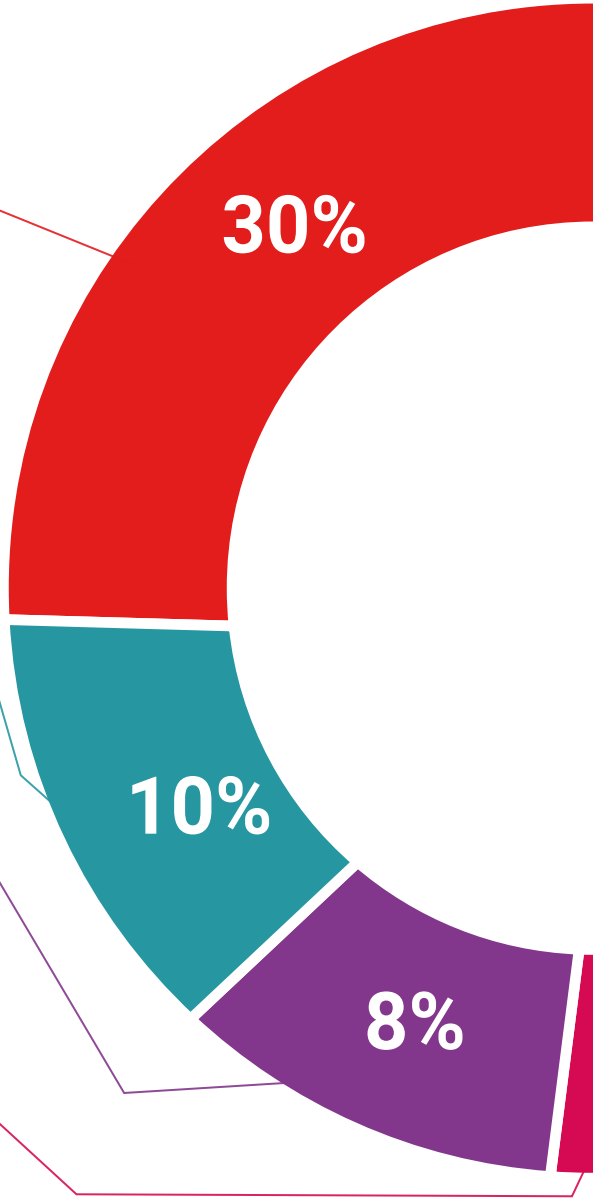
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

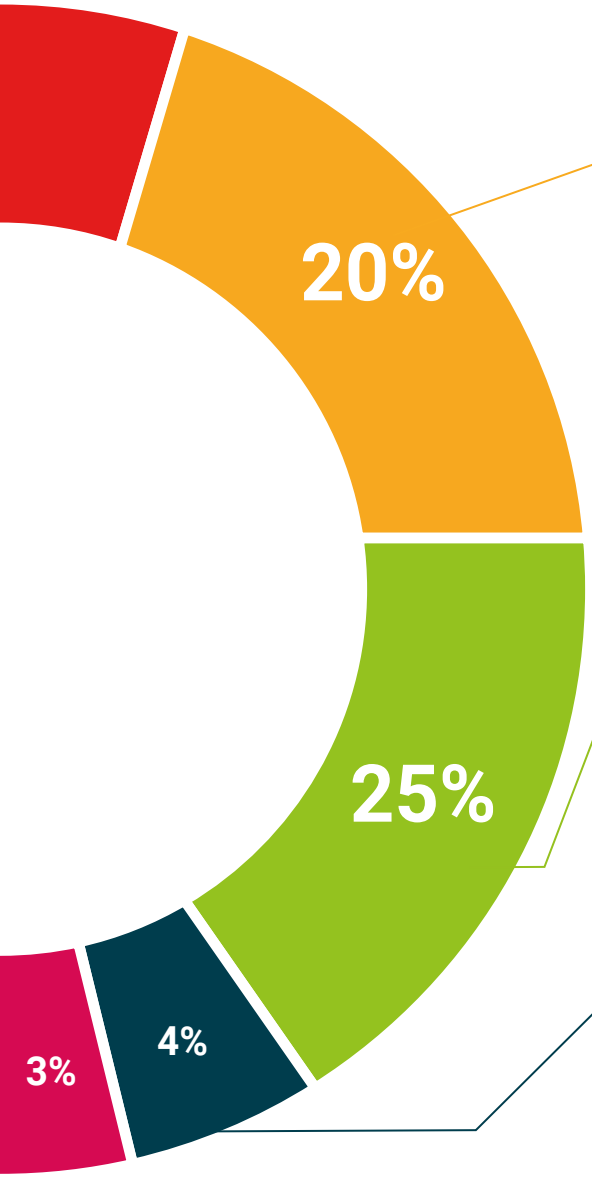
Practising Skills and Abilities

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 Diploma in Artificial Vision and Quantum Computing guarantees, in addition to the most rigorous and up-to-date training, access to a Postgraduate Diploma issued by TECH Technological University.

Successfully complete this training program and receive your diploma without travel or laborious paperwork"

This **Postgraduate Diploma in Computer Vision and Quantum Computing** is the most comprehensive and up-to-date program on the market.

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

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

Title: **Postgraduate Diploma in Computer Vision and Quantum Computing**

Official Nº of Hours: **450 h.**


tech technological university

Awards the following

DIPLOMA

to

Mr./Ms. _____, with identification number _____.

For having passed and accredited the following program

POSTGRADUATE DIPLOMA

in

Computer Vision and Quantum Computing

This is a qualification awarded by this University, equivalent to 450 hours, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH is a Private Institution of Higher Education recognized by the Ministry of Public Education as of June 28, 2018.

June 17, 2020

Tere Guevara Navarro

Dean

This qualification must always be accompanied by the university degree issued by the competent authority to practice professionally in each country. Unique TECH Code: AFWORD23S techtitute.com/certificates

*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.

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