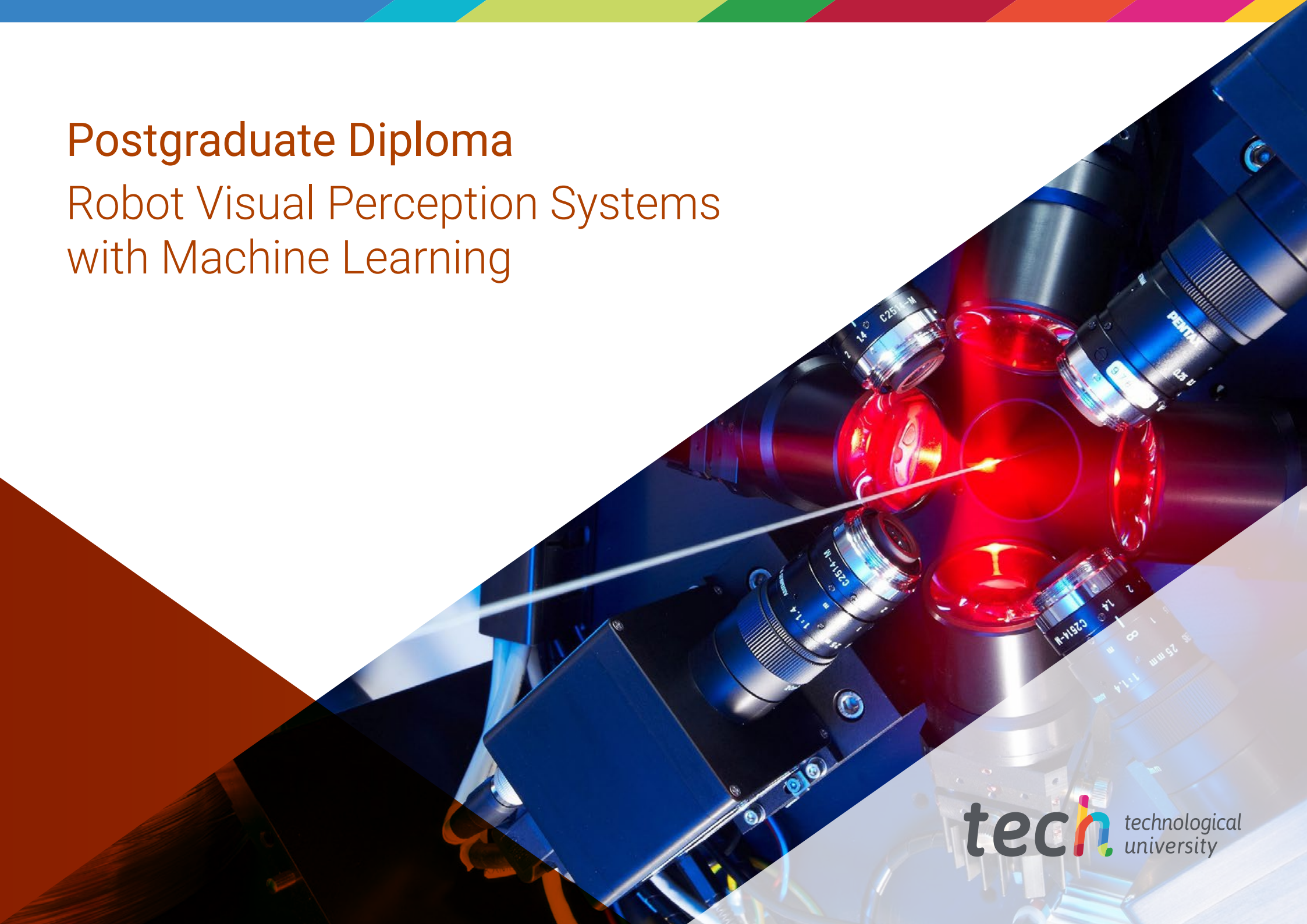
Postgraduate Diploma

Robot Visual Perception Systems with Machine Learning



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Postgraduate Diploma
Robot Visual Perception Systems with Machine Learning

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

Website: **www.techtitute.com/in/engineering/postgraduate-diploma/postgraduate-diploma-robot-visual-perception-systems-machine-learning**

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01

Introduction

The progressive advance of technology has made Robotics part of the daily life of human beings, being sometimes imperceptible the great progress that Robotics has meant in people's lives. Autonomous robots have obtained a great advantage, but their development requires extensive knowledge where the engineer is one of the key pieces in its creation. This 100% online program offers students an extensive learning about the complexity of algorithms in artificial intelligence, mobility and autonomy of machines. All this with a Relearning methodology and a library of multimedia resources that facilitate the solid foundation of concepts.

Be the expert Robotics Engineer that every company wants to have in its team. Enroll now"

Any autonomous robot capable of navigating must provide the mechanisms that provide answers to fundamental questions such as: Where am I, where do I want to go, and how do I get there? This Postgraduate Diploma provides engineers with the knowledge and current technological tools used to answer these questions and propel career in this field.

Due to the high capabilities and complexity of artificial intelligence algorithms, it is essential to master this subject in order to successfully deal with this technology. The specialized teaching team in charge of providing this education will accompany students in this journey to achieve their professional goals with solvency.

This program, taught entirely in online mode, will cover one of the key aspects in the field of robot autonomy, artificial vision. The different architectures, uses of deep neural networks and 2D and 3D vision problems will be covered in this Postgraduate Diploma.

An excellent opportunity for the engineering professionals who want to specialize in a booming industry with a wide range of job opportunities. All of this with a learning system that facilitates the acquisition of a specialization without neglecting personal responsibilities thanks to the absence of fixed schedules to access all the content of the program. Thus, students only need an electronic device with internet connection to access the platform and start at any time of the day.in a program that will boost their career.

This **Postgraduate Diploma in Visual Perception Systems with Automatic Learning** contains the most complete and up-to-date program on the market. The most important features include:

- Development of case studies presented by experts in robotic engineering
- The graphic, schematic, and practical contents with which they are created, provide scientific and practical information on the disciplines that are essential for professional practice
- Practical exercises where self-assessment can be used 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

Specialize and succeed in the Robotics industry. Take the step and sign up”

You have the opportunity to advance in a booming field. Enroll and perfect your knowledge in Artificial Intelligence"

The multimedia resource library of this Postgraduate Diploma provides you with a cutting-edge and highly useful content for your career.

Acquire learning that will lead to the optimal deployment of Neural Networks in Real Applications.

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

Its 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 an immersive education programmed to learn in real situations.

The design of this program focuses on Problem-Based Learning, by means of which the professionals must try to solve the different professional practice situations that are presented throughout the program. For this purpose, the student will be assisted by an innovative interactive video system created by renowned experts.

02

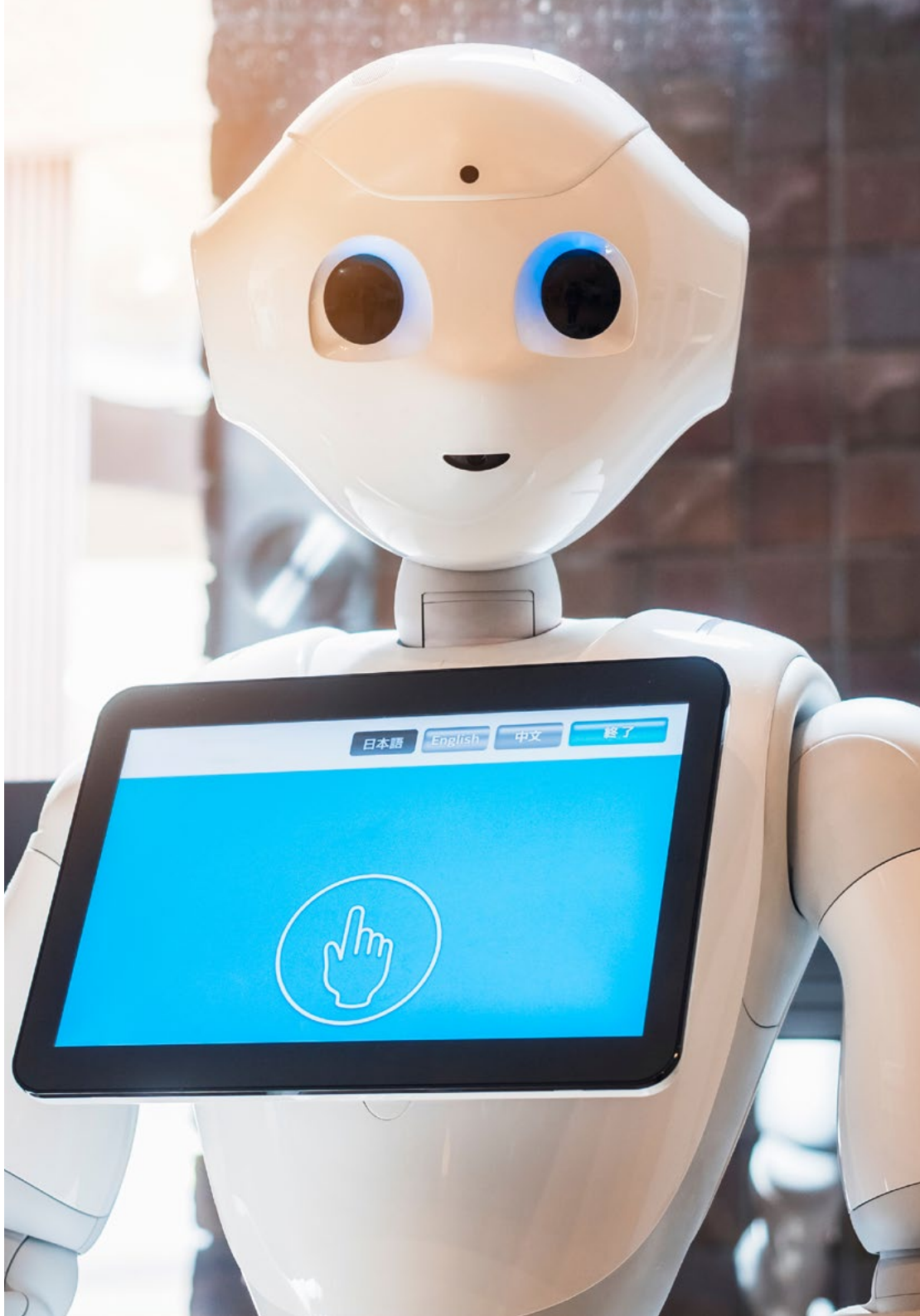
Objectives

This Postgraduate Diploma provides students during the 6 months of duration an online education that will allow them to specialize in an area where they will be able to develop concrete implementations of artificial intelligence algorithms, apply visual information processing tools or develop the mathematical foundations for kinematic and dynamic modeling of robots. All this thanks to an extensive library of multimedia resources and essential readings to fully master this topic.

Thanks to the simulations of real cases you will acquire useful knowledge to put into practice with your next project in Robotics"

General Objectives

- Understand the mathematical foundations for kinematic and dynamic modeling of robots
- Delve into the use of specific technologies for the creation of robot architectures, robot modeling and simulation
- Generate specialized knowledge on Artificial Intelligence
- Develop the technologies and devices most commonly used in industrial automation
- Identify the limits of current techniques to identify bottlenecks in robotic applications



Specific Objectives

Module 1. Intelligent Agents Applying Artificial Intelligence to Robots and Softbots

- Analyze the biological inspiration of Artificial Intelligence and intelligent agents
- Assess the need for intelligent algorithms in today's society
- Determine the applications of advanced Artificial Intelligence techniques on Intelligent Agents
- Demonstrate the strong connection between Robotics and Artificial Intelligence
- Establish the needs and challenges presented by Robotics that can be solved with Intelligent Algorithms
- Develop concrete implementations of Artificial Intelligence Algorithms
- Identify Artificial Intelligence algorithms that are established in today's society and their impact on daily life

Module 2. Artificial Vision Techniques in Robotics: Image Processing and Analysis

- Analyze and understand the importance of vision systems in robotics.
- Establish the characteristics of the different perception sensors in order to choose the most appropriate ones according to the application
- Determine the techniques for extracting information from sensor data
- Apply visual information processing tools
- Design digital image processing algorithms
- Analyze and predict the effect of parameter changes on algorithm performance
- Assess and validate the developed algorithms in terms of results

Module 3. Robot Visual Perception Systems with Machine Learning

- Master the machine learning techniques most widely used today in academia and industry
- Delve into the architectures of neural networks to apply them effectively in real problems
- Reuse existing neural networks in new applications using transfer learning
- Identify new fields of application of generative neural networks
- Analyze the use of learning techniques in other fields of robotics such as localization and mapping
- Develop current technologies in the cloud to develop neural network-based technologies
- Examine the deployment of vision learning systems in real and embedded systems

Access to the most widely used machine learning techniques applied in the industry today"

03

Course Management

TECH maintains a quality education, within everyone's reach, in all its programs. To do this, it carefully selects the teachers who teach them. Thus, the students in this program have a team of professional engineers with extensive experience in the field of Robotics. The knowledge that they impart in the 450 teaching hours of this Postgraduate Diploma will be of great use and application for students who are looking for a job projection in this field.

Advance in your career with a teaching team that will provide you with all their experience in the field of Robotics"

Management

Dr. Ramón Fabresse, Felipe

- Senior Software Engineer at Acurable
- NLP Software Engineer at Intel Corporation
- Software Engineer in CATEC, Indisys
- Researcher in Aerial Robotics at the University of Seville
- PhD Cum Laude in Robotics, Autonomous Systems and Telerobotics at the University of Seville
- Degree in Computer Engineering at the University of Seville
- Professional Master's Degree in Robotics, Automation and Telematics at the University of Seville

Professors

Mr. Campos Ortiz, Roberto

- Software Engineer Quasar Scence Resources
- Software Engineer at the European Space Agency (ESA-ESAC) for the Solar Orbiter mission
- Content creator and Artificial Intelligence expert in the course: "Artificial Intelligence: The technology of the present-future" for the Andalusian Regional Government. Euroformac Group
- Quantum Computing Scientist Zapata Computing Inc
- Graduated in Computer Engineering at Carlos III University
- Master's Degree in Computer Science and Technology at Carlos III University

Dr. Ramon Soria, Pablo

- Computational Vision Engineer at Meta
- Applied Science Team Leader and Senior Software Engineer at Vertical Engineering Solutions
- CEO and founder of Domocracy
- ACFR Researcher (Australia)
- Researcher in the GRIFFIN and HYFLIERS projects at the University of Seville
- PhD in Computational Vision for Robotics at the University of Seville

Dr. Pérez Grau, Francisco Javier

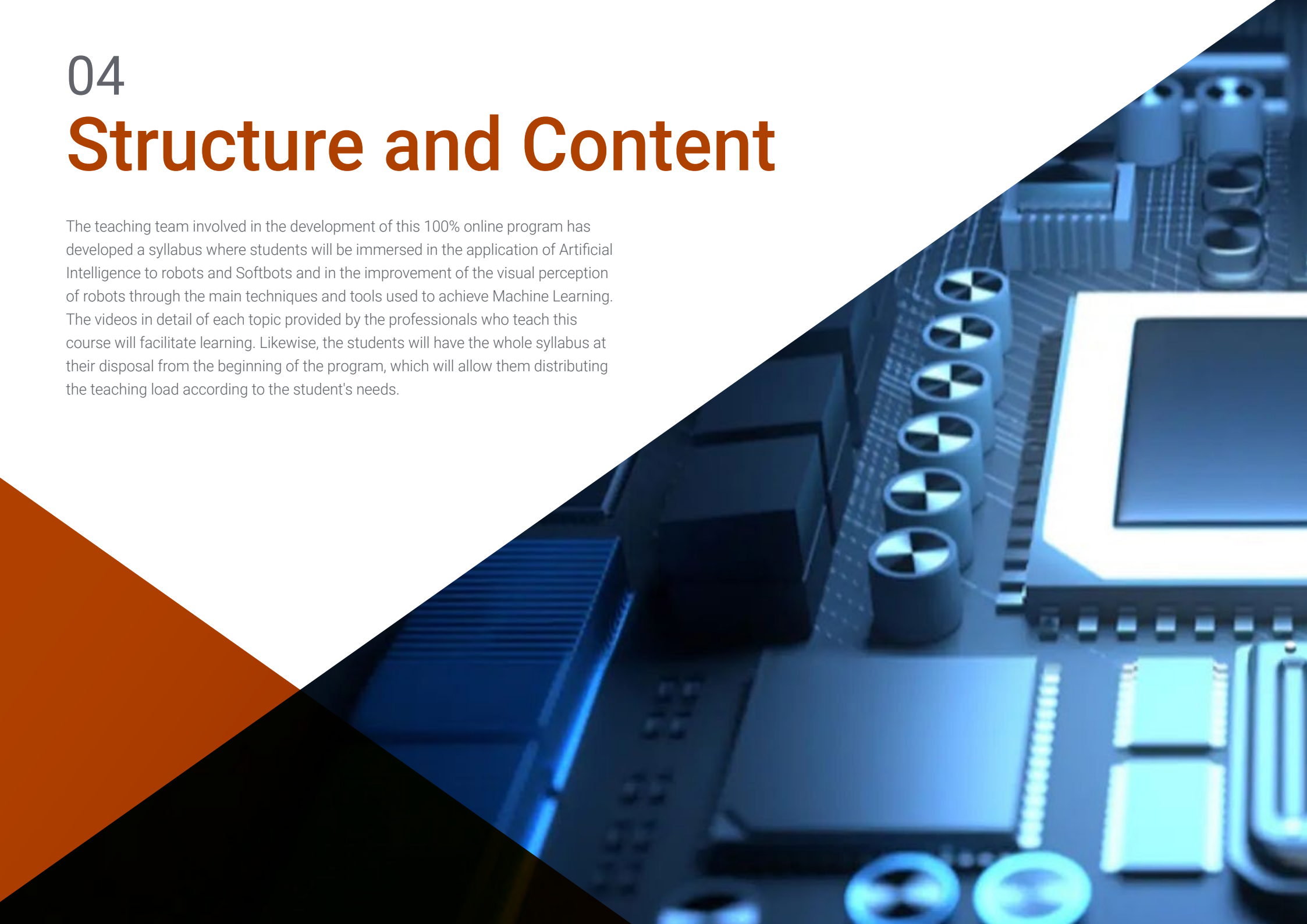
- Head of the Perception and Software Unit at CATEC
- R&D Project Manager at CATEC
- R&D Project Engineer at CATEC
- Associate Professor at the University of Cadiz.
- Associate Professor at the University International of Andalucia
- Researcher in the Robotics and Perception group at the University of Zurich
- Researcher at the Australian Centre for Field Robotics at the University of Sydney
- PhD in Robotics and Autonomous Systems from the University of Seville
- Graduate in Telecommunications Engineering and Computer and Network Engineering from the University of Seville

Take the opportunity to learn about the latest advances in this field in order to apply it to your daily practice"

04

Structure and Content

The teaching team involved in the development of this 100% online program has developed a syllabus where students will be immersed in the application of Artificial Intelligence to robots and Softbots and in the improvement of the visual perception of robots through the main techniques and tools used to achieve Machine Learning. The videos in detail of each topic provided by the professionals who teach this course will facilitate learning. Likewise, the students will have the whole syllabus at their disposal from the beginning of the program, which will allow them distributing the teaching load according to the student's needs.



Enroll now and learn in this Postgraduate Diploma with the best specialists in Robotics”

Module 1. Intelligent Agents. Application of Artificial Intelligence to Robots and Softbots

1.1. Intelligent Agents and Artificial Intelligence
- 1.1.1. Intelligent Robots. Artificial Intelligence
- 1.1.2. Intelligent Agents
  - 1.1.2.1. Hardware Agents. Robots
  - 1.1.2.2. Software Agents. Softbots
- 1.1.3. Robotics Applications

1.2. Brain-Algorithm Connection
- 1.2.1. Biological Inspiration of Artificial Intelligence
- 1.2.2. Reasoning Implemented in Algorithms. Typology
- 1.2.3. Presentability of Results in Artificial Intelligence Algorithms
- 1.2.4. Evolution of Algorithms up to Deep Learning

1.3. Search Algorithms in the Solution Space
- 1.3.1. Elements in Solution Space Searches
- 1.3.2. Solution Search Algorithms in Artificial Intelligence Problems
- 1.3.3. Applications of Search and Optimization Algorithms
- 1.3.4. Search Algorithms Applied to Machine Learning

1.4. Machine Learning
- 1.4.1. Machine Learning
- 1.4.2. Supervised Learning Algorithms
- 1.4.3. Unsupervised Learning Algorithms
- 1.4.4. Reinforcement Learning Algorithms

1.5. Supervised Learning
- 1.5.1. Supervised Learning Methods
- 1.5.2. Decision Trees for Classification
- 1.5.3. Support Vector Machines
- 1.5.4. Artificial Neural Networks
- 1.5.5. Applications of Supervised Learning

1.6. Unsupervised Learning
- 1.6.1. Unsupervised Learning
- 1.6.2. Kohonen Networks
- 1.6.3. Self-Organizing Maps
- 1.6.4. K-Means Algorithm

1.7. Reinforcement Learning
- 1.7.1. Reinforcement Learning
- 1.7.2. Agents Based on Markov Processes
- 1.7.3. Reinforcement Learning Algorithms
- 1.7.4. Reinforcement Learning Applied to Robotics

1.8. Artificial Neural Networks and Deep Learning
- 1.8.1. Artificial Neural Networks. Typology
- 1.8.2. Applications of Neural Networks
- 1.8.3. Transformation from Machine Learning to Deep Learning
- 1.8.4. Deep Learning Applications

1.9. Probabilistic Inference
- 1.9.1. Probabilistic Inference
- 1.9.2. Types of Inference and Method Definition
- 1.9.3. Bayesian Inference as a Case Study
- 1.9.4. Nonparametric Inference Techniques
- 1.9.5. Gaussian Filters

1.10. From Theory to Practice: Developing an Intelligent Robotic Agent
- 1.10.1. Inclusion of Supervised Learning Modules in a Robotic Agent
- 1.10.2. Inclusion of Reinforcement Learning Modules in a Robotic Agent
- 1.10.3. Architecture of a Robotic Agent Controlled by Artificial Intelligence
- 1.10.4. Professional Tools for the Implementation of the Intelligent Agent
- 1.10.5. Phases of the Implementation of AI Algorithms in Robotic Agents

Module 2. Artificial Vision Techniques in Robotics: Image Processing and Analysis

2.1. Computer Vision
- 2.1.1. Computer Vision
- 2.1.2. Elements of a Computer Vision System
- 2.1.3. Mathematical Tools

2.2. Optical Sensors for Robotics
- 2.2.1. Passive Optical Sensors
- 2.2.2. Active Optical Sensors
- 2.2.3. Non-Optical Sensors

2.3. Image Acquisition
- 2.3.1. Image Representation
- 2.3.2. Color Space
- 2.3.3. Digitizing Process

2.4. Image Geometry
- 2.4.1. Lens Models
- 2.4.2. Camera Models
- 2.4.3. Camera Calibration

2.5. Mathematical Tools
- 2.5.1. Histogram of an Image
- 2.5.2. Convolution
- 2.5.3. Fourier Transform

2.6. Image Preprocessing
- 2.6.1. Noise Analysis
- 2.6.2. Image Smoothing
- 2.6.3. Image Enhancement

2.7. Image Segmentation
- 2.7.1. Contour-Based Techniques
- 2.7.2. Histogram-Based Techniques
- 2.7.3. Morphological Operations

2.8. Image Feature Detection
- 2.8.1. Point of Interest Detection
- 2.8.2. Feature Descriptors
- 2.8.3. Feature Matching

2.9. 3D Vision Systems
- 2.9.1. 3D Perception
- 2.9.2. Feature Matching between Images
- 2.9.3. Multiple View Geometry

2.10. Computer Vision based Localization
- 2.10.1. The Robot Localization Problem
- 2.10.2. Visual Odometry
- 2.10.3. Sensory Fusion

Module 3. Robot Visual Perception Systems with Machine Learning

3.1. Unsupervised Learning Methods applied to Computer Vision
- 3.1.1. Clustering
- 3.1.2. PCA
- 3.1.3. Nearest Neighbors
- 3.1.4. Similarity and Matrix Decomposition

3.2. Supervised Learning Methods Applied to Artificial Vision
- 3.2.1. "Bag of Words" Concept
- 3.2.2. Support Vector Machine
- 3.2.3. Latent Dirichlet Allocation
- 3.2.4. Neural Networks

3.3. Deep Neural Networks: Structures, Backbones and Transfer Learning
- 3.3.1. Feature Generating Layers
  - 3.3.1.1. VGG
  - 3.3.1.2. Densenet
  - 3.3.1.3. ResNet
  - 3.3.1.4. Inception
  - 3.3.1.5. GoogLeNet
- 3.3.2. Transfer Learning
- 3.3.3. The Data Preparation for Training

3.4. Artificial Vision with Deep Learning I: Detection and Segmentation
- 3.4.1. YOLO and SSD Differences and Similarities
- 3.4.2. Unet
- 3.4.3. Other Structures

3.5. Computer Vision with Deep Learning II: Generative Adversarial Networks
- 3.5.1. Image Super-Resolution Using GAN
- 3.5.2. Creation of Realistic Images
- 3.5.3. Scene Understanding

3.6. Learning Techniques for Localization and Mapping in Mobile Robotics
- 3.6.1. Loop Closure Detection and Relocation
- 3.6.2. Magic Leap. Super Point and Super Glue
- 3.6.3. Depth from Monocular

3.7. Bayesian Inference and 3D Modeling
- 3.7.1. Bayesian Models and "Classical" Learning
- 3.7.2. Implicit Surfaces with Gaussian Processes (GPIS)
- 3.7.3. 3D Segmentation Using GPIS
- 3.7.4. Neural Networks for 3D Surface Modeling

3.8. End-to-End Applications of Deep Neural Networks
- 3.8.1. End-to-End System. Example of Person Identification
- 3.8.2. Object Manipulation with Visual Sensors
- 3.8.3. Motion Generation and Planning with Visual Sensors

3.9. Cloud Technologies to Accelerate the Development of Deep Learning Algorithms
- 3.9.1. Use of GPUs for Deep Learning
- 3.9.2. Agile Development with Google Colab
- 3.9.3. Remote GPUs, Google Cloud and AWS

3.10. Deployment of Neural Networks in Real Applications
- 3.10.1. Embedded Systems
- 3.10.2. Deployment of Neural Networks. Use
- 3.10.3. Network Optimizations in Deployment, Example with TensorRT.

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 is the most widely used learning system in the best faculties in the world. 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 program, the studies 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

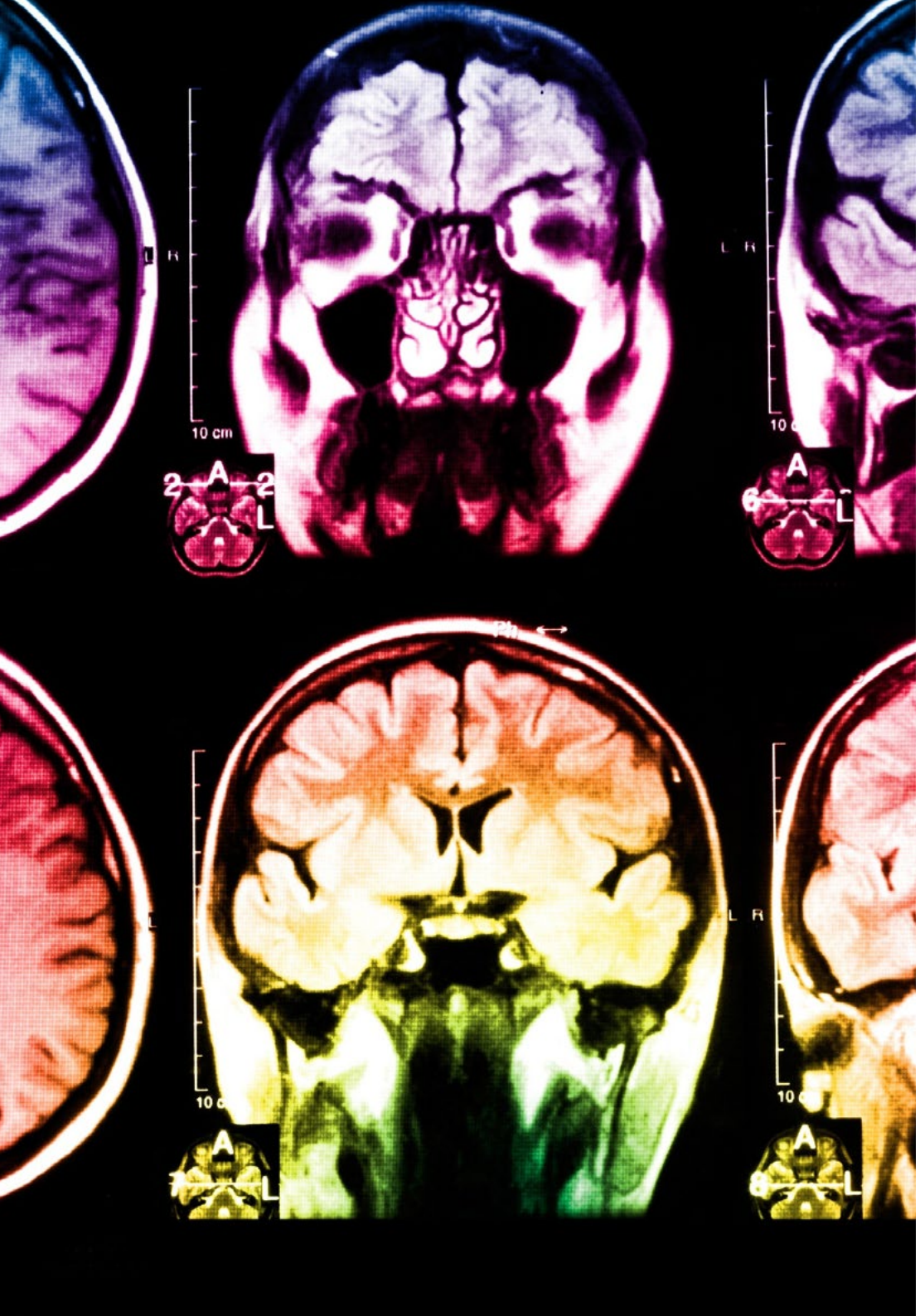
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

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.

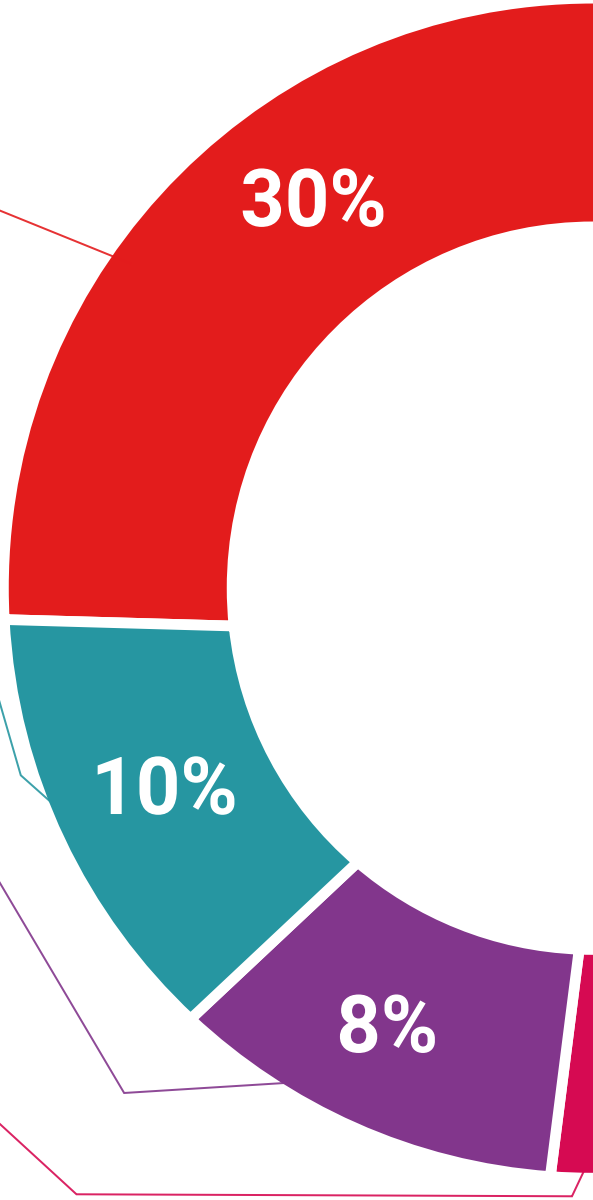
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

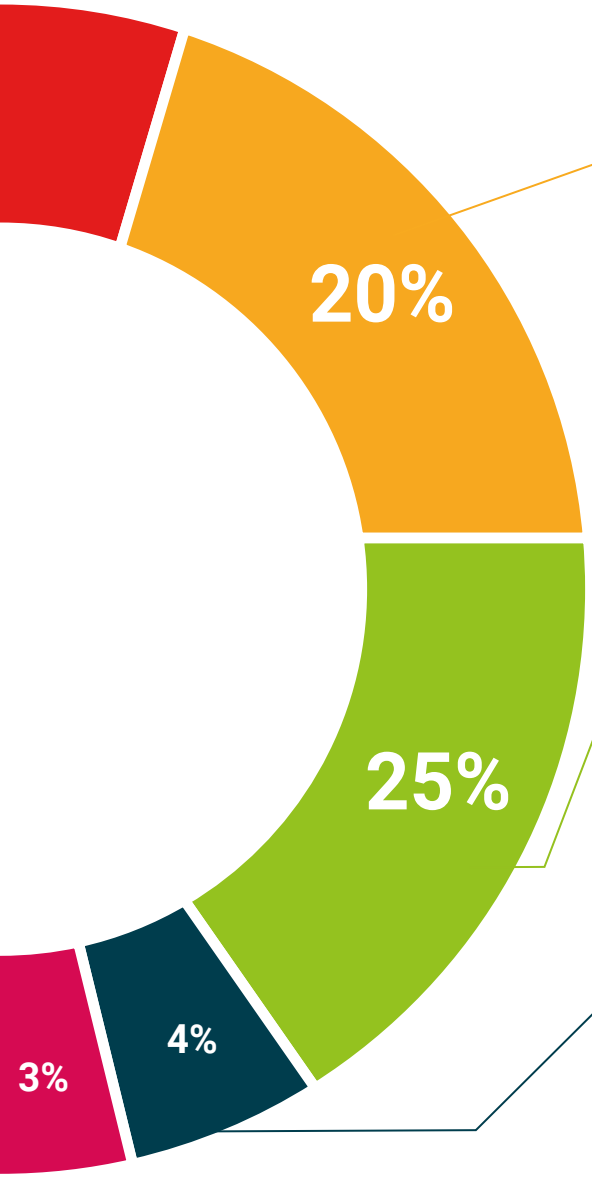
Practising Skills and Abilities

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 Robot Visual Perception Systems with Automatic Learning guarantees students, in addition to the most rigorous and up-to-date education, access to a Postgraduate Diploma issued by TECH Technological University.

Successfully complete this program and receive your Postgraduate Diploma without having to travel or fill out laborious paperwork"

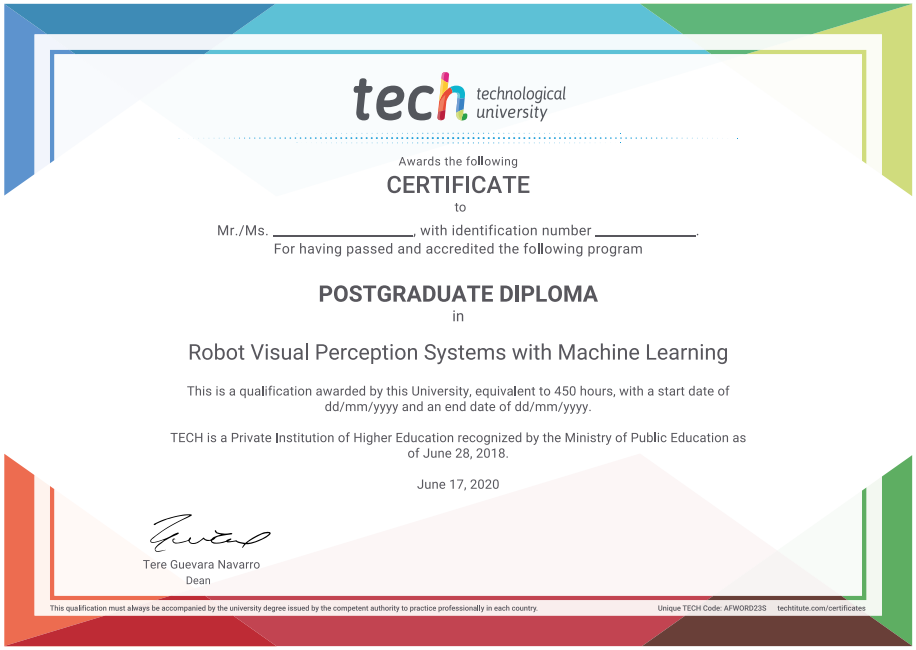
This **Postgraduate Diploma in Robot Visual Perception Systems with Machine Learning** contains the most complete and up-to-date program on the market.

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

The certificate 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 Robot Visual Perception Systems with Machine Learning**

Official Nº of hours: **450 h.**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Awards the following

CERTIFICATE

to

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

For having passed and accredited the following program

POSTGRADUATE DIPLOMA

in

Robot Visual Perception Systems with Machine Learning

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 certificate issued with an apostille, TECH EDUCATION will make the necessary arrangements to obtain it, at an additional cost.

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