



## Postgraduate Diploma Robot Visual Perception Systems with Machine Learning

» Modality: online

» Duration: 6 months

» Certificate: TECH Global University

» Credits: 18 ECTS

» Schedule: at your own pace

» Exams: online

We b site: www.techtitute.com/us/engineering/postgraduate-diploma/postgraduate-diploma-robot-visual-perception-systems-machine-learning.

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### tech 06 | Introduction

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





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

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.

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.





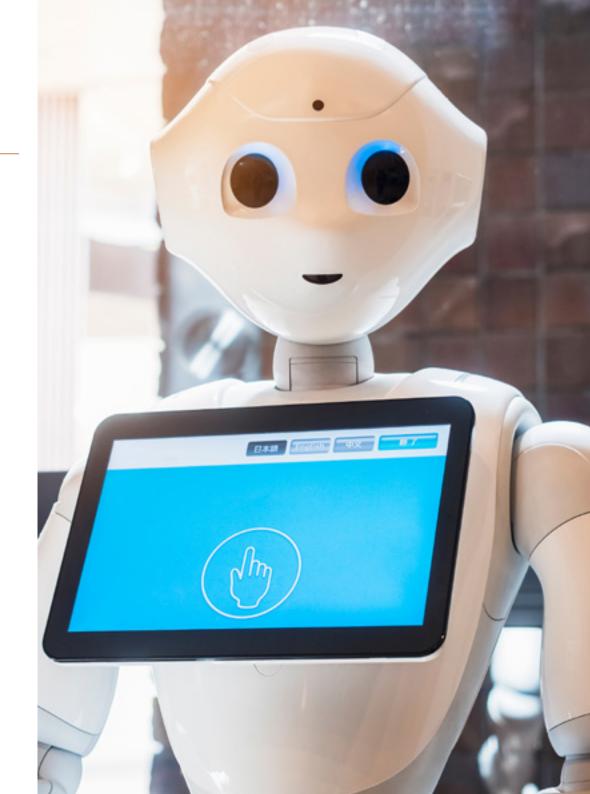


## tech 10 | Objectives



### **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"





#### **International Guest Director**

Seshu Motamarri is an expert in automation and robotics with more than 20 years of experience in various industries such as e-commerce, automotive, oil and gas, food and pharmaceutical. Throughout his career, he has specialized in engineering management and innovation and in the implementation of new technologies, always looking for scalable and efficient solutions. He has also made important contributions in the introduction of products and solutions that optimize both safety and productivity in complex industrial environments.

He has also held key positions, including Senior Director of Automation and Robotics at 3M, where he leads cross-functional teams to develop and implement advanced automation solutions. At Amazon, his role as Technical Lead led him to manage projects that significantly improved the global supply chain, such as the "SmartPac" semi-automated bagging system and the robotic smart picking and stowage solution. His skills in project management, operational planning and product development have enabled him to generate great results in large-scale projects.

Internationally, he is recognized for his achievements in IT. He has been awarded the prestigious Amazon Door Desk Award by Jeff Bezos, and has received the Excellence in Manufacturing Safety Award, reflecting his hands-on engineering approach. In addition, he has been a "Bar Raiser" at Amazon, participating in over 100 interviews as an objective evaluator in the hiring process.

In addition, he has several patents and publications in electrical engineering and functional safety, reinforcing his impact on the development of advanced technologies. His projects have been implemented globally, with highlights in regions such as North America, Europe, Japan and India, where he has driven the adoption of sustainable solutions in the industrial and e-commerce sectors.



### Mr. Motamarri, Seshu

- Senior Director of Global Manufacturing Technology at 3M, Arkansas, United States
- Director of Automation and Robotics at Tyson Foods
- Hardware Development Manager III at Amazon
- Automation Leader at Corning Incorporated
- Founder and member of Quest Automation LLC
- Master of Science (MS), Electrical and Electronics Engineering at University of Houston
- Bachelor of Engineering (B.E.), Electrical and Electronics Engineering, University of Andhra
- Certification in Machinery, TÜV Rheinland Group



Thanks to TECH, you will be able to learn with the best professionals in the world"

### 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. Pérez Grau, Francisco Javier

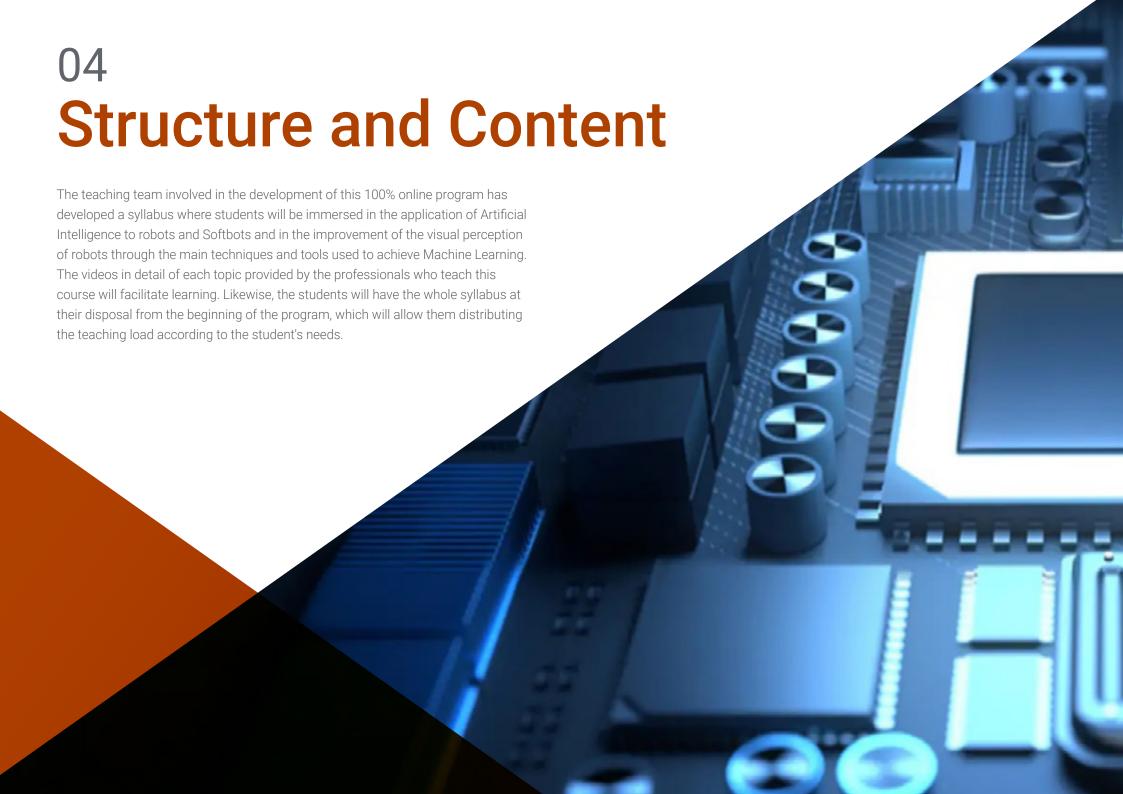
- Head of the Perception and Software Unit at CATEC
- R&D Project Manager at CATEC
- R&D Project Engineer at CATEC
- Associate Professor at the University of Cadiz.
- Associate Professor at the University International of Andalucia
- Researcher in the Robotics and Perception group at the University of 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

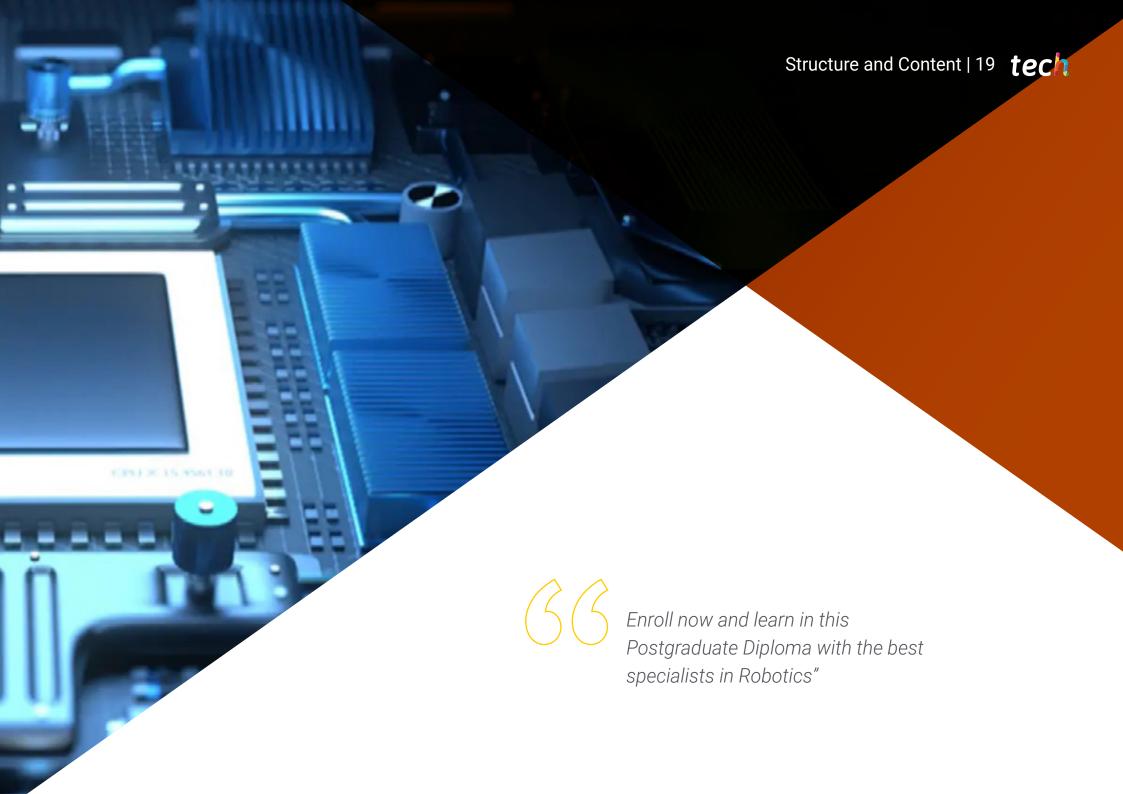






Take the opportunity to learn about the latest advances in this field in order to apply it to your daily practice"





### tech 20 | Structure and Content

## **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





### Structure and Content | 21 tech

- 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

### tech 22 | Structure and Content

#### **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

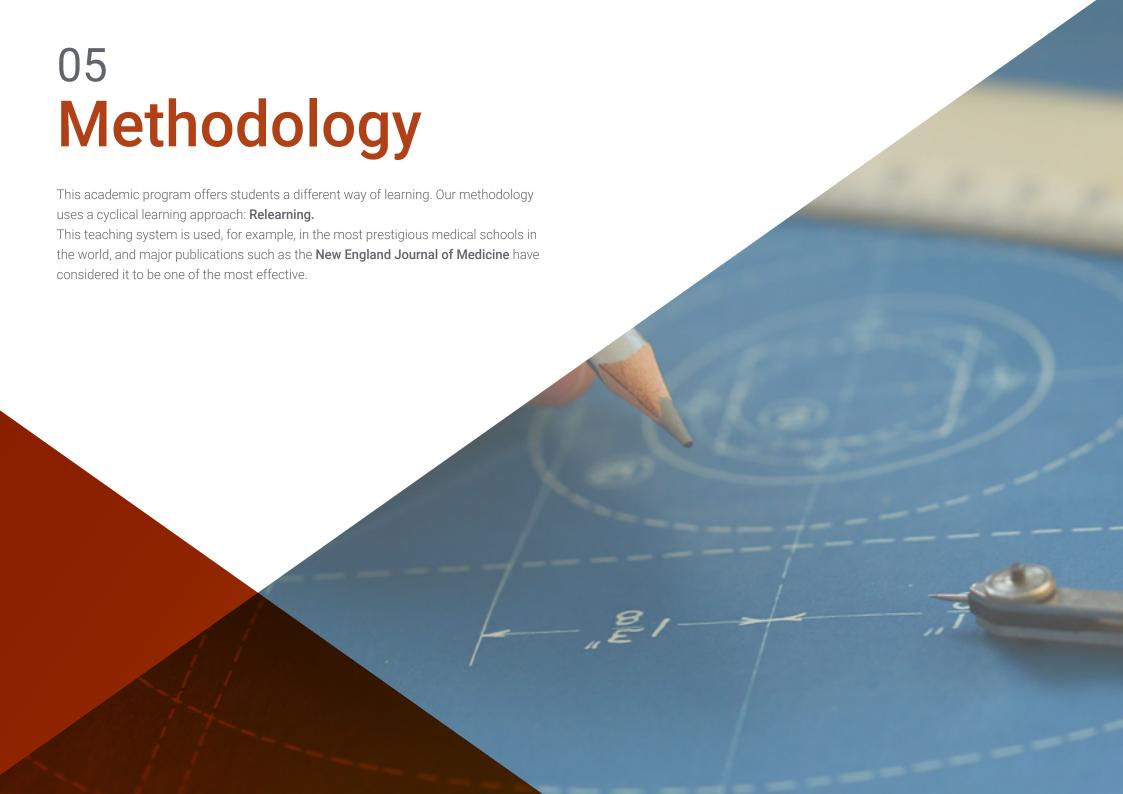
### Module 3. Robot Visual Perception Systems with Machine Learning

- 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



### Structure and Content | 23 tech

- 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.





### tech 26 | Methodology

### 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.

### Methodology | 27 tech



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.

### tech 28 | Methodology

### 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.

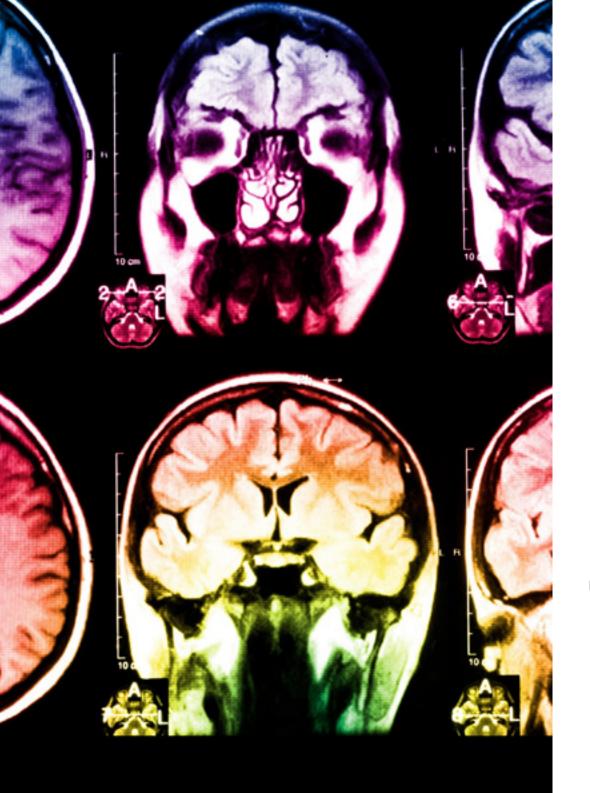
We enhance the Case Study with the best 100% online teaching method: Relearning.

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.





### Methodology | 29 tech

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.





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.

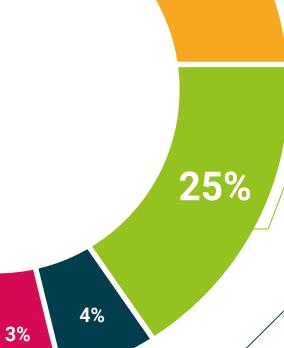


This exclusive educational system for presenting multimedia content was awarded by Microsoft as a "European Success Story".

### **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.





20%





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This program will allow you to obtain your **Postgraduate Diploma in Robot Visual Perception Systems with Machine Learning** endorsed by **TECH Global University**, the world's largest online university.

**TECH Global University** is an official European University publicly recognized by the Government of Andorra (*official bulletin*). Andorra is part of the European Higher Education Area (EHEA) since 2003. The EHEA is an initiative promoted by the European Union that aims to organize the international training framework and harmonize the higher education systems of the member countries of this space. The project promotes common values, the implementation of collaborative tools and strengthening its quality assurance mechanisms to enhance collaboration and mobility among students, researchers and academics.

This **TECH Global University** title is a European program of continuing education and professional updating that guarantees the acquisition of competencies in its area of knowledge, providing a high curricular value to the student who completes the program.

Title: Postgraduate Diploma in Robot Visual Perception Systems with Machine Learning

Modality: online

Duration: 6 months

Accreditation: 18 ECTS



Mr./Ms. \_\_\_\_\_, with identification document \_\_\_\_\_ has successfully passed and obtained the title of:

#### Postgraduate Diploma in Robot Visual Perception Systems with Machine Learning

This is a program of 450 hours of duration equivalent to 18 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH Global University is a university officially recognized by the Government of Andorra on the 31st of January of 2024, which belongs to the European Higher Education Area (EHEA).

In Andorra la Vella, on the 28th of February of 2024



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

tech global university

## Postgraduate Diploma Robot Visual Perception Systems with Machine Learning

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- » Exams: online

# Postgraduate Diploma

Robot Visual Perception Systems with Machine Learning



