Professional Master's Degree
Computer Vision

tech technological university

tech technological university

Professional Master's Degree
Computer Vision

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

Website: **www.techtitute.com/in/artificial-intelligence/professional-master-degree/master-computer-vision**

Index

01 Introduction p. 4

02 Objectives p. 8

03 Skills p. 14

04 Course Management p. 18

05 Structure and Content p. 24

06 Methodology p. 36

07 Certificate p. 44

01

Introduction

Artificial Intelligence (AI) and Machine Learning have become the present of technology due to their numerous applications. For example, in the area of healthcare, these tools contribute to medical diagnosis through images such as X-rays. In this way, they facilitate the identification of patterns and the early detection of diseases. In this context, more and more companies are demanding the incorporation of professionals in Computer Vision capable of mastering the most advanced tools in data analysis. In view of this, TECH has developed a university degree that will delve into this subject and provide students with effective Deep Learning techniques to enrich their professional practice. And all in a convenient 100% online format!

You will delve into Adversarial Networks to generate the most realistic data thanks to this 100% online university degree”

Computer Vision is a field of Machine Learning of great importance to most technology companies. This technology allows both computers and systems to extract meaningful information from digital images, videos and even other visual inputs. Among its many benefits is the increase in the level of precision during manufacturing processes and the elimination of human error. Therefore, these instruments guarantee the highest quality of products while facilitating the resolution of problems during production.

In view of this reality, TECH is developing a Professional Master's Degree that will address Computer Vision in detail. Designed by experts in the field, the curriculum will delve into 3D image processing. In this regard, the program will offer students the most advanced processing software to visualize the data. The syllabus will also focus on Deep Learning analysis, given its relevance in dealing with large and complex data sets. This will allow graduates to enrich their usual work procedures with state-of-the-art algorithms and models. In addition, the teaching materials will provide a wide range of computer vision techniques using different frameworks (among which Keras, Tensorflow v2 Pytorch).

As for the format of this university degree, it is based on a 100% online methodology. All that is required is that graduates have an electronic device with Internet access (such as a computer, cell phone or tablet) to access the Virtual Campus. There they will find a library full of multimedia resources with which they will strengthen their knowledge in a dynamic way. It should be noted that TECH employs the innovative Relearningmethodology in all its programs, which will allow students to assimilate knowledge in a natural way, reinforced with audiovisual resources to ensure that it lasts in memory and over time.

This **Professional Master's Degree in Computer Vision** 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 computer science and computer vision
- 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 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 specialize in a key area of future technology that will immediately advance your career”

Looking to specialize in Evaluation Metrics? Achieve it with this program in just 12 months"

You will effectively handle Deep Learning to solve the most complex problems.

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

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.

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.

02

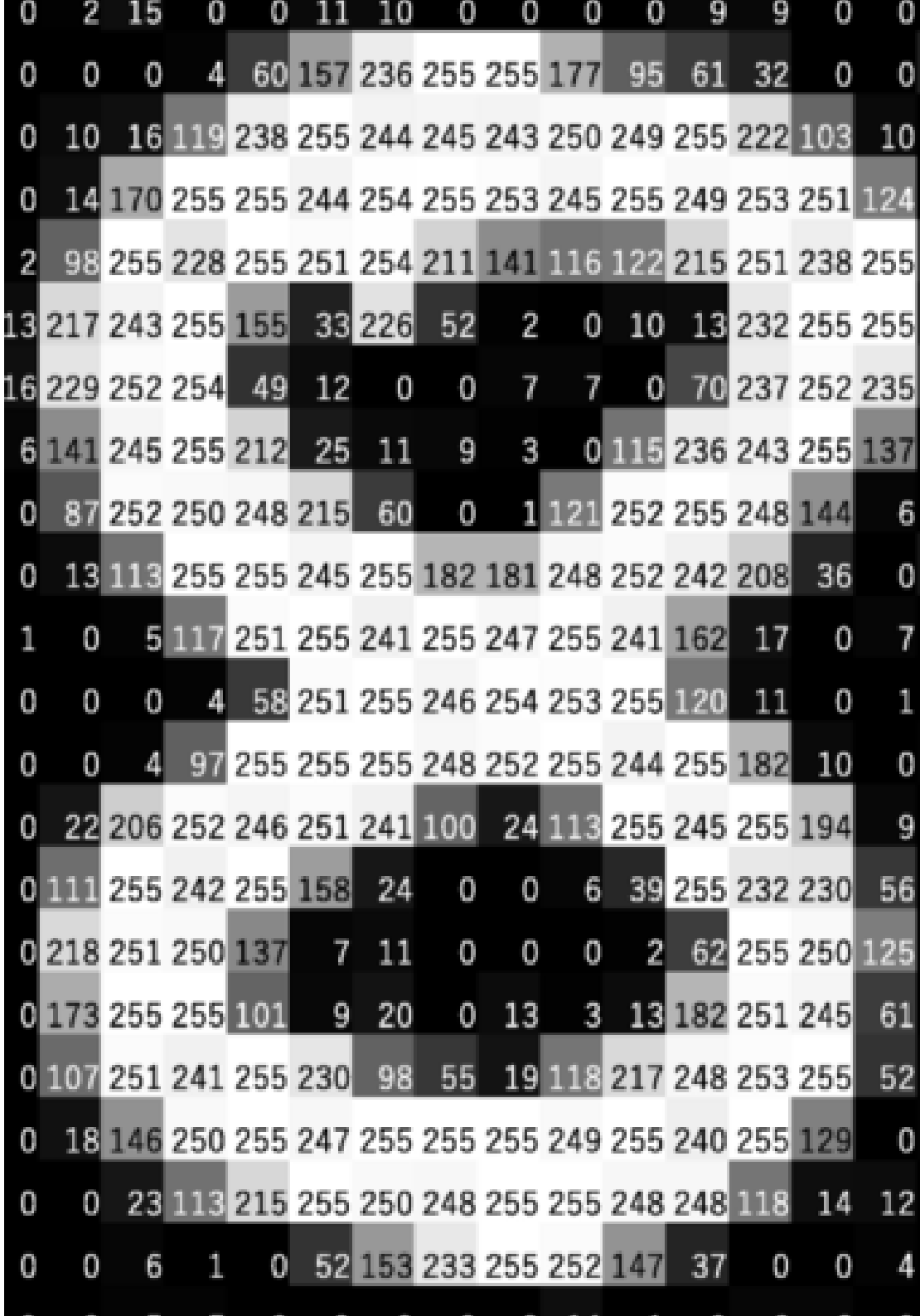
Objectives

Through this university degree, students will acquire a comprehensive approach to Computer Vision. In this way, graduates will keep abreast of the latest developments in this field. They will also acquire new skills to develop their professional work using the most advanced tools of Machine Learning. This will allow them to execute algorithms to create real solutions and innovate in various booming industries, such as video games or cyberspace.

Update your knowledge in Computer Vision through innovative multimedia content"

General Objectives

- Obtain an overview of the devices and hardware used in the computer vision world
- Analyze the different fields in which vision is applied
- Identify where the technological advances in vision are at the moment
- Assess what is being researched and what the next few years hold
- Establish a solid foundation in the understanding of digital image processing algorithms and techniques
- Assess fundamental computer vision techniques
- Analyze advanced image processing techniques
- Introducing the open 3D library
- Analyze the advantages and difficulties of working in 3D instead of 2D
- Introduce neural networks and examine how they work
- Analyze metrics for proper learning
- Analyze existing metrics and tools
- Examine the pipeline of an image classification network
- Analyze semantic segmentation neural networks and their metrics



Specific Objectives

Module 1. Computer Vision

- Establish how the human vision system works and how an image is digitized
- Analyze the evolution of computer vision
- Evaluate image acquisition techniques
- Generate specialized knowledge about illumination systems as an important factor when processing an image
- Specify what optical systems exist and evaluate their use
- Examine the 3D vision systems and how these systems provide depth to images
- Develop the different existing systems outside the field visible to the human eye

Module 2. Applications and State-of-the-Art

- Analyze the use of computer vision in industrial applications
- Determine how vision is applied in the autonomous vehicle revolution
- Analyze images in content analysis
- Develop *Deep Learning* algorithms for medical analysis and Machine Learning algorithms for operating room assistance
- Analyze the use of vision in commercial applications
- Determine how robots have eyes thanks to artificial vision and how it is applied in space travel
- Establish what augmented reality is and fields of use
- Analyze the Cloud Computing revolution
- Present the State of the Art and what the coming years have in store for us

Module 3. Digital Image Processing

- Examine commercial and open-source digital image processing libraries
- Determine what a digital image is and evaluate the fundamental operations to be able to work with them
- Introduce image filters
- Analyze the importance and use of histograms
- Present tools to modify images pixel by pixel
- Propose image segmentation tools
- Analyze morphological operations and their applications
- Determine the methodology in image calibration
- Evaluate methods for segmenting images with conventional vision

Module 4. Advanced Digital Image Processing

- Examine advanced digital image processing filters
- Determine contour extraction and analysis tools
- Analyze object search algorithms
- Demonstrate how to work with calibrated images
- Analyze mathematical techniques for geometry analysis
- Evaluate different options in image compositing
- Develop user interface

Module 5. 3D Image Processing

- Examine a 3D image
- Analyze the software used for 3D data processing
- Developing open3D
- Determine the relevant data in a 3D image
- Demonstrate visualization tools
- Establish denoising filters
- Propose Geometric Calculation tools
- Analyze object detection methodologies
- Evaluate triangulation and scene reconstruction methods

Module 6. Deep Learning

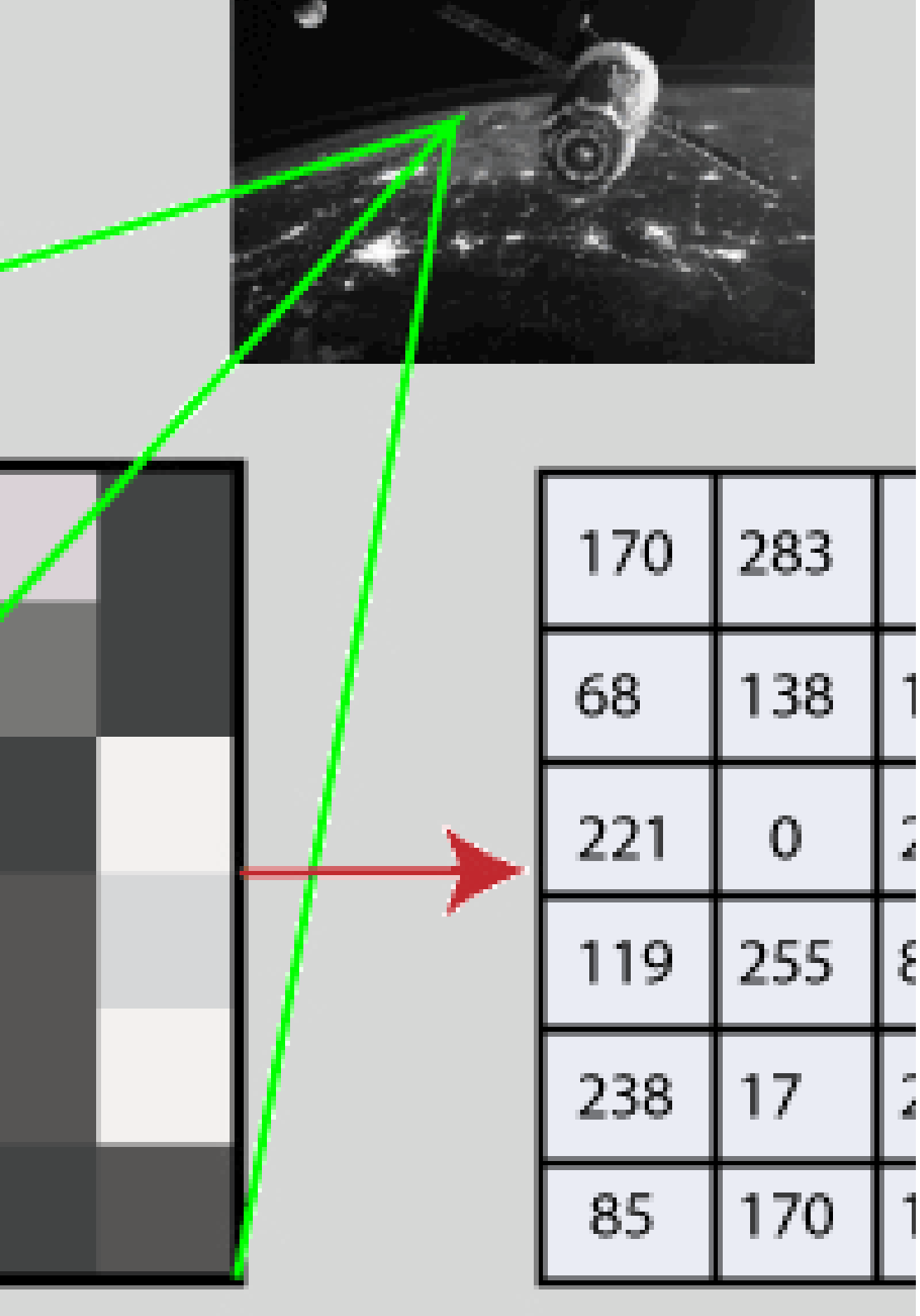
- Analyze the families that make up the artificial intelligence world
- Compile the main *Frameworks* of *Deep Learning*
- Define neural networks
- Present the learning methods of neural networks
- Fundamentals of cost functions
- Establish the most important activation functions
- Examine regularization and normalization techniques
- Develop optimization methods
- Introduce initialization methods

Module 7. Convolutional Neural Networks and Image Classification

- Generate specialized knowledge on convolutional neural networks
- Establish evaluation metrics
- Analyze the performance of CNNs for image classification
- Evaluate Data Augmentation
- Propose techniques to avoid Overfitting
- Examine different architectures
- Compile inference methods

Module 8. Object Detection

- Analyze how object detection networks work
- Examine traditional methods
- Determine evaluation metrics
- Identify the main datasets used in the marketplace
- Propose architectures of the Two Stage Object Detector type
- Analyze Fine Tuning Methods
- Examine different Single Shoot type architectures
- Establish object tracking algorithms
- Apply detection and tracking of people



Module 9. Image Segmentation with Deep Learning

- Analyze how semantic segmentation networks work
- Evaluate traditional methods
- Examine evaluation metrics and different architectures
- Examine video domains and cloud points
- Apply theoretical concepts through various examples

Module 10. Advanced Image Segmentation and Advanced Computer Vision Techniques

- Generate specialized knowledge on the handling of tools
- Examine Semantic Segmentation in medicine
- Identify the structure of a segmentation project
- Analyze Autoencoders
- Develop Adversarial Generative Networks

You will learn valuable lessons through real cases in simulated learning environments"

03

Skills

Thanks to this program, graduates will acquire multiple skills in the fields of *Machine Learning*, *Deep Learning* and Artificial Intelligence. In this way, they will be able to effectively handle digital processing libraries and apply the most advanced image acquisition techniques. On the other hand, they will obtain innovative tools related to Neural Networks, which will allow them to create the most avant-garde projects of Computer Vision.

You will handle the best tools for the development of Computer Vision projects, delving into issues such as Object Detection Neural Networks"

General Skills

- Understand how the real world is being digitized according to the different existing technologies
- Develop the systems that are changing the world of vision and their functionalities
- Master the acquisition techniques to obtain the optimal image
- Know the different digital image processing libraries available on the market
- Develop tools that combine different computer vision techniques
- Establish problem analysis rules
- Demonstrate how functional solutions can be created to address industrial, commercial, and other problems

TECH is a university at the forefront of technology, which puts all its resources at your disposal to help you achieve business success"

Specific Skills

- Determine how a 3D image is formed and its characteristics
- Establish methods for the processing of 3D images
- Understanding the mathematics behind neural networks
- Propose inference methods
- Generate specialized knowledge about object detection neural networks and their metrics
- Identify the different architectures
- Examine tracking algorithms and their metrics
- Identify the most common architectures
- Apply correct cost function for learning
- Analyze public data sources (*Datasets*)
- Examine different labeling tools
- Develop the main phases of a segmentation-based project
- Examine filtering algorithms, morphology, pixel modification, etc
- Generate specialized knowledge about *Deep Learning*
- Develop convolutional neural networks

04

Course Management

In its firm commitment to offer educational programs based on the highest excellence, TECH brings together a high-level teaching staff for the design and delivery of this program. These professionals have an extensive professional background in the field of Machine Vision, where they have been part of renowned companies of international prestige to provide innovative solutions. They are also characterized by staying at the forefront of technology to incorporate into their practice the most advanced tools in this field. In this way, students have the guarantees they demand to access a degree that will raise their professional horizons

An experienced teaching group will guide you throughout the learning process and will resolve any doubts that may arise"

Management

Mr. Redondo Cabanillas, Sergio

- Machine Vision Research and Development Specialist at BCN Vision
- Development and *Backoffice* Team Leader at BCN Vision
- Project Manager and development of computer vision solutions
- Sound Technician at Media Arts Studio
- Specialization in Image and Sound by the Polytechnic University of Catalonia
- Graduate in Political Science and Industry from the Autonomous University of Barcelona
- Higher Level Training Cycle in Sound Villar CP

Professors

Mr. Gutiérrez Olabarría, José Ángel

- Project management, software analysis and design and C programming of quality control and industrial computing applications
- Engineer specialized in Computer Vision and sensors
- Market manager for the iron and steel sector, performing customer contact, contracting, market plans and strategic accounts functions
- Computer Engineer from the University of Deusto
- Master's Degree in Robotics and Automation by ETSII/IT of Bilbao
- Diploma in Advanced Studies of the PhD program in Automation and Electronics by ETSII/IT of Bilbao

Mr. Enrich Llopart, Jordi

- Chief Technology Officer of Bcnvision - Machine Vision
- Project and application engineer. Bcnvision - Machine Vision
- Project and application engineer. PICVISA Machine Vision
- Graduated in Telecommunications Technical Engineering. Specialization in Image and Sound by the University School of Engineering of Terrassa (EET) / Polytechnic University of Catalonia (UPC)
- MPM - Master in Project Management. La Salle University - Ramon Llull University

Ms. Riera i Marín, Meritxell

- Deep Learning Systems Developer at Sycai Medical
- Researcher at Centre National de la Recherche Scientifique (CNRS), France Software Engineer at Zhilabs
- IT *Technician*, Mobile World Congress
- Software engineer at Avanade
- Telecommunications Engineering from the Polytechnic University of Catalonia
- *Master of Science*: *Spécialité Signal, image, systèmes embarqués, automatique* (SISEA) at IMT Atlantique, France
- Professional Master's Degree in Telecommunications Engineering from the Polytechnic University of Catalonia

Mr. González González, Diego Pedro

- Software Architect for Artificial Intelligence based systems
- *Deep learning* and *machine learning* application developer Software architect for embedded systems for rail safety applications
- Linux driver developer
- Systems engineer for railway track equipment
- Embedded Systems Engineer
- *Deep Learning* Engineer
- Official Master's Degree in Artificial Intelligence from the International University of La Rioja (Spain)
- Industrial Engineer by Miguel Hernández University

Mr. Higón Martínez, Felipe

- Electronics, telecommunications and computer engineer
- Validation and prototyping engineer
- Applications Engineer
- Support Engineer
- Master's Degree in Advanced and Applied Artificial Intelligence by IA3
- Technical Engineer in Telecommunications
- Degree in Electronic Engineering from the University of Valencia

Ms. García Moll, Clara

- Junior Visual Computer Engineer at LabLENI
- Computer Vision Engineer. Satellogic
- Full Stack Developer. Grupo Catfons
- Audiovisual Systems Engineering. Pompeu Fabra University (Barcelona)
- Master's Degree in Computer Vision. Autonomous University of Barcelona

Mr. Delgado Gonzalo, Guillem

- Computer Vision and Artificial Intelligence Researcher at Vicomtech
- Computer Vision and Artificial Intelligence Engineer at Gestoos
- Junior Engineer at Sogeti
- Graduated in Audiovisual Systems Engineering at the Polytechnic University of Catalonia
- MSc in Computer Vision at Universitat Autónoma de Barcelona
- Graduate in Computer Science at Aalto University
- Graduate in Audiovisual Systems. UPC - ETSETB Telecos BCN

Mr. Bigata Casademunt, Antoni

- Perception Engineer at Computer Vision Center (CVC)
- Machine Learning Engineer at Visium SA, Switzerland
- Degree in Microtechnology from Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland
- Master's degree in Robotics from the Ecole Polytechnique Fédérale de Lausanne (EPFL)

Mr. Solé Gómez, Àlex

- Researcher at Vicomtech in the Intelligent Security Video Analytics department
- MSc. in Telecommunications Engineering, mention in Audiovisual Systems, by the Polytechnic University of Catalonia
- BSc in Telecommunications Technologies and Services Engineering, mention in Audiovisual Systems, by the Polytechnic University of Catalonia

Mr. Olivo García, Alejandro

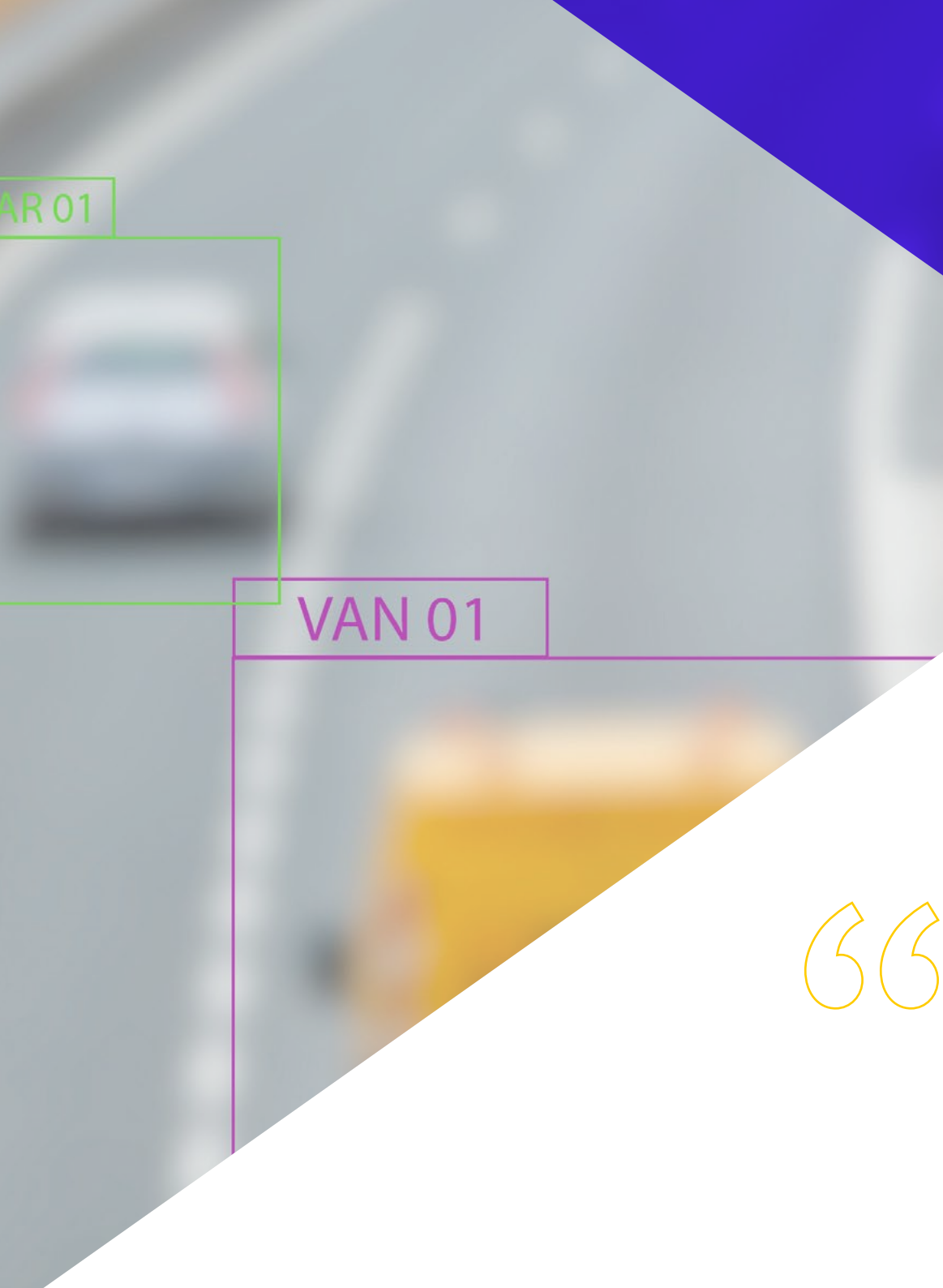
- Vision Application Engineer at Bcnvision
- Degree in Industrial Technologies Engineering from the School of Industrial Engineering Polytechnic University of Cartagena
- Master's Degree in Industrial Engineering by the School of Industrial Engineering Polytechnic University of Cartagena
- Research Chair Scholarship from MTorres company
- Programming in C# .NET in Computer Vision Applications

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

05

Structure and Content

This program will provide students with a comprehensive overview of the State of the Art in Artificial Intelligence. Consisting of 10 complete modules, the academic itinerary will address conventional vision algorithms and will offer the latest advances in *Deep Learning*. The didactic materials will provide the most advanced computer vision techniques, so that students can incorporate them immediately into their professional practice. In addition, the syllabus will analyze in detail the Convolutional Networks in order for the graduates to perform a correct classification of the objects in the images.



The program has no fixed schedule and the curriculum is available from day one. Set your own learning pace!"

Module 1. Computer Vision

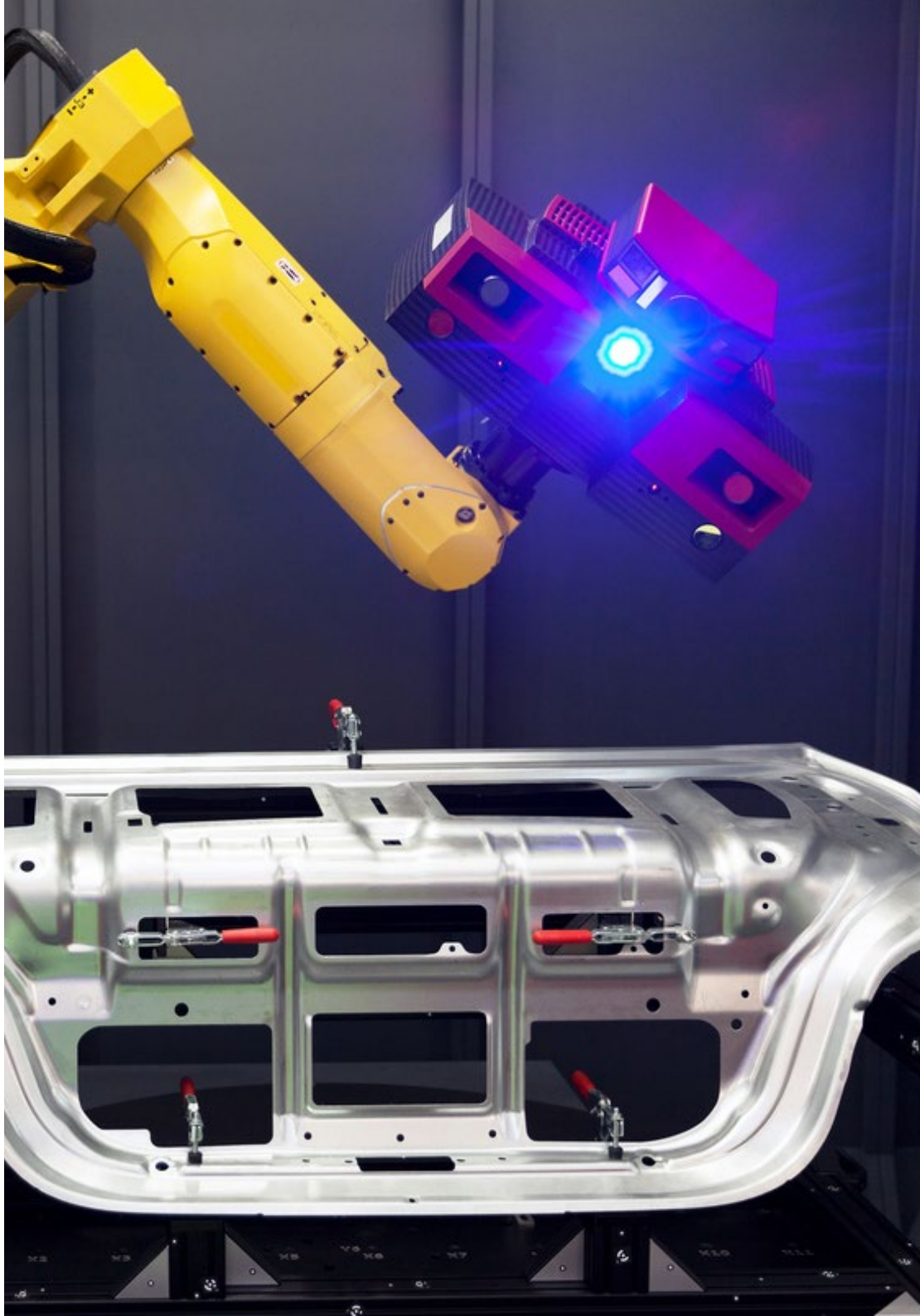
1.1. Human Perception
- 1.1.1. Human Visual System
- 1.1.2. Color
- 1.1.3. Visible and Non-Visible Frequencies

1.2. Chronicle of the Computer Vision
- 1.2.1. Principles
- 1.2.2. Evolution
- 1.2.3. The Importance of Computer Vision

1.3. Digital Image Composition
- 1.3.1. The Digital Image
- 1.3.2. Types of Images
- 1.3.3. Color Spaces
- 1.3.4. RGB
- 1.3.5. HSV and HSL
- 1.3.6. CMY-CMYK
- 1.3.7. YCbCr
- 1.3.8. Indexed Image

1.4. Image Acquisition Systems
- 1.4.1. Operation of a Digital Camera
- 1.4.2. The Correct Exposure for Each Situation
- 1.4.3. Depth of Field
- 1.4.4. Resolution
- 1.4.5. Image Formats
- 1.4.6. HDR Mode
- 1.4.7. High Resolution Cameras
- 1.4.8. High-Speed Cameras

1.5. Optical Systems
- 1.5.1. Optical Principles
- 1.5.2. Conventional Lenses
- 1.5.3. Telecentric Lenses
- 1.5.4. Types of Autofocus Lenses



1.5.5. Focal Length
1.5.6. Depth of Field
1.5.7. Optical Distortion
1.5.8. Calibration of an Image
1.6. Illumination Systems
1.6.1. Importance of Illumination
1.6.2. Frequency Response
1.6.3. LED Illumination
1.6.4. Outdoor Lighting
1.6.5. Types of Lighting for Industrial Applications. Effects
1.7. 3D Capture Systems
1.7.1. Stereo Vision
1.7.2. Triangulation
1.7.3. Structured Light
1.7.4. Time of Flight
1.7.5. Lidar
1.8. Multispectrum
1.8.1. Multispectral Cameras
1.8.2. Hyperspectral Cameras
1.9. Non-Visible Near Spectrum
1.9.1. IR Cameras
1.9.2. UV Cameras
1.9.3. Converting From Non-Visible to Visible by Illumination
1.10. Other Band Spectrums
1.10.1. X-Ray
1.10.2. terahertz

Module 2. Applications and State-of-the-Art

2.1. Industrial Applications
2.1.1. Machine Vision Libraries
2.1.2. Compact Cameras
2.1.3. PC-Based Systems
2.1.4. Industrial Robotics
2.1.5. Pick and Place 2D
2.1.6. Bin Picking
2.1.7. Quality Control
2.1.8. Presence Absence of Components
2.1.9. Dimensional Control
2.1.10. Labeling Control
2.1.11. Traceability
2.2. Autonomous Vehicles
2.2.1. Driver Assistance
2.2.2. Autonomous Driving
2.3. Computer Vision for Content Analysis
2.3.1. Filtering by Content
2.3.2. Visual Content Moderation
2.3.3. Tracking Systems
2.3.4. Brand and Logo Identification
2.3.5. Video Labeling and Classification
2.3.6. Scene Change Detection
2.3.7. Text or Credits Extraction
2.4. Medical Application
2.4.1. Disease Detection and Localization
2.4.2. Cancer and X-Ray Analysis
2.4.3. Advances in Computer Vision given the Covid19
2.4.4. Assistance in the Operating Room
2.5. Spatial Applications
2.5.1. Satellite Image Analysis
2.5.2. Computer Vision for the Study of Space
2.5.3. Mission to Mars

2.6. Commercial Applications
- 2.6.1. Stock Control
- 2.6.2. Video Surveillance, Home Security
- 2.6.3. Parking Cameras
- 2.6.4. Population Control Cameras
- 2.6.5. Speed Cameras

2.7. Vision Applied to Robotics
- 2.7.1. Drones
- 2.7.2. AGV
- 2.7.3. Vision in Collaborative Robots
- 2.7.4. The Eyes of the Robots

2.8. Augmented Reality
- 2.8.1. Operation
- 2.8.2. Devices
- 2.8.3. Applications in the Industry
- 2.8.4. Commercial Applications

2.9. Cloud Computing
- 2.9.1. Cloud Computing Platforms
- 2.9.2. From Cloud Computing to Production

2.10. Research and State-of-the-Art
- 2.10.1. Commercial Applications
- 2.10.2. What's Cooking
- 2.10.3. The Future of Computer Vision

Module 3. Digital Image Processing

3.1. Computer Vision Development Environment
- 3.1.1. Computer Vision Libraries
- 3.1.2. Programming Environment
- 3.1.3. Visualization Tools

3.2. Digital image Processing
- 3.2.1. Pixel Relationships
- 3.2.2. Image Operations
- 3.2.3. Geometric Transformations

3.3. Pixel Operations
- 3.3.1. Histogram
- 3.3.2. Histogram Transformations
- 3.3.3. Operations on Color Images

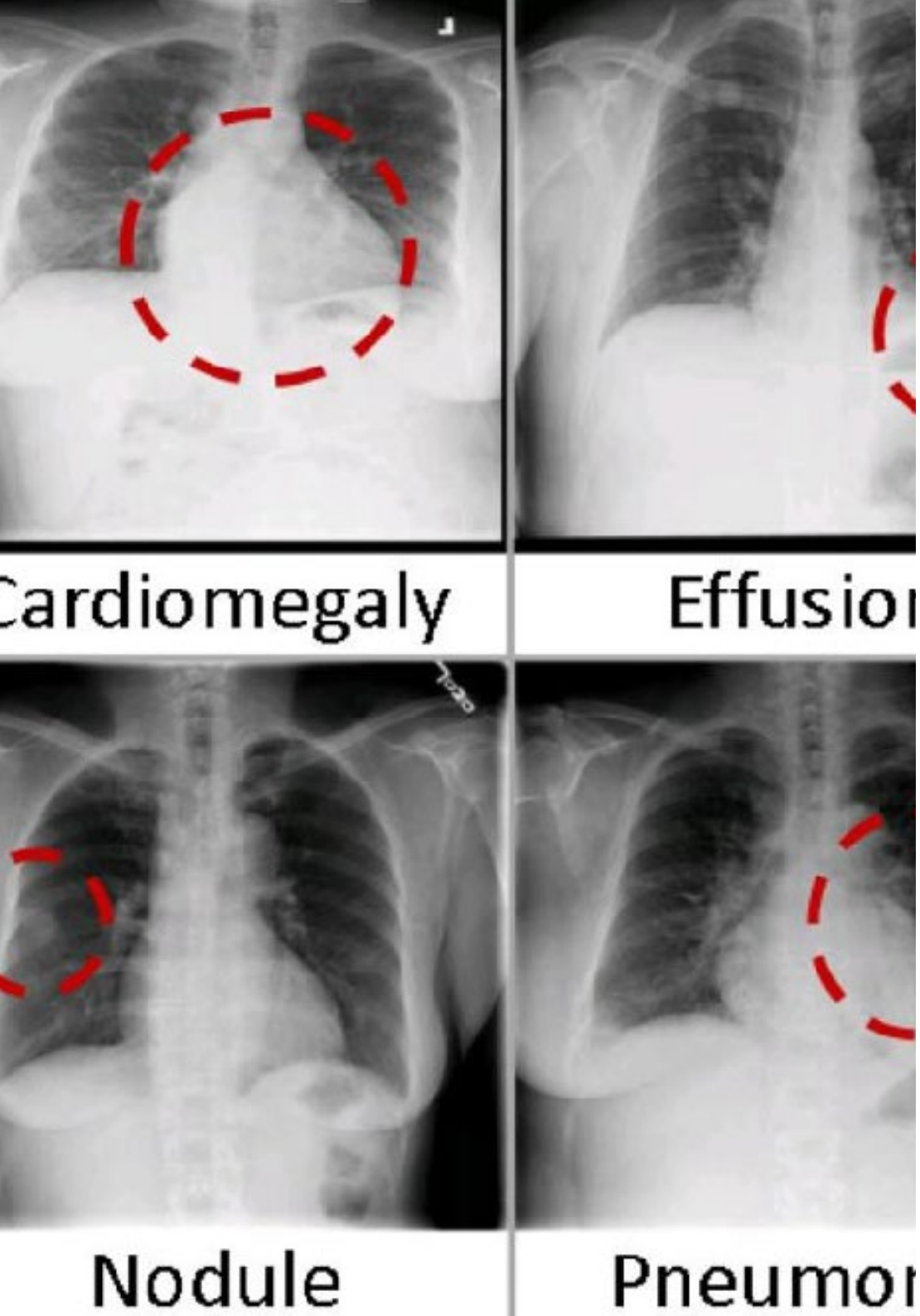
3.4. Logical and Arithmetic Operations
- 3.4.1. Addition and Subtraction
- 3.4.2. Product and Division
- 3.4.3. And/Nand
- 3.4.4. Or/Nor
- 3.4.5. Xor/Xnor

3.5. Filters
- 3.5.1. Masks and Convolution
- 3.5.2. Linear Filtering
- 3.5.3. Non-Linear Filtering
- 3.5.4. Fourier Analysis

3.6. Morphological Operations
- 3.6.1. Erosion and Dilation
- 3.6.2. Closing and Opening
- 3.6.3. Top_hat and Black hat
- 3.6.4. Contour Detection
- 3.6.5. Skeleton
- 3.6.6. Hole Filling
- 3.6.7. Convex Hull

3.7. Image Analysis Tools
- 3.7.1. Edge Detection
- 3.7.2. Detection of Blobs
- 3.7.3. Dimensional Control
- 3.7.4. Color Inspection

3.8. Object Segmentation
- 3.8.1. Image Segmentation
- 3.8.2. Classical Segmentation Techniques
- 3.8.3. Real Applications



3.9. Image Calibration
- 3.9.1. Image Calibration
- 3.9.2. Methods of Calibration
- 3.9.3. Calibration Process in a 2D Camera/Robot System

3.10. Image Processing in a Real Environment
- 3.10.1. Problem Analysis
- 3.10.2. Image Processing
- 3.10.3. Feature Extraction
- 3.10.4. Final Results

Module 4. Advanced Digital Image Processing

4.1. Optical Character Recognition (OCR)
- 4.1.1. Image Pre-Processing
- 4.1.2. Text Detection
- 4.1.3. Text Recognition

4.2. Code Reading
- 4.2.1. 1D Codes
- 4.2.2. 2D Codes
- 4.2.3. Applications

4.3. Pattern Search
- 4.3.1. Pattern Search
- 4.3.2. Patterns Based on Gray Level
- 4.3.3. Patterns Based on Contours
- 4.3.4. Patterns Based on Geometric Shapes
- 4.3.5. Other Techniques

4.4. Object Tracking with Conventional Vision
- 4.4.1. Background Extraction
- 4.4.2. Meanshift
- 4.4.3. Camshift
- 4.4.4. Optical Flow

4.5. Facial Recognition
- 4.5.1. Facial Landmark Detection
- 4.5.2. Applications
- 4.5.3. Facial Recognition
- 4.5.4. Emotion Recognition

4.6. Panoramic and Alignment
- 4.6.1. Stitching
- 4.6.2. Image Composition
- 4.6.3. Photomontage

4.7. High Dynamic Range (HDR) and Photometric Stereo
- 4.7.1. Increasing the Dynamic Range
- 4.7.2. Image Compositing for Contour Enhancement
- 4.7.3. Techniques for the Use of Dynamic Applications

4.8. Image Compression
- 4.8.1. Image Compression
- 4.8.2. Types of Compressors
- 4.8.3. Image Compression Techniques

4.9. Video Processing
- 4.9.1. Image Sequences
- 4.9.2. Video Formats and Codecs
- 4.9.3. Reading a Video
- 4.9.4. Frame Processing

4.10. Real Application of Image Processing
- 4.10.1. Problem Analysis
- 4.10.2. Image Processing
- 4.10.3. Feature Extraction
- 4.10.4. Final Results

Module 5. 3D Image Processing

5.1. 3D Imaging
- 5.1.1. 3D Imaging
- 5.1.2. 3d Image Processing Software and Visualizations
- 5.1.3. Metrology Software

5.2. Open3D
- 5.2.1. Library for 3D Data Processing
- 5.2.2. Features
- 5.2.3. Installation and Use

5.3. The Data
- 5.3.1. Depth Maps in 2D Image
- 5.3.2. Pointclouds
- 5.3.3. Normal
- 5.3.4. Surfaces

5.4. Visualization
- 5.4.1. Data Visualization
- 5.4.2. Controls
- 5.4.3. Web Display

5.5. Filters
- 5.5.1. Distance Between Points, Eliminate Outliers
- 5.5.2. High Pass Filter
- 5.5.3. Downsampling

5.6. Geometry and Feature Extraction
- 5.6.1. Extraction of a Profile
- 5.6.2. Depth Measurement
- 5.6.3. Volume
- 5.6.4. 3D Geometric Shapes
- 5.6.5. Shots
- 5.6.6. Projection of a Point
- 5.6.7. Geometric Distances
- 5.6.8. Kd Tree
- 5.6.9. 3D Features

5.7. Registration and Meshing
- 5.7.1. Concatenation
- 5.7.2. ICP
- 5.7.3. Ransac 3D

5.8. 3D Object Recognition
- 5.8.1. Searching for an Object in the 3d Scene
- 5.8.2. Segmentation
- 5.8.3. Bin Picking

5.9. Surface Analysis
- 5.9.1. Smoothing
- 5.9.2. Orientable Surfaces
- 5.9.3. Octree

5.10. Triangulation
- 5.10.1. From Mesh to Point Cloud
- 5.10.2. Depth Map Triangulation
- 5.10.3. Triangulation of Unordered Point Clouds

Module 6. Deep Learning

6.1. Artificial Intelligence
- 6.1.1. Machine Learning
- 6.1.2. Deep Learning
- 6.1.3. The Explosion of Deep Learning Why Now

6.2. Neural Networks
- 6.2.1. The Neural Network
- 6.2.2. Uses of Neural Networks
- 6.2.3. Linear Regression and Perceptron
- 6.2.4. Forward Propagation
- 6.2.5. Backpropagation
- 6.2.6. Feature Vectors

6.3. Loss Functions
- 6.3.1. Loss Functions
- 6.3.2. Types of Loss Functions
- 6.3.3. Choice of Loss Functions

6.4. Activation Functions
- 6.4.1. Activation Function
- 6.4.2. Linear Functions
- 6.4.3. Non-Linear Functions
- 6.4.4. Output vs. Hidden Layer Activation Functions

6.5. Regularization and Normalization
- 6.5.1. Regularization and Normalization
- 6.5.2. Overfitting and Data Augmentation
- 6.5.3. Regularization Methods: L1, L2 and Dropout
- 6.5.4. Normalization Methods: Batch, Weight, Layer

6.6. Optimization
- 6.6.1. Gradient Descent
- 6.6.2. Stochastic Gradient Descent
- 6.6.3. Mini Batch Gradient Descent
- 6.6.4. Momentum
- 6.6.5. Adam

6.7. Hyperparameter Tuning and Weights
- 6.7.1. Hyperparameters
- 6.7.2. Batch Size vs Learning Rate vs Step Decay
- 6.7.3. Weights

6.8. Evaluation Metrics of a Neural Network
- 6.8.1. Accuracy
- 6.8.2. Dice Coefficient
- 6.8.3. Sensitivity vs Specificity / Recall vs precision
- 6.8.4. ROC Curve (AUC)
- 6.8.5. F1-Score
- 6.8.6. Matrix Confusion
- 6.8.7. Cross-Validation

6.9. Frameworks and Hardware
- 6.9.1. Tensor Flow
- 6.9.2. Pytorch
- 6.9.3. Caffe
- 6.9.4. Keras
- 6.9.5. Hardware for the Training Phase

6.10. Creation of a Neural Network– Training and Validation
- 6.10.1. Dataset
- 6.10.2. Network Construction
- 6.10.3. Education
- 6.10.4. Visualization of Results

Module 7. Convolutional Neural Networks and Image Classification

7.1. Convolutional Neural Networks
- 7.1.1. Introduction
- 7.1.2. Convolution
- 7.1.3. CNN Building Blocks

7.2. Types of CNN Layers
- 7.2.1. Convolutional
- 7.2.2. Activation
- 7.2.3. Batch Normalization
- 7.2.4. Polling
- 7.2.5. Fully Connected

7.3. Metrics
- 7.3.1. Matrix Confusion
- 7.3.2. Accuracy
- 7.3.3. Precision
- 7.3.4. Recall
- 7.3.5. F1 Score
- 7.3.6. ROC Curve
- 7.3.7. AUC

7.4. Main Architectures
- 7.4.1. AlexNet
- 7.4.2. VGG
- 7.4.3. Resnet
- 7.4.4. GoogleLeNet

7.5. Image Classification
- 7.5.1. Introduction
- 7.5.2. Analysis of Data
- 7.5.3. Data Preparation
- 7.5.4. Model Training
- 7.5.5. Model Validation

7.6. Practical Considerations for CNN Training
- 7.6.1. Optimizer Selection
- 7.6.2. Learning Rate Scheduler
- 7.6.3. Check Training Pipeline
- 7.6.4. Training with Regularization

7.7. Best Practices in Deep Learning
- 7.7.1. Transfer Learning
- 7.7.2. Fine Tuning
- 7.7.3. Data Augmentation

7.8. Statistical Data Evaluation
- 7.8.1. Number of Datasets
- 7.8.2. Number of Labels
- 7.8.3. Number of Images
- 7.8.4. Data Balancing

7.9. Deployment
- 7.9.1. Saving and Loading Models
- 7.9.2. Onnx
- 7.9.3. Inference

7.10. Case Study: Image Classification
- 7.10.1. Data Analysis and Preparation
- 7.10.2. Testing the Training Pipeline
- 7.10.3. Model Training
- 7.10.4. Model Validation

Module 8. Object Detection

8.1. Object Detection and Tracking
- 8.1.1. Object Detection
- 8.1.2. Case Uses
- 8.1.3. Object Tracking
- 8.1.4. Case Uses
- 8.1.5. Occlusions, Rigid and Non-Rigid Poses

8.2. Assessment Metrics
- 8.2.1. IOU - Intersection Over Union
- 8.2.2. Confidence Score
- 8.2.3. Recall
- 8.2.4. Precision
- 8.2.5. Recall–Precision Curve
- 8.2.6. Mean Average Precision (mAP)

8.3. Traditional Methods
- 8.3.1. Sliding Window
- 8.3.2. Viola Detector
- 8.3.3. HOG
- 8.3.4. Non-Maximal Suppresion (NMS)

8.4. Datasets
- 8.4.1. Pascal VC
- 8.4.2. MS Coco
- 8.4.3. ImageNet (2014)
- 8.4.4. MOTA Challenge

8.5. Two Shot Object Detector
- 8.5.1. R-CNN
- 8.5.2. Fast R-CNN
- 8.5.3. Faster R-CNN
- 8.5.4. Mask R-CNN

8.6. Single Shot Object Detector
- 8.6.1. SSD
- 8.6.2. YOLO
- 8.6.3. RetinaNet
- 8.6.4. CenterNet
- 8.6.5. EfficientDet

8.7. Backbones
- 8.7.1. VGG
- 8.7.2. ResNet
- 8.7.3. Mobilenet
- 8.7.4. Shufflenet
- 8.7.5. Darknet

8.8. Object Tracking
- 8.8.1. Classical Approaches
- 8.8.2. Particulate Filters
- 8.8.3. Kalman
- 8.8.4. Sort Tracker
- 8.8.5. Deep Sort

8.9. Deployment
- 8.9.1. Computing Platform
- 8.9.2. Choice of Backbone
- 8.9.3. Choice of Framework
- 8.9.4. Model Optimization
- 8.9.5. Model Versioning

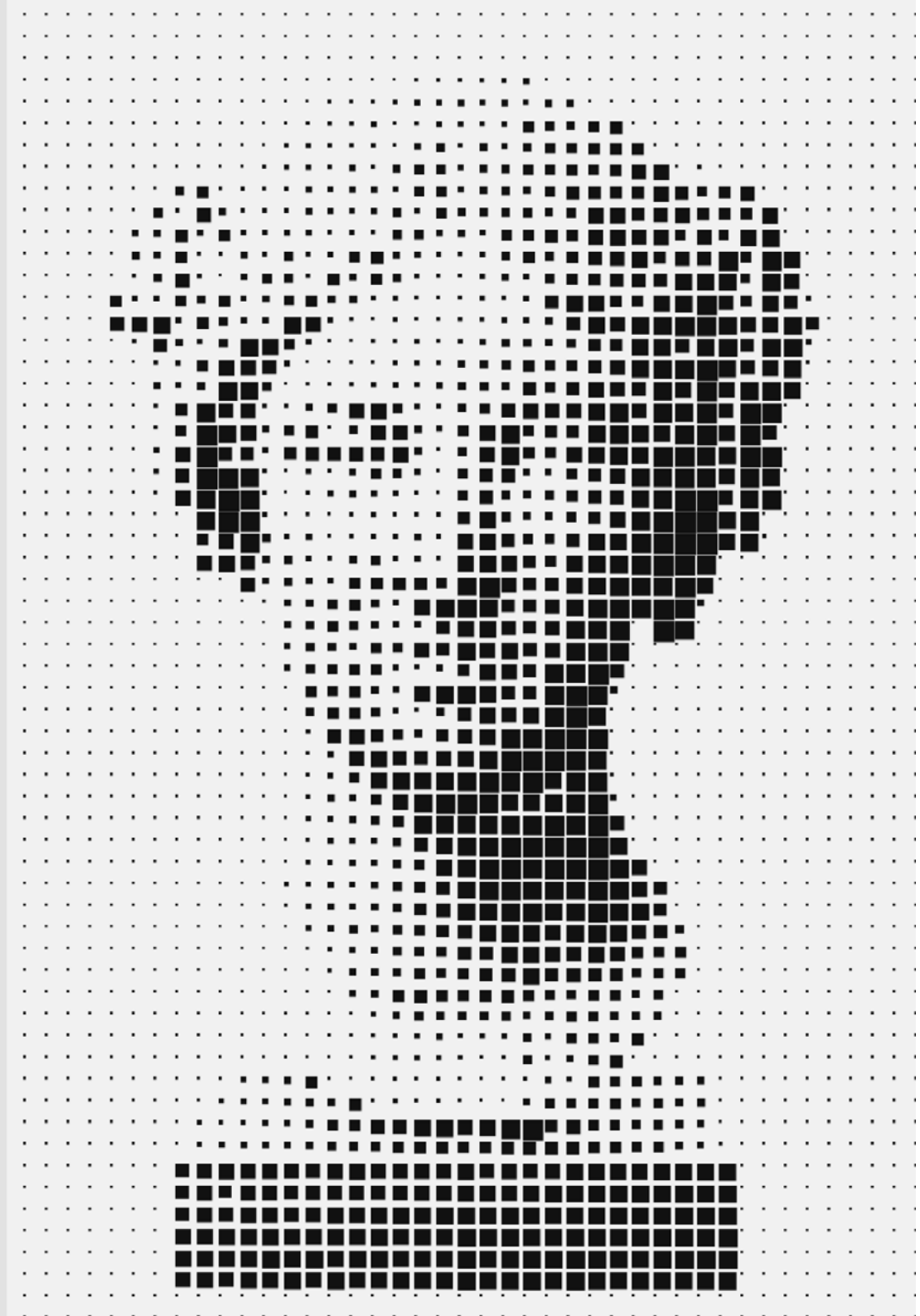
8.10. Study: People Detection and Tracking
- 8.10.1. Detection of People
- 8.10.2. Monitoring of People
- 8.10.3. Re-Identification
- 8.10.4. Counting People in Crowds

Module 9. Image Segmentation with *Deep Learning*

9.1. Object Detection and Segmentation
  9.1.1. Semantic Segmentation
    9.1.1.1. Semantic Segmentation Use Cases
  9.1.2. Instantiated Segmentation
    9.1.2.1. Instantiated Segmentation Use Cases
9.2. Evaluation Metrics
  9.2.1. Similarities with Other Methods
  9.2.2. Pixel Accuracy
  9.2.3. Dice Coefficient (F1 Score)
9.3. Cost Functions
  9.3.1. Dice Loss
  9.3.2. Focal Loss
  9.3.3. Tversky Loss
  9.3.4. Other Functions
9.4. Traditional Segmentation Methods
  9.4.1. Threshold Application with Otsu and Riddlen
  9.4.2. Self-Organized Maps
  9.4.3. GMM-EM Algorithm
9.5. Semantic Segmentation Applying Deep Learning: FCN
  9.5.1. FCN
  9.5.2. Architecture
  9.5.3. FCN Applications
9.6. Semantic Segmentation Applying Deep Learning: U-NET
  9.6.1. U-NET
  9.6.2. Architecture
  9.6.3. U-NET Application
9.7. Semantic Segmentation Applying Deep Learning: Deep Lab
  9.7.1. Deep Lab
  9.7.2. Architecture
  9.7.3. Deep Lab Application
9.8. Instantiated Segmentation Applying Deep Learning: RCNN Mask
  9.8.1. RCNN Mask
  9.8.2. Architecture
  9.8.3. Application of a Mask RCNN
9.9. Video Segmentation
  9.9.1. STFCN
  9.9.2. Semantic Video CNNs
  9.9.3. Clockwork Convnets
  9.9.4. Low-Latency
9.10. Point Cloud Segmentation
  9.10.1. The Point Cloud
  9.10.2. PointNet
  9.10.3. A-CNN

Module 10. Advanced Image Segmentation and Advanced Computer Vision Techniques

10.1. Database for General Segmentation Problems
  10.1.1. Pascal Context
  10.1.2. CelebAMask-HQ
  10.1.3. Cityscapes Dataset
  10.1.4. CCP Dataset
10.2. Semantic Segmentation in Medicine
  10.2.1. Semantic Segmentation in Medicine
  10.2.2. Datasets for Medical Problems
  10.2.3. Practical Applications
10.3. Annotation Tools
  10.3.1. Computer Vision Annotation Tool
  10.3.2. LabelMe
  10.3.3. Other Tools
10.4. Segmentation Tools Using Different Frameworks
  10.4.1. Keras
  10.4.2. Tensorflow v2
  10.4.3. Pytorch
  10.4.4. Others



10.5. Semantic Segmentation Project. The Data, Phase 1
- 10.5.1. Problem Analysis
- 10.5.2. Input Source for Data
- 10.5.3. Data Analysis
- 10.5.4. Data Preparation

10.6. Semantic Segmentation Project. Training, Phase 2
- 10.6.1. Algorithm Selection
- 10.6.2. Education
- 10.6.3. Assessment

10.7. Semantic Segmentation Project. Results, Phase 3
- 10.7.1. Fine Tuning
- 10.7.2. Presentation of The Solution
- 10.7.3. Conclusions

10.8. Autoencoders
- 10.8.1. Autoencoders
- 10.8.2. Autoencoder Architecture
- 10.8.3. Noise Elimination Autoencoders
- 10.8.4. Automatic Coloring Autoencoder

10.9. Generative Adversarial Networks (GANs)
- 10.9.1. Generative Adversarial Networks (GANs)
- 10.9.2. DCGAN Architecture
- 10.9.3. Conditional GAN Architecture

10.10. Enhanced Generative Adversarial Networks
- 10.10.1. Overview of the Problem
- 10.10.2. WGAN
- 10.10.3. LSGAN
- 10.10.4. ACGAN

06

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

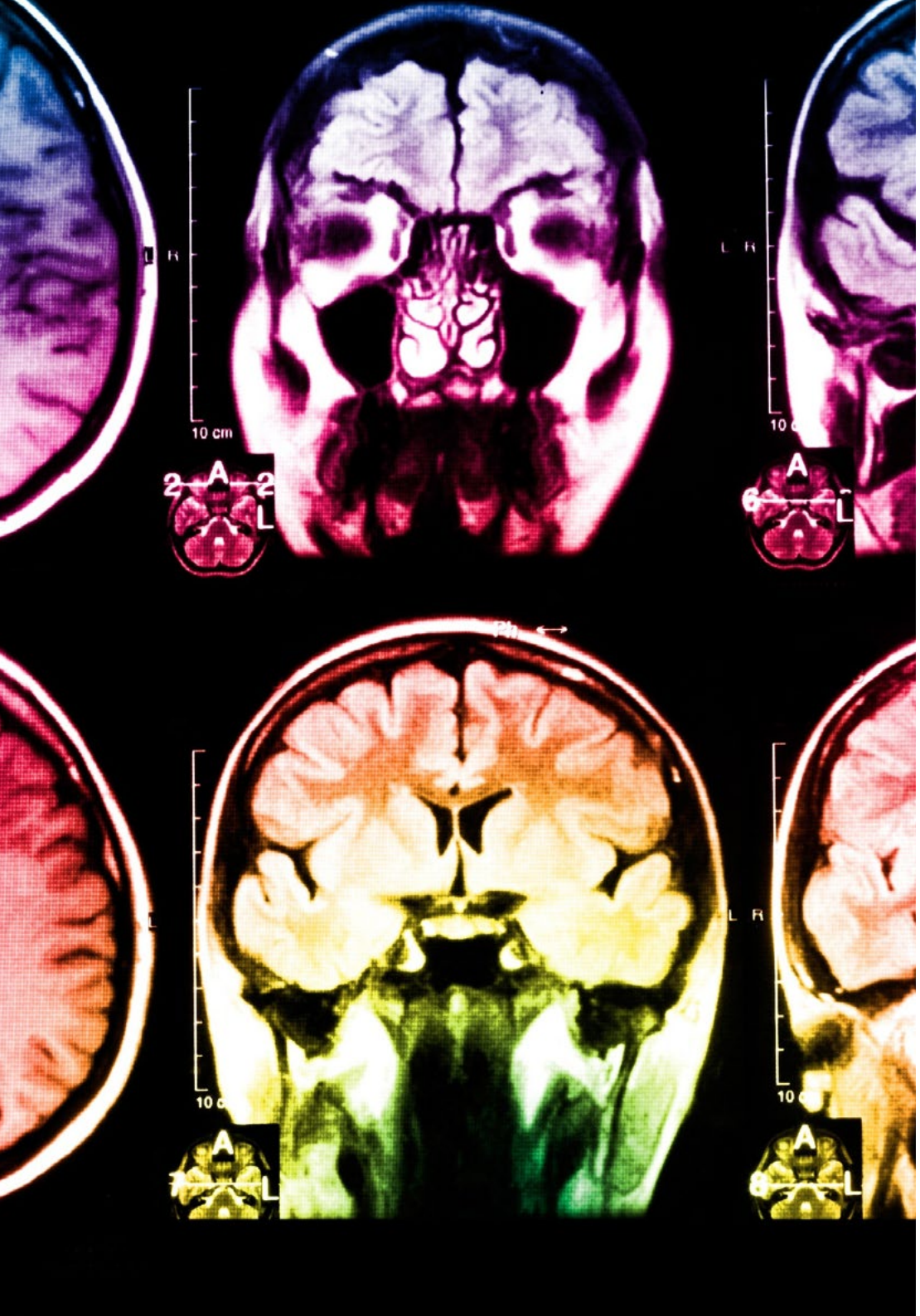
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines different teaching elements in each lesson.

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.

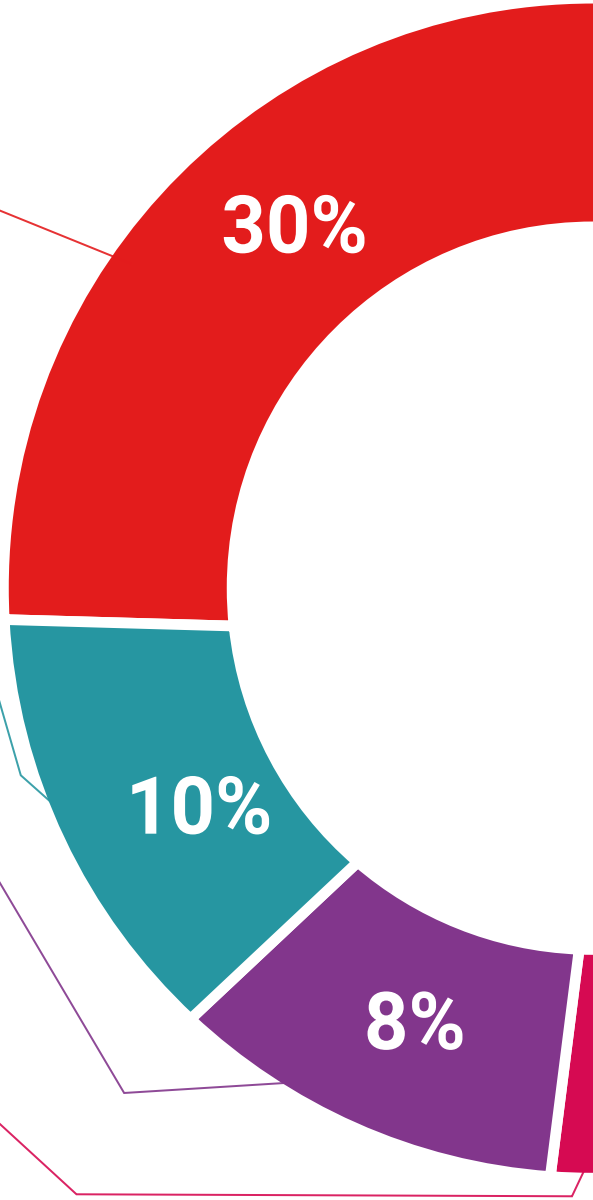
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

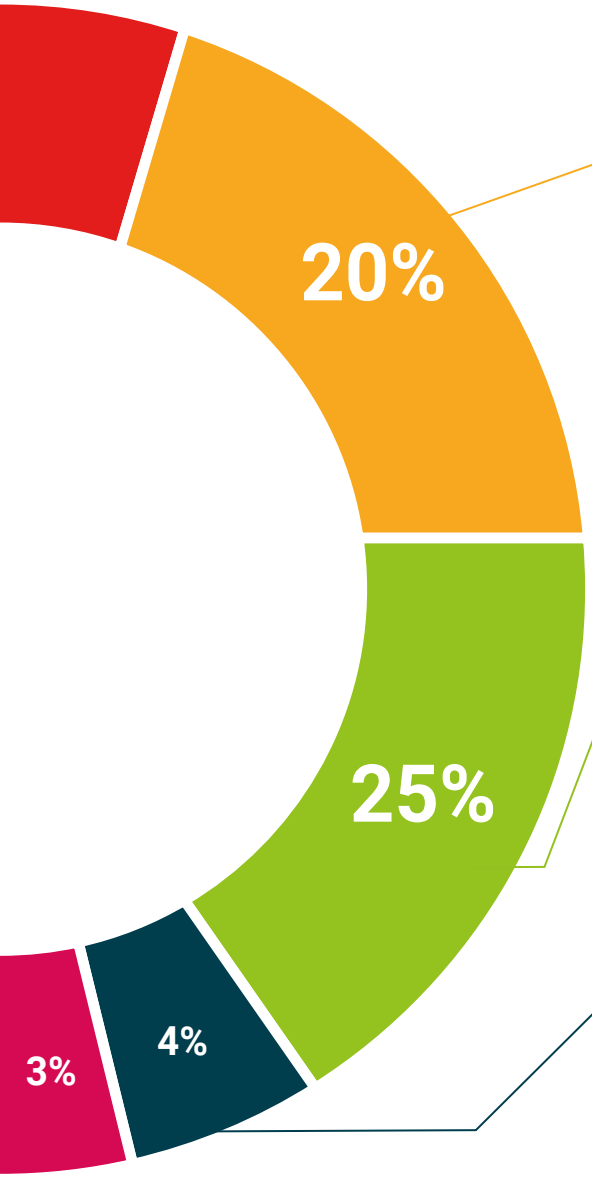
Practising Skills and Abilities

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.

07

Certificate

The Professional Master's Degree in Computer Vision guarantees students, in addition to the most rigorous and up-to-date education, access to a Professional Master's Degree issued by TECH Technological University.

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

This **Professional Master's Degree in Computer Vision** contains the most complete and up-to-date educational program on the market.

After the student has passed the assessments, they will receive their corresponding **Professional Master's Degree** issued by **TECH Technological University** via tracked delivery*.

The certificate issued by **TECH Technological University** will reflect the qualification obtained in the Professional Master's Degree, and meets the requirements commonly demanded by labor exchanges, competitive examinations and professional career evaluation committees.

Title: **Professional Master's Degree in Computer Vision**

Official Nº of hours: **1,500 h.**

tech technological university

Awards the following

CERTIFICATE

to

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

For having successfully passed and accredited the following program

PROFESSIONAL MASTER'S DEGREE

in

Computer Vision

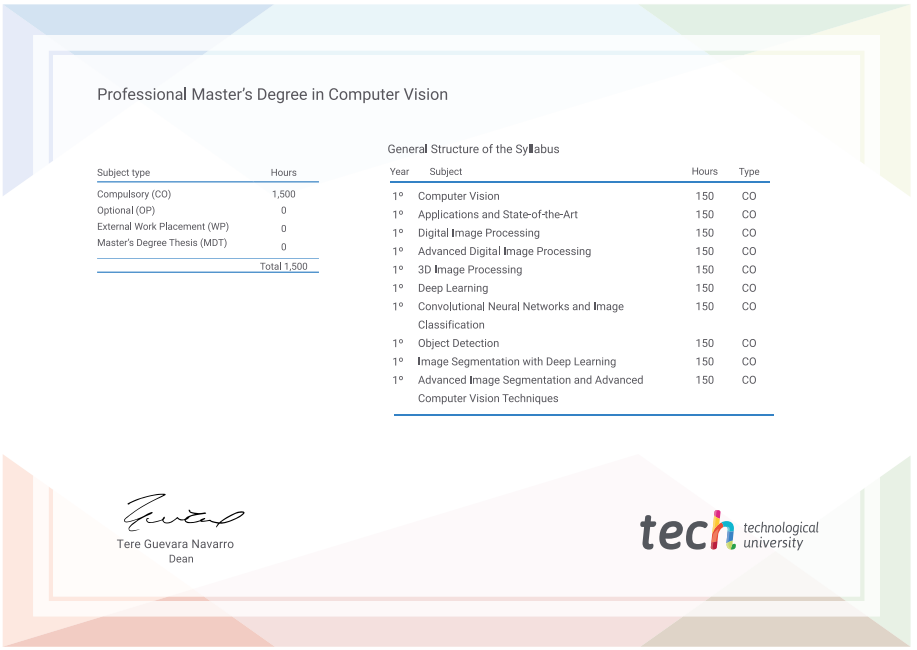
This is a qualification awarded by this University, equivalent to 1,500 hours, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

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

Unique TECH Code: AFWORD23S techtitute.com/certificates


Professional Master's Degree in Computer Vision

Subject type	Hours
Compulsory (CO)	1,500
Optional (OP)	0
External Work Placement (WP)	0
Master's Degree Thesis (MDT)	0
	Total 1,500

General Structure of the Syllabus

Year	Subject	Hours	Type
1º	Computer Vision	150	CO
1º	Applications and State-of-the-Art	150	CO
1º	Digital Image Processing	150	CO
1º	Advanced Digital Image Processing	150	CO
1º	3D Image Processing	150	CO
1º	Deep Learning	150	CO
1º	Convolutional Neural Networks and Image Classification	150	CO
1º	Object Detection	150	CO
1º	Image Segmentation with Deep Learning	150	CO
1º	Advanced Image Segmentation and Advanced Computer Vision Techniques	150	CO

Tere Guevara Navarro
Dean

tech technological university

*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.

tech technological university

Professional Master's Degree

Computer Vision

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

Professional Master's Degree
Computer Vision

tech technological university