

# Professional Master's Degree Artificial Intelligence in Dentistry





## Professional Master's Degree Artificial Intelligence in Dentistry

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

Website: [www.techtitute.com/us/artificial-intelligence/professional-master-degree/master-artificial-intelligence-dentistry](http://www.techtitute.com/us/artificial-intelligence/professional-master-degree/master-artificial-intelligence-dentistry)

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# 01

# Introduction

One of the top priorities of dental professionals is to improve dental care for their patients. In this regard, technological advances have driven new ways to address the management of dental practices. One example of this is Artificial Intelligence (AI). Thanks to these systems, dentists create personalized treatment plans by analyzing users' clinical and radiographic data. Also, these systems can be used during dental procedures to increase accuracy and reduce the risk of errors in oral surgeries such as implant placement. For this reason, TECH is launching a 100% online program that will delve into the approach and planning of AI-assisted therapies.





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*Through this 100% online Professional Master's Degree, you will address the impact of Big Data in Dentistry, examining key concepts and applications”*

Bio-inspired Computing is an interdisciplinary field that draws inspiration from nature and biological processes to design algorithms. Its main objective is to address complex problems and find innovative solutions. For example, this tool is useful for solving optimization difficulties in route planning, network design and resource allocation. Likewise, bio-inspired systems are used in anomaly detection by modeling behavior in complex systems (such as computer networks) to identify threats or attacks.

In this context, TECH is developing a university program that will delve into Bio-inspired Computing, taking into account social adaptation algorithms. The syllabus will analyze various space exploration-exploitation strategies for genetic algorithms. In turn, the syllabus will examine evolutionary programming applied to learning problems. The program will also offer students emerging technologies to improve their dental practice, including 3-D printing, robotic systems and teleodontology. This will enable graduates to provide high quality services, while differentiating themselves from the rest.

Moreover, the revolutionary *Relearning* method is used to ensure gradual learning for students. It is scientifically proven that this teaching model, of which TECH is a pioneer, serves to assimilate knowledge progressively. To this end, it is based on the reiteration of the main concepts so that they remain in the memory without the extra effort involved in memorizing. At the same time, the syllabus is complemented by various audiovisual resources, including explanatory videos, interactive summaries and infographics. All students will need is an electronic device (such as a cell phone, computer or tablet) with Internet access to access the Virtual Campus and expand their knowledge through the most innovative academic content. In addition, the university program includes real case studies in simulated learning environments.

This **Professional Master's Degree in Artificial Intelligence in Dentistry** 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 Artificial Intelligence in Dentistry
- 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



*Get a solid foundation in the principles of Artificial Intelligence in dentistry. Get up to speed with an advanced and adaptable academic program!"*

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*You will be able to interpret from dental images through applications of Computational Intelligence, all thanks to the most innovative multimedia resources”*

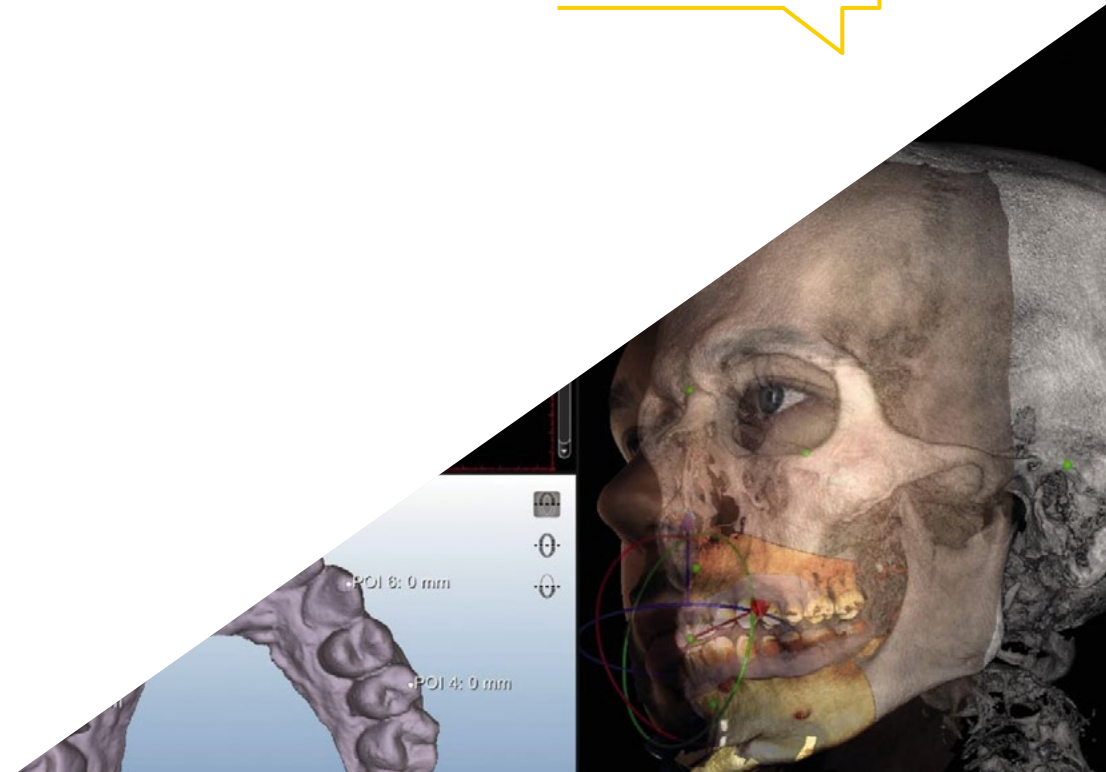
The program's teaching staff includes professionals from the sector who contribute their work experience to this training program, as well as renowned specialists from leading societies and prestigious universities.

The multimedia content, developed with the latest educational technology, will provide 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.

*The use of Machine Learning in Dentistry will improve the accuracy of your diagnoses and treatments.*

*Relearning will allow you to learn with less effort and more performance, getting more involved in your professional specialization.*



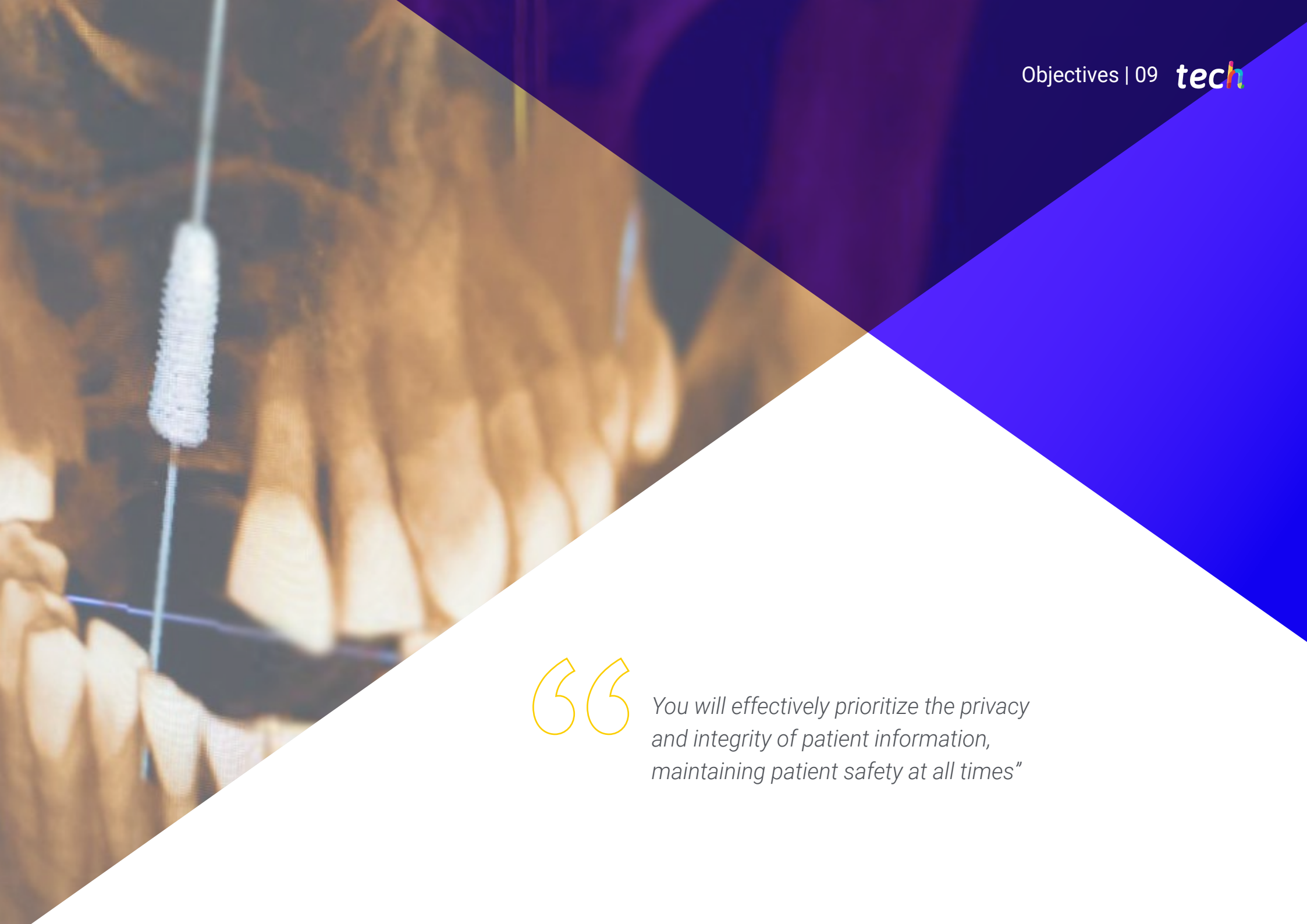
# 02

# Objectives

This university program will provide specialists with a set of technical skills and specialized knowledge to effectively apply AI in the diagnosis, treatment and management of oral health. The academic pathway will focus on providing a thorough understanding of the fundamentals of AI, as well as its specific application in the interpretation of radiographic images, analysis of clinical data and development of predictive tools for dental conditions.







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*You will effectively prioritize the privacy and integrity of patient information, maintaining patient safety at all times”*



## General Objectives

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- Understand the theoretical foundations of Artificial Intelligence
- Study the different types of data and understand the data lifecycle
- Evaluate the crucial role of data in the development and implementation of AI solutions
- Delve into algorithms and complexity to solve specific problems
- Explore the theoretical basis of neural networks for Deep Learning development
- Explore bio-inspired computing and its relevance in the development of intelligent systems
- Analyze current strategies of Artificial Intelligence in various fields, identifying opportunities and challenges
- Gain a solid understanding of Machine Learning principles and their specific application in dental contexts
- Analyze dental data, including visualization techniques to improve diagnostics
- Acquire advanced skills in the application of AI for the accurate diagnosis of oral diseases and interpretation of dental images
- Understand the ethical and privacy considerations associated with the application of AI in dentistry
- Explore ethical challenges, regulations, professional liability, social impact, access to dental care, sustainability, policy development, innovation, and future prospects in the application of AI in dentistry





## Specific Objectives

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### Module 1. Fundamentals of Artificial Intelligence

- ♦ Analyze the historical evolution of Artificial Intelligence, from its beginnings to its current state, identifying key milestones and developments
- ♦ Understand the functioning of neural networks and their application in learning models in Artificial Intelligence
- ♦ Study the principles and applications of genetic algorithms, analyzing their usefulness in solving complex problems
- ♦ Analyze the importance of thesauri, vocabularies and taxonomies in the structuring and processing of data for AI systems
- ♦ Explore the concept of the semantic web and its influence on the organization and understanding of information in digital environments

### Module 2. Data Types and Data Life Cycle

- ♦ Understand the fundamental concepts of statistics and their application in data analysis
- ♦ Identify and classify the different types of statistical data, from quantitative to qualitative data
- ♦ Analyze the life cycle of data, from generation to disposal, identifying key stages
- ♦ Explore the initial stages of the data life cycle, highlighting the importance of data planning and structure
- ♦ Study data collection processes, including methodology, tools and collection channels
- ♦ Explore the Datawarehouse concept, with emphasis on the elements that comprise it and its design
- ♦ Analyze the regulatory aspects related to data management, complying with privacy and security regulations, as well as best practices

### Module 3. Data in Artificial Intelligence

- ♦ Master the fundamentals of data science, covering tools, types and sources for information analysis
- ♦ Explore the process of transforming data into information using data mining and visualization techniques
- ♦ Study the structure and characteristics of datasets, understanding their importance in the preparation and use of data for Artificial Intelligence models
- ♦ Analyze supervised and unsupervised models, including methods and classification
- ♦ Use specific tools and best practices in data handling and processing, ensuring efficiency and quality in the implementation of Artificial Intelligence

### Module 4. Data Mining. Selection, Pre-Processing and Transformation

- ♦ Master the techniques of statistical inference to understand and apply statistical methods in data mining
- ♦ Perform detailed exploratory analysis of data sets to identify relevant patterns, anomalies, and trends
- ♦ Develop skills for data preparation, including data cleaning, integration, and formatting for use in data mining
- ♦ Implement effective strategies for handling missing values in datasets, applying imputation or elimination methods according to context
- ♦ Identify and mitigate noise present in data, using filtering and smoothing techniques to improve the quality of the data set
- ♦ Address data preprocessing in Big Data environments

### Module 5. Algorithm and Complexity in Artificial Intelligence

- ♦ Introduce algorithm design strategies, providing a solid understanding of fundamental approaches to problem solving
- ♦ Analyze the efficiency and complexity of algorithms, applying analysis techniques to evaluate performance in terms of time and space
- ♦ Study and apply sorting algorithms, understanding their performance and comparing their efficiency in different contexts
- ♦ Explore tree-based algorithms, understanding their structure and applications
- ♦ Investigate algorithms with Heaps, analyzing their implementation and usefulness in efficient data manipulation
- ♦ Analyze graph-based algorithms, exploring their application in the representation and solution of problems involving complex relationships
- ♦ Study Greedy algorithms, understanding their logic and applications in solving optimization problems
- ♦ Investigate and apply the backtracking technique for systematic problem solving, analyzing its effectiveness in various scenarios

### Module 6. Intelligent Systems

- ♦ Explore agent theory, understanding the fundamental concepts of its operation and its application in Artificial Intelligence and software engineering
- ♦ Study the representation of knowledge, including the analysis of ontologies and their application in the organization of structured information
- ♦ Analyze the concept of the semantic web and its impact on the organization and retrieval of information in digital environments
- ♦ Evaluate and compare different knowledge representations, integrating these to improve the efficiency and accuracy of intelligent systems
- ♦ Study semantic reasoners, knowledge-based systems and expert systems, understanding their functionality and applications in intelligent decision making

### Module 7. Machine Learning and Data Mining

- ♦ Introduce the processes of knowledge discovery and the fundamental concepts of machine learning
- ♦ Study decision trees as supervised learning models, understanding their structure and applications
- ♦ Evaluate classifiers using specific techniques to measure their performance and accuracy in data classification
- ♦ Study neural networks, understanding their operation and architecture to solve complex machine learning problems
- ♦ Explore Bayesian methods and their application in machine learning, including Bayesian networks and Bayesian classifiers
- ♦ Analyze regression and continuous response models for predicting numerical values from data
- ♦ Study clustering techniques to identify patterns and structures in unlabeled data sets
- ♦ Explore text mining and natural language processing (NLP), understanding how machine learning techniques are applied to analyze and understand text

### Module 8. Neural networks, the basis of Deep Learning

- ♦ Master the fundamentals of Deep Learning, understanding its essential role in Deep Learning
- ♦ Explore the fundamental operations in neural networks and understand their application in model building
- ♦ Analyze the different layers used in neural networks and learn how to select them appropriately
- ♦ Understanding the effective linking of layers and operations to design complex and efficient neural network architectures

- Use trainers and optimizers to tune and improve the performance of neural networks
- Explore the connection between biological and artificial neurons for a deeper understanding of model design
- Tuning hyperparameters for Fine Tuning of neural networks, optimizing their performance on specific tasks

### **Module 9. Deep Neural Networks Training**

- Solve gradient-related problems in deep neural network training
- Explore and apply different optimizers to improve the efficiency and convergence of models
- Program the learning rate to dynamically adjust the convergence speed of the model
- Understand and address overfitting through specific strategies during training
- Apply practical guidelines to ensure efficient and effective training of deep neural networks
- Implement Transfer Learning as an advanced technique to improve model performance on specific tasks
- Explore and apply Data Augmentation techniques to enrich datasets and improve model generalization
- Develop practical applications using Transfer Learning to solve real-world problems
- Understand and apply regularization techniques to improve generalization and avoid overfitting in deep neural networks

### **Module 10. Model Customization and Training with TensorFlow**

- Master the fundamentals of TensorFlow and its integration with NumPy for efficient data management and calculations
- Customize models and training algorithms using the advanced capabilities of TensorFlow
- Explore the tfdata API to efficiently manage and manipulate datasets
- Implement the TFRecord format for storing and accessing large datasets in TensorFlow
- Use Keras preprocessing layers to facilitate the construction of custom models
- Explore the TensorFlow Datasets project to access predefined datasets and improve development efficiency
- Develop a Deep Learning application with TensorFlow, integrating the knowledge acquired in the module
- Apply in a practical way all the concepts learned in building and training custom models with TensorFlow in real-world situations

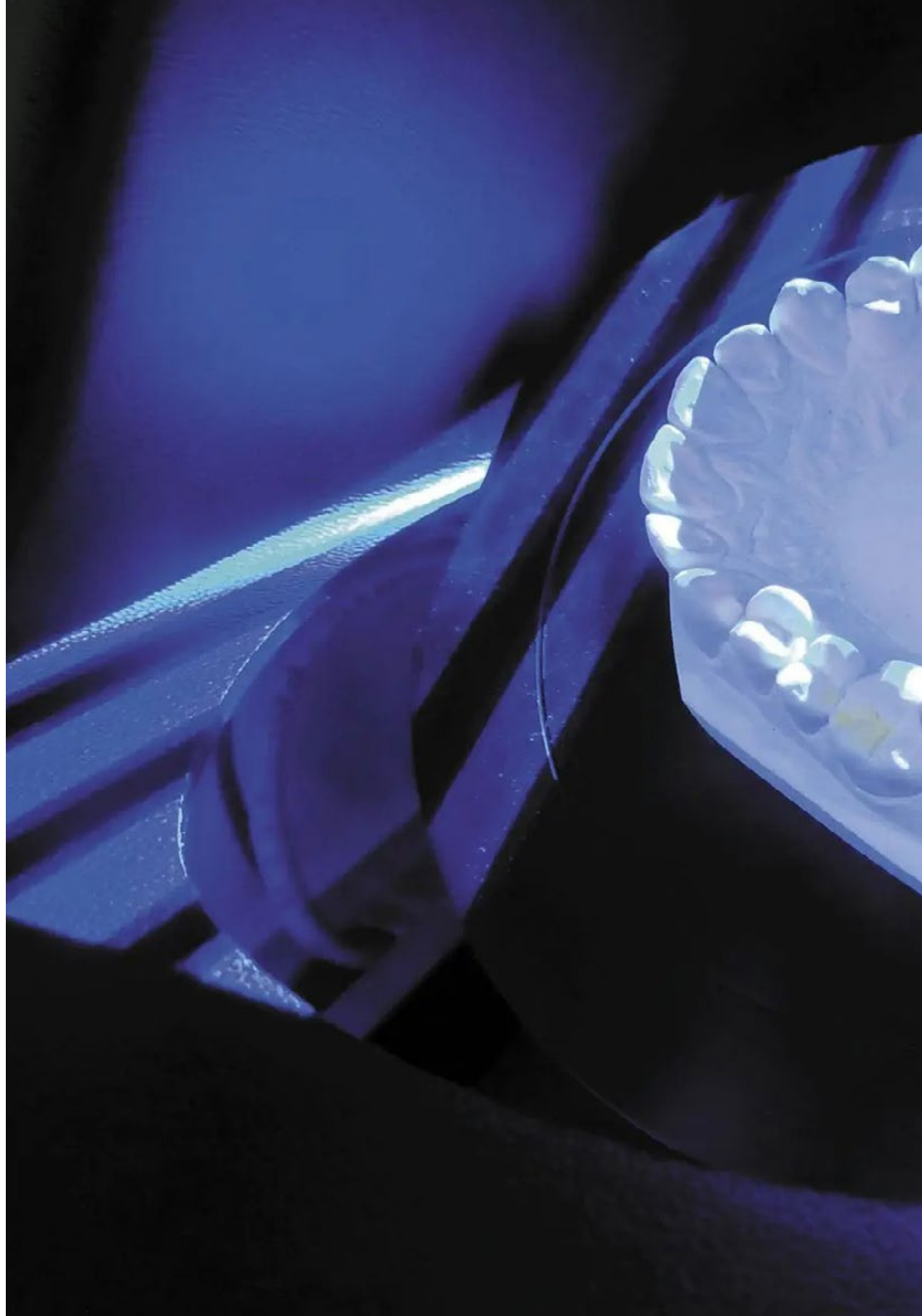
### **Module 11. Deep Computer Vision with Convolutional Neural Networks**

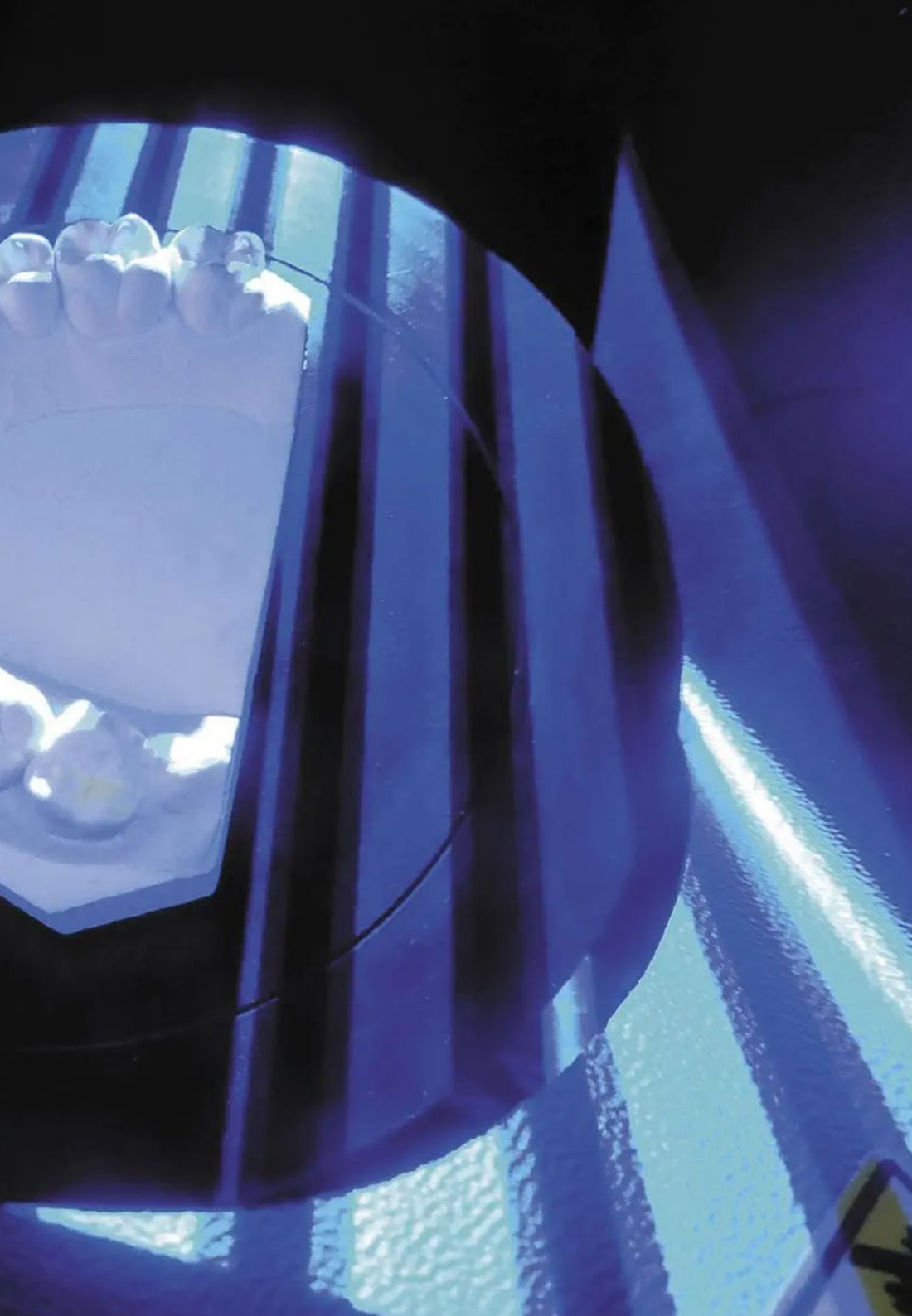
- Understand the architecture of the visual cortex and its relevance in Deep Computer Vision
- Explore and apply convolutional layers to extract key features from images
- Implement clustering layers and their use in Deep Computer Vision models with Keras
- Analyze various Convolutional Neural Network (CNN) architectures and their applicability in different contexts
- Develop and implement a CNN ResNet using the Keras library to improve model efficiency and performance

- Use pre-trained Keras models to leverage transfer learning for specific tasks
- Apply classification and localization techniques in Deep Computer Vision environments
- Explore object detection and object tracking strategies using Convolutional Neural Networks
- Implement semantic segmentation techniques to understand and classify objects in images in a detailed manner

### **Module 12. Natural Language Processing (NLP) with Natural Recurrent Networks (NNN) and Attention**

- Developing skills in text generation using Recurrent Neural Networks (RNN)
- Apply RNNs in opinion classification for sentiment analysis in texts
- Understand and apply attentional mechanisms in natural language processing models
- Analyze and use Transformers models in specific NLP tasks
- Explore the application of Transformers models in the context of image processing and computer vision
- Become familiar with the Hugging Face's Transformers library for efficient implementation of advanced models
- Compare different Transformers libraries to evaluate their suitability for specific tasks
- Develop a practical application of NLP that integrates RNN and attention mechanisms to solve real-world problems





### **Module 13. Autoencoders, GANs, and Diffusion Models**

- ◆ Develop efficient representations of data using Autoencoders, GANs and Diffusion Models
- ◆ Perform PCA using an incomplete linear autoencoder to optimize data representation
- ◆ Implement and understand the operation of stacked autoencoders
- ◆ Explore and apply convolutional autoencoders for efficient visual data representations
- ◆ Analyze and apply the effectiveness of sparse automatic encoders in data representation
- ◆ Generate fashion images from the MNIST dataset using Autoencoders
- ◆ Understand the concept of Generative Adversarial Networks (GANs) and Diffusion Models
- ◆ Implement and compare the performance of Diffusion Models and GANs in data generation

### **Module 14. Bio-Inspired Computing**

- ◆ Introduce the fundamental concepts of bio-inspired computing
- ◆ Explore social adaptation algorithms as a key approach in bio-inspired computing
- ◆ Analyze space exploration-exploitation strategies in genetic algorithms
- ◆ Examine models of evolutionary computation in the context of optimization
- ◆ Continue detailed analysis of evolutionary computation models

- ♦ Apply evolutionary programming to specific learning problems
- ♦ Address the complexity of multi-objective problems in the framework of bio-inspired computing
- ♦ Explore the application of neural networks in the field of bio-inspired computing
- ♦ Delve into the implementation and usefulness of neural networks in bio-inspired computing

### **Module 15. Artificial Intelligence: Strategies and Applications**

- ♦ Develop strategies for the implementation of artificial intelligence in financial services
- ♦ Analyze the implications of artificial intelligence in the delivery of healthcare services
- ♦ Identify and assess the risks associated with the use of AI in the healthcare field
- ♦ Assess the potential risks associated with the use of AI in industry
- ♦ Apply artificial intelligence techniques in industry to improve productivity
- ♦ Design artificial intelligence solutions to optimize processes in public administration
- ♦ Evaluate the implementation of AI technologies in the education sector
- ♦ Apply artificial intelligence techniques in forestry and agriculture to improve productivity
- ♦ Optimize human resources processes through the strategic use of artificial intelligence

### **Module 16. Fundamentals of AI in Dentistry**

- ♦ Acquire solid knowledge of the basic principles of Machine Learning and its specific application in dental contexts
- ♦ Learn methods and tools for analyzing dental data, as well as visualization techniques that enhance interpretation and diagnosis
- ♦ Develop a thorough understanding of the ethical and privacy considerations associated with the application of AI in dentistry, promoting responsible practices in the use of these technologies in clinical settings
- ♦ Familiarize students with the various applications of AI in the field of dentistry, such as oral disease diagnosis, treatment planning, and patient care management
- ♦ Design personalized dental treatment plans according to the specific needs of each patient, taking into account factors such as genetics, medical history and individual preferences

### **Module 17. AI-assisted Dental Diagnostics and Treatment Planning**

- ♦ Acquire expertise in the use of AI for treatment planning, including 3D modeling, orthodontic treatment optimization and treatment plan customization
- ♦ Develop advanced skills in the application of AI for the accurate diagnosis of oral diseases, including interpretation of dental images and pathology detection
- ♦ Obtain competencies to use AI tools in oral health monitoring and oral disease prevention, effectively integrating these technologies into dental practice
- ♦ Collect, manage and use both clinical and radiographic data in AI treatment planning
- ♦ Enable students to evaluate and select AI technologies suitable for their dental practice, considering aspects such as accuracy, reliability and scalability



**Module 18. Innovations and Practical Applications of AI in Dentistry**

- ♦ Develop specialized skills in the application of AI in 3D printing, robotics, dental materials development, clinical management, teleodontology, and automation of administrative tasks, addressing diverse areas of dental practice
- ♦ Acquire the ability to strategically implement AI in dental education and training, ensuring that practitioners are equipped to adapt to constantly evolving technological innovations in the dental field
- ♦ Develop specialized skills in the application of AI in 3D printing, robotics, dental materials development, and automation of administrative tasks
- ♦ Employ AI to analyze patient feedback, optimizing clinical management in dental clinics to improve patient experience
- ♦ Strategically implement AI in dental education, ensuring that professionals are equipped to adapt to the ever-evolving technological innovations in the dental field

**Module 19. Advanced Analytics and Data Processing in Dentistry**

- ♦ Handle large datasets in dentistry, understanding the concepts and applications of Big Data, as well as the implementation of data mining and predictive analytics techniques
- ♦ Acquire expertise in the application of AI in various aspects, such as dental epidemiology, clinical data management, social network analysis and clinical research, using machine learning algorithms
- ♦ Develop advanced skills in the management of large data sets in dentistry, understanding the concepts and applications of Big Data, as well as the implementation of data mining and predictive analytics techniques
- ♦ Employ AI tools for monitoring oral health trends and patterns, contributing to more efficient management
- ♦ Explore and discuss the various ways in which data analytics is used to improve clinical decision making, patient care management and research in Dentistry

**Module 20. Ethics, Regulation and the Future of AI in Dentistry**

- ♦ Understand and address ethical challenges related to the use of AI in dentistry, promoting responsible professional practices
- ♦ Inquire into the regulations and standards relevant to the application of AI in Dentistry, developing skills in policy formulation to ensure safe and ethical practices
- ♦ Address the social, educational, business and sustainable impact of AI in dentistry, to adapt to changes in dental practice in the era of advanced AI
- ♦ Manage the tools necessary to understand and address the ethical challenges related to the use of AI in Dentistry, promoting responsible professional practices
- ♦ Provide students with a thorough understanding of the social, business and sustainable impact of AI in the field of dentistry, preparing them to lead and adapt to changes that arise during their professional practice



*You will get up to date with the most current applications in Artificial Intelligence and apply them to your daily clinical practice as a dentist”*

# 03 Skills

This university program will provide graduates with a comprehensive and up-to-date education that will prepare them to excel in a growing field. Professionals will acquire both advanced skills and an in-depth understanding of clinical management and ethics. In doing so, experts will more than meet the ethical and regulatory challenges in implementing AI in the dental environment. They will also employ state-of-the-art technological tools in their procedures to provide patients with dental excellence.



A close-up photograph showing a person's hands in blue nitrile gloves using dental pliers to work on a dental model. The model consists of several white, rounded teeth. The background is a solid blue color. The image is partially obscured by a white diagonal shape that contains text.

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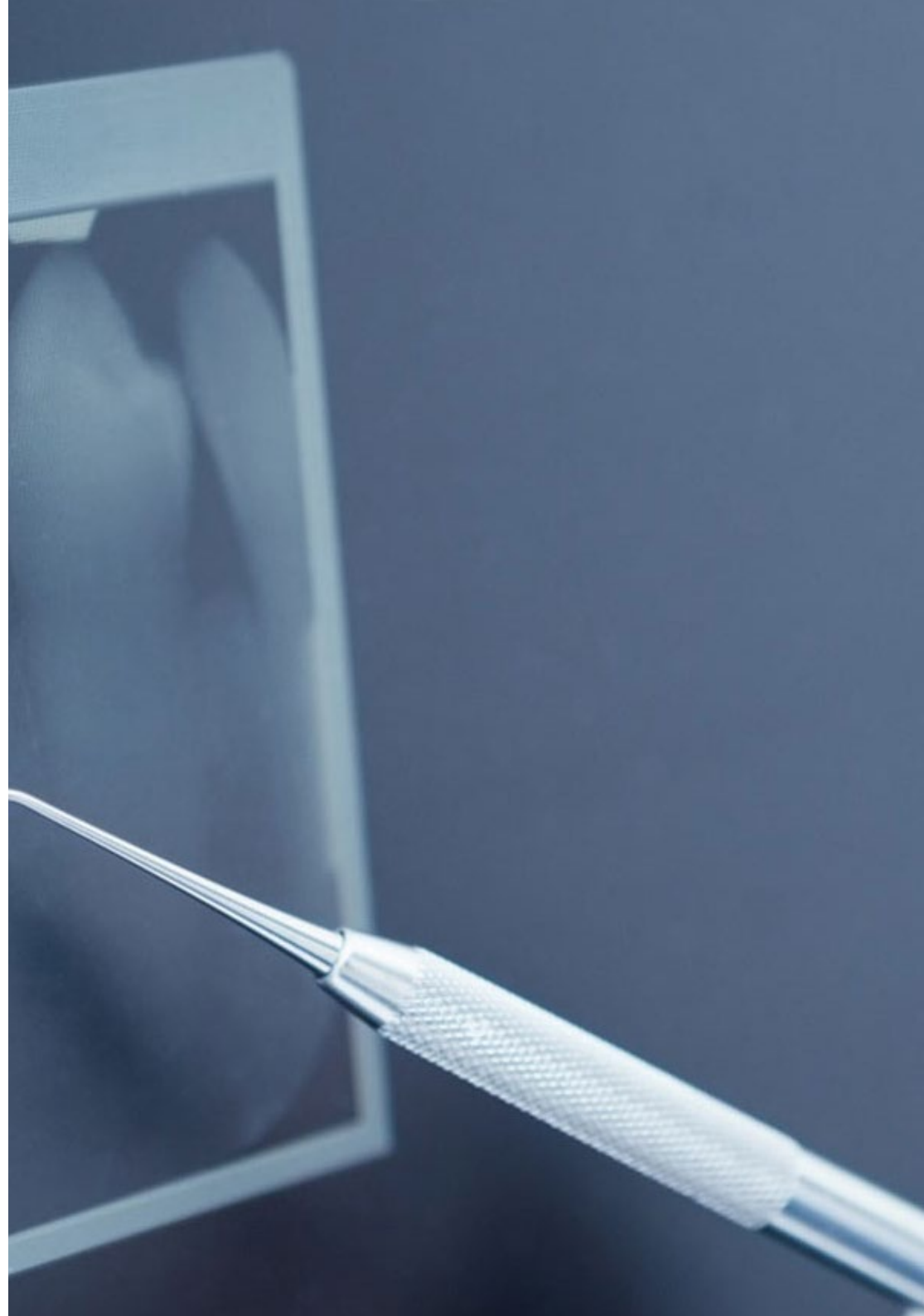
*Through this university program,  
you will master the latest advances  
in innovation and technological  
transformation in dentistry”*

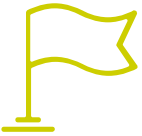


## General Skills

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- ♦ Master data mining techniques, including complex data selection, preprocessing and transformation
- ♦ Design and develop intelligent systems capable of learning and adapting to changing environments
- ♦ Control machine learning tools and their application in data mining for decision making
- ♦ Employ Autoencoders, GANs and Diffusion Models to solve specific challenges in Artificial Intelligence
- ♦ Implement an encoder-decoder network for neural machine translation
- ♦ Apply the fundamental principles of neural networks in solving specific problems
- ♦ Using AI tools in oral health monitoring, oral disease prevention and effective integration of these technologies in dental practice
- ♦ Master the latest AI technologies applied in 3D printing, robotics, clinical management, tele-dentistry and automation of administrative tasks
- ♦ Use AI to analyze patient feedback, improve dental CRM and marketing strategies, and optimize clinical and administrative management in dental clinics
- ♦ Use AI for planning and 3D modeling of orthodontic treatments
- ♦ Handle large datasets, using Big Data concepts, data mining, predictive analytics and machine learning algorithms





## Specific Skills

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- ♦ Apply AI techniques and strategies to improve efficiency in the retail sector
- ♦ Delve into understanding and application of genetic algorithms
- ♦ Implement noise removal techniques using automatic encoders
- ♦ Effectively create training data sets for natural language processing (NLP) tasks
- ♦ Run grouping layers and their use in Deep Computer Vision models with Keras
- ♦ Use TensorFlow features and graphics to optimize the performance of custom models
- ♦ Optimize the development and application of chatbots and virtual assistants, understanding their operation and potential applications
- ♦ Master reuse of pre-workout layers to optimize and accelerate the training process
- ♦ Build the first neural network, applying the concepts learned in practice
- ♦ Activate Multilayer Perceptron (MLP) using the Keras library
- ♦ Apply data scanning and preprocessing techniques, identifying and preparing data for effective use in machine learning models
- ♦ Implement effective strategies for handling missing values in datasets, applying imputation or elimination methods according to context
- ♦ Investigate languages and software for the creation of ontologies, using specific tools for the development of semantic models
- ♦ Develop data cleaning techniques to ensure the quality and accuracy of the information used in subsequent analyses
- ♦ Apply AI for the accurate diagnosis of oral diseases, including dental image interpretation and pathology detection
- ♦ Utilize AI tools in oral health monitoring and oral disease prevention, effectively integrating these technologies into the dental practice
- ♦ Use AI to analyze patient feedback, improve dental marketing and CRM strategies, and optimize clinical and administrative management in dental clinics
- ♦ Using AI tools for monitoring oral health trends and patterns, as well as for cost analysis in dentistry, contributing to a more efficient and data-driven management in the clinical environment



*With the application of Artificial Intelligence, you will optimize diagnoses and treatments to achieve a precise dental practice"*

# 04

# Course Management

This Professional Master's Degree will be taught by a team of specialized professionals with extensive professional experience in the area of AI in Dentistry. Not only their trajectory has been the key for TECH to choose them, but also their current professional work and their proximity will be decisive for the students to reach a more direct knowledge of the reality in this area. Likewise, pharmacists will be able to consult any questions they may have during the course of this program to the teaching team that integrates this university qualification.



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*The faculty of this program has a long history of research and professional application"*

## Management



### Dr. Peralta Martín-Palomino, Arturo

- ♦ CEO and CTO at Prometheus Global Solutions
- ♦ CTO at Korporate Technologies
- ♦ CTO at AI Shephers GmbH
- ♦ Consultant and Strategic Business Advisor at Alliance Medical
- ♦ Director of Design and Development at DocPath
- ♦ Ph.D. in Psychology from the University of Castilla - La Mancha
- ♦ Ph.D. in Economics, Business and Finance from the Camilo José Cela University
- ♦ Ph.D. in Psychology from University of Castilla – La Mancha
- ♦ Professional Master's Degree in Executive MBA by the Isabel I University
- ♦ Professional Master's Degree in Sales and Marketing Management, Isabel I University
- ♦ Expert Master's Degree in Big Data by Hadoop Training
- ♦ Professional Master's Degree in Advanced Information Technologies from the University of Castilla - La Mancha
- ♦ Member of: SMILE Research Group





### **Dr. Martín-Palomino Sahagún, Patricia**

- ♦ Specialist in Dentistry and Orthodontics
- ♦ Private Orthodontist
- ♦ Researcher
- ♦ Ph.D. in Dentistry from the University Alfonso X El Sabio
- ♦ Postgraduate in Orthodontics from the University Alfonso X El Sabio
- ♦ Degree in Dentistry at the University of Alfonso X El Sabio

## **Professors**

### **Mr. Popescu Radu, Daniel Vasile**

- ♦ Pharmacology, Nutrition and Diet Specialist
- ♦ Freelance Producer of Didactic and Scientific Contents
- ♦ Nutritionist and Community Dietitian
- ♦ Community Pharmacist
- ♦ Researcher
- ♦ Professional Master's Degree in Nutrition and Health at the Oberta University of Catalonia (UOC)
- ♦ Professional Master's Degree in Psychopharmacology from the University of Valencia
- ♦ Pharmacist by the Complutense University of Madrid
- ♦ Nutritionist-Dietician at the European University Miguel de Cervantes

### **Dr. Carrasco González, Ramón Alberto**

- ♦ Specialist in Computer Science and Artificial Intelligence
- ♦ Researcher
- ♦ Head of *Business Intelligence* (Marketing) at Caja General de Ahorros de Granada and Banco Mare Nostrum
- ♦ Head of Information Systems (*Data Warehousing* and *Business Intelligence*) at Caja General de Ahorros de Granada and Banco Mare Nostrum
- ♦ Ph.D. in Artificial Intelligence from the University of Granada
- ♦ Computer Engineer from the University of Granada

05

# Structure and Content

This program will provide students with a holistic and multidisciplinary vision of the integration of AI in dentistry. The syllabus will delve into the fundamentals of Machine Learning, data analysis and 3D printing. In this way, students will acquire a profound vision of the technological evolution in the dental field. Likewise, the syllabus will delve into Data Mining, aimed at locating patterns in oral health records to predict the risk of developing diseases. In addition, the balanced approach between theory and practice will enable graduates to lead the responsible adoption of Machine Learning.



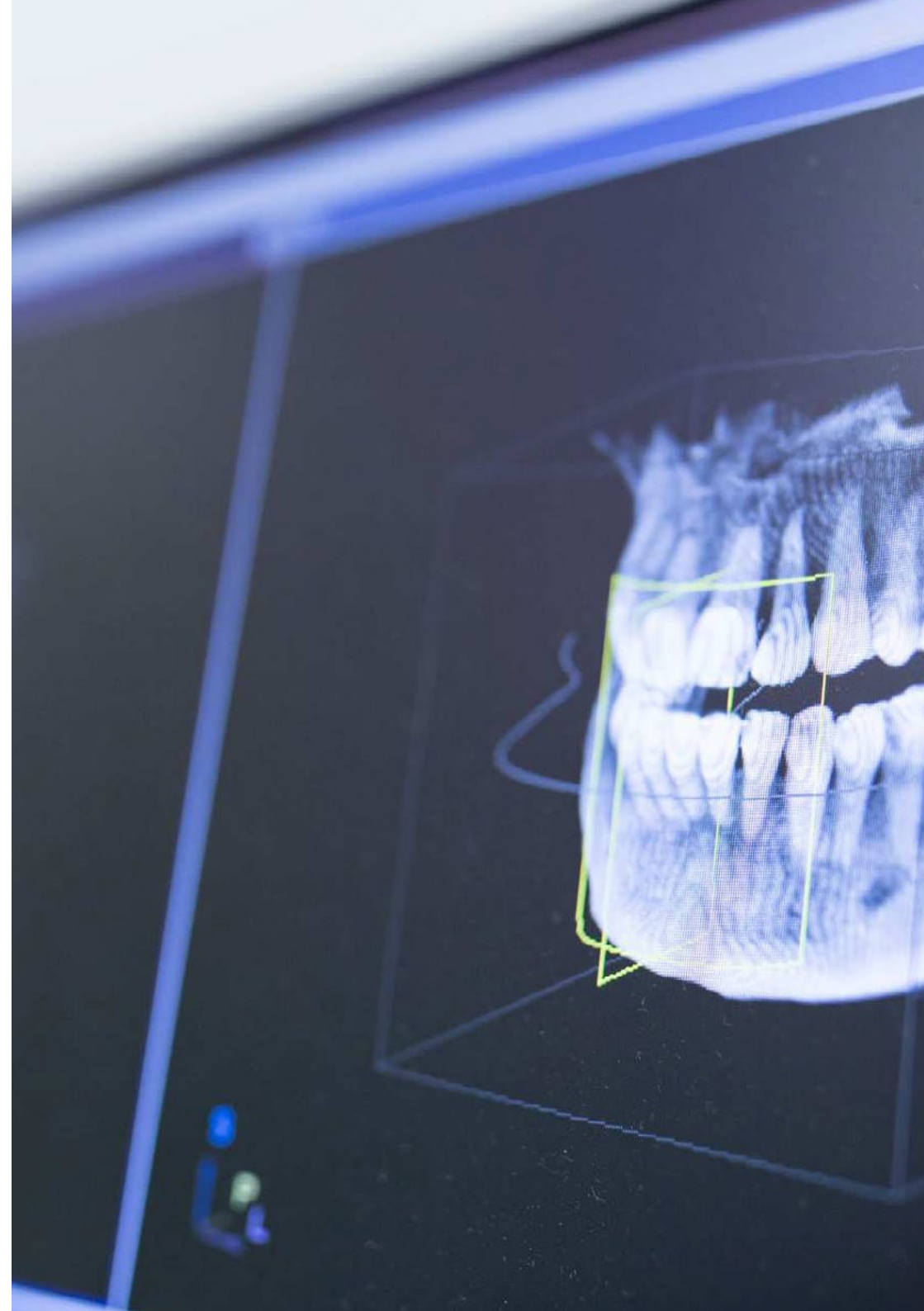


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*A university program that will prepare you to adopt advanced technologies and make a leap in quality in your dental practice”*

## Module 1. Fundamentals of Artificial Intelligence

- 1.1. History of Artificial Intelligence
  - 1.1.1. When Do We Start Talking About Artificial Intelligence?
  - 1.1.2. References in Film
  - 1.1.3. Importance of Artificial Intelligence
  - 1.1.4. Technologies that Enable and Support Artificial Intelligence
- 1.2. Artificial Intelligence in Games
  - 1.2.1. Game Theory
  - 1.2.2. Minimax and Alpha-Beta Pruning
  - 1.2.3. Simulation: Monte Carlo
- 1.3. Neural Networks
  - 1.3.1. Biological Fundamentals
  - 1.3.2. Computational Model
  - 1.3.3. Supervised and Unsupervised Neural Networks
  - 1.3.4. Simple Perceptron
  - 1.3.5. Multilayer Perceptron
- 1.4. Genetic Algorithms
  - 1.4.1. History
  - 1.4.2. Biological Basis
  - 1.4.3. Problem Coding
  - 1.4.4. Generation of the Initial Population
  - 1.4.5. Main Algorithm and Genetic Operators
  - 1.4.6. Evaluation of Individuals: Fitness
- 1.5. Thesauri, Vocabularies, Taxonomies
  - 1.5.1. Vocabulary
  - 1.5.2. Taxonomy
  - 1.5.3. Thesauri
  - 1.5.4. Ontologies
  - 1.5.5. Knowledge Representation Semantic Web
- 1.6. Semantic Web
  - 1.6.1. Specifications RDF, RDFS and OWL
  - 1.6.2. Inference/ Reasoning
  - 1.6.3. Linked Data



- 1.7. Expert Systems and DSS
  - 1.7.1. Expert Systems
  - 1.7.2. Decision Support Systems
- 1.8. Chatbots and Virtual Assistants
  - 1.8.1. Types of Assistants: Voice and Text-based Assistants
  - 1.8.2. Fundamental Parts for the Development of an Assistant: Intents, Entities and Dialogue Flow
  - 1.8.3. Integrations: Web, Slack, WhatsApp, Facebook
  - 1.8.4. Assistant Development Tools: Dialog Flow, Watson Assistant
- 1.9. AI Implementation Strategy
- 1.10. Future of Artificial Intelligence
  - 1.10.1. Understand How to Detect Emotions Using Algorithms
  - 1.10.2. Creation of a Personality: Language, Expressions and Content
  - 1.10.3. Trends of Artificial Intelligence
  - 1.10.4. Reflections

## Module 2. Data Types and Data Life Cycle

- 2.1. Statistics
  - 2.1.1. Statistics: Descriptive Statistics, Statistical Inferences
  - 2.1.2. Population, Sample, Individual
  - 2.1.3. Variables: Definition, Measurement Scales
- 2.2. Types of Data Statistics
  - 2.2.1. According to Type
    - 2.2.1.1. Quantitative: Continuous Data and Discrete Data
    - 2.2.1.2. Qualitative: Binomial Data, Nominal Data and Ordinal Data
  - 2.2.2. According to their Shape
    - 2.2.2.1. Numeric
    - 2.2.2.2. Text:
    - 2.2.2.3. Logical
  - 2.2.3. According to its Source
    - 2.2.3.1. Primary
    - 2.2.3.2. Secondary

- 2.3. Life Cycle of Data
  - 2.3.1. Stages of the Cycle
  - 2.3.2. Milestones of the Cycle
  - 2.3.3. FAIR Principles
- 2.4. Initial Stages of the Cycle
  - 2.4.1. Definition of Goals
  - 2.4.2. Determination of Resource Requirements
  - 2.4.3. Gantt Chart
  - 2.4.4. Data Structure
- 2.5. Data Collection
  - 2.5.1. Methodology of Data Collection
  - 2.5.2. Data Collection Tools
  - 2.5.3. Data Collection Channels
- 2.6. Data Cleaning
  - 2.6.1. Phases of Data Cleansing
  - 2.6.2. Data Quality
  - 2.6.3. Data Manipulation (with R)
- 2.7. Data Analysis, Interpretation and Evaluation of Results
  - 2.7.1. Statistical Measures
  - 2.7.2. Relationship Indices
  - 2.7.3. Data Mining
- 2.8. Data Warehouse (Datawarehouse)
  - 2.8.1. Elements that Comprise it
  - 2.8.2. Design
  - 2.8.3. Aspects to Consider
- 2.9. Data Availability
  - 2.9.1. Access
  - 2.9.2. Uses
  - 2.9.3. Security/Safety
- 2.10. Regulatory Aspects
  - 2.10.1. Data Protection Law
  - 2.10.2. Good Practices
  - 2.10.3. Other Normative Aspects

### Module 3. Data in Artificial Intelligence

- 3.1. Data Science
  - 3.1.1. Data Science
  - 3.1.2. Advanced Tools for Data Scientists
- 3.2. Data, Information and Knowledge
  - 3.2.1. Data, Information and Knowledge
  - 3.2.2. Types of Data
  - 3.2.3. Data Sources
- 3.3. From Data to Information
  - 3.3.1. Data Analysis
  - 3.3.2. Types of Analysis
  - 3.3.3. Extraction of Information from a Dataset
- 3.4. Extraction of Information Through Visualization
  - 3.4.1. Visualization as an Analysis Tool
  - 3.4.2. Visualization Methods
  - 3.4.3. Visualization of a Data Set
- 3.5. Data Quality
  - 3.5.1. Quality Data
  - 3.5.2. Data Cleaning
  - 3.5.3. Basic Data Pre-Processing
- 3.6. Dataset
  - 3.6.1. Dataset Enrichment
  - 3.6.2. The Curse of Dimensionality
  - 3.6.3. Modification of Our Data Set
- 3.7. Unbalance
  - 3.7.1. Classes of Unbalance
  - 3.7.2. Unbalance Mitigation Techniques
  - 3.7.3. Balancing a Dataset
- 3.8. Unsupervised Models
  - 3.8.1. Unsupervised Model
  - 3.8.2. Methods
  - 3.8.3. Classification with Unsupervised Models

- 3.9. Supervised Models
  - 3.9.1. Supervised Model
  - 3.9.2. Methods
  - 3.9.3. Classification with Supervised Models
- 3.10. Tools and Good Practices
  - 3.10.1. Good Practices for Data Scientists
  - 3.10.2. The Best Model
  - 3.10.3. Useful Tools

### Module 4. Data Mining, Selection, Pre-Processing and Transformation

- 4.1. Statistical Inference
  - 4.1.1. Descriptive Statistics vs. Statistical Inference
  - 4.1.2. Parametric Procedures
  - 4.1.3. Non-Parametric Procedures
- 4.2. Exploratory Analysis
  - 4.2.1. Descriptive Analysis
  - 4.2.2. Visualization
  - 4.2.3. Data Preparation
- 4.3. Data Preparation
  - 4.3.1. Integration and Data Cleaning
  - 4.3.2. Normalization of Data
  - 4.3.3. Transforming Attributes
- 4.4. Missing Values
  - 4.4.1. Treatment of Missing Values
  - 4.4.2. Maximum Likelihood Imputation Methods
  - 4.4.3. Missing Value Imputation Using Machine Learning
- 4.5. Noise in the Data
  - 4.5.1. Noise Classes and Attributes
  - 4.5.2. Noise Filtering
  - 4.5.3. The Effect of Noise
- 4.6. The Curse of Dimensionality
  - 4.6.1. Oversampling
  - 4.6.2. Undersampling
  - 4.6.3. Multidimensional Data Reduction

- 4.7. From Continuous to Discrete Attributes
  - 4.7.1. Continuous Data Vs. Discret Data
  - 4.7.2. Discretization Process
- 4.8. The Data
  - 4.8.1. Data Selection
  - 4.8.2. Prospects and Selection Criteria
  - 4.8.3. Selection Methods
- 4.9. Instance Selection
  - 4.9.1. Methods for Instance Selection
  - 4.9.2. Prototype Selection
  - 4.9.3. Advanced Methods for Instance Selection
- 4.10. Data Pre-Processing in Big Data Environments

## Module 5. Algorithm and Complexity in Artificial Intelligence

- 5.1. Introduction to Algorithm Design Strategies
  - 5.1.1. Recursion
  - 5.1.2. Divide and Conquer
  - 5.1.3. Other Strategies
- 5.2. Efficiency and Analysis of Algorithms
  - 5.2.1. Efficiency Measures
  - 5.2.2. Measuring the Size of the Input
  - 5.2.3. Measuring Execution Time
  - 5.2.4. Worst, Best and Average Case
  - 5.2.5. Asymptotic Notation
  - 5.2.6. Criteria for Mathematical Analysis of Non-Recursive Algorithms
  - 5.2.7. Mathematical Analysis of Recursive Algorithms
  - 5.2.8. Empirical Analysis of Algorithms
- 5.3. Sorting Algorithms
  - 5.3.1. Concept of Sorting
  - 5.3.2. Bubble Sorting
  - 5.3.3. Sorting by Selection
  - 5.3.4. Sorting by Insertion
  - 5.3.5. Merge Sort
  - 5.3.6. Quick Sorting (Quick\_Sort)
- 5.4. Algorithms with Trees
  - 5.4.1. Tree Concept
  - 5.4.2. Binary Trees
  - 5.4.3. Tree Paths
  - 5.4.4. Representing Expressions
  - 5.4.5. Ordered Binary Trees
  - 5.4.6. Balanced Binary Trees
- 5.5. Algorithms Using Heaps
  - 5.5.1. Heaps
  - 5.5.2. The Heapsort Algorithm
  - 5.5.3. Priority Queues
- 5.6. Graph Algorithms
  - 5.6.1. Representation
  - 5.6.2. Traversal in Width
  - 5.6.3. Depth Travel
  - 5.6.4. Topological Sorting
- 5.7. Greedy Algorithms
  - 5.7.1. Greedy Strategy
  - 5.7.2. Elements of the Greedy Strategy
  - 5.7.3. Currency Exchange
  - 5.7.4. Traveler's Problem
  - 5.7.5. Backpack Problem
- 5.8. Minimal Path Finding
  - 5.8.1. The Minimum Path Problem
  - 5.8.2. Negative Arcs and Cycles
  - 5.8.3. Dijkstra's Algorithm
- 5.9. Greedy Algorithms on Graphs
  - 5.9.1. The Minimum Covering Tree
  - 5.9.2. Prim's Algorithm
  - 5.9.3. Kruskal's Algorithm
  - 5.9.4. Complexity Analysis
- 5.10. Backtracking
  - 5.10.1. Backtracking
  - 5.10.2. Alternative Techniques

## Module 6. Intelligent Systems

- 6.1. Agent Theory
  - 6.1.1. Concept History
  - 6.1.2. Agent Definition
  - 6.1.3. Agents in Artificial Intelligence
  - 6.1.4. Agents in Software Engineering
- 6.2. Agent Architectures
  - 6.2.1. The Reasoning Process of an Agent
  - 6.2.2. Reactive Agents
  - 6.2.3. Deductive Agents
  - 6.2.4. Hybrid Agents
  - 6.2.5. Comparison
- 6.3. Information and Knowledge
  - 6.3.1. Difference between Data, Information and Knowledge
  - 6.3.2. Data Quality Assessment
  - 6.3.3. Data Collection Methods
  - 6.3.4. Information Acquisition Methods
  - 6.3.5. Knowledge Acquisition Methods
- 6.4. Knowledge Representation
  - 6.4.1. The Importance of Knowledge Representation
  - 6.4.2. Definition of Knowledge Representation According to Roles
  - 6.4.3. Knowledge Representation Features
- 6.5. Ontologies
  - 6.5.1. Introduction to Metadata
  - 6.5.2. Philosophical Concept of Ontology
  - 6.5.3. Computing Concept of Ontology
  - 6.5.4. Domain Ontologies and Higher-Level Ontologies
  - 6.5.5. How to Build an Ontology?
- 6.6. Ontology Languages and Ontology Creation Software
  - 6.6.1. Triple RDF, Turtle and N
  - 6.6.2. RDF Schema
  - 6.6.3. OWL
  - 6.6.4. SPARQL
  - 6.6.5. Introduction to Ontology Creation Tools
  - 6.6.6. Installing and Using Protégé
- 6.7. Semantic Web
  - 6.7.1. Current and Future Status of the Semantic Web
  - 6.7.2. Semantic Web Applications
- 6.8. Other Knowledge Representation Models
  - 6.8.1. Vocabulary
  - 6.8.2. Global Vision
  - 6.8.3. Taxonomy
  - 6.8.4. Thesauri
  - 6.8.5. Folksonomy
  - 6.8.6. Comparison
  - 6.8.7. Mind Maps
- 6.9. Knowledge Representation Assessment and Integration
  - 6.9.1. Zero-Order Logic
  - 6.9.2. First-Order Logic
  - 6.9.3. Descriptive Logic
  - 6.9.4. Relationship between Different Types of Logic
  - 6.9.5. Prolog: Programming Based on First-Order Logic
- 6.10. Semantic Reasoners, Knowledge-Based Systems and Expert Systems
  - 6.10.1. Concept of Reasoner
  - 6.10.2. Reasoner Applications
  - 6.10.3. Knowledge-Based Systems
  - 6.10.4. MYCIN: History of Expert Systems
  - 6.10.5. Expert Systems Elements and Architecture
  - 6.10.6. Creating Expert Systems



## Module 7. Machine Learning and Data Mining

- 7.1. Introduction to Knowledge Discovery Processes and Basic Concepts of Machine Learning
  - 7.1.1. Key Concepts of Knowledge Discovery Processes
  - 7.1.2. Historical Perspective of Knowledge Discovery Processes
  - 7.1.3. Stages of the Knowledge Discovery Processes
  - 7.1.4. Techniques Used in Knowledge Discovery Processes
  - 7.1.5. Characteristics of Good Machine Learning Models
  - 7.1.6. Types of Machine Learning Information
  - 7.1.7. Basic Learning Concepts
  - 7.1.8. Basic Concepts of Unsupervised Learning
- 7.2. Data Exploration and Pre-processing
  - 7.2.1. Data Processing
  - 7.2.2. Data Processing in the Data Analysis Flow
  - 7.2.3. Types of Data
  - 7.2.4. Data Transformations
  - 7.2.5. Visualization and Exploration of Continuous Variables
  - 7.2.6. Visualization and Exploration of Categorical Variables
  - 7.2.7. Correlation Measures
  - 7.2.8. Most Common Graphic Representations
  - 7.2.9. Introduction to Multivariate Analysis and Dimensionality Reduction
- 7.3. Decision Trees
  - 7.3.1. ID Algorithm
  - 7.3.2. Algorithm C
  - 7.3.3. Overtraining and Pruning
  - 7.3.4. Analysis of Results
- 7.4. Evaluation of Classifiers
  - 7.4.1. Confusion Matrixes
  - 7.4.2. Numerical Evaluation Matrixes
  - 7.4.3. Kappa Statistic
  - 7.4.4. ROC Curves
- 7.5. Classification Rules
  - 7.5.1. Rule Evaluation Measures
  - 7.5.2. Introduction to Graphic Representation
  - 7.5.3. Sequential Overlay Algorithm
- 7.6. Neural Networks
  - 7.6.1. Basic Concepts
  - 7.6.2. Simple Neural Networks
  - 7.6.3. Backpropagation Algorithm
  - 7.6.4. Introduction to Recurrent Neural Networks
- 7.7. Bayesian Methods
  - 7.7.1. Basic Probability Concepts
  - 7.7.2. Bayes' Theorem
  - 7.7.3. Naive Bayes
  - 7.7.4. Introduction to Bayesian Networks
- 7.8. Regression and Continuous Response Models
  - 7.8.1. Simple Linear Regression
  - 7.8.2. Multiple Linear Regression
  - 7.8.3. Logistic Regression
  - 7.8.4. Regression Trees
  - 7.8.5. Introduction to Support Vector Machines (SVM)
  - 7.8.6. Goodness-of-Fit Measures
- 7.9. Clustering
  - 7.9.1. Basic Concepts
  - 7.9.2. Hierarchical Clustering
  - 7.9.3. Probabilistic Methods
  - 7.9.4. EM Algorithm
  - 7.9.5. B-Cubed Method
  - 7.9.6. Implicit Methods
- 7.10. Text Mining and Natural Language Processing (NLP)
  - 7.10.1. Basic Concepts
  - 7.10.2. Corpus Creation
  - 7.10.3. Descriptive Analysis
  - 7.10.4. Introduction to Feelings Analysis

## Module 8. Neural networks, the basis of Deep Learning

- 18.1. Deep Learning
  - 8.1.1. Types of Deep Learning
  - 8.1.2. Applications of Deep Learning
  - 8.1.3. Advantages and Disadvantages of Deep Learning
- 8.2. Surgery
  - 8.2.1. Sum
  - 8.2.2. Product
  - 8.2.3. Transfer
- 8.3. Layers
  - 8.3.1. Input Layer
  - 8.3.2. Cloak
  - 8.3.3. Output Layer
- 8.4. Layer Bonding and Operations
  - 8.4.1. Architecture Design
  - 8.4.2. Connection between Layers
  - 8.4.3. Forward Propagation
- 8.5. Construction of the First Neural Network
  - 8.5.1. Network Design
  - 8.5.2. Establish the Weights
  - 8.5.3. Network Training
- 8.6. Trainer and Optimizer
  - 8.6.1. Optimizer Selection
  - 8.6.2. Establishment of a Loss Function
  - 8.6.3. Establishing a Metric
- 8.7. Application of the Principles of Neural Networks
  - 8.7.1. Activation Functions
  - 8.7.2. Backward Propagation
  - 8.7.3. Parameter Adjustment
- 8.8. From Biological to Artificial Neurons
  - 8.8.1. Functioning of a Biological Neuron
  - 8.8.2. Transfer of Knowledge to Artificial Neurons
  - 8.8.3. Establish Relations between the Two

- 8.9. Implementation of MLP (Multilayer Perceptron) with Keras
  - 8.9.1. Definition of the Network Structure
  - 8.9.2. Model Compilation
  - 8.9.3. Model Training
- 8.10. Fine Tuning Hyperparameters of Neural Networks
  - 8.10.1. Selection of the Activation Function
  - 8.10.2. Set the Learning Rate
  - 8.10.3. Adjustment of Weights

## Module 9. Deep Neural Networks Training

- 9.1. Gradient Problems
  - 9.1.1. Gradient Optimization Techniques
  - 9.1.2. Stochastic Gradients
  - 9.1.3. Weight Initialization Techniques
- 9.2. Reuse of Pre-Trained Layers
  - 9.2.1. Learning Transfer Training
  - 9.2.2. Feature Extraction
  - 9.2.3. Deep Learning
- 9.3. Optimizers
  - 9.3.1. Stochastic Gradient Descent Optimizers
  - 9.3.2. Adam and RMSprop Optimizers
  - 9.3.3. Moment Optimizers
- 9.4. Learning Rate Programming
  - 9.4.1. Automatic Learning Rate Control
  - 9.4.2. Learning Cycles
  - 9.4.3. Smoothing Terms
- 9.5. Overfitting
  - 9.5.1. Cross Validation
  - 9.5.2. Regularization
  - 9.5.3. Evaluation Metrics
- 9.6. Practical Guidelines
  - 9.6.1. Model Design
  - 9.6.2. Selection of Metrics and Evaluation Parameters
  - 9.6.3. Hypothesis Testing

- 9.7. Transfer Learning
  - 9.7.1. Learning Transfer Training
  - 9.7.2. Feature Extraction
  - 9.7.3. Deep Learning
- 9.8. Data Augmentation
  - 9.8.1. Image Transformations
  - 9.8.2. Synthetic Data Generation
  - 9.8.3. Text Transformation
- 9.9. Practical Application of Transfer Learning
  - 9.9.1. Learning Transfer Training
  - 9.9.2. Feature Extraction
  - 9.9.3. Deep Learning
- 9.10. Regularization
  - 9.10.1. L and L
  - 9.10.2. Regularization by Maximum Entropy
  - 9.10.3. Dropout

## Module 10. Model Customization and Training with TensorFlow

- 10.1. TensorFlow
  - 10.1.1. Using the TensorFlow library
  - 10.1.2. Model Education with TensorFlow
  - 10.1.3. Operations with graphs in TensorFlow
- 10.2. TensorFlow and NumPy
  - 10.2.1. NumPy computational environment for TensorFlow
  - 10.2.2. Using NumPy arrays with TensorFlow
  - 10.2.3. NumPy operations for TensorFlow graphs
- 10.3. Model Customization and Training Algorithms
  - 10.3.1. Building Custom Models with TensorFlow
  - 10.3.2. Management of Training Parameters
  - 10.3.3. Use of Optimization Techniques for Training
- 10.4. TensorFlow functions and graphs
  - 10.4.1. Functions with TensorFlow
  - 10.4.2. Use of Graphs for Model Training
  - 10.4.3. Optimization of graphs with TensorFlow operations

- 10.5. Data loading and preprocessing with TensorFlow
  - 10.5.1. Loading of datasets with TensorFlow
  - 10.5.2. Data preprocessing with TensorFlow
  - 10.5.3. Using TensorFlow Tools for Data Manipulation
- 10.6. The API tfdata
  - 10.6.1. Using the tfdataAPI for Data Processing
  - 10.6.2. Construction of Data Streams with tfdata
  - 10.6.3. Using the tfdata API for Model Training
- 10.7. The TFRecord format
  - 10.7.1. Using the TFRecord API for Data Serialization
  - 10.7.2. Loading TFRecord Files with TensorFlow
  - 10.7.3. Using TFRecord Files for Training Models
- 10.8. Keras Preprocessing Layers
  - 10.8.1. Using the Keras Preprocessing API
  - 10.8.2. Construction of preprocessing pipelined with Keras
  - 10.8.3. Using the Keras Preprocessing API for Model Training
- 10.9. The TensorFlow Datasets project
  - 10.9.1. Using TensorFlow Datasets for data loading
  - 10.9.2. Data preprocessing with TensorFlow Datasets
  - 10.9.3. Using TensorFlow Datasets for Model Training
- 10.10. Building a Deep Learning application with TensorFlow
  - 10.10.1. Practical Applications
  - 10.10.2. Building a Deep Learning application with TensorFlow
  - 10.10.3. Training a model with TensorFlow
  - 10.10.4. Use of the Application for the Prediction of Results

## Module 11. Deep Computer Vision with Convolutional Neural Networks

- 11.1. The Cortex Visual Architecture
  - 11.1.1. Functions of the Visual Cortex
  - 11.1.2. Theories of Computational Vision
  - 11.1.3. Models of Image Processing
- 11.2. Convolutional Layers
  - 11.2.1. Reuse of Weights in Convolution
  - 11.2.2. Convolution D
  - 11.2.3. Activation Functions
- 11.3. Grouping Layers and Implementation of Grouping Layers with Keras
  - 11.3.1. Pooling and Striding
  - 11.3.2. Flattening
  - 11.3.3. Types of Pooling
- 11.4. CNN Architecture
  - 11.4.1. VGG Architecture
  - 11.4.2. AlexNet architecture
  - 11.4.3. ResNet Architecture
- 11.5. Implementing a CNN ResNet using Keras
  - 11.5.1. Weight Initialization
  - 11.5.2. Input Layer Definition
  - 11.5.3. Output Definition
- 11.6. Use of Pre-trained Keras Models
  - 11.6.1. Characteristics of Pre-trained Models
  - 11.6.2. Uses of Pre-trained Models
  - 11.6.3. Advantages of Pre-trained Models
- 11.7. Pre-trained Models for Transfer Learning
  - 11.7.1. Transfer Learning
  - 11.7.2. Transfer Learning Process
  - 11.7.3. Advantages of Transfer Learning
- 11.8. Deep Computer Vision Classification and Localization
  - 11.8.1. Image Classification
  - 11.8.2. Localization of Objects in Images
  - 11.8.3. Object Detection

- 11.9. Object Detection and Object Tracking
  - 11.9.1. Object Detection Methods
  - 11.9.2. Object Tracking Algorithms
  - 11.9.3. Tracking and Localization Techniques
- 11.10. Semantic Segmentation
  - 11.10.1. Deep Learning for Semantic Segmentation
  - 11.10.1. Edge Detection
  - 11.10.1. Rule-based Segmentation Methods

## Module 12. Natural Language Processing (NLP) with Natural Recurrent Networks (NNN) and Attention

- 12.1. Text Generation using RNN
  - 12.1.1. Training an RNN for Text Generation
  - 12.1.2. Natural Language Generation with RNN
  - 12.1.3. Text Generation Applications with RNN
- 12.2. Training Data Set Creation
  - 12.2.1. Preparation of the Data for Training an RNN
  - 12.2.2. Storage of the Training Dataset
  - 12.2.3. Data Cleaning and Transformation
  - 12.2.4. Sentiment Analysis
- 12.3. Classification of Opinions with RNN
  - 12.3.1. Detection of Themes in Comments
  - 12.3.2. Sentiment Analysis with Deep Learning Algorithms
- 12.4. Encoder-decoder Network for Neural Machine Translation
  - 12.4.1. Training an RNN for Machine Translation
  - 12.4.2. Use of an encoder-decoder network for machine translation
  - 12.4.3. Improving the Accuracy of Machine Translation with RNNs
- 12.5. Attention Mechanisms
  - 12.5.1. Application of Care Mechanisms in RNN
  - 12.5.2. Use of Care Mechanisms to Improve the Accuracy of the Models
  - 12.5.3. Advantages of Attention Mechanisms in Neural Networks
- 12.6. Transformer models
  - 12.6.1. Use of Transformers models for natural language processing
  - 12.6.2. Application of Transformers models for vision



- 12.6.3. Advantages of Transformers models
- 12.7. Transformers for vision
  - 12.7.1. Use of Transformers models for vision
  - 12.7.2. Image Data Preprocessing
  - 12.7.3. Training a TransformersModel for Vision
- 12.8. Hugging Face Transformer Library
  - 12.8.1. Using the Hugging Face Transformers Library
  - 12.8.2. Application of the Hugging Face Transformers Library
  - 12.8.3. Advantages of the Hugging Face Transformers library
- 12.9. Other Transformers Libraries. Comparison
  - 12.9.1. Comparison between the different Transformers libraries
  - 12.9.2. Use of the other Transformers libraries
  - 12.9.3. Advantages of the other Transformers libraries
- 12.10. Development of an NLP Application with RNN and Attention. Practical Applications
  - 12.10.1. Development of a Natural Language Processing Application with RNN and Attention
  - 12.10.2. Use of RNN, Attention Mechanisms and Transformers Models in the Application
  - 12.10.3. Evaluation of the Practical Application

### Module 13. Autoencoders, GANs and Diffusion Models

- 13.1. Representation of Efficient Data
  - 13.1.1. Dimensionality Reduction
  - 13.1.2. Deep Learning
  - 13.1.3. Compact Representations
- 13.2. PCA Realization with an Incomplete Linear Automatic Encoder
  - 13.2.1. Training Process
  - 13.2.2. Implementation in Python
  - 13.2.3. Use of Test Data
- 13.3. Stacked Automatic Encoders
  - 13.3.1. Deep Neural Networks
  - 13.3.2. Construction of Coding Architectures
  - 13.3.3. Use of Regularization

- 13.4. Convolutional Autoencoders
  - 13.4.1. Design of Convolutional Models
  - 13.4.2. Convolutional Model Training
  - 13.4.3. Results Evaluation
- 13.5. Automatic Encoder Denoising
  - 13.5.1. Application of Filters
  - 13.5.2. Design of Coding Models
  - 13.5.3. Use of Regularization Techniques
- 13.6. Sparse Automatic Encoders
  - 13.6.1. Increasing Coding Efficiency
  - 13.6.2. Minimizing the Number of Parameters
  - 13.6.3. Using Regularization Techniques
- 13.7. Variational Automatic Encoders
  - 13.7.1. Use of Variational Optimization
  - 13.7.2. Unsupervised Deep Learning
  - 13.7.3. Deep Latent Representations
- 13.8. Generation of Fashion MNIST Images
  - 13.8.1. Pattern Recognition
  - 13.8.2. Image Generation
  - 13.8.3. Deep Neural Networks Training
- 13.9. Generative Adversarial Networks and Diffusion Models
  - 13.9.1. Content Generation from Images
  - 13.9.2. Modeling of Data Distributions
  - 13.9.3. Use of Adversarial Networks
- 13.10. Model Implementation
  - 13.10.1. Practical Application
  - 13.10.2. Implementation of the Models
  - 13.10.3. Use of Real Data
  - 13.10.4. Results Evaluation

## Module 14. Bio-Inspired Computing

- 14.1. Introduction to Bio-Inspired Computing
  - 14.1.1. Introduction to Bio-Inspired Computing
- 14.2. Social Adaptation Algorithms
  - 14.2.1. Bio-Inspired Computation Based on Ant Colonies
  - 14.2.2. Variants of Ant Colony Algorithms
  - 14.2.3. Particle Cloud Computing
- 14.3. Genetic Algorithms
  - 14.3.1. General Structure
  - 14.3.2. Implementations of the Major Operators
- 14.4. Space Exploration-Exploitation Strategies for Genetic Algorithms
  - 14.4.1. CHC Algorithm
  - 14.4.2. Multimodal Problems
- 14.5. Evolutionary Computing Models (I)
  - 14.5.1. Evolutionary Strategies
  - 14.5.2. Evolutionary Programming
  - 14.5.3. Algorithms Based on Differential Evolution
- 14.6. Evolutionary Computing Models (II)
  - 14.6.1. Evolutionary Models Based on Estimation of Distributions (EDA)
  - 14.6.2. Genetic Programming
- 14.7. Evolutionary Programming Applied to Learning Problems
  - 14.7.1. Rules-Based Learning
  - 14.7.2. Evolutionary Methods in Instance Selection Problems
- 14.8. Multi-Objective Problems
  - 14.8.1. Concept of Dominance
  - 14.8.2. Application of Evolutionary Algorithms to Multi-Objective Problems
- 14.9. Neural Networks (I)
  - 14.9.1. Introduction to Neural Networks
  - 14.9.2. Practical Example with Neural Networks
- 14.10. Neural Networks (II)
  - 14.10.1. Use Cases of Neural Networks in Medical Research
  - 14.10.2. Use Cases of Neural Networks in Economics
  - 14.10.3. Use Cases of Neural Networks in Artificial Vision

**Module 15. Artificial Intelligence: Strategies and Applications**

- 15.1. Financial Services
  - 15.1.1. The Implications of Artificial Intelligence (AI) in Financial Services. Opportunities and Challenges
  - 15.1.2. Case Uses
  - 15.1.3. Potential Risks Related to the Use of AI
  - 15.1.4. Potential Future Developments/uses of AI
- 15.2. Implications of Artificial Intelligence in the Healthcare Service
  - 15.2.1. Implications of AI in the Healthcare Sector. Opportunities and Challenges
  - 15.2.2. Case Uses
- 15.3. Risks Related to the Use of AI in the Health Service
  - 15.3.1. Potential Risks Related to the Use of AI
  - 15.3.2. Potential Future Developments/uses of AI
- 15.4. Retail
  - 15.4.1. Implications of AI in the Retail. Opportunities and Challenges
  - 15.4.2. Case Uses
  - 15.4.3. Potential Risks Related to the Use of AI
  - 15.4.4. Potential Future Developments/uses of AI
- 15.5. Industry
  - 15.5.1. Implications of AI in Industry. Opportunities and Challenges
  - 15.5.2. Case Uses
- 15.6. Potential Risks Related to the Use of AI in Industry
  - 15.6.1. Case Uses
  - 15.6.2. Potential Risks Related to the Use of AI
  - 15.6.3. Potential Future Developments/uses of AI
- 15.7. Public Administration
  - 15.7.1. AI Implications for Public Administration. Opportunities and Challenges
  - 15.7.2. Case Uses
  - 15.7.3. Potential Risks Related to the Use of AI
  - 15.7.4. Potential Future Developments/uses of AI
- 15.8. Educational

- 15.8.1. AI Implications for Education. Opportunities and Challenges
  - 15.8.2. Case Uses
  - 15.8.3. Potential Risks Related to the Use of AI
  - 15.8.4. Potential Future Developments/uses of AI
- 15.9. Forestry and Agriculture
    - 15.9.1. Implications of AI in Forestry and Agriculture. Opportunities and Challenges
    - 15.9.2. Case Uses
    - 15.9.3. Potential Risks Related to the Use of AI
    - 15.9.4. Potential Future Developments/uses of AI
  - 15.10. Human Resources
    - 15.10.1. Implications of AI for Human Resources Opportunities and Challenges
    - 15.10.2. Case Uses
    - 15.10.3. Potential Risks Related to the Use of AI
    - 15.10.4. Potential Future Developments/uses of AI

**Module 16. Monitoring and Control of Dental Health using AI**

- 16.1. AI Applications for Patient's Dental Health Management
  - 16.1.1. Design of Mobile Applications for Dental Hygiene Monitoring
  - 16.1.2. AI Systems for the Early Detection of Caries and Periodontal Diseases
  - 16.1.3. Use of AI in the Personalization of Dental Treatments
  - 16.1.4. Image Recognition Technologies for Automated Dental Diagnostics
- 16.2. Integration of Clinical and Biomedical Information as a Basis for Dental Health Monitoring
  - 16.2.1. Platforms for Integration of Clinical and Radiographic Data
  - 16.2.2. Analysis of Medical Records to Identify Dental Risks
  - 16.2.3. Systems for Correlating Biomedical Data with Dental Conditions
  - 16.2.4. Tools for the Unified Management of Patient Information
- 16.3. Definition of Indicators for the Control of the Patient's Dental Health
  - 16.3.1. Establishment of Parameters for the Evaluation of Oral Health
  - 16.3.2. Systems for Monitoring Progress in Dental Treatments
  - 16.3.3. Development of Risk Indexes for Dental Disease
  - 16.3.4. AI Methods for the Prediction of Future Dental Problems

- 16.4. Natural Language Processing of Dental Health Records for Indicator Extraction
  - 16.4.1. Automatic Extraction of Relevant Data from Dental Records
  - 16.4.2. Analysis of Clinical Notes to Identify Dental Health Trends
  - 16.4.3. Use of NLP to Summarize Long Medical Records
  - 16.4.4. Early Warning Systems Based on Clinical Text Analysis
- 16.5. AI Tools for the Monitoring and Control of Dental Health Indicators
  - 16.5.1. Development of Applications for Monitoring Oral Hygiene and Oral Health
  - 16.5.2. AI-based Personalized Patient Alerts Systems
  - 16.5.3. Analytical Tools for Continuous Assessment of Dental Health
  - 16.5.4. Use of Wearables and Sensors for Real-Time Dental Monitoring
- 16.6. Development of Dashboards for the Monitoring of Dental Indicators
  - 16.6.1. Creation of Intuitive Interfaces for Dental Health Monitoring
  - 16.6.2. Integration of Data from Different Clinical Sources into a Single Dashboard
  - 16.6.3. Data Visualization Tools for Treatment Monitoring
  - 16.6.4. Customization of Dashboards According to the Needs of the Dental Professional
- 16.7. Interpretation of Dental Health Indicators and Decision Making
  - 16.7.1. Data-driven Clinical Decision Support Systems
  - 16.7.2. Predictive Analytics for Dental Treatment Planning
  - 16.7.3. AI for Interpretation of Complex Oral Health Indicators
  - 16.7.4. Tools for the Evaluation of Treatment Effectiveness
- 16.8. Generation of Dental Health Reports using AI Tools
  - 16.8.1. Automation of the Creation of Detailed Dental Reports
  - 16.8.2. Customized Report Generation Systems for Patients
  - 16.8.3. AI Tools for Summarizing Clinical Findings
  - 16.8.4. Integration of Clinical and Radiological Data into Automated Reports
- 16.9. AI-enabled Platforms for Patient Monitoring of Dental Health
  - 16.9.1. Applications for Oral Health Self-monitoring
  - 16.9.2. AI-based Interactive Dental Education Platforms
  - 16.9.3. Tools for Symptom Tracking and Personalized Dental Advice
  - 16.9.4. Gamification Systems to Encourage Good Dental Hygiene Habits
- 16.10. Security and Privacy in the Treatment of Dental Information
  - 16.10.1. Security Protocols for the Protection of Patient Data
  - 16.10.2. Encryption and Anonymization Systems in the Management of Clinical Data
  - 16.10.3. Regulations and Legal Compliance in the Management of Dental Information
  - 16.10.4. Privacy Education and Awareness for Professionals and Patients

## Module 17. AI-assisted Dental Diagnostics and Treatment Planning

- 17.1. AI in Oral Disease Diagnosis
  - 17.1.1. Use of Machine Learning Algorithms to Identify Oral Diseases
  - 17.1.2. Integration of AI in Diagnostic Equipment for Real-Time Analysis
  - 17.1.3. AI-assisted Diagnostic Systems to Improve Accuracy
  - 17.1.4. Analysis of Symptoms and Clinical Signals through AI for Rapid Diagnostics
- 17.2. Dental Image Analysis with AI
  - 17.2.1. Development of Software for the Automatic Interpretation of Dental Radiographs
  - 17.2.2. AI in the Detection of Abnormalities in Oral MRI Images
  - 17.2.3. Improvement in the Quality of Dental Imaging through AI Technologies
  - 17.2.4. Deep Learning Algorithms for Classifying Dental Conditions in Imaging
- 17.3. AI in Caries and Dental Pathology Detection
  - 17.3.1. Pattern Recognition Systems for Identifying Early Cavities
  - 17.3.2. AI for Risk Assessment of Dental Pathologies
  - 17.3.3. Computer Vision Technologies in the Detection of Periodontal Diseases
  - 17.3.4. AI Tools for Caries Monitoring and Progression
- 17.4. 3D Modeling and Treatment Planning with AI
  - 17.4.1. Using AI to Create Accurate 3D Models of the Oral Cavity
  - 17.4.2. AI Systems in the Planning of Complex Dental Surgeries
  - 17.4.3. Simulation Tools for Predicting Treatment Outcomes
  - 17.4.4. AI in the Customization of Prosthetics and Dental Appliances
- 17.5. Optimization of Orthodontic Treatments using AI
  - 17.5.1. AI in the Planning and Follow-up of Orthodontic Treatments
  - 17.5.2. Algorithms for the Prediction of Tooth Movements and Orthodontic Adjustments
  - 17.5.3. AI Analysis to Reduce Orthodontic Treatment Time
  - 17.5.4. Real-time Remote Monitoring and Treatment Adjustment Systems
- 17.6. Risk Prediction in Dental Treatments
  - 17.6.1. AI Tools for Risk Assessment in Dental Procedures
  - 17.6.2. Decision Support Systems for Identifying Potential Complications
  - 17.6.3. Predictive Models for Anticipating Treatment Reactions
  - 17.6.4. Analysis of Clinical Histories using AI to Personalize Treatments



- 17.7. Personalization of Treatment Plans with AI
    - 17.7.1. AI in the Adaptation of Dental Treatments to Individual Needs
    - 17.7.2. AI-based Treatment Recommender Systems
    - 17.7.3. Analysis of Oral Health Data for Personalized Treatment Planning
    - 17.7.4. AI Tools for Adjusting Treatments Based on Patient Response
  - 17.8. Oral Health Monitoring with Intelligent Technologies
    - 17.8.1. Smart Devices for Oral Hygiene Monitoring
    - 17.8.2. AI-enabled Mobile Applications for Dental Health Monitoring
    - 17.8.3. Wearables with Sensors to Detect Changes in Oral Health
    - 17.8.4. AI-based Early Warning Systems to Prevent Oral Diseases
  - 17.9. AI in Oral Disease Prevention
    - 17.9.1. AI Algorithms to Identify Risk Factors for Oral Diseases
    - 17.9.2. Oral Health Education and Awareness Systems with AI
    - 17.9.3. Predictive Tools for the Early Prevention of Dental Problems
    - 17.9.4. AI in the Promotion of Healthy Habits for Oral Prevention
  - 17.10. Case Studies: Diagnostic and Planning Successes with AI
    - 17.10.1. Analysis of Real Cases where AI Improved Dental Diagnosis
    - 17.10.2. Successful Case Studies on the Implementation of AI for Treatment Planning
    - 17.10.3. Treatment Comparisons with and without the Use of AI
    - 17.10.4. Documentation of Improvements in Clinical Efficiency and Effectiveness with AI
- Module 18. Innovation with AI in Dentistry**
- 18.1. 3D Printing and Digital Fabrication in Dentistry
    - 18.1.1. Use of 3D Printing for the Creation of Customized Dental Prostheses
    - 18.1.2. Fabrication of Orthodontic Splints and Aligners using 3D Technology
    - 18.1.3. Development of Dental Implants using 3D Printing
    - 18.1.4. Application of Digital Fabrication Techniques in Dental Restoration
  - 18.2. Robotics in Dental Procedures
    - 18.2.1. Implementation of Robotic Arms for Precision Dental Surgeries
    - 18.2.2. Use of Robots in Endodontic and Periodontic Procedures
    - 18.2.3. Development of Robotic Systems for Dental Operations Assistance
    - 18.2.4. Integration of Robotics in the Practical Teaching of Dentistry
  - 18.3. Development of AI-assisted Dental Materials
    - 18.3.1. Use of AI to Innovate in Dental Restorative Materials
    - 18.3.2. Predictive Analytics for Durability and Efficiency of New Dental Materials
    - 18.3.3. AI in the Optimization of Properties of Materials such as Resins and Ceramics
    - 18.3.4. AI Systems to Customize Materials according to Patient's Needs
  - 18.4. AI-enabled Dental Practice Management
    - 18.4.1. AI Systems for Efficient Appointment and Scheduling Management
    - 18.4.2. Data Analysis to Improve Quality of Dental Services
    - 18.4.3. AI Tools for Inventory Management in Dental Clinics
    - 18.4.4. Use of AI in the Evaluation and Continuous Improvement of Dental Practice
  - 18.5. Teleodontology and Virtual Consultations
    - 18.5.1. Tele-dentistry Platforms for Remote Consultations
    - 18.5.2. Use of Videoconferencing Technologies for Remote Diagnosis
    - 18.5.3. AI Systems for Online Preliminary Assessment of Dental Conditions
    - 18.5.4. Tools for Secure Communication between Patients and Dentists
  - 18.6. Automation of Administrative Tasks in Dental Clinics
    - 18.6.1. Implementation of AI Systems for Billing and Accounting Automation
    - 18.6.2. Use of AI Software in Patient Record Management
    - 18.6.3. AI Tools for Optimization of Administrative Workflows
    - 18.6.4. Automatic Scheduling and Reminder Systems for Dental Appointments
  - 18.7. Sentiment Analysis of Patient Opinions
    - 18.7.1. Use of AI to Assess Patient Satisfaction through Online Feedback
    - 18.7.2. Natural Language Processing Tools for Analyzing Patient Feedback
    - 18.7.3. AI Systems to Identify Areas for Improvement in Dental Services
    - 18.7.4. Analysis of Patient Trends and Perceptions using AI
  - 18.8. AI in Marketing and Patient Relationship Management
    - 18.8.1. Implementation of AI Systems to Personalize Dental Marketing Strategies
    - 18.8.2. AI Tools for Customer Behavioral Analysis
    - 18.8.3. Use of AI in the Management of Marketing Campaigns and Promotions
    - 18.8.4. AI-based Patient Recommendation and Loyalty Systems

- 18.9. Safety and Maintenance of AI Dental Equipment
  - 18.9.1. AI Systems for Monitoring and Predictive Maintenance of Dental Equipment
  - 18.9.2. Use of AI in Ensuring Compliance with Safety Regulations
  - 18.9.3. Automated Diagnostic Tools for Equipment Failure Detection
  - 18.9.4. Implementation of AI-assisted Safety Protocols in Dental Practices
- 18.10. Integration of AI in Dental Education and Training
  - 18.10.1. Use of AI in Simulators for Hands-on Training in Dentistry
  - 18.10.2. AI Tools for the Personalization of Learning in Dentistry
  - 18.10.3. Systems for Evaluation and Monitoring of Educational Progress using AI
  - 18.10.4. Integration of AI Technologies in the Development of Curricula and Didactic Materials

### Module 19. Advanced Analytics and Data Processing in Dentistry

- 19.1. Big Data in Dentistry: Concepts and Applications
  - 19.1.1. The Explosion of Data in Dentistry
  - 19.1.2. Concept of Big Data
  - 19.1.3. Applications of Big Data in Dentistry
- 19.2. Data Mining in Dental Records
  - 19.2.1. Main Methodologies for Data Mining
  - 19.2.2. Integration of Data from Dental Records
  - 19.2.3. Detection of Patterns and Anomalies in Dental Records
- 19.3. Advanced Predictive Analytics Techniques in Oral Health
  - 19.3.1. Classification Techniques for Oral Health Analysis
  - 19.3.2. Regression Techniques for Oral Health Analytics
  - 19.3.3. Deep Learning for Oral Health Analysis
- 19.4. AI Models for Dental Epidemiology
  - 19.4.1. Classification Techniques for Dental Epidemiology
  - 19.4.2. Regression Techniques for Dental Epidemiology
  - 19.4.3. Unsupervised Techniques for Dental Epidemiology
- 19.5. AI for Clinical and Radiographic Data Management
  - 19.5.1. Integration of Clinical Data for Effective Management with AI Tools
  - 19.5.2. Transformation of Radiographic Diagnosis using Advanced AI Systems
  - 19.5.3. Integrated Management of Clinical and Radiographic Data

- 19.6. Machine Learning Algorithms in Dental Research
  - 19.6.1. Classification Techniques in Dental Research
  - 19.6.2. Regression Techniques in Dental Research
  - 19.6.3. Unsupervised Techniques in Dental Research
- 19.7. Social Network Analysis in Oral Health Communities
  - 19.7.1. Introduction to Social Network Analysis
  - 19.7.2. Analysis of Opinions and Sentiment in Social Networks in Oral Health Communities
  - 19.7.3. Analysis of Social Network Trends in Oral Health Communities
- 19.8. AI in Monitoring Oral Health Trends and Patterns
  - 19.8.1. Early Detection of Epidemiologic Trends with AI
  - 19.8.2. Continuous Monitoring of Oral Hygiene Patterns with AI Systems
  - 19.8.3. Prediction of Changes in Oral Health with AI Models
- 19.9. AI Tools for Cost Analysis in Dentistry
  - 19.9.1. Optimization of Resources and Costs with AI Tools
  - 19.9.2. Efficiency and Cost-Effectiveness Analysis in Dental Practices with AI
  - 19.9.3. Cost Reduction Strategies Based on AI-analyzed Data
- 19.10. Innovations in AI for Dental Clinical Research
  - 19.10.1. Implementation of Emerging Technologies in Dental Clinical Research
  - 19.10.2. Improving the Validation of Dental Clinical Research Results with AI
  - 19.10.3. Multidisciplinary Collaboration in AI-powered Detailed Clinical Research

### Module 20. Ethics, Regulation and the Future of AI in Dentistry

- 20.1. Ethical Challenges in the Use of AI in Dentistry
  - 20.1.1. Ethics in AI-assisted Clinical Decision Making
  - 20.1.2. Patient Privacy in Intelligent Dentistry Environments
  - 20.1.3. Professional Accountability and Transparency in AI Systems
- 20.2. Ethical Considerations in the Collection and Use of Dental Data
  - 20.2.1. Informed Consent and Ethical Data Management in Dentistry
  - 20.2.2. Security and Confidentiality in the Handling of Sensitive Data
  - 20.2.3. Ethics in Research with Large Datasets in Dentistry

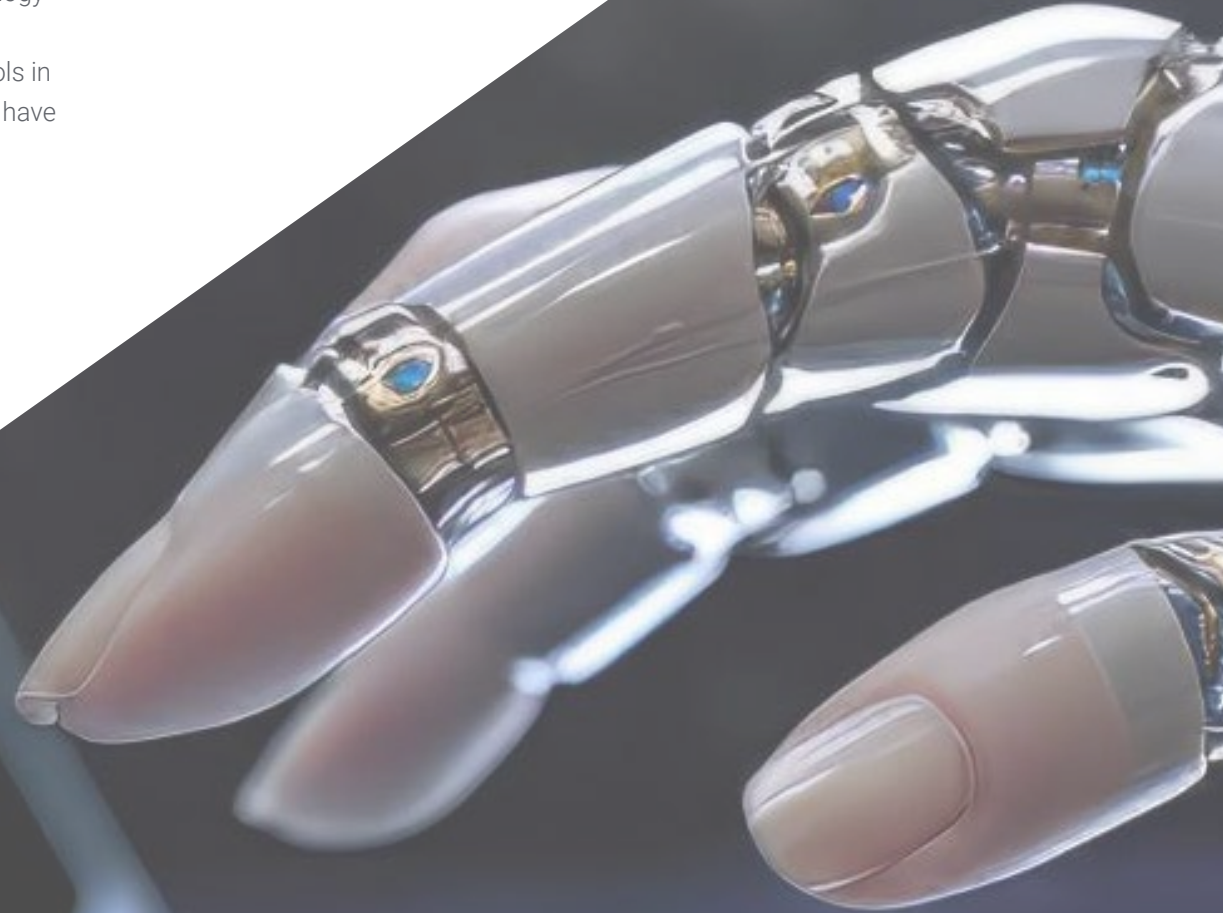
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- 20.3. Fairness and Bias in AI Algorithms in Dentistry
    - 20.3.1. Addressing Bias in Algorithms to Ensure Fairness
    - 20.3.2. Ethics in the Implementation of Predictive Algorithms in Oral Health
    - 20.3.3. Ongoing Monitoring to Mitigate Bias and Promote Equity
  - 20.4. Regulations and Standards in Dental AI
    - 20.4.1. Regulatory Compliance in the Development and Use of AI Technologies
    - 20.4.2. Adaptation to Legal Changes in the Deployment of IA Systems
    - 20.4.3. Collaboration with Regulatory Authorities to Ensure Compliance
  - 20.5. AI and Professional Responsibility in Dentistry
    - 20.5.1. Development of Ethical Standards for Professionals using AI
    - 20.5.2. Professional Responsibility in the Interpretation of AI Results
    - 20.5.3. Continuing Education in Ethics for Oral Health Professionals
  - 20.6. Social Impact of AI in Dental Care
    - 20.6.1. Social Impact Assessment for Responsible Introduction of AI
    - 20.6.2. Effective Communication about AI Technologies with Patients
    - 20.6.3. Community Participation in the Development of Dental Technologies
  - 20.7. AI and Access to Dental Care
    - 20.7.1. Improving Access to Dental Services through AI Technologies
    - 20.7.2. Addressing Accessibility Challenges with AI Solutions
    - 20.7.3. Equity in the Distribution of AI-assisted Dental Services
  - 20.8. AI and Sustainability in Dental Practices
    - 20.8.1. Energy Efficiency and Waste Reduction with AI Implementation
    - 20.8.2. Sustainable Practice Strategies Enhanced by AI Technologies
    - 20.8.3. Environmental Impact Assessment in the Integration of AI Systems
  - 20.9. AI Policy Development for the Dental Sector
    - 20.9.1. Collaboration with Institutions for the Development of Ethical Policies
    - 20.9.2. Creation of Best Practice Guidelines on the Use of AI
    - 20.9.3. Active Participation in the Formulation of AI-related Government Policies
  - 20.10. Ethical Risk and Benefit Assessment of AI in Dentistry
    - 20.10.1. Ethical Risk Analysis in the Implementation of AI Technologies
    - 20.10.2. Ongoing Assessment of Ethical Impact on Dental Care
    - 20.10.3. Long-term Benefits and Risk Mitigation in the Deployment of AI Systems

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 Artificial Intelligence in Dentistry 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.



The image features two black graduation caps (mortarboards) against a bright blue sky with light, wispy clouds. One cap is in the foreground on the left, held by a hand, and the other is slightly behind and to the right. The background is split diagonally by a white and blue geometric shape.

“

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

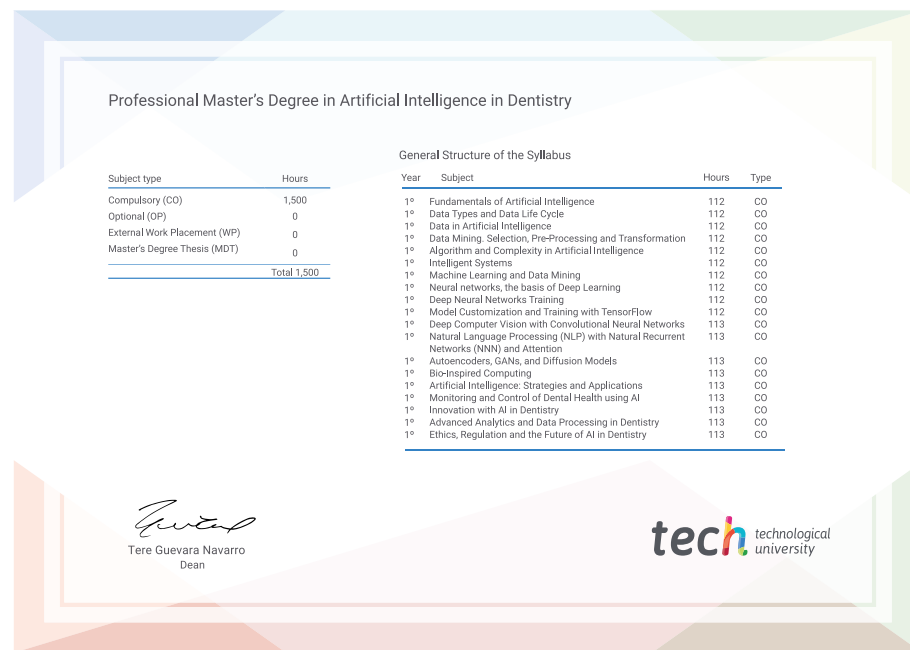
This **Professional Master's Degree in Artificial Intelligence in Dentistry** contains the most complete and up-to-date program on the market.

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

The diploma 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 Artificial Intelligence in Dentistry**

Official N° of Hours: **2,250 h.**



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

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



Professional Master's  
Degree  
Artificial Intelligence  
in Dentistry

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

# Professional Master's Degree Artificial Intelligence in Dentistry

