Professional Master's Degree
Artificial Intelligence in Clinical Research

tech global university

Professional Master's Degree
Artificial Intelligence
in Clinical Research

» Modality: **online**
» Duration: **12 months**
» Certificate: **TECH Global University**
» Credits: **90 ECTS**
» Schedule: **at your own pace**
» Exams: **online**

Website: **www.techtitute.com/us/medicine/professional-master-degree/master-artificial-intelligence-clinical-research**

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01
Introduction

The application of Artificial Intelligence (AI) in Clinical Research has revolutionized the way medical data is analyzed and understood. This approach has streamlined research processes by enabling faster and more accurate analysis of large data sets, identifying patterns and correlations that might go unnoticed by traditional methods. In this way, AI facilitates the prediction of clinical trial results, helps to personalize treatments according to individual profiles and optimizes the early identification of diseases. That is why TECH has developed an academic program that will immerse physicians in innovation in this field. Based on the revolutionary Relearning methodology, the learning system consists of repetition of key concepts.

> *AI's ability to integrate data from various sources, as well as to predict outcomes, contribute to more accurate and personalized medicine"*

Through the application of Artificial Intelligence (AI) in Clinical Research, it is possible to streamline the process of analyzing large medical datasets, allowing researchers to identify patterns, correlations and trends more efficiently. In addition, AI contributes to the personalization of medicine, thanks to the tailoring of treatments according to the individual characteristics of patients. In fact, new technologies not only optimize processes, but also open up new perspectives to address medical challenges and improve the quality of care.

For this reason, TECH has created this program in which AI and biomedicine converge, providing professionals with a deep and practical understanding of the specific applications of this technology in the field of Clinical Research. Accordingly, the structure of the syllabus includes specialized modules, such as computational simulation in biomedicine and advanced analysis of clinical data, which will enable graduates to acquire advanced skills in the application of AI in complex biomedical situations. In addition, the focus on ethics, regulations and legal considerations in the use of AI in the clinical setting will be addressed.

Furthermore, the degree integrates cutting-edge technologies such as genomic sequencing and biomedical image analysis, addressing emerging issues such as sustainability in biomedical research and big data management. In this context, students will be equipped with the necessary skills to lead at the intersection of AI and Clinical Research.

TECH has conceived a comprehensive program based on the innovative *Relearning* methodology with the purpose of forging highly competent AI specialists. This learning modality focuses on reiterating key concepts to consolidate an optimal understanding. You will only need an electronic device connected to the Internet to access the contents at any time, eliminating the need for face-to-face attendance or to comply with established schedules.

This **Professional Master's Degree in Artificial Intelligence in Clinical Research** contains the most complete and up-to-date scientific program on the market. The most important features include:

- Development of practical cases presented by experts in Artificial Intelligence in Clinical Practice
- The graphic, schematic and practical contents with which it is conceived scientific and practical information on those disciplines that are essential for professional practice
- Practical exercises where the self-assessment process can be carried out to improve learning
- Its special emphasis on innovative methodologies
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Content that is accessible from any fixed or portable device with an Internet connection

This program in Artificial Intelligence in Clinical Research is highly relevant to the current landscape of healthcare and technology"

" *You will delve into the latest technologies and the most innovative applications of Artificial Intelligence in Clinical Research, through the best multimedia resources"*

Thanks to this 100% online program, you will comprehensively analyze the essential principles of machine learning and its implementation in the analysis of clinical and biomedical data.

You will delve into the implementation of Big Data and machine learning techniques in Clinical Research. Enroll now!

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.

02
Objectives

This program not only aims to provide a deep understanding of Artificial Intelligence applied to Clinical Research, but also to train leaders capable of addressing current and future challenges in medicine. By entering this degree program, graduates will be immersed in an academic environment where innovation and ethics are intertwined to transform medical care. In this way, they will address medical data analysis techniques, the development of predictive models for clinical trials and the implementation of innovative solutions for the personalization of treatments. Thus, they will address clinical problems with data-driven solutions.
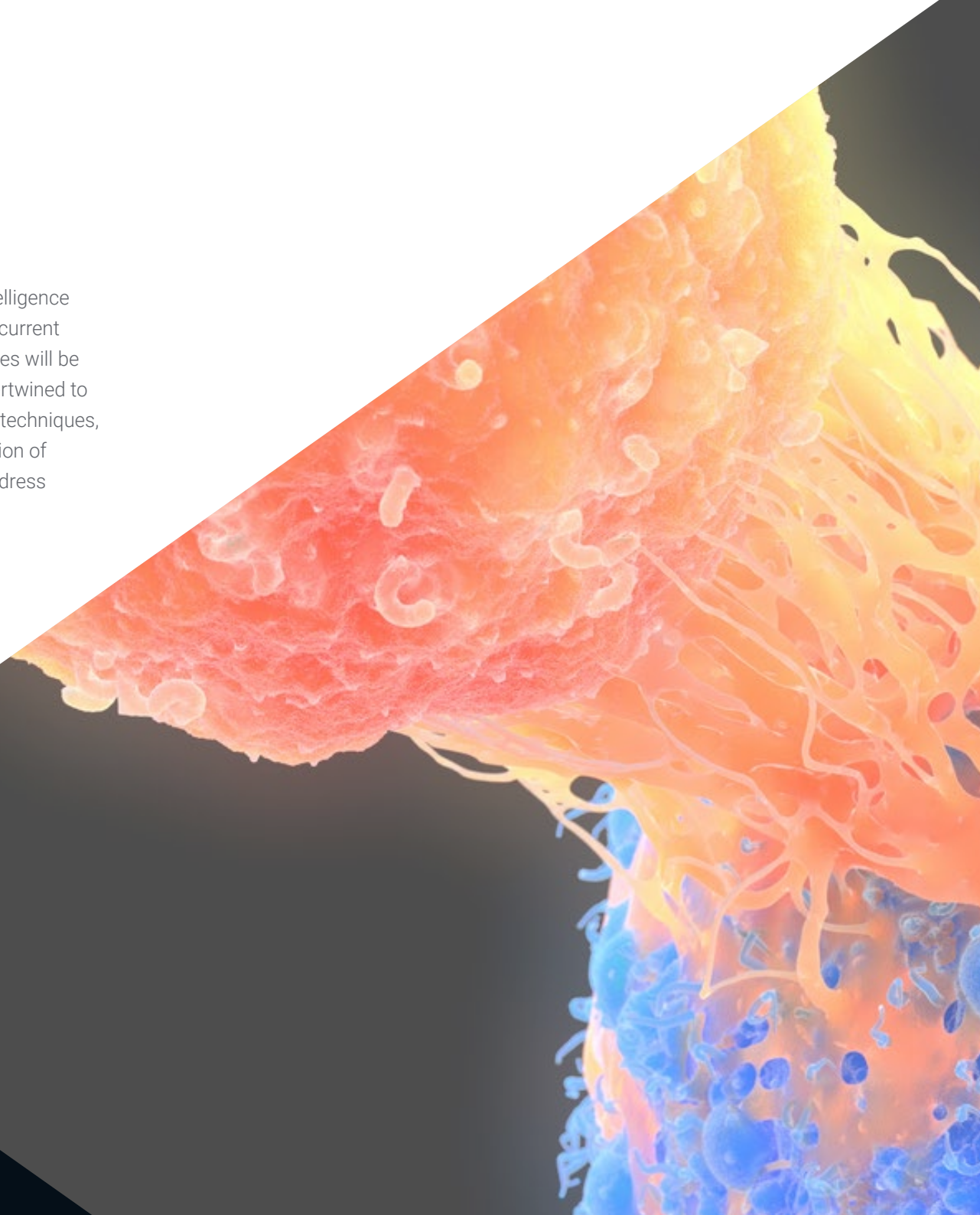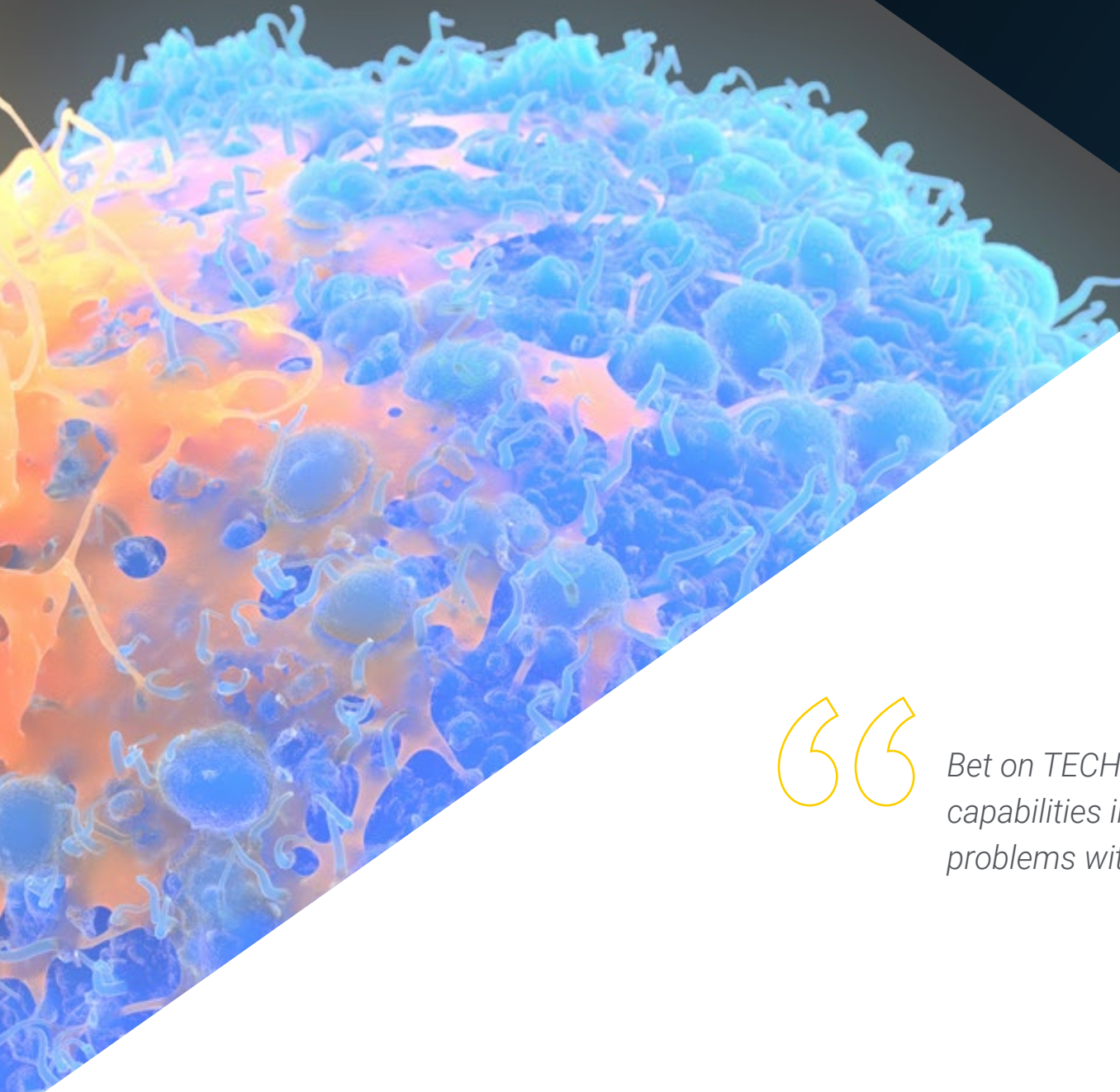
> *Bet on TECH! You will develop capabilities in AI and address clinical problems with data-driven solutions"*

General Objectives

- 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
- Analyze 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 comprehensive view of the transformation of Clinical Research through AI, from its historical foundations to current applications
- Learn effective methods for integrating heterogeneous data into Clinical Research, including natural language processing and advanced data visualization
- Acquire solid knowledge of model validation and simulations in the biomedical domain, exploring the use of synthetic *datasets* and practical applications of AI in health research
- Understand and apply genomic sequencing technologies, data analysis with AI and use of AI in biomedical imaging
- Acquire expertise in key areas such as personalization of therapies, precision medicine, AI-assisted diagnostics and clinical trial management
- Gain a solid understanding of the concepts of Big Data in the clinical setting and become familiar with essential tools for its analysis
- Delve into ethical dilemmas, review legal considerations, explore the socioeconomic and future impact of AI in healthcare, and promote innovation and entrepreneurship in the field of clinical AI
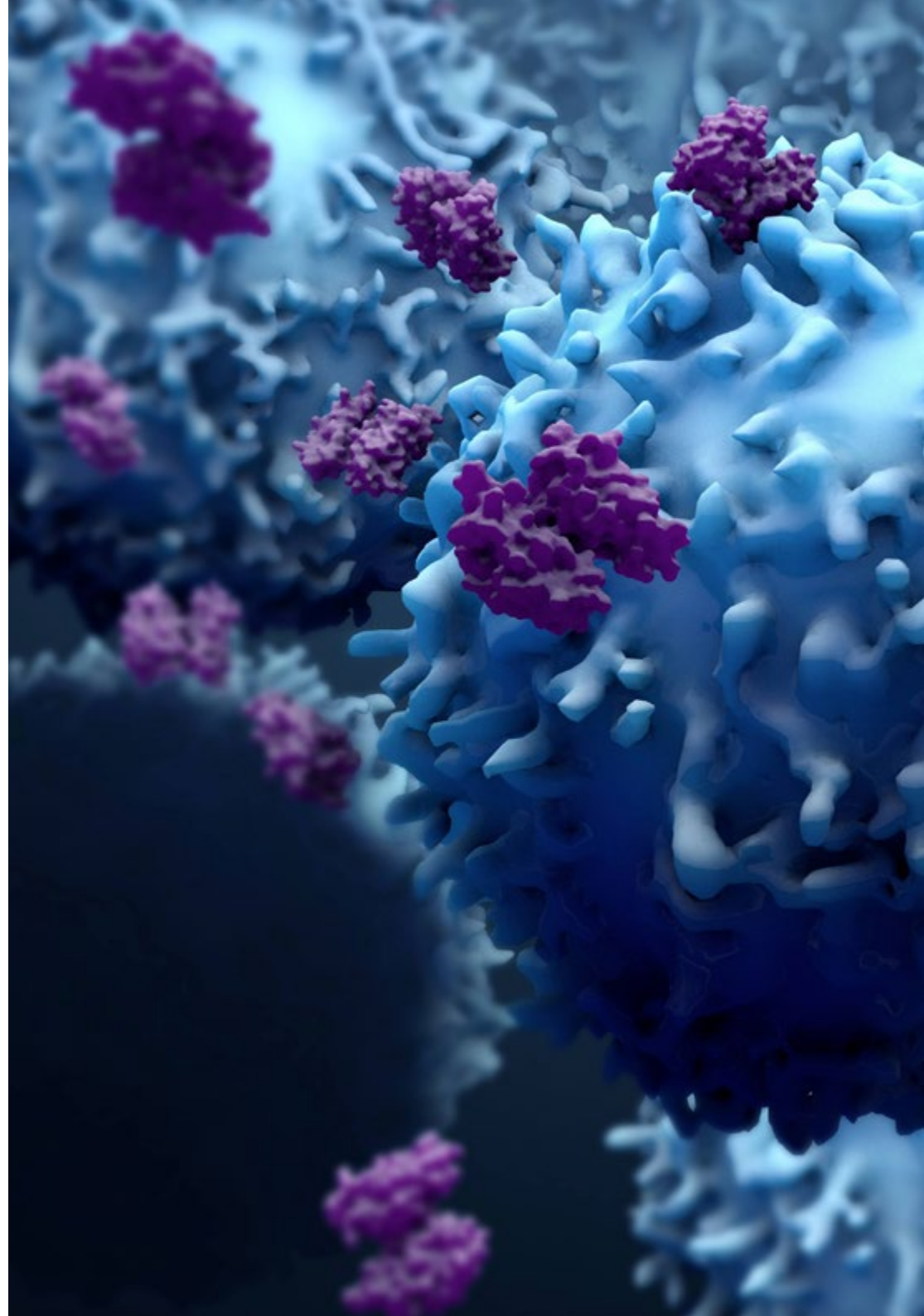
Specific Objectives

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 Greedyalgorithms, 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

- Understand 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

- Tune 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 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. AI Methods and Tools for Clinical Research

- Gain a comprehensive view of the AI is transforming Clinical Research, from its historical foundations to current applications

- Implement advanced statistical methods and algorithms in clinical studies to optimize data analysis

- Design experiments with innovative approaches and perform comprehensive analysis of results in Clinical Research

- Apply natural language processing to improve scientific and clinical documentation in the Research context

- Effectively integrate heterogeneous data using state-of-the-art techniques to enhance interdisciplinary clinical research

Module 17. Biomedical Research with AI

- Acquire solid knowledge on the validation of models and simulations in the biomedical field, ensuring their accuracy and clinical relevance

- Integrate heterogeneous data using advanced methods to enrich the multidisciplinary analysis in Clinical Research

- Develop deep learning algorithms to improve the interpretation and analysis of biomedical data in clinical trials

- Explore the use of synthetic *datasets* in clinical studies and understand the practical applications of AI in health research

- Understand the crucial role of computational simulation in drug discovery, analysis of molecular interactions, and modeling of complex diseases

Module 18. Practical Application of AI in Clinical Research

- Acquire expertise in key areas such as personalization of therapies, precision medicine, AI-assisted diagnostics, clinical trial management and vaccine development

- Incorporate robotics and automation in clinical laboratories to optimize processes and improve the quality of results

- Explore the impact of AI in microbiome, microbiology, *wearables* and remote monitoring in clinical studies

- Address contemporary challenges in the biomedical field, such as efficient management of clinical trials, development of AI-assisted treatments, and application of AI in immunology and immune response studies

- Innovate in AI-assisted diagnostics to improve early detection and diagnostic accuracy in clinical and biomedical research settings

Module 19. Big Data Analytics and Machine Learning in Clinical Research

- Gain a solid understanding of the concepts fundamental of *Big Data* in the clinical setting and become familiar with essential tools Used for its analysis

- Explore advanced data mining techniques, machine learning algorithms, predictive analytics, and AI applications in epidemiology and public health

- Analyze biological networks and disease patterns to identify connections and potential treatments

- Address data security and manage the challenges associated with large volumes of data in biomedical research

- Investigate case studies that demonstrate the potential of *Big Data* in biomedical research

Module 20. Ethical, Legal and Future Aspects of AI in Clinical Research

- Understand the ethical dilemmas that arise when applying AI in clinical research and review the relevant legal and regulatory considerations in the biomedical field
- Address specific challenges in the management of informed consent in AI studies
- Investigate how AI can influence equity and access to health care
- Analyze future perspectives on how AI will shape Clinical Research, exploring its role in the sustainability of biomedical research practices and identifying opportunities for innovation and entrepreneurship
- Comprehensively address the ethical, legal and socioeconomic aspects of AI-driven Clinical Research

Update your skills to be at the forefront of the technological revolution in health, contributing to the advancement of Clinical Research"

03
Skills

This Professional Master's Degree will provide the graduate with an exceptionally complete and specialized update in the application of Artificial Intelligence in the field of Clinical Research. In doing so, you will be equipped with advanced and practical skills to address complex biomedical challenges, from data analysis to simulation of biological processes. In addition, it will provide a comprehensive understanding of cutting-edge technologies such as genomic sequencing and biomedical image analysis. Not to mention the ethical, legal and regulatory aspects, crucial in the implementation of AI in clinical settings.
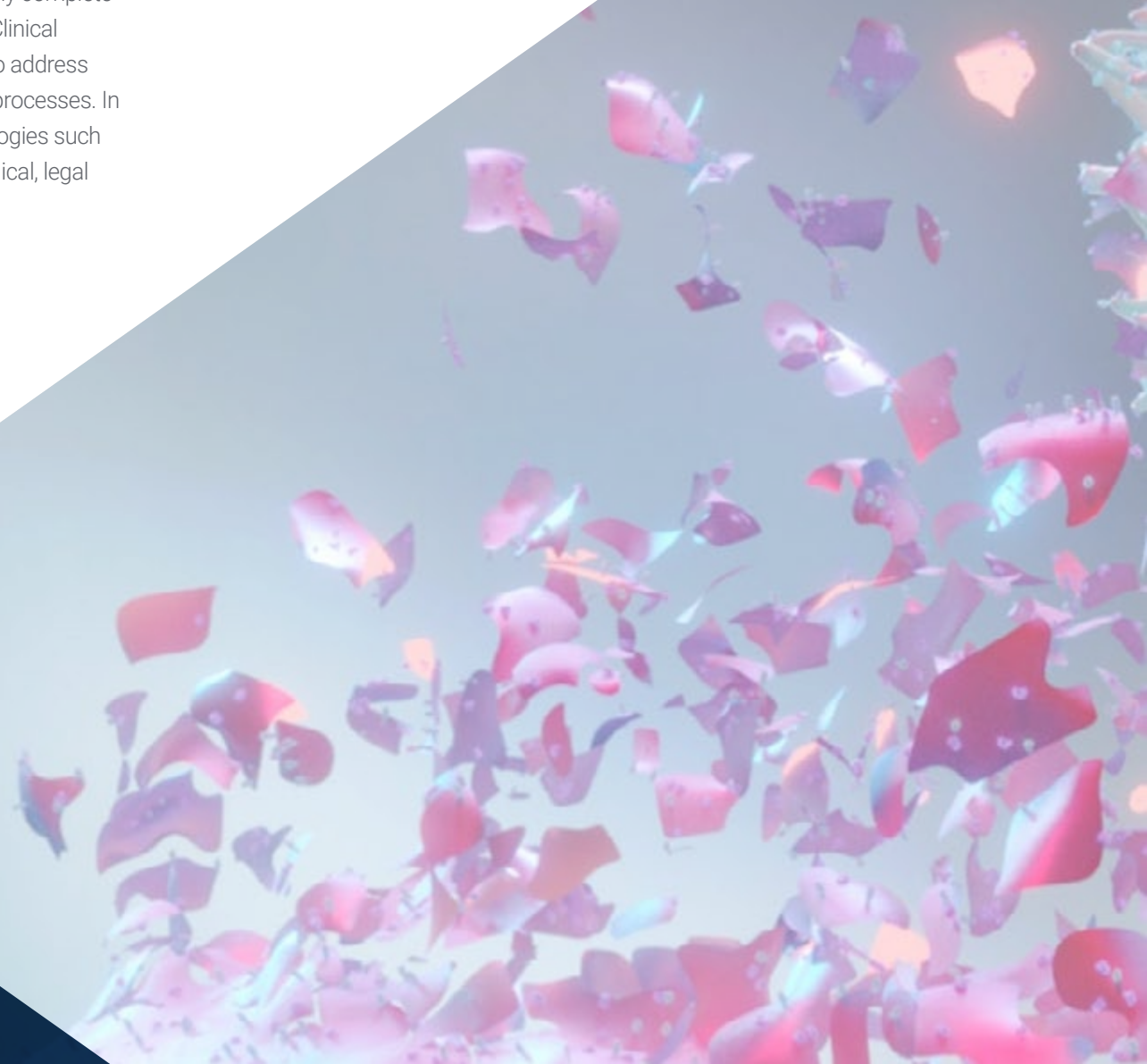
Through this program, you will boost diagnostic accuracy and the design of personalized reatments, revolutionizing healthcare with innovation and efficiency"

General Skills

- 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
- Use AI tools, platforms and techniques, from data analysis to the application of neural networks and predictive modeling
- Apply computational models to simulate biological processes and responses to treatments, using AI to improve understanding of complex biomedical phenomena
- Address contemporary challenges in the biomedical field, such including efficient management of clinical trials and application of AI in immunology

Specific Skills

- 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
- Master AI tools, platforms and techniques used in clinical research, from data analysis to the application of neural networks and predictive modeling.

- Apply computational models in the simulation of biological processes, diseases and responses to treatments, using AI tools to improve the understanding and representation of complex biomedical phenomena.
- Apply genomic sequencing and data analytics technologies with AI intelligence
- Use AI in biomedical image analysis
- Acquire skills in advanced visualization and effective communication of complex data, with a focus on the development of AI-based tools

You will lead innovation in the convergence of Artificial Intelligence and Clinical Research. What are you waiting for to enroll?"

04

Course Management

The faculty of the Artificial Intelligence in Clinical Research program represents academic excellence and practical experience in the convergence of medicine and technology. These outstanding professionals not only possess deep expertise in AI and data analytics, but also have an outstanding track record in the application of these tools in medical research. Their commitment will focus on transmitting not only theoretical knowledge, but also sharing their real-life experiences, providing graduates with an invaluable perspective to face current and future challenges in the healthcare field.

"

The faculty will provide invaluable and practical guidance, merging AI and Clinical Research to create significant advances in healthcare"

Management

Dr. Peralta Martín-Palomino, Arturo

- CEO and CTO at Prometeus 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
- PhD. in Psychology from the University of Castilla - La Mancha
- PhD in Economics, Business and Finance from the Camilo José Cela University
- PhD in Psychology from University of Castilla – La Mancha
- Máster in Executive MBA por la Universidad Isabel I
- Master's Degree in Sales and Marketing Management, Isabel I University
- Expert Master's Degree in Big Data by Hadoop Training
- Master's Degree in Advanced Information Technologies from the University of Castilla - la Mancha
- Member of: SMILE Research Group

Structure and Content

This program is meticulously designed to merge the scientific rigor of clinical research with the disruptive innovations of Artificial Intelligence. Its structure is based on specialized modules, from medical data interpretation to predictive algorithm development and the implementation of technological solutions in clinical environments. The contents are an amalgam between theory and practice, covering the basics of AI and its specific application in the medical field. As a result, graduates will be able to lead advances in the personalization of treatments and the optimization of health care.

> *Benefit from a curriculum developed by experts and top-quality content. Update your clinical practice with TECH!"*

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 Assistants
1.8.2.   Fundamental Parts for the Development of an Assistant: Intents, Entities and Dialog 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

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

Module 8. Neural Networks, the Basis of Deep Learning

Module 9. Deep Neural Networks Training

Module 10. Model Customization and training with TensorFlow

10.4. *TensorFlow* Features and Graphics

    10.4.1. Functions with TensorFlow

    10.4.2. Use of Graphs for Model Training

    10.4.3. Graphics Optimization with TensorFlow Operations

10.5. Loading and Preprocessing Data with TensorFlow

    10.5.1. Loading Data Sets with TensorFlow

    10.5.2. Preprocessing Data with TensorFlow

    10.5.3. Using TensorFlowTools 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 thetfdata API for Model Training

10.7. The TFRecord Format

    10.7.1. Using the TFRecordAPI for Data Serialization

    10.7.2. TFRecord File Upload with TensorFlow

    10.7.3. Using TFRecord Files for Model Training

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. Preprocessing Data with TensorFlow Datasets

    10.9.3. Using TensorFlow Datasets   for Model Training

10.10. Building a Deep Learning App with TensorFlow

    10.10.1. Practical Applications

    10.10.2. Building a Deep Learning App with TensorFlow

    10.10.3. Model Training 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 Visual Cortex 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. Architecture ResNet

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

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. Implementation of the Models

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 Computation 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 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. AI Methods and Tools for Clinical Research

16.1. AI Technologies and Tools in Clinical Research
16.1.1. Use of Machine Learning to Identify Patterns in Clinical Data
16.1.2. Development of Predictive Algorithms for Clinical Trials
16.1.3. Implementation of AI Systems for Improved Patient Recruitment
16.1.4. Implementation of AI Systems for the Real-Time Analysis of groups Data
16.2. Statistical Methods and Algorithms in Clinical Trials
16.2.1. Application of Advanced Statistical Techniques for the Analysis of Clinical Data
16.2.2. Use of Algorithms for the Validation and Verification of Trial Results
16.2.3. Implementation of Regression and Classification Models in Clinical Studies
16.2.4. Analysis of Large Data Sets Using Computational Statistical Methods
16.3. Design of Experiments and Analysis of Results
16.3.1. Strategies for Efficient Clinical Trial Design Using AI
16.3.2. AI Techniques for Analysis and Interpretation of Experimental Data
16.3.3. Optimization of Research Protocols Using AI Simulations
16.3.4. Evaluation of the Efficacy and Safety of Treatments Using AI Models
16.4. Interpretation of Medical Images Using AI in Research
16.4.1. Development of AI systems for the Automatic Detection of Pathologies in Images
16.4.2. Use of Deep Learning for Classification and Segmentation in Medical Imaging
16.4.3. AI Tools for Improving Accuracy in Diagnostic Image
16.4.4. Analysis of Radiological and Magnetic Resonance Imaging using AI

16.5. Clinical Analysis and Biomedical Data Analysis

16.5.1. AI in Genomic and Proteomic Data Processing and Analysis

16.5.2. Tools for the Integrated Analysis of Clinical and Biomedical Data

16.5.3. Use of AI for Identifying Biomarkers in Clinical Research

16.5.4. Predictive Analytics of Clinical Outcomes Based on Biomedical Data

16.6. Advanced Data Visualization in Clinical Research

16.6.1. Development of Interactive Visualization Tools for Clinical Data

16.6.2. Use of AI in the Creation of Graphical Representations of Complex Data

16.6.3. Visualization Techniques for the Easy Interpretation of Research Results

16.6.4. Augmented and Virtual Reality Tools for the Visualization of Biomedical Data

16.7. Natural Language Processing in Scientific and Clinical Documentation

16.7.1. Application of NLP for the Analysis of Scientific Literature and Clinical Records

16.7.2. AI Tools for the Extraction of Relevant Information from Medical Texts

16.7.3. AI Systems for Summarizing and Categorizing Scientific Publications

16.7.4. Use of NLP in Identifying Trends and Patterns in Clinical Documentation

16.8. Heterogeneous Data Processing in Clinical Research

16.8.1. AI Techniques for Integrating and Analyzing Data from Diverse Clinical Sources

16.8.2. Tools for the Management of Unstructured Clinical Data

16.8.3. AI Systems for Clinical and Demographic Data Correlation

16.8.4. Analysis of Multidimensional Data to Obtain Clinical Insights

16.9. Applications of Neural Networks in Biomedical Research

16.9.1. Use of Neural Networks for Disease Modeling and Treatment Prediction

16.9.2. Implementation of Neural Networks in the Classification of Genetic Diseases

16.9.3. Development of Diagnostic Systems Based on Neural Networks

16.9.4. Application of Neural Networks in the Personalization of Medical Treatments

16.10. Predictive Modeling and its Impact on Clinical Research

16.10.1. Development of Predictive Models for the Anticipation of Clinical Outcomes

16.10.2. Use of AI in the Prediction of Side Effects and Adverse Reactions

16.10.3. Implementation of Predictive Models in Clinical Trial Optimization

16.10.4. Risk Analysis of Medical Treatments Using Predictive Modeling

Module 17. Biomedical Research with AI

17.1. Design and Execution of Observational Studies with AI

17.1.1. Implementation of AI for the Selection and Segmentation of Populations in Studies

17.1.2. Use of Algorithms for Real-Time Monitoring of Observational Study Data

17.1.3. AI Tools for the Identification of Patterns and Correlations in Observational Studies

17.1.4. Automation of the Data Collection and Analysis Process in Observational Studies

17.2. Validation and Calibration of Models in Clinical Research

17.2.1. AI Techniques for Ensuring the Accuracy and Reliability of Clinical Models

17.2.2. Use of AI in the Calibration of Predictive Models in Clinical Research

17.2.3. Cross-validation Methods Applied to Clinical Models using AI

17.2.4. AI Tools for the Evaluation of the Generalization of Clinical Models

17.3. Methods for Integrating Heterogeneous Data in Clinical Research

17.3.1. AI Techniques for Combining Clinical, Genomic, and Environmental Data

17.3.2. Use of Algorithms for Handling and Analyzing Unstructured Clinical Data

17.3.3. AI Tools for Normalization and Standardization of Clinical Data

17.3.4. AI Systems for Correlating Different Types of Research Data

17.4. Integration of Multidisciplinary Biomedical Data

17.4.1. AI Systems to Combine Data from Different Biomedical Disciplines

17.4.2. Algorithms for the Integrated Analysis of Clinical and of Laboratory Data

17.4.3. AI Tools for the Visualization of Complex Biomedical Data

17.4.4. Use of AI in the Creation of Holistic Health Models from Multidisciplinary Data

17.5. Deep Learning Algorithms in Biomedical Data Analysis

17.5.1. Implementation of Neural Networks in Analysis of Genetic and Proteomic Data

17.5.2. Using Deep Learning to Identify Patterns in Biomedical Data

17.5.3. Development of Predictive Models in Precision Medicine with Deep Learning

17.5.4. Application of AI in Advanced Biomedical Image Analysis

17.6. Optimization of Research Processes with Automation

17.6.1. Automation of Laboratory Routines with AI Systems

17.6.2. Use of AI for Efficient Management of Resources and Time in Research

17.6.3. AI Tools for Workflow Optimization in Clinical Research

17.6.4. Automated Systems for Tracking and Reporting of Research Progress

17.7. Simulation and Computational Modeling in Medicine with AI

    17.7.1. Development of Computational Models to Simulate Clinical Scenarios

    17.7.2. Use of AI for Simulation of Molecular and Cellular Interactions

    17.7.3. AI Tools in the Creation of Predictive Disease Models

    17.7.4. Application of AI in the Simulation of Drug and Treatment Effects

17.8. Use of Virtual and Augmented Reality in Clinical Trials

    17.8.1. Implementation of Virtual Reality for Training and Simulation in Medicine

    17.8.2. Use of Augmented Reality in Surgical and Diagnostic Procedures

    17.8.3. Virtual Reality Tools for Behavioral and Psychological Studies

    17.8.4. Application of Immersive Technologies in Rehabilitation and Therapy

17.9. Data Mining Tools Applied to Biomedical Research

    17.9.1. Use of Data Mining Techniques to Extract Knowledge from Biomedical Databases

    17.9.2. Implementation of AI Algorithms to Discover Patterns in Clinical Data

    17.9.3. AI Tools for Trend Identification in Large Datasets

    17.9.4. Application of Data Mining in the Generation of Research Hypotheses

17.10. Development and Validation of Biomarkers with Artificial Intelligence

    17.10.1. Use of AI for the Identification and Characterization of New Biomarkers

    17.10.2. Implementation of AI Models for the Validation of Biomarkers in Clinical Studies

    17.10.3. AI Tools in Correlating Biomarkers with Clinical Results

    17.10.4. AI Applications in the analysis of Biomarkers for Personalized Medicine

Module 18. Practical Application of AI in Clinical Research

18.1. Genomic Sequencing Technologies and Data Analysis with AI

    18.1.1. Use of AI for Rapid and Accurate Analysis of Genetic Sequences

    18.1.2. Implementation of Automatic Learning Algorithms in the Interpretation of Genomic Data

    18.1.3. AI Tools to Identify Genetic Variants and Mutations

    18.1.4. Application of AI in Genomic Correlation with Diseases and Traits

18.2. AI in Biomedical Image Analysis

    18.2.1. Development of AI Systems for the Detection of Anomalies in Medical Imaging

    18.2.2. Use of Deep Learning in the interpretation of X-rays, MRI and CT scans

    18.2.3. AI Tools for Improving Accuracy in Diagnostic Imaging

    18.2.4. Implementation of AI in the Classification and Segmentation of Biomedical Images

18.3. Robotics and Automation in Clinical Laboratories

    18.3.1. Use of Robots for the Automation of Tests and Processes in Laboratories

    18.3.2. Implementation of Automated Systems for the Management of Biological Samples

    18.3.3. Development of Robotic Technologies to Improve Efficiency and Accuracy in Clinical Analyses

    18.3.4. Application of AI in the Optimization of Laboratory Workflows

18.4. AI in the Personalization of Therapies and Precision Medicine

    18.4.1. Development of AI Models for the Personalization of Medical Treatments

    18.4.2. Use of Predictive Algorithms in the Selection of Therapies Based on Genetic Profiles

    18.4.3. AI Tools in Dose Adaptation and Drug Combinations

    18.4.4. Application of AI in the Identification of Effective Treatments for Specific Groups

18.5. Innovations in AI-assisted Diagnosis

    18.5.1. Implementation of AI Systems for Rapid and Accurate Diagnostics

    18.5.2. Use of AI in Early Disease Identification through Data Analysis

    18.5.3. Development of AI Tools for Clinical Test Interpretation

    18.5.4. Application of AI in Combining Clinical and Biomedical Data for Comprehensive Diagnostics

18.6. Applications of AI in Microbiome and Microbiology Studies

    18.6.1. Use of AI in the Analysis and Mapping of the Human Microbiome

    18.6.2. Implementation of Algorithms to Study the Relationship Between the Microbiome and Disease

    18.6.3. AI Tools in the Identification of Patterns in Microbiological Studies

    18.6.4. Application of AI in Microbiome-based Therapeutics Research

18.7. Wearables and Remote Monitoring in Clinical Studies

    18.7.1. Development of Wearable Devices with AI for Continuous Health Monitoring

    18.7.2. Use of AI in the Interpretation of Data Collected by Wearable Devices

    18.7.3. Implementation of Remote Monitoring Systems in Clinical Trials

    18.7.4. Application of AI in the Prediction of Clinical Events through Wearable Data

18.8. AI in Clinical Trial Management

    18.8.1. Use of AI Systems to Optimize Clinical Trials Management

    18.8.2. Implementation of AI in Participant Selection and Follow-Up

Module 20. Ethical, Legal and Future Aspects of AI in Clinical Research

20.1. Ethics in the Application of AI in Clinical Research

20.1.1. Ethical Analysis of AI-assisted Decision Making in Clinical Research Settings

20.1.2. Ethics in the Use of AI Algorithms for Participant Selection in Clinical Studies

20.1.3. Ethical Considerations in the Interpretation of Results Generated by AI Systems in Clinical Research

20.2. Legal and Regulatory Considerations in Biomedical AI

20.2.1. Analysis of Legal Regulations in the Development and Application of AI Technologies in the Biomedical Field

20.2.2. Assessment of Compliance with Specific Regulations to Ensure the Safety and Efficacy of AI-based Solutions

20.2.3. Addressing Emerging Regulatory Challenges Associated with the Use of AI in Biomedical Research

20.3. Informed Consent and Ethical Aspects in the Use of Clinical Data

20.3.1. Developing Strategies to Ensure Effective Informed Consent in Projects Involving AI

20.3.2. Ethics in the Collection and Use of Sensitive Clinical Data in the Context of AI-driven Research

20.3.3. Addressing Ethical Issues Related to Ownership of and Access to Clinical Data in Research Projects

20.4. AI and Accountability in Clinical Research

20.4.1. Assessing Ethical and Legal Liability in the Implementation of AI Systems in Clinical Research Protocols

20.4.2. Development of Strategies to Address Potential Adverse Consequences of AI Implementation in Biomedical Research

20.4.3. Ethical Considerations in the Active Involvement of AI in Clinical Research Decision Making

20.5. Impact of AI on Equity and Access to Health Care

20.5.1. Evaluation of the Impact of AI Solutions on Equity in Clinical Trial Participation

20.5.2. Developing Strategies to Improve Access to AI Technologies in Diverse Clinical Settings

20.5.3. Ethics in the Distribution of Benefits and Risks Associated with the Application of AI in Health Care

20.6. Privacy and Data Protection in Research Projects

20.6.1. Assurance of Privacy of Participants in Research Projects Involving the Use of AI

20.6.2. Development of Policies and Practices for Data Protection in Biomedical Research

20.6.3. Addressing Specific Privacy and Security Challenges in the Handling of Sensitive Data in the Clinical Environment

20.7. AI and Sustainability in Biomedical Research

20.7.1. Assessing the Environmental Impact and Resources Associated with the Implementation of AI in Biomedical Research

20.7.2. Development of Sustainable Practices in the Integration of AI Technologies in Clinical Research Projects

20.7.3. Ethics in Resource Management and Sustainability in the Adoption of AI in Biomedical Research

20.8. Auditing and Explainability of AI Models in the Clinical Setting

20.8.1. Development of Audit Protocols for Assessing the Reliability and Accuracy of AI Models in Clinical Research

20.8.2. Ethics in the Explainability of Algorithms to Ensure Understanding of Decisions Made by AI Systems in Clinical Contexts

20.8.3. Addressing Ethical Challenges in Interpreting Results of AI Models in Biomedical Research

20.9. Innovation and Entrepreneurship in the field of Clinical AI

20.9.1. Ethics in Responsible Innovation When Developing AI Solutions for Clinical Applications

20.9.2. Development of Ethical Business Strategies in the Field of Clinical AI

20.9.3. Ethical Considerations in the Commercialization and Adoption of AI Solutions in the Clinical Sector

20.10. Ethical Considerations in International Clinical Research Collaboration

20.10.1. Development of Ethical and Legal Agreements for International Collaboration in AI-driven Research Projects

20.10.2. Ethics in Multi-Institution and Multi-Country Involvement in Clinical Research with AI Technologies

20.10.3. Addressing Emerging Ethical Challenges Associated with Global Biomedical Research Collaborations

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"

At TECH we use the Case Method

What should a professional do in a given situation? Throughout the program, students will face multiple simulated clinical cases, based on real patients, in which they will have to do research, establish hypotheses, and ultimately resolve the situation. There is an abundance of scientific evidence on the effectiveness of the method. Specialists learn better, faster, and more sustainably over time.

With TECH you will experience a way of learning that is shaking the foundations of traditional universities around the world.

According to Dr. Gérvas, the clinical case is the annotated presentation of a patient, or group of patients, which becomes a "case", an example or model that illustrates some peculiar clinical component, either because of its teaching power or because of its uniqueness or rarity. It is essential that the case is based on current professional life, trying to recreate the real conditions in the physician's professional practice.

Did you know that this method was developed in 1912, at Harvard, for law students? The case method consisted of presenting students with real-life, complex situations for them to make decisions and justify their decisions on how to solve them. In 1924, Harvard adopted it as a standard teaching method"

The effectiveness of the method is justified by four fundamental achievements:

1. Students who follow this method not only achieve the assimilation of concepts, but also a development of their mental capacity, through exercises that evaluate real situations and the application of knowledge.

2. Learning is solidly translated into practical skills that allow the student to better integrate into the real world.

3. Ideas and concepts are understood more efficiently, given that the example situations are based on real-life.

4. Students like to feel that the effort they put into their studies is worthwhile. This then translates into a greater interest in learning and more time dedicated to working on the course.

Relearning Methodology

At TECH we enhance the case method with the best 100% online teaching methodology available: Relearning.

This university is the first in the world to combine the study of clinical cases with a 100% online learning system based on repetition, combining a minimum of 8 different elements in each lesson, a real revolution with respect to the mere study and analysis of cases.

Professionals will learn through real cases and by resolving complex situations in simulated learning environments. These simulations are developed using state-of-the-art software to facilitate immersive learning.

01 learning from evidence

02 relearning from evidence

03 testing

04 learning from an expert

05 neurocognitive context dependent learning

06 Von-Restorff effect

07 case based learning through storytelling

08 competencies testing (retesting)

At the forefront of world teaching, the Relearning method has managed to improve the overall satisfaction levels of professionals who complete their studies, with respect to the quality indicators of the best online university (Columbia University).

With this methodology, more than 250,000 physicians have been trained with unprecedented success in all clinical specialties regardless of surgical load. Our pedagogical methodology is developed in a highly competitive environment, with a university student body with a strong socioeconomic profile and an average age of 43.5 years old.

Relearning will allow you to learn with less effort and better performance, involving you more in your specialization, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation to success.

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.

The overall score obtained by TECH's learning system is 8.01, according to the highest international standards.

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.

Surgical Techniques and Procedures on Video

TECH introduces students to the latest techniques, the latest educational advances and to the forefront of current medical techniques. All of this in direct contact with students and explained in detail so as to aid their assimilation and understanding. And best of all, you can watch the videos as many times as you like.

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".

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.

20%

15%

15%

3%

20%

17%

7%

3%

Expert-Led Case Studies and Case Analysis

Effective learning ought to be contextual. Therefore, TECH presents real cases in which the expert will guide students, focusing on and solving the different situations: a clear and direct way to achieve the highest degree of understanding.

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.

Classes

There is scientific evidence on the usefulness of learning by observing experts. The system known as Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

Quick Action Guides

TECH offers the most relevant contents of the course in the form of worksheets or quick action guides. A synthetic, practical, and effective way to help students progress in their learning.

Certificate

The Professional Master's Degree in Artificial Intelligence in Clinical Research in guarantees students, in addition to the most rigorous and up-to-date education, access to a Professional Master's Degree issued by TECH Global University.

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

This program will allow you to obtain your **Professional Master's Degree diploma in Artificial Intelligence in Clinical Research** endorsed by **TECH Global University**, the world's largest online university.

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

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

Title: **Professional Master's Degree in Artificial Intelligence in Clinical Research**

Modality: **online**

Duration: **12 months**

Accreditation: **90 ECTS**

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tech global university

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

Professional Master's Degree in Artificial Intelligence in Clinical Research

This is a program of 2,250 hours of duration equivalent to 90 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

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

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

Dr. Pedro Navarro Illana
Rector

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

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Professional Master's Degree in Artificial Intelligence in Clinical Research

Subject type	ECTS
Compulsory (CO)	90
Optional (OP)	0
External Work Placement (WP)	0
Master's Degree Thesis (MDT)	0
Total	90

General Structure of the Syllabus

Year	Subject	ECTS	Type
1º	Fundamentals of Artificial Intelligence	3	CO
1º	Data Types and Data Life Cycle	3	CO
1º	Data in Artificial Intelligence	3	CO
1º	Data Mining: Selection, Pre-Processing and Transformation	3	CO
1º	Algorithm and Complexity in Artificial Intelligence	3	CO
1º	Intelligent Systems	3	CO
1º	Machine Learning and Data Mining	3	CO
1º	Neural networks, the basis of Deep Learning	3	CO
1º	Deep Neural Networks Training	3	CO
1º	Model Customization and Training with TensorFlow	3	CO
1º	Deep Computer Vision with Convolutional Neural Networks	3	CO
1º	Natural Language Processing (NLP) with Natural Recurrent Networks (NNN) and Attention	3	CO
1º	Autoencoders, GANs, and Diffusion Models	3	CO
1º	Bio-Inspired Computing	3	CO
1º	Artificial Intelligence: Strategies and Applications	3	CO
1º	AI Methods and Tools for Clinical Research	3	CO
1º	Biomedical Research with AI	3	CO
1º	Practical Application of AI in Clinical Research	3	CO
1º	Big Data Analytics and Machine Learning in Clinical Research	3	CO
1º	Ethical, Legal and Future Aspects of AI in Clinical Research	3	CO

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

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Professional Master's Degree
Artificial Intelligence in Clinical Research

- » Modality: **online**
- » Duration: **12 months**
- » Certificate: **TECH Global University**
- » Credits: **90 ECTS**
- » Schedule: **at your own pace**
- » Exams: **online**

Professional Master's Degree
Artificial Intelligence in Clinical Research

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