Course on Evaluation and Implementation of Artificial Intelligence Tools in Radiology

Academic syllabus | Radiology, medical imaging and applied data science

10 lessons	13 hands-on	4 modules	70% passing score

Critical evaluation, selection and safe implementation of AI solutions applied to medical imaging.

Course objectives

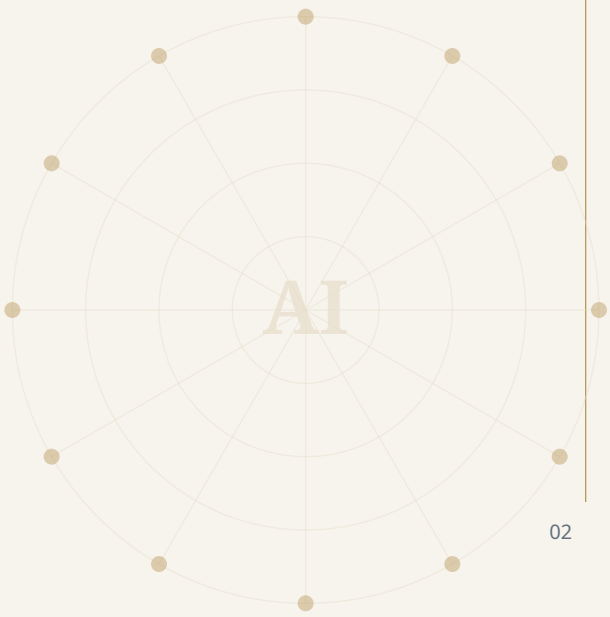
1. Learn the main types of Artificial Intelligence tools currently available in Radiology.
2. Understand and apply key performance metrics for classification, regression, semantic segmentation and object localization problems.
3. Recognize the main factors during the development of Deep Learning tools that may generate bias and problems in model generalization.
4. Become familiar with annotation types and tools for segmentation and 3D modeling of medical images.
5. Use explainability techniques and structured frameworks in Artificial Intelligence projects in Radiology.

Who is this course for?

The course is designed for clinical and non-clinical professionals involved in the use, evaluation, acquisition or implementation of artificial intelligence solutions in radiology and medical imaging. This includes radiologists, general practitioners and specialists, medical students, medical imaging technologists, dentists, project managers, administrative teams, decision-makers, engineers and data science professionals.

Methodology and assessment

Lecture-based classes -10 sessions- followed by practical workshops -13 hands-on sessions- in which theoretical concepts are applied. The workshops focus on acquiring technical competencies with data science tools and Python programming. The course assessment includes 4 quizzes of 10 questions at the end of each module. Passing score: 70% correct answers.

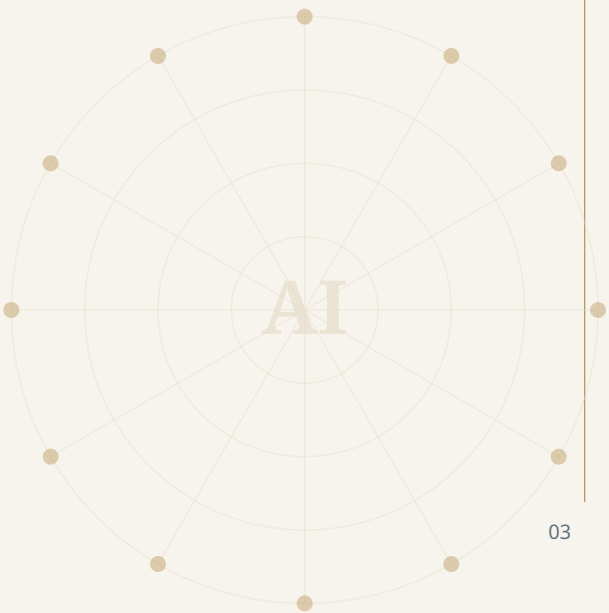


MODULE 1

Introduction to AI and Data Science Techniques

This module establishes the historical and technological foundations, exploring the evolution of radiology and the current role of Artificial Intelligence.

Lesson 1	Introduction to Artificial Intelligence. Historical evolution of radiology from the discovery of X-rays to current AI.
Lesson 2	State of the art of AI tools in Radiology. Review of available commercial tools and implementation challenges.
Hands-on 1 & 2	Introduction to Python and Google Colab. Environment setup, Drive notebooks, GPU runtime and Python programming fundamentals.
Lesson 3	Overview of data types in health care. Text, coded diagnoses and medical images.
Hands-on 3	Introduction to image properties. Loading and basic image processing in Python.
Hands-on 4	Medical image processing in Python. Exploration of DICOM, metadata, volumetric images and processing techniques.
Assessment	Module 1 assessment.



MODULE 2

Fundamentals of Machine Learning and Performance Metrics

This module explores supervised, unsupervised, semi-supervised and self-supervised learning techniques applied to medical data analysis.

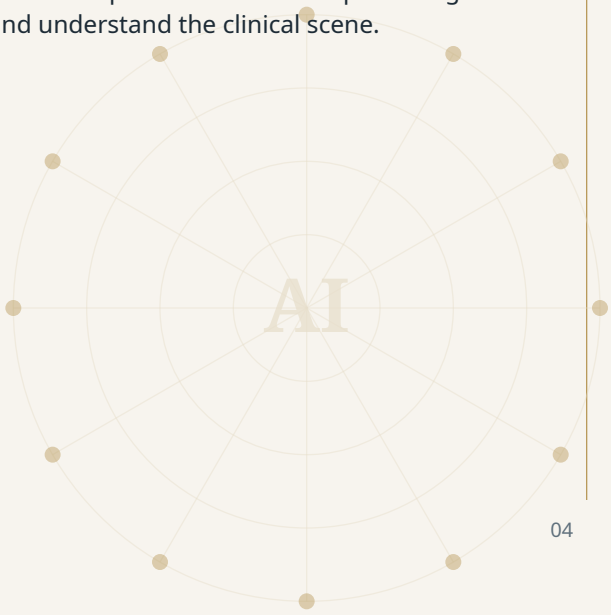
Lesson 4	Overview of Machine Learning, parts 1 and 2. Introduction to machine learning applied to medical images, training strategies and applications.
Hands-on 5	Application of performance metrics in Machine Learning. Practical assessment of metrics for binary and multiclass classification, semantic segmentation, regression and object localization.
Assessment	Module 2 assessment.

MODULE 3

Uses of Deep Learning in Medical Imaging

This module examines deep neural networks and their critical applications in diagnostic imaging.

Lesson 5	Overview of Deep Learning applied to Medical Imaging. Analysis of CNNs and Transformers for classification and detection tasks.
Hands-on 6	Workshop: building the first convolutional neural network model.
Hands-on 7	Workshop: developing the first classifier for medical images.
Hands-on 8	Pneumonia Detection Model. Development of localization models using a YOLO-based approach.
Lesson 6	Image segmentation techniques. Semantic, binary and multiclass segmentation, and architectures such as U-Net.
Hands-on 9	Semi-automatic segmentation tools. Use of ITK-SNAP or 3D Slicer to create reference masks under human supervision.
Hands-on 10	My first semantic segmentation model. Implementation of deep learning models to separate image components and understand the clinical scene.



MODULE 3 CONTINUED

Uses of Deep Learning in Medical Imaging

Continuation of the practical and applied contents of Module 3.

Hands-on 11	Segmentation with TotalSegmentator. Advanced workshop on automatic segmentation of more than 117 anatomical structures in CT and MRI using pre-trained models.
Lesson 7	Deep Learning applied to text: NLP. Fundamentals of Natural Language Processing in radiology, including text normalization, embeddings and LLMs for radiological applications.
Assessment	Module 3 assessment.

MODULE 4

Bias Assessment and Explainability Techniques

The final module focuses on ethical, transparent and standardized implementation of AI projects.

Lesson 8	Algorithmic transparency and explainability techniques (XAI). Local, global and model-agnostic explanations.
Hands-on 12	Application of explainability techniques. Practical use of Grad-CAM, SHAP and Gifsplanation in medical images.
Lesson 9	Bias assessment in AI models. Systematic errors originating from data, development or implementation, including demographic and automation biases.
Hands-on 13	Detection of bias in AI models. Subgroup analysis by age, sex and equipment manufacturer to identify performance and equity gaps.
Lesson 10	Standardized frameworks for AI projects. Good clinical practice guidelines in radiology and general concepts of agile methodologies.
Assessment	Module 4 assessment.