



Universitat de Lleida

DEGREE CURRICULUM
**STATISTICAL MODELS IN
MEDICAL RESEARCH**

Coordination: VILAPRIÑO TERRE, ESTER

Academic year 2023-24

Subject's general information

Subject name	STATISTICAL MODELS IN MEDICAL RESEARCH			
Code	100582			
Semester	2D SEMESTER - DEGREE - JUN/SET			
Typology	Degree	Course	Character	Modality
	Bachelor's Degree in Medicine	2	OPTIONAL	Attendance-based
Course number of credits (ECTS)	3			
Type of activity, credits, and groups	Activity type	PRAULA		TEORIA
	Number of credits	1.5		1.5
	Number of groups	1		1
Coordination	VILAPRIÑO TERRE, ESTER			
Department	BASIC MEDICAL SCIENCES			
Important information on data processing	Consult this link for more information.			
Language	Català Castellà Anglès			
Distribution of credits	30 h in seminars			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
GOMEZ ARBONES, XAVIER	xavier.gomez@udl.cat	,5	
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RIPOL VALENTIN, OSCAR		1	
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Learning objectives

Academic Goals:

1. To provide students with an understanding of the principles and applications of artificial intelligence in the field of medicine.
2. To explore the potential benefits and challenges of implementing AI in healthcare and its impact on patient care and outcomes.
3. To equip students with the knowledge and skills to critically analyze and evaluate AI algorithms and techniques used in medical settings.
4. To foster an appreciation for the ethical, legal, and societal implications of AI in medicine.
5. To encourage students to explore and contribute to ongoing research and advancements in the field of AI in medicine.
6. To develop practical skills in applying AI techniques to medical data analysis and decision-making processes.

Competences

By the end of the course, students should be able to:

1. Define and explain the key concepts and terminology related to artificial intelligence and its applications in medicine.
2. Identify and assess the most commonly used AI and machine learning algorithms in healthcare.
3. Evaluate and preprocess medical data, addressing missing values, outliers, and noise.
4. Apply deep learning models for medical image analysis.
5. Understand natural language processing techniques for medical text analysis and information extraction.
6. Analyze and discuss the ethical considerations, privacy concerns, and biases associated with AI in healthcare.
7. Recognize the emerging trends and future directions in the field of AI in medicine.
8. Apply AI algorithms and methodologies to real-world medical problems through hands-on exercises and projects.
9. Present and communicate effectively about AI in medicine, including case studies and final project presentations.

RAM1 To identify concepts of basic and advanced statistical models of artificial intelligence

RAM2 To generate statistical models that allow an optimal classification of types of patients who require differentiated treatments

Subject contents

Unit 1: Introduction to Artificial Intelligence in Medicine

Unit 2: Machine Learning Fundamentals

Unit 3: Data Acquisition and Preprocessing

Unit 4: Medical Image Analysis

Unit 5: Clinical Decision Support Systems

Unit 6: Natural Language Processing (NLP) in Medicine

Unit 7: Ethical and Legal Considerations

Unit 8: Future Directions and Emerging Trends

Unit 9: Practical Applications and Case Studies

Unit 10: Discussion and Future Implications

Methodology

- Participatory sessions. Presentations with examples and discussion of results, alternating the exposition of theoretical concepts with practical work.
- Simulation tools will be used in order to deepen the meaning of the concepts and their interpretation.
- There will be videos where different aspects of statistical techniques and their usefulness are discussed.
- The student must apply the studied methods and present reasoned reports of the conclusions.
- It is convenient for the student to bring their own computer in class (in part it will facilitate their later work at home).

Development plan

Session 1: Introduction to Artificial Intelligence in Medicine

- Definition and scope of artificial intelligence in medicine.
- Historical overview and key milestones.
- Potential benefits and challenges in healthcare AI.

Session 2: Machine Learning Fundamentals

- Overview of machine learning algorithms and techniques.
- Supervised, unsupervised, and reinforcement learning.
- Evaluation metrics for machine learning models.

Session 3: Data Acquisition and Preprocessing

- Collection and organization of medical data.
- Data quality assessment and preprocessing techniques.
- Handling missing data and outliers.

Session 4: Medical Image Analysis

- Introduction to medical imaging modalities.
- Image preprocessing techniques for noise reduction and enhancement.
- Segmentation and classification of medical images.

Session 5: Medical Image Analysis (continued)

- Deep learning models for medical image analysis.
- Case studies and applications in medical imaging.

Session 6: Clinical Decision Support Systems

- Overview of clinical decision support systems (CDSS).
- Design and development of CDSS using AI techniques.
- Incorporating electronic health records.

Session 7: Natural Language Processing (NLP) in Medicine

- Introduction to NLP and its relevance in healthcare.
- Text preprocessing techniques for medical texts.
- Named entity recognition and information extraction.

Session 8: Natural Language Processing (continued)

- Text classification and sentiment analysis in healthcare.
- Case studies and applications of NLP in medicine.

Session 9: Ethical and Legal Considerations

- Ethical challenges in AI-driven medicine.
- Patient privacy and data security.
- Bias and fairness in AI algorithms.

Session 10: Ethical and Legal Considerations (continued)

- Regulatory frameworks and guidelines for AI in healthcare.
- Responsible AI practices in medicine.

Session 11: Future Directions and Emerging Trends

- Current research and advancements in AI in medicine.
- Precision medicine and personalized healthcare.
- AI-assisted diagnostics and treatment planning.

Session 12: Practical Applications and Case Studies

- Real-world examples and success stories of AI in medicine.
- Hands-on exercises and projects to reinforce concepts.

Session 13: Practical Applications and Case Studies (continued)

- Continued exploration of practical implementation of AI algorithms.
- Guest lecture or industry expert sharing insights.

Session 14: Discussion and Future Implications

- Open discussion on the potential impact of AI in medicine.
- Ethical, social, and economic considerations.
- Career opportunities and future research avenues.

Session 15: Recap and Final Projects

- Recap of key concepts and takeaways from the course.
- Presentation and discussion of final student projects.
- Course evaluation and feedback.

Evaluation

- 1st Activity 25%
- 2nd Activity 25%
- 3rd Activity 25%
- Seminars 25%

Bibliography

Bibliographic Resources:

1. "Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again" by Eric Topol
2. "Artificial Intelligence in Medicine: Technical Basis and Clinical Applications" by Anthony C. Chang

Web Tools and Platforms:

1. TensorFlow (www.tensorflow.org) - An open-source machine learning framework with a wide range of resources and tutorials for AI development.
2. PyTorch (pytorch.org) - Another popular open-source deep learning framework widely used in research and industry.
3. Scikit-learn (scikit-learn.org) - A machine learning library in Python that provides a comprehensive set of tools for data preprocessing, modeling, and evaluation.
4. Google Colab (colab.research.google.com) - A free cloud-based Jupyter notebook environment that enables students to run Python code, experiment with machine learning models, and collaborate on projects.
5. Hugging Face (huggingface.co) - A platform that offers pre-trained models, datasets, and libraries for natural language processing tasks, including text classification and sentiment analysis.
6. Kaggle (www.kaggle.com) - A data science community platform that provides datasets, competitions, and notebooks for AI and machine learning projects.
7. IBM Watson (www.ibm.com/watson) - IBM's AI platform that offers a range of services and tools for healthcare, including natural language understanding and medical imaging analysis.

