CODE xxx Application of AI for Healthcare

Credits: **3 ECTS**
Semester: **1**
Coordinators : **Sébastien Bailly**
e-mail : sbailly@chu-grenoble.fr

Content of the Course Unit

This course aims to provide examples about application of AI on health research. Several methods will be developed including unsupervised clustering, causal inference, text mining and to have a critical reading of IA methods applied in health. Each teacher will share his/her experience on his/her research field and you will be able to identify the finality of the different methods in a health project.

Detailed program

Detailed program with name of people teaching

- **Introduction**: short presentation of the course and objectives (S Bailly)
    - 1 capsule

The objective of this introduction is to summarize the course unit and to present the different fields health for which AI can be applied.

- **Clinical application of data science**: **from data to the project** (Dr T Chevalier)
    - 1 capsule

The objective of this short course is to illustrate the challenges to take up when trying to implement AI in everyday ambulatory medecine. To highlight the different building aspects of a project trying to bring AI in doctor practices, we will describe an experiment which strive to help ambulatory emergency general practitioners in everyday life. How AI could help to evaluate, in real time, patient state severity in order to improve their very early pathway. Aspects of data selection, quality, availability and reliability will be approached but presentation also tackles with hope and fear AI brings with it including AI acceptance by GP and patient, AI possible usage perimeter, AI real-time integration in GP exam, AI faces practitioner experiment, intuition and evaluation.

- **Unsupervised methods for longitudinal data - application in Python on telemonitoring data** (A. Midelet – HP2 Grenoble - Probayes)
    - 2 caspules with TD

This course is constituted by a theoretical part which will develop different methods for sequential data and time series and their application on a dataset. Clustering methods (partitional and hierarchical methods) and the distances and metrics will be introduced first. In a second part of the course, time series segmentation methods will be considered with sliding windows, deterministic modelling (linear regression) and stochastic modelling (hidden Markov Models). A practical work in Python will be proposed about segmentation of telemonitoring data from continuous positive airway pressure devices in obstructive sleep apnea.

- **Datavizualisation: from research project to data vizualisation** (A. Midelet – HP2 - Probayes)
    - 1 capsule with TD

Data visualization is an effective way to understand data during the exploratory data analysis. From basic plots to more advanced heatmaps, the goal of this capsule is to present various tools commonly used for fundamental time series exploration and visualization. By getting a deeper understanding of the visualization making process, the students should become aware of the risks and opportunities when using data visualization.

The first part will focus on plots of raw data (1D plots, bubble plots, scatter plot, line plot, step plot, bar chart, area chart). Then, different ways of assessing the distribution of the data will be introduced (sorted bar charts, histograms, density plot). As a next step, we will apply mathematical transformations on original data to produce intermediate data that we want to visualize (differentiating trends, seasonality, autocorrelation, noise). In the last part, we will explore the relation between two time series through visualizations (heatmaps, mixed charts).

This course will feature telemonitoring data to get hands-on with the introduced tools

- **Causal inference model for observational data** (Dr C. Leyrat – LSHTM London)
    - 3 capsules with TD

Causal inference has recently emerged as a key area of statistics and has received a lot of attention from researchers, statisticians and epidemiologists. Owing to recent advances in this field, causal inference has been made possible outside the context of randomised controlled trials.
The aims of this module are to provide an introduction to causal inference modelling and its methodological framework, to present some recent developments in the field of machine learning and to illustrate the implementation and interpretation of these methods using real-life examples. The first course will introduce causal language and describe the potential outcomes framework and assumptions required for the estimation of causal effects. The second course will give an overview of common statistical methods for causal inference, including g-computation, propensity scores and mediation analysis. The third course will present extensions of these approaches using machine learning, in particular TMLE (Targeted Maximum Likelihood Estimation) and the SuperLearner. There will be opportunities to implement these methods in R through practical activities.

- **Geodesic Learning for precision medicine** (Dr A Attyé – CHU Grenoble Alpes)
    - (1 capsule)

Nonlinear manifold learning techniques for dimensionality reduction are constructed from a theoretical framework based on Riemannian geometry approximation. A Riemannian manifold could be used in medicine to capture high dimensional data variability, such as imaging, biological or physiological data coming from diseased individuals. In this presentation, we will introduce how Geodesic Learning can help physicians to increase sensitivity in detecting abnormalities from quantitative data, how it can decrease false positives generally linked to the General Linear model or help to predict disease outcome.

- **Application of text mining to health project** (Dr L Goeuriot – LIG Grenoble)
    - 3 capsules with TD

The purpose of this course is to introduce students to textual medical data and their processing for AI applications. Textual data in the medical l domain tends to be rather complex, and can be noisy (e.g. medical reports), which makes it challenging to extract information and knowledge from it, and integrate it in AI pipelines. The first part of this module will describe medical textual data and the

fundamental steps of text processing. The second part of the module will present existing medical knowledge bases and the added value of semantic enrichment of textual data. The third and final part of the module will introduce machine learning approaches to extract information, predict or classify from medical textual data.
Each session will propose a practical application.

- **Critical analysis of artificial intelligence for health** (Dr S Chanoine)
    - 1 capsule with application

The proposed training is an application example of the previous sessions that you attended in this module. It is based on epidemiological research to detail the methodology used to understand a public health problem, with specific tools and statistical methods: database linkage, network analysis, unsupervised statistical approach, … One of the objectives of the training is to identify the advantages and disadvantages of each method used and to find solutions to conduct the research.

- **Application of data-aggregation for cancer research** (Dr H. Pluchard – To confirm)?
    - 1 capsule

The objective of this course is to understand how to deal with different sources of data for a clinical research project. The course is based on an example on cancer research with multiple database from cohort, register and hospital data.

Competencies acquired for MIAI Label

Competencies	Novice	Intermediate	Advanced
1 - Select and use the right tools for structuring, exploring, researching, storing, and using data		x	
1.1 - By collecting and consolidating, explaining the data for decision-making assistance (business intelligence)	x		
1.2 - Knowing the sources and the data acquisition to train a model		x	
1.3 - By assessing the ethical and regulatory impacts linked to the data and their use	x		
2 - Know and apply learning and symbolic AI technologies	x		
2.1 - Knowing the main models and tools (their context and application conditions, their inputs and outputs)			x
2.2 - By modeling a customer or application problem and identifying the use of AI to solve it		x	
3 - Identify, explore and model AI technologies on real applications			x
3.1 - By having the ability to interact with specialists in the field to identify the problem and specify the needs			x
3.2 - By understanding the AI architecture dedicated to an application and by making it evolve so that it matches business or customer needs: data (collection, storage, management); learning; decision making; analysis and model relevance.			x
3.3 - By knowing and mastering the management of an AI project in a company			x
3.4 - Using AI to transform the company and its management		x	

Organisation

Hours of courses, on-line Exercises, project, other activities….

Remember: the program is 100% online and in english
Number of capsules: 12 to 14
On-line exercices (directed works): 12h

Rules of validation

Continuous evaluation (%), Final exam (%), online activities (%),….
Continous evaluation (50% including MCQ and online activities), Final exam based on an individual report: 50%