**1 - Motivation and objective**

**Goal**
- Develop a model for efficient real-time patient monitoring and delivering high-quality personalized healthcare.

**Motivation**
- Addressing growing medical knowledge, evolving diseases, and COVID-19 challenges for enhanced patient monitoring and personalized care.

**Problem**
- Increase in chronic diseases

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**2 - Medical data Analysis**

**DATASET**
The study utilized the health data of 30 patients who were hospitalized during the COVID-19 period. Regular analyses were conducted on these patients to monitor the progression of their health condition.

**PREPROCESSING**
- Preparation and cleaning of patient data to enhance the quality and relevance of subsequent analysis and treatment outcomes.

**Idea**
- Dimension reduction (PCA)

**Clustering**
- Clustering similar patients into homogeneous subgroups. The aim is to identify hidden structures and patterns in the patients' data.

**Choice of the metric**
- Kmeans clustering
- Hierarchical clustering

**Kmeans clustering**
- Choice of K

**Hierarchical clustering**
- Choice of linkage method

**Applying PCA to the data allows for simplifying their representation, identifying the most important variables, facilitating visualization, and enhancing the performance of subsequent analysis techniques.**

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**3 - Clustering automation (Supervised learning)**

**Goal**
- Assisting doctors in classifying patients based on their test results.

**Logistic Regression**
- Formula: \( P(y = 1|x) = \frac{1}{1 + e^{-(ax + b)}} \)

**Random Forest Classifier**
- \( \hat{y} = \arg \max_{k} \sum_{i=1}^{K} \left( \frac{1}{n_i} \right) \left( 1 + \frac{1}{R(\epsilon)} \right) \)

**Support Vector Machine**
- \( \hat{y} = \arg \max_{k} \sum_{i=1}^{K} \left( \frac{1}{n_i} \right) \left( 1 + \frac{1}{R(\epsilon)} \right) \)

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**4 - Predictions with Markov Process**

**TRANSITION MATRIX PROPERTIES**
- \( M \) is a stochastic, regular, irreducible, and diagonalizable matrix. Its largest eigenvalue is equal to 1. According to the Perron-Frobenius theorem, the Markov Process with a transition matrix \( M \) has a unique steady state. This steady state is represented by the normalized form of the eigenvector associated with the eigenvalue 1.

**DAILY PATIENT DISTRIBUTION OVERVIEW**

**FORECAST PATIENT HEALTH CHANGES**

**FORECAST PATIENT TRAJECTORY**

**Goal**
- Facilitates proactive interventions and timely treatment adjustments for better patient care.

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**5 - Limitations and Perspectives**

- Independence assumption neglects key factors impacting health outcomes.
- Assumption of stationarity in Markov models conflicts with the dynamic nature of healthcare.

**Using advanced modeling techniques such as non-stationary hidden Markov processes or regime-switching Markov models.**