

# On the Use of Multi-objective Metaheuristics in Pre-processing for Reinforcement Learning

Bachelor-/Master thesis

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## Overview

This project is an innovative, IT-based decision support system for individualized risk stratification, monitoring and therapy management in intensive care medicine, which is developed and prototypically implemented in this R&D project and its usability tested in a user study. It links a patient's data with medical expertise and guideline knowledge as well as patient condition and treatment pathway patterns obtained from data by pattern recognition. The project uses advances in the digitalization of the health care system, state-of-the-art machine learning and new technologies for automated data analysis to achieve treatment paths that are better adapted to the patient and thus avoid undesired long-term consequences such as the need for care and long-term respiration. Due to its learning ability, the system allows to continuously learn new knowledge from the data and to store it in a research knowledge database separate from the productive knowledge database.

## Motivation

In our current work, we managed to design, develop and test a reinforcement learning scheme suited to find a close-to-optimal policy for tuning mechanical ventilation devices in ICU. The learning process was conducted using data available in the Medical Information Mart for Intensive Care III database. Results show a performance gain of more than 40% in survival rate compared to clinician's policy. In this thesis, the objective is to set a machine learning scheme for the pre-processing module, to facilitate optimal choice of patient data used training, verification and testing. Due to the complexity of the problem, this will involve the use of a multi-objective metaheuristic algorithms such as Multi-Objective Evolutionary Algorithms (MOEAs).

## Tasks

### Main Goals

1. Understanding the currently developed RL scheme
2. Understanding Multi-Objective Evolutionary Algorithms (MOEAs)
3. Proposing and implementing a MOEA scheme for the pre-processing module
4. Test the new scheme on a relevant medical problem

## Requirements

### Students

- Information technology
- Computer Science

### Cooperation Partners

- University Hospital Aachen, OIM
- RWTH Aachen University, ICE & ISEK
- Trier University of Applied Sciences