***RAD***

***Requirements Analysis Document***

***U-CURE***

***Versione 1.0***

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# Introduction

The following analysis concerns patients suffering from cardiovascular pathologies and is based on a dataset made available by XXXX (Omissed due to copyright issues) of individuals with heart disease.

The proposed approach involves exploring the features and the relationships between them,

stratifying for the values assumed by the target variable of interest and proceeding to the fit and optimization of a classifier helpful in predicting its values.

The target variable is categorical and quantifies the number of large vessels affected by atherosclerotic problems and affected by an obstruction affecting 50% or more of the vessel volume; its informative value chose concerning the pathology in question.

The output of a decision support system that takes advantage of the proposed algorithm would be the automatic activation of a suggestion for further medical information where necessary and, in particular, the following: "requested further medical information to verify the presence of atherosclerotic problems."

The ML Engine is a microservice used by the U-CURE project to analyze a dataset, train the SVC model, test the model, and classify patients.

The dataset is available at the following link: XXXXX (Omitted due to copyright issues).

## Features

The analysis reported below aims at giving a quantitative idea of the prediction performance of diagnosis of comorbidity of atherosclerosis (to the extent that this prediction aims at a warning for further medical investigation) in the scenario in which the data currently monitored in the U-CURE project is also accompanied by the monitoring of the patient's symptoms regarding chest pain (angina). According to the available data confirming current medical knowledge, this specific feature was necessary to achieve acceptable prediction performances. The data in this specific analysis consist of 8 features of 297 patients. The features considered represent a subgroup of the features available at the link above, selected based on their relevance in diagnosing the concomitant pathology under examination, as follows:

* 1. **Age**
* 2. **Genre**
  + Female
  + Male
* 3.**Chest Pain Type**:
  + Typical Angina
  + Atypical Angina
  + Non-Anginal Pain
  + Asymptomatic
* 4.**Resting Blood Pressure**
* 5.**Resting Electrocardiographic Measurement**:
  + Normal
  + ST-T Wave Abnormality
  + Left Ventricular Hypertrophy
* 6.**ST Depression: Exercise-induced ST depression versus rest**
* 7.**Slope**: Operating peak ST segment slope:
* 8.**Number of Major Vessels**: Number of major blood vessels stained by fluoroscopy and affected by an obstruction >= 50% of the vessel diameter
  + 0
  + 1
  + 2
  + 3

## State of the art

Omissed due to copyright issues.

## Purpose

Omissed due to copyright issues.

## Goals and success criteria

Omissed due to copyright issues.

## Reference documents

|  |  |  |
| --- | --- | --- |
| **ID** | **Description** | **Owner** |
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## Document structure

The document is organized as follows.

* The first section is the Introduction. Its goal is to provide a brief overview of the system's features and the reasons for its development, its purpose, and references to the development context.
* The second section describes the current system if any.
* The third section describes the system to implement, its functional and non-functional requirements, and usage scenarios.
* The document concludes with the fourth section, which contains the glossary of the most essential and used terms to make reading more immediate.

# Current system

Omissed due to copyright issues.

# Proposed system

## Overview

Omissed due to copyright issues.

## Functional Requirements

Omissed due to copyright issues.

## Non Functional Requirements

Omissed due to copyright issues.

# Use case model

## AI Features

### UC.AI001 – Loading of clinical data

|  |  |  |
| --- | --- | --- |
| **Use Case** | | *UC.AI001 - Loading of clinical data* |
| **Description** | | This function allows the Machine learning engineer to provide the dictionary and the clinical dataset and load it into the ML Engine. |
| **Primary actor** | | **Machine learning engineer** |
| **Secondary actors** | | **ML Engine** |
| **Entry Condition** | | The user is logged in. |
| **Extension points** | |  |
| **MAIN SCENARIO** | | |
| **1** | **Machine learning engineer** | The Machine learning engineer clicks the suboption “Load dataset”. |
| **2** | **System** | The system displays a form containing the dataset fields. |
| **3** | **Machine learning engineer** | The Machine learning engineer fills in the dataset name and other details and presses “Save”. |
| **4** | **System** | The system saves the new project data. |
| **5** | **System** | The system requests the ML Engine to process the dataset. |
| **6** | **ML engine** | The ML engine replies with the EDA. |
| **7** | **System** | The system displays the EDA details (categorical, continuous, etc.). |
| **8** | **Machine learning engineer** | The Machine learning engineer fills in the variable of his (or her) interest and presses ‘Transform’. |
| **9** | **System** | The system requests the ML Engine to process the transformation. |
| **10** | **ML engine** | The ML engine replies with the transformation. |
| **11** | **System** | The system displays the transformation details. |
| **Exceptions** | | |
| **7** | **System** | The system displays an error message reporting the dataset inconsistency. |

### UC.AI002 – List model projects

|  |  |  |
| --- | --- | --- |
| **Use Case** | | *UC.AI002 - List model projects* |
| **Description** | | This function allows the Machine learning engineer to list all model projects. |
| **Primary actor** | | **Machine learning engineer** |
| **Secondary actors** | | **ML Engine** |
| **Entry Condition** | | The user is logged in. |
| **Extension points** | | * 4. Open project |
| **MAIN SCENARIO** | | |
| **1** | **Machine learning engineer** | The Machine learning engineer presses the “List all projects” link to list all projects. |
| **2** | **System** | The system searches for all projects. |
| **3** | **System** | The system displays the project list. |
| **4** | **Machine learning engineer** | The Machine learning engineer navigates the results. |
| **Exceptions** | | |
| **3** | **System** | The system displays an error message stating that no data have been retrieved. |

### UC.AI003 – Open project

|  |  |  |
| --- | --- | --- |
| **Use Case** | | *UC.AI003 - Open project* |
| **Description** | | This function allows the Machine learning engineer to open a project |
| **Primary actor** | | **Machine learning engineer** |
| **Secondary actors** | | **ML Engine** |
| **Entry Condition** | | The MAIN SCENARIO of UC.AI002 has been executed successfully. |
| **Extension points** | | * 4. Univariate and bivariate analysis * 4. Comparison of categorical features * 4. Bivariate analysis of continuous features * 4. Multivariate analysis * 4. SVC model training * 4. Model test |
| **MAIN SCENARIO** | | |
| **1** | **Machine learning engineer** | The Machine learning engineer clicks “Open” relating the project of his (or) interest. |
| **2** | **System** | The system searches the project details. |
| **3** | **System** | The system displays the project details. |
| **4** | **Machine learning engineer** | The Machine learning views the project details. |
| **Exceptions** | | |
| **3** | **System** | The system displays an error message. |

### UC.AI004 – Univariate and bivariate analysis

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| --- | --- | --- |
| **Use Case** | | *UC.AI004 - Univariate and bivariate analysis* |
| **Description** | | This function allows the Machine learning engineer to view the univariate and bivariate variables analysis. |
| **Primary actor** | | **Machine learning engineer** |
| **Secondary actors** | | **ML Engine** |
| **Entry Condition** | | The MAIN SCENARIO of UC.AI003 has been executed successfully. |
| **Extension points** | |  |
| **MAIN SCENARIO** | | |
| **1** | **Machine learning engineer** | The Machine learning engineer clicks “Analyze” relating to the variables to analyze. |
| **2** | **System** | The system requests the ML Engine to process the analysis. |
| **3** | **ML engine** | The ML engine replies with the analysis details. |
| **4** | **System** | The system displays the analysis details. |
| **5** | **Machine learning engineer** | The Machine learning engineer fills in the variables of his (or her) interest. |
| **6** | **Machine learning engineer** | The Machine learning engineer presses ‘T-test’. |
| **6** | **System** | The system requests the ML Engine component to process the t-test. |
| **7** | **ML engine** | The ML engine replies with the t-test details. |
| **8** | **System** | The system displays the t-test details. |

### UC.AI005 – Comparison of categorical features

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| --- | --- | --- |
| **Use Case** | | *UC.AI005 - Comparison of categorical features* |
| **Description** | | This function allows the Machine learning engineer to compare the categorical features with the diagnostic target. |
| **Primary actor** | | **Machine learning engineer** |
| **Secondary actors** | | **ML Engine** |
| **Entry Condition** | | The MAIN SCENARIO of UC.AI003 has been executed successfully. |
| **Extension points** | |  |
| **MAIN SCENARIO** | | |
| **1** | **Machine learning engineer** | The Machine learning engineer clicks “Compare categorical features” relating the categorical variables. |
| **2** | **System** | The system requests the ML Engine to process the features comparison. |
| **3** | **ML engine** | The ML engine replies with the features comparison. |
| **4** | **System** | The system displays the features comparison details. |

### UC.AI006 – Bivariate analysis of continuous features

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| --- | --- | --- |
| **Use Case** | | *UC.AI006 - Bivariate analysis of continuous features* |
| **Description** | | This function allows the Machine learning engineer to analyze continuous features. |
| **Primary actor** | | **Machine learning engineer** |
| **Secondary actors** | | **ML Engine** |
| **Entry Condition** | | The MAIN SCENARIO of UC.AI003 has been executed successfully. |
| **Extension points** | |  |
| **MAIN SCENARIO** | | |
| **1** | **Machine learning engineer** | The Machine learning engineer clicks “Continuous feature analysis” relating the continuous features of his interest. |
| **2** | **System** | The system sends the features to analyze. |
| **3** | **ML engine** | The ML engine replies with the analysis. |
| **4** | **System** | The system displays the analysis. |

### UC.AI007 – Multivariate analysis

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| --- | --- | --- |
| **Use Case** | | *UC.AI007 - Multivariate analysis* |
| **Description** | | This function allows the Machine learning engineer to execute a multivariate analysis of the selected features. |
| **Primary actor** | | **Machine learning engineer** |
| **Secondary actors** | | **ML Engine** |
| **Entry Condition** | | The MAIN SCENARIO of UC.AI003 has been executed successfully. |
| **Extension points** | |  |
| **MAIN SCENARIO** | | |
| **1** | **Machine learning engineer** | The Machine learning engineer presses “Multivariate analysis”. |
| **2** | **System** | The system displays a form to select the features. |
| **3** | **Machine learning engineer** | The Machine learning engineer selects the features of his (or her) interest and presses “Execute”. |
| **4** | **System** | The system requests the ML Engine to process the Multivariate analysis of the selected features. |
| **5** | **ML engine** | The ML engine replies with the multivariate analysis. |
| **6** | **System** | The system displays the analysis. |

### UC.AI008 – SVC model training

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| --- | --- | --- |
| **Use Case** | | *UC.AI008 - SVC model training* |
| **Description** | | This function allows the Machine learning engineer to train the model. |
| **Primary actor** | | **Machine learning engineer** |
| **Secondary actors** | | **ML Engine** |
| **Entry Condition** | | The MAIN SCENARIO of UC.AI003 has been executed successfully. |
| **Extension points** | |  |
| **MAIN SCENARIO** | | |
| **1** | **Machine learning engineer** | The Machine learning engineer clicks “Train” link. |
| **2** | **System** | The system shows a form containing the following fields: training parameters, dataset. |
| **3** | **Machine learning engineer** | The Machine learning engineer fills in the model parameters and presses “Execute”. |
| **4** | **System** | The system requests the ML Engine to train the model. |
| **5** | **ML engine** | The ML engine replies with the training results. |
| **6** | **System** | The system updates the new model status. |
| **7** | **System** | The system displays the training details (precision, recall and F1-score). |

### UC.AI009 – Model test

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| **Use Case** | | *UC.AI009 - Model test* |
| **Description** | | This function allows the Machine learning engineer to test the SVC model. |
| **Primary actor** | | **Machine learning engineer** |
| **Secondary actors** | | **ML Engine** |
| **Entry Condition** | | The MAIN SCENARIO of UC.AI003 has been executed successfully AND the SVC model has been already trained. |
| **Extension points** | |  |
| **MAIN SCENARIO** | | |
| **1** | **Machine learning engineer** | The Machine learning engineer clicks the “Test” link. |
| **2** | **System** | The system displays a form containing the training parameters and dataset fields. |
| **3** | **Machine learning engineer** | The Machine learning engineer fills in the parameters for the model, and presses “Execute”. |
| **4** | **System** | The system requests the ML Engine to test the SVC model. |
| **5** | **ML engine** | The ML engine replies with the test results for the model. |
| **6** | **System** | The system displays the test details (precision, recall and F1-score) for the model. |

### UC.AI008 – Patient classification

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| --- | --- | --- |
| **Use Case** | | *UC.AI0010 - Patient classification* |
| **Description** | | This function allows the doctor to classify a new Patient using the SVC model. |
| **Primary actor** | | **Doctor** |
| **Secondary actors** | | **ML Engine** |
| **Entry Condition** | | The user is logged in. |
| **Extension points** | |  |
| **MAIN SCENARIO** | | |
| **1** | **Doctor** | The doctor clicks “Diagnosis” relating to the patient of his (or her) interest. |
| **3** | **System** | The system searches for the SVC model parameters. |
| **4** | **System** | The system requests the ML Engine to classify the patient. |
| **5** | **ML engine** | The ML engine replies with the patient classification. |
| **6** | **System** | The system displays the patient classification. |

# Glossary

The following table lists the terms, abbreviations and acronyms used in this document.

|  |  |
| --- | --- |
| **Acronym** | **Description** |
|  |  |
|  |  |