

ML Based Framework for Understanding the Role of Microbiome in Colon Cancer Diagnostics and Therapeutics

ML4Microbiome – COST Action CA18131 / STSM

1. BASIC PROJECT INFORMATION

Official Project Title	ML Based Framework for Understanding the Role of Microbiome in Colon Cancer Diagnostics and Therapeutics
Acronym / Short Name	ML4Microbiome – COST Action CA18131 / STSM
Programme / Funding Source	European Cooperation in Science and Technology (COST) – COST Action CA18131 “Statistical and machine learning techniques in human microbiome studies” (ML4Microbiome)
Duration	February 2021 – March 2022; research STSM stay: 1 February – 7 March 2021
Coordinator	COST Action CA18131 (ML4Microbiome); STSM host: Prof. Osman Uğur Sezerman, Acibadem Mehmet Ali Aydınlar University, İstanbul, Türkiye
Partner Institutions	Sezerman Lab / Department of Biostatistics and Medical Informatics, Acibadem Mehmet Ali Aydınlar University; Faculty of Computer Science and Engineering, Ss. Cyril and Methodius University in Skopje; international COST network ML4Microbiome

2. PARTICIPATION OF UNIVERSITY SKOPJE ACADEMIC STAFF

Name and Surname: Assistant Professor Dr Miodrag Cekikj

Academic Title: Assistant Professor

Role / Function in the Project: Researcher / Machine Learning Researcher within a Short-Term Scientific Mission (STSM)

Specific Contribution to the Project

Development and evaluation of a machine-learning-based approach for modelling the relationships between the gut microbiome, colorectal carcinogenesis and resistance to therapy. The work included preparation and analysis of microbiome data, feature engineering and selection, building and comparison of ML models, analysis of the joint influence of bacterial genera, and interpretation of predictive signals. The research stay at Sezerman Lab was also used for knowledge transfer between bioinformatics, medical informatics and applied artificial intelligence, and the results were translated into a peer-reviewed scientific publication.

3. CONTENT AND ACHIEVED RESULTS

Brief Project Description

The project explores how machine learning methods can help in understanding the role of the gut microbiome in colorectal cancer, with a focus on diagnostics, carcinogenesis and resistance to therapy. Within COST Action CA18131 – ML4Microbiome and a research stay at Sezerman Lab at Acibadem

University, a multidisciplinary technical approach was developed for processing microbiome data and modelling clinical outcomes. The methodology combines selection of relevant microbiome features, supervised machine learning and model interpretation in order to identify bacterial signals and their combinations associated with therapeutic response and risk. The work created a basis for further research into the application of explainable AI/ML analysis in precision medicine and oncology bioinformatics.

Key Results / Outputs

Developed and evaluated ML methodology for the analysis of microbiome data in colorectal cancer; models for prediction and interpretation of therapy resistance and carcinogenesis; analysis of joint bacterial features and their predictive influence; international research cooperation and knowledge transfer; peer-reviewed publication in MDPI Applied Sciences.

Publications / DOI / Other Relevant Scientific Results

Miodrag Cekikj, Milena Jakimovska Özdemir, Slobodan Kalajdziski, Orhan Özcan, Osman Uğur Sezerman, "Understanding the Role of the Microbiome in Cancer Diagnostics and Therapeutics by Creating and Utilizing ML Models", Applied Sciences 12(9), 4094, 2022. DOI: 10.3390/app12094094

<https://www.mdpi.com/2076-3417/12/9/4094>

4. SIGNIFICANCE FOR THE FACULTY

Benefits for Students, Teaching and/or Research

The project has direct value for teaching and research in the areas of machine learning, bioinformatics, data analysis and applied artificial intelligence. The methodology and published results can be used as a real case study for working with high-dimensional biomedical data, feature selection, ML modelling and interpretability. The experience from the international research stay opens opportunities for student projects, bachelor's and master's theses, as well as for future interdisciplinary collaborations between computer science, medicine and biostatistics.

5. LINKS AND MULTIMEDIA MATERIALS

Official Website / Project Link: ML4Microbiome / COST Action CA18131:

<https://www.cost.eu/actions/ca18131/>

Scientific Publication: <https://www.mdpi.com/2076-3417/12/9/4094>