**STSM Presentation**
**Mikhail Kolev**
Bulgaria/Poland

During the period February 10-24, 2020

I participated in an exchange project – short-term scientific mission in Estonia, University of Tartu, Institute of Molecular and Cell Biology,

under the supervision of Prof. Jaak Truu.

# Intestinal/Gut microbiome association with bone health – review of literature, machine learning methods and data availability

The principle research question was studying the existing literature, machine learning methods and data availability related to the relationships between gut microbiome and bone health. The motivation for this choice was the increased evidence that the human intestinal microbiome plays a critical role in the regulation of significant biological processes and the mechanisms underlying numerous complex diseases.

During the STSM a study of the available literature was made. Various microbiome data and clinical characteristics presented in a series of papers were investigated. Technical and analytical approaches that are appropriate for gut microbiome studies of complex diseases were studied. A special attention to the methods of data processing and analyses was paid.

## Networking development

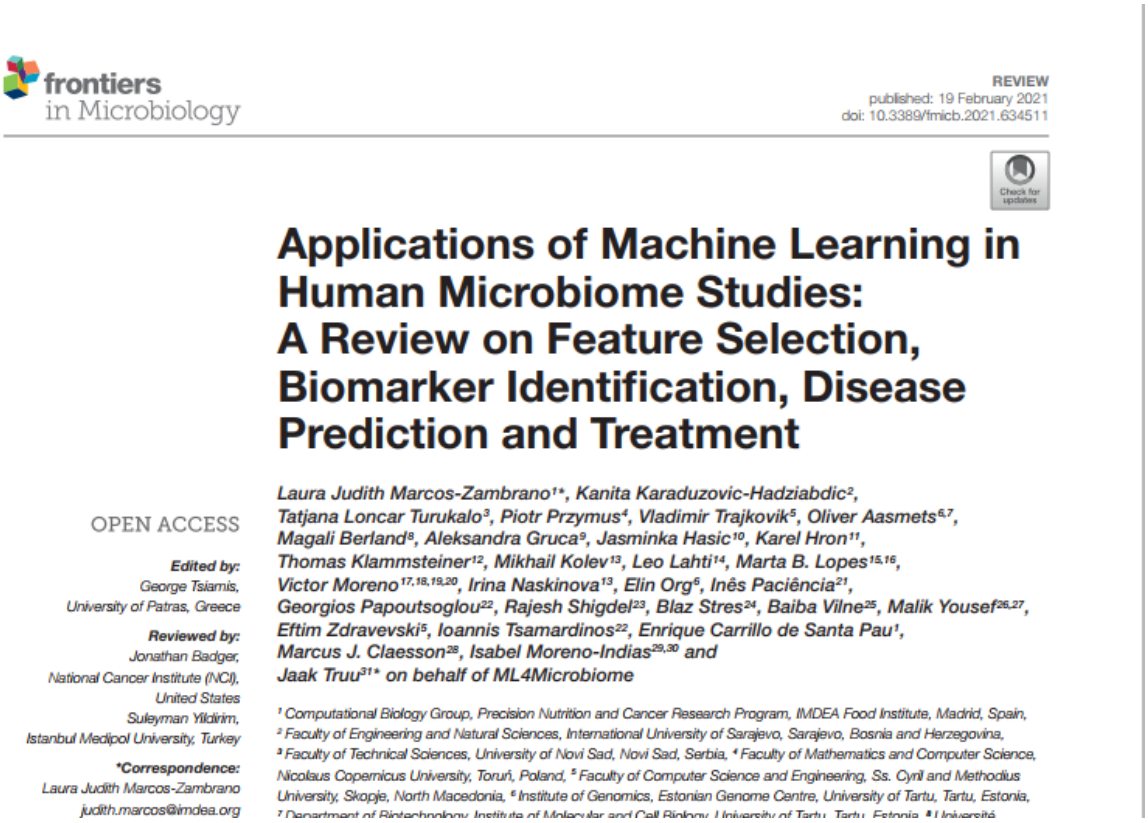
During my stay I was engaged in several types of activities:

Meetings and collaboration with scientists:

- Meetings and discussions with scientist from the Institute of Molecular and Cell Biology, University of Tartu (Marika Truu, Kristjan Oopkaup, Triinu Visnapuu)

- Meetings and discussions with scientist from the Estonian Genome Centre, University of Tartu (Elin Org, Oliver Aasmets)

- Online core group meeting devoted to the preparation of the annual report of Working Group 1 as well as of the paper for Frontiers in Microbiology



frontiers in Microbiology

REVIEW
published: 19 February 2021
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# Applications of Machine Learning in Human Microbiome Studies: A Review on Feature Selection, Biomarker Identification, Disease Prediction and Treatment


Laura Judith Marcos-Zambrano[1]*, Kanita Karaduzovic-Hadziabdic[2], Tatjana Loncar Turukalo[3], Piotr Przymus[4], Vladimir Trajkovik[5], Oliver Aasmets[6,7], Magali Berland[8], Aleksandra Gruca[9], Jasminka Hasic[10], Karel Hron[11], Thomas Klammsteiner[12], Mikhail Kolev[13], Leo Lahti[14], Marta B. Lopes[15,16], Victor Moreno[17,18,19,20], Irina Naskinova[13], Elin Org[6], Inês Paciência[21], Georgios Papoutsoglou[22], Rajesh Shigdel[23], Blaz Stres[24], Baiba Vilne[25], Malik Yousef[26,27], Eftim Zdravevski[5], Ioannis Tsamardinos[22], Enrique Carrillo de Santa Pau[1], Marcus J. Claesson[28], Isabel Moreno-Indias[29,30] and Jaak Truu[31]* on behalf of ML4Microbiome

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We focused on the methodology used to identify and select relevant studies. We have used both manual and automated search of literature corpus in the identification step, performing three independent processes:

An automated search through the available GitHub resources using NLP algorithms to identify relevant software repositories and extract corresponding scientific papers.

Piotr Przymus, Vladimir Trajkovik

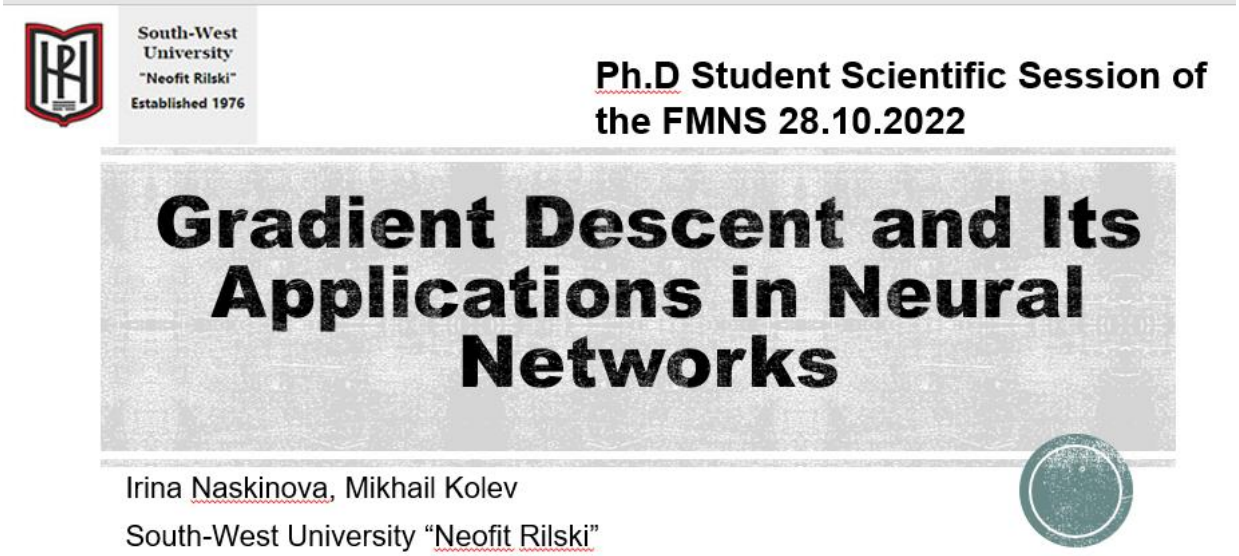
An automated search of digital libraries of three major publishers (PubMed, Springer and IEEE) using NLP Toolkit (Zdravevski et al., 2019)

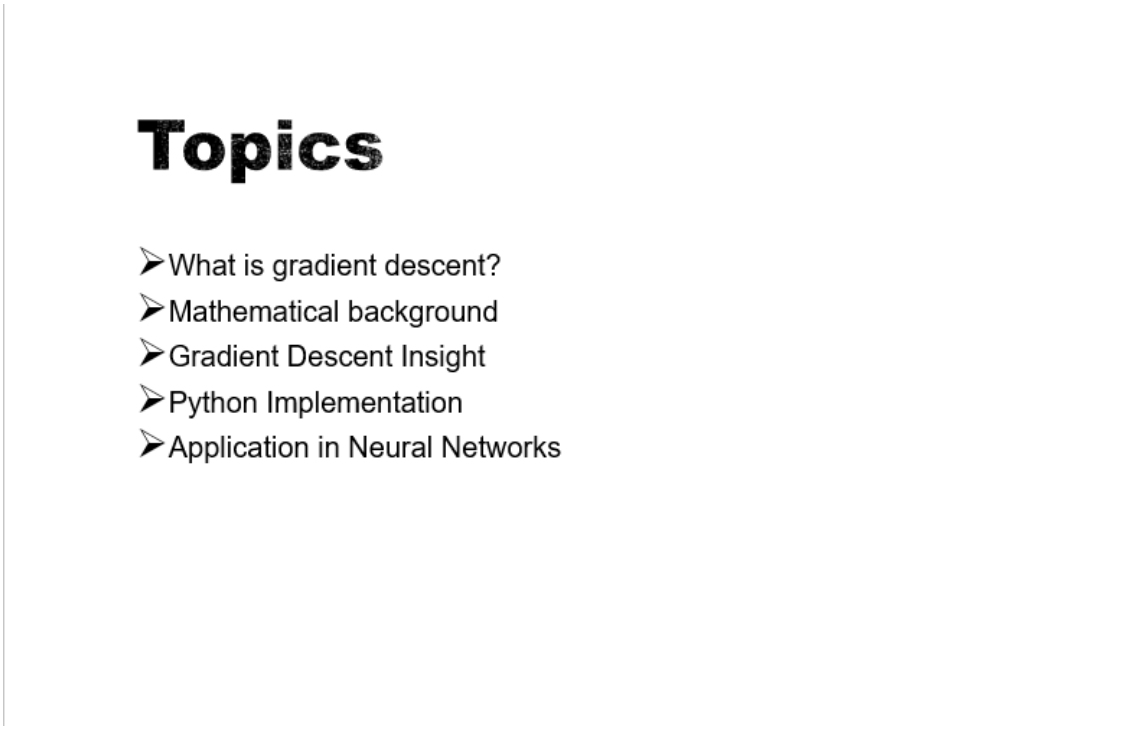
Manual search – crowdsourcing of the studies relevant for the review topic

Future Paper

on Deep learning methods in microbiome studies

**Career development**



Action number: CA18139
STSM title: Machine Learning Models in Osteoporosis and Scoliosis
STSM start and end date: 11/02/2020 to 25/02/2020
Grantee name: Irina Naskinova

in Ireland, Dublin College University, the Machine Learning Lab
under the supervision of Kathleen Curran

The purpose of the short term scientific mission was to enhance the clinical diagnosis of osteoporosis and scoliosis with machine learning algorithms for medical image recognition.

The purpose of the research is localization and segmentation of zebrafish spine which can be used for accelerating the diagnosis of scoliosis, osteoporosis, or osteogenesis imperfecta.

During the research experiments were done with traditional image processing, initially in Matlab and later applying python implementation for the same filters.

Gabor filter was identified as particularly useful for segmenting the intervertebral disks of the zebrafish and the spinal column as a whole. Since the interference from peripheral tissue and the ribs is challenging. The specificity of the shape -- elliptical structure and the direction of the disks is going to be used. A model was developed with Gabor filters which was used to run initial test. Further work needs to be done to make the model more accurate.

The research and implementations is centered on identifying a method which we expect to have promissing results in segmenting the zebrafish spinal column.

Zebrafish xray images were provided by Erika Kague, Ph.D (Senior Research Associate, School of Physiology, Pharmacology and Neuroscience
Biomedical Sciences, University of Bristol) were used to create image segmentation of zebrafish vertebra column with the purpose of identifying body curvature.

The extraction of IVD structure information, such as shape and direction, and avoiding interference from peripheral tissues is challenging. The Gabor filter, a windowed Fourier transform, derives from the work of Gabor D. Daugman [19] extended the Gabor filter to two-dimensional (2D) spatial position. Given the biological background and the optimal space and spatial-frequency localization of Gabor filter [20], it is widely used for image process applications [21–23]. When the direction and frequency of the objects in an image are consistent with those of 2D-Gabor filters, the wavelet transformation has a strong response. Since the IVDs in spinal MRI are regular and ellipse-shaped, the recognition of IVDs is possible by transformation of Gabor filtering.

PhD Thesis

Habilitation Thesis

I got the opportunity to learn about new approaches in data research, entered new fields of biology and medicine and established scientific contacts with leading specialists in the field of the COST Action.