Project description for Master's thesis

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Project title

Utilizing Deep Learning for Rapid Antimicrobial Resistance Detection in Bacteria Using MALDI-TOF Mass Spectra

Project description

Rapid and accurate detection of antimicrobial resistance (AMR) in bacterial pathogens is a crucial challenge in modern medicine. Current culture-based AMR testing methods are time-consuming, often taking up to 72 hours to yield results, which can delay effective treatment.

This project aims to leverage the capabilities of deep learning, specifically convolutional neural networks (CNNs), to predict antimicrobial resistance directly from MALDI-TOF (Matrix-Assisted Laser Desorption/Ionization-Time of Flight) mass spectra profiles of clinical bacterial isolates.

Utilizing data from the comprehensive Database of Resistance Information on Antimicrobials and MALDI-TOF Mass Spectra (DRIAMS), this project aims not only to train CNNs to differentiate between susceptible and resistant bacterial strains, but also to delve into the underlying explanatory signals within the MALDI-TOF spectra that correlate with resistance. This deep analysis seeks to identify spectral indicators of resistance, potentially leading to novel insights into the mechanisms of AMR. The analysis might be stratified by bacterial species, allowing for a more nuanced understanding of species-specific resistance markers.

Activity plan

- Week 1 - 2: literature reading, data acquisition, and data wrangling
- Week 3 - 4: data wrangling, determining initial CNN architecture, and initial network coding
- Week 5 - 6: coding network, decision on loss function, hyper-parameter tuning
- Week 7 - 8: continued hyper-parameter tuning, setting up experiments for validation
- Week 9 - 10: further coding of experiments, possibly initial writing on thesis
- Week 11 - 12: finalizing experiments and getting results; writing thesis
- Week 13 - 14: writing thesis