Integrating Machine Learning and Optimization Methods for Medical Diagnosis

Maria C. Mariani[1], Jazmin Quezada[2] , Osei K. Tweneboah[3]

Abstract

The rapid advancement of machine learning techniques has revolutionized the field of medical diagnosis by offering powerful tools to analyze complex data-sets and make accurate predictions. These advancements equip us with potent tools to dissect intricate data-sets and make exceptionally precise predictions. Our novel approach combines machine learning with optimization models to heighten the accuracy of medical diagnoses. This method primarily concentrates on refining and optimizing parameters of widely used machine learning algorithms in medical diagnosis, encompassing logistic regression, support vector machines, and neural networks. Function $diagnosis = f(p_1, p_2, ..., p_{n_f})$ can be approximated by using many approximation techniques (neural networks, various nonlinear regression models, etc.). To find optimal result of the algorithm f it is possible to extrapolate values of the function f and find possible new optimal value. Through the strategic application of optimization techniques, we meticulously navigate the parameter space of these algorithms to uncover the most optimal setups. Furthermore, by representing algorithms as computational graphs and leveraging their relationships with diagnostic outcomes, we can project the ideal characteristics of existing algorithms. This has the potential to steer the development of new, exceedingly accurate diagnostic tools. The integration of machine learning and optimization models provides a systematic, data-driven framework for enhancing existing algorithms and uncovering inventive solutions, ultimately resulting in improved medical outcomes. The efficacy of this approach is demonstrated in a logistic regression case study, where parameters like the inverse of regularization strength (C) are precisely adjusted. The outcomes of the logistic regression were approximated and extended with the aid of graph neural networks (GNN), ultimately contributing to improved medical diagnosis.