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Abstract: Increasingly we are faced with complex health data, thus researchers are limited in their capacity to mine data in a way that accounts for the complex inter-relationships between health variables of interest. This research tackles the challenge of producing accurate health prediction models in order to overcome the limitations of simple multivariate regression techniques and the assumption of linear association, also known as algorithmic models, by combining it with a soft computing approach. Predictive models develop methods to enable healthcare researchers and professionals to predict the likelihood of an individual's proclivity to a disease and the likely effectiveness of possible treatments. Personalized approaches focus on the individual - relying on the individual's existing health data across the healthcare system with treatment targeted at the individual.

Keywords: HPC for Healthcare, HPC Application, Large-Scale Simulation

1 Motivation

Predictive analytics can improve healthcare in many ways [1]: increase the accuracy of diagnoses, help preventive medicine and public health, provide physicians with answers they are seeking for individual patients, offer employers and hospitals with predictions concerning insurance costs, allow researchers to develop models that require thousands of cases and that can become more accurate over time, and patients have the potential benefit of better outcomes due to more accurate predictive models [2, 3, 4, 5].

There are two main advantages of using high performance computation and machine learning for medical estimation. First, it incorporates learning from previous situations and outcomes. This learning ability is very important for effort-estimation models because there are substantial amounts of available historical data that can assist in predicting similar diagnoses. Secondly, soft computing can model a complex set of relationships between the dependent and independent variables, which can be adapted for clinical use. Overall, prediction and personalization models have the potential to: (a) facilitate diagnosis by reducing the "guesstimation" often used by health professionals; (b) improve the accuracy and performance of the estimations; (c) develop learning and adaptation ability; (d) improve imperviousness to imprecise and uncertain inputs. One paramount feature of this framework is that the architecture is inherently independent of the choice of algorithmic models or the nature of the prediction problems.

2 Research Objectives and Outcomes

Advancing research in prediction and personalization in chronic disease and acute conditions is one key to supporting the increasing demand for healthcare services. Our proposed research meets three objectives:

1) The creation of robust tools to mine medical databases as well as the necessary interfaces to deliver information in an accessible format to the end user.
2) An immediate objective entails validating the accuracy and improvement of a soft computing framework against current algorithmic models in order to solve the health-related estimation problems.
3) A longer-term objective is to apply this generic framework to other aspects of medical estimation, such as the prediction of health conditions and the risk assessment of disease outcomes.

Overall, this work will help physicians in diagnosing and predicting the medical condition of patients with higher accuracy and speed. This innovative project, which utilizes the skills of clinical researchers, software engineers, and mathematicians, moves us closer to translating knowledge into practice by harnessing medical data and facilitating the optimal allocation of treatment in a cost-effective manner The successful implementation of this research, will assist physicians and patient make crucial decisions in a timely fashion, leading to the creation of new healthcare.

The evaluation of new neuro-fuzzy models to predict the medical condition of patients will be carried out in collaboration with physicians and will help them make crucial decisions on-the-fly. At first, we will focus on cardiovascular disease, which is increasing in incidence and prevalence all over the world. There are evidence-based conceptual models of the risks and outcomes of coronary artery disease and hypertension that use statistical techniques, such as hierarchical regression modeling and multilevel modeling. We will incorporate a neuro-fuzzy approach into these algorithms in order to improve their accuracy. The knowledge gained through this project can extend to various diseases and conditions, including Alzheimer, cancer growth, and sepsis.

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