Automated Computational Intelligence and Machine Learning Advising in Healthcare

Janusz Wojtusiak, PhD[1] and Jacek M. Zurada, PhD[2]
[1]George Mason University, Fairfax, VA, [2]University of Louisville, Louisville, KY

Abstract
A method for automated advising of healthcare researchers and clinicians in using computational intelligence and machine learning (CIML) methods is described. The method guides users in a step-by-step process to map their research problems into CIML domain, select appropriate software and tools, help interpret results, and connect with CIML researchers whose expertise is relevant to the problem. The method is based on a distributed collaboration and resource sharing model within CIML virtual organization.

Introduction
There is a substantial gap between state-of-the-art methods developed in the field of computational intelligence and machine learning (CIML) and those commonly used in healthcare. Healthcare researchers and clinicians are not aware of, and do not have expertise to use advanced methods that can significantly benefit their work. One important reason for this situation is lack of unification and coordination in CIML resources. Developed software is difficult to use, requires technical expertise, and is not easily available.

To improve this situation, there is a need to maintain a repository of unified CIML resources, and provide access to experts from other disciplines who are potential users of these methods. The goal of the presented work is to construct an automated advising method able to guide healthcare researchers, professionals, and clinicians through CIML resources, and provide them with advice on which methods to use and how to obtain results specific to their research questions. This is part of a larger project aiming at building a computational intelligence and machine learning virtual organization (CIML VO), which brings together and unifies distributed resources (software, tools, datasets, problems, articles, educational materials) along with expertise of researchers in the field, in order to spark new development in the field and reach to healthcare community[1].

Overview of the Advising Method
The goal of the advising system is to interact with users in order to identify specific CIML problems to be solved, select best applicable tools, help interpret solutions, and identify experts who want to collaborate. This is possible because all resources in CIML VO are described using a set of multitype attributes that can be used for the mapping[2]. This is a multi-step process:

Identify CIML area: in initial text-based problem statements, keywords are identified. Then, more detailed questions are used to select area (concept learning, classification, optimization, etc.)

Select tools: within the selected area additional requirements are used to select specific tools.

Select additional materials: following links existing in CIML VO, tutorials, articles, lectures, similar tools, and other materials are identified, ranked and presented to the user.

Link with other researchers: characteristics of CIML area, software, selected materials are matched against profiles of known researchers (both CIML experts and the system users) to check for relevant expertise.

The key part of the process is that users interact with the system using their own terminology (no need to understand CIML). The system automatically maps the used terms into specific CIML areas using ontology-based domain translation system. The process is designed to minimize the number of questions needed, and can include users' profiles constructed using machine learning techniques.

References

1. Zurada, J.M., Mazurowski, M.A., Abdullin, A., Ragade, R., Wojtusiak, J. and Gentle, J. E., "Building Virtual Community in Computational Intelligence and Machine Learning," *Computational Intelligence Magazine*, 4, 1, pp. 43-54, 2009.
2. Wojtusiak, J., Zurada, J. M., Malof, J.M., Mehta, D. and Moidu, K., "Toward VO-based Collaboration between Computational Intelligence - Machine Learning and Healthcare Communities," *Recent Advances in Intelligent Information Systems*, Klopotek, M.A., Przepiorkowski, A, Wierzchon, S.T. and Trojanowski, K. (Eds.), 507-518, Academic Publishing House EXIT, 2009.