CoDE (Computer & Decision Engineering)

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The Computer & Decision Engineering (CoDE) department has officially started the 1st May 2006. It results from the association of three laboratories of the Engineering Faculty of the Université Libre de Bruxelles: IRIDIA, I&R and SMG. The aim of this department is to join the expertise of the three laboratories to realize innovative research and particularly in the area of "business intelligence".

CoDE is currently composed of 9 Professors, 8 senior researchers, 31 PhD students and 6 scientific and industrial collaborators.

IRIDIA is the Artificial Intelligence research laboratory of the Université Libre de Bruxelles. It is deeply involved in theoretical and applied research in computational intelligence. The major domains of competence are: swarm intelligence, metaheuristics to solve combinatorial and continuous space optimization problems, the foundational study of biological networks and business applications. The research program in swarm intelligence is centered on the design of algorithms or distributed problem-solving mechanisms using the collective behavior of social insect colonies as main source of inspiration. In particular, members of IRIDIA have proposed innovative algorithms to solve different types of optimization problems and to control swarms of robots. The metaheuristic unit is internationally known for the ant colony optimization metaheuristic and is a leading team in various stochastic local search methodologies such as iterated local search and evolutionary computation. Members of the unit are also interested in multi-objective optimization with a focus on two main aspects:

1) The development of stochastic local search algorithms for multi-objective combinatorial optimization problems such as those based on the Pareto local search and the two-phase framework.

2) The sound evaluation and comparison of the results of multi-objective optimizers through outperformance relations, attainment functions, statistical tests and graphical means; another related issue here is the analysis of multi-objective optimizers through experimental design techniques.

Another point of research is related to biological networks. The main interest is the study of neural networks, immune networks, and chemical reaction systems and in the identification of what are their common features and mechanisms. Members of the unit are also interested in exploiting the results of these studies for the conception of adaptive distributed engineering artifacts. Finally, IRIDIA develops practical business intelligence applications such as data mining and object oriented solutions for companies and administrations.

The laboratory of computer science and networks (I&R) is taking part in numerous research projects, be it for the university or as part of national or international projects. These cover many fields of computer science, from spatio-temporal data modelling to semantic web, from software engineering to wireless network routing, from bioinformatics to data visualization.
In the field of modeling, the department conceived, with the collaboration of the database laboratory of the École Polytechnique Fédérale de Lausanne, the MADS model for the representation of spatio-temporal data. Spatio-temporal databases make a historically significant and innovative field of study, as important scientific advances are necessary to develop the new generation of car navigation support and GPS-type geolocalised services. The LOBSTER project studies the benefits in this discipline of semantic web, a set of methods that provide a formal representation of the knowledge and the creation of intelligent agents capable of logical reasoning. Semantic Web is also the subject of several bioinformatics projects, such as INMOBIO which uses them to improve our comprehension of metabolic chains, primary means of investigation for the discovery of new medications. On the other hand, the BIOMAZE project has developed the state of the art concerning the visualization of those extremely complex metabolic chains. Finally in the study of software engineering, the new VARIBRU project aims at developing solutions to support the creation of an unique software that will easily adapt to different users, contexts or environments. These techniques shall be applied during the entire life cycle of the software, from the very beginning of its development till the very moment of its use.

The "Service de Mathématiques de la Gestion" (SMG) is the operational research laboratory of the Engineering Faculty. Research activities of the SMG are mainly devoted to Decision Engineering, with a particular emphasis on Multicriteria Decision Aid.

Historically, members of the unit have been at the origin of the PROMETHEE & GAIA methods. New research themes are conducted in this direction. From a methodological point of view, an extension of PROMETHEE to sorting problems, called FlowSort, is currently under study. Additionally, new software developments are considered in a “first spin off” project that has started in September 2007.

Members of the SMG are stimulating the application of general multicriteria tools to various application fields. One may cite for instance the development and analysis of multicriteria auctions (combinatorial multicriteria auctions, lexicographic auctions) or the integration of multicriteria methods to geographical information systems. Another major research interest covers multicriteria relational clustering. The aim here is to develop new algorithms that allow the detection of group structures and relations between these groups in a multicriteria context. Finally, the topic of performance evaluation of telecommunication systems is addressed by means of queueing theory and matrix analytic methods.

From a practical point of view, researchers of the SMG are regularly involved in industrial projects. For instance, they have successfully collaborated with Elia (which is the company in charge of electricity transmission in Belgium) to elaborate a model for the replacement of low and high voltage equipments. Another project has been conducted with the federal police to evaluate the crime gravity in Belgium.

The common goal of IRIDIA, I&R and SMG is to develop new research synergies in cross disciplinary fields.