Postgraduate Course for Non-Computer-Scientists: **Modelling for Discrete Optimisation**

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Motivation. Optimisation in general, and discrete (or: combinatorial) optimisation in particular, is a service science, just like mathematics. Hard constrained discrete optimisation problems occur in many academic disciplines of science and technology, as well as in industry and society, and their efficient solving via effective modelling is of paramount importance there. Examples include vehicle routing, resource allocation in energy systems, the design of optimal chips in biology, the planning of minimal experiments, the scheduling of a wastewater treatment plant, and the verification of electronic circuits.

Since such problems occur in many guises in a wide range of disciplines, the ability to recognise them as well as knowledge of technologies able to solve them optimally (or near optimally) should be in the repertoire of many PhD students at the TekNat faculty.

Powerful tools for discrete optimisation are now accessible via a single user-friendly integrated development environment: with only relatively easy-to-acquire knowledge of declarative problem *modelling* principles and *basic* programming skills, one can leave the algorithmic problem *solving* issues to the decades of cutting-edge research embedded in those tools, called *solvers*. This approach allows the solving of complex problems that are often mistakenly considered unsolvable or where only small instances are solvable fast enough if inadequate methods are used.

Course. A slight adaptation of the 5-credit course *Modelling for Combinatorial Optimisation* (1DL449) will be taught in 2017 to PhD students at TekNat (except the IT department). The syllabus is at `http://www.uu.se/en/admissions/master/selma/kursplan/?kpid=31583`: the idea is to teach, through examples, the use of a high-level declarative modelling language and its toolchain (see `http://minizinc.org`), interfaced with world-class solvers of several discrete optimisation technologies, such as mixed integer linear programming (MIP), stochastic local search (SLS), constraint programming (CP), Boolean satisfiability (SAT and SMT), and hybrids.

The course shows that a *single* model of a problem can be run on *multiple* solvers, even of *different* technologies, without needing to learn their very diverse modelling languages and without needing to understand (deeply, if at all) how they work. For most scientists and engineers, the time to achieve a particular solution speed or quality is drastically reduced by such a model-once-solve-everywhere toolchain.

An appetiser seminar will be given on Wednesday 5 April at 11:00 (sharp) in room ITC/1211.

Instruction and Examination. There are 12 lectures, 3 teacher-chosen assignments with submitted reports (3 credits), and a self-chosen project with a presentation and a submitted report (2 credits), the latter ideally within each student's own research area.

Logistics. The teacher is Prof. Pierre Flener (`http://user.it.uu.se/~pierref`), assisted by his PhD student Gustav Björdal, both of the Department of Information Technology in Polacksbacken, near the Ångström Laboratory.

If you are interested in taking this postgraduate course, then `mailto:Pierre.Flener@it.uu.se?Subject=M4DO-signup` the list of months (among May, June, August, September, and October 2017) during which you would be able to take a one-month version of the course.