FID3005 Constraint Programming 7.5 credits

Villkorsprogrammering

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FID3005 valid from Spring 2011

Grading scale

G

Education cycle

Third cycle

Specific prerequisites

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

The overall aim of the course is to create understanding of the fundamental concepts underly- ing constraint programming; develop skills in modeling and solving combinatorial problems; develop skills in taking advantage of strong algorithmic techniques; create understanding of merits and limitations of constraint programming.

More specifically, after the course a student should be able to:

• explain and apply basic modeling techniques for constraint problems, including the selection of variables, constraints, and optimization criteria.

• describe and apply depth-first search and branch-and-bound search for solving con-straint problems.

• describe and define constraint propagation, search branching, and search tree explo- ration. Prove correctness, consistency, and completeness of propagators implementing constraints. Define and prove correctness of branching strategies. Describe optimiza- tions of constraint propagation based on fixpoint reasoning.

• describe advanced modeling techniques, analyze combinatorial problems for the ap plicability of these techniques, and apply and combine them. These techniques in- clude: general symmetries, value and variable symmetries, symmetry breaking with constraints, symmetry breaking during search, domination constraints, redundant con- straints, re- dundant modeling and channeling, using strong algorithmic techniques, and branching heuristics.

• describe and apply Regin's algorithm for the distinct constraint as an example of strong constraint propagation. Explain algorithms for the element constraint, linear con straints, and disjunctive scheduling constraints. Implement a simple propagation al gorithm.

• describe the main strength and weaknesses of constraint programming and how con straint programming relates to other methods (local search and integer programming).

• describe and apply current research trends in constraint programming in all areas men tioned above.

Course contents

Modeling with constraint programming: typical techniques for modeling in different ap plication areas (redundant constraints, symmetry elimination); refining models by strong algorithmic methods; heuristic search methods; application to hard real-size problems.

Basic principles underlying constraint programming: models for propagation and search and their essential properties; different levels of consistency; different constraint do roams.

Strong algorithmic methods: Regin's distinct algorithm; edge-finding; integration (achiev ing required properties for propagation).

Relation to other techniques used in solving combinatorial problems: integer programming, local search; discussion of merits and weaknesses; hybrid approaches (column genera- tion, etc).

Research area overview: major conferences and journals. Current hot topics and connec-tion to other research areas.

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Approved written examination, approved assignments, and approved application of current research (in the form of using it for a research paper, report, or project, etc).

The course is graded with P/F (pass or fail).

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.