COMPLETE PROGRAM

Tuesday, August 19, 2008

Room: ***Van Gogh***

08:45 Opening Session

09:00 International Timetabling Competition 2007

TA1 – Plenary 1

Room: ***Van Gogh*** **Chairperson:** ***Michel Gendreau***

09:30 How to Fix a Broken Timetable: Collaborative Mechanisms for Managing Airport Capacity Reductions in the U.S.

Ball, Michael O. (University of Maryland, USA), mball@rhsmith.umd.edu

Scheduled commercial passenger airlines operate based on published itineraries between designated city-pairs. Due the dependence of air transportation system capacity on weather conditions, it is very common for there to be significant disruptions in air-line schedules. This creates a strong need for systems to optimize system performance under degraded conditions. Typically, one must minimize the deviation between the original timetable and the schedule actually used. In this paper we describe the set of resource allocation methods and practices used jointly by airlines and the Federal Aviation Administration within the U.S. to address these types of problems.

TB1 – Plenary 2

Room: ***Van Gogh*** **Chairperson:** ***Edmund Burke***

11:00 Towards a Reference Model for Timetabling and Rostering

De Causmaecker, Patrick (Katholieke Universiteit Leuven, Belgium)
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In this talk we discuss the need for a reference model in the field of timetabling and rostering. The reference model should allow to describe the interaction between different levels of planning and between the subjects involved to provide the information for the definition of applications at the most detailed level. Furthermore it should allow to systematically study complexity and hardness of the problems in the domain. We present a notation for rostering that allows classification and argue that it can be used in such a systematic study.

TC1 – Course Timetabling I

Room: ***Van Gogh***

13:30 A Conversion Scheme for Turning a Curriculum-based Timetabling Problem into a School Timetabling Problem

Nurmi, Kimmo (Satakunta University of Applied Sciences, Finland), kimmo.nurmi@samk.fi
Kyngäs, Jari (Satakunta University of Applied Sciences, Finland), jari.kyngas@samk.fi

The article describes a conversion scheme for turning a curriculum-based timetabling problem into a school timetabling problem. The motivation for this paper is to give directions on how to solve problems lying between school timetabling and curriculum-based timetabling. The converted problem instances are solved using a previously published school timetabling algorithm.

14:00 A Hybrid Genetic Algorithm for Curriculum Based Course Timetabling Problem

Massoodian, Soolmaz (The University of Isfahan, Iran), soolmaz_massoodian@yahoo.com
Esteki, Afsaneh (The University of Isfahan, Iran), esteki_afsaneh@yahoo.com

A hybrid genetic algorithm for curriculum based course timetabling with two main stages uses a local search at each stage, eliminating hard constraint violations in the first stage and minimizing soft constraints in the second; thus, preventing reintroduction of hard constraint violations in the final output.

14:30 QuikFix - A Repair-based Timetable Solver

Clark, Michael (Metaparadigm Pte Ltd, Singapore), michael@metaparadigm.com
Henz, Martin (National University of Singapore, Singapore), henz@comp.nus.edu.sg
Love, Bruce (Overseas Family School, Singapore), bruce_love@ofs.edu.sg

QuikFix is a software program for solving timetabling problems adapting repair-based heuristic search to the timetabling domain. A high-level timetabling-specific model enforces structural constraints and allows for meaningful moves in the search space. QuikFix uses known techniques to improve the search performance, such as multi-starts, tabu lists, and strategic oscillation.

15:00 An Application of the Threshold Accepting Metaheuristic for Curriculum Based Course Timetabling

Geiger, Martin Josef (University of Hohenheim, Germany), mjgeiger@uni-hohenheim.de

The article presents a local search approach for the solution of timetabling problems in general, with a particular implementation for competition track 3 of the International Timetabling Competition 2007 (ITC 2007). The heuristic search procedure is based on Threshold Accepting to overcome local optima. A stochastic neighborhood is proposed and implemented, randomly removing and reassigning events from the current solution.

TC2 – Examination Timetabling I

Room: ***Gagnon***

13:30 Multi-Objective Aspects of the Examination Timetabling Competition Track

Burke, Edmund K. (University of Nottingham, United Kingdom), ekb@cs.nott.ac.uk
McCollum, Barry (Queen's University, United Kingdom), b.mccollum@qub.ac.uk

McMullan, Paul (Queen's University, United Kingdom), p.p.mcmullan@qub.ac.uk
Parkes, Andrew J. (University of Nottingham, United Kingdom), ajp@cs.nott.ac.uk

We investigate multi-objective aspects of the new examination timetabling model introduced as part of the 2007 International Timetabling Competition. We propose one way to group together the objectives to represent the separate interests of the students and administration, and produce an example of an associated (Pareto), trade-off curve.

14:00 The Use of Fuzzy Models to Asses Fittest Solutions in Optimizing Multi-Objective Examination Timetabling Problems

Abdul Gani, Taufiq (University Sains Malaysia, Malaysia), taufiq@cs.usm.my
Tajudin Khader, Ahamad (University Sains Malaysia, Malaysia), tajudin@cs.usm.my
Al-Betar, Mohammed (University Sains Malaysia, Malaysia), moh_betar@cs.usm.my
Budiarto, Rahmat (University Sains Malaysia, Malaysia), rahmat@cs.usm.my

This paper presents how to asses the fitness solutions in optimizing multi objective examination timetabling problems. In contrast to most of published works, our proposed algorithm try to solve the problems in more natural ways. Examination timetabling problems are multi-objective in nature, but most of published works still used aggregation of constraint violations into a single objective function. Recently Pareto concepts have been proposed to seek for trade off solutions in a Pareto optimal set. However, this basic Pareto concept do not provide mechanism to asses the fitness of the solutions. Farina and Amato (2004), proposed Fuzzy Optimality concepts that consider the size of improvements in evaluating the dominance relations of two given solutions. This paper extends their idea to assess quality of the fittest solutions comparing to their other associates or the rest of the solutions in a population during program executions. A series of experiments is conducted using real dataset to assess performance of the proposed algorithm in term of constraint violations, fitness value and size of improvements. The results show that the algorithm can provide us a better understanding on the convergences of the quality of the fittest solutions.

14:30 ***Learning Heuristic Selection in Hyperheuristics for Examination Timetabling***

Burke, Edmund K. (University of Nottingham, United Kingdom), ekb@cs.nott.ac.uk
Misir, Mustafa (Yeditepe University, Turkey), mmisir@cse.yeditepe.edu.tr
Ochoa, Gabriela (University of Nottingham, United Kingdom), gxo@cs.nott.ac.uk
Özcan, Ender (University of Nottingham, United Kingdom), exo@cs.nott.ac.uk

In this study, a perturbative hyperheuristic combining reinforcement learning heuristic selection with great deluge acceptance criteria is investigated over a set of exam timetabling benchmarks. The results show that the choice of adaptation rate for punishment might influence the performance of a learning hyperheuristic extremely.

TC3 – Tournament Scheduling

Room: ***Lemieux***

13:30 Fairness in Round Robin Tournaments

Briskorn, Dirk (University of Kiel, Germany), briskorn@bwl.uni-kiel.de
Knust, Sigrid (University of Osnabrück, Germany), sigrid@informatik.uni-osnabrueck.de

We address a problem concerning fairness in a sports league where teams are divided into strength groups. We answer open questions regarding the existence of fair round robin tournaments for specific configurations.

14:00 ***An Approximation Algorithm for the Traveling Tournament Problem***

Miyashiro, Ryuhei (Tokyo University of Agriculture and Technology, Japan), rmiya@cc.tuat.ac.jp
Matsui, Tomomi (Chuo University, Japan), matsui@ise.chuo-u.ac.jp
Imahori, Shinji (The University of Tokyo, Japan), imahori@mist.i.u-tokyo.ac.jp

We propose a new lower bound for the traveling tournament problem (TTP), and construct a randomized approximation algorithm whose approximation ratio is less than 2+(9/4), /(n-1), where n is the number of teams. For the TTP, this is the first approximation algorithm with a constant approximation ratio, which is less than 2+3/4.

14:30 ***A Heuristic Approach for the Travelling Tournament Problem using Optimal Travelling Salesman Tours***

Ryckbosch, Frederick (KaHo Sint-Lieven, Belgium), frederick.ryckbosch@gmail.com
Vanden Berghe, Greet (KaHo Sint-Lieven; K.U.Leuven, Belgium), greet.vandenberghe@kahosl.be
Kendall, Graham (University of Nottingham, United Kingdom), gxk@cs.nott.ac.uk

We introduce a constructive heuristic for the travelling tournament problem that combines sequences of road trips that appear in the optimal solution to the travelling salesman problem. The heuristic does not lead to near-optimal solutions but it raises the performance of a local search improvement heuristic.

15:00 ***An ILS Heuristic for the Traveling Tournament Problem with Fixed Venues***

Costa, Fabrício N. (Universidade Federal de Minas Gerais, Brazil), fabrimac@dcc.ufmg.br
Urrutia, Sebastián (Universidade Federal Fluminense, Brazil), surrutia@dcc.ufmg.br
Ribeiro, Celso C. (Universidade Federal Fluminense, Brazil), celso@ic.uff.br

We propose an ILS heuristic for the Traveling Tournament Problem with Predefined Venues. Initial solutions are derived from canonical 1-factorizations of the tournament graph. Two types of local search moves and two types of perturbations are used. Computational results show that the ILS heuristic outperforms heuristics based on integer programming.

TD1 – Activity Scheduling

Room: ***Van Gogh***

16:00 Scheduling TV Commercials: Models and Solution Methodologies

McMullan, Paul (Queens University, United Kingdom), p.p.mcmullan@qub.ac.uk
McCollum, Barry (Queens University, United Kingdom), b.mccollum@qub.ac.uk
Kendall, Graham (University of Nottingham, United Kingdom), gxk@cs.nott.ac.uk

Commercial television advertising is a billion-pound industry, but broadcasters need to utilize the time devoted to advertisements profitably to maximize revenue. Existing research and commercial applications are poor or based on simple test cases. This work looks at creating a more realistic problem definition and utilising cutting-edge scheduling techniques to improve this area.

16:30 Surgery Allocation and Scheduling

Burke, Edmund K. (University of Nottingham, United Kingdom), ekb@cs.nott.ac.uk
Riise, Atle (University of Oslo, Norway), atle.riise@sintef.no

The surgery allocation and scheduling problem is important for efficient operation room management. We solve the combined allocation and scheduling of interventions in the context of admission planning, using a simple iterated local search. We analyse the fitness landscape, and show how an adaptive neighbourhood filtering may improve the search.

TD2 – Transportation Scheduling

Room: ***Gagnon***

16:00 Designing the Master Schedule for Demand-Adaptive Transit Systems

Crainic, Teodor Gabriel (Université du Québec à Montréal, Canada), theo@crt.umontreal.ca
Errico, Fausto (Université du Québec à Montréal, Canada), fausto.errico@polimi.it
Malucelli, Federico (Politecnico di Milano, Italy), malucell@elet.polimi.it
Nonato, Maddalena (Università di Ferrara, Italy), nntmdl@unife.it

Demand-Adaptive Systems display features of both traditional fixed-line bus services and purely on-demand systems. We focus on a tactical level planning decision which we called Master-Schedule. We propose a mathematical description and a solution framework based on sampling. Results of numerical experiments are given and analyzed.

TD3 – Employee Scheduling I

Room: ***Lemieux***

16:00 A Reactive Approach for the Multi-Skill Project Scheduling Problem

Bellenguez-Morineau, Odile (Ecole des Mines de Nantes, France), odile.morineau@emn.fr

This paper deals with the Multi-Skill Project Scheduling Problem (MSPSP), in case of disruptions. First, the problem is defined, then a way to build a first schedule is introduced and finally the reactive approach used to repare the schedule is presented.

16:30 A Flexible Model for Integrated Production Scheduling and Employee Timetabling in Robotic Assembly Lines

Alcaide López de Pablo, David (University of La Laguna, SPAIN), dalcaide@ull.es
Kats, Vladimir (Institute of Industrial Mathematics, Israel), vkats@iimath.com
Levner, Eugene (Holon Institute of Technology, Israel), levner@hit.ac.il

Robotic assembly systems have the practical need of integrating automatic scheduling and employee timetabling. Scheduling decisions are usually done first, maximizing productivity; whereas employee timetabling decisions are done next, adapted to the production, minimizing labour costs. We propose a model to maximize productivity, under bounded labour costs, treating simultaneously production scheduling and employee timetables.

TE2 – Demonstration I

Room: ***Gagnon***

17:00 ***MAGHO - A Tool for Teachers and Physical Resources Assignment, and for Student´s Schedulling***

Votre, Vilmar Pedro (Universidade Presbiteriana, Brazil), vilmar@mackenzie.br

Magho – a tool for graduate timetabling for semester-wise operation of Mackenzie (Brazil). It innovates using guided teachers assignment, starting with disciplines and time slices candidatures-preferences. For students, it gives a good enrolment suggestion, under the set of restrictions, balancing class sizes, for lecture and labs. It operates the room scheduling by discipline, looking for sufficient space, and minimum students walking.

TE3 – Demonstration II

Room: ***Lemieux***

17:30 M-Sched: A University Course Timetabler

Hossain, Shahadat (University of Lethbridge, Canada), hossain.shahadat@gmail.com
Zibran, Minhaz (University of Calgary, Canada), mfzibran@ucalgary.ca

We consider the problem of scheduling instructors and courses in a typical academic department at a post-secondary institution. The software implementation {\\em M-Sched} that we present in this note emphasizes the interaction with the ”human expert” to produce qualitatively superior schedules. The methodology reflects the complex nature of the scheduling problem where important constraints of qualitative nature cannot be accurately incorporated in the model and consequently, a fully automated solution is not feasible.

Wednesday, August 20th, 2008

WA1 – Course Timetabling II

Room: ***Van Gogh***

9:00 The Fralon Algorithm to the Post Enrolment Course Timetabling

Frausto-Solis, Juan (ITESM, Mexico), juan.frausto@itesm.mx
Alonso-Pecina, Federico (ITESM, Mexico), federicoalonsopecina@hotmail.com

This paper presents a hybrid Simulated Annealing-Tabu Search algorithm, developed for the Course timetabling problem of Patat track2. This algorithm has two phases; the first one finds a feasible solution which is improved in the second one.

9:30 Solving the Post Enrolment Course Timetabling Problem by Ant Colony Optimization

Mayer, Alfred (Vienna University of Technology, Austria), alfred.mayer@student.tuwien.ac.at
Nothegger, Clemens (Vienna University of Technology, Austria), cn@ipf.tuwien.ac.at
Chwatal, Andreas (Vienna University of Technology, Austria), andy@ads.tuwien.ac.at
Raidl, Günther (Vienna University of Technology, Austria), raidl@ads.tuwien.ac.at

We present a new approach to tackle the problem posed by the ITC2007. The heuristic procedure is based on Ant Colony Optimization. The key feature of our algorithm is to use two distinct procedure pheromone matrices in order to improve convergence. The algorithm was among the best algorithms submitted.

10:00 A Time-Dependent Metaheuristic Algorithm for Track-2 of the Second International Timetabling Competition

Lewis, Rhyd (Cardiff University, Wales), lewisr9@cf.ac.uk

A time-dependent metaheuristic algorithm is presented for the timetabling problem used in track-2 of ITC2007. A brief description and analysis of this algorithm will be given. I also intend to discuss some issues regarding the competition in general, in particular the way in which the winners of the competition were chosen.

WA2 – High School Timetabling I

Room: ***Gagnon***

9:00 Resource Assignment in High School Timetabling

Kingston, Jeffrey (The University of Sydney, Australia), jeff@it.usyd.edu.au

This paper explores one aspect of the high school timetabling problem, namely the assignment of resources, such as teachers and rooms, to meetings after times are assigned. Several algorithms, with run times of just a few seconds, are presented and tested on real-world data.

9:30 *An Approach for the Class/Teacher Timetabling Problem using Graph Coloring*

Bello, Geraldo (Universidade Federal do Espírito Santo, Brazil), geraldo.bello@terra.com.br

Rangel, Maria Cristina (Universidade Federal do Espírito Santo, Brazil), crangel@inf.ufes.br
Boeres, Maria Claudia (Universidade Federal do Espírito Santo, Brazil), boeres@inf.ufes.br

This work proposes an adaptation to a Class/Teacher Timetabling Problem formulation using Graph Coloring. The effect of this approach is verified by means of the comparison of results obtained by the Tabu Search Algorithm for the problem.

WA3 – Nurse Scheduling I

Room: ***Lemieux***

9:00 A Heuristic Approach for Solving Real World Nurse Rostering

Frøyseth, Helle (SINTEF ICT, Norway), helle.froyseth@sintef.no
Stølevik, Martin (SINTEF ICT, Norway), martin.stolevik@sintef.no
Riise, Atle (SINTEF ICT, Norway), atle.riise@sintef.no

A flexible model and solution approach for the nurse rostering problem is described. Our approach uses a customized CSP search algorithm to create the initial solution and Iterated Local Search for optimization. The approach has been tested with good results on real world problems.

9:30 Local Search Neighbourhoods to Deal with a Novel Nurse Rostering Model

Bilgin, Burak (Katholieke Hogeschool Sint-Lieven, Belgium), burak.bilgin@kahosl.be
De Causmaecker, Patrick (Katholieke Universiteit Leuven, Belgium), Patrick.DeCausmaecker@kuleuven-kortrijk.be
Rossie, Benoît (SAGA Consulting NV, Belgium), Benoit.Rossie@saga.be
Vanden Berghe, Greet (KaHo Sint-Lieven; K.U.Leuven, Belgium), greet.vandenberghe@kahosl.be

A novel, generic nurse rostering model is developed to accurately represent real world problem instances. Novel local search neighbourhoods are developed to take advantage of the problem properties. These neighbourhoods are utilised within a variable neighbourhood approach. The performance of the solution method is evaluated empirically on real world data.

10:00 Staff Scheduling by a Genetic Algorithm with a Two-Dimensional Chromosome Structure

Dean, John (Park University, USA), jdean4@kc.rr.com

This study implements two genetic algorithm staff-scheduling solutions for scheduling nurses at an actual hospital. To represent each schedule, one solution uses a traditional bit-string chromosome structure, while the other solution uses a two-dimensional array chromosome structure. Experimental results show that the two-dimensional array staff-scheduling implementation performs better.

WB1 – Plenary 3

Room: ***Van Gogh*** **Chairperson:** ***Louis-Martin Rousseau***

11:00 Constraint-Based Rostering

Pesant, Gilles (École Polytechnique de Montréal, Canada), pesant@crt.umontreal.ca

This short paper presents how rostering problems can be modeled and solved using constraint programming. The emphasis is on the choice of constraints which efficiently exploit the substructures of

rostering problems, on the way to occasionally bend the rules in order to handle over constrained instances, and on generic search heuristics built from the constraints in the model.

WC1 – Course Timetabling III

Room: ***Van Gogh***

13:30 Benchmarking Curriculum-Based Course Timetabling: Formulations, Data Formats, Instances, Validation, and Results

De Cesco, Fabio (EasyStaff S.r.l., Italy), fabio@easystaff.it
Di Gaspero, Luca (University of Udine, Italy), l.digaspero@uniud.it
Schaerf, Andrea (University of Udine, Italy), schaerf@uniud.it

We propose a set of real-world formulations for the Curriculum-Based Course Timetabling problem, with the aim of encouraging researchers to reduce their problems to one of them, gaining the opportunity to compare and assess their results. This work's web-site maintains all the necessary infrastructures: validators, formats, instances, scores, lower-bounds, and solutions.

14:00 Constructing Initial Neighbourhoods to Identify Critical Constraints

Moody, Douglas (CUNY Graduate Center, USA), dmoody@citytech.cuny.edu
Kendall, Graham (University of Nottingham, United Kingdom), gxk@Cs.Nott.ac, uk
Bar-Noy, Amotz (CUNY Graduate Center, USA), amotz@sci.brooklyn.cuny.edu

Recent course scheduling competitions have seen solution approaches which construct an initial solution quickly, and then employ a local search to improve the solution. With the use of different seeds, this process is repeated, searching for the best solution. Solutions with constraint violations provide little guidance on which constraints to relax in order to produce a better quality solution. Our approach seeks to construct several high quality initial solutions and analyze their characteristics which enables us to predict the relative success of the local search phase. With this capability, sets of initial solutions can be generated with selected constraint relaxations, leading to a prediction of which constraint relaxation can most improve the final solution, leading to a good quality solution.

14:30 Curriculum Based Course Timetabling: Optimal Solutions to the Udine Benchmark Instances

Lach, Gerald (TU Berlin, Germany), lach@math.tu-berlin.de
Luebbecke, Marco (TU Berlin, Germany), m.luebbecke@math.tu-berlin.de

We present a new integer programming approach to the university course timetabling problem, and report on solving benchmark instances from the two International Timetabling Competitions. Our algorithm is very robust in the sense that it deterministically gives satisfactory lower and upper bounds in reasonable computation time without particular tuning.

15:00 A Branch-and-cut Procedure for Udine Course Timetabling

Burke, Edmund K. (University of Nottingham, United Kingdom), ekb@cs.nott.ac.uk
Marecek, Jakub (The University of Nottingham, United Kingdom), jxm@cs.nott.ac.uk
Parkes, Andrew J. (The University of Nottingham, United Kingdom), ajp@cs.nott.ac.uk
Rudova, Hana (Masaryk University, The Czech Republic), hanka@fi.muni.cz

We present a branch-and-cut procedure for the Udine Course Timetabling Problem. Using ILOG CPLEX 10, we can obtain optima for comp01 and comp11 within 15 minutes, as well as good lower bounds for a few more instances.

WC2 – Examination Timetabling II

Room: ***Gagnon***

13:30 *Some New Heuristic Strategies for Examination Timetabling*

Burke, Edmund (University of Nottingham, United Kingdom), ekb@cs.nott.ac.uk
Pham, Nam (University of Nottingham, United Kingdom), nxp@cs.nott.ac.uk
Qu, Rong (University of Nottingham, United Kingdom), rxq@cs.nott.ac.uk
Yellen, Jay (Rollins College, USA), jyellen@rollins.edu

This work studies the linear combination of compound vertex selectors (consisting of sequences of primitive heuristics) in a constructive algorithm for exam timetabling problems. Experiments justify the use of certain primitive heuristics in compound selectors and a pre-processing step that partitions vertices into hard- or easy-to-colour sets.

14:00 *Combining Examinations to Accelerate Timetable Construction*

Kendall, Graham (University of Nottingham, United Kingdom), gxk@cs.nott.ac.uk
Li, Jiawei (University of Nottingham, United Kingdom), jwl@cs.nott.ac.uk

We propose an approach that combines examinations in order to accelerate initial timetable construction, as well as a later search. The conditions for combining exams are described, and we are able to offer some guarantees as to the quality of solutions that remain in the reduced search space.

14:30 *A Mixed-Integer Mathematical Model for Exam Timetabling: A Case Study at Fatih University Vocational School*

Sevkli, Mehmet (Fatih University, Turkiye), msevkli@fatih.edu.tr
Uysal, Ozgur (Fatih University, Turkiye), ouysal@fatih.edu.tr
Sari, Mustafa (Fatih University, Turkiye), msari@fatih.edu.tr

In this study, a real exam timetabling problem is tackled. A mixed-integer mathematical model is developed with the objective of minimizing the total exam conflicts regarding all the specific constraints. The problem is solved using Xpress-MP optimization software and a conflict-free exam schedule is obtained in a few seconds.

15:00 *Estimating the Optimum Standard Penalty of Examination Schedules*

Sodeinde, Tayo (University of Ottawa, Canada)
White, George (University of Ottawa, Canada), white@site.uottawa.ca

Future values of the standard penalty of examination schedules is predicted by fitting a logistics equation to the "best values" found by several research groups using different algorithms for casting schedules. The fitted equation permits an estimation of the minimum or limiting value of the standard penalty.

WC3 – Sport Scheduling

Room: ***Lemieux***

13:30 *An Application of the Traveling Tournament Problem: The Argentine Volleyball League*

Bonomo, Flavia (Universidad de Buenos Aires, Argentina), fbonomo@dc.uba.ar
Burzyn, Alejandro (Universidad de Buenos Aires, Argentina), aburzyn@dc.uba.ar
Cardemil, Andres (Universidad de Buenos Aires, Argentina), acardemil@dc.uba.ar
Duran, Guillermo (Universidad de Buenos Aires, Argentina), gduran@dm.uba.ar
Marenco, Javier (Universidad de Buenos Aires, Argentina), jmarenco@dc.uba.ar

Sports scheduling has become a very active field, providing both interesting and challenging problems to the combinatorial optimization community. In this work we describe the automatic scheduling of the regular phase of the Argentine first division volleyball league and further research on related topics.

14:00 *A Multiobjective Approach for UK Football Scheduling*

Kendall, Graham (University of Nottingham, United Kingdom), gxk@cs.nott.ac.uk
While, Lyndon (University of Western Australia, Australia), lyndon@csse.uwa.edu.au
McCollum, Barry (Queen's University, United Kingdom), b.mccollum@qub.ac.uk
Cruz, Frederico (University of Nottingham, United Kingdom), frc@cs.nott.ac.uk

We investigate the minimisation of two competing objectives when scheduling United Kingdom football fixtures over Christmas/New Year. One objective minimises the travel distance. The other minimises the number of "paired" teams that can play at home on the same day. Results suggest that this is a worthwhile approach for this problem.

14:30 *Comparing League Formats with Respect to Match Unimportance in Belgian Football*

Goossens, Dries (K.U.Leuven, Belgium), dries.Goossens@econ.kuleuven.be
Beliën, Jeroen (K.U.Leuven, Belgium), jeroen.belien@ehsal.be
Spieksma, Frits (K.U.Leuven, Belgium), frits.spieksma@econ.kuleuven.be

Most clubs in the highest Belgian football league are convinced that the league format should be changed in order to increase the competition's attractiveness. We simulate the course of three league formats and measure their attractiveness by the number of important matches. We show how each league format aligns with the expectations of each type of club.

15:00 *Maximising Stadium Attendance: A Case Study of Malaysian Football*

Abdul Hamid, Nor Hayati (University of Nottingham, United Kingdom), nha@cs.nott.ac.uk
Kendall, Graham (University of Nottingham, United Kingdom), gxk@cs.nott.ac.uk

Malaysian football is seeing a decrease in the number of supporters at stadiums. We propose that a level of importance is defined for each fixture, which we then maximise. This is in the expectation that the more important a match, the more attractive it will be for supporters.

WD1 – Course Timetabling IV

Room: ***Van Gogh***

16:00 ***An LP-based Heuristic for the Post Enrolment Course Timetabling Problem of the ITC***

Van den Broek, John (Eindhoven University of Technology, The Netherlands), j.j.j.v.d.broek@tue.nl
Hurkens, Cor (Eindhoven University of Technology, The Netherlands), wscor@win.tue.nl

We present a deterministic heuristic for the post enrolment course timetabling problem of the ITC. The heuristic is based on an LP-solution constructed with column generation. We get an integer solution by fixing a column one at a time. Our results are compared with the results of the five finalists.

16:30 ***A Modular Multiphase Heuristic Solver for Post Enrolment Course Timetabling***

Chiarandini, Marco (University of Southern Denmark, Denmark), marco@imada.sdu.dk
Fawcett, Chris (University of British Columbia, Canada), fawcettc@cs.ubc.ca
Hoos, Holger (University of British Columbia, Canada), hoos@cs.ubc.ca

We give a short description of the solver that ranked third in Track Two of the International Timetabling Competition 2007. Our heuristic approach is based on stochastic local search, and was automatically configured and tuned by the software tool ParamILS. One notable feature is our ability to consistently find feasible solutions.

17:00 ***Local Search and Constraint Programming for the Post-Enrolment-based Course Timetabling Problem***

Cambazard, Hadrien (Cork Constraint Computation Centre, Ireland), h.cambazard@4c.ucc.ie
Hebrard, Emmanuel (Cork Constraint Computation Centre, Ireland), e.hebrard@4c.ucc.ie
O'Sullivan Barry (Cork Constraint Computation Centre, Ireland), b.osullivan@4c.ucc.ie
Papadopoulos Alexandre. (Cork Constraint Computation Centre, Ireland), a.papadopoulos@4c.ucc.ie

We present a study of the university post-enrolment timetabling problem, proposed as Track 2 of the 2007 International Timetabling Competition. We approach the problem using several techniques, particularly local search, constraint programming techniques and hybrids of these in the form of a large neighbourhood search scheme. Our local search approach won the competition. Our best constraint programming approach uses an original problem decomposition. Incorporating this into a large neighbourhood search scheme seems promising.

WD2 – High School Timetabling II

Room: ***Gagnon***

16:00 ***An XML Format for Benchmarks in High School Timetabling***

Post, Gerhard (University Twente, The Netherlands), g.f.post@math.utwente.nl
Ahmadi, Samad (De Montfort University, United Kingdom), sahmadi@dmu.ac.uk
Daskalaki, Sophia (University of Patras, Greece), sdask@upatras.gr
Kingston, Jeffrey (The University of Sydney, Australia), jeff@it.usyd.edu.au
Kyngas, Jari (Satakunta University of Applied Sciences, Finland), Jari.Kyngas@samk.fi
Nurmi, Kimmo (Satakunta University of Applied Sciences, Finland), cimmo.nurmi@samk.fi
Ranson, David (University of Sussex, United Kingdom), d.j.ranson@sussex.ac.uk
Ruizenaar, Henri (University Twente, The Netherlands), h.w.a.ruizenaar@ewi.utwente.nl

In this paper we describe the High School Timetabling Problem in several countries to find a common set of constraints and objectives. Our main goal is to provide exchangeable benchmarks for this problem. To achieve this we propose a standardisation of data formats suitable for different countries and educational systems.

16:30 ***Strong Bounds with Cut and Column Generation for Class-Teacher Timetabling***

Santos, Harold G. (Universidade Federal do Rio de Janeiro, Brazil), hsantos@ic.uff.br
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Ochi, Luiz Satoru (Universidade Federal Fluminense, Brazil), satoru@ic.uff.br
Maculan Filho, Nelson (Universidade Federal do Rio de Janeiro, Brazil), nelson.maculan@gmail.com

This work presents an integer programming formulation for a variant of the Class-Teacher Timetabling problem. The formulation contains a very large number of variables and rows. A cut and column generation algorithm is provided. The lower bounds obtained allowed us to prove the optimality of some open instances.

17:00 ***Solving the School Time Tabling Problem Using Tabu Search, Simulated Annealing, Genetic and Branch & Bound Algorithms***

Wilke, Peter (University Erlangen-Nuremberg, Germany), wilke@cs.fau.ukde

Using a real world School Time Tabling problem we compare the performance of different optimization algorithms, namely Tabu Search, Simulated Annealing, Genetic Algorithm and Branch & Bound. All experiments are being executed using the same problem specification. The used software was developed to compare several optimization algorithms under identical conditions.

WD3 – Nurse Scheduling II

Room: ***Lemieux***

16:00 ***Using Particle Swarm Optimization to Determine the Visit Times in Community Nurse Timetabling***

Martin, Kevin (Lancaster University, United Kingdom), kev82@khn.org.uk
Wright, Michael (Lancaster University, United Kingdom), m.wright@lancaster.ac.uk

By formulating the community nurse scheduling problem as a VRPSTW we show how it can be treated as two separate problems, an assignment problem and a convex optimization problem. We introduce a particle swarm based framework for solving the convex problem and compare it to a commonly used approach.

16:30 ***Comparison of Algorithms for Nurse Rostering Problems***

Petrovic, Sanja (University of Nottingham, United Kingdom), sxp@cs.nott.ac.uk
Vanden Berghe, Greet (KaHo Sint-Lieven; K.U.Leuven, Belgium), greet.vandenberghe@kahosl.be

This paper addresses the problem of comparing approaches to nurse rostering that has not been investigated in the community yet. We introduce seven criteria: expressive power, flexibility, algorithmic power, learning capabilities, maintenance, rescheduling capabilities, and parameter tuning. Two approaches of different nature, based on meta-heuristics and case-based reasoning, are evaluated and compared against the introduced criteria.

Thursday, August 21st , 2008

HA1 – Course Timetabling V

Room: ***Van Gogh***

9:00 Enrollment Generators, Clustering and Chromatic Numbers

Beyrouthy, Camille (University of Nottingham, United Kingdom), cbb@cs.nott.ac.uk
Burke, Edmund K. (University of Nottingham, United Kingdom), ekb@cs.nott.ac.uk
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Parkes, Andrew J. (University of Nottingham, United Kingdom), ajp@cs.nott.ac.uk

We study the timetable conflict graphs produced by an artificial generator of student enrolments. We find correlations of their chromatic number with their density and clustering coefficient. The work gives evidence that the clustering coefficient is a useful measure of a graph.

9:30 *University Course Timetabling with Probability Collectives*

Autry, Brian (Naval Postgraduate School, USA), bmautry@nps.edu
Squire, Kevin (Naval Postgraduate School, USA), kmsquire@nps.edu

We present an approach to post-enrollment timetabling based on Probability Collectives (PC), theory. PC theory is a relatively new agent-based approach to global optimization, drawing on ideas from drawing ideas from evolutionary game theory and statistical physics. This work comprised our submission to the 2nd International Timetabling competition.

10:00 *A Tabu Search Procedure for Course Timetabling Problem at a Tunisian University*

Elloumi, Abdelkarim (University of Sfax, Tunisia), abdelkarim.elloumi@fsegs.rnu.tn
Kamoun, Hichem (University of Sfax, Tunisia), hichem.kamoun@fsegs.rnu.tn
Ferland, Jacques (Université de Montréal, Canada), ferland@iro.umontreal.ca

In a previous work (Dammak et al. 2008), we have developed a heuristic based on the size of classes to find a feasible solution to the course timetabling problem at the Faculty of Economics and Management Sciences of Sfax. In this paper, we start by the solution generated by the heuristic and apply the tabu search procedure in order to ameliorate the quality of the solution via a suitable objective function constructed in the light of three criteria: number of holes, number of isolated lessons and number of professor preferences violations.

HA2 – Sectioning and Space Planning

Room: ***Gagnon***

9:00 An Integer Programming Approach to Classroom Space Planning at the Faculties of Engineering and Architecture at Dalhousie University

Venkatadri, Uday (Dalhousie University, Canada), Uday.Venkatadri@dal.ca
Kripakaran, Srivatsav L. (Dalhousie University, Canada)
Cyrus, J. Pemberton (Dalhousie University, Canada)

We discuss an Integer Programming model that was developed for classroom space planning at the Faculties of Engineering and Architecture at Dalhousie University. The Faculties of Engineering and Architecture at Dalhousie University are at a critical juncture in terms of program delivery and enrollment. We developed a binary integer classroom space planning model incorporating basic constraints of a timetabling problem. Based on the solution to this model, we analyzed how classroom space can be reassigned. The results of the model were presented for campus planning and our suggestion involved resizing some existing classrooms and building new ones. We studied a number of scenarios and conducted some sensitivity studies.

9:30 Conflict Inheritance in Sectioning and Space Planning

Beyrouthy, Camille (University of Nottingham, United Kingdom), cbb@cs.nott.ac.uk
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Parkes, Andrew J. (University of Nottingham, United Kingdom), ajp@cs.nott.ac.uk

In the timetabling of large student groups we may need to both split events into smaller events, and also to assign students to these events. We investigate the interaction between these from a space planning perspective, and in particular, the effects on the effective conflict matrix.

10:00 Comprehensive Approach to Student Sectioning

Muller, Tomas (Purdue University, USA), muller@unitime.org
Murray, Keith (Purdue University, USA), kmurray@unitime.org

Student sectioning is the problem of assigning students to particular sections of courses they request. In this paper, three approaches to this problem are examined and combined in order to tackle it on a practical level: student sectioning during course timetabling, batch sectioning after a complete timetable is developed, and online sectioning for making additional changes to student schedules.

HA3 – Employee Scheduling II

Room: ***Lemieux***

9:00 Days-Off Scheduling in Large-Scale Multi-Skill Staff Rostering: An Integer Programming Solution

Klinkert, Andreas (Zurich University of Applied Sciences, Switzerland),
andreas.klinkert@zhaw.ch

An integer programming model is presented to solve a large-scale acyclic days-off scheduling problem for multi-skill staff in airport ground handling. Special focus is given to a tractable formulation of the daily staffing level constraints in order to provide enough workers with appropriate skills for every combination of shifts.

9:30 Hybrid and Modular Approach to Employee Timetabling

Bokal, Drago (University of Maribor, Slovenia), drago.bokal@uni-mb.si
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Taranenko, Andrej (University of Maribor, Slovenia), andrej.taranenko@uni-mb.si
Zagar, Klemen (Cosylab, Slovenia), klemen.zagar@cosylab.com

We consider an employee timetabling problem: a set of employees with various qualifications has to be assigned to a set of shifts. Our experiments show that the hybrid technique combining both general local hill climbing and tabu search performs better than exclusively using either GLHC or tabu search.

10:00 Scheduling Breaks in Shift Plans for Call Centers

Beer, Andreas (Graz University of Technology, Austria), abeer@ist.tugraz.at
Gärtner, Johannes (Ximes Inc., Austria), gaertner@ximes.com
Musliu, Nysret (Vienna University of Technology, Austria), musliu@dbai.tuwien.ac.at
Schafhauser, Werner (Vienna University of Technology, Austria), schafha@dbai.tuwien.ac.at
Slany, Wolfgang (Graz University of Technology, Austria), wsi@ist.tugraz.at

In this paper we consider a real-life break scheduling problem for call center agents involving a large number of breaks and constraints. To solve this problem we present two local search approaches, a min-conflicts based search algorithm and a tabu search algorithm and consider a hybridization of both techniques.

HB1 – Plenary 4

Room: ***Van Gogh*** **Chairperson: Bernard Gendron**

11:00 Flight Gate Allocation: Models, Methods and Robust Solutions

Pesch, Erwin (University Siegen, Germany), erwin.pesch@uni-siegen.de

We consider the problem of assigning flights to airport gates. We examine the general case in which an aircraft serving a flight may be assigned to different gates for arrival and departure processing and for optional intermediate parking. restrictions to this assignment include gate closures and shadow restrictions, i. e. the situation where certain gate assignments may cause blocking of neighboring gates. The objectives include maximization of the total assignment preference score, a minimal number of unassigned flights during overload periods, minimization of the number of tows, maximization of a robustness measure as well as a minimal deviation from a given reference schedule. We discuss exact as well as ejection chain based solution procedures which are based on modeling as resource constrained project scheduling problem or as a clique partitioning problem.

HC1 – Course Timetabling VI

Room: ***Van Gogh***

13:30 A Statistical Analysis of the Features of a Dynamic Tabu Search Algorithm For Course Timetabling Problems

Bellio, Ruggero (Università di Udine, Italy), bellio@dss.uniud.it
Di Gaspero, Luca (Università di Udine, Italy), l.digaspero@uniud.it
Schaerf, Andrea (Università di Udine, Italy), schaerf@uniud.it

We propose a dynamic tabu search algorithm for the solution of timetabling problems, and we undertake a systematic statistical study of the relative influence of the relevant features on the performances of the algorithm.

14:00 Standardization of Constraints for the Second International Timetabling Competition Problem Instances

Chand, Atish (University of the South Pacific, Fiji), chand_at@usp.ac.fj

University timetabling problem hardness and solution acceptability has been difficult to compare due to the variety of constraints, data formats and categories of university timetabling problems. This paper shows the commonality in the various university timetabling tracks' constraints and specifies how a generic standard model can represent the various constraints.

14:30 ITC2007: Solver Description

Muller, Tomas (Purdue University, USA), muller@unitime.org

This paper provides a brief description of a constraint-based solver that was applied by the author to the problem instances in all three tracks of the International Timetabling Competition 2007.

15:00 Academic Timetabling: Linking Research and Practice

McCollum, Barry (Queen's University, United Kingdom), b.mccollum@qub.ac.uk
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Burke, Edmund (University of Nottingham, United Kingdom)), ekb@cs.nott.ac.uk
Gough, Adrian (Corbett Engineering Ltd, United Kingdom), a.gough@celcat.com
Kendall, Graham (University of Nottingham, United Kingdom)), gxk@cs.nott.ac.uk

The timetabling of courses and examinations is a challenging problem faced by many institutions across the world on an ongoing basis. The difficulty arises from a combination of factors e.g. variation within institutional requirements, the range of constraints that have to be captured in the model, political considerations within the institution, software and associated support. This work aims at exploring the potential of a working partnership between the commercial sector and academics.

HC2 – Examination Timetabling III

Room: ***Gagnon***

13:30 A Late Acceptance Strategy in Hill-Climbing for Exam Timetabling Problems

Burke, Edmund (The University of Nottingham, United Kingdom), ekb@cs.nott.ac.uk
Bykov, Yuri (The University of Nottingham, United Kingdom), yxb@cs.nott.ac.uk

We present a new and very simple search strategy, which we have termed the "Late Acceptance" method. The idea is to compare the candidate solution, not with the current one but, with a solution which was "current" several iterations before. This strategy was implemented within Hill-Climbing and applied to exam timetabling problems. It has produced strong results which are competitive with the best previously published ones.

14:00 A Multi-Staged Algorithmic Process for the Solution of the Examination Timetabling Problem

Gogos, Christos (University of Patras, Greece), cgogos@ece.upatras.gr
Alefragis, Panayiotis (University of Patras, Greece), alefrag@ece.upatras.gr
Housos, Efthymios (University of Patras, Greece), housos@ece.upatras.gr

We present a three stage approach for the examination timetabling problem. The first stage constructs a good quality feasible solution, the second stage improves it using local search and the final stage uses mathematical programming and analyzes each examination period in isolation. The procedure produces solutions under a runtime limit imposed.

14:30 Managing the Tabu List Length Using a Fuzzy Inference System: An Application to Exams Timetabling

Amaral, Paula (Universidade Nova de Lisboa, Portugal)
Cardal Pais, Tiago (Quinta da Torre Campus FCT-UNL, Portugal), tpp@uninova.pt

In this paper we present an application of Tabu Search to the exams timetabling problem. To avoid the tuning of the tabu tenure we developed a fuzzy inference rule based system based on two concepts - Frequency and Inactivity. Computational results show that this technique improves the performance of Tabu Search.

15:00 Heuristic Strategies to Modify Existing Timetables

Burke, Edmund (University of Nottingham, United Kingdom), ekb@cs.nott.ac.uk
McCollum, Barry (Queen's University, United Kingdom), b.mccollum@qub.ac.uk
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Yellen, Jay (Rollins College, USA), jyellen@rollins.edu

We present our work in progress toward the development of a decision-support system with graphical user interface for the improvement and repair of existing timetables. Our approach uses a weighted graph model along with vertex- selection and vertex-colouring heuristics to guide decisions for rescheduling certain events on demand.

HC3 – Team Meetings

Room: ***Lemieux***

13:30 Solving the Social Golfer Problem with a GRASP

Triska, Markus (Vienna University of Technology, Austria), triska@dbai.tuwien.ac.at
Musliu, Nysret (Vienna University of Technology, Austria), musliu@dbai.tuwien.ac.at

The Social Golfer Problem (SGP), is a sports scheduling problem. We present a greedy randomized adaptive search procedure (GRASP), for the SGP. Our method is the first metaheuristic technique that can solve the original problem instance optimally, and it is also highly competitive on other instances.

14:00 An Improved SAT Formulation for the Social Golfer Problem

Triska, Markus (Vienna University of Technology, Austria), triska@dbai.tuwien.ac.at
Musliu, Nysret (Vienna University of Technology, Austria), musliu@dbai.tuwien.ac.at

The Social Golfer Problem (SGP), is a sports scheduling problem. We revisit an existing SAT encoding for the SGP and correct some of its clauses. We then change the encoding and achieve considerable performance improvements when solving many SGP instances with common SAT solvers.

14:30 Scheduling Meetings by Agents

Gershman, Amir (Ben-Gurion University, Israel), amirger@cs.bgu.ac.il
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Meisels, Amnon (Ben-Gurion University, Israel), am@cs.bgu.ac.il
Rokach, Lior (Ben-Gurion University, Israel), lior.rokach@gmail.com
Zivan, Roie (Ben-Gurion University, Israel), zivanr@bgu.ac.il

The present paper proposes a realistic model for representing and solving meetings scheduling problems (MSPs), and the use of constraints optimization algorithms to solve MSPs. A mechanism to balance the trade-off between competitive and cooperative environment is introduced, along with an experimental evaluation of the model's features.

15:00 A Heuristic Approach to Grouping and Timetabling of Student Project Teams

Akkan, Can (Sabanci University, Turkey), canakkan@sabanciuniv.edu
Bozkaya, Burcin (Sabanci University, Turkey), bbozkaya@sabanciuniv.edu

We model a problem of timetabling groups of student teams presentations, while grouping the teams to have certain similarity and diversity characteristics. A mixed-integer programming formulation and a tabu-search algorithm are developed. Performance of the tabu-search algorithm is tested on a set of randomly generated instances which are also solved by the MIP formulation.

HD1 – Course Timetabling VII

Room: ***Van Gogh***

16:00 Harmony Search Algorithm for University Course Timetabling Problem

Al-Betar, Mohammed (University Sains Malaysia, Malaysia), mohbetar@cs.usm.my
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Abdul Gani, Taufiq (University Sains Malaysia, Malaysia), taufiq@cs.usm.my

Harmony search algorithm is a new population based algorithm; the major thrust of this algorithm lies in its ability to integrate exploitation and exploration in a parallel optimization environment. In this paper, a harmony search algorithm is applied to university course timetabling against standard benchmarks prepared by Socha et al (2002).

16:30 A Hybrid Algorithm for the University Course Timetabling Problem

Gunawan, Aldy (National University of Singapore, Singapore), aldygunawan@nus.edu.sg
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Poh, Kim Leng (National University of Singapore, Singapore), isepohkl@nus.edu.sg

We introduce a mathematical programming model that combines teacher assignment and course scheduling problems simultaneously. We also propose a hybrid algorithm that combines Simulated Annealing and Tabu Search to solve it. This algorithm is able to provide good quality solutions to several randomly generated problem instances within reasonable computation time.

17:00 Practice and Theory of Timetabling at IBMEC-SP Faculty: A Case Study

Gramani, Maria Cristina (IBMEC-SP Faculty, Brazil), mariacng@isp.edu.br

In this paper we show a real problem where the strategic planning is directly related to the results obtained from the classroom assignment problem. The decision to offer new courses or to expand the existent ones depends on the efficiency of this operational problem.

HD2 – Space Allocation Issues

Room: ***Gagnon***

16:00 Evaluating the Space Planning Benefits of Partitionable Rooms

Beyrouthy, Camille (University of Nottingham, United Kingdom), cbb@cs.nott.ac.uk
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Parkes, Andrew J. (University of Nottingham, United Kingdom), ajp@cs.nott.ac.uk

In many real world situations, it would be easier to find feasible timetables if a room had movable partitions; allowing it to be used either as multiple rooms or as a large single room. We propose methods to evaluate the potential benefits for timetabling and space planning of having such rooms.

16:30 University Timetabling in Minimum Area of Classroom Using Evolutionary Computation by Virus Evolutionary Theory

Saito, Susumu (Tokyo University of Science, Japan), ssaito@ms.kuki.tus.ac.jp
Sato, Shunsuke (Tokyo University of Science, Japan)

The class schedule was created by a genetic algorithm using the virus evolutionary theory under the condition of the minimum number and area of classroom. In order to obtain the optimum value of the parameters related with the escapement from local minima, Design of Experiments and Design Navigation Method were used.

HD3 – Methodology

Room: ***Lemieux***

16:00 A Study of Simulated Annealing Hyperheuristics

Burke, Edmund K. (University of Nottingham, United Kingdom), ekb@cs.nott.ac.uk
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Misir, Mustafa (Yeditepe University, Turkey), mmisir@cse.yeditepe.edu.tr
Özcan, Ender (University of Nottingham, United Kingdom), exo@cs.nott.ac.uk

The performance of a recently proposed simulated annealing hyperheuristic with a learning mechanism is compared to the performances of other simulated annealing hyperheuristics. As heuristic selection mechanisms, simple random, greedy and choice function methods are tested. Choice function - simulated annealing hyperheuristic turns out to be the most promising approach.

16*:30 Data Mining: An Aid Towards More Efficient Hyper-heuristic Search*

Burke, Edmund (University of Nottingham, United Kingdom), ekb@cs.nott.ac.uk
Li, Jingpeng (University of Nottingham, United Kingdom), jpl@cs.nott.ac.uk
Qu, Rong (University of Nottingham, United Kingdom), rxq@cs.nott.ac.uk

We propose a new idea of applying data mining techniques, such as neural networks and logistic regression methods, to speed up the hyper-heuristic search. After training, the patterns hidden in good solutions can be recognized, which can then be used to classify newly obtained solutions without calculating their fitness values.

17:00 Optimal Scheduling Using Workflow as a Constraint

Verborgh, David (Vrije Universiteit Brussel Belgium), dverborg@vub.ac.be
Van de Velde, Rudi (Vrije Universiteit Brussel, Belgium), rudi.vandevelde@uzbrussel.be

In the current work we describe a model for representing non-deterministic schedules to match multiple instantiations of workflow schemes. Furthermore we describe an algorithm to optimize such schedules using heuristic search as a basis. The heuristic is based on the precedence order of the scheduled workflow schemes.

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