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The Cross-domain Heuristic Search Challenge (CHeSC 2011)

CARDIFF UNIVERSITY

PRIFYSGOL

Organising Committee: Matthew Hyde and Gabriela Ochoa Advisory Board: Edmund K. Burke, Michel Gendreau, Graham Kendall, Barry McCollum, Ender Ozcan, Andrew Parkes and Sanja Petrovic

Hyper-heuristics

A hyper-heuristic is an automated methodology for selecting or generating heuristics to solve hard computational search problems

Challenge

- Can we develop the ability to automatically work well on different problems?
- Raising the level of generality
- Develop search methodologies that are more generally applicable

E. K. Burke, M. Hyde, G. Kendall, G. Ochoa, E. Ozcan, and J. Woodward (2010). <u>A Classification of Hyper-heuristics Approaches</u>, *Handbook of Metaheuristics*, International Series in Operations Research & Management Science, M. Gendreau and J-Y Potvin (Eds.), Springer (in press)

However ...

Current hyper-heuristic research

- Papers deal with very few problems: sometimes 2, rarely 3, ... mostly only 1!
- Question: Can we produce a benchmark to test the generality of heuristic search algorithms?

HyFlex (Hyper-heuristics Flexible framework)

- A software framework (benchmark library) for designing and evaluating general-purpose search algorithms
- Provides the problem-specific components
- Efforts focused on designing high-level strategies

HyFlex: re-use and Interchange





HH fremework:(Cowling P., Kendall G. and Soubeiga, 2000, 2001), (E. K. Burke et al., 2003) Extension: J. Woodward, A. J. Parkes, G. Ochoa, A Mathematical Framework for Hyper-heuristics. PPSN Hyper-heuristics Workshop. 2008 The Cross-domain Heuristic Search Challenge (CHeSC 2011)

Overview of the problem domain modules

- I. A routine to initialise (randomised) solutions
- 2. A set of heuristics to modify solutions
 - a. Mutational: makes a random modification
 - b. Ruin-recreate: partially destroy a solution and rebuild it using a constructive procedure
 - c. Local-search: iterative procedures searching on the neighbourhood of solutions
 - d. Crossover: takes parent solutions and produce offspring solution
- 3. A set of interesting instances, that can be easily loaded (LoadInstance(i))
- 4. A population or list of solutions



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Personnel Scheduling

Instances: Wide range of data sets (Industry, Academia, +10 countries)

Low level heuristics: 12,

different types. LS based on new, horizontal and vertical moves



	BCV-A.12.1	1294	12	5	31	[2,7]	
	BCV-A.12.2	1953	12	5	31	[2,7]	
	ORTEC01	270	16	4	31	[4]	
	ORTEC02	290	16	4	31	[4]	
	GPost	5	8	2	28		
	GPost-B	3	8	2	28		
	QMC-1	16	19	3	28		
	QMC-2	29	19	3	28		
٠	Ikegami-2Shift-DATA1	0	28	2	30	[9]	
•	lkegami-3Shift-DATA1	б	25	3	30	[9]	
	Ikegami-3Shift-DATA1.1	13	25	3	30	[9]	
٠	lkegami-3Shift-DATA1.2	12	25	3	30	[9]	
+	Millar-2Shift-DATA1	0	8	2	14	[9]	
•	Millar-2Shift-DATA1.1	0	8	2	14	[9]	
1	Valouxis-1	20	16	3	28	[13]	



Horizontal swap: move shifts in single employee's work pattern

The "cross-domain" competition

Conduct a competition ("cross-domain" challenge):

- Using HyFlex
- Winner: algorithm with best overall performance across all of the different domains
- The **Decathlon Challenge** of search heuristics
- Why run a competition?
 - Competitions appear to help advance research
 - Success examples: Timetabling, Nurse Rostering, Planning, SAT, CSP, RoboCop, ...
 - Bring together researchers from sub-fields of CS,AI and OR
 - Achieve a deeper understanding of the design principles of hyper-heuristics across a wide set of problems



Scoring System

Formula I

- For each instance (race): algorithms will be ranked by the best objective function value (single run)
- The top eight 'drivers' score points
- Ties: Points to the relevant positions added and shared equally



Interesting Instances





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The Java Software

ExampleHyper-Heuristic I.java

ExampleHyper-Heuristic2.java

ExampleHyper-Heuristic3.java

> Your Hyper Heuristic??

HyperHeuristic abstract class



The Cross-Domain Heuristic Search Challenge

Develop the most general high level strategy

Your Hyper Heuristic??



Questions?

Important Dates: May 15, 2011: Registration deadline. June 15, 2011: Submission of final documents. http://www.asap.cs.nott.ac.uk/chesc2011