The Challenge of DIMACS Challenges

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Outline

What is a DIMACS Challenge?

" The DIMACS Implementation Challenges address questions of determining realistic algorithm performance where worst case analysis is overly pessimistic and probabilistic models are too unrealistic: experimentation can provide guides to realistic algorithm performance where analysis fails. Experimentation also brings algorithmic questions closer to the original problems that motivated theoretical work. It also tests many assumptions about implementation methods and data structures. It provides an opportunity to develop and test problem instances, instance generators, and other methods of testing and comparing performance of algorithms. And it is a step in technology transfer by providing leading edge implementations of algorithms for others to adapt. "

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In short, a Challenge is a challenge to see how well our theory works computationally.

What It Is Not!

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The Nine Challenges

No.	Name	Year	Volume	Organizers
1	Network Flows and Matching	1991	1993	Johnson and C. McGeoch
2	NP Hard Problems	1993	1996	Trick
3	Parallel Computation	1994	1997	Bhatt
4	Computational Biology	1995		Vingron
5	Priority Queues, Dictionaries, and Multidimensional Point Sets	1996	2002	C. McGeoch
6	Near Neighbor Searches	1998	2002	Goldwasser
7	Semidefinite Optimization	2000		Pataki
8	Traveling Salesman Problem	2001		Johnson, L. McGeoch, Glover, Rego
9	Shortest Path	2006	2009	Demetrescu, Goldberg, and Johnson

Challenge Outline

- Get a Committee (and a Coordinator)

Takes about a year or more from start to the Workshop; Volumes have taken a couple of years

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- Workshop
- Conference Volume

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- We learn about algorithms: *Tabu Search doesn't compete with simulated annealing for clique and coloring.*
- We learn about instances: *All practical graph coloring instances are easy: they have a large, obvious clique!*
- We get conjectures about random instances: *All random satisfiability instances are easy, except for a very narrow range of parameters*

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- We get a literature review.

Snapshot of Where We Are

DSJC125.5	125	3891	17	12	
----	----	----	18		CuLu96
----	----	----	20		GlPaRy96
----	----	----	17		LeCo96
----	----	----	20	12	MeZa08
----	----	----	19		DuRe08
DSJC125.9	125	6961	45	42	
----	----	----	47	42	MeZa08
----	----	----	45		DuRe08
DSJC250.1	250	3218	9	5	
----	----	----	9	5	MeZa08
----	----	----	10		DuRe08
DSJC250.5	250	15668	29	14	
----	----	----	32		CuLu96
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There has been little improvement in solving random graph coloring instances in the last 15 years

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File formats and instances are useful 15 years later.

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Can form the basis for continuing activities: Johnson, Mehrotra and I continue to encourage work on graph coloring.

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Conference volumes are well cited. Google scholar count for the 2nd computational challenge: 546

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Individual Papers Are Well Cited

Cites	Per year	Rank	Authors	Title	Year	Publication
420	30.00	182	B Selman, H Kautz, ...	Local search strategies for satisfiabili...	1996	DIMACS Series in Discrete Mathematics and ...
274	14.42	187	P Godefroid	Using partial orders to improve auto...	1991	... '90: proceedings of a DIMACS workshop, June 18-21, ...
255	19.62	188	J Gu, PW Purdom, J...	Algorithms for the satisfiability (SAT)...	1997	DIMACS Series in Discrete Mathematics and ...
239	15.93	189	A Jepson, M Black	Mixture models for optical flow comp...	1995	Partitioning Data Sets: DIMACS Workshop, April 19-21 ...
210	11.05	193	RJ Lipton	New directions in testing	1991	... : proceedings of a DIMACS Workshop, October 4-6, ...
188	14.46	207	MY Vardi	Why is modal logic so robustly decid...	1997	DIMACS Series in Discrete Mathematics and ...
185	11.56	208	M Halle, W Idsardi	General properties of stress and met...	1994	Language Computations: DIMACS Workshop on Human ...
165	15.00	209	E Winfree, X Yang, ...	Universal computation via self-asse...	1999	DNA based computers II: DIMACS workshop, June 10- ...
161	10.06	210	YLIPM PARDALOS, ...	A greedy randomized adaptive searc...	1994	... and related problems: DIMACS Workshop, May 20-21, ...
159	9.35	68	O Dubois, P Andre, ...	Sat versus unsat	1993	Second DIMACS Implementation Challenge
124	9.54	242	W Marrero, EM Clar...	Model checking for security protocols	1997	DIMACS Workshop on Design and Formal Verification of ...
123	7.24	244	N Alon, Y Roichman	Random Cayley graphs and expanders	1993	... graphs: proceedings of a DIMACS workshop, May 11- ...
123	11.18	243	RG Downey, MR Fel...	Parameterized complexity: A framew...	1999	... from DIMACS and DIMATIA to the future: DIMATIA-DIMACS ...
118	9.08	245	D Luckham	Rapide: A language and toolset for s...	1997	... methods in verification: DIMACS workshop July 24-26, ...
103	7.36	246	A Van Gelder, YK Tsuji	Satisfiability testing with more reaso...	1996	... : Second DIMACS Implementation Challenge., DIMACS ...
97	8.08	73	E Winfree	Simulations of computing by self-ass...	1998	DIMACS: DNA-Based Computers
92	13.14	247	D Bryant	A classification of consensus method...	2003	... October 25-26, 2000 and October 2-5, 2001, DIMACS ...
86	5.38	248	WP ADAMS, TA JO...	Improved linear programming-based ...	1994	... and related problems: DIMACS Workshop, May 20-21, ...
84	6.00	249	C Fleurent, JA Ferland	Object-oriented implementation of h...	1996	Cliques, Coloring, and Satisfiability: Second DIMACS ...
83	0.00	250	S Poljak, Z Tuza	Maximum cuts and large bipartite su...		Combinatorial Optimization. Papers from the DIMACS ...

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More subgroups (satisfiability now has its own conferences)

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From the 2nd Challenge Call for Papers:

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HOW TO PARTICIPATE.  For more information about participating in the
Implementation Challenge, send a request for the document "General
Information" (available September 15, 1992) to
                 challenge@dimacs.rutgers.edu.
Request either LaTeX format (sent through email) or hard copy (sent
through U. S. Mail), and include your return address as appropriate.
Challenge materials will also be available via anonymous FTP from
DIMACS, and we expect most communication with respect to the Challenge
to take place over the Internet.
```

Using Web 2.0 for the Challenges

Much easier to communicate now even compared to 10 years ago (Web 1.0). We can have

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- Specialized systems to keep track of and verify (!) results
- A more distributed coordinating team

ROIS: Registy for Optimization Instances and Solutions

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ROIS HOME

Instances

Graphs
Display Sources
Display Graphs
Distances
Display Sources
Display Distance Matrices

Benchmarks/ Solutions

Coloring
Display Solutions

Instances

- Undirected graphs (clique, coloring)
- Distance matrices (traveling tournament problem)

Benchmarks and Solutions

- Maximum Clique
- Graph Coloring
- Traveling Tournament Problem

Contact: Michael Trick trick at cmu.edu

Please note: Extremely preliminary!

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ROIS HOME

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Graphs
Display Sources
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Distances
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Benchmarks/ Solutions

Coloring
Display Solutions

Display Coloring Solutions

Name	Nodes	Edges	UB	LB	Ref
1-FullIns_3	30	100	4	4	
----	----	----	4	4	MeZa08
----	----	----	4		DuRe08
1-FullIns_4	93	593	5	4	
----	----	----	5	4	MeZa08
----	----	----	5		DuRe08
1-FullIns_5	282	3247	6	4	
----	----	----	6	4	MeZa08
----	----	----	6		DuRe08
1-Insertions_4	67	232	5	3	
----	----	----	5	3	MeZa08
----	----	----	5		DuRe08
1-Insertions_5	202	1227	6	3	
----	----	----	6	3	MeZa08

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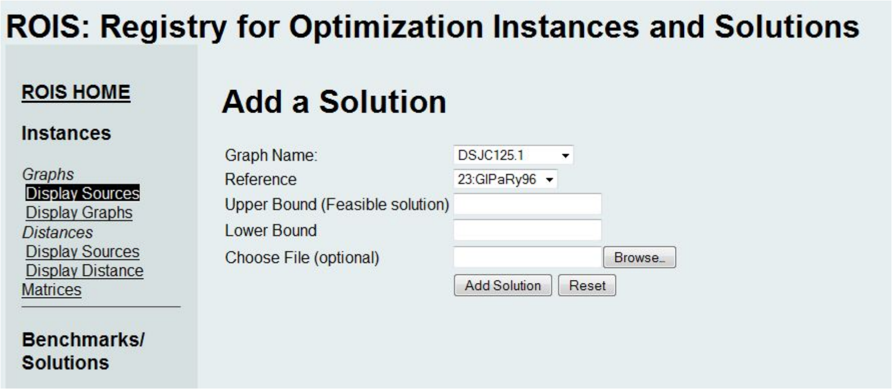

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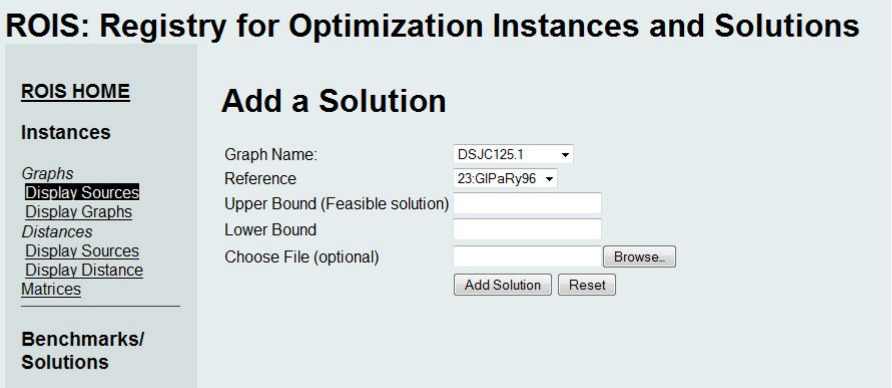

Bottom line: a lot of the work can be automated!

Primary Reason for More Challenges

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Still a huge amount to do.

John Hooker on Computational Experiments

> Typically the investigator has a bright idea for a new algorithm and wants to show that it works better, in some sense, than known algorithms. This requires computational test, perhaps on a standard set of benchmark problems. If the new algorithm wins, the work is submitted for publication. Otherwise it is written off as a failure. In short, the whole affair is organized around an algorithmic race whose outcome determines the fame and fate of the contestants.
> [...] The emphasis on competition is fundamentally anti-intellectual and does not build the sort of insight that in long run conduces to more effective algorithms. It tells us what algorithms are better but not why. The understanding we do accrue generally derives from initial tinkering that takes place in the design stages of the algorithm. Because only the results of the formal competition are exposed to the light of publication, the observations that are richest in information are too often conducted in an informal, uncontrolled manner."

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(If they are interesting and instructive)

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WE NEED MORE CHALLENGES!

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