

SLS RUNTIME VISUALIZATION

THE PROBLEM DOMAIN: STOCHASTIC LOCAL SEARCH

- Class of meta-heuristics for solving hard combinatorial optimization problems
 - They explore a solution (search) space by moving from one complete (potentially infeasible) solution to another via some definition of a neighbourhood.
- Common (academic) problems: satisfiability (SAT), traveling salesman problem (TSP), job shop problem (JSP), vehicle routing problem (VRP)
 - (all NP-complete)
- Substantial portion of SLS development time is spent analyzing and tuning their performance



THE PROBLEM DOMAIN: STOCHASTIC LOCAL SEARCH

- Can be instrumented to provide information about the runtime behaviour of the search
- solution quality over time/iteration
 - Not always as simple to describe as academic problems. An industrial scheduling problem may be measured using 30+ (competing) objectives.
- solution over time/iteration
 - solutions can be very large



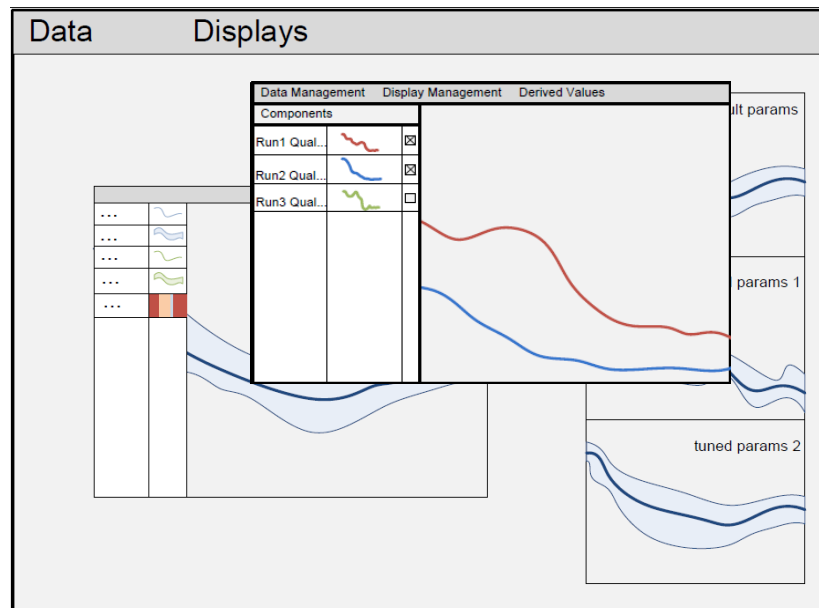
THE PROBLEM DOMAIN: STOCHASTIC LOCAL SEARCH

- state of the search over time/iteration
 - contents tabu lists, nogood caches, size/contents of neighbourhoods
 - current strategy (ie, intensification vs diversification)



THE VISUALIZATION APPROACH

- Issue #1: No standard visualization task
- Solution: Interactive creation of multiple layered time series plots



THE VISUALIZATION APPROACH

- Issue #2: Data collect may not be what you want to be visualizing, may be interested in
 - aggregate runtime behaviour
 - similarity of solutions over time to some elite solution
 - etc.
- Solution: Generating derived values.



THE VISUALIZATION APPROACH

- Issue #3: Lots of collected data, but only a small subset is important at a time
- Solution: Pivoting view of available data sets
 - Relevant data sets are likely to be (near) neighbours under some pivot

LKH Data Set window showing a pivot view. The 'filter' field is empty. The data is organized by 'run' (0-14) and 'avg 0-14'. The 'tag order' is 'instance, measurement, solver, run'.

instance	measurement	solver	run
a280.tsp	current solution per iteration	Kjeld's LKH w/ default parameter set	0
			1
			10
			11
			12
			13
			14
			2
			3
			4
			5
			6
			7
			8
			9
			avg 0-14

LKH Data Set window showing a pivot view. The 'filter' field is empty. The data is organized by 'solver' (Kjeld's LKH w/ default parameter set) and 'run' (0-11). The 'tag order' is 'solver, run, measurement, instance'.

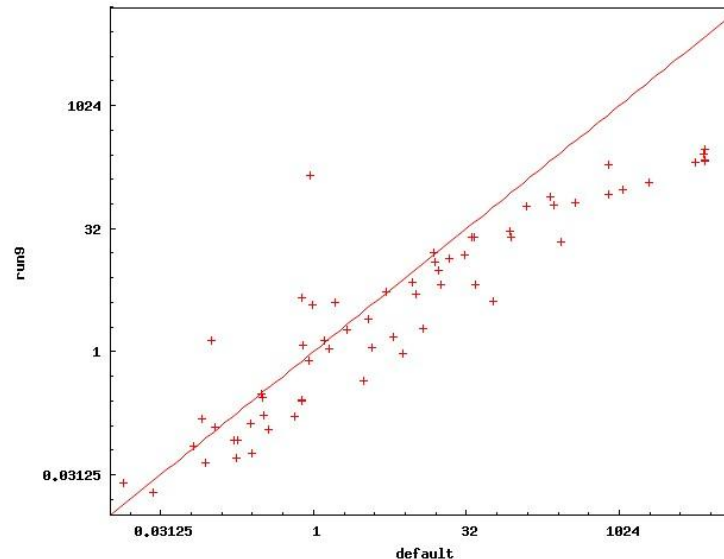
solver	run	measurement	instance
Kjeld's LKH w/ default parameter set	0	current solution per iteration	a280.tsp
			ali535.tsp
			brd14051.tsp
			d1291.tsp
			d18512.tsp
			fnl14461.tsp
			gil262.tsp
			pcb3038.tsp
			pla7397.tsp
			sl1032.tsp
			vm1084.tsp
		time per iteration	
		tour quality per iteration	
	1		
	10		
	11		

LKH Data Set window showing a pivot view. The 'filter' field is empty. The data is organized by 'instance' (a280.tsp) and 'run' (0-11). The 'tag order' is 'instance, run, solver, measurement'.

instance	run	solver	measurement
a280.tsp	0	Kjeld's LKH w/ default parameter set	current solution per iteration
			time per iteration
			tour quality per iteration
		Kjeld's LKH w/ parameter set 1	
		Kjeld's LKH w/ parameter set 10	
		Kjeld's LKH w/ parameter set 2	
		Kjeld's LKH w/ parameter set 3	
		Kjeld's LKH w/ parameter set 4	
		Kjeld's LKH w/ parameter set 5	
		Kjeld's LKH w/ parameter set 6	
		Kjeld's LKH w/ parameter set 7	
		Kjeld's LKH w/ parameter set 8	
		Kjeld's LKH w/ parameter set 9	
	1		
	10		
	11		

EVALUATION DATA SET

- Focusing on subtle variations of Keld Helsgaun's LKH implementation (state of the art SLS for TSP)
 - Testing done on TSPLIB instances
 - optimal solution known for each one
- Substantially different behaviour despite very similar search strategies



PROJECT STATUS – WHAT'S DONE

○ Data Set:

- Data Format for logging runtime information
- First pass at instrumenting Keld's LKH implementation

○ Data Set Viewer

○ Utilities

- (reasonably) efficient time series representation for both display and computation of derived values



PROJECT STATUS – CURRENT WORK / PARTIALLY DONE

- Additional solver instrumentation & runs
 - longer sets of runs take ~2 weeks to complete
- Basic Time Series Plot
- Interface for generating derived values



PROJECT STATUS – HAVEN'T STARTED

- Problem domain (TSP) specific displays / derived values
- Potential rewrite of data set viewer to try to improve performance when dealing with several thousand items

