



University
of
St Andrews

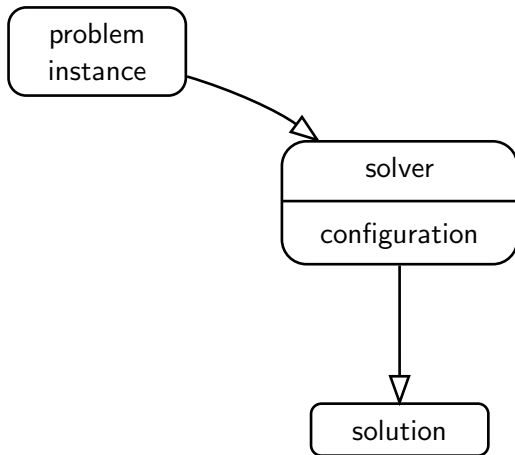
Machine learning for algorithm selection

A case study for the alldifferent constraint

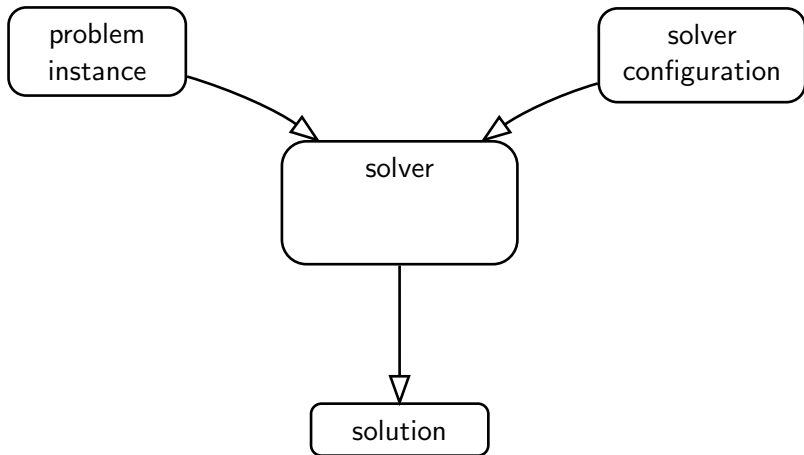
Lars Kotthoff

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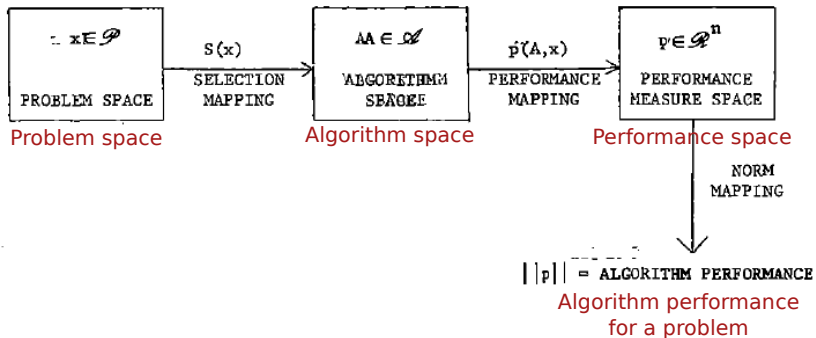
10 June 2010



Background



Background

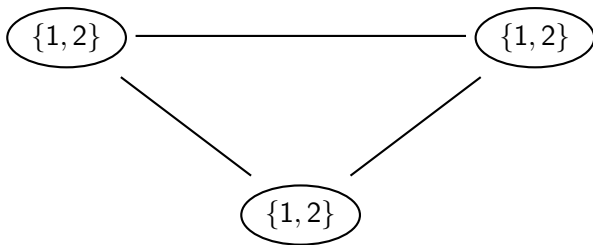


Rice, John R. "The Algorithm Selection Problem." *Advances in Computers* 15 (1976): 65-118.

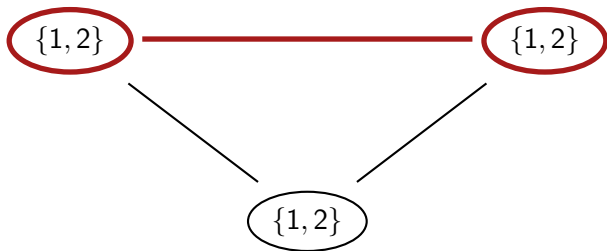
alldifferent

$$\text{alldifferent}(x, y, z) \iff x \neq y \wedge y \neq z \wedge x \neq z$$

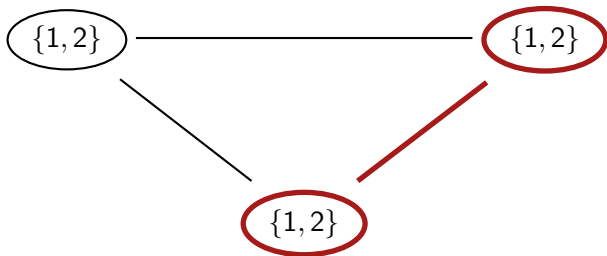
alldifferent



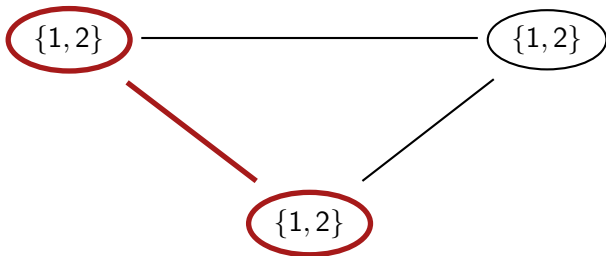
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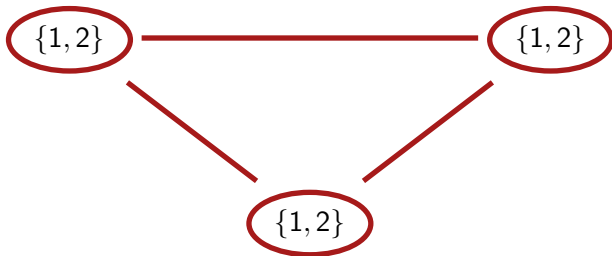
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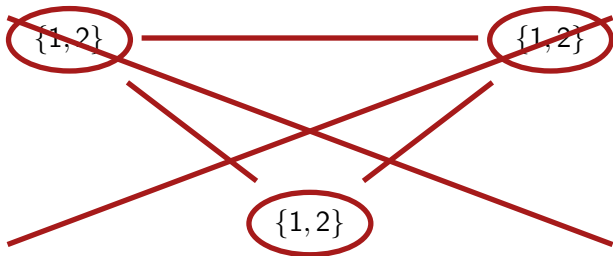
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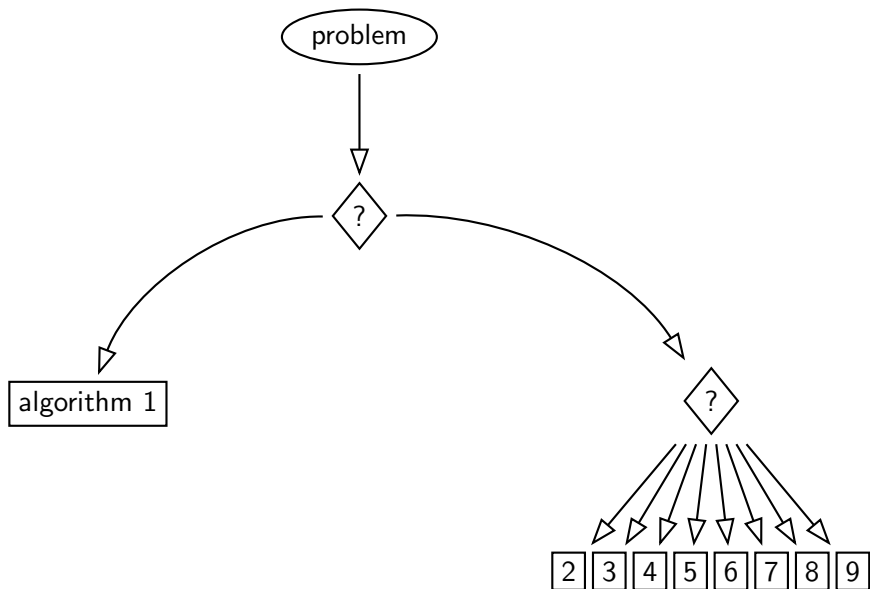
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alldifferent

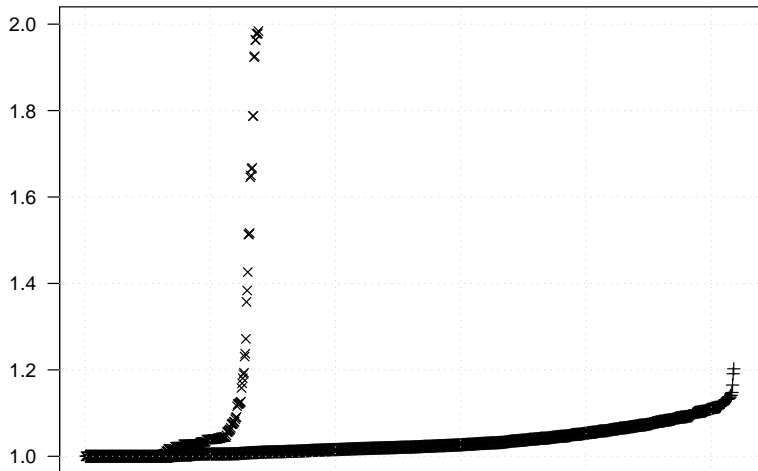


Problem



Motivation

speedup of best over default variant



problems

problems

Minion (constraint solver)

problems

Minion (constraint solver)

→run times, problem attributes

problems

Minion (constraint solver)

→run times, problem attributes

WEKA (machine learning toolkit)

problems

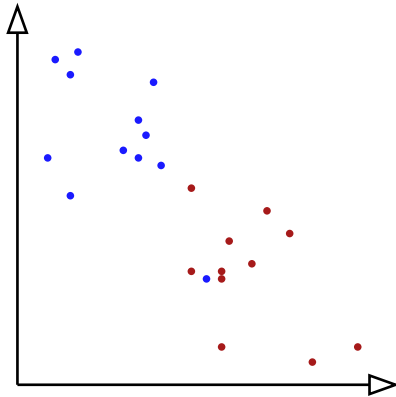
Minion (constraint solver)

→run times, problem attributes

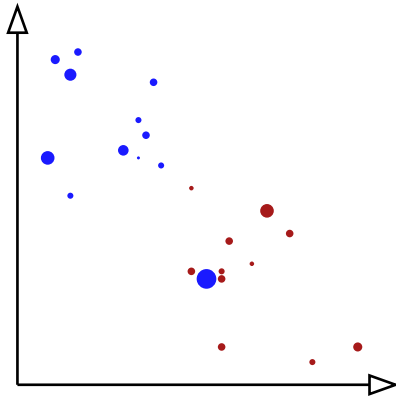
WEKA (machine learning toolkit)

→classifier

Instance weighting



Instance weighting



Ensemble classification

problems

Minion (constraint solver)

→run times, problem attributes

WEKA algorithm 1 WEKA algorithm 2 ... WEKA algorithm n

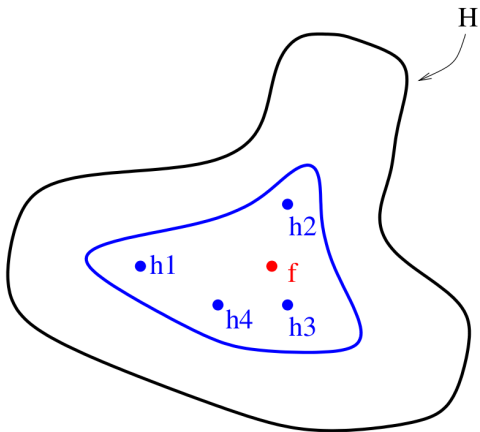
→classifier

→classifier

...

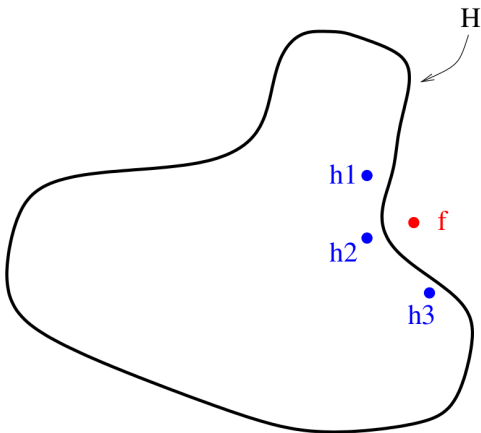
→classifier

Ensemble classification



Dietterich, Thomas G. "Ensemble Methods in Machine Learning." In Proceedings of the First International Workshop on Multiple Classifier Systems, 1857:115. Lecture Notes In Computer Science. Springer-Verlag, 2000.

Ensemble classification



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Results

set 1		set 2	
8 s		0.002 s	win
- 3 s	-	27 s	attribute calculation, classifier run
<hr/>		<hr/>	
= 5 s	=	-27 s	net win

per problem instance

Questions?