Machine learning for algorithm selection

A case study for the `alldifferent` constraint

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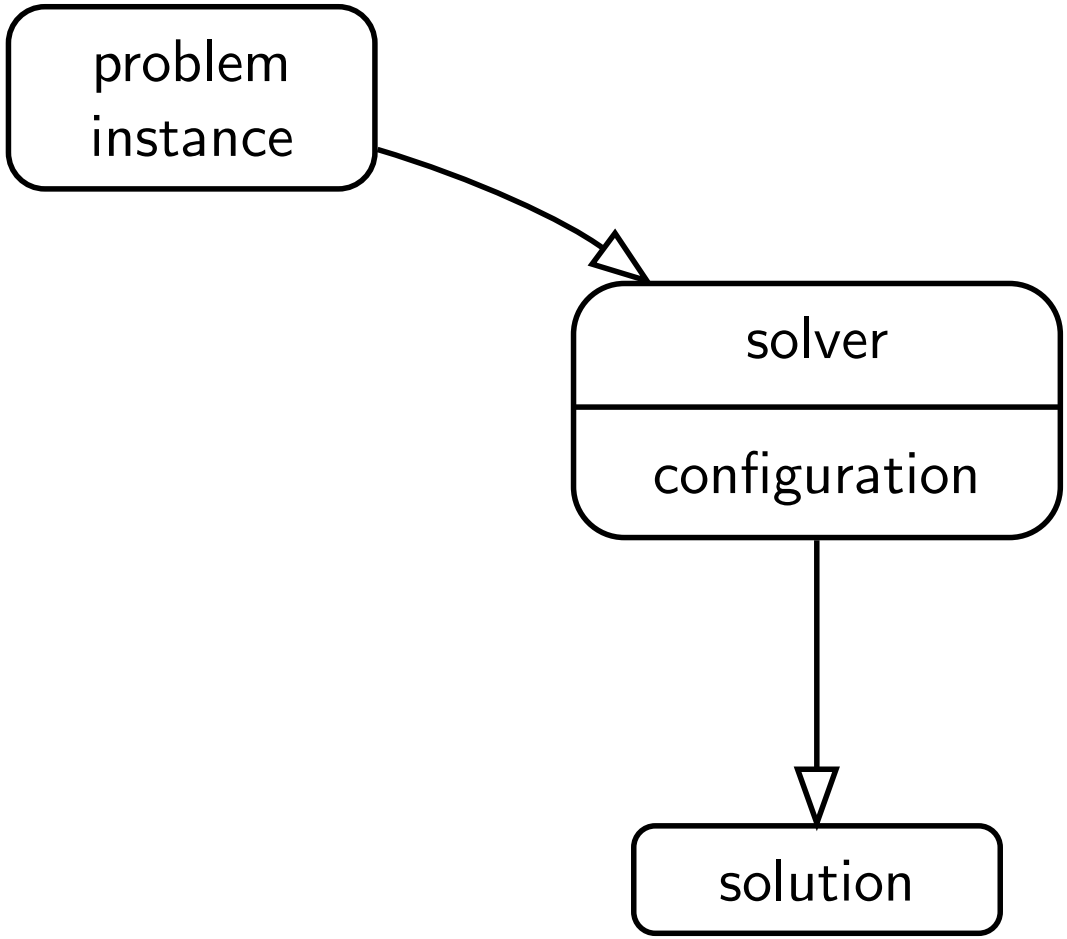
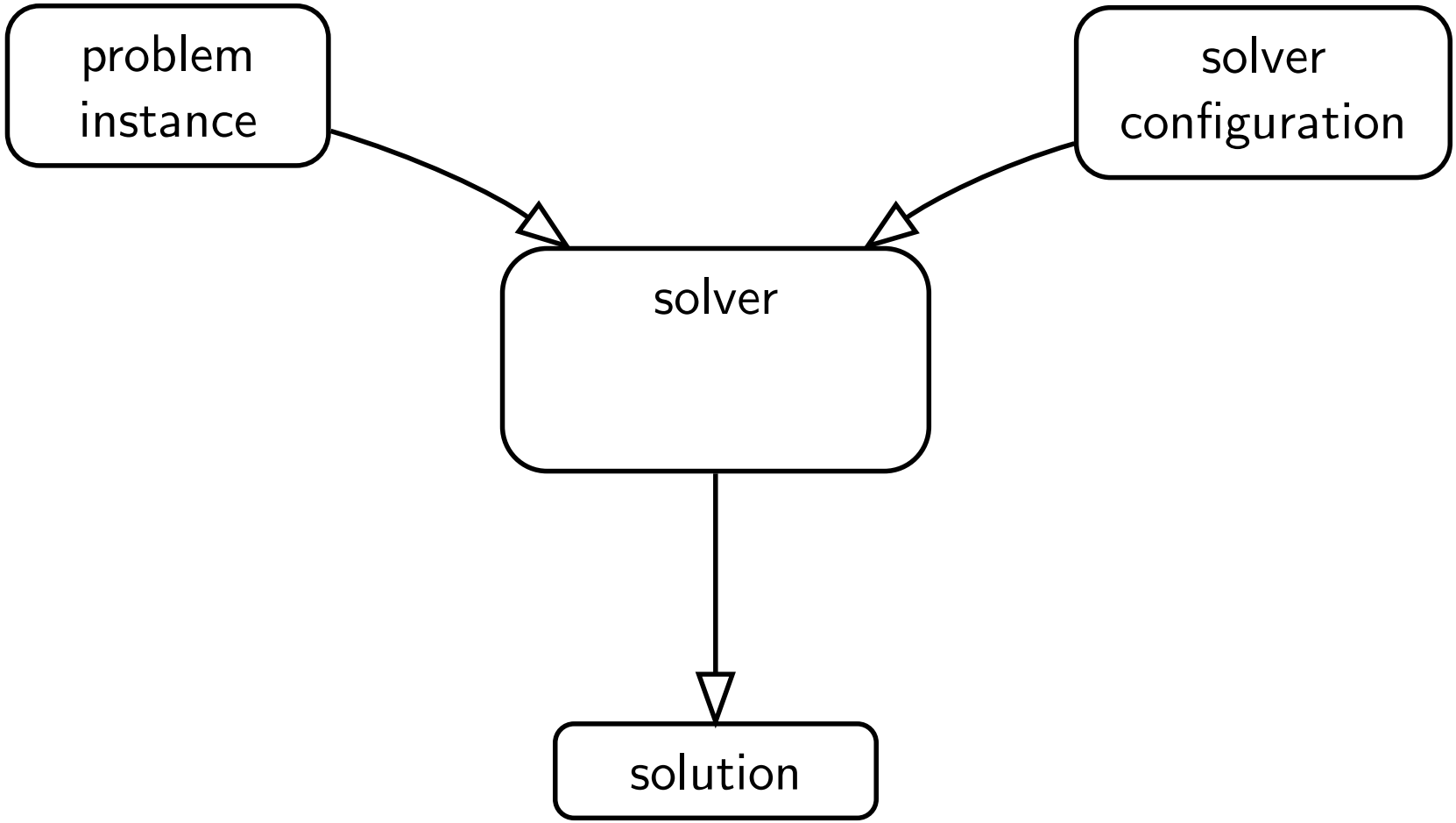
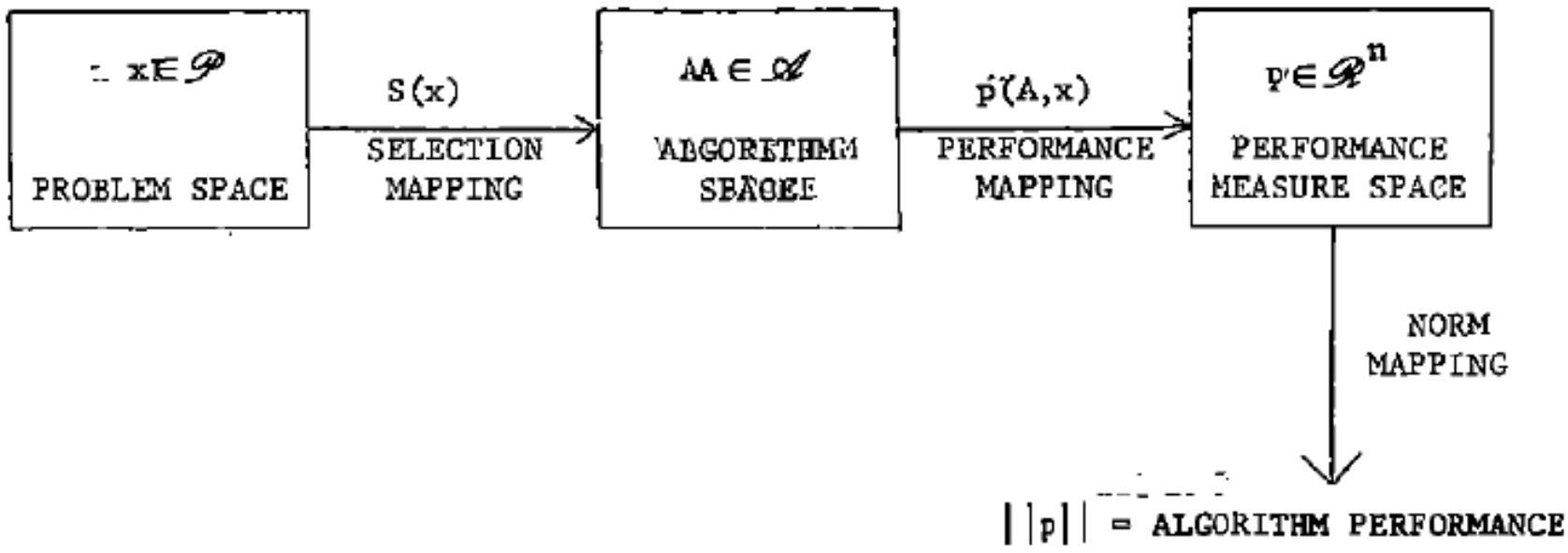
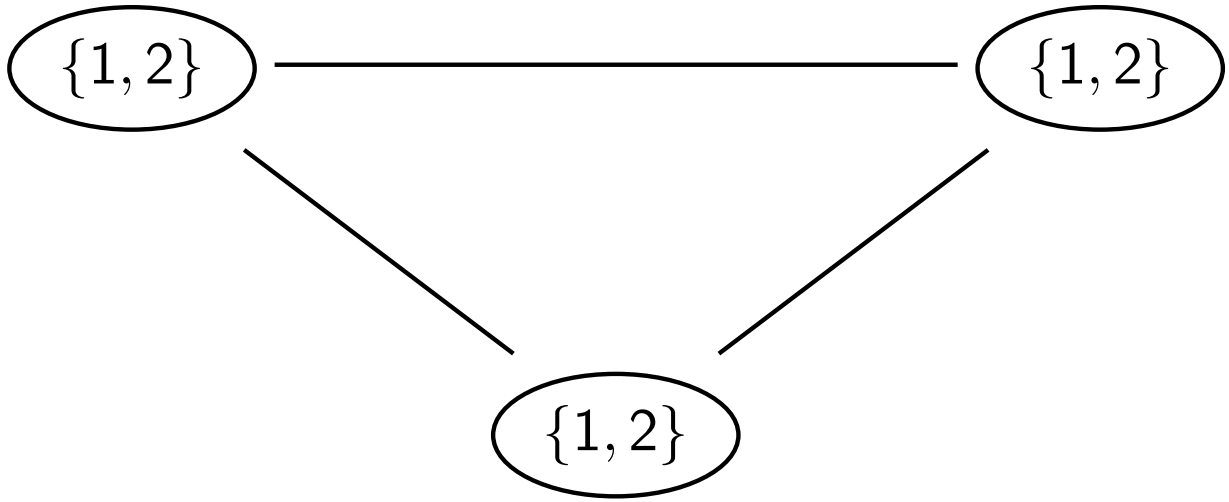

problem
instance
solver
configuration
solution


problem
instance
solver
configuration
solver
solution

Background


$x \in \mathcal{P}$
PROBLEM SPACE
S(x)
SELECTION MAPPING
$AA \in \mathcal{A}$
ALGORITHM SPACE
$p'(A,x)$
PERFORMANCE MAPPING
$p' \in \mathcal{P}^n$
PERFORMANCE MEASURE SPACE
NORM MAPPING
$||p||$ = ALGORITHM PERFORMANCE

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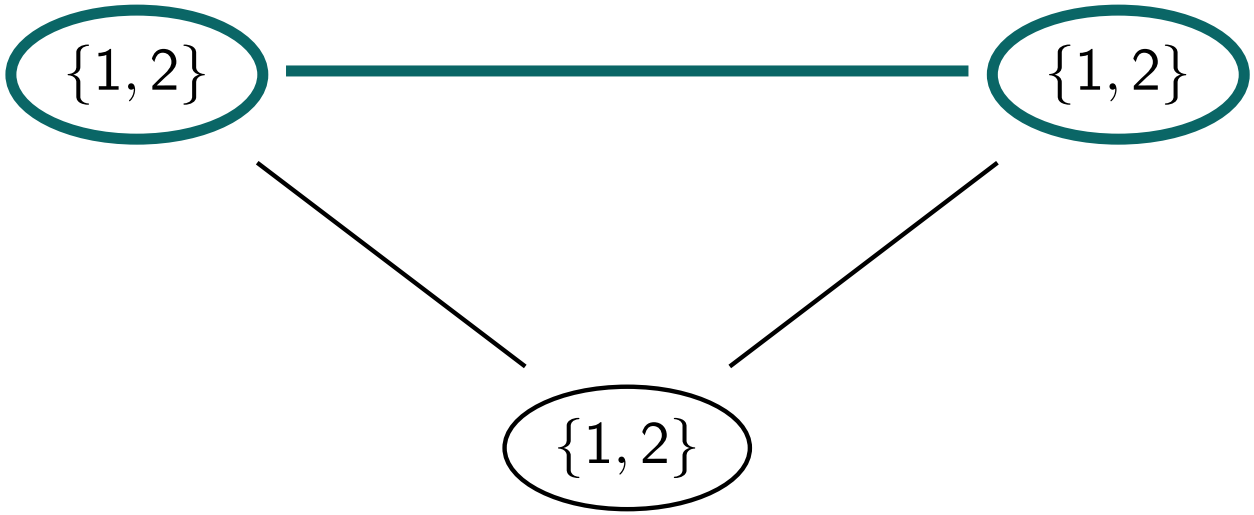
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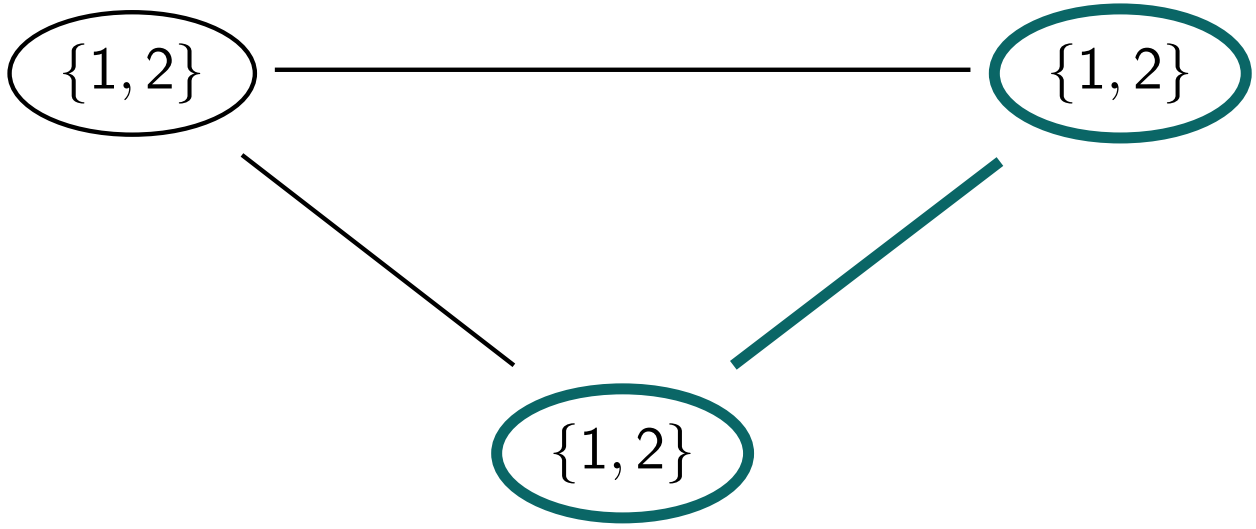
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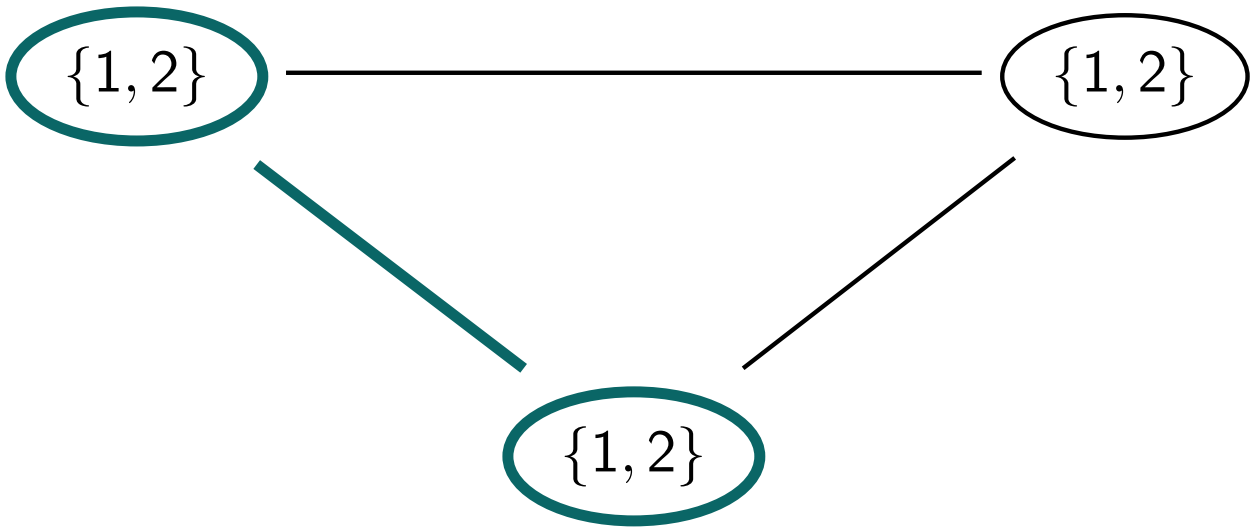
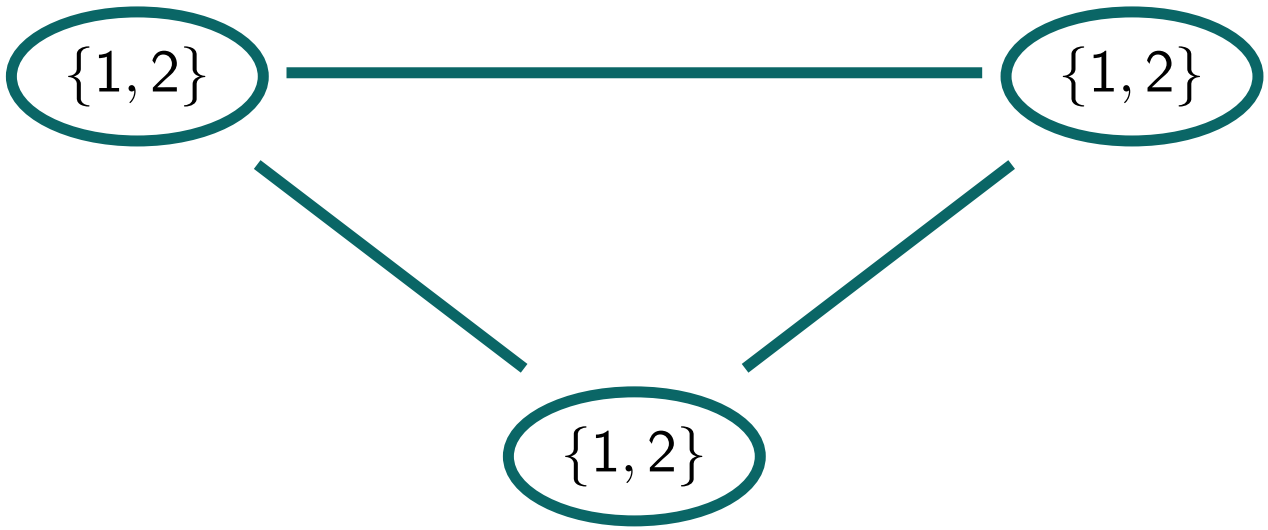
alldifferent

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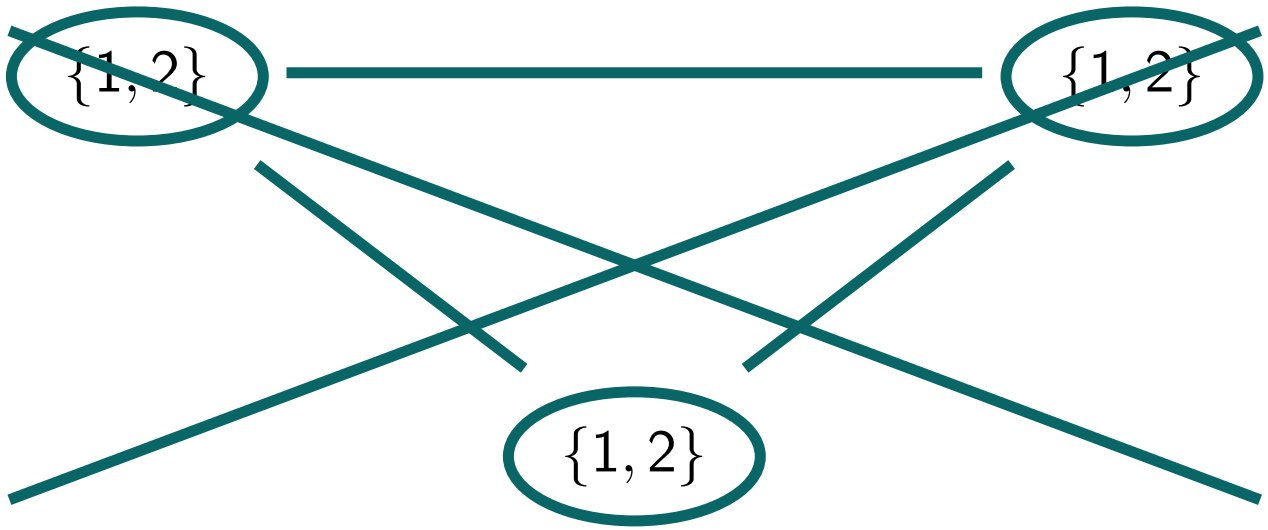
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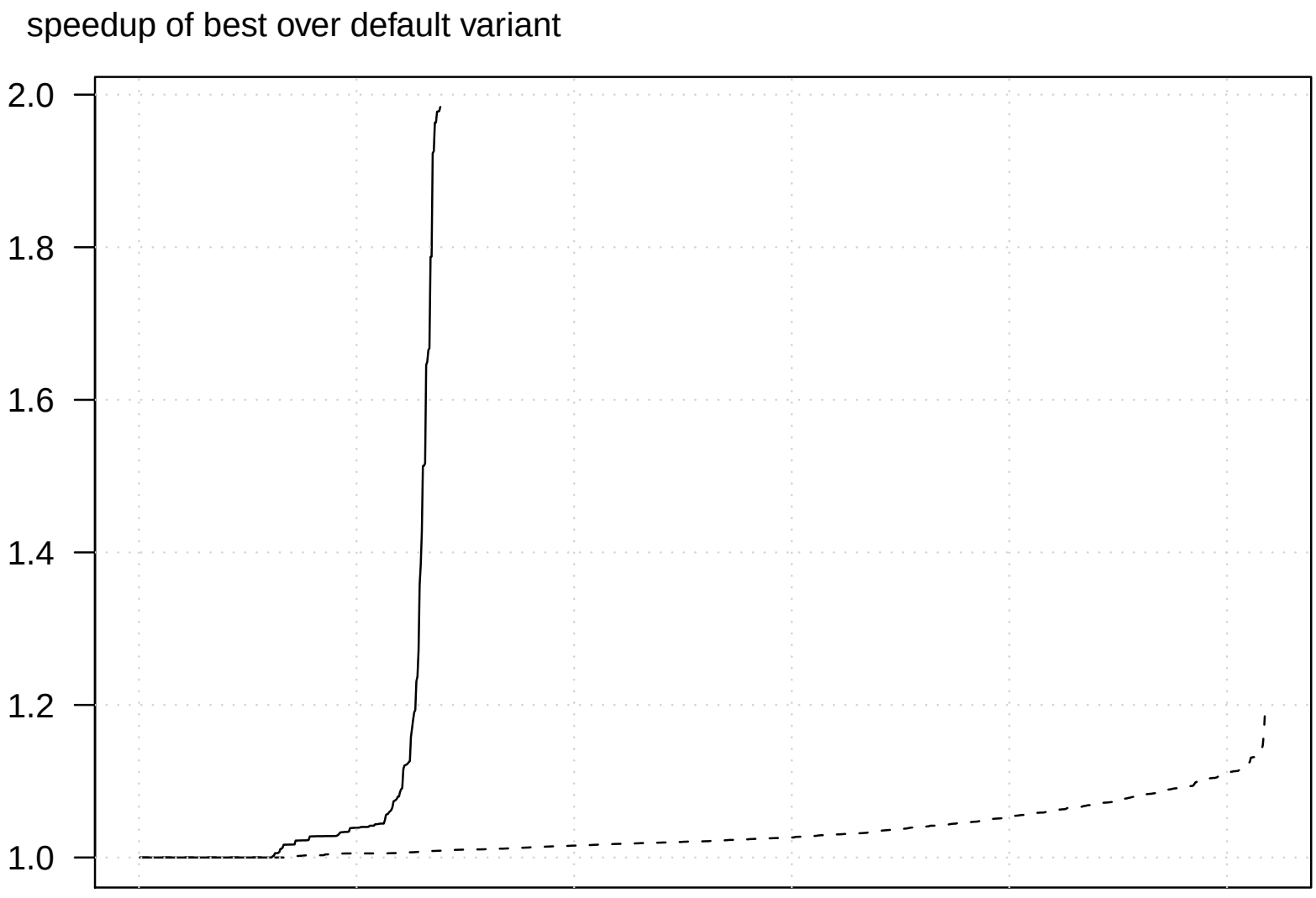
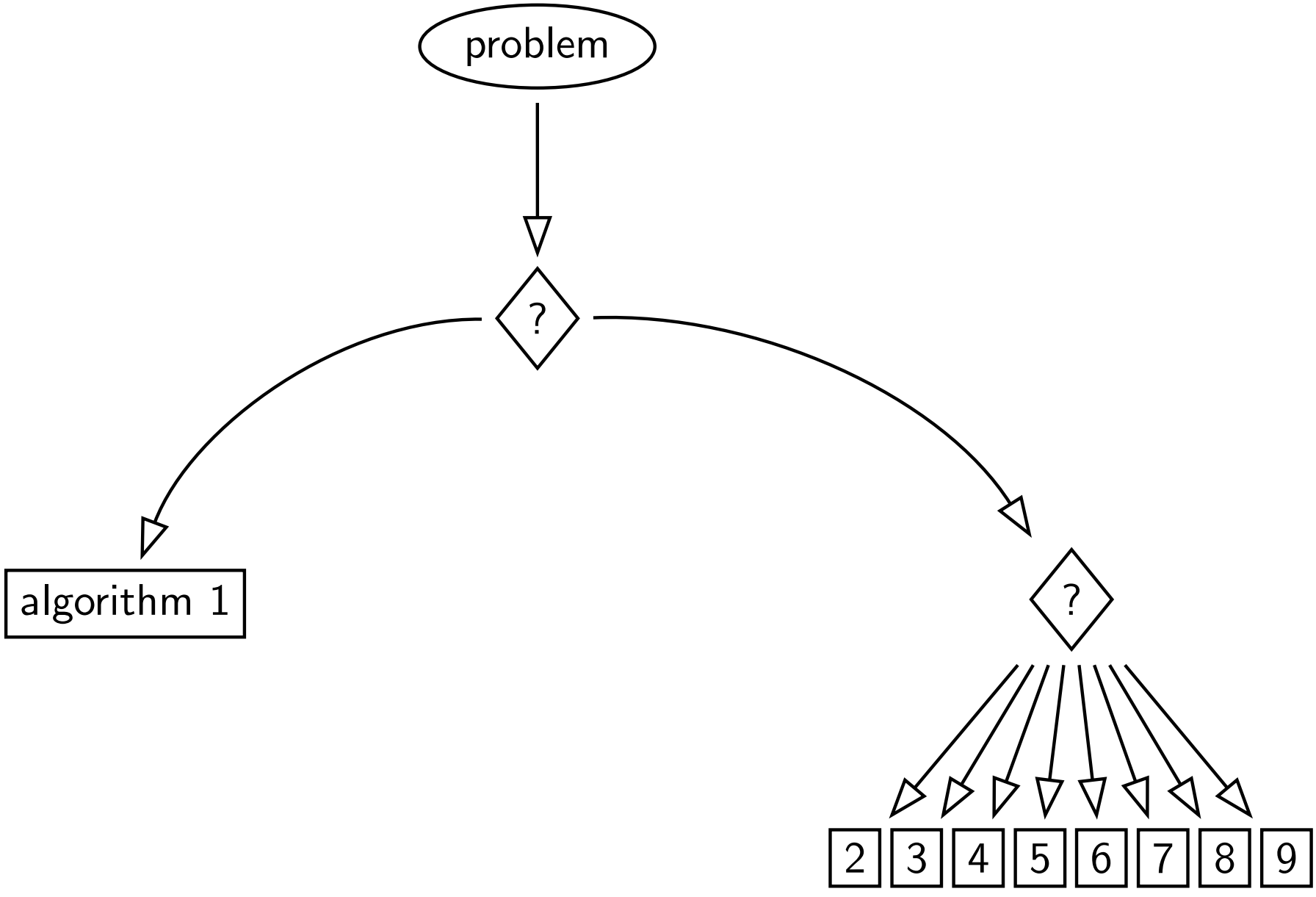
Motivation




problem
?
algorithm 1
?
2
3
4
5
6
7
8
9

problems

Methodology

problems

Minion (constraint solver)

Methodology

problems

Minion (constraint solver)

$\longrightarrow$ run times, problem attributes

Methodology

problems

Minion (constraint solver)

⟶▷run times, problem attributes

WEKA (machine learning toolkit)

Methodology

problems

Minion (constraint solver)

⟶▷run times, problem attributes

WEKA (machine learning toolkit)

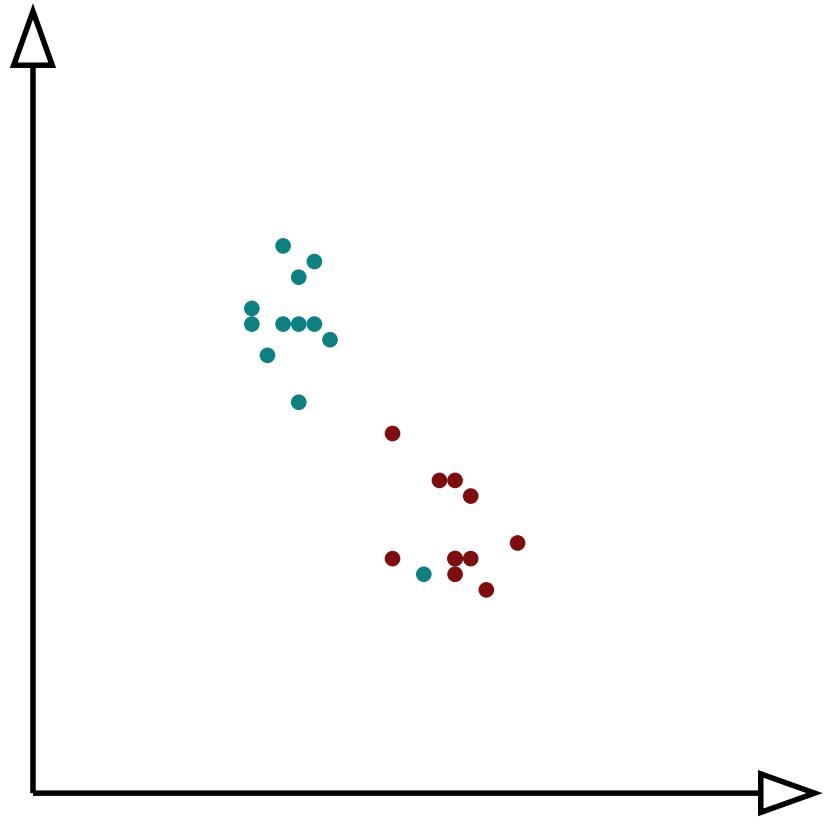
⟶▷classifier

Results

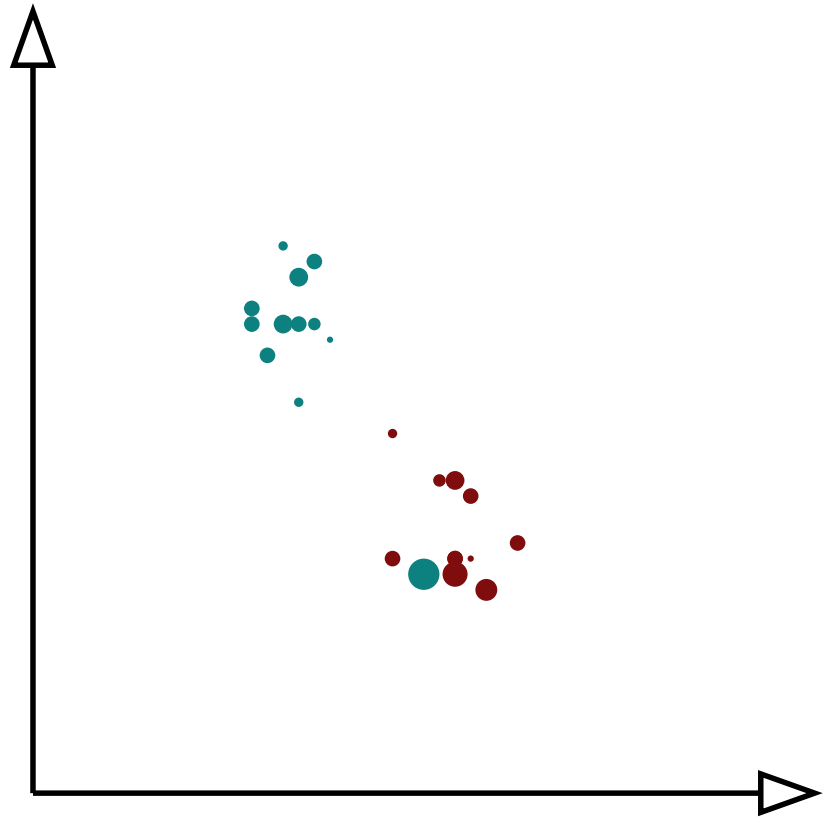
set 1		set 2		
8	s	0.002	s	win
- 3	s	- 27	s	attribute calculation, classifier run
= 5	s	= -27	s	net win

per problem instance

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