

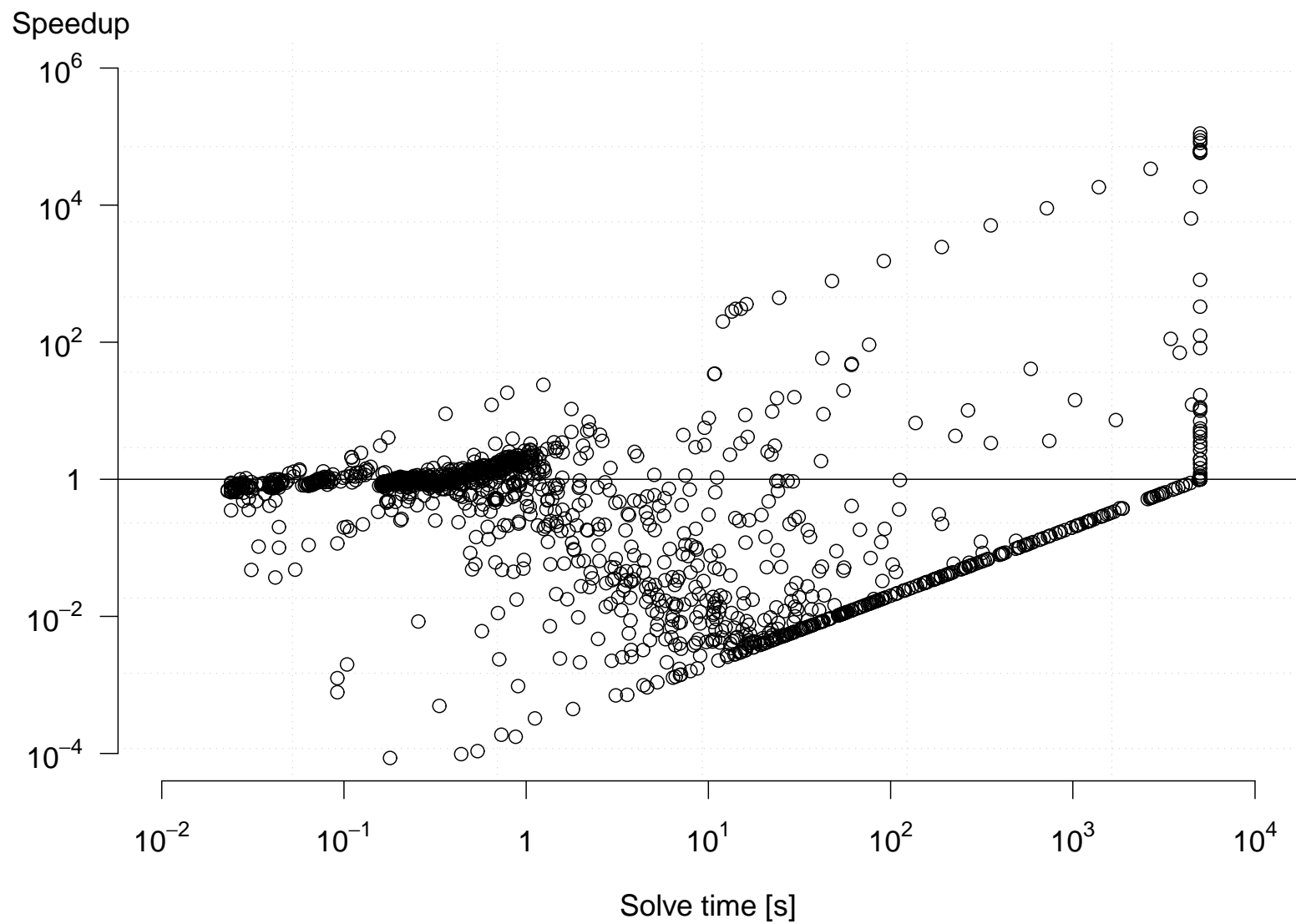
Learning When to Use Lazy Learning in Constraint Solving

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**ECAI
2010**

Motivation



Lazy learning improves solve time in some cases, but not always. When should we use it?

Lazy Learning

▷ $w, x, y, z \in \{1, 2, 3\}$

Lazy Learning

- ▷ $w, x, y, z \in \{1, 2, 3\}$
- ▷ `alldifferent(x, y, z)`

Lazy Learning

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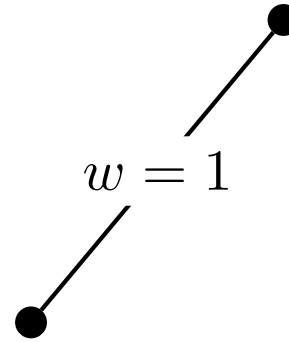
▷ $x + y = 5$

Lazy Learning

- ▷ $w, x, y, z \in \{1, 2, 3\}$
- ▷ `alldifferent(x, y, z)`
- ▷ $x + y = 5$
- ▷ further constraints on w

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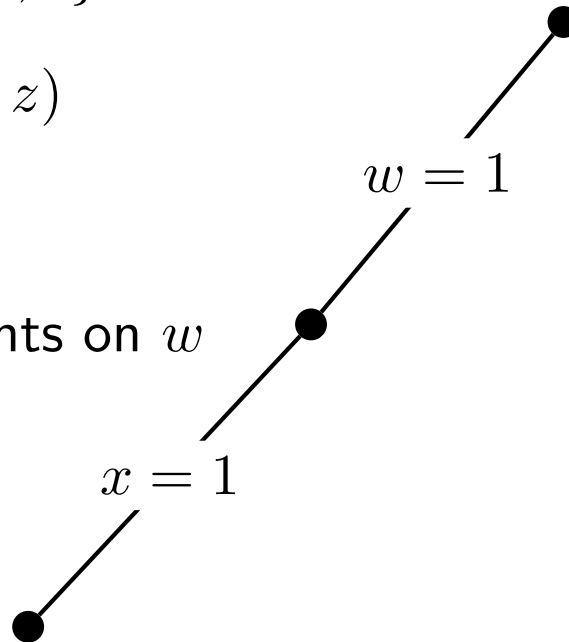
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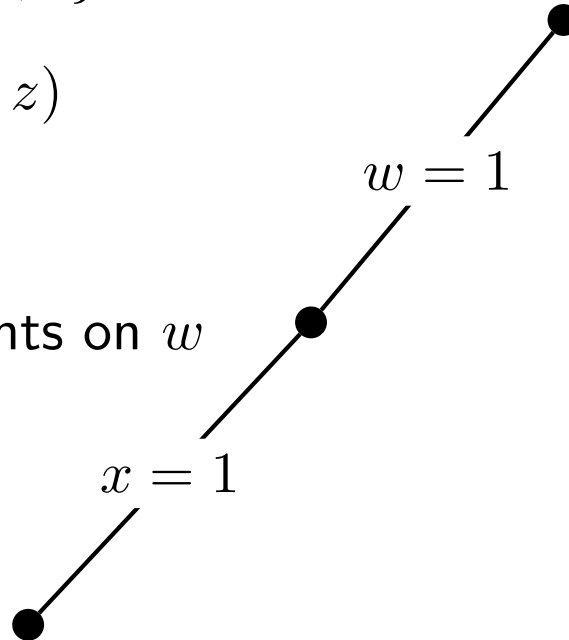
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$\text{alldifferent} \rightarrow y \in \{2, 3\}, z \in \{2, 3\}$

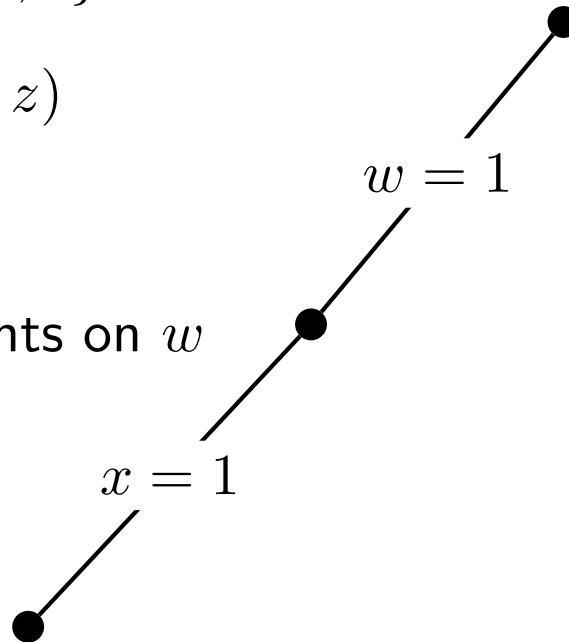
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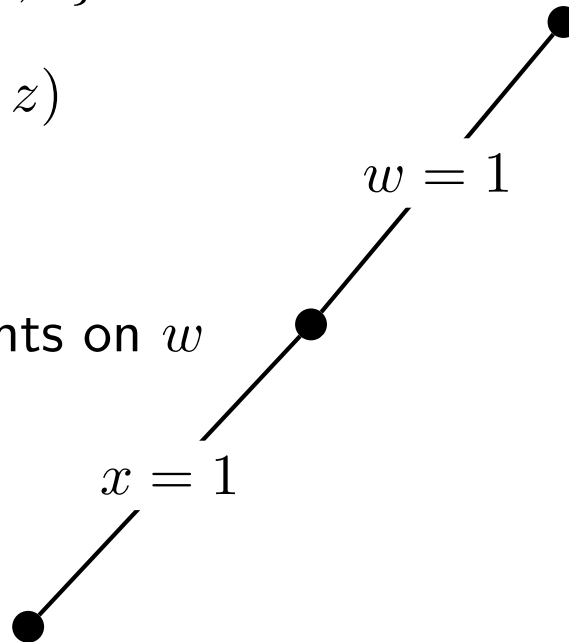
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explanation for failure: $x + y = 5$ and $x = 1$

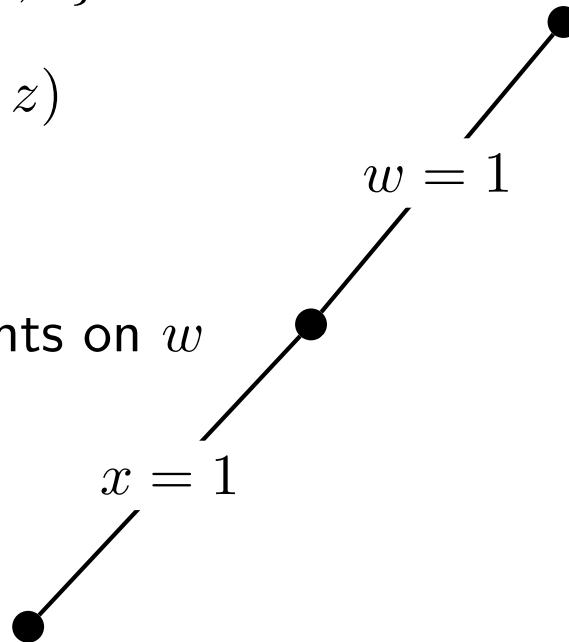
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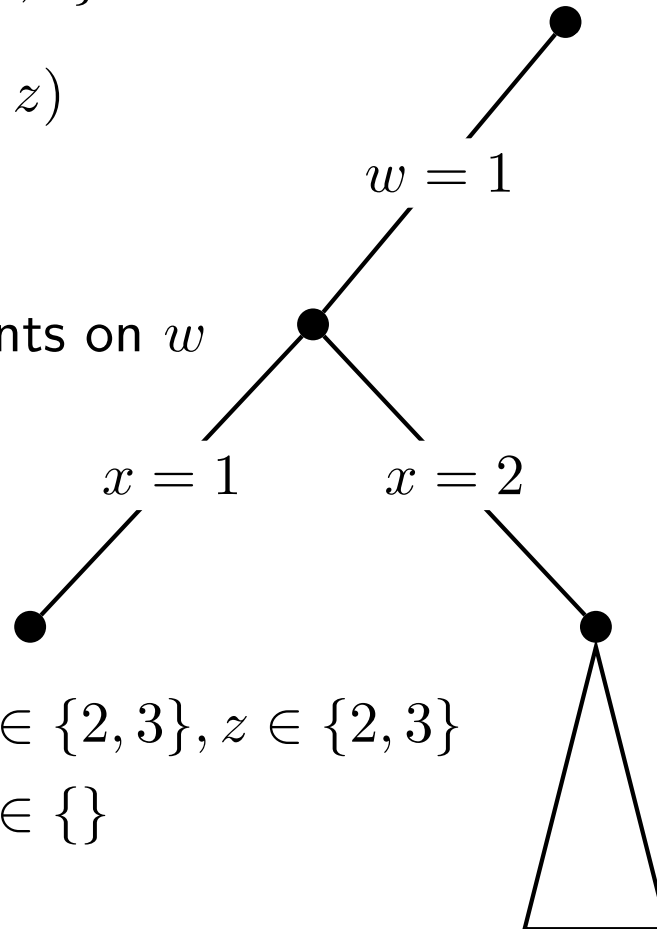
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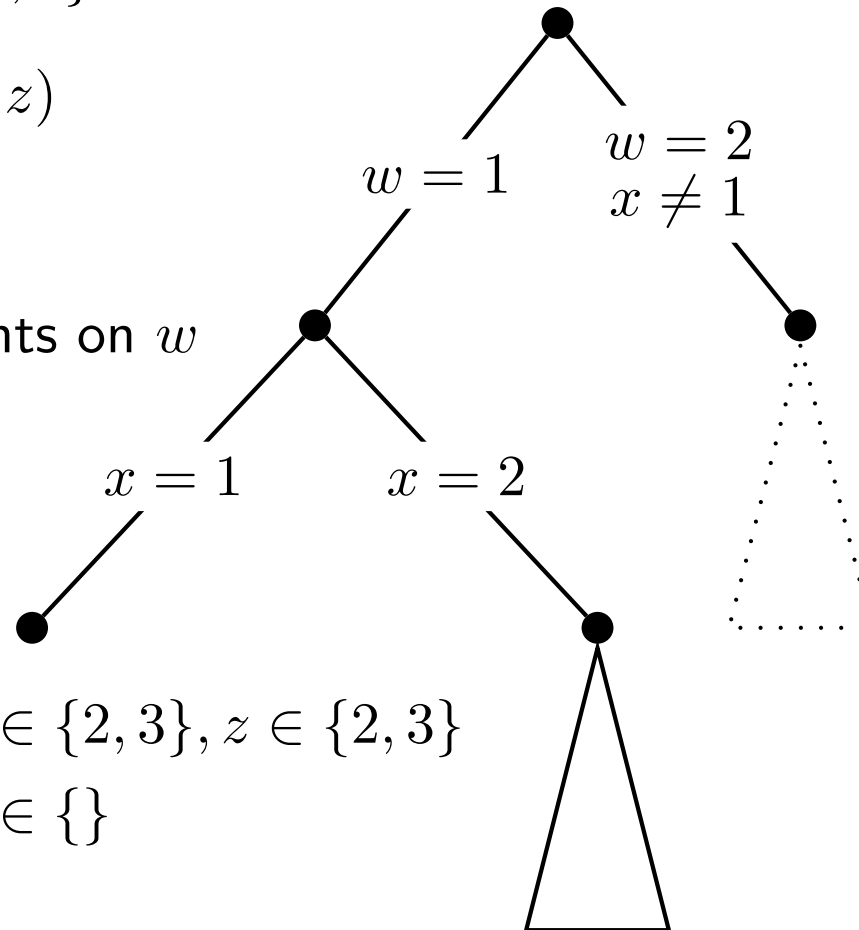
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Machine Learning

classification problem – use lazy learning or not?

Machine Learning

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Machine Learning

classification problem – use lazy learning or not?



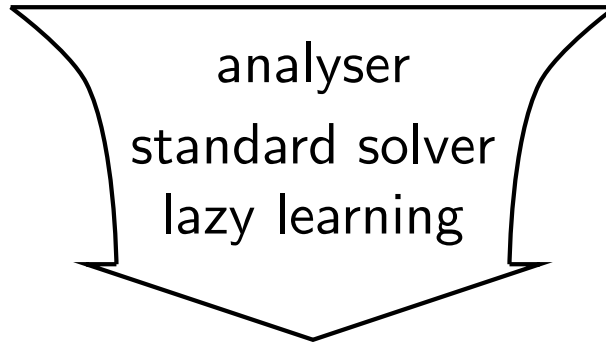
C4.5 decision tree builder

Methodology

problem instances

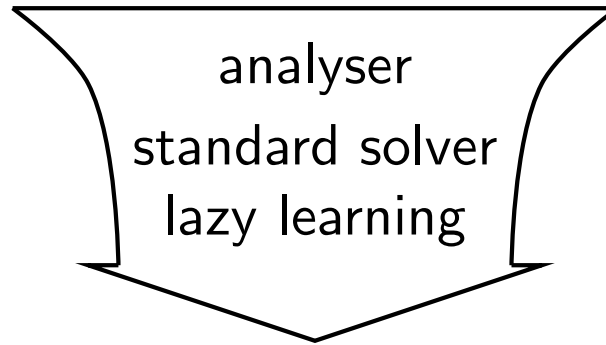
Methodology

problem instances



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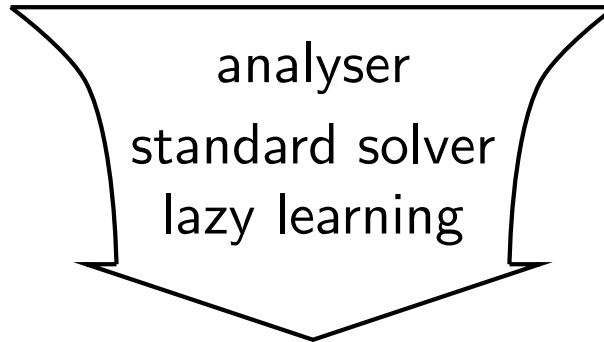


85 problem attributes

run times → which solver to use
misclassification penalties

Methodology

problem instances



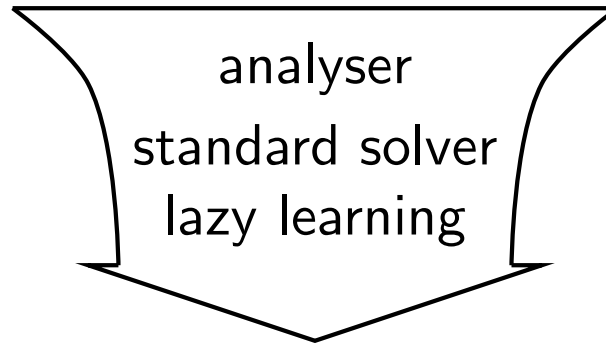
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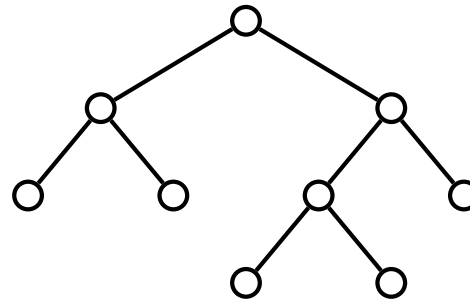
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Validation

manual inspection of generated decision trees

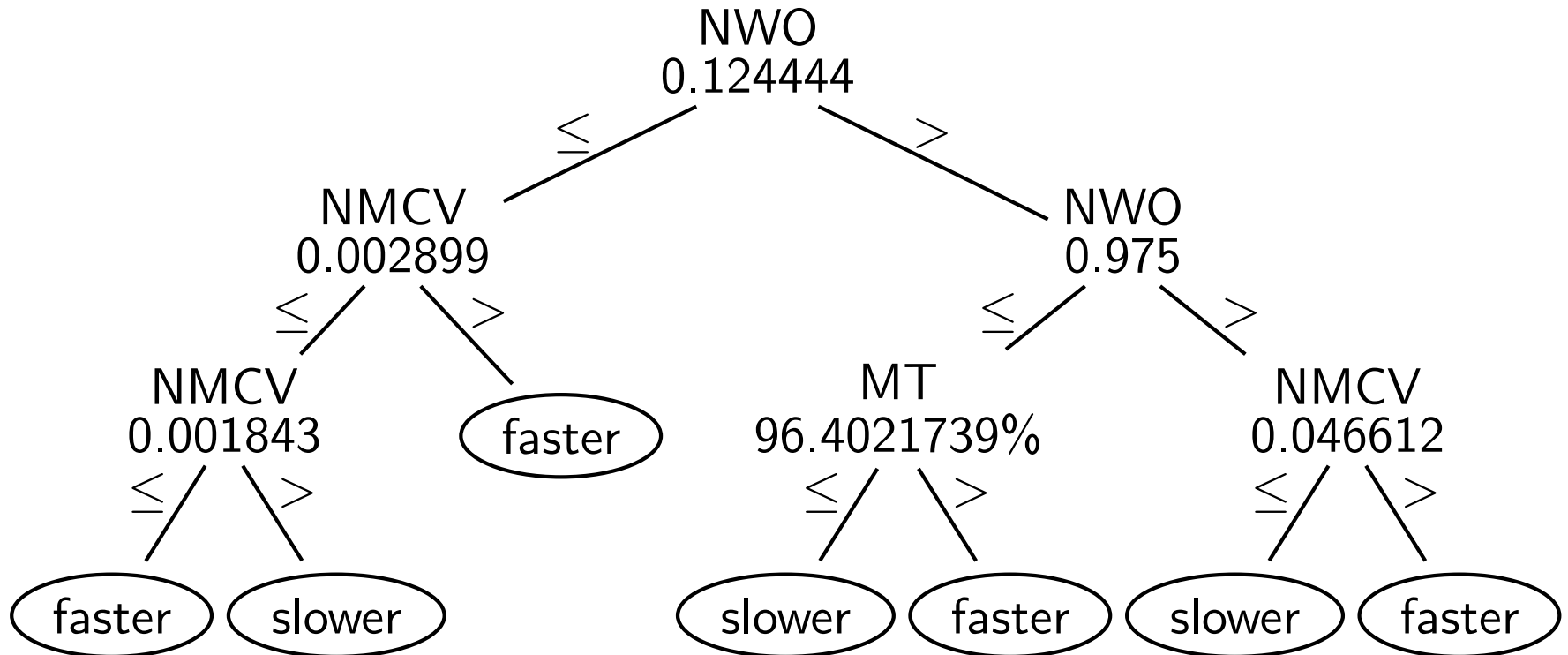
Validation

manual inspection of generated decision trees

cross-validation across different problem classes

Decision Tree

lazy learning solver faster?

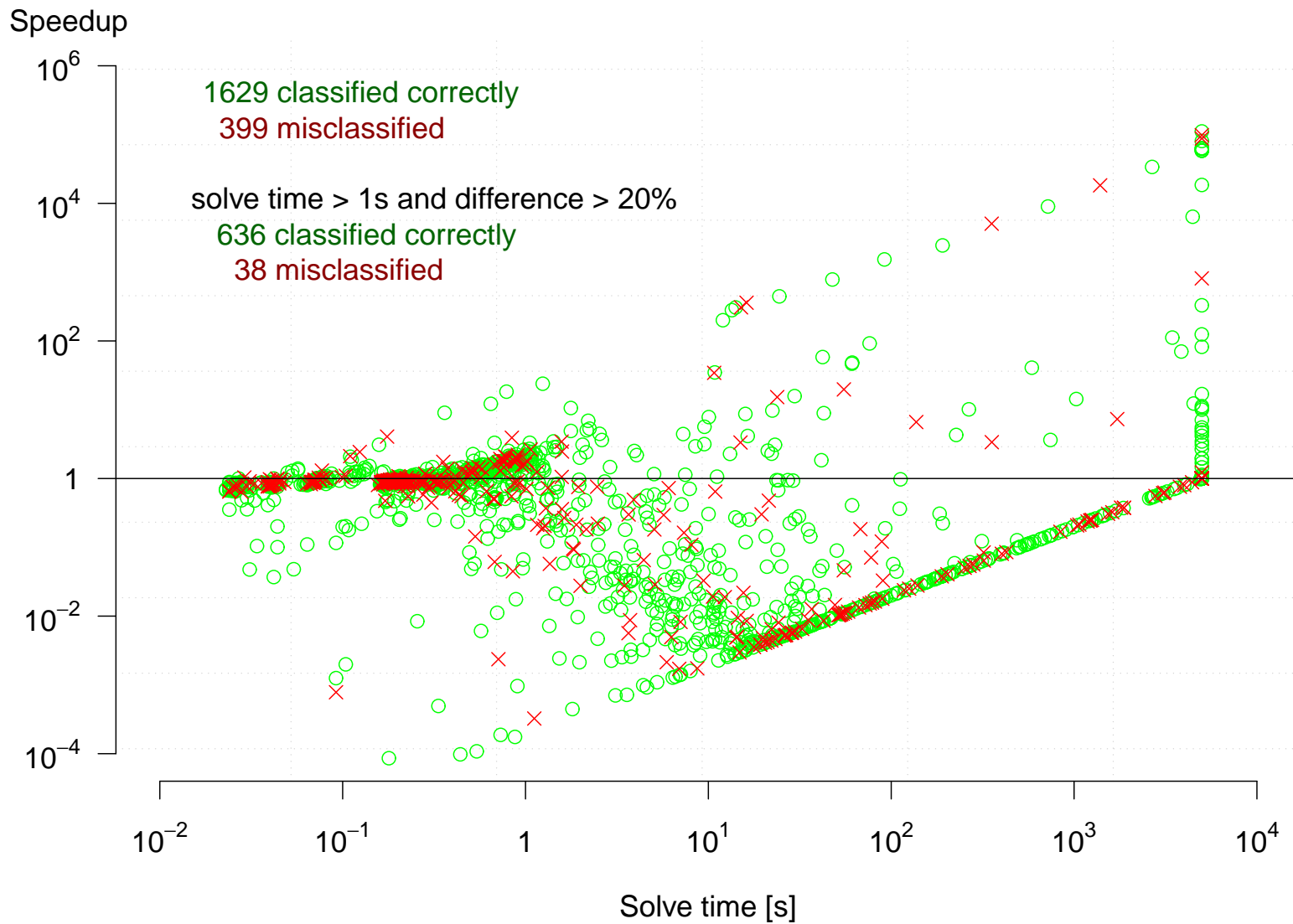


NWO normalised width of ordering

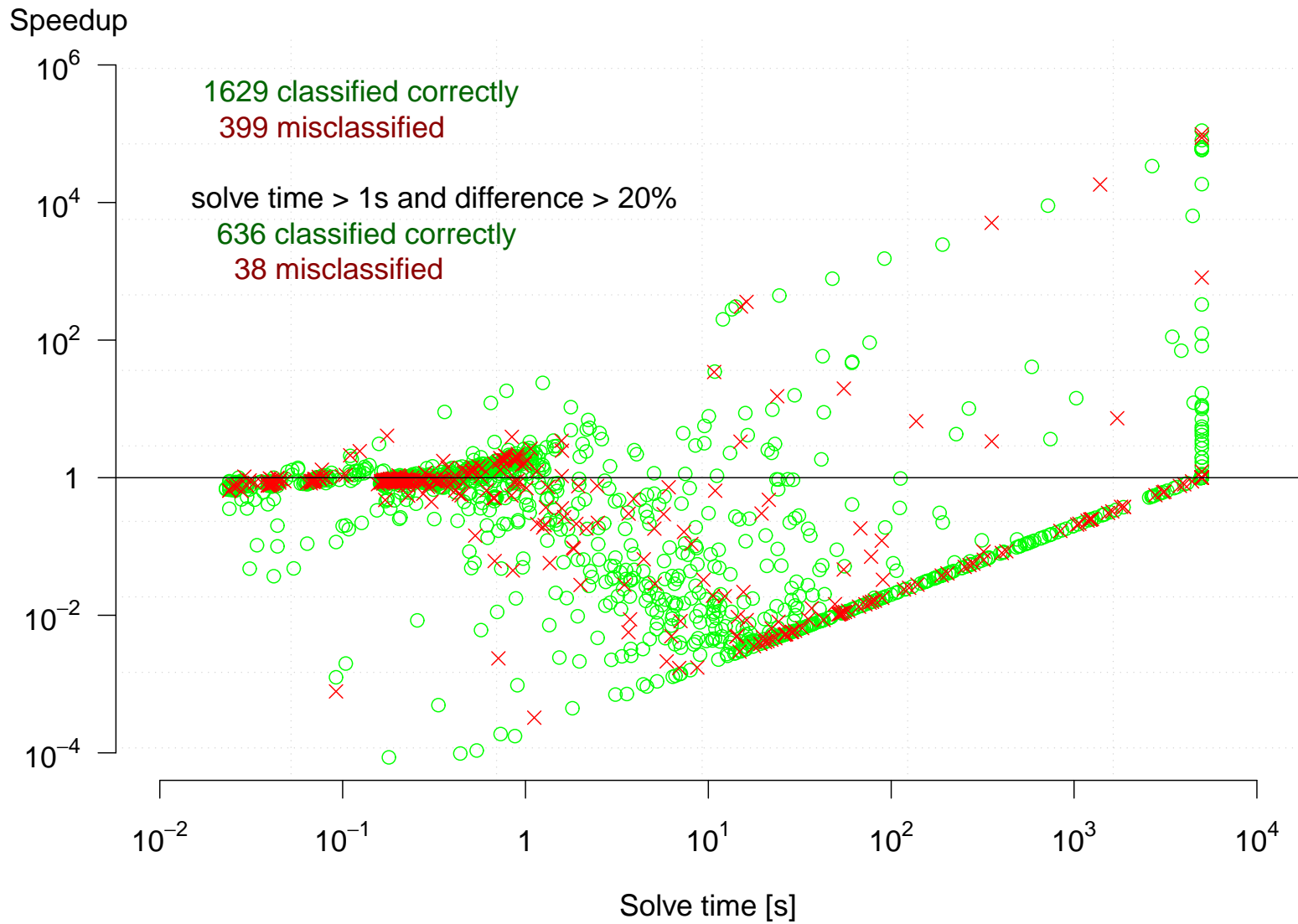
NMCV normalised mean constraints per variable

MT mean tightness

Performance

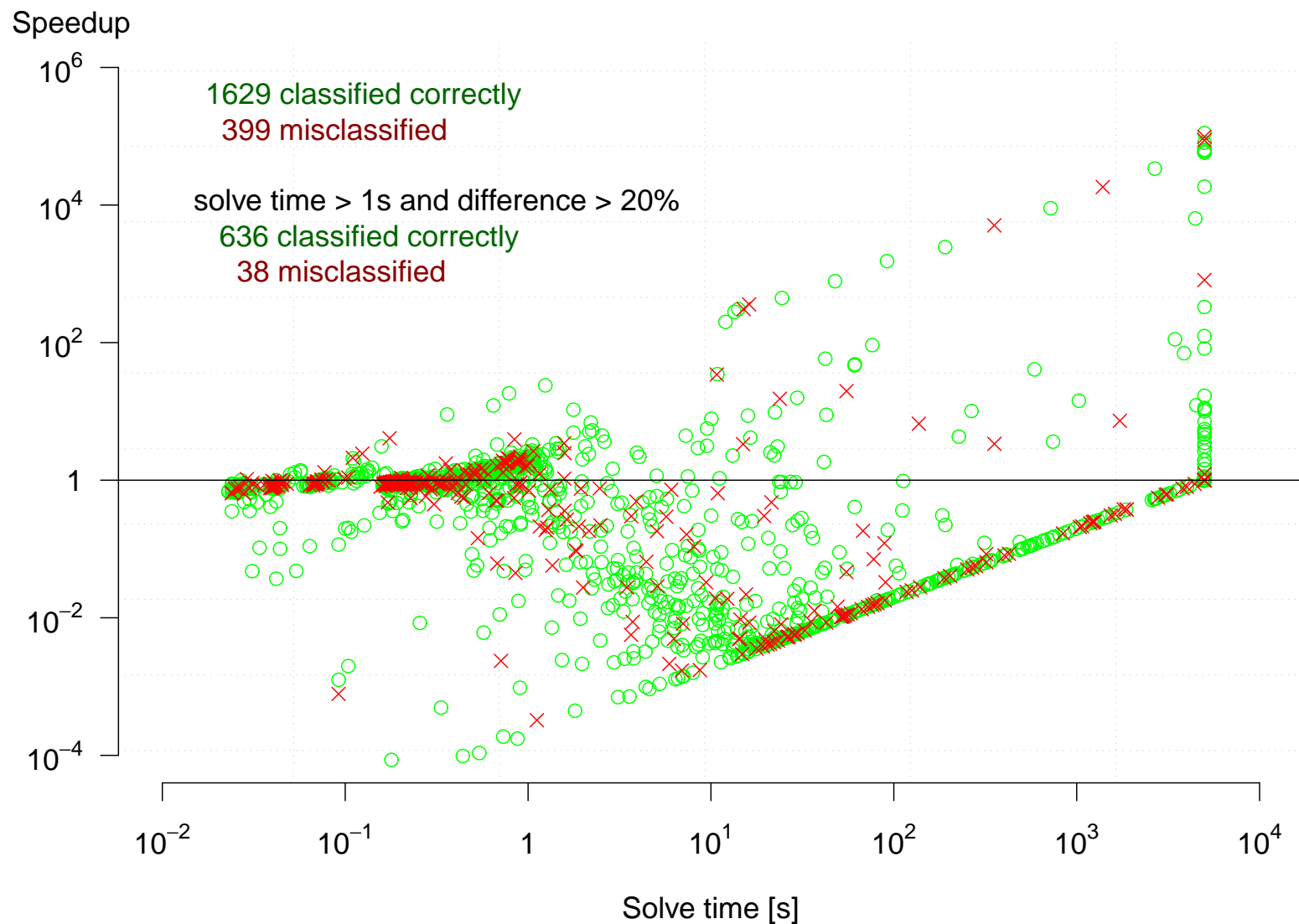


Performance



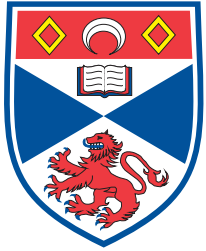
average time per instance \approx 750 seconds

Performance



average time per instance \approx 750 seconds

average gain per instance \approx 64 seconds

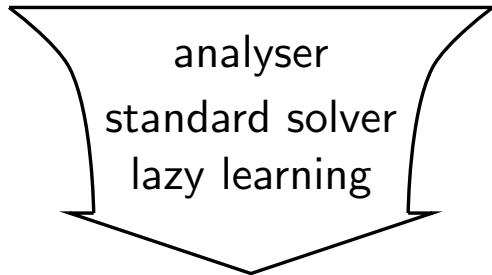


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Questions?

problem instances



85 problem attributes

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