**Motivation**

- Availability of many ML algorithms and implementations
- ML tools used by non-expert people

**Problem definition**

- Classification problem \( f : X \rightarrow Y, D = \{ \ldots \} \)
- Set of learning algorithms \( \{ A_1, \ldots, A_n \} \) with hyperparameters \( \{ \lambda_1, \ldots, \lambda_n \} \)
- Model selection:
  - choose \( A^* \) with optimal general performance
- Hyperparameter optimization:
  - choose \( \lambda_i^* \) optimal for algorithm \( A_i \)
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- Hyperparameter optimization:
  - choose optimal \( \lambda^*_i \) for algorithm \( A_i \)
- Combined optimization:
  - choose \( A^*_i \) and \( \lambda^*_i \) optimal for \( D \)

**Solution**

- Sequential Model-based Algorithm Configuration (SMAC)
- Robust optimization under noisy function evaluations
- Use random forest of regression trees

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**Auto-WEKA**

- application of CASH problem to the ML algorithms implemented in WEKA
- 39 classifiers: 27 base, 10 meta methods, 2 ensemble
- 3 search methods, 8 feature evaluators
- 786 hyperparameters, \( 10^{47} \) configurations

**Auto-WEKA results**

- Performance for 10-fold cross-validation of UCI problems
- Better results for 20 problems over 21
<table>
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<th>Other applications</th>
<th>Extensions</th>
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<td>• Propositional satisfiability (SAT)</td>
<td>• Algorithm runtime prediction</td>
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<td>• Mixed Integer programming</td>
<td>learning ( f : \text{Input} \rightarrow \text{Time} )</td>
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<td>• Planning</td>
<td>• Portfolio-based algorithm selection</td>
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<td>• On-line automatic parameter configuration</td>
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