Simplified Planner Selection

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Workshop on Heuristics and Search for Domain-independent Planning

October 21, 2020
Motivation
Motivation
Motivation
Motivation
Motivation

SymBA*
Motivation

SymBA*  
Complementary
Motivation

SymBA*

Complementary

Symple-1
Motivation

SymBA*

Complementary1

Symple-1

...
Portfolios

Given:

\[ P = \{\text{SymBA*}, \text{Complementary1}, \text{Symple-1}\} \]
\[ T = 1800s \]

Schedule:

<table>
<thead>
<tr>
<th>SymBA*</th>
<th>Complementary1</th>
<th>Symple-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
</tr>
</tbody>
</table>

Mapping:

\[ f : Task \mapsto P \]
Delfi (Katz et al., 2018)

Images from the Noun Project: RomStu (file), Agni (network), Alfa Design (image), Samuel Dion-Girardeau (brain)
Delfi (Katz et al., 2018)

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- Problem Description Graph (Pochter, Zohar, and Rosenschein, 2011)
- Abstract Structure Graph (Sievers et al., 2019)

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128x128 pixels

Images from the Noun Project: RomStu (file), Agni (network), Alfa Design (image), Samuel Dion-Girardeau (brain)
Delfi (Katz et al., 2018)

- Convolutional Neural Network (CNN)

Images from the Noun Project: RomStu (file), Agni (network), Alfa Design (image), Samuel Dion-Girardeau (brain)
Delfi (Katz et al., 2018)
**Contribution**

- **Simpler techniques** and **simple features** have a **similar performance**.
- Our approach is **robust** to data changes.
- We identify **important features**.
- We investigate which planners are selected.
Graph Encodings

**Problem Description Graph**

```
\begin{align*}
\text{op}_1 & \quad \text{eff}_{1,1} \\
\text{val}_{1,1} & \quad \text{val}_{1,2} \\
\text{var}_1 & \quad \text{var}_2 \\
\text{s}_0 & \quad \text{s}_{\ast}
\end{align*}
```

**Abstract Structure Graph**

```
\begin{align*}
\Pi \\
L_1 & \quad L_2 \\
O & \quad A \\
\ldots & \quad \ldots
\end{align*}
```
Machine Learning Techniques

Linear Regression

\[ X \times W = 0 \]

Multi-Layer Perceptron

Decision Tree
Training

- data set of Ferber et al. (2019)
  - tasks, graphs, runtimes
- extract properties
- labels: time, logtime, coverage
- 10 repetitions

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Features

Graph:
- #nodes
- #edges
- density
- #connected components
- $\max_{c \in \text{ConnComp}} |c|$

Node:
- eccentricity
- degree
- in-degree
- out-degree

Feature augmentations: log-scale, normalize
## Delfi Setting

<table>
<thead>
<tr>
<th></th>
<th>Grounded</th>
<th></th>
<th>Lifted</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LR</td>
<td>RF</td>
<td>MLP</td>
<td>Delfi</td>
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<tr>
<td></td>
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<td>0.1</td>
<td>1</td>
<td>2</td>
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<tr>
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<td>57.0</td>
<td>86.2</td>
<td>82.1</td>
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<tr>
<td>Log</td>
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<td><strong>89.0</strong></td>
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<td>55.2</td>
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<td>74.5</td>
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Feature Importance

Coverage Change in %

- max. (out) degree
- #edges
- max. in-degree
- #nodes/|ConnComp|
- mean (in/out) degree

- mean (in/out) degree
- max. (in/out) degree
- median degree
- density
- #nodes/#edges

Grounded:
- Decrease
- Increase

Lifted:
- Decrease
- Increase
Planner Usage

Usage
- 39%
- 25%
- 21%
- 10%

Coverage
- SymBA*
- h2+DKS+LM-cut
- h2+OSS+iPDB
- h2+OSS+01-PDB

Percentage markers:
- 0%
- 50%
- 100%
Planner Usage

### Usage
- **SymBA**: 39%
- **h2+DKS+LM-cut**: 25%
- **h2+OSS+iPDB**: 21%
- **h2+OSS+01-PDB**: 10%

### Coverage
- SymBA*: 0%
- h2+DKS+LM-cut: 50%
- h2+OSS+iPDB: 100%
- h2+OSS+01-PDB: 100%
Planner Usage

Usage
39%
25%
21%
10%

Coverage

SymBA*

h2+DKS+LM-cut

h2+OSS+iPDB

h2+OSS+01-PDB

0%  50% 100%
Planner Choices

Delfi

grounded
Conclusion

Simple planner selection ...

- matches the state of the art!
- is robust!
- recognizes the strengths of individual planners!

In the future, we will ...

- use PDDL features.
- investigate why a planner is chosen.

