Generalized Potential Heuristics for Classical Planning
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Description Logics for Planning
(SOI with equality role-value-maps)

Primer Concepts & Roles
- ontable = \{ \}
- on = \{ \}
- holding = \emptyset
- clear = \{ \}

Complex Concepts & Roles
- \( C_2 \): Blocks that are correct placed on the table \(\text{ontable} \cap \text{ontable} = \emptyset\)
- \( C_3 \): Blocks that are placed on their target block \( (\exists \text{ontable} \land T) \cap (\text{on} = \text{ontable}) = \{ \}\)
- \( C_4 \): Blocks with no target in the goal \(\neg (\text{ontable} \cup \exists \text{ontable} \land T) = \{ \}\)
- \( C_5 \): Blocks on object consistent with the goal \( C_1 \cup C_2 \cup C_3 = \{ \}\)
- \( C_6 \): Blocks where the block above is consistent with the goal \( \forall \text{ontable} \cdot (\text{on} = \text{ontable}) = \{ \}\)
- \( C_7 \): Blocks that are well-placed \( C_1 \cup \forall \text{ontable} \cdot (C_2 \cap C_3) = \{ \}\)
- \( C_8 \): Blocks held while their target block is clear and well-placed \( \text{holding} \cap \exists \text{ontable} \cdot (\text{clear} \land C_5) = \emptyset\)

Goal Concepts & Roles
- onC = \{ \}

Running Example: Blocksworld
Initial state
Goal

Generalized Concepts & Roles
- clear
- holding
- ontable
- Goal

Empirical Results

<table>
<thead>
<tr>
<th>Domain</th>
<th>Gripper</th>
<th>Miconic</th>
<th>Spanner</th>
<th>VisitAll</th>
</tr>
</thead>
<tbody>
<tr>
<td>(</td>
<td>\mathcal{F})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complexity</td>
<td>8 (18)</td>
<td>6 (14)</td>
<td>8 (20)</td>
<td>5 (8)</td>
</tr>
<tr>
<td>Features</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Total Time</td>
<td>8h</td>
<td>32m</td>
<td>178s</td>
<td>87s</td>
</tr>
<tr>
<td>Total MIP</td>
<td>7.4h</td>
<td>26m</td>
<td>6.8s</td>
<td>2.1s</td>
</tr>
</tbody>
</table>

Conclusions & Future Work
- We can learn interpretable, linear solving mechanisms that work for infinite classes of problems from small instances.
- First-order theorem proving could be used to prove deductively the correctness of the learned heuristics.