Learning of Lifted Macro-Events for Heuristic-Search Temporal Planning

Paper #1117

1 Pseudo-code for the Empirical Selection of Macro-Events

Algorithm 1 Empirical Selection of Macro-Events

1: **procedure** EMPIRICALSELECTION(ϑ, UME, $\mathcal{T}_{\text{val}}$, $\aleph$)
2: SORT(*UME*, *Frequency*)
3: $\mathcal{M}_1 \leftarrow \emptyset$; $i \leftarrow 0$
4: **while** CUMULATIVEFREQUECYPERCENTAGE($\mathcal{M}_1$, UME) $< \vartheta$ **do**
5: $\mathcal{M}_1 \leftarrow \mathcal{M}_1 \cup \{$*UME [i]*$\}$; $i \leftarrow i + 1$
6: SORT(*UME*, *Support*)
7: $\mathcal{M}_2 \leftarrow \emptyset$; $i \leftarrow 0$
8: **while** CUMULATIVESUPPORTPERCENTAGE($\mathcal{M}_2, \mathcal{T}_{\text{val}}$) $< \vartheta$ **do**
9: $\mathcal{M}_2 \leftarrow \mathcal{M}_2 \cup \{$*UME [i]*$\}$; $i \leftarrow i + 1$
10: *SelectedMacros* $\leftarrow \mathcal{M}_1 \cup \mathcal{M}_2$
11: **if** $\aleph \in \{PA+\}$ **then** REMOVESUBMACROS(*SelectedMacros*)
12: **return** *SelectedMacros*

Algorithm 1 describes the second round of lifted macro-events selection. In particular, it refines the set of used macros UME exploiting planner-specific empirical statistics extracted from the validation phase.

It takes as input a threshold $\vartheta \leq 1$, the set of used macros UME, the set of validation instances $\mathcal{T}_{\text{val}}$, and a planning approach $\aleph \in \{FA, PA\} \times \{\pm\}$. It computes $\mathcal{M}_1$ and $\mathcal{M}_2$, namely the two minimal subsets of used macros UME, that cover at least $\vartheta \times 100\%$ of the total frequencies and of the size of $\mathcal{T}_{\text{val}}$, with the minimal cardinality and the highest value of cfp and csp, respectively. Indeed, it starts sorting UME according to the *frequency* values and then it constructs the set $\mathcal{M}_1$ adding one by one the lifted macros with higher frequency until the *cumulative frequency percentage* (cfp) is greater than or equal to the threshold ϑ. The procedure to compute $\mathcal{M}_2$ is similar, using the *support* values instead of frequencies. Then, the *SelectedMacros* is the union set of the two previously computed.

In conclusion, we recall that in the PA+ case, the presence of submacros is redundant. Since both partial applicability and intermediate nodes are supported, if a macro such as $\langle a, b, c, d\rangle$ is included in the final set, all its sub-macros ($\langle a, b\rangle$, $\langle a, b, c\rangle$) can be safely removed (line 11).

2 Additional experimental results

Table 1 shows the results of the sensitivity analysis of the hyperparameter ϑ in terms of execution time: we report the average execution time (in seconds) for the instances successfully solved by the planner. When showing a value of 600, it corresponds to cases where no problem was solved and all runs reached the timeout limit, which, as a reminder, is set to 600 seconds. This table justifies the selection of the best result, highlighted in bold in Table 2 of the paper.

MAJSP - h_{add}

ϑ	FA-	FA+	PA-	PA+
0.5	6.71	600	600	**8.67**
0.6	6.83	600	7.94	9.22
0.7	7.06	600	8.61	9.19
0.8	7.05	**7.32**	8.58	9.26
0.9	**5.98**	8.35	**7.59**	11.07
1	7.48	9.66	8.24	9.64

MAJSP - h_{ff}

ϑ	FA-	FA+	PA-	PA+
0.5	96.9	600	600	600
0.6	100.1	600	175.07	600
0.7	98.98	600	263.76	600
0.8	99.47	87.26	63.74	67.4
0.9	**75.49**	87.79	**44.09**	53.98
1	89.58	**57.27**	81.37	**67.1**

Kitting - h_{add}

ϑ	FA-	FA+	PA-	PA+
0.5	111.01	111.13	110.69	110.22
0.6	111.01	174.02	110.69	110.22
0.7	111.01	153.32	18.02	110.22
0.8	110.43	153.71	17.94	70.29
0.9	163.15	**120.56**	**153.94**	47.34
1	**88.96**	139.17	235.82	**220.69**

Matchcellar - h_{ff}

ϑ	FA-	FA+	PA-	PA+
0.5	**32.91**	**283.3**	**32.76**	**296.4**
0.6	32.91	283.3	32.76	296.4
0.7	32.91	283.3	32.76	296.4
0.8	32.93	283.18	131.53	293.61
0.9	127.12	285.71	133.58	298.16
1	141.35	282.14	220.19	308.98

Table 1. Sensitivity analysis of ϑ: for each planning approach, we report the average time (in seconds) of execution of the planner on instances solved. In bold we highlight the best result consistently with Table 2 of the paper.

For this reason, it is sometimes possible to observe a bold value that is higher than other entries: this is due to a higher coverage, meaning that more instances were solved, including some that required a greater computational effort. In these cases, that are FA+, PA-, PA+ for Kitting-h_{add} and PA+ for MAJSP - h_{ff}, the cactus plots in Figure 1 validate the selection. Moreover, the other two cactus plots, i.e., FA- and PA- for MAJSP with h_{ff}, represent the two cases in which, given the same coverage, the average execution times reported in Table 1 show a significant difference. All other cactus plots for every configuration are available in the additional material.

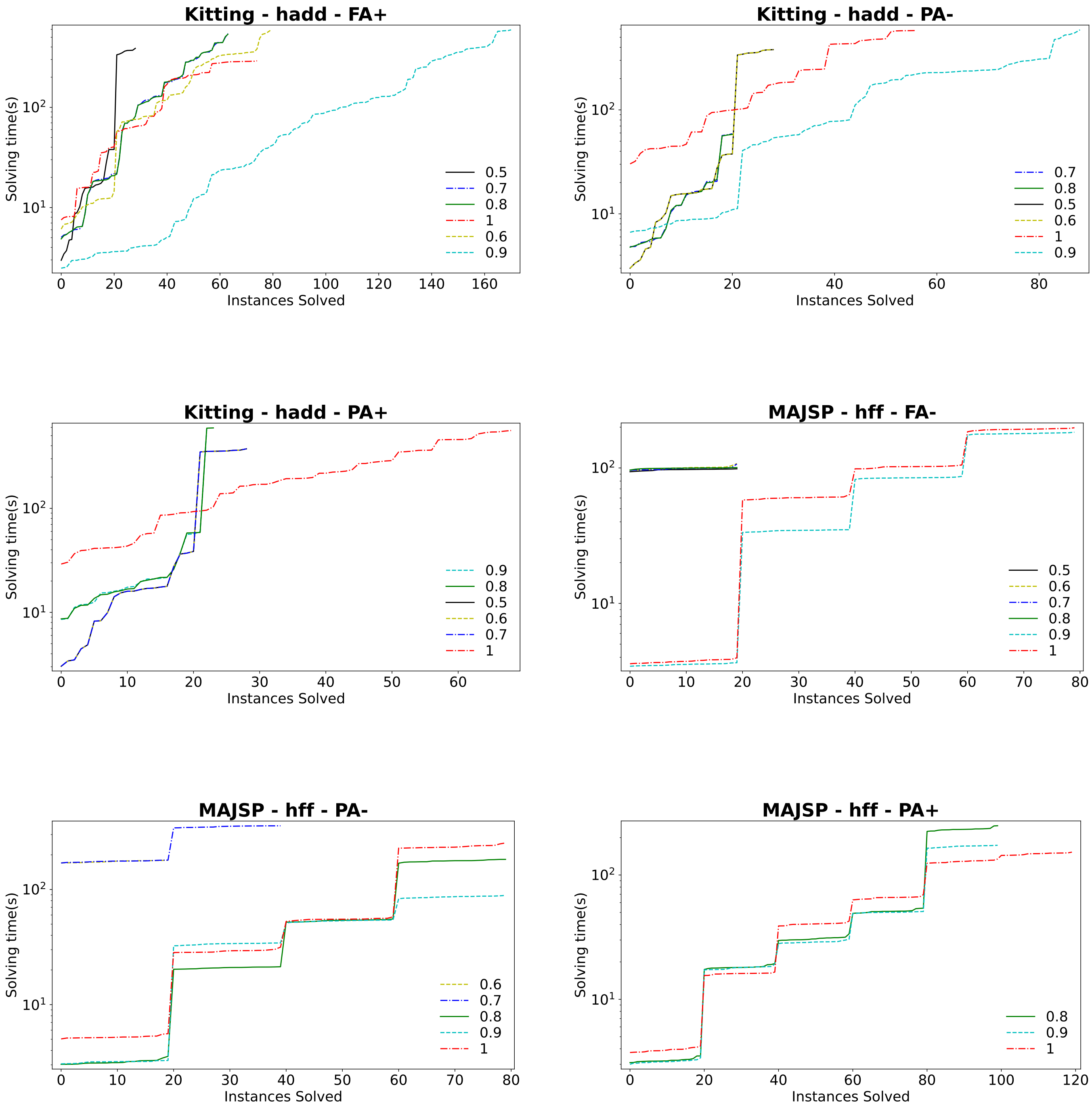

Figure 1. Cactus plots of interesting configurations.