Reproducibility Report for ACM SIGMOD 2023 Paper: "Efficiently Computing Join Orders with Heuristic Search"

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We have assessed the artifacts and reproduced the key findings and performance results reported in the original paper. The authors have provided compiled binary files of the experimental code and a separate README file containing guidelines, scripts, and links necessary for replicating the results and plots. Using them, we have successfully replicated the results presented in Tables 1-3 and Figures 5-10 from the original paper.

1 INTRODUCTION

The original paper [1] investigates the heuristic search approach to optimize the join order. The main idea is converting join order optimization to the shortest path problem. Then further optimization can be employed according to the properties of the join order problem and heuristic search.

The experiment compares proposed approaches with state-of-the-art algorithms on (1) optimization time and (2) quality of the computed query plan by the normalized cost (for the potentially suboptimal algorithms). Through experimental evaluations, the paper shows that for star and clique queries, heuristic search gives an optimal plan faster by an order of magnitude than the baselines.

2 SUBMISSION

The proposed method and other approaches for comparison are implemented in mu*t*able , a main-memory database system developed by the authors' group. [1] A short README file contains links to the source code of this system:

- GitHub repository with code, data, and scripts at: https://github.com/mutable-org/mutable. The same resources are also available at GitLab repository https://gitlab.cs.uni-saarland.de/bigdata/mutable/mutable.
- The README file describes a setup of the system, mu*t*able, through pre-compiled binaries and the steps to run the experiments.
- Scripts locate at a submodule named `evalution` https://gitlab.cs.uni-saarland.de/bigdata/mutable/evaluation.

3 HARDWARE AND SOFTWARE ENVIRONMENT

Table 1 details ours and authors' environments. As mu*t*able is a main-memory database, the authors do not provide storage information. In our environment, the operating system is `Ubuntu 20.04.4 LTS` and the kernel is `Linux 5.15.0-86-generic`.

Table 1. Hardware environment

	Paper	Repro Review
CPU	AMD Ryzen Threadripper 1900X @ 3.8GHz	Intel Core i9-10900 CPU @ 2.8GHz
Cores	8 (× 2 threads)	10 (× 2 threads)
RAM	32 GiB	64 GiB

[1] https://mutable.uni-saarland.de/

4 REPRODUCIBILITY EVALUATION

4.1 Process

In the present reproducibility report, we used the pre-compiled binary files (version `0.0.90`) as introduced in README, and cloned the repository of the same version from the URL mentioned above. Because of an authorization issue, we clone the corresponding submodule `evaluation`[2] separately with its subsubmodules. We followed the steps in README file to set up the system. During the process, `pygraphviz` [3] and `psycopg2` [4] packages resulted in dependency issues that we resolved using their respective open documentation. Then, we used the shell commands provided in the folder `evaluation` to run the experiments.

The results were generated at the root of the project, which includes three CSV files. Then running the `Jupyter` file in the folder `evaluation`, the figures were generated in the folder `evaluation/fig`.

4.2 Results

The resources provided by the authors are sufficient to reproduce all results shown in Tables 1-3 and Figures 5-10 in the original paper [1]. These figures contain the results of the experiments on the optimization time, the cost of the query plan, and the detailed analysis of the heuristic search algorithm. Our reproduced results are shown in Figure 1–Figure 6, which are consistent with the original paper. It is worth noting that, although there are slight variations in runtime values compared to the original paper, the observed patterns and relative performance differences remain identical. As indicated by the authors, replicating Table 4 in the original paper, located outside the experimental section, would necessitate a modification in the source code and recompilation of mu*t*able system. Consequently, the script for reproducing this result was not provided. Nevertheless, this is trivial and does not impact the paper's conclusions.

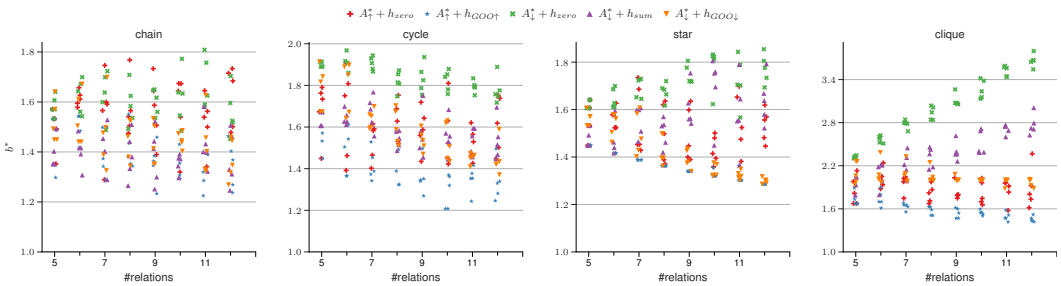


Fig. 1. Reproduction of Figure 5 in the original paper: Information value of different heuristics.

5 SUMMARY

The authors provide detailed, complete scripts and documentation for the reproduction. All experimental results were successfully reproduced and visualized on our machine with fully automated scripts.

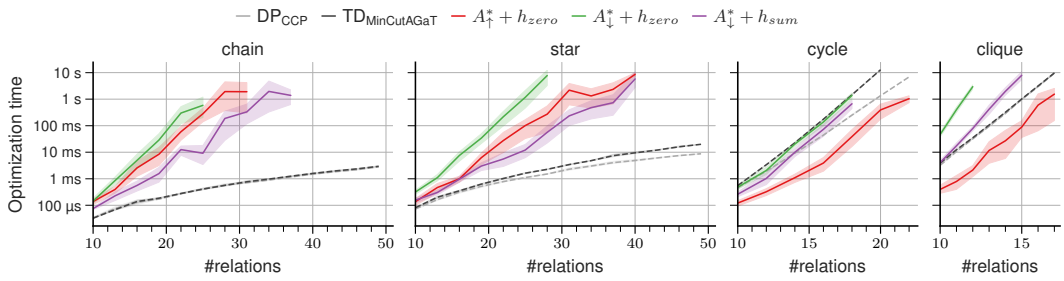
REFERENCES

[1] Immanuel Haffner and Jens Dittrich. 2023. Efficiently Computing Join Orders with Heuristic Search. *Proc. ACM Manag. Data* 1, 1 (May 2023), 26 pages. https://doi.org/10.1145/3588927

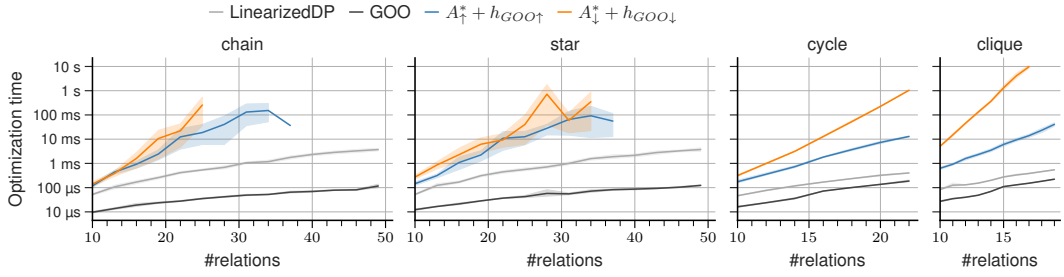
[2] Submodule's commit SHA: `e0ee342f5516efb248ce663d10d0b4d5f4f11567`

[3] https://pygraphviz.github.io/

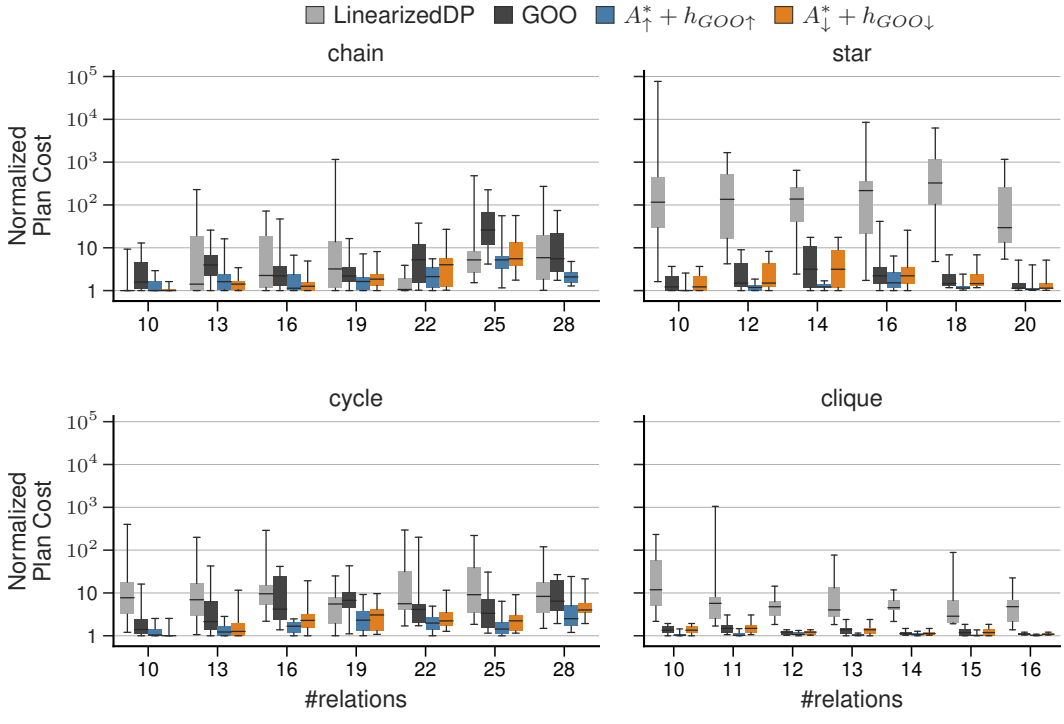
[4] https://www.psycopg.org/docs/



(a) Optimization time of optimal algorithms.

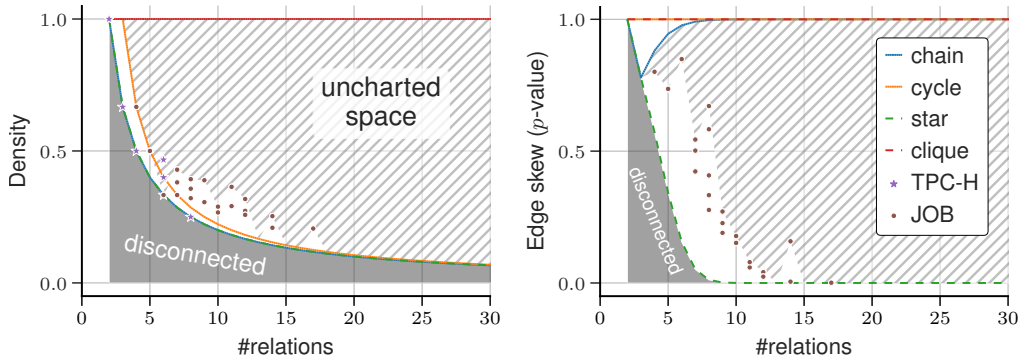


(b) Optimization time of suboptimal algorithms.



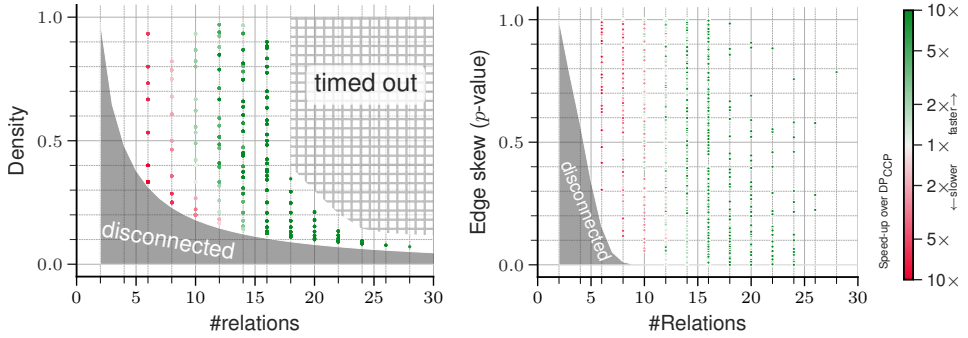
(c) Plan cost of suboptimal algorithms.

Fig. 2. Reproduction of Figure 6(a-c) in the original paper: Comparison of heuristic search to state of the art.



(a) By density. (b) By edge skew (p-value).

Fig. 3. Reproduction of Figure 7(a, b) in the original paper: Landscape of possible query graphs.



(a) By density. (b) By edge skew (p-value).

Fig. 4. Reproduction of Figure 8(a, b) in the original paper: Speed-up of $A^*_{\uparrow} + h_{zero}$ in QGraEL.

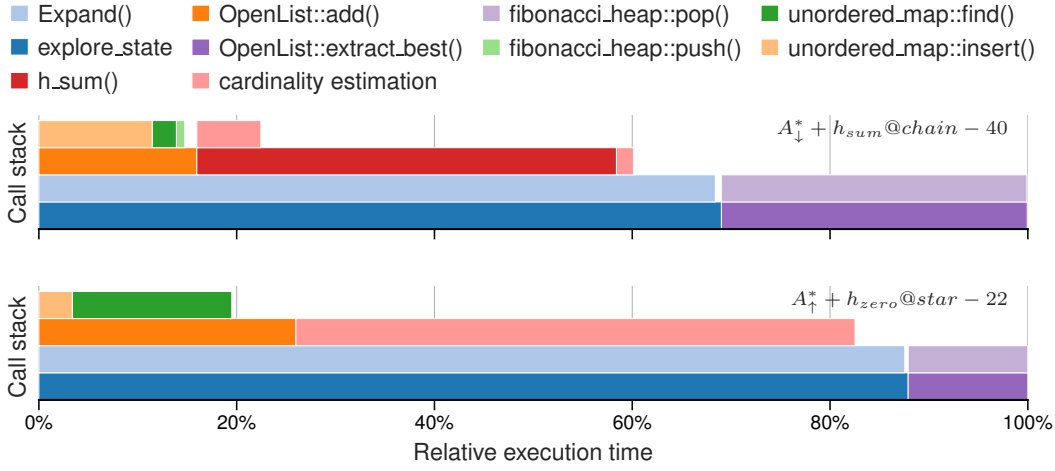


Fig. 5. Reproduction of Figure 9 in the original paper: Detailed running time analysis of heuristic search.

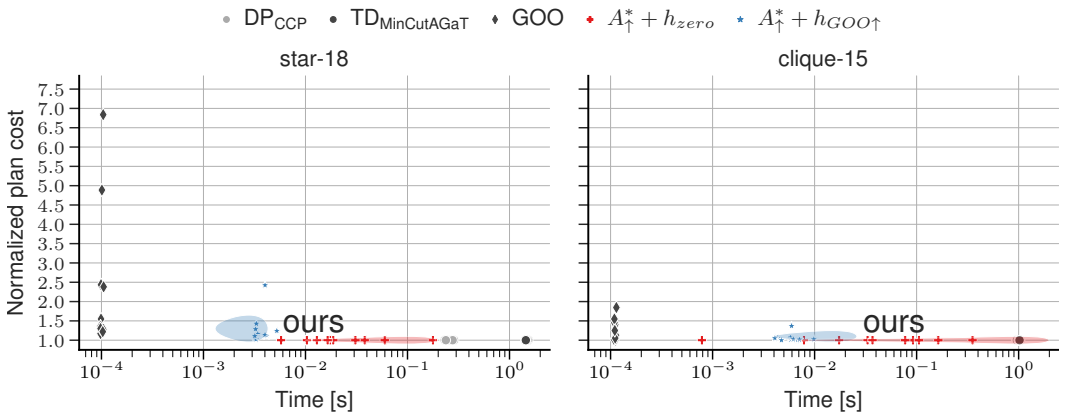


Fig. 6. Reproduction of Figure 10 in the original paper: Pareto frontier of optimization time vs. plan cost. The visualization Jupyter script for this figure needs a minor modification: change `r'DP\textsubscript{CCP}'` and `r'TD\textsubscript{MinCutAGaT}'` to `r'$\text{DP}_\text{CCP}$'` and `r'$\text{TD}_\text{MinCutAGaT}$'`.