Diploma Thesis Review

Charles University, Faculty of Mathematics and Physics

Thesis author	Rajat Sharma
Thesis author	Evolutionary techniques in AutoML
Year submitted	2024
Study program	Computer Science – Artificial Intelligence
Branch of study	Computer Science – Artificial Intelligence

Review author	doc. Mgr. Martin Pilát, Ph.D.	**Role**	opponent
Department	KTIML MFF UK		

Review text:

The goal of Rajat Sharma's thesis was to design an algorithm for the optimization of machine learning pipelines. This goal was barely fulfilled – the student implemented a number of standard methods for optimization of very simple machine learning pipelines. The implementation does not include cartesian genetic programming or grammar-based evolution that were specifically mentioned in the assignment. The designed algorithm also does not include hyper-parameter tuning.

The whole thesis is divided into four chapters (plus introduction and conclusion). The first chapter includes the preliminaries – description of AutoML itself and also description of a few classic optimization heuristics. The descriptions in this chapter are rather high-level, without any details. The sources for this chapter are mostly various blog-posts and various other online sources. Using books and scientific papers would definitely be better and is expected in a master thesis. The second chapter very briefly describes related work, however, only a few systems are mentioned, and the newest one is TPOT, which is now six years old. Any more recent approaches are missing.

The third chapter contains the description of the system created by the author. It creates only very simple pipelines consisting of a categorical and a numerical pre-processor and a classifier. These workflows are optimized using classical optimization heuristics, such as hill-climbing, simulated annealing, and a simple evolutionary algorithm. The description of the methods is also quite weak, with many details missing (e.g. what are the genetic operators of the evolutionary algorithm?). Any more recent techniques, such as grammar-based evolution or cartesian genetic programming are missing. These would allow for a more complex machine learning workflows that were the main goal of the thesis. The technique also does not seem to include hyper-parameter optimization, which was another of the goals.

The technique is evaluated in the fourth chapter. It evaluates the different heuristics on 11 different datasets. The datasets are selected reasonably – they include both small and larger datasets and can be used to evaluate the algorithm well. The experiments with the exhaustive search are quite interesting as they show the performance of various combinations of the methods. The other experiments are rather poor. Most of the results are presented only for the wine-quality dataset (e.g. in Tables 4.9-4.13). It also seems that the experiments were performed only once and they are not statistically evaluated in any way. Comparison to existing AutoML algorithms is also missing.

Overall, as already mentioned, the thesis barely fulfills the assignment. The text of the thesis is quite weak, missing many details. The techniques evaluated by the student are only the classic ones, without any extensions by the student, and the experimental evaluation is also rather poor. I consider this a theses that is on or even below the lower boundary of what can be recognized as a master thesis and I let the committee decide, if it should be defended in its current form.

I have a few questions for the defense:

1. From the experiments, it seems you only evaluated the technique on the single (wine quality) dataset. What were the results on the other datasets mentioned in the thesis?
2. I miss some comparison with existing methods – did you perform any?
3. Were the results statistically evaluated in any way?
4. The future work mentions extension by hyper-parameter tuning. How could this be implemented?

I recommend the thesis for defense.

I do not recommend the thesis for an award.

Prague, September 2, 2024

Signiture: