Posudek diplomové práce

Matematicko-fyzikální fakulta Univerzity Karlovy

Autor práce	Yuliya Yamalutdinova
Název práce	Image Reassembling Algorithms
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Studijní program	Informatika

Studijní obor Umělá inteligence

Autor posudku	Roman Neruda	**Role**	Oponent
Pracoviště	Institute of Computer Science, CAS		

Text posudku:

The topic of the work "Image reassembling algorithms" by Yuliya Yamalutdinova is an exploration of genetic algorithm-based solvers of jigsaw puzzles. The topic is challenging as the main formalizations of the problem have been proven to be NP-complete. At the same time, this task is not just an artificial problem, it has practical applications in areas such as reconstructing objects from shards in archaeology or restoring shredded documents.

The goal of the work is to analyze existing GA solvers that work mostly on square dissections, and to extend the approach to deal with more general shapes. Several classes of images are also considered, including the standard color ones as well as black and white pictures, and pictures with text related to one application area.

The work is divided into four chapters with introduction and conclusion, and an appendix containing brief software documentation. The first chapter contains related work overview focusing both on the approaches and applications. The second chapter describes the state-of-the-art square-piece solver by Sholomon at al that serves as a starting point for student's own work. The core of the theoretical work is included in chapter 3 that describes several versions of the extended solver. There are three solver versions, one which works with rectangular shapes, one for triangular-shape pieces, and finally, one for recursively divided rectangular shapes. Chapter four contains three sets of experiments on a previously published benchmark dataset, its black and white version, and a custom data containing printed text. Finally, the conclusion section summarizes the achievements of the work and sketches possibilities for further research.

Among the strong points of the thesis, I would like to emphasize the following.

1.   The extension of existing work to more complex problems. While the previous state-of-the-art genetic solvers consider square pieces only, the student proposed versions of the algorithm that work with rectangular, triangular, and random rectangle type of pieces.

2.   The set of sound experiments that are well described, and at the same time show on par performance of the author's original proposal. The experimental part that concerns black and white and printed text images is novel and thus it represents a valuable contribution of the work.

3.   The implementation of all algorithms in python using standard tools such as Deap and Shapely contributes to the reproducibility of the results and can serve the scientific

community as a tool for further research. Also, the datasets used in the experiments are included in the attachment of the work.

There are several notes and questions I would like to be addressed during the defense.

1.   In section 2.2.3 you mention a randomized mechanism for accepting connection of edges that operates within a crossover and serves as a mutation. Have you considered other possibilities of mutation operators, such as small random changes in the individual or hill-climbing like local search?

2.   Could you please describe in more detail what makes a problem difficult for the random recursive rectangular pieces, in particular, why is the problem in fig. 3.9 easier to solve than the one in fig. 3.10?

3.   Can you speculate about the reasons why the algorithm in printed text experiment described in section 4.2 performs worse overall, and what might improve the performance for this particular kind of data?

Considering all the above-mentioned facts, I gladly recommend the proposal to be accepted as a master thesis.

Práci doporučuji k obhajobě.

Práci nenavrhuji na zvláštní ocenění.

Pokud práci navrhujete na zvláštní ocenění (cena děkana apod.), prosím uveďte zde stručné zdůvodnění (vzniklé publikace, významnost tématu, inovativnost práce apod.).

Datum   September 1, 2022   **Podpis**