

CS4012 Computing Fundamentals

Final Project

Due date: 9-May-2018, 11:59 PM

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Description

This project aims at exploring the design and implementation of hyper-heuristics for the vertex coloring problem. The deliverables for this final project consist of (1) a zip file with the codes implemented as part of the project and any supplementary files; and (2) a report in pdf format. Regarding the report, it must be prepared in a paper-like format (up to 10 pages), containing the following elements:

Title. A title that captures the reader's attention and that properly describes what is contained in the report.

Abstract. Provides a clear and brief description of what the paper is about. The abstract must not exceed 250 words and must not contain abbreviations or acronyms.

Introduction. Presents an overview of the paper. This section should capture the reader's attention so they feel they need to read the rest of the document (why is this problem interesting/relevant, why we need a hyper-heuristic approach, etc.). This section must clearly state the contributions of your work and how this approach is different/better to anything else described in the literature. At the end of this section there must be a reminder of the rest of the paper (like an index but in a paragraph).

Background. Defines the problem and presents similar works. This section requires you to review the current literature in order to:

- Formally define the vertex coloring problem.
- Identify which methods have been used in the past to solve this problems. You must provide a brief description of such methods and clearly describe their strengths and weaknesses.
- Identify the most recent approaches to solve this problem (the state-of-the-art). You must provide a brief description of such methods and clearly describe their strengths and weaknesses.
- Identify a set of instances here you can test your model. Is it possible to compare your results against the ones obtained by other methods?

Problem characterization. In order to discriminate among different instances of the same problem, your hyper-heuristic needs a set of features that allow such a discrimination. You will need to propose some features for this purpose. For example (these might not be useful at all): the percentage of nodes remaining to be colored, the frequency of colors used, the degree of the graph considering only colored nodes, etc. Please have in mind that these features will indeed affect the performance of your hyper-heuristic. You are requested to define and implement at least six features to characterize the vertex coloring problem.

Heuristics. This section describes the heuristics studied and their justification. You will need to investigate about existing heuristics for selecting the next node to color and heuristics to decide the color to use. Then, the problem requires two types of heuristic: node selection and color selection. For this work we expect you to investigate and describe at least five node selection heuristics and three color selection ones. Then, there

will be 5×3 possible combination of heuristics. As part of your answer a small example with the behavior of your heuristics is requested¹.

Solution model. Describes, in detail, the hyper-heuristic approach proposed and the rationale behind it. In this section, you must provide all the details of how your hyper-heuristic learns and how its performance should be evaluated. For this work, you are expected to base your hyper-heuristic on methods such as tabu search, simulated annealing, support vector machines and naïve Bayes classifiers, among others.

Experiments and results. Explains the experiments conducted and analyzes the results. Discusses the main results in an objective way. This section should contain tables or figures (the representation that best suits your results). It is also recommended that your results are statistically validated (hypothesis tests, confidence intervals, etc.). Please consider that some instances are distributed along with this document but they are only distributed for you to test some preliminary ideas. The instances used for your work must be properly documented and characterized according to the set of features defined in previous steps. It is likely that you need to modify the codes for reading the instances or adapting the new instances to the existing format.

Conclusion. Presents the conclusion (why is this work important and how it contributes to the community) and some ideas for future work (the things you did not have time to complete but would have been useful to explore).

References. The list of works cited in the paper. Please have in mind that your manuscript must contain, at least, 20 references to other papers and that references to text books will not be accepted.

Prepare your manuscript with \LaTeX using the IEEE conference template². The idea is that the best manuscripts might be revised and submitted to a conference.

Submit a zip file containing all the requested files to Blackboard. **Have in mind that the investigation in this project must be conducted and reported by maximum three students.**

¹To help you for this task, three simple heuristics for node selection are already implemented in the code: Default, Degree and Saturation degree. At this moment, the next available color is the one to be used.

²Available at https://www.ieee.org/conferences_events/conferences/publishing/templates.html