 <small>ESCOLA SUPERIOR DE TECNOLOGIA E GESTÃO</small>	Tipo de Prova Practical Work	Ano letivo 2022/2023	Data 05-05-2023
	Curso Degree in Informatics Engineering	Delivery date (See the Moodle)	
	Unidade Curricular Algorithm Analysis and Optimization	Defense date (See Exam Schedule)	

Observations

This practical work is intended to all students enrolled in the curricular unit independently of the evaluation system by which they chose, for evaluation of the practical component.

- Students should get together in groups of 4 elements to divide, in the best way, the tasks defined in this work. Exceptionally, and only when justified, groups with other number of elements may be considered.
- A link will be available on Moodle for the registration of students in the various working groups. The members of the same group can be assigned different grades. The final formation of the working groups will be opportunely published in Moodle.
- Each working group should make a presentation and defense of their practical work. The schedule of presentations and defenses of the work will be opportunely published in Moodle.

Objectives


This work intends to initiate students in scientific research, which consists in:

- Develop and implement an optimization algorithm for solving the Travelling Salesman Problem (TSP) for undirected graphs only.
- Apply knowledge about complexity theory to evaluate the performance of the algorithm used.

Tasks

The practical work consists of carrying out the following tasks:

- 1. Bibliographic research about the Travelling Salesman Problem** - This task consists in carrying out a bibliographic research (in libraries and on the Internet in addition to the one available on Moodle) about TSP through books and scientific papers published on the subject. This research will allow making a theoretical introduction and the state-of-the-art about the TSP for any typology of graphs and, in turn, to know the different Operational Research (OR) methodologies adequate to its resolution.
- 2. Implementation of an algorithm to solve the Travelling Salesman Problem** - This task consists in the analysis, development and implementation of an algorithm that solves the TSP for undirected graphs. The working group must use the IO methodologies that solve the TSP and then develop the algorithm and code it in a programming language of their choice. For the quality testing of the algorithm, the working group should define a test set consisting of at least three instances of the TSP with a priori knowledge of the optimal solution.
- 3. Performance analysis of the algorithm used** - This task consists in determining the order of complexity (notation Big O) of the algorithm developed for solving the TSP. Therefore, the working group must include in the program code the necessary and sufficient instructions to calculate the order of complexity (see **Practical guide for complexity analysis.pdf** available on Moodle) and measure the running time of the algorithm. To determine the order of complexity of the algorithm, the working party shall define for this purpose a battery of tests consisting of at least three

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instances of the TSP with successively increasing size of the algorithm's input.

4. **Preparation of the final report of the practical work** - This task consists in writing a report describing all the work done, namely, the summary, the theoretical introduction, the IO methodology used, the TSP algorithm, the results obtained and the conclusions. The source code of the implemented algorithm and the due comments must be included in the final report of the practical work (template available in Moodle of the curricular unit), in the section regarding annexes.
5. **Final report delivery** - The final report of the practical work is the only document (in .pdf format) that must be submitted on the Moodle platform by the representative of the working group for evaluation of the practical component of the course.

Notes

These will be made available on Moodle in due course:

- Template of the report to be used in task 4.
- Other documents considered useful in this work.

Links about the TSP implementation:

<https://www.geeksforgeeks.org/traveling-salesman-problem-tsp-implementation/>

<https://www.interviewbit.com/blog/travelling-salesman-problem/>

https://www2.isye.gatech.edu/~mgoetsch/cali/VEHICLE/TSP/TSP005_.HTM

<https://medium.com/ivymobility-developers/algorithm-a168afcd3611>

<https://www.guru99.com/travelling-salesman-problem.html>

<https://www.javatpoint.com/traveling-salesperson-problem-using-branch-and-bound>

<https://www.baeldung.com/cs/tsp-dynamic-programming>

<https://www.geeksforgeeks.org/traveling-salesman-problem-using-branch-and-bound-2/>

<https://www.mathworks.com/matlabcentral/fileexchange/25542-nearest-neighbor-algorithm-for-the-travelling-salesman-problem>