Universidade do Minho

Licenciatura em Engenharia Informática

Mestrado Integrado em Engenharia Informática

Inteligência Artificial, 3º Ano, 1º Semestre 2024/2025

Group Assessment Instrument

Theme: Problem Solving - Search Algorithms

Goals: This work aims to develop search algorithms that optimise food distribution in areas affected by a natural disaster. The aim is to ensure that available resources are used efficiently, prioritising the area's most in need and maximising the number of people served within a limited time.

Statement: During a natural disaster, providing essential supplies such as food, water and medicine to the most affected areas becomes an urgent priority. The affected areas can vary in severity and needs, from places with a high population density to isolated regions that are difficult to access. Each zone presents specific challenges, and their accessibility depends on local geography and changing weather conditions. Various transport vehicles (drones, helicopters, boats, trucks, etc.) are used to reach these areas efficiently. However, each vehicle has limitations, such as maximum load capacity, fuel range and travel times, which are directly influenced by environmental and geographical conditions. Selecting the appropriate vehicle for each zone and optimizing your route is critical to ensuring supplies arrive on time, especially in regions where the situation can quickly worsen without assistance.

The main task in this context is to develop a distribution strategy that maximises coverage of affected areas, minimising waste of limited resources and ensuring service to the most critical areas within a restricted time frame. This requires creating a system of priorities where areas with greater severity or more significant populations in need receive preferential attention. Additionally, the strategy must consider operational constraints such as limited vehicle capacity, time required to travel different routes, and any roadblocks that may arise, such as destroyed roads or adverse weather conditions. At the same time, wasting perishable food must be avoided, and fuel usage must be optimised to ensure that vehicles can make as many deliveries as possible before refuelling. In this way, the efficiency of the distribution operation is maximised, helping to save as many lives as possible in the challenging conditions of a natural disaster.

Tasks: Given the statement in question, the following tasks are described:

- Formulate the problem as a problem solving, detailing the initial state, objective test, operators (available actions) and the cost of the solution.
- Represent delivery zones and possible paths in graph form, modelling the problem to allow the application of search algorithms.

- Develop and compare different search strategies (informed and uninformed), considering different priorities and changing conditions, such as blocked routes and vehicle limitations.
- Implement and test search algorithms that consider emergency priorities and vehicle limitations.
- Simulate dynamic conditions, such as weather changes, that can affect vehicle speeds and block access to certain areas.

To develop this work, it is necessary to consider some aspects:

- Geographic limitations that prevent certain vehicles from accessing certain areas (for example, terrain inaccessible to trucks).
- Dynamic weather conditions that affect weather and vehicle routing (e.g. storms).
- Zone priorities are based on the needs and severity of the situation.
- Limitation of resources (e.g. cargo weight and volume) and fuel, forcing efficient management of refuelling and route choices.
- Each zone has a critical time window, after which access may become impossible.

Including new functionalities or characteristics in the system is encouraged, such as more search algorithms, whether informed or uninformed, for fixed and/or dynamic obstacles in the scenarios. Such elements will never put minimum job satisfaction at risk but will benefit the overall job evaluation.

The results obtained in both phases must be the subject of a report, which contains, among others:

- Description of the problem;
- Formulation of the problem;
- Description of all tasks performed, as well as all decisions made by the working group;
- Summary and discussion of the results obtained.

Delivery and Evaluation: Completing this Assessment Instrument includes delivering the respective report and submitting the work carried out within the deadlines and under the established terms.

The report and code from the group work must be submitted on the Blackboard platform in a single compressed file using the provided link. The file must be identified in the form IA-GRUPO[G], where [G] designates the working group number.

This assessment instrument must be delivered by December 21, 2024, but it can be delivered by January 3, 2025, without penalty.

The evaluation will also include a presentation session on the work developed. The presentation sessions will occur from January 6th to 10th, 2025.

As established in the evaluation system, delivery outside the established deadlines will result in a 25% fine on the classification.

Peer review: Each group must carry out a collective analysis of each element's contribution and effort to advance the work. From this analysis, they should be able to identify members who perform above, average and below. For this assessment component, 1 value is provided for each student (5% of the assessment), which reflects their contribution to the development of the instrument. To this end, each group must place

on the first page of the report to be developed, after the cover, the assessment made by the group. On this page, they must indicate the respective delta (portion to be added to the score of this component) for each group element. Remember that deltas can be negative, null or positive and that, in each group, the sum of the deltas must be equal to 0.00.

Example 1 (all students receive 1 value corresponding to equal effort among all):

PG1234 João DELTA = 0
PG5678 António DELTA = 0
PG9123 Maria DELTA = 0

Example 2 (AntÓnio receives 2 values, João and Maria receive 0.5 values in this component):

PG1234 João DELTA = -0.5
PG5678 António = 1
PG9123 Maria DELTA = -0.5

Bibliography: It is advisable to consult the tool manuals and monographs provided as references for the curricular unit, namely:

- Russell and Norvig (2009). Artificial Intelligence - A Modern Approach, 3rd edition, ISBN-13: 9780136042594;
- Costa E., Simões A., (2008), Inteligência Artificial-Fundamentos e Aplicações, FCA, ISBN: 978-972-722-34

Código de Conduta: Those involved in this academic work will declare that they have acted with integrity and will confirm that they have not resorted to plagiarism, any form of misuse of information, or falsification of results during its preparation. They will further declare that they know and respect the University of Minho's Code of Ethical Conduct.