

**The National Higher School of Artificial Intelligence**  
**Introduction to Artificial Intelligence**  
**Course Project: Using General Graph Search for**  
**Educational, Health, or Economic Applications in Algeria**

**Release date: 08/03/2024**

**Due Date: 11/05/2024 (11:59pm at the latest)**

**Project Aim:**

The aim of this project is to give you a practical experience of various techniques used for problem solving. More specifically, you are asked to use some of the (informed and uninformed) strategies based on the general Graph Search algorithm you have implemented in the lab along with a version of Constraint Satisfaction Problem (CSP) technique. These techniques will be used to solve when of the real-life problems suggested below.

You should also provide the possibility of visualising any Search tree or CSP solution. A basic visualisation will do but it is up to you to make it as friendly as possible... for a bonus. ☺

Your work should be returned typed as a pdf file and submitted on Google Classroom under your group as explained below.

**General Notes:**

You are required to submit a complete report which, for each aspect of the project, gives the needed explanations and results of the execution of your implementation. A good report is not one which explains the code; it rather explains the solutions and any decisions taken to make the design workable and effective. It will also present the problem that is considered in the tests and may also give convincing comparatives of executions on the different techniques. The well-commented codes will be submitted under electronic format in one package according to the directives given below.

The project is to be worked on by teams of 4 students, one of whom will be designated as the Team Leader and is the one who will be in charge of any communication with the course instructors. In your report, you will include a table that will indicate precisely who did what on the project. **Bear in mind that it is not acceptable that a student work only on report writing; all the students will have to get involved in all aspects of the project.** (We will be strict on this!) Each team will give a demo and the team members will not necessarily have the same grade; it depends on their individual contributions and their answers to questions during the demo as detailed below. The demos will be given at ENSIA in shaa Allaah.

**Practical Aspects:**

As stated above, the work must be done in teams of 4 students. Any other grouping will not be allowed and will be penalised.

You are asked to do the following:

1. Your team leader will send me an email no later than Tuesday 12/03/2022 at 11:59 p.m. to give me the members of your team, namely the Name, First name, Student ID number, email and Group of each member of the team. **If you fail to have an acceptable number of members (i.e. EXACTLY 4) in your team, your project grade will be affected.**
2. Any future communication will be with team leaders ONLY (unless I believe I need to include the rest of the team, for whatever reason).
3. The team leader should indicate also in his/her email (see item 1) the priorities your team assigns to the 4 mini-project proposals. Priority A means the one you prefer the most, B is next to it, ..., and D is the one you prefer the least. There is no guarantee that you will be assigned your top choice. But what is sure is that failing to submit the 4 priorities, you will be assigned a mini-project by default.

4. I will inform you by Friday 15/03/2024 in shaa Allaah of the mini-project topic assignments for the various 4-member teams.
5. Mini-project work submission: Both the **report** and the **code** will be submitted onto Google Classroom as **ONE COMPRESSED FOLDER** that has the team leader's name. **It is your responsibility to ensure that no files are missing and the two files (the pdf and the compressed one) are submitted within the deadline.** Failure to do so, your project will be penalised. **If your submission is empty you will get 0 for the relevant parts of the project mark.**

### **Deliverables:**

As mentioned above, you will submit on Google Classroom ONE PDF file which contains your report and your code.

1. The report must be such that you
  - a) Clearly explain the problem and the solutions you provide in your project. (See the above "Project Aim" and "General Notes" sections.)
  - b) Explain in full detail your design choices for your solution, and the results, including summary/comparative tables, etc.
  - c) Include brief guidelines for using your solution if needed.
  - d) In a table, state who did what very precisely (points will be deducted if the distribution of responsibilities is not specified in the report.) The tasks may be related to writing the report (sections), solution design, implementation, testing, etc. **Each team member MUST be involved in all aspects of the project.**

Observe all the rules mentioned in this document.

2. Your Python code package will be uploaded onto Google Classroom as part of the ONE compressed file according to the explanations that will be given to you in due time. In all cases, The file must include:
  - The problem descriptions data you have used, which must be placed in a separate folder named **Data**. The data files must be meaningful.
  - Do not expect your instructor to correct or debug your code. It must run right away.
  - The names of any files and folders must be as intuitive and meaningful as possible.
  - Respect the good software development practices you have been taught for all your code.
  - A scan of the "Declaration on plagiarism and intellectual dishonesty" filled in in pen and signed by all the members of the team. I hate plagiarism whether in the report or in the script: learn to rely on your own efforts, develop your skills, and avoid serious problems!! (Bear in mind that there are tools to detect text plagiarism and code plagiarism.)

**Project submission date and time: Saturday 11 May 2024 no later than 11:59 pm. (Recall that submissions are time-stamped to the second on Google Meet.)**

- For every 24 hours of late submission from the deadline, 25% of the obtained grade will be deducted.
- No report will be accepted after Wednesday 15/05/2024 11:59 p.m.
- Note that even after having submitted your project report and code, you are entitled to continue improving your code/app till the demo day (hour!).

### **Important Note:**

A good report does not have to be long! It is up to you to decide how to have a sufficiently complete report that remains as short as possible. In other words, it is not a question of filling in but of making a written presentation as scientific and clear as possible. To help you, I limit the length of the report to 15 pages with

font Times New Roman size 11. Tables of results and/or comparisons must be included in the report and discussed.

**The final project grade for your team will be relative to that of the other teams!! So you are competing with all the other teams.**

**Grading of the mini-project :**

Mini-project part	Grading Scheme	Points (Total 20)
Report including analysis and discussion of the results	30 %	/6
Formulation of the problem and DATA (in reasonable quantity and quality) folder and ease of integration of these formulations in the package. (Note that it is a General Search Algorithm in a large part of this project, hence one should easily be able to apply your implementation to other problems)	20 %	/4
Overall solution (the package functionalities, richness, friendliness, visualisation of search, etc.) and code quality	20 %	/4
Demo and Questions&Answers	30 %	/6

**Final notes:**

- Students in the same team will not necessarily have the same grades since at least the quality of their answers to demo questions will vary.
- It is your RESPONSIBILITY to ensure that you have uploaded your package onto Google Classroom. No excuse will be accepted for any failure to do so in which case the corresponding marks will be zeroed.
- No email submission will be accepted.
- Respect ALL the above directives.

## **Description of the alternative problems**

### **A. Timetabling at ENSIA:**

Aim: To optimise the timetabling at ENSIA in terms of the room occupation, minimal presence of the students at the school and most reasonable schedules for the faculty members.

- a. Find everything from the school's website: courses, # of hours per week, slots of teaching, classrooms available, faculty members' CVs (courses they have already taught, their specialisation, and research interests)
- b. Find out the capacities of the various amphitheatres and tutorial and lab rooms.
- c. Define an appropriate objective function whenever needed: it should take into account various sound criteria (do research what is done in the world).
- d. Apply different search strategies: 2 uninformed, A\* or IDA\* and Hill Climbing (any of its versions),
- e. Do comparative analyses and suggest the best scheduling for S1 and S2 for each of the first 3 years as well as S1 of Year 4. The comparative analyses should be about the search for the solution and also about the cost in terms of time and space requirements.
- f. Would the best algorithm suggest different schedules than what was actually used at the school? Are the search-found schedules better? In what sense?
- g. Tackle the same problem as a constraint-satisfaction problem using any of the techniques to be seen in class.
- h. Compare the results obtained in the previous two questions.

**Some useful references:** (But DO your own research and collection of information)

- <https://www.ensia.edu.dz/>
- The timetables used during the year 2023-2024 will be made available to you (if you choose this topic). Each timetable shows the days and times and room of the lectures, tutorials and labs as well as the assigned faculty member.

**B. Agricultural land production planning:**

**Aim:** to organise the agricultural production in Algeria so as to optimize various objectives.

- Find out what each city/Wilaya is good at, what is its yearly production, size of the land used for agriculture and what it grows, productivity, etc.
- What is the country's consumption of main products: wheat, corn, dates, potatoes, tomatoes, green pepper, aubergines,
- Changes in product prices according to the seasons
- Suppose we ultimately want to:
  - Have the lowest prices for the consumer (what does lowest price mean? Think about a meaningful definition)
  - Have the highest production (in some products? Some strategic products? Etc.?)
  - Self-sufficiency in the production of products (all? some products? Some strategic products? Etc.?)
- Define an appropriate objective function whenever needed.
- Apply different search strategies: 2 uninformed, A\* or IDA\* and Hill Climbing (any of its versions),
  - Do comparative analyses and suggest the best assignment of agricultural production in the country. The comparative analyses should be about the search for the solution and also about the cost in terms of time and space requirements.
  - Tackle the same problem as a constraint-satisfaction problem using any of the techniques to be seen in class.
  - Tackle the same problem as a constraint-satisfaction problem using any of the techniques to be seen in class.
  - Compare the results obtained in the previous two questions.

**Some useful references:** (But DO your own research and collection of information)

- <https://madr.gov.dz/%d8%a7%d9%84%d8%a5%ad%d8%b5%d8%a7%d8%a6%d9%8a%d8%a7%d8%aa-%d8%a7%d9%84%d9%81%d9%84%d8%a7%d8%ad%d9%8a%d8%a9/>
- <https://madr.gov.dz/wp-content/uploads/2022/04/SERIE-B-2016.pdf>
- <https://madr.gov.dz/wp-content/uploads/2022/04/SERIE-B-2019.pdf>
- <https://capc.dz/wp-content/uploads/2022/03/Presentation-Boussaoud-CAPC-26-mars.pdf>
- <https://fac.umc.edu.dz/fst/fichiers/Agriculture%20alg%C3%A9rienne%20M1%20Rural.pdf>
- <https://www.ons.dz/spip.php?rubrique306>
- [https://www.ons.dz/IMG/pdf/i.IPC\\_Mars2023.pdf](https://www.ons.dz/IMG/pdf/i.IPC_Mars2023.pdf)

**C. Supply Chain and Logistics**

**Aim:** Being able to minimize delivery time, reduce costs, and ensure timely availability of goods.

- Consider the map of Algeria (from Google maps or whatever other source)
- Consider the most recent agricultural production in Algeria (wheat, potatoes, dates, tomatoes, and citrus) and taking into account the seasons.
- Find out the fleet of trucks (or semi-trailers, etc.) available to the various companies that transport goods between cities and the capacities of the various trucks they have.
- Define an appropriate objective function whenever needed: it should take into account various sound criteria (do research what is done in the world).

- e. Apply different search strategies: 2 uninformed, A\* or IDA\* and Hill Climbing (any of its versions).
- f. Would the different algorithms suggested different schedules than what was actually planned?
- j. Do comparative analyses and suggest the best assignment of fleet transportation of various products and quantities according to the seasons. The comparative analyses should be about the search for the solution and also about the cost in terms of time and space requirements.
- g. Tackle the same problem as a constraint-satisfaction problem using any of the techniques to be seen in class.
- h. Compare the results obtained in the previous two questions.

**Some useful references:** (But DO your own research and collection of information)

- <https://www.europages.fr/entreprises/alg%C3%A9rie/transport%20routier.html>
- Filter from this website any relevant companies and search for any other such companies.

#### **D. Healthcare Network Optimisation:**

**Aim:** To optimise ambulance routes, patient transfers, and emergency response times. More specifically, to find an optimal route to a relevant hospital or health clinic (depending on the case) for a patient who needs to visit a hospital/clinic in Algiers.

- a. Consider the map of Algiers and the hospital/clinic network.
- b. You will need to collect information about the various (specialised or general) services that exist in each facility and their capacities in terms of handling patients at the emergency service for treatment in the emergency unit or potential orientation to one of the other services.
- c. You will assume to have some information about each patient whether he/she will need treatment at the general emergency unit or one of the emergency unit of one of the other specialised units in the same hospital/clinic.
- d. Apply different search strategies: 2 uninformed, A\* or IDA\* and Hill Climbing (any of its versions).
- k. Do comparative analyses and suggest the best assignment of a patient to a hospital/clinic with the best route to get him/her there. The comparative analyses should be about the search for the solution and also about the cost in terms of time and space requirements.
- e. For the same problem, consider integrating a constraint-satisfaction approach to solving the problem or part of it using any of the techniques to be seen in class.
- f. Compare and discuss the results obtained in the previous two questions.

**Some useful references to start with:**

- [https://fr.wikipedia.org/wiki/Liste\\_des\\_hôpitaux\\_en\\_Algérie](https://fr.wikipedia.org/wiki/Liste_des_hôpitaux_en_Algérie)
- <https://www.aps.dz/regions/155674-la-wilaya-d-alger-sera-renforcee-par-6-nouveaux-hopitaux-et-une-maternite>
- <https://sante.gov.dz/etablissements-de-sante/>

*Enjoy!*

