The National Higher School of Artificial Intelligence
Data Structures and Algorithms 2

Programming Mini Project: Agricultural Production Management System

Submission deadline: Saturday 16/12/2023, not later than 11:59pm

The Ministry of Agriculture wants to develop a system to manage the farmers' agricultural production in the country. The ministry has organised the country into Wilayas and, within each Wilaya, into cities, and then areas within each city. The system is connected to the electricity and water consumption of each piece of land (i.e. farmer).

Because the company would like to eventually do a lot of mining of the data to better understand the farmers and the various stakeholders, it keeps data about each farmer. This data includes the name and ID number of the farmer and the number of people who help him/her on his/her piece of land as well as the age and gender (male/female) of each of these. For each farmer, the system also keeps the national ID number of his/her land. Any month, the farmer may sell cereals, fruits, vegetables, dates, and/or olives he/she has produced through the system (platform) to the buyers/suppliers who would then take care of transporting and reselling the products to other areas in the country. (you do not need to worry about this transportation and reselling.)

In order to limit the use of pesticides, which are harmful to public health, the ministry has introduced a system of penalising the farmers who use pesticides. To apply this penalty each municipality has experts directly linked to the ministry who inspect the farmers' products right before sales on the platform. The farmer product would be given a severity x of 1, 2 or 3 depending on how high the levels of pesticides are in the product. As such, the price of any product (potatoes, mandarins, dates, etc.) on the platform would be decreased by 10*x %.

Since the Ministry wants to encourage households to produce as much as possible to improve the country's self-sufficiency in agricultural product needs but at the same time without waste of water resources, a national prize is given monthly to the farmer who has sold the most on the platform on any of the five categories[1] (cereals, fruits, vegetables, dates, olives) while being as optimal as possible in terms of water consumption. To this end, the platform computes the ratio kilograms of product sold per 1 cubic meter of water consumed[2].

The Agricultural Production Management System (APMS) we want to build needs to keep all the needed data about the following:

- the information about each farmer as explained above;
- data about the amounts a farmer received a given month for selling on the platform any of the products. (In a given month, a farmer might for example sell 10 MDA of vegetables and 20MDA of fruits and 0 MDA on any of cereals, dates, and olives.);
- data about how much a farmer was penalised for any of his products in a given month;
- data about the monthly electricity consumption by each farmer;
- data about the monthly water consumption by each farmer.

This data will be kept, and accumulated as appropriate, over the years.

The APMS should organise all this data in such a way that all operations of access to the data and of processing it to return the below results should be done as quickly as possible.

The APMS is supposed to be web-based or mobile-based, but this is really optional; you can only implement the strictly necessary functionalities. But nicer systems will be positively appreciated.

[1] There is one national prize for each of the five categories of products.
[2] Be careful that the water consumption is for al the products sold that month.

Based on EXACTLY[3] THE AFOREMENTIONED DATA, the results expected from the APMS are the following, in addition to any other results you may wish (to include and explain in your report why they are good additions).

- A report on the sales of any farmer on any month.
- A listing summarising all the sales of all the farmers of any specified area or city or wilaya or even the whole country.
- The prize winners for the 5 categories of products on any month.
- A listing summarising all the penalties applied to the farmers on any of the 5 categories of products for any specified area or city or Wilaya or even the whole country.
- One may wish to display any of the previous results for a given month, year, or even period (from a start date to an end date).
- Appropriate relevant figures (curves, bar charts, etc.) could be displayed for the previous results.

Part A of the Project:

We have decided to store the data in a Binary Search Tree (plus any other ADTs as you see appropriate)

1. Give the graphical representation of the most suitable ADT for the APMS. This global ADT could be a combination of ADTs, each of which would be useful for any purposes you will need to explain.
2. Give a complete specification of this ADT.
3. Implement all the operations, making use as much as possible of any ADTs and operations we have studied in class.
4. Write a program which computes the average time for displaying the various results mentioned above.

Part B of the Project:

We have decided to store the data in an AVL Tree.

5. Implement all the operations, making use as much as possible of any ADTs and operations we have studied in class.
6. Write a program which computes the average time for displaying the various results mentioned above.
7. Compare the results obtained in questions 4 and 6, and give your conclusion.

Enjoy!

[3] Not less, and not more types of data!