.NET Challenge 2024 - Final Round

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1 Summary

You have been provided with a grid of potential office locations, each with a designated set of potential clients we could service. Each office location will start generating revenue when an office is placed on it, or next to it. By (de)constructing offices, it is your goal to generate as much revenue as possible at the end of the simulation.

2 Problem Description

Office Locations

There is a grid of X by Y office locations. Each cell in the grid represents 1 potential office location. Each office location is defined by:

- a potential revenue
- X coordinate
- Y coordinate

Surrounding Office Locations

The surrounding office locations or adjacent office locations (x', y') for 1 office location with coordinates (x, y) are defined as visualized in Figure 1. The orange cell is the office location (x, y), while the blue cells are the surrounding office locations (x', y').

All coordinates referenced are on the grid: $0 \leq x' \leq maxX$ and $0 \leq y' \leq maxY$. This means that if an office is lying on the outskirts of the grid, it will have less surrounding office locations.

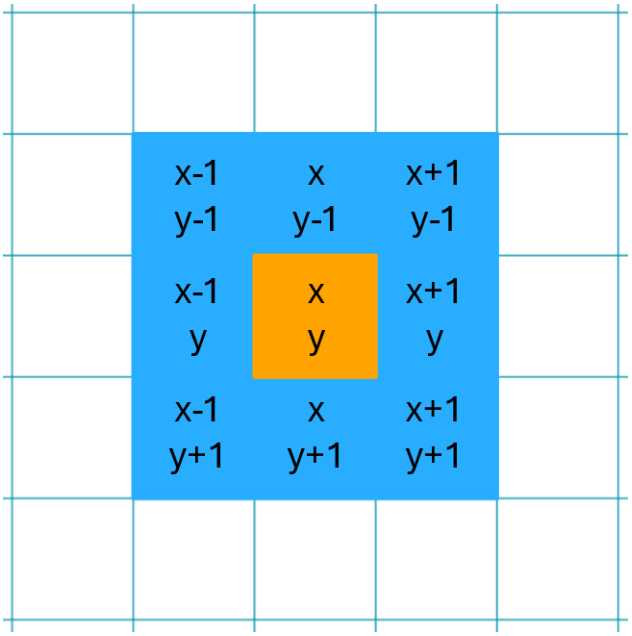

Figure 1: Surrounding office locations

2.1 Defining Offices

The central focus of the assignment revolves around constructing new or destructing existing offices inside the grid. It is your goal to find the best office locations based on a scoring system - see section Scoring.

Once an office location is chosen, that office location starts generating revenue. This revenue is based on the office location itself, and the office locations around it - see section Surrounding Office Locations.

Your output solution file will will have multiple solution lines with following information for each line:

- The year
- The X and Y coordinates
- The office status:
  - Status *Construction*: The office is constructed in this year.
  - Status *Destruction*: The office is destructed in this year.

Once an office is constructed on coordinates (x, y), there can be no more office constructions on coordinates (x, y) in the following years, unless the office is first deconstructed.

Another important rule: it is not allowed to construct an office next to another office - see section Surrounding Office Locations).

Deconstructing an office will cause the office to no longer generate revenue in that year. The office will stop counting to the maximum office quote starting the next year.

2.2 Input data sets

For each assignment, we give you all necessary details in a JSON file. Additionally, we offer a set of C# tools to help you read the information from these files and organize your results. You have the option to modify these tools, but be cautious not to change how the final results are structured, as this could cause errors when you submit your solution.

AssignmentModels.Assignment

- **YearsToSimulate** The period of time you need to simulate.
- **OfficeMaxX** The size of the X axis on the office grid.
- **OfficeMaxY** The size of the Y axis on the office grid.
- **MaximumYearlyOffices** A list with the maximum amount of offices that can be constructed. Each position represents the maximum for a specific year (indexed). This list will never decrement over time.
- **OfficeLocations** The offices and their information. First index corresponds with the X coordinate, second index corresponds with the Y coordinate.
  - **PotentialRevenue** A list with the potential revenue if an office is available on this location. Each position represents the revenue for a specific year (indexed).

3 Scoring

The score is calculated as the sum of total credits after the last year.

Each year, an office will reward you with a revenue. This revenue is based on the sum of

- the potential revenue in the office location for that year,
- and 20 % of the potential revenue in surrounding office locations for that year.

You can use the following formula for an office with coordinates (x, y) (orange and blue refer to Figure 1):

$$Revenue_{x,y} = potentialRevenue_{orange} + \sum 0.2 * potentialRevenue_{blue}$$

Each year, the following happens:

- You start with an initial credit. For year 0, this is 0. For year i, this is the credit at the end of year $i-1$.
- The office revenues are added to the credit. When an office is constructed, it immediately starts generating revenue each year. When an office is deconstructed, there are no revenues for that office in that year!

3.1 Output validation

Your output file will be invalid when one of the following statements is true:

- You have no solution lines.
- You list office (de)constructions outside of the allowed years.
- You list an office (de)construction on a location that is not on the grid.
- You list a wrong status for an office.
  - Status *Construction* in year i is only possible when there is no office constructed on this location yet.
  - Status *Destruction* in year i is only possible when there is an office constructed on this location. I.e. there is a solution line in year $i-t$ (with $t>0$) for that location with status *Construction*, but there is no other listing between year $i-t$ and year i for that location.
- You construct more offices than the maximum amount yearly.
- Your offices overlap in a given year. See section Defining Offices for more details.

4 Optional: Example

Assignment is defined as follows:

- **YearsToSimulate** 3 years
- **OfficeMaxX** size 3
- **OfficeMaxY** size 3
- **MaximumYearlyOffices** $[2,2,2]$
- **OfficeLocations with PotentialRevenue**
  - Location $(0,0)$ has PotentialRevenue [100,100,100]
  - Location $(1,2)$ has PotentialRevenue [200,200,200]
  - Other locations have PotentialRevenue [10,10,10]

Your solution is the following:

- Construction of office on location $(0, 0)$ in year 0
- Construction of office on location $(1, 2)$ in year 1
- Destruction of office on $(0, 0)$ in year 2

Note that in this assignment it is also possible to construct both offices in year 0.

4.1 Score calculation

This will lead to the following revenue in year 0:

- office $(0, 0)$ generates revenue: $100 + 3 * (0.2 * 10) = 106$

in year 1:

- office $(0, 0)$ generates revenue: $100 + 3 * (0.2 * 10) = 106$
- office $(1, 2)$ generates revenue: $200 + 5 * (0.2 * 10) = 210$

in year 2:

- office $(0, 0)$ generates no revenue, because it is being deconstructed
- office $(1, 2)$ generates revenue: $200 + 5 * (0.2 * 10) = 210$

Final score is: $106 + 106 + 210 + 210 = 632$

5 Optional: Tips & Tricks

- Start with a simple solution: ignore surrounding office locations, only construct offices, ...
- Afterwards optimize your solution: account for surrounding office locations, deconstruct offices for more profitable locations, ...
- Test your solutions early! A simple solution with a low score is better than a complex solution that does not validate!