Plants

Task

8. Different kinds of plants live on a planet. If the nutrient of a plant runs out (its nutrient level becomes zero), the plant wastes away. There are three kinds of radiation on the planet: alpha, delta, no radiation. The different species of plants react to radiation differently. The reaction involves a change in the nutrient level of the plant and the radiation the next day. The radiation of the next day will be alpha radiation if the sum of the demand for alpha radiation over all plants is greater than the sum of the demand for delta radiation by at least three. If the demand for delta radiation is greater by at least three than the demand for alpha radiation, the radiation will be delta. If the difference is less than three, there will be no radiation. There is no radiation the first day.

Each plant has a name (string), a nutrient level (int), and a boolean that denotes whether it's alive. The plant species are wombleroot, wittentoot and woreroot. The different plant species react to the different radiations as follows. The level of nutrients changes first. After that, the plant can influence the radiation of the next day if it's still alive.

Wombleroot: Alpha radiation makes the nutrient level increase by 2, no radiation makes it decrease by 1, and delta radiation makes it decrease by 2. It demands alpha radiation by a strength of 10 regardless of the current radiation. This plant also wastes away if its nutrient level increases above 10.

Wittentoot: Alpha radiation makes the nutrient level decrease by 3, no radiation makes it decrease by 1, delta radiation makes it increase by 4. This plant demands delta radiation with strength 4 if its nutrient level is less than 5, with strength 1 if its nutrient level is between 5 and 10, and doesn't influence the radiation if its nutrient level is greater than 10.

Woreroot: Its nutrient level increases by 1 if there is alpha or delta radiation, and decreases by 1 if there is no radiation. Doesn't influence the radiation of the next day.

Simulate the ecosystem of plants until there is no radiation on two consecutive days. Print all the data of the plants and the level of radiation on each day.

The program should read the data of the simulation from a text file. The first line contains the number of plants. Each of the next lines contains the data of one plant: its name, its species, and its starting nutrient level. The species can be: wom - wombleroot, wit - wittentoot, wor - woreroot. The program should ask for the filename and display the contents of the file. You can assume that the input file is correct. A possible input file:

```
4
Hungry wom 7
Lanky wit 5
Big wor 4
Tall wit 3
```

Analysis

NutrientLevel Change

Wombleroot:

Radiation	NutrientLevel
Alpha	+2
Delta	-2
None	-1

Wittentoot:

Radiation	NutrientLevel
Alpha	-3
Delta	+4
None	-1

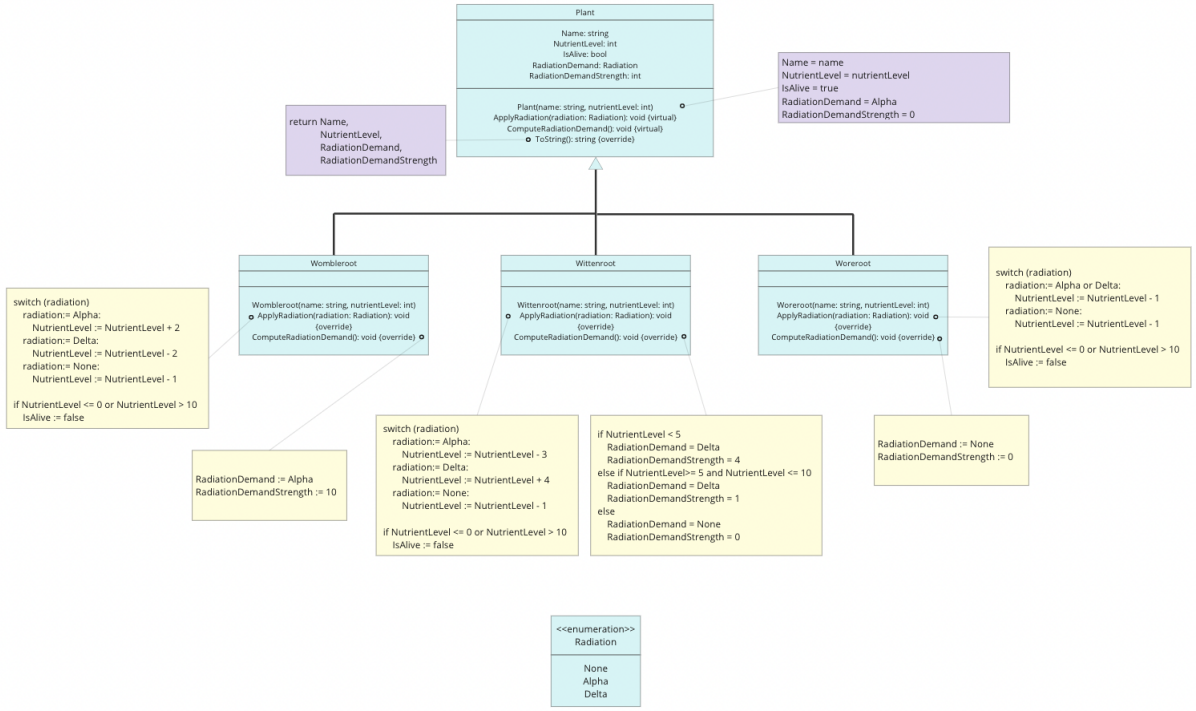
Woreroot:

Radiation	NutrientLevel
Alpha	+1
Delta	+1
None	-1

Radiation Change

DemandDifference	Radiation
alphaDemand - deltaDemand >= 3	Alpha
deltaDemand - alphaDemand >= 3	Delta
Else	None

Plan



Specification:

$$A = radiation : Radiation^n,\ plants : Plants^m,$$

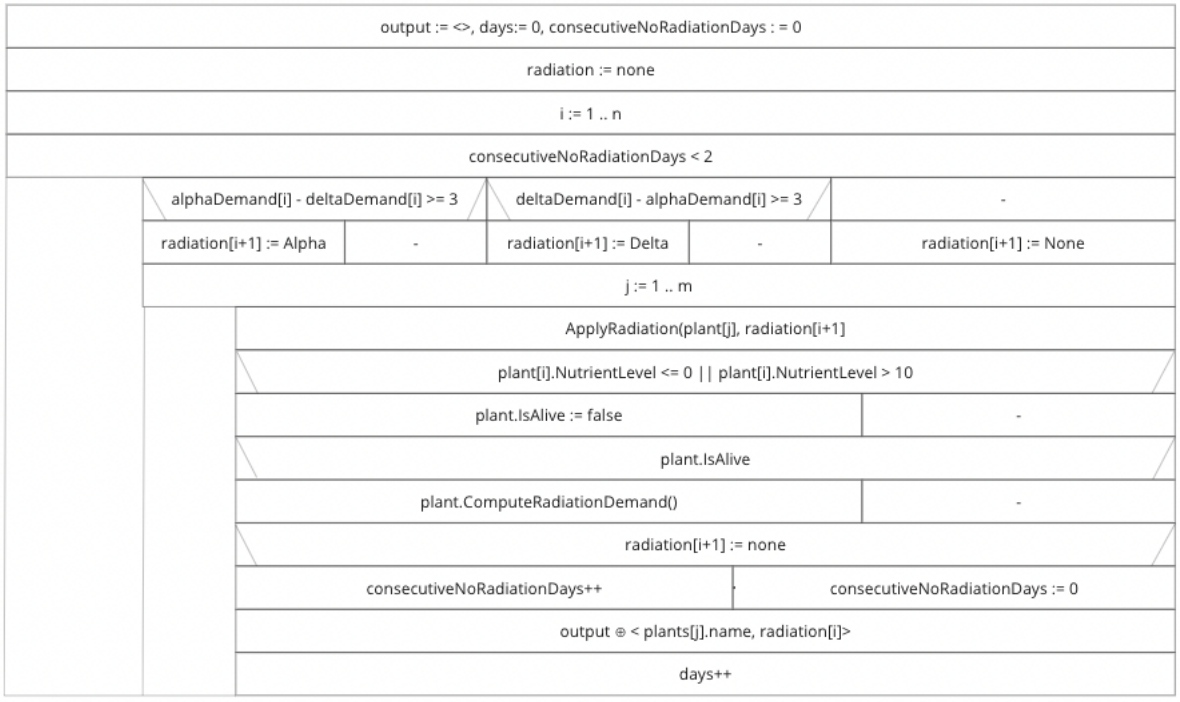
$$Pre = radiation = radiation_0 \wedge\ plants = plants_0$$

$$Post = \forall i[1..n] : (\exists j \in [1..m] : plants[j].ApplyRadiation(plants[j], radiation[i+1]), output = \oplus_{j=1..m} < plan$$

Analogy:

enor(E)	i = 1..n, j = 1..m
f(e)	<ApplyRadiation(plants[j], radiation[i+1]>
cond(e)	consecutiveNoRadiationDays < 2
s	output
H, +, 0	Plants*, ⨁, <>

Structogram:



Testing

1. Test Case: Empty input file
    - Description: The input file is empty, containing no plant data.
    - Expected Behavior: The program should not throw any exceptions and should terminate gracefully, without performing any simulation.
2. Test Case: Single plant with no radiation demand
    - Description: The input file contains a single plant entry with a species that does not have any radiation demand.
    - Expected Behavior: The program should simulate a single day with no radiation, and the plant's nutrient level should remain unchanged throughout the simulation.
3. Test Case: Single plant with nutrient level above 10
    - Description: The input file contains a single plant entry with a nutrient level above 10.
    - Expected Behavior: The program should simulate a single day with no radiation, and the plant should die (IsAlive = false) due to its nutrient level exceeding the limit.
4. Test Case: Multiple plants with different radiation demands
    - Description: The input file contains multiple plant entries, each with a different radiation demand.
    - Expected Behavior: The program should perform the radiation simulation for multiple days until there are no radiation events for two consecutive days. The nutrient levels of plants should be updated based on the radiation and radiation demands, and their status should be printed for each day.