ESS201 – C++ Programming
International Institute of Information Technology Bangalore

**Lab-Test01: C++ Classes, Composition**
Exam on Nov 11, 2020 (Wednesday), at 1:30 pm IST | 2 hours exam
***Submission on both Domjudge and LMS***

---

***Premise:***
You are an ecologist keeping track of the population of species in different ecosystems around the world. You get reports from different natural resources management authorities worldwide to keep track of population of species, and your interest is to track population of endangered species.

For now, you are considering only population of orangutan, panda, rhinoceros, and tiger, coded as O, P, R, and T, respectively. You keep the current *summative/total/aggregate counts* of these animals, NO, NP, NR, and NT respectively.

---

***Log Statement/Command Types:***
The reports contain log statements. A log statement or command is comma-separated formatted word of the below-mentioned types.
A,20,10
(is the command that implies adding ecosystem at geolocation (20N, 10E). Geolocations are given as latitude, longitude. Latitude can have values between -90 and 90, which are for 90S and 90N, respectively; and longitude can have values between -179 to 180, which correspond to 179W and 180E, respectively. When adding a new ecosystem in your database, it must be given an index. The index of a new ecosystem is one more than that which is last added to your database. Ecosystems in your database start with index 0, and are indexed as per their addition into the database. )

AA,P,20,1
(is the command that implies adding 20 panda to the ecosystem with index 1. Implementation of the addition command requires appropriate update for the total counts. If an ecosystem of the chosen index does not exist, do nothing.)

DD,T,20,1
(is the command that implies reduction of tiger population by 20 in the ecosystem with index 1. Implementation of the reduction command requires appropriate update for the total counts. If the current animal population in the ecosystem is less than the number given in the log/command, then do nothing. Maintain the animal population in any ecosystem to be always non-negative. If an ecosystem of the chosen index does not exist, do nothing.)

D,1
(implies delete the ecosystem with index 1. Implementation of deletion of an ecosystem implies all the counts of the animals in the ecosystem need to be set to 0, and hence, also reduced from your summative counts. Deleting an ecosystem does not imply removing it from your database, it simply means turning a flag “is_live” to be false for the ecosystem. The idea is that at a later date, the ecosystem can become live if appropriate support is provided. If an ecosystem of the chosen index does not exist, do nothing.)

C,2,-10,-60

(implies create a new ecosystem (target) by *cloning* ecosystem with index 2 (source). Cloning means that the animal population is the same in number and composition in both the source and target ecosystems. The target, however, is assigned the index as would be done for any new ecosystem. The target is assigned the geolocation as given in the command, i.e. (10S,60W) here. As a new ecosystem, the target has value of is_live to be TRUE, irrespective of the is_live value of the source. The is_live value of the source ecosystem is not relevant for cloning. If the source ecosystem does not exist, do nothing.)

A few more things to remember:

- The index of an ecosystem is unique.
- The population of all animals in an ecosystem have to be changed to 0 if "is_live" is changed to FALSE for the ecosystem.
- The default value for "is_live" for a new ecosystem is TRUE.
- An ecosystem, which has is_live=FALSE, can have animals added using AA,*,*,* command. Once the animal population is added to the ecosystem, its is_live value can be reset to TRUE.
- Deletion operation cannot be done on an ecosystem with is_live=FALSE.

---

***Task Description with Input/Output Formats:***
Your task is to write C++ code that will help you maintain the data. Your C++ program will take in the log statements till date and print out the summative/total counts.

The end of input statement is marked by -1. An input sample:
A,20,10 AA,P,20,0 AA,T,200,0 AA,O,100,0 A,30,0 AA,P,200,0 AA,T,20,1 AA,O,20,1 D,1 A,30,20 C,1,-10,-60 -1

Your output statement is in the following format, including outputs for all created ecosystems and the total counts:
<E0> <E1> <E2> … <NO>,<NP>,<NR>,<NT>

<E0> is the output for the ecosystem of index 0. The output has to say the values of following for the ecosystem object in comma-separated fashion:
<index>,<lat>,<long>,<value of is_live as 0 or 1>,<#orangutan>,<#panda>,<#rhinoceros>,<#tiger>

Thus, the output for the above input sample has been fleshed out here in parts:
<E0> 1,30,0,0,0,0,0,0 <E2> 3,-10,-60,1,0,0,0,0 100,220,<NR>,200
*Note: The yellow highlights are provided to indicate space character " ", for easier readability of this document.*

---

***Requirements:***
Create C++ classes for Ecosystem, and Geolocation.
Use composition to achieve the following relationship: "a Geolocation is a part-of Ecosystem".

Marks will be allocated for writing appropriate constructors, destructors, accessors, and manipulators, and operator overloading. Overload std::cout for Ecosystem to print the final output.

Maintain multiple files; class interfaces in header files, and source code in .cpp files, and a separate file main.cpp for the main function.

---