CSE 2017 Data Structure
Project#3, Spring 2023

Assigned: 5. 11

Due: 6. 1

In this problem, you are asked to keep track of the hierarchical structure of an organization's changing staff. As the first event in the life of an organization, the chief executive officer (CEO) is named. Subsequently, any number of hires and fires can occur. Any member of the organization (including the CEO) can hire any number of direct subordinates, and any member of the organization (including the CEO) can be fired. The organization's hierarchical structure can be represented by a tree. Consider the example shown by Figure 1.
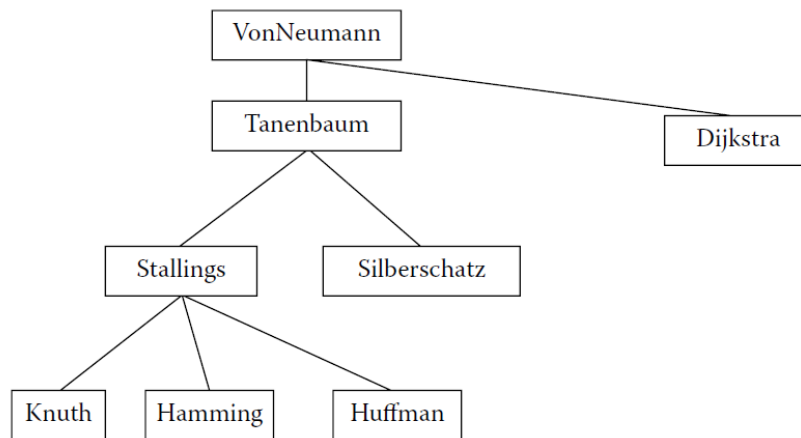

Figure 1. the hierarchical structure of an organization

VonNeumann is the CEO of this organization. VonNeumann has two direct subordinates: Tanenbaum and Dijkstra. Members of the organization who are direct subordinates of the same member are ranked by their respective seniority. In the diagram, the seniority of such members decreases from left to right. For example, Tanenbaum has higher seniority than Dijkstra.

When a member hires a new direct subordinate, the newly hired subordinate has lower seniority than any other direct subordinates of the same member. For example, if VonNeumann (in Figure 2) hires Shannon, then VonNeumann's direct subordinates are Tanenbaum, Dijkstra, and Shannon in order of decreasing seniority.
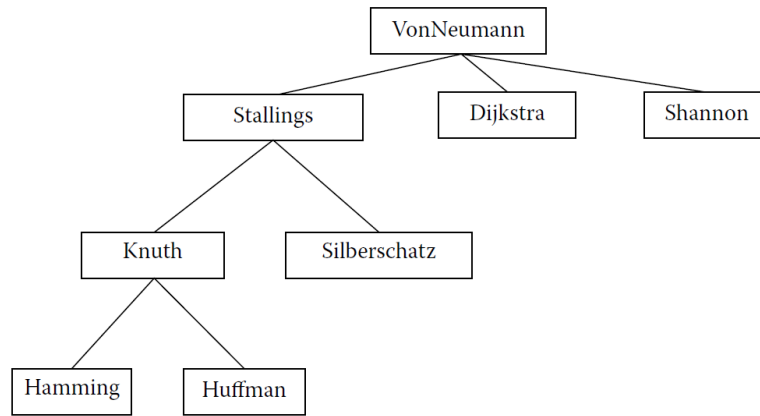
Figure 2. the hierarchy resulting from Figure 1.

When a member of the organization gets fired, there are two possible scenarios. If the victim (the person who gets fired) had no subordinates, then he or she will simply be dropped from the organization's hierarchy. If the victim had any subordinates, then his or her highest-ranking (by seniority) direct subordinate will be promoted to fill the resulting vacancy. The promoted person will also inherit the victim's seniority. Now, if the promoted person also had some subordinates, then his or her highest-ranking direct subordinate will similarly be promoted, and the promotions will cascade down the hierarchy until a person having no subordinates has been promoted. In Figure 1, if Tanenbaum gets fired, then Stallings will be promoted to Tanenbaum's position and seniority, and Knuth will be promoted to Stallings's previous position and seniority. Figure 2 shows the hierarchy resulting from Figure 1 after (1) VonNeumann hires Shannon and (2) Tanenbaum gets fired

Input

The first line of the input contains only the name of the person who is initially the CEO. All names in the input file consist of 2–20 characters, which may be upper- or lowercase letters, apostrophes, and hyphens (but no blank spaces). Each name contains at least one uppercase and at least one lowercase letter.

The first line will be followed by one or more additional lines. The format of each of these lines will be determined by one of the following three rules of syntax:

- [Existing member] hires [new member]

- fire [existing member]

- print

Here [existing member] is the name of any individual who is already a member of the organization, and [new member] is the name of an individual who is not a member of the organization yet. The three types of

lines (hires, fire, and print) can appear in any order, any number of times. You may assume that at any time there is at least one member (who is the CEO) and no more than 1000 members in the organization.

Output

For each print command, print the current hierarchy of the organization, assuming all hires and fires since the beginning of the input have been processed as explained above. Tree diagrams (such as those in Figures 1 and 2) are translated into textual format according to the following rules:

■ Each line in the textual representation of the tree will contain exactly one name.

■ The first line will contain the CEO's name, starting in column 1.

■ The entire tree, or any subtree, having the form shown in Figure 3 will be represented in textual form as shown in Figure 4

The output resulting from each print command in the input will be terminated by one line consisting of exactly 60 hyphens. There will not be any blank lines in the output.

Sample Input	Sample Output
VonNeumann	VonNeumann
VonNeumann hires Tanenbaum	+Tanenbaum

Sample Input	Sample Output
VonNeumann hires Dijkstra	++Stallings
Tanenbaum hires Stallings	+++Knuth
Tanenbaum hires Silberschatz	+++Hamming
Stallings hires Knuth	+++Huffman
Stallings hires Hamming	++Silberschatz
Stallings hires Huffman	+Dijkstra
print	---
VonNeumann hires Shannon	VonNeumann
fire Tanenbaum	+Stallings
print	++Knuth
fire Silberschatz	+++Hamming
fire VonNeumann	+++Huffman
print	++Silberschatz
	+Dijkstra
	+Shannon

	Stallings
	+Knuth
	++Hamming
	+++Huffman
	+Dijkstra
	+Shannon

Submission

Upload the source code as an attachment. The "main" function should be in a OrganizationTree.cpp. If your code is all in one file, you may simply attach the .cpp file. If your source code is in several files, combine them into a single .zip file.