

## DS Project 3 – Welcome to Elizabeth's promenade

### 1. Description (very important)

Csejte is a forest with many unsolved disappearance cases. Many travelers accidentally came in here and no one saw them come out after. People said that this forest is haunted with curse, calling it "the ghost forest". Bob, who was an experienced police, was interested in these cases for many years. He thought that there must be some way to rescue the missing people.

The ghost forest was located in a small town with about two thousand residents. However, the residents just knew that going into the forest was never a good idea, only fools would do that. After the investigation for many years, a very old elder who was respected by the town residents said that it's the time to say a story to Bob. It's about the history of the ghost forest. She told him that about three hundred years ago, there was a beautiful castle located in the ghost forest. The castle had a hostess, named Elizabeth, who was a beautiful white-haired lady lived in happiness. However, after her husband died in an accident, she became very grief and couldn't accept the truth. She never came out the castle. The castle was ruined and covered with trees and weeds over years. After the elder finished the story, she died with the last breath.

The residents were very shocked when the elder died just after she told Bob the story. Since Bob had been in the town for many years and didn't do any helpful things about the disappearance cases, many people scorned him. They thought Bob killed the elder. They became mobs and tried to kill him just for an eye for an eye and a life for a life. Bob was nowhere to hide except for the forest. Worth of last resort, he ran into the ghost forest. When Bob stopped running, he noticed that he was trapped in the deep forest and had no idea where he was. The sky became dark and the surroundings became cold. Suddenly, he heard a lovely female voice in a direction. *"Come here...to the warm place!"* the sound whispered. Bob involuntarily walked to the voice's direction, and to his surprise, here came the castle.

Bob walked into the castle and saw a beautiful white-haired lady standing on the hall.

*"Hello, my honored guest. I'm Elizabeth, the castle's hostess."*

**"E...Elizabeth? That's impossible!! You have been dead for three hundred years!"** Bob said.

*"Maybe...or not. I feel so lonely now...could you dance with me?"*

**"Never!!"** Bob tried to run out the castle with scared; however, the door had been locked. Elizabeth laughed.



*"You're so cute! Just like my husband!"* She waved her arm and all the candles in the castle were lightened, the scene Bob saw was extremely terrified – hundreds of the missing people were here, dancing in a special step without any consciousness just like puppets.

*"Do you know.....I have been waiting for my husband coming back.....for many years?"* said Elizabeth.

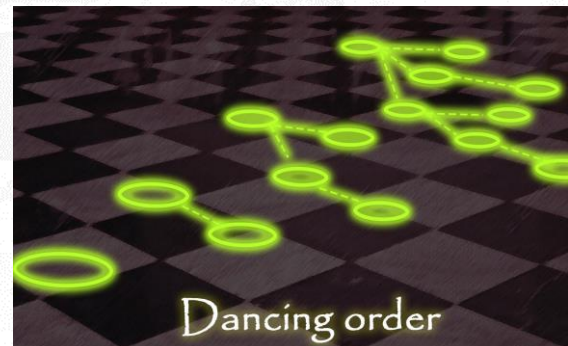
*"For three hundred years! These years I felt so lonely, if anyone came to the forest, I would entice them to join my promenade! They were all my dancing puppets and I absorbed their energy so that I could never become old! I can wait for my husband forever!"* She smiled creepily.

*"Welcome to my promenade, become my puppet and dance for me!"*

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Elizabeth waved her arms again, Bob's legs moved and joined the promenade involuntarily. Bob felt that his consciousness was losing gradually.

**"There must be some methods to break the curse!"** Bob thought. Bob found that the dance has a special order. It could be divided by many partitions and each partition can be thought as a tree with different layer. Every people in the tree would be sorted by their energy. The one in the parent location had lower energy than everyone in his children location. In other words, the one in the root place should had the least energy, we called him "the root". In these partitions, every trees should have different level, if any of two trees had the same level, the tree with the lower energy of "the root" would become the new root, and the other one would become his children.



Elizabeth would absorb each person's energy during the dance, if someone's energy was lower than his parent, they would swap the place. Also, if "the root" loss too much energy then he would die. Elizabeth would throw away him, and all of the next layer people of "the root" would become the new root, however, if any of these new tree had the same level, they should be merged by the same method described before. If a new person joined the promenade, he could be seen as a new tree with one level, then did the merge. Finally, if a group of people joined it, Elizabeth would make them be a new dance partition. They would dance by themselves first, and then put all of them to merge into the original promenade.

Bob needed someone to build a simulation of the promenade, recording all the people's energy and their position so that he could figure out the way to break the curse. Could you help him before he losses all of his energy?



## 2. Input/Output:

In this project you have to implement all the people's statement in the promenade (binomial heap). The promenade would always less than **1000000** people. Each person has his own unrepeated id **i** ( $0 \leq i \leq 1000000$ ) and energy **e** ( $0 \leq e \leq 100000$ ) to record. There are two files attached in this project you can use:

- 1) **Source.cpp**: The file to handle test data's input, you SHOULD NOT change anything in the file.
- 2) **promenade.h**: The file to implement the statement of the promenade, you have to fill in five functions in this file:

a. **one\_person\_joined**: If the input file command is "**P [id] [energy]**", it would call this function. This function should make a person with his [id] and [energy] to join the promenade.

b. **one\_group\_joined**: If the input file command is "**G [id1] [energy1] [id2] [energy2] ...**", it would call this function. This function should make another promenade merging into the original one.

c. **absorb\_energy**: If the input file command is "**A [id] [energy]**", it would call this function. In this function you should find the person with [id] and decrease his energy by [energy]. Then adjust everyone's position to maintain the promenade (The energy of person in the parent position should always be lower than all of his children). If his energy is lower than or equal to zero, you should throw him out of the promenade. If you can't find the person with [id], just ignore it.

d. **calculate\_people\_below**: If the input file command is "**C [energy]**", it would call this function. You should walk through the promenade and return the number of how many people's energy is lower than or equal to [energy].

e. **get\_weakest\_person**: If the input file command is "**W**", it would call this function. Return the id of the person with the lowest energy. If there are more than one solution, just return one of them.

Also, If the input file command is "**N**", the program would call the function "**promenade::size()**". It should return how many people in the promenade.

You have to run the project in workstation. Here's the testing command:

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> g++ Source.cpp
```

```
> ./a.out [input filename]
```

### 3.Sample testing data:

**Input file(test1.txt):**

P 1 10

P 2 5

A 1 10

C 5

W

N

**Workstation command:**

> g++ Source.cpp

> ./a.out test1.txt

**Output (print on screen):**

The number of people below 5 energy is: 1

The weakest person's id is: 2

The number of people in Elizabeth's promenade is: 1

**Input file(test2.txt):**

P 1 10

P 2 30

G 3 20 4 10 5 80 6 5 7 100

P 8 90

P 9 10

A 2 27

A 1 9999

A 6 5

C 20

W

N

**Workstation command:**

> g++ Source.cpp

> ./a.out test2.txt

**Output (print on screen):**

The number of people below 20 energy is: 4

The weakest person's id is: 2

The number of people in Elizabeth's promenade is: 7



## 4. Requirements

### Program

- I. You need to turn in the **codes**. "**Source.cpp**" and "**promenade.h**"
- II. You should use **binomial heap structure** to implement the promenade.
- III. Using standard output to print out your results on the **screen** and record them in your report.
- IV. Your program must be readable (Ex. Comments, variable names, function names)
- V. **Do not use any STL function to build the structure.**
- VI. Adding your own global values, global functions is available. But do not destroy the original structure in the file attached.

### Report

- I. Name the file "**hw3\_StudentID.pdf**", Ex: hw3\_0316000.pdf)
- II. Describe your implementation. (Ex: algorithm, program executing process)
- III. Sample testing Results: the execution result for sample testing (show it by taking screenshots)
- IV. **No more than 2 pages.**

## 5. Grading policy

- I. Question (5%): What is the name of the ghost forest?
- II. Programming (80%): Your code can run without crashing and giving correct results to all the testing data.
- III. Report (20%)
- IV. Bonus (0%): If you have the courage and the determination to break the curse and come to demo, you would get the bonus.

If there have any undesirable mistake to the requirement. Each mistake minus 10 points.

## 6. Submit (e3 will be closed on time)

Compress all your files (including your code(.h/.cpp) and report(.pdf)) Name your compressed file "**hw3\_studentID.zip**". Upload your compressed file to e3.

**Deadline: 2016.1.11, 23:59**

**No late upload.**