The year is 3506 and a very contagious new virus, named COVID 33, is spreading rapidly. World Health has finally decided to invest in some new advanced computer programs for contact tracing, as the current ones haven’t been upgraded since the last pandemic, COVID-19.

Currently, they have a database storing a list of person-to-person contact traces of the form of a tuple (Pi , Pj , tk), where Pi and Pi and Pj are the two people involved in the interaction that happened at time tk. Note that traced interactions are directionless, as in the trace (A, B, tk) is the same as the trace (B, A, tk). They have hired you to improve their algorithms for contact tracing by extending this current system into ContactTracer.java.

Note that it would be wise to understand the entire question before attempting to do the individual parts (as your design decisions may change).

1. Implement the constructors for ContractTracer, which takes as input a list of check-ins of the form described above. Additionally, implement addTrace which adds a new contact trace datum to the internal data structure.
2. Implement getContactTimes, which returns a list of times that two people have been in direct contact in the tracing data. This list should be returned in ascending order of time.
3. Implement the getContacts and getContactsAfter methods, which take as input a person and then return the set of people that person has come into direct contact with in the tracing data. For the getContactsAfter method, it only returns contacts that have happened at or after the given timestamp.
4. Now that we have a data structure which can help us store and query the tracing information, we want to implement an algorithm to help find potential infectees from a given source. That is, given a person P who become contagious with COVID 33 at exactly time t, we want to find all the people who now may have contracted COVID 33 from person P (and therefore need to be contacted for testing and tracing), or may have contracted it from someone else who P has infected (and so on...).

For this question, we will assume the following:

1. If a person comes into contact with COVID 33 at time t and they do not have it already, they might contract the virus and become contagious at exactly t + 60 minutes.
2. If a person is contagious with COVID 33 at time t, then they may instantly spread it to anybody they come into contact with at or after time t.

**Small example:** For example, suppose your contact tracing database has the following information (note: this is not necessarily how you may choose to store this information but just a representation of it).

|  |  |  |
| --- | --- | --- |
| Person 1 | Person 2 | Time |
| Anna | Sanni | 1st October 3PM |
| Anna | Matt | 2nd October 8PM |
| Matt | Kristian | 3rd October 9PM |
| Kristian | Sanni | 3rd October 9:30PM |
| Kristian | Kenton | 3rd October 11PM |
| Kristian | Max | 3rd October 11PM |
| Kenton | Kristian | 4th October 10AM |

If Anna become contagious with COVID 33 at 1st October 3:30PM, then Matt, Kristian, Kenton, and Max would need to be contacted for tracing due to possible transmission.