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**Contact Tracing**

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**Problem Description**

With the Internet of Things available around us, we could collect contact traces from mobile apps via Bluetooth beacons. Suppose we have such contact traces as below:

PID1	PID2	Time
11	10	32
21	11	42
12	13	55
13	21	66

In the traces, the first record shows one person with ID 11 has contacted another person with ID 10 at time 32.

Now you are required to handle such traces that may have up to billions of records.

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**Task**

Write a program to achieve the following functions:

1. For a particular person  $A$ , find all other persons who contacted  $A$  after a particular time  $T$ .
2. Parallelise the task with multithreading and show the performance improvement related to the number of threads used.
3. Suppose a magic power is contagious. If one contacts a person with the magic power, they are likely to get the magic power. More contacts mean more likely to get the magic power. For a group of persons with the magic power with their times of empowerment, find out all other persons who are likely to get the power. Discuss the possible approaches to quantify the likelihood and implement one approach in your program.
4. Write a report (less than one page) to show the performance of the parallel implementation, and explain your likelihood-estimation approach and its implementation.

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**Relates to Objectives**

1.1, 1.2, 2.1, 2.2, 2.6, 3.1, 3.4, 3.5, 3.6, 4.1, 4.2, 4.3, 4.7, 4.8

(Pair)