

Etude 12: Contact Tracing

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Parallel Implementation Performance

Below are the tables containing process time data from our code based on the number of processes running for each given txt file and the following task.

For a particular person A , find all other persons who contacted A after a particular time T .

Values used were $A = 22$, $T = 1$ and the maximum number of processes for each table is 4.

trace_medium.txt

Number of threads	Process time taken (s)
1	0.0002849999999999800
2	0.00016700000000002800
3	0.00013199999999991000
4	9.89999999999602E-05

trace1.txt

Number of threads	Process time taken (s)
1	0.0003340000000000570
2	0.00017499999999992500
3	0.00015500000000001600
4	0.00014500000000006200

trace2.txt

Number of threads	Process time taken (s)
1	0.00029199999999995900
2	0.0001440000000000033
3	0.0001560000000000045
4	0.00016700000000002800

Each table, apart from trace2.txt, shows that as the process number increases, the process time taken decreases. The most significant difference in time between processes is going from one thread to two concurrent threads. In each table it shows the process time is about twice as fast.

The approximate increases in process speed for each table between one process in two processes are the following:

trace_medium.txt = 1.71x faster

trace1.txt = 1.91x faster

trace2.txt: 2.03x faster

The increase in speed after this is negligible.

Likelihood Estimation Approach

For our likelihood estimation approach for getting the magic power, we came up with the following equation:

$$\begin{aligned} &\text{for all } n: \\ &\quad \text{if } cl \leq 5: \\ &\quad \quad lh = 0.1^{(cl)} \end{aligned}$$

where:

lh = likelihood of getting the magic power

n = empowered contacts that have had any degree of contact with person

cl = contact 'chain length' from current n

We used this formula as it demonstrates that the more empowered contacts a person has, the higher the probability of them getting the magic power. The multiplier of 0.1 indicates that if a person has direct contact with 10 or more empowered individuals they will certainly get the magic power which seems entirely plausible. Also, this means that as the chain length increases the likelihood of getting the magic power still increases, but by far less. An example of this is if A had the magic power at time T and had contacted B after T, then B's likelihood of getting the magic power would increase by 0.1. Then if C had contacted B after B had contacted A, their chain length from A would be 2 so their likelihood of getting the magic power would increase by $0.1^2 = 0.01$. We have decided not to consider any chain length past 5 as it would result in a persons likelihood only increasing by 0.00001 or 0.001% which is a negligible amount.

We have implemented this approach in our code with the method likelihood which returns a list of persons who have had contact with empowered individuals and their probability of getting the magic power, based off of how many direct and indirect empowered contacts they've had which is found within the method. The method finds this by finding the contacts of the empowered, adding 0.1^1 to these contacted persons probabilities, then iteratively finds who those persons have contacted