Q1

The possibility that two people choose to go to same hotel now becomes 0.01*0.01/500000=2*$10^{-10}$. If they visit a same hotel on 4 different days, then the possibility should be $2 * 10^{-10^4} = 8 * 10^{-40}$. The number of pairs of people now becomes $\binom{5*10^9}{2}$, and the number of chosen 4 days becomes $\binom{5*10^3}{4}$ due to the changes of examples. As a result:

$$\binom{5 * 10^9}{2} * \binom{5 * 10^3}{4} * 8 * 10^{-40}$$

$$\approx \frac{5 * 10^{9^2}}{2} * \frac{5 * 10^{3^4}}{24} * 8 * 10^{-40} \approx 2.604 * 10^{-7}$$

The number of suspect pairs should be less than $2.604 * 10^{-7}$.

Q3. For the map part, when the program deals with a user, it first connects this user with every friend as 1 degree friends, then connects every friend with every other friend as 2 degree friends.

For the reduce part, when the program deals with a new data, it first check whether this belong to an exist 1 degree friendship, if yes ignore it. Then check whether this 2 degree friendship already exist, if yes, save this friendship one more times. If no, create a new stored friendship.

Below is the caught examples

924 439,2409,6995,11860,15416,43748,45881

8941 8940,8943,8944

8942 8940,8943,8944,8939

9019 317,9023,9022

9020 317,9023,9016,9017,9022,9021

9021 317,9023,9016,9017,9022,9020

9022 317,9016,9017,9023,9019,9020,9021

9990 13134,13478,13877,34299,34485,34642,37941

9992 9991,35667,9987,9989

9993 13134,13478,13877,34299,34485,34642,37941,9991