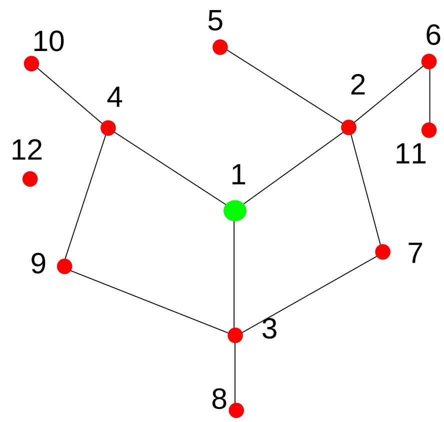

FIG. 1: The friends of node 1. Node 2, 3 and 4 are the friends of node 1 which Eq. (2) yields that $d(1,2) + d(1,3) + d(1,4) = w$. The size of the network is $n = 12$ and the information sequence is $\{2,3,4,5,6,7,7,8,9,9,10\}$ and the frequencies of all nodes are $q_2 = q_3 = q_4 = q_5 = q_6 = q_8 = q_{10} = \frac{1}{11}$, $q_7 = q_9 = \frac{2}{11}$, $q_1 = q_{11} = q_{12} = 0$. If one site is reached several times when constructing the long range connections from node 1 or from its nearest neighbors, the node will appear in the node sequence and in Eq. (2) the same number of times.

II. RESULTS

Our optimization model (OM) is based on Eqs. (2) and (3) which represent two competing processes. To maximize entropy (Eq. (3)), it is preferred to have friends at long distances in order to explore new parts of the network and to obtain more information. However the farther one goes he can have less friends due to the finite energy limited by Eq. (2). Assuming the PDF of having a friend at distance r obeys

$$P(r) \propto r^{-\alpha}, \tag{4}$$

we can explore the value of α that yields maximum entropy under the condition of Eq. (2).

The optimization model is simulated on a toroidal lattice whose size is $L \times L$ ($L = 10000$ means that individuals can make friends in a population of 10^8) and lattice ('Manhattan') distance is employed. Because toroidal lattice is a regular network and each node has a unique index, we can calculate the lattice distance between any pair of nodes and we do not need to construct the whole network, enabling us to simulate very large lattices.

For a large enough 2-dimensional lattice, the number of nodes that have distance r from a given node is proportional to r. So if $w \to +\infty$, that means if we consider the maximal diversity