Peer-to-peer networks – (due till May 7, 2008)

Exercise 8.1: Routing in Pastry

a) In Pasty, the node closest to the key 5734 is to be found. We assume that the initiator of the query is the „first node“ which has no common prefix with the key. The first nodes makes a lookup in its routing table and forwards the query to a second node which is already closer but not yet responsible for the four digit key 5734. Only the „third node“ should be the final node where the query ends.

Fill in the complete routing tables of the three nodes and find appropriate values for their leave sets. We assume that the network is dense enough to populate every cell in the tables.

b) The „second node“ points to another node in (1, 1) (row 1, column 1 / marked with (brackets)). The particular nodes (1, 1) has vanished. How do you fill in the gap? What are you doing if your first, second, ... seventh attempt to fill in the gap fails?

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Key: 5734

first node (ID ....)

routing table
0: .... .... .... .... .... .... ....
1: .... .... .... .... .... .... ....
2: .... .... .... .... .... .... ....
3: .... .... .... .... .... .... ....

leave set
 : .... .... .... .... .... .... ....

second node (ID ....)

routing table
0: .... .... .... .... .... .... ....
1: ....(....).... .... .... .... ....
2: .... .... .... .... .... .... ....
3: .... .... .... .... .... .... ....

leave set
 : .... .... .... .... .... .... ....

third node (ID ....)

routing table
0: .... .... .... .... .... .... ....
1: .... .... .... .... .... .... ....
2: .... .... .... .... .... .... ....
3: .... .... .... .... .... .... ....

leave set
 : .... .... .... .... .... .... ....
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Exercise 8.2: Kademlia

a) Kademlia defines the distance between two IDs by applying the XOR operator and interpreting the result as an integer. Show that this actually defines a metrics

Show that:

$$d(x,y) > 0 \; \forall \; x \neq y$$
$$d(x,y) = 0 \Rightarrow x = y$$
$$d(x,y) = d(y,x)$$
$$d(x,y) \leq d(x,z) + d(z,y)$$

b) Kademlia's authors states, that a node knows only few neighbors in a far distance and increasingly more neighbors for smaller distances. Explain why.

c) The authors of Kademlia claim that particularly the fact d(x,y)=d(y,x) makes the protocol superior as compared to Chord. Try to find a reason why. (Keep in mind that a node learns from the queries of other nodes.)