Exercise 1

Exercises Peer-to-Peer-Systems and Security (SS2012)

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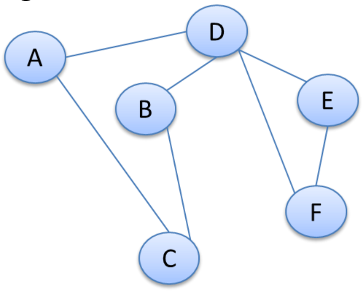
Thursday 3.5. 2012
Hand-in: Thursday 10.5. in lecture or by mail to niedermayer – at – net.in.tum.de
Exercise: Monday 14.5. in lecture

<u>Rules:</u> There will be four exercise sheets. You have to hand-in 70 % of the assignments, attend at least 3 exercise courses and present a solution in the exercise course to get the 0.3 bonus.

Assignment 1 Clustering-Coefficient C and characteristic path length L
This assignment is about the clustering coefficient and the characteristic path length. Here is the graph.



Determine C, L as well as the diameter of the graph.

Assignment 2 Clustering-Koeffizient C
In this assignment you should create an example graph with certain properties.

a) A connected graph with 8 nodes and C=0.5 (approx.). Prove your claim by calculating C.
b) A connected graph with 6 nodes and at least 7 links and C=0. Calculate C for the graph.

Assignment 3 P2P Protocol
A protocol for an unstructured network. Each node joins via some node it knows. As a first step, it simply adds a link between itself and the node it used for the join. Then it operates as follows:

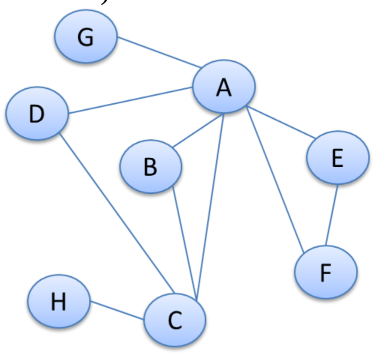
- If the node has less than 100 neighbors, every 100 s the node asks a neighbor for 10 other nodes. Each of the nodes in the reply will be contacted with probability p=25 %. This means that it will establish a connection, and add it to the list of known nodes. Otherwise, it ignores the node.
- Every 5 s it will contact one random neighbor to see if it still exists. If not, the connection to the node will be closed and the neighbor will be removed from the list of known nodes.

Questions:

a) What is the probability that none of the 10 nodes in a reply is contacted?
b) Give an example for a problem of this protocol. How could you fix it?
c) Assume the network is bootstrapped via one server that knows all nodes. If a new peer wants to join, it asks for a node that is in the network. The server returns a random peer. What kind of a network graph would you expect (Random, Small World, Power Law)? Argue why your answer is true (hint: state your assumptions and conclusions) and why the others are not.

Assignment 4 Power Law

Assume now that a new node N is joining the graph. It will set its first link according the Barabasi-Albert model (linear preferential attachment).



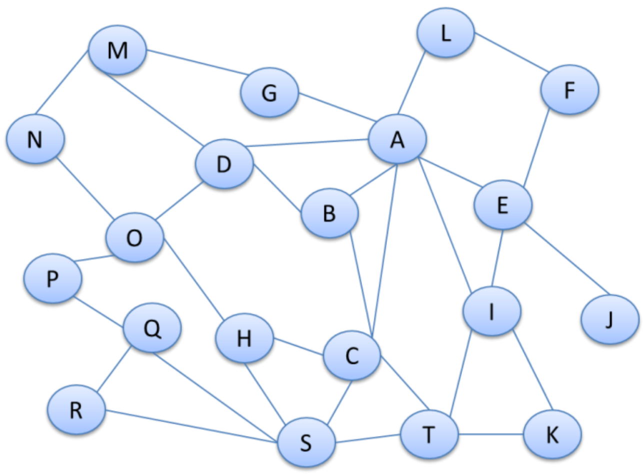
a) With what probability will it select node A?
b) Give an example of a reason that explains why a new node that does not know the network may have a higher chance of contacting node A than e.g. node G.
c) What will happen if an attacker shuts down node A?
d) What could you do to avoid Power Law graphs and hubs?

Assignment 5 CoolSpotsMunich I

Assume that the CoolSpotsMunich network is an unstructured network just as in the first slides of chapter 1.2 where the peers form an unstructured network and each peers stores its own data (items = “spots” / interesting points in Munich area with description, rating, GPS location, etc.) locally.

You will now optimize the network using replication of items. Every hour a node will look up 2 random peers using a random walk. At each hop a random next hop is selected (all previous hops excluded). Each walk is 3 hops long. You will do this 2 times to get the 2 peers.

The node will then store its spots (items) on these 2 peers. Nodes will delete the spots / items of other nodes after 2 hours.



Assume the lookup is limited to 2 hops (neighbour + neighbour of neighbour).

a) Node A will now ask for all spots in Garching. Can A be sure to get back all items on Garching that exist in the network? Justify your answer.
b) Assume that the random walks of node O ended on nodes A and T. Are its items now available to all nodes? How many nodes would reach its items without this replication?