Proposals for Master Degree Thesis
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This document proposes some topics for Master Thesis. The thesis are related to some research topics I am currently investigating together some collegues of CNR, Pisa.

1. **Distribute Current Flow Betweeness Centrality**

   The current flow betweenness is a widely used centrality measure for graphs. Differently from the classical betweenness centrality, it exploits electrical current model to evaluate centrality of nodes. We have recently proposed a distributed, approximated gossip-based and message passing algorithm for the computation of the current flow betweenness centrality. The algorithm makes use of laws of electrical circuits to compute the current flow between pairs of nodes. Each node, according to its local information, adaptively generates new flows to improve the betweenness knowledge of the whole graph. The thesis will investigate a block-based version of the algorithm, where each the graph is partitioned and the Kirkhoff laws of the circuits are applied to each sub-graph to simplify them. The different partitions are analysed in parallel by different nodes which cooperate to obtain the final solution.

2. **Data Availability in Distributed Online Social Networks**

   Although most online social networks rely on a centralized infrastructure, several proposals of distributed online social networks have been recently presented. Since in distributed online social networks user profiles are stored on the nodes of the users belonging to the network, one of the main challenges comes from guaranteeing the profile availability when the owner of the data is not online. In this thesis we will investigate a distributed online social network based on a friend-to-friend P2P overlay where user's data is stored only on friend peers. The approach is based on the ego-network concept, which models the social network from the local point of view of a single user. We have proposed a distributed algorithm based on a notion of coverage of the ego-network which assures that users store their data only on the nodes of their friends, and that each online user can retrieve the private data of its offline friends through a common online friend. We formalize this as a Neighbour Dominating Set problem. The thesis will investigate the problem of the consistency of multiple copies of a social profile replicated on the friend's nodes.

3. **Anonimity Mechanisms for Digital Currency: A Bitcoin Perspective**

   This work will focus on digital currencies, focusing particularly on Bitcoin because of its dominant position. It is interesting to verify if the current Bitcoin protocol fulfills its promises as a digital currency, and it is our intention to focus especially on users privacy protection (without ignoring the other interesting research topics). Since the very start users anonymity was not Bitcoin main goal. This has brought to a major flaw in the project, which protects user anonymity only with the

use of pseudonyms, with the hope of breaking ownership linking between addresses and real world identities. Any cryptocurrency which intends to scale to world acceptance needs strong privacy assurances, which nowadays Bitcoin seems to fail to give. The work will concentrate on showing Bitcoin privacy shortcomings in practice and developing effective countermeasures