ABSTRACT OF THE PROJECT

The main scientific goal of this project is to construct efficient randomized algorithms for selected network problems in the online and the limited recourse budget model. These models gain increasing popularity as they address the real-life problems typical for modern networks related to their dynamics. As of now, papers in this field are regularly accepted to prestigious theoretical science conferences such as FOCS, STOC, and SODA. To give an example, the online model captures scenarios, where clients arrive one at the time, demand some service or some commodities, and the decision of providing a service or a commodity to a client is irrevocable. This means, that there might be a client in the future, who wants to buy a commodity that was already sold to another client in the past. The irreversible commitment to past decisions required in the online model often leads to unavoidable errors in making decisions. As a result, the provider often cannot hope to get a high profit from serving the clients. To bypass these inconvenient limitations, and still keep the clients satisfied, the focus in the field of online algorithms has moved towards relaxations of the online model, where more power is given to the provider.

One way of supplying the provider with more power is to allow it to make random decisions. In that case, the provider tries to maximize its expected gain over all the random choices that he makes. Another way is to allow the provider to change a very limited number of past decisions. The limit on the number of changes to the past decisions is called the recourse budget.

Both these relaxations have been successfully applied to the online model where only the clients arrive online, and the set of services is invariant throughout the entire process. It was shown, that with random decisions the provider can significantly improve its expected gain. Moreover, in many cases a very small recourse budget allows the provider to obtain the optimum gain. Inspired by this success we plan to apply these relaxations to more general arrival models, for instance when both the clients and the services arrive in the online fashion.

Moreover, we plan to address more real-life scenarios. Another important scenario that can be addressed by the online model is when the users of the network need to be partitioned into a small number of clusters, and only the non-conflicting users can be assigned to the same cluster. The users of the network arrive in the online manner, and have to be assigned a cluster right after their arrival. This is a very important and fundamental network problem, much harder than the client-service assignment problem. In fact, with no structural assumptions on the input network, the number of clusters has to be extremely high, even if the clustering algorithm is allowed to use randomization. A natural assumption here is that the input network can at any time be partitioned into k clusters for some small value of k, given that the algorithm has unlimited recourse power. For such networks, it is possible to obtain meaningful improvements for online algorithms with limited recourse power. Our main objective is to apply randomization and limited budget model to such networks, and analyze what improvements are possible compared to the more restricted online scenario with no randomization allowed.

Moreover, we plan to analyze yet another real-life scenario, when the users of the network appear in a random order. Random arrival of the users is a very realistic assumption, and not much work has been dedicated so far to study this model rigorously for either the client-server or the clustering problem.