Bachelor project topics.

1) LP-Relaxations of Kidney Exchange Problem formulations

The kidney exchange problem (KEP) is the problem of, given a set of patient-donor pairs and possibly non-directed donors, finding the maximum number of transplants that can be performed under the constraints that i) whenever the donor in a pair donates his kidney, the patient must receive one in return, ii) the length of cycles and chains respect a given upper bound. Around the world, many kidney exchange programs have been established, which use (variants of) the KEP problem to allocate donor kidneys. While this problem is NP-hard in general, real-life instances can usually be solved extremely quickly using standard IP-solvers. One reason for this is that IP-formulations for this problem have very tight LP-relaxations in practice.

Goals of this project:

- Investigate the scientific literature on KEP formulations.
- Investigate the integrality gaps of various known formulations.

2) Guarantees for Collaboration in Kidney Exchange

Different hospitals or countries (agents) running their own kidney exchange can work together. Merging kidney exchange pools allows for additional transplants overall. However, there is a risk that individual agents lose transplants by joining such a common pool. For this reason, guarantees can be given. For example, in the chosen solution, each agent receives at least as many transplants in the common pool as they would have received working independently.

Goals of this project:

- Investigate scientific literature on collaboration in Kidney Exchange
- Implement (and devise) and test guarantees common pools can make with respect to total transplants, cooperation of individual agents,…

3) Online Matching (for organ allocation)

Patients waiting for a transplant are placed on a waiting list. Whenever an organ becomes available, one patient on this list is chosen to receive the organ. Choosing the correct recipient so as to maximize total benefits is a difficult task. There is as a trade-off between certain immediate benefits and uncertain later benefits. For example, if a patient receives an organ today, he will no longer be available to receive a possibly better matched organ tomorrow. This problem is an on-line matching problem (https://people.eecs.berkeley.edu/~vazirani/pubs/online.pdf).

Goals of this project:

- Investigate scientific literature on on-line matching.
- Analyze and/or simulate online matching algorithms in a simplified “organ allocation” setting.