COST Action IC1205 on Computational Social Choice: STSM Report
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During my STSM to the University of Patras, I worked together with my host Ioannis Caragiannis, as well as Panagiotis Kanellopoulos and Aris Filos-Ratsikas (who visited Patras at the same time) on problems related to envy-free pricing. During this time we identified several open questions in this domain and obtained some preliminary algorithmic results.

The envy-free pricing problem is as follows. A seller has multiple indivisible goods that he is trying to sell to multiple buyers with quasi-linear utilities and combinatorial valuations over the goods (formally, each buyer i has a value vi(S) for every bundle of goods S). This fundamental market model does not always admit a competitive equilibrium and several approaches have been taken over time to understand how pricing should be done such that the market is cleared, including bundling items or restricting the class of valuations at hand.

However, while bundling is not always feasible (similarly, it's not always possible to restrict the valuations in arbitrary markets), one operation that the seller always has available is to take items off the market (equivalently, price them very highly so that nobody would want to buy them). The seller can always remove all but one items from the market – this gives a reduced market with multiple buyers and only one indivisible item, which is guaranteed to have a competitive equilibrium. The question then is to remove enough items so that a market equilibrium is guaranteed to exist, while maximizing revenue or social welfare.

During my visit, we designed a general algorithm that obtains an n-approximation of the optimal social welfare (and revenue) for arbitrary combinatorial valuations. Then, we considered several succinct classes of valuations, such as single minded buyers, for which it appears that the answer to the best attainable revenue/social welfare in an envy-free pricing is unknown. A buyer is said to be single minded if the buyer is only interested in one set of items and is happy (i.e. gets maximal value from the allocation) if he gets that set (or a superset of it), and unhappy (i.e. gets value zero) otherwise.

For the class of single minded buyers, we designed a min(m,n) approximation to the optimal social welfare/revenue for the envy-free pricing problem. We also gave a lower bound of 2 and are working on identifying the correct approximation of the optimal revenue/social welfare achievable for this class, as well as designing polynomial time algorithms for computing such approximations (whenever possible). Several other classes such as subadditive valuations also appear to not be well undestood in the context of envy-free pricing and we are planning to continue investigating this problem to clarify the bounds attainable for different classes of valuations and give polynomial time algorithms (whenever possible) for computing market clearing allocations.