Report on the outcomes of a Short-Term Scientific Mission[1]

Action number: CA16228

Grantee name: Alexandros Tsigonias-Dimitriadis

Details of the STSM

Title: Initiate research collaboration with Prof. Leonardi
Start and end date: 28/02/2022 to 17/03/2022

Description of the work carried out during the STSM

Description of the activities carried out during the STSM. Any deviations from the initial working plan shall also be described in this section.

(max. 500 words)

During the almost three-week stay, we started working on an open problem related to prophet inequalities, which was one of the proposed topics of the working plan. We formulated the research question and obtained some novel results, together with Prof. Leonardi and some members of his group. More specifically, we studied the performance of algorithms designed for a new objective function. Traditionally, when studying prophet inequalities, the measure of performance (i.e., the objective function)_is the ratio of the expected performance of our algorithm over the expected performance of a prophet, which is loosely the optimal algorithm with full knowledge of any instance in advance. We study an equally well-motivated objective function: the expected ratio of an algorithm's performance over the optimal one. Let's call this new objective the expectation of ratio. We start with the simplest single-choice prophet inequality and provide an algorithm that obtains the optimal expectation of ratio (note that the tight result is different from the one for the classic objective of the ratio of expectations). Then we turn our attention to one of the most well-studied and well-motivated (online) combinatorial settings: online matching with edge (or vertex) arrivals in general graphs. In this setting, we are given the underlying graph and independent distributions on the weights of the edges, but not the weights themselves. Then the weights of the edges are revealed one by one in adversarial order. For each edge, we have to decide immediately and irrevocably whether to include it in the matching. In the end, we want to produce a feasible matching and compare its weight to the maximum weight offline matching (that is, the one where all the realized edge weights are known in advance). We provide an algorithm that achieves constant expectation of ratio. In fact, we manage to significantly generalize our result so that it holds not only for matchings but for any structure with downward-closed feasibility constraints.

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Note that the obtained constant is not tight, but it's positive that we can provably achieve constant ratio with very simple algorithms and for very general constraints.

Description of the STSM main achievements and planned follow-up activities

Description and assessment of whether the STSM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the STSM. Agreed plans for future follow-up collaborations shall also be described in this section.

(max. 500 words)

Overall, I believe that the STSM achieved its planned goals and expected outcomes. The specific Action objectives and deliverables described in the working plan were also achieved. In the given time, we managed to initiate a research collaboration with a well-defined question and some positive results already. We are now continuing our collaboration remotely and working towards submitting our results in a few months, either in an algorithmic game theory/mechanism design or a theoretical computer science conference. We are optimistic that we can have a paper ready for submission in mid to late summer. We are also currently working towards tightening some of the results mentioned in the previous section of this report and also thinking of some extensions to showcase the limitations of our algorithms and techniques. We believe that our results will contribute to the literature on combinatorial prophet inequalities and provide a more complete picture of what simple algorithms can achieve for the two objectives (the classic and the one we defined) and how much the two differ from each other.