Searching with predictions

Areas of interest: Theoretical computer science, operations research, artificial intelligence.

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General presentation of the topic  In search problems we are given an environment (e.g., a network that represents a city), and a mobile searcher, initially stationed at some specified point in the environment. Somewhere in the environment, there is an immobile hider whose exact position is unknown to the searcher. The objective is to design a strategy, i.e., a way to navigate the environment so as to locate the hider as efficiently as possible. The performance evaluation of the strategy is often done using the framework of competitive analysis of online algorithms, see e.g. [5]. Here, we must find the worst-case ratio of the time it takes for the searcher to locate the hider to the time it would take if we knew the exact position of the target in advance. Problems of this type are studied not only in theoretical computer science, but also in operations research [2] and artificial intelligence [3].

Traditionally, search games are studied assuming no information on the hider’s exact position (particularly as far as deterministic strategies are concerned). However, there is a recent trend from Machine Learning, in which the online algorithm has some external information, or prediction about the input [6, 7]. The prediction may be erroneous, i.e., noisy. In the context of search problems, the prediction can be, for example, a rough indicator of the whereabouts of the hider within the network. The objective is to design and analyze search strategies that incorporate this prediction, and evaluate the performance in terms of the prediction error. A first study of this class of problems was recently presented in [1].

Objectives  The purpose of this internship is to further study search games with predictions. Of particular interest are the following two settings: i) Randomized search strategies, in which the searcher may chose the way to navigate through the network in a randomized, instead of deterministic manner, and ii) Combining the use of several predictions, as in the recent work [4]. The applicants are encouraged to get in touch with the supervisor for further details.
There is also potential for experimental evaluation of the algorithms, depending on the skills and interests of the applicant. However, the main objective is the analytical evaluation of search strategies.

Qualifications

- A solid background and general interest in theoretical analysis of algorithms are essential.
- Experience in coding and experimental evaluation is desirable.
- Willingness to do research in a very active area, with publications coming out every week.
- Good command of English.

References


