Online searching with earliest clearance

Areas of interest: Artificial Intelligence, Theoretical Computer Science.
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General presentation of the topic

Suppose you have a searcher who wants to locate a missing object or person, also called hider in a given domain. The searcher does not know the position of the hider. The objective is to design a search strategy, that is, a way for the searcher to navigate through the domain as efficiently as possible. One particular way of evaluating the performance of a search strategy is via the competitive ratio: this is defined as the worst case ratio (over all placements of the hider), of the total distance that the searcher traversed divided by the distance that it would have to traverse if it knew the precise location of the hider.

A lot of previous work has been done on variants of the above fundamental problem. The work has intersections with three broad fields of research: Theoretical Computer Science (see e.g. [5]), Artificial Intelligence (see e.g. [4]), and Operations Research (see the book [1]). A recent application of the competitive framework in general networks can be found in [3].

While the competitive framework is useful, this is not quite how we search in real life. For instance, in a search-and-rescue operation, we have to clear-up a certain area, as efficiently as possible. If we do not locate the missing person, we assume that we may have missed it; we thus re-start the search from scratch. It is thus important to meet two goals at the same time: 1) be competitively efficient while we search; 2) clear up the desired area as quickly as possible, so as to be able to re-start as soon as possible.

In this internship, we will formulate and study the above framework.

Objectives

The internship involves two main directions.

The first direction considers a simple search domain that is a star. This setting is simple, but it is very useful in AI. The objective here is to apply some ideas based on linear programming formulations that were first exploited in [2]. This part is theoretical in nature, but we have all the available tools to approach it, and obtain exact optimal strategies.
The second direction is to design efficient search strategies for domains that are formulated as graphs (or networks). Here it is impossible to obtain good theoretical results. We would like to design a good heuristic and analyze it, preferably on real data. We have specific ideas about how to achieve this goal.

**Qualifications**  No prior knowledge of search algorithms is required, but a good theoretical and programming background is required. The intern should be willing to do coding and, preferably, work with real data.

Ideally, the outcome of this work will be submitted to a competitive AI conference such as AAAI and IJCAI.

**References**


