Research Proposal:
Rendevous Problems and Search Games on Planar Graphs

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1 Introduction

Since seeing a couple very simple graph theory problems in middle school, graph theory has captured my attention. My first algorithms course was last year and it was one of my favorite classes. I’m currently taking Extremal Combinatorics which has covered a variety of graph theory problems. Last summer, I also was in an REU which worked on a graph theory problem and really enjoyed working on problems in that field. I wanted to do my senior thesis in these areas because I find them interesting and love working on problems in these areas.

Consider the following problem: you walk out of your house on a foggy night and you know you parked your car somewhere along the street. How do you find your car efficiently without knowing which direction or how far away the car is?

Search games are a more general case of the problem given above. There is one player searching for a goal in a search space. The player has some limitation on his knowledge. In particular, he does not know the exact location of the object he is searching for. The goal of the player is to make the time of finding the object in the worst case as close as possible to the time to find the object if he had complete information.

Some variations include varying the information the player has with regard to the search space, and to the position of the goal. Another variant of search games are rendezvous problems, where there are multiple searchers trying to converge at a single point. These searchers may be the same in that they all use the same algorithm, or they may be distinguishable.

2 Proposed Research

One simple extension of the first problem is the Cow-path problem, where instead of searching on a line (2 rays) you search along \( k \) rays, and sometimes you can move between the rays later on. This basic problem can be
extended in many simple ways, just by varying information given and the search space.

One area of search games is rendezvous problems, where there are two or more players searching for each other in a search space. These can also vary in how much information the players start with and how much communication has been allowed. I can study when the players leave tokens for each other. In other words, they can leave pieces in the search space when they are at that place in the search space.

3 Prior Research

The $k$-lane Cow-path problem was studied by [2]. They found an algorithm and proved its optimality in a special case. [1] then went on to further generalize the result.

Rendezvous problems (where there are two players searching through each other) have been studied on a line, lattices, and a continuous plane [3]. Not much has been studied where tokens are allowed. [5] and [6] both studied leaving tokens on a ring. Also, [4] studied when there is a token placed at the starting positions of each player and no where else.

References


