Maker Breaker Triangle Game

Maker Breaker games evolved from positional games and are a well studied topic in combinatorics. We want to study in particular the maker breaker triangle game. This game works as follows. We play on the complete graph with \( n \) vertices and two players, Maker and Breaker. We additionally fix some \( q \) and then the rules are as follows. Maker can claim one of the edges for himself, then Breaker claims \( q \) edges for himself. This repeats until either Maker can claim the 3 edges of a triangle or until all edges are claimed and Maker has not won yet in which case we call this a win for Breaker.

This game has gotten some attention. Clearly both players have optimal strategies as there is no uncertainty involved. Maybe less obvious, for \( q = 1 \) this is a makers win, that is playing optimally, Maker can always force a victory. On the contrary for \( q = n − 1 \) this is a breakers win. Now the interesting question is, for what value of \( q \) does this switch?

It has been known for a while that the rough point of how large \( q \) must be for Breaker to win is of the order \( \theta(\sqrt{n}) \). In a recent paper [1] the gap was narrowed down to \( q \in [\sqrt{2}, \frac{\sqrt{8}}{3}n + o(n)] \). This was done with a clever strategy for Breaker using a potential function describing what the most urgent vertices are.

The goal of this thesis would be to take a closer look at this potential function, see if it can be optimized and implement it on with some strategies for Maker to see how it performs in practice.

**Prerequisites:** Passing grade in at least one of the courses APC or Randomized Algorithms.

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**References**