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Searching the Complete Bipartite Graph using Coined and Lackadaisical Quantum Walks

The coined quantum walk is a discretization of the Dirac equation of relativistic quantum mechanics, and it is the basis of many quantum algorithms. We investigate how it searches the complete bipartite graph for one of possibly several marked vertices, which can lie in one or both partite sets. Following this, we add a weighted self-loop to each vertex, which permits the walker to stay put. This is a lackadaisical quantum walk, and since the graph can be irregular, the weights of the self-loops in one partite set can naturally differ from the weights in the other set. When the marked vertices lie in one partite set, this yields a speedup over the loopless, regular coined quantum walk, which is consistent with previous works on other graphs. When the marked vertices lie in both partite sets, however, speedups are surprisingly rare.

This is join work with Mason Rhodes.