Quantum Research Project

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1   Abstract

This project aims to analyze a computer science perspective of the random walk, in the fields of qunantum computing: the quantum walks. A random walk, known also as stochastic process, is a mathematical object that describes a path in which the steps are choosen randomly. In the fields of computer science this object can be seen as a building block useful to construct more complex algorithms. An interesting application, of random walks, concerns graphs, for instance graph search. Thanks to quanutm computers we can achive a speedup with respect to classical computer, even though this speedup differs among the graphs type.

2   Introduction

2.1   Random Walks

A random walk, also known as a stochastic or random process, is a mathematical object which describe a path constitued by random step over a mathematical space. A common example is a random walk in the integer set Z, starting from a certain point, for instance x=0, the path is defined by randomly choose to move left or right by increase or decrease the actual value of x by 1. Tossing a coin will help in choosing randomly, with equal probability, the next step to take. The previous example could be generalized by increasing the dimension of the mathematical space considered, in a cartesian plane the starting point will have two coordinates and the possible moves becomes 4. The random walk can be divided in two major classes, discrete and continous random walk: in the first class

2.2   Random Walks in Computer Science

In computer science an interesting application of the object described above is in graphs. A random walk could be applied for search a specific node by mark and find it in random steps.

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2.3 Random walks in Quantum Computing: Quantum Walks

Since quantum computer deals with randomness by nature we can imagine a relevant speedup on performance, for sure thanks to quantum mechanics the randomness that help us choosing which way to take is "more random" with respect to classical computer. If we compare the speedup in time we need to make distinctions by classes of graphs.

3 References

1 https://cnot.io/

2 https://algassert.com/quirk

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