

Project Proposal - Exact Cover

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Introduction

According to Wikipedia, given a collection S of subsets of a set X , an exact cover is a subcollection S^* of S such that each element in X is contained in exactly one subset in S^* .

Exact cover is an NP-complete problem. To solve it efficiently, Knuth proposed Algorithm X in 2000, which is an DFS-based algorithm with a data structure named Dancing Links for pruning.

Goal

Since Dancing Links is based on double-linked list, it is not a persistence data structure. We will design and develop an immutable version of Dancing Links to fit it in a functional programming language like Haskell.

Then we will parallelize the searching part, making it utilize multi-processors as much as possible.

To evaluate our work, we will use Sudoku and N-Queens as two examples of exact cover problems, and validate their correctness and run benchmarks against different configurations.