Parallel Functional Programming Project Proposal: Genetic Algorithms (GenAlgo)

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1 Background

Genetic algorithms are a class of algorithms designed for solving search problems. Their key technique is generating a population of many potential solutions, evaluating them, and then choosing the next generation from a "crossover" of the best solutions of the previous generation. For many search problems, there are often many local minima that typical optimization algorithms can get stuck in, so an algorithm that introduces randomness can be useful for finding a global optimum. This is also a useful class of algorithms as it can find approximate solutions to NP-problems in reasonable amounts of time.

Some example problems that can be solved efficiently with genetic algorithms are N-Queens, hyperparameter optimization, code-breaking, and market modeling.

2 Proposal

We feel that genetic algorithms are a great applications for parallelism as there are places to parallelize throughout the different stages of the algorithm:

1. Population initialization
2. Fitness calculation
3. Population sorting
4. Crossover
5. Mutation

However, there are also bottlenecks where all stages of the algorithm need to be finished in order to proceed, meaning that it's a non-trivial parallelization problem.

We propose making a generic parallelized genetic algorithm solver, that can take a (sequential) fitness function, that scores a given solution, and a binary

representation of the solution, as an input (among other parameters), allowing us to solve a variety of problems with this tool. We will primarily use the N-Queens problem as our example during development, but will be able to test other problems.

References

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