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# A Decomposition Method for Symbolic Regression Problems

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## Abstract

The purpose of this paper is to improve the efficiency of Genetic Programming (GP) by decomposing a regression problem into several subproblems. An optimization problem is defined to find subproblems of the original problem for which the performance of GP is better than for the original problem. In order to evaluate the proposed decomposition method, the subproblems of several benchmark problems are found by solving the optimization problem. Then, a 2-layer GP system is used to find subproblems' solutions in the first layer and the solution of the original problem in the second layer. The results of this 2-layer GP system show that the proposed decomposition method does not generate trivial subproblems. It generates subproblems that improve the efficiency of GP against when subproblems are not used.

*Keywords:* Genetic Programming, Symbolic Regression, Performance Estimation, Decomposition, Optimization

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## 1. Introduction

Genetic Programming (GP) [1, 2] is an evolutionary computation technique that is also used as a machine learning tool for various applications such as classification, regression, etc. One of the challenges of GP is related to the solving of complex problems. To improve the efficiency of GP for complex problems, decomposition is one of the most widely used approaches not only in GP but also in other fields.

The idea of decomposition has three stages. The first stage is to break down a complex problem into several simpler, less complex subproblems that are easy to solve using existing algorithms, here it means GP. The second stage is to solve subproblems and achieve a subsolution for each subproblem. The last stage is to combine the subproblems' solutions together in order to solve the

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