4-18-2012

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Applying Genetic Programming to Develop a Rubik’s Cube Solver
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Abstract
Genetic programming, a method of developing code using evolutionary principles in a computer simulation, can theoretically be applied to any problem. This work explored the applicability of genetic programming to generating a human-readable set of rules that could be used to solve the cube. This involved developing a language to describe solutions to the cube as a series of rules, an algorithm to process those rules, and a fitness function to describe how good a possible solution is. Because of the high dimensionality of the problem, the difficulty in creating a good fitness function, and the need to develop both good rules and good solutions simultaneously, the ultimate goal was not achieved. However, through the effort to apply genetic programming to develop a Rubik’s Cube solver, valuable information was gathered on what needs to be done for such an attempt to be successful.

Possible Actions

Examples of Rules

Antecedent (54 characters)

Consequent

UUUUUUUUUBUBBBUBUBUUBUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUU.AQBR.
UUUUUUUUUBUBBBUBUBUUBUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUU.BNAM.

Elements of Genetic Development

• Starting Population: Randomly generated, begins Evolution Process
• Fitness Function: Used to evaluate solutions, drives evolutionary process
• Creating the Next Generation: Solutions selected and “bred” for new generation

Conclusions

• Rules and solutions (sets of rules) both need to be developed genetically
• Use of an near optimal cube solver in the fitness function likely beneficial
• The goal of developing a human readable solution genetically is attainable

Simplification and Experiments

• Two color cube: Reduces size of the search space
• Nearly Solved Cube: Reduces complexity of solution
• Single Action Consequents: Reduces size of the search space
• Human Written Solver: Provides context for complexity of good solutions