Redundant Node Pruning and Adaptive Search Method for Genetic Programming

Yoichiro Maeda
Faculty of Information Science and Technology
Osaka Electro-Communication University
18-8 Hatsu-cho, Neyagawa, Osaka 572-8530 Japan

Satomi Kawaguchi
Sougou System Service Ltd.
680 Oomandokoro-cho, Karasuma, Bukkoji,
Shimogyo-ku, Kyoto 600-8413 Japan

Abstract

In this paper, we proposed two methods to realize efficient search of GP. We also report results of simulation which performed to prove the effectiveness of our proposed methods.

1 RPGP

Large amount of calculation due to complex tree structure is the most important problem in the research of GP. First of all, we propose RPGP (Redundant node Pruning Genetic Programming) to improve the search efficiency of GP. In the RPGP, we define the redundant node with unexecuted partial tree and can improve the search efficiency by pruning redundant nodes. For pruning redundant nodes in the program generated by GP, we perform encoding to replace individuals expressed with the tree structure to genes with digits and decoding to return reversely. We encode individuals generated by GP, apply the RPGP operation to redundant nodes in the gene, decode pruned individuals and perform the process of the fitness calculation.

2 FASGP

There is an important problem that original GP and RPGP does not necessarily performs proper genetic operations in accordance with the stage of a search. Therefore, we propose FASGP (Fuzzy Adaptive Search method for Genetic Programming) because of improving search efficiency in GP. In the early stage of a search, FASGP makes a crossover rate low and a mutation rate high by simplified fuzzy rules because of keeping varieties of individuals. In the last stage of a search, FASGP makes a crossover rate high and a mutation rate low because of searching only excellent individuals.

In the initial generation, the mutation rate (RMC) and the crossover rate (RCA) of genetic operations are decided by fuzzy reasoning with input values of the maximum fitness value (VAL) and the difference between maximum and average fitness value (VAL-ASF).

3 Simulation

We performed the simulation of the famous artificial ant problem called Santa Fe Trail to confirm the efficiency of this method. In the simulation, an artificial ant with limited energies eats 89 foods walking in 32*32 square. We compared artificial ant simulation results performed by using GP, RPGP and FASGP+RPGP. Figure 1 shows a result of the average fitness in case the population size is 1000. In three cases, we found that RPGP and FASGP can often obtain the good solution also in various populations. Totally, we also confirmed that FASGP (+RPGP) has the most excellent search ability than GP or RPGP.

References

J. Koza (1992). *Genetic Programming.* MIT Press.

Y. Maeda (1998). Adaptive Search Method for Genetic Programming Using Fuzzy Reasoning. *14th Fuzzy System Symposium.* 267-270. (in Japanese)

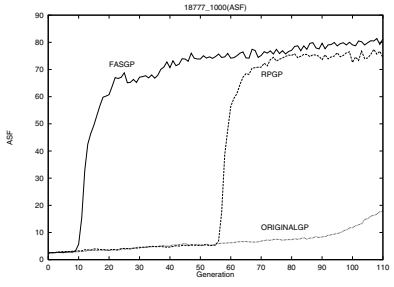

Figure 1: Simulation Result (Average Fitness Value)