Distributed Genetic Programming with Mobile Agents

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Abstract

This paper presents a system for accessing the potential of Genetic Programming [Koza 1992] by exploiting the availability of computer networks to distribute the computational load over a large number of machines. The goal is to utilise the CPU and memory resources of Intranet systems, to facilitate GP operations. In addition the use of a large-scale parallel network of machines allows a demetic grouping of sub-populations to be created, in order to enhance the genetic diversity within a GP system. While several existing schemes for parallelisation of GP exist, (e.g. Andre & Koza 1996) this work demonstrates how Java based mobile agents are ideally suited to this task. An intelligent agent infrastructure has been created, which assists a user by automating the deployment and monitoring of a parallel GP system using mobile agents. The major benefits realised are greater cost efficiency in utilising available computer power and ease of use.

1 INTRODUCTION

Genetic Programming has proved to be a powerful algorithm for the automatic evolution of computer programs. However, as with all evolution based search mechanisms the computational effort required is immense and scales with the size and complexity of the problem. In particular the variable length of GP chromosomes can lead to the utilisation of large amounts of memory. This paper proposes that mobile software agents are an ideal platform for the automated distribution and management of large scale distributed genetic systems.

2 MOBILE AGENTS

The essential concept in using mobile agents for a Distributed Parallel Processing (DPP) system is that the agents automatically redistribute the task processes across the network, in order to access the best available computing resources, at any point in time.

As these agents behave co-operatively as a team our system is called **MATS**: the Mobile Agent Team system. One of the design objectives of MATS was to minimise the code that would need to be moved about the network. This was achieved by localising the most complex functionality in an anchored (non-mobile) agent, which can then communicate with the simpler specialised mobile agents through a message passing mechanism. In effect, this is a marriage of the autonomous and social features of 'collaborative' agents with the facilities offered by mobile agent technology. To minimise the complexity of our mobile agents, we have differentiated them according to particular roles, based on the functions of sensing, server construction, code distribution and code management.

3 CONCLUSIONS

The use of intelligent software agents to facilitate the construction of a parallel distributed GP system has proved to be an extremely cost effective solution. More importantly it opens the possibility of allowing open access to network resources for deploying any evolution-based algorithm, which requires very large populations of individuals.

References

Andre, David and Koza, John R. 1996a. Parallel genetic programming: A scalable implementation using the transputer network architecture. In Angeline, Peter J.and Kinnear, Kenneth E. Jr. (editors). 1996. Advances in Genetic Programm 2. Cambridge, MA: The MIT Press. Chapter 16.

Koza J., "Genetic Programming: On the Programming of Computers by Means of Natural Selection." (book) Publisher MIT Press, 1992.