A Hybrid Evolutionary Algorithm for Task Matching and Scheduling

錢雅惠、江傳文
E-mail: 9225038@mail.dyu.edu.tw

ABSTRACT
Heterogeneous cluster computing is regarded as a promising approach to solve CPU-intensive problems at a low cost. One can decompose a composite parallel program into constituent tasks so that these tasks can be assigned to different process elements (PEs) for concurrent execution. These tasks generally can be characterized by a task graph, which is represented as a directed acyclic graph (DAG). In this dissertation, we develop a hybrid evolutionary algorithm for allocating task graphs onto a heterogeneous cluster-computing system. Based on a general framework of genetic algorithms (GAs), this proposed algorithm is specific to its two operators: the topological order crossover (TOX) and the guided mutation (GM). We proof that the chromosomes generated by the TOX operator satisfy the precedence constraints and have higher validity as well while compared to the conventional single-point order crossover (OX). We also combine the GM operator and concepts of the simulated annealing (SA) so that a useless mutation can be avoided. The proposed algorithm is evaluated through a comparison with tabu search (TS), SA, and GAs in terms of the schedule length in DAGs. Experimental results show that the proposed algorithm outperforms the three while solving the task mapping and scheduling problem.

Keywords: task matching and scheduling; genetic algorithms; simulated annealing; tabu search

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