Mathematical programming approaches to composing multi-criteria cooperative learning groups based on conceptual maps

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Cooperative learning is a useful way for learning, whereas how to divide learners into adaptive groups becomes an important issue. In this study, we use the conceptual maps to evaluate the learning performance for each student and propose a mechanism to gauge the conceptual complementarities between two individuals. We then set several grouping strategies based on complementary scores, coverage of concepts and fairness between groups.

We propose two mathematical models based on integer programming (IP) formulations by different grouping strategies. We illustrate our grouping mechanisms by examples and show how previous group composition strategies can be integrated into our proposed grouping mathematical models.

To effectively grouping students within short period of time, we propose a genetic algorithm (GA) and a greedy algorithm (GREEDY) and compare their performances with the formulations solved by a state-of-the-art IP solver. The test results indicate GA and GREEDY can efficiently deal with larger problems, and GA is more robust with better performance than GREEDY.

Keywords: Cooperative learning, Grouping strategies, Conceptual graph, Integer programming, Genetic Algorithm