DESIGN AND STATISTICAL ANALYSIS OF INITIAL SOLUTION CONSTRUCTION APPROACH IN CURRICULUM BASED COURSE TIMETABLING PROBLEM

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ABSTRACT

Purpose - This paper investigates the construction phase approach in which the sequential order of the courses/lectures applied several combination of graph heuristics to generate a population of initial solutions in curriculum-based course timetabling (CBCTT). The construction of population of initial solution is a prerequisite in a population-based metaheuristic implementation. To produce a population of initial solution require algorithm that can produce multiple feasible solutions and these solutions must be diverse. This process is a crucial task because it can affect the convergence speed and also the quality of the final solution (Rahnamayan, Tizhoosh, & Salama, 2007). This study able to produce a set of initial solution, therefore it is able to contribute to the improvement phase of approach that uses population of initial solutions such as ant colony optimization (ACO) (Socha, Joshua, & Michael, 2002), genetic algorithm (GA) (Lewis & Paechter, 2005), and harmony search algorithm (HSA) (Al-Betar & Khader, 2010). The approach in this study also shows that a feasible timetable can be found for numerous data set problems.

Methodology - The first step in the method is to determine the sequential order of courses/lectures to be schedule using the combination of graph heuristics. From six different graph heuristics described in Burke, McCollum, Meisels, Petrovic, & Qu (2007), this study investigates only three type of heuristics. The graph heuristics are largest degree (events that have a large number of conflicts with other events are scheduled earlier), weighted degree (events that have large number of students in the conflict are scheduled earlier), saturation degree (events that have the smallest number of free valid periods are assigned earlier). The courses were ordered using single heuristic, and a combination of two heuristics. The ordering method is identified by the following label of combination(s): L (largest degree), W (weighted degree), S (saturation degree), LS (largest degree with saturation degree, WS (weighted degree with saturation degree), SL (saturation degree with largest degree), and SW (saturation degree with weighted degree). The weighted degree is a heuristic that orders the events by the descending number of students involved in conflicts. This heuristic already contains the largest degree (descending number of conflicts) heuristic, therefore there is no combination between largest degree and weighted degree.

In the second step, each of the lectures/courses which is previously arranged based on the heuristics setting will be randomly and iteratively allocated to valid empty slots while satisfying all the hard constraints. If a lecture unable to be allocated to any slots due to no more valid empty

slots, it will be added into the unscheduled lectures record. The unscheduled lectures/courses record will be assigned later to the timetable using several methods that executed in a sequence. The unassigned lecture assignment procedures consisted of 9 procedures. Each procedure tries to assign all the unassigned lectures to a valid timeslot. If there are more unassigned lectures, the next procedures will be executed. This implies that the current procedures are not able to assign some lectures; therefore, the next procedure will be attempted.

Findings - The total number of initial solutions produced over 50 iterations for 20 runs of SW, LS and SL is shown in Table 1. It is observed that graph heuristics SW and SL have the probability of producing zero (0) feasible of initial solutions in Run 18 and 8 respectively. Based on this, it can be concluded that the graph heuristic LS is the best setting compared to SW and SL.

Table 1: Comparing SW, LS and SL in Producing Feasible Initial Solutions Produced over 50 Iterations for 20 runs on Comp05 data instance

Run	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
SW	3	5	2	2	5	2	6	3	3	4	3	4	1	2	1	4	2	**0**	3	2
LS	3	2	4	2	2	4	2	2	1	2	3	4	3	2	4	5	3	3	2	3
SL	7	2	2	3	3	2	3	**0**	3	3	3	4	2	3	3	8	2	2	4	4

Keywords: Curriculum-based university course timetabling, graph heuristics, initial solution, population-based metaheuristic, statistical analysis

CONCLUSIONS

This paper presented construction approach that uses combination of graph heuristics to determine the sequential order of courses/lectures in curriculum based course timetabling problem to produce a population of initial solutions. Result demonstrates that the construction approach with the use of largest degree followed by saturation degree, created maximum number of population instead of the use of single graph heuristics. The result of this study can be applied in the second phase of solving CBCTT that is the implementation phase, so that the solution (timetable) will be optimize to the lowest number of soft constraints, i.e. near to optimal solution.

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