A SURVEY OF METAHEURISTIC APPROACHES FOR CURRICULUM BASED COURSE TIMETABLING PROBLEM

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ABSTRACT

Purpose - The aim of this paper is to explore approaches applied for solving CBCTT by presenting features of implementation related to it. The idea is to prepare references structure for future implementation. There are numerous surveys related to approaches in University course timetabling problem (UCTP) (Babaei, Karimpour, & Hadidi, 2014; Nandhini & Kanmani, 2009). Usually surveys that carried out involved post enrollment course timetabling problem (PECTT) and curriculum-based course timetabling problem (CBCTT) together in one literature. Sometimes the depth of information tend to be reduced as both version need to be highlighted at the same place. This can leads to confusing of references in implementation of new approach in terms of features that each versions support. The review of available approaches in solving CBCTT problem in this paper produces information that can be used for future development and experimentation such as number of instances that should be used, neighborhood structure(s) that can be applied and number of experiment repetitions. As stated by Wolpert & Macready (1997) that there is no unique 'best' algorithm which performs better than any other algorithm on every test problem (data instance), hence, this paper provides guidelines for future investigation on solving CBCTT problem using other metaheuristic techniques or approaches.

Methodology - This paper surveys some of the approaches that have been applied and reported in the literature to solve the CBCTT using the same benchmark data instances that are available at the website of Curriculum-based Course Timetabling (http://tabu.diegm.uniud.it/ctt). As the basis for comparison, each approach was described in terms of the following parameters (if exist): technique(s), neighborhood structure applied, number of instances tested, formulation used, number of experiment repetitions and result achieved (quality of solution). The result for each data instance is then compared to the best known solutions.

Findings - Table 1 shows the comparison results of the CBCTT benchmark datasets between the best approaches of simulated annealing (SA), tabu search (TS), great deluge (GD) and artificial bee colony (ABC) together with the best known solution (until 7/4/2017) for the benchmark datasets with particular technique(s) and author(s) produced in CBCTT website (http://tabu.diegm.uniud.it/ctt). Work from Abdullah & Turabieh (2012) that implemented TS related approaches shows eleven best (bold) results over 21 problem instances with the lowest total penalties i.e. 1451.

Table 1: Comparison of Results on CBCTT Benchmark Datasets by SA, TS, GD and ABC related Approaches with the Best Known Solution

	Best of SA	Best of TS	Best of GD	Best of ABC	Best of Known Solution		
Data Instance	**Tarawneh et al. (2013) (A_3)**	**Abdullah & Turabieh (2012) (A_8)**	**Abdullah et al. (2010) (A_{11})**	**Fong et al. (2014) (A_{16})**	**Solution**	**Author(s)**	**Technique(s)**
comp01	5	5	5	5	5	Andrea Schaerf	Tabu Search
comp02	35	30	39	87	24	Barcelogic Team	SAT-based
comp03	77	70	76	126	64	Alexander Kiefer	Very Large Neighborhood Search (VLNS)
comp04	43	35	35	81	35	Tomas Muller	Local Search
comp05	293	300	315	776	284	Alexander Kiefer	VLNS
comp06	51	42	50	182	27	Barcelogic Team	SAT-based
comp07	15	8	12	68	6	Barcelogic Team	SAT-based
comp08	46	37	37	132	37	S. Abdullah and H. Turabieh	Other
comp09	99	100	104	191	96	lu and hao	Tabu Search
comp10	6	7	10	152	4	Barcelogic Team	SAT-based
comp11	0	0	0	21	0	Andrea Schaerf	Tabu Search
comp12	307	323	337	462	294	Alexander Kiefer	VLNS
comp13	71	59	61	141	59	lu and hao	Tabu Search
comp14	55	55	53	163	51	Gerald Lach	Mathematical Programming
comp15	68	70	73	171	62	Alexander Kiefer	VLNS
comp16	32	18	32	152	18	Barcelogic Team	SAT-based
comp17	61	65	72	142	56	Barcelogic Team	SAT-based
comp18	70	72	77	103	61	Alexander Kiefer	VLNS
comp19	62	58	60	173	57	Tomas Muller	Local Search
comp20	14	11	22	163	4	Barcelogic Team	SAT-based
comp21	81	86	95	212	74	Antony Phillips	Mathematical Programming
Total Penalties	1491	**1451**	1565	3703			

Keywords: Curriculum-based university course timetabling, metaheuristics approaches, survey

CONCLUSIONS

This paper reviewed several literature on solving CBCTT problem using metaheuristics approaches. The parameters such as the algorithms, neighbourhood structures, number of data instances, formulation, number of experiment repetitions and results were highlighted in the review. The comparison on the results produced by each approaches was also presented to determine the best metaheuristics approach so far. The output of this review can be used by researchers that want to further investigate on other metaheuristics approaches in solving the CBCTT problem.

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