

EXAM SCHEDULING

OFFLINE 3 (LOCAL SEARCH)

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Introduction

The exam scheduling problem is a combinatorial optimization problem that aims to schedule a set of exams and with a given set of constraints. The problem can be modeled as a graph coloring problem, where each exam is represented by a vertex, and two vertices are connected if the corresponding exams have common students. The goal is to assign a time slot or a room to each exam, such that no two exams that have common students are assigned the same time slot.

Methodology

In this assignment, a constructive heuristics approach is used to generate an initial solution to the exam scheduling problem. The approach uses four heuristics: DSatur, Largest Degree, Largest Enrollment, and Random Ordering. The heuristics aim to assign a color to the vertices in such a way that the number of conflicts (i.e., edges between vertices of the same color) is minimized.

To further improve the solution, a penalty function based on the exponential approach is used. The penalty is calculated when two courses of the same student fall in less than six days. The goal is to minimize the penalty while keeping the courses conflict free. To achieve this, local search techniques such as Kempe-chain interchange and pair swap heuristic are applied.

Outputs on Benchmark Dataset

Benchmark Data	Known Best Solution		Scheme - 1 Largest Degree + Kempe + Pairswap			
			Time Slots	Penalty		
	Time Slots	Penalty		After Largest Degree	After Kempe	After Pairswap
CARF92	32	3.74	32	10.61	5.5	4.87
CARS91	35	4.42	35	11.72	6.68	5.92
KFU93	20	12.96	20	46.47	16.97	14.38
TRE92	23	7.75	22	15.81	10.71	10.23
YOR83	21	34.84	23	65.62	36.99	36.06

Benchmark Data	Known Best Solution		Scheme - 2 Saturation Degree + Kempe + Pairswap			
			Time Slots	Penalty		
	Time Slots	Penalty		After Saturation Degree	After Kempe	After Pairswap
CARF92	32	3.74	30	9.69	5.84	5.34
CARS91	35	4.42	31	12.45	7.67	7
KFU93	20	12.96	19	46.7	18.79	16.97
TRE92	23	7.75	23	15.92	10.31	9.85
YOR83	21	34.84	20	61.66	45.56	44.9

Benchmark Data	Known Best Solution		Scheme - 3 Largest Enrollment + Kempe + Pairswap			
			Time Slots	Penalty		
	Time Slots	Penalty		After Largest Enrollment	After Kempe	After Pairswap
CARF92	32	3.74	35	10.69	4.79	4.11
CARS91	35	4.42	36	13.78	6.26	5.53
KFU93	20	12.96	21	54.5	14.82	13.47
TRE92	23	7.75	22	16.34	10.66	10.2
YOR83	21	34.84	24	63.87	34.28	33.26

Benchmark Data	Known Best Solution		Scheme - 4 Random Ordering + Kempe + Pairswap			
			Time Slots	Penalty		
	Time Slots	Penalty		After Random Ordering	After Kempe	After Pairswap
CARF92	32	3.74	43	7.61	3.97	3.11
CARS91	35	4.42	45	9.44	5.16	4.09
KFU93	20	12.96	25	38.52	12.08	9.99
TRE92	23	7.75	28	13.12	7.61	7.02
YOR83	21	34.84	27	48.87	28.26	27.26

Conclusion

It is observed that as the total number of time slots decreases, the penalty calculated by the exponential approach increases. This indicates that there is a trade-off between the number of time slots and the number of conflicts between exams of the same student. To balance this trade-off, local search techniques such as Kempe-chain interchange and pair swap heuristic were applied to further improve the solution and reduce the penalty.