An Application of Graph Coloring in University Time Table Problem

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Abstract: ***University Timetabling is a way of allocating students, teachers and space used for lectures at available time slots. We used vertex colouring with the Welsh Powell algorithm for the study. In the present paper we will prepare the timetable of one university using Welsh Powell algorithm. The results of the study prove that graph colouring is the basis for allocating time and space slots in the scheduling process.***

Keywords: **Graph Coloring, Welsh Powell Algorithm**

1. INTRODUCTION

University Timetable Problems (UTP) have become one ofthe research topics that have been widely conducted [1, 2, 3].Jat& Yang [4] states that UTP is a multidimensionalallocation issue, where students and lecturers are allocated incourses, subject classes and time preferences (both lecturersand students) are allocated in classrooms and time slots(timeslots). UTP is a type of time allocation problem that issolved by evaluating the limits given. Scheduling the classes is the hard practice all the universities and school performed every year many times and this can be considered only when number of class room available, Teacher availability. This process has many constraints also like
(a) ATeacherhas many teaching subjects.
(b) Different subjects have the same room.
(c)lecture rooms available is Limited.
(d) Needscertain rooms (specifically) for several courses, and
(e) Therequest of the lecturer concerned not to teach at a certain timeslot.

There are various scheduling methods that have beendeveloped before. Burke & Sanja [5] state that there are atleast four groups of methods that have been used in variousstudies, including sequential methods, cluster methods,constructional based methods, and meta-heuristics. Onemethod that is often used for lecture scheduling problems isthe graph coloring method. This technique is included in thegroup of sequential methods.

1.1 Definition :

Graph :A graph 'G' is a set of vertex, called nodes 'v' which are connected by edges,called links 'e'. Thus G= (v , e).

Vertex (Node): A node v is an intersection point of a graph. It denotes a location such as a city, a road intersection, or a transport terminal (stations, harbours, and airports).

Edge (Arc): An edge e is a link between two nodes. A link denotes movements between nodes. It has a direction that is generally represented as an arrow. If an arrow is not used, it means the link is bi-directional.

Graph Coloring: A coloring of a graph is an assignment of colors to the vertices of the graph so that no two adjacent vertices have the same color.

Chromatic Number: The chromatic number of a graph is the minimum number of colors in a proper coloring of that graph.

1.2 Welsh Powell Algorithm

- Step 1: Input the conflict graph G.
- Step 2: Compute degree sequence of the input conflict graph G.
- Step 3: Assign color1 to the vertex vi of G having highest degree.
- Step 4: Assign color1 to all the non-adjacent uncoloured vertices of vi and store color1 into used colour array.
- Step 5: Assign new colour which is not previously used to the next uncoloured vertex having next highest degree.
- Step 6: Assign the same new colour to all non-adjacent uncoloured vertices of the newly coloured vertex.
- Step 7: Repeat step-5 and step-6 until all vertices are coloured.
- Step 8: Set minimum number of non-conflicting time-slots n= chromatic number of the coloured graph=total number of elements in used colour array.
- Step 9: End

2. Result & Analysis

2.1 Data Collection

We begin with collecting the data, we have collected the data of Term 3 and Term 5 B.Sc. Mathematics from Sharda University. There are 11 courses with each of credit 4 so total credit 44 and 3 laboratory of credit 2 so, there are 50 credits in one semester. Available room 3.

2.2 Coloring Process

After the data collection, the next step is to dograph coloring. In this case, the course is the vertex of thegraph, while the lecturer, study program and semesterbecome the edge connecting one node with another node.Each subject taught by the same lecturer is considered tohave a related side. Likewise if the subject is in one studyprogram and the same semester will be considered to have arelated side.

No	*Course*	*Lecturer*	*credits*	*Semester*	*vertex*
1	MSM 204	1	4	3	1/4/3
2	MSM 207	2	4	3	2/4/3
3	MSM229	3	4	3	3/4/3
4	BCH 201	4	4	3	4/4/3
5	PHB 219	5	4	3	5/4/3
6	MSM 250	6	2	3	6/2/3
7	MSM 251	3	2	3	3/2/3
8	MSM 302	1	4	5	1/4/5
9	MSM 315	3	4	5	3/4/5
10	MSM 307	7	4	5	7/4/5
11	MSM 311	8	4	5	8/4/5
12	MSM 312	2	4	5	2/4/5
13	MSM 314	9	4	5	9/4/5
14	MSM 355	10	2	5	10/2/5

Table 1

Now we will start coloring the graph with the highest degree we can see from the above table that course MSM229 has the maximum degree so we will color it with color 1 and same color assigned to all the vertices not adjacent to course MSM229. We will continue the process until all vertices has been colored.

From the above coloring we can make Scheduling (Time Table)

Course/ Lecturer	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
L1	2							1						
L2		1										1		
L3			1				2		1					
L4				1										
L5					1									
L6						1								
L7										1				
L8											1			
L9													1	
L10														1

Table 2

We can draw a bipartite graph from the above table

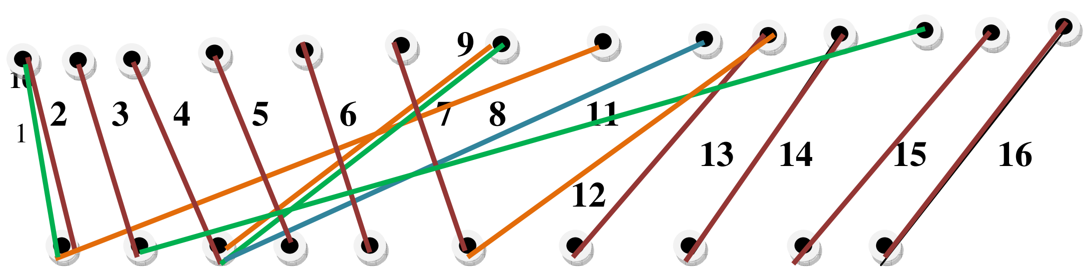

Figure 1

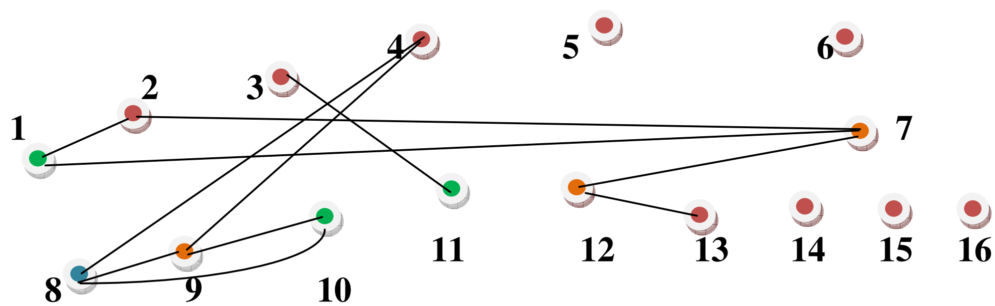

Figure 2

From the above line graph we obtain the result as

Orange	Blue	Maroon	Green
7	8	2	1
9		3	10
12		4	11
		5	
		6	
		13	
		14	
		15	
		16	

Table 3

Thus the solution of the above result is as follows:

Class 1	Class 2	Class 3	Class 4
C8-L1	C9-L3	C2-L2	C1-L1
C7-L3		C4-L4	C7-L3
C10-L6		C5-L5	C12-L2
		C6-L6	
		C13-L13	
		C14-L14	

Table 4

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