JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 2, 2022, p. 3447-3454
https://publishoa.com
ISSN: 1309-3452

Applications of Graph Coloring Using Vertex Coloring

M. Rajagaspar[1] & S. Senthil[2*]

[1]Research Scholar, Department of Mathematics,
Vels Institute of Science, Technology and Advanced Studies, Chennai, Tamilnadu, India.
Email : m.rajagaspar69@gmail.com

[2]Assistant Professor, Department of Mathematics,
Vels Institute of Science, Technology and Advanced Studies, Chennai, Tamilnadu, India.
[*]Corresponding Author:Email : senthils.sbs@velsuniv.ac.in

Received: 2022 March 15; **Revised:** 2022 April 20; **Accepted:** 2022 May 10.

Abstract

Graph coloring is one of the best approach which deals with many problems of graph theory. In this paper an overview is presented in an idea of graph theory and graph colorings especially, to project the idea of vertex coloring and also a few outcomes had been determined. The coloring issue has an uncountable application in present day such as document move problem, making schedule of time table, information mining, networking etc.Then our prediction deals with the exposure of the writings on graph theory, graph colorings, and made deep investigation on vertex coloring.

Keywords: Graph theory, Graph coloring, Vertex coloring, etc.

1. Introduction

A graph coloring is an assignment of labels, called colors, to the vertices of a graph such that no two adjacent vertices share the same color.Applications for solved problems have been found in areas such as computer science, information theory, and complexity theory. Many day-to-day problems, like minimizing conflicts in scheduling, are also equivalent to graph colorings.Nowadays the studies about the behaviour of several graph parameters in product graphs have become into an interesting topic of research in graph theory.Graph coloring especially used various in research areas of science such data mining, image segmentation, clustering, image capturing, networking etc., For example a data structure can be designed in the form of tree which in turn utilized vertices and edges. Similarly modelling of network topologies can be done using graph concepts. In the same way the most important concept of graph coloring is utilized in resource allocation, scheduling. Also, paths, walks and circuits in graph theory are used in tremendous applications say travelling salesman problem, database design concepts, resource networking. This leads to the development of new algorithms and new theorems that can be used in tremendous applications.In this paper, we present some real-life applications of graph coloring.

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2. Preliminaries

2.1Definition(Vertex Coloring)

A vertex coloring of a graph is an assignment f : V→ C from its vertex set to a co-domain set C whose element are called colors.An assignment of colors to the vertices of a graph G is called vertex coloring. For any positive integer k, a vertex **k- coloring** is a vertex coloring that uses exactly k different colors.

2.2 Definition(Proper Vertex Coloring)

A proper vertex coloring of a graph is a vertex such that the endpoints of each edge are assigned two different colors. A graph is said to be vertex **k-colorable** if it has a **proper vertex k- coloring**.

3. Applications of Graph Coloring using Vertex Color

3.1 Problem on Scheduling Lecture Halls for the Students

Eight courses are offered by a computer institute. With a X, the table below displays which pairs of courses share one or more students. At one time, only two lecture halls are available for usage. Determine the number of time slots for students to attend classes without interfering with their second course using graph coloring.

	MS	Pr L	3-D	Ph T	Co Dr	CAD	Et	Cy
MS Tools		X		X	X	X		
Programming Languages	X		X	X			X	X
3-D Animations	X				X			X
Photoshop Techniques	X	X				X	X	
Corel Draw	X	X	X			X		
Auto CAD	X			X	X	X		
Ethical Hacking	X	X		X		X		X
Cyber Law		X					X	

Solution:

Take the courses to be the vertices V = {v_1, v_2, v_3, v_4, v_5, v_6, v_7, v_8} corresponding to the courses MS Tools, Programming Languages, 3-D Animations, Photoshop Techniques, Corel Draw, Auto CAD, Ethical Hacking, Cyber Law respectively. **The Simple Sequential Coloring Algorithm**

Step 1: Let the vertices be,

Vertex	Computer Courses
v_1	MS Tools

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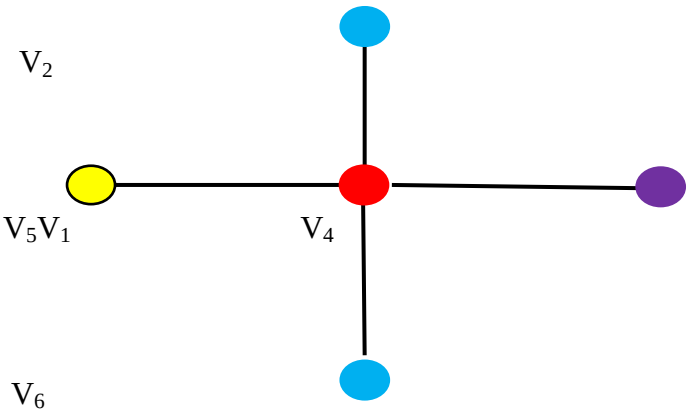
v_2	Programming Languages
v_3	3-D Animations
v_4	Photoshop Techniques
v_5	Corel Draw
v_6	Auto CAD
v_7	Ethical Hacking
v_8	Cyber Law

Step 2: Plotting the vertices in such a way that the courses enrolled by the students does not make conflict.

Step 3: Start giving coloring on the vertices to find the minimum number of time slots that can be allotted for the students.

(i) Plotting Red color for the vertex V_1 for the students who opted MS Tools.



V_1

(ii) From MS Tools extending the edges to mark the students who opted other courses in the pair of MS Tools.

The students who had taken MS Tools also taken, Programming, Photoshop and Coral Draw and Auto CAD as their second course.V_1, V_2,V_4, V_5, and V_6 are adjacent.

(iii) Moving on to the next step, join the vertices and give coloring for the next pair of courses.

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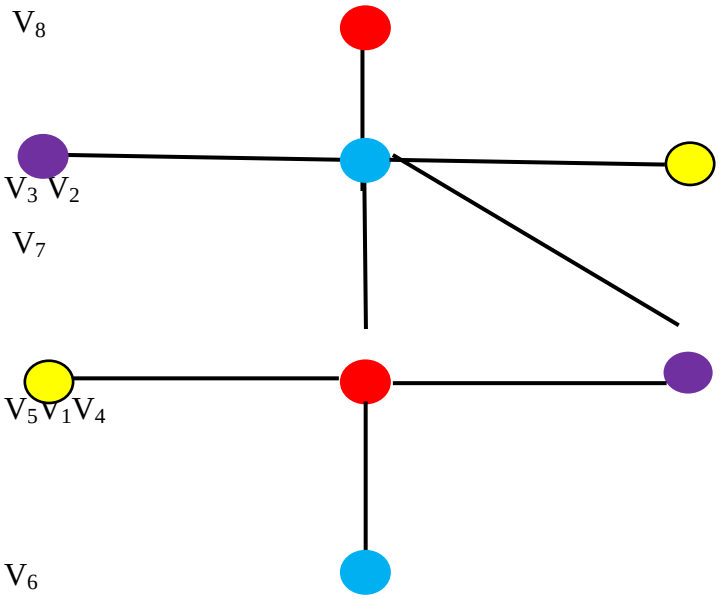
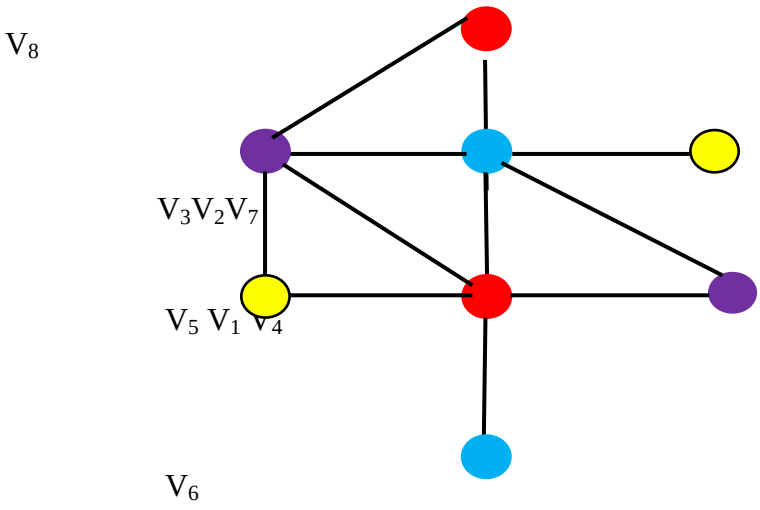


This shows the students who took the course programming also associated with MS Tools, 3-D Animation, Photoshop, Ethical Hacking and Cyber law. From the vertex V_2, it connects to the vertices V_1, V_3, V_4, V_7 and V_8.

(iii) From the vertex V_3, extend the edges to connect the courses to their pairs.



This shows the students who opted for course 3-D Animation also chooses MS Tools, Corel Draw and Cyber law as their second option.

So, from the vertex V_3 the edges lines up to the vertices V_1, V_5 and V_8.

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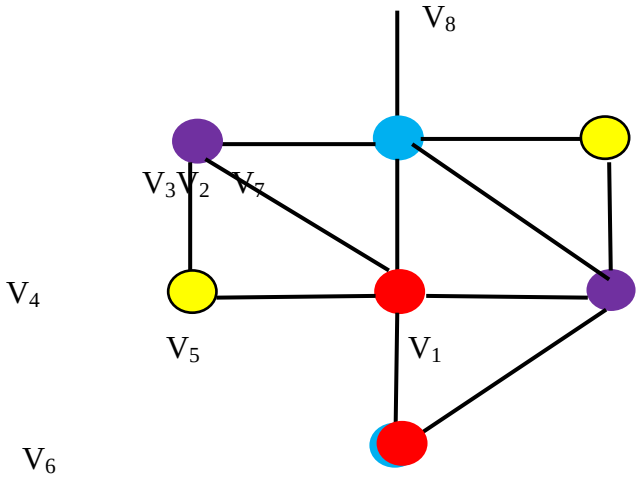
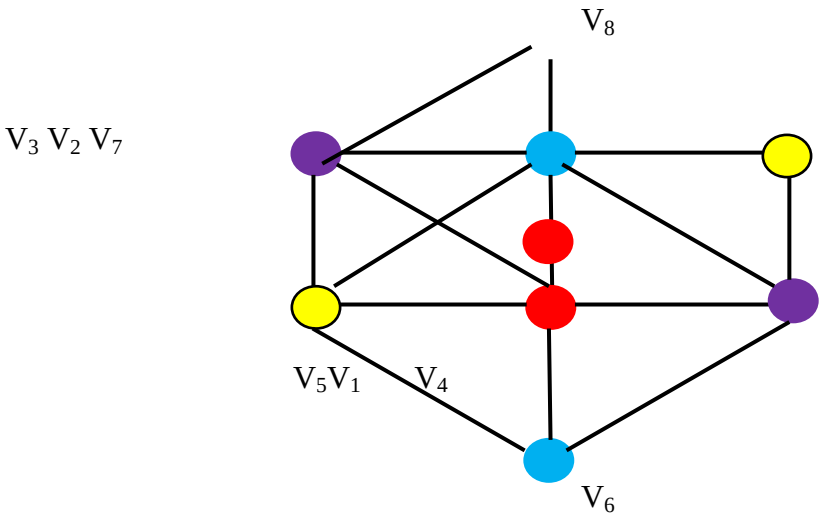
(v)Now, moving further, from the vertex V_4 stretches its edges towards, the courses which has been paired with it.



This shows the students who opted for course Photoshop also chooses MS Tools, Programming, Auto CAD, and Ethical Hacking as their second option. So, from the vertex V_4 the courses connect towards to the vertices V_1, V_2, V_6 and V_7.

(vi)Moving forward to the next step, the vertex V_5 holds the vertices which are all its corresponding pair courses.



The above graph describes that the students who chosen Corel Draw, in addition they chose MS Tools, Programming, 3-D Animation, Auto CAD as their next preference.

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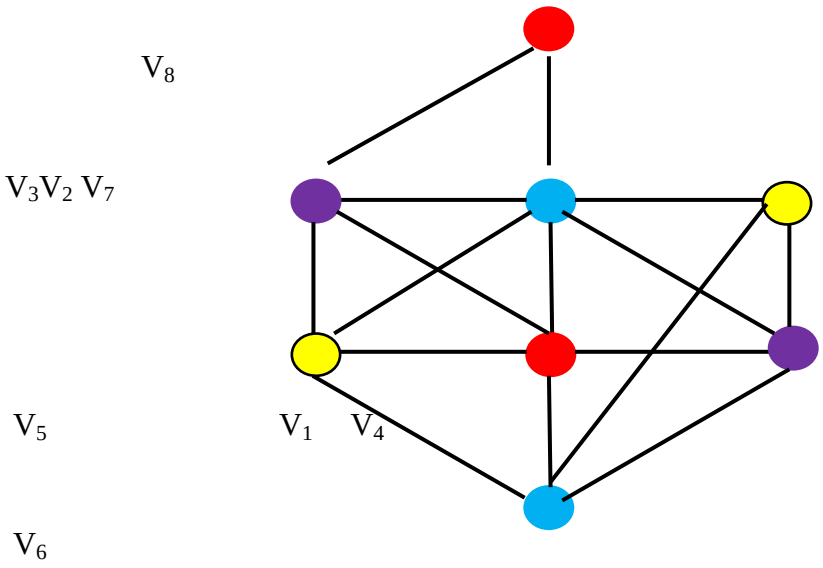
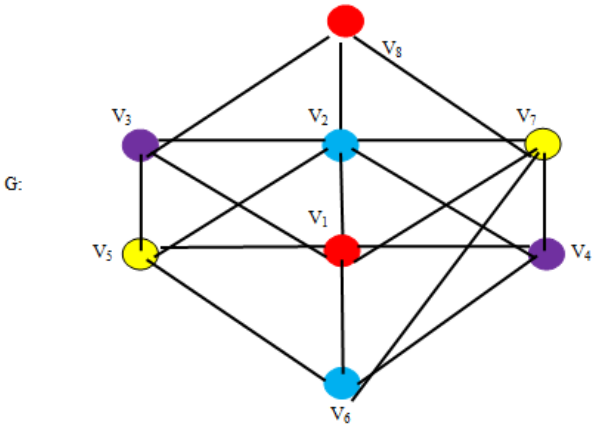
(vii)Then, the next step is to take the vertex V_6 extends its vertices to its paired courses.



From the above graph, we come to know that the candidates who had chosen Auto CAD, also chooses MS Tools, Photoshop, Corel Draw and Ethical Hacking.

(viii)The final step is to connect the last vertex V_7 with its corresponding vertices. Stepping forward to the next procedure, the vertex V_7, pairs with the vertices V_1, V_2, V_4, V_6 and V_8, corresponding to their courses.

The following graph insists that the course Ethical Hacking taken students also taken MS Tools, Programming, Photoshop, Auto CAD and Cyber law as their choices.



Now, we have connected all the vertices with their corresponding courses.

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Step 4:

To determine the minimum time slots for the courses, given that there will be only two lecture halls available. By grouping the colors, we can deduce the perfect time slots for the courses without clashing with other courses at a time.

Time slot 1: Red Color– $V_1$and **V_8** – **MS Tools** and **Cyber law**.

Time slot 2: Blue Color– $V_2$and **V_6** – **Programming** and**Auto CAD.**

Time slot 3: Purple Color – $V_3$and **V_4 - 3D – Animation** and **Photoshop.**

Time slot 4: [redacted]**– V_5**and **V_7 -** [redacted] and [redacted]**.**

Hence, the Chromatic number **χ (G) = 4**

Therefore, the minimum time slots for the given eight courses are four. There will be four classes will be held per day in two lecture classes which the courses will not clash with each other.

4. Conclusion

Vertex coloring problem plays a major role in solving many day-to-day life problems. This part of work explains the solution for the real-life problems which includes scheduling and storing. A detailed explanation of two fascinating situations has been handled using some interesting algorithms. Hence, we can deduce solution for any kind of real time critical situations using these vertex coloring algorithms.

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