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# APPLICATION OF GRAPH COLOR (VERTEX COLOR) BY BLOOD GROUPS (RECEIVERS)

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**Abstract -** Graph coloring problem is one of the most popular areas in the field of graph theory and has a long and illustrious history. In a graph coloring, each vertex of the graph is colored in such a manner that no two adjacent vertices have the same color. So far there are several techniques are presented for vertex coloring. In this paper, we propose an paper based on the blood groups (receivers), to color all the vertices of the given graph with the minimum number of colors and we provide the explanation for the proposed paper. This paper helps us to determine the chromatic number of any graph.

***Key Words*:** Blood groups, Vertex coloring, Chromatic

## I. INTRODUCTION

Many real – world situations can conveniently be described by means of a diagram consisting of a set of points together with lines joining certain pairs of these points. For example, the points could represent people with lines joining pair of friends. Notice that in such diagrams one is mainly interested in whether or not two given points are joined by a line; the manner in which they are joined is immaterial. A mathematical abstraction of situations of this type gives rise to the concept of graph [1]. A graph is a set of vertices and edges, the vertices being denoted by set V and edges by set E [2]. Graph coloring has been studied as an algorithmic problem since the early 1970s. The first result about graph coloring deals almost exclusively with planar graphs in the form of the coloring of maps. Graph coloring problem belongs to the class of combinatorial optimization problem and studied due to its lot of application in the area of data science, networking, register allocation and many more. There are many types of coloring such as vertex coloring, edge coloring, total coloring, fractional coloring etc.

Vertex coloring problem can be defined as to assign the color to every vertex of the graph by keeping the constraints that no two adjacent vertices receives the same color such that the number of colors assigned to the vertices should be minimum. The minimum number of colors that will be used to color the vertices of the given graph G is called the chromatic number of the graph and it is denoted by $\chi$ (G) [3]. A graph is said to be k –colorable if it can be colored by using k – colors and its chromatic number is k and the graph is called k – chromatic graph [2]. An edge coloring of a graph is a proper coloring of the edges, which means an assignment of colors to edges so that no vertex is incident to edges of the same color. An edge coloring of a graph with k colors is called a k – edge coloring. The smallest number of colors needed for an edge coloring of a graph G is the edge chromatic number and it is denoted by $\chi'(G)$. Total coloring is a type of coloring of both the vertices and edges of a graph. Total coloring is always assumed to be proper in the sense that no adjacent vertices, no adjacent edges and no edge and its end vertices are assigned the same color. The total chromatic number of a graph G is the fewest colors needed in any total coloring of G and is denoted by $\chi''(G)$.

On the greedy algorithms which mostly uses the techniques of deciding the color of vertices sequentially in the coloring process [2]. Greedy algorithm gives the minimum number of colors for vertex coloring but it need not to be a chromatic number. Tabu search techniques provide the optimal coloring of a graph [4]. David S. Johnson et al presented the simulated annealing schemes for graph coloring [5]. Daniel Brelaz presented the new methods to color the vertices of a graph [6]. One of the algorithms uses the machine based learning for graph coloring problem and used 78 identified features for that problem [7]. Amit Mittal et al described a method for graph coloring with minimum number of colors and it takes less time as compared to other techniques [8].

# II. BASIC DEFINITION

Graph coloring is one of the well known parameter in graph theory and many researchers introduced different types of coloring of which vertex coloring is one among them. Although a graph is the pictorial representation of a real – world problem[12].

## 2.1 Graph

A graph is determined as a mathematical structure that represents a particular function by connecting a set of points. It is used to create a pair wise relationship between objects. The graph is made up of vertices (nodes) that are connected by the edges (lines).

## 2.2 Graph Coloring

A proper 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.

## 2.3 Vertex Coloring

A vertex coloring is an assignment of labels or colors to each vertex of a graph such that no edge connects two identically colored vertices. The most common type of vertex coloring seeks to minimize the number of colors for a given graph.

## 2.4 Chromatic Number

In a graph, no two adjacent vertices, adjacent edges, or adjacent regions are colored with minimum number of colors. This number is called the chromatic number and the graph is called a properly colored graph.

## 2.5 Blood Groups

The ABO blood group system consists of 4 types of blood group – **A, B, AB, and O** and is mainly based on the antigens and antibodies on red blood cells and in the plasma. Your blood group is determined by the genes you inherit from your parents.

# III. USING VERTEX COLOR BY BLOOD GROUPS ( RECEIVERS )

Let select all the blood groups is

$O^+$, $O^-$ , $A^+$, $A^-$ , $B^+$, $B^-$ ,$AB^+$ ,$AB^-$

Blood Groups – Receivers Table

| B G | $O^+$ | $O^-$ | $A^+$ | $A^-$ | $B^+$ | $B^-$ | $AB^+$ | $AB^-$ |
|---|---|---|---|---|---|---|---|---|
| $O^+$ | ✓ | ✓ | | | | | | |
| $O^-$ | | ✓ | | | | | | |
| $A^+$ | ✓ | ✓ | ✓ | ✓ | | | | |
| $A^-$ | | ✓ | | ✓ | | | | |
| $B^+$ | ✓ | ✓ | | | ✓ | ✓ | | |
| $B^-$ | | ✓ | | | | ✓ | | |
| $AB^+$ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| $AB^-$ | | ✓ | | ✓ | | ✓ | | ✓ |

Take the blood groups to be the vertices

$$V = \{ v_1, v_2, v_3, v_4, v_5, v_6, v_7, v_8 \}$$

Let be the vertices be, $O^+$, $O^-$ , $A^+$, $A^-$ , $B^+$, $B^-$ ,$AB^+$ ,$AB^-$ respectively,

| vertices | Blood groups |
|---|---|
| $v_1$ | $O^+$ |
| $v_2$ | $O^-$ |
| $v_3$ | $A^+$ |
| $v_4$ | $A^-$ |
| $v_5$ | $B^+$ |
| $v_6$ | $B^-$ |
| $v_7$ | $AB^+$ |
| $v_8$ | $AB^-$ |

**Slot:1 Red Color- $v_1$ and $v_8$ - $O^+$ and $AB^-$**

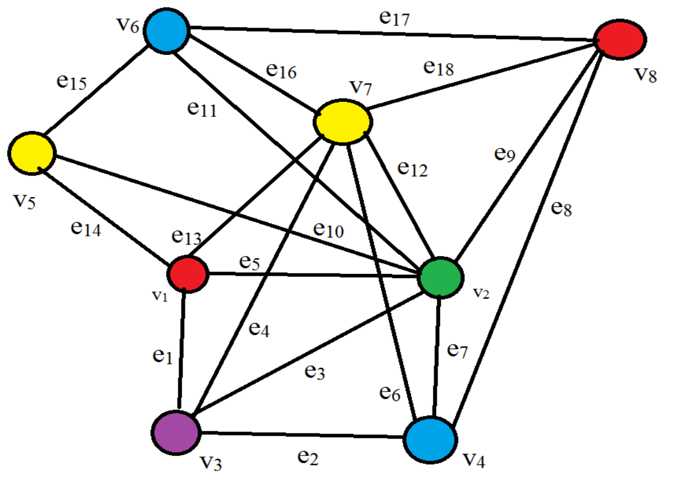
**Slot:2 Violet Color- $v_3$ - $A^+$**

**Slot:3 Yellow Color- $v_5$ and $v_7$ - $B^+$ and $AB^-$**

**Slot:4 Blue Color- $v_6$ and $v_4$ - $B^-$ and $A^-$**

**Slot:5 Green Color- $v_2$ - $O^-$**

**Graph for Blood Group(Receivers):**




## Explanation:

Take the Blood groups to be the vertices

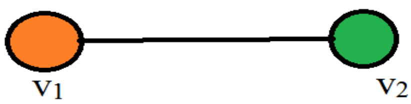
$V = \{ v_1, v_2, v_3, v_4, v_5, v_6, v_7, v_8 \}$ and

$E = \{ e_1, e_2, e_3, e_4, e_5, e_6, e_7, e_8, e_9, e_{10}, e_{11}, e_{12}, e_{13}, e_{14}, e_{15}, e_{16}, e_{17}, e_{18} \}$

Let be the vertices be, $O^+$, $O^-$, $A^+$, $A^-$, $B^+$, $B^-$, $AB^+$, $AB^-$ respectively,

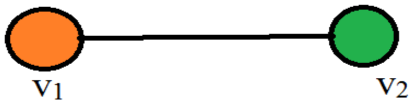
Start giving coloring on the vertices,

( i ) Plotting Red color for the vertex $v_1$ which is $O^+$,



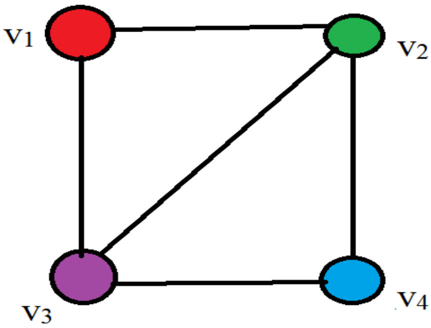

Here $O^+$ is the receiver and $O^+$ received from $O^+$ and $O^-$ .

( ii ) From $O^+$ extending the edges to mark the blood groups which is received.



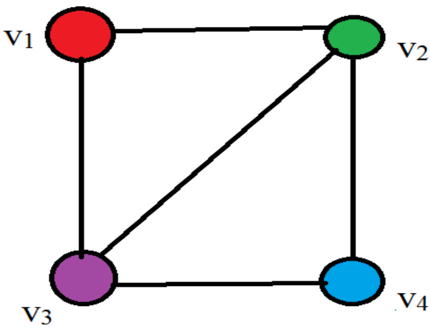

Here $O^-$ is the receiver and it received blood from same $O^-$ .

( iii ) Moving on to the next step, join the vertices and give coloring for the next blood group.

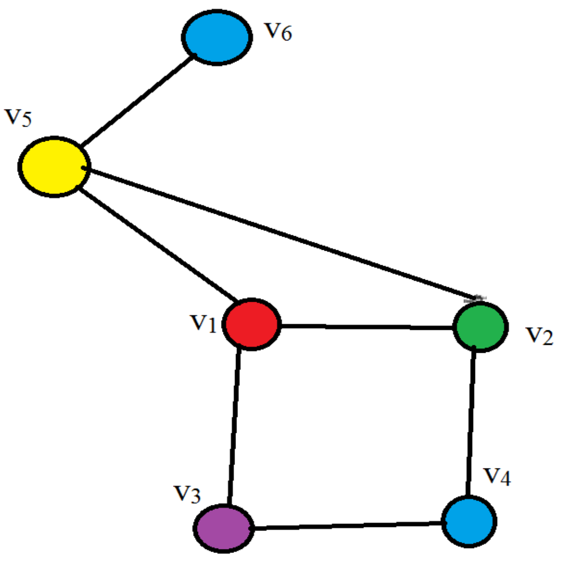



This shows that the blood group which received from other blood group. $A^+$ is the receiver and it is received blood from $O^+$, $O^-$ , $A^+$, $A^-$.

( iv ) From vertex $v_4$ of $A^-$ received blood from $O^-$ , $A^-$ and also vertex $v_4$ extend the edges to connect the blood groups.

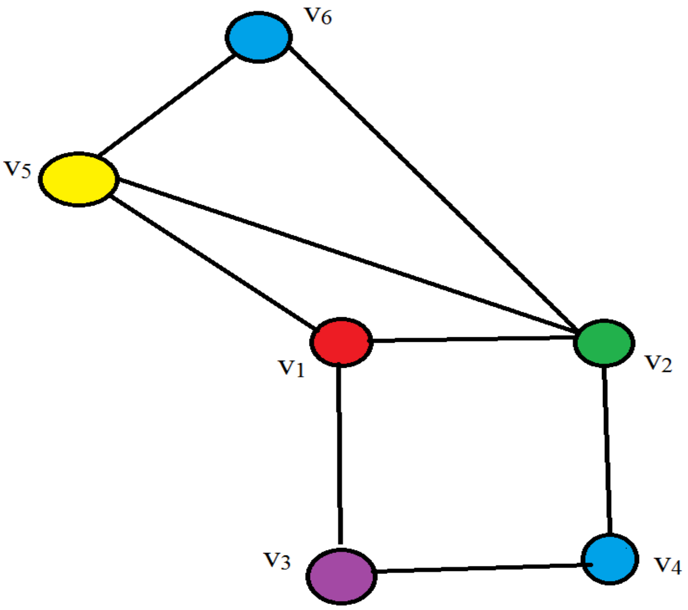



( v ) Now, moving further, from the vertex $v_5$ stretches the edges towards,



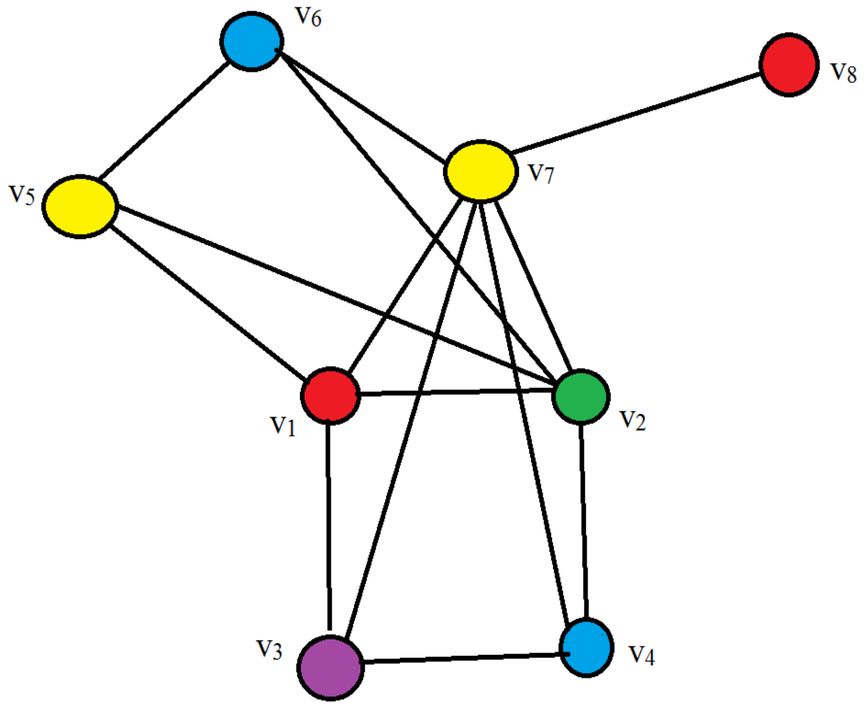

This shows that ($v_5$ ) $B^+$ received blood from $O^+$, $O^-$ ,$B^+$, $B^-$ at the same fro vertex $v_5$ the blood groups connect towards to the vertices $v_1$,$v_2$, $v_5$,$v_6$.

( vi ) Moving forward to the next step; the vertex $v_6$ extend the edges.



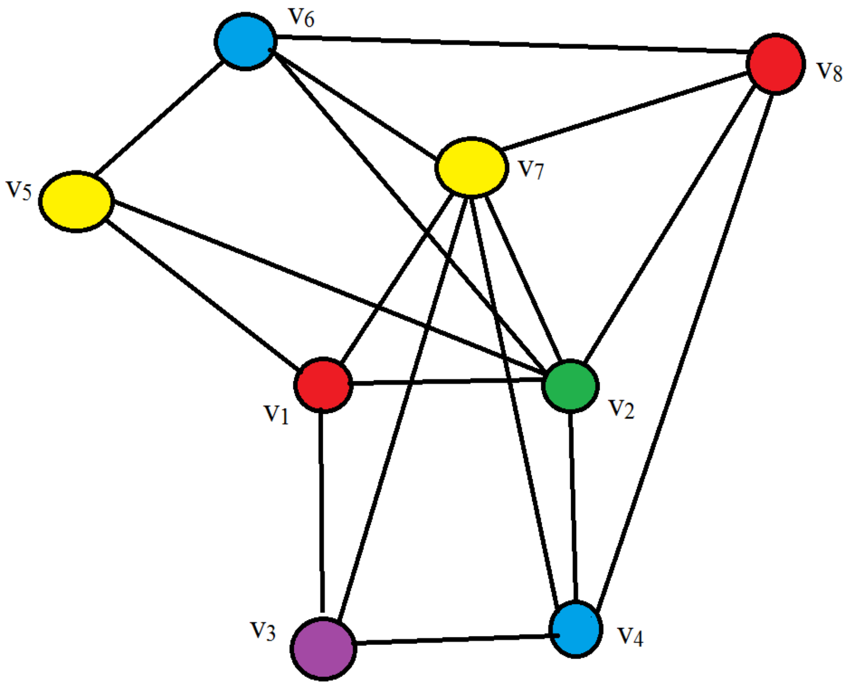

Here the vertex $v_6$ of the blood group $B^-$ is received blood from $O^-$ , $B^-$ .

( vii ) Then, the next step is to take the vertex $v_7$ extend the edges.




The above graph shows that the vertex $v_7$ of the blood group $AB^+$ which is received blood from all the blood groups ( $O^+$, $O^-$ , $A^+$, $A^-$ , $B^+$, $B^-$ ,$AB^+$ ,$AB^-$ ).

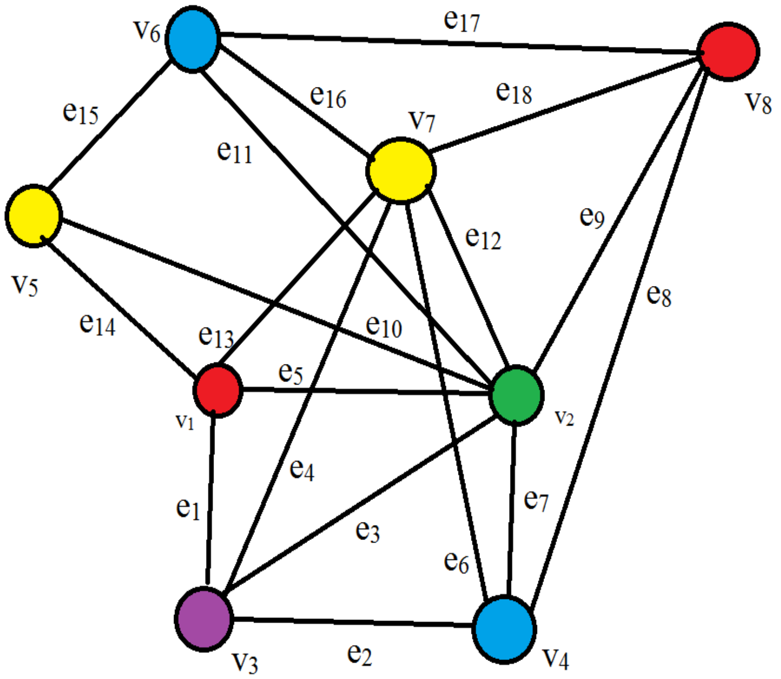
( viii ) The final step is to connect the last vertex $v_8$ and it extend the edges to $v_2$,$v_4$,$v_6$




Here the blood group $AB^-$ is received blood from ($v_2$,$v_4$,$v_6$, $v_8$ ) $O^-$ , $A^-$ , $B^-$ ,$AB^-$ .

Now we have connected all the vertices with their corresponding blood groups.

Putting the name for edges




( ix ) Therefore, hence the chromatic number $\chi$ (G) =5.

## IV. CONCLUSIONS

In this paper we discussed with the topic of Application of graph color ( vertex color ) by blood groups (Receivers) and how to applying blood groups(Receivers) in graph with explanation.

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**BIOGRAPHIES**

I am Ms. M. Kanya and I'm studying II M.Sc. Mathematics. I'm interested in maths, particularly graph theory. Here I create a graph using vertex color by blood group-receivers. In future, I want to publish many papers which is relevant to maths.