Three Colors Problem by Using India River Map

T.Brijit Berna[1], S.Meena[2], D.Karolin Livingcy[3]

[1]II M.Sc Student, Department of Mathematics,
St.Antony's College of Arts and Sciences For Women Thamaraipadi, Dindigul-5
[2]Assistant Professor, Department of Mathematics,
St.Antony's College of Arts and Sciences For Women Thamaraipadi, Dindigul-5
[3]II M.Sc Student, Department of Mathematics,
St.Antony's College of Arts and Sciences For Women Thamaraipadi, Dindigul-5

---***---

Abstract - 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 purpose an algorithm based on the three-color problem, to color all the given graph with the minimum number of colors and provide the numerical examples for the proposed algorithm. This algorithm helps us to determine the chromatic number of any graph.

***Key Words*:** Vertex Coloring, Chromatic Number, Graph Theory.

1.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 is immaterial. A mathematical abstraction of situations of this type gives rise to the concept of graph.

A graph is a set of vertices and edges the vertices being denoted by set V and edges by set E

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 $\varkappa(G)$

A graph is said to be K-color able if it can be colored by using k- colors and its chromatic number is K and the graph is called K-chromatic graph

A Vertex coloring of a graph is a proper coloring of the vertex so that no vertex is incident to vertex of the same color. A vertex coloring of graph with k colors is called a k vertex coloring.

The smallest number of colors needed for a vertex coloring of a graph G is the vertex chromatic number and it is denoted by $\varkappa'(G)$. 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 chromatic number of a graph G is the fewest colors needed in any total coloring of G and is denoted by $\varkappa''(G)$.

On the greedy algorithms which mostly uses the techniques of deciding the color of vertices sequentially in the coloring process. greedy algorithms give the minimum number of colors for vertex coloring but it need not be a chromatic number

Preliminaries:

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 real-world problem, a matrix is the convenient and useful way of representing a graph.

Some basic definitions and their remarks are presented here under for clear understanding of the algorithm proposed in this paper.

Definition:

Painting all the vertices of a graph with colors such that no two adjacent vertices have the same color is called the proper coloring or simply coloring of a graph.

A graph in which every vertex has been assigned a color according to a proper coloring is called a proper colored graph. A graph G that requires k different colors for its proper coloring, and no less, is called a k -chromatic graph, and the number k is called the chromatic number of G.

2. Three Colors Problem By Using India River Map

Algorithm

Step:1

Consider the India map connect the whole river point of the graph 'G'

Step:2

Use graph coloring to determine the least number colors than can be used to color the map of India. So that rivers with common boundaries have different colors

Step:3 Problem Solving Strategies:

i. Assign a label to each river these will be vertices
ii. Use edge to connect the vertices of rivers that share borders

Step:4 Use the procedure for coloring a graph

a) Label degrees

b) Start coloring with lowest degree vertex

Step:5

The color of each region is the color of the corresponding vertex

The result is a 3-color graph. It turns out that 3-colors are necessary for this although other configurations are possible

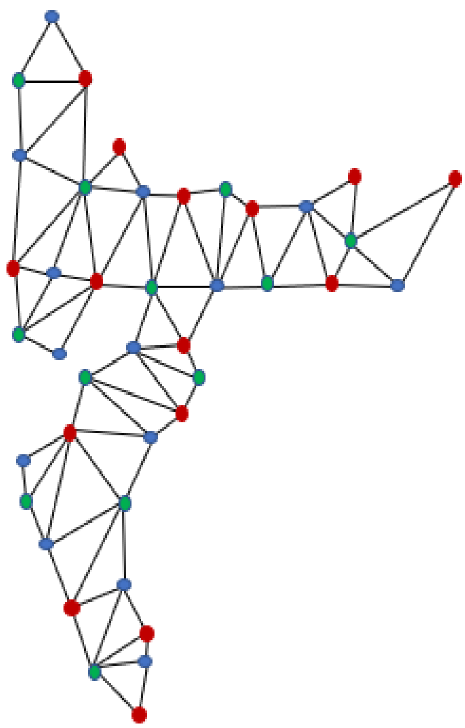
Step:6

Hence $\psi(G)=3$

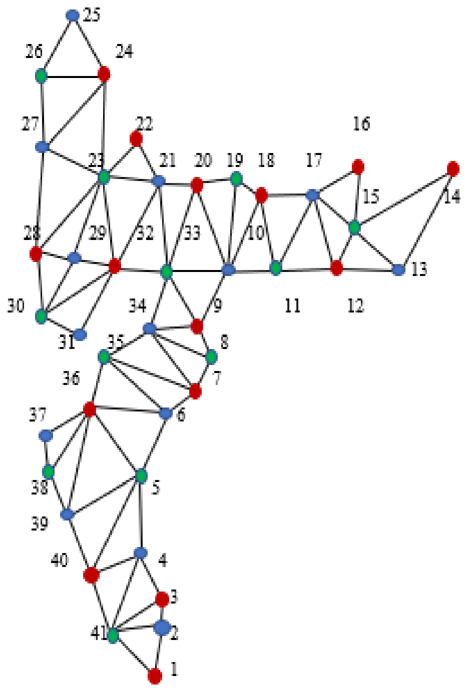
EXPLANATION OF APPLYING THREE COLORS PROBLEM BY USING INDIA RIVER MAP

1.Consider the India river map connect the whole river point of the Graph 'G'

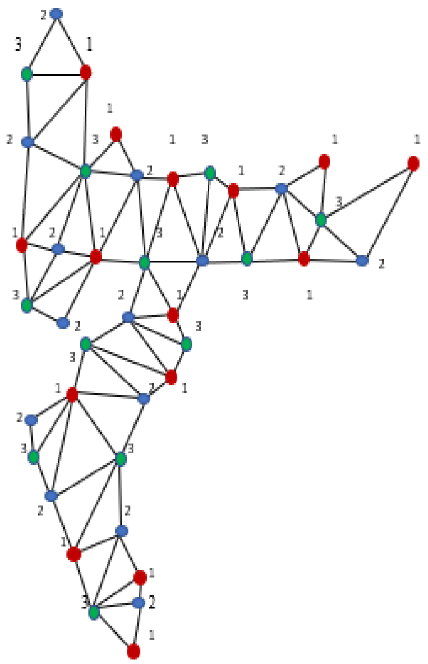
2.Assign a label to each river. these will be your vertices



3.Use edges to connect the vertices of rivers that share borders



4. Use the procedure for coloring a graph
   a) Label degrees
   b) Start coloring with lowest degree vertex



5. The color of each region is the color of the corresponding vertex.
   The result is a three-color graph. It turns out that three colors are necessary for this although other configurations are possible

6. Hence ψ(G)=3

3. CONCLUSION

In this paper we discussed a new algorithm is presented to find the proper coloring of any given graph using three color problem and which suits all types of graphs and how to apply for three colors by using India map river with no adjacency and proof of explanation.

ACKNOWLEDGEMENT

I am grateful to all of those with whom I have had the pleasure to work during this and other related projects. Each of the members of my Dissertation committee has provided me extensive

REFERENCES

1. J. A. Bondy, U. S. R. Murty, *Graph theory with applications*, The Macmillan press limited**,** Great Britain (1976).

2. Charu Negi, Ajay Narayan Shukla, Vertex coloring problem approach using adjacency matrix, *International journal of engineeringtechnology science and research, 4(12)* (2017) 97 – 101.

3. Ajay Narayan Shukla, M. L. Garg, An approach to solve graph coloring problem using adjacency matrix, *Bioscience biotechnology research communications,12(2)* (2019) 472 – 477.

4. Hertz, D. de Werra, Using tabu search techniques for graph coloring, *Computing 39* (1987) 345 – 351.

5. David S. Johnson, Cecilia R. Aragon, Lyle A.Mcgeoch, Catherine Schevon, Optimization by simulated annealing: an experimental evaluation; part II, graph coloring and number partitioning, *Institute for operations research and the management sciences, 39(3)* (1991) 378 – 406.

6. Daniel Brelaz, New methods to color the vertices of a graph, *Communications of the ACM, 22(4)* (1979) 251 – 256.

7. Nysret Musliu, Martin Schwengerer, Algorithm selection for the graph coloring problem, 1- 15.

8. Amit Mittal, Parash Jain, Srushti Mathur, Preksha Bhatt, Graph coloring with minimum colors an easy approach, *In the proceedings of the 2011 International conference on communication systems and network technologies*, (2011) 638 – 641.

9. R. M. R. Lewis, *A guide to graph coloring algorithms and applications*, Springer international publishing, Switzerland (2016).

10. K A Santoso, Dafik, I H Agustin, R M Prihandini, R Alfarisi, Vertex coloring using the adjacency matrix, *In the proceedings of the 2019 IOP conference*,(2019) 1 – 6.

11. M. Saqib Nawaz, M. Fayyaz Awan, Graph coloring algorithm using adjacency matrices, *International journal of scientific & engineering research*, *4(4)* (2013) 1840 – 1842.

BIOGRAPHIES

T.Brijit Berna Student at currently studying II M.sc Mathematics . I like Operations Research and Graph Theory. I research in Graph Theory related paper.